HIMA

HIMA AUSTRALIA Pty Ltd

P-08-023-00
Brisbane City Council
PLC 15 Replacement

Supply and Programming of PLC 15 for the Luggage Point Water Reclamation Plant

Brisbane City Council

SCSQ

COPY

Operations and Maintenance Manual Part 1		
END USER:	The Luggage Point WRP Main Beach Rd. Pinkenba, Qld 4008	Luggage Point
CLIENT:	Manager Commercial Services Projects Water Distribution PO Box 745 Fortitude Valley Queensland 4006	BWQ80144-07/08

Part 1 Introduction and Background Information

1 Introduction

Luggage Point Water Reclamation Plant (WRP) has a capacity of 900,000 Equivalent Population (EP). Situated at Main Beach Rd Pinkenba it processes 65% of Brisbane's wastewater received from the entire S1 catchment, and as such is a critical facility for Brisbane Water.

Operating at Luggage Point WRP is an energy recovery system, which utilises digester gas as an energy source, converting it to heat and electricity for use on site.

Two Mirrlees Engines coupled to 3-phase Alternators provide up to 1.8MW each of electricity into the grid. They can also be operated in "island state" supplying power to the Luggage Point site only.

The two Engines are dual-fuel capable, able to be run on both diesel and digester gas. The Engines are started and shutdown using diesel alone, and may be run continuously on diesel or digester gas. While running on gas, they use diesel as a pilot fuel.

Heat energy is recovered from the Engine jacket and valve cage cooling water, and from the exhaust gas heat exchangers. Heat is transferred from the primary cooling water to the secondary cooling water via the Secondary Heat Exchangers. The digester sludge is then heated by the secondary hot water through the Digester Heat Exchangers (refer PLC08).

Any excess heat in the primary system not required for digester heating is wasted to an effluent stream via the Dump Heat Exchangers.

A Hazardous Areas Report carried out in mid 2007 by GHD has identified a need to upgrade the control system for the gas system associated with each Engine, to hardware that has TUV SIL2 certification. This new Engines Safety PLC, (PLC15), is to control only items associated with the gas supply to the Engines, while the rest of the equipment around the Engines will be controlled by a non-TUV SIL2 rated PLC, (PLC11). The two PLC's will be interlocked to provide seamless control of the Engines with the requirement to always fail to a safe condition.

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2 Description of Equipment and Process

The SIS solution is based on the HIQuad H41qe-HS single rack, semi redundant platform. The systems meets the requirements for TUV SIL 3 operation with no time restriction for replacement of failed components.

The system includes redundant 1oo2D (2oo4) central processing, providing bumpless fail-over at the processor level as well as the ability to make program changes on line. The system has a 1oo1D structure at the I/O level.

The central processing rack contains redundant central processing cards and a redundant slot for communication interface cards. Communications to the GE Fanuc PCS utilise redundant serial ports on the CPU cards. Ethernet communication via a Coprocessor card is utilised by the engineering workstation.

All works will be designed, executed, documented and tested in accordance with IEC/AS61508 and IEC/AS61511 and the specification for the scope of works as per the requirements of Brisbane City Council.

3 Design Details

3.1 Design Criteria

Design and fully document a TUV SIL2 rated PLC system for Engines 1&2 safety rated devices in accordance with this specification, and to the requirements of the relevant Australian Standards, including AS 3814-2005.

3.2 Process Design

3.2.1 Main Gas Shutoff Valve (VV2430)

Digital Output:	Slot 8, Output 1	Wire 15886
State:	Off = Valve Closed On = Valve Open	
References:		
P+ID:	486/5/5-0016-003	
Electrical Drawing:	486/7/5-UT2L1126E rev C	

The Main Gas Shutoff Valve is located outside the west engine room wall, on the common gas main from the Gas Compressors, prior to the line splitting into the individual gas feeds for each engine. The valve is arranged for "Energise to Open" control, and it has a "Spring to Close" actuator. The pneumatic solenoid that controls the valve is called "GSCV".

The following inputs affect the state of this valve:

		Type	Input	Wire
(i)	Main Gas Shutoff Valve Remote Selected	DI	Slot 3, Input 1	15848
(ii)	Main Gas Shutoff Valve Emergency Close	DI	Slot 3, Input 2	15849
(iii)	Main Gas Shutoff Valve Closed LS	DI	Slot 3, Input 3	15850
(iv)	Main Gas Shutoff Valve Open LS	DI	Slot 3, Input 4	15851
(v)	PLC11 "Healthy" input	DI	Slot 3, Input 16	15900
(vi)	PLC11 Network Connection Healthy Comms Heatbeat			

The Emergency Close input is currently wired so that it is ON when the button has been activated. While this circuit is not "fail-safe" to the PLC, it is not required to be, because it is "fail-safe" in the hard-wired logic. A Normally-Closed contact, (when the Emergency Stop is not activated), is included in the hard-wired circuit that controls the "GSCV" solenoid.

Note: The Gas Module Inhibit signals from PLC11 (via modbus) are to be overridden and turned off if they are on for greater than 1830 seconds.

Conditions that allow this valve to open:

- The Main Gas Shutoff Valve selector on the station aux switchboard is set to "Remote", and,
- the Main Gas Shutoff Valve Emergency Close button has not been pressed, and,
- the Engine 1 Gas Module does not have an active alarm, AND the Eng1 Gas Module has not been inhibited, and,

- the Engine 1 Gas Module is not in Fault, AND the Eng1 Gas Module has not been inhibited, and,
- the Engine 2 Gas Module does not have an active alarm, AND the Eng2 Gas Module has not been inhibited, and,
- the Engine 2 Gas Module is not in Fault, AND the Eng2 Gas Module has not been inhibited, and,
- either engine is running, (from PLC11), and,
- communications with PLC11 is healthy, and PLC11 itself is healthy.

Conditions that will cause this output to turn OFF:

When this output is ON, at least one engine will be running and selected to run on gas.

The following conditions will cause the Main Gas Shutoff Valve to turn OFF:

- Neither engine is running, or,
- the Main Gas Shutoff Valve Emergency Close button has been pressed, (0=Normal, 1=Emergency Close), or,
- the Main Gas Shutoff Valve selector on the station aux switchboard has been set to "Close", or,
- either Engine Gas Module has an active alarm, and it has not been inhibited, or,
- either Engine Gas Module is Faulted, and it has not been inhibited, or,
- the Main Gas Shutoff Valve has failed to open, (limit switch not on within 5 seconds of the request to open), or,
- communications with PLC11 is not healthy, or PLC11 itself is not healthy.

3.2.2 Engine x Gas Isolation Valves

Digital Outputs:	Engine 1:	GIVR Relay	Slot 4, Output 1	Wire 15005
	Engine 2:	GIVR Relay	Slot 6, Output 1	Wire 15325
Closed Indication:	Engine 1:	Primary Isol Valve:	Slot 4, Output 2	Wire 15006
		Secondary Isol Valve:	Slot 4, Output 3	Wire 15007
		Vent Valve:	Slot 4, Output 4	Wire 15008
	Engine 2:	Primary Isol Valve:	Slot 6, Output 2	Wire 15326
		Secondary Isol Valve:	Slot 6, Output 3	Wire 15327
		Vent Valve:	Slot 6, Output 4	Wire 11328

References:

P+ID:		486/5/5-0016-003 rev O
Electrical Drawings:	Engine 1:	486/7/5-UT2L1163E rev C
	Engine 2:	486/7/5-UT2L1198E rev C

(The control for each set of valves is the same for each engine)

This output controls the position of the three valves on the gas supply line:

	Engine 1	**Engine 2**	**"Safe"**	**Eng Running**
Gas Primary Isolation Valve	VV2431	VV2435	Closed	Open
Gas Secondary Isolation Valve	VV2432	VV2436	Closed	Open
Safety Gas Vent Valve	VV2433	VV2437	Open	Closed

(The state of the valves when in the "safe" condition is shown, along with the state when the engine is running).

A single relay called "GIVR" controls all three valves. When GIVR is energised, the Safety Gas Vent Valve Solenoid will energise closing the Safety Gas Vent Valve, and when it's "closed" limit switch turns ON, the Primary and Secondary Gas Isolation Valve Solenoids will be energised. The interlock with the "closed" limit switch is via the hard-wired circuit. All valves currently have "Spring to Close" actuators, however, the two Vent Valves are to have their actuators turned through 90 degrees so that they become "Spring to Open" valves.

Control Sequence

The following inputs affect the state of this output:

	Type	Engine 1	Wire	Engine 2	Wire
(i) Engine x Gas Isol Vlvs Remote Seld	DI	Slot 1, Input 3	15004	Slot 2, Input 3	15324
(ii) Engine x Gas Module Alarm	DI	Slot 1, Input 12	15867	Slot 2, Input 12	15869
(iii) Engine x Gas Module Fault	DI	Slot 1, Input 11	15866	Slot 2, Input 11	15868
(iv) Engine x Gas Module Inhibit	SCADA Cmd				
(v) Engine x Gas Enable Solenoid SV4	DO	Slot 5, Output 2	15278	Slot 7, Output 2	15602
(vi) Engine x Gas Vent Valve Closed LS	DI	Slot 1, Input 1	15002	Slot 2, Input 1	15322
(vii) Engine x Gas Vent Valve Open LS	DI	Slot 1, Input 2	15003	Slot 2, Input 2	15323
(viii) Engine x Primary Isol Valve Closed LS	DI	Slot 1, Input 4	15174	Slot 2, Input 4	15498
(ix) Engine x Primary Isol Valve Open LS	DI	Slot 1, Input 5	15175	Slot 2, Input 5	15499
(x) Engine x Secondary Isol Vlv Closed LS	DI	Slot 1, Input 6	15141	Slot 2, Input 6	15465
(xi) Engine x Secondary Isol Vlv Open LS	DI	Slot 1, Input 7	15142	Slot 2, Input 7	15466
(xii) Engine x Gas High Pressure Switch	AI	Slot 9, Input 1	PSH15000	Slot ?, Input 2	PSH15320
(xiii) PLC15 "Healthy" input	DI	Slot 3, Input 16	15900	Slot 3, Input 16	15900
(xiv) PLC11 Network Connection Healthy	Comms Heatbeat				

Conditions that allow this output to turn ON:

When the engine has been started on Diesel, it has been running at Medium Speed for a continuous two minutes, and the engine has been selected to run on Gas, the "Engine x Gas Enable Solenoid SV4" output will be turned ON, (refer to the separate description for this output).

The following conditions will allow the Engine x Gas Isolation Valves Relay, (GIVR), to turn ON:

- The SV4 output turns ON, (see conditions above), and,
- the Gas Isolation Valves Switch is set to "Remote", (0=Close, 1=Remote), and,
- the Engine x Gas Module does not have an active alarm, or the Engine x Gas Module has been inhibited, and,
- the Engine x Gas Module is not in Fault, or the Engine x Gas Module has been inhibited, and,
- the Gas Pipeline Pressure Switch is not indicating High Pressure setpoint, and,
- communications with PLC11 is healthy, and PLC11 itself is healthy.

When the Engine x Gas Isolation Valves Relay, (GIVR), turns ON, the state of the Safety Gas Vent Valve "closed" limit switch, and the Primary and Secondary Isolation Valves "Open" limit switches will be checked. If any of them has not turned on within five seconds of the GIVR output turning ON, the changeover to gas operation will be aborted, and one of the following messages will be posted on the SCADA Alarm Page:

"Engine x Gas Vent Valve Failed to Close"
"Engine x Primary Gas Isolation Valve Failed to Open"
"Engine x Secondary Gas Isolation Valve Failed to Open"

In addition, the following message will also appear on the Engines Page, and the alarm; "Engine x Changeover to Gas Aborted" will be posted to the Alarm Page.

Conditions that will cause this output to turn OFF:

When this output is ON, the engine will be running on gas, the Gas Primary and Secondary Isolation Valves will be open and the Safety Gas Vent Valve will be closed.

The following conditions will cause the Engine x Gas Isolation Valves Relay, (GIVR), to turn OFF:

- The SV4 output turns OFF, (due to normal or emergency shutdown conditions described in the control section for SV4), or,
- the Gas Isolation Valves Switch is set to "Close", (0=Close, 1=Remote), or,
- the Engine x Gas Module has an active alarm, and the Engine x Gas Module has not been inhibited, or,
- the Engine x Gas Module is Faulted, and the Engine x Gas Module has not been inhibited, or,
- the Gas Pipeline Pressure Switch is indicating High Pressure for a continuous five seconds, or,
- the Safety Vent Valve "closed" input turns OFF, or,
- the Gas Primary Isolation Valve "open" input turns OFF, or,
- the Gas Secondary Isolation Valve "open" input turns OFF, or,
- communications with PLC11 is not healthy, or PLC11 itself is not healthy.

"Closed" Indication

PLC15 controls the outputs that turn on the "Closed" indicator lamps for the three gas valves for each engine. These outputs directly mimic the state of the three "Closed" LS inputs, one per valve.

Engine x Gas Isolation Valves

- Engine x Emergency Stop Solenoid (SV3)

Digital Outputs: Wire 15277	Engine 1:	BESR2 Relay/SV3 Sol	Slot 5, Output 1
	Engine 2: Wire 15601	BESR2 Relay/SV3 Sol	Slot 7, Output 1
		ON State: Normal condition	
		OFF State: Emergency Shutdown	

References:

P+ID:		486/7/5-UT2L0149M rev B
Electrical Drawings:	Engine 1:	486/7/5-UT2L1147E rev F
	Engine 2:	486/7/5-UT2L1182E rev G

(The control for the solenoid is the same for each engine)

This output controls the BESR2 (new) Relay, a Normally Open contact off which de-energises Solenoid Valve SV3, and causes a shutdown of the engine and blowdown of the diesel rack. SV3 can also be de-energised from the activation of any one of the Emergency Stop buttons located at (i) the Alternator Protection Panel, (ii) the Control Desk, or (iii) the Lunch Room (beside the Main Control Room). The normal state for this output is for it to be ON, allowing normal operation of the engine. This provides a fail-safe condition whereby a failure of PLC15 will turn off the output and cause an emergency shutdown of the engine.

Control Sequence

The following inputs affect the state of this output:

			Type	Engine 1	Wire	Engine 2	Wire
(i)	Engine x Estop Supply Relay	ESVSR	DI	Slot 1, Input 8	15185	Slot 2, Input 8	15509
(ii)	Engine x Estop Operated PS3		DI	Slot 1, Input 9	15186	Slot 2, Input 9	15510
(iii)	Engine x Estop Relay ESR		DI	Slot 1, Input 10	15191	Slot 2, Input 10	15515
(iv)	PLC15 "Healthy" input		DI	Slot 3, Input 16	15900	Slot 3, Input 16	15900
(v)	PLC11 Network Connection Healthy		Comms Heatbeat				
(vi)	Engine x Emergency Stop Request		SCADA Command				

Conditions that allow this output to turn ON:

The following conditions ensure the Engine x Emergency Stop output is ON, (SV3 energised):

- The Engine x Emergency Stop Valve Monitor Supply Relay input, ESVSR, is ON, and,
- the Engine x Emergency Stop Operated PS3 is OFF, and,
- the Engine x Emergency Stop Relay input, ESR, is ON, and,
- PLC15 is running and has no CPU or program execution faults active, and,
- communications with PLC11 is healthy, and PLC11 itself is healthy.

Conditions that will cause this output to turn OFF:

When this output is ON, the engine is able to operate normally.
Any one of the following conditions will turn OFF the Engine x Emergency Stop output, (energising SV3):

- The Engine x Emergency Stop Valve Monitor Supply Relay input, ESVSR, turns OFF, or,
- the Engine x Emergency Stop Operated input, PS3 turns ON, or,
- the Engine x Emergency Stop Relay input, ESR, turns ON, or,
- an operator Emergency Stop command has been sent from the OWS and the Engine is in Remote/Manual mode, (this command comes from PLC11), or,
- PLC15 stops running, or has an active CPU or program execution fault, or,
- communications with PLC11 is not healthy, or PLC11 itself is not healthy.

3.2.3 Engine x Gas Enable Solenoid (SV4)

Digital Outputs:	Engine 1:	GR Relay/SV4 Sol	Slot 5, Output 2	Wire 15278
	Engine 2:	GR Relay/SV4 Sol	Slot 7, Output 2	Wire 15602

References:

P+ID:		486/7/5-UT2L0149M rev B
Electrical Drawings:	Engine 1:	486/7/5-UT2L1147E rev F
	Engine 2:	486/7/5-UT2L1182E rev G

(The control for each solenoid is the same for each engine)

This output controls the Gas Enable Solenoid, SV4. When the output is ON, the Gas System is able to be operated as soon as the Diesel/Gas Changeover output, (DGR), is turned ON by PLC11.

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Control Sequence

The following inputs affect the state of this output:

		Type	Engine 1	Wire	Engine 2	Wire
(i)	Engine x Estop Supply Relay ESVSR	DI	Slot 1, Input 8	11185	Slot 2, Input 8	15509
(ii)	Engine x Estop Operated PS3	DI	Slot 1, Input 9	15186	Slot 2, Input 9	15510
(iii)	Engine x Estop Relay ESR	DI	Slot 1, Input 10	15191	Slot 2, Input 10	15515
(iv)	Engine x Gas Module Alarm	DI	Slot 1, Input 12	15867	Slot 2, Input 12	15869
(v)	Engine x Gas Module Fault	DI	Slot 1, Input 11	15866	Slot 2, Input 11	15868
(vi)	Engine x Gas Module Inhibit	SCADA Cmd				
(vii)	Engine x Gas High Pressure Switch	AI	Slot 9, Chnl 1	PSH15000	Slot 9, Chnl 2	PSH15320
(viii)	Engine x Cylinder 1 Temperature	AI	Slot 9, Input 1	TE11962	Slot 10, Input 1	TE11978
(ix)	Engine x Cylinder 2 Temperature	AI	Slot 9, Input 2	TE11963	Slot 10, Input 2	TE11979
(x)	Engine x Cylinder 3 Temperature	AI	Slot 9, Input 3	TE11964	Slot 10, Input 3	TE11980
(xi)	Engine x Cylinder 4 Temperature	AI	Slot 9, Input 4	TE11965	Slot 10, Input 4	TE11981
(xii)	Engine x Cylinder 5 Temperature	AI	Slot 9, Input 5	TE11966	Slot 10, Input 5	TE11982
(xiii)	Engine x Cylinder 6 Temperature	AI	Slot 9, Input 6	TE11967	Slot 10, Input 6	TE11983
(xiv)	Engine x Gas Request from PLC11	PLC11 Comms				
(xv)	PLC11 "Healthy" input	DI	Slot 3, Input 16	15900	Slot 3, Input 16	15900
(xvi)	PLC11 Network Connection Healthy	Comms Heatbeat				

Conditions that allow this output to turn ON:
When the engine has been started on Diesel, it has been running at Medium Speed for a continuous two minutes, the VCB is closed, and the engine has been selected to run on Gas, the "Engine x Gas Enable Solenoid SV4" output will be turned ON. The logic associated with the request to change over to gas is carried out in PLC11 and transmitted via the communications network.

The following conditions will allow the Engine x Gas Enable Solenoid, (SV4), to be energised:

- The Engine x Emergency Stop Valve Monitor Supply Relay input, ESVSR, is ON, and,
- the Engine x Emergency Stop Operated PS3 is OFF, and,
- the Engine x Emergency Stop Relay input, ESR, is OFF, and,
- the Engine x Gas Module does not have an active alarm, or the Engine x Gas Module has been inhibited, and,
- the Engine x Gas Module is not in Fault, or the Engine x Gas Module has been inhibited, and,
- the Gas Pipeline Pressure Switch is not indicating High Pressure, and,
- PLC11 has requested Gas to be supplied to Engine x, and,
- communications with PLC11 is healthy, and PLC11 itself is healthy.

Conditions that will cause this output to turn OFF:
When this output is ON, the engine will be able to run on gas, and the Gas Rack will be connected.

The following conditions will cause the Engine x Gas Enable Solenoid, (SV4), to turn OFF:

- The Engine x Emergency Stop Valve Monitor Supply Relay input, ESVSR, turns OFF, or,
- the Engine x Emergency Stop Operated input, PS3 turns ON, or,
- the Engine x Emergency Stop Relay input, ESR, turns ON, or,
- the Engine Gas Module has an active alarm, and the Gas Module has not been inhibited, or,
- the Engine Gas Module is Faulted, and the Gas Module has not been inhibited, or,
- the Gas Pipeline Pressure Switch is indicating High Pressure for a continuous five seconds, or,

- Any one of the six Cylinder Temperature Sensors has been above its High/High Temperature setpoint for a continuous 15 seconds, or,
- PLC11 has requested Engine x to changeover from Gas to Diesel, or,
- communications with PLC11 is not healthy, or PLC11 itself is not healthy.

3.2.4 Engine x Okay To Go To Gas

Digital Outputs:	Engine 1:	Slot 5, Output 3	Wire 15001
	Engine 2:	Slot 7, Output 3	Wire 15010
		ON State:	Normal condition (Okay to go to Gas)
		OFF State:	Not okay to go to Gas

Control Sequence

(The control for this output is the same for each engine)

This output is used when PLC15 has determined that the engine should switch back to diesel because there is an active fault condition in the gas system, but the fault condition is not dangerous enough to require an Emergency Shutdown.

The output is connected straight to a Digital Input on PLC11, (ie PLC15 volt-free contact switching 0v supply from PLC11), and when turned OFF by PLC15 it causes PLC11 to initiate a switch back to diesel operation. The normal state for this output is for it to be ON, allowing the engine to switch to gas if running on diesel, or continue to operate normally on gas.

Conditions that will cause this output to turn OFF:

When this output is ON, the engine is able to operate normally on gas.
Any one of the following conditions will turn OFF the "Engine x Okay To Go To Gas" output:

- There is an active "Failed to Open" or "Failed to Close" fault condition on any one of the following four valves:
    a. Main Shutoff Valve
    b. Engine x Gas Primary Isolating Valve
    c. Engine x Gas Secondary Isolating Valve
    d. Engine x Gas Safety Vent Valve, or,
- PLC15 stops running, or has an active CPU or program execution fault, or,
- communications with PLC11 is not healthy, or PLC11 itself is not healthy.

3.3 Operational Mode

All gas valves will operate in Remote/Auto mode only. None of the valves will be able to be controlled manually from the OWS. However, the air solenoid valves at each actuator do have a local manual over-ride in case of emergency.

3.4 Modifications to existing plant – technical interfaces

Changes to existing plant include relocation of termination for all IO associated with PLC15, from the preexisting PLC11. Further modifications/replacement of PLC11 is within the scope of a separate project.

Part 2 Installation and Commissioning

4 Installation and Pre-Commissioning Procedure

4.1 Required Services

The system requires a single phase 230Vac 50Hz supply, capable of delivering 16A. This power supply should be supplied by a suitably sized UPS.

4.2 Handling, Unpacking and Storage

The cabinet is to be shipped totally enclosed in a wooden knock down crate. This crate will be built with a pallet base such that it may be transported by a forklift. The cabinet must remain upright at all times during shipping, storage, handling and installation.
Lifting eyebolts have been fitted to all four corners of the system cabinet, to facilitate movement by lifting strops and a crane, once the transport crate has been removed.

4.3 Installation Process

4.4 Pre-commissioning Test Procedures

Pre-commissioning Test Procedures are detailed in the Site Acceptance Test document, refer section 3.7.

5 Commissioning Procedure

Commissioning procedures are detailed in the Site Acceptance Test document, refer section 3.7. After a major overhaul or shutdown, the Site Acceptance Test should be repeated in its entirety.

6 Training Program

HIMA Australia offers the following training courses:

a. Operation and Maintenance of Safety Instrumented Systems Course
b. Maintenance & Troubleshooting Course
c. Advanced System Training Course
d. TÜV Functional Safety Program

These training courses are explained in greater detail below.

In addition to the documentation provided in this manual, much documentation is available from the ELOP II v4.1 CD delivered with the spare parts for the system.

It is considered essential for the safe, reliable and effective operation, that all operations and maintenance personnel who have any interaction with the PLC 15 system have the knowledge required to operate and maintain safety instrumented systems (or SIS) such that the designed functional safety is maintained throughout the operation and maintenance phases of the AS61511 safety life-cycle. This knowledge can be obtained through the Operation and Maintenance of Safety Instrumented Systems Course.

Further to the required knowledge of operating and maintaining a Safety Instrumented System, maintenance personnel responsible for PLC15 should be attend the Maintenance and Troubleshooting course, to ensure appropriate system specific knowledge is available.

If any changes configuration changes are to be made to the PLC15 system, it is essential that the engineers responsible attend the Advanced System Training course.

NOTE: Due to the Type B classification of the Engines, AS3814-2005 dictates that no changes to PLC15 may be made without approval from the Technical Regulator (Gas Examiner).

If changes to the PLC15 system require changes to a separate phase in the AS61511/61508 lifecycle, these changes will be reclassified as modifications. It is essential that any persons working across multiple phases of a Safety Instrumented System lifecycle have a thourough understanding of the aforementioned standards. The HIMA TUV Functional Safety program will assess this understanding and prove competency of an individual to carry out the modifications.

Availability
Our courses are run regularly in cities around Australia or alternatively we can provide a site-based course specifically to your requirements. Check our events calendar for regularly run courses. If the course is not scheduled, or is scheduled at a time that is inconvenient, call the sales consultant in your area and we will do our best to accommodate your requirements.

For more information contact HIMA:
Tel: (08) 9323 2100
Email: training@hima.com.au
www.hima.com.au

a. Operation and Maintenance of Safety Instrumented Systems Course:

The objective of this course is to provide operations and maintenance personnel with the knowledge required to operate and maintain safety instrumented systems (or SIS) such that the designed functional safety is maintained throughout the operation and maintenance phases of the AS61511 safety life-cycle.

The course contains plenty of examples and activities and is competency based. Attendees are invited to take part in a test at the end of the course to validate their knowledge and to obtain a "certificate of attainment".

The course is aimed at process plant operators, maintenance technicians/engineers, instrument/electrical technicians/engineers , plant managers, operations managers, maintenance managers, maintenance planners etc.

This course is also recognised by Engineers Australia (EA) for Continuing Professional Development (CPD) purposes.

Topics
- Safety Instrumented Systems
- Planning and Scheduling
- Procedures
- Proof Testing
- Management of Change
- Training and Competency
- Configuration Management Duration

Duration
1 Day

b. Maintenance & Troubleshooting Course

This training course provides the participant with the necessary knowledge for the operation of a plant, including small modifications of the user program.

Prerequisites are basic knowledge of electrical and digital functions, knowledge of personal computer (Windows-2000/XP).

Course Contents:

System overview and design of the HIMA-PES

- Functions of central and I/O modules
- Power supply and voltage distribution
- Standard IEC 61131-3, program organisation units,
- Types of data and variables
- Configuration, libraries, resource types
- Structure of system software and projects
- Offline-Test and code generation of user programs
- Loading and starting of the HIMA-PES
- Online-Test, forcing of I/O circuits

- Modification of a logic
- Execution of a online-Modification
- Creation of name packets for monitoring
- Forcing of signals
- Exchange of modules during operations
- Printout and use of project documentation
- Notes for the operation of a safety-related PES

Duration
2 days

c. Advanced System Training Course

This course provides training on hardware and communication configurations including system architectures and maintenance along with the configuring, loading and modifying of a HIMA PES application program.

Basic knowledge of electrical and digital functions, knowledge of Windows 2000 based software.

Training Course Contents:

Day 1 - Hardware and Maintenance

- HIMA system overview
- Field communications overview
- System block diagrams, system architectures
- Replacing modules
- Diagnostics

Day 2 to 4 – System Software

- Installation of system software
- Standard IEC 61131-3, description of functions and function blocks
- Configuration libraries, resource types
- Implementation of I/O modules, connection of variables to I/O modules
- System overview and design of the HIMA PES
- Functions of central I/O modules
- Structure of system software and projects
- Offline test, code generation, code comparison, loading and online tests
- Function blocks of HIMA, generally and according I/O
- Data communication HIPRO-N, HIPRO-S, Profibus-DP, Modbus, OPC, Ethernet
- Programming exercises
- Copy of objects, archives and backups of projects
- Safety functions and fault reactions
- Layout and compiling and document printout
- Notes for the operation of a safety related PES

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Duration
4 days

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d. TÜV Functional Safety Program

HIMA's functional safety engineering course is a TÜV Rheinland Group certified training course for engineering professionals. The course focuses on functional safety aspects for the process, oil & gas, and chemical industries according to AS 61511 and is part of the TÜV Functional Safety Program.

This course is also recognised by Engineers Australia (EA) for Continuing Professional Development (CPD) purposes.

What is the TÜV Functional Safety Program?

The TÜV Functional Safety Program is an extended vocational training program institutionalised by TÜV Rheinland Group, together with international course providers, to support know-how and knowledge transfer to engineers working in the field of functional safety. The aim is to achieve a global, clear and uniform standard of competence towards compliance to the requirements of AS 61511 and other functional safety standards. For more information about the program please visit http://www.tuvasi.com/.

Who should attend?

The training course is meant for those individuals involved in any part of the functional safety lifecycle primarily in the oil & gas, chemical, and processing industries, for example:

- Plant and quality managers
- Control and process engineers
- Risk, reliability, safety and quality engineers
- Loss prevention engineers
- System integrators and consultants
- Anybody who wants to get their competency certified by TÜV

Part 3 Appropriate Records

7 Inspection and Test Plans

DOCUMENT FRONT SHEET

Purchase Order No.	BWQ80144 07/08	**HIMA AUSTRALIA Pty Ltd** www.hima.com.au
Client Document No.		
HIMA's Document No.	P-08-023-00_SAT	
Document Title	Site Acceptance Test Procedure	2/21 Frederick St. Belmont Perth WA 6104
System Description	H41qce-HS	
VDRL/Doc Code & Type (Refer to vendor data req.)	N/A	Unit 13 21 Sabre Drive Port Melbourne VIC 3207
Status (Check Applicable)	☒ FOR APPROVAL ☐ CERTIFIED FINAL ☐ AS-BUILT ☐ INFORMATION ONLY ☐ OTHER (IDENTIFY)	Unit 21 8 Riverland Drive Loganholme QLD 4129

Notes:

Procedure to verify and accept correct site installation of a PES

REV	DATE	DESCRIPTION	BY	CHECKED	APPROVED
A	22/4/09	For Approval	MJW	SR	MJW

Revision History

P-08-023-00_SAT-revA.doc

1. Introduction

The purpose of this procedure is to provide guidance for the site acceptance testing (SAT) of a Programmable Electronic System (PES).

The testing includes a mechanical check of the system, system power-up, internal diagnostics checks, and establishing communication to any engineering workstation (programming and debugging tool, PADT), human-machine interfaces (HMI), and distributed control systems (DCS).

Detailed testing of communication links e.g. verification of signal mapping will be performed during the commissioning phase.

The SAT will be considered successful and complete when the above is achieved.

All items requiring attention by HIMA will be punch-listed (appendix C). Where appropriate, they will be cleared immediately or flagged for later completion.

1.1. Scope

This SAT procedure only refers to the PLC 15 system. Each individual system must have it's own SAT procedure.

2. SAT drawings and documentation

The following documents *may* be required as reference.

- Client documents
    - User requirements specification
    - Termination drawings
    - Loop drawings
- HIMA hardware drawings, inclusive of
    - HIMA Earthing Detail
    - HIMA AC/DC Power Distribution
    - HIMA I/O Wiring
    - HIMA Communication Bus Topology and Hook Up Details
- MODBUS Address Lists
- Work identified post-FAT to be completed at site (Post-FAT punch list)

All documents used during the SAT should be recorded on the test record sheets.

Any changes to the documentation resulting from the SAT testing will be 'As-Built' in red pen, initialled and dated. Any changes, other than corrections to align the system with the documentation, require that a 'System Change Request' Form (appendix A) is completed and authorised.

Any changes to the application program also require that a 'System Change Request' Form (appendix A) is completed and authorised.

Changes to the PES software configuration must be recorded on a configuration record sheet before leaving site (appendix B).

Upon completion of SAT, all used documents will be archived as part of the test records. Changes may be back-drafted at HIMA's standard schedule rates and an as-built set of documentation issued to the client upon request.

3. Roles & responsibilities

The following chapter is generic to all possible types of HIMA installations. Roles and responsibilities will be performed as required for the particular installation.

3.1. Cabinet installation

This is the sole responsibility of the client. HIMA will verify that the installation has been performed correctly both mechanically and electrically under the terms of this SAT procedure.

3.2. Project engineer

- Verification of earthing system integrity.
- Initial system power up
- Verification of correct basic operation of CU and I/O hardware.
- Verification of 3rd party communication links
- Setup of ELOPII Engineering Terminal(s)
- Completion of system checklists
- Mechanical and wiring checks with the client
- Mark up and control of as built hardware documentation
- Remedial work for hardware punch list items. This may require the assistance of client site technicians
- Execution of engineering in-line with Quality Assurance and IEC 61511 requirements

3.3. Project manager / senior project engineer

Most issues should be resolved on site between the HIMA representative engineer and the client engineer. In the event that issues cannot be resolved, the HIMA representative may call on colleagues to help resolve the issues.

The HIMA site representative may call on office staff for external support in project management, resource issues, work conditions, materials requirements etc.

3.4. Client or nominated representative

- Approval of this procedure.
- Sign-off SAT on behalf of the project.
- Active participant in the SAT process.
- Managing the SAT process (schedule, permits, isolations, resource planning etc.)

4. SAT testing

The following sections appear in the recommended order of testing. The PES stand-alone testing will be considered complete following the completion of tests detailed in this section.

All tests must be ticked as passed or not applicable in order for the SAT to end successfully.

If additional testing not covered by these procedures is required, this should be attached or covered under 'additional testing' at the end of this document. This also applies to requests for tests to be repeated. Any incomplete work or non-conformances detected during the SAT will be recorded in the punch list and where possible testing should continue. At the end of the SAT the punch list will be checked for outstanding items.

4.1. Hardware & mechanical inspection

Hardware and mechanical inspection is carried out as the first activity of arrival on site. Satisfactory completion of this inspection is required prior to commencing further inspection or testing.

The field marshalling disconnect (knife-gate) terminals must be open prior to commencing the system power up.

4.2. Power up

A top-down approach must be used in powering the PES. The power distribution drawings must be followed to ensure each breaker/fuse powers the correct terminals/devices. The drawings should be highlighted as each part of system is powered.

The engineer must check the correct response has been received from closing each breaker/fuse.

4.3. PES diagnostics

Once the system is installed and powered, the PES diagnostics should be checked to ensure no unexpected errors are present in the system.

All testable I/O cards should be clear of faults once powered, with the exception of monitored and analogue output cards. At this stage, it is expected that monitored I/O cards are reporting faults as the loops will be open circuit. These faults will not be cleared until loop checking is complete.

There may also be faults with the communications to other PESs and third party devices. These must be cleared under the communications section of the SAT before the procedure can be signed-off.

All diagnostics specific to the PES should report as healthy.

4.4. Communications

Communications to the GE Fanuc PLC11 must be verified as part of the SAT. This test is to ensure that there is a valid link between the PES and PLC11. Separate validation of all data transfer across the link will be part of commissioning activities.

Particular attention should be paid to redundancy. Where redundant communications exist, each element of redundancy should be checked in its failure mode. Diagnostics for these failures must also exist.

5. SAT procedure

HIMA Test Engineer:

TESTING DOCUMENTS

Document No	Title	Revision	Comment

ITEM	ACTIVITY	N/A	PASS	COMMENTS
HARDWARE & MECHANICAL INSPECTION				
	INITIAL CHECKS ***(must be completed prior to proceeding with power-up!)***			
1	Check and record external mechanical damage		☐	
2	Check and record internal mechanical damage (e.g. swing frame movement, damaged hinges, mounted components)		☐	
3	Cabinet is securely fixed (e.g. to wall or floor)		☐	
4	Doors and swing frames close easily.		☐	
5	All gland plates earth and sealed to IP requirements		☐	
6	Check for loose or dislodged equipment (re-fit as required)		☐	
7	All earthing systems are wired and tested. Segregation maintained as per site standards (usually connected to common earth stake)		☐	
8	All circuit breakers/isolators open		☐	
9	All terminal disconnects (knife-gates) are open		☐	

HARDWARE VERIFICATION AND POWER UP CHECKLIST

Record the serial / ID number of ANY multi-meter used during this phase.

ITEM	ACTIVITY	N/A	PASS	COMMENTS
POWER-UP				
10	**INCOMING AC POWER UP**			
11	Measure and record power supply voltage to ensure supply is in the correct range. VOLTAGE (V ac): FREQUENCY (Hz):	☐	☐	
12	Close the breaker connected to the power supply unit (PSU). Ensure the correct operation of the PSU. Confirm output voltage & record. VOLTAGE (V dc):	☐	☐	
13	If PSU's are not redundant, go to step 10.			
	REDUNDANT AC POWER UP			
14	Close both breakers connected to PSU and confirm correct output voltage. Switch breaker 1 to open & confirm correct redundant operation. VOLTAGE (V ac): FREQUENCY (Hz):	☒	☐	
	INCOMING DC POWER UP, Feed 1 (external or from PSU)[1]			
15	Ensure the voltage is as per requirements, usually 24V dc and record. Close breaker/isolator supplying the power distribution bus (e.g. K7205). Ensure the voltage is correct at the power distribution bus. VOLTAGE (V dc):	☐	☐	
	INCOMING DC POWER UP, Feed 2 (external or from PSU)			
16	Ensure the voltage is as per requirements, usually 24V dc and record. Close breaker/isolator supplying the power distribution bus (e.g. K7205). Ensure the voltage is correct at the power distribution bus. Switch breaker 1 to open & confirm correct redundant operation. VOLTAGE (V dc):	☐	☐	
	LIGHTS & GPO (AC or DC Voltage)			
17	Close the breaker connected to the lights & ensure their correct operation	☐	☐	
18	Close the breaker connected to RCD/GPO & ensure power availability.	☐	☐	

[1] Where a both 240V ac rectifier and external 24V dc incoming feed are used, ensure that a suitably sized de-coupling diodes are used ***BEFORE*** throwing the switch

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	CU RACK POWER UP			
19	Power the 24V/5V individually, in the case of the H41q/51q central rack, ensure the power supply monitoring module LEDs are healthy for each PSU e.g. F7130, F7126 etc.	☐	☐	
20	Ensure F7126 output are within 0.025V of each other (test points at front of module	☐	☐	
21	Load the current revision of the application program and ensure the central units run up correctly		☐	
22	Check watchdog voltage at every rack. Must be >21.5V, -10+15%	☐	☐	
23	Ensure correct 5V module power supply at each I/O rack. Must be > 4.85V	☐	☐	
24	Check CU fan(s) operational and air flow direction correct.	☐	☐	
25	Check I/O rack fan(s) operational and air flow direction correct.	☒	☐	
	I/O MODULE POWER UP			
26	Power each module/set of modules by closing breakers/disconnect terminals ***one-by-one*** as applicable. Ensure the breakers power the correct modules as defined in the engineering drawings		☐	
	OTHER DEVICES			
27	Power communications modules and ensure normal behaviour	☐	☐	
28	Power fans and ensure correct direction of air motion	☐	☐	
29	Ensure field power is available as per the engineering drawings (e.g. F3236 power, DO's etc.)	☐	☐	
30	Ensure Earth Leakage Detector powered and working correctly	☒	☐	

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ITEM	ACTIVITY	N/A	PASS	COMMENTS
DIAGNOSTICS				
	POWER DISTRIBUTION. ***Ensure the following alarms are clear prior to proceeding to the next stage***			
31	Failure of 240Vac primary feed circuit breaker	☒	☐	
32	Failure of 240Vac secondary feed circuit breaker	☒	☐	
33	Fault in 240Vac-to-24Vdc primary rectifier. If applicable ensure the secondary rectifier is sufficient to maintain the fully operational system.	☐	☐	
34	Fault in 240Vac-to-24Vdc secondary rectifier. If applicable ensure the primary rectifier is sufficient to maintain the fully operational system.	☐	☐	
35	24Vdc primary feed circuit breaker trip	☐	☐	
36	24Vdc secondary feed circuit breaker	☐	☐	
37	24Vdc power distribution MCB trip, e.g. Fx.1 to Fx.18	☐	☐	
38	**H51q only:** 24Vdc distribution failure to individual I/O modules by F7133 module. Faults for testable I/O modules should be raised in the application program	☒	☐	
39	5Vdc PSU failure	☐	☐	
	GENERAL HARDWARE. ***Ensure the following alarms are clear prior to proceeding to the next stage***			
40	Cabinet roof fan (e.g. K9202) fault	☐	☐	
41	Cabinet I/O rack fan (e.g. K9203) fault	☒	☐	
42	CU fan fault	☐	☐	
43	Thermostat over-temperature	☐	☐	
44	Earth leakage fault: 0Vdc to protective earth.	☒	☐	
45	Earth leakage fault: 24Vdc to protective earth.	☒	☐	
46	Electronic fuse module fault (H7014)	☒	☐	

ITEM	ACTIVITY	N/A	PASS	COMMENTS
COMMUNICATIONS				
	OPC Communications			
47	Primary link communicates to the OPC Server as required as a stand alone link. Ensure network speed/duplex settings are correct for the attached network equipment. The COL light on the Ethernet card should not be lit often.	☒	☐	
48	Secondary link communicates to the OPC Server as required as a stand alone link. Ensure network speed/duplex settings are correct for the attached network equipment. The COL light on the Ethernet card should not be lit often.	☒	☐	
49	Both links communicate to the OPC Server as required when redundancy is available	☒	☐	
50	The OPC Server communicates correctly with external OPC clients	☒	☐	
A)	BPCS (basic process control system)	☒	☐	
B)	Override workstation	☒	☐	
C)	Other (please specify)	☒	☐	
	Ethernet Communications			
51	Primary link communicates to the BPCS as required as a stand alone link	☒	☐	
52	Secondary link communicates to the BPCS as required as a stand alone link	☒	☐	
53	Both links communicate to the BPCS as required when redundancy is available	☒	☐	
55	Correct communication established to other HMI (e.g. PanelView), specify details	☒	☐	CITECT SCADA via GE FANUC PLC 11
56	Correct communication established to Engineering Workstation 1 (Laptop)	☐	☐	
57	Correct communication established to Engineering Workstation 2 (Desktop)	☐	☐	
	Serial Communications			
58	Primary link communicates to the BPCS as required as a stand alone link	☐	☐	CU1 side of BV7046
59	Secondary link communicates to the BPCS as required as a stand alone link	☐	☐	CU2 side of BV7046
60	Both links communicate to the BPCS as required when redundancy is available	☐	☐	

ITEM	ACTIVITY	N/A	PASS	COMMENTS
COMMUNICATIONS DIAGNOSTICS				
	COMMUNICATIONS. ***Ensure the following result in alarms as specified in the FDS or similar. Alarms may be individual or wired to a common cabinet fault.***			
61	OPC primary communication link failure	☒	☐	
62	OPC secondary communication link failure	☒	☐	
63	HIPRO-S primary communication link failure	☒	☐	
64	HIPRO-S secondary communication link failure	☒	☐	
65	Ethernet primary communication link to BPCS failure	☒	☐	
66	Ethernet secondary communication link to BPCS failure	☒	☐	
67	Ethernetl communication link to HMI failure	☒	☐	
68	SOE communication link failure	☒	☐	

When all the tests contained with in this checklist are complete, both the client and the HIMA representative must complete the following:-

APPROVAL

CLIENT		HIMA	
Name(s)		Name(s)	
Company		Company	
Position		Position	
Sign		Sign	
Date		Date	

Appendix A – SIS change request forms

SIS CHANGE REQUEST

HIMA

Project Name: BCC PLC 15 Replacement **Number:** P-08-023-00 **Pos:** 15 **SCR #:**

CHANGE REQUEST INITIATION		**PRIORITY:**		**DATE REQUIRED:**	
Originator:		☐	Emergency		
Position:		☐	Routine		
Company:		☐	Urgent	**CHANGE DESCRIPTION:**	
Date:				☐	New Requirement
SYSTEM DESCRIPTION:		**SUBJECT / ITEM:**		☐	Requirement Change
H41qce-HS		☐	Software	☐	Defect
PHASE:		☐	Hardware	☐	Set point/Constant Change
		☐	Document	☐	Temporary Change !

COMMENTS:

SAFETY REVIEW ☐ *Attachments included*				**Estim. Hrs.**	**Actual Hrs.**
Level:	☐ **SIL 1 (Supervised Practitioner)**	☐ **SIL 2 (Practitioner)**	☐ **SIL 3 (Independent Team)**		
Completed By:		**Date:**			
IMPACT ANALYSIS ☐ *Attachments included*					
Hardware:					
Electrical/Wiring:					
Software:					
Communications partners e.g. OPC					
Reloadability:					
Documents:					
Completed By:		**Date:**			

AUTHORISATION TO PROCEED ***(Responsible person to sign here. If this change is to a type B gas appliance, it MUST be authorised by a licenced gas fitter / inspector, either by signature here or by attachment of authorising documents) Attachments inc.*** ☐

Name:		Position		Company	
Signature:		Licence #		Date:	

CHANGE STATUS

	Name	Company	Position	Signature	Date
Changed by:					
	Code ver. pre-mod:		Code ver. post-mod:		

If this is a temporary change (see CHANGE DESCRIPTION above), DO NOT sign of until the temporary change is removed!

	Name	Company	Position	Signature	Date
Tested					
Accepted					

Code iterations required to complete this SCR must be recorded overleaf. Record completed SCR in SCR Log.

SIS CHANGE REQUEST

HIMA

Project Name: **Number:** **Pos:** **SCR #:**

IF AN SCR REQUIRES SEVERAL CODE ITERATIONS TO REACH COMPLETION, RECORD EACH ITERATION BELOW!

ITERATION		COMMENT	BY	DATE
From version				
To version				

ITERATION		COMMENT	BY	DATE
From version				
To version				

ITERATION		COMMENT	BY	DATE
From version				
To version				

ITERATION		COMMENT	BY	DATE
From version				
To version				

ITERATION		COMMENT	BY	DATE
From version				
To version				

ITERATION		COMMENT	BY	DATE
From version				
To version				

ITERATION		COMMENT	BY	DATE
From version				
To version				

ITERATION		COMMENT	BY	DATE
From version				
To version				

ITERATION		COMMENT	BY	DATE
From version				
To version				

ITERATION		COMMENT	BY	DATE
From version				
To version				

Record completed SCR in SCR Log.

Appendix B – Configuration record sheets

Appendix C – Punch list

HIMA

PES Configuration Record

Project Number: __P-08-023-00__________ Pos: _15_ Sheet Number: __1__of __1__

Application code detail

Configuration:	
Resource:	
Program:	
Code Version:	

H41/51q

System details

System Type:	
CPU OS version:	
Node address:	
Default baud rate:	57K6
F8621A OS version:	

CU Dip Switch Settings

S1		1	2	3	4	5	6	7	8
	on	x	x	x	x	x	x	x	x
	off	x	x	x	x	x	x	x	x

Cycle Time (ms)

Avg		Max	

I/O parameters

Noise blanking:	0
Reaction to output errors:	Normal Op

Safety

Online parameter change:	x / ✓
Safety time (s):	
Watchdog (ms):	1000mS
Requirement class (AK):	

Allowed actions

Test operation:	x / ✓
Warm/cold start:	x / ✓
Reload:	x / ✓

Change

Constants:	x / ✓
Variables:	x / ✓
Force I/O:	x / ✓

HIMatrix

System details

System Type:	
CPU OS version:	
COM OS version:	
MAC address:	
I.P. address:	
SRS:	
System ID:	
Logon1 / Password 1:	
Logon2 / Password 2:	
Logon3 / Password 3:	

Safety

Safety time (s):	
Watchdog (ms):	50mS
Main enable	x / ✓

Other parameters

Auto start	x / ✓
Start/restart permitted	x / ✓
Loading permitted	x / ✓
Test mode	x / ✓
Forcing permitted	x / ✓
Stop with force timeout	x / ✓
Maximum COM time slice	0mS
Code generation version	3

License Keys

CU1 CM_F_____ Setting									
OS Version:									
IP Address:									
S1									
S2									
Function:		HIPRO-S x / ✓							
A & E x / ✓		MODBUS TCP x / ✓							
OPC x / ✓		ELOP II TCP x / ✓							
		1	2	3	4	5	6	7	8
S1	ON								
	OFF								
S2	ON								
	OFF								

CU2 CM_F_____ Setting									
OS Version:									
IP Address:									
S1									
S2									
Function:		HIPRO-S x / ✓							
A & E x / ✓		MODBUS TCP x / ✓							
OPC x / ✓		ELOP II TCP x / ✓							
		1	2	3	4	5	6	7	8
S1	ON								
	OFF								
S2	ON								
	OFF								

Name:		Sign:	
Position:		Date:	

When this document has been completed it should be filed in the relevant project folder.

PROJECT PUNCHLIST

Project Name: BCC PLC 15 Replacement **Number:** P-08-023-00 **Pos: 15**

This punchlist can be used, during testing, for hardware or software items.

Item	MFR	ENG	CLIENT	Description	Initiator/ Date	Action by/ Date Req'd	HIMA sign-off	Client sign-off	Date completed

Functional Test Procedure - SAT

1 Gas Isolation Valves

1.1 Control Modes of Operation

All gas valves will operate in Remote/Auto mode only. None of the valves will be able to be controlled manually from the OWS. However, the air solenoid valves at each actuator do have a local manual over-ride in case of emergency.

1.1.1 Main Gas Shutoff Valve (VV2430)

Digital Output:	Slot 8, Output 1	Wire 15886
State:	Off = Valve Closed	
	On = Valve Open	
References:		
P+ID:	486/5/5-0016-003	
Electrical Drawing:	486/7/5-UT2L1126E rev C	

The Main Gas Shutoff Valve is located outside the west engine room wall, on the common gas main from the Gas Compressors, prior to the line splitting into the individual gas feeds for each engine. The valve is arranged for "Energise to Open" control, and it has a "Spring to Close" actuator. The pneumatic solenoid that controls the valve is called "GSCV".

The Emergency Close input is wired so that it is ON when the button has been activated. While this circuit is not "fail-safe" to the PLC, it is not required to be, because it is "fail-safe" in the hard-wired logic. A Normally-Closed contact, (when the Emergency Stop is not activated), is included in the hard-wired circuit that controls the "GSCV" solenoid.

Conditions that allow this valve to open:

1.	The Main Gas Shutoff Valve selector on the station aux switchboard is set to "Remote", and,	☐
2.	The Main Gas Shutoff Valve Emergency Close button has not been pressed, and,	☐
3.	The Engine 1 Gas Module does not have an active alarm, AND the Eng1 Gas Module has not been inhibited, and,	☐
4.	The Engine 1 Gas Module is not in Fault, AND the Eng1 Gas Module has not been inhibited, and,	☐
5.	The Engine 2 Gas Module does not have an active alarm, AND the Eng2 Gas Module has not been inhibited, and,	☐
6.	The Engine 2 Gas Module is not in Fault, AND the Eng2 Gas Module has not been inhibited, and,	☐
7.	Either engine is running, (from PLC11), and,	☐
8.	Communications with PLC11 is healthy, and PLC11 itself is healthy.	☐

Conditions that will cause this output to turn OFF:
When this output is ON, at least one engine will be running and selected to run on gas.

The following conditions will cause the Main Gas Shutoff Valve to turn OFF:

1.	Neither engine is running, or,	☐
2.	The Main Gas Shutoff Valve Emergency Close button has been pressed, (0=Normal, 1=Emergency Close), or,	☐
3.	The Main Gas Shutoff Valve selector on the station aux switchboard has been set to "Close", or,	☐
4.	Either Engine Gas Module has an active alarm, and it has not been inhibited, or,	☐
5.	Either Engine Gas Module is Faulted, and it has not been inhibited, or,	☐
6.	The Main Gas Shutoff Valve has failed to open, (limit switch not on within 5 seconds of the request to open), or,	☐
7.	Communications with PLC11 is not healthy, or PLC11 itself is not healthy.	☐

1.1.2 Engine x Gas Isolation Valves

Digital Outputs:	Engine 1:	GIVR Relay	Slot 4, Output 1	Wire 15005
	Engine 2:	GIVR Relay	Slot 6, Output 1	Wire 15325
Closed Indication:	Engine 1:	Primary Isol Valve:	Slot 4, Output 2	Wire 15006
		Secondary Isol Valve:	Slot 4, Output 3	Wire 15007
		Vent Valve:	Slot 4, Output 4	Wire 15008
	Engine 2:	Primary Isol Valve:	Slot 6, Output 2	Wire 15326
		Secondary Isol Valve:	Slot 6, Output 3	Wire 15327
		Vent Valve:	Slot 6, Output 4	Wire 11328

References:

P+ID:		486/5/5-0016-003 rev O
Electrical Drawings:	Engine 1:	486/7/5-UT2L1163E rev C
	Engine 2:	486/7/5-UT2L1198E rev C

(The control for each set of valves is the same for each engine)

This output controls the position of the three valves on the gas supply line:

	Engine 1	**Engine 2**	**"Safe"**	**Eng Running**
• Gas Primary Isolation Valve	VV2431	VV2435	Closed	Open
• Gas Secondary Isolation Valve	VV2432	VV2436	Closed	Open
• Safety Gas Vent Valve	VV2433	VV2437	Open	Closed

(The state of the valves when in the "safe" condition is shown, along with the state when the engine is running).

A single relay called "GIVR" controls all three valves. When GIVR is energised, the Safety Gas Vent Valve Solenoid will energise closing the Safety Gas Vent Valve, and when it's "closed" limit switch turns ON, the Primary and Secondary Gas Isolation Valve Solenoids will be energised. The interlock with the "closed" limit switch is via the hard-wired circuit. The two Vent Valves are to be "Spring to Open" valves, and the Isolation valves are to be "Spring to Close".

Control Sequence

The following inputs affect the state of this output:

		Type	Engine 1	Wire	Engine 2	Wire
(i)	Engine x Gas Isol Vlvs Remote Seld	DI	Slot 1, Input 3	15004	Slot 2, Input 3	15324
(ii)	Engine x Gas Module Alarm	DI	Slot 1, Input 12	15867	Slot 2, Input 12	15869
(iii)	Engine x Gas Module Fault	DI	Slot 1, Input 11	15866	Slot 2, Input 11	15868
(iv)	Engine x Gas Module Inhibit	SCADA Cmd				
(v)	Engine x Gas Enable Solenoid SV4	DO	Slot 5, Output 2	15278	Slot 7, Output 2	15602
(vi)	Engine x Gas Vent Valve Closed LS	DI	Slot 1, Input 1	15002	Slot 2, Input 1	15322
(vii)	Engine x Gas Vent Valve Open LS	DI	Slot 1, Input 2	15003	Slot 2, Input 2	15323
(viii)	Engine x Primary Isol Valve Closed LS	DI	Slot 1, Input 4	15174	Slot 2, Input 4	15498
(ix)	Engine x Primary Isol Valve Open LS	DI	Slot 1, Input 5	15175	Slot 2, Input 5	15499
(x)	Engine x Secondary Isol Vlv Closed LS	DI	Slot 1, Input 6	15141	Slot 2, Input 6	15465
(xi)	Engine x Secondary Isol Vlv Open LS	DI	Slot 1, Input 7	15142	Slot 2, Input 7	15466
(xii)	Engine x Gas High Pressure Switch	AI	Slot ?, Input 1	PSH11000	Slot ?, Input 2	PSH11320
(xiii)	PLC15 "Healthy" input	DI	Slot 3, Input 16	15900	Slot 3, Input 16	15900
(xiv)	PLC11 Network Connection Healthy	Comms Heatbeat				

Conditions that allow this output to turn ON:

When the engine has been started on Diesel, it has been running at Medium Speed for a continuous two minutes, and the engine has been selected to run on Gas, the "Engine x Gas Enable Solenoid SV4" output will be turned ON, (refer to the separate description for this output).

The following conditions will allow the Engine x Gas Isolation Valves Relay, (GIVR), to turn ON:

		ENG1	ENG2
1.	The SV4 output turns ON, (see conditions above), and,	☐	☐
2.	The Gas Isolation Valves Switch is set to "Remote", (0=Close, 1=Remote), and,	☐	☐
3.	The Engine x Gas Module does not have an active alarm, or the Engine x Gas Module has been inhibited, and,	☐	☐
4.	The Engine x Gas Module is not in Fault, or the Engine x Gas Module has been inhibited, and,	☐	☐
5.	The Gas Pipeline Pressure Switch is not indicating High Pressure setpoint, and,	☐	☐
6.	Communications with PLC11 is healthy, and PLC11 itself is healthy.	☐	☐

When the Engine x Gas Isolation Valves Relay, (GIVR), turns ON, the state of the Safety Gas Vent Valve "closed" limit switch, and the Primary and Secondary Isolation Valves "Open" limit switches will be checked. If any of them has not turned on within **twelve** seconds of the GIVR output turning ON, the changeover to gas operation will be aborted, and one of the following messages will be posted on the SCADA Alarm Page:

		ENG1	ENG2
1.	"Engine x Gas Vent Valve Failed to Close"	☐	☐
2.	"Engine x Primary Gas Isolation Valve Failed to Open"	☐	☐
3.	"Engine x Secondary Gas Isolation Valve Failed to Open"	☐	☐
4.	In addition, the following message will also appear on the Engines Page, and the alarm; "Engine x Changeover to Gas Aborted" will be posted to the Alarm Page.	☐	☐

Conditions that will cause this output to turn OFF:
When this output is ON, the engine will be running on gas, the Gas Primary and Secondary Isolation Valves will be open and the Safety Gas Vent Valve will be closed.

The following conditions will cause the Engine x Gas Isolation Valves Relay, (GIVR), to turn OFF:

		ENG1	ENG2
1.	The SV4 output turns OFF, (due to normal or emergency shutdown conditions described in the control section for SV4), or,	☐	☐
2.	The Gas Isolation Valves Switch is set to "Close", (0=Close, 1=Remote), or,	☐	☐
3.	The Engine x Gas Module has an active alarm, and the Engine x Gas Module has not been inhibited, or,	☐	☐
4.	The Engine x Gas Module is Faulted, and the Engine x Gas Module has not been inhibited, or,	☐	☐
5.	The Gas Pipeline Pressure Switch is indicating High Pressure for a continuous five seconds, or,	☐	☐
6.	The Safety Vent Valve "closed" input turns OFF, or,	☐	☐
7.	The Gas Primary Isolation Valve "open" input turns OFF, or,	☐	☐
8.	The Gas Secondary Isolation Valve "open" input turns OFF, or,	☐	☐
9.	Communications with PLC11 is not healthy, or PLC11 itself is not healthy.	☐	☐

"Closed" Indication
PLC15 controls the outputs that turn on the "Closed" indicator lamps for the three gas valves for each engine. These outputs directly mimic the state of the three "Closed" LS inputs, one per valve.

		ENG1	ENG2
1.	Engine x Primary Gas Isolation Valve	☐	☐
2.	Engine x Secondary Gas Isolation Valve	☐	☐
3.	Engine x Gas Safety Vent Valve	☐	☐

1.1.3 Engine x Emergency Stop Solenoid (SV3)

Digital Outputs:	Engine 1:	BESR2 Relay/SV3 Sol	Slot 5, Output 1	Wire 15277
	Engine 2:	BESR2 Relay/SV3 Sol	Slot 7, Output 1	Wire 15601
		ON State:	Normal condition	
		OFF State:	Emergency Shutdown	

References:

P+ID:		486/7/5-UT2L0149M rev B
Electrical Drawings:	Engine 1:	486/7/5-UT2L1147E rev F
	Engine 2:	486/7/5-UT2L1182E rev G

(The control for the solenoid is the same for each engine)

This output controls the BESR2 (new) Relay, a Normally Open contact off which de-energises Solenoid Valve SV3, and causes a shutdown of the engine and blowdown of the diesel rack. SV3 can also be de-energised from the activation of any one of the Emergency

Stop buttons located at (i) the Alternator Protection Panel, (ii) the Control Desk, or (iii) the Lunch Room (beside the Main Control Room). The normal state for this output is for it to be ON, allowing normal operation of the engine. This provides a fail-safe condition whereby a failure of PLC15 will turn off the output and cause an emergency shutdown of the engine.

Control Sequence

The following inputs affect the state of this output:

		Type	Engine 1	Wire	Engine 2	Wire
(i)	Engine x Estop Supply Relay ESVSR	DI	Slot 1, Input 8	15185	Slot 2, Input 8	15509
(ii)	Engine x Estop Operated PS3	DI	Slot 1, Input 9	15186	Slot 2, Input 9	15510
(iii)	Engine x Estop Relay ESR	DI	Slot 1, Input 10	15191	Slot 2, Input 10	15515
(iv)	PLC15 "Healthy" input	DI	Slot 3, Input 16	15900	Slot 3, Input 16	15900
(v)	PLC11 Network Connection Healthy	Comms Heatbeat				
(vi)	Engine x Emergency Stop Request	SCADA Command				

Conditions that allow this output to turn ON:

The following conditions ensure the Engine x Emergency Stop output is ON, (SV3 energised):

		ENG1	ENG2
1.	The Engine x Emergency Stop Valve Monitor Supply Relay input, ESVSR, is ON, and,	☐	☐
2.	The Engine x Emergency Stop Operated PS3 is OFF, and,	☐	☐
3.	The Engine x Emergency Stop Relay input, ESR, is ON, and,	☐	☐
4.	PLC15 is running and has no CPU or program execution faults active, and,	☐	☐
5.	Communications with PLC11 is healthy, and PLC11 itself is healthy.	☐	☐

Conditions that will cause this output to turn OFF:

When this output is ON, the engine is able to operate normally.
Any one of the following conditions will turn OFF the Engine x Emergency Stop output, (energising SV3):

		ENG1	ENG2
1.	The Engine x Emergency Stop Valve Monitor Supply Relay input, ESVSR, turns OFF, or,	☐	☐
2.	The Engine x Emergency Stop Operated input, PS3 turns ON, or,	☐	☐
3.	The Engine x Emergency Stop Relay input, ESR, turns OFF, or,	☐	☐
4.	An operator Emergency Stop command has been sent from the OWS and the Engine is in Remote/Manual mode, (this command comes from PLC11), or,	☐	☐
5.	PLC15 stops running, or has an active CPU or program execution fault, or,	☐	☐
6.	Communications with PLC11 is not healthy, or PLC11 itself is not healthy.	☐	☐
7.	Over Temperature or Invalid Temperature	☐	
8.	PSH15000 or PSH15320	☐	

1.1.4 Engine x Gas Enable Solenoid (SV4)

Digital Outputs:	Engine 1:	GR Relay/SV4 Sol	Slot 5, Output 2	Wire 15278
	Engine 2:	GR Relay/SV4 Sol	Slot 7, Output 2	Wire 15602

References:

P+ID:		486/7/5-UT2L0149M rev B
Electrical Drawings:	Engine 1:	486/7/5-UT2L1147E rev F
	Engine 2:	486/7/5-UT2L1182E rev G

(The control for each solenoid is the same for each engine)

This output controls the Gas Enable Solenoid, SV4. When the output is ON, the Gas System is able to be operated as soon as the Diesel/Gas Changeover output, (DGR), is turned ON by PLC11.

Control Sequence

The following inputs affect the state of this output:

		Type	Engine 1	Wire	Engine 2	Wire
(i)	Engine x Estop Supply Relay ESVSR	DI	Slot 1, Input 8	11185	Slot 2, Input 8	15509
(ii)	Engine x Estop Operated PS3	DI	Slot 1, Input 9	15186	Slot 2, Input 9	15510
(iii)	Engine x Estop Relay ESR	DI	Slot 1, Input 10	15191	Slot 2, Input 10	15515
(iv)	Engine x Gas Module Alarm	DI	Slot 1, Input 12	15867	Slot 2, Input 12	15869
(v)	Engine x Gas Module Fault	DI	Slot 1, Input 11	15866	Slot 2, Input 11	15868
(vi)	Engine x Gas Module Inhibit	SCADA Cmd				
(vii)	Engine x Gas High Pressure Switch	AI	Slot ?, Chnl 1	PSH11000	Slot ?, Chnl 2	PSH11320
(viii)	Engine x Cylinder 1 Temperature	AI	Slot 9, Input 1	TE11962	Slot 10, Input 1	TE11978
(ix)	Engine x Cylinder 2 Temperature	AI	Slot 9, Input 2	TE11963	Slot 10, Input 2	TE11979
(x)	Engine x Cylinder 3 Temperature	AI	Slot 9, Input 3	TE11964	Slot 10, Input 3	TE11980
(xi)	Engine x Cylinder 4 Temperature	AI	Slot 9, Input 4	TE11965	Slot 10, Input 4	TE11981
(xii)	Engine x Cylinder 5 Temperature	AI	Slot 9, Input 5	TE11966	Slot 10, Input 5	TE11982
(xiii)	Engine x Cylinder 6 Temperature	AI	Slot 9, Input 6	TE11967	Slot 10, Input 6	TE11983
(xiv)	Engine x Gas Request from PLC11	PLC11 Comms				
(xv)	PLC11 "Healthy" input	DI	Slot 3, Input 16	15900	Slot 3, Input 16	15900
(xvi)	PLC11 Network Connection Healthy	Comms Heatbeat				

Conditions that allow this output to turn ON:
When the engine has been started on Diesel, it has been running at Medium Speed for a continuous two minutes, the VCB is closed, and the engine has been selected to run on Gas, the "Engine x Gas Enable Solenoid SV4" output will be turned ON. The logic associated with the request to change over to gas is carried out in PLC11 and transmitted via the communications network.

The following conditions will allow the Engine x Gas Enable Solenoid, (SV4), to be energised:

		ENG1	ENG2
1.	The Engine x Emergency Stop Valve Monitor Supply Relay input, ESVSR, is ON, and,	☐	☐
2.	The Engine x Emergency Stop Operated PS3 is OFF, and,	☐	☐
3.	The Engine x Emergency Stop Relay input, ESR, is OFF, and,	☐	☐
4.	The Engine x Gas Module does not have an active alarm, or the Engine x Gas Module has been inhibited, and,	☐	☐
5.	The Engine x Gas Module is not in Fault, or the Engine x Gas Module has been inhibited, and,	☐	☐
6.	The Gas Pipeline Pressure Switch is not indicating High Pressure, and,	☐	☐
7.	PLC11 has requested Gas to be supplied to Engine x, and,	☐	☐
8.	Communications with PLC11 is healthy, and PLC11 itself is healthy.	☐	☐

Conditions that will cause this output to turn OFF:
When this output is ON, the engine will be able to run on gas, and the Gas Rack will be connected.

The following conditions will cause the Engine x Gas Enable Solenoid, (SV4), to turn OFF:

		ENG1	ENG2
1.	The Engine x Emergency Stop Valve Monitor Supply Relay input, ESVSR, turns OFF, or,	☐	☐
2.	The Engine x Emergency Stop Operated input, PS3 turns ON, or,	☐	☐
3.	The Engine x Emergency Stop Relay input, ESR, turns ON, or,	☐	☐
4.	The Engine Gas Module has an active alarm, and the Gas Module has not been inhibited, or,	☐	☐
5.	The Engine Gas Module is Faulted, and the Gas Module has not been inhibited, or,	☐	☐
6.	The Gas Pipeline Pressure Switch is indicating High Pressure for a continuous five seconds, or,	☐	☐
7.	Any one of the six Cylinder Temperature Sensors has been above its High/High Temperature setpoint for a continuous 15 seconds, or,	☐	☐
8.	PLC11 has requested Engine x to changeover from Gas to Diesel, or,	☐	☐
9.	Communications with PLC11 is not healthy, or PLC11 itself is not healthy.	☐	☐

1.1.5 Engine x Okay To Go To Gas

Digital Outputs:	Engine 1:	Slot 5, Output 3	Wire 15001
	Engine 2:	Slot 7, Output 3	Wire 15010
		ON State:	Normal condition (Okay to go to Gas)
		OFF State:	Not okay to go to Gas

Control Sequence

(The control for this output is the same for each engine)

This output is used when PLC15 has determined that the engine should switch back to diesel because there is an active fault condition in the gas system, but the fault condition is not dangerous enough to require an Emergency Shutdown.

The output is connected straight to a Digital Input on PLC11, (ie PLC15 volt-free contact switching 0v supply from PLC11), and when turned OFF by PLC15 it causes PLC11 to initiate a switch back to diesel operation. The normal state for this output is for it to be ON, allowing the engine to switch to gas if running on diesel, or continue to operate normally on gas.

Conditions that will cause this output to turn OFF:

When this output is ON, the engine is able to operate normally on gas.
Any one of the following conditions will turn OFF the "Engine x Okay To Go To Gas" output:

		ENG1	ENG2
1.	There is an active "Failed to Open" or "Failed to Close" fault condition on any one of the following four valves:	☐	☐
a.	Main Shutoff Valve	☐	☐
b.	Engine x Gas Primary Isolating Valve	☐	☐
c.	Engine x Gas Secondary Isolating Valve	☐	☐
d.	Engine x Gas Safety Vent Valve, or,	☐	☐
2.	PLC15 stops running, or has an active CPU or program execution fault, or,	☐	☐
3.	communications with PLC11 is not healthy, or PLC11 itself is not healthy.	☐	☐

1.1.6 Gas Module Inhibits (Maintenance Over-ride)

Facility is provided so that the Gas Module "Fault" and "Alarm" inputs can be inhibited while maintenance / calibration is performed on the Gas Modules. The inhibit is activated from PLC11 via the communications interface. An inhibit can only be active for a maximum of 1830 seconds (30.5 minutes), before it is automatically disabled by PLC15.

		ENG1	ENG2
1.	Engine x Gas Module can be inhibited from PLC11	☐	☐
2.	Engine x Gas Module inhibit is disabled when the inhibit request from PLC11 is removed	☐	☐
3.	Engine x Gas Module inhibit is automatically disabled after 1830 seconds	☐	☐

1.2 Alarm List

The following list of alarms are to be generated by PLC15. All alarms are to be latched in the PLC logic, and will require the field alarm state to abate, before the alarm can be reset via the OWS. This list is not complete and will be added to by the contractor during programming of the PLC.

	Alarm Message	Cause	Action	ENG1	ENG2
1.	Engine x changeover to gas aborted	Safety Gas Vent Valve failed to close, OR, Primary Isol Valve failed to open, OR, Secondary Isol Valve failed to open	Latch out the changeover to gas running and return to running on diesel. If the engine is still selected to run on gas, and the fault has not been fixed and cleared within 20 minutes, shutdown the engine.	☐	☐
2.	Engine x Safety Gas Vent Valve failed to close	"Close" LS input not received within 5 secs of the request to close	Abort the changeover to gas operation	☐	☐
3.	Engine x Safety Gas Vent Valve failed to open	"Open" LS input not received within 5 secs of the request to open	Shut the Main Gas Isolation Valve VV2430. If the other engine is running on gas, immediately change it back to diesel operation	☐	☐
4.	Engine x Primary Isolation Valve failed to close	"Close" LS input not received within 7 secs of the request to close	Shut the Main Gas Isolation Valve VV2430. If the other engine is running on gas, immediately change it back to diesel operation	☐	☐
5.	Engine x Primary Isolation Valve failed to open	"Open" LS input not received within 7 secs of the request to open	Abort the changeover to gas operation	☐	☐
6.	Engine x Secondary Isolation Valve failed to close	"Close" LS input not received within 7 secs of the request to close	Shut the Main Gas Isolation Valve VV2430. If the other engine is running on gas, immediately change it back to diesel operation	☐	☐
7.	Engine x Secondary Isolation Valve failed to open	"Open" LS input not received within 7 secs of the request to open	Abort the changeover to gas operation	☐	☐

8.	Main Gas Shutoff Valve failed to close	"Close" LS input not received within 5 secs of the request to close	Inhibit either engine from running on gas if selected to run on gas, but allow an engine to run on diesel. Shutdown any engine that is running on diesel and also has a "failed to close" on either of its Gas Primary or Secondary Isolation Valves.	☐	
9.	Main Gas Shutoff Valve failed to open	"Open" LS input not received within 5 secs of the request to open	Inhibit the changeover to gas operation for any starting engine. If an engine is running on gas when the alarm occurred, switch it back to diesel.	☐	
10.	Engine x Estop Valve Supply Fault	ESVSR input turns OFF.	Inhibit engine from starting. Stop engine if running.	☐	☐
11.	Engine x Emergency Stop Operated Alarm	Emergency Stop operated input turns ON	Inhibit engine from starting. Stop engine if running.	☐	☐
12.	Engine x Emergency Stop Relay Alarm	Emergency Stop Relay has been operated and input turns ON	Inhibit engine from starting. Stop engine if running.	☐	☐
13.	Engine x Cylinder x High/High Temp Shutdown. Engine x Auto Shutdown on High/High Cylinder Temp	Cylinder temperature sensor reads above the High/high temp alarm SP for a continuous 15 secs. (6 sensors per engine)	Stop engine.	☐	☐
14.	Engine x Gas Module Alarm	Gas Module Alarm input turns ON for a continuous 5 seconds	Stop engine.	☐	☐
15.	Engine x Gas Module Fault	Gas Module Alarm input turns OFF for a continuous 5 seconds	Stop engine.	☐	☐
16.	PLC15 Power Supply x Fault	Only one of the power supply "healthy" inputs turns OFF.	Alarm to SCADA but no other action.	☐	☐
17.	PLC15 Power Supply Complete Failure	Both of the power supply inputs turns OFF	Shutdown all running engines	☐	
18.	PLC11 Comms Failed to PLC15	Communication "heartbeat" has failed from PLC11	Shutdown all running engines	☐	
19.	PLC15 has detected a fault in PLC11	The PLC11 Healthy input has turned OFF	Shutdown all running engines	☐	
20.	Engine x Gas Supply High Pressure	The Eng x High Pressure switch input turns off for a cont. 5 sec	Close the Gas Isolating Valves and initiate a normal shutdown sequence	☐	☐

Note: All faults that rely on 24vDC for their "healthy" state, are to have a 250ms delay before actuation, and are to be inhibited if both of the 24vDC Power Supply "Healthy" inputs are OFF.

8 Commissioning Report

DOCUMENT FRONT SHEET

Purchase Order No.	BWQ80144 07/08	HIMA AUSTRALIA Pty Ltd www.hima.com.au
Client Document No.		
HIMA's Document No.	P-08-023-00_SAT	
Document Title	Site Acceptance Test Procedure	2/21 Frederick St. Belmont Perth WA 6104
System Description	H41qce-HS	
VDRL/Doc Code & Type (Refer to vendor data req.)	N/A	Unit 13 21 Sabre Drive Port Melbourne VIC 3207
Status (Check Applicable)	☒ FOR APPROVAL ☐ CERTIFIED FINAL ☐ AS-BUILT ☐ INFORMATION ONLY ☐ OTHER (IDENTIFY)	Unit 21 8 Riverland Drive Loganholme QLD 4129

Notes:

Procedure to verify and accept correct site installation of a PES

REV	DATE	DESCRIPTION	BY	CHECKED	APPROVED
A	22/4/09	For Approval	MJW	SR	MJW

Revision History

P-08-023-00_SAT-revA.doc

1. Introduction

The purpose of this procedure is to provide guidance for the site acceptance testing (SAT) of a Programmable Electronic System (PES).

The testing includes a mechanical check of the system, system power-up, internal diagnostics checks, and establishing communication to any engineering workstation (programming and debugging tool, PADT), human-machine interfaces (HMI), and distributed control systems (DCS).

Detailed testing of communication links e.g. verification of signal mapping will be performed during the commissioning phase.

The SAT will be considered successful and complete when the above is achieved.

All items requiring attention by HIMA will be punch-listed (appendix C). Where appropriate, they will be cleared immediately or flagged for later completion.

1.1. Scope

This SAT procedure only refers to the PLC 15 system. Each individual system must have it's own SAT procedure.

2. SAT drawings and documentation

The following documents *may* be required as reference.

- Client documents
    - User requirements specification
    - Termination drawings
    - Loop drawings
- HIMA hardware drawings, inclusive of
    - HIMA Earthing Detail
    - HIMA AC/DC Power Distribution
    - HIMA I/O Wiring
    - HIMA Communication Bus Topology and Hook Up Details
- MODBUS Address Lists
- Work identified post-FAT to be completed at site (Post-FAT punch list)

All documents used during the SAT should be recorded on the test record sheets.

Any changes to the documentation resulting from the SAT testing will be 'As-Built' in red pen, initialled and dated. Any changes, other than corrections to align the system with the documentation, require that a 'System Change Request' Form (appendix A) is completed and authorised.

Any changes to the application program also require that a 'System Change Request' Form (appendix A) is completed and authorised.

Changes to the PES software configuration must be recorded on a configuration record sheet before leaving site (appendix B).

Upon completion of SAT, all used documents will be archived as part of the test records. Changes may be back-drafted at HIMA's standard schedule rates and an as-built set of documentation issued to the client upon request.

3. Roles & responsibilities

The following chapter is generic to all possible types of HIMA installations. Roles and responsibilities will be performed as required for the particular installation.

3.1. Cabinet Installation

This is the sole responsibility of the client. HIMA will verify that the installation has been performed correctly both mechanically and electrically under the terms of this SAT procedure.

3.2. Project engineer

- Verification of earthing system integrity.
- Initial system power up
- Verification of correct basic operation of CU and I/O hardware.
- Verification of 3rd party communication links
- Setup of ELOPII Engineering Terminal(s)
- Completion of system checklists
- Mechanical and wiring checks with the client
- Mark up and control of as built hardware documentation
- Remedial work for hardware punch list items. This may require the assistance of client site technicians
- Execution of engineering in-line with Quality Assurance and IEC 61511 requirements

3.3. Project manager / senior project engineer

Most issues should be resolved on site between the HIMA representative engineer and the client engineer. In the event that issues cannot be resolved, the HIMA representative may call on colleagues to help resolve the issues.

The HIMA site representative may call on office staff for external support in project management, resource issues, work conditions, materials requirements etc.

3.4. Client or nominated representative

- Approval of this procedure.
- Sign-off SAT on behalf of the project.
- Active participant in the SAT process.
- Managing the SAT process (schedule, permits, isolations, resource planning etc.)

4. SAT testing

The following sections appear in the recommended order of testing. The PES stand-alone testing will be considered complete following the completion of tests detailed in this section.

All tests must be ticked as passed or not applicable in order for the SAT to end successfully.

If additional testing not covered by these procedures is required, this should be attached or covered under 'additional testing' at the end of this document. This also applies to requests for tests to be repeated. Any incomplete work or non-conformances detected during the SAT will be recorded in the punch list and where possible testing should continue. At the end of the SAT the punch list will be checked for outstanding items.

4.1. Hardware & mechanical Inspection

Hardware and mechanical inspection is carried out as the first activity of arrival on site. Satisfactory completion of this inspection is required prior to commencing further inspection or testing.

The field marshalling disconnect (knife-gate) terminals must be open prior to commencing the system power up.

4.2. Power up

A top-down approach must be used in powering the PES. The power distribution drawings must be followed to ensure each breaker/fuse powers the correct terminals/devices. The drawings should be highlighted as each part of system is powered.

The engineer must check the correct response has been received from closing each breaker/fuse.

4.3. PES diagnostics

Once the system is installed and powered, the PES diagnostics should be checked to ensure no unexpected errors are present in the system.

All testable I/O cards should be clear of faults once powered, with the exception of monitored and analogue output cards. At this stage, it is expected that monitored I/O cards are reporting faults as the loops will be open circuit. These faults will not be cleared until loop checking is complete.

There may also be faults with the communications to other PESs and third party devices. These must be cleared under the communications section of the SAT before the procedure can be signed-off.

All diagnostics specific to the PES should report as healthy.

4.4. Communications

Communications to the GE Fanuc PLC11 must be verified as part of the SAT. This test is to ensure that there is a valid link between the PES and PLC11. Separate validation of all data transfer across the link will be part of commissioning activities.

Particular attention should be paid to redundancy. Where redundant communications exist, each element of redundancy should be checked in its failure mode. Diagnostics for these failures must also exist.

5. SAT procedure

HIMA Test Engineer:

TESTING DOCUMENTS

Document No	Title	Revision	Comment

P-08-023-00 Site Acceptance Test Procedure POS: 15

'EM	ACTIVITY	N/A	PASS	COMMENTS
ARDWARE & MECHANICAL INSPECTION				
	INITIAL CHECKS ***(must be completed prior to proceeding with power-up!)***			
	Check and record external mechanical damage		☑	
	Check and record internal mechanical damage (e.g. swing frame movement, damaged hinges, mounted components)		☑	
	Cabinet is securely fixed (e.g. to wall or floor)		☑	
	Doors and swing frames close easily.		☑	
	All gland plates earth and sealed to IP requirements		☐	
	Check for loose or dislodged equipment (re-fit as required)		☑	
	All earthing systems are wired and tested. Segregation maintained as per site standards (usually connected to common earth stake)		☑	
	All circuit breakers/isolators open		☑	
	All terminal disconnects (knife-gates) are open		☑	

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ıRDWARE VERIFICATION AND POWER UP
ıECKLIST

:ord the serial / ID number of ANY multi-meter used during this phase.

