invensys
Foxboro

T940X Process Supervisor
Handbook

HA028225

February 2012 (issue 8)

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Declaration of Conformity

Manufacturer's name:	**Eurotherm Limited**
Manufacturer's address:	**Faraday Close, Worthing, West Sussex, BN13 3PL, United Kingdom**
Product type:	**Process Supervisor**
Models:	**T940X Processor module (Status level A1 or higher)** **T320 Connection Module (Status level T12 or higher)** **T310 Backplane (Status level T11 or higher)**
Safety specification:	**BS EN61010-1: 2001-02**
EMC emissions specification:	**BS EN61326 2002-02**
EMC immunity specification:	**BS EN61326 2002-02**

Eurotherm Limited hereby declares that the above products conform to the safety and EMC specifications listed. Eurotherm Limited further declares that the above products comply with the EMC Directive 89 / 336 / EEC amended by 93 / 68 / EEC, and also with the Low Voltage Directive 73 / 23 / EEC.

Signed: W D Davis Dated: 5th August 2004

Signed for and on behalf of Eurotherm Limited
William Davis
(General Manager)

CE

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Restriction of Hazardous Substances (RoHS)

Product group T940X/T310/T320

Table listing restricted substances

Chinese

限制使用材料一览表

产品 T940X/T310/ T320	有毒有害物质或元素					
	铅	汞	镉	六价铬	多溴联苯	多溴二苯醚
印刷线路板组件	X	O	O	O	O	O
附属物	O	O	O	X	O	O
基座	X	O	O	X	O	O
O	表示该有毒有害物质在该部件所有均质材料中的含量均在SJ/T11363-2006 标准规定的限量要求以下。					
X	表示该有毒有害物质至少在该部件的某一均质材料中的含量超出SJ/T11363-2006 标准规定的限量要求。					

English

Restricted Materials Table

Product T940X/T310/ T320	Toxic and hazardous substances and elements					
	Pb	Hg	Cd	Cr(VI)	PBB	PBDE
PCBA	X	O	O	O	O	O
Enclosure	O	O	O	X	O	O
Base	X	O	O	X	O	O
O	Indicates that this toxic or hazardous substance contained in all of the homogeneous materials for this part is below the limit requirement in SJ/T11363-2006.					
X	Indicates that this toxic or hazardous substance contained in at least one of the homogeneous materials used for this part is above the limit requirement in SJ/T11363-2006.					

Approval

Name:	Position:	Signature:	Date:
Martin Greenhalgh	Quality Manager	Martin Greenhalgh	09/Feb/2007

PROCESS SUPERVISOR HANDBOOK

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EFFECTIVITY

This manual refers to software version V5.2 for Process Supervisor units of the status levels listed below. Please see earlier issues of this manual for instruments with earlier status levels. The status level appears as a two or three character group, enclosed in parentheses ((T13) for example), at the end of the serial number.

T940X Processor unit (G6 or higher)

T320 Connect module (T11 or higher)

T310 Backplane (T11 or higher)

See The Modbus/Profibus manual (HA028104) for details of serial communications.

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GLOSSARY OF TERMS

Items in italics in the descriptions below also appear as glossary items in their own right

2500	I/O sub-system for use with Process Supervisor units
ALIN	Local Instrument Network (*LIN*) protocol on *ARCNET*
ALIN bridge	*LIN* to *ALIN* network link
Application	A *LIN database* and associated *SFCs*
ARCNET	A single non-branching, masterless network, running at 2.5M*Baud* allowing peer-to-peer communications and file transfer up to 100 metres.
Baud	Used to describe transmission speeds over communications links. (9600 baud = approximately 1000 ASCII characters per second)
Brown-out	A brown-out is a transient power variation or partial power failure severe enough to prevent continuation of the process until the process supervisor has been re-initialised.
Cold start	A Cold start is where the instrument starts with the last-loaded database loaded using either default parameters or parameters held in the cold start parameter file. See also *Hot Start*
Cold Start time	The Cold Start time is a pre-set duration, following power off, after which a *Hot Start* is not possible, and a *Cold Start* must be initiated instead.
Configuration	The process of specifying the components of an application.
Control strategy	A control strategy is the overall programmed function of the *LIN database* within an instrument, ready to act upon a real life process.
CIDR	Classless Inter-domain Routing. A standard for *IP addressing*.
COSHH	Control of Substances Hazardous to Health legislation
CSP	Cold Start Primary - the left-hand *processor module*. Applies to *redundant mode* systems only.
CSS	Cold Start Secondary - the right-hand *processor module*. Applies to *redundant mode* systems only.
DRAM	Dynamic Random Access Mamory
Duplex	Twin synchronised processors capable of operating in *redundant mode*
EDB	External database
EEPROM	Electrically Erasable Programmable Read Only Memory
ELIN	Local Instrument Network (*LIN*) protocol on Ethernet
EMC	Electro-magnetic compliance
Eurotherm Project Studio	A suite of programs for building, testing and configuring programs and systems for process control and I/O.
e-Suite	A control/monitoring/configuration system for use with process supervisor units.
FB	*Function block*.
FBD	*Function Block* Diagram - a programming language.
Function block	A unit of software that performs a named function. It can be linked to other function blocks to build a *LIN database* and hence a control strategy for an instrument.
GSD file	A GSD (Gerätestammdaten) file contains instrument parameter information, which a Profibus master needs in order to communicate with the instrument.
Hot start	After a power loss, the instrument attempts to re-start with the current database still loaded and with all parameters and values for that application still at the values they held when processing stopped. If the restart fails the processor enters an *idle* state.
Hot & Cold start:	After a power loss, the instrument attempts to re-start with the current database still loaded and with all parameters and values for that application still at the values they held when processing stopped. If the restart fails the processor attempts a *cold start*.
ICM	Inter-CPU Messaging for redundancy.
Idle	A state in which the *processor module* is powered up, but with an empty database. This state is entered as a result of '*test*' being selected as start-up mode, or if a *hot start* or *cold start* is not successful.
IP	Internet Protocol.

iTools	A Eurotherm utility for configuring networks of Eurotherm I/O controllers.**GLOSSARY (Cont.)**
LIN	Local Instrument Network, a Eurotherm proprietary system for networking process monitoring and control instruments.
LIN database	The *LIN* database is a set of software function blocks that constitute the control strategy of a LIN instrument.
LIN protocol	The communications protocol employed to control instruments linked by a *LIN*.
LINtools	A Eurotherm utility for configuring networks of LIN instruments.
Modbus®	A proprietary communications protocol (Gould-Modicon Modbus RTU).
Non-redundant mode	One or more processors running but not *synchronised*.
PAL	Programmable Logic Array.
Primary	In a *Redundant mode* system, the primary is that processor which is in control. The other processor is called the *secondary* processor.
Processor module	The process supervisor consists of a backplane fitted with one or two Processor Modules and a connection module. 'Processor Module' should not be confused with Central Processor Unit (CPU) which is electronics hardware contained within the Processor module.
Process variable	Characteristics of a process - such as temperature, pressure and valve aperture - that can change value.
Profibus	A communications standard.
PSU	Power supply unit.
Redundant mode	Two *synchronised* processor modules (the *primary* and *secondary)*. The *secondary* processor tracks the *primary* in every respect so that it can take command should the primary (or the supply power to it) fail.
RFI	Radio frequency interference.
Secondary	In a *Redundant mode* system, the *primary* is that processor which is in control. The other processor is called the secondary processor and it continuously tracks the primary, so that it can assume control should the primary fail.
Synchronised	During the start up sequence in *redundant mode*, once the *primary* processor is running, it copies database and *function block* data to the *secondary*. Once this is complete, and the database is running in both *processor modules*, the *processor modules* are said to be synchronised.
SFC	Sequential Function Chart. An SFC monitors key variables and parameters and, on the basis of the values it finds, decides which route through a flowchart the application should follow.
Simplex	A processor working alone i.e in *non-redundant mode*.
SLIN	*LIN protocol* on a serial link (point-to-point).
Tepid Start	Similar to a *hot start*, but with a only limited amount of database information.
Test start	Once started, the *processor module* enters an idle mode, with an empty data base loaded.

CHAPTER 1 INTRODUCTION

The process supervisor is one part of a complete control system. The entire package is described in the System Configuration Manual HA028314.

1.1 MANUAL CONTENTS

This manual is divided into the following chapters:

Chapter 1. Introduction

Chapter 2. Installation

Chapter 3. User Interface (explaining the front panel LEDs and switches)

Chapter 4. Start Up (step-by-step instructions on how to start up or re-start the instrument)

Chapter 5. Configuration (how to configure, or more typically re-configure, control strategy and communications protocols on site, usually to match changes in the plant being controlled). (Initial configuration, to Customer Specification, is normally carried out prior to delivery.)

Chapter 6. Diagnostics (how to diagnose faults that could develop in the instrument, by recognising fault indications)

Chapter 7. Task Organisation and tuning

Chapter 8. Service

Chapter 9. Technical Specification and order codes

Annex A Configuration (Full configuratioln)

1.2 OTHER INFORMATION SOURCES

For details of (LIN) based function blocks, their parameters and input/output connections refer to the LIN blocks reference section of the LIN product manual (HA082375U003) which explains how control strategy LIN blocks are selected, interconnected etc. The creation and monitoring of databases and communications configurations is described in the Eurotherm Project studio documentation. The configuration of Sequential Function Charts (SFCs) is described in the LINtools Online help file (RM263001U055) to be found in 'on-line books' in the LINtools application directory. Modbus and Profibus implementations are discussed in the Communications Manual (HA028014).

1.3 THE PROCESS SUPERVISOR UNITS

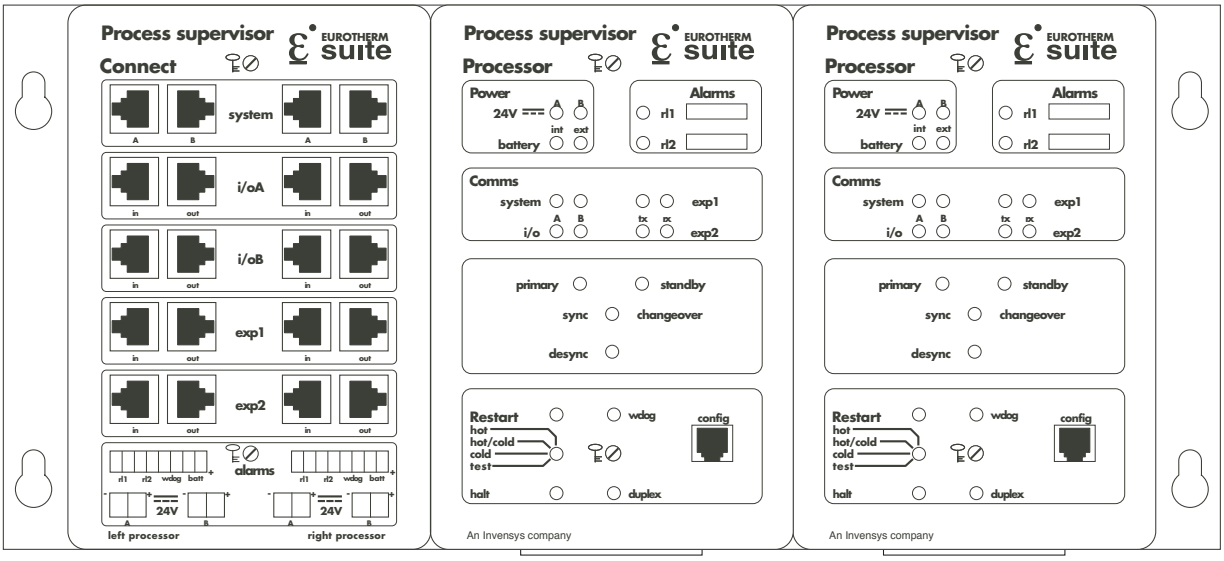

Figure 1.3 Connect module (left) and dual processor modules (centre and right) on the backplane

1.3.1 Typical applications

The process supervisor is designed to control processing plants using distributed input/output modules, interconnected using networks. A number of process supervisors can be networked together, allowing thousands of I/O points to be monitored and controlled.

1.3.2 Features

The main features of the process supervisor are as follows

LIN

A LIN-based network using either ALIN or ELIN. This allows communications with I/O modules and the wider network via either a 'daisy-chain' configuration (ALIN only) or a central ALIN or ELIN 'hub'. See Chapter 2, figure 2.5.

MODBUS

The Unit supports Modbus comms via the connect module exp1 (master) and exp 2 (slave) ports if so configured. Modbus-tcp-slave is also supported.

PROFIBUS.

The Unit supports Profibus communications via the connect module i/oB port.

REDUNDANT PROCESSOR MODULES

The processors can be set up for redundant or non-redundant operation. When operating in redundant (duplex) mode, a high speed data link (ICM) between the primary and secondary processor units provides exact tracking of the control database, allowing bumpless takeover by the secondary unit should the primary processor fail.

Note: See the 'Important Information' leaflet (HA028256) for any backwards compatibility details.

AUTOMATIC TAKE-OVER

Takeover of control by the secondary processor in the event of primary failure is automatic, with no loss of I/O states and no need to re-initialise I/O points. Revalidation of all attached LIN nodes is automatic.

REDUNDANT POWER SUPPLY CONNECTION

Two independent power connectors for each processor unit, plus external battery for memory backup ensures full redundancy. An internal battery supports the data in SRAM (if fitted) and the real-time clock for a minimum of 72 hours.

LIVE PROCESSOR REPLACEMENT

Live replacement of a failed processor can be carried out, with no wiring disconnections. The replacement unit loads its strategy and current status from the active processor. Full hardware and software status indication allows rapid verification and diagnostics.

DIAGNOSTICS

Automatic health checks, self-testing, and initialisation on power-up.

FRONT PANEL ANNUNCIATION.

Front panel LEDs are provided for communications and processor status. Control switches are also fitted on each processor module.

CONTINUOUS HEALTH MONITORING

Extensive on-going diagnostics and health monitoring of communications and I/O status.

1.3.2 FEATURES (Cont.)

WATCHDOG

Watchdog relay for each processor, with Connect module front-panel AND/OR connections.

I/O

Distributed I/O is networked using serial communications links.

CONFIGURATION.

Strategies and sequences configured/downloaded/monitored with Eurotherm Project Studio or the resident configurator (needs external terminal).

BLOCK STRUCTURE.

Continuous strategies are built up by interconnection of fixed function blocks from a comprehensive library of analogue and logic elements, common to all LIN based instruments.

ST USER ALGORITHMS

Special ACTION blocks support user-algorithms written in ST (Structured Text) and are well-suited to implement plant logical devices.

BLOCK SUPPORT

All standard LIN data base function blocks are supported in redundant mode. Special diagnostic blocks are available for hardware and software status reporting.

ENCLOSURES

Process supervisor units can be supplied in a range of enclosures, both wall-mounted and floor-standing. Power supplies, standard terminations, transmitter power supplies, and I/O modules can all be fitted within these enclosures, and if required, a visual supervisor unit can be door mounted to allow a visual representation of process variables.

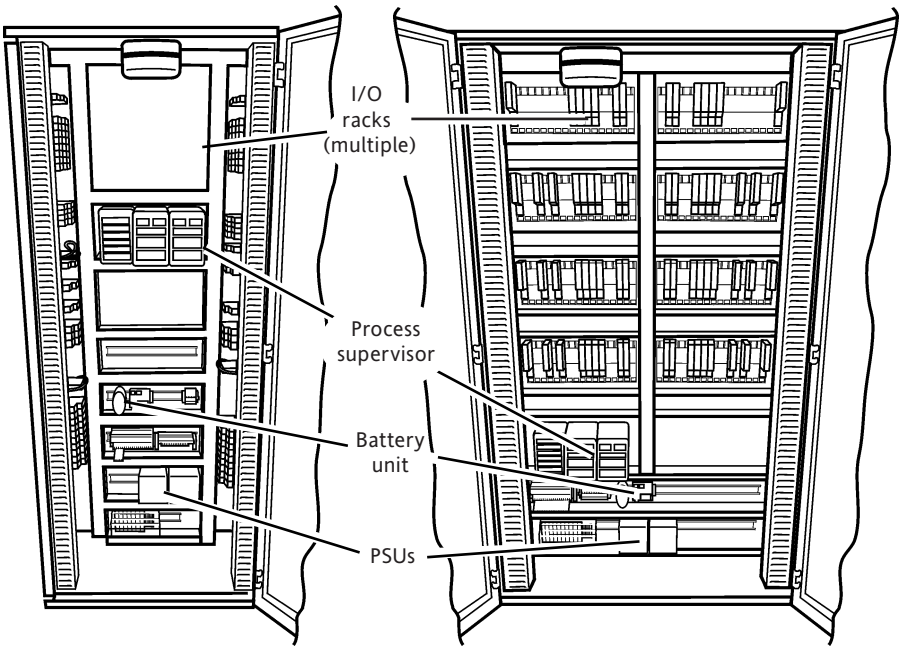

Figure 1.3.2c Typical installations

Note: The process interface i/o modules can be mounted vertically as shown in the sides of the single bay enclosure, or horizontally as shown in the two-bay version.

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CHAPTER 2 INSTALLATION

This chapter presents safety and EMC information and describes the mechanical and electrical installation of the instrument. The main topics covered are as follows:

1. Safety & EMC information (section 2.1)
2. Unpacking (section 2.2)
3. Mechanical layout (section 2.3)
4. Set-up switch definition (section 2.4)
5. Connections and wiring (section 2.5)

2.1 SAFETY AND EMC INFORMATION

This unit meets the requirements of the European Directives on Safety and EMC as detailed on the Declaration of conformity IA249986U610, a copy of which appears at the beginning of this manual. It is, however, the responsibility of the installer to ensure the safety and EMC compliance of any particular installation.

Note: In order to comply with the Low Voltage Directive quoted in the Declaration of Conformity at the beginning of this manual, neither the positive nor the negative supply line may exceed 40V peak, with respect to Safety Earth potential.

2.1.1 Installation requirements for EMC

This unit conforms with the essential protection requirements of the EMC Directive 89/336/EEC, amended by 93/68/EEC. It also satisfies the emissions and immunity standards for industrial environments.

To ensure compliance with the European EMC directive certain installation precautions are necessary as follows:

1 General guidance. For general guidance refer to the EMC Installation Guide (HA025464).

2 Relay outputs. When using relay outputs it may be necessary to fit a filter suitable for suppressing conducted emissions. The filter requirements will depend on the type of load.

3 Routing of wires. To minimise the pick-up of electrical noise, low voltage DC connections and sensor input wiring should be routed away from high-current power cables. Where it is impractical to do this, shielded cables should be used, with the shield grounded at both ends.

2.1.2 Installation safety requirements

PERSONNEL

Installation must be carried out only by authorized personnel.

HAZARDOUS VOLTAGES

CAUTION

In order to comply with the requirements of BS EN61010, the voltage applied between any I/O terminal and safety earth may not exceed 30V ac or 50 V dc.

CAUTION

The configuration port is not isolated - see section 2.5.2.

CONDUCTIVE POLLUTION

Electrically conductive pollution (e.g. carbon dust, water condensation) must be excluded from the enclosure in which the unit is mounted. To ensure the atmosphere is suitable, an air filter should be installed in the air intake of the enclosure. Where condensation is likely, a thermostatically controlled heater should be included in the enclosure.

VENTILATION

Ensure that the enclosure or cabinet housing the unit provides adequate ventilation/heating to maintain the operating temperature of the unit within the limits indicated in the Specification (see Chapter 9).

PRECAUTIONS AGAINST ELECTROSTATIC DISCHARGE

CAUTION

Circuit boards inside the units contain components which can be damaged by static electrical discharge. Before any circuit board is removed or handled it should be ensured that the handler, the instrument and the circuit board are all at the same potential.

2.1.3 Keeping the product safe

To maintain the units in a safe condition, observe the following instructions.

MISUSE OF EQUIPMENT

If the equipment is used in a manner not specified in this handbook or by Eurotherm Ltd., the protection provided by the equipment may be impaired.

SERVICE AND REPAIRS

Except for those parts detailed in Chapter 8, the Process Supervisor has no user-serviceable parts. Contact the nearest manufacturer's agent for repair.

2.2 UNPACKING

The instrument and accessories should be carefully unpacked and inspected for damage. The original packing materials should be retained in case re-shipment is required. If there is evidence of shipping damage, the supplier or the carrier should be notified within 72 hours and the packaging retained for inspection by the manufacturer's and/or carrier's representative.

2.2.1 Handling precautions

CAUTION

Circuit boards inside the units contain components which can be damaged by static electrical discharge. Before any circuit board is removed or handled it should be ensured that the handler, the instrument and the circuit board are all at the same potential.

2.2.2 Package contents

Note: The process supervisor may form part of a larger assembly, and/or may be housed in a floor or wall-mounted enclosure. If so, the documentation that accompanied those items should be referred-to.

The package contents should be checked against the order codes, using the labels on the components. Order codes are listed in Chapter 9 of this handbook.

PRODUCT LABELLING

Product labelling includes:

1. Sleeve label. On the outside of the processor and connect module sleeves, showing the model number , serial number, and hardware build level.
2. Backplane label. On the edge of the backplane, showing the model number, serial number, and hardware build level.
3. Label showing software and hardware build level.
4. Flash memory card label showing version and issue number.
5. Safety earth symbol adjacent to safety earth stud.

2.3 MECHANICAL LAYOUT AND INSTALLATION

Figure 2.3.1a shows two processor modules and a connect module mounted on the backplane. Remote I/O modules (described in the 2500 Installation and wiring instructions, HA027773) are connected to the processor modules using the i/oA and/or i/oB communications sockets of the connection module. Figures 2.3.1b and 2.3.1c show front views of the modules.

When only a single processor is fitted, it is recommended that a blanking plate (BA260496) be fitted to the vacant slot, to maintain EMC emission/immunity specifications.

The processor modules can operate either independently (simplex), or else in 'redundant' (duplex) mode in which case one of the processors acts as a primary, backed up by the other processor (the secondary), which can take over from the primary at any time.

Power is supplied to each processor module by one or two external 24V (nom.) power supplies. The two supplies are effectively OR'd together within the processor module, so they can run in parallel, thus ensuring that the processor continues to operate even if one of the supplies fails.

A separate plug is available to allow the connection of an external battery (2.4 to 5.0 V), to maintain the real-time clock (RTC) during shut down. An internal battery can be fitted to maintain the RTC for 10 years. Chapter 8 gives installation/replacement procedures for the internal battery, and Chapter 9 gives details of suitable batteries, both internal and external.

2.3.1 Layout drawings

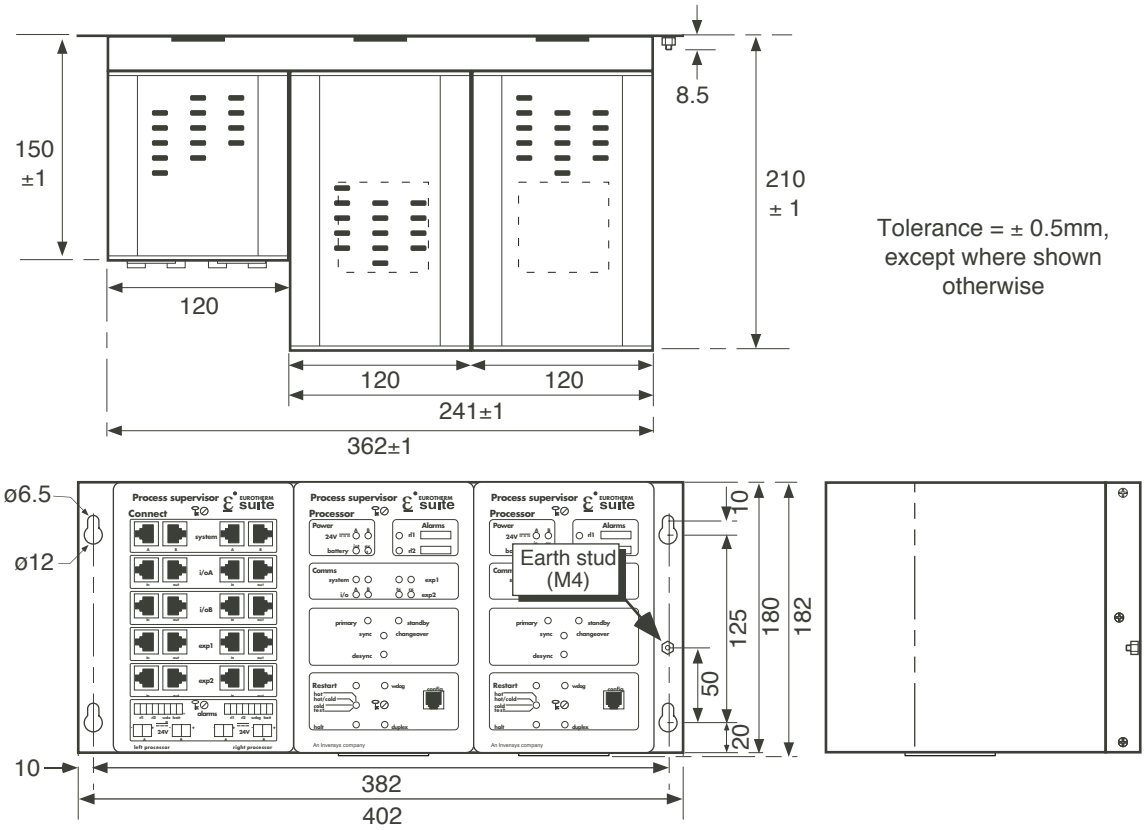


Figure 2.3.1a Dimensions (mm)

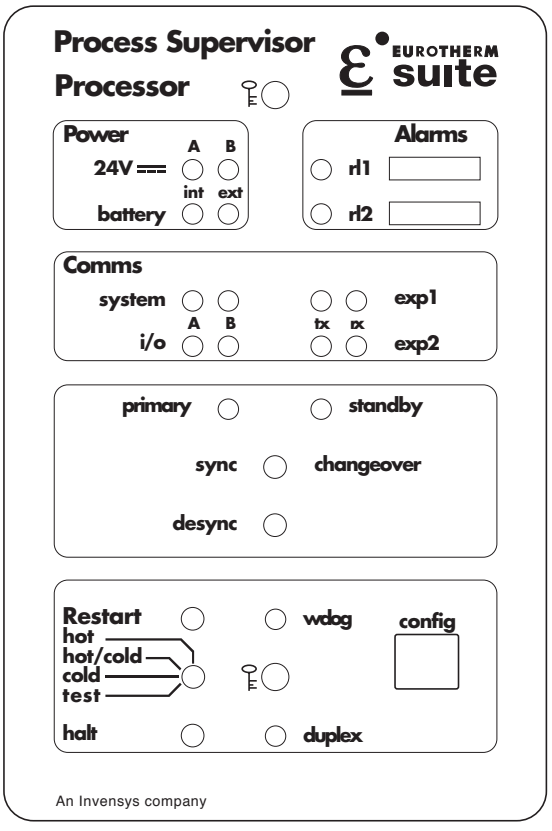


Figure 2.3.1b Processor module front panel layout

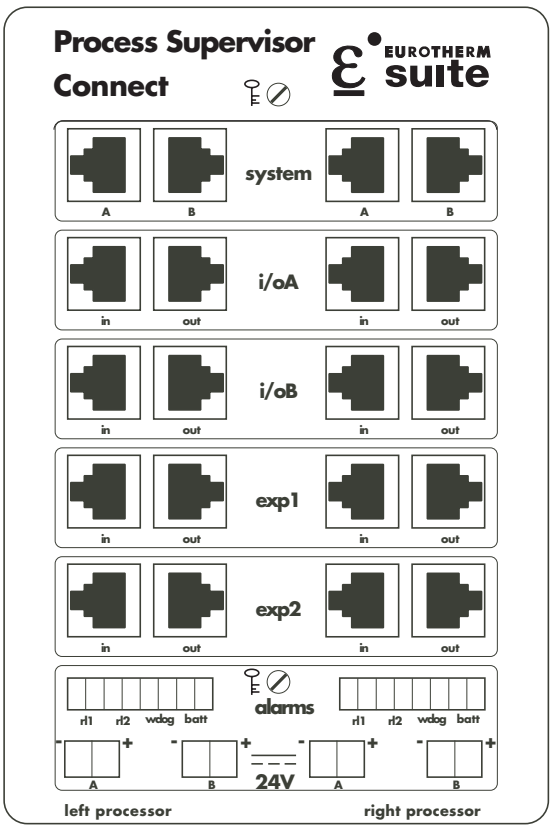


Figure 2.3.1c Connect module front panel layout

2.3.2 Removal of modules

It is recommended that power be removed and all wiring be disconnected from the connection module, before it is removed from the backplane.

Although Processor Modules are designed to be removed/replaced with power applied, the life of the connector will be maximised if they are removed with power off.

Note: Figure 2.3.2 shows a connection module. The procedure is identical for processor modules.

To remove a module:

1 Remove wiring, by disconnecting connectors
2 Unscrew both retaining screws (anticlockwise) to jack the unit out of its connector.
3 Lift the unit off its retaining catch.

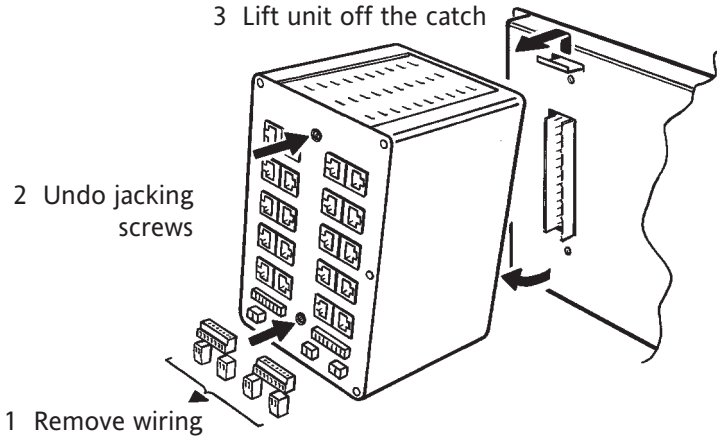


Figure 2.3.2 Module removal

2.3.3 Fitting of modules

1 Lift the module onto its retaining catch, and gently push the module towards the backplane to mate the connector.

CAUTION

Do not force the unit onto its connector or damage will occur

2 Re-engage and tighten both retaining screws a few turns each at a time, to a maximum torque of 2.5 Nm.

2.4 BACKPLANE SWITCHES

2.4.1 Location

The backplane switches for setting communications addresses and for selecting options on and off are revealed (figure 2.4.1) when the right-hand processor module or the cover plate is removed from the back plane.

2.4.2 Switch functions

SW1: LIN ADDRESS SETTING SWITCH

Figure 2.4.2a below shows the LIN address-setting switch SW1 (located on the backplane as shown in figure 2.4.1). The figure shows a sample set up for address pair 7A/7B.

Whenever there are two processor modules fitted to the backplane and working in non-redundant mode, the left-hand processor unit is allocated the even address (Bit 0 = 0) and the right-hand processor is allocated the odd address (Bit 0 = 1).

When working in redundant mode, the primary processor is initially the left-hand (even address) unit and the secondary is initially the right-hand (odd address) unit. Should it prove necessary for the secondary to take over, and become the primary, it will also take over the even address.

Note: In redundant mode, a single processor module running on its own in the chassis never adopts the odd address as it is always the primary controller. It is strongly recommended that this odd address be kept 'spare' and not allocated to another instrument on the same LIN segment. This avoids address clashes if a second processor module is subsequently added to the backplane.

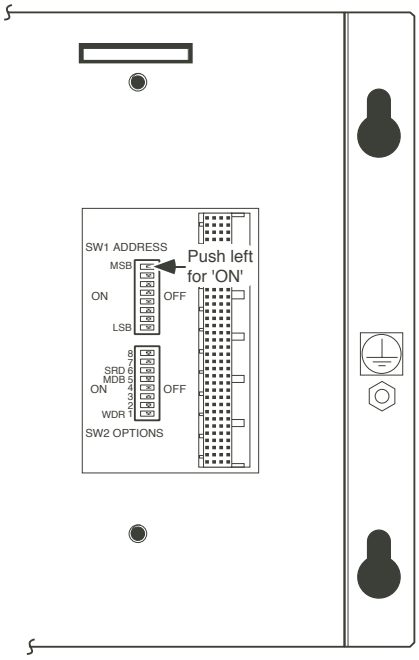
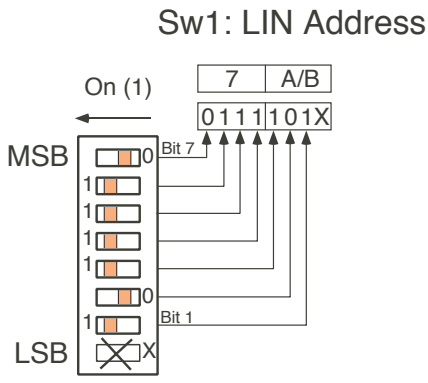


Figure 2.4.1 Location of backplane switches



Example of how to set address pair 7A/7B (Bit 0 automatically set to 0 (thus 7A) for left processor and to 1 (7B) for right processor) Addresses 00, FE and FF are reserved and MUST NOT be used.

Binary	Hex
0000	0
0001	1
0010	2
0011	3
0100	4
0101	5
0110	6
0111	7
1000	8
1001	9
1010	A
1011	B
1100	C
1101	D
1110	E
1111	F

Figure 2.4.2a LIN address setup example

2.4.2 BACKPLANE SWITCH FUNCTIONS (Cont.)

SW2: OPTIONS SWITCH

Figure 2.4.2b, below, shows the Options switch SW2 (located on the backplane as shown in figure 2.4.1, above).

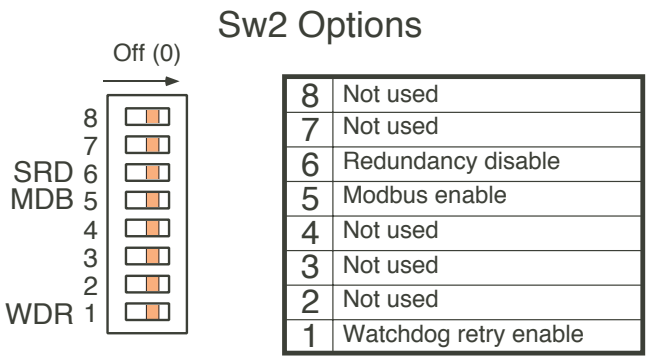


Figure 2.4.2b Option switch layout

WDR (WATCHDOG RETRY)

Setting this switch segment 'on' (slide to the left) causes the processor to try to start again after any watchdog failure. Setting the segment 'off' (slide to the right) disables the re-try and the processor will need manual restart after a watchdog failure.

MDB (MODBUS ENABLE)

Setting this switch segment 'on' (slide to the left) enables Modbus communications (if fitted). Setting the segment 'off' (slide to the right) disables Modbus Communications.

SRD (REDUNDANCY DISABLE)

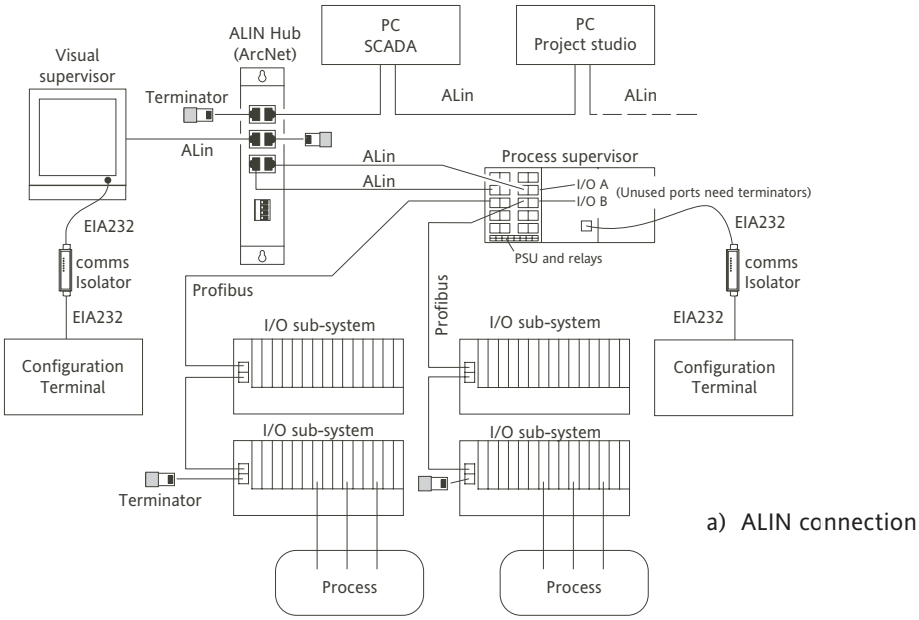
Setting this switch segment 'off' (slide to the right) selects redundant mode, with two processors defined initially as 'primary' (left-hand processor) and 'secondary' (right-hand processor). Setting the segment 'on' (left) disables redundancy mode, and both processors (if two are fitted) run independently.

2.5 CONNECTIONS AND WIRING

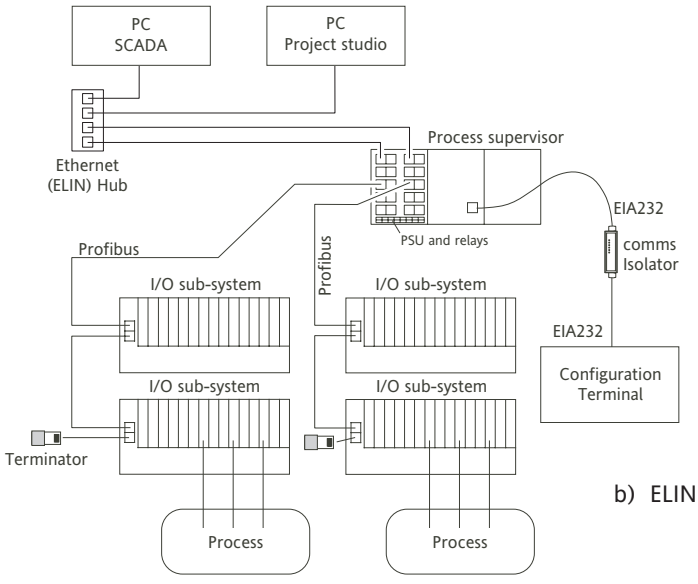
Units may be supplied mounted in an enclosure, together with the appropriate termination assemblies — either fitted in the enclosure or supplied in kit form. Please refer to the documentation that was supplied with the enclosure for details of the connections and wiring.

If you are assembling the system yourself, you should refer to the relevant I/O Modules Reference Manual, the LIN/ALIN/ELIN Installation & User Guide (HA082429U005) and the Communications Manual (HA028014) for advice on connections and wiring to the I/O modules.

Figure 2.5 below shows simplified overall connection diagrams for a control system using a) an ALIN hub and b) an ELIN hub. Hubs are useful for individual line lengths of up to 100 metres. For line lengths greater than this one or more pairs of hubs with fibre-optic connections is recommended. As detailed later in this chapter, it is also possible (with ALIN systems) to connect local items together in series, using a daisy-chain technique, rather than in a star layout using a Hub.



a) ALIN connection



b) ELIN connection

Figure 2.5 Typical overall connection diagrams

2.5.1 Connect module

The RJ45 connectors on the front panel can be wired for ELIN, ALIN, Modbus or Profibus use, according to specification at time of order. The pairs of connectors on the left hand side of the module are assigned to the left hand processor; the right hand connectors to the right-hand module. Each pair of connectors (except system A/B) is wired in parallel to provide for easy daisy chaining.

Plug-in modules to provide biassing components to terminate the transmission line, are available from the manufacturer. Such terminators are required only at the final node of the transmission line.

Note: Terminators are not required for ELIN systems

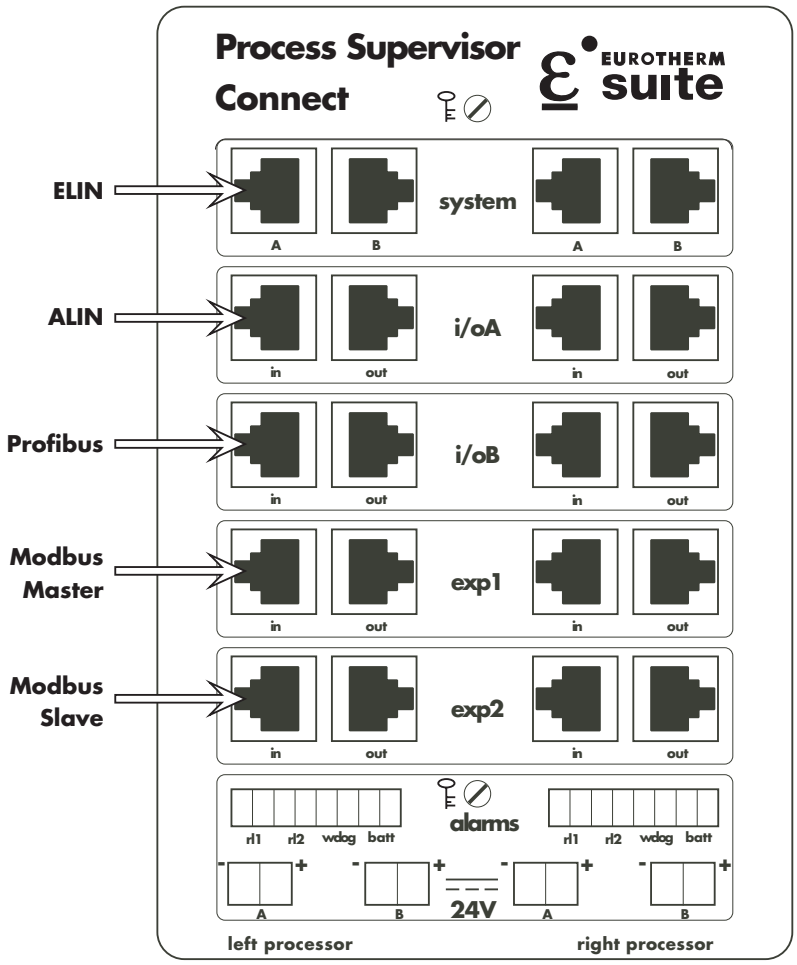
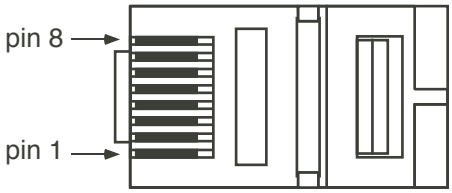


Figure 2.5.1a Connect module front panel

2.5.1 CONNECT MODULE (Cont.)

COMMUNICATIONS CONNECTORS

Figure 2.5.1b shows the connector pinouts for Modbus (EIA422 or EIA485), Profibus and LIN standards. For the pinout for the processor CONFIG port, see section 2.5.2 below.



RJ 45 plug: View on underside

EIA422/485 (5-wire)	
1	TxB
2	TxA
3	Signal common
4	Not used
5	Not used
6	Signal common
7	RxB
8	RxA
Plug shroud to cable screen	

Slave device exp1/2

EIA485 (3-wire)	
1	EIA485B
2	EIA485A
3	Signal common
4	Not used
5	Not used
6	Signal common
7	Not used
8	Not used
Plug shroud to cable screen	

Master/slave device exp1/2

EIA422/485 (5-wire)	
1	RxB
2	RxA
3	Signal common
4	Not used
5	Not used
6	Signal common
7	TxB
8	TxA
Plug shroud to cable screen	

Master device exp1/2

ELIN	
1	Tx+
2	Tx-
3	Rx+
4	Not used
5	Not used
6	Rx-
7	Not used
8	Not used
Plug shroud to cable screen	

SystemA

ALIN	
1	Not used
2	Not used
3	Not used
4	ALIN A
5	ALIN B
6	Not used
7	Not used
8	Not used
Plug shroud to cable screen	

ioA

Profibus	
1	EIA485 B
2	EIA485 A
3	Signal common
4	Not used
5	Not used
6	+5V (for pull-up)
7	Not used
8	Not used
Plug shroud to cable screen	

ioB

Figure 2.5.1b Pinout for Connect module RJ45 type plugs

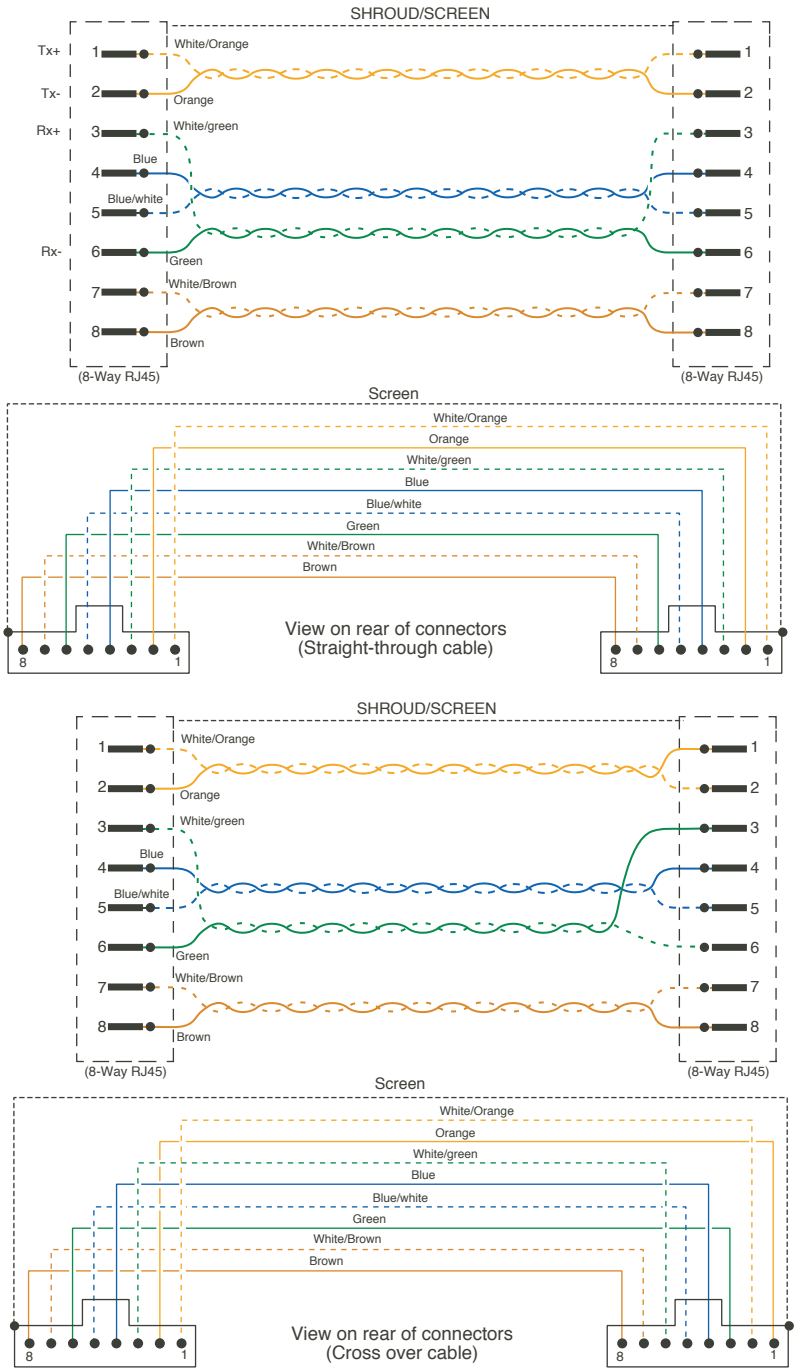
2.5.1 CONNECT MODULE (Cont.)