:M	ACTIVITY	N/A	PASS	COMMENTS
WER-UP				
	INCOMING AC POWER UP			
	Measure and record power supply voltage to ensure supply is in the correct range. VOLTAGE (V ac): 241.6 FREQUENCY (Hz): 49.97	☐	☑	
	Close the breaker connected to the power supply unit (PSU). Ensure the correct operation of the PSU. Confirm output voltage & record. VOLTAGE (V dc): 24.22	☐	☑	
	If PSU's are not redundant, go to step 10.			
	REDUNDANT AC POWER UP			
	Close both breakers connected to PSU and confirm correct output voltage. Switch breaker 1 to open & confirm correct redundant operation. VOLTAGE (V ac): FREQUENCY (Hz):	☒	☐	
	INCOMING DC POWER UP, Feed 1 (external or from PSU)[1]			
	Ensure the voltage is as per requirements, usually 24V dc and record. Close breaker/isolator supplying the power distribution bus (e.g. K7205). Ensure the voltage is correct at the power distribution bus. VOLTAGE (V dc):	☐	☐	
	INCOMING DC POWER UP, Feed 2 (external or from PSU)			
	Ensure the voltage is as per requirements, usually 24V dc and record. Close breaker/isolator supplying the power distribution bus (e.g. K7205). Ensure the voltage is correct at the power distribution bus. Switch breaker 1 to open & confirm correct redundant operation. VOLTAGE (V dc):	☐	☐	
	LIGHTS & GPO (AC or DC Voltage)			
	Close the breaker connected to the lights & ensure their correct operation	☐	☑	
	Close the breaker connected to RCD/GPO & ensure power availability.	☐	☑	

[1] Where a both 240V ac rectifier and external 24V dc incoming feed are used, ensure that a suitably sized de-coupling diodes are used *BEFORE* throwing the switch

P-08-023-00 Site Acceptance Test Procedure POS: 15

CU RACK POWER UP		
Power the 24V/5V individually, in the case of the H41q/51q central rack, ensure the power supply monitoring module LEDs are healthy for each PSU e.g. F7130, F7126 etc.	☐	☑
Ensure F7126 output are within 0.025V of each other (test points at front of module	☑	☐
Load the current revision of the application program and ensure the central units run up correctly		☑
Check watchdog voltage at every rack. Must be >21.5V, -10+15%	☐	☑
Ensure correct 5V module power supply at each I/O rack. Must be > 4.85V	☑	☐
Check CU fan(s) operational and air flow direction correct.	☐	☑
Check I/O rack fan(s) operational and air flow direction correct.	☒	☐
I/O MODULE POWER UP		
Power each module/set of modules by closing breakers/disconnect terminals ***one-by-one*** as applicable. Ensure the breakers power the correct modules as defined in the engineering drawings		☑
OTHER DEVICES		
Power communications modules and ensure normal behaviour	☐	☑
Power fans and ensure correct direction of air motion	☐	☑
Ensure field power is available as per the engineering drawings (e.g. F3236 power, DO's etc.)	☐	☑
Ensure Earth Leakage Detector powered and working correctly	☒	☐

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EM	ACTIVITY	N/A	PASS	COMMENTS
AGNOSTICS				
	POWER DISTRIBUTION. ***Ensure the following alarms are clear prior to proceeding to the next stage***			
	Failure of 240Vac primary feed circuit breaker	☒	☐	
	Failure of 240Vac secondary feed circuit breaker	☒	☐	
	Fault in 240Vac-to-24Vdc primary rectifier. If applicable ensure the secondary rectifier is sufficient to maintain the fully operational system.	☐	☑	
	Fault in 240Vac-to-24Vdc secondary rectifier. If applicable ensure the primary rectifier is sufficient to maintain the fully operational system.	☐	☑	
	24Vdc primary feed circuit breaker trip	☑	☐	
	24Vdc secondary feed circuit breaker	☑	☐	
	24Vdc power distribution MCB trip, e.g. Fx.1 to Fx.18	☐	☑	
	H51q only: 24Vdc distribution failure to individual I/O modules by F7133 module. Faults for testable I/O modules should be raised in the application program	☒	☐	
	5Vdc PSU failure	☑	☐	
	GENERAL HARDWARE. ***Ensure the following alarms are clear prior to proceeding to the next stage***			
	Cabinet roof fan (e.g. K9202) fault	☐	☑	
	Cabinet I/O rack fan (e.g. K9203) fault	☒	☐	
	CU fan fault	☐	☑	
	Thermostat over-temperature	☐	☑	
	Earth leakage fault: 0Vdc to protective earth.	☒	☐	
	Earth leakage fault: 24Vdc to protective earth.	☒	☐	
	Electronic fuse module fault (H7014)	☒	☐	

HIMA

P-08-023-00 Site Acceptance Test Procedure POS: 15

ITEM	ACTIVITY	N/A	PASS	COMMENTS
	COMMUNICATIONS			
	OPC Communications			
47	Primary link communicates to the OPC Server as required as a stand alone link. Ensure network speed/duplex settings are correct for the attached network equipment. The COL light on the Ethernet card should not be lit often.	☒	☐	
48	Secondary link communicates to the OPC Server as required as a stand alone link. Ensure network speed/duplex settings are correct for the attached network equipment. The COL light on the Ethernet card should not be lit often.	☒	☐	
49	Both links communicate to the OPC Server as required when redundancy is available	☒	☐	
50	The OPC Server communicates correctly with external OPC clients	☒	☐	
A)	BPCS (basic process control system)	☒	☐	
B)	Override workstation	☒	☐	
C)	Other (please specify)	☒	☐	
	Ethernet Communications			
51	Primary link communicates to the BPCS as required as a stand alone link	☒	☐	
52	Secondary link communicates to the BPCS as required as a stand alone link	☒	☐	
53	Both links communicate to the BPCS as required when redundancy is available	☒	☐	
55	Correct communication established to other HMI (e.g. PanelView), specify details	☒	☐	CITECT SCADA via GE FANUC PLC 11
56	Correct communication established to Engineering Workstation 1 (Laptop)	☐	☑	
57	Correct communication established to Engineering Workstation 2 (Desktop)	☐	☐	
	Serial Communications			
58	Primary link communicates to the BPCS as required as a stand alone link	☐	☑	CU1 side of BV7046
59	Secondary link communicates to the BPCS as required as a stand alone link	☐	☑	CU2 side of BV7046
60	Both links communicate to the BPCS as required when redundancy is available	☐	☑	

Functional Test Procedure [SAT]

1 Gas Isolation Valves

1.1 Control Modes of Operation

All gas valves will operate in Remote/Auto mode only. None of the valves will be able to be controlled manually from the OWS. However, the air solenoid valves at each actuator do have a local manual over-ride in case of emergency.

1.1.1 Main Gas Shutoff Valve (VV2430)

Digital Output:	Slot 8, Output 1	Wire 15886
State:	Off = Valve Closed On = Valve Open	
References:		
P+ID:	486/5/5-0016-003	
Electrical Drawing:	486/7/5-UT2L1126E rev C	

The Main Gas Shutoff Valve is located outside the west engine room wall, on the common gas main from the Gas Compressors, prior to the line splitting into the individual gas feeds for each engine. The valve is arranged for "Energise to Open" control, and it has a "Spring to Close" actuator. The pneumatic solenoid that controls the valve is called "GSCV".

The Emergency Close input is wired so that it is ON when the button has been activated. While this circuit is not "fail-safe" to the PLC, it is not required to be, because it is "fail-safe" in the hard-wired logic. A Normally-Closed contact, (when the Emergency Stop is not activated), is included in the hard-wired circuit that controls the "GSCV" solenoid.

Conditions that allow this valve to open:

1.	The Main Gas Shutoff Valve selector on the station aux switchboard is set to "Remote", and,	☑ ✓
2.	The Main Gas Shutoff Valve Emergency Close button has not been pressed, and,	☑ ✓
3.	The Engine 1 Gas Module does not have an active alarm, AND the Eng1 Gas Module has not been inhibited, and,	☑ ✓
4.	The Engine 1 Gas Module is not in Fault, AND the Eng1 Gas Module has not been inhibited, and,	☑ ✓
5.	The Engine 2 Gas Module does not have an active alarm, AND the Eng2 Gas Module has not been inhibited, and,	☑ ✓
6.	The Engine 2 Gas Module is not in Fault, AND the Eng2 Gas Module has not been inhibited, and,	☑ ✓
7.	Either engine is running, (from PLC11), and,	☑ ✓
8.	Communications with PLC11 is healthy, and PLC11 itself is healthy.	☑ ✓

Conditions that will cause this output to turn OFF:
When this output is ON, at least one engine will be running and selected to run on gas.

The following conditions will cause the Main Gas Shutoff Valve to turn OFF:

1.	Neither engine is running, or,	☑
2.	The Main Gas Shutoff Valve Emergency Close button has been pressed, (0=Normal, 1=Emergency Close), or,	☑
3.	The Main Gas Shutoff Valve selector on the station aux switchboard has been set to "Close", or,	☑
4.	Either Engine Gas Module has an active alarm, and it has not been inhibited, or,	☑
5.	Either Engine Gas Module is Faulted, and it has not been inhibited, or,	☑
6.	The Main Gas Shutoff Valve has failed to open, (limit switch not on within 5 seconds of the request to open), or,	☑
7.	Communications with PLC11 is not healthy, or PLC11 itself is not healthy.	☑

1.1.2 Engine x Gas Isolation Valves

Digital Outputs:	Engine 1:	GIVR Relay	Slot 4, Output 1	Wire 15005
	Engine 2:	GIVR Relay	Slot 6, Output 1	Wire 15325
Closed Indication:	Engine 1:	Primary Isol Valve:	Slot 4, Output 2	Wire 15006
		Secondary Isol Valve:	Slot 4, Output 3	Wire 15007
		Vent Valve:	Slot 4, Output 4	Wire 15008
	Engine 2:	Primary Isol Valve:	Slot 6, Output 2	Wire 15326
		Secondary Isol Valve:	Slot 6, Output 3	Wire 15327
		Vent Valve:	Slot 6, Output 4	Wire 11328

References:

P+ID:		486/5/5-0016-003 rev O
Electrical Drawings:	Engine 1:	486/7/5-UT2L1163E rev C
	Engine 2:	486/7/5-UT2L1198E rev C

(The control for each set of valves is the same for each engine)

This output controls the position of the three valves on the gas supply line:

	Engine 1	**Engine 2**	**"Safe"**	**Eng Running**
• Gas Primary Isolation Valve	VV2431	VV2435	Closed	Open
• Gas Secondary Isolation Valve	VV2432	VV2436	Closed	Open
• Safety Gas Vent Valve	VV2433	VV2437	Open	Closed

(The state of the valves when in the "safe" condition is shown, along with the state when the engine is running).

A single relay called "GIVR" controls all three valves. When GIVR is energised, the Safety Gas Vent Valve Solenoid will energise closing the Safety Gas Vent Valve, and when it's "closed" limit switch turns ON, the Primary and Secondary Gas Isolation Valve Solenoids will be energised. The interlock with the "closed" limit switch is via the hard-wired circuit. The two Vent Valves are to be "Spring to Open" valves, and the Isolation valves are to be "Spring to Close".

Control Sequence

The following inputs affect the state of this output:

		Type	Engine 1	Wire	Engine 2	Wire
(i)	Engine x Gas Isol Vlvs Remote Seld	DI	Slot 1, Input 3	15004	Slot 2, Input 3	15324
(ii)	Engine x Gas Module Alarm	DI	Slot 1, Input 12	15867	Slot 2, Input 12	15869
(iii)	Engine x Gas Module Fault	DI	Slot 1, Input 11	15866	Slot 2, Input 11	15868
(iv)	Engine x Gas Module Inhibit	SCADA Cmd				
(v)	Engine x Gas Enable Solenoid SV4	DO	Slot 5, Output 2	15278	Slot 7, Output 2	15602
(vi)	Engine x Gas Vent Valve Closed LS	DI	Slot 1, Input 1	15002	Slot 2, Input 1	15322
(vii)	Engine x Gas Vent Valve Open LS	DI	Slot 1, Input 2	15003	Slot 2, Input 2	15323
(viii)	Engine x Primary Isol Valve Closed LS	DI	Slot 1, Input 4	15174	Slot 2, Input 4	15498
(ix)	Engine x Primary Isol Valve Open LS	DI	Slot 1, Input 5	15175	Slot 2, Input 5	15499
(x)	Engine x Secondary Isol Vlv Closed LS	DI	Slot 1, Input 6	15141	Slot 2, Input 6	15465
(xi)	Engine x Secondary Isol Vlv Open LS	DI	Slot 1, Input 7	15142	Slot 2, Input 7	15466
(xii)	Engine x Gas High Pressure Switch	AI	Slot ?, Input 1	PSH11000	Slot ?, Input 2	PSH11320
(xiii)	PLC15 "Healthy" input	DI	Slot 3, Input 16	15900	Slot 3, Input 16	15900
(xiv)	PLC11 Network Connection Healthy	Comms Heatbeat				

Conditions that allow this output to turn ON:

When the engine has been started on Diesel, it has been running at Medium Speed for a continuous two minutes, and the engine has been selected to run on Gas, the "Engine x Gas Enable Solenoid SV4" output will be turned ON, (refer to the separate description for this output).

The following conditions will allow the Engine x Gas Isolation Valves Relay, (GIVR), to turn ON:

		ENG1	ENG2
1.	The SV4 output turns ON, (see conditions above), and,	✓	✓
2.	The Gas Isolation Valves Switch is set to "Remote", (0=Close, 1=Remote), and,	✓	✓
3.	The Engine x Gas Module does not have an active alarm, or the Engine x Gas Module has been inhibited, and,	✓	✓
4.	The Engine x Gas Module is not in Fault, or the Engine x Gas Module has been inhibited, and,	✓	✓
5.	The Gas Pipeline Pressure Switch is not indicating High Pressure setpoint, and,	✓	✓
6.	Communications with PLC11 is healthy, and PLC11 itself is healthy.	✓	✓

When the Engine x Gas Isolation Valves Relay, (GIVR), turns ON, the state of the Safety Gas Vent Valve "closed" limit switch, and the Primary and Secondary Isolation Valves "Open" limit switches will be checked. If any of them has not turned on within five seconds of the GIVR output turning ON, the changeover to gas operation will be aborted, and one of the following messages will be posted on the SCADA Alarm Page: 12

		ENG1	ENG2
1.	"Engine x Gas Vent Valve Failed to Close"	✓	✓
2.	"Engine x Primary Gas Isolation Valve Failed to Open"	✓	✓
3.	"Engine x Secondary Gas Isolation Valve Failed to Open"	✓	✓
4.	In addition, the following message will also appear on the Engines Page, and the alarm; "Engine x Changeover to Gas Aborted" will be posted to the Alarm Page.	✓	✓

Conditions that will cause this output to turn OFF:
When this output is ON, the engine will be running on gas, the Gas Primary and Secondary Isolation Valves will be open and the Safety Gas Vent Valve will be closed.

The following conditions will cause the Engine x Gas Isolation Valves Relay, (GIVR), to turn OFF:

		ENG1	ENG2
1.	The SV4 output turns OFF, (due to normal or emergency shutdown conditions described in the control section for SV4), or,	☑	☑
2.	The Gas Isolation Valves Switch is set to "Close", (0=Close, 1=Remote), or,	☑	☑
3.	The Engine x Gas Module has an active alarm, and the Engine x Gas Module has not been inhibited, or,	☑	☑
4.	The Engine x Gas Module is Faulted, and the Engine x Gas Module has not been inhibited, or,	☑	☑
5.	The Gas Pipeline Pressure Switch is indicating High Pressure for a continuous five seconds, or,	☑	☑
6.	The Safety Vent Valve "closed" input turns OFF, or,	☑	☑
7.	The Gas Primary Isolation Valve "open" input turns OFF, or,	☑	☑
8.	The Gas Secondary Isolation Valve "open" input turns OFF, or,	☑	☑
9.	Communications with PLC11 is not healthy, or PLC11 itself is not healthy.	☑	☑

"Closed" Indication
PLC15 controls the outputs that turn on the "Closed" indicator lamps for the three gas valves for each engine. These outputs directly mimic the state of the three "Closed" LS inputs, one per valve.

		ENG1	ENG2
1.	Engine x Primary Gas Isolation Valve	☑	☑
2.	Engine x Secondary Gas Isolation Valve	☑	☑
3.	Engine x Gas Safety Vent Valve	☑	☑

1.1.3 Engine x Emergency Stop Solenoid (SV3)

Digital Outputs:	Engine 1:	BESR2 Relay/SV3 Sol	Slot 5, Output 1	Wire 15277
	Engine 2:	BESR2 Relay/SV3 Sol	Slot 7, Output 1	Wire 15601
		ON State:	Normal condition	
		OFF State:	Emergency Shutdown	

References:

P+ID:		486/7/5-UT2L0149M rev B
Electrical Drawings:	Engine 1:	486/7/5-UT2L1147E rev F
	Engine 2:	486/7/5-UT2L1182E rev G

(The control for the solenoid is the same for each engine)

This output controls the BESR2 (new) Relay, a Normally Open contact off which de-energises Solenoid Valve SV3, and causes a shutdown of the engine and blowdown of the diesel rack. SV3 can also be de-energised from the activation of any one of the Emergency

Stop buttons located at (i) the Alternator Protection Panel, (ii) the Control Desk, or (iii) the Lunch Room (beside the Main Control Room). The normal state for this output is for it to be ON, allowing normal operation of the engine. This provides a fail-safe condition whereby a failure of PLC15 will turn off the output and cause an emergency shutdown of the engine.

Control Sequence

The following inputs affect the state of this output:

		Type	Engine 1	Wire	Engine 2	Wire
(i)	Engine x Estop Supply Relay ESVSR	DI	Slot 1, Input 8	15185	Slot 2, Input 8	15509
(ii)	Engine x Estop Operated PS3	DI	Slot 1, Input 9	15186	Slot 2, Input 9	15510
(iii)	Engine x Estop Relay ESR	DI	Slot 1, Input 10	15191	Slot 2, Input 10	15515
(iv)	PLC15 "Healthy" input	DI	Slot 3, Input 16	15900	Slot 3, Input 16	15900
(v)	PLC11 Network Connection Healthy	Comms Heatbeat				
(vi)	Engine x Emergency Stop Request	SCADA Command				

Conditions that allow this output to turn ON:

The following conditions ensure the Engine x Emergency Stop output is ON, (SV3 energised):

		ENG1	ENG2
1.	The Engine x Emergency Stop Valve Monitor Supply Relay input, ESVSR, is ON, and,	☑	☑
2.	The Engine x Emergency Stop Operated PS3 is OFF, and,	☑	☑
3.	The Engine x Emergency Stop Relay input, ESR, is ON, and,	☑	☑
4.	PLC15 is running and has no CPU or program execution faults active, and,	☑	☑
5.	Communications with PLC11 is healthy, and PLC11 itself is healthy.	☑	☑

Conditions that will cause this output to turn OFF:

When this output is ON, the engine is able to operate normally.
Any one of the following conditions will turn OFF the Engine x Emergency Stop output, (energising SV3):

		ENG1	ENG2
1.	The Engine x Emergency Stop Valve Monitor Supply Relay input, ESVSR, turns OFF, or,	☑	☑
2.	The Engine x Emergency Stop Operated input, PS3 turns ON, or,	☑	☑
3.	The Engine x Emergency Stop Relay input, ESR, turns OFF, or,	☑	☑
4.	An operator Emergency Stop command has been sent from the OWS and the Engine is in Remote/Manual mode, (this command comes from PLC11), or,	☑	☑
5.	PLC15 stops running, or has an active CPU or program execution fault, or,	☑	☑
6.	Communications with PLC11 is not healthy, or PLC11 itself is not healthy.	☑	☑
7.	Over Temperature or Invalid Temperature	☑	☑
8.	PSH15000 or PSH15320	☑	☑

1.1.4 Engine x Gas Enable Solenoid (SV4)

Digital Outputs:	Engine 1:	GR Relay/SV4 Sol	Slot 5, Output 2	Wire 15278
	Engine 2:	GR Relay/SV4 Sol	Slot 7, Output 2	Wire 15602

References:

P+ID:		486/7/5-UT2L0149M rev B
Electrical Drawings:	Engine 1:	486/7/5-UT2L1147E rev F
	Engine 2:	486/7/5-UT2L1182E rev G

(The control for each solenoid is the same for each engine)

This output controls the Gas Enable Solenoid, SV4. When the output is ON, the Gas System is able to be operated as soon as the Diesel/Gas Changeover output, (DGR), is turned ON by PLC11.

Control Sequence

The following inputs affect the state of this output:

		Type	Engine 1	Wire	Engine 2	Wire
(i)	Engine x Estop Supply Relay ESVSR	DI	Slot 1, Input 8	11185	Slot 2, Input 8	15509
(ii)	Engine x Estop Operated PS3	DI	Slot 1, Input 9	15186	Slot 2, Input 9	15510
(iii)	Engine x Estop Relay ESR	DI	Slot 1, Input 10	15191	Slot 2, Input 10	15515
(iv)	Engine x Gas Module Alarm	DI	Slot 1, Input 12	15867	Slot 2, Input 12	15869
(v)	Engine x Gas Module Fault	DI	Slot 1, Input 11	15866	Slot 2, Input 11	15868
(vi)	Engine x Gas Module Inhibit	SCADA Cmd				
(vii)	Engine x Gas High Pressure Switch	AI	Slot ?, Chnl 1	PSH11000	Slot ?, Chnl 2	PSH11320
(viii)	Engine x Cylinder 1 Temperature	AI	Slot 9, Input 1	TE11962	Slot 10, Input 1	TE11978
(ix)	Engine x Cylinder 2 Temperature	AI	Slot 9, Input 2	TE11963	Slot 10, Input 2	TE11979
(x)	Engine x Cylinder 3 Temperature	AI	Slot 9, Input 3	TE11964	Slot 10, Input 3	TE11980
(xi)	Engine x Cylinder 4 Temperature	AI	Slot 9, Input 4	TE11965	Slot 10, Input 4	TE11981
(xii)	Engine x Cylinder 5 Temperature	AI	Slot 9, Input 5	TE11966	Slot 10, Input 5	TE11982
(xiii)	Engine x Cylinder 6 Temperature	AI	Slot 9, Input 6	TE11967	Slot 10, Input 6	TE11983
(xiv)	Engine x Gas Request from PLC11	PLC11 Comms				
(xv)	PLC11 "Healthy" input	DI	Slot 3, Input 16	15900	Slot 3, Input 16	15900
(xvi)	PLC11 Network Connection Healthy	Comms Heatbeat				

Conditions that allow this output to turn ON:
When the engine has been started on Diesel, it has been running at Medium Speed for a continuous two minutes, the VCB is closed, and the engine has been selected to run on Gas, the "Engine x Gas Enable Solenoid SV4" output will be turned ON. The logic associated with the request to change over to gas is carried out in PLC11 and transmitted via the communications network.

The following conditions will allow the Engine x Gas Enable Solenoid, (SV4), to be energised:

		ENG1	ENG2
1.	The Engine x Emergency Stop Valve Monitor Supply Relay input, ESVSR, is ON, and,	☑	☑
2.	The Engine x Emergency Stop Operated PS3 is OFF, and,	☑	☑
3.	The Engine x Emergency Stop Relay input, ESR, is OFF, and,	☑	☑
4.	The Engine x Gas Module does not have an active alarm, or the Engine x Gas Module has been inhibited, and,	☑	☑
5.	The Engine x Gas Module is not in Fault, or the Engine x Gas Module has been inhibited, and,	☑	☑
6.	The Gas Pipeline Pressure Switch is not indicating High Pressure, and,	☑	☑
7.	PLC11 has requested Gas to be supplied to Engine x, and,	☑	☑
8.	Communications with PLC11 is healthy, and PLC11 itself is healthy.	☑	☑

Conditions that will cause this output to turn OFF:
When this output is ON, the engine will be able to run on gas, and the Gas Rack will be connected.

The following conditions will cause the Engine x Gas Enable Solenoid, (SV4), to turn OFF:

		ENG1	ENG2
1.	The Engine x Emergency Stop Valve Monitor Supply Relay input, ESVSR, turns OFF, or,	☑	☑
2.	The Engine x Emergency Stop Operated input, PS3 turns ON, or,	☑	☑
3.	The Engine x Emergency Stop Relay input, ESR, turns ON, or,	☑	☑
4.	The Engine Gas Module has an active alarm, and the Gas Module has not been inhibited, or,	☑	☑
5.	The Engine Gas Module is Faulted, and the Gas Module has not been inhibited, or,	☑	☑
6.	The Gas Pipeline Pressure Switch is indicating High Pressure for a continuous five seconds, or,	☑	☑
7.	Any one of the six Cylinder Temperature Sensors has been above its High/High Temperature setpoint for a continuous 15 seconds, or,	☑	☑
8.	PLC11 has requested Engine x to changeover from Gas to Diesel, or,	☑	☑
9.	Communications with PLC11 is not healthy, or PLC11 itself is not healthy.	☑	☑

1.1.5 Engine x Okay To Go To Gas

Digital Outputs: Engine 1: Slot 5, Output 3 Wire 15001
Engine 2: Slot 7, Output 3 Wire 15010
ON State: Normal condition (Okay to go to Gas)
OFF State: Not okay to go to Gas

Control Sequence

(The control for this output is the same for each engine)

This output is used when PLC15 has determined that the engine should switch back to diesel because there is an active fault condition in the gas system, but the fault condition is not dangerous enough to require an Emergency Shutdown.

The output is connected straight to a Digital Input on PLC11, (ie PLC15 volt-free contact switching 0v supply from PLC11), and when turned OFF by PLC15 it causes PLC11 to initiate a switch back to diesel operation. The normal state for this output is for it to be ON, allowing the engine to switch to gas if running on diesel, or continue to operate normally on gas.

Conditions that will cause this output to turn OFF:

When this output is ON, the engine is able to operate normally on gas.
Any one of the following conditions will turn OFF the "Engine x Okay To Go To Gas" output:

		ENG1	ENG2
1.	There is an active "Failed to Open" or "Failed to Close" fault condition on any one of the following four valves:	☑	☑
a.	Main Shutoff Valve	☑	☑
b.	Engine x Gas Primary Isolating Valve	☑	☑
c.	Engine x Gas Secondary Isolating Valve	☑	☑
d.	Engine x Gas Safety Vent Valve, or,	☑	☑
2.	PLC15 stops running, or has an active CPU or program execution fault, or,	☑	☑
3.	communications with PLC11 is not healthy, or PLC11 itself is not healthy.	☑	☑

1.1.6 Gas Module Inhibits (Maintenance Over-ride)

Facility is provided so that the Gas Module "Fault" and "Alarm" inputs can be inhibited while maintenance / calibration is performed on the Gas Modules. The inhibit is activated from PLC11 via the communications interface. An inhibit can only be active for a maximum of 1830 seconds (30.5 minutes), before it is automatically disabled by PLC15.

		ENG1	ENG2
1.	Engine x Gas Module can be inhibited from PLC11	☑	☑
2.	Engine x Gas Module inhibit is disabled when the inhibit request from PLC11 is removed	☑	☑
3.	Engine x Gas Module inhibit is automatically disabled after 1830 seconds	☑	☑

1.2 Alarm List

The following list of alarms are to be generated by PLC15. All alarms are to be latched in the PLC logic, and will require the field alarm state to abate, before the alarm can be reset via the OWS. This list is not complete and will be added to by the contractor during programming of the PLC.

	Alarm Message	Cause	Action	ENG1	ENG2
1.	Engine x changeover to gas aborted	Safety Gas Vent Valve failed to close, OR, Primary Isol Valve failed to open, OR, Secondary Isol Valve failed to open	Latch out the changeover to gas running and return to running on diesel. If the engine is still selected to run on gas, and the fault has not been fixed and cleared within 20 minutes, shutdown the engine.	☑	☑
2.	Engine x Safety Gas Vent Valve failed to close	"Close" LS input not received within 5 secs of the request to close	Abort the changeover to gas operation	☑	☑
3.	Engine x Safety Gas Vent Valve failed to open	"Open" LS input not received within 5 secs of the request to open	Shut the Main Gas Isolation Valve VV2430. If the other engine is running on gas, immediately change it back to diesel operation	☑	☑
4.	Engine x Primary Isolation Valve failed to close	"Close" LS input not 7 received within 5 secs of the request to close	Shut the Main Gas Isolation Valve VV2430. If the other engine is running on gas, immediately change it back to diesel operation	☑	☑
5.	Engine x Primary Isolation Valve failed to open	"Open" LS input not 7 received within 5 secs of the request to open	Abort the changeover to gas operation	☑	☑
6.	Engine x Secondary Isolation Valve failed to close	"Close" LS input not 7 received within 5 secs of the request to close	Shut the Main Gas Isolation Valve VV2430. If the other engine is running on gas, immediately change it back to diesel operation	☑	☑
7.	Engine x Secondary Isolation Valve failed to open	"Open" LS input not 7 received within 5 secs of the request to open	Abort the changeover to gas operation	☑	☑

8.	Main Gas Shutoff Valve failed to close	"Close" LS input not received within 5 secs of the request to close	Inhibit either engine from running on gas if selected to run on gas, but allow an engine to run on diesel. Shutdown any engine that is running on diesel and also has a "failed to close" on either of its Gas Primary or Secondary Isolation Valves.	☑	
9.	Main Gas Shutoff Valve failed to open	"Open" LS input not received within 5 secs of the request to open	Inhibit the changeover to gas operation for any starting engine. If an engine is running on gas when the alarm occurred, switch it back to diesel.	☑	
10.	Engine x Estop Valve Supply Fault	ESVSR input turns OFF.	Inhibit engine from starting. Stop engine if running.	☑	☑
11.	Engine x Emergency Stop Operated Alarm	Emergency Stop operated input turns ON	Inhibit engine from starting. Stop engine if running.	☑	☑
12.	Engine x Emergency Stop Relay Alarm	Emergency Stop Relay has been operated and input turns ON	Inhibit engine from starting. Stop engine if running.	☑	☑
13.	Engine x Cylinder x High/High Temp Shutdown. Engine x Auto Shutdown on High/High Cylinder Temp	Cylinder temperature sensor reads above the High/high temp alarm SP for a continuous 15 secs. (6 sensors per engine)	Stop engine.	☑	☑
14.	Engine x Gas Module Alarm	Gas Module Alarm input turns ON for a continuous 5 seconds	Stop engine.	☑	☑
15.	Engine x Gas Module Fault	Gas Module Alarm input turns OFF for a continuous 5 seconds	Stop engine.	☑	☑
16.	PLC15 Power Supply x Fault	Only one of the power supply "healthy" inputs turns OFF.	Alarm to SCADA but no other action.	☑	☑

17.	PLC15 Power Supply Complete Failure	Both of the power supply inputs turns OFF	Shutdown all running engines	☑	
18.	PLC11 Comms Failed to PLC15	Communication "heartbeat" has failed from PLC11	Shutdown all running engines	☑	
19.	PLC15 has detected a fault in PLC11	The PLC11 Healthy input has turned OFF	Shutdown all running engines	☑	
20.	Engine x Gas Supply High Pressure	The Eng x High Pressure switch input turns off for a cont. 5 sec	Close the Gas Isolating Valves and initiate a normal shutdown sequence	☑	☑

Note: All faults that rely on 24vDC for their "healthy" state, are to have a 250ms delay before actuation, and are to be inhibited if both of the 24vDC Power Supply "Healthy" inputs are OFF.

ITEM	ACTIVITY	N/A	PASS	COMMENTS
COMMUNICATIONS DIAGNOSTICS				
	COMMUNICATIONS. ***Ensure the following result in alarms as specified in the FDS or similar. Alarms may be individual or wired to a common cabinet fault.***			
61	OPC primary communication link failure	☒	☐	
62	OPC secondary communication link failure	☒	☐	
63	HIPRO-S primary communication link failure	☒	☐	
64	HIPRO-S secondary communication link failure	☒	☐	
65	Ethernet primary communication link to BPCS failure	☒	☐	
66	Ethernet secondary communication link to BPCS failure	☒	☐	
67	Ethernet communication link to HMI failure	☒	☐	
68	SOE communication link failure	☒	☐	

When all the tests contained with in this checklist are complete, both the client and the HIMA representative must complete the following:-

APPROVAL

CLIENT		HIMA	
Name(s)	SCOTT ADAMS	Name(s)	SUSHIL RANE
Company	BCC - WATER DISTRIBUTION	Company	HIMA
Position	CONTROL SYSTEMS OFFICER	Position	PROJECT ENGINEER
Sign	[signature]	Sign	[signature]
Date	16-6-09	Date	04.06.09

Appendix A – SIS change request forms

SIS CHANGE REQUEST

HIMA

Project Name: BCC PLC 15 Replacement **Number:** P-08-023-00 **Pos:** 15 **SCR #:**

CHANGE REQUEST INITIATION		**PRIORITY:**		**DATE REQUIRED:**
Originator:	SCOTT ADAMS	☐	Emergency	19/5/09
Position:	CONTROL SYSTEMS OFFICER	☑	Routine	
Company:	BCC	☐	Urgent	**CHANGE DESCRIPTION:**
Date:	19-5-09			☐ New Requirement
SYSTEM DESCRIPTION:		**SUBJECT / ITEM:**		☐ Requirement Change
H41qce-HS		☑	Software	☑ Defect
PHASE:		☐	Hardware	☐ Set point/Constant Change
COMMISSIONING		☐	Document	☐ Temporary Change !

COMMENTS: IMPLEMENT CUSTOM POU TO PROVIDE GREATER DIAGNOSTICS OF ALL THERMOCOUPLE INPUTS (HF-TMP-3 BLOCK). INCORPORATE HIGH HIGH ALARM TO TRIP LOGIC.

SAFETY REVIEW ☐ *Attachments Included*				**Estim. Hrs.**	**Actual Hrs.**
Level:	☑ SIL 1 (Supervised Practitioner)	☐ SIL 2 (Practitioner)	☐ SIL 3 (Independent Team)		
Completed By:		Date:			
IMPACT ANALYSIS ☐ *Attachments Included*					
Hardware:	N/A				
Electrical/Wiring:	N/A				
Software:	NEW POU TO BE DESIGNED, TESTED AND IMPLEMENTED			4	4
Communications partners e.g. OPC	N/A				
Reloadability:	RELOADABLE				
Documents:	APPLICATION PROGRAM PRINTOUT - P-08-023-00_AP			0.5	
Completed By:	M. WALKER	Date:	19/5/09		

AUTHORISATION TO PROCEED ***(Responsible person to sign here. If this change is to a type B gas appliance, it MUST be authorised by a licenced gas fitter / inspector, either by signature here or by attachment of authorising documents) Attachments Inc.*** ☐

Name:	SCOTT ADAMS	Position	CONTROL SYS OFFICER	Company	BCC - WATER DISTRIBUTION
Signature:	[signature]	Licence #		Date:	16-6-09

CHANGE STATUS

	Name	Company	Position	Signature	Date
Changed by:	MATT WALKER	HIMA AUSTRALIA	PROJECT ENG.	[signature]	19/5/09
	Code ver. pre-mod:	6804	Code ver. post-mod:	77EF	

If this is a temporary change (see CHANGE DESCRIPTION above), DO NOT sign of until the temporary change is removed!

	Name	Company	Position	Signature	Date
Tested	SUSHIL RANE	HIMA AUSTRALIA	PROJECT ENG	[signature]	04/06/09
Accepted					

Code iterations required to complete this SCR must be recorded overleaf. Record completed SCR in SCR Log.

SIS CHANGE REQUEST

HIMA

Project Name: BCC PLC15 Replacement **Number:** P.08.023.01 **Pos:** 15 **SCR #:** 11

IF AN SCR REQUIRES SEVERAL CODE ITERATIONS TO REACH COMPLETION, RECORD EACH ITERATION BELOW!

ITERATION		COMMENT	BY	DATE
From version	77EF		MW/SR	19/05/09
To version	2098			

ITERATION		COMMENT	BY	DATE
From version	2098		MW/SR	19/05/09
To version	40E4			

ITERATION		COMMENT	BY	DATE
From version	40E4		SR	20/05/09
To version	285D			

ITERATION		COMMENT	BY	DATE
From version	285D		SR	20/05/09
To version	D70A			

ITERATION		COMMENT	BY	DATE
From version	D70A		SR	20/05/09
To version	F0F5			

ITERATION		COMMENT	BY	DATE
From version	F0F5		SR	20/05/09
To version	C89D			

ITERATION		COMMENT	BY	DATE
From version	C89D		SR	20/05/09
To version	8F29			

ITERATION		COMMENT	BY	DATE
From version	8F29		SR	20/05/09
To version	C89D			

ITERATION		COMMENT	BY	DATE
From version	C89D	Modified Engine 02 Logic as per Engine 01.	SR	04/06/09
To version	0AB1			

ITERATION		COMMENT	BY	DATE
From version	0AB1		SR	04/06/09
To version	F01D			

Record completed SCR in SCR Log.

Appendix B – Configuration record sheets

PES Configuration Record

Brisbane City Council
Installed Under Job Number: P08-023-00 Node: 15
Record: 139 Status: 3. Commissioned

HIMA

`ite Details				**ELOP II Details**	
Installed Site	Luggage Point WRP			ELOP II Project Name	P0802300-BCC
Node Location	Engine Hall Mezzanine Floor			Configuration	BCC_LP_WRP
Code Style				Resource	PLC__15
BMS	No	Fire & Gas	No	Program Name	PLC__15
ESD	Yes	Process Control	No	Latest Code Version	F01D
System Details				**Communications Details**	
System Type	H41q-HS			ELOP II Connection	Ethernet via F8627X card
CU1 Type	X Type	Cycletime Ave	120	Control System Connection	Serial RS485 MODBUS
CU2 Type	X Type	Cycletime Max	128	HMI Connection	
OS Version	7.0-8 (06.05)	Def. Baud Rate	57600	SOE Connection	
CU Dip Switch Settings (1=On)	00001110			HIPRO-S Model	
Safety Parameters				**Ethernet Cards**	
Safety Time (s)	5	Watchdog (ms)	1000	Ethernet Card Type	F8627X
Parameter change online			Yes	Operating System	v4.18
Constants	Yes	Test Operation	No	HIPRO-S DIRECT Timeout	
Variables	Yes	Start	No	DIP Switches CU1CM S1: (1=On)	01000000
Force IO	Yes	Reload	Yes	DIP Switches CU1CM S2: (1=On)	01000000
Noise Blanking Cycles	2			DIP Switches CU2CM S1: (1=On)	00001110
Reaction to Output Errors	Normal Operation			DIP Switches CU2CM S2: (1=On)	00101000
Last Person to Attend Site	Sushil Rane			Date	04-06-2009

Notes and Comments

Name	SUSHIL RANE	Signed	SR
Position	PROJECT ENGINEER	Date	04.06.09

Appendix C – Punch list

PROJECT PUNCHLIST

Project Name: BCC PLC 15 Replacement **Number:** P-08-023-00 **Pos: 15**

This punchlist can be used, during testing, for hardware or software items.

Item	MFR	ENG	CLIENT	Description	Initiator/ Date	Action by/ Date Req'd	HIMA sign-off	Client sign-off	Date completed

9 As Constructed Drawings

Please Refer to additional Folder Operations and Maintenance Manual Part 2

10 List of Contract Variations and Plant Modifications

BRISBANE CITY COUNCIL
Brisbane Water
Supply and Programming of PLC 15 for the
Luggage Point Water Reclamation Plant

BWQ80144-07/08
PLC 15

Part 4 Operation and Maintenance

11 Operation

11.1 Operational Procedures

With the exception of the maintenance procedures detailed in sections 12.1 and 12.2, and testing of the RCBO F2, no operational interaction is required.

11.2 Fault Protection and Rectification

a. Alarm, protection and Safety Devices

I. F1: The cabinet is fitted with a 16A double pole Minitiature Circuit Breaker – F1. F1 is located at the top of terminal rail 3, on the right hand side of the gearplate -TR3-A. F1. isolates the electrical supply to all factory fitted components within the cabinet. This MCB is of a D curve type, to prevent the inrush current of the powersupplies immediately tripping the breaker upon energising. In the event of a trip, the cause of the trip should be identified and rectified, before the MCB is reset to energise the equipment again.

II. F2: The cabinet is fitted with a dual socket GPO, which is supplied and protected by F2. F2 is a single pole 10A RCBO, which will trip instantaneously at 30mA of earth leakage current. F2 is located near the top of terminal rail 3, on the right hand side of the gearplate -TR3-B. F2. isolates the electrical supply to all factory fitted components within the cabinet. This RCBO is also a C curve type circuit breaker so will also protect against overload current. In the event of a trip, the cause of the trip should be identified and rectified, before the RCBO is reset to energise the equipment again. It is recommended that the RCBO be routinely tested to verify the detection of earth leakage, as part of the testing schedule for all earth leakage breakers onsite.

III. F3: The cabinet is fitted with a manually operated 240Vac fluorescent light. This light is supplied from double pole Minitiature Circuit Breaker – F2. F2 is located near the top of terminal rail 3, on the right hand side of the gearplate -TR3-C. F3. This MCB is of a C curve type. In the event of a trip, the cause of the trip should be identified and rectified, before the MCB is reset to energise the equipment again.

IV. Diagnostic Display

- The diagnostic display consists of a four-digit alphanumeric display as well as two LEDs with "IO" and "CPU" identification on the front plate of the central module of the PES. Via two pushbutton additional information can be called from the PES. The kind of information is explained below. One push-button switch is for selecting the next higher or lower level, the other pushbutton switch is for selection of information on the same level.

  An overview of the levels of the diagnostic display can be found in the manual Functions of the OS in appendix 8.

- Errors in the Central Area ("CPU" LED lights up)

Display Text	Explanation
DEAD EXCP NMIL	fatal error at start up only switching off/on is possible if no communication: replace the module
RAMT CHCK WAIT	display after switching on until switching on the IO's
STOP	error stop

- Errors in the IO Area ("IO" LED lights up)

If several I/O modules are defective, all I/O positions affected including the I/O channels are displayed alternating. After the defective module has been exchanged or the line fault has been repaired, the error display is reset via the ACK button on the central module. Then the I/O module resp. the channel is active again.
Other information can be selected via the two push-button even if the "I/O" display lights up. If within 20 seconds no new information is requested, the I/O positions are again displayed.
In case of error stop, it is possible to call the last error by pushing the button => of the central module once.

Display	Explanation
1104	position of a faulty IO module 04: position in the IO subrack 1: number of the IO subrack 1: number of the cabinet or the I/O bus
1108/2/4	channel fault of a IO module with line supervision /2/4: numbers of the faulty channels 08: position in the IO subrack 1: number of the IO subrack 1: number of the cabinet or the I/O bus
11**	Fault of more than four testable IO modules or of the complete IO subrack 1: number of the IO subrack 1: number of the cabinet or I/O bus It is impossible to address the I/O subrack (connecting cable, I/O bus, power supply, connection module)

- List of Error Codes

In the manual, Functions of the OS, in appendix 8, section 17.4 is a list which contains all messages and error codes. The error codes important for the operator are explained in more detail. They are displayed in addition to the above described diagnostic displays after being called via the two push-button on the front of the central module.
The error codes and diagnostic codes are only interesting as far as further examination by the manufacturer is concerned. If an error occurs, its error code is stored. This error code is overwritten by a new error code as soon as the next error occurs. Therefore only the latest error is stored. Older error codes can be called with the ELOP II control panel.

The error code is deleted only if the central module is loaded with a new project, or if the central module is deleted and loaded again.

b. Consequences of Power Failure
In the event of a power failure, all digital outputs from PLC15 will immediately become open circuit. This will lead to an emergency shutdown of both engines.
The system should be repowered following the procedure described in section 11.4.
There are no further considerations for re-energising of the system, within the life of the buffer batteries, which is approximately 1000 days when new.

c. Trouble Shooting
Experience has shown, that due to the high availabilty of the HIMA HIQuad H41qce-HS system, the vast majority of faults found relate to field devices and wiring.
The diagnostic display is the quickest means of faultfinding the system. Interpretation of the display is described in section 11.2:iv.
Before replacing a failed module, it must be certain that the module did not fail due to an external fault, to prevent damaging the replacement module.
Some modules, such as the F6220 thermocouple input module, require that a fault be acknowleged, using the ACK button on the central unit, before the channel will become operational again, even if the fault has been rectified.

11.3 Start Up and Shut Down Procedures

Before commencing the isolation procedure in section 11.4, a controlled shutdown of both engines should be initiated from the SCADA, to avoid an emergency shutdown.

Before restoration of power to PLC15, it should be ensured that no persons are working on any equipment controlled by PLC15, and that all equipment that is controlled by PLC15 is in a serviceable condition or is adequately isolated if still under maintenance.

Under no circumstances should PLC15 be run with hardwired bridges or physical over-rides in place.

11.4 Isolation and Restoration Procedures

Isolation and restoration is required only from an electrical perspective, as this is the only form of energy supplied to the cabinet. Persons responsible for electrical isolation and recharge should be suitably qualified and competent.
All BCC, Luggage Point Site and Australian Standards and Codes should be observed when isolating or restoring power supplies, including testing, tagging and lockout procedures.

Isolation
A bottom up approach must be used to isolate the PES. The power distribution drawings must be followed to ensure the correct devices are swithced. The correct order is to isolate:

a. The MCB's in the K7214 powerdistribution module, in descending order, beginning with breaker 18. Spare breakers should already be in the off state.
b. The push-button breaker on the front of PS2
c. The push-button breaker on the front of PS1
d. The mains voltage incoming breaker – F1

This isolation procedure does not entirely remove energy from the PLC15 cabinet, to achieve this, the 240Vac electricity supply will need to be isolated elsewhere. Extra care should also be taken if there are any UPS in the 240Vac supply.

Restoration

Before restoring power to the cabinet, the 240Vac supply should be checked to ensure it is of suitably rated and of acceptable quality.

A top-down approach must be used in powering the PES. The power distribution drawings must be followed to ensure the correct devices are switched. The correct order is to power:

a. The mains voltage incoming breaker – F1
b. The push-button breaker on the front of PS1
c. The push-button breaker on the front of PS2
d. The MCB's in the K7214 powerdistribution module, in ascending order, beginning with breaker 1, and skipping breakers labelled as "SPARE"

The engineer must check the correct response has been received from closing each breaker/fuse.

Once the system is powered, the PES diagnostics should be checked to ensure no unexpected errors are present in the system.

All testable I/O cards should be clear of faults once powered.

All diagnostics specific to the PES should report as healthy.

12 Maintenance

12.1 Preventative Maintenance

The preventative maintenance tasks that need to be performed include:

- Cleaning/replacement of cabinet door filters – maintenance interval needs to evaluated dependant on the level of airborne particulates which would cause blocking of the filters. It is recommended that the cleanliness of the filters be monitored on a fortnightly basis initially. It is further recommended that the filter elements are replaced at a maximum 2 year interval.
- A thorough preventative maintenance service of PLC15 can be performed by

12.2 Corrective Maintenance

There are no further scheduled maintenance activities.

- Replacement of Central Unit and backplane buffer batteries. It is recommended that the batteries are replaced at no greater than 6 year intervals, or within 3 months of BATI or BATT indication on the diagnostic display, whichever is sooner. Procedures for replacement of the batteries are found in the manual HK 0008-e System Catalog, along with part numbers.
- System Rack and cabinet fans, K9212 and K9202 should be replaced at the same time as the buffer batteries.
- Periodic proof testing – the HIMA PES can be proof tested by executing the full safety loop. In practice the input and output devices have a more frequent proof test interval (12 months in the case of PLC15) then the HIMA PES. If BCC tests the complete safety loop because of the field devices, then the HIMA PES is automatically included in these tests. No additional periodic tests are required for the HIMA PES.
  If the proof test of the field devices does not include the HIMA PES then the PES needs to be tested as a minimum once every 10 years. This can be done by executing a reset of the HIMA PES.

12.3 List of Sub-Contractor and Proprietary Equipment

Refer to the Bill of Materials in Appendix ???.

12.4 Recommended Spare Parts and Special Tools

All recommended spare parts have been purchased as part of the PLC15 project. These spare parts are:

- 98 4323603 - F3236K - Digital Input 16 channel
- 98 4343003 - F3430K - Digital Output 4 channel relay module 4A @ 250V
- 98 4621703 - F6217K - Analog Input 8 channel
- 98 4622003 - F6220K - Thermocouple Input 8 channel

12.5 List of Manufacturer and Supplier Details

A detailed list of all parts supplied, is available in the Bill of Materials found in appendix ???. The Bill of Materials lists the manufacturer of each item. The local suppliers for these manufacturers are as follows:

HIMA Germany
Local Supplier- HIMA Australia Pty Ltd
21/8 Riverland Drive
LOGANHOLME QLD 4129

Phone: (07) 3412 3000
Fax: (07) 3412 3049
Email: info@hima.com.au

Rittal
Local Supplier- Rittal Pty Ltd
2/20 Graystone St
TINGALPA QLD 4173

Phone: (07) 3890 3833
Fax: (07) 3890 3834
Email: info@rittal.com.au

Weidmuller
Local Supplier- Ramelec (QLD) Pty Ltd
2/5 Breene Pl
MORNINGSIDE QLD 4170

Phone: (07) 3899 1322
Fax: (07) 3899 1422
Email: qld@ramelec.com.au

Clipsal / Merlin Gerin/Krone
Local Supplier- Rexel
3/9 Graystone St
TINGALPA QLD 4173

Phone: (07) 3331 1200
Fax: (07) 3331 1225

Email: qld@ramelec.com.au

Part 5 Appendix

DOCUMENT FRONT SHEET

Purchase Order No.	BWQ80144-07/08	Job No.	P-08-023
Client Document No.	N/A		
HIMA's Document No.	P-08-023-00-BOM		
Document Title	Bill of Materials		
System Description	H41qce-HS		
VDRL/Doc Code & Type (Refer to vendor data req.)	BOM		
Status (Check Applicable)	☐ FOR APPROVAL		
	☐ CERTIFIED FINAL		
	☒ AS-BUILT		
	☐ INFORMATION ONLY		
	☐ OTHER (IDENTIFY)		

HIMA

HIMA AUSTRALIA Pty Ltd
www.hima.com.au

Unit 2
21 Frederick St
Belmont WA 6104

Unit 13
21 Sabre Drive
Port Melbourne VIC 3207

Unit 21
8 Riverland Drive
Loganholme QLD 4129

Notes:

REV	DATE	DESCRIPTION	BY	CHECKED	APPROVED
1	12/6/09	As Built	MJW	SR	MJW
0	18/3/08	Issued for FAT	MJW	PL	MJW
B	2/12/08	Updated following detailed Hardware design	MJW	MTH	MJW
A	16/10/08	Issued for Approval to order Hardware from Suppliers	MJW	MTH	MJW

Revision History

Project:	PLC 15 Replacement
End User:	Brisbane City Council
Client:	Brisbane Water
HIMA Project Number:	P-08-023-00
Client Project Number:	BWQ80144-07/08
Unit Position:	15
Unit Description:	PLC 15

Bill of Materials

Qty	CODE	PART No	Description	Manufacturer	REV
	HIMA PES Hardware & Software				
1	K 9202	99 6920202	Cabinet fan with 2 axial fans and run monitoring	HIMA Germany	1
1	K 9202-MOUNT	99 0000008	Fan Mounting kit	HIMA Germany	1
2	PS 1000/230 01	98 2200080	Power supply 960W / 40A @ 24VDC (230VAC feeding)	HIMA Germany	1
1	M 3421	98 2200089	Subrack for up to 3 PS1000 PSU's, 4U high	HIMA Germany	1
1	M 7202	78 1990009	Air guide for the 19-inches system with labelling front	HIMA Germany	1
1	M 4412	60 5240001	Cable tray for subracks M3421	HIMA Germany	1
1	M 4413	60 5240002	Cover plate for subracks M3421	HIMA Germany	1
1	M 3443	78 1990004	Labelling field 19 Inches, 1U high	HIMA Germany	1
1	K 7214	99 6721402	24VDC distribution board 150A, no diagnostic display	HIMA Germany	1
2	ETA2210-16	57 0350160	Incoming 24V power circuit breakers for Distribution Module 16A	HIMA Germany	1
16	ETA2210-4	57 0350040	Incoming 24V power circuit breakers for Distribution Module 4A	HIMA Germany	1
1	M 3431	60 529001	Front Plate 19" 1U High	HIMA Germany	1
1	M 3432	61 529002	Front Plate 19" 2U High	HIMA Germany	1
6	M 3434	62 529003	Front Plate 19" 4U High	HIMA Germany	1
11	H 7020	52 0000001	HIMA Inter Connection Boards, ICBs.	HIMA Germany	1
22	FK-MCP 1,5/8	52 0000002	Combicon connectors for ICBs	HIMA Germany	1
1	H 7506	99 2750602	Bus Terminal with protective terminal	HIMA Germany	1
1	BV 7046-4	99 0000263	Data connection cable - 4m	HIMA Germany	1
1	B 4237-1	99 7134237	H41qce-HS Assembly	HIMA Germany	1
3	F 3236K	98 4323603	Digital Input 16 channel	HIMA Germany	1
3	Z 7116/3236	93 0513236	Cable with cable plug for F 3236	HIMA Germany	1
1	F 6217K	98 4621703	Analog Input 8 channel Line monitored	HIMA Germany	1
1	Z 7128/6217/C5/ITI	93 0526217	Cable with cable plug for F 6217	HIMA Germany	1
2	F 6220K	98 4622003	Thermocouple Input 8 channel Line monitored	HIMA Germany	1
2	Z 7062/6220/Ex/C5/U100mV	93 62201005	Cable with cable plug for F 6220	HIMA Germany	1
5	F 3430K	98 4343003	Digital Output 4 channel relay module 4A @ 250V	HIMA Germany	1
5	Z 7149/3430/C5/P2	99 0000446	Cable with cable plug for F 3430	HIMA Germany	1
2	M 2215	99 0000161	Single card position blanking plate	HIMA Germany	1
2	F 8627X	98 4862766	Communication module ethernet (ELOP-II TCP, Modbus TCP, OS 4.18)	HIMA Germany	1
1	BV 7053-0.6	99 0000311	HSR Cable	HIMA Germany	1
2	ELOPII Professional USB	89 2042336	ELOP II software - Professional (full functionality) USB Dongle	HIMA Germany	1

Project:	PLC 15 Replacement
End User:	Brisbane City Council
Client:	Brisbane Water
HIMA Project Number:	P-08-023-00
Client Project Number:	BWQ80144-07/08
Unit Position:	15
Unit Description:	PLC 15

Bill of Materials

Qty	CODE	PART No	Description	Manufacturer	REV
	Communications Equipment				
1	IE-XM-RJ45/RJ45	8879050000	RJ45 Terminal	Weidmuller	1
1	Cat6 Patchlead	6451 5 939-40	Patch Cable, High Band, Category 6, RJ45, 4.5m blue	Krone	1
	System Cabinet				
1	TS 8806.500	TS8806.500	Standard Cabinet TS 8806 - 800w, 2000h, 600d, RAL 7035, with gear plate	Rittal	1
1	TS 8106.235	TS8106.235	Cabinet Walls 2000mm x 600mm RAL 7035 (pair)	Rittal	1
1	SR 2341.200	SR 2341.200	Swing Frame	Rittal	1
1	SR 1997.200	SR 1997.200	Installation Kit for Swing Frame	Rittal	1
1	TZ 4140.020	TZ 4140.020	Cabinet Light with manual integrated switch - Fluorescent 14W	Rittal	1
1	PS 4638.800	PS 4638.800	Door Mounted Utility Lecturn 613mm (w) x 400mm (d)	Rittal	1
1	SK 3110.000	3110000	Thermostat	Rittal	1
2	SK 3325.200	3325207	Filters	Rittal	1
1	TS 8601.800	8601800	100mm Plinth Front and Rear Sections - RAL 7022	Rittal	1
1	TS 8601.060	8601060	100mm Plinth Side Sections - RAL 7022	Rittal	1
1	SZ 2509.000	2509000	Lifting Eyebolts (packet of 4)	Rittal	1
1	TS 8611.070	8611070	Comfort Handle for semi-cylinder RAL 7035	Rittal	1
1	SZ 2467.000	2467000	Lock insert Ergoform-S lock for Ergoform-S system	Rittal	1
1	Clipsal 25	25	Double GPO	Clipsal	1
1	449A	449AWE	Mounting Plate for Double GPO	Clipsal	1
1	449AP	449AP	Back Plate	Clipsal	1
1	C60HD16A 2 Pole	25715	240 V Breaker PSU 'D Curve' 16A 2P	Merlin Gerin	1
1	C60H RCBO 30 mA AC class	26858	ELCB for GPO (10A)	Merlin Gerin	1
1	C60N 6A 2 Pole	25815	240 V Breaker Cabinet Light 'C Curve' 6A 2P	Merlin Gerin	1
	Marshalling Equipment				
144	WTR2.5	1011100000	Disconnect link terminals	Weidmuller	1
8	WDU4	1020100000	4mm terminals	Weidmuller	1
4	WPE4	1010100000	4mm terminals EARTH	Weidmuller	1
1			Earth Bars with clamps - Instrument Earth		1
	Spares				
1	F 3236K	98 4323603	Digital Input 16 channel	HIMA Germany	1
1	F 6217K	98 4621703	Analog Input 8 channel	HIMA Germany	1
1	F 6220K	98 4622002	Thermocouple Input 8 channel Line monitored	HIMA Germany	1
1	F 3430K	98 4343003	Digital Output 4 channel relay module 4A @ 250V	HIMA Germany	1

P-08-023-00_BOM-rev1.xls 12/06/2009

2 of 2

DOCUMENT FRONT SHEET

Purchase Order No.	BWQ80144-07/08	**Job No.**	P-08-023
Client Document No.	N/A		
HIMA's Document No.	P-08-023-00-AP		
Document Title	Application Program Printout		
System Description	H41qce-HS		
VDRL/Doc Code & Type (Refer to vendor data req.)	AP		
Status (Check Applicable)	☐ FOR APPROVAL		
	☐ CERTIFIED FINAL		
	☐ AS-BUILT		
	☒ INFORMATION ONLY		
	☐ OTHER (IDENTIFY)		

HIMA
HIMA AUSTRALIA Pty Ltd
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Notes:

2	05/06/09	Post SAT	SR	MJW	MJW
1	22/4/09	Post FAT	SR	MJW	SR
A	18/3/08	Issued for Approval	MJW	PL	MJW
REV	**DATE**	**DESCRIPTION**	**BY**	**CHECKED**	**APPROVED**

Revision History

HIMA AUSTRALIA Pty Ltd	HIMA AUSTRALIA Pty Ltd	HIMA AUSTRALIA Pty Ltd
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Brisbane City Council - Luggage Point Water Reclamation Plant
PLC 15
Agreement Number: BWQ80144-07/08
HIMA AUSTRALIA Pty Ltd Project No. P-08-023

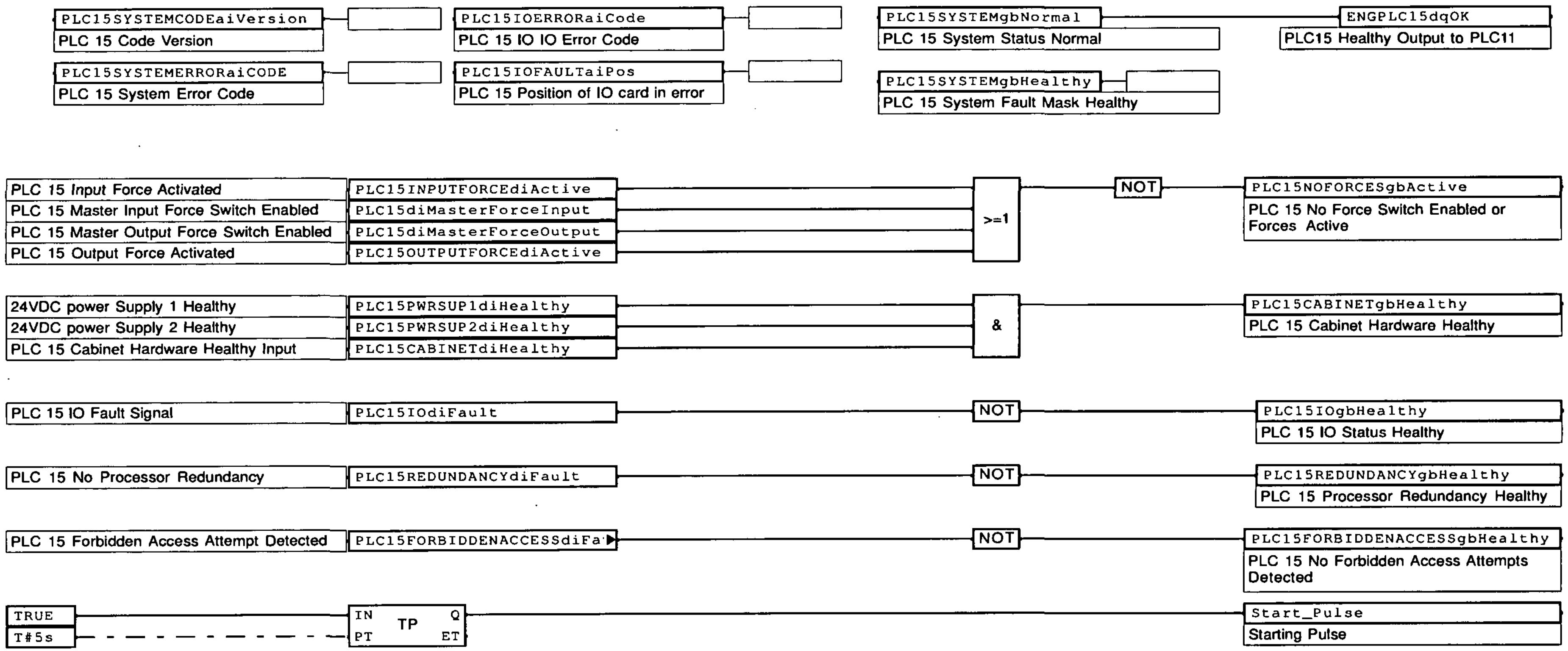
HIMA SYSTEM DIAGNOSTICS
COMMUNICATIONS MONITORING
I/O CARD ERROR DETECTION

3				date	name	Brisbane City Council	ELOP II	logic PLC___15 Page 1	version rev SCR01
2			made	Date	Name	BCC - PLC 15 Replacement			coordinates A/0
1			check						6050... page 21 of 79 sh.
revision	date	name	status: LZ			based	replaced	replaced	

Page 2 - System Diagnostics

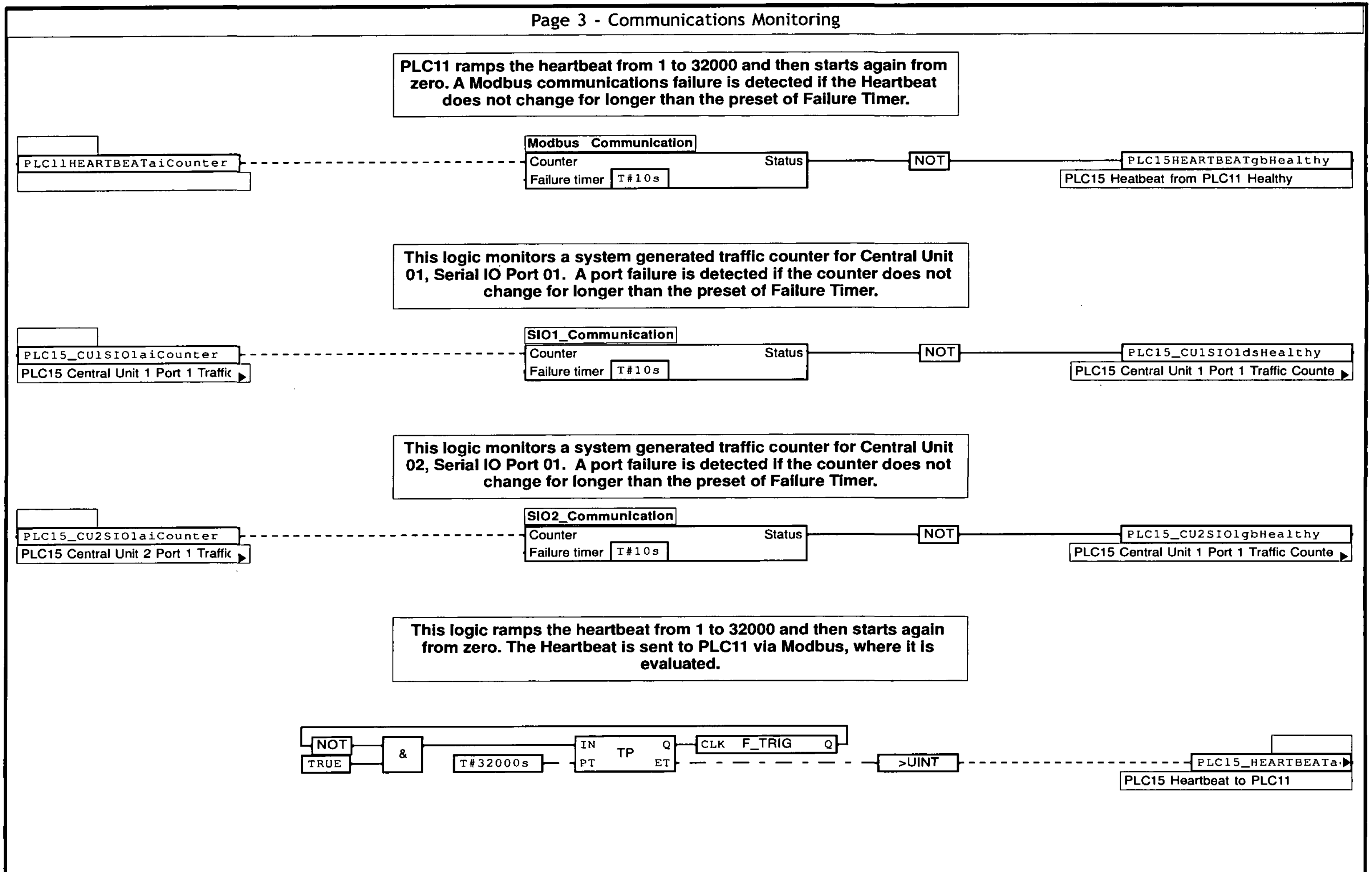
Code Revision History: This comment field should be updated before code is generated! Modification of code requires Gas Inspector sign off!

Code Version:	Date:	By:	Comment:
		M.Walker	Pre-FAT



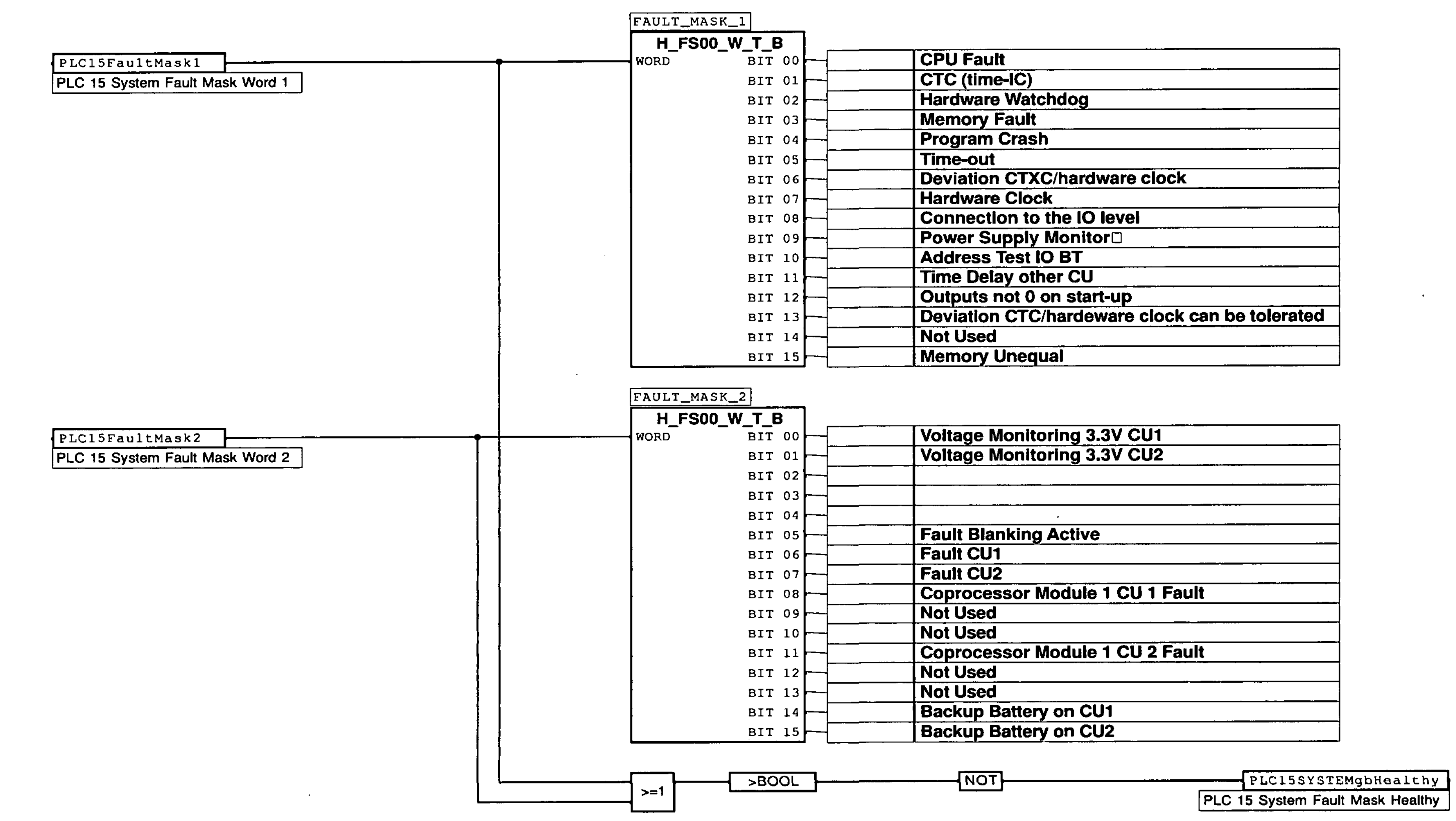
Sheet-number: A/1 Creator: mwalker Creation date: 04/02/09 Tester: Testing date: Revision: srane/19/05/09/SCR02 srane/19/02/09/ srane/17/02/09/

				date	name					
3			made	Date	Name	Brisbane City Council	ELOP II	logic	version	rev SCR02
2			check			BCC - PLC 15 Replacement		PLC___15	coordinates	A/1
1			status:	LZ				Page 2	6050...	page 22
revision	date	name				based	replaced / replaced	System Diagnostics		of 79 sh.



3				date	name	Brisbane City Council	ELOP II	logic PLC__15 Page 3 Communications Monitoring	version rev SCR01
2			made	Date	Name	BCC - PLC 15 Replacement			coordinates A/2
1			check					6050...	page 23
revision	date	name	status: LZ			based / replaced	replaced		of 79 sh.

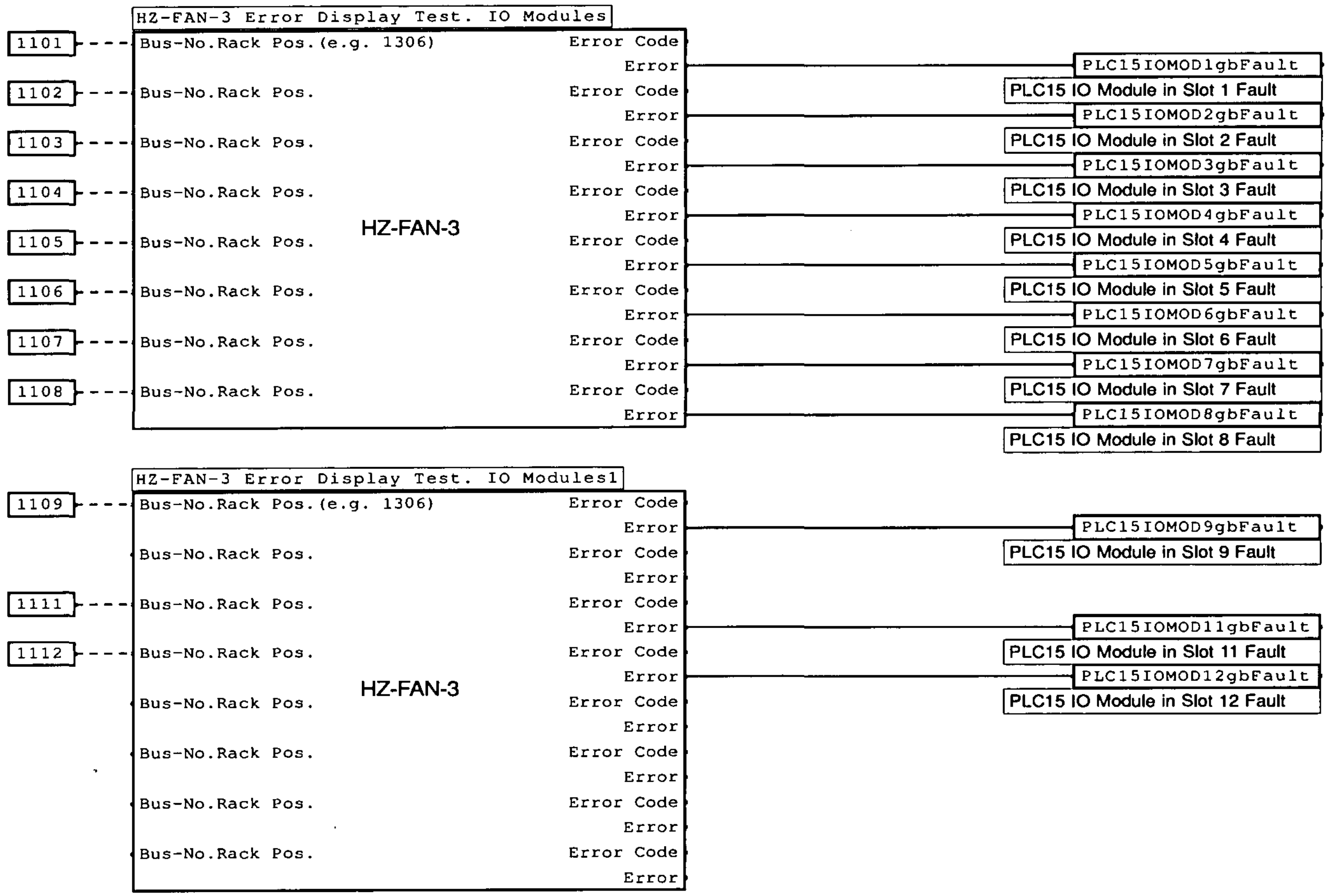
Page 4 - System Fault Mask Decoding



Sheet-number: A/3 Creator: mwalker Creation date: 04/02/09 Tester: Testing date: Revision:

3				date	name	Brisbane City Council	ELOP II	logic	version rev SCR01
2			made	Date	Name	BCC - PLC 15 Replacement		PLC__15	coordinates A/3
1			check					Page 4	6050... page 24
revision	date	name	status: LZ			based / replaced	replaced	System Fault Mask Decoding	of 79 sh.

Page 5 - Testable IO Card Error Detection



Sheet-number: A/4 Creator: mwalker Creation date: 04/02/09 Tester: Testing date: Revision: srane/27/03/09/Bus-No. Changed from 10xx to 11xx

3				date	name	Brisbane City Council	ELOP II	logic	version rev SCR01
2			made	Date	Name	BCC - PLC 15 Replacement		PLC__15	coordinates A/4
1			check					Page 5	6050... page 25
revision	date	name	status: LZ			based	replaced / replaced	Testable IO Card Error Detection	of 79 sh.

Contains SIF#19 Logic
Engine No 1 Flame Arrester to Exhaust Manifold High Temperature -> Engine #1 Shutdown
SIL1 RRF10.1

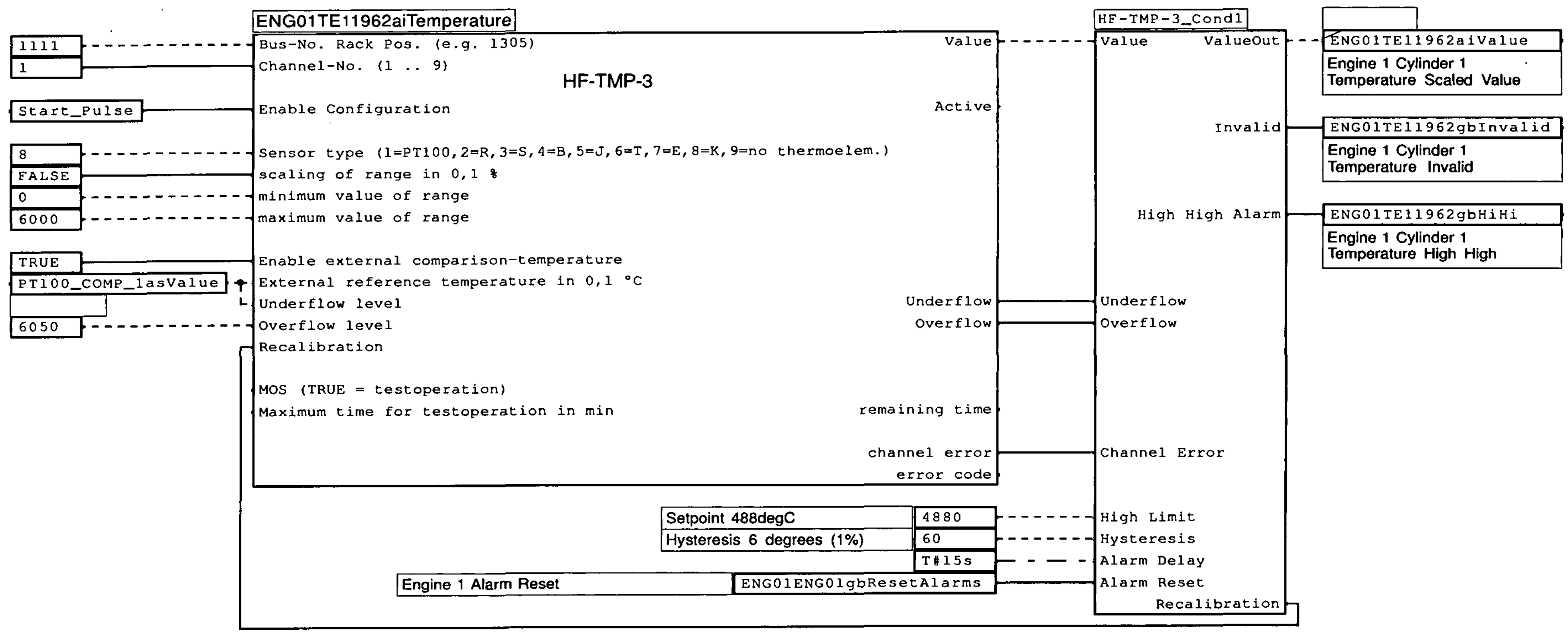
ENGINE 1
THERMOCOUPLE INPUT PROCESSING
4-20mA INPUT PROCESSING

					date	name					
3							Brisbane City Council	ELOP II	logic	version rev SCR01	
2				made	Date	Name	BCC - PLC 15 Replacement		PLC___15	coordinates B/0	
1				check					Page 6	6050...	page 26
	revision	date	name	status: LZ			based	replaced / replaced			of 79 sh.

Page 7 - Engine 1 Cylinder 1 Temperature

ENG01TE11962aiTemperature
Engine 1 Cylinder 1 Temperature
Cable # PLC15-TE11962

PART OF SIF#19 LOGIC



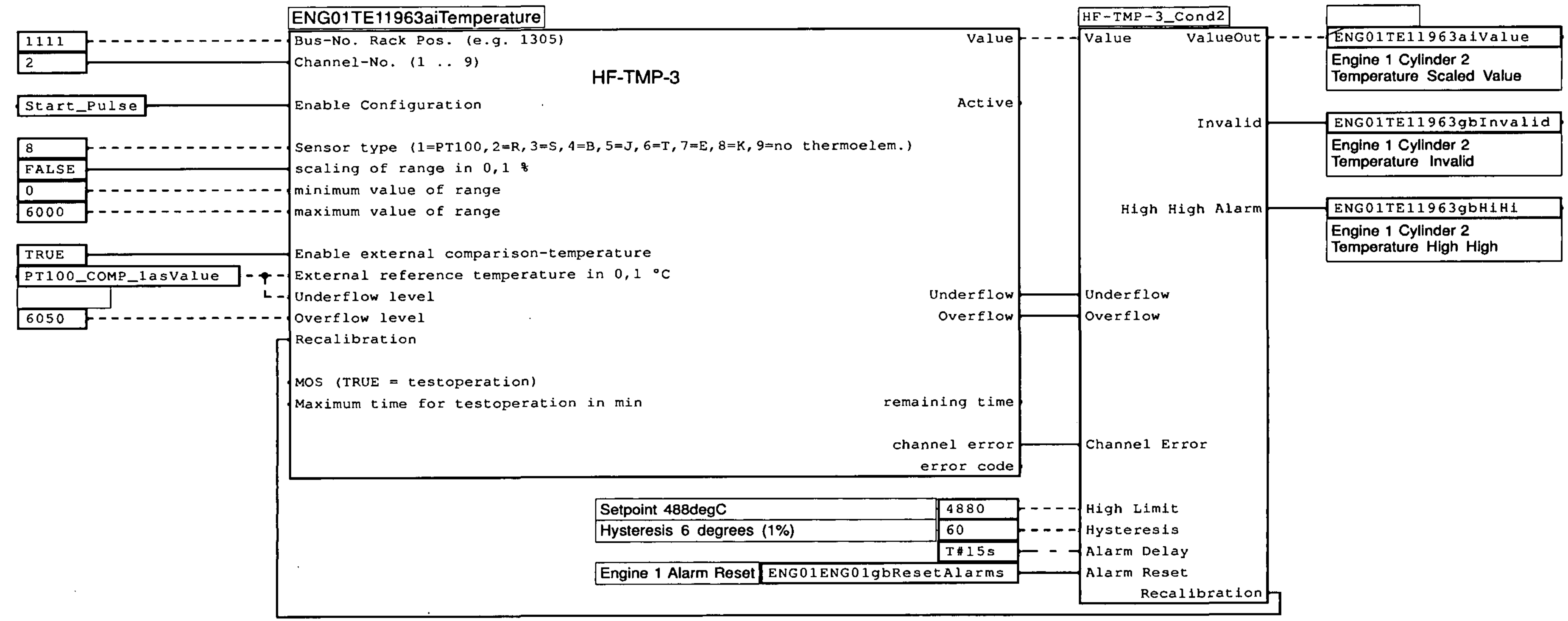
Sheet-number: B/1 Creator: mwalker Creation date: 04/02/09 Tester: Testing date: Revision: srane/18/05/09/ mwalker/02/04/09/ srane/02/04/09/ 036591/02/04/09/ srane/31/03/09/

3				date	name	Brisbane City Council BCC - PLC 15 Replacement	ELOP II	logic PLC___15 Page 7 Engine 1 Cylinder 1 Temperature	version rev SCR01 coordinates B/1
2			made	Date	Name				6050...
1			check						page 27 of 79 sh.
revision	date	name	status: LZ			based	replaced	replaced	

Page 8 - Engine 1 Cylinder 2 Temperature

ENG01TE11963aiTemperature
Engine 1 Cylinder 2 Temperature
Cable # PLC15-TE11963

PART OF SIF#19 LOGIC



Sheet-number: B/2 Creator: mwalker Creation date: 04/02/09 Tester: Testing date: Revision: mwalker/02/04/09/ 036591/02/04/09/ srane/27/03/09/Bus-No. Chnaged from 10xx to 11xx srane/17/02/09/

3			date	name	Brisbane City Council
2		made	Date	Name	BCC - PLC 15 Replacement
1		check			
revision	date	name	status: LZ		based

ELOP II | replaced | replaced

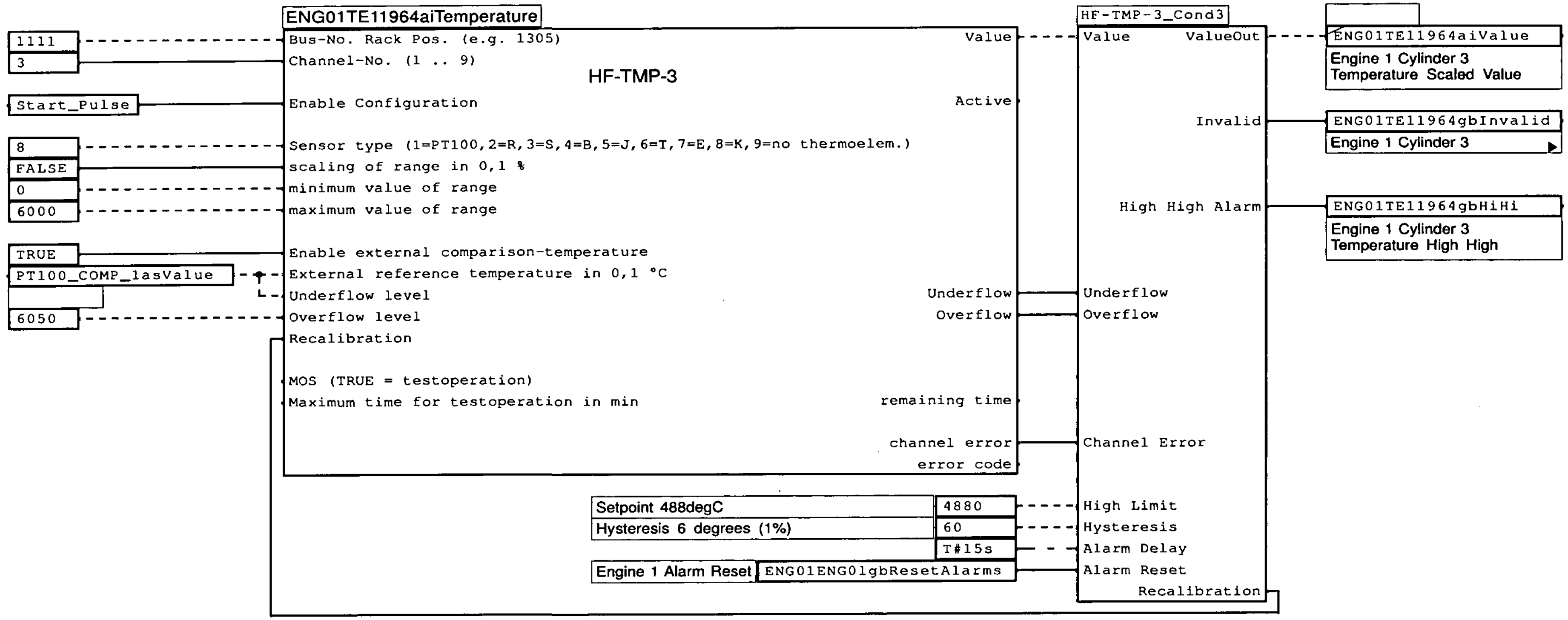
logic PLC__'15 Page 8 Engine 1 Cylinder 2 Temperature

version rev SCR01 | coordinates B/2 | 6050... | page 28 of 79 sh.

Page 9 - Engine 1 Cylinder 3 Temperature

ENG01TE11964aiTemperature
Engine 1 Cylinder 3 Temperature
Cable # PLC15-TE11964

PART OF SIF#19 LOGIC



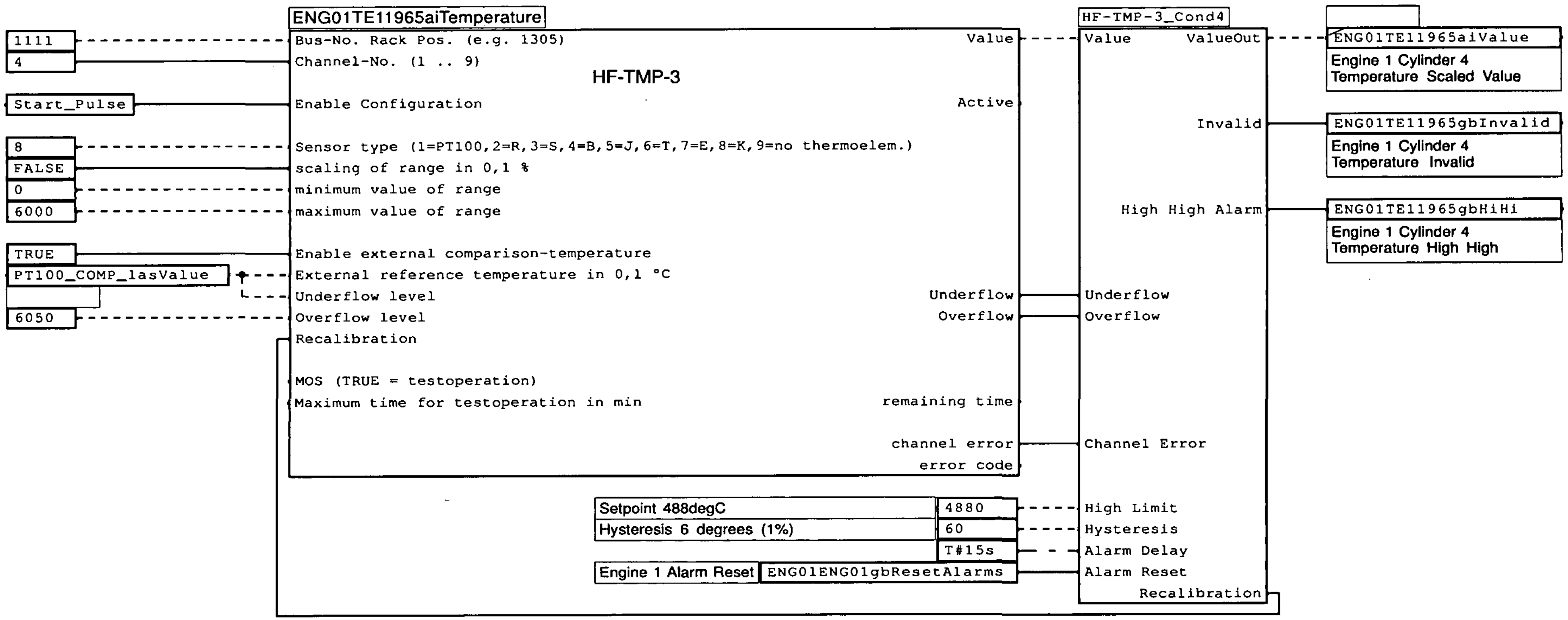
Sheet-number: B/3 Creator: mwalker Creation date: 04/02/09 Tester: Testing date: Revision: srane/18/05/09/ mwalker/02/04/09/ 036591/02/04/09/ srane/27/03/09/Bus-No. Chnaged from 10xx to 11x

3				date	name	Brisbane City Council	ELOP II	logic	version rev SCR01
2			made	Date	Name	BCC - PLC 15 Replacement		PLC___15	coordinates B/3
1			check					Page 9	6050... page 29
revision	date	name	status: LZ			based / replaced	replaced	Engine 1 Cylinder 3 Temperature	of 79 sh.

Page 10 - Engine 1 Cylinder 4 Temperature

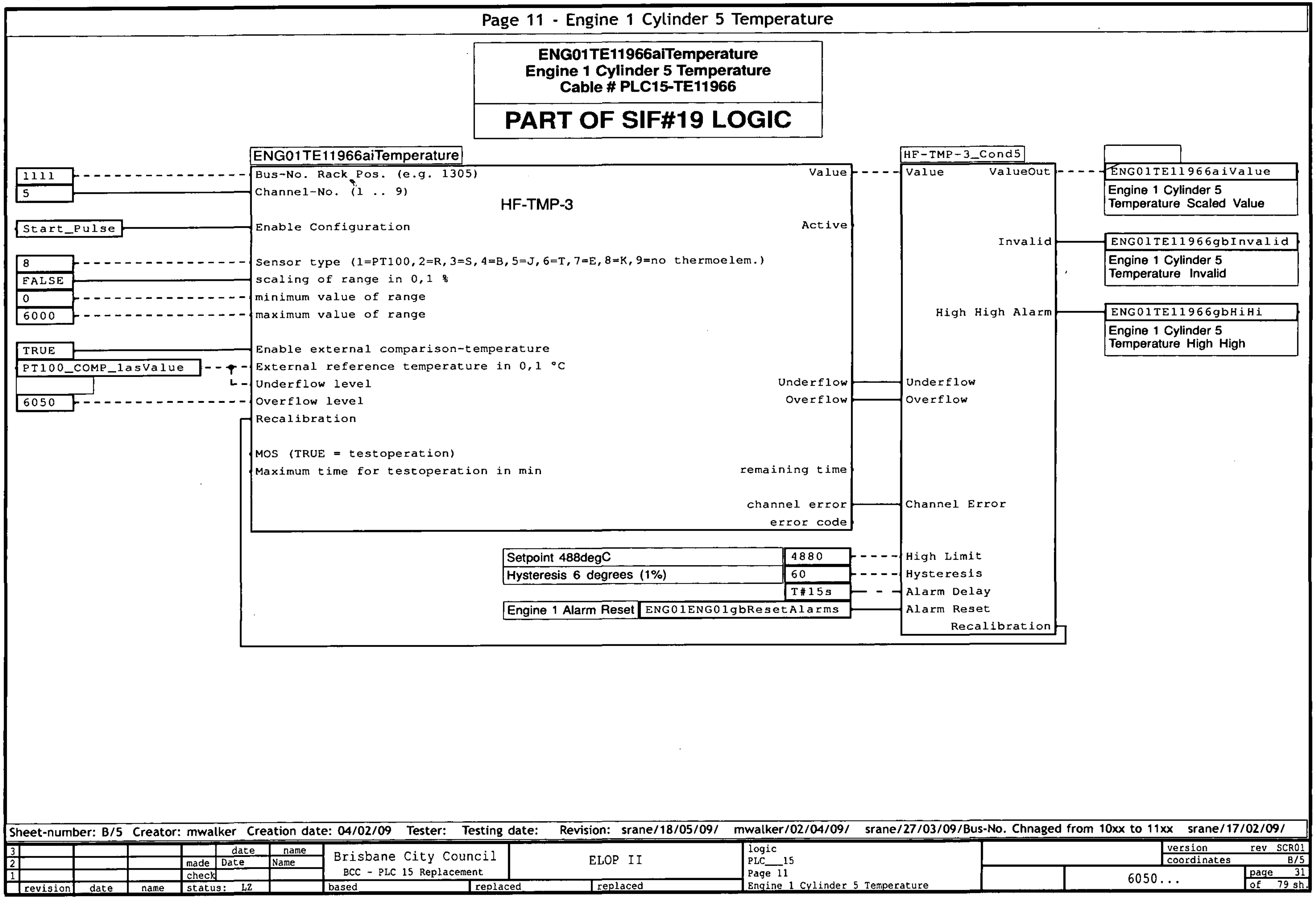
ENG01TE11965aiTemperature
Engine 1 Cylinder 4 Temperature
Cable # PLC15-TE11965

PART OF SIF#19 LOGIC



Sheet-number: B/4 Creator: mwalker Creation date: 04/02/09 Tester: Testing date: Revision: srane/18/05/09/ mwalker/02/04/09/ 036591/02/04/09/ srane/27/03/09/Bus-No. Chnaged from 10xx to 11x

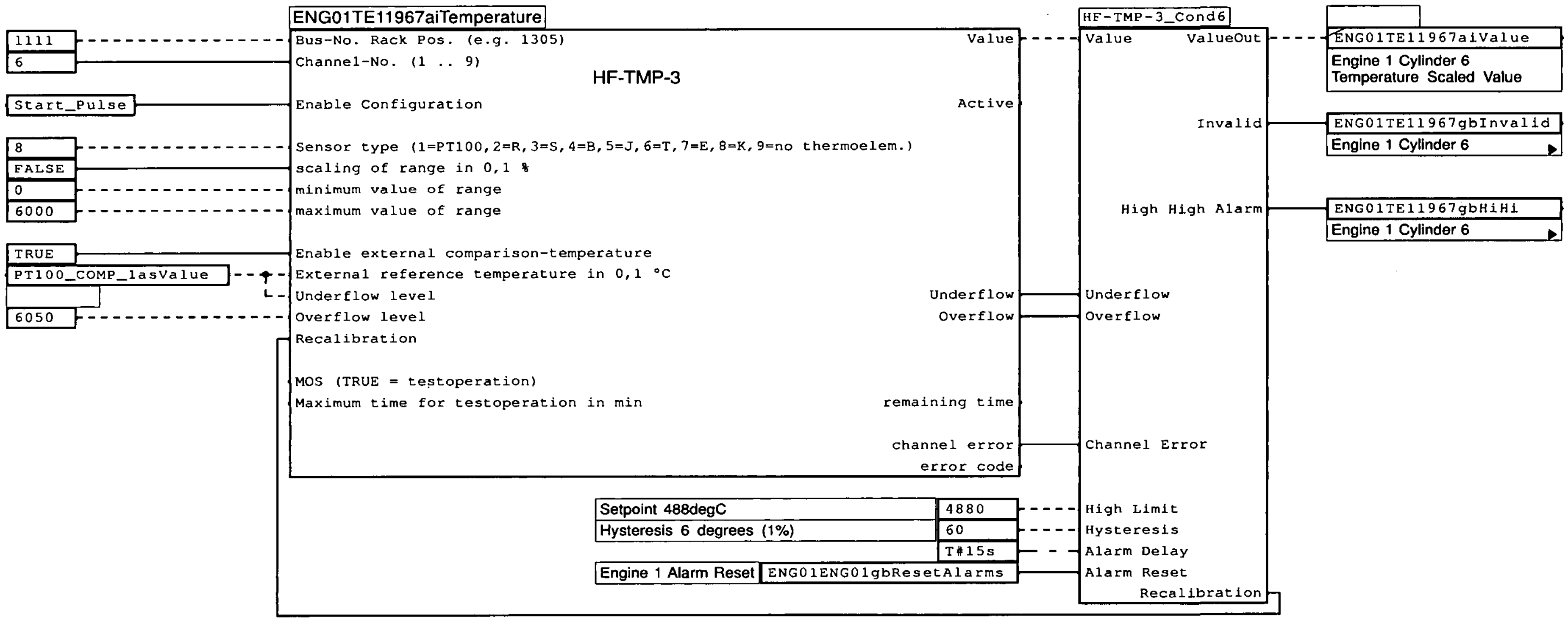
3				date	name	Brisbane City Council	ELOP II	logic		version rev SCR01
2			made	Date	Name	BCC - PLC 15 Replacement		PLC__15		coordinates B/4
1			check					Page 10	6050...	page 30
revision	date	name	status: LZ			based / replaced	replaced	Engine 1 Cylinder 4 Temperature		of 79 sh.


Page 11 - Engine 1 Cylinder 5 Temperature
ENG01TE11966aiTemperature
Engine 1 Cylinder 5 Temperature
Cable # PLC15-TE11966
PART OF SIF#19 LOGIC
ENG01TE11966aiTemperature
HF-TMP-3
1111
5
Start_Pulse
8
FALSE
0
6000
TRUE
PT100_COMP_1asValue
6050
Bus-No. Rack Pos. (e.g. 1305)
Channel-No. (1 .. 9)
Enable Configuration
Sensor type (1=PT100,2=R,3=S,4=B,5=J,6=T,7=E,8=K,9=no thermoelem.)
scaling of range in 0,1 %
minimum value of range
maximum value of range
Enable external comparison-temperature
External reference temperature in 0,1 °C
Underflow level
Overflow level
Recalibration
MOS (TRUE = testoperation)
Maximum time for testoperation in min
Value
Active
Underflow
Overflow
remaining time
channel error
error code
HF-TMP-3_Cond5
Value
ValueOut
Invalid
High High Alarm
Underflow
Overflow
Channel Error
High Limit
Hysteresis
Alarm Delay
Alarm Reset
Recalibration
Setpoint 488degC
4880
Hysteresis 6 degrees (1%)
60
T#15s
Engine 1 Alarm Reset
ENG01ENG01gbResetAlarms
ENG01TE11966aiValue
Engine 1 Cylinder 5 Temperature Scaled Value
ENG01TE11966gbInvalid
Engine 1 Cylinder 5 Temperature Invalid
ENG01TE11966gbHiHi
Engine 1 Cylinder 5 Temperature High High
Sheet-number: B/5 Creator: mwalker Creation date: 04/02/09 Tester: Testing date: Revision: srane/18/05/09/ mwalker/02/04/09/ srane/27/03/09/Bus-No. Chnaged from 10xx to 11xx srane/17/02/09/
date name
made Date Name
check
status: LZ
3
2
1
revision date name
Brisbane City Council
BCC - PLC 15 Replacement
ELOP II
based
replaced
replaced
logic
PLC__15
Page 11
Engine 1 Cylinder 5 Temperature
version rev SCR01
coordinates B/5
6050...
page 31
of 79 sh.

Page 12 - Engine 1 Cylinder 6 Temperature

ENG01TE11967aiTemperature
Engine 1 Cylinder 6 Temperature
Cable # PLC15-TE11967

PART OF SIF#19 LOGIC

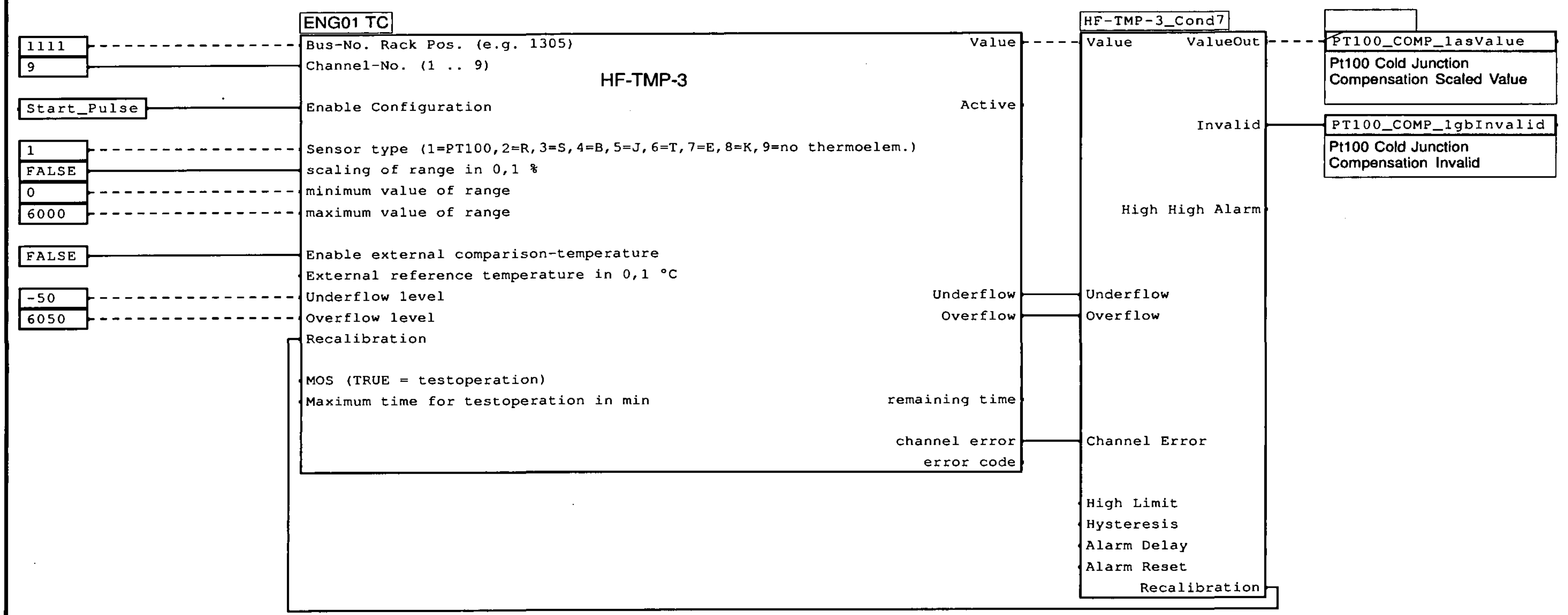


Sheet-number: B/6 Creator: mwalker Creation date: 04/02/09 Tester: Testing date: Revision: srane/18/05/09/ mwalker/02/04/09/ 036591/02/04/09/ srane/27/03/09/Bus-No. Chnaged from 10xx to 11x

revision	date	name		date	name					
3						Brisbane City Council	ELOP II	logic	version	rev SCR01
2			made	Date	Name	BCC - PLC 15 Replacement		PLC___15	coordinates	B/6
1			check					Page 12	6050...	page 32
			status: LZ			based	replaced / replaced	Engine 1 Cylinder 6 Temperature		of 79 sh.

Page 13 - Engine 1 T/C Cold Junction Compensation

ENG01 PT100 Temperature Compensation
Engine 1 Temperature Comp.
Cable # PT100_COMP_1



Sheet-number: B/7 Creator: mwalker Creation date: 04/02/09 Tester: Testing date: Revision: srane/18/05/09/ 036591/02/04/09/ srane/31/03/09/ srane/27/03/09/Bus-No. Chnaged from 10xx to 11xx

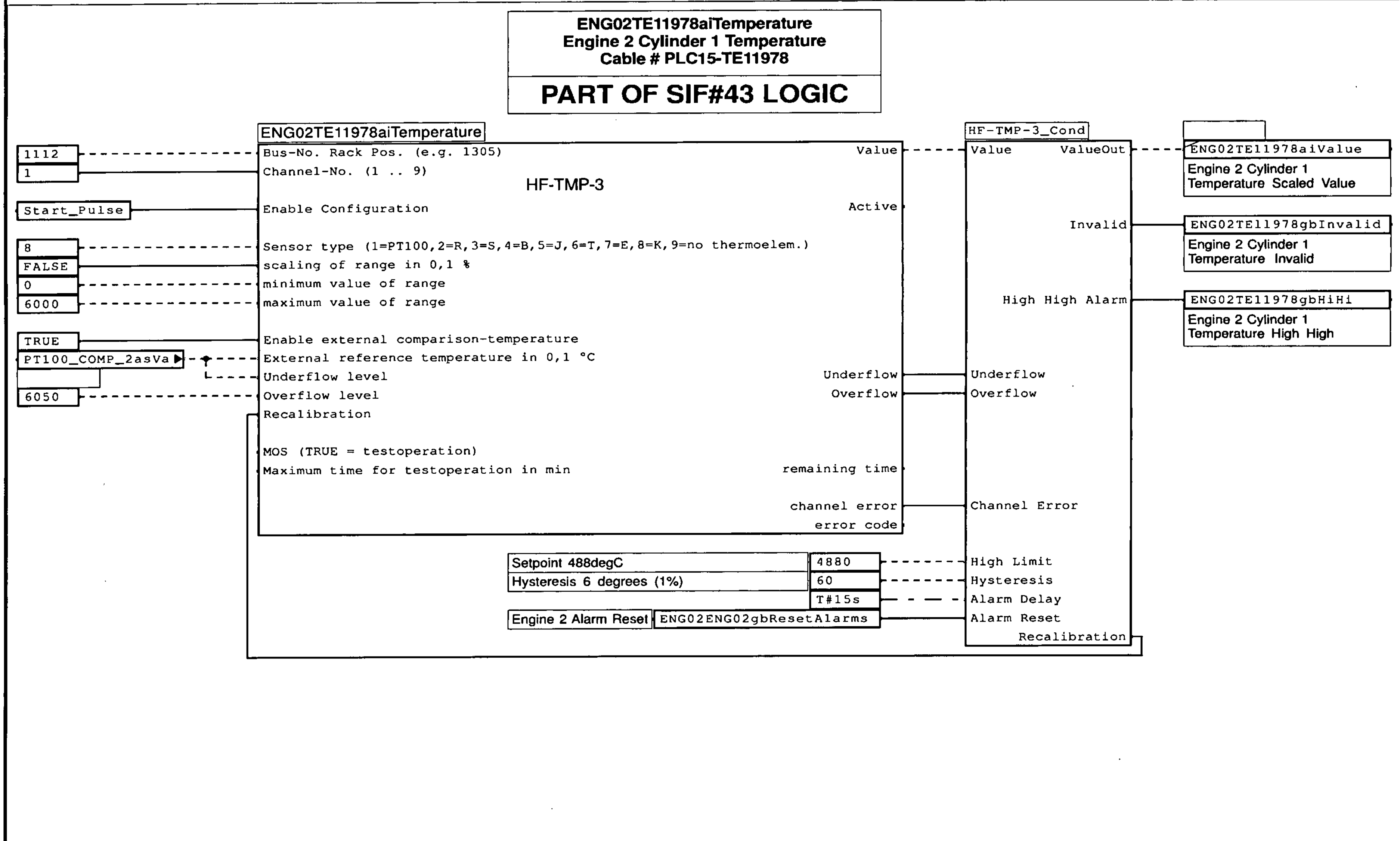
				date	name				
3						Brisbane City Council	ELOP II	logic	version rev SCR01
2			made	Date	Name	BCC - PLC 15 Replacement		PLC___15	coordinates B/7
1			check					Page 13	6050... page 33
revision	date	name	status: LZ			based / replaced	replaced	Engine 1 T/C Cold Junction Compensation	of 79 sh.

Contains SIF#43 Logic
Engine No 2 Flame Arrester to Exhaust Manifold High Temperature -> Engine #2 Shutdown
SIL1 RRF10.1

ENGINE 2
THERMOCOUPLE INPUT PROCESSING
4-20mA INPUT PROCESSING

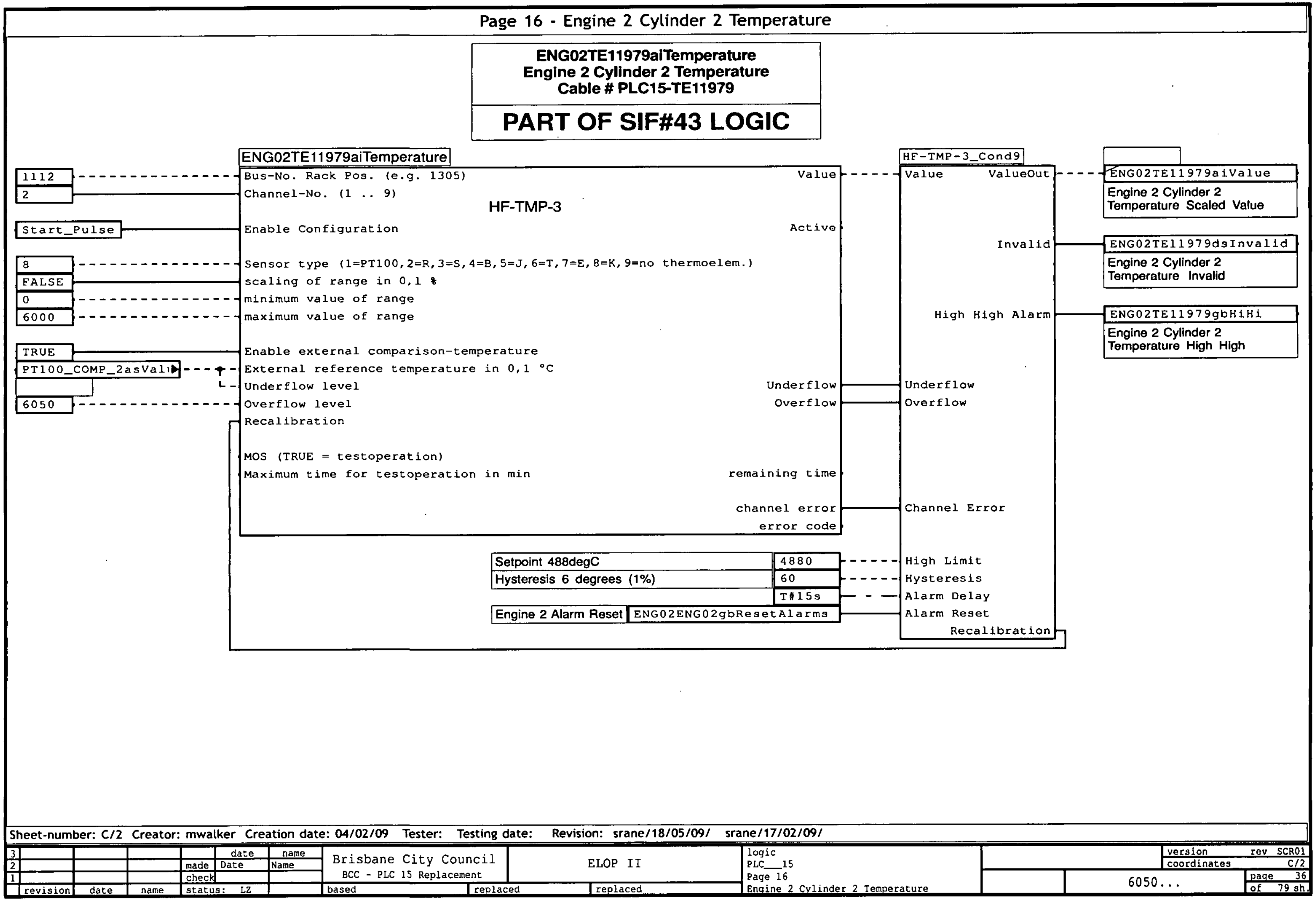
3				date	name	Brisbane City Council	ELOP II	logic PLC___15 Page 14	version rev SCR01
2			made	Date	Name	BCC - PLC 15 Replacement			coordinates C/0
1			check						6050... page 34
revision	date	name	status: LZ			based	replaced	replaced	of 79 sh.

Page 15 - Engine 2 Cylinder 1 Temperature

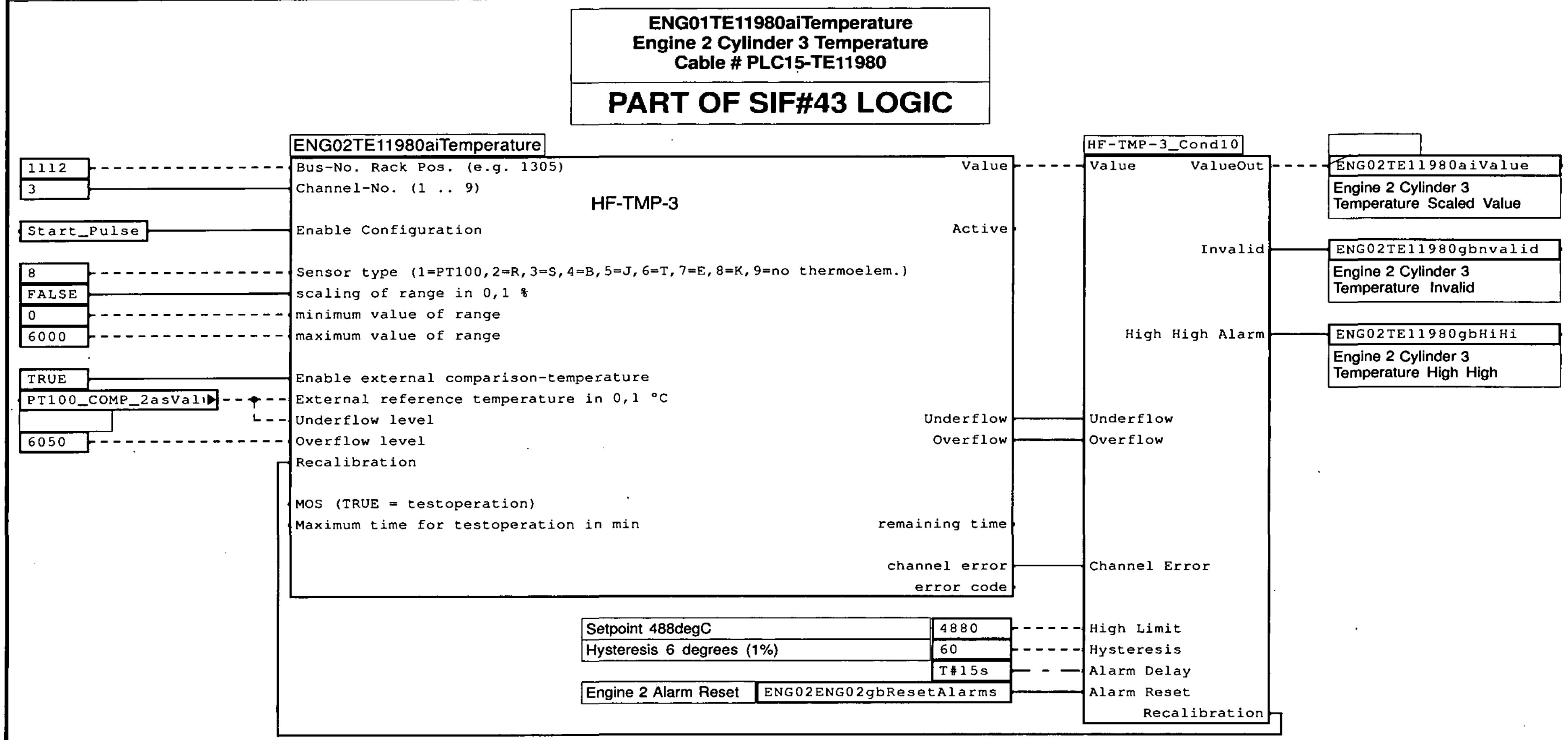


Sheet-number: C/1 Creator: mwalker Creation date: 04/02/09 Tester: Testing date: Revision: srane/18/05/09/ mwalker/02/04/09/ srane/17/02/09/

3				date	name	Brisbane City Council BCC - PLC 15 Replacement	ELOP II	logic PLC__15 Page 15 Engine 2 Cylinder 1 Temperature	version rev SCR01 coordinates C/1
2			made	Date	Name				6050...
1			check						page 35
revision	date	name	status:	LZ		based / replaced	replaced		of 79 sh.


Page 16 - Engine 2 Cylinder 2 Temperature
ENG02TE11979aiTemperature
Engine 2 Cylinder 2 Temperature
Cable # PLC15-TE11979
PART OF SIF#43 LOGIC
ENG02TE11979aiTemperature
HF-TMP-3
1112
Bus-No. Rack Pos. (e.g. 1305)
2
Channel-No. (1 .. 9)
Start_Pulse
Enable Configuration
8
Sensor type (1=PT100,2=R,3=S,4=B,5=J,6=T,7=E,8=K,9=no thermoelem.)
FALSE
scaling of range in 0,1 %
0
minimum value of range
6000
maximum value of range
TRUE
Enable external comparison-temperature
PT100_COMP_2asVal
External reference temperature in 0,1 °C
Underflow level
6050
Overflow level
Recalibration
MOS (TRUE = testoperation)
Maximum time for testoperation in min
Value
Active
Underflow
Overflow
remaining time
channel error
error code
HF-TMP-3_Cond9
Value
ValueOut
Invalid
High High Alarm
Underflow
Overflow
Channel Error
High Limit
Hysteresis
Alarm Delay
Alarm Reset
Recalibration
Setpoint 488degC
4880
Hysteresis 6 degrees (1%)
60
T#15s
Engine 2 Alarm Reset
ENG02ENG02gbResetAlarms
ENG02TE11979aiValue
Engine 2 Cylinder 2 Temperature Scaled Value
ENG02TE11979dsInvalid
Engine 2 Cylinder 2 Temperature Invalid
ENG02TE11979gbHiHi
Engine 2 Cylinder 2 Temperature High High
Sheet-number: C/2 Creator: mwalker Creation date: 04/02/09 Tester: Testing date: Revision: srane/18/05/09/ srane/17/02/09/
3
2
1
revision
date
name
date
name
made
Date
Name
check
status: LZ
Brisbane City Council
BCC - PLC 15 Replacement
based
replaced
ELOP II
replaced
logic
PLC__15
Page 16
Engine 2 Cylinder 2 Temperature
6050...
version
rev SCR01
coordinates
C/2
page 36
of 79 sh.

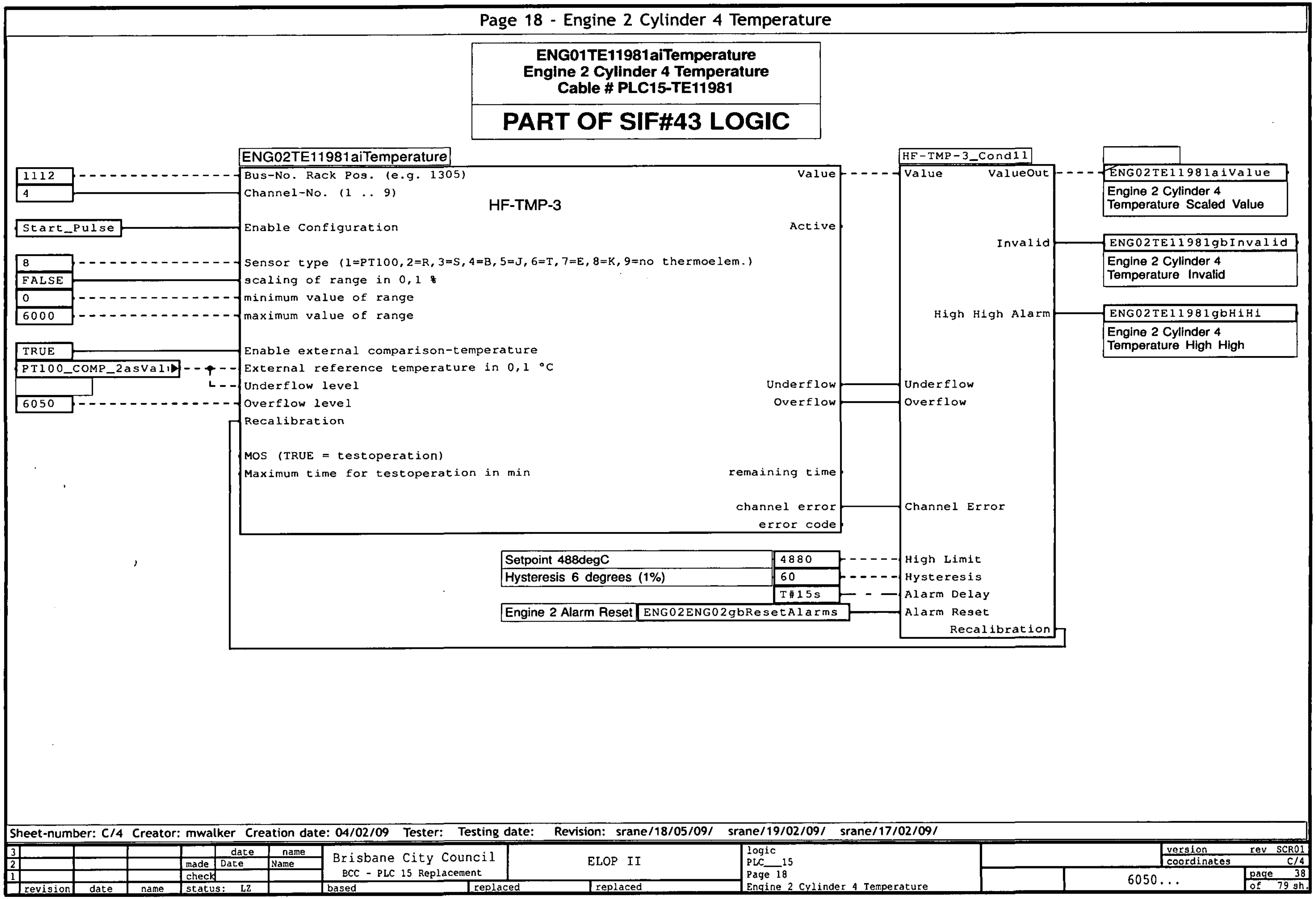
Page 17 - Engine 2 Cylinder 3 Temperature

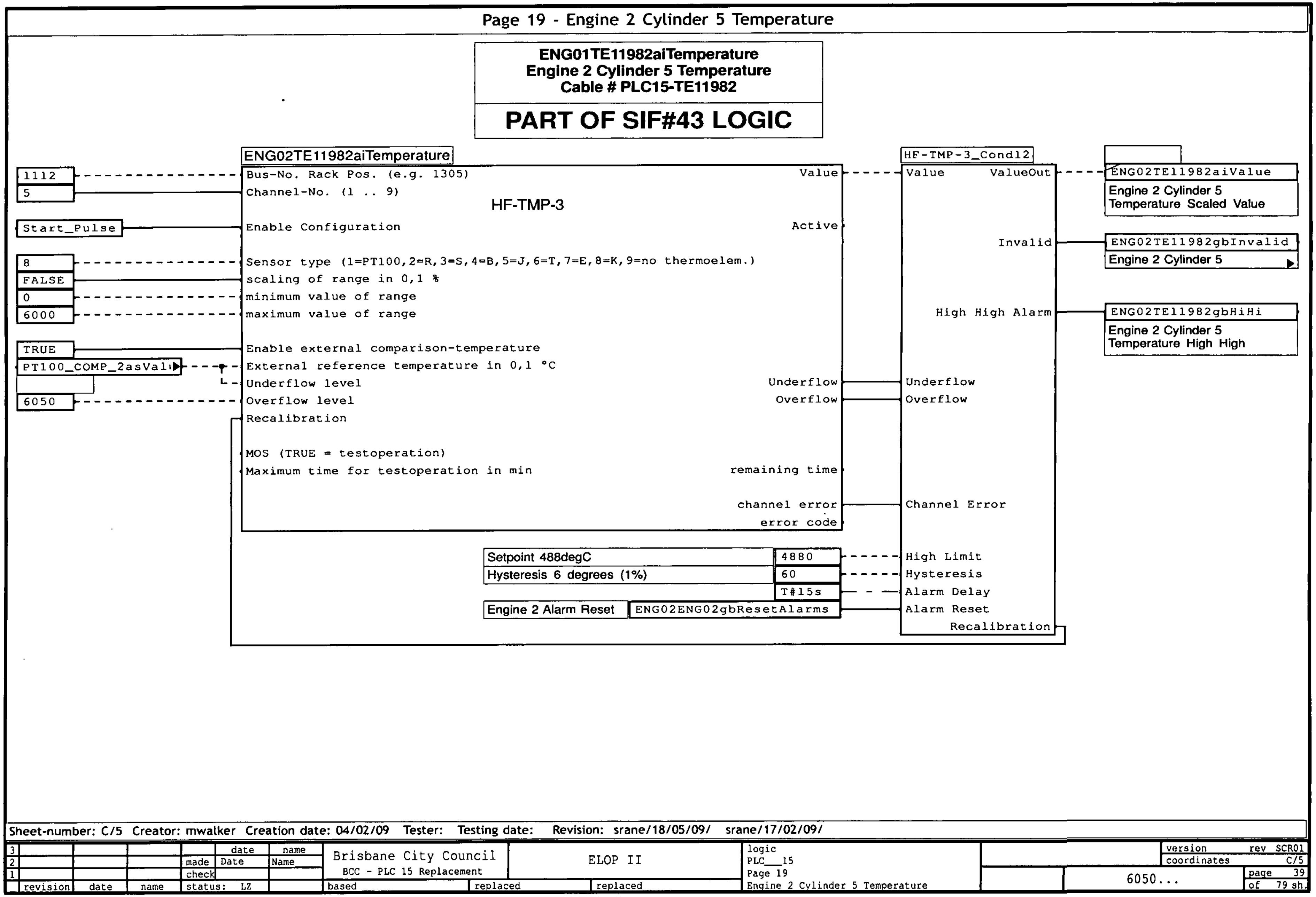


Sheet-number: C/3 Creator: mwalker Creation date: 04/02/09 Tester: Testing date: Revision: srane/18/05/09/ srane/17/02/09/

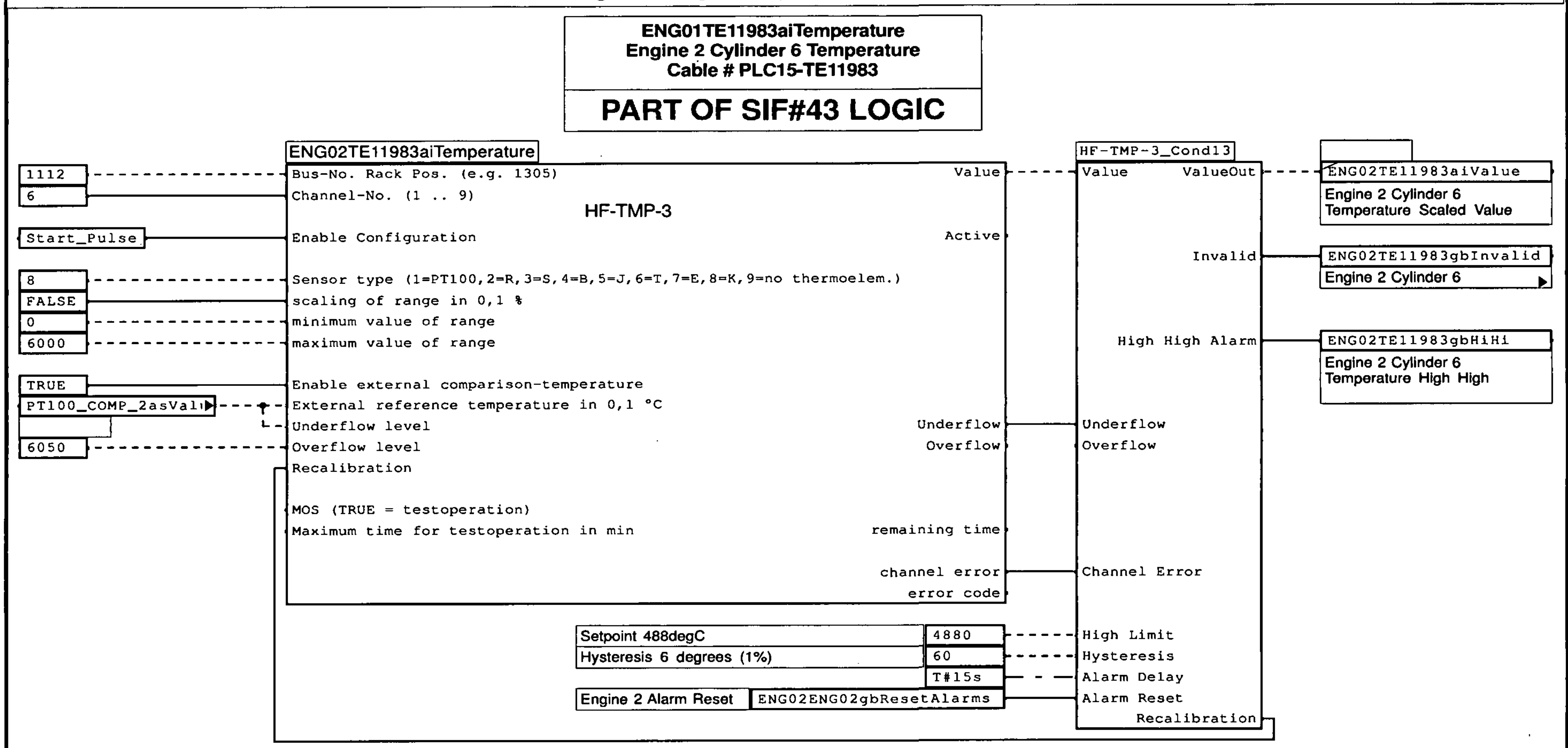
3				date	name	Brisbane City Council	ELOP II	logic
2			made	Date	Name	BCC - PLC 15 Replacement		PLC__15
1			check					Page 17
revision	date	name	status: LZ			based / replaced	replaced	Engine 2 Cylinder 3 Temperature

version rev SCR01
coordinates C/3
6050...
page 37
of 79 sh.


Page 18 - Engine 2 Cylinder 4 Temperature
ENG01TE11981aiTemperature
Engine 2 Cylinder 4 Temperature
Cable # PLC15-TE11981
PART OF SIF#43 LOGIC
ENG02TE11981aiTemperature
HF-TMP-3
1112
4
Start_Pulse
8
FALSE
0
6000
TRUE
PT100_COMP_2asVal
6050
Bus-No. Rack Pos. (e.g. 1305)
Channel-No. (1 .. 9)
Enable Configuration
Sensor type (1=PT100,2=R,3=S,4=B,5=J,6=T,7=E,8=K,9=no thermoelem.)
scaling of range in 0,1 %
minimum value of range
maximum value of range
Enable external comparison-temperature
External reference temperature in 0,1 °C
Underflow level
Overflow level
Recalibration
MOS (TRUE = testoperation)
Maximum time for testoperation in min
Value
Active
Underflow
Overflow
remaining time
channel error
error code
HF-TMP-3_Cond11
Value
ValueOut
Invalid
High High Alarm
Underflow
Overflow
Channel Error
High Limit
Hysteresis
Alarm Delay
Alarm Reset
Recalibration
Setpoint 488degC
4880
Hysteresis 6 degrees (1%)
60
T#15s
Engine 2 Alarm Reset
ENG02ENG02gbResetAlarms
ENG02TE11981aiValue
Engine 2 Cylinder 4 Temperature Scaled Value
ENG02TE11981gbInvalid
Engine 2 Cylinder 4 Temperature Invalid
ENG02TE11981gbHiHi
Engine 2 Cylinder 4 Temperature High High
Sheet-number: C/4 Creator: mwalker Creation date: 04/02/09 Tester: Testing date: Revision: srane/18/05/09/ srane/19/02/09/ srane/17/02/09/
3
2
1
revision
date
name
made
check
status: LZ
date
Date
name
Name
Brisbane City Council
BCC - PLC 15 Replacement
based
replaced
ELOP II
replaced
logic
PLC___15
Page 18
Engine 2 Cylinder 4 Temperature
version
coordinates
rev SCR01
C/4
6050...
page 38
of 79 sh.


Page 19 - Engine 2 Cylinder 5 Temperature
ENG01TE11982aiTemperature
Engine 2 Cylinder 5 Temperature
Cable # PLC15-TE11982
PART OF SIF#43 LOGIC
ENG02TE11982aiTemperature
HF-TMP-3
1112
5
Start_Pulse
8
FALSE
0
6000
TRUE
PT100_COMP_2asVal
6050
Bus-No. Rack Pos. (e.g. 1305)
Channel-No. (1 .. 9)
Enable Configuration
Sensor type (1=PT100,2=R,3=S,4=B,5=J,6=T,7=E,8=K,9=no thermoelem.)
scaling of range in 0,1 %
minimum value of range
maximum value of range
Enable external comparison-temperature
External reference temperature in 0,1 °C
Underflow level
Overflow level
Recalibration
MOS (TRUE = testoperation)
Maximum time for testoperation in min
Value
Active
Underflow
Overflow
remaining time
channel error
error code
HF-TMP-3_Cond12
Value
ValueOut
Invalid
High High Alarm
Underflow
Overflow
Channel Error
High Limit
Hysteresis
Alarm Delay
Alarm Reset
Recalibration
Setpoint 488degC
4880
Hysteresis 6 degrees (1%)
60
T#15s
Engine 2 Alarm Reset
ENG02ENG02gbResetAlarms
ENG02TE11982aiValue
Engine 2 Cylinder 5
Temperature Scaled Value
ENG02TE11982gbInvalid
Engine 2 Cylinder 5
ENG02TE11982gbHiHi
Engine 2 Cylinder 5
Temperature High High
Sheet-number: C/5 Creator: mwalker Creation date: 04/02/09 Tester: Testing date: Revision: srane/18/05/09/ srane/17/02/09/
3
2
1
revision
date
name
date
name
made
Date
Name
check
status: LZ
Brisbane City Council
BCC - PLC 15 Replacement
based
replaced
ELOP II
replaced
logic
PLC__15
Page 19
Engine 2 Cylinder 5 Temperature
version
rev SCR01
coordinates
C/5
6050...
page 39
of 79 sh.

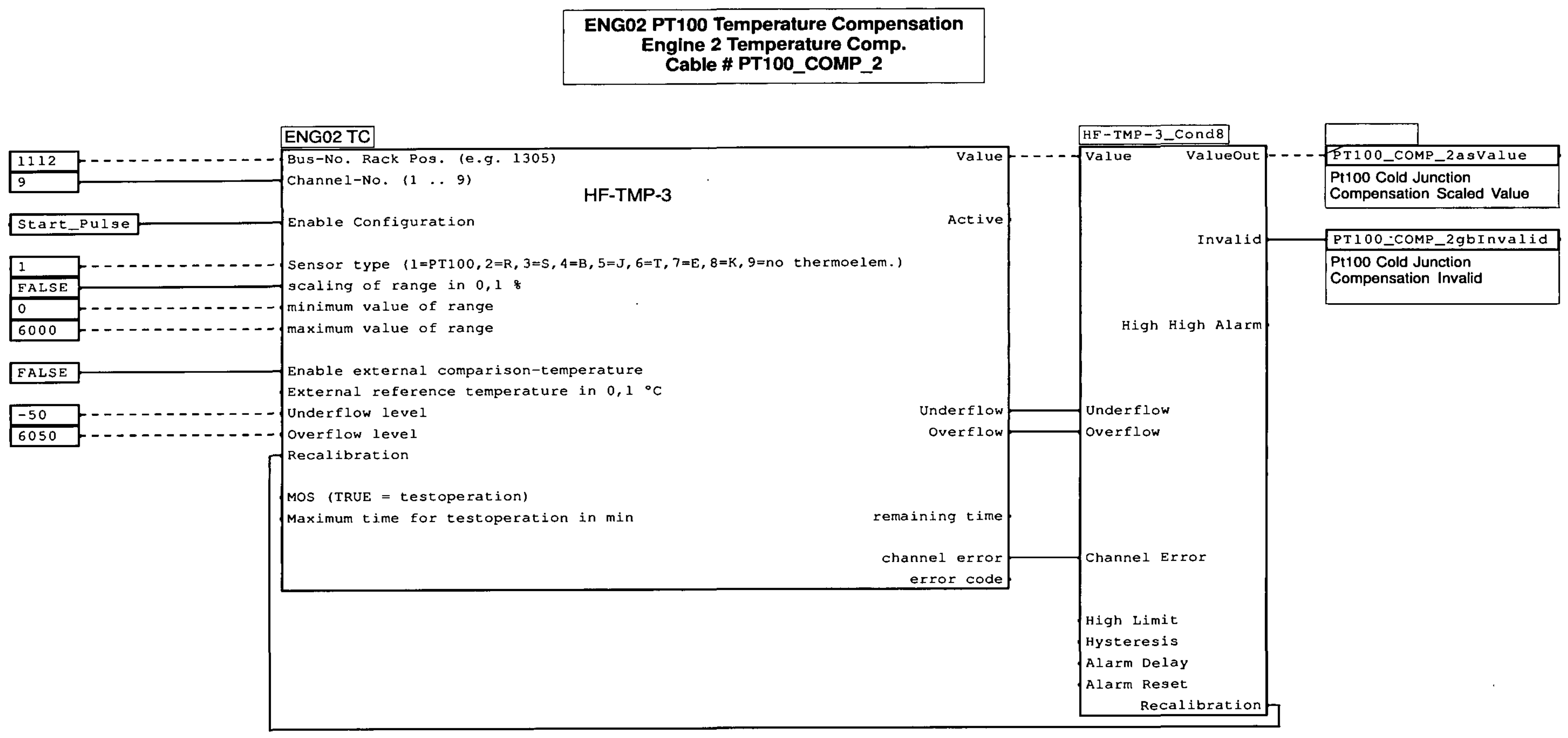
Page 20 - Engine 2 Cylinder 6 Temperature



Sheet-number: C/6 Creator: mwalker Creation date: 04/02/09 Tester: Testing date: Revision: srane/18/05/09/ mwalker/02/04/09/ srane/17/02/09/

3				date	name	Brisbane City Council	ELOP II	logic	version rev SCR01
2			made	Date	Name	BCC - PLC 15 Replacement		PLC___15	coordinates C/6
1			check					Page 20	6050... page 40
revision	date	name	status: LZ			based replaced	replaced	Engine 2 Cylinder 6 Temperature	of 79 sh.

Page 21 - Engine 2 T/C Cold Junction Compensation



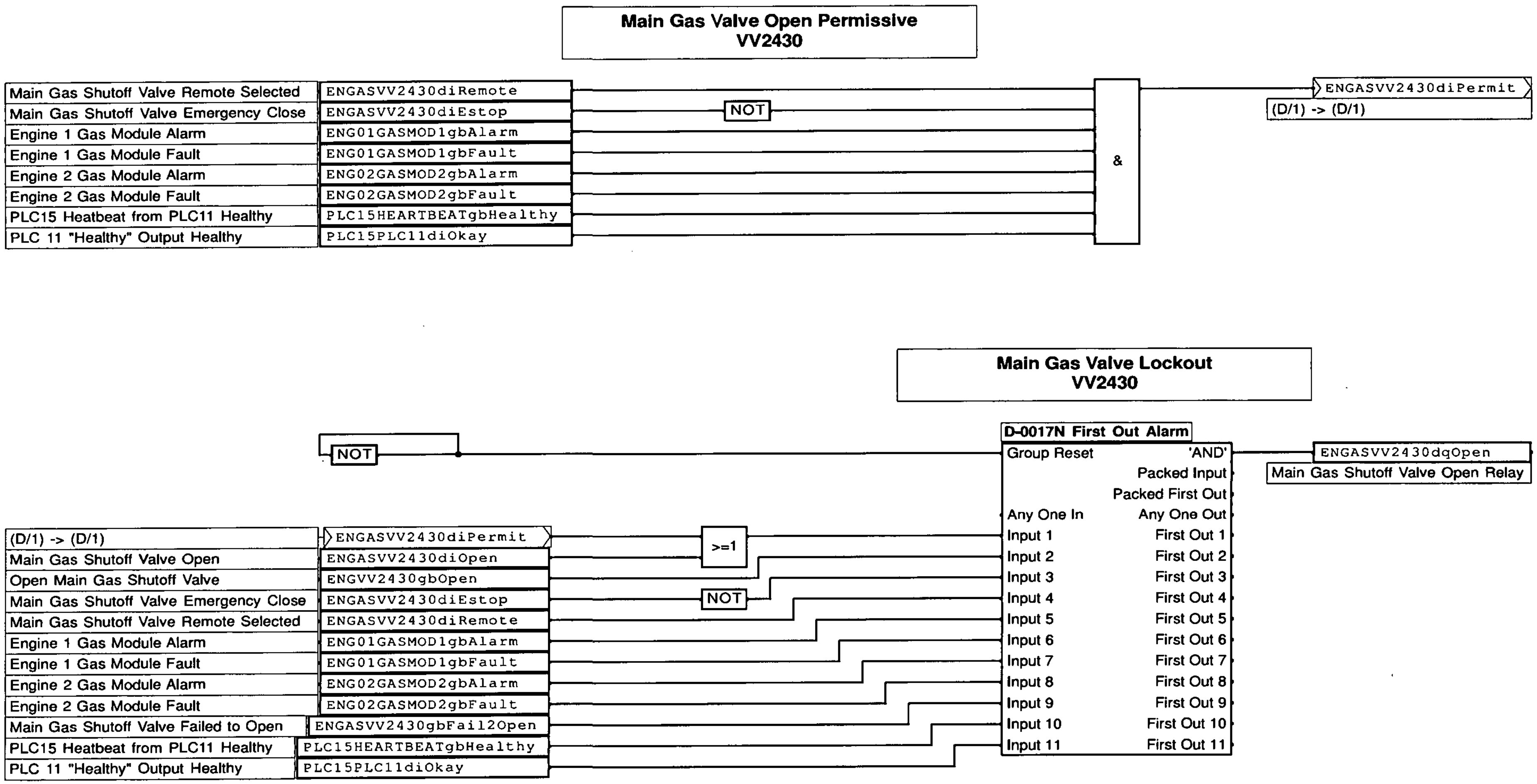
Sheet-number: C/7 Creator: mwalker Creation date: 04/02/09 Tester: Testing date: Revision: srane/18/05/09/ 036591/02/04/09/ srane/27/03/09/Bus-No. Chnaged from 10xx to 11xx srane/17/02/09/

3				date	name	Brisbane City Council	ELOP II	logic	version rev SCR01
2			made	Date	Name	BCC - PLC 15 Replacement		PLC__15	coordinates C/7
1			check					Page 21	6050... page 41
revision	date	name	status: LZ			based / replaced	replaced	Engine 2 T/C Cold Junction Compensation	of 79 sh.

COMMON CONTROL LOGIC

3					date	name	Brisbane City Council	ELOP II	logic		version rev SCR01
2				made	Date	Name	BCC - PLC 15 Replacement		PLC___15		coordinates D/0
1				check					Page 22	6050...	page 42
	revision	date	name	status: LZ			based	replaced	replaced		of 79 sh.

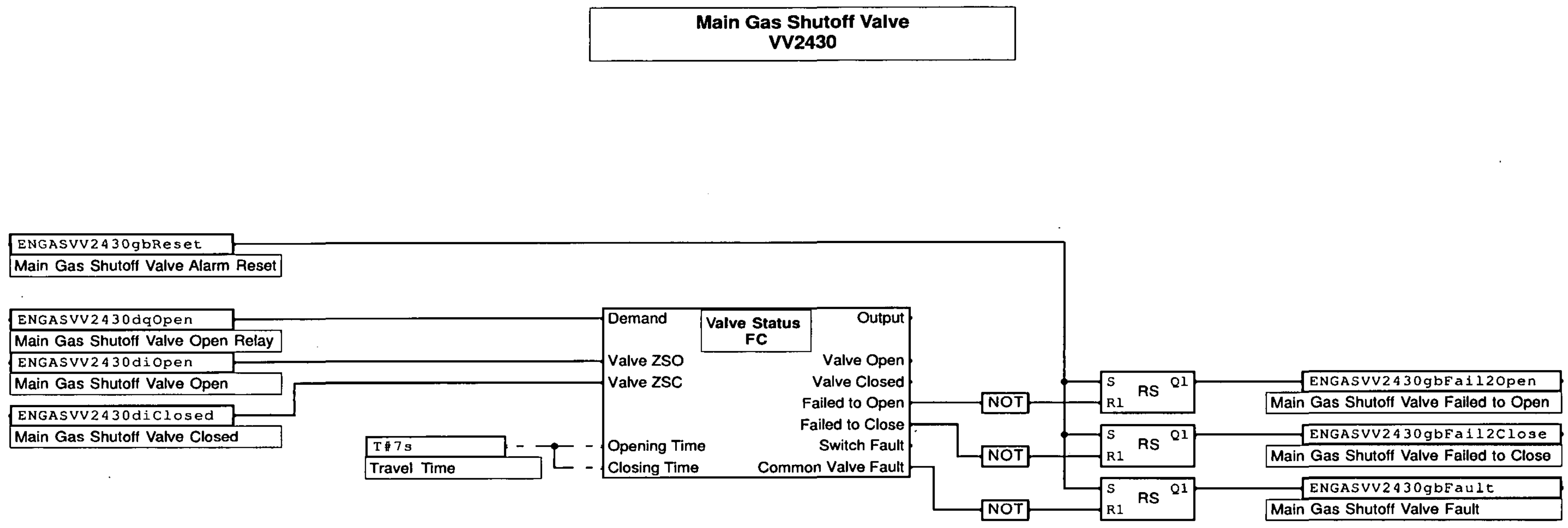
Page 23 - Main Gas Shutoff Valve Logic



Sheet-number: D/1 Creator: mwalker Creation date: 04/02/09 Tester: Testing date: Revision: mwalker/02/04/09/ 036591/02/04/09/ srane/31/03/09/

3				date	name	Brisbane City Council	ELOP II	logic	version rev SCR10
2			made	Date	Name	BCC - PLC 15 Replacement		PLC__15	coordinates D/1
1			check					Page 23	6050... page 43
revision	date	name	status: LZ			based / replaced	replaced	Main Gas Shutoff Valve Logic	of 79 sh.

Page 24 - Main Gas Shutoff Valve



Sheet-number: D/2 Creator: mwalker Creation date: 16/03/09 Tester: Testing date: Revision: srane/04/06/09/Opening / Closing Time changed to 7Sec mwalker/02/04/09/ 036591/02/04/09/

3				date	name	Brisbane City Council	ELOP II	logic	version rev SCR10
2			made	Date	Name	BCC - PLC 15 Replacement		PLC___15	coordinates D/2
1			check					Page 24	6050... page 44
revision	date	name	status: LZ			based replaced	replaced	Main Gas Shutoff Valve	of 79 sh.

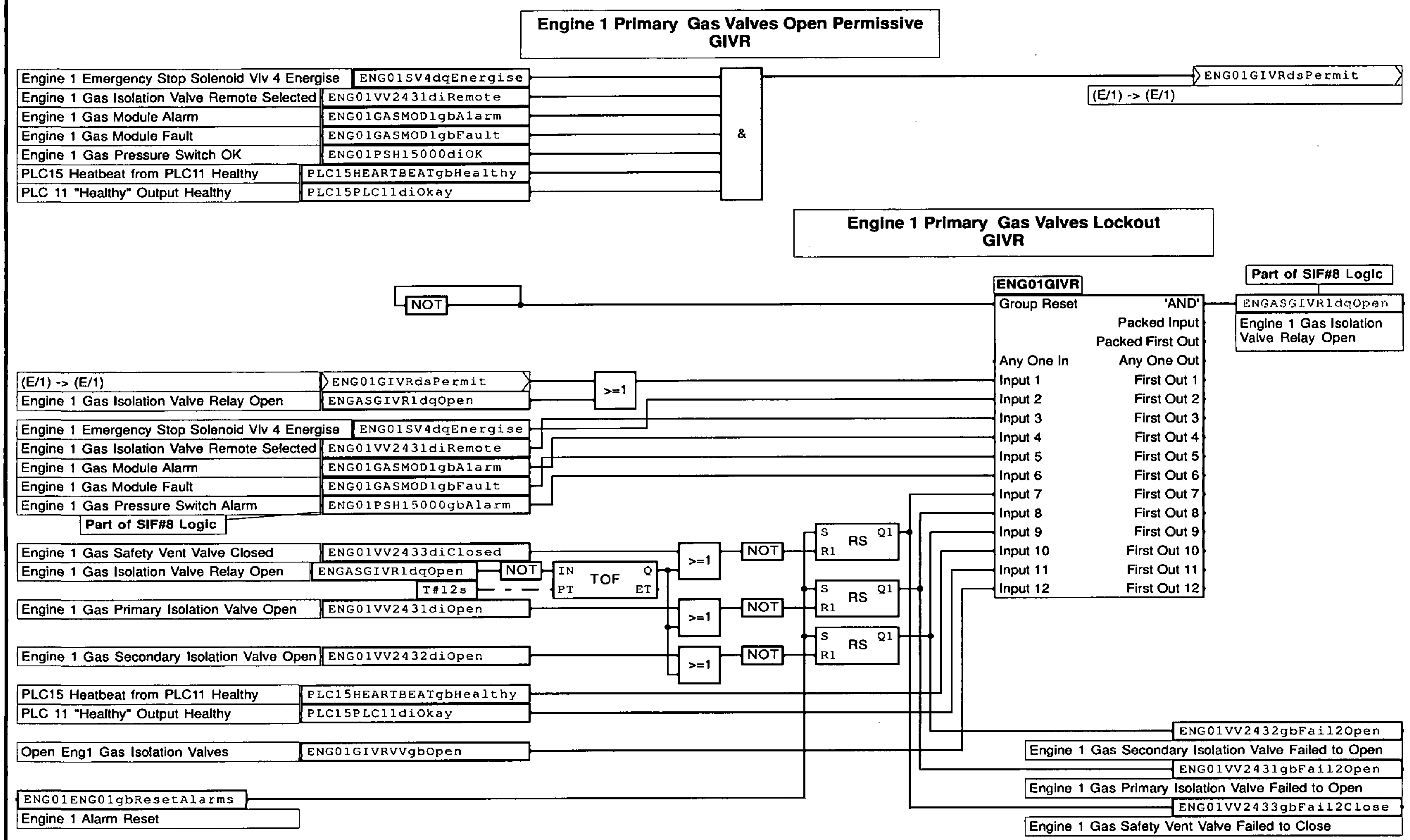
Contains SIF#8 Logic
Engine No 1 main gas to flame arrestor high pressure -> Engine #1 Shutdown
SILa RRF0

Contains SIF#19 Logic
Engine No 1 Flame Arrester to Exhaust Manifold High Temperature -> Engine #1 Shutdown
SIL1 RRF10.1

ENGINE 1 CONTROL SEQUENCE

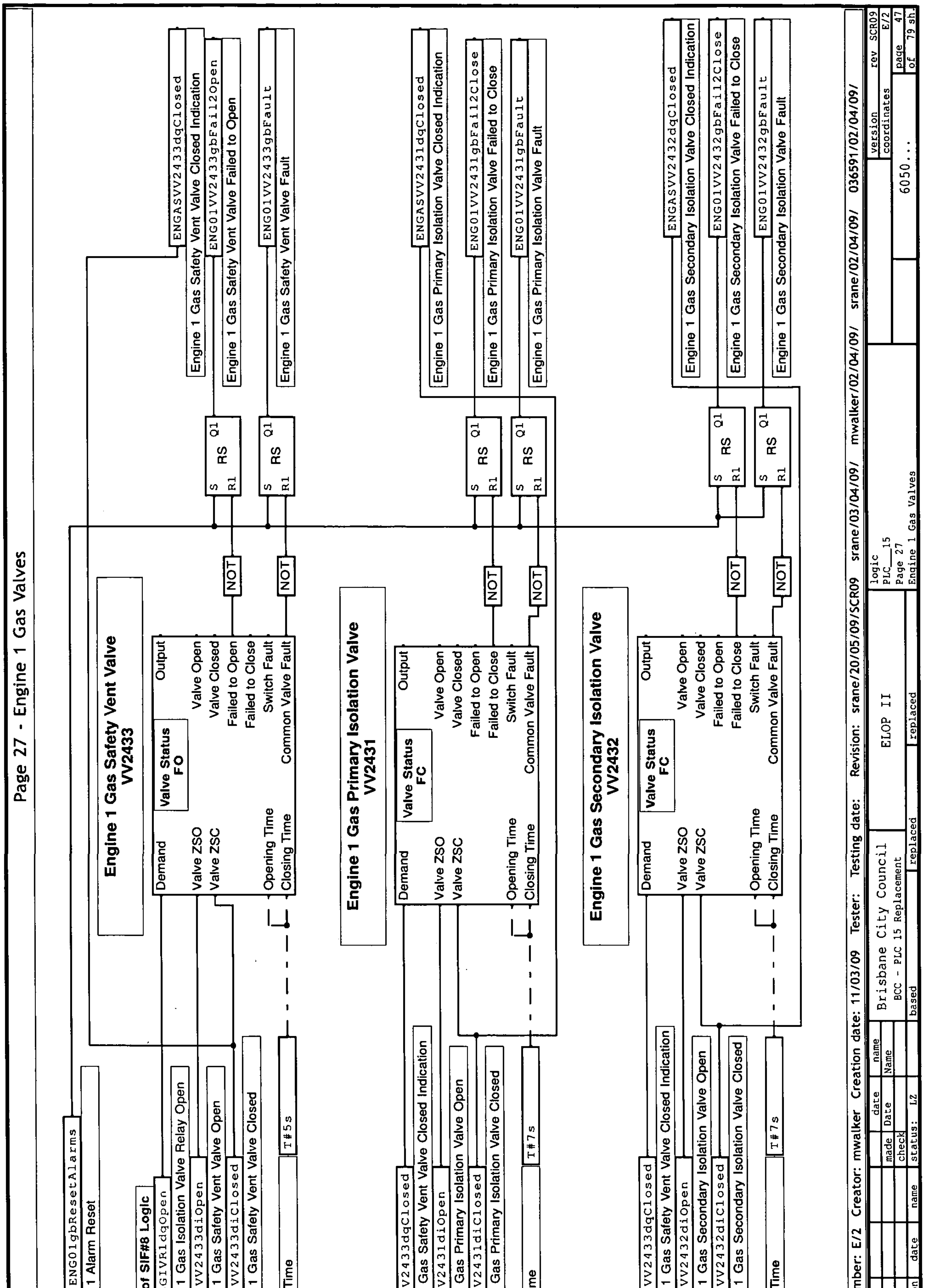
3				date	name	Brisbane City Council	ELOP II	logic PLC___15 Page 25		version rev SCR01
2			made	Date	Name	BCC - PLC 15 Replacement				coordinates E/0
1			check						6050...	page 45
revision	date	name	status: LZ			based	replaced	replaced		of 79 sh.

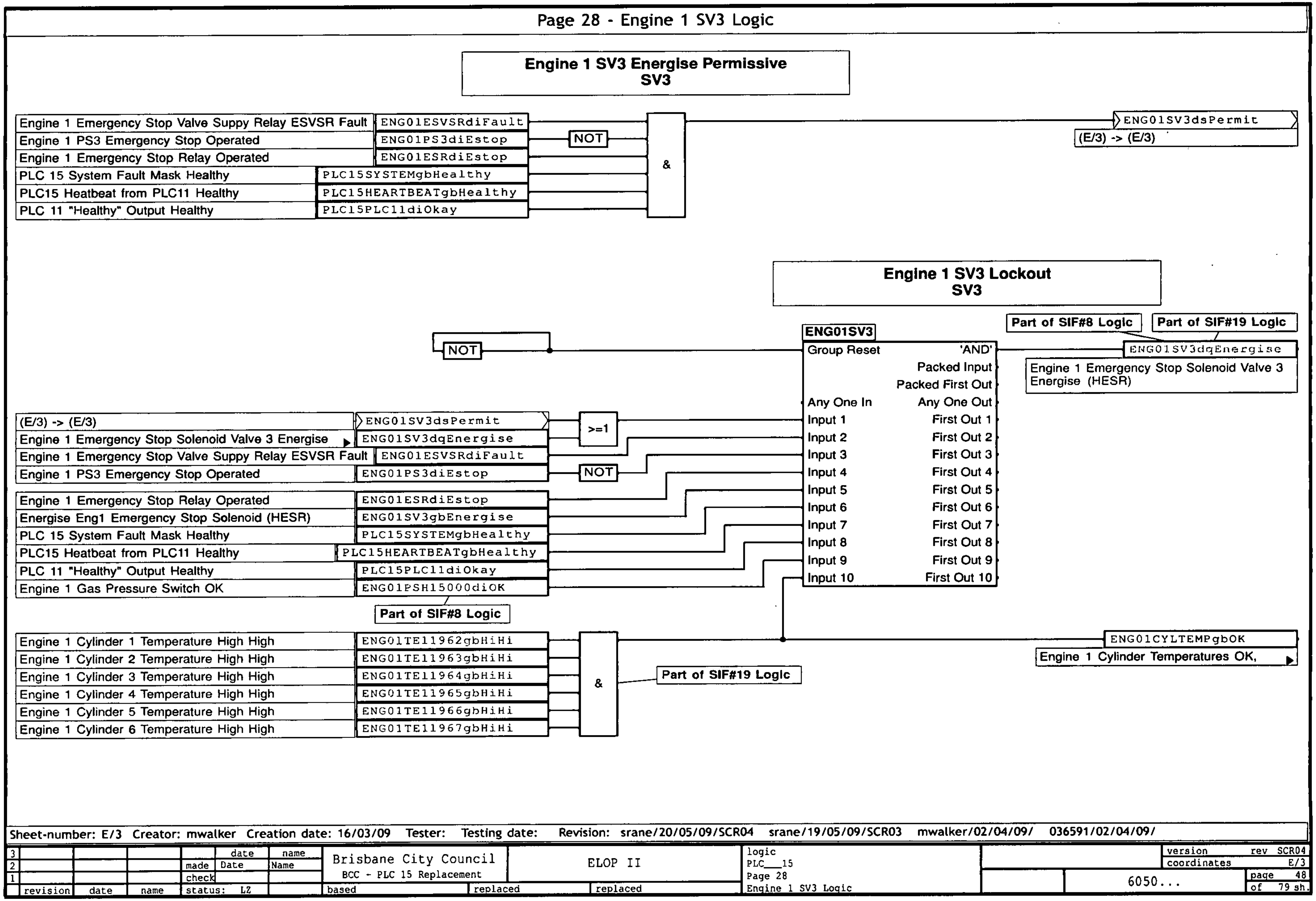
Page 26 - Engine 1 Gas Valves Logic



Sheet-number: E/1 Creator: mwalker Creation date: 16/03/09 Tester: Testing date: Revision: srane/20/05/09/SCR07 srane/03/04/09/ mwalker/02/04/09/ 036591/02/04/09/ srane/30/03/09/

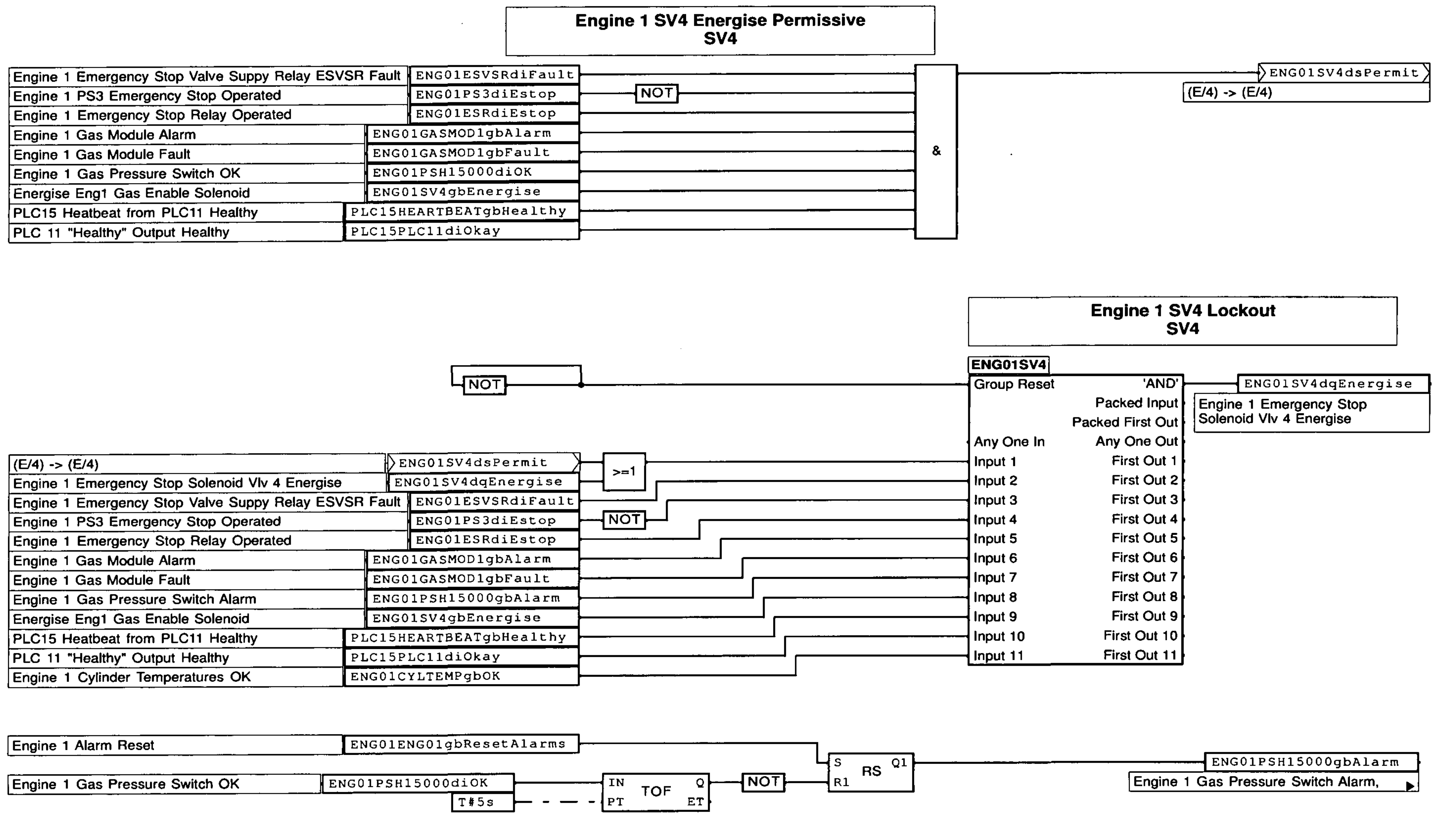
3				date	name	Brisbane City Council	ELOP II	logic	version	rev SCR11
2			made	Date	Name	BCC - PLC 15 Replacement		PLC__15	coordinates	E/1
1			check					Page 26	6050...	page 46
revision	date	name	status: LZ			based	replaced	replaced	Engine 1 Gas Valves Logic	of 79 sh.