ELIN CONNECTORS

The Connect module contains two pairs of RJ45 type connectors called system A/B. The left-hand pair is for the left-hand processor; the right-hand pair for the right-hand processor.

Note: System B connectors not supported at time of print.

Connection with an ELIN hub is made using a RJ45-to-RJ45 cable assembly. When connecting to the ELIN Hub, a 'straight-through' cable is used. When connecting directly, a 'cross-over' cable is required. Figure 2.5.1c shows the connections.



a) Straight-through version

b) Cross over version

Figure 2.5.1c ELIN connection details

2.5.1 CONNECT MODULE (Cont.)

ALIN CONNECTORS

The Connect module contains two pairs of ALIN RJ45 type connectors called i/oA. The left-hand pair is for the left-hand processor; the right-hand pair for the right-hand processor. The two sockets making up each pair are connected in parallel to allow easy daisy-chaining.

Connection with an ALIN hub, or a PCI ArcNet card (also fitted with 8-way RJ45 connectors) can be made using an RJ45-to-RJ45 cable assembly available from the manufacturer under part number S9508-5/2RJ45. This cable has all eight connections made at both ends, thus making it suitable for all applications, not just ALIN which uses only a single twisted pair). Fig 2.5.1d is a schematic showing the connections.

Notes:

1 The Rx and Tx legends apply to Modbus master connectors. Slave connections have Tx and Rx reversed as shown in figure 2.5.1b above.

2 Wire colours shown may not be correct for your cable form

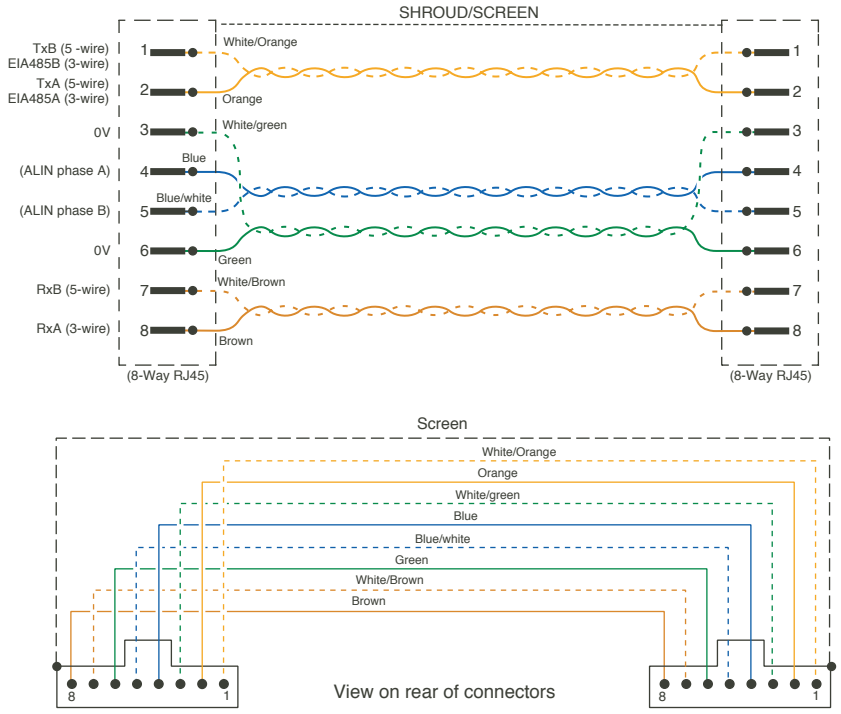


Figure 2.5.1d S9508-5/2RJ45 connection details

2.5.1 CONNECT MODULE (Cont.)

ELIN HUBS

The use of standard 'off-the-shelf' Ethernet hubs is recommended, using 'Straight-through' cables (figure 2.5.1c). For further details, the LIN/ALIN/ELIN installation and user guide (HA082429U005) should be referred to.

ALIN HUBS (ACTIVE)

Figure 2.5.1e shows a simple ALIN hub layout, and figure 2.5.1f a daisy-chain layout. The hub layout is preferred in cases where the integrity of the ALIN network is considered to be susceptible to lengths of daisy-chain becoming inoperative due to cable breakage or individual hardware faults.

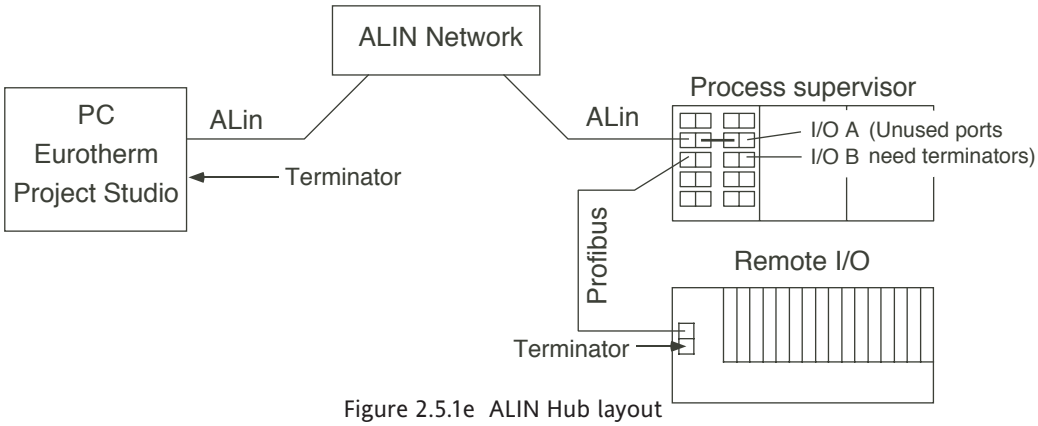


Figure 2.5.1e ALIN Hub layout

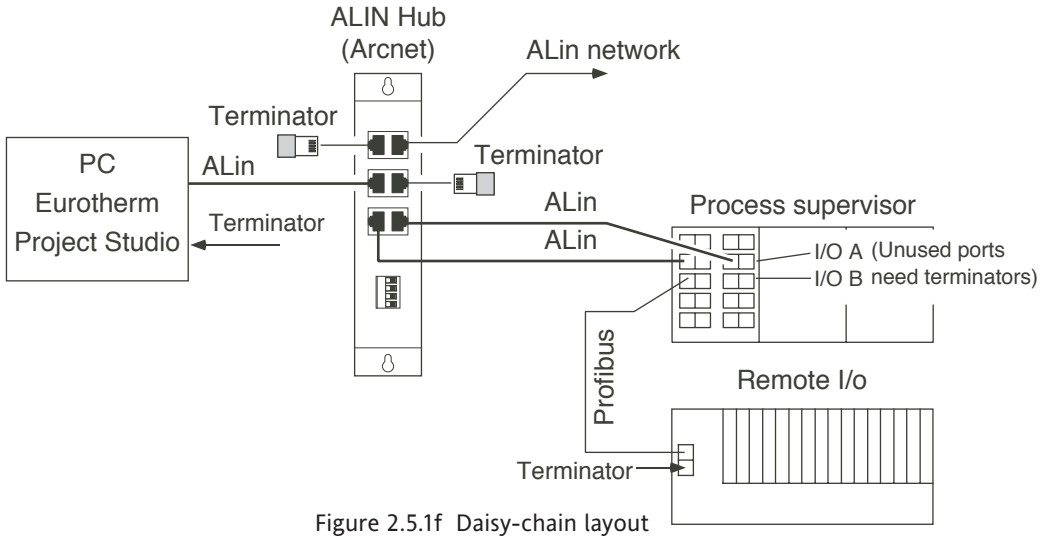


Figure 2.5.1f Daisy-chain layout

2.5.1 CONNECT MODULE (Cont.)

ALIN HUBS (PASSIVE)

Mechanically, a passive ALIN hub consists of a metal box with 12 RJ-45 type connectors and one RJ11 connector (for earlier equipment). Electronically, the hub consists of a resistor network designed to allow each of the 12 ports to be connected to a single unterminated- node, using a cable up to three metres in length. Cable termination is provided by each port, and vacant ports must be left unterminated. This system ensures survival with one port short circuited and any number (up to the maximum) of open-circuit ports.

DAISY-CHAIN LAYOUT

This method of connection is the preferred method where the integrity of the network is certain. Further details are to be found in the LIN/ALIN/ELIN Installation and user guide HA082429U005.

CABLING

Shielded RJ45 connectors and screened Category 5 cables are widely available. Note, however, that specifications vary and not all components are suitable for reliable ALIN operation. In view of the problems that can arise with inadequate cabling, it is strongly recommended that ready-made interconnecting cables are ordered from the manufacturer.

2.5.1 CONNECT MODULE (Continued)

DC SUPPLY WIRING

Each processor has two 24V supply connections (A and B) near the bottom of the Connect module front panel. The unit will operate on any dc voltage between 18V and 36V at a maximum power requirement of 50W per processor module. In addition to this, a separate connector allows an external battery of between 2.5 and 5.0V to be connected to maintain the real-time clock. Typical drain currents are 0.2 mA at 2.5V and 0.3 mA at 3.4V.

Recommended power supply units and batteries are listed in Chapter 9.

A lithium thionyl chloride battery can be fitted inside each processor unit to maintain the Real-time clock data for 10 years, should an external battery not be available during power down, or if the Connect module is removed from the backplane.

Figure 2.5.1g shows the locations of the connectors and gives recommended conductor sizes based on current carrying capability and connector capacity.

Note: In order to comply with the Low Voltage Directive quoted in the Declaration of Conformity at the beginning of this manual, neither the positive nor the negative supply line may exceed 40V peak, with respect to Safety Earth potential.

FUSES

All positive supply lines must incorporate a fuse. Suitable types are 3A Type T for 24 Volt supplies and 0.5V Type T for each external battery fitted.

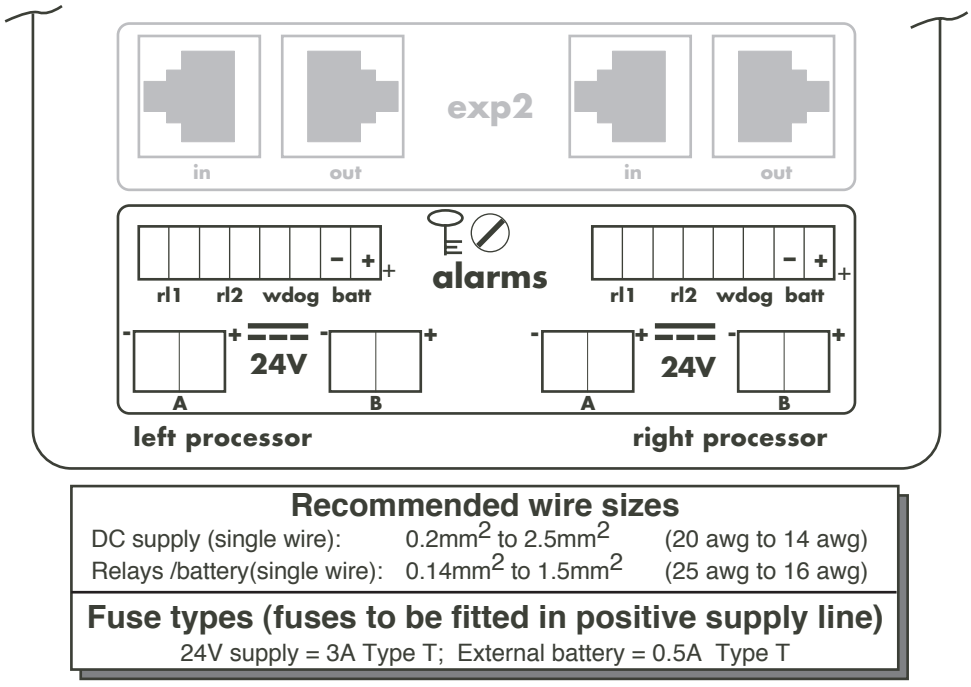


Figure 2.5.1g DC and relay connection details

2.5.1 CONNECT MODULE (Cont.)

RELAY WIRING

There are three relays associated with each processor module, and the common and normally open terminals of these relays are wired to the front of the Connect module as shown in figures 2.5.1h and 2.5.1i. The contact ratings (resistive loads) for the relays are 30V ac / 50V dc at 0.5A.

The operational strategy of relays 1 and 2 (rl1 and rl2 respectively) is entirely software controlled and is set up during configuration.

The watchdog relay is under system control; a number of health checks being made, before the relay is operated. If during operation any of the health checks fail, the relay goes into its alarm (power-off) state. See Chapter 3 (User Interface) for full details of the watchdog system.

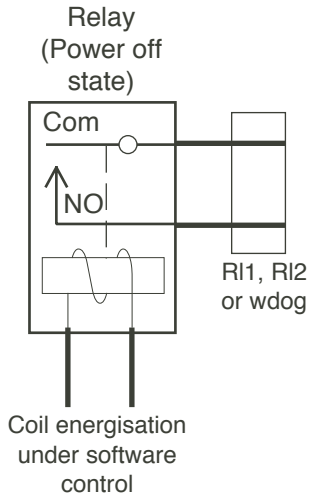


Figure 2.5.1h Relay wiring

The relays can be wired in series or in parallel. When in parallel, both Processors have to fail, before the alarm becomes valid. When in series, the alarm becomes valid if either processor fails. Figure 2.5.1i shows the relays wired in series to a 24V dc 'healthy' lamp. Figure 2.5.1j shows a parallel configuration, using an auxiliary relay to display both healthy and warning states.

Note: For all relays, the common and normally open contacts are open circuit during power-off, and remain so for some seconds at power-up, until software control has become established. After that, the contacts are short circuit when the relay coil is energised, and open-circuit when the coil is not energised.

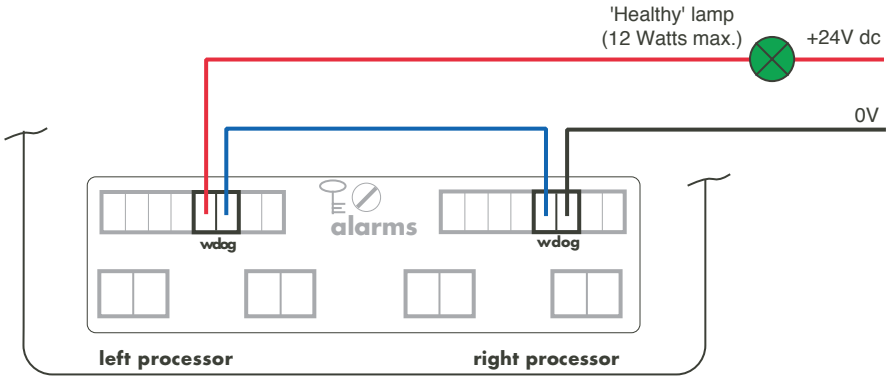


Figure 2.5.1i Example wiring for watchdog relays in series

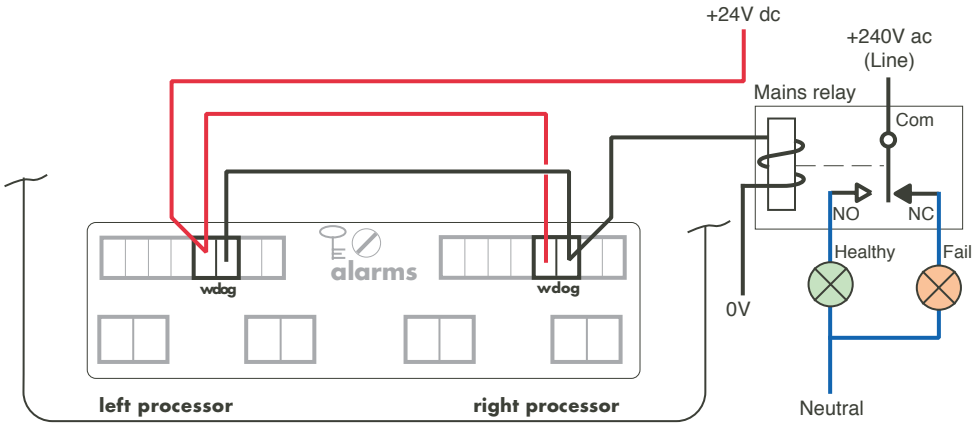


Figure 2.5.1j Example wiring for watchdog relays in parallel

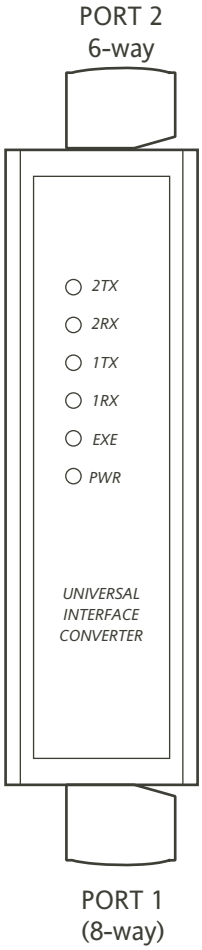
2.5.2 Processor module

The processor module contains one user connection, an RJ11-type plug for the connection of a configuration terminal for on-line monitoring and minor configuration editing. It is possible to configure a whole system from such a terminal, but is not recommended because of the complexity of most systems.

It is recommended that a Communications isolator be connected between the processor module and the terminal. Figure 2.5.2a gives a pinout for such a unit. Figure 2.5.2b shows cables for connecting the processor config port directly to a PC's EIA232 port, both 9-way and 25-way versions.

Communications parameters should be set up as listed below, from the Properties/Connect-to/Configure connection menu:

Baud Rate	9600
N° of data bits	7
N° of start bits	1
Parity	Even
N° of stop bits	1



EIA232 Connections

Signal etc.	Communications isolator			Processor
	Port 1 (8-way)	Port 2 (6-way)	Port 1 RJ11	Config Port RJ11
RX Input	3	3	5	5
TX Output	1	1	4	4
Signal ground	6	6	3	3
RTS	5 (input)			
Supply +	7			
Supply +	8			

Notes: 1 For isolators with a DIP switch adjacent to Port 2, set all elements Off for EIA232 Comms.
2 The RJ11 connector is in parallel with Port 1 (Signals only - not power)
3 For recommended isolators and suitable made-up cables, refer to the ordering guide in Chapter 10.
4 Supply power range is 7 to 35Vdc. Worst case inrush current = 660mA at 4V.

Figure 2.5.2a Isolator wiring details

2.5.2 PROCESSOR MODULE (Cont.)

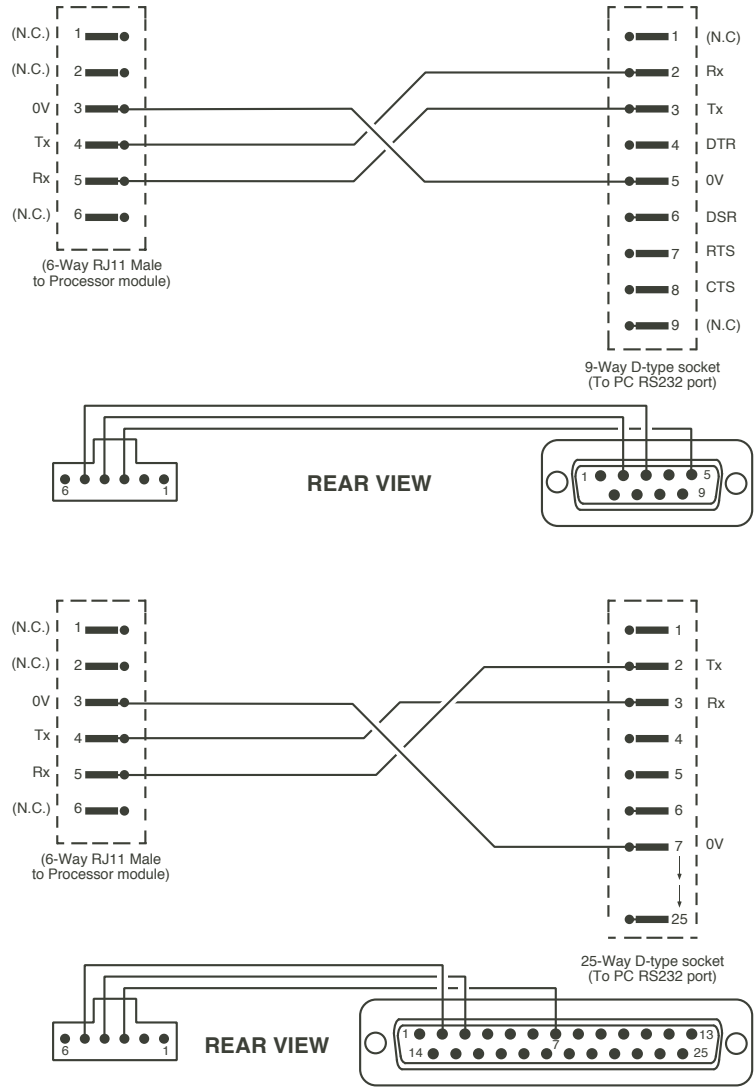


Figure 2.5.2b Direct connection between CONFIG port and PC

2.5.2 PROCESSOR MODULE (Cont.)

CONFIGURATION OF CONTROL STRATEGIES AND SEQUENCES

You can configure control strategies and sequences for the Process Supervisor using either an external PC-based graphical software package (Eurotherm Project Studio), or with the simpler inbuilt configurator and a dumb terminal.