Page 27 - Engine 1 Gas Valves
ENG01ENG01gbResetAlarms
Engine 1 Alarm Reset
Part of SIF#8 Logic
ENGASGIVR1dqOpen
Engine 1 Gas Isolation Valve Relay Open
ENG01VV2433diOpen
Engine 1 Gas Safety Vent Valve Open
ENG01VV2433diClosed
Engine 1 Gas Safety Vent Valve Closed
Travel Time
T#5s
Engine 1 Gas Safety Vent Valve
VV2433
Demand
Valve ZSO
Valve ZSC
Opening Time
Closing Time
Valve Status
FO
Output
Valve Open
Valve Closed
Failed to Open
Failed to Close
Switch Fault
Common Valve Fault
NOT
S
R1
RS
Q1
ENGASVV2433dqClosed
Engine 1 Gas Safety Vent Valve Closed Indication
ENG01VV2433gbFail2Open
Engine 1 Gas Safety Vent Valve Failed to Open
ENG01VV2433gbFault
Engine 1 Gas Safety Vent Valve Fault
ENGASVV2433dqClosed
Engine 1 Gas Safety Vent Valve Closed Indication
ENG01VV2431diOpen
Engine 1 Gas Primary Isolation Valve Open
ENG01VV2431diClosed
Engine 1 Gas Primary Isolation Valve Closed
Travel Time
T#7s
Engine 1 Gas Primary Isolation Valve
VV2431
Valve Status
FC
ENGASVV2431dqClosed
Engine 1 Gas Primary Isolation Valve Closed Indication
ENG01VV2431gbFail2Close
Engine 1 Gas Primary Isolation Valve Failed to Close
ENG01VV2431gbFault
Engine 1 Gas Primary Isolation Valve Fault
ENGASVV2433dqClosed
Engine 1 Gas Safety Vent Valve Closed Indication
ENG01VV2432diOpen
Engine 1 Gas Secondary Isolation Valve Open
ENG01VV2432diClosed
Engine 1 Gas Secondary Isolation Valve Closed
Travel Time
T#7s
Engine 1 Gas Secondary Isolation Valve
VV2432
Valve Status
FC
ENGASVV2432dqClosed
Engine 1 Gas Secondary Isolation Valve Closed Indication
ENG01VV2432gbFail2Close
Engine 1 Gas Secondary Isolation Valve Failed to Close
ENG01VV2432gbFault
Engine 1 Gas Secondary Isolation Valve Fault
Sheet-number: E/2 Creator: mwalker Creation date: 11/03/09 Tester: Testing date: Revision: srane/20/05/09/SCR09 srane/03/04/09/ srane/02/04/09/ mwalker/02/04/09/ 036591/02/04/09/
Brisbane City Council
BCC - PLC 15 Replacement
ELOP II
logic
PLC 15
Page 27
Engine 1 Gas Valves
6050...
version rev SCR09
coordinates E/2
page 47
of 79 sh.
revision date name status: LZ based replaced replaced
made Date Name
check



Page 28 - Engine 1 SV3 Logic
Engine 1 SV3 Energise Permissive SV3
Engine 1 Emergency Stop Valve Suppy Relay ESVSR Fault
ENG01ESVSRdiFault
Engine 1 PS3 Emergency Stop Operated
ENG01PS3diEstop
Engine 1 Emergency Stop Relay Operated
ENG01ESRdiEstop
PLC 15 System Fault Mask Healthy
PLC15SYSTEMgbHealthy
PLC15 Heatbeat from PLC11 Healthy
PLC15HEARTBEATgbHealthy
PLC 11 "Healthy" Output Healthy
PLC15PLC11diOkay
NOT
&
ENG01SV3dsPermit
(E/3) -> (E/3)
Engine 1 SV3 Lockout SV3
Part of SIF#8 Logic
Part of SIF#19 Logic
ENG01SV3
Group Reset
'AND'
Packed Input
Packed First Out
Any One In
Any One Out
Input 1
Input 2
Input 3
Input 4
Input 5
Input 6
Input 7
Input 8
Input 9
Input 10
First Out 1
First Out 2
First Out 3
First Out 4
First Out 5
First Out 6
First Out 7
First Out 8
First Out 9
First Out 10
ENG01SV3dqEnergise
Engine 1 Emergency Stop Solenoid Valve 3 Energise (HESR)
(E/3) -> (E/3)
ENG01SV3dsPermit
Engine 1 Emergency Stop Solenoid Valve 3 Energise
ENG01SV3dqEnergise
Engine 1 Emergency Stop Valve Suppy Relay ESVSR Fault
ENG01ESVSRdiFault
Engine 1 PS3 Emergency Stop Operated
ENG01PS3diEstop
>=1
NOT
Engine 1 Emergency Stop Relay Operated
ENG01ESRdiEstop
Energise Eng1 Emergency Stop Solenoid (HESR)
ENG01SV3gbEnergise
PLC 15 System Fault Mask Healthy
PLC15SYSTEMgbHealthy
PLC15 Heatbeat from PLC11 Healthy
PLC15HEARTBEATgbHealthy
PLC 11 "Healthy" Output Healthy
PLC15PLC11diOkay
Engine 1 Gas Pressure Switch OK
ENG01PSH15000diOK
Part of SIF#8 Logic
Engine 1 Cylinder 1 Temperature High High
ENG01TE11962gbHiHi
Engine 1 Cylinder 2 Temperature High High
ENG01TE11963gbHiHi
Engine 1 Cylinder 3 Temperature High High
ENG01TE11964gbHiHi
Engine 1 Cylinder 4 Temperature High High
ENG01TE11965gbHiHi
Engine 1 Cylinder 5 Temperature High High
ENG01TE11966gbHiHi
Engine 1 Cylinder 6 Temperature High High
ENG01TE11967gbHiHi
&
Part of SIF#19 Logic
ENG01CYLTEMPgbOK
Engine 1 Cylinder Temperatures OK,
Sheet-number: E/3 Creator: mwalker Creation date: 16/03/09 Tester: Testing date: Revision: srane/20/05/09/SCR04 srane/19/05/09/SCR03 mwalker/02/04/09/ 036591/02/04/09/
3
2
1
revision date name
date name
made Date Name
check
status: LZ
Brisbane City Council
BCC - PLC 15 Replacement
based
replaced
ELOP II
replaced
logic
PLC__15
Page 28
Engine 1 SV3 Logic
version rev SCR04
coordinates E/3
6050...
page 48
of 79 sh.

Page 29 - Engine 1 SV4 Logic

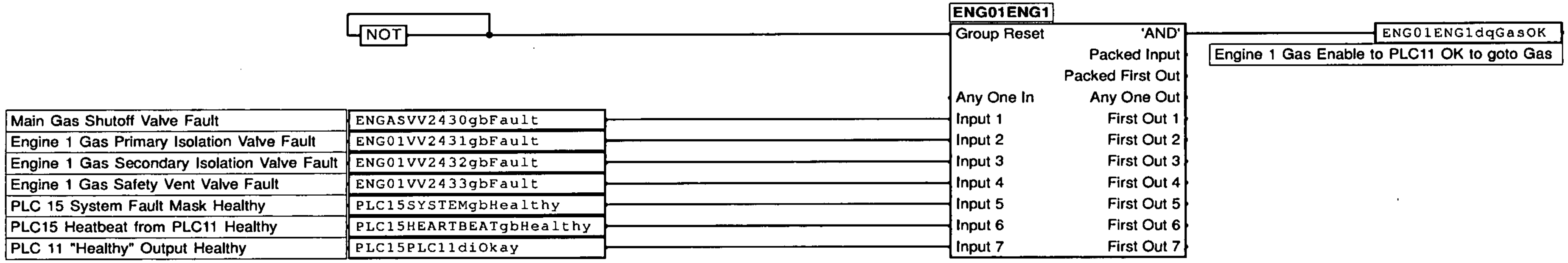


Sheet-number: E/4 Creator: mwalker Creation date: 16/03/09 Tester: Testing date: Revision: srane/20/05/09/SCR04 srane/03/04/09/ 036591/02/04/09/

3				date	name	Brisbane City Council	ELOP II	logic		version rev SCR04
2			made	Date	Name	BCC - PLC 15 Replacement		PLC__15		coordinates E/4
1			check					Page 29	6050...	page 49
revision	date	name	status:	LZ		based	replaced / replaced	Engine 1 SV4 Logic		of 79 sh.

Page 30 - Engine 1 OK to go to Gas

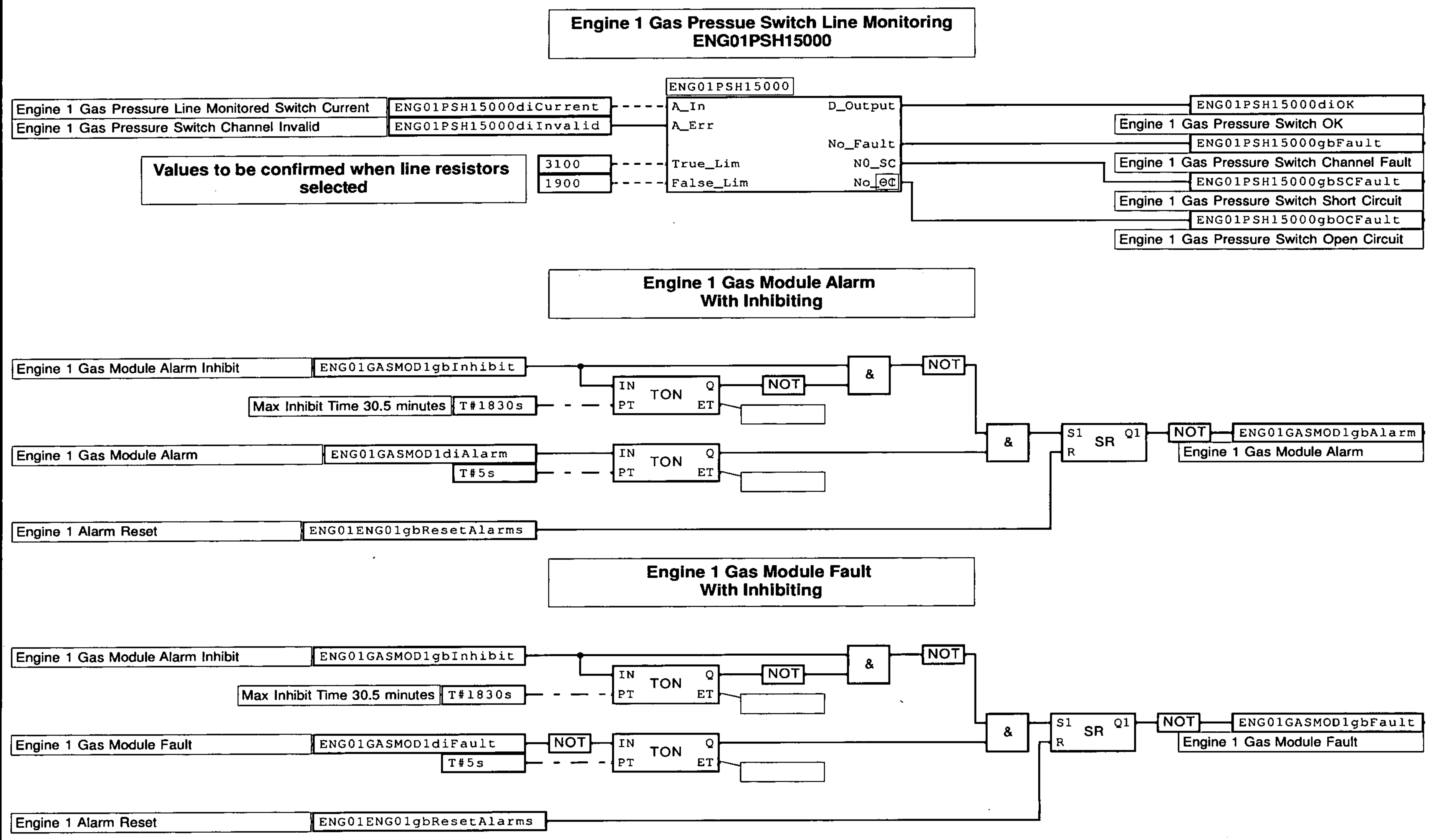
Engine 1 OK to go to Gas Lockout
ENG1



Sheet-number: E/5 Creator: mwalker Creation date: 16/03/09 Tester: Testing date: Revision: srane/03/04/09/ 036591/02/04/09/ srane/30/03/09/

3				date	name	Brisbane City Council	ELOP II	logic PLC___15	version rev SCR01
2			made	Date	Name	BCC - PLC 15 Replacement		Page 30	coordinates E/5
1			check					Engine 1 OK to go to Gas	6050... page 50 of 79 sh.
revision	date	name	status: LZ			based	replaced	replaced	

Page 31 - Engine 1 Gas PS and Module Inhibits



Sheet-number: E/6 Creator: mwalker Creation date: 16/03/09 Tester: Testing date: Revision: mwalker/02/04/09/ 036591/02/04/09/ srane/31/03/09/ srane/30/03/09/ srane/27/03/09/

3				date	name	Brisbane City Council	ELOP II	logic	version rev SCR01
2			made	Date	Name	BCC - PLC 15 Replacement		PLC__15	coordinates E/6
1			check					Page 31	6050... page 51
revision	date	name	status: LZ			based	replaced / replaced	Engine 1 Gas PS and Module Inhibits	of 79 sh.

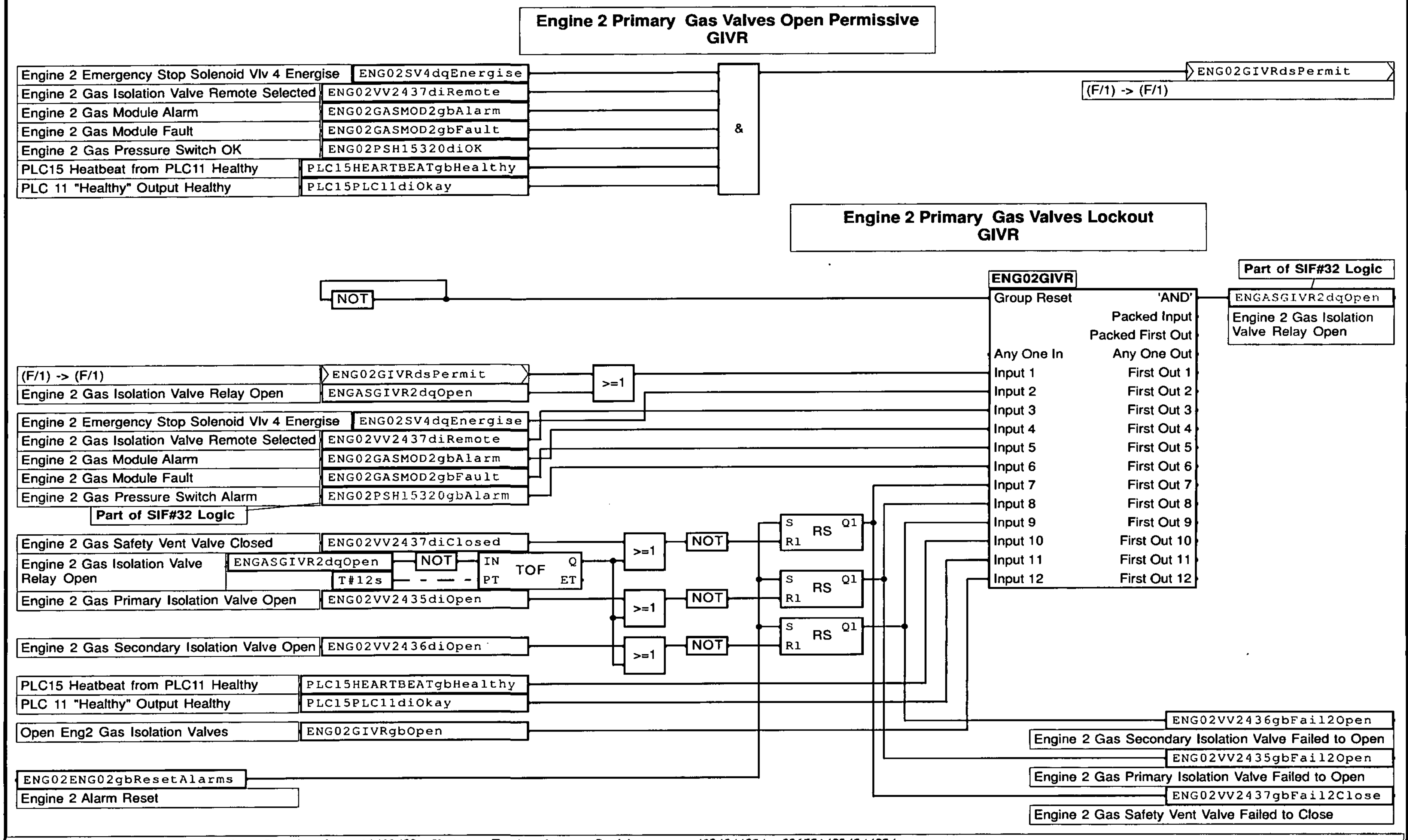
Contains SIF#32 Logic
Engine No 2 main gas to flame arrestor high pressure -> Engine #2 Shutdown
SILa RRF0

Contains SIF#43 Logic
Engine No 2 Flame Arrester to Exhaust Manifold High Temperature -> Engine #2 Shutdown
SIL1 RRF10.1

ENGINE 2 CONTROL SEQUENCE

3					date	name	Brisbane City Council	ELOP II	logic	version rev SCR01
2				made	Date	Name	BCC - PLC 15 Replacement		PLC___15	coordinates F/0
1				check					Page 32	6050... page 52
	revision	date	name	status: LZ			based	replaced	replaced	of 79 sh.

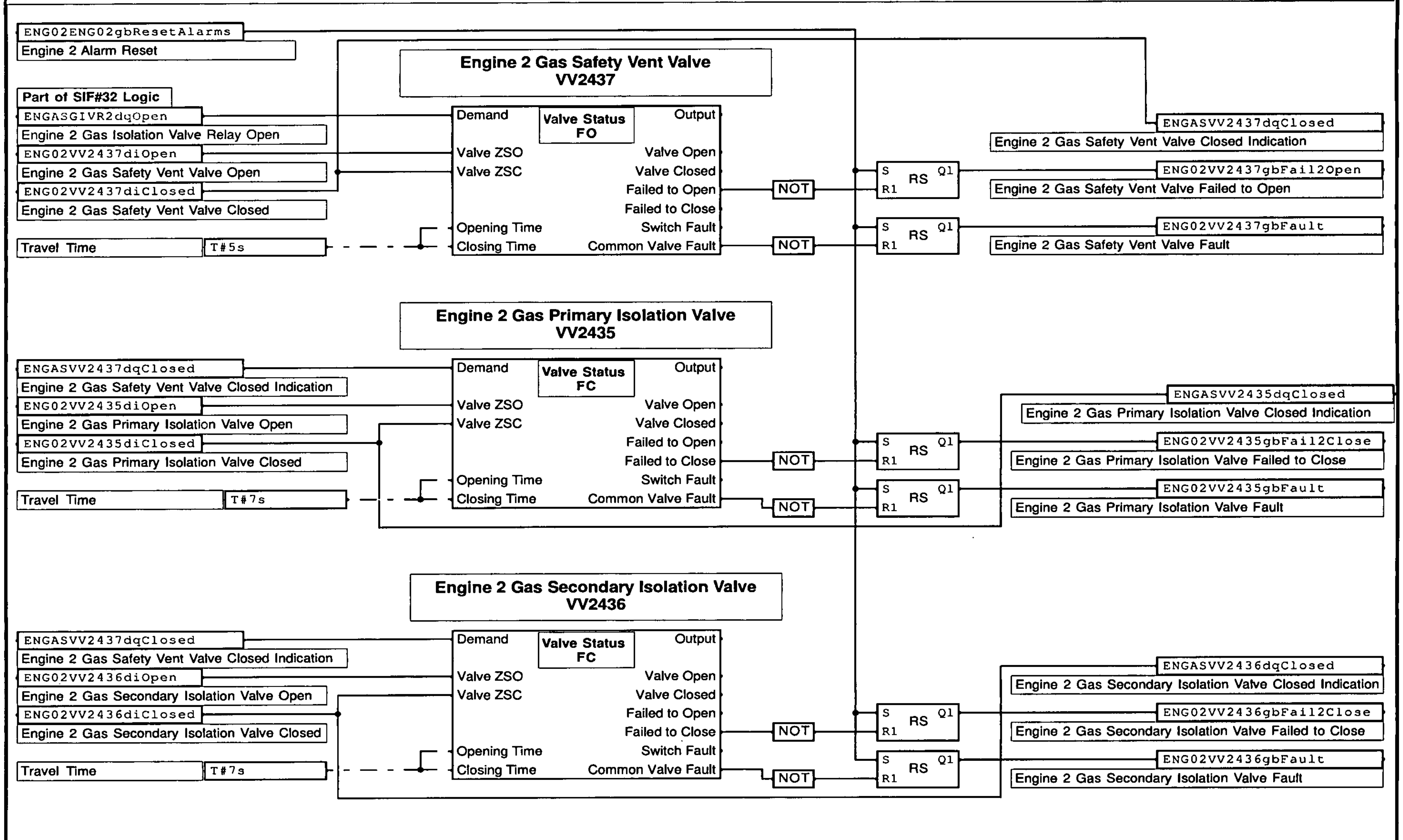
Page 33 - Engine 2 Gas Valves Logic



Sheet-number: F/1 Creator: mwalker Creation date: 16/03/09 Tester: Testing date: Revision: srane/03/04/09/ 036591/02/04/09/

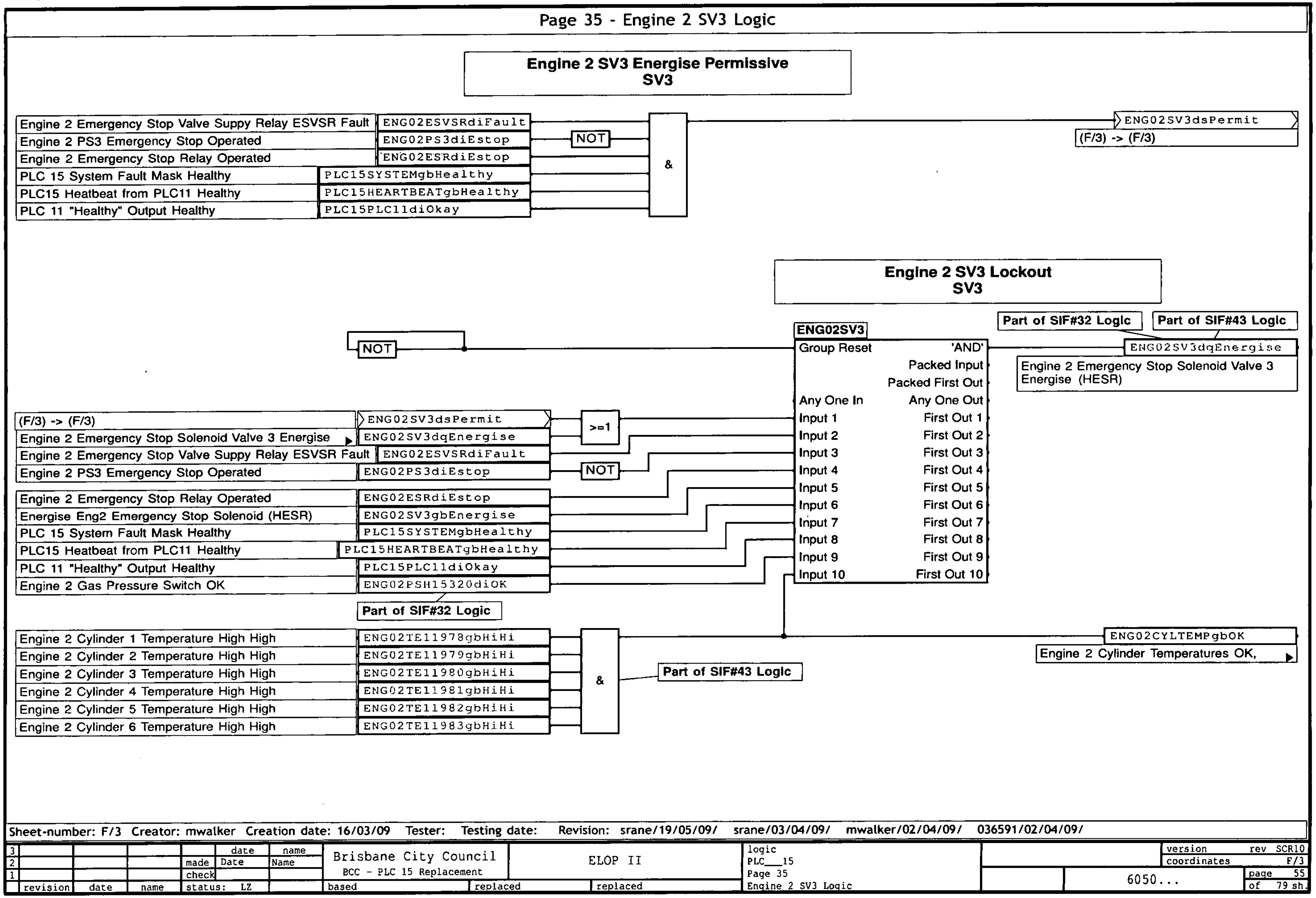
3				date	name	Brisbane City Council	ELOP II	logic	version rev SCR11
2			made	Date	Name	BCC - PLC 15 Replacement		PLC__15	coordinates F/1
1			check					Page 33	6050... page 53
revision	date	name	status: LZ			based	replaced / replaced	Engine 2 Gas Valves Logic	of 79 sh.

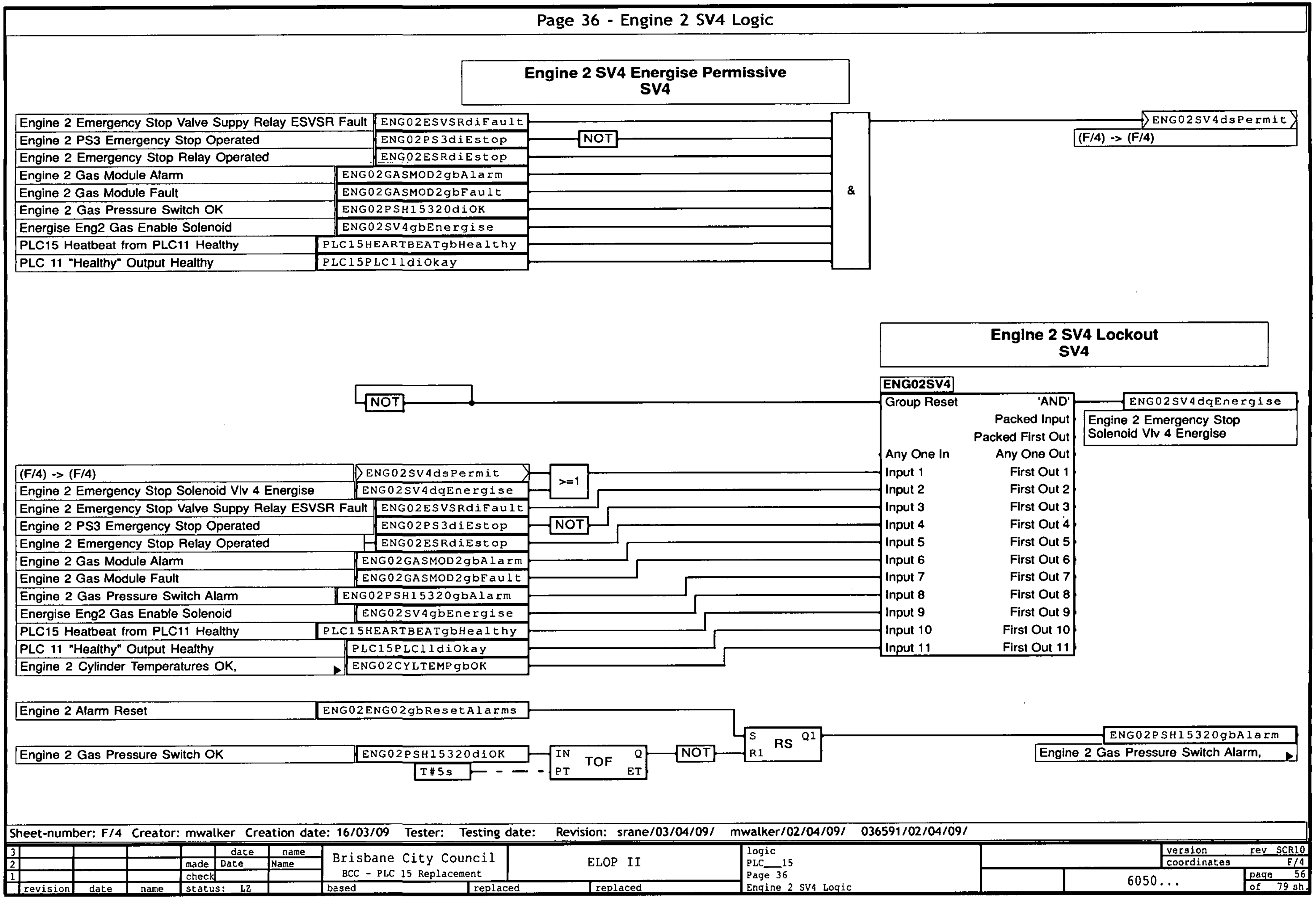
Page 34 - Engine 2 Gas Valves



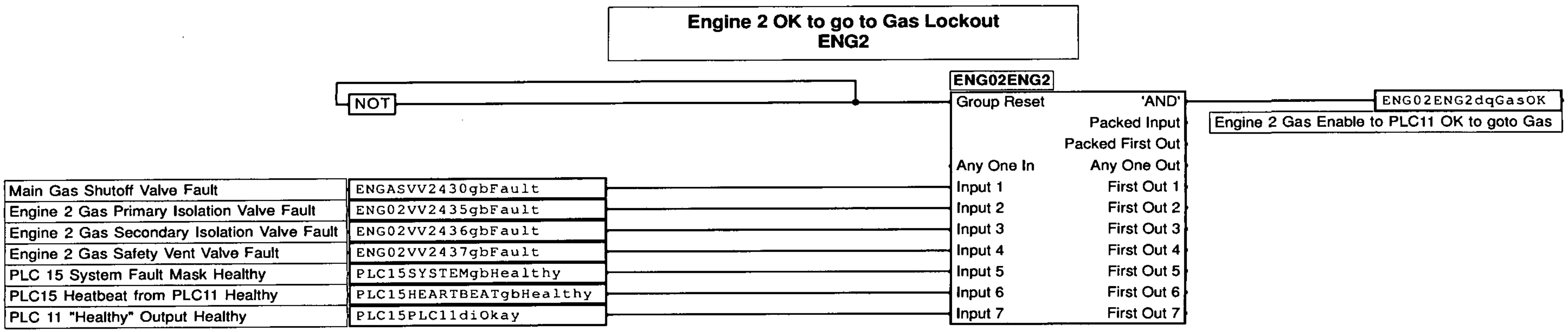
Sheet-number: F/2 Creator: mwalker Creation date: 16/03/09 Tester: Testing date: Revision: srane/03/04/09/ mwalker/02/04/09/ srane/02/04/09/ 036591/02/04/09/ srane/30/03/09/

3				date	name	Brisbane City Council	ELOP II	logic	version rev SCR10
2			made	Date	Name	BCC - PLC 15 Replacement		PLC__15	coordinates F/2
1			check					Page 34	6050... page 54
revision	date	name	status: LZ			based / replaced	replaced	Engine 2 Gas Valves	of 79 sh.


Page 35 - Engine 2 SV3 Logic
Engine 2 SV3 Energise Permissive
SV3
Engine 2 Emergency Stop Valve Suppy Relay ESVSR Fault
ENG02ESVSRdiFault
Engine 2 PS3 Emergency Stop Operated
ENG02PS3diEstop
NOT
Engine 2 Emergency Stop Relay Operated
ENG02ESRdiEstop
PLC 15 System Fault Mask Healthy
PLC15SYSTEMgbHealthy
PLC15 Heatbeat from PLC11 Healthy
PLC15HEARTBEATgbHealthy
PLC 11 "Healthy" Output Healthy
PLC15PLC11diOkay
&
ENG02SV3dsPermit
(F/3) -> (F/3)
Engine 2 SV3 Lockout
SV3
NOT
ENG02SV3
Group Reset
'AND'
Packed Input
Packed First Out
Any One In
Any One Out
Input 1
Input 2
Input 3
Input 4
Input 5
Input 6
Input 7
Input 8
Input 9
Input 10
First Out 1
First Out 2
First Out 3
First Out 4
First Out 5
First Out 6
First Out 7
First Out 8
First Out 9
First Out 10
Part of SIF#32 Logic
Part of SIF#43 Logic
ENG02SV3dqEnergise
Engine 2 Emergency Stop Solenoid Valve 3 Energise (HESR)
(F/3) -> (F/3)
ENG02SV3dsPermit
>=1
Engine 2 Emergency Stop Solenoid Valve 3 Energise
ENG02SV3dqEnergise
Engine 2 Emergency Stop Valve Suppy Relay ESVSR Fault
ENG02ESVSRdiFault
Engine 2 PS3 Emergency Stop Operated
ENG02PS3diEstop
NOT
Engine 2 Emergency Stop Relay Operated
ENG02ESRdiEstop
Energise Eng2 Emergency Stop Solenoid (HESR)
ENG02SV3gbEnergise
PLC 15 System Fault Mask Healthy
PLC15SYSTEMgbHealthy
PLC15 Heatbeat from PLC11 Healthy
PLC15HEARTBEATgbHealthy
PLC 11 "Healthy" Output Healthy
PLC15PLC11diOkay
Engine 2 Gas Pressure Switch OK
ENG02PSH15320diOK
Part of SIF#32 Logic
Engine 2 Cylinder 1 Temperature High High
ENG02TE11978gbHiHi
Engine 2 Cylinder 2 Temperature High High
ENG02TE11979gbHiHi
Engine 2 Cylinder 3 Temperature High High
ENG02TE11980gbHiHi
Engine 2 Cylinder 4 Temperature High High
ENG02TE11981gbHiHi
Engine 2 Cylinder 5 Temperature High High
ENG02TE11982gbHiHi
Engine 2 Cylinder 6 Temperature High High
ENG02TE11983gbHiHi
&
Part of SIF#43 Logic
ENG02CYLTEMPgbOK
Engine 2 Cylinder Temperatures OK,
Sheet-number: F/3 Creator: mwalker Creation date: 16/03/09 Tester: Testing date: Revision: srane/19/05/09/ srane/03/04/09/ mwalker/02/04/09/ 036591/02/04/09/
3
2
1
revision
date
name
date
name
made
Date
Name
check
status: LZ
Brisbane City Council
BCC - PLC 15 Replacement
based
replaced
ELOP II
replaced
logic
PLC__15
Page 35
Engine 2 SV3 Logic
version
rev SCR10
coordinates
F/3
6050...
page 55
of 79 sh.

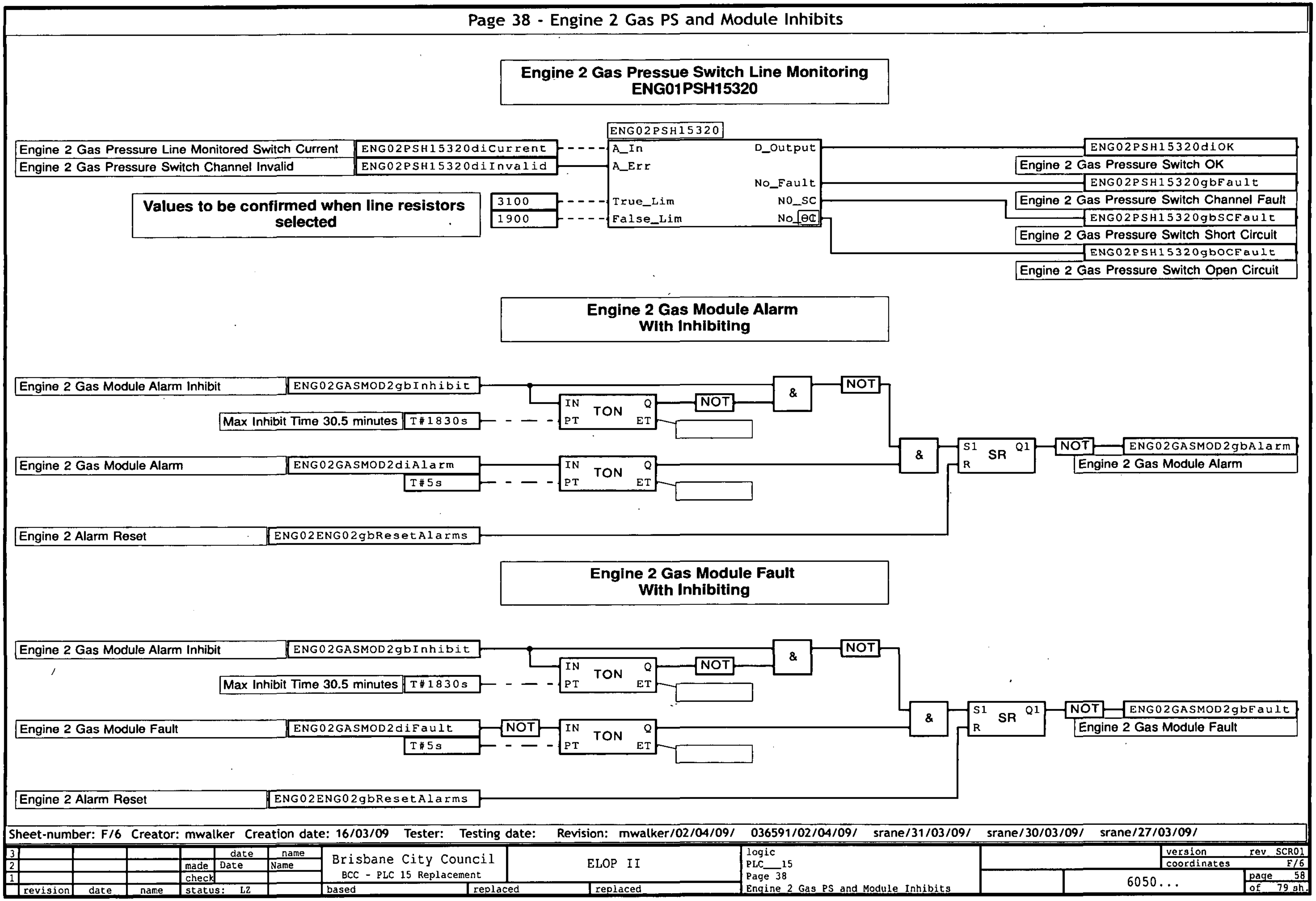

Page 36 - Engine 2 SV4 Logic
Engine 2 SV4 Energise Permissive SV4
Engine 2 Emergency Stop Valve Suppy Relay ESVSR Fault
ENG02ESVSRdiFault
Engine 2 PS3 Emergency Stop Operated
ENG02PS3diEstop
Engine 2 Emergency Stop Relay Operated
ENG02ESRdiEstop
Engine 2 Gas Module Alarm
ENG02GASMOD2gbAlarm
Engine 2 Gas Module Fault
ENG02GASMOD2gbFault
Engine 2 Gas Pressure Switch OK
ENG02PSH15320diOK
Energise Eng2 Gas Enable Solenoid
ENG02SV4gbEnergise
PLC15 Heatbeat from PLC11 Healthy
PLC15HEARTBEATgbHealthy
PLC 11 "Healthy" Output Healthy
PLC15PLC11diOkay
NOT
&
ENG02SV4dsPermit
(F/4) -> (F/4)
Engine 2 SV4 Lockout SV4
ENG02SV4
NOT
Group Reset
'AND'
Packed Input
Packed First Out
Any One In
Any One Out
Input 1
Input 2
Input 3
Input 4
Input 5
Input 6
Input 7
Input 8
Input 9
Input 10
Input 11
First Out 1
First Out 2
First Out 3
First Out 4
First Out 5
First Out 6
First Out 7
First Out 8
First Out 9
First Out 10
First Out 11
ENG02SV4dqEnergise
Engine 2 Emergency Stop Solenoid Vlv 4 Energise
(F/4) -> (F/4)
ENG02SV4dsPermit
Engine 2 Emergency Stop Solenoid Vlv 4 Energise
ENG02SV4dqEnergise
Engine 2 Emergency Stop Valve Suppy Relay ESVSR Fault
ENG02ESVSRdiFault
Engine 2 PS3 Emergency Stop Operated
ENG02PS3diEstop
Engine 2 Emergency Stop Relay Operated
ENG02ESRdiEstop
Engine 2 Gas Module Alarm
ENG02GASMOD2gbAlarm
Engine 2 Gas Module Fault
ENG02GASMOD2gbFault
Engine 2 Gas Pressure Switch Alarm
ENG02PSH15320gbAlarm
Energise Eng2 Gas Enable Solenoid
ENG02SV4gbEnergise
PLC15 Heatbeat from PLC11 Healthy
PLC15HEARTBEATgbHealthy
PLC 11 "Healthy" Output Healthy
PLC15PLC11diOkay
Engine 2 Cylinder Temperatures OK,
ENG02CYLTEMPgbOK
>=1
NOT
Engine 2 Alarm Reset
ENG02ENG02gbResetAlarms
Engine 2 Gas Pressure Switch OK
ENG02PSH15320diOK
T#5s
IN
PT
TOF
Q
ET
NOT
S
R1
RS
Q1
ENG02PSH15320gbAlarm
Engine 2 Gas Pressure Switch Alarm,
Sheet-number: F/4 Creator: mwalker Creation date: 16/03/09 Tester: Testing date: Revision: srane/03/04/09/ mwalker/02/04/09/ 036591/02/04/09/
3
2
1
revision
date
name
date
name
made
Date
Name
check
status: LZ
Brisbane City Council
BCC - PLC 15 Replacement
based
replaced
ELOP II
replaced
logic
PLC__15
Page 36
Engine 2 SV4 Logic
version
rev SCR10
coordinates
F/4
6050...
page 56
of 79 sh.

Page 37 - Engine 2 OK to go to Gas



Sheet-number: F/5 Creator: mwalker Creation date: 16/03/09 Tester: Testing date: Revision: srane/03/04/09/ 036591/02/04/09/

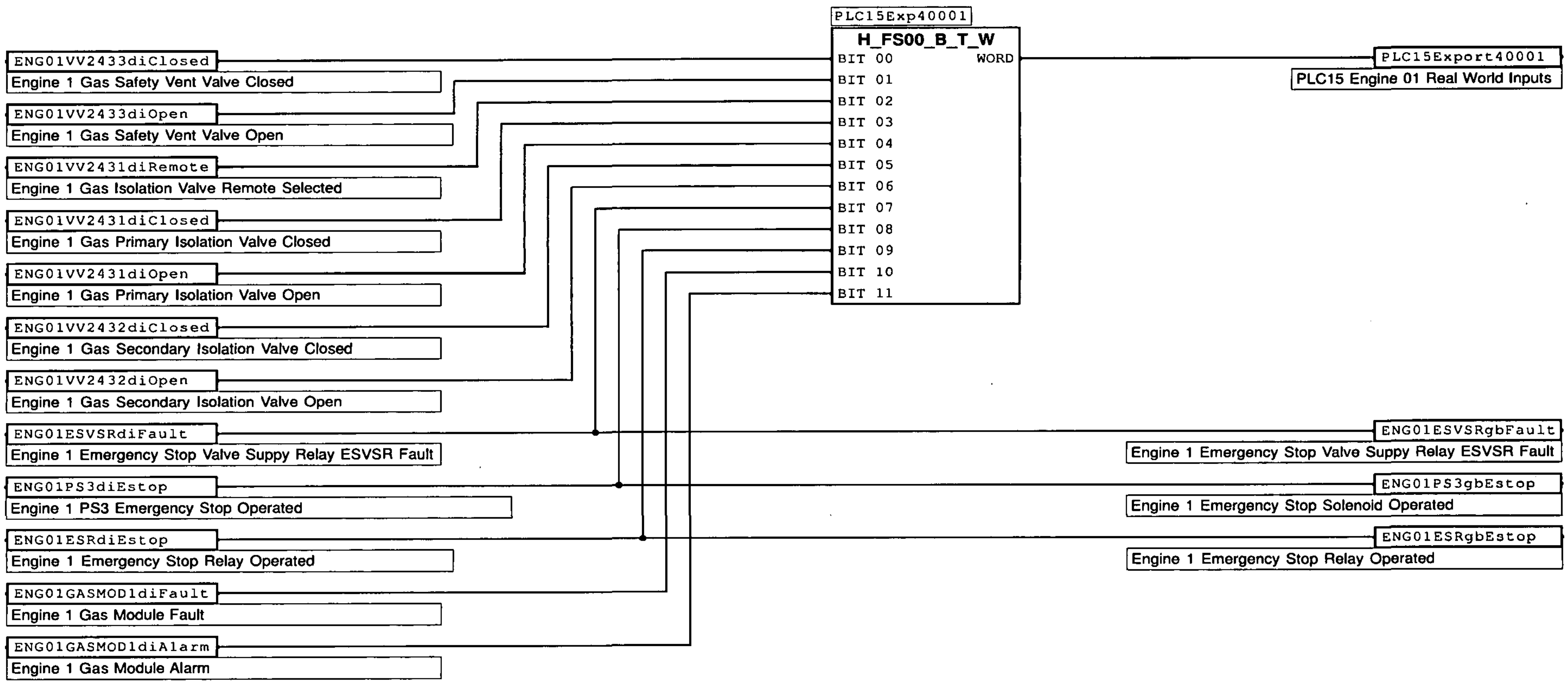
3				date	name	Brisbane City Council	ELOP II	logic	version rev SCR01
2			made	Date	Name	BCC - PLC 15 Replacement		PLC__15	coordinates F/5
1			check					Page 37	6050... page 57
revision	date	name	status: LZ			based / replaced	replaced	Engine 2 OK to go to Gas	of 79 sh.


Page 38 - Engine 2 Gas PS and Module Inhibits
Engine 2 Gas Pressue Switch Line Monitoring
ENG01PSH15320
Engine 2 Gas Pressure Line Monitored Switch Current
ENG02PSH15320diCurrent
Engine 2 Gas Pressure Switch Channel Invalid
ENG02PSH15320diInvalid
Values to be confirmed when line resistors selected
3100
1900
ENG02PSH15320
A_In
A_Err
True_Lim
False_Lim
D_Output
No_Fault
NO_SC
No_OC
ENG02PSH15320diOK
Engine 2 Gas Pressure Switch OK
ENG02PSH15320gbFault
Engine 2 Gas Pressure Switch Channel Fault
ENG02PSH15320gbSCFault
Engine 2 Gas Pressure Switch Short Circuit
ENG02PSH15320gbOCFault
Engine 2 Gas Pressure Switch Open Circuit
Engine 2 Gas Module Alarm
With Inhibiting
Engine 2 Gas Module Alarm Inhibit
ENG02GASMOD2gbInhibit
Max Inhibit Time 30.5 minutes
T#1830s
IN
PT
TON
Q
ET
NOT
&
Engine 2 Gas Module Alarm
ENG02GASMOD2diAlarm
T#5s
Engine 2 Alarm Reset
ENG02ENG02gbResetAlarms
S1
R
SR
Q1
ENG02GASMOD2gbAlarm
Engine 2 Gas Module Alarm
Engine 2 Gas Module Fault
With Inhibiting
Engine 2 Gas Module Alarm Inhibit
ENG02GASMOD2gbInhibit
Max Inhibit Time 30.5 minutes
T#1830s
Engine 2 Gas Module Fault
ENG02GASMOD2diFault
T#5s
Engine 2 Alarm Reset
ENG02ENG02gbResetAlarms
ENG02GASMOD2gbFault
Engine 2 Gas Module Fault
Sheet-number: F/6 Creator: mwalker Creation date: 16/03/09 Tester: Testing date: Revision: mwalker/02/04/09/ 036591/02/04/09/ srane/31/03/09/ srane/30/03/09/ srane/27/03/09/
revision
date
name
made
check
status: LZ
Date
Name
Brisbane City Council
BCC - PLC 15 Replacement
based
replaced
ELOP II
replaced
logic
PLC__15
Page 38
Engine 2 Gas PS and Module Inhibits
version
rev SCR01
coordinates
F/6
6050...
page 58
of 79 sh.

PLC15 -> PLC11
MODBUS COMMUNICATION
BIT PACKING

3				date	name	Brisbane City Council	ELOP II	logic	version rev SCR01
2			made	Date	Name			PLC__15	coordinates G/0
1			check			BCC - PLC 15 Replacement		Page 39	6050... page 59
revision	date	name	status: LZ			based	replaced	replaced	of 79 sh.

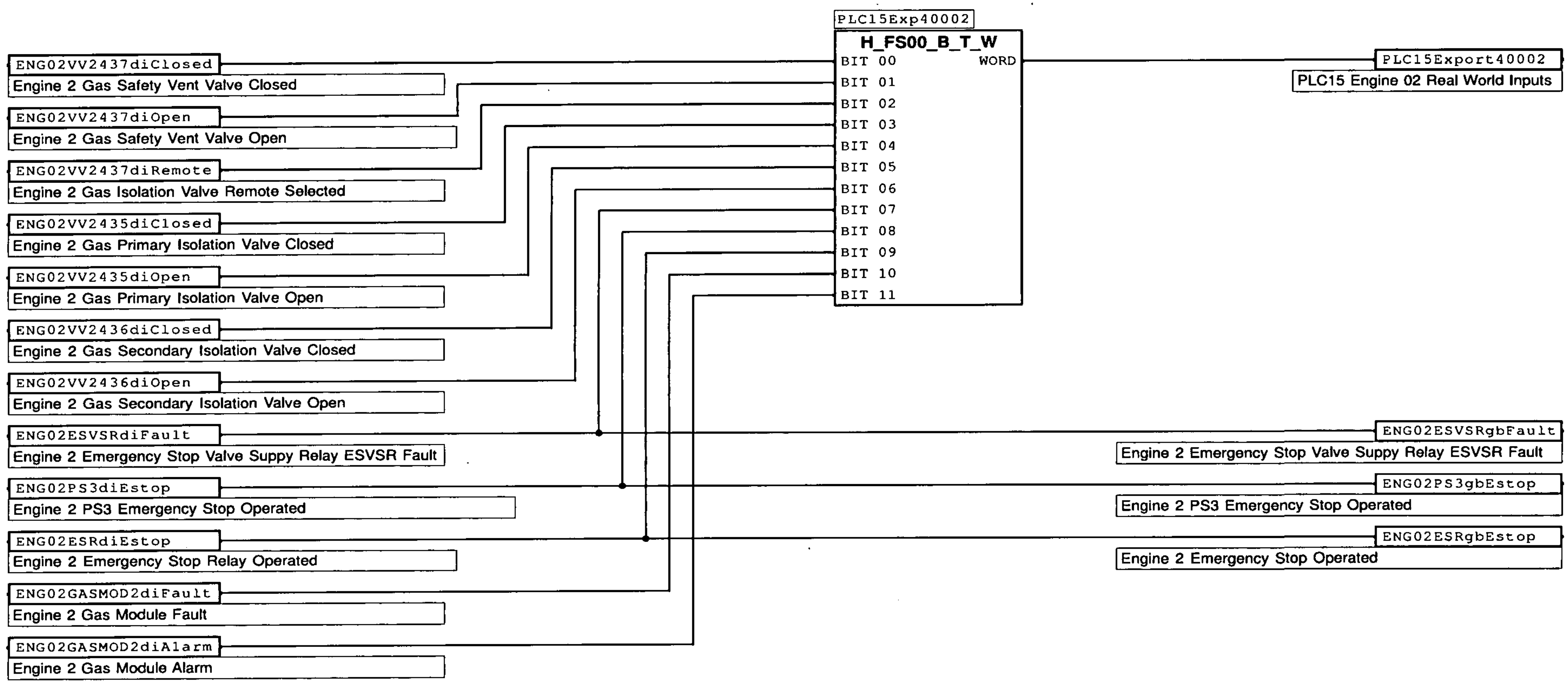
Page 40 - PLC15 Export 40001 - Real World Inputs



Sheet-number: G/1 Creator: mwalker Creation date: 16/03/09 Tester: Testing date: Revision: 036591/02/04/09/

3				date	name	Brisbane City Council	ELOP II	logic	version rev SCR01
2			made	Date	Name	BCC - PLC 15 Replacement		PLC___15	coordinates G/1
1			check					Page 40	6050... page 60
revision	date	name	status: LZ			based	replaced / replaced	PLC15 Export 40001 - Real World Inputs	of 79 sh.

Page 41 - PLC15 Export 40002 - Real World Inputs



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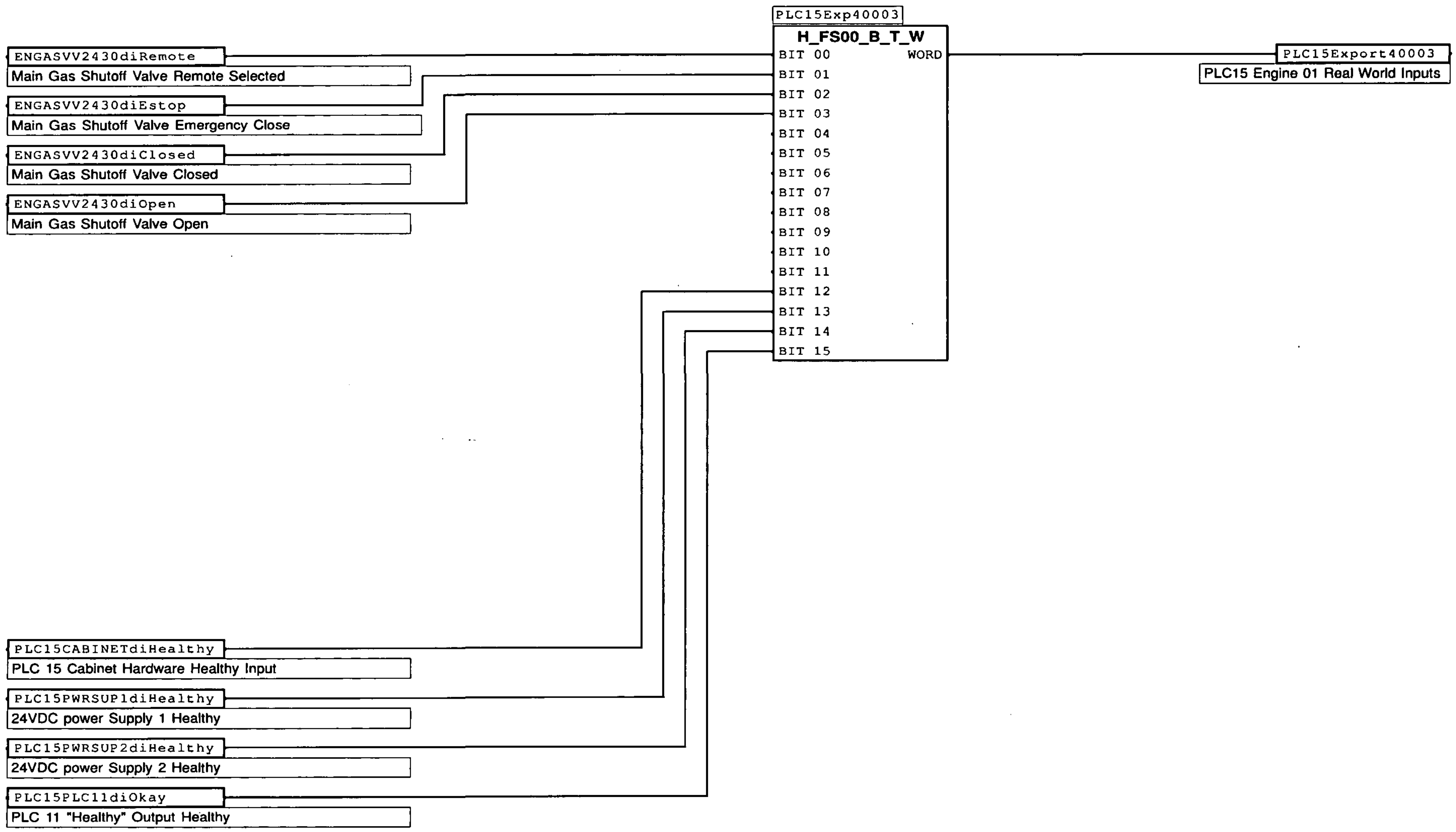
3				date	name	Brisbane City Council	ELOP II	logic
2			made	Date	Name	BCC - PLC 15 Replacement		PLC__15
1			check					Page 41
revision	date	name	status: LZ			based	replaced	replaced	PLC15 Export 40002 - Real World Inputs

version rev SCR01
coordinates G/2
6050...
page 61
of 79 sh.

Page 42 - PLC15 Export 40003 - Real World Inputs



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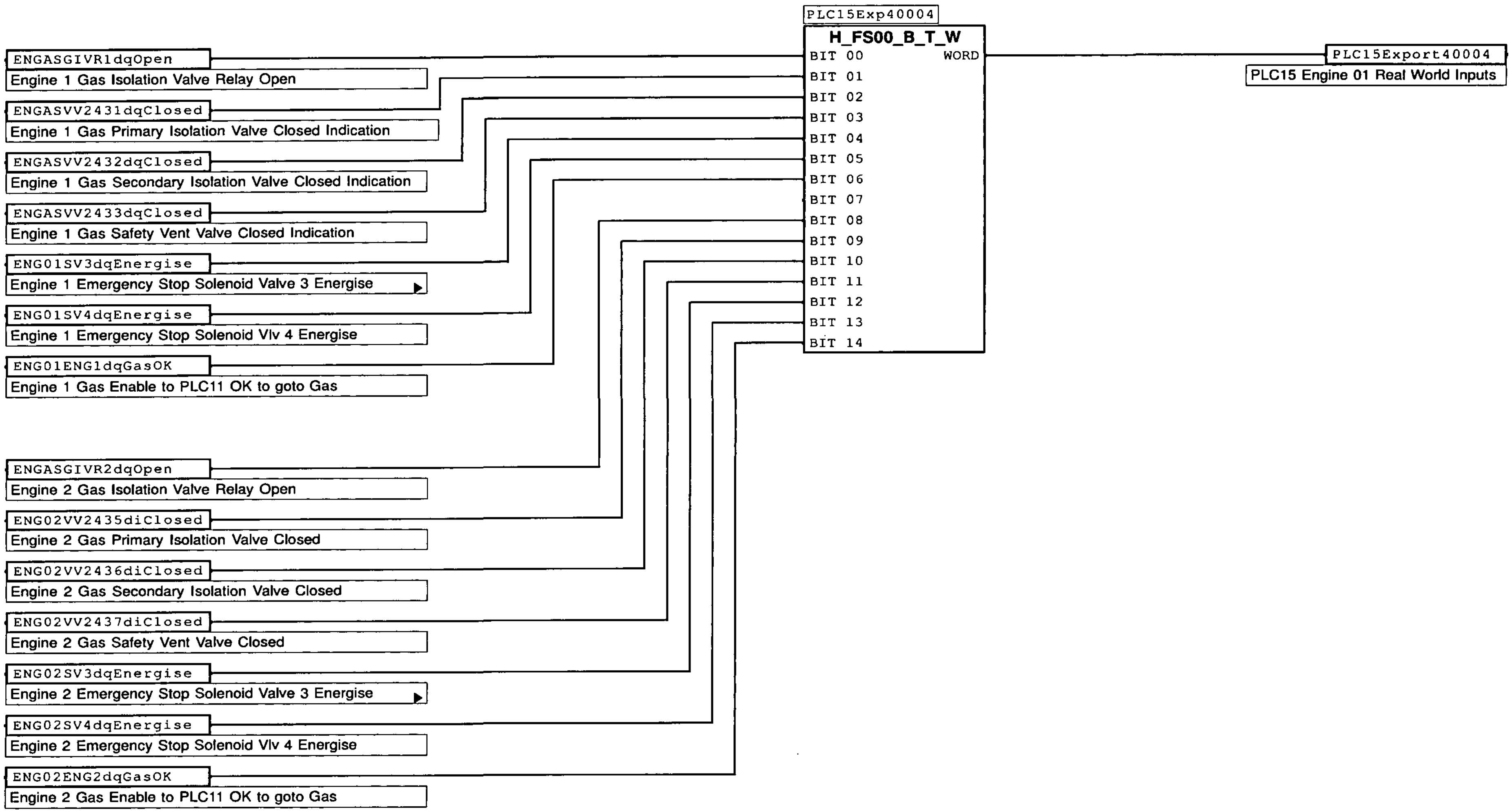
1			check					Page 42	6050... page 62
revision	date	name	status:	LZ		based	replaced / replaced	PLC15 Export 40003 - Real World Inputs	of 79 sh.

Page 43 - PLC15 Export 40004 - Real World Inputs



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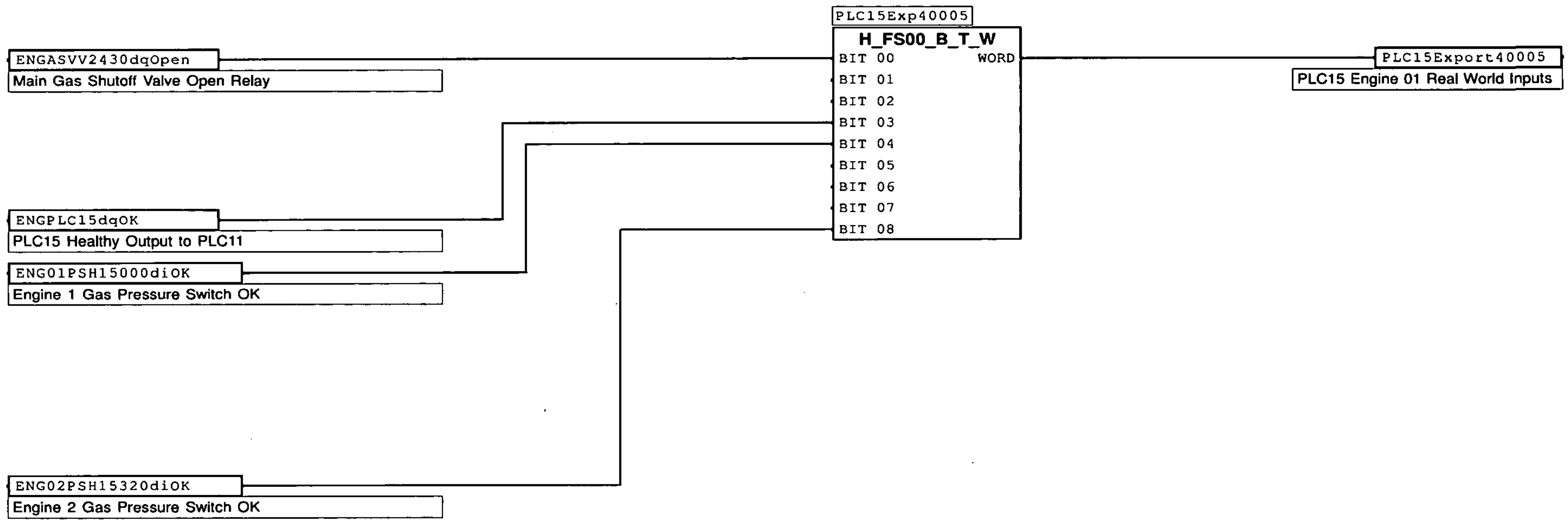
3				date	name	Brisbane City Council	ELOP II	logic	version rev SCR03
2			made	Date	Name	BCC - PLC 15 Replacement		PLC___15	coordinates G/4
1			check					Page 43	6050... page 63
revision	date	name	status: LZ			based	replaced	replaced	PLC15 Export 40004 - Real World Inputs	of 79 sh.

Page 44 - PLC15 Export 40005 - Real World Inputs



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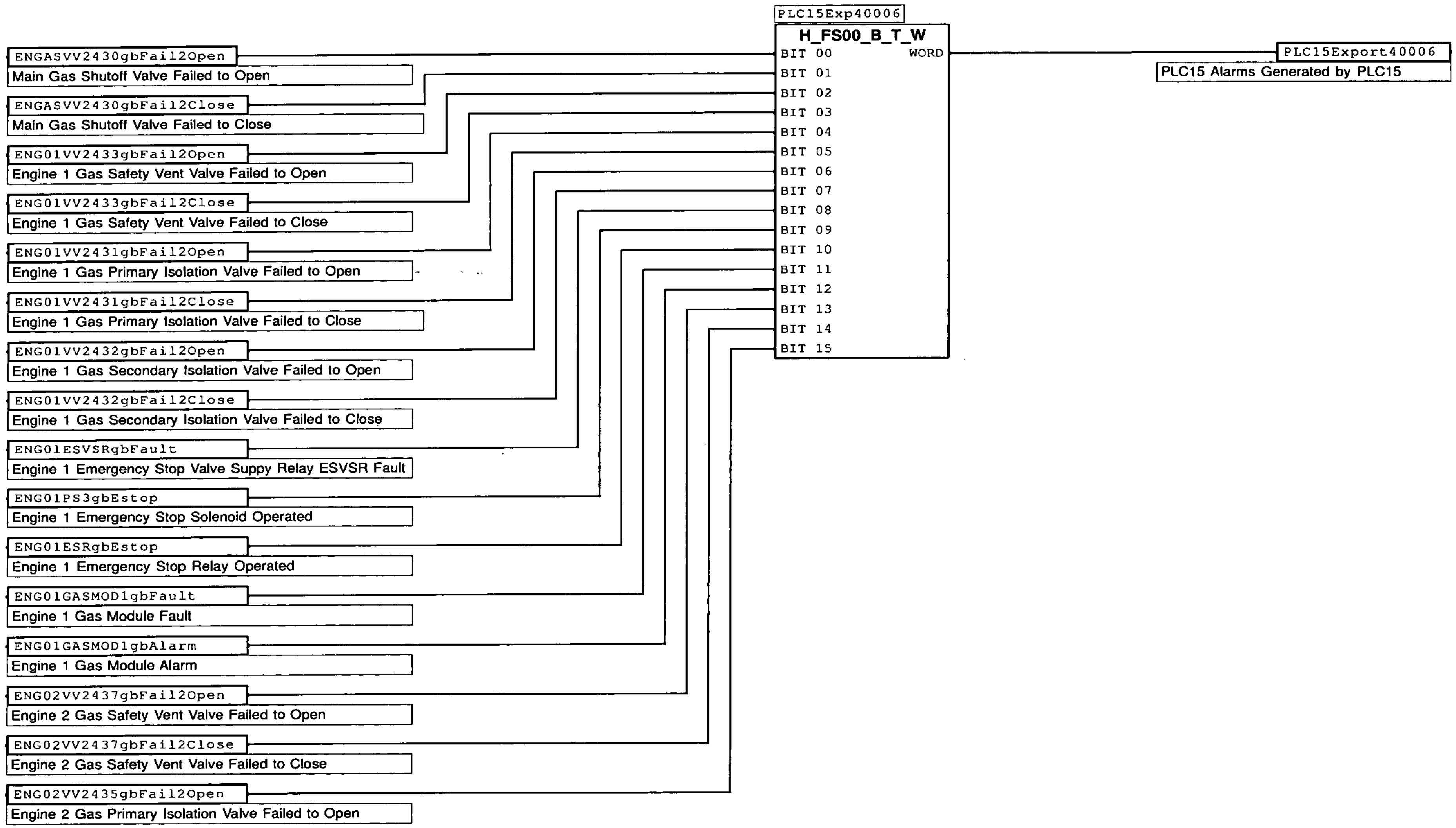
2			made	Date	Name	BCC - PLC 15 Replacement		PLC___15		coordinates G/5
1			check					Page 44	6050...	page 64
revision	date	name	status: LZ			based / replaced	replaced	PLC15 Export 40005 - Real World Inputs		of 79 sh.

Page 45 - PLC15 Export 40006 - PLC 15 Alarms



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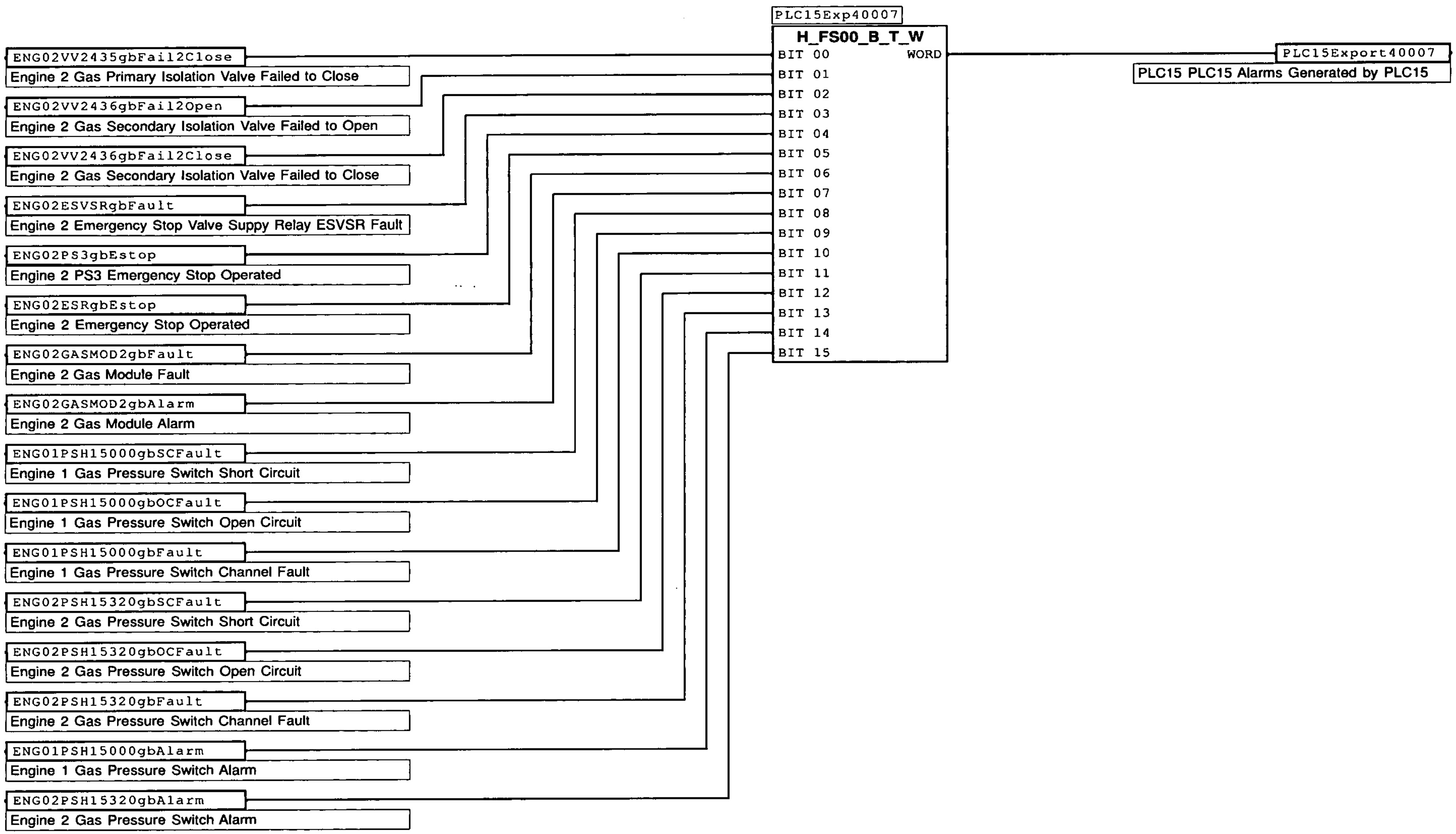
1			check					Page 45	6050... page 65
revision	date	name	status: LZ			based	replaced / replaced	PLC15 Export 40006 - PLC 15 Alarms	of 79 sh.

Page 46 - PLC15 Export 40007 - PLC 15 Alarms



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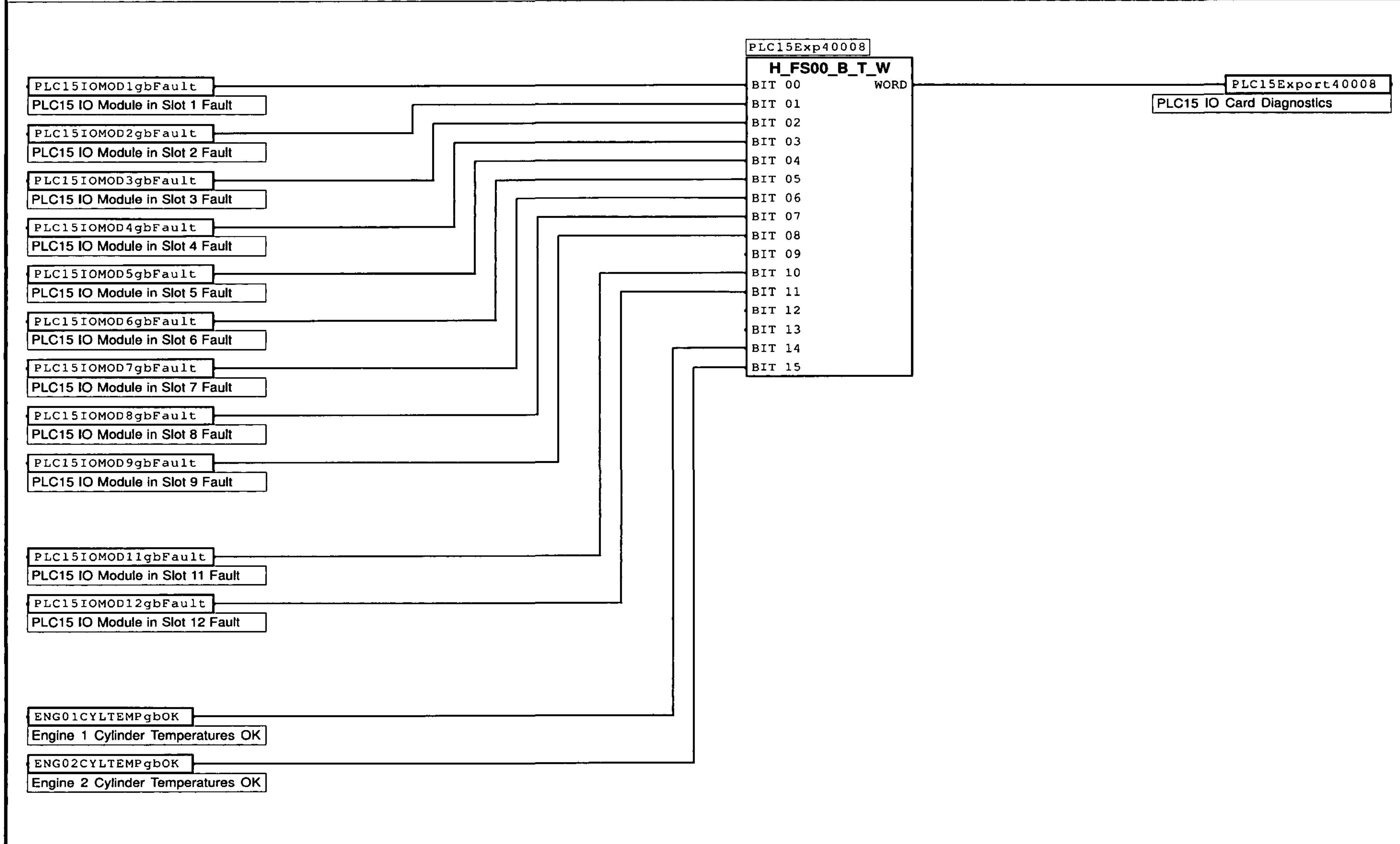
2			made	Date	Name	BCC - PLC 15 Replacement		PLC___15	coordinates G/7
1			check					Page 46	6050... page 66
revision	date	name	status: LZ			based / replaced	replaced	PLC15 Export 40007 - PLC 15 Alarms	of 79 sh.

PLC15 -> PLC11
MODBUS COMMUNICATION
BIT PACKING

3				date	name	Brisbane City Council	ELOP II	logic		version rev SCR01
2			made	Date	Name	BCC - PLC 15 Replacement		PLC___15		coordinates H/0
1			check					Page 47	6050...	page 67
	revision	date	name	status: LZ		based	replaced	replaced		of 79 sh.

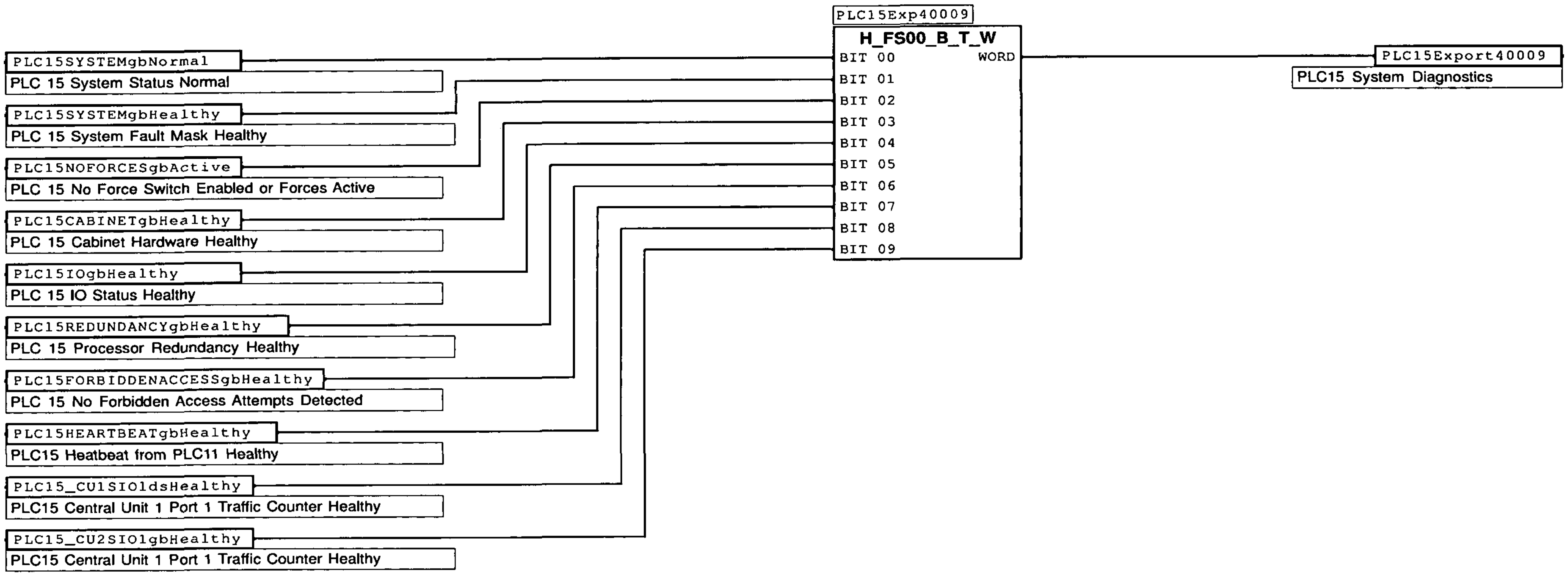
Page 48 - PLC15 Export 40008 - PLC 15 IO Card Diag



Sheet-number: H/1 Creator: mwalker Creation date: 16/03/09 Tester: Testing date: Revision: 036591/02/04/09/

3				date	name	Brisbane City Council	ELOP II	logic		version rev SCR01
2			made	Date	Name	BCC - PLC 15 Replacement		PLC__15		coordinates H/1
1			check					Page 48	6050...	page 68
revision	date	name	status: LZ			based	replaced / replaced	PLC15 Export 40008 - PLC 15 IO Card Diag		of 79 sh.

Page 49 - PLC15 Export 40009 - PLC15 System Alarms



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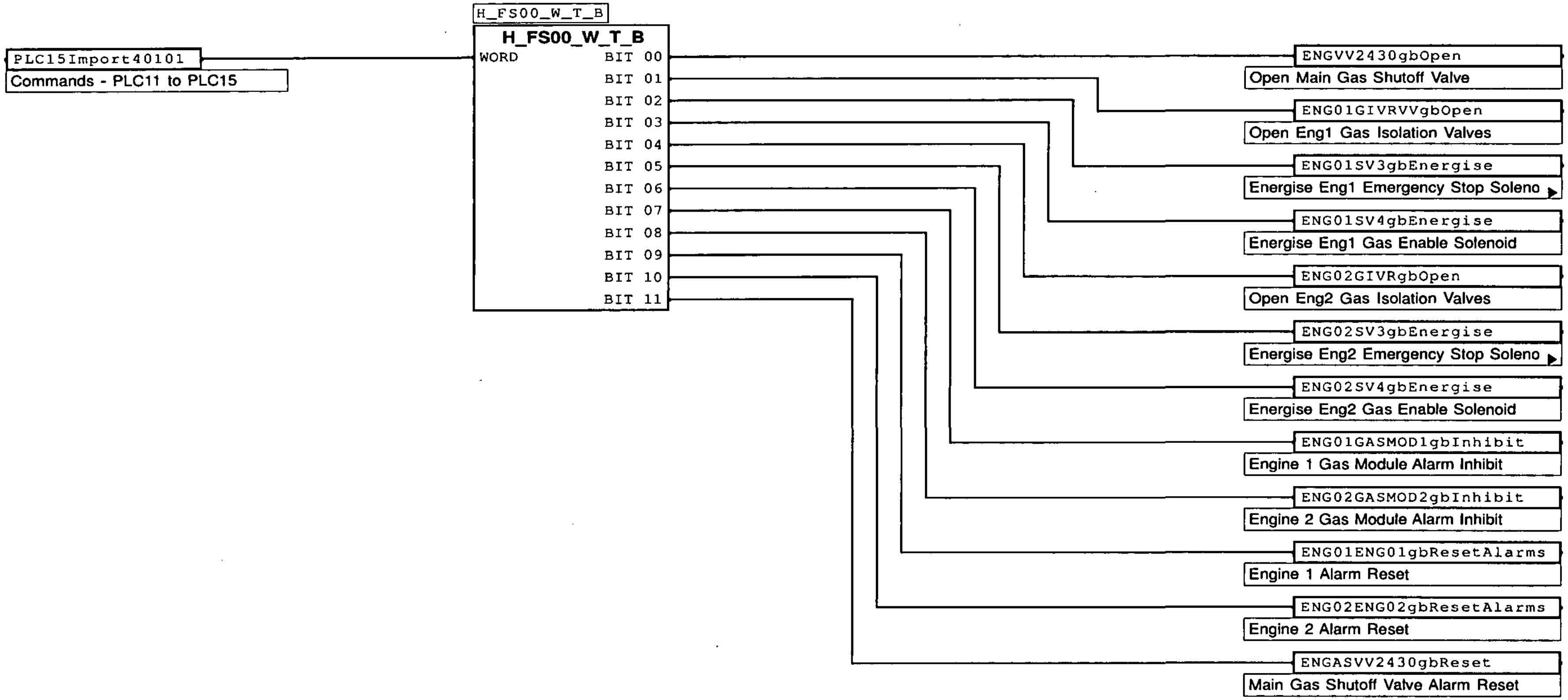
2			made	Date	Name	BCC - PLC 15 Replacement		PLC__15	coordinates H/2
1			check					Page 49	6050... page 69
revision	date	name	status: LZ			based / replaced	replaced	PLC15 Export 40009 - PLC15 System Alarms	of 79 sh.

PLC11 -> PLC15
MODBUS COMMUNICATION
BIT UN-PACKING

3					date	name	Brisbane City Council	ELOP II	logic PLC__15 Page 50	version rev SCR01
2				made	Date	Name				coordinates I/0
1				check			BCC - PLC 15 Replacement			6050... page 70
	revision	date	name	status: LZ			based / replaced	replaced		of 79 sh.

Page 51 - PLC15 Import 40101 - Commands from PLC11



Sheet-number: I/1 Creator: mwalker Creation date: 16/03/09 Tester: Testing date: Revision:

3				date	name	Brisbane City Council	ELOP II	logic	version rev SCR03
2			made	Date	Name	BCC - PLC 15 Replacement		PLC__15	coordinates I/1
1			check					Page 51	6050... page 71
revision	date	name	status: LZ			based replaced	replaced	PLC15 Import 40101 - Commands from PLC11	of 79 sh.

HIMA

B 4237-1/-2 / H41q-HS/HRS

B 4237-1/-2: Assembly Kit / H41q-HS/HRS: System

System H41q-HS/HRS in K 1409 system subrack, 5 HU, 19 inches with redundant central modules, power supply 24/5 V, I/O level, communication module (optional), coprocessor modules (optional) and four fans
H41q-HS / B 4237-1: single channel bus, redundant central modules
H41q-HRS / B 4237-2: redundant bus, redundant central modules
TÜV certified, applicable up to SIL 3 according to IEC 61508

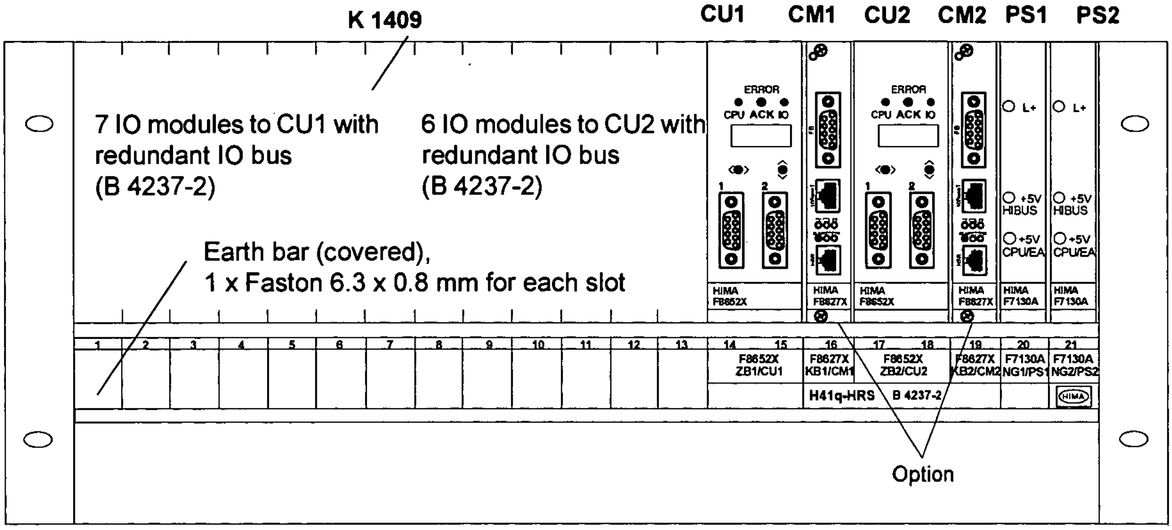


Figure 1: Front view

1 Parts of B 4237-1/2 assembly kit / H41q- HS/HRS system

- 1 x K 1409 system rack, 5 HU, 19 inches, with cable tray with four fan modules K 9212, hinged receptacle for the label and backplane Z 1009.
  On the rear buffer batteries (G1, G2).
- additional modules on the rear
  - 2 x Z 6011 decoupling and fusing to feed the power supply modules
  - 1 x Z 6018 fan run monitoring and fuse monitoring
  - 2 x Z 6013 decoupling and fusing for the supply voltage of the WD signal
  - 1 x Z 6007 jumper plug (combination of the separated buses, single channel system H41q-HS / B 4237-1)

includes the modules:
- 2 x F 8652X central module (CU1, CU2)
- 2 x F 7130A power supply module 24 V / 5 VDC (PS1, PS2)
  The 5 V outputs of both power supplies are switched in parallel.

Modules for option (separate order):
- 2 x F 8621A coprocessor module F 8621A (CM1, CM2)
- 2 x communication modules (CM1, CM2)

e.g. F 8627X (Ethemet) or F 8628X (Profibus DP)

- H41q-HS / B 4237-1: max. 13 IO modules (slots 1 - 13)
- H41q-HRS / B 4237-2:
  7 IO modules (slots 1- 7) related to central module 1
  6 IO modules (slots 8 - 13) related to central module 2

Note	**Operating system/resource type in ELOP II** The assembly kit is usable since operating system BS41q/51q V7.0-8. Resource type in ELOP II: H41qce-HS/H41qce-HRS.

2 Modules

2.1 Central module F 8652X

The central module for safety related applications with TÜV certificate of the PES H41q-HS/ HRS contains the essential functions demonstrated in the block diagram of the central module:

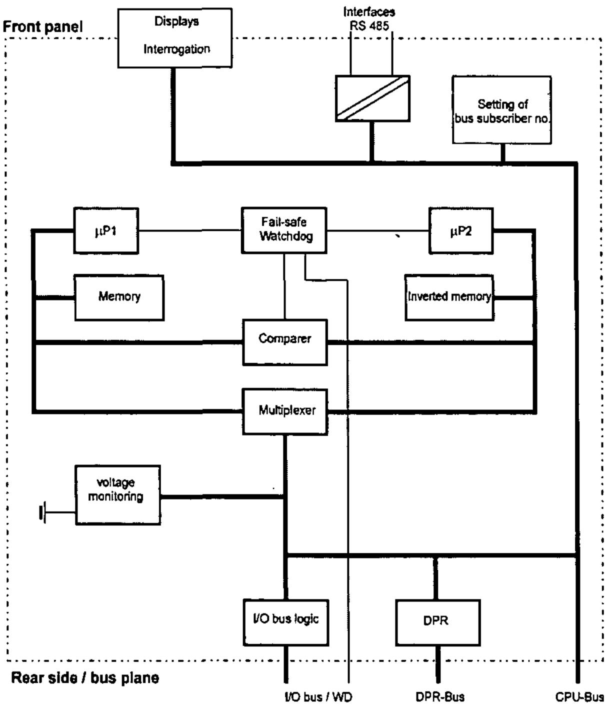


Figure 2: Block diagram of the central module F 8652X

- two clock-synchronized microprocessors
- each microprocessor with an own memory, one processor operates with real data and program and the other one with inverted data and program
- testable hardware comparer for all the external accesses of both microprocessors, in case of a fault the watchdog will be set to the safe status and the status of the processor is announced
- Flash-EPROMs of the program memory for the operating system and the user program usable for min. 100,000 writing cycles
- Data memory in sRAM
- Multiplexer to connect I/O bus, DPR and redundant CU
- Battery backup of the sRAMs via batteries with monitoring

- 2 interfaces RS 485 with galvanic isolation. Transmission rate: max. 57600 bps
- 4digit diagnostic display and 2 LEDs for information out of the system, I/O level and user program
- Dual Port RAM for fast memory access to the second central module
- Hardware clock, battery buffered
- I/O bus logic and connection to the input/output modules
- Watchdog
- Power supply monitoring, testable (5 V system voltage)
- Battery monitoring

2.2 Coprocessor module F 8621A

Right of the central module of the H41q-HS/HRS PES respectively one coprocessor module can be installed. The coprocessor module mainly contains:

- Microprocessor HD 64180 with a clock frequency of 10 MHz
- Operating system EPROM
- RAM for a PLC master project

Note The RAM for the master project is buffered via the batteries on the backplane of the subrack.

- Two interfaces RS 485, via communication software function block setting of the baud rate up to 57600 bps
- Dual port RAM (DPR) for the communication with the central module via CPU bus

2.3 Communication modules F 8627/F 8628, F 8627X/F 8628X

Right of the central module of the H41q-HS/HRS PES respectively one communication module can be installed. The communication module mainly contains:

- 32-bit RISC microprocessor
- Operating system
- RAM for further protocols
- F 8627 Ethernet interface (safe**ethernet**, OPC, ...)
  F 8628 Profibus-DP slave interface
- Dual port RAM (DPR) for the communication with the central module via CPU bus

Special applications with the communication module F 8627X:

- connection of the central module to a PADT (ELOP II TCP)
- connection to other communication partners within an Ethernet network (Modbus TCP)

Special application with the communication module F 8628X:

- ELOP II TCP connection (PADT) via the Ethernet interface of the F 8628X to the H41q/H51q controller

3 Startup and maintenance

⚠ Before startup the system switch on the rear buffer batteries G1 and G2 via DIP switches on the backplane!

A battery change of the buffer batteries without load (CPU in operation) is recommended every 6 years.
Buffer battery with soldering lug: HIMA part no. 44 0000016.
Buffer battery without soldering lug: HIMA part no. 44 0000019.
Further informations see also catalog H41q/H51q, chapter 9, "Startup and maintenance".

4 Wiring of the assembly kit

The assembly kit is already wired for operation. Wirings have still to be done by the user (optional modules, see "Assembly kit, wiring diagram").

⚠ With installation of the assembly kit a conductive connection to the frame or a separate earth connection has to be installed according to the EMC requirements.
Connection PE earth: Faston 6.3 x 0.8 mm.
Pay attention for the manufacturers information concerning detaching and replugging of the Faston connectors!

4.1 Current distribution within the assembly kit

4.1.1 HIMA devices for current distribution

It is recommended to use the HIMA supplies and current distributions:

K 7212 redundant feeding up to 35 A total current, with 2 decoupling diodes and 2 network filters, with fusing of up to 12 single circuits with circuit breakers or

K 7213 redundant feeding up to 35 A total current, with fusing of up to 12 single circuits with circuit breakers or

K 7214 redundant feeding up to 150 A total current, with fusing of up to 18 single circuits with circuit breakers or

K 7215 redundant feeding up to 150 A total current, with fusing of up to 18 single circuits with circuit breakers, graphical display.

4.1.2 Supply 24 VDC

The supply voltage 24 VDC may be fed two times to the system H41q-HS/HRS. See also catalog H41q/H51q, chapter 3.3, The Input/Output Level, 24 VDC Supply and Distribution.

Connection	Wire and connection	Fusing	Use
XG.24/25:2 (L+)	RD 2.5 mm^2, Faston 6.3 x 0.8	max. 16 A	PS1, PS2
XG.24/25:1(L-)	BK 2.5 mm^2, Faston 6.3 x 0.8		Reference pole L-
XG.14 (L-)	BK 2 x 2.5 mm^2, Faston 6.3 x 0.8 (see note)		Reference pole L-
XG.6 (L+)	RD 1 mm^2, Faston 2.8 x 0.8 13 single connections	max. 4 A slow blow	see wiring diagram
RD = Color code red	BK = Color code black		

Table 1: Supply 24 VDC

⚠ **Connection XG.14**: To be wired to the central L- bus bar with at least 2 x 2.5 mm^2 BK. If output modules with 2-pole connection to the actors are used depending on the load up to 4 x 2.5 mm^2 BK wiring is necessary.

4.1.3 Supply 5 VDC

The 5 VDC power supply does not have to be wired separately as it is already installed as part of the subrack.

The 5 VDC power is used for the CPU, the control of the interfaces and the I/O modules. It is generated by 24 VDC / 5 VDC power supply module type F 7130A. The subrack is equipped with two power supply modules. The power supply modules are switched in parallel. If one of them fails, the other supplies the PES.

The 5 VDC output voltage of the power supply module (for the CPU, I/O and the interfaces) are monitored on the central module checking undervoltage, overvoltage or failure.

In case of a faulty power supply module the operating system of the CPU informs the user program via a system variable.

In case of a 5 VDC system power failure a lithium battery on the central module buffers the hardware clock and sRAM on the central module.

4.2 Connection of the monitoring loop (for fuses and fans)

Connection	Wire and connection	Fusing	Use
XG.21:4/5/6	GY 0.5 mm^2, Faston 2.8 x 0.8	max. 4 A slow blow	Floating NO/NC contact for signaling
GY = Color code gray			

Table 2: Connection of the monitoring loop

4.3 Internal fuses

Position	Size	Dimension	HIMA part no.
Z 6011	4 A slow blow	5 x 20 mm	57 0174409
Z 6013	1.6 A slow blow	5 x 20 mm	57 0174169

Table 3: Internal fuses

4.4 Connections of the WD to H41q-HRS / B 4237-2

Connection	Procedure
XG.12 and XG.13	Remove override between both connections

Table 4: Connections of the WD

4.5 Backplane bus

Central module CU and I/O modules are connected via the backplane bus.
The jumper plug Z 6007 on connection XD .1 combines the separated I/O buses. For the single channel system this is mandatory (H41q-HS). With redundant I/O bus (H41q-HRS) the jumper plug Z 6007 at the backplane of the subrack is not installed.

B 4237-1/-2 / H41q-HS/HRS (0605)

4.6 Connections on the rear

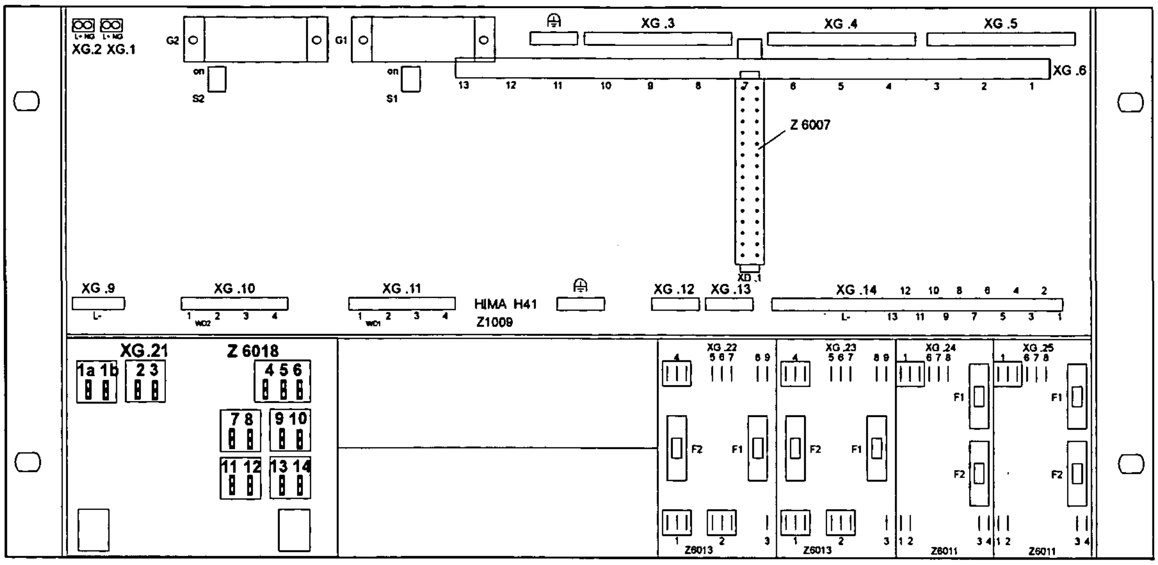


Figure 3: Connections on the rear of the system rack K 1409

4.6.1 Wiring ex works

XD .1	Jumper plug Z 6007 (Combination of the separated I/O buses, single channel system H41q-HS), not at redundant system H41q-HRS
XG .1, XG .2	Supply L+ for the power supply module Reference pole: XG .9 (L-)
XG .3, XG .4, XG .5	Potential distributor, free disposal of
XG .9	L- for the power supply module
XG .10	Watchdog signal from CU2
XG .11	Watchdog signal from CU1
XG .12	Watchdog signal for I/O modules 2. I/O bus
XG .13	Watchdog signal for I/O modules 1. I/O bus
	PE (earth)

Connections of the additional modules Z 6011, Z 6018, Z 6013:

XG. 21, XG. 22, XG .23	refer to assembly kit, wiring diagram
S1, S2	for switching off the buffer batteries G1, G2 Delivery state: Buffer batteries are switched off!

4.6.2 Wiring by customer

XG .6: 1 - 13	L+ for I/O modules (slots 1 to 13) 13 single connections, see also connection XG .14
XG .14: 1 - 13	Reference potential L- for I/O modules Slots 1 - 13, see also connection XG .6
XG .24, XG .25	Supply 24 VDC, see assembly kit, wiring diagram (L+, L-)

B 4237-1/-2 / H41q-HS/HRS (0605)

4.7 Assembly kit, wiring diagram

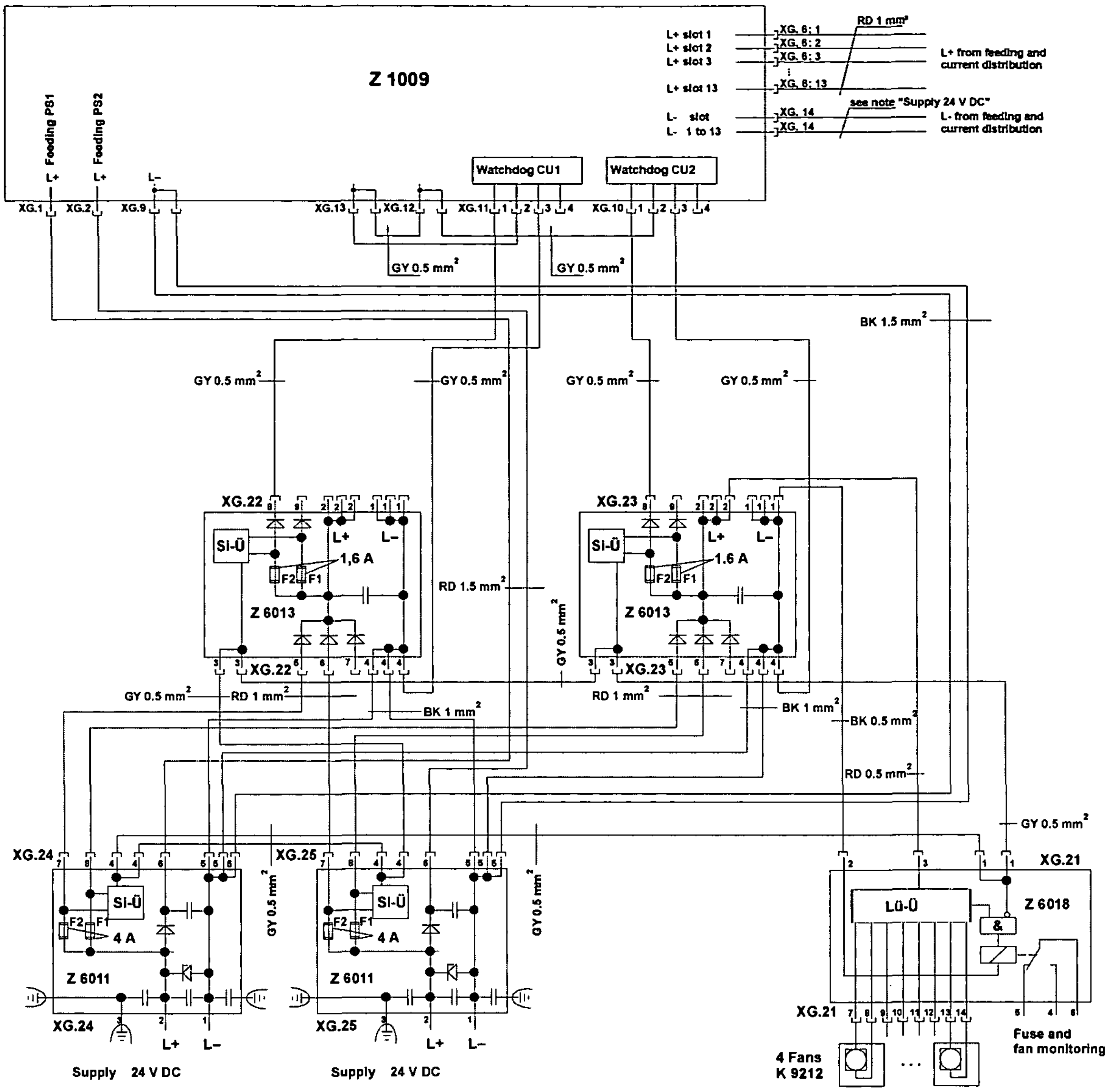


Figure 4: Assembly kit, wiring diagram

Lü-Ü =Fan monitoring
Si-Ü = Fuse monitoring

Note	The assembly kit is fully wired for a possible extension to redundant systems. For extension to redundant I/O buses remove jumper plug Z 6007 (H41q-HRS).

5 Side view B 4237-1/-2 assembly kit H41q-HS/HRS system

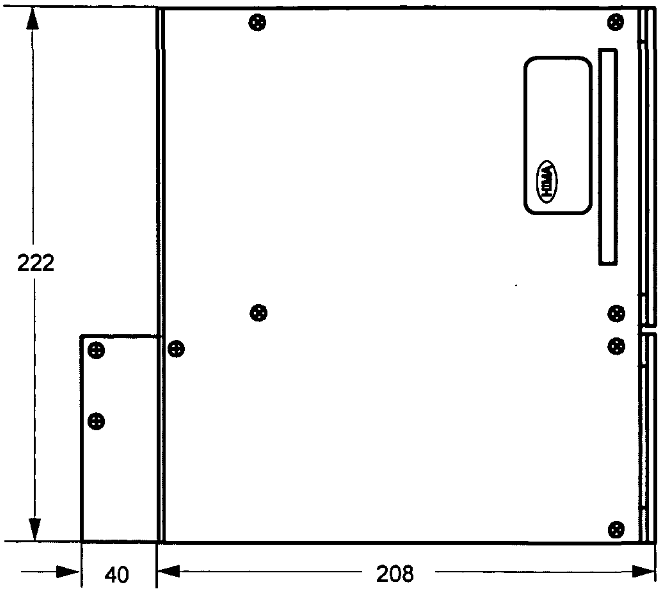


Figure 5: Side view

K 7214 (0548)

HIMA

K 7214

CE

K 7214: Feeding and current distribution

- for SELV and PELV
- redundant feeding up to 150 A total current
- for fusing of up to 18 single circuits with circuit breakers (manufacturer E-T-A ®)

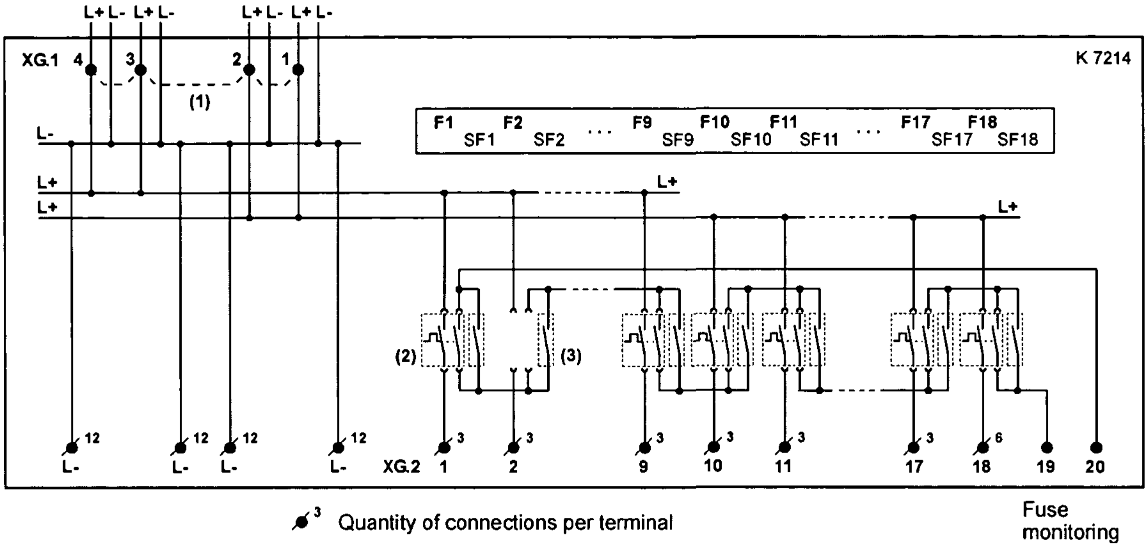


Figure 1: Wiring diagram

Explanations

(1) After inserting the provided jumper into the terminal the two separated groups with 9 circuit breakers each are interconnected

(2) Circuit breaker F.. with monitoring contact

(3) The monitoring contacts of non-equipped circuit breaker slots can be overridden with the slide switches SF..

Position 1	circuit breaker not equipped
Position 2	circuit breaker equipped

Construction:

Printed circuit board with front sockets for up to 18 circuit breakers (with monitoring), connecting field on the rear with tension spring clamps.

Total current	150 A max.
Power Supply	SELV or PELV with 24 VDC or 48 VDC
Dimensions	19 inches, 2 units high
Mounting depth	approx. 180 mm
Protection class	IP 00
Weight	1.2 kg (without circuit breakers)

K 7214 (0548)

Preferred type of circuit breakers (not delivered with K 7214):

Nominal current	Manufacturer	Type	HIMA part no.
4 A	E-T-A®	2210-S211-P1T2-H111 4 A	57 0350040
16 A	E-T-A®	2210-S211-P1T2-H111 16 A	57 0350160

Table 1: Preferred type of circuit breakers

For further details refer to the original data sheet E-T-A ®.

Connections and wiring:

Connection	Max. Cross section of wires
XG.1: 1 / 2 / 3 / 4	16 mm^2
Feeding L-	16 mm^2
Distribution L-	2.5 mm^2
XG.2: 1...20	2.5 mm^2

Table 2: Connections and wiring

Accessories:
Accessories supplied by HIMA:

- M 3447 Labeling field with three guiding rings (1 HU)
- M 3443 Labeling field with cable duct (1 HU)
- M 3445 Labeling field with 2 cable ducts (1 HU)

Views:

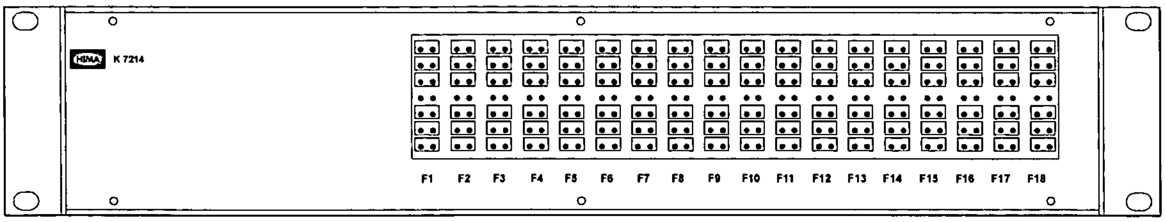


Figure 2: Front view with slots for circuit breakers F1 to F18

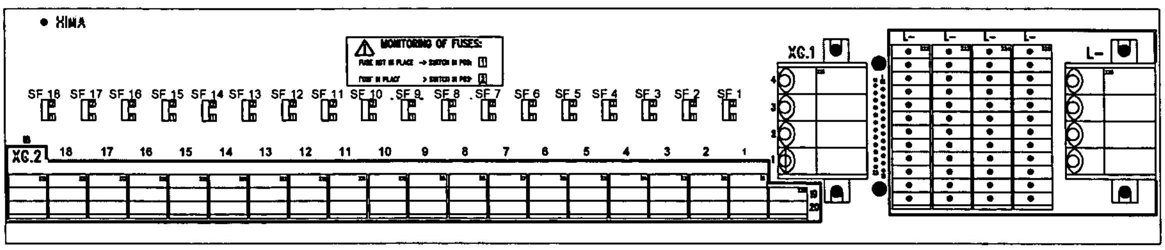


Figure 3: Rear view with switches SF1 to SF18

2/2

HIMA

M 3421

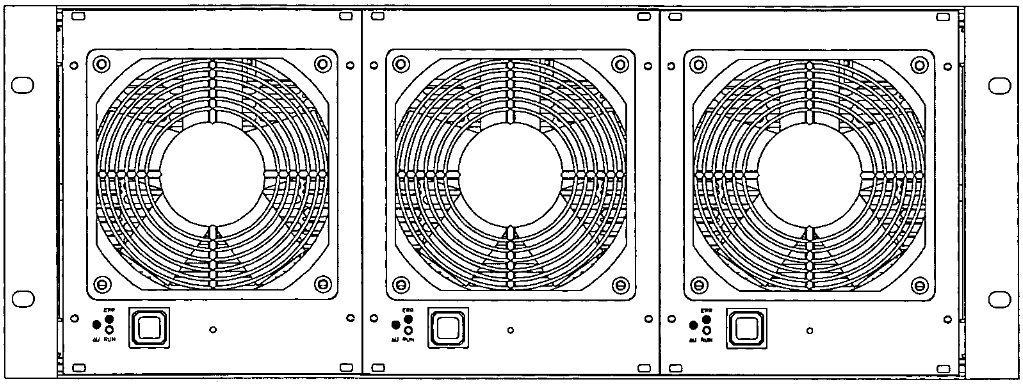
Subrack M 3421

Subrack for the 19-inches system according to EN 60297-3,
4 units high, for up to three power supply units PS 1000 (24V or 48V)

Contents

1 Subrack M 3421

1.1 Construction

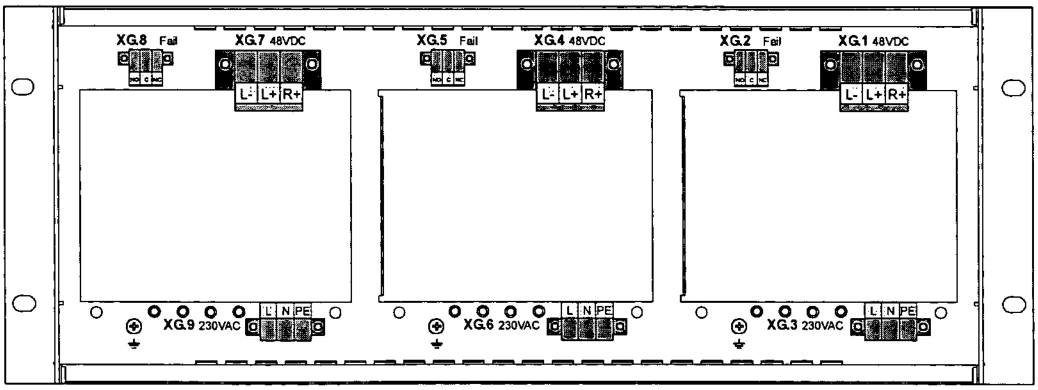


Front view with power supply units (Delivery without power supply units)

Figure 1: Front view subrack M 3421

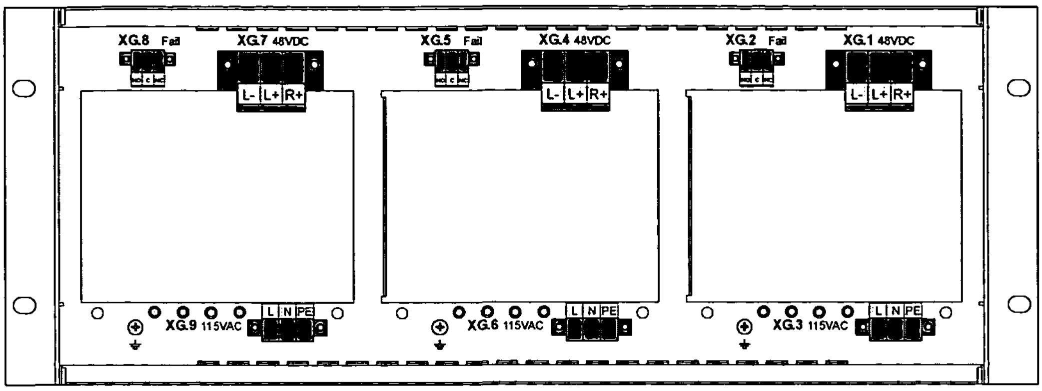
Each power supply is equipped with a fan at the front. It is important for mounting the subrack to ensure an easy air flow at its front and rear.

When a power supply unit is plugged into a slot of the subrack, all connections of it are made automatically via plug-in terminals on the rear of the subrack.



Terminals for separated connection of the power supply units
(Example for 48 V output voltage)

Figure 2: Rear view (240 VAC)



Terminals for separated connection of the power supply units
(Example for 48 V output voltage)

Figure 3: Rear view (120 VAC)

A coding field is located below the ventilation slots on the back plate of the power supply series with 48 VDC output voltage. This field has four plain holes for guide pins.

In case of the power supply unit 120 V the left and the right guide pin of the coding field are screwed from the inside of the power supply (see rear view 120 VAC, grey circles).

At the 240 V power supply unit only the left guide pin exists (see rear view 240 VAC, grey circle). In this way one could distinguish the different power supply series (120 VAC / 240 VAC) on the rear side of the subrack M 3421.

The guide pins code the type of power supply.

They also help when the power supply is plugged into the subrack. The pins fit to the according plain holes in the back plate of the subrack.

Notes for parallel or redundant operation of power supply units
For parallel or redundant operation of the power supply units the concerning terminals R+ are interconnected (with L- as reference pole). Additional decoupling diodes are not required.

Redundant switched off power supply units can be replaced during operation without switching off any other unit.

1.2 Accessories for Subrack M 3421

Cable tray M 4412, for assembly at the rear (top or bottom), with mounting screws	Part no. 60 5240001
Blind plate M 4413, 4 units high, 28 spacing units for front covering of an empty slot, with mounting screws	Part no. 60 5240002
Air guide M 7202, 19 inches, 1 unit high with labeling field Use with components built-in below the subrack M 3421	Part no. 78 1990009

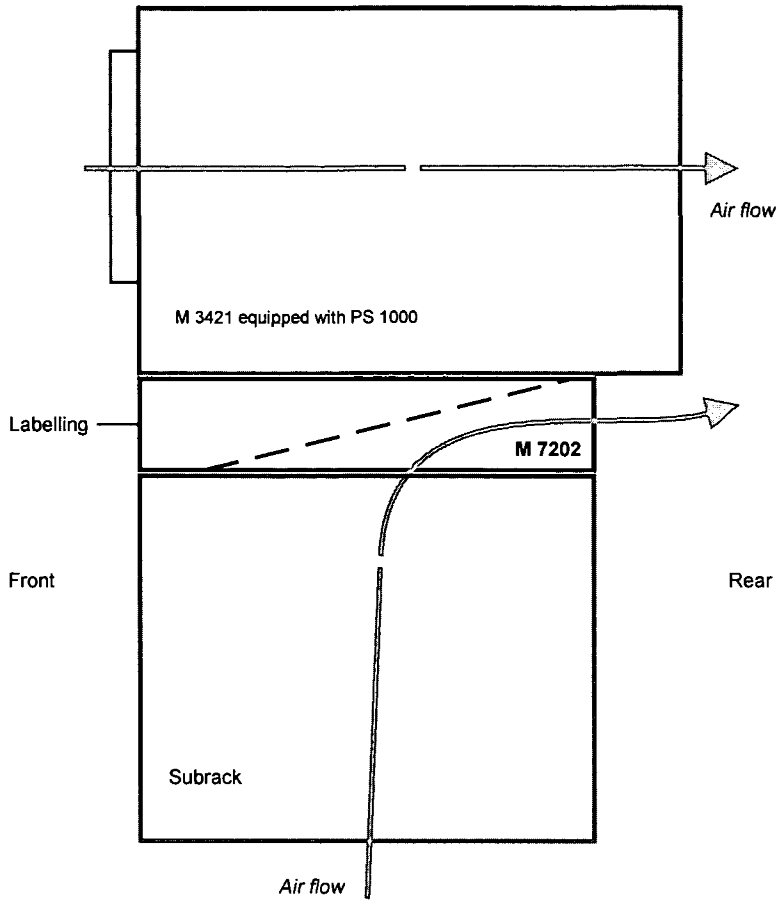


Figure 4: Air guiding with M 7202

1.3 Technical Data Subrack M 3421

Subrack M 3421	
Material	Housing: Steel sheet, galvanized Side walls: Aluminium, surface chromated
Equipment	max. 3 power supply units PS 1000 (24V or 48V)
Total load (fully equipped)	120 A continuously (40 A per unit)
Connections	Cross section of terminals per slot: 240/120 VAC 4 mm^2 24/48 VDC 10 mm^2 Fail 1.5 mm^2
Dimensions	482.6 mm (19 inches), 4 units high
Mounting depth	340 mm (including cable supply)
Weight	approx. 3.3 kg (without equipment)

HI 800 053 DEA

CE

HIMA

PS 1000/230 01

Power Supply Unit PS 1000/230 01

230 VAC / 24 VDC
Continuous load 40 A

Electronically controlled power supply unit for 19-inches subracks

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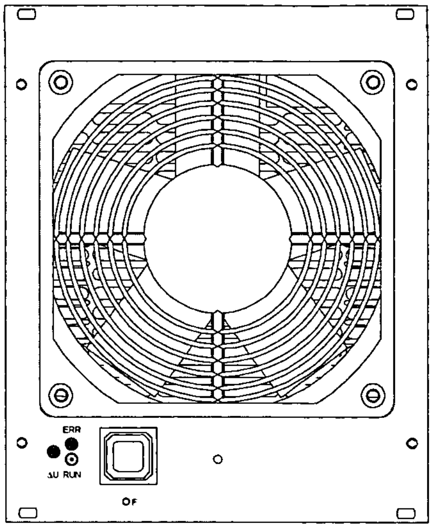
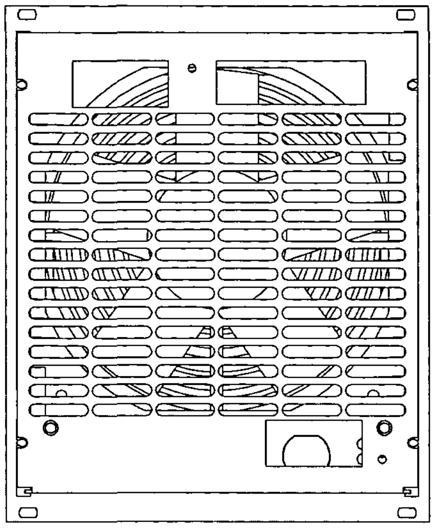
1 Power Supply PS 1000/230 01

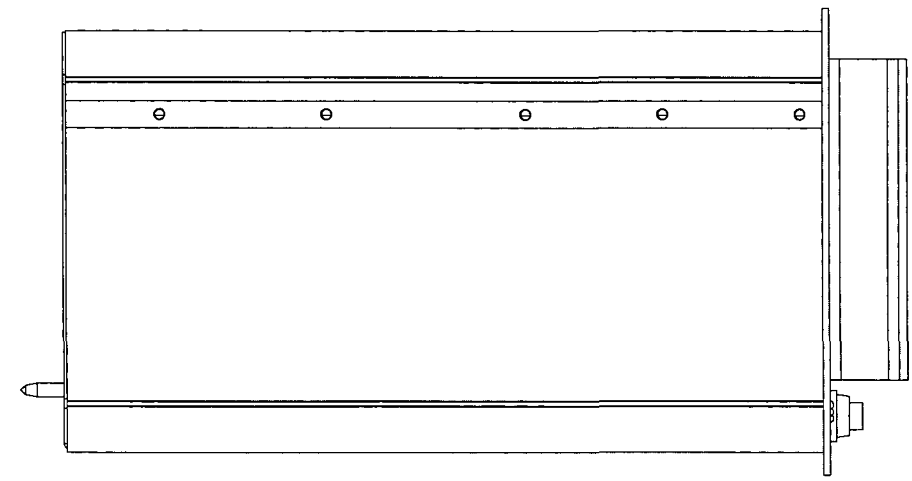
1.1 Views



Front view



Rear view



Side view

Figure 1: Views power supply PS 1000/230 01

The power supply PS 1000/230 01 is an electronically controlled modular module to be used in the 19-inches subrack M 3421, 4 units high (cf. data sheet M 3421).

The output of the power supply is short-circuit-proof.

The function of the power supply is indicated by a green LED on the front plate.

The fan speed is monitored, and faults are indicated via the red error LED and the contact.

All connections of the power supply are made automatically via plug-in terminals when it is plugged into its slot in the subrack.

The power supply meets the IEC 61131-2 standard.

The output voltage (R+ / L+ / L-) of the device meets the requirements for SELV and/or PELV circuits.

1.2 Block Diagram

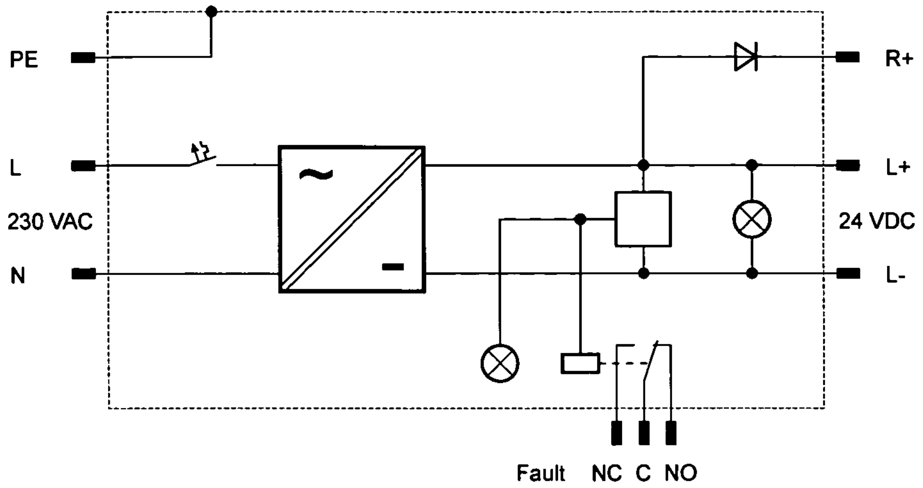


Figure 2: Block diagram, elements non-operated / de-energized

1.3 ESD Protective Measures

Only personnel who have knowledge of ESD protective measures are permitted to replace a power supply unit.

An electrostatic discharge can damage the built-in electronic components!

- Touch an earthed object to discharge any static in your body.
- When carrying out the work, make sure the working area is free of static and wear an earthing strip.
- When the module is not in use, ensure it is protected from electrostatic charges, e. g. keep it in its packaging.

1.4 Fault Messages

Faults occurring in the power supply are displayed via the red LED indicator on the front plate and annunciated by a potential-free changeover contact (cf. block diagram).

Error contact (Fail)	State
C-NC closed (C-NO open)	Relay energized, normal unit function
C-NC open (C-NO closed)	Relay de-energized, fault in the unit

Table 1: Changeover contact of the power supply

The electrical connection of the error contact is made with three plug-in terminals at the rear of the subrack M 3421.

Up to three power supply units can be inserted into one subrack M 3421, also for parallel or redundant operation without additional decoupling diodes.

Redundant switched off units can be replaced during operation without switching off any other unit.

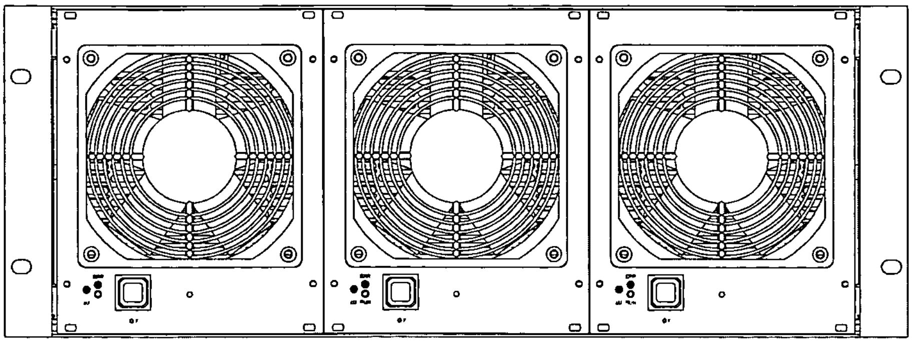


Figure 3: Front view of a fully equipped subrack M 3421

Each power supply is equipped with a fan at the front. It is important for mounting the subrack to ensure an easy air flow at its front and rear.

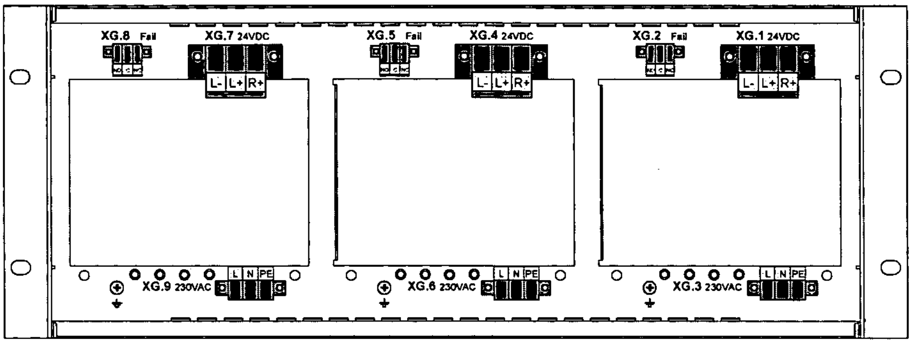


Figure 4: Rear view of the subrack M 3421 with terminals

All connections for the power supplies are made via plug-in terminals at the rear of the subrack.

Note The 4 coding holes (for 48 V power supplies) in the subrack below the rear front of the power supply must be screwed with the delivered screws, so it is impossible to mount 48 V power supplies in 24 V power supply slots.

The use of 48 V power supplies in 24 V plants results in the destruction of the 24 V devices!

Note At manual switch-on and switch-off of the power supplies a latency of one minute must be regarded as time between switch-off and switch-on.

Reason: Recovery time of the soft start circuit.

1.5 Use of several Power Supplies

If several 24 V power supplies are used in redundant operation (parallel operation), the common output current I must be set to the same value for all power supplies via the ΔU potentiometer at the front of each power supply. The output current of the power supplies can be measured with a clamp measuring unit at the current terminals at the rear front of the subrack.

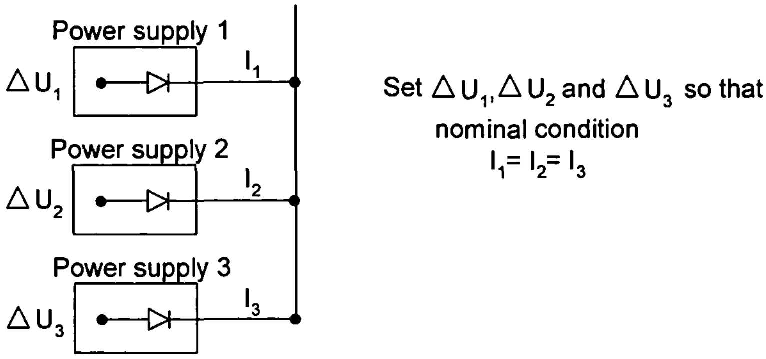


Figure 5: Adjustment of several power supplies via the ΔU potentiometer

1.6 Technical Data PS 1000/230 01

Power supply	
Input voltage	230 VAC, -15...+10 % and 240 VAC, -15...+10 %, 50...60 Hz
Output voltage	24 VDC, adjustable ±10 % via potentiometer ΔU in the front plate
Fuse	240 VAC 10 A automat
Maximum load	40 A continuously
Regulation	< 100 mV at load change 0...100 %
Efficiency	> 89 %
Power dissipation	< 110 W
Hold-up time	20 ms
Degree of protection	IP 20
Humidity	< 95 % rel., non-condensing
Ambient temperature	0...60 °C
Storage temperature	-40...+85 °C
Dimensions	28 SU, 4 units high W x H x D: 142 x 173 x 281 mm
Weight	approx. 6 kg
External fusing	16 A gL
Connections	min. cross sections for wiring: 240 VAC 1.5 mm² 24 VDC 10 mm² Fail 0.5 mm²
Fault contact Switching capacity	one potential-free changeover contact, connection via terminals 3 x 1.5 mm² in the subrack 30 VDC / 1 A 30 VAC / 0.5 A
MTTF	30 years

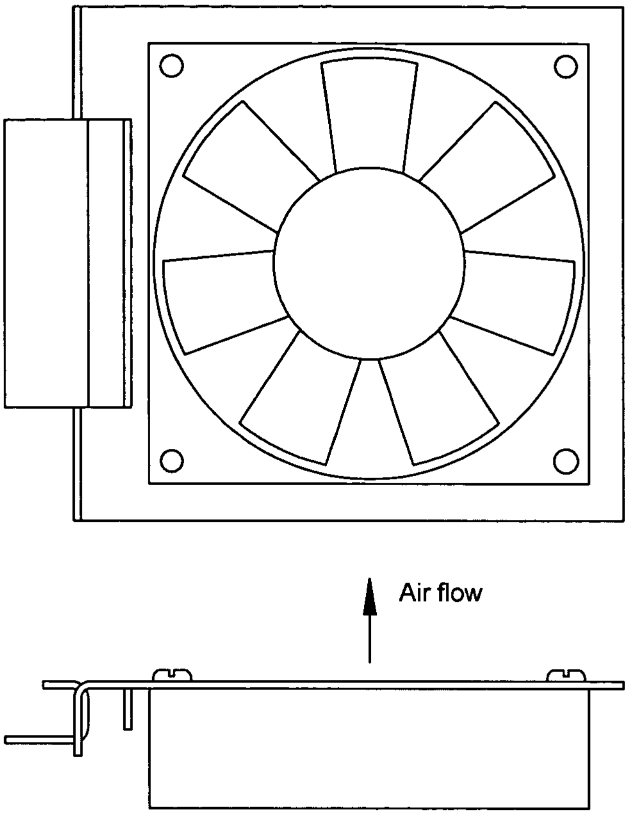
HI 800 071 AEA

HIMA

K 9212

Module Fan K 9212

Axial fan module
for mounting in the subrack



Installation: Snap-in mounting on a subrack´s profiles
Up to four fans can be assembled side by side. Free spaces are filled up with perforated plates for lateral adjustment (see accessories).

Application: Selective ventilation for modules with enhanced power dissipation in all HIMA central subracks (H41q, H51q)

Electric connection: To the fan monitoring unit Z 6018

Accessories:

Perforated plate 1	107,3 mm	Part no. 605290006
Perforated plate 2	53,3 mm	Part no. 605290007

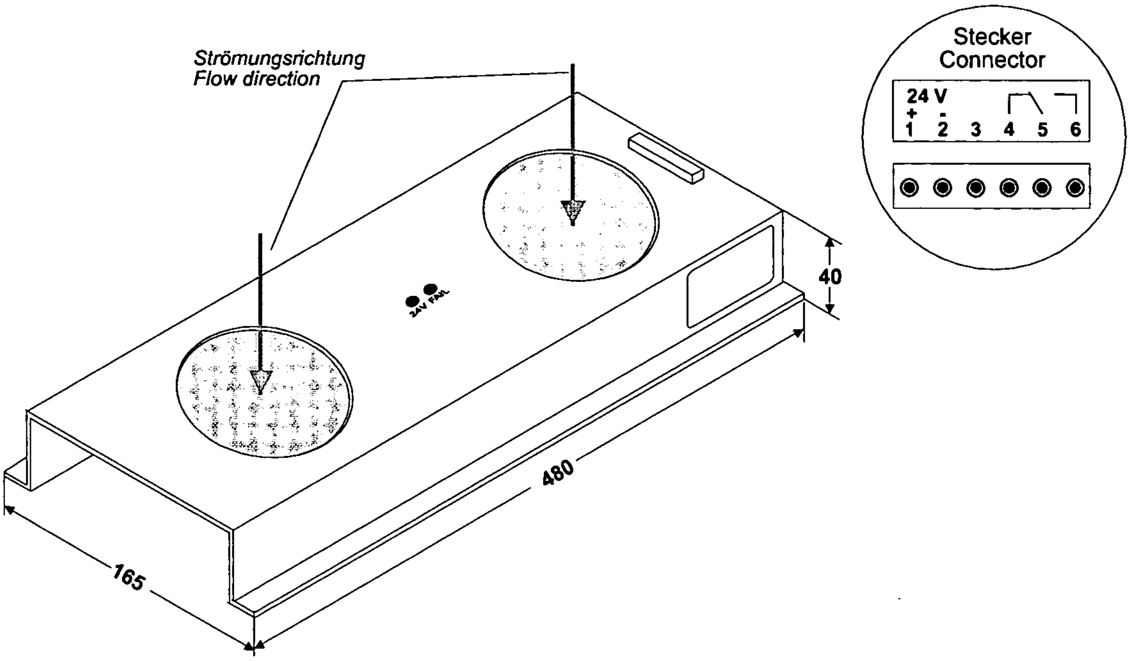
Material	Chassis: Aluminium
Air flow rate	80 m^3 per hour
Lifetime	70,000 h (at 40 °C)
Operating data	24 VDC / 200 mA
Weight	0.3 kg

HIMA

K 9202

Cabinet Fan K 9202

Forced-draft fan drawer with two axial fans,
with fan run monitoring



Installation: Below the top plate cutout of the cabinet

Application: For the ventilation of the cabinet

Accessories: Air discharge opening grill and fixing accessories for top plate cutout, already mounted in the standard cabinet

Display of operation and errors:

Operation status	Connector pin 4-5 Contact	Connector pin 5-6 Contact	LED FAIL	LED 24 V
Without error	open	closed	OFF	ON
Operating voltage missing or fuse failure	closed	open	OFF	OFF
Fan fault *	closed	open	ON	ON

* Fan speed < 75...85 % of the rated speed

Material	Aluminium, anodized
Operating data	24 V DC / 500 mA
Air flow rate	200 m^3 per hour
Life at 40 °C	70 000 h
Weight	1.2 kg

F 8652X

F 8652X: Central module

Use in the PES H41q-MS, -HS, -HRS,
Safety-related, applicable up to SIL 3 according to IEC 61508

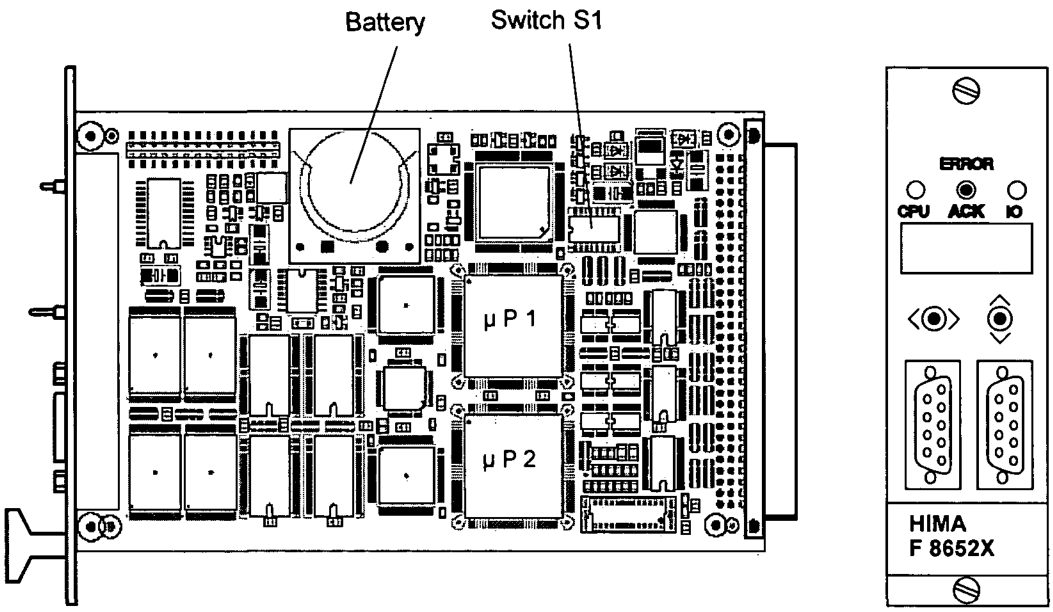


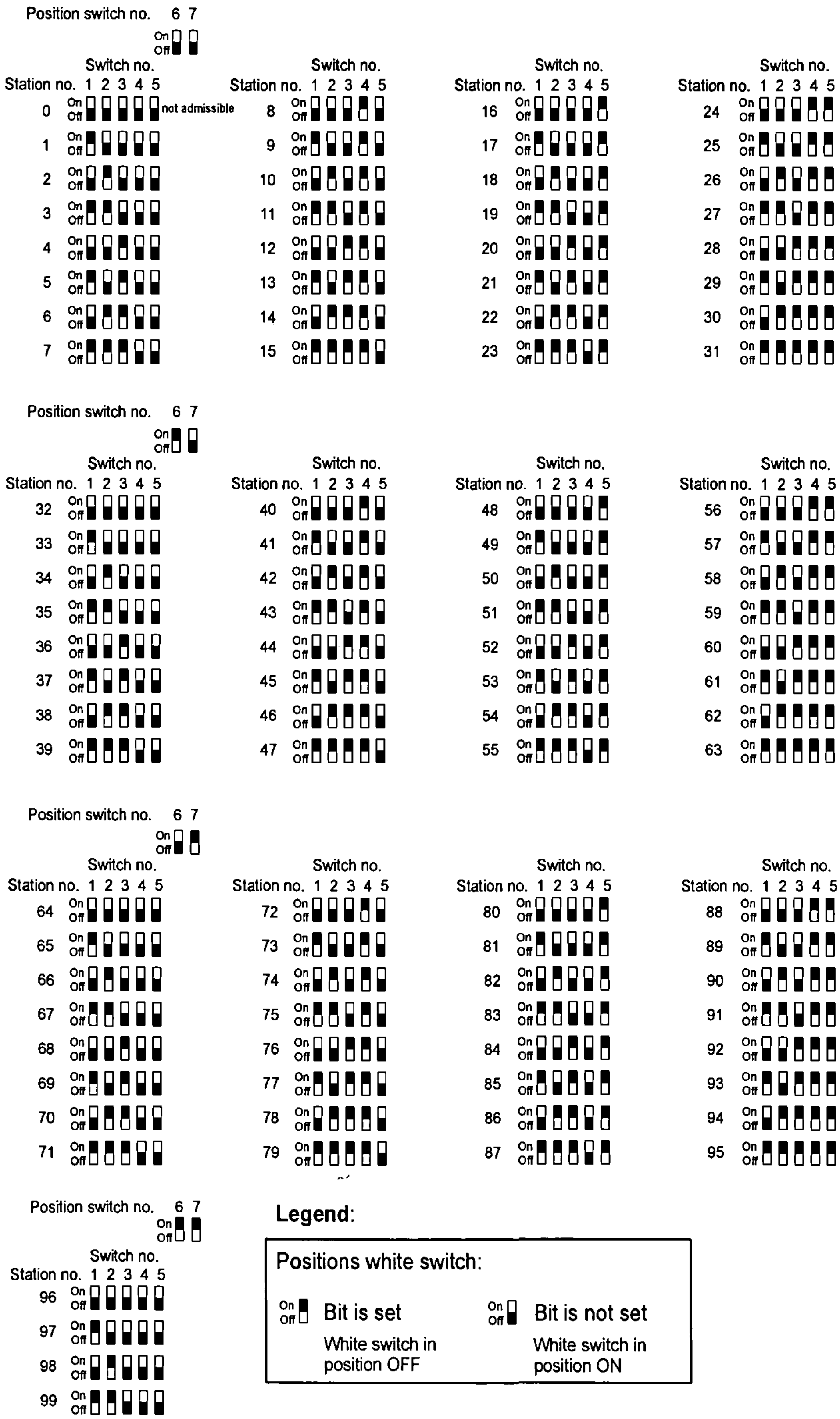
Figure 1: View

Central module with two clock-synchronized microprocessors

Microprocessors	INTEL 386EX, 32 bits
Clock frequency	25 MHz
Memory per microprocessor	
Operating System	Flash-EPROM 1 MB
User program	Flash-EPROM 1 MB *
Data	SRAM 1 MB *
	* Degree of utilization depending on operating system version
Interfaces	Two serial interfaces RS 485 with electric isolation
Diagnostic display	Four digit matrix display with selectable information
Shutdown on fault	Safety-related watchdog with output 24 V, loadable up to 500 mA, short-circuit proof
Construction	Two European standard PCBs, one PCB for the diagnostic display
Space requirement	8 SU
Operating data	5 V / 2 A

F 8652X (0606)

Setting of the bus station no. via switches S1-1/2/3/4/5/6/7:



Setting of the transmission rate with switch S1-8:

2/4

F 8652X (0606)

Pin	RS 485	Signal	Meaning
1	-	-	not used
2	-	RP	5 V, decoupled by diodes
3	A/A'	RxD/TxD-A	Receive/Transmit Data A
4	-	CNTR-A	Control signal A
5	C/C'	DGND	Data Ground
6	-	VP	5 V, positive pole of power supply
7	-	-	not used
8	B/B'	RxD/TxD-B	Receive/Transmit Data B
9	-	CNTR-B	Control signal B

Table 1: Pin assignment of the interface RS 485, 9-pole

For the serial interface only the bus station no. 1-31 can be set.
Within an Ethernet network the bus station no. can be set from 1 to 99. Therefore the switches S1-6/7 must be set in addition to the switches S1-1/2/3/4/5.
The number of the communication partners within a network is still limited to 64.
This enhanced setting of the bus station no. is only possible from operating system BS41q/51q V7.0-8 (05.31) of the central module.

Applications with the communication module F 8627X:

- connection of the central module to a PADT (ELOP II TCP)
- connection to other communication partners within an Ethernet network (safe**ethernet**, Modbus TCP)

The communication runs from the central module via the backplane bus to the communication module F 8627X and from the Ethernet ports of the F 8627X into the Ethernet network and vice versa.

Special features of the central module:

- Self-education: from operating system BS41q/51q V7.0-8 (05.31)
- ELOP II TCP: from operating system BS41q/51q V7.0-8 (05.31)

Further informations about the bus station no., ELOP II TCP, loading of operating systems and application programs (self-education) et al. corresponding to the central module you will find in the data sheet of the F8627X as well as the operating system manual of H41q/H51q and the safety manual of H41q/H51q.

⚠ Before removing a central module its fixing screws must be completely loosened and freely movable. Remove the module from the bus board by pushing the ejection lever (front label) top down and quickly removing in an upward motion to ensure that faulty signals are not triggered within the system!
To attach the module, place it on the terminal block and press it inwards as far as it will go. This action should be performed quickly to ensure that faulty signals are not triggered within the system!

F 8652X (0606)

Function of the ejection lever with front label

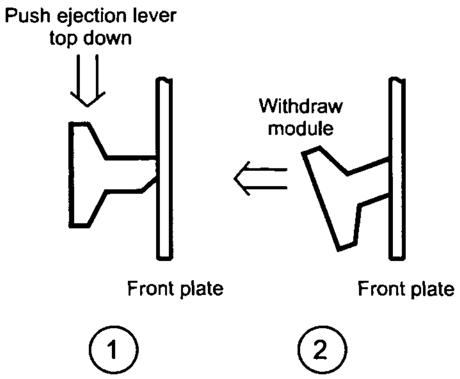


Figure 2: Function of the ejection lever

Diagnostic display of the central module

- Four digit alphanumerical display,
- two LEDs for the general display of errors (CPU for the central modules, IO for the testable input/output modules),
- two toggle switches to request detailed error information,
- push-button ACK resets the error indication;
  in failure stop ACK behaves like restarting the system.

For further information on the diagnostic display and lists of error codes, refer to the documentation "Functions of the operational system BS 41q/51q" (also on ELOP II CD).

Notes for start-up and maintenance

- Lifetime of the buffer battery (*without* voltage feeding):
  1000 days at T_A = 25 °C
  200 days at T_A = 60 °C
- It is recommended to change the buffer battery (CPU in operation) at the latest after 6 years, or with display BATI within three months
  (Lithium battery, e.g. type CR 2477N, HIMA part no. 44 0000018)
- Check the bus station no. and transmission rate at switch S1 for correct settings
- **Important:** When upgrading an F 8652 to an F 8652X module the fan concept has also to be changed!

F 3236 (0524)

F 3236

F 3236: 16-channel input module

safety-related, applicable up to SIL 3 according to IEC 61508

- for 1-signals or sensors
- with safety isolation

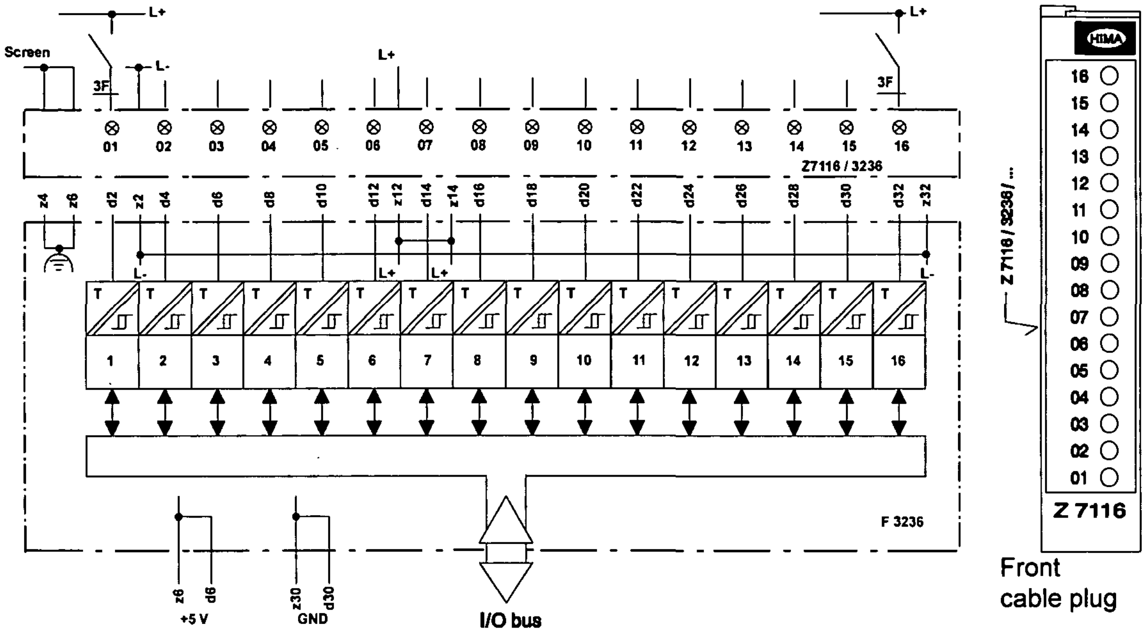


Figure 1: Block diagram and front cable plug

The module is automatically fully tested during operation for safety-related errors. The essential test procedures are:

- Cross-talking of the inputs by walking-zero
- Functions of the filter capacitors
- Function of the module

The LEDs of the cable plug are not tested.

Inputs	1-signal, 6 mA (incl. cable plug) or mechanical contact 24 V
Switching time	typ. 8 ms
Space requirement	4 SU
Operating data	5 VDC / 120 mA 24 VDC / 200 mA

F 3236 (0524)

Channel	Connec-tion	Colour
1	d2	WH
2	d4	BN
3	d6	GN
4	d8	YE
5	d10	GY
6	d12	PK
7	d14	BU
8	d16	RD
9	d18	BK
10	d20	VT
11	d22	WHBN
12	d24	WHGN
13	d26	WHYE
14	d28	WHGY
15	d30	WHPK
16	d32	WHBU
L–	z2	BK
L+	z12	RD
Screen	z4	YEGN
	z6	YEGN

Cable
LiYY 16 x 0.25 mm^2

q = 1 mm^2
l = 750 mm

Flat pin plug
2.8 x 0.8 mm^2

Flat pin plug 6.3 x 0.8 mm, to be connected to the earth bar under the slot

q = 1 mm^2
l = 120 mm

Figure 2: Lead marking of the cable plug Z 7116 / 3236 / C..

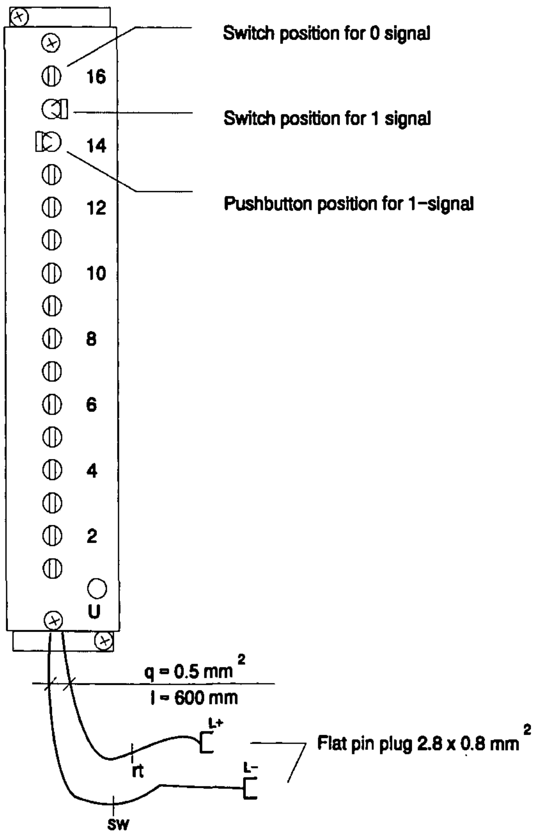


Figure 3: Test plug diagram Z 7201 / 3236

2/2

HIMA

F 3430

F 3430: 4-channel relay module

safety-related, applicable up to SIL 3 according to IEC 61508

- Switching voltage ≥ 5 V, ≤ 250 VAC / ≤ 110 VDC,
- with integrated safety shutdown,
- with safety isolation, with 3 subsequent relays (in diversity),
- solid state output (open collector) for LED display in the cable plug

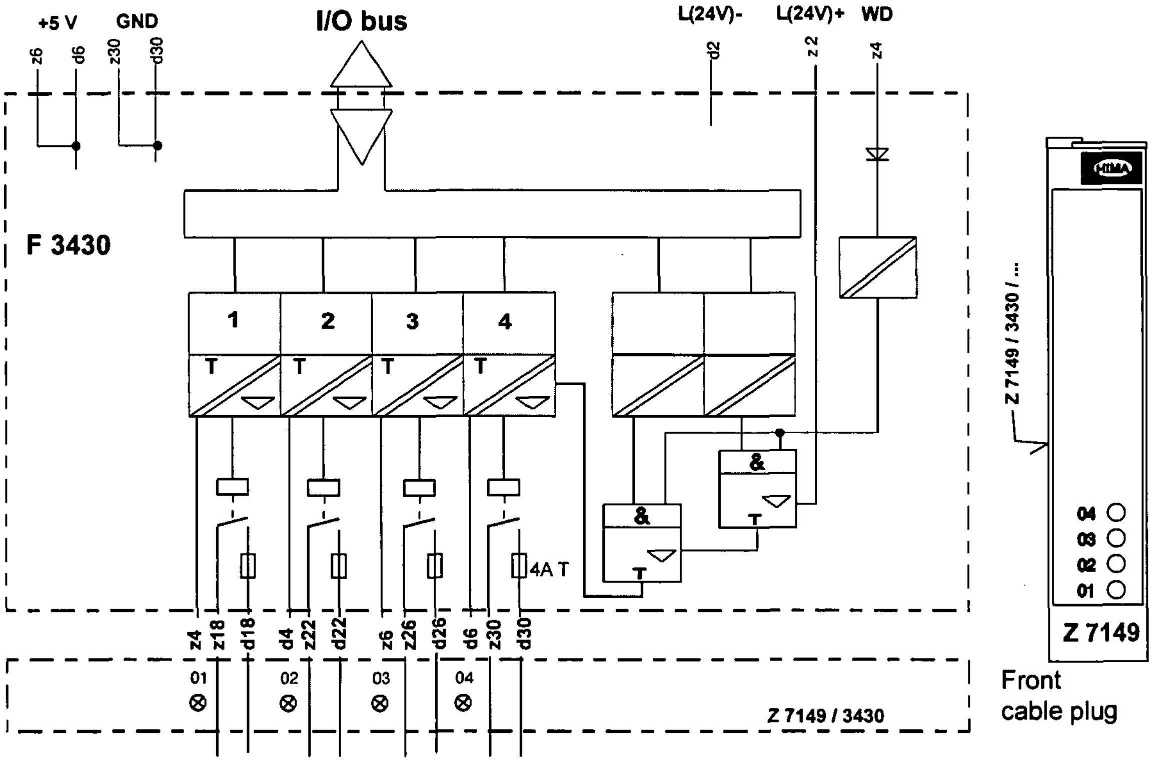


Figure 1: Block diagram and front cable plug

Relay output	NO contact, dust-tight	
Contact material	Silver alloy, gold-flashed	
Switching time	approx. 8 ms	
Reset time	approx. 6 ms	
Bounce time	approx. 1 ms	
Switching current	10 mA ≤ I ≤ 4 A	
Life, mech.	≥ 30 x 10^6 cycles	
Life, elec.	≥ 2.5 x 10^5 cycles with full resistive load and ≤ 0.1 cycles per second	
Switching capacity AC	up to 250 VAC	max. 500 VA, cos φ > 0.5
Switching capacity DC (non inductive)	up to 30 VDC	max. 120 W
	up to 70 VDC	max. 50 W
	up to 110 VDC	max. 30 W
Space requirement	4 SU	
Operating Data	5 VDC / < 100 mA	
	24 VDC / < 120 mA	

F 3430 (0507)

Channel	Connection	Colour	
1	z18	WH	Cable LiYY 8 x 1.5 mm^2
	d18	BN	
2	z22	GN	
	d22	YE	
3	z26	GY	
	d26	PK	
4	z30	BU	
	d30	RD	

Lead marking of the cable plug
Z 7149 / 3430 / C../P2

Figure 2: Lead marking of the cable plug

The module has a safe isolation between the input and the output contact, according EN 50178 (VDE 0160). The clearance in air and the creepage distance are dimensioned for overvoltage class III up to 300 V.

The module is equipped with relays in diversity.

The relay amplifier is suitable for the switching of safety-related circuits. Thus the amplifier can be used for safety shutdowns, e. g. to cut off the entire fuel supply for combustion plants.

Restrictions

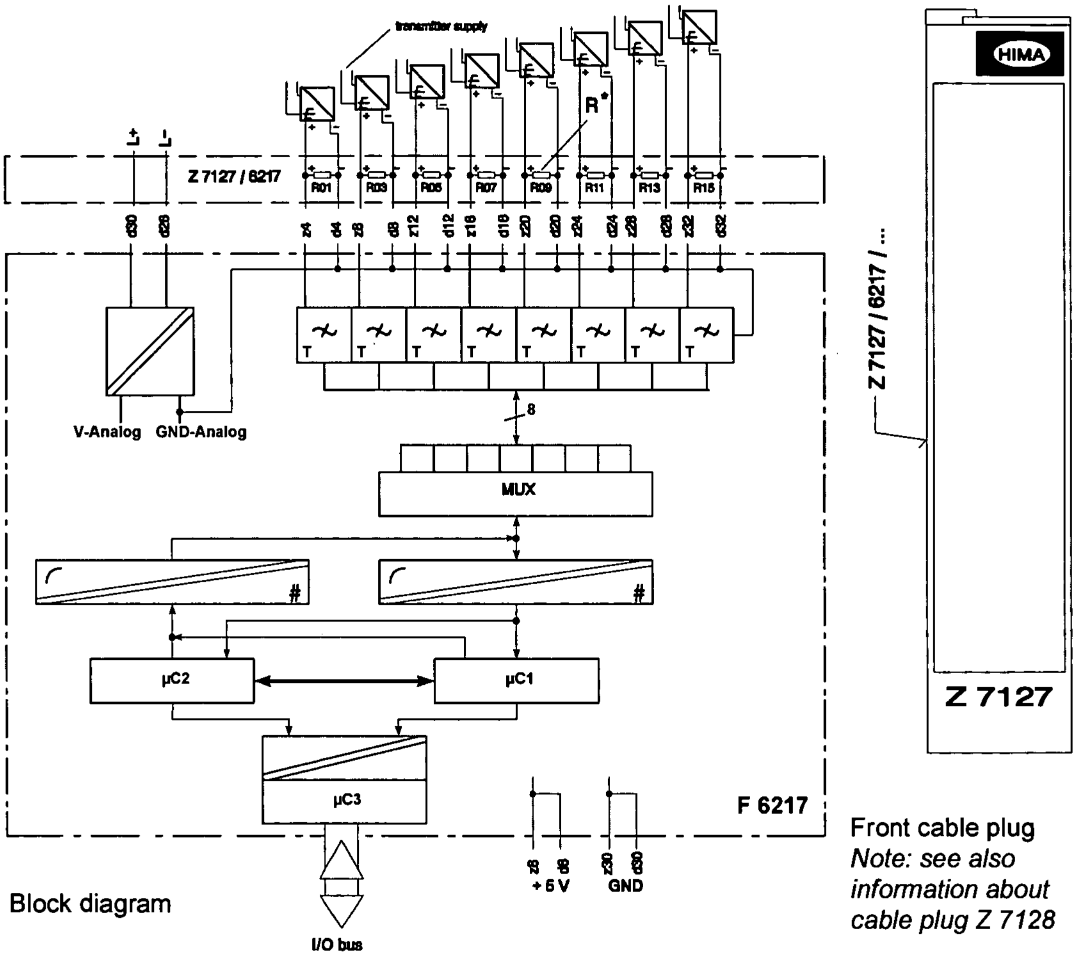
- For the application it must be ensured that the module is replaced after reaching the maximum quantity of switching cycles (e. g. 300.000 switching cycles at a rated operation 30 VDC / 4 A).
- For SIL 3 plants (according to IEC 61508) function checks have to be made by the manufacturer within a period of three years, for SIL 2 plants within a period of six years.
- The replacement of components must be made only by the manufacturer regarding the valid standards and TÜV restrictions.

F 6217

F 6217: 8-channel analog input module

safety-related, applicable up to SIL 3 according to IEC 61508

- for current inputs 0/4...20 mA, voltage inputs 0...5/10 V
- with safe isolation
- resolution: 12 bits



Block diagram

Front cable plug
Note: see also information about cable plug Z 7128

Figure 1: Block diagram and front cable plug

Interpretation of channel bit faults for each channel to project in ELOP II.

Input voltage	0...5.5 V
max. input voltage	7.5 V
Input current	0...22 mA (via shunt), 22 mA = 4095
max. input current	30 mA
R*: Shunt with current input	250 Ω; 0.05 %; 0.25 W; T<10 ppm/K; part-no: 00 0710251
Resolution	12 bit, 0 mV = 0, 5.5 V = 4095
Measurand update	50 ms
Safety time	< 450 ms
Input resistance	100 kΩ

F 6217 (0606)

Time const. input filter	approx. 10 ms
Basic error	0.1 % at 25 °C
Operating error	0.3 % at 0...+60 °C
Error limit related on safety	1 %
Electric strength	200 V against GND
Space requirement	4 SU
Operating data	5 VDC / 80 mA, 24 VDC / 50 mA

Channel	Connection	Color
1	z4	BN
	x4	
	d4	WH
2	z8	YE
	x8	
	d8	GN
3	z12	PK
	x12	
	d12	GY
4	z16	RD
	x16	
	d16	BU
5	z20	VT
	x20	
	d20	BK
6	z24	WHGN
	x24	
	d24	WHBN
7	z28	WHGY
	x28	
	d28	WHYE
8	z32	WHBU
	x32	
	d32	WHPK
L–	d26	BK
L+	d30	RD
Cable screen		YEGN

Channel	Connection	Color
1	z4	
	x4	BN
	d4	WH
2	z8	
	x8	YE
	d8	GN
3	z12	
	x12	PK
	d12	GY
4	z16	
	x16	RD
	d16	BU
5	z20	
	x20	VT
	d20	BK
6	z24	
	x24	WHGN
	d24	WHBN
7	z28	
	x28	WHGY
	d28	WHYE
8	z32	
	x32	WHBU
	d32	WHPK
L–	d26	BK
L+	d30	RD
Cable screen		YEGN

Cable
LiYCY
20 x 0.25 mm^2
screened

l = 750 mm
q = 1 mm^2

Flat pin
plug 2.8 x
0.8 mm^2

l = 120 mm
q = 2.5 mm^2

Flat pin plug 6.3 x 0.8 mm, to be connected to the earth bar under the slot

Lead marking cable plug to connect current/ voltage Z 7127 / 6217 / C.. / I (U5V)

Lead marking cable plug to connect voltage via potentiometer and smart transmitters Z 7127 / 6217 / C.. / U10V

Figure 2: Lead marking cable plug

The module contains a redundant, safety-related processor system. Because of this, all the tests are executed directly on the module. The main test routines are:

- Linearity of the A/D converters
- Overflow of the A/D converters
- Cross talking between the eight input channels
- Function of the input filters
- Function of the I/O bus communication

F 6217 (0606)

– Self tests of the microcontrollers
– Tests of the memories

The channel error bit is set for a recognized error; the evaluation must be made in the user program.

Current inputs

Measuring range 0/4 - 20 mA

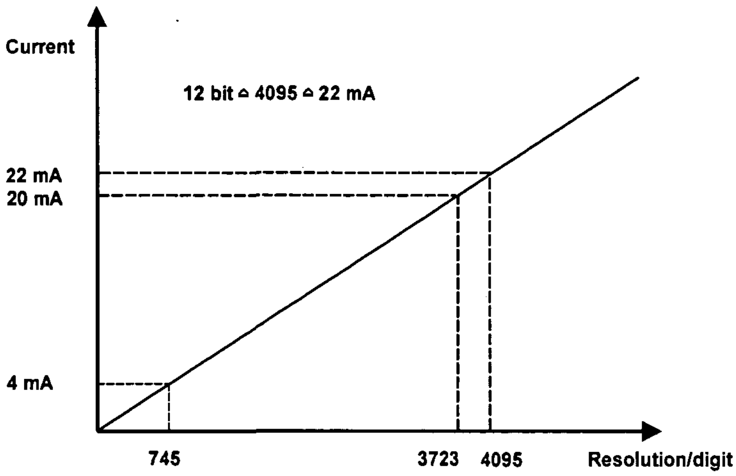


Figure 3: Current inputs

Redundant connection of current or voltage

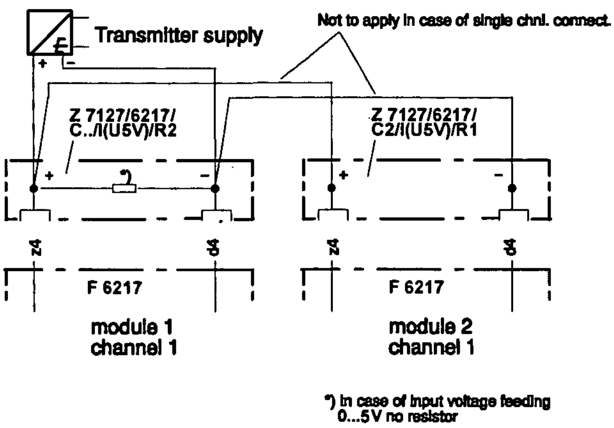
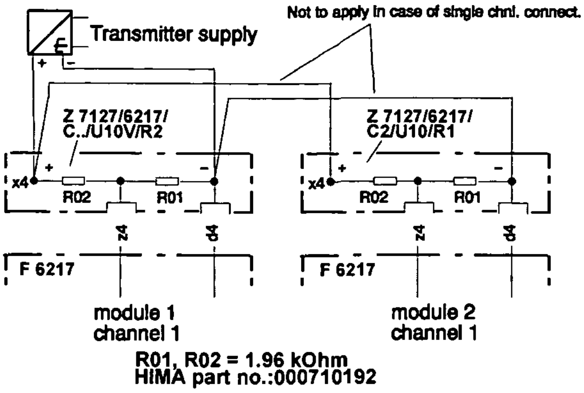


Figure 4: Redundant connection of current or voltage

F 6217 (0606)



Note : Regard to the internal resistance of the transmitter voltage supply

Figure 5: Redundant connection via voltage divider

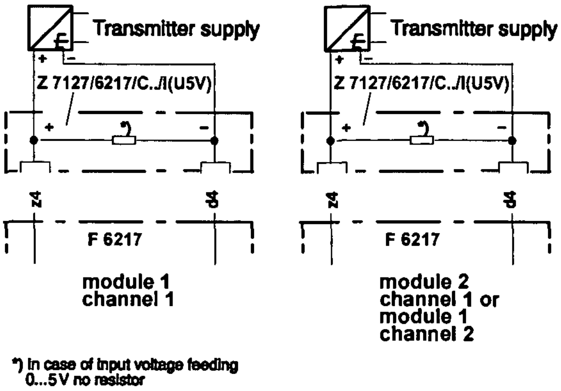


Figure 6: Current or voltage connection of redundant transmitters (evaluation in the user program)

Occupation of not used inputs

Not used voltage inputs 0 ... 5 V have to be terminated with jumpers. Not used current inputs are terminated with the shunt, not used voltage inputs 0...10 V with the voltage divider in the cable connector.