EUROTHERM PROJECT STUDIO

Control strategies and sequences to be run in a Process Supervisor may be configured and downloaded (ALIN or ELIN connection required) using the Eurotherm Project Studio, which is fully described in the documentation supplied with it. Information is also available via the Eurotherm network explorer. The LIN Product Manual (Part no. HA082375U003) should be consulted for details of the function blocks that can run in the Process Supervisor.

TERMINAL CONFIGURATOR RESTRICTIONS

The use of the configurator is restricted according to the operating mode of the Process Supervisor in the following ways:

1. The terminal configurator can be used only on the primary processor module.
2. The database must not be running if you want the full capability to create blocks, databases, edit field values, and modify pool data (e.g. engineering units). If it is running, the configurator can write only to the normally runtime-writeable fields: e.g. block names cannot be edited, but new blocks may be added and new 'wires' can be made on-line.

These restrictions prevent files or edits occurring in the primary database that cannot be tracked by the secondary database.

Note: When the database is started after the terminal configurator has been used, an automatic database save is performed. This ensures that any changes are notified to the secondary CPU during synchronisation.

2.5.3 Safety earth connection

As shown in figure 2.3.1a, an M4 earth stud connection is provided on the back plane metalwork. This stud should be bonded to a good local earth using multistrand tri-rated 1.5mm^2 (21A) green/yellow earth cable, with ring terminals for security.

2.5.4 Transparent Modbus Access (TMA)

This feature allows the use of the Eurotherm iTools package to configure Model 2500 controllers without having to disconnect them from the Process Supervisor.

As depicted in figure 2.5.4, below, the 2500s are 'daisy-chained' from the Instruments's Modbus Master port (Exp 1) or the Profibus port (I/O B) via an EIA422 link. The PC is connected to the Exp 2 port via an EIA232 link, or to the System A port via an Ethernet link. With the iTools package running on the PC, the 2500s can then be configured by 'talking through' the Process Supervisor.

Notes:

1. In order for TMA to work, the database must contain a Gateway file (.GWF) to configure the slave port with the same name as the database file (.dbf).
2. If the Profibus port is used, the 2500 unit(s) must support Profibus DP-V1.
3. Instead of using PC/iTools via an occasional EIA232 link, a SCADA facility can be used via a permanent EIA422 (exp2 port) or Modbus TCP link (System A port).
4. PC/iTools can also be connected to the Modbus port, but needs an EIA422/485 convertor. For an occasional link it is normally considered more convenient to use the CFG port on the front panel as described above.

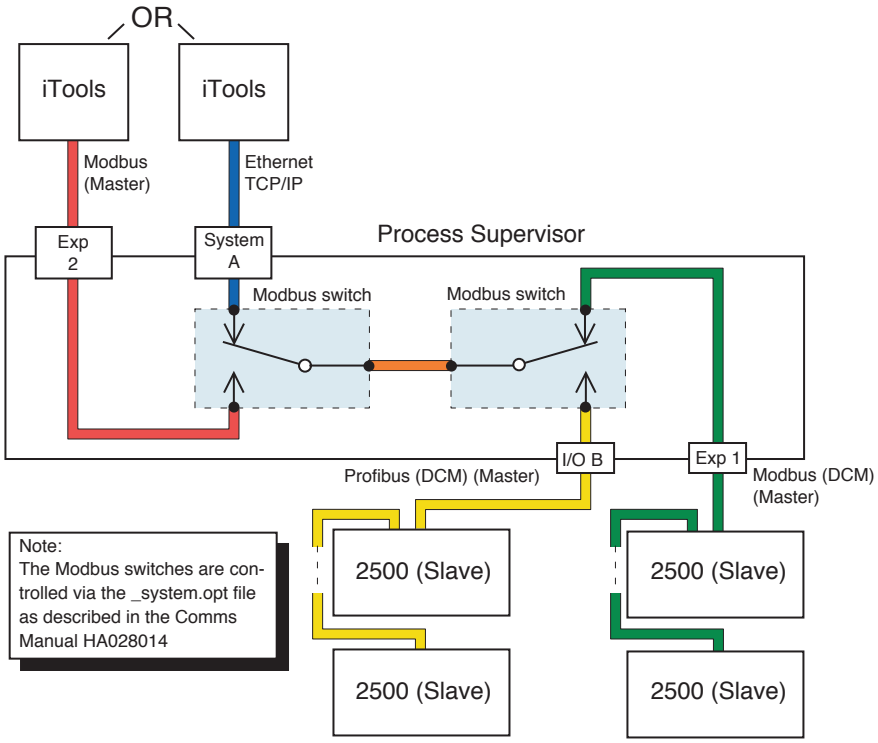


Figure 2.5.4 TMA schematic

CHAPTER 3 USER INTERFACE

3.1 INTRODUCTION

This chapter describes the functions of the processor module LEDs and switches.

As shown in figure 3.1, the items are arranged in groups on the processor module front panel, and each group is described in turn below. Table 3.1 (below) is a concise list of the LEDs and their functions.

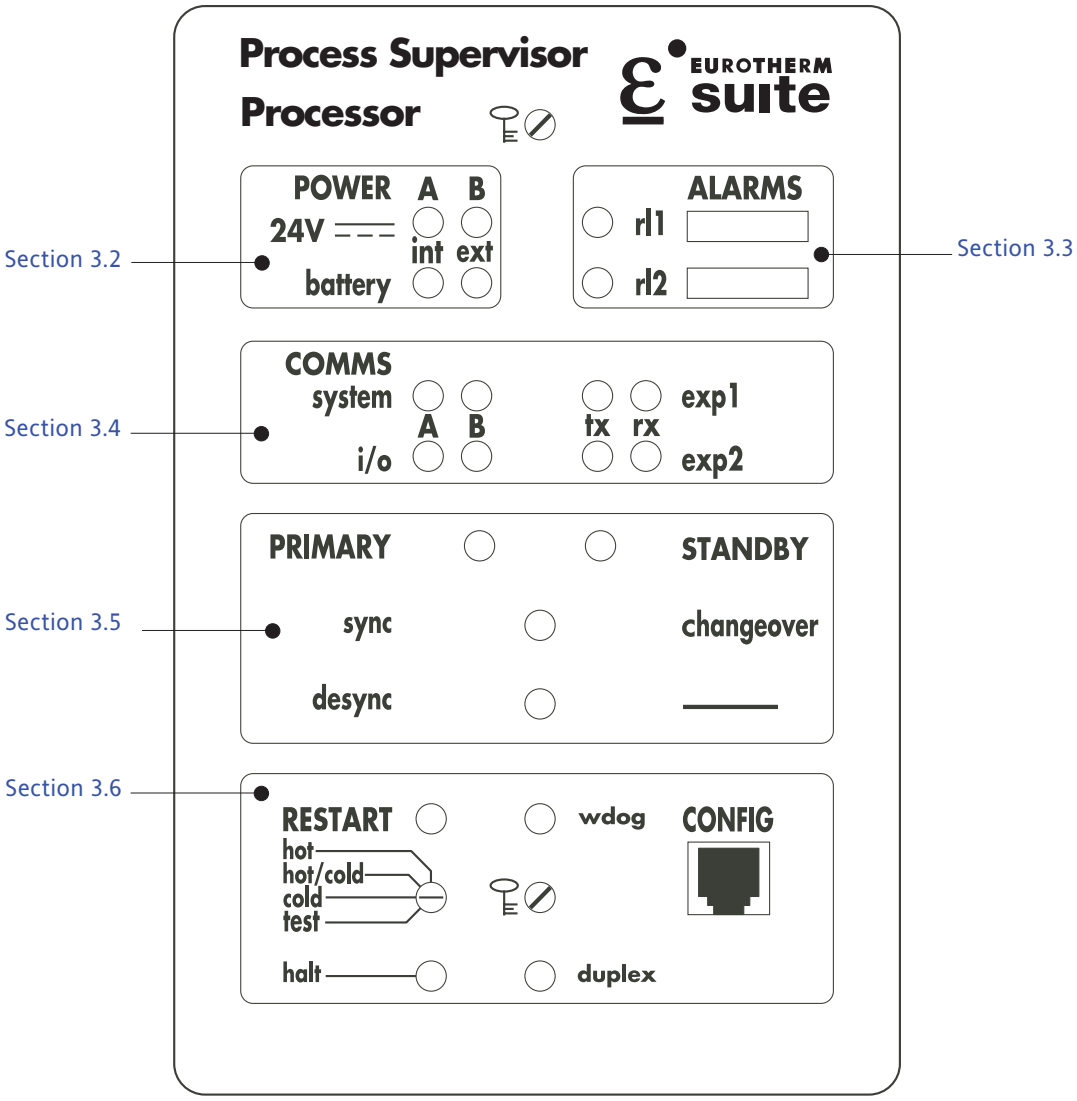


Figure 3.1 Processor module front panel

3.1 INTRODUCTION (Cont.)

			Diagnostic Value (Ch. 6)
Power	Power A	Green..... Main power input valid Off..... Main power input failed	
	Power B	Green..... Auxiliary power input valid Off..... Auixiliary power input failed	
	backup ext	Green..... External battery power valid (Off until start-up complete) Off..... External battery power failed	
	backup int	Green..... Internal battery power valid (Off until start-up complete) Off..... Internal battery power failed	
Alarms	rl1	Yellow..... Alarm active Off..... Alarm not active	08
	rl2	Yellow..... Alarm active Off..... Alarm not active	04
Comms	System A	Green..... System A communications valid Red..... System A communications hardware failure Flashing Red/Off..... System A communications cable fault Off..... System A communications not in use	
	System B	Green..... System B communications valid Red..... System B communications hardware failure Flashing Red/Off..... System B communications cable fault Off..... System B communications not in use	
	I/O A	Green..... I/O A communications valid Red..... I/O A communications hardware failure Flashing Red/Off..... I/O A communications cable fault Off..... I/O A communications not in use	
	I/O B	Green..... I/O B communications valid Flashing Green/off.. Remote unit fault (Profibus comms. only) Red..... I/O B communications hardware failure Flashing Red/Off..... I/O B communications cable fault Off..... I/O B communications not in use	
	Exp1 Tx / Rx	Intermittent yellow....Communications taking place	Rx = 20 Tx = 10
	Exp2 Tx / Rx	Intermittent yellow... Communications taking place	Rx = 80 Tx = 40
Startup	Primary	Green..... This CPU is primary Off..... This CPU is not primary Flashing.....Powered up but no database is running	02
	Standby	Yellow.....This CPU is secondary and synchronised Off..... This CPU is not secondary synchronised Flashing.....Synchronisation process in progress.	01
	wdog	Green Normal running (including system boot) Red Watchdog failure; CPU in reset Red 25% Grn 75% Instrument starting - system healthy Red 75% Grn 25% Instrument starting - system unhealthy (low supply voltage or fan failure). Orange Instrument too hot	
	Duplex	Green..... Redundancy communications valid Off..... System in non-redundant mode Red 50%/Grn 50%.. Inter CPU communications failed	

Table 3.1 LED functions

3.2 POWER MONITORING LEDS

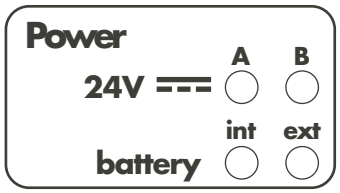


Figure 3.2 Power monitoring LED group

This group of LEDs, located near the top left of the processor module front panel, shows the status of the power inputs wired to the Connect module, and of the internal battery.

3.2.1 A and B

For each processor, two independent sources of 24V power (A and B) can be wired to the Connect module. The LEDs labelled A and B, illuminate green if power supply inputs A and B respectively are greater than 14V.

All sources must be fused (3 A type T) in the positive supply line.

3.2.2 ext

Each processor unit can be backed-up by an external battery wired to the 8-way terminal blocks on the Connect module. This maintains the data in the real-time clock for a period that depends on the Ampere-hour (Ah) rating of the battery. Typical load currents are 200 µA at battery voltage of 2.4V and 300 µA at 3.4V. Once the start-up sequence is complete, the 'ext' LED illuminates continuously green if the battery voltage is greater than approximately 2.6V, and 24V supply power is available. When 24V power is not available the LED is not illuminated.

External battery supplies must be fused (0.5 A type T) in the positive supply line.

3.2.3 int

A further backup for the real-time clock can be provided by an optional internal battery. The 'int' LED operates for this battery in the same way as described above for 'ext', except in that the internal battery voltage must be greater than approximately 3V for the LED to be illuminated. Battery life = 10 years.

Note: Recommended power supply and battery units are listed in chapter 9 of this manual.

3.3 ALARM LEDS

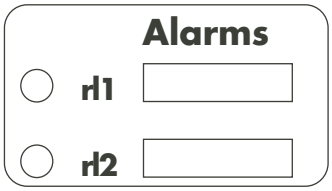


Figure 3.3 Alarm Relay LEDs

This pair of LEDs is located near the top right of the processor module front panel, and indicates the status of the relay outputs ‘rl1’ and ‘rl2’ available at the 8-way terminal blocks on the Connect module. Each LED illuminates yellow if its associated relay is in alarm state (coil not energised). This happens both in alarm and during start-up.

3.4 COMMS LEDS

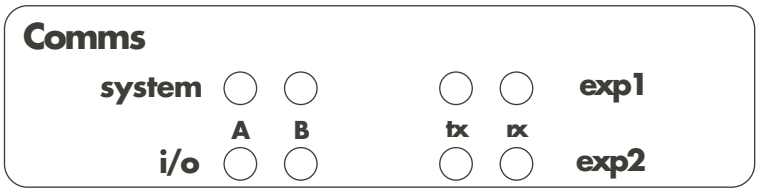


Figure 3.4 Communications LEDs

This group of eight LEDs is located just above the centre of the control panel.

3.4.1 System A/B, i/oA, i/oB

These LEDs all operate in a similar way to one another, to indicate the status of the various communications systems associated with the Process Supervisor. Table 3.4.1 below, explains the interpretation of these LEDs, together with individual error weights which are used in redundant systems to determine what action to take in case of error - see section 4.8.

I/OB LED	Description	State	Error weight
Steady green	Communications running successfully.	All OK	2
Flashing green (i/oB only)	The unit is running Profibus and successfully communicating with at least one slave, but other slaves are not responding. This fault cannot appear on a Redundant Secondary as the necessary information is not available to it.	Faulty slave	2
Flashing red	The unit is running, but it cannot communicate (e.g. because of a cable break).	Faulty network	1
Steady red	Process Supervisor hardware fault	Faulty hardware	1
Off	The relevant comms system is not running	Not running	0
System A = ELIN; System B = ELIN; I/OA = ALIN; I/OB = Profibus			

Table 3.4.1 System and i/o LED interpretations and error weights

3.4.2 Exp1 tx/rx

This pair of LEDs indicates communications activity at the 'exp1' (expansion 1) port of the Connect module. When working correctly, the LEDs flicker yellow at varying rates according to processor receive (rx) and transmit (tx) activity.

3.4.3 Exp2 tx/rx

This pair of LEDs indicates communications activity at the 'exp2' (expansion 2) port of the Connect module. When working correctly, the LEDs flicker yellow at varying rates according to processor receive (rx) and transmit (tx) activity.

3.5 CHANGEOVER LEDS AND SWITCHES

The sync and desync switches are set behind the panel, and should be operated, when necessary, by a blunt, plastic tool such as the recessed end of a trim-pot adjuster.

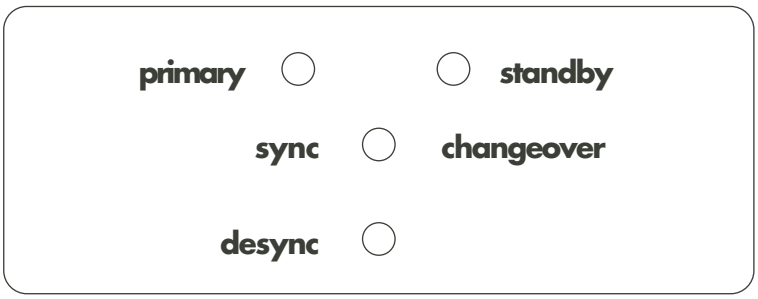


Figure 3.5 Changeover LEDs and switches

This group of components is located slightly below the centre of the processor front panel, and is used to monitor and control the redundant / non-redundant mode selection. The group consists of two LEDs 'Primary' and 'Standby' and two membrane switches 'sync' and 'desync'. Section 3.5.5, below, gives a brief description of synchronisation.

3.5.1 Primary LED

This LED is illuminated green if this processor module is currently the primary processor. During start up, this LED flashes on and off, until a database has been loaded and is running successfully.

The LED is off, if this processor is not the primary.

3.5.2 Standby LED

This LED is illuminated yellow continuously if this processor module is currently the secondary module of a synchronised redundant system, and is thus able to take over from the primary if required

If this processor is the secondary, the LED will flash whilst the processors are synchronising. This normally happens during start up, but can be forced by operation of the primary 'sync' push switch.

3.5.3 Sync/changeover switch

Operation of the primary processor's 'sync/changeover' switch causes the secondary module to start synchronising with the primary module. The secondary's 'Standby' LED flashes during this synchronising process. Once synchronisation is complete, operation of the secondary processor's 'sync' switch causes primary/secondary changeover.

3.5.4 Desync switch

Operation of the desync push-switch causes synchronised processors to de-synchronise.

3.5.5 Processor module Synchronisation

Applicable only to redundant systems, synchronisation means the bulk transfer of all relevant data from that processor which is designated the primary processor to that which is designated the secondary, followed by continuous maintenance of this copied data. This allows the secondary processor to take over from the primary should the primary fail.

This synchronisation process takes place automatically, if both processor modules are powered-up together, and have previously been run as a redundant synchronous pair. Should either of the above conditions not be met, then, at power-up the primary and secondary processors adopt unsynchronised states (Primary unsynch and Secondary unsynch). In such a case, the secondary module cannot take over from the primary in the event of failure.

To synchronise the processors, the primary's 'sync' push switch must be operated.

Once synchronisation has been achieved, the processors are said to be in primary synch state and secondary synch state, and the secondary is able to take over from the primary if required.

Note: With some peripherals, comms failures may be reported during the synchronising process.

TIME TO SYNCHRONISE

The time taken to complete the synchronisation process varies according to the complexity of the control strategy and on how heavily the Flash file system is used. Typically, the 'Load and Run' part of the procedure takes a number of seconds, and the file transfer can take some minutes. During this period, the primary processor runs the control process as normal.

3.6 STARTUP LEDS AND SWITCHES

The Restart and halt switches are set behind the panel, and should be operated, when necessary, by a blunt, plastic tool such as the recessed end of a trim-pot adjuster.

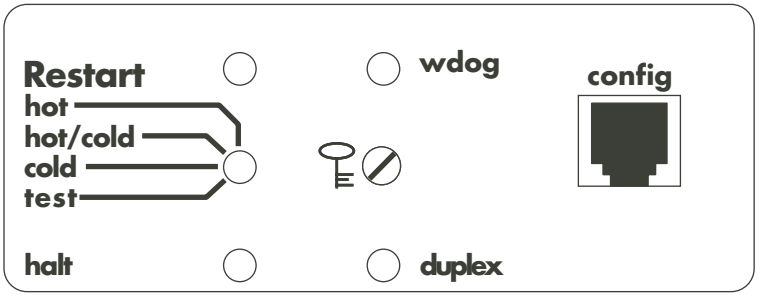


Figure 3.6 Startup control and monitoring

This group of components is located near the bottom of the processor module front panel and consists of two LEDs, two push switches and a four-position rotary switch.

3.6.1 wdog LED

This LED gives information about how start-up is progressing (see chapter 4 for details) and, about what faults might have occurred to cause a processor module to stop running the data base.

If the LED is flashing red/green, the module is in start-up mode. A ratio of 25% red:75% green means that the system is healthy. A ratio of 75% red:25% green means that the input voltage is too low, or that one or both fans have failed.

If the LED is illuminated continuously green, the processor module is running normally as far as the software is concerned, and there are no detectable hardware errors.

If the LED is illuminated continuously red, the processor module is in reset, as a result of one or more of the following errors having been detected:

1. One of the cooling fans has failed during start up. (If a fan fails at any other time, an alarm is set in the header block)
2. The processor circuits have overheated, but have now cooled down.
3. The processor clock is not running.
4. Halt switch has been operated.
5. A software fault has forced a ‘Halt’.

If the LED is illuminated continuously ‘orange’, the instrument is too hot.

As shown in Chapter 2, (figure 2.4.2b) sliding segment 1 of SW2 to the left will cause the processor repeatedly to try to re-start after a watchdog failure. Sliding the segment to the right disables this re-try facility, and the processor has to be re-started by the user.

3.6.2 Duplex LED

This LED is illuminated green, if the inter-processor communications are valid, and successful data transfers are taking place between the two processor modules. Applies only to redundant systems.

The LED flashes red/green if the inter-processor communications have failed.

The LED is off if the system is not running in redundant mode.

3.6.3 Restart switch

Operation of this push switch causes the relevant processor to restart in the mode selected on the rotary mode switch immediately below it.

Used after a watchdog failure has occurred.

3.6.4 Halt switch

Operation of this switch for more than four seconds causes a watchdog failure to stop the processor. In a redundant system, 'Halt' on the primary processor causes the secondary to take over. This function is normally used only during commissioning or servicing.

3.6.5 Start up mode

This is selected at an eight-position rotary switch, with its positions labelled: Hot, Hot/cold, Cold and Test. (180˚ switch actuator positions are wired identically such that position 1 = position 5, position 2 = position 6 and so on.) A full discussion of start-up modes is given in chapter 4.

HOT

A time-out period can be configured by the user for hot start, and this period varies from application to application. The time out period is defined as 'that period (after the database has stopped running) within which the data base can be re-started without noticeably degrading or endangering the control process. If a restart is requested within this time, and the database is still valid, the processor will restart, using the last known data base. If the data is not valid, the last-loaded database file, overlaid with 'tepid data' (stored at the end of each iteration), is used. If the timeout has been exceeded, the processor will not attempt to restart, but will clear the memory and create an empty data base. This is called the 'idle' state.

Note: Tepid data is discussed in section 4.2.1, below.

COLD

If cold start is requested, the processor will attempt to start from the default data base. If this is not possible, the processor will enter 'idle' mode.

HOT/COLD

With the switch set to this position, if a hot start is not possible, a cold start will be attempted.

TEST

This is normally used only during commissioning or servicing, for example under the following conditions:

1. First-time start up.
2. Start-up after a new version of system software has been installed.
3. Memory configuration has been changed.
4. If the processor is to start-up, but is not yet to run a data base.

The memory is cleared, and a blank data base is created.

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CHAPTER 4 START-UP

This chapter describes the start-up sequence for the unit. Topics covered include the differences between redundant and non-redundant systems and start-mode (hot/cold etc.).

4.1 REDUNDANCY MODES

Redundant (duplex) mode is where two processor units are fitted and are required to act in such a way that one can take over from the other in case of failure. In such a case, one processor unit (normally the left-hand one) is called the 'primary' and the other the 'secondary'. The secondary tracks the primary so that it can take over with minimum disturbance to the controlled system.

Non-Redundant (simplex) mode is where a) there is only one processor or b) there are two processors fitted which act independently of one-another (either intentionally, or because one has failed).

Redundant/non-redundant mode is selected using the options switch (SW2) on the back plane, as shown in section 2.4 of this manual.

4.2 START-UP MODES

The required start-up mode is selected using the eight-way rotary switch located near the bottom left of the processor front panel. This allows 'Hot', 'Hot/cold', 'Cold' or 'Test' to be selected. (Each start mode has two positions on the switch, 180° apart.) Figures 4.2a and 4.2b, below, show a simplified flow diagram for the different modes.

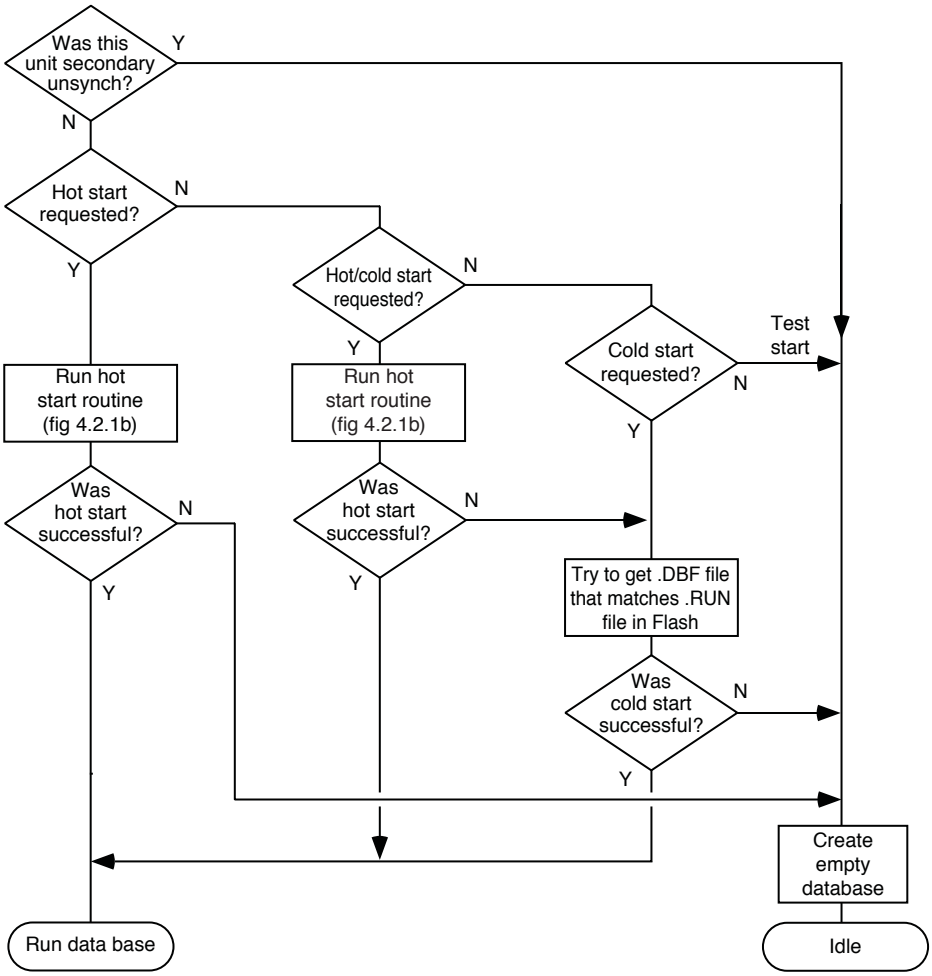


Figure 4.2a Simplified start-up flow diagram

4.2 START-UP MODES (Cont.)

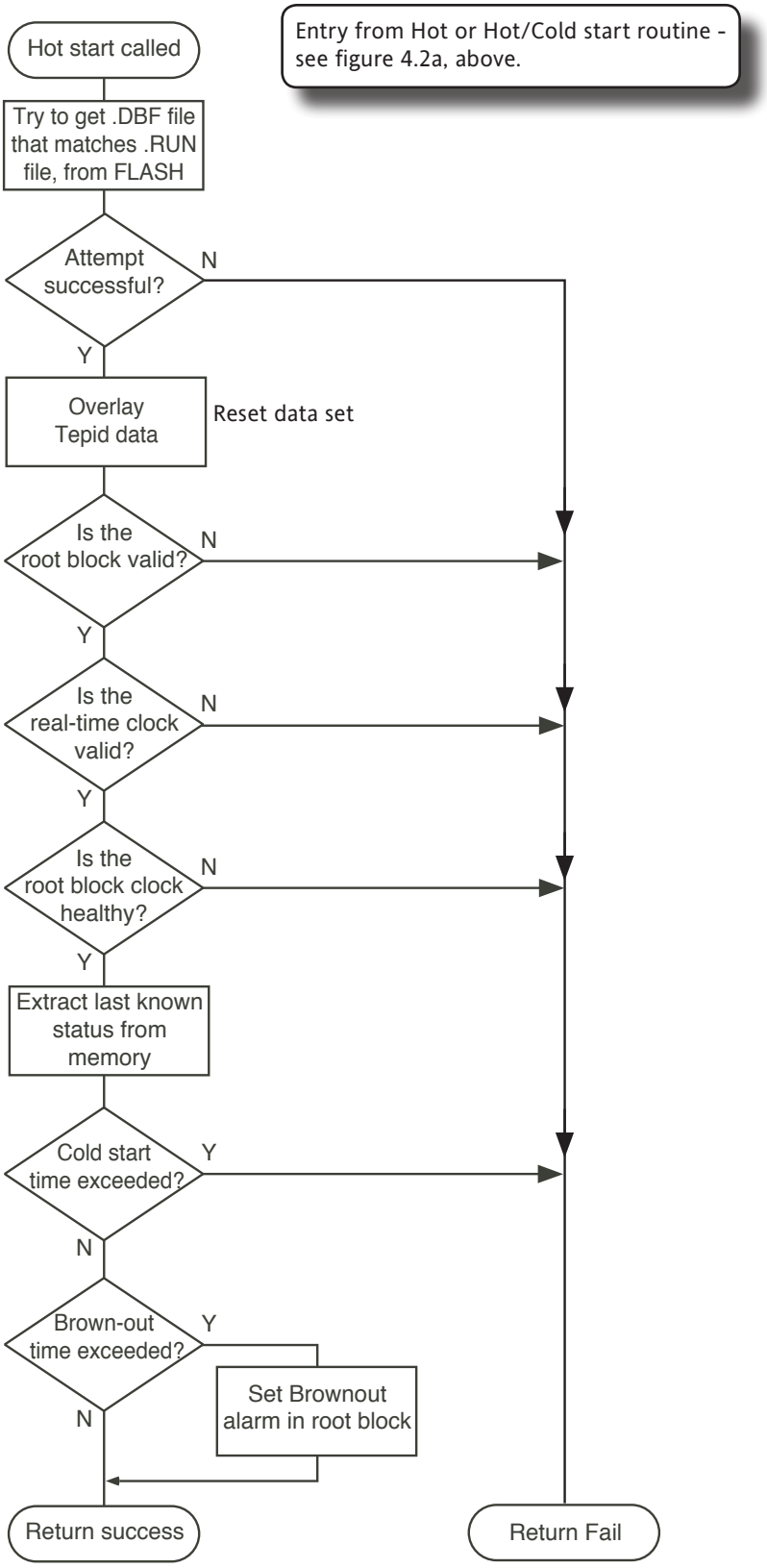


Figure 4.2b Hot/Tepid start flowchart

4.2.1 Hot start

A Hot start means that the instrument re-starts from where it stopped.

In the T940X, a hot start overlays “tepid data” to the last loaded database. The fields and blocks included in this “tepid data” overlay are defined as the reset data in the in the Cold Start Parmater file (.CPF). Refer to section 4.2.5 Reset Data Set.

At the end of each task iteration, a package of “tepid data” is assembled in RAM, ready to be written to non-volatile memory should a power-down occur. The tepid data is defined by the reset data set.

A suitable time period (Cold Start Time) is configured in the root block of the control data base, and if this period is exceeded after the data base stops running, then a hot start is not permissible. The Cold Start Time for any process can be defined as: That period, after the database stops running, within which the database can be restarted from where it left off without degrading or endangering the control process to an unacceptable degree.

A brownout time can be set in the root block, and if power to the unit is lost for this duration or longer, the brownout alarm will be set (also in the root block).

If the hot start fails (because the database is corrupted or because the Cold Start Time has been exceeded) the data base will be cleared and the processors will enter an ‘Idle’ state and remain there until physically restarted. (See also Hot/Cold start.)

4.2.2 Hot/cold start

This setting causes the unit to attempt a hot start. If the hot start fails, however, instead of going straight into idle state as with ‘hot start’, the unit attempts to carry out a cold start. Refer to the next section for details on cold start.

4.2.3 Cold start

Cold start means that the instrument re-starts with the previous database loaded, but with all parameters and values set to starting values appropriate to the process (that is, re-initialised) as manually defined by the configuring engineer. If the cold start fails the data base is cleared and the processors enter an ‘Idle’ state and remain there until physically restarted.

In the event of a cold start, the instrument searches for a file with the same name as the .DBF file, just loaded, but with the extension .CPF. If such a file is found it is executed to define initial configuration values.

Refer to section 4.2.5 Reset Data Set below for details on the contents and syntax of the .CPF file.

4.2.4 Test start

Test start means that the instrument starts up with that part of the memory, which holds the database, cleared (set to zero throughout).

A test start is typically run when:

1 at the very first start up in the life of an instrument
2 when no automatic re-start is required
3 when the start-up preconditions for a redundant system are to be modified
4 when a new version of software has been loaded
5 when there have been modifications in the instrument hardware.
6 in order to clear redundancy start-up data from memory

4.2.5 Reset Data Set

The reset data set is defined in the Cold Start Parameter (.CPF) file. The reset data set is used in three different scenarios:

- Defines the Cold Start Parameters. During a cold start, the .CPF file is used to define a set of initial values to specified blocks and fields.
- When Options.SaveDBF becomes true during runtime. In this case, the values of parameters listed in the reset data set are not overwritten in the .DBF file during the Options.SaveDBF function.
- Defines the “tepid data” set. The “tepid data” set is a list of parameters whose values are stored in non-volatile memory during a power failure so that the values can be restored during a hot start.

The maximum number of fields listed in the .CPF file is 2560. Included in this 2560 are the default fields (PID.xx, etc), plus the date, time and an automatically generated checksum field.

The syntaxes supported by the .CPF file are as follows:

- `Block.Field[.Subfield]:=Value;`
  These are the defined values used each time the instrument cold starts. The instrument uses the specified value and overlays it on the defined (sub)field regardless of what the (sub)field value is in the database.

- `>Block.Field[.Subfield]:=Value;`
  This is used in the same manner as above but overlays a value on a (sub)field which is normally read-only (for example, setting a totalisation to a specific value). The defined value is only used during the first scan of the database, after which the (sub)field is updated at each block execution.

- `Block.Field[.Subfield];`
  This syntax adds the (sub)field to the reset data set for this instrument,. It is used to:

  - automatically restore (sub)field values during a hot start after a power failure.

  - prevent the defined subfield being saved when Options.SaveDBF in the header block is set True.

- `–Block.Field[.Subfield];`
  This syntax removes the (sub)field from the reset data set for this instrument. This means the (sub)field:

  - is not retained through a hot start, and

  - is saved when Options.SaveDBF in the header block is set True.

A .CPF file can also include ST comment lines, such as `(* Comment *)`. An example .CPF file is shown below:

```
(* Production plant Cold Start Initialisation --- .CPF file *)
(* Ensure no automatic control until started *)
XCV-124.Mode := “Manual”;
(* Ensure vent valve open *)
XCV-123.Demand := “False”; (* Open *)
(* Initialise totalisation block*)
>COUNT-01.NTotal := 10;
>COUNT-01.NTotFrac := 0.5;
(* Reset data preserved for hot start, not initialised at cold start*)
Totaliser.total;
```

4.3 STARTING A SINGLE (NON REDUNDANT) PROCESSOR

4.3.1 Start-up sequence

Figure 4.3.1 shows the locations of the various LEDs.

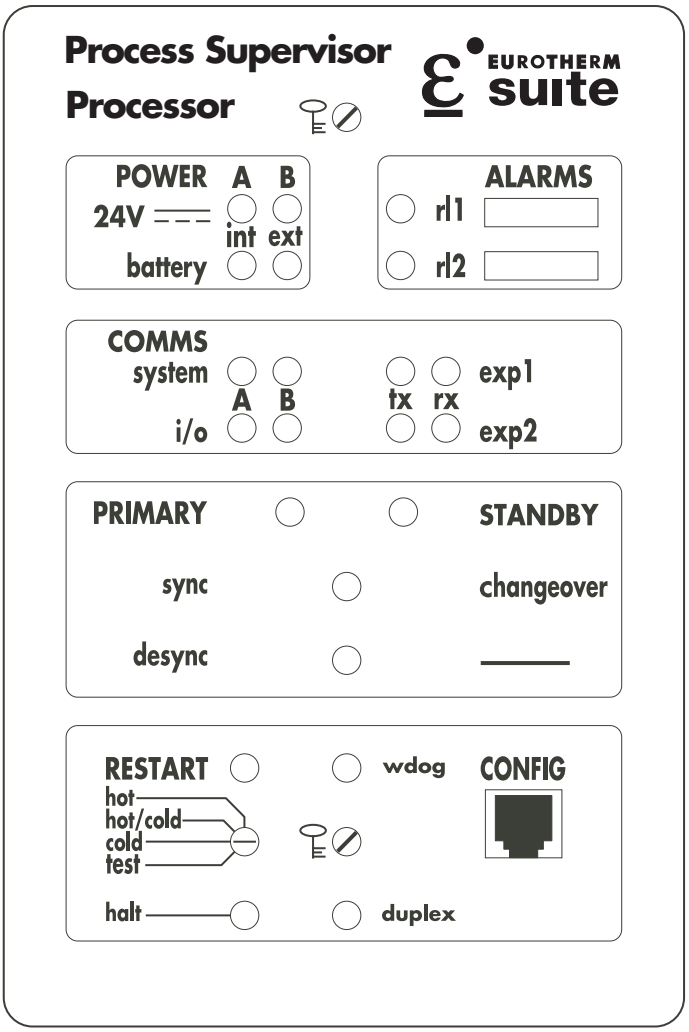


Figure 4.3.1 Processor module front panel

OFF STATE

In the Off state, all LEDs are extinguished.

STARTING STATE

When power is applied, the relevant Power LED(s) illuminate green immediately.

The Basic I/O System diagnostic LEDs (rl1, rl2, exp1 rx, exp1 tx, exp2 rx, exp2 tx, Primary and Standby) flash intermittently until the processor is initialised, at which point they all switch off. (See chapter 6 for more details of these LEDs).

'Wdog' flashes green/red until the sequence is complete and the CPU has started running the applications software, after which it is illuminated continuously green. See section 4.3.2 below, for further details.

The start-up procedure concludes with the processor attempting to establish Ethernet (ELIN) or Arcnet (ALIN) communications, depending on whether an ARCNET card is fitted, and whether 'ELIN = On' in the network .unh file. During this period, the Primary LED flashes on and off.

4.3.1 START UP SEQUENCE (Cont.)

PRIMARY UNSYNCH STATE

When the start-up sequence is complete, then as a minimum, the Power and wdog LEDs are illuminated continuously green. The primary LED will be illuminated continuously if a data base is running, or it will flash if a data base is not running

The COMMS system LEDs will also be illuminated green if the associated comms links are operating correctly, or Red (steady or flashing) if not.

In addition, if any other communications are in progress, the relevant LEDs will be illuminated, either continuously or intermittently. See Section 3.4 for more details of the communications LEDs.

If back-up batteries are fitted, the 'int' and 'ext' LEDs are illuminated as appropriate.

4.3.2 Watchdog indications

The watchdog LED has four modes of operation:

1. Steady green In this state, either the processor is running with no detectable hardware or software faults, the cooling fans are working and the processor temperature is within its working range, or one of the Monitors has been accessed - see section 4.6.
2. Steady Red When continuously red, a hardware or software fault has developed - see section 4.5, below
3. Long red/short green flash. This occurs at the beginning of the start-up procedure, whilst the status of the fans and the temperature of the central processing unit are checked.
4. Long green/short red flash. This indicates that the fan status and temperature measurement were acceptable, and initialisation is continuing correctly. This mode remains active until the start-up process is complete, after which the LED stops flashing and is illuminated continuously green.

4.3.3 Watchdog relay

For primary or simplex units, the watchdog relay is in its alarm state until the Primary LED is continuously illuminated. For secondary units, the watchdog relay comes out of alarm when the database is started, part way through the synchronisation sequence.

4.4 STARTING UP A PAIR OF PROCESSORS

4.4.1 Redundant mode

This start-up sequence is similar to that described for a single processor (section 4.3 above) except in the control and action of the Standby and Duplex LEDs. Figure 4.3.1 (above) shows the locations of the various LEDs.

Powering up decisions

Figure 4.4.1 shows the states possible with a pair of processor units in redundant mode.

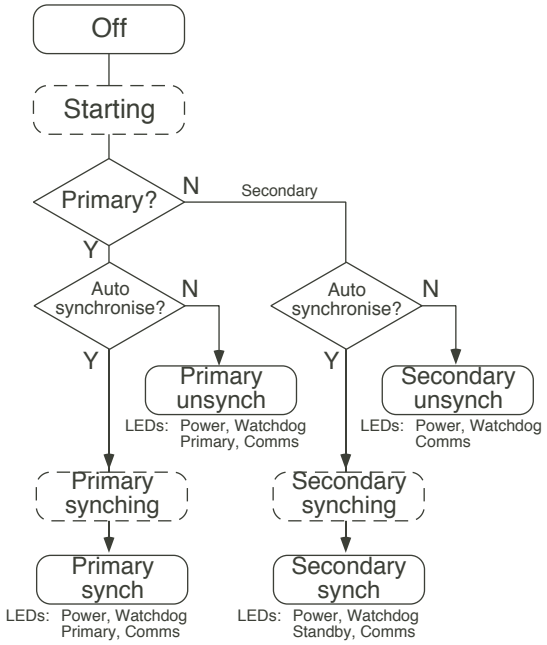


Figure 4.4.1 Power-up redundancy states for a pair of processor units in redundant mode

PRIMARY/SECONDARY CRITERIA

With processor units in redundant mode, it is necessary that one be defined as the primary; the other as the secondary. As described above in section 4.1 of this chapter, the primary unit initially assumes control and the secondary tracks the primary such that it can assume control should the primary unit fail. Which of the processors powers-up as the primary is determined as follows:

1 If both processors are powered-up 'simultaneously' from their as-delivered default states, the left hand PROCESSOR MODULE (as viewed from the front) attempts to assume primary status.

2 If both processors are powered-up 'simultaneously' from other than default state, further tests must be made on the basis of 'last time's' information held in battery-backed memory. This information contains data relating to whether this processor was primary or secondary prior to the last power off. If both processors were primary or both secondary last time, or if the data is inconclusive, then the left hand processor will attempt to assume primary status this time, otherwise they will power-up according to last-time's status.

3 If the processors are powered-up sequentially, then the first-powered will attempt to assume primary status.

4.4.1 REDUNDANT MODE (Cont)

AUTOSYNCHRONISATION

Once the primary/secondary status of the processors has been determined, the system must decide whether synchronisation of the primary and secondary should be automatic or whether it should proceed only after a request from the operator (sync switch). This decision is made as follows:

If the processors are powered-up within 1 second of one another, AND they were running as a synchronised pair prior to power-down (data held in battery-backed memory), then synchronisation will take place without operator intervention.

If either of the above conditions is not met (or if the battery-backed data is not available) then both units will enter unsynchronised states in which case the secondary cannot take over from the primary. This state will continue until the 'sync' switch on the primary processor is operated.

SYNCHRONISATION

During synchronisation (automatic or manual), the primary processor carries out the following:

1. The transfer of any cold or hot start data base files to the secondary.
2. It instructs the secondary to load the relevant database.
3. Once this is complete, transfers current block data to the secondary.

During the synchronisation process, the 'Standby' LED on the secondary processor front panel flashes. Once synchronisation is complete, the Standby LED is continuously illuminated yellow, the 'Duplex' LED is illuminated green and redundant operation starts, with the processors in their synchronised states. In these states, the secondary continuously tracks the primary by receiving data from it including attachments, input reads, block execute synchronisation commands, check sums, block data and health data.

Notes:

1. During synchronisation, some peripherals may report a comms failure. Such failures are transient and clear within approximately two seconds.
2. In redundant operating mode, the secondary refuses any ALIN messages other than identity requests. All database related comms and file system comms are handled by the primary processor.

TIME TO SYNCHRONISE

The time taken to complete the synchronisation process varies according to the complexity of the control strategy and on how heavily the Flash file system is used. Typically, the 'Load and Run' part of the procedure takes a number of seconds, and the file transfer can take some minutes.

Where primary and secondary databases have substantial differences (e.g. when attempting synchronisation for the first time), multiple syncs may be required to copy all the files to the secondary. When such is the case, it can be detected from the Red_Ctrl block sync fields.

4.4.2 Non-redundant mode

Starting a pair of processors in non-redundant (simplex) mode is the same as starting a single processor. Whether the units power up in redundant or non-redundant mode depends on the setting of the SRD element of the Options switch (SW2) on the back plane - see Section 2.4 in Chapter 2 of this manual.

4.5 LED FAULT INDICATIONS

The Alarm, Comms and Primary and Standby LEDs are illuminated in various patterns during the first part of the start-up sequence. Should the sequence stop at this time, the pattern of these LEDs give diagnostic information as follows:

POWER A/B LEDS

If either of the Power LEDs fails to light green on power-up there is a fault in the relevant power supply or the Connect module has been removed. If the Connect module is correctly fitted, isolate the power supply unit and remedy the fault.

WATCHDOG LED

If the Watchdog LED changes from short green/long red to steady red, the hardware has failed the temperature and fan tests. Switch off and remedy the fault.

If the LED changes from long green/short red to steady red, one or more components of the software have not loaded properly. Switch off, switch on, and if still unsuccessful, contact a service engineer.

If the LED changes from steady green to red, an operational fault has developed.

If the LED illuminates steady orange, the unit has overheated.

PRIMARY LED

If this LED is off, power to the processor module is off or the processor module is not the primary. If the LED is flashing green/off, there is no database running, either because the unit is still starting up, or because a database has not been loaded or has failed to start.