Not used inputs, redundant connection

Example is for channel 1.
Installation of jumpers outside of the cable connectors on the terminals:

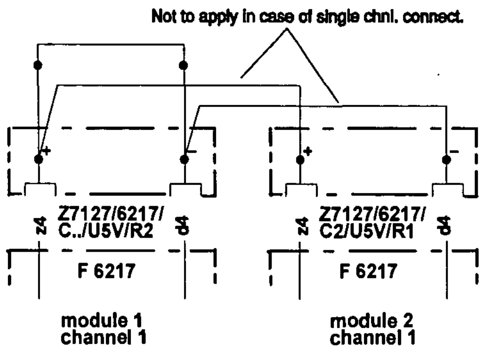


Figure 7: Voltage input 0...5 V

F 6217 (0606)

Notes to the safety-related operation and use

Screened cables have to be used for the field input circuits, twisted cables are recommended. If it is sure that the environment of the transmitter up to the module is free from interferences and the distance is relatively short (e. g. inside a cabinet) then the cabling can be performed without screened cables or twisted cables. However, the interference immunity of the analog inputs can only be achieved by using screened cables.

Planning notes for ELOP II

For each input channel of the module exists an analog input value and an appertaining channel fault bit. With activated channel fault bit a safety-related reaction has to be programmed in ELOP II related to the corresponding analog input.

Recommendations for the use of the module according to IEC 61508, SIL 3

- Cables for power supply shall be locally separated from the input circuits,
- Application of a suitable earthing must be regarded,
- Measures against rising of the temperature have to be taken outside of the module, e. g. fans in the cabinet,
- Recording events in a logbook for operation and maintenance.

A maintenance of the module is not required. In case of fault there is a switch-off. The failed module must be replaced.

Z 7128 Cable plug with transmitter supply

For the supply of transmitters the Z 7128 cable plug with transmitter supply is available (suitable only for two-wire connections).

This cable plug **may not be used** together with zener barriers!

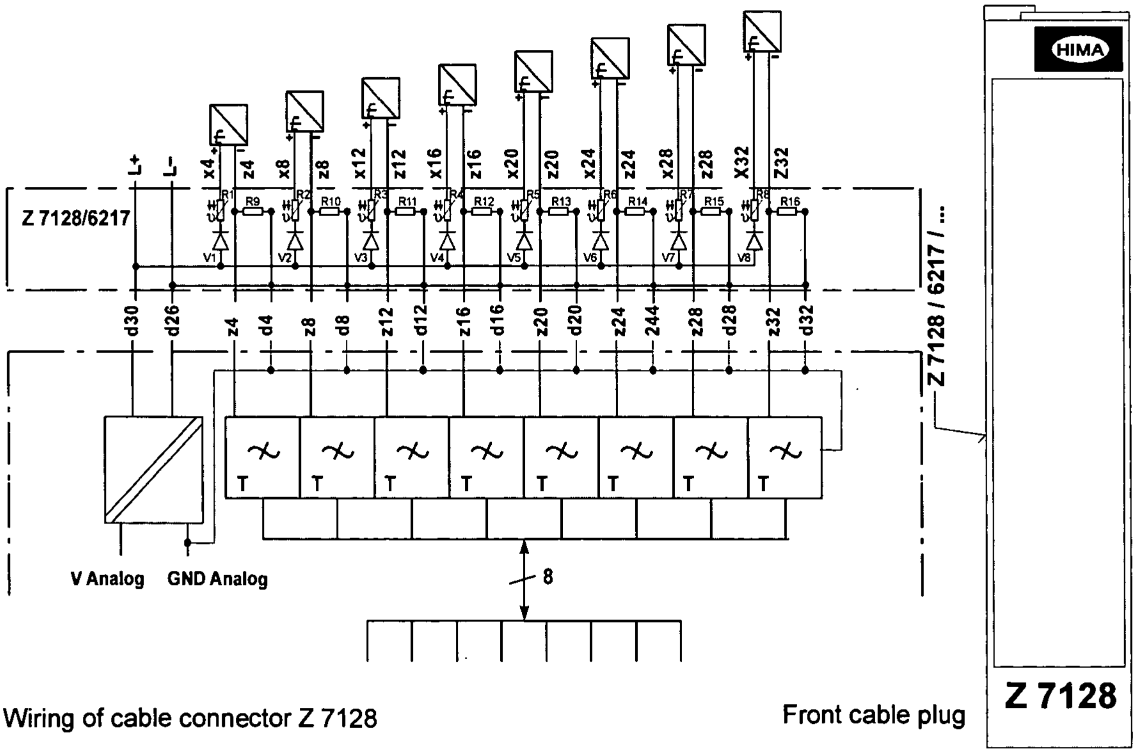


Figure 8: Wiring of cable connector Z 7128

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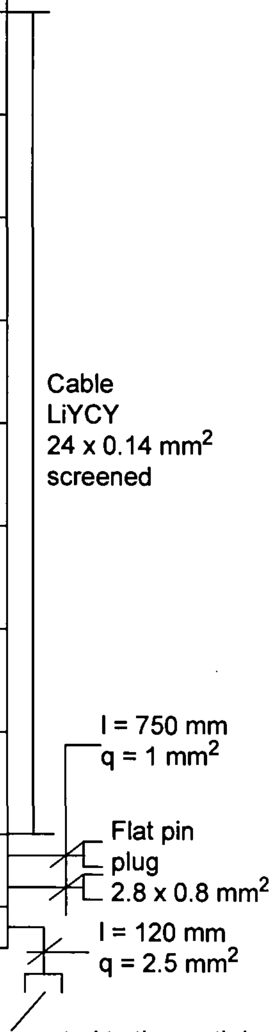
F 6217 (0606)

Channel	Connection	Color
1	z4 x4 d4	BN WH GN
2	z8 x8 d8	GY YE PK
3	z12 x12 d12	RD BU BK
4	z16 x16 d16	WHBN VT WHGN
5	z20 x20 d20	WHGY WHYE WHPK
6	z24 x24 d24	WHRD WHBU WHBK
7	z28 x28 d28	BNYE BNGN BNGY
8	z32 x32 d32	BNBU BNPK BNRD
L– EL+(L+)	d26 d30	BK RD
Cable screen		YEGN



Flat pin plug 6.3 x 0.8 mm, to be connected to the earth bar under the slot

Lead marking cable plug with transmitter supply Z 7128 / 6217 / C.. / ITI

Figure 9: Lead marking cable plug with transmitter supply

Cable plugs marked with R1 and R2 are for redundant systems, applications refer to previous figures.

If using the transmitter Saab/Rosemount 3300 GWR with internal zener diode a galvanic isolation in the signal connection must be provided to remove interferences (signal spikes, undefined signal levels) at the analog inputs of the F 6217.
Therefore e.g. the analog isolator with HART H 6200 of HIMA can be used.

F 6217 (0606)

Interferences of the module in low frequency range (10 Hz)

External disturbing pulses in the range of 10 Hz, e.g. at pressure measurements of nearby piston pumps, can lead to temporary channel bit faults at the analog inputs. Intemal hardware tests carried out in the same rhythm are influenced by this pulses (fluctuations) in an adverse way. Input channels could be interpreted as faulty and de-energized.

Solution

- Pressure sensors:
  By internal damping via adjustable digital filters in the sensor disturbing pulses can be minimized or eliminated.
- Use of low-pass filter H 7017:
  The high time constant of the low-pass filter eliminates the low frequency disturbing pulses in the input current.

⚠ The low-pass filter may only be used in safety-related circuits with low-shut-down because in case of a failure in the filter (leakage current) the measured values are reduced. The time relay of the filter has to be regarded in calculating the safety time.

Note Additional transmitter supplies, e.g. via front cable plug Z 7128, have no disturbing influences on the operation of the module F 6217.

F 6217 (0606)

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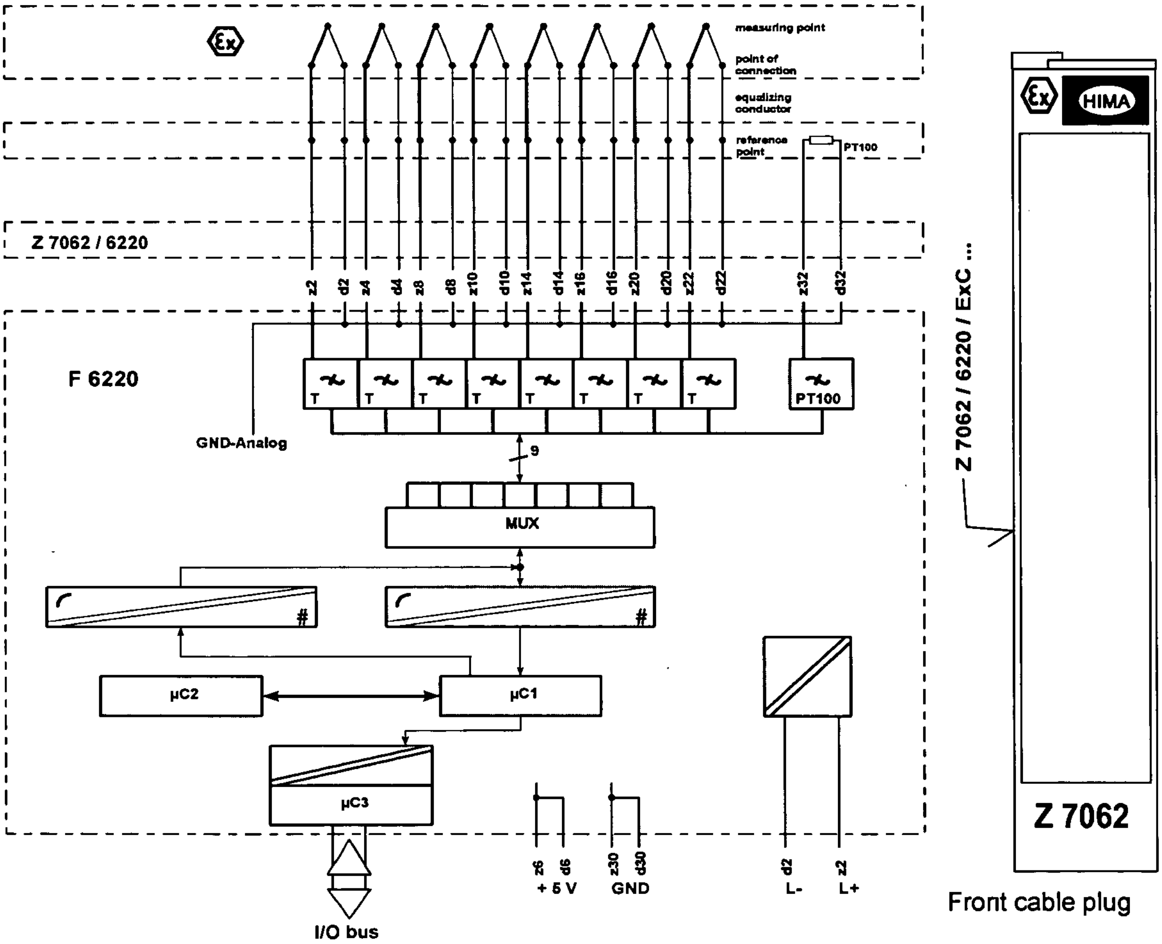
F 6220

F 6220: 8-channel thermocouple input module (Ex)i, safety-related

- with Pt 100 input for comparison measurement
- with safe isolation, applicable up to SIL 3 according to IEC 61508
- EC type examination certificate: ATEX EX5 00 02 19183 031

1 Overview



Block diagram

Front cable plug

Figure 1: Block diagram and front cable plug

Software function block in user program: HF-TMP-3

Inputs	thermocouples R, S, B, J, K, T, E, according to DIN EN 60584-1, temperature limits between -270 °C...+1820 °C, or low voltage input -100 mV...+100 mV, individual parameterizable by function block,

F 6220 (0625)

	for intrinsically safe circuits [EEx ia] IIC
	1 Pt 100 resistance thermometer, according to DIN IEC 751 input only for reference temperature
Measurand update	80 ms
Space requirement	4 SU
Operating data	5 VDC / 125 mA, 24 VDC / 300 mA

⚠

The module must only be operated with forced ventilation (fan).
The fan (K 9203) must be installed above the subrack where the F 6220 module is plugged in.
If the F 6220 module is operated in an H 41q, the fan (K 9212) must be installed directly under the F 6220 module.
In order to ensure the forced ventilation, the air deflector panel M 7201 (1 HE) must to be mounted over the fan (K 9203) or over the kit H 41q. The air deflector panel M 7201 deflects the warm air to the rear, in order to avoid a temperature rise of the subracks and modules which are mounted above.

2 Useable thermocouples

Linearization in	
Nominal range	< ±0.1 %
Resolution	0.1 °C

Type	**R**
Thermocouple	Pt13%Rh/Pt
Nominal range:	
Input voltage	-0.226 mV...21.003 mV
Temperature limits	-50 °C...1760 °C
Monitored	
Range of use:	
Input voltage	-0.226 mV...21.003 mV
Temperature limits	-50 °C...1760 °C
Value in ELOP II	-500...+17600 (variable type INT)

Type	**S**
Thermocouple	Pt10%Rh/Pt
Nominal range:	
Input voltage	-0.236 mV...18.609 mV
Temperature limits	-50 °C...1760 °C
Monitored	
Range of use:	
Input voltage	-0.236 mV...18.609 mV
Temperature limits	-50 °C...1760 °C
Value in ELOP II	-500...+17600 (variable type INT)

F 6220 (0625)

Type	**B**
Thermocouple	Pt30%Rh/Pt6%Rh
Nominal range:	
Input voltage	0.092 mV... 13.820 mV
Temperature limits	150 °C...1820 °C
Monitored	
Range of use:	
Input voltage	0.002 mV...13.820 mV
Temperature limits	50 °C... 820 °C
Value in ELOP II	+500...+18200 (variable type INT)

Type	**J**
Thermocouple	Fe/CuNi
Nominal range:	
Input voltage	-8.095 mV...69.553 mV
Temperature limits	-210 °C...1200 °C
Monitored	
Range of use:	
Input voltage	-8.095 mV... 69.553 mV
Temperature limits	-210 °C...1200 °C
Value in ELOP II	-2100...+12000 (variable type INT)

Type	**K**
Thermocouple	CrNi/NiAl
Nominal range:	
Input voltage	-6.035 mV...54.819 mV
Temperature limits	-210 °C...1370 °C
Monitored	
Range of use:	
Input voltage	-6.458 mV...54.819 mV
Temperature limits	-270 °C...1370 °C
Value in ELOP II	-2700...+13700 (variable type INT)

Type	**T**
Thermocouple	Cu/CuNi
Nominal range:	
Input voltage	-5.753 mV...21.003 mV
Temperature limits	-210 °C...400 °C
Monitored	
Range of use:	
Input voltage	-6.258 mV...21.003 mV
Temperature limits	-270 °C...400 °C
Value in ELOP II	-2700...+4000 (variable type INT)

Type	**E**
Thermocouple	CrNi/CuNi
Nominal range:	
Input voltage	-9.063 mV... 76.373 mV
Temperature limits	-210 °C...1000 °C
Monitored	
Range of use:	
Input voltage	-9.835 mV... 76.373 mV
Temperature limits	-270 °C...1000 °C
Value in ELOP II	-2700...+10000 (variable type INT)

3 Technical data

3.1 Low voltage input

Input voltage	-100 mV...+100 mV
Linearization	< ±0.1 %
Resolution	0.01 mV (with scaling 0.1 %)
Value in ELOP II	-10000...+10000 (variable type INT)

3.2 Input for comparison measurement

Input for comparison Measurement	Pt100 with two-wire measurement (max. line length 6 m)
Reference temperature	
Limits	-40 °C...+80 °C
Resolution	0.1 °C
Value in ELOP II	-400...+800 (variable type INT)

The Pt 100 input of the module F 6220 can be used as reference temperature for all channels. As alternative it is possible to use for each channel of the module an own reference temperature.

3.3 Further data

Input resistance	> 1 MΩ
Line length	approx. 300 m, double screened cable, twisted pair, circuits load impedance max. 500 Ω
Noise voltage suppression	≥ 60 dB (common-mode 50 / 60 Hz)
Voltage endurance	< 375 V (Ex circuit -> non Ex circuit) < 7 V (Ex circuit -> non Ex circuit)

The value in ELOP II can be scaled (0...1000) by the software function block HF-TMP-. It is possible to select only a window of the range.

3.4 Errors

Basis fault (from nominal value)	< 0.1 % at 25 °C
Safety accuracy	< 1 %
Metrological individual faults:	
Channel fault	± 0.1 %
Temperatur fault zero point	± 0.1 % / 10 K
Temperature fault end point	± 0.1 % / 10 K
Linearity fault	± 0.05 %

F 6220 (0625)

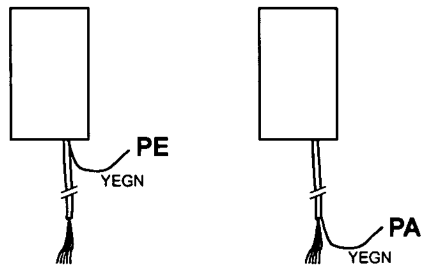
Channel	Connection	Color
1	z2 d2	WH BN
2	z4 d4	GN YE
3	z8 d8	GY PK
4	z10 d10	BU RD
5	z14 d14	BK VT
6	z16 d16	GYPK RDBU
7	z20 d20	WHGN BNGN
8	z22 d22	WHYE BNYE
Pt 100	z32 d32	WHGY BNGY
Cable screen		YEGN

Cable
LiFYCY
12 x 2 x 0.2 mm²
screened

l = 60 mm
q = 2.5 mm²

Note:
Intrinsically safe version of the cable plug without screen, PA at the end of the cable:

non Ex: Ex:



Lead marking cable plug
Z 7062 / 6220 / C ... / U100mV (gray)

Flat pin plug 6.3 x 0.8 mm, to be connected to the earth bar under the slot

Figure 2: Lead marking cable plug

Cable plug Z 7062 / 6220 / Ex / C ... / U100mV (blue)
(intrinsically safe version, see note below)

Note	Intrinsically safe cables must be marked, e.g. with a blue (RAL 5015) color of the isolation.

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4 Operating Instructions for F 6220

4.1 Usage

The module can be used to measure temperatures with low-resistance thermocouples. As reference junction temperature serves a PT 100. The thermocouples can be installed in hazardous areas up to zone 0.

Digitized process signals are available in the HIMA PES.

The inputs must not apply with external voltage. Beside all not described applications are not admissible.

4.2 Electrical data regarding intrinsic safety

The respective indications can be learnt from the enclosed EC type examination certificate.

4.3 Assembling

The module must be installed out of the hazardous area.

The modules shall be installed in 19 inches I/O subracks. The mounting position can be horizontal or vertical.
There are no installation instructions, any modules can be equipped together without free slots between.

4.4 Application hints for explosion protection

The relevant standards shall be observed, particularly:

- DIN EN 60079-14 (VDE 0165, part 1)
- EN 50014
- EN 50020

Besides that the following points shall be observed:

- The modules inclusive the connection facilities must be installed with a minimum degree of protection IP 20 according to EN 60529 (VDE 0470 part 1).
- The specified ambient temperature for the explosion protection is T = -25 °C to +60 °C.
- Two intrinsically safe input circuits from two thermocouple input modules Type F 6220 or some intrinsically safe input circuits from one thermocouple input module can be connected together. The calculation must use the reduced values for the max. inductivity.
- The separation between intrinsically safe and non-intrinsically safe terminals must have a distance of ≥ 50 mm (filament dimension).
- The separation between two intrinsically safe terminals must have a distance of ≥ 6 mm (filament dimension).
- Intrinsically safe and non-intrinsically safe lines and cables must be installed separately or the intrinsically safe lines must be additionally insulated.
- Intrinsically safe lines and cables must be marked, for example with light-blue colored

(RAL 5015) insulation.

- The wiring must be mechanically secured, that by an unintentional disconnection the minimum distance (EN 50020 / part 7, table 4) between an intrinsically safe connection and a non-intrinsically safe connection is not falling below the minimum.
- The cable shield must be wired on the equipotential bonding PA. For non-intrinsically safe applications the cable shield can be wired on the protective earth PE at the I/O subrack.

The used lines or cable must fulfill following insulation test voltages:

- Intrinsically safe lines ≥ 1000 VAC
- Non-intrinsically safe lines ≥ 1500 VAC
- The ends of stranded lines must be finished with wire end ferrules. The terminals must be able to connect the used conductor cross-sections.

4.5 General application notes

- Not used input channels must be short-circuited.
- In the case of a fault the output VALUE (INT) of the software function block HF-TMP-3 gets the value 0 without declaration of underflow or overflow. In this case the output of the software function block CHANNEL ERROR (BOOL) must be evaluated in the user program.
- For safety integrity level SIL 3 the reference temperature must be used out of the user program or out of the compare of two reference temperatures from two modules.
- The temperature of the thermocouple in applications with SIL 3 must be calculated out of two thermocouples.
- The parameterization of the module must be performed according to the operating system manual for the current used version of the operating system. Especially the chapter about the noise blanking has to be regarded.
  Setting: Safety time ≥ 3 x watchdog time.

4.6 Start-up

Before commissioning the installation must be approved by an expert for intrinsically safe functions, particularly checking the power supply connections and the connections of intrinsically safe circuits.

4.7 Operation

The error codes for the module are shown in the display of the corresponding central module. For further informations see operating system manual.

4.8 Maintenance

When a module fails the defective module can be replaced against the same type or approved spare part. The repair of defective modules must only be made by the manufacturer.

EC Type Examination Certificate

No.: EX5 00 02 19183 031

TÜV PRODUCT SERVICE

in accordance with Annex III of Council Directive No. 94/9/EC for equipment and protective systems intended for use in potentially explosive atmospheres (ATEX) for

HIMA Paul Hildebrandt GmbH + Co KG
Albert-Bassermann-Straße 28

68782 Brühl

Product:	**Automation devices, safety-related type F**
Model:	**F 6220**
Parameters:	see appendix (four pages)

The above mentioned product meets the provisions of the Directive.

This certificate is issued on the basis of the product provided for testing and certification and on its technical documentation. The detailed results of the test and the provided technical documentation are listed in

Test report no.: 990187410

This certificate pertains only to the sample product submitted to TÜV PRODUCT SERVICE for testing. Therefore this certificate has no specified period of validity.

Released with the above mentioned certificate number by the Certification Body of TÜV PRODUCT SERVICE.

Department: PS-IQSE / jb
Date: 17.03.2000

TÜV PRODUCT SERVICE GMBH is a Notified Body in accordance with Council Directive 94/9/EC for equipment and protective systems intended for use in potentially explosive atmospheres with the identification number 0123.

TÜV PRODUCT SERVICE GMBH · Zertifizierstelle · Ridlerstrasse 65 · D-80339 München

F 6220 (0625)

Appendix to EC Type Examination Certificate
No.: EX5 00 02 19183 031

TÜV PRODUCT SERVICE

1 Description

The module F6220 is a associated apparatus for installation only outside an atmosphere capable of explosion. This subassembly unit for installation in a subrack consist of two PCB-boards. Nine galvanically coupled intrinsically safe input ports are connectable at the front and the output- and the power supply port are connectable at the rear of this module.

2 Electrical data

2.1 Intrinsically safe port, X2

The channel 1..8 for thermocouple and channel 9 for platinumsensor (PT 100) are intrinsically safe and safety isolated up to a peak value of 375V to the other terminals.

Input, Pin	Function	Common Reference, Pin
Z2	Thermocouple [1]	D2
Z4	Thermocouple [2]	D4
Z6	not connected	D6
Z8	Thermocouple [3]	D8
Z10	Thermocouple [4]	D10
Z12	not connected	D12
Z14	Thermocouple [5]	D14
Z16	Thermocouple [6]	D16
Z18	not connected	D18
Z20	Thermocouple [7]	D20
Z22	Thermocouple [8]	D22
Z24	not connected	D24
Z26	not connected	D26
Z28	not connected	D28
Z30	not connected	D30
Z32	Platinumsensor [PT 100]	D32

Appendix to EC Type Examination Certificate
No.: EX5 00 02 19183 031

TÜV PRODUCT SERVICE

2.1.1 Input port for thermocouple, channel 1...8

Voltage, U_o	crest value DC 19 V
Current, I_o	crest value DC 6 mA
Power, P_o	crest value 28,5 mW
internal capacitor, C_i	negligible
internal inductance, L_i	negligible

The permissible ratings for max. capacitor and inductance for one and two parallel input ports are listed in the following tables.

2.1.1.1 EEx ia IIC

max. connectable inductance of one and several input port	L_o = 2 mH
max. connectable capacitor of one input port	C_o = 0,2 µF
max. connectable capacitor of two parallel input port	C_o = 0,2 µF

2.1.1.2 EEx ia IIB

max. connectable inductance of one and several input port	L_o = 2 mH
max. connectable capacitor of one input port	C_o = 1,1 µF
max. connectable capacitor of two parallel input port	C_o = 1,1µF

2.1.1.3 EEx ib IIC

max. connectable capacitor of one and several input port	C_o (L_o = 0) = 0,25 µF
max. connectable inductance of one input port	L_o (C_o = 0) = 0,6 H
max. connectable inductance of two parallel input port	L_o (C_o = 0) = 0,58 H

2.1.1.4 EEx ib IIB

max. connectable capacitor of one and several input port	C_o (L_o = 0) = 1,5 µF
max. connectable inductance of one input port	L_o (C_o = 0) = 1 H
max. connectable inductance of two parallel input port	L_o (C_o = 0) = 1 H

F 6220 (0625)

Appendix to EC Type Examination Certificate
No.: EX5 00 02 19183 031

TÜV PRODUCT SERVICE

2.1.2 Input port for platinumsensor (PT 100)

Voltage, U_o	crest value DC 19 V
Current, I_o	crest value DC 11 mA
Power, P_o	crest value 52,3 mW
internal capacitor, C_i	negligible
internal inductance, L_i	negligible

2.1.2.1 EEx ia IIC

max. connectable inductance	L_o = 2 mH
max. connectable capacitor	C_o = 0,2 µF

2.1.2.2 EEx ia IIB

max. connectable inductance	L_o = 2 mH
max. connectable capacitor	C_o = 1,1 µF

2.1.2.3 EEx ib IIC

max. connectable capacitor	C_o (L_o = 0) = 0,26 µF
max. connectable inductance	L_o (C_o = 0) = 0,3 H

2.1.2.4 EEx ib IIB

max. connectable capacitor	C_o (L_o = 0) = 1,5 µF
max. connectable inductance	L_o (C_o = 0) = 1 H

2.2 Output port, X1 pin Z8, Z22...Z28 / D8, D20...D28 (non-intrinsically safe)

Voltage crest value 5 V

2.3 Power supply port, X1 pin Z2 / D2 (non-intrinsically safe)

Nominal voltage	DC 24 V
Voltage	crest value DC 30 V
Power	6 W
Absolute maximum voltage to not affect the intrinsic safety	U_m crest value 40V

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Appendix to EC Type Examination Certificate
No.: EX5 00 02 19183 031

TÜV PRODUCT SERVICE

3 Identifying marking

The legible and durable marking must include the following option list:

- Name and address of the manufacturer,
- CE-marking (Annex X, point A directive 94/9/EC),
- designation of series or type / serial number,
- year of construction,
- the identifier Ex II (1)G [EEx ia] IIC
- essential information for safe use

4 Intended use in potentially explosive atmospheres

Pay attention to intended use in potentially explosive atmospheres by detailed instructions for safe use by the manufacturer according Annex II directive 94/9/EC.

5 Production quality assurance

The manufacturer shall operate an approved quality system for production, final equipment inspection and testing according Annex X directive 94/9/EC.

Munich, March 17th 2000
TÜV PRODUCT SERVICE GmbH PS-IQSE

Notified Body
Dipl.-Ing. J. Blum

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H 7506 (0630)

HIMA

H 7506

H 7506: Bus terminal

for the installation of HIBUS-2 (RS 485)

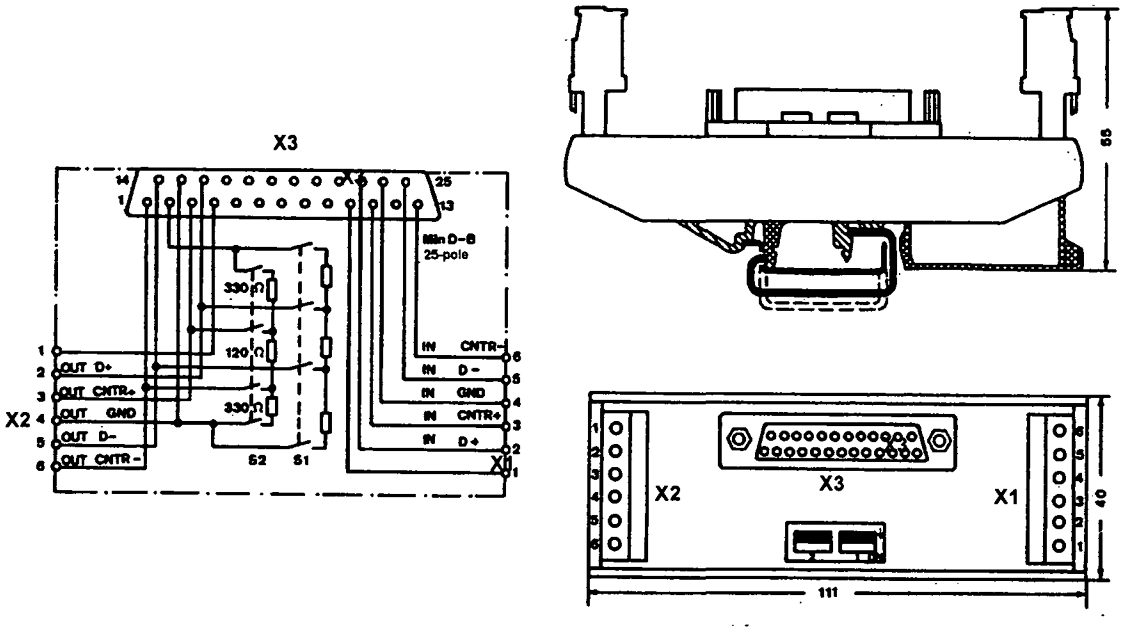

Figure 1: Wiring diagram, top view, front view

The bus terminal consists of a 25-pole Min-D socket to connect single channel PES and redundant PES H41q/H51q via the data cables BV 7040 or BV 7046.

The connections for the 2-wire bus are made by means of two 6-pole terminal blocks. By selection of two switches the bus terminating resistors can be switched on at each end of the 2-wire bus. If the bus terminal block H 7506 is used at the end of the 2-wire bus then the terminal block X2 cannot be connected.

Use of the bus terminal H 7506 see the following application and the applications in data sheet H 7505.

Mechanical design	Terminal box for top hat profile rail according to EN 50022 two 6-pole terminal blocks for cross-sections up to 2.5 mm^2 one 25-pole Min-D socket, protective earth terminal

Note	Do not use PIN1 bus terminal X1.1 and X2.1 to prevent interferences on the bus. Connect the wire shield to the protective earth terminal.

H 7506 (0630)

Application:
Programmer station (PADT) with RS 485 interface card RS 485 PCI

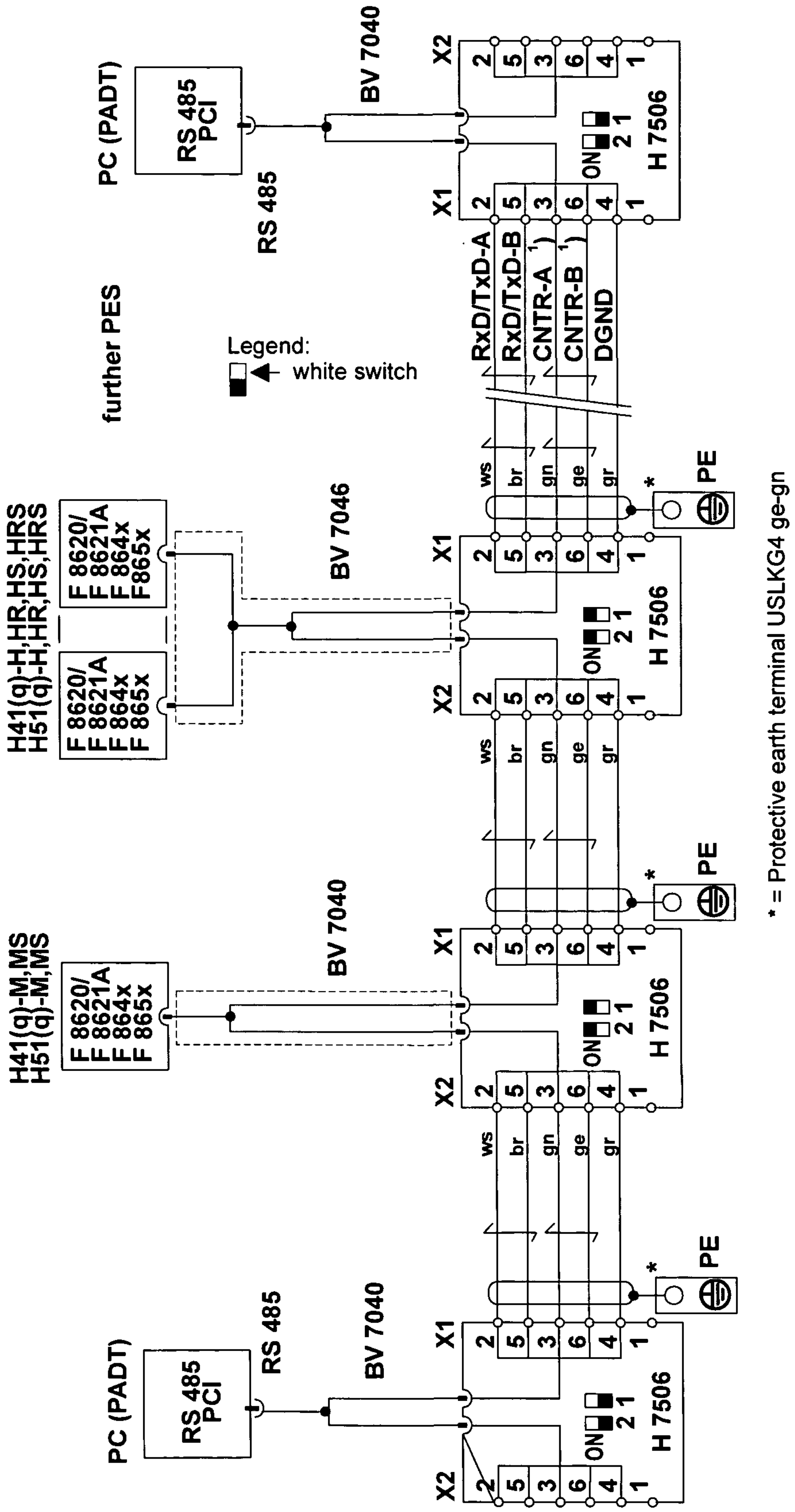

Figure 2: Programmer station (PADT) with RS 485 interface card RS 485 PCI

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BV 7046 (0524)

HIMA

BV 7046

CE

BV 7046: Data connecting cable

Connection of the bus terminal H 7506 to the interface in the H41q/H51q systems (redundant systems)

Standard lengths: 2 m, 4 m

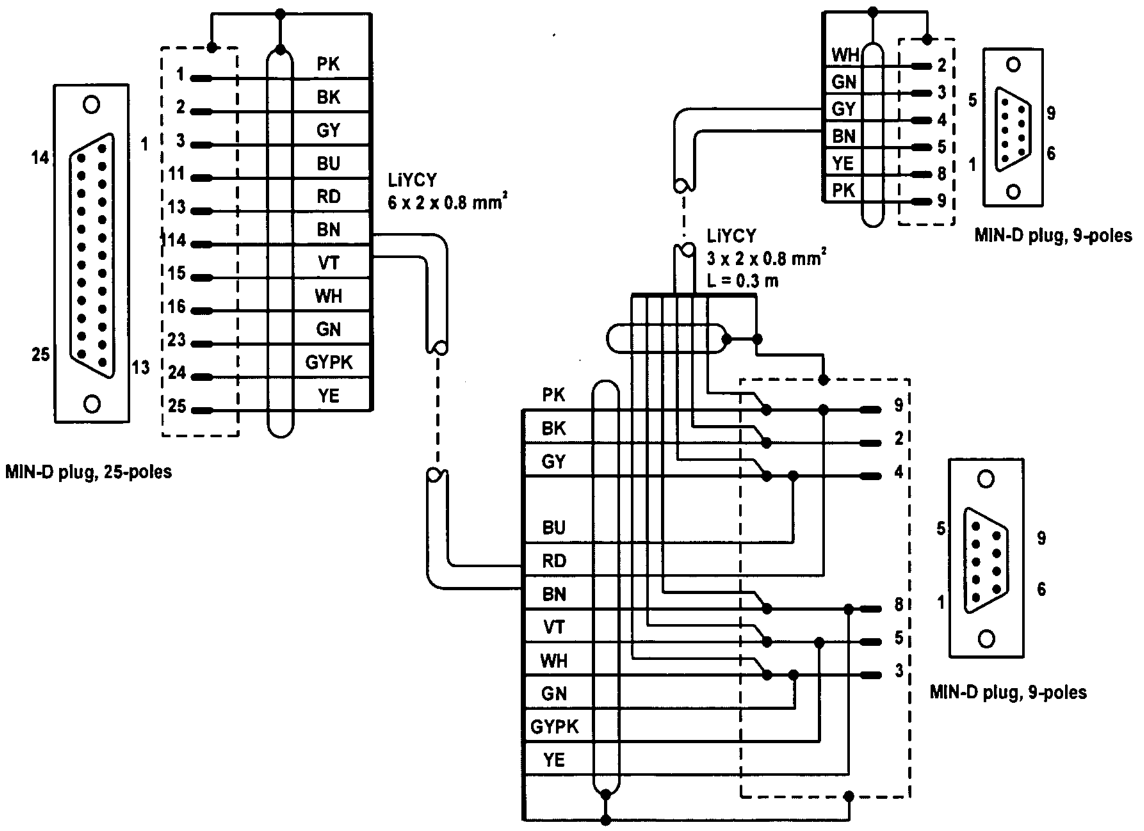

Figure 1: Wiring

Note Depending on the used cross section the bus length calculated for the cable BV 7046 is four times the cable length.

BV 7046 (0524)

Pin	RS 485	Signal	Meaning
1	-	-	not used
2	-	RP	5 V, decoupled by diodes
3	A/A'	RxD/TxD-A	Receive/Transmit Data A
4	-	CNTR-A	Control signal A
5	C/C'	DGND	Data Ground
6	-	VP	5 V, positive pole of power supply
7	-	-	not used
8	B/B'	RxD/TxD-B	Receive/Transmit Data B
9	-	CNTR-B	Control signal B

Table 1: Pin assignment of the interface RS 485, 9-pole

Programmable Systems
The H41q and H51q System Families

Data Sheet / Operating Instructions
for Module
F 8627(X)

HIMA Paul Hildebrandt GmbH + Co KG
Industrial Automation

HI 800 265 EEA

Caution

The safety-related H41q/H51q systems as described in this manual can be used for several different purposes. The knowledge of regulations and the technically perfect transfer carried out by qualified staff are prerequisites for the safe installation, start-up and for the safety during operation and maintenance of the H41q/H51q systems.

In case of unqualified interventions into the automation devices, de-activating or bypassing safety functions, or if advices of this manual are neglected (causing disturbances or impairments of safety functions), severe personal injuries, property or environmental damage may occur for which we cannot take liability.

Important Notes

All HIMA products mentioned in this manual are protected with the HIMA trade-mark. As not differently noted down this is possibly also valid for other mentioned manufactueres and their products.

All listed modules are CE certified and meet the requirements of the EMC Guideline of the European Community.

All technical statements and data in this manual have been worked out very carefully, and effective checks and inspections have been applied. This manual may however contain flaws or typesetting errors. Therefore HIMA does not offer any warranties nor assume legal reponsibility nor any liability for the possible consequences of any errors in this manual. HIMA would appreciate being informed on possible errors.

The technology is subject to changes without notice.

Delivery Conditions

For our deliveries and services apply the “General Conditions for Delivery of Products and Services of the German Electrical Industry “ - edition January 2002 -, resp. the “Conditions of Delivery for System Software and Peripheral Devices for the HIMA Automation System“ (e. g. programmer units, printers, screen monitors). The products of this price list are subject to the valid export regulations.

Eventual complaints can be recognized only when we are being notified within 14 days after receipt of the merchandize.

The prices shown in a special list are valid ex works, packing charges excluded. The prices are subject to change.

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F 8627/F 8627X

F 8627X:Ethernet module

F 8627X Communication Module for Ethernet-Communication
Application in H41q/H51q PES (beginning with OS 41q/51q V7.0-7 (9906)).
Appertaining ELOP II Function block: HK-COM-3

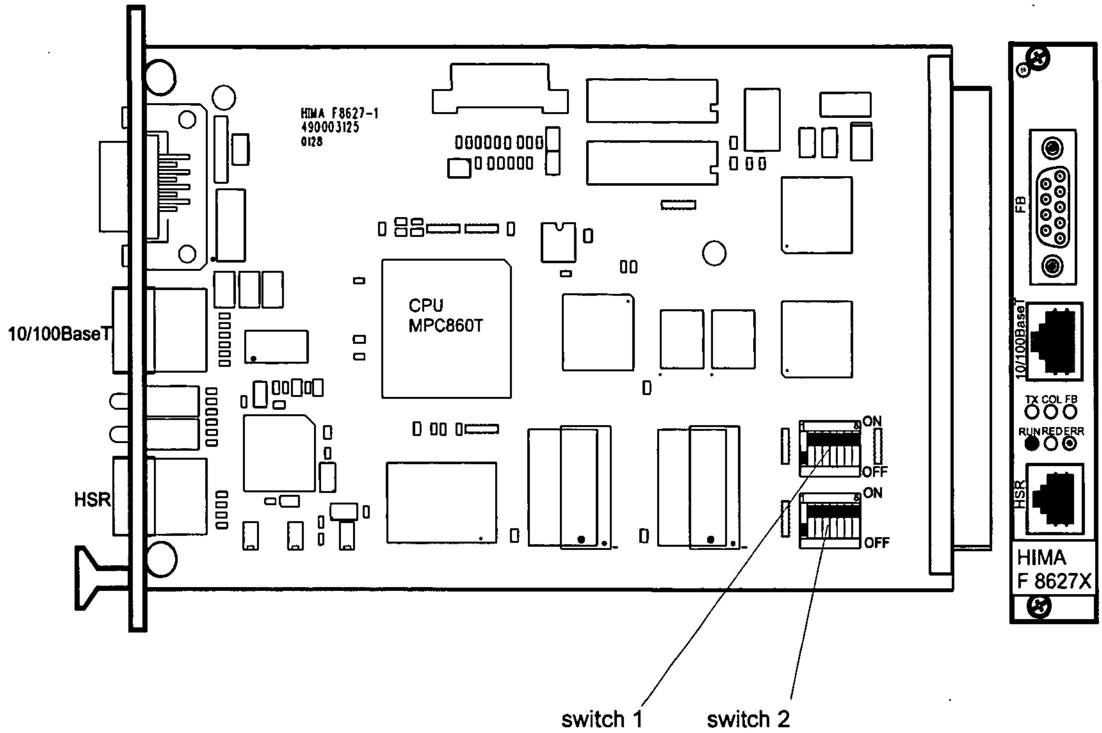

Figure 1: Communication module F 8627X

1 Technical data

Processor	32 bit Motorola CPU MPC860T with integrated RISC communication controller
Operating voltage	5 V
Current consumption	1 A
Space required	3 HU (units high), 4 SU (units wide)
Ethernet Interface	10BaseT or 100Base TX according to the IEEE 802.3 standard, connection via an RJ-45 plug.
HSR Interface	High-speed serial communication interface to the redundant HSR (High Speed Redundancy) communication module. Connection via an RJ-12 plug with BV 7053.
Serial Interface	The serial interface FB is not used.
Diagnostic Display	6 LEDs for display diagnostic during operation.
DIP switches	2 DIP switches for setting the module functions.

2 Functions of F 8627X

2.1 General

A H41q/H51q controller can simultaneously exchange via an F 8627X non safety-related data with a HIMA OPC server and safety-related data via safe**ethernet**. In this case, the F865x central module ensures safety.

Beginning with operating system version 4.x, the F 8627X supports the functions "MODBUS TCP slave" and "ELOP II TCP". The ELOP II TCP connection provides a fast data exchange between a PADT (PC) and the F 865x central module.

Note	The F 8627X has the same functions as the F 8627 and is compatible with it. The new functions are only supported in an F 8627**X** with operating system V4.x or higher.

2.2 Operating system versions

Overview of the operating system versions which can be loaded into the F 8627X.
The F 8627X is delivered with operating system version 4.x

Operating system version	Properties/Mode
From OS version 2.x	• HIPRO-S Mode • A maximum of 31 HIMA PES can communicate with each other in a safety-related manner. • A PES can communicate with a maximum of 4 HIMA OPC servers (see also Table 8, "Overview of the communication with a HIMA OPC server via the F 8627X in combination with HIPRO-S," on page 18).

From OS version 3.x	• Compatible to OS version 2.x
	• HIPRO-S-DIRECT Mode
	  • No more than 99 safe**ethernet** members can be configured in the total network. An individual PES can have 63 safe**ethernet** communication partners.
	  • In HIPRO-S-DIRECT mode the number of OPC servers can be set via switch from 0 up to 14 (see also Table 8, "Overview of the communication with a HIMA OPC server via the F 8627X in combination with HIPRO-S," on page 18).

From OS version 4.x (only F 8627X)	• Compatible with OS versions 2.x and 3.x • A PES can communicate as a MODBUS TCP slave via Port 502 and Port 8896. • ELOP II TCP connection between a PADT (PC) and F 8627X. **System environment required for F 8627X** • Central module F 865x, OS version (05.34) or higher • ELOP II, version 4.1 Build (6118) or higher

Table 1: F 8627X operating system versions

2.3 Compatibility of the operating system versions

Communication modules having different operating system versions may operate within one rack, even if the communication modules are interconnected redundantly or communicate with one another via Ethernet.
Observe that the used functions of a communication module are supported by the respective operating system (see Table 1).

Note Observe the application guidelines and settings of the F 8627X in Chapter 6.

2.3.1 Ethernet communication between F 8627X and F 8625

Check the following Ethernet communication settings between F 8627X and F 8625:

- If the F 8627X is directly connected with a F 8625 (using a "cross over" Ethernet cable without a switch), then "Autonegotiation" must be activated on the F 8627X (switch S2/3 to „ON").
- The DIRECT Mode on the F 8627X must be switched off (set switch S1/7 to "OFF").
- "Passive mode" may only be used (set switch S1/8 to "OFF") if also activated on the communication partners.

2.3.2 Redundant interconnection in an H41q/H51q controller

The following table shows the operating systems for the redundant interconnection of the communication modules (CM) F 8627X and F 8627X/F 8625 and the settings that must be considered.

CM1	CM2	Properties/Settings
F 8625 OS V1.x	F 8627X from OS V2.x up to OS V4.x	The "DIRECT Mode" on the F 8627X module must be switched off (switch S1/7 to „OFF").
F 8627X from OS V2.x up to OS V4.x	F 8627X from OS V2.x up to OS V4.x	The used functions must be supported by the used OS versions (see Table 1).

Table 2: Redundant interconnection of the communication modules

Note The "passive mode" and the "DIRECT mode" may only be activated if activated on the redundant communication module.

Note For redundant interconnection it is recommended to use communication modules of the same type with the same operating system.

2.4 Replacing an F 8627X

⚠ An F 8627X must never be removed from a redundant operation without a special procedure.
Before removing an F 8627X, its fixing screws must be completely loosened and freely movable. Remove the module from the bus board by pushing the ejection lever (front label) top down and quickly removing in an upward motion to ensure faulty signals are not triggered within the system.
To attach the module, place it on the terminal block and press it inwards as far as it will go. This action should be performed quickly to ensure that faulty signals are not triggered within the system.

2.4.1 Operation of the ejection lever

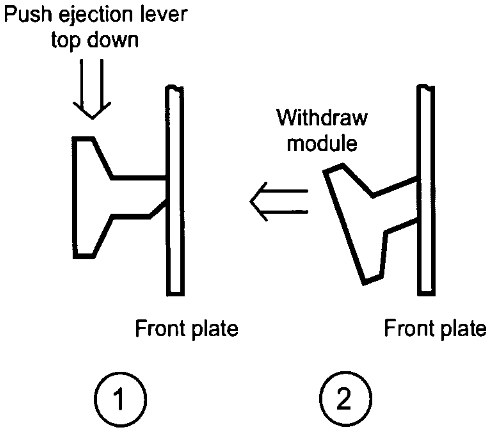

Figure 2: Operation of the ejection lever

2.4.2 Procedure for exchanging a redundant F 8627X in a redundant H41q/H51q controller

⚠ Make sure that you connect the Ethernet cable to the Ethernet socket (10/100BASE-T) and the HSR cable to the HSR socket (HSR).
The respective connectors must be pressed in until they snap into their sockets.

1. Unplug communication cable (Ethernet).
2. Corresponding central module (e.g. F 8650X) with operating system
   - Version below (05.34): remove the central module!
   - Version beginning with (05.34): erase application program manually to deactivate the central module (see operation system manual "Erasing the application program")
3. Unplug HSR cable BV 7053 (if used).
4. Remove communication module F 8627X.
5. Check the new F 8627X
   - Check the DIP-switch settings
     (see chapter 4 and compare to the exchanged F 8627X).
   - Check whether if the operating system (see sticker on the F 8627X) supports the used functions!
6. Plug the new communication module F 8627X.
7. Plug the HSR cable BV 7053 (if required).
8. Corresponding central module (e.g. F 8650X) with operating system
   - Version below (05.34): plug the central module!
   - Version beginning with (05.34): push the button "Ack" to activate the central module (see operation system manual "Self-Education")
9. Wait until the LED "RUN" on the F 8627X lights continiously.
10. Plug the communication cable (Ethernet).

Note The ARP entry on the PADT (PC) must be deleted if the new F 8627X has the **same IP address** as the old F 8627X.
If the new F 8627X has the same IP address it cannot be connected to the PADT (PC).

Example: Delete the ARP entry of an F 8627X with
IP address **192.168.0.67**.

- Start the "Dos Shell" on the PADT (PC)
- Enter the command **arp -d 192.168.0.67**.

3 Diagnostic LEDs on module front

3.1 Top row LEDs on module front

TX	COL	FB	Operating status
ON	-	-	Send LED of Ethernet communication
-	ON	-	Collision on the Ethernet segment
-	-	OFF	No display (always OFF)

Table 3: Top row LEDs on module front

3.2 Bottom row LEDs on module front

RUN	RED	ERR	Operating status
ON	-	OFF	Ethernet communication protocol active
Flashing	-	OFF	Ethernet communication protocol inactive
-	ON	OFF	Communication to redundant communication module active. **Note** The redundancy LED is OFF if DIRECT Mode (switch 1/7 ON) or Mono (switch S2/2 ON) is enabled. This applies also in case of a redundant connection via HSR cable.
Flashing	-	Flashing	Booting of the communication module
ON	-	Flashing	Beginning with OS version 4.6 User Error / Configuration Error • Res-ID and ID are not equal • Ethernet communication protocol inactive, even if the communication module is in RUN status.
OFF	-	ON	Fatal error in communication module. Module must be replaced.
OFF	-	Flashing 3-times	Saving the error code in Flash-EPROM (required for repair purposes) ***Do not unplug communication module!***

Table 4: Bottom row LEDs on module front

4 Functions of the switches

4.1 Functions of switch 1 (S1)

S1	ON	OFF	Description
1	10 ms	0 ms	The "Timeout" is the timeframe within which the receiver must acknowledge receiving packets from the transmitter. It is set via the switches S1/1-5. Standard value: 10 ms (switch 1/1-5 "OFF"). Switches S1/1-5 can be combined by the user. 10 ms must be added for each combination of switches. HIPRO-S-DIRECT must be activated (switch 1/7 "ON").
2	20 ms	0 ms	
3	40 ms	0 ms	
4	400 ms	0 ms	
5	1000 ms	0 ms	
6	ID_IP ON	ID_IP OFF	For OS versions < 4.x no function (See also Chapter 5.2.3) ID_IP ON The bus station number (ID) which is set on the F 865x central module via switches (S1 1-7) is used as Res-ID if no Res-ID could be determined from the loaded user program. ID_IP OFF The bus station number (ID) which is set on the F 865x central module via switches (S1 1-7) is never used for the Res-ID.
7	DIRECT Mode enabled	DIRECT Mode disabled	HIPRO-S-DIRECT Mode must be activated if more than one bus configuration is required. HIPRO-S-DIRECT is supported beginning with the F 8627X OS version 3.x.
8	Passive Mode disabled	Passive Mode enabled	The Passive Mode controls the communication to the HIMA OPC server. Passive Mode enabled: The Token Passing between the F 8627X to the HIMA OPC servers is disabled. The HIMA OPC servers cyclically exchange data with the F 8627X, independent of the token owner. Passive Mode disabled: The Token Passing between the F 8627X and the HIMA OPC servers is enabled. The HIMA OPC servers only exchange data with the F 8627X if they have the Token.

Table 5: Functions of switch 1 (S1)

4.2 Functions of switch 2 (S2)

S2	ON	OFF	Description
1	Ethernet Channel 1	Ethernet Channel 2	F 8627X allocation to the Ethernet channel 1 or Ethernet channel 2.
2	Mono	Redundant	Wiring of the modules (Not used in HIPRO-S-DIRECT Mode)
3[1]	Auto-negotiation On	Auto-negotiation Off	Automatic adaptation of transmission rate (10/100 MBit/s) and duplex mode if is Switch S2/3 is ON.
4	100 MBit/s	10 MBit/s	The switch position of switch is only relevant if switch S2/3 (auto-negotiation) is OFF.
5[1] [2]	Full duplex	Half duplex	The switch position of switch is only relevant if switch S2/3 (auto-negotiation) is OFF. Simultaneous sending and receiving if switch S2/5 is ON. Note on full-duplex operation: In network topologies where hubs are used, hubs must be replaced by full-duplex switches (hubs are not full-duplex capable).
6	2 OPC server	0	Beginning with the F 8627X OS version 3.x, the number of HIMA OPC servers (0 to 14) must be set via switches. Switches S2/6-8 can be combined by the user. If HIPRO-S-DIRECT is not active the number of HIMA OPC servers is four. For determining the Node Ids and IP addresses for the configuration of HIMA OPC server, see Chapter 6.8.1.4 and Chapter 6.9.1.5.
7	4 OPC server	0	
8	8 OPC server	0	

Table 6: Functions of switch 2 (S2)

1) Beginning with OS versions 3.x, only the transmission rate is automatically adapted when "Autonegotiation On" (S2/3 ON) is set. The duplex mode must be set using switch S2/5.

2) Beginning with OS versions 3.x, autonegotiation must be activated at the communication partner (e.g. switch) if full duplex (S2/5 ON) is set on the F 8627X . Not observing these settings can lead to communication problems.

Note Beginning with OS version 4.x, an F 8627X with the settings "Autonegotiation Off" (S2/3 OFF) and "full duplex" (S2/5 ON) may not operate with a communication partner (e.g. switch) with Autonegotiation activated.
Since these settings are allowed for OS version V3.x and below, they must be checked and, if necessary, adapted when upgrading to OS version V4.x or higher. Not observing these settings can lead to communication problems.

---

5 Ethernet connection via the F 8627X

5.1 Determining the F 8627X IP address

For all OS versions the F 8627X IP address is determined from the resource name of the loaded user program.
The IP address is composed of the network address and the host address. The default network address is **192.168.0**.
The last byte of the IP address 192.168.0.x is the host address and is calculated as follows:

For ethernet module channel 1 (switch 2/1 = ON)
Host address = (the last two digits of the resource name) * 2 + 1

For ethernet module channel 2 (switch 2/1 = OFF)
Host address = (the last two digits of the resource name) * 2 + 2

Note The resource name **must** have eight characters and the last two characters (Res-ID) **must** be numbers!
IDs allowed:

DIRECT Mode ON (switch 1/7 ON)
Res-ID: 1 up to 99
DIRECT Mode OFF (switch 1/7 OFF)
Res-ID: 1 up to 64

The ethernet module does not change to RUN status, if the Res-ID > 64 and the DIRECT Mode is deactivated.

Important for safe**ethernet**:
If more than 30 communication partners are configured, several bus configurations must be created in ELOP II, since a bus configuration in ELOP II supports no more than 31 participants.

Example:
Resource name MT200_**33**, module channel 1 (switch 2/1 = ON)
Host address: 33 * 2 + 1= 67; IP address = 192.168.0.**67**

Resource name MT200_**33,** module channel 2 (switch 2/1 = OFF)
Host address: 33 * 2 + 2 = 68; IP address = 192.168.0.**68**

F 8627X settings upon delivery
IP address 192.168.0.63 (switch 2/1 ON) or 192.168.0.64 (switch 2/1 OFF).
Switch ID_IP is deactivated (switch 1/6 OFF).

5.2 ELOP II TCP connection to the central module (CM)

Via the PADT (PC), the user can establish an ELOP II TCP connection to the F 865x central module via the F 8627X.
The ELOP II TCP connection provides a fast data exchange between a PADT and the F 865x central module.

Res-ID: The Res-ID is identical to the last two numbers of the resource name.

ID: The ID is set via DIP switches 1 to 7 on the F 865x central module.

5.2.1 Requirements for a ELOP II TCP connection

- F 865x central module OS version (05.34) or higher
- ELOP II, version 4.1 build (6118) or higher
- F 8627X Ethernet module OS version 4.x or higher
- HSR cable in redundant systems

5.2.2 Connection of ELOP II PADT (PC) to F 8627X

A PADT can only connect to a H41q/H51q via a single F 8627X on the H41q/H51q (even in cases of redundancy).
The selected F 8627X transfers the telegrams to the associated F 865x central module and via the HSR cable (BV 7053) to the redundant F 8627X and the associated F 865x central module.
The HSR cable between the two redundant F 8627X enables the communication to both central modules as well as the "Reload" of a redundant H41q/51q.

Note For ELOP II TCP connection, any free IP address for the PADT may be used. If the PADT IP addresses and the F 8627X are located in the same subnet, a routing entry for the subnet of the F 8627X is not required on the PADT (see also Chapter 5.2.6.1).

Note Carefully check that no other participant (e.g. H41q/H51q , OPC server or PC) has the same IP address, as this could cause communication problems. Next time, when expanding communication, please consider the H41q/H51q and the OPC server IP-addresses.

5.2.3 Create ELOP II TCP connection to a H41q/H51q

Perform the following settings on the H41q/H51q:

- Activate the ID_IP (switch 1/6 ON) on the F 8627X .
- Set channel 1 or channel 2 on the Ethernet module F 8627X (see chapter 5.1).
- Set the redundant channel (if available) on the redundant Ethernet module F 8627X (see chapter 5.1).
- Make sure that a proper operating system OS Version (05.34) or higher is loaded in the F 865x central modules.
- Set the same number for the "ID" on the F 865x central module (DIP switches, see F 865x data sheet), which is used as Res-ID in the resource name (last two digits of the resource name).

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If necessary, delete the User Program of the Central Module F 865x
If a user program with a wrong resource name (e.g. no or wrong Res ID) exists in the F 865x, no ELOP II TCP connection can be established.
Delete the user program with the wrong resource name, so that the F 8627X can be determine the IP address from the F 865x ID settings (DIP switches 1-7).

Note Please refer to the manual "Functions of the operating system BS41q/ H51q (HI 800 105)" for further information about "Erasing the user program".

Perform the following Settings in ELOP II

- Create a resource, having a name from which the required IP address can be determined (see chapter 5.1).
- In the dialog "cabinet layout" add the F 8627X module icons for the documentation of the cabinet allocation.

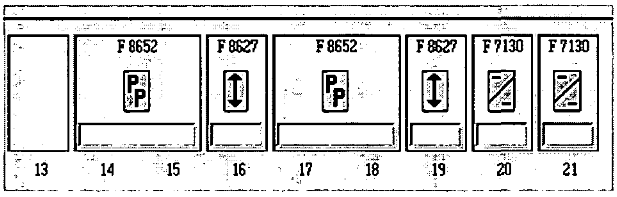

Figure 3: Cabinet Layout

- Open the context menu of the resource and select *Properties.*

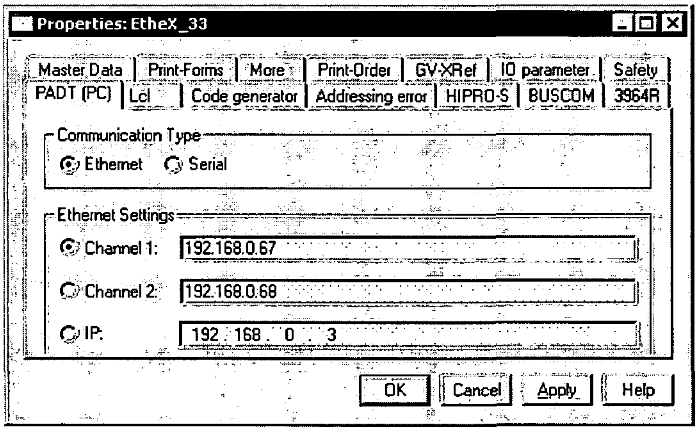

Figure 4: ELOP II dialog "Properties"

- Open the tab *PADT (PC)* and select the communication type *Ethernet.*
- Select one of the IP addresses *channel1* or *channel2* which are determined by ELOP II. By this the F 8627X connected to the PADT is selected.
- Click "OK" to close the "Properties" dialog with "OK".

Load the User Program into the H41q/H51q

- Connect the selected F 8627X with the PADT corresponding to a connection from chapter 5.2.5.

Note In case of a redundant H41q/H51q, make sure that the HSR cable (BV 7053) is plugged; otherwise there is no access available to the redundant central module F 865x.

- Open the context menu of the resource and select *Control Panel.*
If a connection has been established, "OK" appears in the field "Communication".

- Load the user program into the central module(s) F 865x using "Download/Reload".
- Start the H41q/H51q controller.

In case of problems with the ELOP II TCP communication see also chapter 5.2.6.

5.2.4 Upgrade of a H41q/H51q to ELOP II TCP without system stop

Preconditions

A H41q/H51q controller may change to ELOP II TCP without a system stop if the following conditions are fulfilled:

- The conditions for a ELOP II TCP connection are fullfilled (see chapter 5.2.1).
- A suitable operating system OS version (05.34) or higher must be loaded in the central module(s) F 865x.
- In the F 865x a user program must exist having a resource name , from which the F 8627X can determine an IP address.
- On all F 865x the same number for the ID must be set, which is used as Res ID in the resources name. For the reading of the ID, see manual "functions of the operating system BS41q/H51q" (HI 800 105).

Installation of the F 8627X module

For installation of the F 8627X Consider chapter 2.4.

- On all F 8627X activate the ID_IP (switch 1/6 ON).
- Set channel 1 or channel 2 on the Ethernet module F 8627X (see chapter 5.1).
- Set the redundant channel (if available) on the redundant Ethernet module F 8627X (see chapter 5.1).
- Replace the existing modules F 8627 by F 8627X, by which the ELOP II TCP connection is carried out. If no F 8627X modules were used previously, then plug the F 8627X into the specified module slot.

Perform the following Settings in ELOP II

- Open the resource context menu and select *Properties.*
- Open the tab *PADT (PC)* and select the communication type *Ethernet.*
- Select one of the IP addresses *channel1* or *channel2* that are determined by ELOP II. By this the F 8627X connected to the PADT is selected.
- Click "OK" to close the "Properties" dialog with "OK".

Load the User Program into the H41q/H51q

- Connect the selected F 8627X to the PADT corresponding to a wiring from chapter 5.2.5.

Note In case of a redundant H41q/H51q, make sure that the HSR cable (BV 7053) is plugged; otherwise no access possible to the redundant central module F 865x.

- Open the context menu of the resource and select *control panel.*
  If a connection has been established, "OK" appears in the field "Communication"

In case of problems with the ELOP II TCP communication see also chapter 5.2.6.

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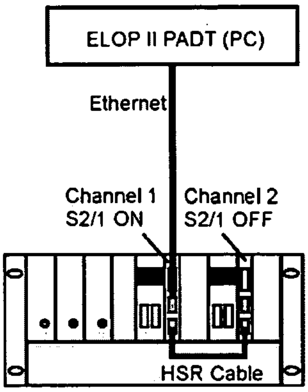
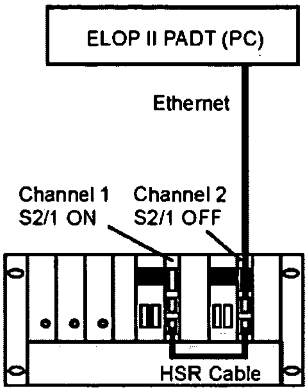
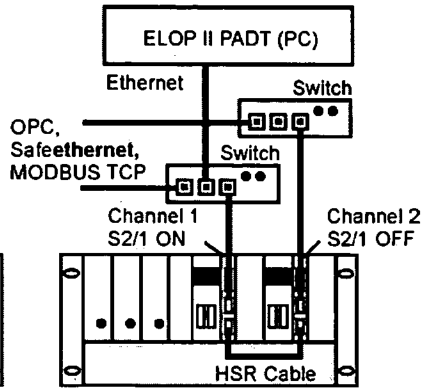
5.2.5 ELOP II TCP connections to H41q/H51q controllers

ELOP II, OPC and safe**ethernet** can operate on the same network.
Certain restrictions apply to HIPRO-S and OPC (see Table 7 and Table 8 in Chapter 6).
If the PADT and the H41q/H51q controller are directly connected with one another, a "cross over" Ethernet cable is required.

5.2.5.1 ELOP II TCP connections to redundant H41q/H51q controllers



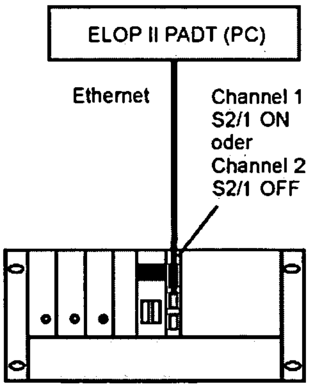


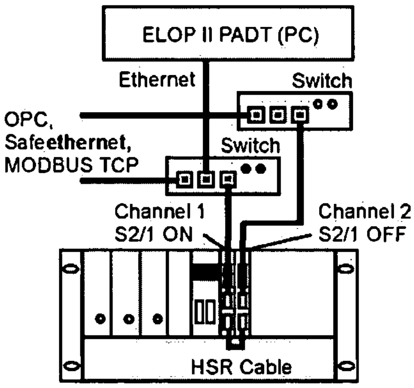


The PADT can establish a connection to the H41q/H51q

- only via channel 1 (left figure).
- only via channel 2 (middle figure).
- only via channel 1 (right figure).

5.2.5.2 ELOP II TCP connections to mono H41q/H51q controller





The PADT can establish a connection to the H41q/H51q

- either via channel 1 or via channel 2 ,depending on F 8627X switch 2/1 (left figure).
- only via channel 1 (right figure).

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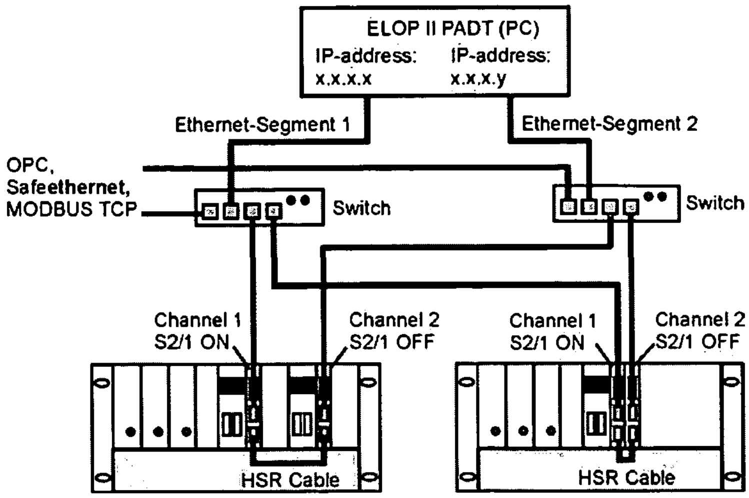
5.2.5.3 ELOP II TCP connection to H41q/H51q controllers via a redundant network



The PADT can establish a connection to the H41q/H51q systems via ethernet segment 1 or ethernet segment 2.
A routing entry for each ethernet module of the PADT is required (see also chapter 5.2.6).

⚠ **Others possibilities of the ELOP II TCP wiring shown above are not authorized and can cause problems!**

⚠ Only communication modules of the same type may be connected to one another using the HSR cable (the connection between F 8627X and F 8628X is not permitted).

5.2.6 If ELOP II TCP communication can not be established

First check

- If ELOP II TCP wiring was correctly performed (see Chapter 5.2.5.1 to Chapter 5.2.5.3) and
- the F 865x ID (DIP switches 1-7) and the ressources RES-ID are identical.

Note A H41q/H51q PES can only communicate with a single PADT. If the user accesses the same PES using a second PADT, he can establish a connection to this PES by repeatedly pushing the button "Initialize communication". Then the connection to the first PADT is disconnected and the message "2. PADT (PC) connected to the PES" is displayed in the control panel's "Communication" field.

5.2.6.1 Is the PADT (PC) network card located in the same subnet?

1. Determining the IP address of the PADT(PC) network

- In MS-Windows, open the settings of the PADT network connections from the PADT.
- Select the network card used for connecting to the F 8627X.
- Select properties of the internet protocoll.
  - If the network card is not located in the same F 8627X subnet "**192.168.0.x**", follow step 2 for creating a connection.
  - If the network card is located in the same subnet but no connection is available, check the connection using the function "Ping" specified in Chapter 5.2.6.3.

2. Establishing a network connection between a PC and an F 8627X, if they are located in different subnets.

- First method: Change the IP address of the PC network card in use
  - In the properties of the TCP/IP connection, enter a free IP address which is located in the same subnet as the F 8627X "**192.168.0.x**".
- Second method: Create a routing entry to the F 8627X on the PC
  - Start the "Dos Shell" on the PC.
  - Enter the following command:
    route add [IP address F 8627X] mask 255.255.255.255 [IP address PC]

Note To ensure the routing entry remains permanent (e.g. after the PC is restarted), use the **-p** parameter with the route command. Example: **route -p add**. Check if the routing entry for connecting the PC network card to the F 8627X is correct by using the command **route print**.

- Start the ELOP II control panel to establish a connection to the F 8627X.

5.2.6.2 Connection problem after exchanging an F 8627X

The ARP entry on the PC must be deleted if the new F 8627X has the **same IP address** as the old F 8627X.
Otherwise the new F 8627X with the same IP address cannot be connected to the PADT (PC).

Example: Delete the ARP entry of an F 8627X with the IP address **192.168.0.67**.

- Start the "Dos Shell" on the PADT (PC).
- Enter the command **arp -d 192.168.0.67**.

5.2.6.3 Check the connection to the F 8627X using "Ping"

- Start the "Dos Shell" on the PADT (PC).
- Enter the command **Ping 192.168.0.x**.
- Messages generated by "Ping":
  - Ethernet connection is OK : "Reply from 192.168.0.x: bytes = 32 time < 4ms...."
    If ELOP II connection is available check the resource settings in ELOP II.
  - Ethernet connection is not OK: "Request timed out."
    Check the wiring, routing entrie etc.

Note If all steps described in this chapter have been followed and the F 8627X does not respond, check if other participants can be accessed using the PC's netword card.

5.2.6.4 The F 8627X determines its IP address in accordance with the following priorities

1. The IP address is determined from the Resource ID (Res-ID) of the user program that is loaded in the F 865x.
   The Res-ID of the user program always has a higher priority than the F 865x ID settings (DIP-switch 1-7).
2. The IP address is determined from the F 865x ID settings (DIP switches 1-7), if the Res-ID cannot be determined from the current user program's resource name and switch ID_IP is activated on the F 8627X (switch 1/6 ON).
3. IP address of the "Basic Configuration"
   If no IP address can be determined using the Res-ID or ID (switch 1/6 OFF) as described in the first two cases, the last IP address determined on this F 8627X is used.

6 Communication via the F 8627X

This chapter describes the F 8627X communication types and the required settings.
ELOP II TCP and MODBUS TCP can be operated in conjunction with any of the exisiting communication types (OPC, HIPRO-S and HIPRO-S-DIRECT).

Note If the HIPRO-S-DIRECT Mode is activated (see 6.4.4) the HSR-Communication for the MODBUS TCP slave via Port 8896 is deactivated (no redundancy).

6.1 Overview

The following tables provide a quick overview of the communication type properties that can be set for the F 8627X as well as the conditions that must be fulfilled to do so.

HIPRO-S	HIPRO-S-DIRECT
F 8625 / F 8627 / F 8627X all OS versions	F 8627, beginning with OS version 3.x F 8627X
DIRECT Mode Off Switch 1/7 (OFF)	DIRECT Mode On Switch 1/7 (ON)
Token passing	No token passing
No more than 64 safe**ethernet** members can be configured in the entire network.	No more than 99 safe**ethernet** members can be configured in the entire network.
One PES may have no more than 30 safe**ethernet** communication partners.	A PES can have no more than 63 safe**ethernet** communication partners.
Timeout fixed to 16 ms	Timeout adjustable 10 ms up to 1480 ms Switch S1/1-5
Communication between each PES and any other PES (HIPRO-S dummies might be required)	Not required
Ethernet network with low load: Only HIMA PES or HIMA OPC servers	An existing Ethernet network can be used if the requirements[1)] are fullfilled.
Hub/Switch	Switch
HSR cable required for redundancy	HSR cable is required for ELOP II TCP and MODBUS TCP (Port 502)
Half/Full-Duplex	Full-Duplex

Table 7: Overview of the HIPRO-S (DIRECT) communication via the F 8627X

1) Requirements for using an existing Ethernet network for the HIMA PES with F 8627X

- Network may only contain switches
- Full-Duplex (no collisions)
- Sufficient bandwidth for transmission
- Calculating the timeout with the delay time induced by active network components (e.g. switches, gateways) taken into account.

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OPC without Passive Mode	OPC with Passive Mode	OPC with Passive Mode + HIPRO-S-DIRECT
F 8625 from version 1.x F 8627 / F 8627X from version 2.x on	F 8625 from version 1.13 F 8627 / F 8627X from version 2.x on	F 8627 / F 8627X from version 3.x on
DIRECT Mode Off Switch 1/7 (OFF)	DIRECT Mode Off Switch 1/7 (OFF)	DIRECT Mode On Switch 1/7 (ON)
Passive Mode Off Token passing to a HIMA OPC server Switch 1/8 (ON)	Passive Mode On No token passing to an HIMA OPC server Switch 1/8 (OFF)	If "DIRECT Mode Off" switch 1/7 is activated (ON), the F 8627X's settings remain "Passive Mode On".
Deactivate the Passive Mode in the HIMA OPC server.	Activate the Passive Mode in the HIMA OPC server.	Activate the Passive Mode in the HIMA OPC server.
Number of HIMA OPC servers fixed to 4	Number of HIMA OPC servers fixed to 4	Up to 14 OPC servers can be used Switch S2/6-8
Monitoring Time for HIMA OPC server: fixed to 16 ms	Monitoring Time for HIMA OPC server: fixed to 16 ms	Monitoring Time for HIMA OPC server: fixed to 6 seconds
The F 8625 / F 8627(X) communicates with an OPC server via BUSCOM variables.	The F 8625 / F 8627(X) communicates with an OPC server via BUSCOM variables.	The F 8627(X) communicates with an OPC server via BUS-COM variables.
For communicating with a HIMA OPC server without Passive Mode, HIPRO-S variables must be sent from each PES to all other PES (one data direction is sufficient) to ensure token passing. HIPRO-S dummyies may have to be configured.	HIPRO-S variables **must not** be defined when communicating with a HIMA OPC server in passive mode (otherwise OPC without passive mode). F 8625: from V. 1.13 F 8627(X): from V. 2.x No restrictions/specifications for HIPRO-S variables. F 8625: from V. 1.17 F 8627 / F 8627X: from version 3.x on	No restrictions/specifications for HIPRO-S variables.
Hub/Switch	Switch	Switch
HSR cable required for redundancy	HSR cable required for redundancy	HSR cable is required for ELOP II TCP and MODBUS TCP (Port 502)
Half/Full-Duplex	Full-Duplex	Full-Duplex

Table 8: Overview of the communication with a HIMA OPC server via the F 8627X in combination with HIPRO-S

The simultaneous use of both an F 8621A coprocessor module for safety-related communication and an F 8627X communication module for Ethernet communication is not allowed.

6.2 Application guidelines and notes

- The requirements of the IEEE 802.3 standards must be met.
- The cycle time of the communication partners' central module may differ up to factor 4.
- The entire transmission network must ensure a transmission rate of 10 MBit/s or 100 MBit/s.
- To ensure a deterministic data exchange for safety-related communication, a load-free Ethernet segment must be connected to the HIMA communication modules. If this is not possible, a specified time response can not be guaranteed on the Ethernet segment. This may result in a safety shutdown because of exceeded monitoring time.
- No connection between the redundant Ethernet segments is required.
- The HSR cable BV 7053 is required for redundancy in HIPRO-S, OPC and MODBUS TCP.
- The HSR cable between both redundant F 8627X functionally replace "Y-cable" BV 7049 when ELOP II TCP is connected to a PADT (PC).
- Replacing a communication module (see Chapter 2.4).
- Should the Ethernet segment not be available to HIMA communication modules, the following IP address cannot be used otherwise:
  192.168.0.3 up to 192.168.0.130 (up to OS version 3.x)
  192.168.0.3 up to 192.168.0.200 (from OS version 3.x on)
- All single communication module connections must be connected to the same logical Ethernet segment.
- Communication modules belonging to one PES and having the same module number must be connected to different Ethernet segments.

⚠ The F 8627X automatically accesses all HIPRO-S data, configured in the PES. This may cause problems, if a F 8621A simultaneously operates as PES master in the same PES.
In this case, the function block HK-COM-3 must deactivate the HIPRO-S communication via the F 8627X or the F 8621A configuration must change over to HIPRO-N.

6.3 Ethernet possible connections

All connected Ethernet components must meet the requirements specified in the application guidelines!
The Ethernet segments may always have a redundant structure. If a HIPRO-S is used, the HSR cable BV 7053 must be plugged in between the redundant communication modules F 8627X (via HSR interface).
The HSR cable BV 7053 is also required for the redundant MODBUS TCP and ELOP II TCP connection (see chapter 5.2).

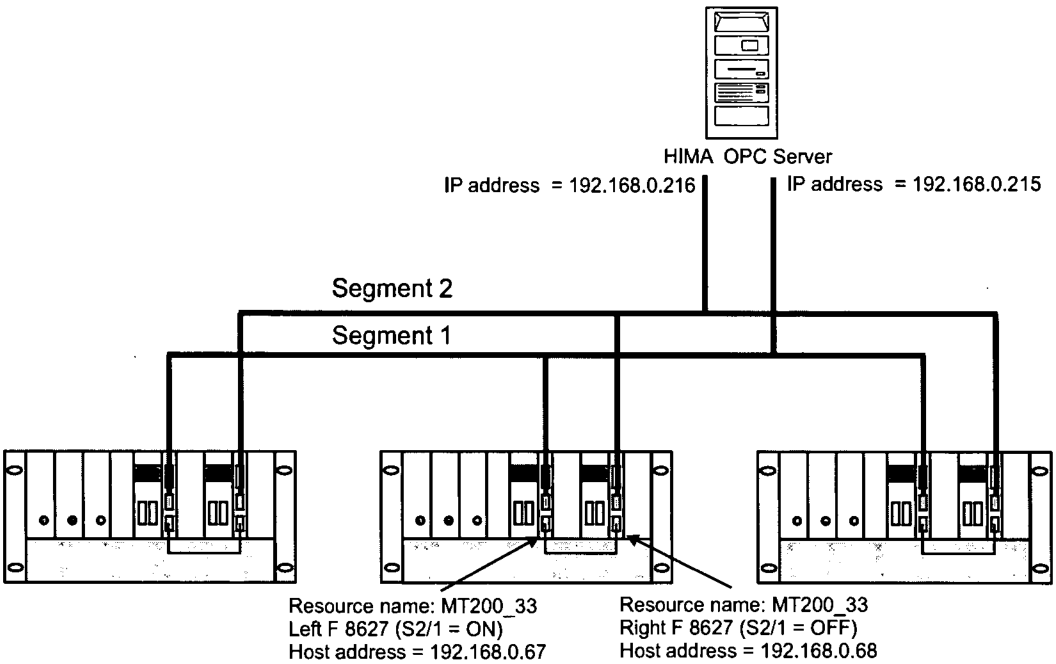

Figure 5: Redundant connection via 2 segments

For a "truly" redundant connection, an own network segment is required for each channel. All F 8625/27 (and PC network cards) with odd IP addresses (e.g. 192.168.0.67) must be attached to segment 1 and all F 8625/27 with even IP addresses to segment 2 (see Chapter 5.1).

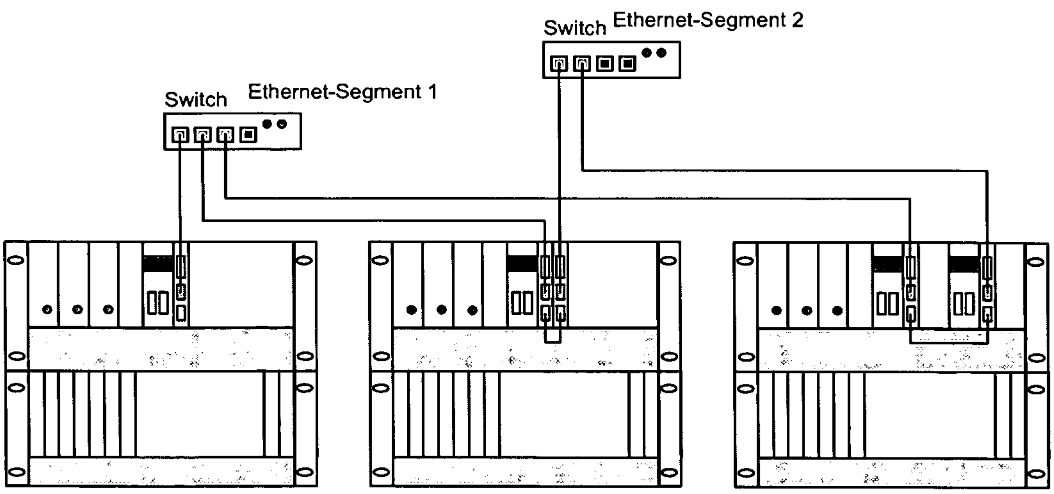

Figure 6: Possible PES connections

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Figure 6: shows all possible PES connections.