I/OB LED	Description	State	Error weight
Steady green	The unit is running Profibus and successfully communicating with all slaves. For a redundant Secondary this means only that it can communicate with the primary, as this is the only node it may communicate with.	All OK	2
Flashing green	The unit is running Profibus and successfully communicating with at least one slave, but other slaves are not responding. This fault cannot appear on a Redundant Secondary as the necessary information is not available to it.	Faulty slave	2
Flashing red	The unit is running Profibus, but it cannot 'see' any slaves (e.g. because of a cable break).	Faulty network	1
Steady red	The unit is unable to start the Profibus because the Profibus circuit board is faulty.	Faulty hardware	1
Off	The Profibus is not running because there is no data base running, no Profibus port is configured or there is a configuration error preventing the Profibus from starting.	Not running	0

COMMS LEDS

The comms protocol (e.g. Modbus, ALIN etc.) associated with any one comms connector is configurable, and it is therefore not possible to be more specific about failure indication than the following:

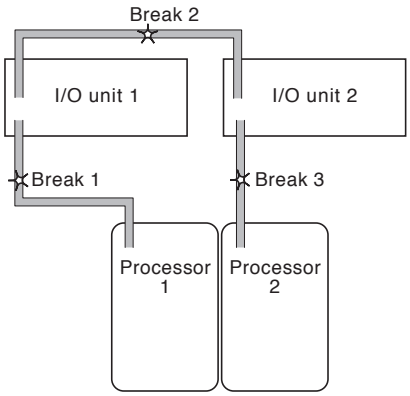
SYSTEM AND I/O LEDS.

If a system or I/O comms LED does not light green, the processor module has not yet established communications. If the LED is illuminated continuously red, there is a hardware fault. If the LED is flashing between red/off, there is a cable or connector fault. See also section 3.4.

EXP1, EXP2 LEDS.

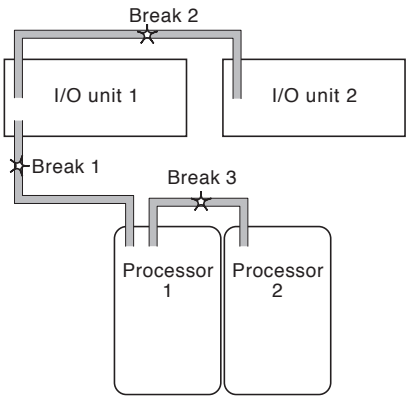
These LEDs remain off until the processor module has established communications, at which time the LEDs flicker, thereby indicating communications activity.

DUPLEX LED



Break point	Processor reaction
Break 1	Processor 1 (P) can see no slaves. Processor 2 (S) cannot see the primary. Both report 'faulty network' (I/OB LEDs flash red). Processors change over. Processor 2 (P) now sees all slaves and reports 'OK' (LED steady green). Processor 1 (S) cannot see Processor 2 and reports 'Faulty network' (LED flashes red). Units desynchronise, with processor 2 the primary.
Break 2	Processor 1 (P) can see some slaves and reports 'faulty slave'. (LED flashes green). Processor 2 (S) cannot see the primary and reports 'faulty network' (LED flashes red). Units desynchronise, with processor 1 remaining the primary.
Break 3	Processor 1 (P) can see all slaves and reports 'OK' (LED steady green). Processor 2 (S) cannot see the primary and reports 'Faulty network' (LED flashes red). Units desynchronise, with processor 1 remaining the primary.
(P) = primary; (S) = secondary. Processor 1 initially primary; processor 2 initially secondary	

If this LED is illuminated green, inter-processor communications have been successfully established



Break point	Processor reaction
Break 1	Processor 1 (P) can see no slaves and reports 'Faulty network'. I/OB LED flashes red. Processor 2 (S) can see the primary and reports 'OK' (LED steady green). Units remain synchronised.
Break 2	Processor 1 (P) can see some slaves and reports 'faulty slave' (LED flashes green). Processor 2 (S) can see the primary and reports 'OK' (LED steady green). Units remain synchronised.
Break 3	If processor 1 is the primary, Processor 1 (P) can see all slaves and reports 'OK' (LED steady green). Processor 2 (S) cannot see the primary and reports 'Faulty network' (LED flashes red). Units desynchronise, with processor 1 remaining the primary. If processor 2 is the primary, processor 2 (P) can see no slaves and processor 1 (S) cannot see the primary. Both report 'faulty network' (LEDs flash red). Processors change over. Processor 1 (P) now sees all slaves and reports 'OK' (LED steady green). Processor 2 (S) cannot see Processor 1 (P) and reports 'Faulty network' (LED flashes red). Units desynchronise, with processor 1 the primary.
(P) = primary; (S) = secondary. Processor 1 initially primary; processor 2 initially secondary	

and are running. If the LED is flashing green/red communications have been established,

but are not running (usually after a de-synch. request).

If the LED is off, no interprocessor communications have been established, usually because the system is non-redundant.

CHAPTER 5 CONFIGURATION

The main topics of this chapter are:

5.1 The Terminal Configurator
5.2 LINtools online reconfiguration
5.3 Modbus tools

5.1 THE TERMINAL CONFIGURATOR

This section explains how the IP Address and subnet mask parameters are configured for the unit, and how ELIN parameters are accessd for edit, using the Terminal Configurator resident within the processor unit(s). (In redundant mode the Terminal Configurator is accessible only on the Primary processor.)

For full details of the Terminal configurator, see Annex A. The remainder of section 5.1 is an extract from this annex, concentrating on the configuration of ELIN parameters.

5.1.1 Configuration Access

The Configurator is accessed by connecting the instrument from its Configuration port on the front panel, to a 'VT100' compatible terminal (for example, an IBM-compatible PC running a terminal emulation package).

5.1.2 Connecting to a PC

The CONFIG port on the primary processor front panel should be connected to the PC EIA232 port using a cable fitted with an RJ11 connector at one end and (typically) a 9-way 'D-type' connector at the other. The connector pinouts are detailed in Chapter 2, Installation. If further details are required, refer to the documentation supplied with the PC.

Notes:

1. To configure a redundant-mode instrument (dual synchronised processors), the terminal PC must be linked to the primary processor, not the secondary.
2. It is recommended that the CONFIG port be isolated from the PC or other communications equipment by means of a communications isolator (see section 2.5.2 for details). The manufacturer accepts no responsibility for any damage, either to the Process Supervisor or to any associated equipment, which is caused by not using such an isolator.

5.1.3 Running the configurator

This section describes accessing and quitting the Configurator using HyperTerminal®. If a different terminal program is being used, its user documentation should be consulted (if necessary) for the equivalent procedures.

Which screen appears at start-up depends on whether the Instrument is running before HyperTerminal ® is running or, as described below, it is switched on after HyperTerminal®. In the former case, the 'sign-on' screen described below does not appear, neither does the `1 ANSI-CRT` message. To get to the initial menu, type <1> (one) and wait for the menu to be displayed.

Note: The sign-on screen also appears when quitting the terminal configurator.

® Hyperterminal is a trademark of Hilgraeve Inc.

5.1.3 RUNNING THE CONFIGURATOR (Cont.)

INITIAL MENU ACCESS

Note: The detail of the following procedure varies according to the Windows version in use.

1 Power up the PC and start Hyperterminal® (All Programs/Accessories/Communications/Hyperterminal®). After entering a name for the link (if necessary) and defining the computer port (e.g. COM1) enter the port settings tab and set up the communications parameters as follows:

Baud rate = 9600, Data bits = 7, Stop bits = 1, Parity = 'Even', Flow control = Xon/Xoff.

2 When the hyperterminal starts, go into the file menu and click on 'Properties'. In the 'Settings' tab select 'Emulation' = 'VT100', then click OK.

3. Power up the instrument. The sign-on screen appears. Figure 5.1.3a, below shows a typical display. Type <1> to call the 'initial menu'.

```
T940X Process Supervisor  - V5/1 - 51M at 266 MHz
(Hardware Build: 00001)
Profibus card: PB-COMBIC104-PB  Version: T01.069a14.09.02
Ethernet (MAC) address = 00:30:59:01:86:E9
IP address = 10.1.1.2
Subnet mask = 255.255.255.0
Default gateway = 149.121.164.253
POST result (0000) = SUCCESS
Hotstart failed because: Warmstart switch is disabled
Last shutdown because: Successful Power Down

1 ANSI-CRT
>>>
```

Figure 5.1.3a Typical sign-on screen

Ethernet (MAC) address Shows the address of the Ethernet interface. This value is unique and is permanently fixed for an individual instrument.

IP address Gives the IP address currently assigned to this instrument. This address must be entered manually.

Subnet Mask Gives the subnet mask currently assigned to this instrument. An IP host uses the subnet mask, in conjunction with its own IP address, to determine if a remote IP address is on the same subnet (in which case it can talk directly to it), or a different subnet (in which case it must talk to it via the Default Gateway). Please see 'IP Subnets', below.

Default Gateway Gives the IP address of the Default Gateway. It is the address via which this instrument must talk in order to communicate with IP addresses on other subnets. If undefined then this instrument can talk only to other IP hosts on this same subnet.

5.1.3 RUNNING THE CONFIGURATOR (Cont.)

INITIAL MENU ACCESS (Cont.)

If Modbus is enabled, the configurator Initial menu appears, as shown in figure 5.1.3b. If Modbus is disabled, the Main menu appears instead, as shown in figure 5.1.4a. (Modbus in enabled/disabled by means of the Options switch (SW2) on the backplane as described in section 2.4.2.)

```
INIT        Choose option
(Running)
                          >DATABASE - General configuration
                            GATEWAY  - MODBUS configuration
```

Figure 5.1.3b Configurator initial menu

Note: If the Initial or Main menu appears, this indicates that the Processor module has entered configuration mode.

Locate the cursor (**>**) at a menu item using the cursor keys, then press <Enter> to display the next level in the menu hierarchy. This is called selecting an item. In general, to access the next lower level of the menu hierarchy <Enter> is pressed. To return to the next higher level menu or close a 'pop-up' options menu the <Escape> key is pressed. <PageUp> and <PageDown> allow hidden pages in long tables to be accessed.

For keyboards without cursor-control keys, equivalent 'control' character combinations may be used, as indicated in Table 5.1.3a. To use these, the <Ctrl> key is held down and the specified character typed.

Function	Key combination
Clear screen	<Ctrl> + W
Cursor Up	<Ctrl> + U
Cursor Down	<Ctrl> + D
Cursor Left	<Ctrl> + L
Cursor Right	<Ctrl> + R
Page Up	<Ctrl> + P
Page Down	<Ctrl> + N
Stop automatic update	<Ctrl> + V

Table 5.1.3a Cursor-control — equivalent key combinations

Some tables allow a value to be entered directly, or via a called-up menu. For direct entry, the first character(s) of the chosen option is (are) typed, followed by <Enter>. Alternatively, the menu can be accessed with <Enter> or <Tab> as the first character after the field is selected.

5.1.3 RUNNING THE CONFIGURATOR (Cont.)

INITIAL MENU ACCESS (Cont.)

IP SUBNETS

The current IP address system is known as Classless Inter-domain Routing (CIDR). The process supervisor predates this standard and divides the internet address space into a number of classes (see table 5.1.3b, below). For this type of addressing the subnet masks are on byte (as opposed to bit) boundaries. Therefore a subnet mask for a class C address such as 255.255.252.0 is converted to 255.255.255.0. In order to avoid misinterpretation of the information in the NETWORK.UNH always use valid pre-CIDR subnet masks.

Class	Address	Example	Default subnet mask
A	0 network: 7 bits; host: 24 bits	90.1.2.3	255.0.0.0
B	10 network: 14 bits; host: 16bits	128.0.1.2	255.255.0.0
C	110 network: 21 bits; host: 8 bits	192.0.0.1	255.255.255.0
D	1110 multicast group ID: 28 bits	224.0.0.1	None

Table 5.1.3b Address space class definitions

THE INITIAL MENU

The Initial menu (figure 5.1.3a, above) lists two options viz 'Database' and 'Gateway'. Database allows access to the Main menu for configuring a LIN database as described in section 5.2, below. Gateway allows access to the Gateway menu, for setting up a Modbus configuration. It is recommended that this configuration be carried out via the PC configuration program, as described in section 5.3.

QUITTING THE TERMINAL EMULATION PROGRAM

Exit from configuration mode must be done from the terminal by pressing <Escape> repeatedly until the following text appears.

```
...Do you really want to quit terminal configurator?
...Enter y or Y to quit or any other character to come back to the main menu

...?
```

<Y> or <y> takes the processor out of configuration mode. Any other key returns the user to the main menu.

Note: It is not possible to stop/start/download/upload files via Network explorer (E-suite package) for a processor in configuration mode. Any attempt to do so results in error 8333 ('Configurator in use') being reported. Processor configuration mode must be quitted before these operations are attempted.

CAUTION

Always quit the primary processor from configurator mode after use. If this is not done, an operator unaware that the Processor module is still in configurator mode might subsequently plug in a terminal and type <Enter> <Enter> — hoping to see the version and power-up/shutdown messages. The result could be totally unexpected because the configurator would react according to where it was left, e.g. if last used to start a database it would execute the start sequence (twice).

5.1.4 Database configuration

Figure 5.1.4a shows the Main menu.

```
MAIN MENU  Select option
(Running)
                    >MAKE       - Create block
                     COPY       - Copy block
                     DELETE     - Delete block
                     INSPECT    - Inspect block
                     NETWORK    - Network setup
                     UTILITIES  - Engineering utilities
                     ALARMS     - Current Alarms
```

Figure 5.1.4a Configurator Main menu

Annex A describes all of the above menu items. For convenience, UTILITIES is described below, as it is from here that the ELIN parameters are accessed.

UTILITIES

Allows program control, I/O calibration, and filing. Select UTILITIES from the main menu to display the Utilities options, shown in Figure 5.1.4b.

```
UTILITIES Select option

                    >START      - Start runtime system
                     STOP       - Stop runtime system
                     SAVE       - Save database
                     LOAD       - Load database
                     FILE       - File page
                     TRY        - Try Changes
                     UNTRY      - Untry Changes
                     APPLY      - Apply changes
                     UNDO       - Undo changes
                     ELIN       - Elin Setup
```

Figure 5.1.4b UTILITIES options menu

5.1.4 DATABASE CONFIGURATION (Cont.)

UTILITES (Cont.)

ELIN SETUP PAGE COMMAND

This page allows the instrument's network.unh file to be configured.

> Note: The network configuration can be edited using the Instrument Properties dialogue via the Project Environment or the instrument folder. The 'network.unh' file can also be edited using an appropriate text editor, e.g. 'notepad.exe'.

```
Elin Setup (network.unh file)
-------------------------------------------------------------------------
                                        |
LIN PROTOCOL SETUP                      | REMOTE SUBNET NODE LIST
                                        |
  Protocol Name        RKN              |  149.121.173.1
  All Subnet Enable    OFF              |
  Elin Only Enable     ON               |
LOCAL IP SETUP                          |
  Get Address Method Fixed              |
  IP Address           149.121.128.209  |
  Subnet               255.255.252.0    |
  Default Gateway      149.121.128.138  |
ELIN PARAMETERS                         |
  Unack Timeout          100  msec      |
  Rmt Unack Timeout     1000  msec      |
  No of retries            3            |
  EDB Timeout used         5  sec       |
  EDB Timeout Unused      30  sec       |
  DBM Timeout TX conf   2000  msec      |
```

LIN PROTOCOL SETUP — This area of the screen allows specification of those items in the "[LIN]" section of the network.unh file.

LOCAL IP SETUP — Allows the specification of those items in the "[IP]" section of the network.unh file. The IP address etc. is entered using data obtained from the network administrator.

ELIN PARAMETERS — Allows ELIN timeout and retry parameters to be edited. These parameters allow ELIN to be set up to run using slow networks such as radio MODEMs. Contact the Process Supervisor manufacturer for more details.

REMOTE SUBNET NODE LIST — Allows the user to enter the IP addresses of all the nodes with which it is required to communicate. (The "[PR]" section of the network.unh file.)

5.1.4 DATABASE CONFIGURATION (Cont.)

ELIN SETUP PAGE COMMAND (Cont.)

Once all the required entries have been made, the ESC key should be operated. A confirmation message asks if the network.unh file is to be updated. If 'Y', the file is updated and a power cycle is requested.

CROSS SUBNET WORKING

With 'All Subnet Enable' set 'OFF' (default), the instrument will not communicate ELIN cross subnet. This can be overridden in the network.unh file by setting 'All Subnet Enable' to 'ON'. This defines the behaviour when the Process Supervisor powers on. The ability to communicate cross subnet can be modified at run time by using the "Options.AllSubnt" bit in the instrument's header block. Set to TRUE, this bit enables cross-subnet working. When set to FALSE, cross-subnet working is disabled.

Note: This bit may be set FALSE, remotely, from a cross-subnet connection. If this is done, communications will be lost, and it will thus not be possible to reset it to TRUE from the cross-subnet connection.

5.2 LINTOOLS ON-LINE RECONFIGURATION

Note: The recommended method of editing a LIN Database is via the LINtools software.

LINtools provides the user with a view of control strategy components, such as those listed below, and an easy way to manage those components.

Databases (Function Block Diagram - FBD, file extension .dbf)

Sequences (Sequential Function Chart - SFC, file extension .sdb)

Action block methods (Structured Text - ST, and Ladder, file extension .stx and .sto)

Modbus Gateway configurations (file extension .ujg and .gwf)

In summary, LINtools:

1. Provides a simplified view of the instrument configuration
2. Provides Build and Download functions
3. Assigns LIN names and node addresses to external databases
4. Provides On-line Reconfiguration to a running LIN Database only

Notes:

1. External databases (EDBs) are LN Databases running in other LIN instruments.
2. On-line Reconfiguration does not apply to other files, e.g. Modbus Gateway file (.gwf), Sequential Function Chart file (.sdb) etc.

5.2.1 On-line Reconfiguration

On-line Reconfiguration of an I/O system may involve adding and editing blocks and wires in a running control strategy.

Changes, such as adding new function blocks and wires are automatically made as ‘Tentative’. However, when using on-line reconfiguration, LINtools will not permit changes to certain fields of I/O channel blocks unless specific criteria are met. To ensure that changes made to function block fields do not impact on the running control strategy until rwequired, the function block is detached from the control strategy.

On-line Reconfiguration allows the user to make ‘Tentative’ changes to a running control strategy before applying them. During on-line reconfiguration, the user can edit a LIN Database loaded in LINtools, and ‘Try’ changes in the instrument to ensure they have the desired affect. The user can then either ‘Apply’, ‘Discard’ or ‘Untry’ the changes.

‘Apply’ makes the changes permanent. both in LIN tools and in the instrument.

‘Discard’ restores the strategy to the preious saved state.

‘Untry’ removes the changes from the live instrument, but retains them in the host Computer, so that the changes can be edited in LINtools before tryng again.

CAUTION

Any changes made directly to a running block cannot be ‘Tried/Untried’, but are applied immediately (e.g. changing a function block value).

5.2.1 ONLINE CONFIGURATION (Cont.)

In order to make 'Tentative' changes to a running function block, the user must first 'Unlink' that function block in LINtools, so any changes are not directly applied to the function block in a running control strategy. The user can then 'Try' the changes as normal. The instrument creates a new copy of the function block, with all the changes, and runs it in place of the original.

At this point the instrument will be running the altered LIN Database, however, the original function block is still present in the LIN Database, thus allowing it to be restored if 'Untry' or 'Discard' is selected. The user can also 'Re-link' the function block, discarding all changes made to it, by selecting 'Undo Unlink' on the function block.

5.2.2 Preparing to run LINtools

Getting ready to run LINtools consists of two procedures:

1. Connecting the instrument to a Computer.
2. Creating a Project folder.

CONNECTING TO A COMPUTER

The instrument can be accessed over the Ethernet network via an Ethernet hub/switch connected to the 'config' port on the primary T940 module and to the Ethernet port on the computer.

Note To configure a redundant mode instrument, the computer must be linked to the primary processor.

CREATING A PROJECT FOLDER

A New Project folder is created via the 'New Project' wizard, started from the 'Start/Programs/ ... /New Project' command. Thereafter the context-sensitive menus are used to create the required Network and Instrument folders.

Note '...' indicates the file path of the installed software.

Each Network folder represents a network and type defined via the 'New Network' wizard and contains all the Instruments within that network. Each Instrument folder represents a type of instrument defined via the 'New Instrument' wizard and contains all the files required for the successful operation of the control strategy by the instrument at the specified address.

If the manufacturer's Project structure software is being used, then when all the Networks and Instruments have been created, the Build 'Project Name' command is used to enter all the configured project information into the Project database.

Notes:

1. Any automatically generated LIN Database can be saved to the correct Instrument folder using LINtools.
2. The Build command can be used at any time, but Networks must be built before Instruments.

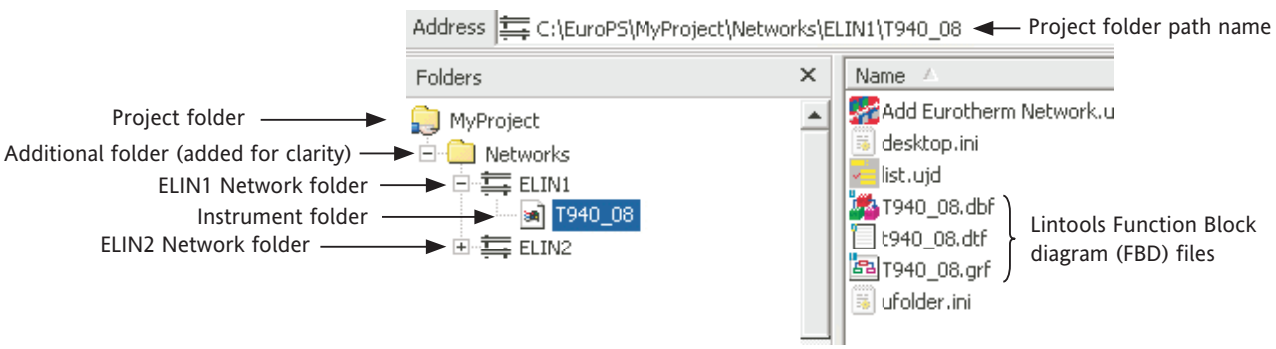


Figure 5.3.2 Project directory structure

5.2.3 Running LINtools

An empty LINtools instance can be started via the /Start/Progams/ ... / LINtools Engineering Studio command.

Note '...' indicates the file path of the installed software.

Use the 'Open' command to find an existing LIN Database in the Computer and then select the required file type and finally open, or simply double-click the LINtools Database file (.dbf), see LINtools OnLine Help for details of LIN Database configuration and Online Reconfiguration procedures using the LINtools program.

Note If the instrument is currently running an automatically created LIN Database (_auto.dbf) it can be copied to a Computer using the commands in the manufacturers Network Explorer, see 'Uploading an Instrument Control Strategy' below.

UPLOADING AN INSTRUMENT CONTROL STRATEGY

CAUTION

On-line Reconfiguration changes may seriously effect the operation of your system.

When a LIN Database has been automatically generated it exists only within the instrument. The manufacturers Network Explorer running on a Computer allows the LIN Database to be stopped, and then saved, with an appropriate filename. The copy to command can then be used to copy this LIN Database to an instrument folder, so it can be edited using LINtools. Once the automatically generated LIN Database has been copied and added to an instrument folder, it can be opened in LINtools.

LINtools displays a list of function blocks in order of creation, but this list can be converted in to a graphical representation to show the wiring between each function block clearly. The LIN Database file can now be edited, and when satisfactory, saved and downloaded to the instrument (see Downloading Instrument Control Strategy). If the LIN Database was edited before it was downloaded, a dialogue appears indicating that the LIN Databases are not the same. Confirmation is required before the download can start.

Note: Once the copied LIN Database has been opened in LINtools, sufficient information is available to allow LINtools to perform On-line Reconfiguration of the instrument LIN Database.

DOWNLOADING AN INSTRUMENT CONTROL STRATEGY

Any LIN Database currently running in an instrument can be edited using the On-line Reconfiguration (See On-line Reconfiguration - section 5.2.2). However, the LIN Database file, .dbf, and any other files on the Computer included in the download list, can be downloaded at any time. Appropriate indication is displayed when the LIN Database on the Computer and the Instrument LIN Database do not correspond, allowing the user to decide whether to continue.

RECONFIGURING INSTRUMENT CONTROL STRATEGY

Note: On-line Reconfiguration only applies to LIN Database files, .dbf.

Using the 'Apply' command during On-line Reconfiguration causes changes in the running LIN Database to be saved. Other files (e.g. Modbus Gateway file (.gwf), Sequential Function Chart file (.sdb),or User Screen PageSets file (.ofl), etc.), that have been edited using the relevant Tools, or which are dependent on the LIN Database at load, MUST be downloaded. After files have been downloaded and the strategy is stable, the application must be stopped and then loaded again, or the instrument must power-cycled.

5.3 MODBUS TOOLS

This section refers to the Process Supervisor when operating in Modbus Slave mode. When operating as a master, the Process Supervisor uses DCM blocks (e.g. D25-AI). For details, refer to the communications manual HA028014.

Any LIN instrument can be configured as a Modbus Master communicating with one or more Modbus instruments. A LIN instrument may alternatively be configured as a Modbus Slave instrument.

Note This software application supports up to three Modbus Gateway configurations.

Modbus Tools defines the communications between LIN and Modbus instruments.

Modbus configuration data is defined in a Modbus Gateway File (.gwf) which is downloaded, with the LIN Database (.dbf), into a LIN instrument. The data in the .gwf is used to define the transfer of data between LIN and Modbus instruments.

This data defines:

1. The operating mode (i.e. Modbus Slave)
2. The serial line set-up (or TCP)
3. The mapping between fields in function blocks and the registers of a Modbus instrument
4. How field values are transferred between instruments (which Modbus functions to use, Modbus register addresses and the format in which data is to be transferred).

5.3.1 Preparing to run Modbus Tools

As the Modbus Tools can be accessed from within the LINtools program it requires the same preparation as LINtools, consisting of:

1. Connecting the instrument to a Computer.

2. Creating a Project folder.

The Modbus Tools OnLine Help should be referred to for details of Modbus Configuration procedures using Modbus Tools.

5.3.2 Running Modbus Tools

An empty Modbus Tools window can be started via the ‘Start/ .../ LINtools Advanced/MODBUS Tools’ command. Use the ‘Open’ command to locate the required Instrument, select the required file type and open.

Alternatively, double-click the LIN MODBUS Database file (.ujg) from the required Instrument folder.

Note The Modbus Tools OnLine Help should be referred to for details of Modbus configuration procedures using Modbus Tools.

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CHAPTER 6 ERROR CONDITIONS & DIAGNOSTICS

This chapter describes the various ways to tell if a fault has occurred in the process supervisor, (not in the process being supervised).

The main topics covered are:

6.1 Error indication types
6.2 Processor module front-panel error displays
6.3 Power-up failures
6.4 Power-on self-tests
6.5 Diagnostic blocks
6.6 Error numbers

6.1 ERROR INDICATION TYPES

Error indications include:

LEDs. The processor module LEDs are the most immediate source of error and instrument status information concerning basic I/O system (BIOS) start, watchdog functions and normal running. During BIOS start, a number of the front panel LEDs are intermittently illuminated to indicate the BIOS status. If a processor start fails, the pattern that these LEDs adopt prior to the failure is helpful to service engineers, so it is recommended that this pattern is recorded (along with the unit serial number) before a service call is made.

Error messages.

A large number of highly specific error messages are transmitted (mainly during start-up) by the processor modules, which can be viewed if a VDU terminal is attached via the EIA232 CONFIG port on the front of the processor unit.

POSTs. The results of power-on self-tests (POSTs) can be used to pinpoint error conditions in the instrument.

Diagnostic blocks.

A range of function blocks can be included in the running strategy database to provide diagnostic information on various topics, including the redundancy mechanism, the ICM (inter-processor communications), the I/O interface, and others.

6.2 PROCESSOR MODULE FRONT PANEL ERROR DISPLAYS

6.2.1 LEDs

Figure 6.2.1 shows the processor module front-panel LEDs. Table 6.2.1 specifies their functions.

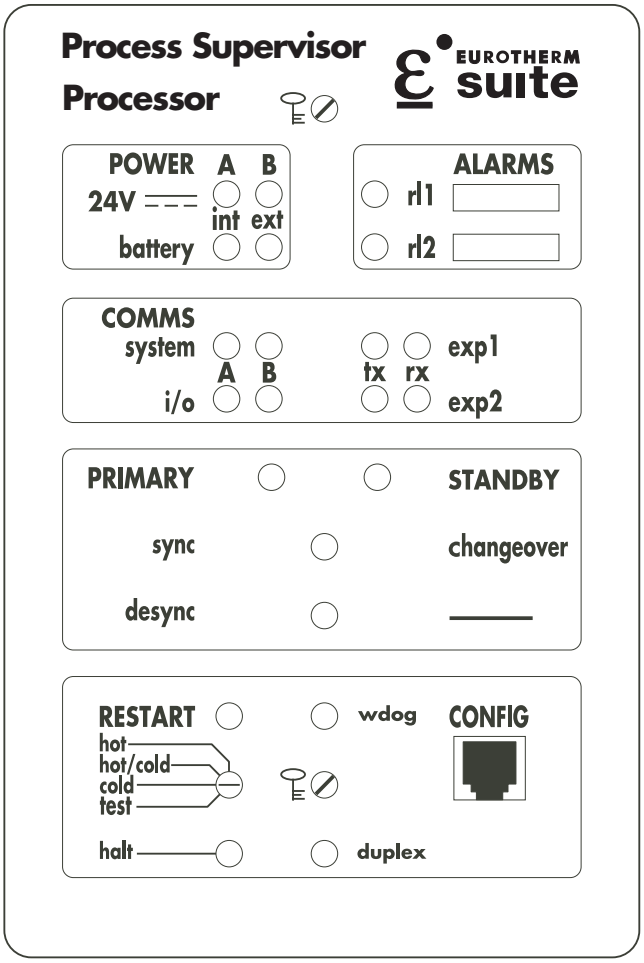

Figure 6.2.1 Processor module front panel

6.2.1 LEDs (Cont.)

			Diagnostic Value
Power	Power A	Green..... Main power input valid Off..... Main power input failed	
	Power B	Green..... Auxiliary power input valid Off..... Auixiliary power input failed	
	backup ext	Green..... External battery power valid (Off until start-up complete) Off..... External battery power failed	
	backup int	Green..... Internal battery power valid (Off until start-up complete) Off..... Internal battery power failed	
Alarms	rl1	Yellow..... Alarm active Off..... Alarm not active	08
	rl2	Yellow..... Alarm active Off..... Alarm not active	04
Comms	System A	Green..... System A communications valid Red..... System A communications hardware failure Flashing Red/Off..... System A communications cable fault Off..... System A communications not in use	
	System B	Green..... System B communications valid Red..... System B communications hardware failure Flashing Red/Off..... System B communications cable fault Off..... System B communications not in use	
	I/O A	Green..... I/O A communications valid Red..... I/O A communications hardware failure Flashing Red/Off..... I/O A communications cable fault Off..... I/O A communications not in use	
	I/O B	Green..... I/O B communications valid Flashing Green/off.. Remote unit fault (Profibus comms. only) Red..... I/O B communications hardware failure Flashing Red/Off..... I/O B communications cable fault Off..... I/O B communications not in use	
	Exp1 Tx / Rx	Intermittent yellow....Communications taking place	Rx = 20 Tx = 10
	Exp2 Tx / Rx	Intermittent yellow... Communications taking place	Rx = 80 Tx = 40
Startup	Primary	Green..... This CPU is primary Off..... This CPU is not primary Flashing.....Powered up but no database is running	02
	Standby	Yellow.....This CPU is secondary and synchronised Off..... This CPU is not secondary synchronised Flashing.....Synchronisation process in progress.	01
	wdog	Green Normal running (including system boot) Red Watchdog failure; CPU in reset Red 25% Grn 75% Instrument starting - system healthy Red 75% Grn 25% Instrument starting - system unhealthy (low supply voltage or fan failure). Orange Instrument too hot	
	Duplex	Green..... Redundancy communications valid Off..... System in non-redundant mode Red 50%/Grn 50%.. Inter CPU communications failed	

Table 6.2.1 Processor LED functions

6.2.2 Processor failure modes

The front-panel LEDs can indicate directly the following processor module failure or potential failure modes: power loss, watchdog failure, desynchronisation, loss of primary status, database halt, communications failure, and ICM failure.

When a processor, which is running as one of a redundant pair, fails, it usually changes its redundancy state in response to the failure, e.g. from primary to secondary, or from synchronised to unsynchronised. Figure 6.2.2 maps out various ways in which a pair of processor modules might fail, and shows how they change redundancy state as a consequence.

In the figure, the boxes represent possible processor module states, and the arrowed lines between boxes represent transitions from one state to another. Arrows are labelled with the fault conditions causing the transition. 'Primary processor module' and 'secondary processor module' are abbreviated as '#1' and #2' respectively. The front panel LEDs help to identify what state each processor is in, as well as the nature of any failure. (The 'Comms' LEDs will be on, off or flashing as indicated in table 6.2.1.)

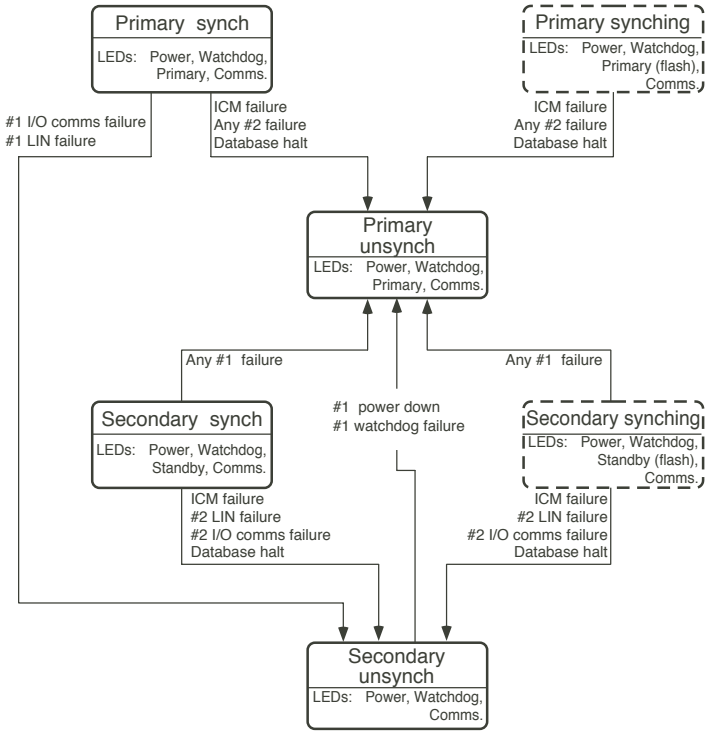

Figure 6.2.2 Processor unit failure modes

6.2.3 Power failure

In the event of a power failure all the LEDs associated with the affected processor are extinguished and the processor adopts the OFF state.

PRIMARY PROCESSOR MODULE

A power failure in the primary unit of a redundant pair, will cause the secondary unit to adopt the Primary Unsynch state.

If the secondary was not synchronised at the time, the database halts. The new primary's PRIMARY LED flashes to show that the database is not running.

If the secondary was synchronised at the time of takeover, the database continues to run in the new primary (PRIMARY LED on continuously).

SECONDARY PROCESSOR MODULE

A power failure in the secondary unit of a redundant pair, will cause the primary unit to enter the Primary Unsynch state.

6.2.4 Watchdog failure

In the event of a watchdog failure of a processor module, the green watchdog LED is illuminated red and the affected processor module enters a 'Watchdog fail' state.

In this state the indications given by the standby, primary, and comms LEDs are unreliable and should be ignored. Operation of the RESTART button resets the watchdog and restarts the CPU if this is possible.

On watchdog failure of a processor module in redundant mode, the surviving processor module adopts (or maintains) the PRIMARY UNSYNCH state. And as in the case of power failures, the survivor runs the database only if it was synchronised before takeover, halting it otherwise.

6.2.5 ICM (Inter-CPU Messaging for redundancy) failure

Note: An ICM failure is not associated with any single processor module, and so is not classed as either primary or secondary in figure 6.2.2.

An ICM failure is indicated by the standby and duplex LEDs when the primary and secondary processors can no longer communicate with each other across the internal high-speed link, making database synchronisation impossible to maintain. Figure 6.2.2 shows that an ICM fail causes desynchronisation of the processor modules, but no primary/secondary changeovers.

STANDBY LED:	Off	
Duplex LED	Off	No communications link established
	Flashing red/green	Communications possible, but not taking place (usually due to a 'desynch' request.)

6.2.5 ICM FAILURE (Cont.)

ACTION IN THE EVENT OF ICM FAILURE

In the event of an ICM failure the processors desynchronise. The control strategy must be designed to present the supervisory system with an appropriate alarm to annunciate this state. (E.G. use the RED_CTRL block's *ICM_Ok* status bit).

If the ICM does fail, the secondary processor module should be replaced. If this solves the problem re-synchronise the processors. If the fault persists, the running, primary processor module is the most likely cause and should be replaced. Initially the original secondary should be re-fitted as it is unlikely to be faulty and will still retain the current database in memory, with the parameter values existing at the time of desynchronisation. The faulty primary, should now be removed, this causing the secondary to take over as sole primary but with a stopped database. If appropriate, restart the existing database by powering down and then up again. Otherwise, reload a 'default' database and restart it in the new primary.

This last option is a cold start and requires manual supervision of the plant during the transition.

Note: A fault in the backplane is a possible but unlikely cause of ICM failure.

6.2.6 LIN failure

This occurs when a processor is not communicating over the LIN, because the cable is damaged or disconnected or there is a hardware (electronics) failure.

An interconnection failure causes the relevant comms LEDs associated with the affected processor module to flash on and off. A hardware fault is indicated by the relevant System or i/o LED's being illuminated continuously red.

A LIN failure in a synchronised primary processor module causes primary/secondary changeover and loss of synchronisation, i.e. Primary synch adopts Secondary unsynch, and Secondary synch adopts Primary unsynch.

Figure 6.2.2 shows that if an unsynchronised primary processor module suffers a LIN failure no changes of state occur (there are no arrows leading *out* of the PRIMARY UNSYNCH box).

In the event of a LIN failure in a synchronised secondary processor, it adopts the Secondary unsynch state (yellow standby LED off), and the primary processor module correspondingly desynchronises to the Primary unsynch state). If the secondary processor module was unsynchronised at the time of the failure, no change of state occurs.

EFFECT OF LIN FAILURE ON REDUNDANCY MODE CONTROL

LIN failure affects the ability to synchronise processor modules. A LIN-failed secondary processor cannot successfully be synchronised with the primary by pressing the primary's synch switch, for example. Attempts to do this are inhibited by the redundancy control software, and this is indicated by the yellow standby LED's lack of response.

6.2.7 Database stop

If the database in the primary processor stops running for any reason, the green primary LED starts to flash and the processor modules desynchronise. Attempts to resynchronise are inhibited by the redundancy control software. The yellow standby LED of the secondary processor is extinguished.

6.2.8 I/O Comms failure

This occurs if a processor detects a hardware or interconnection fault in the link to the I/O system(s) it is attempting to communicate with. If a fault is detected, this is indicated by the relevant i/oA, i/oB, or System LED's going red; either continuous red (hardware fault) or flashing red/off (connection fault).

As shown in figure 6.2.2, if an I/O failure is detected with redundant processors in any state other than 'unsync', the two processors will go into their unsync states. If the failure is in the primary, then the secondary will become the new primary and assume control, and the original primary will become the secondary. If the failure is in the secondary, no change-over occurs.

6.3 POWER-UP FAILURE

6.3.1 Processor unit power-up routine

A number of error conditions can occur during the power-up phase of a processor module. This power-up routine is described in Chapter 4, and this should be referred-to for detailed information. Various messages are generated by the processor module during power-up, and these can be displayed on a VDU terminal attached to the front-panel EIA232 CONFIG connector (see chapter 2). These messages appear when configuration mode is accessed. Full lists of error messages are given in section 6.6 of this chapter.

Figure 6.3.1a charts the power-up routine in a simplified schematic form, and figure 6.3.1b shows the hot start 'subroutine' that may be called by the main power-up routine. The two flow diagrams also show various error conditions.

6.3.1 PROCESSOR UNIT POWER-UP ROUTINE (Cont.)

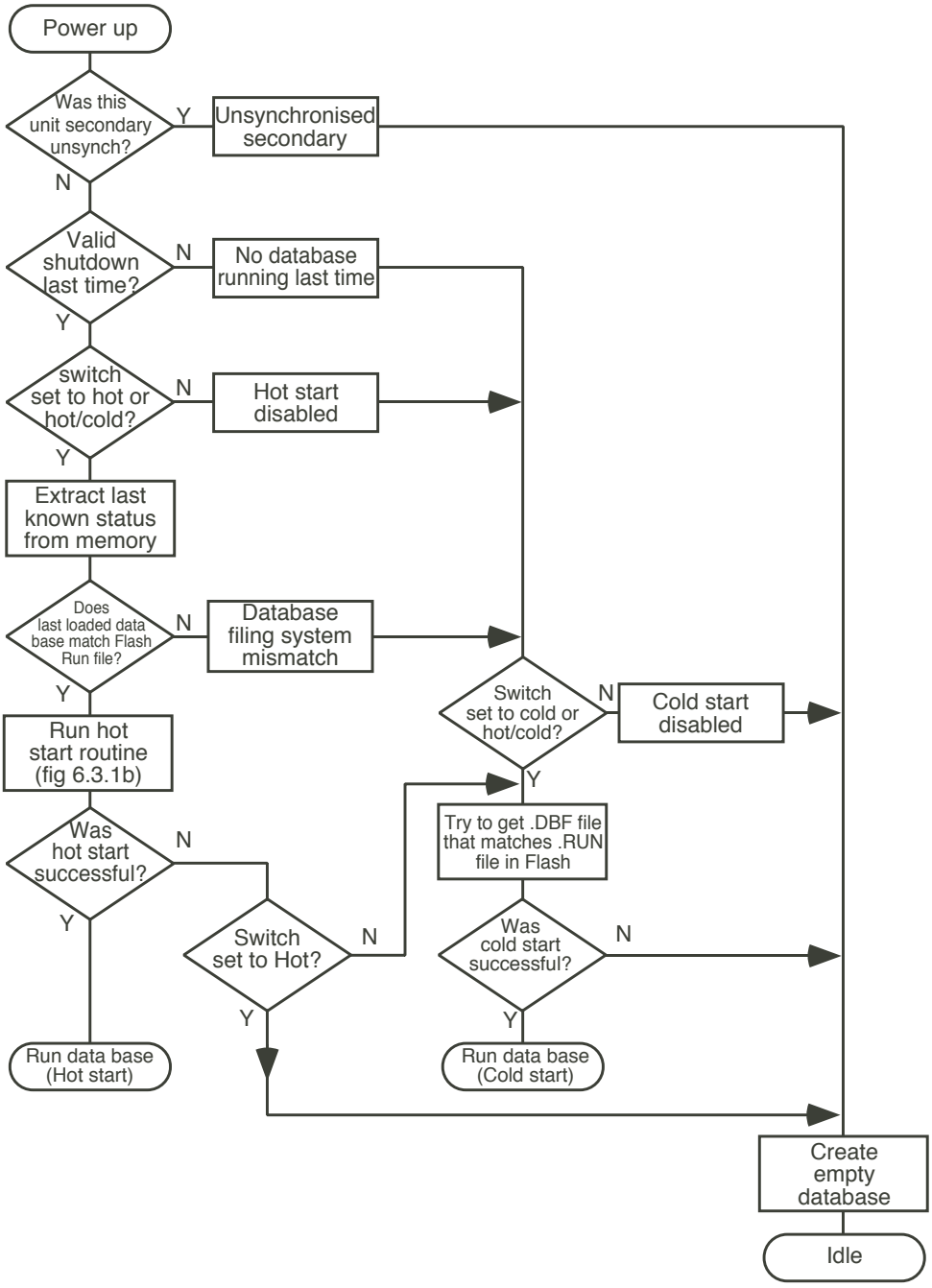

Figure 6.3.1a Processor unit power-up routine flowchart — simplified

6.3.1 PROCESSOR UNIT POWER-UP ROUTINE (Cont.)

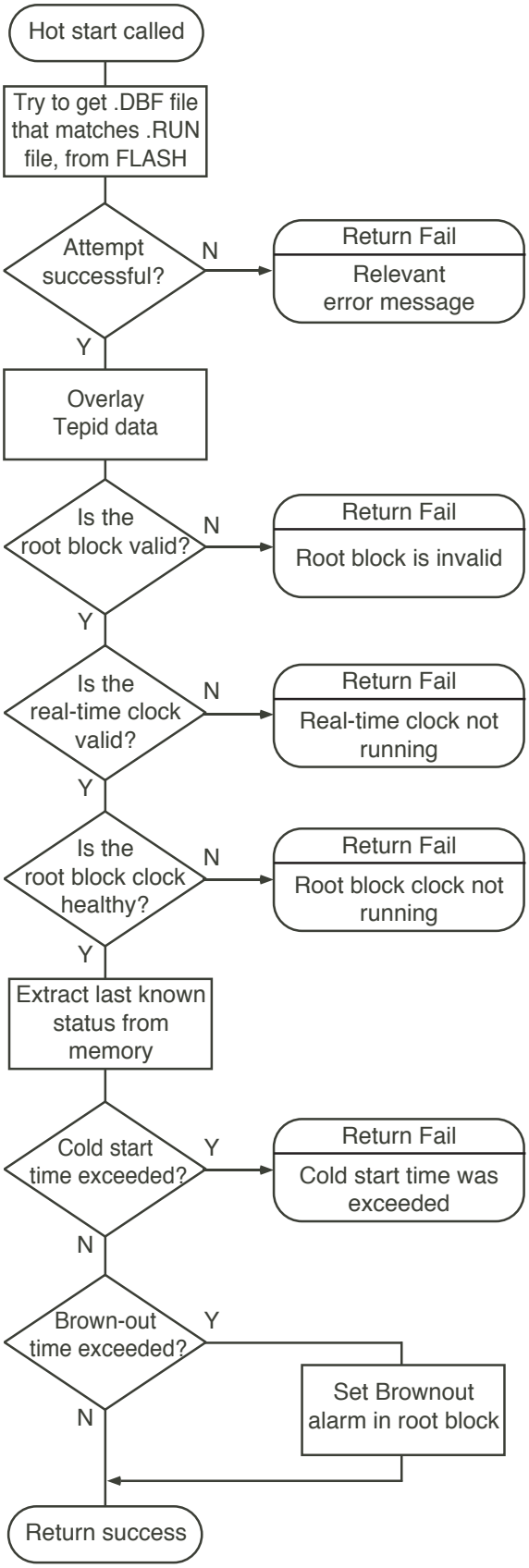

Figure 6.3.1b Processor unit warm start routine flowchart — simplified

6.4 POSTS (POWER ON SELF TESTS)

Whenever a processor module is powered-up, it automatically performs a series of diagnostic tests. The results can be displayed on a VDU terminal plugged into the EIA232 CONFIG port in the processor front panel as described in Chapter 5 of this manual.