- Left: Single PES on one Ethernet segment (each switch is an independent Ethemet segment).
- Centre: Single PES with two communication modules on both Ethernet segments.
- Right: PES with two communication modules on both Ethernet segments.

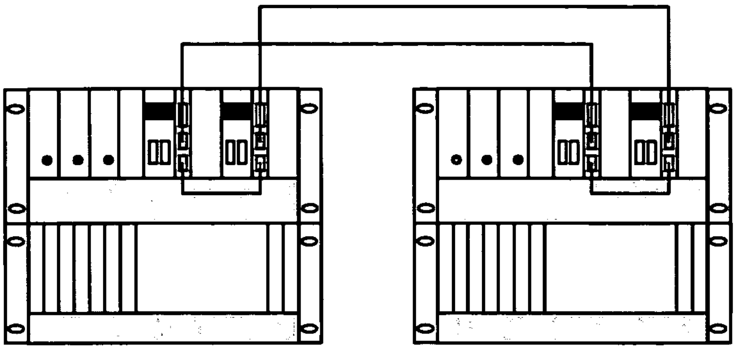

Figure 7: Interconnection of two PES

When two PES are interconnected together (Figure 7), no switch is required. Both 10BaseT or 100BaseTX interfaces of the communication modules are directly connected by a special cross-over cable (with twisted wires).

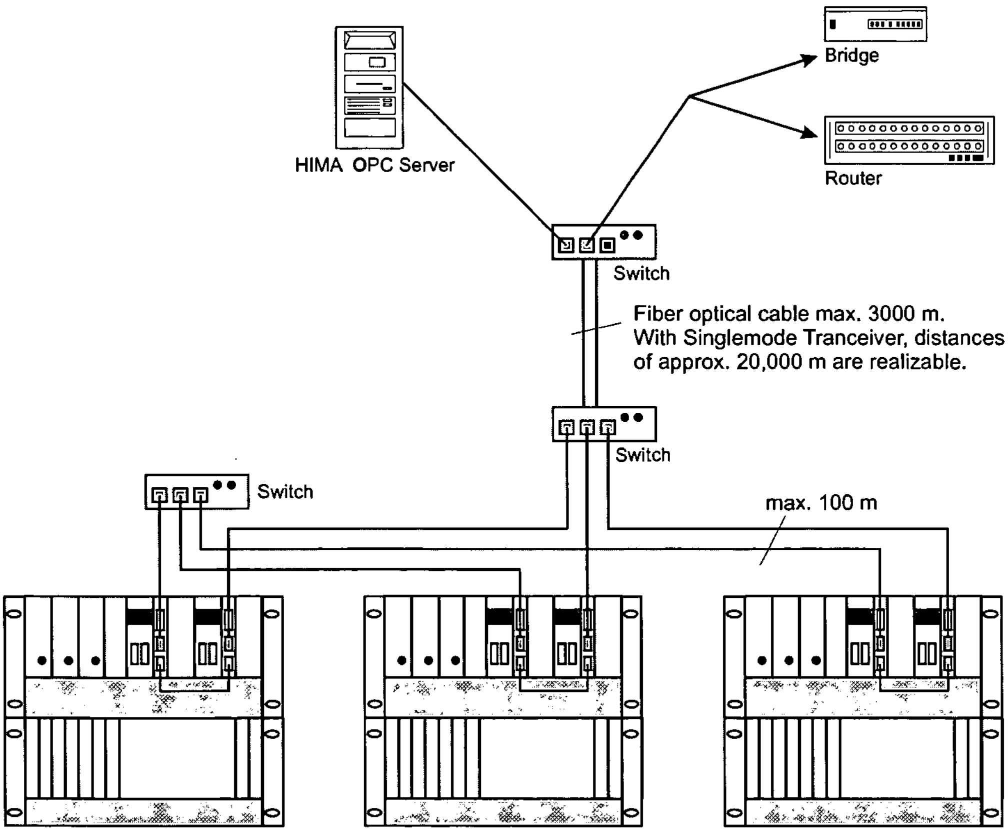

Figure 8: Redundant interconnection with switches

In Figure 8, three PES are completely redundantly interconnected via two switches.
A third switch is connected to the redundantly interconnected PES via a redundant fibre optic connection (the fibre optic interface is integrated in the switch). An HIMA OPC server and further Ethernet components are connected to the third switch.

6.4 MODBUS TCP slave

Requirements for the MODBUS TCP slave

- F 865x central module, beginning with OS version (05.34)
- F 8627XEthernet module, beginning with OS version 4.x

A MODBUS TCP slave is active if

- BUSCOM variables are existing
- the F 8627X is in RUN mode (RUN-LED on the F 8627X is lighting continuosly)
- the associated F 865x central module is in RUN or MONO operating mode

The serial MODBUS slave is still supported (serial interface RS 485 on the F 865x central module).

The MODBUS TCP slave IP address is the F 8627X IP address (see chapter 5.1).
A MODBUS TCP master can access the MODBUS TCP slave in the H41q/H51q via the ports 502 and 8896.

- Via F 8627X port 502, the F 865x central module operates as a MODBUS TCP slave with the known functions (see manual "Functions of the operating system" HI 800 105).
- Via F 8627X port 8896, the F 8627X operates as a MODBUS TCP slave with further MODBUS function codes.

Both ports 502 and 8896 share the possible MODBUS TCP connections in according with the principle First Come, First Serve.

The following table shows three possible equipment configuration variants of H51q and how many MODBUS TCP master can access the F 865x central module.

Variants	F 865x	associated F 8627X	Max. number of MODBUS master
1	1 x CU1	1	4
	1 x CU2	1	4
2	1 x CU1	2	8
	1 x CU2	2	8
3	1 x CU1	5 (maximum equipment)	20
	1 x CU2	5 (maximum equipment)	20

Table 9: Variants for MODBUS master access the H51q

Note Up to 40 MODBUS TCP masters can access the H51q controller. However, a maximum number of 16 MODBUS TCP master is recommended (see variant 2 in Table 9).

Partitioning of the BUSCOM address range in the MODBUS TCP slave (H41q/H51q)
All variables which should be sent via the MODBUS TCP slave must be created as BUSCOM variables using ELOP II.
While configuring the MODBUS communication, the user must ensure that separate address ranges are used for BUSCOM Import Variables for each MODBUS master; otherwise, the acceptance of the data sent by a MODBUS TCP master cannot be guaranteed.

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The following figure shows an example, how the BUSCOM import address range of the H41q/ H51q can be partitioning for the MODBUS TCP masters.

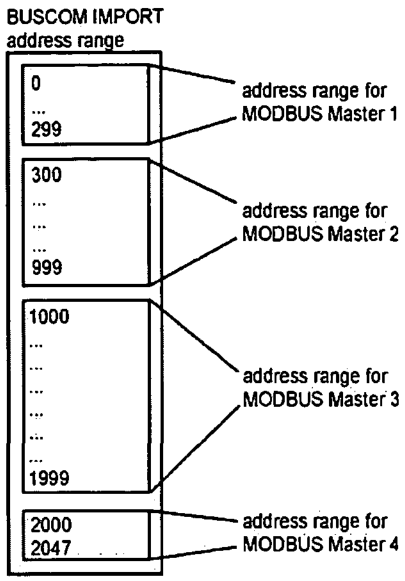

Figure 9: Partitioning of the BUSCOM Import address range for the MODBUS TCP Master

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Note In case of port 8896, the BUSCOM variables are mapped into the process data image of the F 8627X. The MODBUS TCP master must therefore access the BUSCOM variables using the identity numbers (see chapter 7).
To avoid further dividing the BUSCOM variable address ranges into BOOL and WORD areas, we recommend creating BUSCOM variables of type WORD only. This helps maintain a more simple overview.

6.4.1 Polling intervall of the MODBUS TCP slave

The polling interval is the interval in which the MODBUS TCP slave is polled by the MODBUS master. The polling interval is registered within the MODBUS master.

Note The polling interval of the MODBUS TCP slaves should be selected depending on the cycle time of the F 865x central module.

$t_{Poll} = CT + n * 15ms$

CT: Maximum cycle time (ms) of the central module in status RUN (it is displayed on ELOP II control-panel).
n: Number of MODBUS masters polling the MODBUS slave
15ms: Process time per request in which the MODBUS masters should give to the F 865x central module.

Note Please read the cycle time under full communication load again and check whether the maximum cycle time "CT" has increased. An adaption of t_{Poll} may be necessary.

6.4.2 Redundant MODBUS communication

To ensure a redundant MODBUS communication, the MODBUS master must be redundantly connected to the MODBUS slave (see Chapter 5.2.5.3).
To ensure the redundant MODBUS communication between a H41q/H51q PES and a MODBUS master, the following two methods are possible:

Cable redundancy
Under all circumstances, MODBUS communication only takes place via a single ethernet channel. If the MODBUS master no longer receives a responding telegram on the active channel, it can switch to the other channel and continue exchanging data. The MODBUS master can thus switch to the redundant channel if a network segment fails (e.g. broken ethernet cable or a faulty switch).

Redundancy with two "Peer to Peer" connections
In this case, the MODBUS master in use must possess the function to establish two independent MODBUS "Peer to Peer" connections to the MODBUS slave's two F 8627X.
The same data are then transmitted over both ethernet connections to the two F 8627X simultaniosly.
The user must ensure that separate BUSCOM address ranges are used for each Ethernet channel transmitting the redundant BUSCOM variables (see figure below).

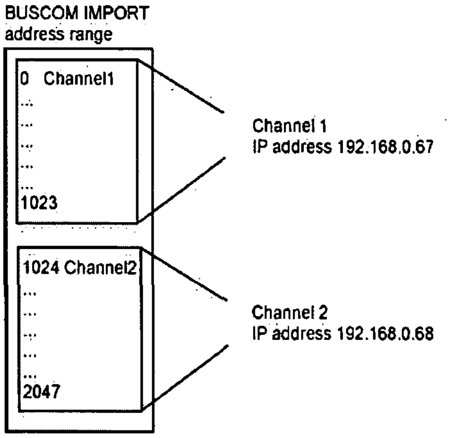

Figure 10: Partitioning of the BUSCOM Import address range for the redundant BUSCOM variables

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Note	In case of port 8896, the BUSCOM variables are mapped into the F 8627X process data image. The MODBUS TCP master must therefore access the BUSCOM variables using the identity numbers (see Chapter 7).

The logic of the user program must ensure, that the user program always processes the most current data record of the channel.

A monotonically increasing sequence number, incremented by the MODBUS TCP master, can serve e.g. as a criterion for determining how up-to-date the BUSCOM variables in the separate address ranges are.

Figure 10 shows an example, in which the sequence number is registered in the BUSCOM variables Channel1 and Channel2, respectively.

6.4.3 Connection via port 502

Via F 8627X port 502, the F 865x central module operates as a MODBUS TCP slave and can be directly reached.
The BUSCOM Variables can be accessed via the BUSCOM adresses configured in ELOP II.
The MODBUS slave on the central module provides the MODBUS function codes, as described in the manual "Functions of the operating system" HI 800 105.

Note The events query and the synchronization of the central module (CM) software clock is only possible via TCP server port 502.
The HSR communication for a MODBUS TCP slave via port 502 is independent of the HIPRO-S-DIRECT mode.

The F 8627x and F 865x react to a MODBUS request via port 502 as follows:

- If the F 8627X is in mono operation mode (i.e. no HSR connection to a second F 8627X), then the F 8627X must have a connection to the F 865x, which in turn must be in RUN status to answer a MODBUS request with the corresponding MODBUS response.
- If two F 8627X are operating redundantly (i.e. HSR connection to a second F 8627X), then one of the two redundant F 8627X must have a connection to its associated F 865x, which in turn must be in RUN or MONO status to answer a MODBUS request with the corresponding MODBUS response.

If the MODBUS request cannot be passed on to an F 865x, the F 8627X sends the error code 0x0B back to the MODBUS master.

Note Processing each MODBUS Request increases the cycle time for the F 865x central module. To avoid increasing the cycle time too much, the F 8627X limits the minimal polling interval per MODBUS master to 50 ms.

Using port 502, if the recommended polling interval "t_{Poll}" is ignored, the MODBUS communication may behave as follows:

- Should the same master send other MODBUS request within 50 ms, other MODBUS requests from the same master are received within 50 ms after a MODBUS request, the F 8627X transfers last MODBUS-Request from this master to the F 865x central module, if:
  - the central module is not processing a MODBUS request from this master and
  - 50 ms are expired.
- As long as the F 865x is processing a MODUBUS request from a master, it will only accept another MODBUS request from this master after a minimum of 400 ms.
- In case of a new connection, the first request is passed on to the F 865x after ≥ 50 ms.

Note If the MODBUS master is only connected to one F 8627X on the H41q/H51q, the MODBUS master <u>must</u> always be connected to the F 8627X plugged into the left F 865x via an Ethernet cable.
This ensures that the data written most recently from the MODBUS master are also reflected in the data currently being processed by the user program.

6.4.4 Connection via port 8896

The MODBUS TCP master accesses the process data image from the F 8627X via port 8896. In this case, the F 8627X is an active MODBUS TCP slave and relieves the burden on the F 865x.
On port 8896, the BUSCOM variables are mapped into the F 8627X's process data image. For this reason, the MODBUS TCP master must access the identity numbers resulting from the process data mapping (see Chapter 7).

⚠ The WORD and BOOL variables are located in a common memory area on the F 8627X.
In case of port 8896, a MODBUS telegram for WORD can access the address range of the WORD and BOOL variables.
The user must pay attention to correctly interpret the variable types of reading and writing data.

Note MODBUS function codes 2, 4, 23 and 43 are supported by port 8896. HK-COM 3 function block must allow the not safety-related data exchange via MODBUS TCP. The address mapping of the BUSCOM variables into the F 8627X is described in Chapter 7.

Note If port 502 is not used in the H41q/H51q controller, the polling interval for port 8896 can be set to $t_{Poll} \geq CT$.

F 8627X reacts to a MODBUS request via port 8896 as described below:

- If the F 8627X is in mono operation mode (i.e. no HSR connection to a second F 8627X), then the MODBUS TCP slave on the F 8627X must be active to answer a MODBUS request with the corresponding MODBUS response.
- If two F 8627X are operating redundantly (i.e. HSR connection to a second F 8627X), then the MODBUS TCP slaves must be active on one of the two redundant F 8627X to answer a MODBUS request with the corresponding MODBUS response.

If the MODBUS request cannot be passed to an active MODBUS TCP slave, the F 8627X sends the error code 0x0B back to the MODBUS master.

Note HSR communication for a MODBUS TCP slave via port 8896 is only possible if both F 8627X are operating in redundant mode (DIP-switch 2/2 OFF) and the HPRO-S-DIRECT mode is deactivated (DIP-switch 1/7 OFF).

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Via MODBUS TCP port 8896, the F 8627X supports the following function codes:

Function	Code	Type	Description
Read Coils	01	BOOL	Reads several variables (BOOL) from the slave's import or export area (same range as code 02).
Read discrete Inputs	02	BOOL	Reads several variables (BOOL) from the slave's export area.
Read Holding Registers	03	WORD	Reads several variables of any type from the slave's import or export area (same range as code 04).
Read Input Registers	04	WORD	Reads several variables of any type from the slave's export area.
Write Single Coil	05	BOOL	Writes one single variable (BOOL) in the slave's import area.
Write Single Register	06	WORD	Writes one single variable (WORD) in the slave's import area.
Write Multiple Coils	15	BOOL	Writes several variables (BOOL) in the slave's import area.
Write Multiple Registers	16	WORD	Writes several variables of any type in the slave's import area.
Read/Write Multiple Registers	23	WORD	Writes and reads several variables of any type in and from the slave's import area.
Read Device Identification	43	x[1)]	Transmits the slave's identification data to the master.

1) Note about the Modbus Function: Read Device Identification (43)

The HIMA Modbus slave supplies identification data to the master and supports the following Object-Ids:

<u>Basic:</u>
0x00 VendorName "HIMA Paul Hildebrandt GmbH + Co KG"
0x01 ProductCode "<Serial Number>"
0x02 MajorMinorRevision "<CU-OS Key 0x23ad CRC 0x-------- / COM Vx.y CRC>"

<u>Regular:</u>
0x03 VendorUrl "http://www.hima.com"
0x04 ProductName "HIQuad"
0x05 ModelName "<RessourceTyp>" z.B. "F 8627X"
0x06 UserApplicationName "<Buchst00>" resource name from ELOP projekt

<u>Extended:</u>
0x80 CPU OS version/CRC "< CU-OS Key 0x23ad CRC 0x-------->"
0x81 CPU OSL version/CRC deliver the error code 2 (Invalid Data)
0x82 CPU BL version/CRC deliver the error code 2 (Invalid Data)
0x83 COM OS version/CRC "<Vx.y / 0x234adcef>"
0x84 COM OSL version/CRC deliver the error code 2 (Invalid Data)
0x85 COM BL version/CRC deliver the error code 2 (Invalid Data)
0x86 Configuration-CRC "<Data-version 0x13ac / Area-version 0x13ac / Code-version 0x13ac / Run-version 0x13ac>"

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The following ReadDevice ID Codes are supported:
(1) Read Basic device identification (stream access)
(2) Read regular device identification (stream access)
(3) Read extended device identification (stream access)
(4) Read one specific identification object (inidividual access)

For further information about MODBUS TCP, refer to "Modbus Application Protocol Specification" www.modbus.org.

Note The function codes 03, 04 and 16 support data type Word (2 bytes) and any other data types. The interpretation of the two MODBUS master request parameters (start address, number) is done as follows:
Start address describes the index of the first variable to be transmitted.
Number determines the size of the area to be transmitted:
2*number bytes must be transmitted, provided the area ends directly at a variable boundary.

6.4.5 Error codes

Error code	Description
0x01 (Invalid Code)	If MODBUS TCP master sends a telegram with an unknown function code, MODBUS TCP slave responds with error code 0x01 (invalid code).
0x02 (Invalid Data)	If MODBUS TCP master's telegram does not match with the MODBUS TCP slave's configuration (e.g. the request telegram does not end "even" at a variable border), MODBUS TCP slave responds with error code 0x02 (invalid data).
0x03 (Invalid Value)	If MODBUS TCP master sends a telegram with faulty values (e.g. length field), MODBUS TCP slave respons with error code 0x03 (invalid value).
0x0B	No reply for a MODBUS Request is possible. In case of Port 502 No F 865x central module is reachable. In case of Port 8896 No active MODBUS TCP slave on the F 8627X is reachable. Note: The function code "0x0B" is based on a gateway function. Please refer to the Modbus specification at page modbus.org

6.5 HIPRO-S

HIPRO-S is a safe communication via the HIPRO-S variables configured in the PES.
In the HIPRO-S Mode, the Ethernet bus access control is done by token passing. This mode provides operation with a hub and avoids collisions on the network.

No more than 31 safe**ethernet** members can be configured in the entire network.
One PES can have up to 30 safe**ethernet** communication partners since a bus configuration in ELOP II supports a maximum of 31 communication partners.
All communication partners must be configured in the same bus configuration.
A PES can communicate with maximal 4 HIMA OPC servers. The number of communication partners is not reduced by the number of configured HIMA OPC servers.

The communication modules for HIPRO-S must be configured in ELOP II and via the DIP switches.

- Switch 2/1 sets the module numbers, which corresponds to the attached Ethernet segment (see Table 6 and Figure 5).
- Switch 2/2 set a mono or redundant interconnection of the communication module group (see Table 6 and Figure 5).

6.5.1 Notes for creating HIPRO-S user program

While creating the user program, the following points should be considered:

- In ELOP II, a resource name must have eight characters, the last two of which must be numbers (see Chapter 5.1.)
- With HIPRO-S, safety-related communication must be set up such that **each PES** has configured a safety-related data exchange **with all other PES** (i.e. exchange of dummy data if no other user data are exchanged).
  The direction of the data exchange can be freely selected.
- To check the HIPRO-S configuration, the PES master program should be compiled, but not loaded into the master. Potential errors can be corrected.
- Via the system variables, the diagnosis of the safety-related communication can be evaluated in the user program.
- ELOP II's function block HK-COM-3 can be used to project and monitor the F 8627X.
- The monitoring time "MT/MTe" for HIPRO-S connections must be calculated (Chapter 6.7).

6.6 HIPRO-S-DIRECT

Like HIPRO-S, HIPRO-S-DIRECT is a safety communication via the HIPRO-S variables configured in the PES. This mode can only be used with switches.
HIPRO-S-DIRECT mode allows a faster exchange of data than HIPRO-S mode.

No more than 99 safe**ethernet** members can be configured in the entire network.
One PES can have up to 63 safe**ethernet** communication partners.
If more than 30 communication partners are configured, several bus configurations must be created in ELOP II since a bus configuration in ELOP II supports a maximum of 31 bus participants.

The number of HIMA OPC servers can be set from 0 to 14. The number of HIPRO-S communication partners is not reduced by the number of configured HIMA OPC servers.
If HIPRO-S-DIRECT mode is active (switch 1/7 "ON"), switch S1/8 "passive mode" no longer influences communication. For this reason, "passive mode" must also be activated on the HIMA OPC servers.

The communication modules for HIPRO-S must be configured in ELOP II and via DIP-switches

- Switch 2/1 sets the module number which corresponds to the attached Ethernet segment (see Table 6 and Figure 5).
- Set switch 1/7 (Table 5 on page 7) to "ON" to activate the HIPRO-S-DIRECT mode.
- Switches 1/1 to 1/5 (Table 5 on page 7) set the "Timeout" for the answer of the communication partner.

Switch 1	Timeout
On Off	10 ms
On Off	20 ms
On Off	30 ms
On Off	40 ms
On Off	50 ms
On Off	60 ms
On Off	70 ms
On Off	80 ms
On Off	400 ms
On Off	1000 ms

Table 10: Settings of switch 1 (S1)

Legend:

Positions white switch:

On Off White switch in position OFF

On Off White switch in position ON

Not used switch

Note All communication partners must be connected via switches. Consider the delay time of the used switches. If the delay time is higher than 5 ms, "Time-out" for the answer of the communication partners must be configured via switches (S1/1-5) on each F 8627X.

- F 8627X redundancy mode is fixed to MONO in the HIPRO-S-DIRECT operating mode, independently of the position of switch 2/2. The HSR cable connection is not required for HIPRO-S-DIRECT communication.
- The number of HIMA OPC servers (0, 2, 4, 6, 8, 10, 12 or 14) can be set via switches 2/6 to 2/8 (see Table 6).

6.6.1 Notes for creating HIPRO-S-DIRECT's user program

While creating the user program, the following points must be considered:

- In ELOP II, the resource name must have eight characters, the last two of which must be numbers (see Chapter 5.1.)
- The exchange of dummy data is not required.
- If more than 31 communication members are required, they can be configured in several bus configurations. A communication partner must be configured in all bus configurations in which its communication partners are configured (see Chapter 6.8).
- To check the HIPRO-S configuration, the PES master program should be compiled, but not loaded into the master. Potential errors can be corrected.
- Via the system variables, the diagnosis of the safety-related communication can be evalutated in the user program.
- ELOP II's function block HK-COM-3 can be used to project and monitor the F 8627X.
  In this case, a distinction differ between safe and non-safe communication can be made. (see ELOP II Online Help).
- The monitoring time "MT/MTe" for HIPRO-S connections must be calculated (Chapter 6.7).

6.7 Calculating the monitoring time for HIPRO-S/ HIPRO-S DIRECT connections

The monitoring time for HIPRO-S/ HIPRO-S-DIRECT connections is used for monitoring the update of HIPRO-S import variables at regular intervals.
The relevant factor is the safety time of the overall plant. If no imported safety-related variables are written within the defined period of time, they are set to 0 in the PES.
The monitoring time of the HIPRO-S/ HIPRO-S-DIRECT connections is set in the dialog window *Properties->HIPRO-S* of the corresponding target resource and must not be confused with the monitoring time of each PES.

⚠ Setting the monitoring time depends on the process and must be agreed upon with the appropriate authority. The monitoring time must not exceed the time period agreed upon.

If the monitoring time provided by the authority exceeds or is equal to **13200 ms**, the user can set the monitoring time of the HIPRO-S or HIPRO-S-DIRECT connections to **13200 ms** in the target resource. This value corresponds to the monitoring time, which is sufficient for the maximum size of a bus configuration (HIPRO-S with 31 or HIPRO-S-DIRECT with 64 members).

6.7.1 Calculation method and formulas

Step 1: Determining the maximum Ethernet transmission time (T_{max})
To calculate the monitoring time, the maximum Ethernet transmission time of the HIPRO-S data T_{max} must be determined.

T_{max} for HIPRO-S communication
$T_{max} = (NP^2 + NP + 100)$ ms
If $T_{max} < 600$ ms than T_{max} must set to 600 ms.

NP:	Number of PES communication partners + 4 OPC servers which are fixed configured in HIPRO-S mode.
T_{max}:	Maximum Ethernet transmission time of the HIPRO-S Data.

T_{max} for HIPRO-S-DIRECT communication
$T_{max} = T_{DIP}$

T_{DIP}:	Set value of the Timeout for HIPRO-S-DIRECT (Chapter 6.6) via switch 1/1-5.
T_{max}:	Maximum Ethernet transmission time of the HIPRO-S-DIRECT data.

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Step 2: Calculating the Watchdog Time

- $\mathbf{WD_{Source(Target)}} = \mathbf{CT * 1.7}$ for H41q/H51q (F 8650 up to F 8653)
- $\mathbf{WDe_{Source(Target)}} = \mathbf{CT * 1.5 + D * 5.5}$for H41qe/H51qe (F 8650E/X up to F 8653E/X)

$WD(e)_{Target}$: Watchdog time (ms) for the target resource
$WD(e)_{Source}$:Watchdog time (ms) for the source resource
CT: Maximum cycle time (ms) of the central module in RUN operation mode (is displayed in the ELOP II control panel).
D: Data size in kByte "Data Size (without SI Data)" (is displayed by the ELOP II Compiler).

Step 3: Calculating the monitoring time MT/MTe

Calculating the monitoring time MT for H41q/H51q

$$MT = 2 * WD_{Source} + 2 * T_{max} + 2 * WD_{Target}$$

MT: Monitoring time (HIPRO-S connection)
WD_{Target}: Watchdog time (ms) for the target resource
WD_{Source}: Watchdog time (ms) for the source resource
T_{max}: From "Step 1".

Calculating the monitoring time MTe for H41qe/H51qe

$$MTe = 2 * WDe_{Source} + 2 * T_{max} + 2 * WDe_{Target}$$

MTe: Monitoring time (HIPRO-S connection)
WDe_{Target}: Watchdog time (ms) for the target resource
WDe_{Source}: Watchdog time (ms) for the source resource
T_{max}: From "Step 1".

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Step 4: Setting up the calculated monitoring time
The calculated monitoring time MT or MTe must set in the dialog window *Properties -> HIPRO-S* of the target resource.

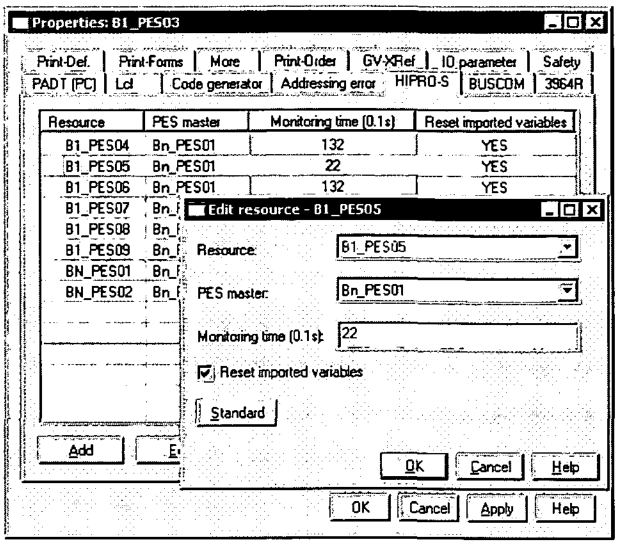

Figure 11: Configuration of the HIPRO-S connections

Setting the monitoring time depends on the process and must be agreed upon with the appropriate authority. The monitoring time must not exceed the time period agreed upon.

6.7.2 Example for calculating the monitoring time

Calculating of the monitoring time for a H41qe/H51qe with HIPRO-S and 20 communication partners.

Step 1: Calculating the maximum transmission time "T_{max}"
20 communication partners + 4 HIMA OPC server (fixed configuration)
-> NP = 24
$T_{max} = NP^2 + NP + 100$
$T_{max} = 576 + 24 + 100$
$T_{max} = 700$ ms

Note In HIPRO-S-DIRECT mode, T_{max} is not calculated but it must be set up via DIP switches 1/1-5 (see Chapter 4.1).

Step 2: Calculating the HIPRO-S source/target resource

Calculating the Watchdog Time WDe_{Source} from the source resource

- Note the maximum PES cycle time "**CT**" in RUN status, which is displayed on the ELOP II control panel of the HIPRO-S source-resource (e.g. **100 ms**).
- Note the datasize "**D**" in kByte "Data Size (without SI Data)" from the source-resource, which is displayed by the ELOP II Compiler (e.g. **2 kByte**).
- Calculate the Watchdog Time "**WDe_{Source}**" for the source-resource
  $WDe_{Source} = CT * 1.5 + D * 5.5$
  $WDe_{Source} = 100 * 1.5 + 2 * 5.5$
  $WDe_{Source} = 161$ ms

Calculating the Watchdog Time WDe_{Target} from the target resource

- Note the maximum PES cycle time "**CT**" in RUN status, which is displayed on the ELOP II control panel of the HIPRO-S target-resource (e.g. **150 ms**).
- Note the datasize "**D**" in kByte "Data Size (without SI Data)" from the target-resource, which is displayed by the ELOP II Compiler
  (e.g. **1.5 kByte**).
- Calculate the Watchdog Time "**WDe_{Target}**" for the target-resource
  $WDe_{Target} = CT * 1.5 + D * 5.5$
  $WDe_{Target} = 150 * 1.5 + 1.5 * 5.5$
  $WDe_{Target} = 233.25$ ms -> 234 ms

Step 3: Calculating monitoring time "MTe"

- $MTe = 2 * WDe_{Source} + 2 * T_{max} + 2 * WDe_{Target}$
  $MTe = 2 * 161 + 2 * 700 + 2 * 234$
  MTe = 2190 ms -> 2200 ms

Step 4: Set the calculated monitoring time "MTe" in the target-resource

- Open the dialog window "Properties" using the context menu
  Properties -> HIPRO-S of the target-resource.
- Select the source-resource in the list of HIPRO-S communication partners and click the button *EDIT*.
- Set the monitoring time "**MTe**" in the dialog window "Edit resource".

Calculating the monitoring time "**MTe**"

- for each of the 20 communication partners in this target-resource.
- for each of the 20 communication partners in its own resource.

⚠ Setting the monitoring time depends on the process and must be agreed upon with the appropriate authority. The monitoring time must not exceed the time period agreed upon.

6.8 Example of "Bus configuration with 64 resources"

In this example 64 resources are configured and partitioned into three bus configurations. Both resources "B*n*_PES01" and "B*n*_PES02" are configured for each bus and provide a gateway between the three bus configurations.
The bus configuration is identical for the communication versions "MONO" and "Double MONO". When "Double MONO" is used, a second F 8627X communication module with the corresponding DIP switch settings must be plugged into the redundant module slot for each communication partner.

Note Respect the guidelines and application notes for configuring the Ethernet Segments (Chapter 6.2).

6.8.1 Function description of bus configuration

- The resources "B*n*_PES01" and "B*n*_PES02" are created in all three bus configurations. The resources "B*n*_PES01" and "B*n*_PES02" can thus exchange data with any other configured resource.
- In the bus configuration "BUS 1", the resources "B1_PES03" up to "B1_PES31" can communicate directly with each other.
- In the bus configuration "BUS 2", the resources "B2_PES32" up to "B2_PES60" can communicate directly with each other.
- In the bus configuration "BUS 3", the resources "B3_PES61" up to "B3_PES64" can communicate directly with each other
- If data from different bus configurations must be exchanged between resources, the data must be sent via the gateway resources "B*n*_PES01" and "B*n*_PES02".

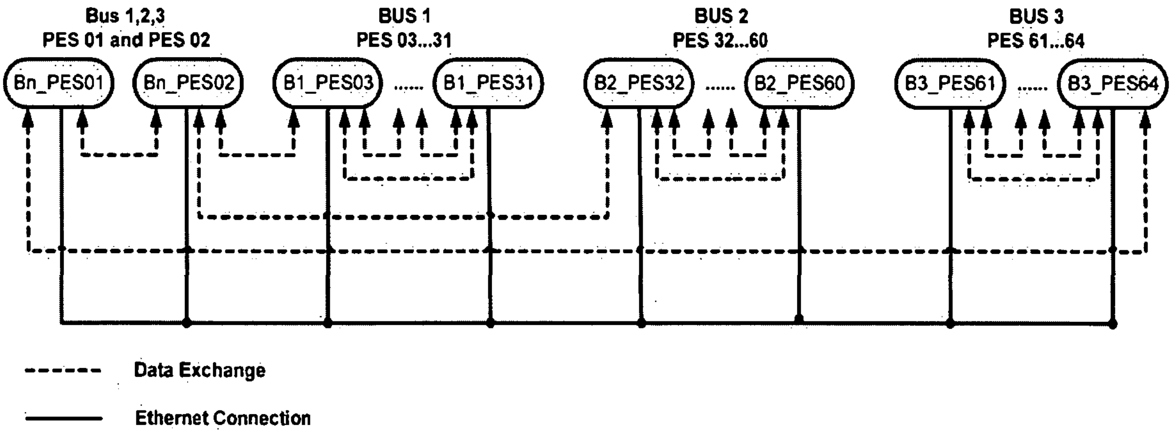

Figure 12: "MONO" bus configuration with HIPRO-S-DIRECT

Note All communication partners must be connected via switches. Consider the delay time of the used switches. If the delay time is higher than 5 ms, "Time-out" for the answer of the communication partners must be configured via switches (S1/1-5) on each F 8627X.

6.8.2 Setting up the bus configuration in ELOP II

The user should be familiar with the programming tool **ELOP II** and HIMA H41q/H51q PES. Refer to the manual "First steps ELOP II" and the ELOP II Online Help for further information.

Note	All resources must be created in the same configuration (here "Config"). Consider also the notes about parameterizing the HIPRO-S-DIRECT mode and generating the user program (Chapter 6.6).

Create the following resources in the configuration "Config":

- "B*n*_PES01" and "B*n*_PES02"
- "B1_PES03" to "B1_PES31"
- "B2_PES32" to "B2_PES60"
- "B3_PES61" to "B3_PES64"

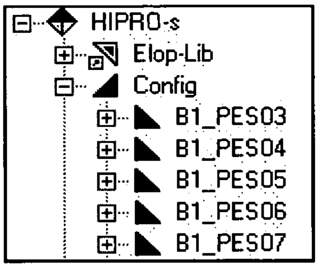

Figure 13: 64 resources in the configuration "Config"

In the application program of each resource, use the software function block HK-COM-3 for configuring and monitoring the F 8627X.

- The HK-COM3 must be assigned as described in the following table:

Input	Value
CU-Slot (1,2)	1
COM-Slot (1,2,3,4,5)	1
Enable Configuration	TRUE/FALSE
Function	0, 1 or 3

- In the user program, HK-COM3's outputs are used for monitoring.

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Create and configure the three busses (see Table 11, Table 12, Table 13):

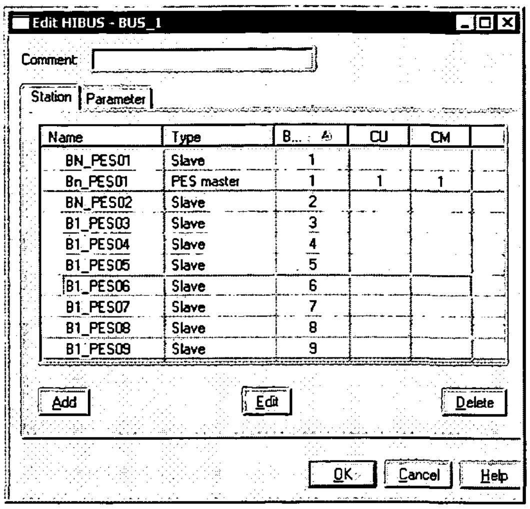

Figure 14: Configuration of BUS 1 in ELOP II

BUS 1 (Bus member)					
Name	**Type**	**BSN**	**CU**	**CB**	**Number**
B*n*_PES01	PES master	1	1	1	1
B*n*_PES01	slave	1			1
B*n*_PES02	slave	2			1
B1_PES03	slave	3			
"	"	"	"	"	29
B1_PES31	slave	31			

Table 11: Configuration of BUS 1

BUS 2 (Bus member)					
Name	**Type**	**BSN**	**CU**	**CB**	**Number**
B*n*_PES02	PES master	2	1	2	1
B*n*_PES01	slave	1			1
B*n*_PES02	slave	2			1
B2_PES32	slave	3			
"	"	"	"	"	29
B2_PES60	slave	31			

Table 12: Configuration of BUS 2

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BUS 3 (Bus member)					
Name	**Type**	**BSN**	**CU**	**CB**	**Number**
B3_PES61	PES master	3	2	2	1
B*n*_PES01	slave	1			1
B*n*_PES02	slave	2			1
B3_PES61	slave	3			4
"	"	"	"	"	
B3_PES64	slave	6			

Table 13: Configuration of BUS 3

In each resource, define the communication partners (resources), with which HIPRO-S data are to be exchanged.
Determine and set the monitoring time for the communication partners (see Chapter 6.7).

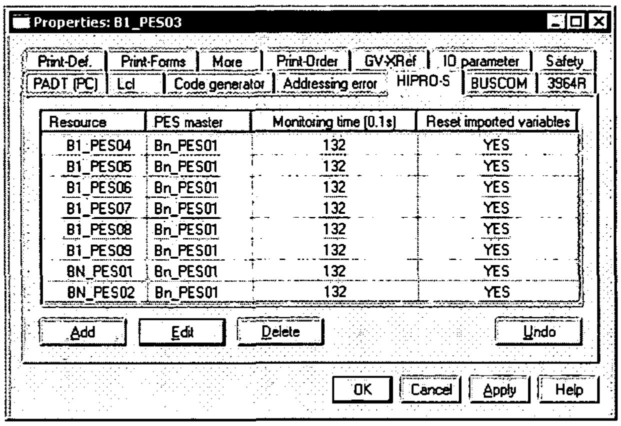

Figure 15: HIPRO-S communication partners of the resource

⚠ Setting the monitoring time depends on the process and must be agreed upon with the appropriate authority. The monitoring time must not exceed the time period agreed upon.

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In ELOP II, define the HIPRO-S variable which should be used for the HIPRO-S communication:

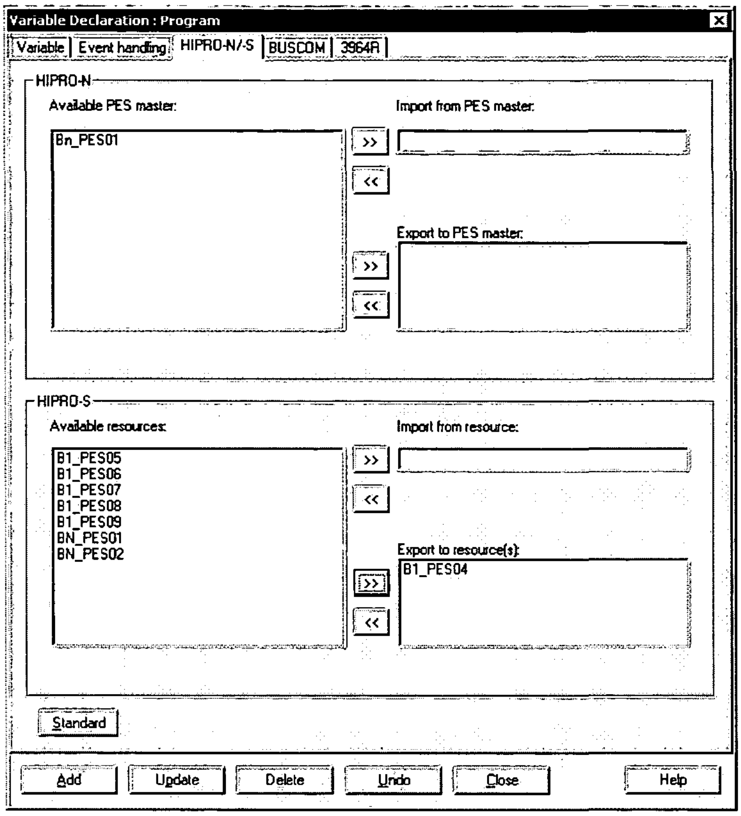

Figure 16: Configuration of a HIPRO-S variable in ELOP II

Note To verify the HIPRO-S-DIRECT configuration, the PES master program should be compiled, but not be loaded into the master. Potential errors can thus be corrected.

6.9 Communication with HIMA OPC Server (BUSCOM)

The F 8627X communicates with an OPC server via the non safety related BUSCOM variables.

Note	The F 8627X OPC communication is only possible with a HIMA OPC server.

6.9.1 F 8627X configuration

The F 8627X is configured in ELOP II and via DIP switches.

In ELOP II, the resource name under ELOP II must have eight characters, the last two of which must be numbers. The numbers must be unique to avoid collisions while determining the communication module's IP address (see Chapter 5.1).

While configuring the communication with a HIMA OPC server, pay particular attention to the Passive mode (see Chapter 6.9.1.1 to Chapter 6.9.1.3).

6.9.1.1 Passive mode disabled (switch S1/8 "ON")

The token passing between the F 8627X and the HIMA OPC servers is active.

- If the Passive Mode is disabled on the F 8627X, it must also be disabled on the HIMA OPC s+ervers.
- With HIPRO-S, safety-related communication must be set up such that **each PES** has configured a safety-related data exchange **with all other PES** (i.e. exchange of dummy data if no other user data are exchanged). The direction of the data exchange can be freely selected.
  This procedure is used because all Ethernet nodes must be known in each PES within SafeEthernet to ensure communication within the network (token passing).

6.9.1.2 Passive mode enabled (switch S1/8 "OFF")

In this mode the F 8627X's behavior is passive and HIMA OPC server polls it in certain time intervals.
The token passing between the F 8627X and the HIMA OPC servers is disabled.

- The Passive mode may be only activated on a F 8627X, if HIMA OPC server also supports it (HIMA OPC server version 3.2.0 and higher).
- The Passive Mode can also be activated, if safety-related communication for the F 8627X module is configured.

Note	If HIPRO S DIRECT mode is active (switch 1/7 "ON"), switch S1/8 "passive mode" no longer influences communication. For this reason, "passive mode" must also be activated on the HIMA OPC servers.

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6.9.1.3 Benefits of passive mode

- If safety-related communication will not be performed via the F 8627X, then safety-related dummy variables need not be defined between the PES during configuration.
- It is now possible to have simultaneously a safety-related communication (via AG master F 8621A or a second F 8625/27) and non safety-related communication to a HIMA OPC server in one PES since no more dummy variables are needed for communicating with the HIMA OPC server.
- An overload of the PC running the HIMA OPC server can be prevented in cases in which the number of available communication partners is too small (e.g. due to frequent token holding caused by the short token cycle).

Note Hubs may not be used in Passive mode. Switches are recommended.

6.9.1.4 Numbers of HIMA OPC server and determination of the node Id

- HIPRO-S mode (S1/7 "OFF"): Fixed to four HIMA OPC servers.
  Node Ids of the HIMA OPC servers are 107 to 110.
- HIPRO-S-DIRECT mode (S1/7 "ON"):
  Switches 2/6-8 set the number of HIMA OPC servers with which the F 8627X can exchange BUSCOM variables.
  A range of node Id's is available for the number of HIMA OPC servers selected via switch 2 (see Table 14).
- The Node Id is required for configuring the HIMA OPC server (see manual "HIMA OPC server 3.0 Rev. 2").

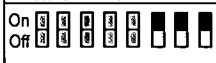
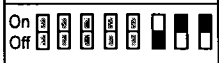
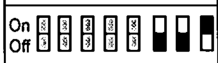
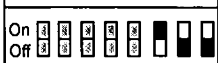
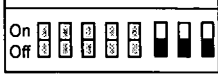
Switch 2	Number of HIMA OPC server	Node Id
	0	-
	2	107 and 108
	4	107 up to 110
	6	107 up to 112
	8	107 up to 114
	10	107 up to 116
	12	107 up to 118
	14	107 up to 120

Table 14: Settings of switch 2 (S2)

Legend:

Positions white switch:

On Off White switch in position OFF

On Off White switch in position ON

Not used switch

6.9.1.5 Determining the IP address of the OPC Server network card

The IP address is composed of the network address and the host address. The default network address is 192.168.0.
The last byte of the IP address 192.168.0.x is the host address and it is calculated from the Node Id as specified below:

Host address = Node Id * 2 + 1 (For IP address Segment 1)
Host address = Node Id * 2 + 2 (For IP address Segment 2)

The following IP addresse are resulting from the calculation (see Table 15).

Node Id	IP Address Segment 1	IP Address Segment 2
107	192.168.0.215	192.168.0.216
108	192.168.0.217	192.168.0.218
109	192.168.0.219	192.168.0.220
110	192.168.0.221	192.168.0.222
111	192.168.0.223	192.168.0.224
112	192.168.0.225	192.168.0.226
113	192.168.0.227	192.168.0.228
114	192.168.0.229	192.168.0.230
115	192.168.0.231	192.168.0.232
116	192.168.0.233	192.168.0.234
117	192.168.0.235	192.168.0.236
118	192.168.0.237	192.168.0.238
119	192.168.0.239	192.168.0.240
120	192.168.0.241	192.168.0.242

Table 15: Mapping of IP addresses to node Id's

The IP address must be set in the properties of the network card of the PC running the HIMA OPC server.

6.9.2 Configuring of the BUSCOM variables in ELOP II

The F 8627X communicates with an OPC server via the BUSCOM variables, which must be created in ELOP II by the user.
The BUSCOM variables created in ELOP II can be exported into a text file, which in turn can be directly imported into the HIMA OPC server for configuration.

6.9.2.1 Address range of the BUSCOM variables

The address of the BUSCOM variables are calculated as follows
Base address + Relative address =BUSCOM address.

Note The base address' settings are located in the resource's properties. In the "BUSCOM" tab, the user can set the base address separately for Import, Export and Import/Export; however, using the standard base address settings is recommended.

The following address ranges can be used for BUSCOM variables:

BUSCOM variables	**Address range (Base address+ relative address)**
BOOL	0 up to 2047 or 4096 up to 8191
UINT (WORD, INT, SINT, USINT)	0 up to 2047 or 4096 up to 8191

Table 16: Address range of the BUSCOM variables

Note Select one of the two address ranges for the BUSCOM variables. If this is not possible, please contact the HIMA support.

Addresses for the BUSCOM variables can be allocated automatically or manually, but each address is allocated with reference to the base address.

6.9.2.2 Manually assigning the address for BUSCOM variables

By activating the function "set relative address" in the dialog located "Variable Declaration", set the address must be assigned manually. The base address is displayed above the input field. An overview of all used addresses can be found selecting in the *context menu of the resource->documentation->Res docu (generated).*

Note The user should assign the address for the BUSCOM variables, manually to avoid a reorganization of the addresses (address shift) after adding new BUSCOM variables.

6.9.2.3 Automatically assigning the address for BUSCOM variables

Deactivate the function "set relative address" located in the dialog "Variable Declaration".
The automatic address assignment of the BUSCOM variables is arranged in alphabetical order on the basis of the variable name.
An overview of all used addresses can be found selecting the *context menu of the resource->documentation->Res docu (generated).*

Once new BUSCOM variables have been added, a *not reloadable code* must always be generated to allow the addressing to be reconfigured.

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6.9.3 Example of a configuration in ELOP II for the communication with a HIMA OPC-Server

Define the BUSCOM variables used for the OPC communication:

- Select one of the following properties to determine the communication direction of the BUSCOM variables:

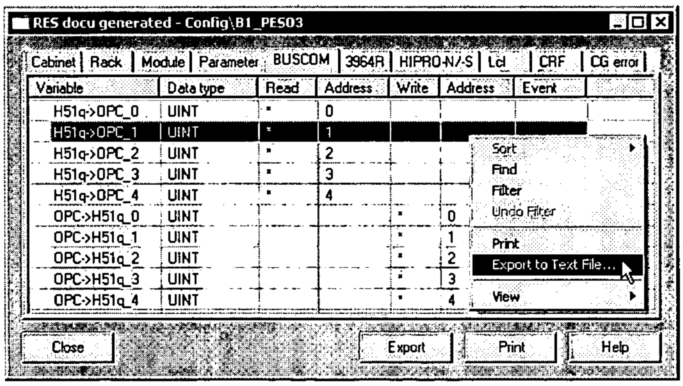
Export:	read by HIMA OPC server
Import:	written by HIMA OPC server
Import/Export:	both written and read by HIMA OPC server

Create the BUSCOM resources' list for HIMA OPC server:

- Open the resource's context menu and select *Documentation*.
- Select the submenu function *RES-Docu (generated)* to open the dialog "Res-Docu (generated)".
- Select the tab "BUSCOM" located in the dialog "Res-Docu (generated)".
- Right click on the BUSCOM variable line, to open the export context menu.
- Select *Export to Text File.*

Note Consider that no filters are set during the export!

- Save the file with the extension **.txt* on a storage medium (server, floppy disk), which the HIMA OPC server can read.



Read: To be read by the HIMA OPC server

Write:To be written by the HIMA OPC server

Figure 17: Dialog "Res-Docu (generated)"

The generated BUSCOM list appears as seen in Figure 18 and can be used by the HIMA OPC server without any changes.

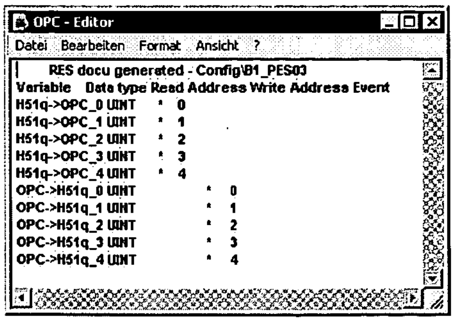


Figure 18: BUSCOM list for the HIMA OPC server

7 Address mapping of the BUSCOM variables

7.1 Data types of BUSCOM variables

Overview, how the BUSCOM variables are represented and stored.

ELOP II (variable data types)	Process data mapping on the F 8627X	Size of data types on the F 8627X and F 865x
BOOL	BOOL	1 Byte
WORD (WORD INT UINT)	WORD	2 Bytes

Table 17: Data type definitions

All 2 Byte data types configured in ELOP II as BUSCOM variables are transmitted as WORD. 1 Byte data types (e.g. Byte, SINT) must be packed into BUSCOM variables of data type WORD (e.g. with the function blocks "Pack" and "Unpack") such that they can be transmitted.

7.2 BUSCOM address of the F 865x central module

The user can set-up the BUSCOM Addresses of the BUSCOM variables by specifying the base and relative addresses in ELOP II.

The addresses of the BUSCOM variables are calculated on the central module F 865x as follows:

Base address + Relative address = BUSCOM address

The relative address must be set such that the BUSCOM address is located in the same range as the corresponding base address (see Table 18).

Note The base address' settings are located in resource's properties. In the "BUSCOM" tab, the user can set the base address separately for Import, Export and Import/Export; however, using the standard base address settings is recommended.

The BOOL and WORD variables are stored within the import and export areas of the F 865x and further seperated into 0 and 1 areas.

Ranges	BOOL (BUSCOM address)	WORD (BUSCOM address)
Import range 0 (Base address 0000)	0000 to 2047	0000 to 2047
Import range 1 (Base address 4096)	4096 to 8191	4096 to 8191
Export range 0 (Base address 0000)	0000 to 2047	0000 to 2047
Export range 1 (Base address 4096)	4096 to 8191	4096 to 8191

Table 18: BUSCOM variable ranges in the F 865x central module

7.3 Mapping of the BUSCOM variables on the F 8627X

To transmit the BUSCOM variables, they are mapped from the F 865x central module to the F 8627X communication module.
The BUSCOM variables from the F 865x are copied into two memory areas located in the F 8627X internal memory.
The memory areas EV and IV reflect the export and the import variables respectively. In the memory area, a BUSCOM variable is described by its identity number.

Note This scheme for converting BUSCOM variables (on the F 865x) into identity numbers (on the F 8627X) is used for WORD as well as for BOOL variables.

⚠ Consider at MODBUS Port 8896, that you neither reading nor writing with a Modbus telegram beyond the address range of a variable type (see also Chapter 6.4.4)

7.3.1 Example 1

In this example the **WORD** variables in the export area 0 (on the F865x) start with the BUSCOM address 0 and are mapped to the memory area EV (on the F 8627X) with the identity number 0.
The identity numbers of the WORD variables in memory area EV are in ascending order up to the last WORD variable (identity number 110) from export area 0.

In this example, the **BOOL** variables in export area 0 (on the F 865x) start with BUSCOM address 0 and are mapped to memory area EV (on the F 8627X) beginning with identity number 111, which follows the last identity number of the WORD variables (i.e. 110).
The identity numbers of the BOOL variables in memory area EV are in ascending order up to the last BOOL variable (indentity number 150) from export area 0.

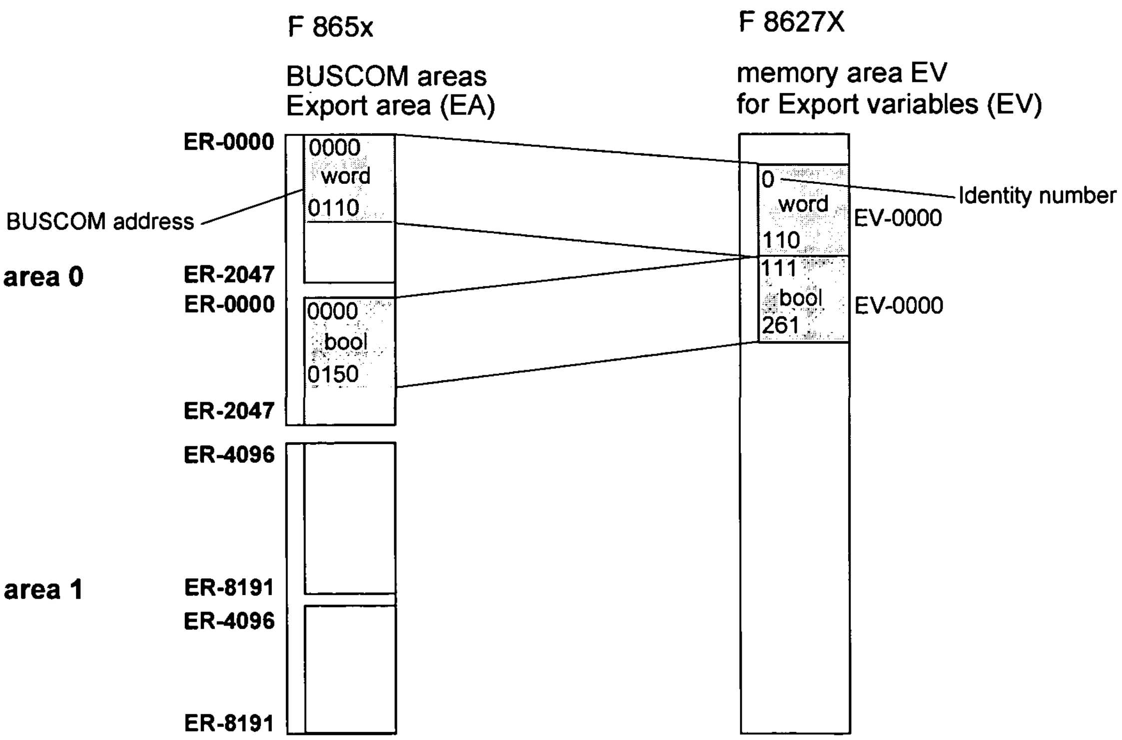


Figure 19: Mapping of WORD- and BOOL-variables from export area 0

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7.3.2 Example 2

In this example the **BOOL** variables in the export area 0 (on the F865x) start with the BUSCOM address 0 and mapped to the memory area EV (on the F 8627X) with the identity number 0. The identity numbers of the BOOL variables in memory area EV are in ascending order up to the last BOOL variable (identity number 100) from export area 0.

In this example, the **BOOL** variables in export area 1 (on the F 865x) start with BUSCOM address 4096 and are mapped to memory area EV (on the F 8627X) beginning with identity number 101, which follows the last identity number of the BOOL variables (i.e. 100).
The identity numbers of the BOOL variables in memory area EV are in ascending order up to the last BOOL variable 4196 from export area 1.

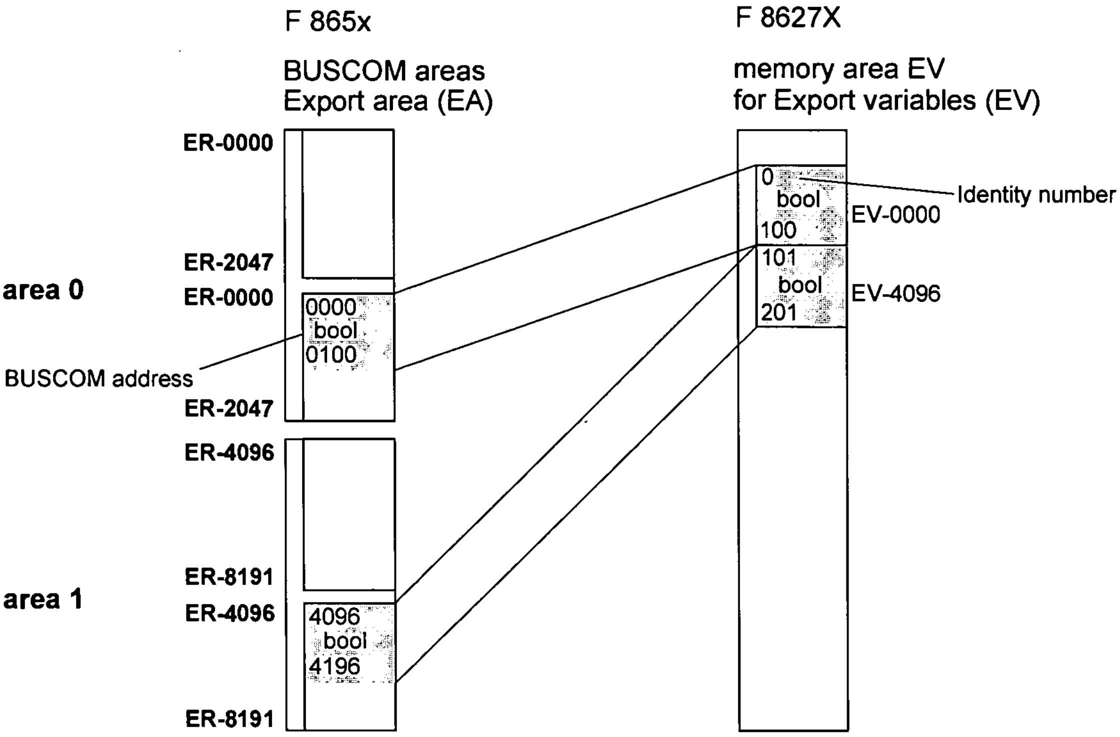

Figure 20: Mapping of BOOL-variables from export areas 0 and 1

7.3.3 Example 3

In this example, the **WORD** variables in export area 0 (on the F 865x) start with BUSCOM address 1 and are mapped to the memory area EV (on the F 8627X) beginning with identity number 1. The identity numbers of the WORD variables in memory area EV are in ascending order up to the last WORD variable (0110) from export area 0.
The unused BUSCOM address 0 is assigned a dummy variable and mapped to identity number 0 within memory area EV.

In this example, the **WORD** variables in export area 1 (on the F 865x) start with BUSCOM address 4100 and are mapped to the memory area EV (on the F 8627X) beginning with identity number 115. The identity numbers of the WORD variables in memory area EV are in ascending order up to the last
WORD variable (4200) from export area 1.
The unused BUSCOM addresses 4096 to 4099 are assigned dummy variables and mapped to identity numbers 111 to 114 within memory area EV.

In this example, the **BOOL** variables in export area 0 (on the F 865x) start with BUSCOM address 0 and are mapped to the memory area EV (on the F 8627X) beginning with identity number 216 which follows the identity number 215 of the last WORD variable from export area 0. The identity numbers of the BOOL variables in memory area EV are in ascending order up to the last BOOL variable (0100) from export area 0.

In this example, the **BOOL** variables in export area 1 (on the F 865x) start with BUSCOM address 4096 and are mapped to the memory area EV (on the F 8627X) beginning with identity number 317 which follows the identity number 316 of the last BOOL variable from export area 0.
The identity numbers of the BOOL variables in the memory area EV are ascending up to the last BOOL variable 4196 from the export area 1.

Note If BUSCOM variables do not start at the beginning of an area, this area is padded with dummy variables on the central module and also mapped on the communication module.

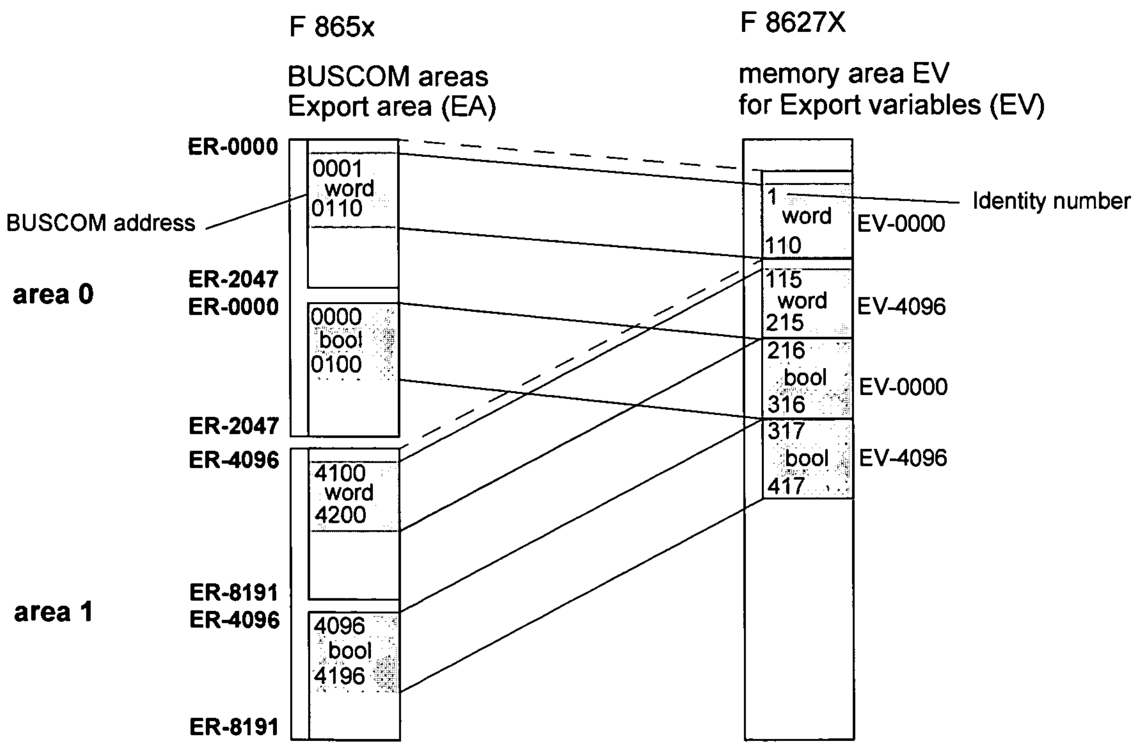

Figure 21: Mapping of WORD- and BOOL-variables from export areas 0 and 1

8 Replacing of the operating system

8.1 Upgrading/downgrading the operating system versions of the F 8627X

The following instructions describe the upgrade/downgrade the operation systems for the F 8627X module.

Upgrading/downgrading may only be performed by HIMA service engineers. It is recommended that the operating system is changed, e.g. in times of a shutdown of the plant.

8.1.1 Upgrading/downgrading from version 2.x

To upgrade/downgrade version 2.x, the operating system file with extension ***.flash** must be loaded.

When upgrading from version 2.x to another version, the user must ensure that only the correct operating system file is loaded into the corresponding module.
If the module F 8627X was loaded with any incorrect file, the functionality of the F 8627X is lost and can not be programmed any longer with the diagnostic dialog ComEth. In this case the module F 8627X must be programmed new by HIMA.

After upgrading to version 3.x and higher a protection mechanism is activated and only operating system files with extension ***.ldb** can be loaded.

8.1.2 Upgrading/downgrading from version 3.x and higher

To upgrade/downgrade version 3.x and higher, the operating system file with extension ***.ldb** must be loaded.

After downgrading to version 2.x, the protection mechanism preventing incorrect files from being loaded is no longer active!

8.2 Downloading the operating system into the F 8627X

The operating system for the F 8627X module is downloaded using the diagnosis dialog **ComEth**.

The connection between the **ComEth**'s control panel and the F 8627X Ethernet module should be closed, if **ComEth** is not used.
The connection to the **ComEth**'s diagnosis panel can remain.

Downgrading from version ≥ V4.x to version ≤ V3.x!
If the F 8627X is set to "Autonegotiation Off" (S2/3 OFF) and full duplex (S2/5 ON), then autonegotiation must be activated for all communication partners (e.g. switch) once the downgrade has been completed (see also Chapter 4.2).

Upgrading from version ≤ V3.x to version ≥ V4.x!
If the F 8627X is set to "Autonegotiation Off" (S2/3 OFF) and full duplex (S2/5 ON), then autonegotiation must be deactivated for all communication partners (e.g. switch) once the upgrade has been completed (see also Chapter 4.2).

- Start the ComEth diagnosis dialog and check in the error-state viewer that the
  - "main program version" is 0.8.0 or higher
  - "diagnostic text version" is 0.2.0 or higher.
- Select *Project->New* on the menubar of the ComEth diagnosis dialog, to create a new Project.
- Select *New Configuration* in the context menu of the new project, to create a new configuration.
- Select *New Resource* in the context menu of the new configuration, to create a new resource.
- Select *New F 8627X* in the context menu of the new resource, to create a new F 8627X in the new resource.
- Select *Properties* in the context menu of the new F 8627X, to open the dialog window "Properties".

Configure the input fields as follows:

- Enter any unique name for the F 8627X (e.g. CU1CM1) in the input field.
- In the input field "IP address", enter the IP address of the F 8627X module into which the operating system is to be loaded. For determining the IP address of the F 8627X module, (see Chapter 5.1).
- The view box "IP address PC" displays all IP addresses of the available PADT (PC) network cards. Select the IP address of the network card to be used for creating the connection to the F 8627X module.

Note

OS versions < V4.x
The PADT (PC) IP address must:

- be located in the same subnet as the F 8627 module.
- have an IP address in one of the following ranges:
  - from 192.168.0.201 to 192.168.0.214 or
  - from 192.168.0.243 to 192.168.0.254.

Exception: If the PADT (PC) is simultaneously used as an OPC server and already has own one of the OPC server IP addresses, it also can also use this IP address.

If several network cards are available on the PADT (PC), a corresponding routing entry must be set for the network card which is used for connection to the F 8627.

OS versions ≥ V4.x
Any free IP address for the PADT may be used. If the PADT IP addresses of the PADT and the F 8627X are located in different subnets, a routing entry for the subnet of the F 8627X is required on the PADT (PC).

- Select *Control Panel* in the context menu of the new F 8627X to open the Control Panel.
- Select *PADT->Connect* in the control panel to create a connection to the F 8627X module.

The next step causes a communication loss, if no redundant F 8627X module exists or if the redundant module does not have any connection!

- Click the button *Stop Device* in the ComEth control panel, to set the F 8627X module into the STOP state (green RUN LED blinks).
- Select *Extra->OS Update* in the ComEth control panel to open the standard dialog for opening a file.
- Select and load the **proper** operating system for the upgrade/downgrade into the selected F 8627X module (see Chapter 8.1.1 and Chapter 8.1.2).

If the operating system download of the F 8627X was aborted, the F 8627X must **not** be removed!
Close the **ComEth** control panel and reopen it. Repeat the previous step to load the F 8627X operating system.

Note

After successfully downloading the F 8627X operating system, **the F 8627X module must be rebooted**. After rebooting the new operating system is started. Until then, the F 8627X operates using with the old operating system.

F 8627X (0650)

To reboot the F 8627X:

- Remove and replace the F 8627X module or
- select the function *Extra->Reboot Device* located in the ComEth Control Panel dialog.
- Check the upgrade/downgrade
- Select *PADT->Connect* in the control panel to create a new connection to the F 8627X module.
- Select the tab *version* and check that the OS version displayed is the same as the OS version of the Upgrade/Downgrade.
- If a redundant F 8627X module exists, follow the same procedure.

Note The ARP entry must be deleted on the PADT (PC) if another F 8627X is to be loaded and has the **same IP address** as the F 8627X loaded immediately beforehand; otherwise, a connection cannot be opened to the newly loaded F 8627X with the same IP address.

Example: Delete the ARP entry of a F 8627X with the IP address **192.168.0.67**.

- Start the "Dos Shell" on the PADT (PC)
- Enter the command **arp -d 192.168.0.67**.

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9 Recommended literature

[1] Safety Manual H41q/H51q
HIMA GmbH+Co KG Bruehl, 2005: HI 800 013

[2] Functions of the Operating System H41q/H51q
HIMA GmbH+Co KG Bruehl, 2005: HI 800 105

[3] Online Help in ELOP II
HIMA GmbH+Co KG Bruehl, 2005

[4] First Steps ELOP II
HIMA GmbH+Co KG Bruehl, 2001: HI 800 000

[5] HIMA OPC server 3.0 Rev. 2
HIMA GmbH+Co KG Bruehl, 2004

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HIMA
...the safe decision.

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(0650)

REVISION CONTROL

Version	Date	Person	Comment
Rev 0.2	14-Dec-07	Paul Gellatly	Original Issue
Rev 1.0	22-Jan-08	Paul Gellatly	Issued for tender
Rev 2.0	19-Jan-09	Paul Gellatly	Revised following meeting with HIMA - 2xDO added, wire numbers changed, module quantities & channel numbers changed to suit HIMA B.O.M. (3xDI, 5xDO, 1xAI, 2xTC)
Rev 3.0	9-Feb-09	Matt Walker	Added HIMA module numbers, marshalling and interconnect board terminal numbers
Rev 4.0	11-Mar-09	Matt Walker	Modified AI-1 for LMDI pressure switches, updated titles, and updated slot number for T/C input modules
Rev 4.1	12-Mar-09	Scott Adams	Change PLC Tagnames (ds to gb and as to gr)
Rev 4.2	7-Apr-09	Scott Adams	Added SIS_Cabinet_Healthy input and changed PSH11000 to PSH15000 and PSH11320 to PSH15320. Added in tagnames for compensation RTD's

PLC15 - Engines Safety PLC

PLC I/O Summary

	Number of Modules	Points per module	Total Points	Used Points	Spare Points	Percent Spare
Digital Inputs	3	16	48	31	17	35%
Digital Outputs	5	4	20	16	4	20%
Analogue Inputs	1	8	8	2	6	75%
RTD Inputs	0	8	0	0	0	0%
T/C Inputs	2	8	16	12	4	25%
Analogue Outputs	0	8	0	0	0	0%
Totals:	11		92	61	31	

BRISBANE WATER

Luggage Point WWTP Control System Upgrade Project - 16 Channel Digital Input I/O List

PLC Number: 15 - Engines Safety PLC
Location: Safety PLC Cabinet - Engines Bay
Rack Number: System Rack (11**)
Slot Number: 1 (1001)
Module Model Number: F3236
Description: 16 Channel Digital Input

Chnl	Equip.	Ellipse	Equip. Name	I/O Description	PLC Tag	Marshalling Terminal		Interconnect Board Terminal		Address	Off State	On State	Wire	Modbus Address (Word)	Modbus Address (Bit)	PLC11 Remap to	Drawing Elect 486/7/5-	Drawing P&ID	Comment
						+	-	+	-										
1	VV2433		Engine 1 Gas Safety Vent Valve	Closed	ENG01VV2433diClosed	TR01:1	TR01:2	TR02-A:1	TR02-A:1+	1001/1	Not Closed	Closed	15002	40001	1	%M14001			
2	VV2433		Engine 1 Gas Safety Vent Valve	Opened	ENG01VV2433diOpen	TR01:3	TR01:4	TR02-A:2	TR02-A:2+	1001/2	Not Open	Open	15003	40001	2	%M14002			
3	VV2431		Engine 1 Gas Isolation Valves	Remote Selected	ENG01VV2431diRemote	TR01:5	TR01:6	TR02-A:3	TR02-A:3+	1001/3	Close	Remote	15004	40001	3	%M14003			
4	VV2431		Engine 1 Gas Primary Isolation Valve	Closed	ENG01VV2431diClosed	TR01:7	TR01:8	TR02-A:4	TR02-A:4+	1001/4	Not Closed	Closed	15174	40001	4	%M14004			
5	VV2431		Engine 1 Gas Primary Isolation Valve	Opened	ENG01VV2431diOpen	TR01:9	TR01:10	TR02-A:5	TR02-A:5+	1001/5	Not Open	Open	15175	40001	5	%M14005			
6	VV2432		Engine 1 Gas Secondary Isolation Valve	Closed	ENG01VV2432diClosed	TR01:11	TR01:12	TR02-A:6	TR02-A:6+	1001/6	Not Closed	Closed	15141	40001	6	%M14006			
7	VV2432		Engine 1 Gas Secondary Isolation Valve	Opened	ENG01VV2432diOpen	TR01:13	TR01:14	TR02-A:7	TR02-A:7+	1001/7	Not Open	Open	15142	40001	7	%M14007			
8	ESVSR		Engine 1 Emerg Stop Valve Supply Relay (ESVSR)	ESVSR Fault	ENG01ESVSRdiFault	TR01:15	TR01:16	TR02-A:8	TR02-A:8+	1001/8	Fault	Normal	15185	40001	8	%M14008			
9	PS3		Engine 1 Emergency Stop Operated PS3	Emergency Stop Operated	ENG01PS3diEstop	TR01:17	TR01:18	TR02-A:9	TR02-A:9+	1001/9	Normal	Emerg/Stop	15186	40001	9	%M14009			
10	ESR		Engine 1 Emergency Stop Relay ESR	Emergency Stop Operated	ENG01ESRdiEstop	TR01:19	TR01:20	TR02-A:10	TR02-A:10+	1001/10	Normal	Emerg/Stop	15191	40001	10	%M14010			
11	GASMOD1		Engine 1 Gas Module	Fault	ENG01GASMOD1diFault	TR01:21	TR01:22	TR02-A:11	TR02-A:11+	1001/11	Fault	Normal	15886	40001	11	%M14011			
12	GASMOD1		Engine 1 Gas Module	Alarm	ENG01GASMOD1diAlarm	TR01:23	TR01:24	TR02-A:12	TR02-A:12+	1001/12	Normal	Alarm	15887	40001	12	%M14012			
13														40001	13	%M14013			
14														40001	14	%M14014			
15														40001	15	%M14015			
16														40001	16	%M14016			

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Luggage Point WWTP Control System Upgrade Project - 16 Channel Digital Input I/O List

PLC Number: 15 - Engines Safety PLC
Location: Safety PLC Cabinet - Engines Bay
Rack Number: System Rack (10**)
Slot Number: 2 (1002)
Module Model Number: F3236
Description: 16 Channel Digital Input

Chnl	Equip.	Ellipse	Equip. Name	I/O Description	PLC Tag	Marshalling Terminal		Interconnect Board Terminal		Address	Off State	On State	Wire	Modbus Address (Word)	Modbus Address (Bit)	PLC11 Remap to	Drawing Elect 486/7/5-	Drawing P&ID	Comment
						+	-	+	-										
1	VV2437		Engine 2 Gas Safety Vent Valve	Closed	ENG02VV2437diClosed	TR01:25	TR01:26	TR02-B:1	TR02-B:1+	1002/1	Not Closed	Closed	15322	40002	1	%M14017			
2	VV2437		Engine 2 Gas Safety Vent Valve	Opened	ENG02VV2437diOpen	TR01:27	TR01:28	TR02-B:2	TR02-B:2+	1002/2	Not Open	Open	15323	40002	2	%M14018			
3	VV2437		Engine 2 Gas Isolation Valves	Remote Selected	ENG02VV2437diRemote	TR01:29	TR01:30	TR02-B:3	TR02-B:3+	1002/3	Close	Remote	15324	40002	3	%M14019			
4	VV2435		Engine 2 Gas Primary Isolation Valve	Closed	ENG02VV2435diClosed	TR01:31	TR01:32	TR02-B:4	TR02-B:4+	1002/4	Not Closed	Closed	15498	40002	4	%M14020			
5	VV2435		Engine 2 Gas Primary Isolation Valve	Opened	ENG02VV2435diOpen	TR01:33	TR01:34	TR02-B:5	TR02-B:5+	1002/5	Not Open	Open	15499	40002	5	%M14021			
6	VV2436		Engine 2 Gas Secondary Isolation Valve	Closed	ENG02VV2436diClosed	TR01:35	TR01:36	TR02-B:6	TR02-B:6+	1002/6	Not Closed	Closed	15465	40002	6	%M14022			
7	VV2436		Engine 2 Gas Secondary Isolation Valve	Opened	ENG02VV2436diOpen	TR01:37	TR01:38	TR02-B:7	TR02-B:7+	1002/7	Not Open	Open	15466	40002	7	%M14023			
8	ESVSR		Engine 2 Emergency Stop Valve Supply Relay (ESVSR)	ESVSR Fault	ENG02ESVSRdiFault	TR01:39	TR01:40	TR02-B:8	TR02-B:8+	1002/8	Fault	Normal	15509	40002	8	%M14024			
9	PS3		Engine 2 Emergency Stop Operated PS3	Emergency Stop Operated	ENG02PS3diEstop	TR01:41	TR01:42	TR02-B:9	TR02-B:9+	1002/9	Normal	Emerg/Stop	15510	40002	9	%M14025			
10	ESR		Engine 2 Emergency Stop Relay ESR	Emergency Stop Operated	ENG02ESRdiEstop	TR01:43	TR01:44	TR02-B:10	TR02-B:10+	1002/10	Normal	Emerg/Stop	15515	40002	10	%M14026			
11	GASMOD2		Engine 2 Gas Module	Fault	ENG02GASMOD2diFault	TR01:45	TR01:46	TR02-B:11	TR02-B:11+	1002/11	Fault	Normal	15868	40002	11	%M14027			
12	GASMOD2		Engine 2 Gas Module	Alarm	ENG02GASMOD2diAlarm	TR01:47	TR01:48	TR02-B:12	TR02-B:12+	1002/12	Normal	Alarm	15869	40002	12	%M14028			
13														40002	13	%M14029			
14														40002	14	%M14030			
15														40002	15	%M14031			
16														40002	16	%M14032			

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Luggage Point WWTP Control System Upgrade Project - 16 Channel Digital Input I/O List

PLC Number: 15 - Engines Safety PLC
Location: Safety PLC Cabinet - Engines Bay
Rack Number: System Rack (10**)
Slot Number: 3 (1003)
Module Model Number: F3236
Description: 16 Channel Digital Input

Chnl	Equip.	Ellipse	Equip. Name	I/O Description	PLC Tag	Marshalling Terminal		Interconnect Board Terminal		Address	Off State	On State	Wire	Modbus Address (Word)	Modbus Address (Bit)	PLC11 Remap to	Drawing Elect 486/7/5-	Drawing P&ID	Comment
						+	-	+	-										
1	VV2430		Main Gas Shutoff Valve	Remote Selected	ENGASVV2430diRemote	TR01:49	TR01:50	TR02-C:1	TR02-C:1+	1003/1	Close	Remote	15848	40003	1	%M14033			
2	VV2430		Main Gas Shutoff Valve	Emergency Close	ENGASVV2430diEstop	TR01:51	TR01:52	TR02-C:2	TR02-C:2+	1003/2	Normal	Emerg Stop	15849	40003	2	%M14034			
3	VV2430		Main Gas Shutoff Valve	Closed	ENGASVV2430diClosed	TR01:53	TR01:54	TR02-C:3	TR02-C:3+	1003/3	Not Closed	Closed	15850	40003	3	%M14035			
4	VV2430		Main Gas Shutoff Valve	Open	ENGASVV2430diOpen	TR01:55	TR01:56	TR02-C:4	TR02-C:4+	1003/4	Not Open	Open	15851	40003	4	%M14036			
5										1003/5				40003	5	%M14037			
6										1003/6				40003	6	%M14038			
7										1003/7				40003	7	%M14039			
8										1003/8				40003	8	%M14040			
9										1003/9				40003	9	%M14041			
10										1003/10				40003	10	%M14042			
11										1003/11				40003	11	%M14043			
12										1003/12				40003	12	%M14044			
13	PLC15CABINET		PLC15 Cabinet	Healthy	PLC15CABINETdiHealthy	TR03-F:16	TR03-F:5	TR02-C:13	TR02-C:13+	1003/13	Faulted	Healthy	15903	40003	13	%M14045			
14	PWRSUP1		24vDC Power Supply 1	Healthy	PLC15PWRSUP1diHealthy	TR03-F:1	TR03-F:2	TR02-C:14	TR02-C:14+	1003/14	Faulted	Healthy	15901	40003	14	%M14046			
15	PWRSUP2		24vDC Power Supply 2	Healthy	PLC15PWRSUP2diHealthy	TR03-F:3	TR03-F:4	TR02-C:15	TR02-C:15+	1003/15	Faulted	Healthy	15902	40003	15	%M14047			
16	PLC11OK		PLC11 "Healthy" Output	Healthy	PLC15PLC11diOkay	TR01:57	TR01:58	TR02-C:16	TR02-C:16+	1003/16	Faulted	Healthy	15900	40003	16	%M14048			

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Luggage Point WWTP Control System Upgrade Project - 4 Channel Digital Output I/O List

PLC Number: 15 - Engines Safety PLC
Location: Safety PLC Cabinet - Engines Bay
Rack Number: System Rack (10**)
Slot Number: 4 (1004)
Module Model Number: F3430
Description: 4 Channel Digital Output

Chnl No.	Equip. No.	Ellipse No.	Equip. Name	I/O Description	PLC Tag	Marshalling Terminal		Interconnect Board Terminal		Address	Off State	On State	Wire No.	Modbus Address (Word)	Modbus Address (Bit)	PLC11 Remap to	Drawing No. Elect 486/7/5-	Drawing No. P&ID	Comment
						+	-	+	-										
1	GIVR		Engine 1 Gas Isolation Valves Relay	Open	ENGASGIVRdqOpen	TR01:59	TR01:60	TR02-D:1	TR02-D:3	1004/1	Isolate Gas	Open Block & Vent	15005	40004	1	%M14049			
2	VV2431		Engine 1 Gas Primary Isolation Valve	Closed Indication	ENGASVV2431dqClosed	TR01:61	TR01:62	TR02-D:5	TR02-D:7	1004/2	Closed Lamp OFF	Closed Lamp ON	15006	40004	2	%M14050			
3	VV2432		Engine 1 Gas Secondary Isolation Valve	Closed Indication	ENGASVV2432dqClosed	TR01:63	TR01:64	TR02-D:9	TR02-D:11	1004/3	Closed Lamp OFF	Closed Lamp ON	15007	40004	3	%M14051			
4	VV2433		Engine 1 Gas Safety Vent Valve	Closed Indication	ENGASVV2433dqClosed	TR01:65	TR01:66	TR02-D:13	TR02-D:15	1004/4	Closed Lamp OFF	Closed Lamp ON	15008	40004	4	%M14052			

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Luggage Point WWTP Control System Upgrade Project - 4 Channel Digital Output I/O List

PLC Number: 15 - Engines Safety PLC
Location: Safety PLC Cabinet - Engines Bay
Rack Number: System Rack (10**)
Slot Number: 5 (1005)
Module Model Number: F3430
Description: 4 Channel Digital Output

Chnl No.	Equip. No.	Ellipse No.	Equip. Name	I/O Description	PLC Tag	Marshalling Terminal +	Marshalling Terminal -	Interconnect Board Terminal +	Interconnect Board Terminal -	Address	Off State	On State	Wire No.	Modbus Address (Word)	Modbus Address (Bit)	PLC11 Remap to	Drawing No. Elect 486/7/5-	Drawing No. P&ID	Comment
1	SV3		Engine 1 Emergency Stop Solenoid SV3	Energise	ENG01SV3dqEnergise	TR01:67	TR01:68	TR02-E:1	TR02-E:3	1005/1	De-energise SV3	Energise SV3	15277	40004	1	%M14053			
2	SV4		Engine 1 Gas Enable Solenoid SV4	Energise	ENG01SV4dqEnergise	TR01:69	TR01:70	TR02-E:5	TR02-E:7	1005/2	De-energise SV4	Energise SV4	15278	40004	2	%M14054			
3	ENG1		Engine 1 Gas Enable to PLC11	Okay to go to Gas	ENG01ENG2doGasOkay	TR01:71	TR01:72	TR02-E:9	TR02-E:11	1005/3	Not okay to go to Gas	Okay to go to Gas	15001	40004	3	%M14055			
4										1005/4				40004	4	%M14056			

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Luggage Point WWTP Control System Upgrade Project - 4 Channel Digital Output I/O List

PLC Number: 15 - Engines Safety PLC
Location: Safety PLC Cabinet - Engines Bay
Rack Number: System Rack (10**)
Slot Number: 6 (1006)
Module Model Number: F3430
Description: 4 Channel Digital Output

Chnl No.	Equip. No.	Ellipse No.	Equip. Name	I/O Description	PLC Tag	Marshalling Terminal		Interconnect Board Terminal		Address	Off State	On State	Wire No.	Modbus Address (Word)	Modbus Address (Bit)	PLC11 Remap to	Drawing No. Elect 486/7/5-	Drawing No. P&ID	Comment
						+	-	+	-										
1	GIVR		Engine 2 Gas Isolation Valves Relay	Open	ENG02GIVRdqOpen	TR01:73	TR01:74	TR02-F:1	TR02-F:3	1006/1	Isolate Gas	Open Block & Vent	15325	40004	1	%M14057			
2	VV2435		Engine 2 Gas Primary Isolation Valve	Closed Indication	ENG02VV2435dqClosed	TR01:75	TR01:76	TR02-F:5	TR02-F:7	1006/2	Closed Lamp OFF	Closed Lamp ON	15326	40004	2	%M14058			
3	VV2436		Engine 2 Gas Secondary Isolation Valve	Closed Indication	ENG02VV2436dqClosed	TR01:77	TR01:78	TR02-F:9	TR02-F:11	1006/3	Closed Lamp OFF	Closed Lamp ON	15327	40004	3	%M14059			
4	VV2437		Engine 2 Gas Safety Vent Valve	Closed Indication	ENG02VV2437dqClosed	TR01:79	TR01:80	TR02-F:13	TR02-F:15	1006/4	Closed Lamp OFF	Closed Lamp ON	15328	40004	4	%M14060			

BRISBANE WATER

Luggage Point WWTP Control System Upgrade Project - 4 Channel Digital Output I/O List

PLC Number: 15 - Engines Safety PLC
Location: Safety PLC Cabinet - Engines Bay
Rack Number: System Rack (10**)
Slot Number: 7 (1007)
Module Model Number: F3430
Description: 4 Channel Digital Output

Chnl No.	Equip. No.	Ellipse No.	Equip. Name	I/O Description	PLC Tag	Marshalling Terminal		Interconnect Board Terminal		Address	Off State	On State	Wire No.	Modbus Address (Word)	Modbus Address (Bit)	PLC11 Remap to	Drawing No. Elect 488/7/5-	Drawing No. P&ID	Comment
						+	-	+	-										
1	SV3		Engine 2 Emergency Stop Solenoid SV3	Energise	ENG02SV3dqEnergise	TR01:81	TR01:82	TR02-G:1	TR02-G:3	1007/1	De-energise SV3	Energise SV3	15601	40004	1	%M14061			
2	SV4		Engine 2 Gas Enable Solenoid SV4	Energise	ENG02SV4dqEnergise	TR01:83	TR01:84	TR02-G:5	TR02-G:7	1007/2	De-energise SV4	Energise SV4	15602	40004	2	%M14062			
3	ENG2		Engine 2 Gas Enable to PLC11	Okay to go to Gas	ENG02ENG2dqGasOkay	TR01:85	TR01:86	TR02-G:9	TR02-G:11	1007/3	Not okay to go to Gas	Okay to go to Gas	15010	40004	3	%M14063			
4														40004	4	%M14064			

BRISBANE WATER

Luggage Point WWTP Control System Upgrade Project - 4 Channel Digital Output I/O List

PLC Number: 15 - Engines Safety PLC
Location: Safety PLC Cabinet - Engines Bay
Rack Number: System Rack (10")
Slot Number: 8 (1008)
Module Model Number: F3430
Description: 4 Channel Digital Output

Chnl No.	Equip. No.	Ellipse No.	Equip. Name	I/O Description	PLC Tag	Marshalling Terminal		Interconnect Board Terminal		Address	Off State	On State	Wire No.	Modbus Address (Word)	Modbus Address (Bit)	PLC11 Remap to	Drawing No. Elect 486/7/5-	Drawing No. P&ID	Comment
						+	-	+	-										
1	VV2430		Main Gas Shutoff Valve	Open Relay	ENGASVV2430dqOpen	o	TR01:88	TR02-H:1	TR02-H:3	1008/1	Closed	Open	15886	40005	1	%M14065			
2										1008/2				40005	2	%M14066			
3										1008/3				40005	3	%M14067			
4	PLC15OK		PLC15 "Healthy" Output to PLC11	Healthy	ENGPLC15dqOkay	TR01:89	TR01:90	TR02-H:13	TR02-H:15	1008/4	Faulted	Healthy	15009	40005	4	%M14068			

BRISBANE WATER

Luggage Point WWTP Control System Upgrade Project - 8 Channel Analogue Input I/O List

PLC Number: 15 - Engines Safety PLC
Location: Safety PLC Cabinet - Engines Bay
Rack Number: System Rack (10**)
Slot Number: 9 (1009)
Module Model Number: F6217
Description: 8-Channel Analoue Input Module - Channels 1 and 5 being used for Line Monitored Digital Inputs

Chnl No.	Equip. No.	Ellipse No.	Equip. Name	I/O Description	PLC Tag	Marshalling Terminal		Interconnect Board Terminal		Address	Engineering Units		Wire No.		Modbus Address (Word)	PLC11 Remap to	Drawing No. Elect 486/7/5-	Drawing No. P&ID 486/7/5-	Comment
						+	-	+	-		4mA	20mA	+	-					
1	PT15000		Engine 1 Gas Pressure Switch	Pressure	ENG01PT15000diPressure	TR01:91	TR01:92	TR02-I:2	TR02-I:2-	1009/1	0 kPa	500 kPa	PLC15-PT15000+	PLC15-PT15000-	40010	%R14001			Send to PLC11
2																			
3																			
4																			
5	PT15320		Engine 2 Gas Pressure Switch	Pressure	ENG02PT15320diPressure	TR01:93	TR01:94	TR02-I:10	TR02-I:10-	1009/5	0 kPa	500 kPa	PLC15-PT15320+	PLC15-PT15320-	40011	%R14002			Send to PLC11
6																			
7																			
8																			

BRISBANE WATER

Luggage Point WWTP Control System Upgrade Project - 8 Channel Thermocouple Input I/O List

PLC Number: 15 - Engines Safety PLC
Location: Safety PLC Cabinet - Engines Bay
Rack Number: System Rack (10**)
Slot Number: 11 (1011)
Module Model Number: F6220
Description: 8 Channel T/C Analogue Input

Chnl No.	Equip. No.	Ellipse No.	Equip. Name	I/O Description	PLC Tag	Marshalling Terminal		Interconnect Board Terminal		Address	Engineering Units		Wire No.		Modbus Address (Word)	PLC11 Remap to	Drawing No. Elect 486/7/5-	Drawing No. P&ID 486/7/5-	Comment
						+	-	+	-		Sensor Type	Displayed Range	+	-					
1	TE11962		Engine 1 Cylinder 1	Temperature	ENG01TE11962aiTemperature	TR01:95	TR01:96	TR02-J:1	TR02-J:2	1010/1	Type K TC	0-600 DegC	PLC15-TE11962+	PLC15-TE11962-	40012	%R14003			Send to PLC11 as Integer where 6000 = 600.0 DegC
2	TE11963		Engine 1 Cylinder 2	Temperature	ENG01TE11963aiTemperature	TR01:97	TR01:98	TR02-J:1	TR02-J:4	1010/2	Type K TC	0-600 DegC	PLC15-TE11963+	PLC15-TE11963-	40013	%R14004			Send to PLC11 as Integer where 6000 = 600.0 DegC
3	TE11964		Engine 1 Cylinder 3	Temperature	ENG01TE11964aiTemperature	TR01:99	TR01:100	TR02-J:5	TR02-J:6	1010/3	Type K TC	0-600 DegC	PLC15-TE11964+	PLC15-TE11964-	40014	%R14005			Send to PLC11 as Integer where 6000 = 600.0 DegC
4	TE11965		Engine 1 Cylinder 4	Temperature	ENG01TE11965aiTemperature	TR01:101	TR01:102	TR02-J:7	TR02-J:8	1010/4	Type K TC	0-600 DegC	PLC15-TE11965+	PLC15-TE11965-	40015	%R14006			Send to PLC11 as Integer where 6000 = 600.0 DegC
5	TE11966		Engine 1 Cylinder 5	Temperature	ENG01TE11966aiTemperature	TR01:103	TR01:104	TR02-J:9	TR02-J:10	1010/5	Type K TC	0-600 DegC	PLC15-TE11966+	PLC15-TE11966-	40016	%R14007			Send to PLC11 as Integer where 6000 = 600.0 DegC
6	TE11967		Engine 1 Cylinder 6	Temperature	ENG01TE11967aiTemperature	TR01:105	TR01:106	TR02-J:11	TR02-J:12	1010/6	Type K TC	0-600 DegC	PLC15-TE11967+	PLC15-TE11967-	40017	%R14008			Send to PLC11 as Integer where 6000 = 600.0 DegC
7																			
8																			
9	PT100_COMP1		Engine 1 TC Cold Junction Comp.	Temperature	PLC15PT100_COMP1aiTemperature	TR01:107	TR01:108	TR02-J:16	TR02-J:17	1010/9	Pt100 RTD	0-100 DegC	PT100_COMP1+	PT100_COMP1-					Cold Junction Compensation

BRISBANE WATER

Luggage Point WWTP Control System Upgrade Project - 8 Channel Thermocouple Input I/O List

PLC Number: 15 - Engines Safety PLC
Location: Safety PLC Cabinet - Engines Bay
Rack Number: System Rack (10**)
Slot Number: 12 (1012)
Module Model Number: F6220
Description: 8 Channel T/C Analogue Input

Chnl No.	Equip. No.	Ellipse No.	Equip. Name	I/O Description	PLC Tag	Marshalling Terminal		Interconnect Board Terminal		Address	Engineering Units		Wire No.		Modbus Address (Word)	PLC11 Remap to	Drawing No. Elect 486/7/5-	Drawing No. P&ID 486/7/5-	Comment
						+	-	+	-		Sensor Type	Displayed Range	+	-					
1	TE11978		Engine 2 Cylinder 1	Temperature	ENG02TE11978aiTemperature	TR01:109	TR01:110	TR02-K:1	TR02-K:2	1011/1	Type K TC	0-600 DegC	PLC15-TE11978+	PLC15-TE11978-	40018	%R14009			Send to PLC11 as integer where 6000 = 600.0 DegC
2	TE11979		Engine 2 Cylinder 2	Temperature	ENG02TE11979aiTemperature	TR01:111	TR01:112	TR02-K:1	TR02-K:4	1011/2	Type K TC	0-600 DegC	PLC15-TE11979+	PLC15-TE11979-	40019	%R14010			Send to PLC11 as integer where 6000 = 600.0 DegC
3	TE11980		Engine 2 Cylinder 3	Temperature	ENG02TE11980aiTemperature	TR01:113	TR01:114	TR02-K:5	TR02-K:6	1011/3	Type K TC	0-600 DegC	PLC15-TE11980+	PLC15-TE11980-	40020	%R14011			Send to PLC11 as integer where 6000 = 600.0 DegC
4	TE11981		Engine 2 Cylinder 4	Temperature	ENG02TE11981aiTemperature	TR01:115	TR01:116	TR02-K:7	TR02-K:8	1011/4	Type K TC	0-600 DegC	PLC15-TE11981+	PLC15-TE11981-	40021	%R14012			Send to PLC11 as integer where 6000 = 600.0 DegC
5	TE11982		Engine 2 Cylinder 5	Temperature	ENG02TE11982aiTemperature	TR01:117	TR01:118	TR02-K:9	TR02-K:10	1011/5	Type K TC	0-600 DegC	PLC15-TE11982+	PLC15-TE11982-	40022	%R14013			Send to PLC11 as integer where 6000 = 600.0 DegC
6	TE11983		Engine 2 Cylinder 6	Temperature	ENG02TE11983aiTemperature	TR01:119	TR01:120	TR02-K:11	TR02-K:12	1011/6	Type K TC	0-600 DegC	PLC15-TE11983+	PLC15-TE11983-	40023	%R14014			Send to PLC11 as integer where 6000 = 600.0 DegC
7																			
8																			
9	PT100_COMP2		Engine 2 TC Cold Junction Comp.	Temperature	PLC15PT100_COMP2aiTempera	TR01:121	TR01:122	TR02-K:16	TR02-K:17	1011/9	Pt100 RTD	0-100 DegC	PT100_COMP2+	PT100_COMP2-					Cold Junction Compensation

DOCUMENT FRONT SHEET

Purchase Order No.	BWQ80144-07/08	**Job No.**	P-08-023
Client Document No.	N/A		
HIMA's Document No.	P-08-023-00-IOWS		
Document Title	Input / Output Wiring Schedule		
System Description	H41qce-HS		
VDRL/Doc Code & Type (Refer to vendor data req.)	IOWS		
Status (Check Applicable)	☐ FOR APPROVAL		
	☐ CERTIFIED FINAL		
	☒ AS-BUILT		
	☐ INFORMATION ONLY		
	☐ OTHER (IDENTIFY)		

HIMA

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Belmont WA 6104

Unit 13
21 Sabre Drive
Port Melbourne VIC 3207

Unit 21
8 Riverland Drive
Loganholme QLD 4129

Notes:

REV	DATE	DESCRIPTION	BY	CHECKED	APPROVED
1	12/6/09	As Built	MW	SR	MW
0	18/3/09	Issued for FAT	MW	PL	MW
A	2/12/08	Issued for Approval	SR	MTH	MW

Revision History

P-08-023-00-IOWS_Rev1

Tarn zyn0 9	LOOP_TYPE	TAG_NUM	TAG_DUTY	TAG_COMMENT	Cabinet_ID	Term_block	Term_No	Wire Marker	ICB_TERM	ICB_TYPE	ICB_PLUG_TERM	CORE_ID	IO_TYPE	IO_CONN	IO_POS	ELOP IO_POS	IO_CH	IO_PIN	PWR_REF	COMMENT
									TR02-A											
1 2	DI	ENG01VV2433diClosed	Engine 1 Gas Safety Vent Valve Closed	15002	PLC 15	TR1	1 2	24VDC-5 15002+	1+ 1		A1	WH	F3236	Z7116	-D4.1	1101	1	d2		15002
3 4	DI	ENG01VV2433diOpen	Engine 1 Gas Safety Vent Valve Open	15003	PLC 15	TR1	3 4	24VDC-5 15003+	2+ 2		A2	BN	F3236	Z7116	-D4.1	1101	2	d4		15003
5 6	DI	ENG01VV2431diRemote	Engine 1 Gas Isolation Valve Remote Selected	15004	PLC 15	TR1	5 6	24VDC-5 15004+	3+ 3		A3	GN	F3236	Z7116	-D4.1	1101	3	d6		15004
7 8	DI	ENG01VV2431diClosed	Engine 1 Gas Primary Isolation Valve Closed	15174	PLC 15	TR1	7 8	24VDC-5 15174+	4+ 4		A4	YE	F3236	Z7116	-D4.1	1101	4	d8		15174
9 10	DI	ENG01VV2431diOpen	Engine 1 Gas Primary Isolation Valve Open	15175	PLC 15	TR1	9 10	24VDC-5 15175+	5+ 5		A5	GY	F3236	Z7116	-D4.1	1101	5	d10		15175
11 12	DI	ENG01VV2432diClosed	Engine 1 Gas Secondary Isolation Valve Closed	15141	PLC 15	TR1	11 12	24VDC-5 15141+	6+ 6		A6	PK	F3236	Z7116	-D4.1	1101	6	d12		15141
13 14	DI	ENG01VV2432diOpen	Engine 1 Gas Secondary Isolation Valve Open	15142	PLC 15	TR1	13 14	24VDC-5 15142+	7+ 7		A7	BU	F3236	Z7116	-D4.1	1101	7	d14		15142
15 16	DI	ENG01ESVSRdiFault	Engine 1 Emergency Stop Valve Suppy Relay ESVSR Fault	15185	PLC 15	TR1	15 16	24VDC-5 15185+	8+ 8		A8	RD	F3236	Z7116	-D4.1	1101	8	d16		15185
17 18	DI	ENG01PS3diEstop	Engine 1 Emergency Stop Operated PS3 Emergency Stop Operated	15186	PLC 15	TR1	17 18	24VDC-5 15186+	9+ 9		A9	BK	F3236	Z7116	-D4.1	1101	9	d18		15186
19 20	DI	ENG01ESRdiEstop	Engine 1 Emergency Stop Relay Emergency Stop Operated	15191	PLC 15	TR1	19 20	24VDC-5 15191+	10+ 10		A10	VT	F3236	Z7116	-D4.1	1101	10	d20		15191
21 22	DI	ENG01GASMOD1diFault	Engine 1 Gas Module Fault	15866	PLC 15	TR1	21 22	24VDC-5 15866+	11+ 11		A11	WHBN	F3236	Z7116	-D4.1	1101	11	d22		15866
23 24	DI	ENG01GASMOD1diAlarm	Engine 1 Gas Module Alarm	15867	PLC 15	TR1	23 24	24VDC-5 15867+	12+ 12		A12	WHGN	F3236	Z7116	-D4.1	1101	12	d24		15867
25 26	DI	Spare							13+ 13		A13	WHYE	F3236	Z7116	-D4.1	1101	13	d26		
27 28	DI	Spare							14+ 14		A14	WHGY	F3236	Z7116	-D4.1	1101	14	d28		
29 30	DI	Spare							15+ 15		A15	WHPK	F3236	Z7116	-D4.1	1101	15	d30		
31 32	DI	Spare							16+ 16	H7020	A16	WHBU	F3236	Z7116	-D4.1	1101	16	d32		
33 34									X17 X18	X19 X20	X21 X22	OR						z14		
35												Red	F3236	Z7116	-D4.1			z12	-XG8.1	L+
36												Black	F3236	Z7116	-D4.1			z2	-XG14.1	L-
									TR02-B											
37 38	DI	ENG02VV2437diClosed	Engine 2 Gas Safety Vent Valve Closed	15322	PLC 15	TR1	25 26	24VDC-6 15322+	1+ 1		A1	WH	F3236	Z7116	-D4.2	1102	1	d2		15322
39 40	DI	ENG02VV2437diOpen	Engine 2 Gas Safety Vent Valve Open	15323	PLC 15	TR1	27 28	24VDC-6 15323+	2+ 2		A2	BN	F3236	Z7116	-D4.2	1102	2	d4		15323
41 42	DI	ENG02VV2437diRemote	Engine 2 Gas Isolation Valve Remote Selected	15324	PLC 15	TR1	29 30	24VDC-6 15324+	3+ 3		A3	GN	F3236	Z7116	-D4.2	1102	3	d6		15324
43 44	DI	ENG02VV2435diClosed	Engine 2 Gas Primary Isolation Valve Closed	15498	PLC 15	TR1	31 32	24VDC-6 15498+	4+ 4		A4	YE	F3236	Z7116	-D4.2	1102	4	d8		15498
45 46	DI	ENG02VV2435diOpen	Engine 2 Gas Primary Isolation Valve Open	15499	PLC 15	TR1	33 34	24VDC-6 15499+	5+ 5		A5	GY	F3236	Z7116	-D4.2	1102	5	d10		15499
47 48	DI	ENG02VV2436diClosed	Engine 2 Gas Secondary Isolation Valve Closed	15465	PLC 15	TR1	35 36	24VDC-6 15465+	6+ 6		A6	PK	F3236	Z7116	-D4.2	1102	6	d12		15465
49 50	DI	ENG02VV2436diOpen	Engine 2 Gas Secondary Isolation Valve Open	15466	PLC 15	TR1	37 38	24VDC-6 15466+	7+ 7		A7	BU	F3236	Z7116	-D4.2	1102	7	d14		15466
51 52	DI	ENG02ESVSRdiFault	Engine 2 Emergency Stop Valve Suppy Relay ESVSR Fault	15509	PLC 15	TR1	39 40	24VDC-6 15509+	8+ 8		A8	RD	F3236	Z7116	-D4.2	1102	8	d16		15509
53 54	DI	ENG02PS3diEstop	Engine 2 Emergency Stop Operated PS3 Emergency Stop Operated	15510	PLC 15	TR1	41 42	24VDC-6 15510+	9+ 9		A9	BK	F3236	Z7116	-D4.2	1102	9	d18		15510
55 56	DI	ENG02ESRdiEstop	Engine 2 Emergency Stop Relay Emergency Stop Operated	15515	PLC 15	TR1	43 44	24VDC-6 15515+	10+ 10		A10	VT	F3236	Z7116	-D4.2	1102	10	d20		15515
57 58	DI	ENG02GASMOD2diFault	Engine 2 Gas Module Fault	15868	PLC 15	TR1	45 46	24VDC-6 15868+	11+ 11		A11	WHBN	F3236	Z7116	-D4.2	1102	11	d22		15868
59 60	DI	ENG02GASMOD2diAlarm	Engine 2 Gas Module Alarm	15869	PLC 15	TR1	47 48	24VDC-6 15869+	12+ 12		A12	WHGN	F3236	Z7116	-D4.2	1102	12	d24		15869
61 62	DI	Spare							13+ 13		A13	WHYE	F3236	Z7116	-D4.2	1102	13	d26		
63 64	DI	Spare							14+ 14		A14	WHGY	F3236	Z7116	-D4.2	1102	14	d28		
65 66	DI	Spare							15+ 15		A15	WHPK	F3236	Z7116	-D4.2	1102	15	d30		
67 68	DI	Spare							16+ 16	H7020	A16	WHBU	F3236	Z7116	-D4.2	1102	16	d32		
69 70									X17 X18	X19 X20	X21 X22	OR						z14		
71												Red	F3236	Z7116	-D4.2			z12	-XG8.2	L+
72												Black	F3236	Z7116	-D4.2			z2	-XG14.2	L-

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Brisbane City Council
Luggage Point Water Reclamation Plant
PLC 15 Replacement

P-08-023-00-IOWS_Rev1

Term zyno : 9	LOOP_TYPE	TAG_NUM	TAG_DUTY	TAG_COMMENT	Cabinet_ID	Term_block	Term_No	Wire Marker	ICB_TERM	ICB_TYPE	ICB_PLUG_TERM	CORE_ID	IO_TYPE	IO_CONN	IO_POS	ELOP IO_POS	IO_CH	IO_PIN	PWR_REF	COMMENT
									TR02-C											
73 74	DI	ENGASVV2430diRemote	Main Gas Shut Off Valve Remote Selected	15848	PLC 15	TR1	49 50	24VDC-7 15848+	1+ 1		A1	WH	F3236	Z7116	-D4.3	1103	1	d2		15848
75 76	DI	ENGASVV2430diEstop	Main Gas Shut Off Valve Emergency Close	15849	PLC 15	TR1	51 52	24VDC-7 15849+	2+ 2		A2	BN	F3236	Z7116	-D4.3	1103	2	d4		15849
77 78	DI	ENGASVV2430diClosed	Main Gas Shut Off Valve Closed	15850	PLC 15	TR1	53 54	24VDC-7 15850+	3+ 3		A3	GN	F3236	Z7116	-D4.3	1103	3	d6		15850
79 80	DI	ENGASVV2430diOpen	Main Gas Shut Off Valve Open	15851	PLC 15	TR1	55 56	24VDC-7 15851+	4+ 4		A4	YE	F3236	Z7116	-D4.3	1103	4	d8		15851
81 82	DI	Spare							5+ 5		A5	GY	F3236	Z7116	-D4.3	1103	5	d10		
83 84	DI	Spare							6+ 6		A6	PK	F3236	Z7116	-D4.3	1103	6	d12		
85 86	DI	Spare							7+ 7		A7	BU	F3236	Z7116	-D4.3	1103	7	d14		
87 88	DI	Spare							8+ 8		A8	RD	F3236	Z7116	-D4.3	1103	8	d16		
89 90	DI	Spare							9+ 9		A9	BK	F3236	Z7116	-D4.3	1103	9	d18		
91 92	DI	Spare							10+ 10		A10	VT	F3236	Z7116	-D4.3	1103	10	d20		
93 94	DI	Spare							11+ 11		A11	WHBN	F3236	Z7116	-D4.3	1103	11	d22		
95 96	DI	Spare							12+ 12		A12	WHGN	F3236	Z7116	-D4.3	1103	12	d24		
97 98	DI	PLC15CABINETdiHealthy	PLC 15 Cabinet Healthy	15903	PLC 15	TR3.F	5 16	24VDC-7 15903+	13+ 13		A13	WHYE	F3236	Z7116	-D4.3	1103	13	d26		15903
99 100	DI	PLC15PWRSUP1diHealthy	24VDC power Supply 1 Healthy	15901	PLC 15	TR3.F	1 2	24VDC-7 15901+	14+ 14		A14	WHGY	F3236	Z7116	-D4.3	1103	14	d28		15901
101 102	DI	PLC15PWRSUP2diHealthy	24VDC power Supply 2 Healthy	15902	PLC 15	TR3.F	3 4	24VDC-7 15902+	15+ 15		A15	WHPK	F3235	Z7116	-D4.3	1103	15	d30		15902
103 104	DI	PLC15PLC11diOkay	PLC 11 "Healthy" Output Healthy	15900	PLC 15	TR1	57 58	24VDC-7 15900+	16+ 16	H7020	A16	WHBU	F3236	Z7116	-D4.3	1103	16	d32		15900
105 106									X17 X18	X19 X20	X21 X22	OR						z14		
107 108												Red Black	F3236 F3236	Z7116 Z7116	-D4.3 -D4.3			z12 z2	-XG8.3 -XG14.3	L+ L-
									TR02-D											
109 110 111 112	DO	ENGASGIVR1dqOpen	Engine 1 Gas Isolation Valve Relay Open	15005	PLC15	TR1	59 60	15005 + 15005 -	1 3 3+		A1 A3	WH BN	F3430	Z7149	-D4.4	1104	1	z18 d18		15005
113 114 115 116	DO	ENGASVV2431dqClosed	Engine 1 Gas Primary Isolation Valve Closed Indication	15006	PLC15	TR1	61 62	15006 + 15006 -	5 7 7+		A5 A7	GN YE	F3430	Z7149	-D4.4	1104	2	z22 d22		15006
117 118 119 120	DO	ENGASVV2432dqClosed	Engine 1 Gas Secondary Isolation Valve Closed Indication	15007	PLC15	TR1	63 64	15007 + 15007 -	9 11 11+		A9 A11	GY PK	F3430	Z7149	-D4.4	1104	3	z26 d26		15007
121 122 123 124	DO	ENGASVV2433dqClosed	Engine 1 Gas Safety Vent Valve Closed Indication	15008	PLC15	TR1	65 66	15008 + 15008 -	13 15 15+	H7020	A13 A15	BU RD	F3430	Z7149	-D4.4	1104	4	z30 d30		15008
125 126									X17 X18	X19 X20	X21 X22	OR	24VDC-6							24VDC Supply
127 128												Red Black	F3430 F3430	Z7149 Z7149	-D4.4 -D4.4			z12 z2	-XG8.4 -XG14.3	

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Brisbane City Council
Luggage Point Water Reclamation Plant
PLC 15 Replacement

P-08-023-00-IOWS_Rev1

TR02-E

Tam zyn0 9	LOOP_TYPE	TAG_NUM	TAG_DUTY	TAG_COMMENT	Cabinet_ID	Term_block	Term_No	Wire Marker	ICB_TERM	ICB_TYPE	ICB_PLUG_TERM	CORE_ID	IO_TYPE	IO_CONN	IO_POS	ELOP IO_POS	IO_CH	IO_PIN	PWR_REF	COMMENT
129 130 131 132	DO	ENG01SV3dqEnergise	Engine 1 Emergency Stop Solenoid Valve 3 Energise (HESR)	15277	PLC15	TR1	67 68	15277 + 15277 -	1 3 3+	A1 A3	z18 d18	WH BN	F3430	Z7149	-D4.5	1105	1	d18		15277
133 134 135 136	DO	ENG01SV4dqEnergise	Engine 1 Emergency Stop Solenoid Valve 4 Energise	15278	PLC15	TR1	69 70	15278 + 15278 -	5 7 7+	A5 A7	z22 d22	GN YE	F3430	Z7149	-D4.5	1105	2	d22		15278
137 138 139 140	DO	ENG01ENG1dqGasOK	Engine 1 Gas Enable to PLC11 OK to goto Gas	15001	PLC15	TR1	71 72	15001 + 15001 -	9 11 11+	A9 A11	z26 d26	GY PK	F3430	Z7149	-D4.5	1105	3	d26		15001
141 142 143 144	DO	Spare							13 15 15+	A13 A15	z30 d30	BU RD	F3430	Z7149	-D4.5	1105	4	d30		
145 146									X17 X18	X19 X20	X21 X22	OR	24VDC-9							24VDC Supply
147												Red	F3430	Z7149	-D4.5			z12	-XG8.5	L+
148												Black	F3430	Z7149	-D4.5			z2	-XG14.5	L-

TR02-F

Tam zyn0 9	LOOP_TYPE	TAG_NUM	TAG_DUTY	TAG_COMMENT	Cabinet_ID	Term_block	Term_No	Wire Marker	ICB_TERM	ICB_TYPE	ICB_PLUG_TERM	CORE_ID	IO_TYPE	IO_CONN	IO_POS	ELOP IO_POS	IO_CH	IO_PIN	PWR_REF	COMMENT
131 132 133 134	DO	ENGASGVR2dqOpen	Engine 2 Gas Isolation Valve Relay Open	15325	PLC15	TR1	73 74	15325 + 15325 -	1 3 3+	A1 A3	z18 d18	WH BN	F3430	Z7149	-D4.6	1106	1	d18		15325
135 136 137 138	DO	ENGASVV2435dqClosed	Engine 2 Gas Primary Isolation Valve Closed Indication	15326	PLC15	TR1	75 76	15326 + 15326 -	5 7 7+	A5 A7	z22 d22	GN YE	F3430	Z7149	-D4.6	1106	2	d22		15326
139 140 141 142	DO	ENGASVV2436dqClosed	Engine 2 Gas Secondary Isolation Valve Closed Indication	15327	PLC15	TR1	77 78	15327 + 15327 -	9 11 11+	A9 A11	z26 d26	GY PK	F3430	Z7149	-D4.6	1106	3	d26		15327
143 144 145 146	DO	ENGASVV2437dqClosed	Engine 2 Gas Safety Vent Valve Closed Indication	15328	PLC15	TR1	79 80	15328 + 15328 -	13 15 15+	A13 A15	z30 d30	BU RD	F3430	Z7149	-D4.6	1106	4	d30		15328
147 148									X17 X18	X19 X20	X21 X22	OR	24VDC-10							24VDC Supply
149												Red	F3430	Z7149	-D4.6			z12	-XG8.6	L+
150												Black	F3430	Z7149	-D4.6			z2	-XG14.6	L-

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Tam zyn0 9	LOOP_TYPE	TAG_NUM	TAG_DUTY	TAG_COMMENT	Cabinet_ID	Term_block	Term_No	Wire Marker	ICB_TERM	ICB_TYPE	ICB_PLUG_TERM	CORE_ID	IO_TYPE	IO_CONN	IO_POS	ELOP IO_POS	IO_CH	IO_PIN	PWR_REF	COMMENT
151 152 153 154	DO	ENG02SV3dqEnergise	Engine 2 Emergency Stop Solenoid Valve 3 Energise (HESR)	15601	PLC15	TR1	81 82	15601 + 15601 -	1 3 3+	A1 A3	z18 d18	WH BN	F3430	Z7149	-D4.7	1107	1	d18		15601
155 156 157 158	DO	ENG02SV4dqEnergise	Engine 2 Emergency Stop Solenoid Valve 4 Energise	15602	PLC15	TR1	83 83	15602 + 15602 -	5 7 7+	A5 A7	z22 d22	GN YE	F3430	Z7149	-D4.7	1107	2	d22		15602
159 160 161 162	DO	ENG02ENG2dqGasOK	Engine 2 Gas Enable to PLC11 OK to goto Gas	15010	PLC15	TR1	85 86	15010 + 15010 -	9 11 11+	A9 A11	z26 d26	GY PK	F3430	Z7149	-D4.7	1107	3	d26		15010
163 164 165 166	DO	Spare							13 15 15+	A13 A15	z30 d30	BU RD	F3430	Z7149	-D4.7	1107	4	d30		
167 168									X17 X18	X19 X20	X21 X22	OR	24VDC-11							24VDC Supply
169												Red	F3430	Z7149	-D4.7			z12	-XG8.7	L+
170												Black	F3430	Z7149	-D4.7			z2	-XG14.7	L-

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Termzyn09	LOOP_TYPE	TAG_NUM	TAG_DUTY	TAG_COMMENT	Cabinet_ID	Term_block	Term_No	Wire Marker	ICB_TERM	ICB_TYPE	ICB_PLUG_TERM	CORE_ID	IO_TYPE	IO_CONN	IO_POS	ELOP IO_POS	IO_CH	IO_PIN	PWR_REF	COMMENT
171						TR1	87	15886 +	1	A1	z18	WH						d18		15886
172	DO	ENGASVV2430dqOpen	Main Gas Shutoff Valve Open Relay	15886	PLC15		88	15886 -												
173									3	A3	d18	BN	F3430	Z7149	-D4.8	1108	1			
174									3+											
175									5	A5	z22	GN						d22		
176	DO	Spare																		
177									7	A7	d22	YE	F3430	Z7149	-D4.8	1108	2			
178									7+											
179									9	A9	z26	GY						d26		
180	DO	Spare																		
181									11	A11	d26	PK	F3430	Z7149	-D4.8	1108	3			
182									11+											
183						TR1	89	15009 +	13	A13	z30	BU						d30		15009
184	DO	ENGPLC15dqOK	PLC15 Healthy Output to PLC11	15009	PLC15		90	15009 -												
185									15	A15	d30	RD	F3430	Z7149	-D4.8	1108	4			
186									15+											
187									X17	X19	X21									
188									X18	X20	X22	OR	24VDC-12							24VDC Supply
189												Red	F3430	Z7149	-D4.8			z12	-XG8.8	L+
190												Black	F3430	Z7149	-D4.8			z2	-XG14.8	L-

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191	AI	ENG01PSH15000dlCurrent	Engine 1 Gas Pressure Switch	PLC15-PSH15000	PLC 15	TR1	91	PLC15-PSH15000 +	1		A1	WH	F6217	Z7128	-D4.09	1109	1	x4		PLC15-PSH15000
192							92	PLC15-PSH15000 -	2		A2	BN						z4		
193	AI	Spare							3		A3	YE	F6217	Z7128	-D4.09	1109	2	x8		Loop powered 4-20mA
194									4		A4	GY						z8		
195	AI	Spare							5		A5	PK	F6217	Z7128	-D4.09	1109	3	x12		Loop powered 4-20mA
196									6		A6	BU						z12		
197	AI	Spare							7		A7	RD	F6217	Z7128	-D4.09	1109	4	x16		Loop powered 4-20mA
198									8		A8	BK						z16		
199	AI	ENG01PSH15320dlCurrent	Engine 2 Gas Pressure Switch	PLC15-PSH15320	PLC 15	TR1	93	PLC15-PSH15320 +	9		A9	WHYE	F6217	Z7128	-D4.09	1109	5	x20		PLC15-PSH15320
200							94	PLC15-PSH15320 -	10		A10	WHGY						z20		
201	AI	Spare							11		A11	WHGN	F6217	Z7128	-D4.09	1109	6	x24		Loop powered 4-20mA
202									12		A12	VT						z24		
203	AI	Spare							13		A13	WHBN	F6217	Z7128	-D4.09	1109	7	x28		Loop powered 4-20mA
204									14		A14	WHOR						z28		
205	AI	Spare							15		A15	WHBU	F6217	Z7128	-D4.09	1109	8	x32		Loop powered 4-20mA
206									16	H7020	A16	WHRD						z32		
207									X17	X19	X21	GN						d4		Analogue GND
208									X18	X20	X22	WHBK						d32		
209												Red	F6217	Z7128	-D4.09			d30	-XG8.9	L+
210												Black	F6217	Z7128	-D4.09			d26	-XG14.9	L-

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Term zynG 9.	LOOP_TYPE	TAG_NUM	TAG_DUTY	TAG_COMMENT	Cabinet_ID	Term_block	Term_No	Wire Marker	ICB_TERM	ICB_TYPE	ICB_PLUG_TERM	CORE_ID	IO_TYPE	IO_CONN	IO_POS	ELOP IO_POS	IO_CH	IO_PIN	PWR_REF	COMMENT
231	AI	ENG01TE11962aiTemperature	Engine 1 Cylinder 1 Temperature	PLC15-TE11962	PLC 15	TR1	95	PLC15-TE11962 +	1		A1	WN	F6220	Z7062	-D4.10	1111	1	z2		
232							96	PLC15-TE11962 -	2		A2	BN						d2		PLC15-TE11962
233	AI	ENG01TE11963aiTemperature	Engine 1 Cylinder 2 Temperature	PLC15-TE11963	PLC 15	TR1	97	PLC15-TE11963 +	3		A3	GN	F6220	Z7062	-D4.10	1111	2	z4		
234							98	PLC15-TE11963 -	4		A4	YE						zd		PLC15-TE11963
235	AI	ENG01TE11964aiTemperature	Engine 1 Cylinder 3 Temperature	PLC15-TE11964	PLC 15	TR1	99	PLC15-TE11964 +	5		A5	GY	F6220	Z7062	-D4.10	1111	3	z8		
236							100	PLC15-TE11964 -	6		A6	PK						d8		PLC15-TE11964
237	AI	ENG01TE11965aiTemperature	Engine 1 Cylinder 4 Temperature	PLC15-TE11965	PLC 15	TR1	101	PLC15-TE11965 +	7		A7	BU	F6220	Z7062	-D4.10	1111	4	z10		
238							102	PLC15-TE11965 -	8		A8	RD						d10		PLC15-TE11965
239	AI	ENG01TE11966aiTemperature	Engine 1 Cylinder 5 Temperature	PLC15-TE11966	PLC 15	TR1	103	PLC15-TE11966 +	9		A9	BK	F6220	Z7062	-D4.10	1111	5	z14		
240							104	PLC15-TE11966 -	10		A10	VT						d14		PLC15-TE11966
241	AI	ENG01TE11967aiTemperature	Engine 1 Cylinder 6 Temperature	PLC15-TE11967	PLC 15	TR1	105	PLC15-TE11967 +	11		A11	GYPK	F6220	Z7062	-D4.10	1111	6	z16		
242							106	PLC15-TE11967 -	12		A12	RDBU						d16		PLC15-TE11967
243	AI	SPARE							13		A13	WHGN	F6220	Z7062	-D4.10	1111	7	z20		
244									14		A14	BNGN						d20		Shorting Link
245	AI	SPARE							15		A15	WHYE	F6220	Z7062	-D4.10	1111	8	z22		
246									16	H7020	A16	BNYE						d22		Shorting Link
247									X17	X19	X21									
248									X18	X20	X22									
249															-D4.10			z2	-XG8.11	L+
250															-D4.10			d2	-XG14.11	L-
251					PLC 15	TR1	107	PT100COMP_1+		WTR2.5		WHGY	F6220	Z7602	-D4.10	1111	9	z32		Cold Junction Comp.
252							108	PT100COMP_1-		WTR2.5		BNGY			-D4.10	1111		d32		Cold Junction Comp.

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Term zynG 9.	LOOP_TYPE	TAG_NUM	TAG_DUTY	TAG_COMMENT	Cabinet_ID	Term_block	Term_No	Wire Marker	ICB_TERM	ICB_TYPE	ICB_PLUG_TERM	CORE_ID	IO_TYPE	IO_CONN	IO_POS	ELOP IO_POS	IO_CH	IO_PIN	PWR_REF	COMMENT
253	AI	ENG02TE11978aiTemperature	Engine 2 Cylinder 1 Temperature	PLC15-TE11978	PLC 15	TR1	109	PLC15-TE11978 +	1		A1	WN	F6220	Z7062	-D4.11	1112	1	z2		
254							110	PLC15-TE11978 -	2		A2	BN						d2		PLC15-TE11978
255	AI	ENG02TE11979aiTemperature	Engine 2 Cylinder 2 Temperature	PLC15-TE11979	PLC 15	TR1	111	PLC15-TE11979 +	3		A3	GN	F6220	Z7062	-D4.11	1112	2	z4		
256							112	PLC15-TE11979 -	4		A4	YE						d4		PLC15-TE11979
257	AI	ENG02TE11980aiTemperature	Engine 2 Cylinder 3 Temperature	PLC15-TE11980	PLC 15	TR1	113	PLC15-TE11980 +	5		A5	GY	F6220	Z7062	-D4.11	1112	3	z8		
258							114	PLC15-TE11980 -	6		A6	PK						d8		PLC15-TE11980
259	AI	ENG02TE11981aiTemperature	Engine 2 Cylinder 4 Temperature	PLC15-TE11981	PLC 15	TR1	115	PLC15-TE11981 +	7		A7	BU	F6220	Z7062	-D4.11	1112	4	z10		
260							116	PLC15-TE11981 -	8		A8	RD						d10		PLC15-TE11981
261	AI	ENG02TE11982aiTemperature	Engine 2 Cylinder 5 Temperature	PLC15-TE11982	PLC 15	TR1	117	PLC15-TE11982 +	9		A9	BK	F6220	Z7062	-D4.11	1112	5	z14		
262							118	PLC15-TE11982 -	10		A10	VT						d14		PLC15-TE11982
263	AI	ENG02TE11983aiTemperature	Engine 2 Cylinder 6 Temperature	PLC15-TE11983	PLC 15	TR1	119	PLC15-TE11983 +	11		A11	GYPK	F6220	Z7062	-D4.11	1112	6	z16		
264							120	PLC15-TE11983 -	12		A12	RDBU						d16		PLC15-TE11983
265	AI	SPARE							13		A13	WHGN	F6220	Z7062	-D4.11	1112	7	z20		
266									14		A14	BNGN						d20		Shorting Link
267	AI	SPARE							15		A15	WHYE	F6220	Z7062	-D4.11	1112	8	z22		
268									16	H7020	A16	BNYE						d22		Shorting Link
269									X17	X19	X21									
270									X18	X20	X22									
271															-D4.11			z2	-XG8.12	L+
272															-D4.11			d2	-XG14.12	L-
273					PLC 15	TR1	121	PT100COMP_2+		WTR2.5		WHGY	F6220	Z7602	-D4.11	1112	9	z32		Cold Junction Comp.
274							122	PT100COMP_2-		WTR2.5		BNGY			-D4.11	1112		d32		Cold Junction Comp.

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Luggage Point Water Reclamation Plant
PLC 15 Replacement

DOCUMENT FRONT SHEET

Purchase Order No.	BWQ80144-07/08	**Job No.**	P-08-023-00
Client Document No.			
HIMA's Document No.	P-08-023-SRS		
Document Title	**SAFETY REQUIREMENT SPECIFICATION (SRS)**		
System Description	**BRISBANE CITY COUNCIL , LUGGAGE POINT WATER RECLAIMATION PLANT ESS (PLC15)**		
VDRL/Doc Code & Type (Refer to vendor data req.)	N/A		
Status (Check Applicable)	☐ FOR APPROVAL ☒ CERTIFIED FINAL ☐ AS-BUILT ☐ INFORMATION ONLY ☐ OTHER (DRAFT FOR REVIEW)		

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REV	DATE	DESCRIPTION	BY	CHECKED	APPROVED
0	5/02/09	Final	PL	GL	PL
B	22/01/09	Client comments incorporated	PL		
A	06/01/09	First draft – Issued for Review	PL		

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Sign:	Sign:	Sign:		
		Revision:	**Date:**	**Page:**
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BCC, Luggage point WRP PLC 15 – Safety Requirement Specification

1 INTRODUCTION

The Luggage Point Water Reclamation Plant (WRP) Engine Safeguarding System (ESS) is the system dedicated to provide protection and operator assistance in the starting, stopping and running of the Mirrlee's engine energy recovery unit in accordance with the requirements of Australian Standards listed in section 1.3.

It is designed to prevent incorrect operation of and damage to the energy recovery unit. The ESS is a stand-alone system with required interfaces to the SCADA system via PLC 11, which performs the non safety related control of the engines.

The ESS functions include:

- Safety Interlock System
- Fuel Gas Trip System
- Gas Monitoring and Tripping Systems
- Temperature Monitoring and Tripping Systems

AS61511, the safety-instrumented system standard for the process industry requires the allocation of safety functions to protection layers as part of Clause 9. This task was performed during the Safety Integrity Level (SIL) study held at BW's premises on 9th of December 2008. As a result of this study, SIL rated safety functions were identified and thus a Safety Instrumented System SIS was deemed to be required. Australian regulations also identify this as a requirement, and thus the foundation of the ESS is a TÜV approved programmable electronic system, referred further in this document as PLC 15.

PLC 15 is located adjacent to the existing Bailey cabinet in the WRP engine bay and is completed with associated inputs, outputs and field devices that control the engine for the energy recovery unit. All PLC 15 data is available to the control room operator via a Serial Modbus link to Engines Main PLC 11, which in turn has an established communications to the plant SCADA system. All engine start and stop sequences are controlled by Engines Main PLC 11. The crank without fuel purge sequence will be carried out by the existing Si-Tech Co-Generator Control unit (CGC). PLC 15 is only to perform control on items associated with the engines gas supply system.

1.1 Purpose

The purpose of this document is to:

- Specify the safety integrity requirements of the safety instrumented functions in accordance with *AS61511 Clause 10*
- Specify the application software safety requirements the for PLC 15 necessary to implement the required safety instrumented function(s) consistent with the architecture of PLC 15 in accordance with *AS61511 Clause 12.2*
- Specify the requirements of the application software for PLC 15 in accordance with relevant Australian gas appliance standards.

This document is intended to be used through all of the remaining phases of the project's safety lifecycle as summarised below:

- Design and Engineering of the Safety Instrumented System
- Installation & Commissioning
- Validation
- Operations & Maintenance

The SRS is to be used as the basis for the design, implementation, verification and validation of the defined safety instrumented functions. It should also be used to develop the documentation that is designed to support the operation and maintenance of the system.

1.2 Reference Documents

The following documents were used as the basis for developing this specification:

- SIL Assessment Report P08023-01-SAR-0, dated 07/01/09 HIMA
- E-mail HTML document "Re Revised SRS" dated 04/02/2009
- Brisbane Water document BW80144 Official Order Rev1.pdf
- P&ID's

Drawing. No.	Description	Rev
486/5/5-0016-003	Engines Start Air & Gas Supply P+ID	0
486/7/5-UT2L0149M	Engine No.1 Pneumatic Control Schematic Diagram	F
486/7/5-UT2L0150M	Engine No.1 Pneumatic Control Schematic Diagram	F

1.3 Standards, Codes and Regulations

The functions described in this document shall be designed in accordance with the requirements set forth in the following standards, codes & regulations.

AS 3814 – 2005	AG501-2005 Industrial and Commercial Gas-Fired Appliances
AS 61508 – 1999	Functional Safety of Electrical/Electronic/Programmable Electronic Safety-related Systems (Parts 1 to 7)
AS 61511 – 2004	Functional Safety – Safety instrumented systems for the process industry sector (parts 1 to 3)

1.4 Abbreviations

The following abbreviations are used throughout this document.

AS	Australian Standard
BCC	Brisbane City council
BW	Brisbane Water
ESD	Emergency Shutdown
ESS	Engine Safeguarding System
LOP	Layer Of Protection
MTTF	Mean Time To Fail
MTTR	Mean Time To Repair
P&ID	Piping And Instrument Drawing
PE	Programmable Electronic
PLC	Programmable Logic Controller
PES	Programmable Electronic System
PFD	Probability of Failure on Demand
RRF	Risk Reduction Factor
SCADA	Supervisory Control And Data Acquisition
SIF	Safety Instrumented Function
SIL	Safety Integrity Level
SIS	Safety Instrumented System
SRS	Safety Requirements Specification
TÜV	Technischer Überwachungs Verein
WRP	Water Reclamation Plant

HIMA BCC, Luggage point WRP PLC 15 – Safety Requirement Specification

2 GENERAL REQUIREMENTS

- Programmable Electronic (PE) technology shall be used for the SIS logic solver. The selected system shall be certified by a competent body according to IEC/AS 61508 to the SIL level required to accommodate the most stringent Safety Instrumented Function (SIF) implemented in the system.

- The SIS logic solver shall be located adjacent to the existing Bailey cabinet in the WRP engine bay. The cabinet shall be a minimum IP54 or equivalent enclosure.

- Field sensors and actuators shall be designed to operate in the following conditions:

Ambient temperature:	Max 50ºC Max 55ºC (*as required by AS1853 – 1983 2.2.3*) Min 5ºC Min 0ºC (*as required by AS1853 – 1983 2.2.3*)
Humidity:	80% at 30ºC
Contaminants:	Moderate levels of airborne dust exist, as well as moderate to low levels of corrosive gasses such as hydrogen Sulphide, and other corrosive gasses, salt air.
Elevation above AHD:	Less than 250m

- All (SIFs) shall be designed such that movement of the final element to the safe position will be performed by removing power from the element (i.e. de-energize to trip). Where this is not possible such as with shunt trips, suitably certified line-monitored output cards shall be used.

- Smart sensors shall be write-protected to prevent inadvertent modification from a remote location.

- Where trips alarms are derived from analogue inputs, these trip alarms shall move to their trip state on event of a faulted, over-range (short circuit) or under-range (open circuit) analogue signal.

Unless specified otherwise in an individual SIF, a low demand mode is assumed. Typically, a system is regarded to be operating in low demand mode when the demand rate is lower than twice the proof test frequency and no greater than once a year.

- Unless specified otherwise in an individual SIF, the proof test interval shall not be less than 12 months.

- Unless specified otherwise, in an individual SIF subsystem, where redundancy is provided, the allowed MTTR shall not exceed 12 hours.

- Unless specified otherwise in an individual SIF, the response time of a SIF shall not exceed 3 seconds (*AS3814 – 2005 2.24.5, AS2593 – 2004 3.4.2*). The maximum response time for each sub-system, operating asynchronously shall not exceed as shown below.

Sensor Sub-system	100ms
Logic Solver Sub-system	900ms
Final Element Sub-system	2000ms

- Unless specified otherwise in an individual SIF, Overrides / inhibits and bypasses shall not be implemented. (*AS 3814 – 2005 2.14.7*)

3 INTEGRITY & SAFETY REQUIREMENTS

3.1 Assumptions

The following was assumed in preparing this document:

- The list of SIFs presented in the referenced documents are complete and the information associated with individual SIFs are correct and approved to be used in subsequent phases of the Safety Lifecycle for this system.

- An AS61508/11 approved methodology was used to produce those assessments, and the risk matrix was calibrated to the site tolerable risk criteria.

- Any other protective functions to be implemented as part of the SIS are deemed to carry "no special requirements" in regard to the health and safety of personnel or the environment, production & equipment loss and product quality.

3.2 Summary of Safety Instrumented Functions

ID	Safety Instrumented Function	Result
SIF#8	Engine No 1 main gas to flame arrestor high pressure -> Engine #1 Shutdown	SILa RRF 0
SIF#19	Engine No 1 Flame Arrester to Exhaust Manifold High Temperature -> Engine #1 Shutdown	SIL1 RRF 10.1
SIF#32	Engine No 2 main gas to flame arrestor high pressure -> Engine #2 Shutdown	SILa RRF 0
SIF#43	Engine No 2 Flame Arrester to Exhaust Manifold High Temperature -> Engine #2 Shutdown	SIL1 RRF 10.1

3.3 SIF#8 Engine No 1 main gas to flame arrestor high pressure

Ref. Record Number	SIF#8
P&ID Reference	486/5/5-0016-003, 486/7/5-UT2L0149M
Hazard Description	Leakage of flammable material
Causes	Blockage in flame arrestor/ Pressure control loop failure in PLC10
Consequences	Leakage of flammable material leading to possible localised explosion or increased running costs due to having to run on diesel fuel.
Process Safety State	Engine No 1 shutdown – All fuel valves closed
Other LOP Considered	PLC 10, Pressure relief valves at the compressor and gas train.

SIF Characterisation:

Description	Engine No 1 main gas to flame arrestor high pressure -> Engine #1 Shutdown
Sensor sub-system	Pressure Switch PSH11000
Actuator sub-system	Primary gas isolation valve VV2431, Secondary gas isolation valve VV2432, Emergency Stop Solenoid - SV3
Secondary Action	Open bleed valve VV2433 Close main gas shutoff valve VV2430, GSCV Initiate Engine No 1 stop command to PLC11 Initiate compressor CMP45, CMP46 & CMP47 stop command (Via comms)

Safety Integrity Requirements:

Target SIL	a
Risk Reduction Factor	0
Demand Mode	LOW
Proof Test Interval	1.0 Years
MTTR	As per section 2

Functional Requirements:

Functionality	A high pressure detected by pressure switch PSH11000 shall close Primary and secondary gas isolation valves VV2431 & VV2432, **AND** de-energise Emergency Stop Solenoid - SV3. This safety interlock shall be active at all times, independent of operating modes.
Trip Set-point	High pressure set-point shall be set at 440kPa
Response time	As per section 2
Diagnostics	A detected fault shall cause executive action The fault must generate an alarm on the SCADA System
Reset	Lockout reset

3.4 SIF#19 Engine No 1 Flame Arrester to Exhaust Manifold High Temperature

Ref. Record Number	SIF#19
P&ID Reference	486/5/5-0015-004
Hazard Description	Ignition of un-combusted material
Causes	Burnt exhaust valve
Consequences	Fire in exhaust system, leading to engine damage and the possibility of burns.
Process Safety State	Engine No 1 shutdown – All fuel valves closed
Other LOP Considered	None

SIF Characterisation:

Description	Engine No 1 flame arrester to exhaust manifold high temperature -> Engine No 1 shutdown
Sensor sub-system	Temperature transmitters TE11962 , TE11963, TE11964, TE11965, TE11966 or TE11967
Actuator sub-system	Primary gas isolation valve VV2431, Secondary gas isolation valve VV2432, Emergency Stop Solenoid - SV3
Secondary Action	Open bleed valve VV2433, Close main gas shutoff valve VV2430, GSCV Initiate Engine No 1 stop command to PLC11 De-energise Gas Enable Solenoid – SV4

Safety Integrity Requirements:

Target SIL	1
Risk Reduction Factor	10.10
Demand Mode	CONTINUOUS
Proof Test Interval	1.0 Years
MTTR	As per section 2

Functional Requirements:

Functionality	A high temperature detected by any temperature transmitter TE11962 , TE11963, TE11964, TE11965, TE11966 or TE11967 shall close Primary and secondary gas isolation valves VV2431 & VV2432, **AND** de-energise Emergency Stop Solenoid - SV3 This safety interlock shall be active at all times, independent of operating modes.
Trip Set-point	High temperature set-point shall be set at 488 DegC
Response time	As per section 2
Diagnostics	A detected fault on transmitter shall cause executive action The faulted transmitter must generate an alarm on the SCADA System
Reset	Lockout reset

3.5 SIF#32 Engine No 2 main gas to flame arrestor high pressure

Ref. Record Number	SIF#32
P&ID Reference	486/5/5-0016-003, 486/7/5-UT2L0150M
Hazard Description	Leakage of flammable material
Causes	Blockage in flame arrestor/ Pressure control loop failure in PLC10
Consequences	Leakage of flammable material leading to possible localised explosion or increased running costs due to having to run on diesel fuel.
Process Safety State	Engine No 2 shutdown – All fuel valves closed
Other LOP Considered	PLC 10, Pressure relief valves at the compressor and gas train.

SIF Characterisation:

Description	Engine No 2 main gas to flame arrestor high pressure -> Engine #2 Shutdown
Sensor sub-system	Pressure Switch PSH11320
Actuator sub-system	Primary gas isolation valve VV2435, Secondary gas isolation valve VV2436, Emergency Stop Solenoid - SV3
Secondary Action	Open bleed valve VV2437 Close main gas shutoff valve VV2430, GSCV Initiate Engine No 2 stop command to PLC11 Initiate compressor CMP45, CMP46 & CMP47 stop command (Via comms)

Safety Integrity Requirements:

Target SIL	a
Risk Reduction Factor	0
Demand Mode	LOW
Proof Test Interval	1.0 Years
MTTR	As per section 2

Functional Requirements:

Functionality	A high pressure detected by pressure switch PSH11320 shall close Primary and secondary gas isolation valves VV2435 & VV2436, **AND** de-energise Emergency Stop Solenoid - SV3.. This safety interlock shall be active at all times, independent of operating modes.
Trip Set-point	High pressure set-point shall be set at 440kPa
Response time	As per section 2
Diagnostics	A detected fault shall cause executive action The fault must generate an alarm on the SCADA System
Reset	Lockout reset

3.6 SIF#43 Engine No 2 Flame Arrester to Exhaust Manifold High Temperature

Ref. Record Number	SIF#43
P&ID Reference	486/5/5-0015-005
Hazard Description	Ignition of un-combusted material
Causes	Burnt exhaust valve
Consequences	Fire in exhaust system, leading to engine damage and the possibility of burns.
Process Safety State	Engine No 2 shutdown – All fuel valves closed
Other LOP Considered	None

SIF Characterisation:

Description	Engine No 2 flame arrester to exhaust manifold high temperature -> Engine No 2 shutdown
Sensor sub-system	Temperature transmitter TE11978, TE11979, TE11980, TE11981, TE11982 or TE11983
Actuator sub-system	Primary gas isolation valve VV2435, Secondary gas isolation valve VV2436, Emergency Stop Solenoid - SV3
Secondary Action	Open bleed valve VV2437, Close main gas shutoff valve VV2430, GSCV Initiate Engine No 2 stop command to PLC11 De-energise Gas Enable Solenoid – SV4

Safety Integrity Requirements:

Target SIL	1
Risk Reduction Factor	10.10
Demand Mode	CONTINUOUS
Proof Test Interval	1.0 Years
MTTR	As per section 2

Functional Requirements:

Functionality	A high temperature detected by any temperature transmitter TE11978, TE11979, TE11980, TE11981, TE11982 or TE11983 shall close Primary and secondary gas isolation valves VV2435 & VV2436, **AND** de-energise Emergency Stop Solenoid - SV3 This safety interlock shall be active at all times, independent of operating modes.
Trip Set-point	High temperature set-point shall be set at 488 DegC
Response time	As per section 2
Diagnostics	A detected fault on transmitter shall cause executive action The faulted transmitter must generate an alarm on the SCADA System
Reset	Lockout reset

4 FUNCTIONAL REQUIREMENTS

The following section describes the functional requirements for the BW gas engine's ESS.

4.1 Engine Start sequence

This is carried out by PLC 11, and falls outside of the scope of this document.

4.1.1 Pre-start Purge

This is to carried out be by the Co-Generator Control (CGC) unit, and falls outside of the scope of this document

4.2 Engine Stop Sequence

This is to be carried out by PLC 11, and falls outside of the scope of this document.

4.3 Trips

The previously described safety functions outline if and how the machines are to be tripped or interlocked. Additional non-safety trips are to be implemented within PLC15, details of which can be found in the Brisbane Water purchase order document 'BW80144 Official Order rev1.pdf'. The safety and non-safety trip functions of PLC15 shall be separate and each SIF clearly labeled within the logic.

Any trip should lock the system out, and shall only reset via a soft command from the SCADA system when the initiating event is no longer present.

4.4 Logic Requirements

4.4.1 Logic Design

The logic shall be designed using appropriate function blocks and shall take advantage of pre-tested, existing function blocks where possible. Suggestions of function blocks are as follows.

- Analogue scaling function block (with alarms)
- Valve control function block (with position monitoring)

All trip logic shall be coded using negative logic.

4.4.2 Analogue Inputs

In general, analogue instruments shall be treated such that all associated trip points are placed in the trip state when faulted, thus resulting in the trip action and thereby revealing the fault. Where redundant instruments are specified, configurations such as 1oo2D may be used to minimise spurious trips.

The following faults shall be detected and made available on the communications interface as a common fault for annunciation on the SCADA system.

- Open circuit fault (set at 3.5 mA)
- Short circuit fault (set at 21 mA)
- Any associated IO card / channel fault

In addition to the analogue input's common fault, PLC15 shall also make available the scaled analogue value. This shall be in floating point format.
The PLC15 shall only implement trip levels where executive action is taken (e.g. LL, HH). General alarms (e.g. L, H) may be configured additionally within the SCADA system /PLC 11 using the scaled analogue signal. This will allow for easier non-critical alarm set-point changes. Where possible, the functionality described above should be incorporated in an analogue scaling function block.

4.4.3 Actuated Valves

Each actuated valve will be fitted with two limit switches to provide position indication, that is; Opened and Closed. PLC15 will be required to annunciate an alarm, should a discrepancy be found in the required position (solenoid valve) against the actual position (position switches).
A discrepancy can occur if both position switches show an active signal at any time, or, neither position switches show an active signal after a valve travel delay. In this case, a "Position Fault" alarm for the valve shall be generated. Each gas valve will be required to reach its desired position within 5 seconds.

The following status and faults shall be available on the communications interface for annunciation on the SCADA system.

- Common valve fault (Summary of 3 faults shown below)
    - Valve failed to open
    - Valve failed to close
    - Position fault (Both limits on, or both limits off after travel time)
- Valve confirmed open (Open and NOT Closed)
- Valve confirmed closed (Closed and NOT Open)
- Status of physical limit switch inputs and solenoid outputs

Where possible, the functionality described above should be incorporated in a valve control function block.

To avoid single point random hardware failures, each gas valve shall be capable of having its solenoid energised/ de-energised individually from PLC15.

4.4.4 Internal Tag Naming

Please refer to "Software Guidelines – PLC Control Logic – Network Control systems" document, document Id 003547, which forms part of the "official order.pdf" document, for prefered tag naming conventions.

4.4.5 PES Faults

PLC15 shall combine all critical faults / errors in the hardwired, for annunciation in the SCADA system.

- System Normal
    - IO System Fault
    - CPU System Fault
- PLC15 Cabinet Fault:
    - 24V Sub rack
    - K7214
    - B4237 Fan & Fuse
    - Thermostat

In addition to the above summary faults, the following shall also be made available on the communications interface.

- Force system status
- IO Card faults status
- Mono Operation
- Program version
- CPU Fault Masks status

4.5 PLC11 / PLC15 Interface

4.5.1 Hard-wired PLC 11 -> PLC15

Refer to the IO wiring schedule LPWWTP PLC15 IO List Rev 2-0.xls in section 5.1

4.5.2 Hard-wired PLC15 -> PLC 11

Refer to the IO wiring schedule LPWWTP PLC15 IO List Rev2.0.xls in Section 5.1

4.5.3 Communications Interface

PLC 15 shall be provided with a serial Modbus communications interface to the existing SCADA system via PLC11, for sending non-critical status information. The communications interface shall comply with the following requirements:

- Baud Rate: 57600
- Stop Bits: 1
- Parity: Even

In general, the communications interface shall comply with the requirements of Section 11.7.3 of AS61511-2004. In addition to this Section 2.26.3 (a) of AS3814-2005 needs to be considered where "All systems that perform safety functions shall be hard wired"

The communications interface shall be monitored for integrity by both PLC11 and the PLC15.

A detected failure of the communications link shall not cause a demand upon the SIF's, however it shall cause the closure of the gas fuel valves to the engines. The logic for this functionality shall be independent of the SIF logic.

In general, PLC15 shall provide the following status signals to the SCADA SYSTEM.

- State of all inputs and outputs
- Status of sensors such as alarm/trip state, first-up alarm, faults
- Indication of actuators such as open / closed state, failed to open / close fault and common valve fault.
- PES system status (power supply, CPU, IO module status, force status etc.) for alarm annunciation. Refer section 4.4.5

4.5.4 First Out Alarms

PLC 15 shall provide a first-out alarm system for each gas engine, such that the initiating cause of a trip can be determined. Once the initial trip cause is captured, all subsequent trip causes shall be masked.

PLC15 shall provide a register for each first-out group used. Whilst in a reset state or normally operating, the register shall indicate 0. On a trip the register shall show a number representing the initiating trip for that group.

5 APPENDIX A

5.1 IO List

HIMA SAFETY NONSTOP

HIMA AUSTRALIA Pty Ltd
Unit 2, 21 Frederick Street
Belmont WA 6104

Telephone: + 61 (0) 8 9323 2100
Facsimile: + 61 (0) 8 9323 2192

Melbourne Office
Unit 13, 21 Sabre Drive
Port Melbourne VIC 3207

Telephone: + 61 (0) 3 8645 3600
Facsimile: + 61 (0) 3 9645 3295

Brisbane Office
Unit 21, 8 Riverland Drive
Loganholme QLD 4129

Telephone: + 61 (0) 7 3412 3000
Facsimile: + 61 (0) 7 3412 3049

ABN: 13 105 173 831

www.hima.com.au

R.J. Kilborn
Energy Management Consultant
P.O. Box 226 Nerang
Queensland 4211

Your ref./Date	Our ref./Contact	Tel.-Number: 07 3412 3000	Date 15/6/09
BWQ80144 07/08	P-08-023-00	Fax-Number: 07 3412 3049	
	Matt Walker	E-Mail: mwalker@hima.com.au	

To: R.J.Kilborn – Energy Management Consultant

We certify that the Type B appliance described in the accompanying submission for:

GAS FIRED ENGINES at BRISBANE CITY COUNCIL WASTE WATER TREATMENT PLANT, LUGGAGE POINT, QUEENSLAND

Job has had its Programmable Electronic System (PES) exhaustively tested by simulation and field testing under all known possible combinations to try to detect any possible systematic software and systematic/random hardware faults.

To the best of our assessment the PES is error-free and functions according to the logic on the attached flow sheet.

Yours faithfully

Matthew Walker
Project Engineer
TÜV Functional Safety Engineer ID TÜV FSEng 1485/08
HIMA AUSTRALIA Pty Ltd

TÜV Rheinland Group

TÜV Industrie Service GmbH
Automation, Software und Informationstechnologie

ZERTIFIKAT
CERTIFICATE

Nr./No. 968/EZ 129.06/05

Prüfgegenstand **Product tested**	Safety Related Programmable Electronic System	**Hersteller** **Manufacturer**	HIMA Paul Hildebrandt GmbH + Co. KG Albert-Bassermann-Straße 28 D-68782 Brühl bei Mannheim
Typbezeichnung **Type designation**	H41q-MS, H41q-HS, H41q-HRS H51q-MS, H51q-HS, H51q-HRS	**Verwendungs-zweck** **Intended application**	Safety Related Programmable Electronic System for process control, Burner Management (BMS), emergency shut down, machinery, where the safe state is the de-energized state. Fire and Gas, where the safe/demand state is the de-energized or energized state.

Prüfgrundlagen **Codes and standards forming the basis of testing**	IEC 61508, Part 1-7:2000 IEC 61511:2004 EN 954-1:1996 DIN VDE 0116:1989, EN 50156-1:2004 EN 12067-2:2004, EN 298:2003, EN 230:1990 NFPA 85:2001 EN 61131-2:2003 EN 61000-6-2:2001, EN 61000-6-4:2001 EN 54-2:1997, NFPA 72:2002
Prüfungsergebnis **Test results**	The system is suitable for safety related applications up to SIL 3 (IEC 61508, IEC 61511) and CAT 4 (EN 954-1).
Besondere Bedingungen **Specific requirements**	For the use of the systems, the Safety Manual, the User Manual and the actual revision of the official list of product documentation, hardware modules and software components released by HIMA and TÜV Rheinland have to be considered.

TÜV Rheinland | Bauart geprüft Type approved | Funktionale Sicherheit | FS | Functional Safety

Der Prüfbericht-Nr.: 968/EZ 129.06/05 vom 2005-08-02 ist Bestandteil dieses Zertifikates.
Der Inhaber eines für den Prüfgegenstand gültigen Genehmigungs-Ausweises ist berechtigt, die mit dem Prüfgegenstand übereinstimmenden Erzeugnisse mit dem abgebildeten Prüfzeichen zu versehen.

The test report-no.: 968/EZ 129.06/05 dated 2005-08-02 is an integral part of this certificate.
The holder of a valid licence certificate for the product tested is authorized to affix the test mark shown opposite to products, which are identical with the product tested.

TÜV Industrie Service GmbH
Geschäftsfeld ASI
Automation, Software und Informationstechnologie
Am Grauen Stein, 51105 Köln
Postfach 91 09 51, 51101 Köln

H. Gall

2005-08-02

Datum/Date | Firmenstempel/Company seal | Unterschrift/Signature

2005-08-02

TÜV

TÜV Rheinland Group

Automation, Software and Information Technology

Type approval safety-related
automation devices
HIMA H41q: H41q-MS, H41q-HS, H41q-HRS
HIMA H51q: H51q-MS, H51q-HS, H51q-HRS
of HIMA Paul Hildebrandt GmbH + Co. KG

Report-No.: 968/EZ 129.06/05
Date: 2005-08-02

This report is the English translation of the original report in German with the same report-no.

2005-08-02

TÜV Rheinland Group

Amendment to
Type approval safety-related automation devices
HIMA H41q: H41q-MS, H41q-HS, H41q-HRS
HIMA H51q: H51q-MS, H51q-HS, H51q-HRS
of HIMA Paul Hildebrandt GmbH + Co. KG

Report-No.:	968/EZ 129.06/05
Date:	2005-08-02
Number of pages: (excluding appendices)	6
Object(s) subject to testing:	HIMA H41q: H41q-MS, H41q-HS, H41q-HRS HIMA H51q: H51q-MS, H51q-HS, H51q-HRS
Client/Manufacturer:	HIMA Paul Hildebrandt GmbH + Co. KG Alber-Bassermann-Straße 28 D-68782 Brühl
P.O. number client/Date:	Frame contract HIMA/TÜV dated 2002-11-08
Test house:	TÜV Industrie Service GmbH Automation, Software, Information Technology (ASI) Am Grauen Stein D-51105 Köln
Quotation number test house/Date:	Proposal to the frame contract HIMA/TÜV dated 2002-10
Order number test house/Date:	9071450 dated 2004-07-06
Processor:	Dipl.-Ing. Wolfgang Velten-Philipp
Place of testing:	See test house
Testing period:	July - August 2005

The test results exclusively relate to the test objects.

2005-08-02

TÜV Rheinland Group

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2005-08-02

TÜV Rheinland Group

1 Objective

The scope of the type approval should determine if new test requirements for the safety-related automation devices H41q-MS, H41q-HS, H41q-HRS, H51q-MS, H51q-HS, H51q-HRS manufactured by HIMA Paul Hildebrandt GmbH + Co. KG result from newer releases of the test standards.

2 Testing standards

Functional Safety

[N1] IEC 61508:2000, parts 1 - 7
Functional safety of electrical/electronic/programmable electronic safety related systems

Electrical safety and resistance against environmental conditions

[N2] IEC 61131-2:2003
Programmable Controllers
Part 2, Equipment requirements and tests

Electromagnetic Compatibility

[N3] EN 61000-6-2:2001
Electromagnetic Compatibility (EMC)
- Generic Standards
- Immunity for Industrial Environments

[N4] EN 61000-6-4:2001
Electromagnetic Compatibility (EMC)
- Generic emission standard
- Residential, commercial, and light industry

Application specific standards

[N5] DIN VDE 0116:1989
Electrical Equipment of Furnaces

[N6] EN 50156-1:2004
Electrical Equipment for Furnaces
Part1: Requirements for Application Design and Installation

[N7] NFPA 85:2001
Boiler and Combustion Systems Hazards Code

[N8] EN 954-1:1996
Safety of machinery - Safety related parts of control systems
- Part 1: General principles for design

[N9] EN 60204-1:1997
Safety of machinery
- Electrical equipment of machines

[N10] EN 298:2003
Automatic gas burner control systems for gas burners and gas burning appliances with or without fans

[N11] EN12067-2:2004
Gas/air ratio controls for gas burners and for gas burning appliances
Part 2, Electronic types

[N12] EN 230:1990
Monobloc Oil Burners
Safety, control and regulation devices and safety times

[N13] EN 54-2:1997
Fire detection and fire alarm systems
Part 2: Control and indicating equipment

[N14] NFPA 72:1999
National Fire Alarm Code

[N15] ISA S84.01
Application of safety instrumented systems for the process industry

[N16] IEC 61511:2004, parts 1-3
Functional safety - Safety instrumented systems for the process industry sector

3 Test object(s)

The test objects are the safety-related automation devices H41q-MS, H41q-HS, H41q-HRS, H51q-MS, H51q-HS, H51q-HRS manufactured by HIMA Paul Hildebrandt GmbH + Co. KG. These products were certified in /U1/, /U2/ in accordance with the test standards listed the respective reports.

4 Documentation

4.1 Test and certification reports

U1	Test report No.: 968/EZ129.00/02 dated 2002-05-24, TÜV Rheinland
U2	Test report No.: 968/EZ129.01/03 dated 2003-09-10, TÜV Rheinland

4.2 Other documentation

H1	Overview, product documentation H51q(e), Rev. 1.2 dated 2005-08 (CD-ROM with cross references to all relevant documents, dated 2005-08
H2	EMC Test report 5200-340 dated 2005-08-17, EMV Rhein-Neckar
H3	HIMA QSE Type approval F8650X.1 dated 2005-06-02, HIMA
H4	PFD and PFS H41q/H51q system according to IEC 61508, Rev. 1.9, HIMA
H5	Safety manual H41q/H41qc and H51q, HI 800012 EDA, HI 800012 EEA
H6	User manual, system family H41q and H51q, catalogue HK0008D, HK0008E

5 Protocol and results type approval

The test objects were analyzed with respect to changed or amended requirements specified in chapter 2 of the test standards.

Result

The partially modified tests for environmental simulation in accordance with [N2] were performed and passed [H2, H3]. No additional requirements resulted in comparison with the test standards used in [U21 U2].

6 Summary

The carried out analyses have indicated that the safety automation devices H41q-MS, H41q-HS, H41q-HRS, H51q-MS, H51q-HRS of HIMA Paul Hildebrandt GmbH + Co. KG can be used for applications up to SIL 3 according to IEC 61508 and to IEC 61511.

The results as described in test reports /U1/, /U2/ have not changed and remain valid.

The basis for the classification is the low and high demand mode with and without continuous supervision.

All system configurations are fulfilling the requirements of the application related standards while complying with the constraints detailed by the safety and user manuals.

The actual version of hard and software can be obtained from the module and firmware release list which is released together by the manufacturer and the test house.

Cologne, 2005-08-02
TIS/ASI/Kst. 968 vt-nie

The expert

Dipl.-Ing. Wolfgang Velten-Philipp

Matthew Walker

Project Engineer

TÜV Functional Safety Engineer ID TÜV FSEng 1485/08

Education

National Certificate in Industrial Measurement and Control (Level 4, NZ)
National Certificate in Electrical Engineering (Level 4, NZ)

Summary of Experience

9 Years Industrial Control Systems Experience
DCS/PLC/PES Systems
Hardware and Software Design of Programmable Electronic Safety Systems
Process Control and Process Related Trouble Shooting
Sensors and Final Elements (Conventional IO and Foundation Fieldbus)
Drives and Motors (AC and DC)

Relevant Experience

2.5 Years Project Engineering – Safety Systems
Minerals and Mining (Bauxite/Alumina Refining)
Oil and Gas
Power Generation (Boilers and Turbines)
Delivering System Maintenance Training courses to customer Engineers and Technicians
2 Years Systems Engineering – Pulp and Paper Quality Control Systems
Newsprint
Tissue
Linerboard
Pulp

DeltaV DCS Commissioning Engineer
Rio Tinto Alcan Gove G3 Expansion Project. Commissioning from loop checks through to operation, including convential IO, Foundation Fieldbus and Profibus devices.

5 Years Industrial Control Systems:
Pulp & Paper – Newsprint, Tissue, Linerboard and Pulp Drying Machines
Boiler Plants
Continuous Pulp Mill
Chemical Plant

Installation Supervision and Commissioning of ABB ACS800 AC Variable Speed Multidrive

Re-Commissioning HMNZS Manawanui Propulsion Control System

Mechatronics – Runner up in NZ SkillsEx 2004

Career History

2006 – Present **HIMA Australia Pty Ltd. Brisbane, QLD** Project Engineer
2004 – 2006 **ABB Industrial Automation Group. Rotorua, NZ** Field Service Engineer
2000 – 2004 **Tasman Pulp & Paper. Kawerau, NZ** Control Systems Apprentice

Professional Development

TÜV Certified Functional Safety Engineeer: ID TÜV FSE 1485/08
HIMA HIQuad H51q/H41q and ELOP II Factory EngineerTraining
HIMA HIMatrix and ELOP II Factory Engineer Training
HIMA HIMax and SILworx Engineer Training
SMAR System 302 Engineer Training
Fieldbus Foundation – Foundation Fieldbus Essentials for Instrumentation Professionals
ABB A331 – Configuration and Operation of AC400 Series Controllers
ABB T320 – 800xA with AC400 Connect
ABB G160 – ACS800 Multidrive, Start Up & Service Hands On
ABB G162 – ACS800 Multidrive, Control Section AC800M, Operation and Maintenance
ABB H165X – PMC800 Programming
ABB H160 – PMC800 Drives System Training
FITO - National Certificate in Pulp and Paper Manufacturing (Level 2, NZ)
WINTEC - Maintenance Planning and Organisation (Level 5, NZ)
Allen Bradley PLC5 Training
Norgren - Applied Pneumatics
Norgren - Electro Pneumatics
St. Johns - Workplace First Aid
Impac - Certified Workplace Health and Safety Representative (NZ)
Institute of Geological and Nuclear Sciences - Use of Industrial Gauges Containing Sealed Radioactive Sources

HIMA Australia Projects

Rocky Point Green Power Project
Turbine Protection System
Rio Tinto Alcan Gove G3 Expansion Project
Burner Management Systems for 3 Boilers, 2 Calciners and 2 Liquor Purification Units.
Emergency Shutdown Systems for Low and High Temperature Digestion plants.
Shell Todd Oil Services
Debottlenecking Safety Instrumented System
Queensland Alumina Limited
Lurgi Calciner Burner Management System Conversion to Gas
Brisbane City Council
Luggage Point Water Reclamation Plant, Waste Gas Power and Heat Recovery Engine Safety Instrumented System

Sushil Rane
Project Engineer

Education

Electronics & Radio Engineering from Mumbai, India

Summary of Experience

14 years experience industry experience
10 years experience with automation systems
DCS (DeltaV), PLC (Quantum, Modicon 984), SCADA (Intellution), MES (OSI-PI)
Software Design & Implementation
HMI Design & Implementation
Commissioning work
Service, Support
Modbus, Profibus, Fieldbus, OPC experience

Relevant Experience

Instrumentation & Control
Directing detailed engineering, system engineering & logic diagrams
Handling process measurements, control instrumentation & services to monitor, optimize manufacturing processes.
Managing erection/ commissioning of process control equipments for smooth operations.
Preparing drawings & documents required for implementing Control System related jobs.

Software Development / Engineering
Designing Automation & Control Systems involving configuration, programming and testing.
Coordinating the entire development including requirement analysis, finalizing specifications, designing, prototype development and testing activities.
Programming of PLC like Quantum, Modicon 984, GE Versa Pro and Emerson DeltaV DCS.
HMI screen development, report generation.

Career History

June 1994 – Mar 1998	Aplab Limited, Thane, India	Service Engineer
April 1998 – Apr 2004	Larsen & Toubro Limited, Mumbai, India	Project Engineer
May 2004 – Feb 2008	Emerson Export Engineering Centre, Pune, India	Senior System Engineer
March 2008 – Current	HIMA Australia Pty Ltd	Project Engineer

Professional Development

APC-SILCON UPS Maintenance Course
Emerson DeltaV 7009 Course
AS 61511 Safety Lifecycle Awareness Course
HIMA HIQuad Course

HIMA Australia Projects

Alcan Gove
Commissioning Support
Brisbane City Council
Luggage Point Water Reclamation Plant, Waste Gas Power and Heat Recovery Engine Safety Instrumented System