Note: It is recommended that the terminal screen be cleared <Ctrl>+<W> prior to use. If the screen has not been cleared the POST output may merge with the existing display and be unreadable.

At switch on, the Basic I/O system (BIOS) starts running and checks that the Central Processor Unit (CPU)* is operating correctly. This stage of power-up is apparent by the intermittent lighting of what are called the 'BIOS LEDs' shown in figure 6.4, below. Should the CPU fail to initialise fully, the final pattern of these LEDs may be of use to service engineers, but is not interpretable by the user.

* Note: This CPU is a part of the internal electronics of the 'Processor Module' and the two terms should not be confused.

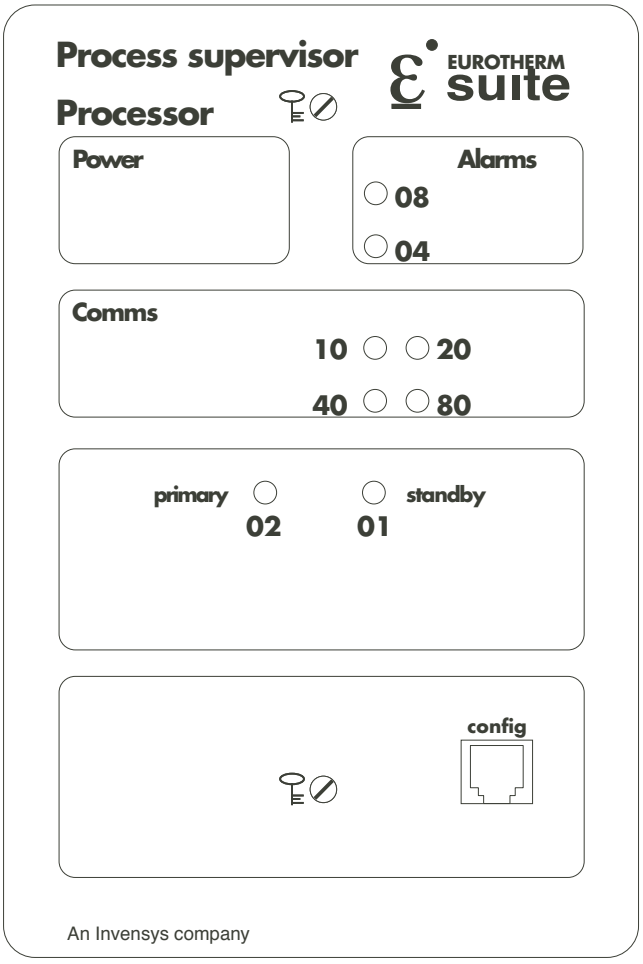

Figure 6.4 BIOS LEDs and their code values

6.4 POWER-ON SELF TESTS (Cont.)

Once the CPU is running, it runs the Boot ROM (Flash disk) which enables the system monitor (SMON). If the system monitor is not entered within one second, the start-up process continues with the loading of the application and system code from the FLASH ROM (accessible at the rear of the unit). At this point, a 1 second entry point for a second monitor (the 'M' monitor) appears (10 seconds for TEST start-up). Refer to Section 8.4 for details of the monitors.

The POST now checks that all the electronic systems hardware is available for the Communications protocols* required by the software. If not, this is deemed to be a 'Serious Hardware Fault', and although the power-up sequence continues, the processor will not load a data base, and will stop with its Primary LED flashing on and off, and the relevant Comms LED in its fault condition.

*Note: Checks are not carried out on Modbus.

The System now attempts to start the software, determining first whether the options switch (SW2) on the backplane is set for redundant or non-redundant mode.

If redundant working is required, the primary/secondary status of each processor module is decided, according to the criteria in Section 4.4.1, if necessary, using 'signature' data relating to last-time's power down, auto synchronise states and so on.

A check is made to ensure that the ICM (inter-processor) communications are valid, and if so, the primary processor continues-its power up sequence, according to the mode selected at the front panel switch. The STANDBY LED starts flashing on and off when the primary starts to down load data to the secondary.

If the ICM test fails, or if non-redundant working is required, the processor(s) continue the power-up sequence, according to the mode selected at the front panel switch.

A diagnostic test result code appears at the bottom of the screen, with a value of 0000 (check successfully completed), 0001 (only minor problems reported) or 0002 (major problem(s) reported). If the code is 0002, the processor fails to power-up.

6.4 POWER-ON SELF TESTS (Cont.)

ERROR TYPES

SERIOUS ERRORS.

Serious errors are reported if the unit's operation is impaired, but still capable of running. These errors are:

1. ELIN/ALIN/Profibus hardware failure. Results in an inability to communicate with those systems using the particular protocol. The relevant front panel LEDs are continuously red.
2. Less than 8 MB of memory in dynamic RAM.
3. No config.txt file (normally installed on the system FLASH device, or created via the monitor)

FATAL ERRORS.

A fatal error is one where the unit's operation is impaired to the extent that it cannot continue to operate, or cannot start up. In a redundant system, the processor modules will desynchronise. This type of error is caused when Flash memory is not available due to a hardware fault.

6.5 DIAGNOSTIC BLOCKS

Several diagnostic function blocks are available from the DIAG category, that can be installed in the control database at configuration time to help in diagnosing any error conditions that may arise in the running strategy. The VIEW facility in the LINtools package can then be used, via the LIN network, to look at the fields in these blocks to find out what is happening. Alternatively a terminal emulation program running in a PC can be used to access the processor module's resident configurator, via the EIA232 CONFIG connector, to allow the diagnostic block parameters to be viewed in inspection mode.

These diagnostic blocks are described in the LIN Product Manual (HA082375U999). The table below provides a brief summary.

BLOCK	FUNCTION
PS_TASK	Block server tasks timing information, in priority order.
ICM_DIAG	ICM (Inter-CPU Messaging for Redundancy) diagnostics. Statistics on numbers and types of message passing between redundant processor modules.
RED_CTRL	Redundancy control block. Shows Processor Redundancy Management Task (PRMT) parameters. Can also be used to trigger processor module synchronisation, desynchronisation, and primary/secondary processor swap.
FTQ_DIAG	Low-level statistics on the queues maintained by the PRMT for interfacing with the various processes occurring in the Unit controller/supervisor.
MDBDIAG	Modbus diagnostics.
PMC_DIAG	Simple Profibus
PBUS_DIAG	Detailed Profibus
TOD_DIAG	Time-of-day synchronisation diagnostic block. Statistics on broadcasts, requests, receipts, rejections, etc.
SFC_DIAG	Sequence-related diagnostics and resource statistics. Number of configured and available resources.

6.6 ERROR NUMBERS

This section lists the error messages that may be seen during the running of the Unit controller/supervisor connected to a terminal — either via the EIA232 port or over other serial ports.

6.6.1 Error number structure

All error conditions have an associated 4-digit number, and usually a corresponding text message as well. Error numbers are hexadecimal 4-digit groups. The first two digits show the 'package' that was running when the error occurred, and the last two specify the particular error associated with that package.

RUNNING PACKAGES

Packages are defined as:

82	File system (table 6.6.2a)
83	Database system (table 6.6.2b)
85	Objects system (table 6.6.2c)
86	Trend system (table 6.6.2d)
87	Control config (table 6.6.2e)
89	Network error (table 6.6.2f)
8B	Sequence database system (table 6.6.2g)
8C	Sequence runtime system (table 6.6.2h)
8D	Structured text system (table 6.6.2i)
8F	PCLIN/PC I/F package (table 6.6.2j)
90	T1000 menu system (table 6.6.2k)
91	Configuration files (table 6.6.2l)
99	External database (table 6.6.2m)
9A	MODBUS codes (table 6.6.2n)
9B	Xec codes (table 6.6.2p)
9C	Kernel items (table 6.6.2r)
9D	Objects (table 6.6.2s)
9E	Locks (table 6.6.2t)
A0	Machine Architecture Library (MAL) (table 6.6.2u)
A1	Application Master Comms (AMC) (table 6.6.2v)
A4	Modbus Master Comms (MMC) (table 6.6.2w)
A6	Asynchronous I/O (table 6.6.2x)
AD	Profibus (table 6.6.2y)

6.6.2 Error messages

Table 6.6.2 lists error messages package by package. Note that this is a complete list of all error messages generated by LIN-based systems, and therefore includes errors that are additional to those which can be generated by the Process Supervisor.

The error code FFFF means "unknown".

6.6.2 ERROR MESSAGES (Cont.)

8201	Not mounted
8202	Invalid device
8203	Physical error
8204	Not implemented
8205	Format error
8206	Not present
8207	Device full
8208	File not found
8209	No handle
820A	Bad filename
820B	Verify error
820C	File locked
820D	File read-only or No key fitted
820E	Unable to perform file check
820F	Unable to defer another file during synchronisation
8210	Illegal combination of open flags
8211	Couldn't complete file operation as synchronisation is in progress
8212	File cannot be modified
8213	Failed to duplicate file operation
8214	No handle to duplicate queue
8215	File systems no longer synchronised
8216	Synchronisation aborted
8217	Response length error
8218	File system timeout
8219	File synchronisation not requested
821A	Duplicate on secondary rejected
821B	Non specific error
821C	Sync fail due to .DBF check
821D	Sync fail due to .DBF load file name error
821E	Drive letter already assigned
821F	Filing out of memory
8220	Illegal link drive letter
8221	No such link exists
8222	Read/write file transfer to large
8223	Read file error
8224	Write file error

Table 6.2.2a File system error codes (82xx)

8301	Bad template
8302	Bad block number
8303	No free blocks
8304	No free database memory
8305	Not allowed by block create
8306	In use
8307	Database already exists
8308	No spare databases
8309	Not enough memory
8320	Bad library file
8321	Bad template in library
8322	Bad server
8323	Cannot create EDB entry
8324	Bad file version
8325	Bad template spec
8326	Unable to make block remote
8327	Bad parent
8328	Corrupt data in .DBF file
8329	Corrupt block spec
832A	Corrupt block data
832B	Corrupt pool data
832C	No free resources
832D	Template not found
832E	Template resource fault
8330	Cannot start
8331	Cannot stop
8332	Empty database
8333	Configurator in use or device busy
8340	.DBF file write failed
8341	More than one .RUN file found
8342	.RUN file not found
834A	Connection Source is not an O/P
834B	Multiple connection to same I/P
834C	Connection Destination not I/P
834D	No free connection resources
834E	Bad conn. src/dest block/field
834F	Invalid connection destination
8350	Warmstart switch is disabled
8351	No database was running
8352	Real-time clock is not running
8353	Root block clock is not running
8354	Coldstart time was exceeded
8355	Root block is invalid
8356	Too many control loops
8357	Coldstart switch is disabled
8360	Unsynchronised Block Types
8361	DB/Filing system mismatch
8362	Unsynchronised Secondary
8363	Operation forbidden whilst CPUs synchronising/ changing over
8364	Pwr-up data inhibits run
8365	POST hardware failure
8366	Not fixed function strategy
8367	Default strategy missing

Table 6.6.2b Database system error codes (83xx)

6.6.2 ERROR MESSAGES (Cont.)

8501	Out of F RAM - DO NOT save file
8502	Out of N RAM - DO NOT save file

Table 6.6.2c Objects system error codes (85xx)

8602	Bad channel number
8603	Bad type code
8611	Bad handle or not hist
8613	File exists
8614	Exceeded global limit
8615	Unexpected end of file
8616	Read error
8617	Write error
8619	Bad filename
861A	Bad timestamp

Table 6.6.2d Trend system error codes (86xx)

8701	Unnamed blocks
8702	Cannot save compounds
8703	No root block
8704	.GRF file write failed
8705	Compounds too deep
8706	Unused GRF block - deleted
8707	Unused GRF connection - deleted
8708	Missing GRF block - added
8709	Missing GRF connection - added
870A	Unknown DBF/GRF block mismatch
870B	Unknown DBF/GRF connect mismatch
870C	DBF/GRF file mismatch - use FIX

Table 6.6.2e Control config error codes (87xx)

8901	Network timeout
8902	Rejected by local node
8903	Rejected by remote node
8904	Not implemented
8905	Not active on local node
8906	Not active on remote node
8907	Transmit failure
8908	Failed to get memory
8909	Decode packet
890A	Remote file system busy
890B	Illegal TEATT
890C	Wrong TEATT
890D	NServer is busy
890E	TEATT not owned
890F	Duplicate block
8910	TEATT rejected
8911	Port disabled
8912	No port configuration
8913	Bad network filename
8999	Network node invalid

Table 6.6.2f Network error codes (89xx)

8B01	Object Overload
8B02	Text Overload
8B03	No Matching Step Name
8B04	No Matching Action Name
8B05	Step already Exists
8B06	Action already Exists
8B07	Link already Exists
8B08	Leave a Bigger Gap
8B09	Bad Time Format
8B0A	File Read Error
8B0B	File Write Error
8B0C	File doesn't Exist
8B0D	File not Open
8B0E	Create Action ?
8B0F	No Match with string
8B10	No More Matches
8B11	Match found in Transition
8B12	Match found in Action
8B13	Changed - Are you sure ?
8B14	Link Already Exists
8B15	Illegal Chars in Name
8B16	Action Did Not Compile
8B17	Fatal Memory Overflow - Quit Now!
8B18	Out of memory when compiling
8B19	Root action must be SFC
8B1A	Invalid actions found during compilation
8B1B	Invalid DB name
8B1C	No database loaded
8B1D	Map is invalid

Table 6.6.2g
Sequence data base system error codes (8Bxx)

8C01	Database not Running
8C02	No Sequences Loaded
8C03	Sequence is being displayed
8C04	Cannot find an SFC_DISP block
8C05	Cannot find Source File
8C06	Sequence Not Loaded

Table 6.6.2h Sequence runtime error codes (8Cxx)

6.6.2 ERROR MESSAGES (Cont.)

8D01	Syntax Error
8D02	Statement expected
8D03	Assignment expected
8D04	THEN expected
8D05	no ELSE or END_IF
8D06	END_IF expected
8D07	";"expected
8D08	Bad bracket matching
8D09	Identifier too long
8D0A	Bad identifier
8D0B	Unrecognised symbol
8D0C	Code Buffer Full
8D0D	Expression expected
8D0E	Can't find this name
8D0F	"String" > 8 chars
8D10	End quotes expected
8D11	Bad Number.

Table 6.6.2i Structured text error codes (8Dxx)

8F01	PCLIN Card not responding
8F02	PCLIN Request failed
8F04	EDB not known or not external
8F07	Unknown EDB
8F0A	Unable to delete ED
8F14	Bad block number
8F15	Template mismatch
8F16	Block failed to attach
8F17	Block failed to detach

Table 6.6.2j PCLIN/PC I/F package error codes (8Fxx)

9001	Invalid PIN
9002	PINs do not match - unchanged
9003	Invalid PIN - reset to 1234
9004	Access denied
9005	Invalid default security info
9006	Invalid DTU A security info
9007	Invalid DTU B security info

Table 6.6.2k T1000 menu system error codes (90xx)

9100	Couldn't open config file
9101	Section not found
9102	Parameter not found
9103	Argument not found
9104	Config area too small
9105	Config file syntax error
9106	Config header corrupted
9107	Not a number
9108	Out of memory

Table 6.6.2l Configuration files error codes (91xx)

9901	No EDB's left
9902	EDB already exists
9903	Invalid EDB

Table 6.6.2m External data base errors (99xx)

9A01	Invalid Second Register
9A02	Not a 32 bit field type
9A03	Invalid Scan Count
9A04	Incorrect Modbus function types
9A05	Invalid register position
9A06	Second register of 32 bit pair
9A07	Invalid register type

Table 6.6.2n MODBUS error codes (9Axx)

9B01	Illegal unique task id
9B02	Task id already being used
9B03	No more task control blocks
9B04	Out of XEC memory
9B64	Task aborted
9B65	Task timeout

Table 6.6.2p Xec error codes (9Bxx)

6.6.2 ERROR MESSAGES (Cont.)

9C01	Already registered
9C02	Too many kernel users
9C03	Couldn't allocate the local storage that was required
9C04	Error changing priority
9C05	Need to supply an instance name
9C06	Failed to get platform info
9C07	Platform not known
9C33	Feature not implemented (QUE)
9C34	Insufficient memory supplied (QUE)
9C35	Size of data for read or write invalid (QUE)
9C36	Unable to write to queue
9C37	Unable to read from queue
9C38	Unable to allocate memory (QUE)
9C65	No Kernel instance to make intra-signal unique
9C66	Signal already exists
9C67	Failed to create signal
9C68	Failed to open signal
9C69	Failed to close signal
9C6A	Timeout waiting on signal

Table 6.6.2r Kernel items (9Cxx)

9D01	Object already exists
9D02	Out of objects
9D03	Object does not exist
9D04	Bad invocation parameter
9D05	Object handle is now stale
9D06	Object handle is invalid
9D07	Too many users of object

Table 6.6.2s Objects error codes (9Dxx)

9E01	Lock has entered an inconsistent state and cannot be granted
9E02	Lock was not granted in the required mode
9E03	Timeout attempting to acquire
9E04	Unable to convert mode of lock
9E05	Already hold a read lock
9E06	Already hold a writer lock
9E07	Do not hold a read lock
9E08	Do not hold a writer lock
9E09	Write lock detected during read unlock
9E0A	Reader lock detected during write unlock
9E0B	Unable to grant read to write conversion as a conversion of this form is already in progress
9E0C	Unable to represent user in lock control structures
9E0D	lck_Unlock invoked but not enabled
9E0E	Nesting requested but lock not a mutex
9E0F	Overflow of nested mutex
9E10	Unable to convert a nested mutex

Table 6.6.2t Locks error codes (9Exx)

A001	Could not create user's event (MAL)
A002	Could not open user's event (MAL)
A003	Could not set user's event (MAL)
A004	Unable to grant system wide mutex due to it being in an inconsistent state
A005	Unable to grant system wide mutex due to a timeout
A006	Unable to grant system wide mutex reason unknown
A007	Unable to grant system wide mutex as not created
A008	Unable to suspend user (MAL)
A009	Unable to allocate memory (MAL)
A00A	Unable to change priority (MAL)
A00B	Error waiting on signal (MAL)
A00C	Error releasing signal waiters (MAL)

Table 6.6.2u MAL error codes (A0xx)

A101	Cyclic comms enabled on node(s)
A102	No memory left
A103	Bad info given
A104	Data is referenced
A105	No data group installed
A106	Pending message
A107	Fault external to AMC
A108	Not supported
A10A	Conflict
A10B	Task not running
A10C	Bug
A10D	Manual cyclic only (pmc reject)
A10E	Cannot add cyclic request
A10F	Slave rejected cyclics
A110	No pmc callback

Table 6.6.2v AMC error codes (A1xx)

A401	Out of / Bad resource(s)
A402	Bad info supplied
A403	Pending message
A404	Problem external to MMC
A405	Not supported
A406	Timeout
A407	Frame parity error
A408	Corrupt message
A409	Link protocol error
A40A	Modbus exception recvd
A40B	Tx fail

Table 6.6.2w MMC error codes (A4xx)

6.6.2 ERROR MESSAGES (Cont.)

A601	Asynchronous I/O in progress
A602	No asynchronous I/O in progress
A603	Not yet implemented
A604	Tx operation complete but not all characters transferred
A605	Rx operation complete, but not all characters received
A606	Event not unique
A607	General CIO error
A608	No asynch. operation fetched
A609	Out of serial lines
A60A	Unable to allocate the requested line
A60B	Failed to submit asynchronous I/O
A60C	Input/output timed out
A60D	Indeterminate error during fetch
A60E	I/O timed out but failed to cancel operation in progress

Table 6.6.2x Asynchronous I/o error codes (A6xx)

AD01	Cyclic data not available	AD20	Not used
AD02	Cannot make cyclic into acyclic	AD21	Unable to set master protocol params.
AD03	Profibus C1 not allowed	AD22	Unable to set master comms params.
AD04	Profibus C2 not allowed	AD23	Unable to set slave comms params.
AD05	Acyclic frag. limit exceeded	AD24	Failed to start Profibus line task
AD06	Comms line requested is not Profibus	AD25	Failed to stop Profibus line task
AD07	Resource alloc failure	AD26	Bad slave diagnostic
AD08	PMC not initialised	AD27	Acyclics restarted
AD09	No more cyclic data space	AD28	Master rejected acyclic req.
AD0A	No more cyclic tag space	AD29	Master acyclic resp. error
AD0B	Attempt to append while running	AD2A	Slave acyclic req. rejected
AD0C	Data attribs. not set	AD2B	Slave acyclic resp error
AD0D	Data group size / type mismatch	AD2C	Acyclic timeout
AD0E	Data group size / type unknown	AD2D	No slave acyclic resp.
AD0F	Data group wrong line number	AD2E	Failed to get diags.
AD10	Data group node addr. wrong	AD2F	Failed to get slave diags.
AD11	Data group addresses not contiguous	AD30	No slave diags. available
AD12	Not in assembling mode	AD31	Bad pointer parameter
AD13	Cyclics not configured	AD32	Parameter out of range
AD14	Cyclics not running	AD33	Slave cfg overflow
AD15	Attempt to change card state	AD34	Slave prm overflow
AD16	Bad data group list	AD35	C1 acyclic data too big
AD17	Changeover not complete	AD36	C2 acyclic data too big
AD18	Acyclics not ready	AD37	Slave not running
AD19	Too many diag. clients	AD38	Pending acyclic
AD1A	Line already initialised	AD39	C2 RW not supported by slave
AD1B	Comms attribs ptr failure	AD3A	C2 unexpected connection close
AD1C	Comms attribs data failure	AD3B	Master card startup error
AD1D	Cannot achieve cycle time	AD3C	Not used
AD1E	Master baud rate not supported	AD3D	Could not get slave IO data
AD1F	Cannot kill cards DB	AD3E	Slave not running at changeover

Table 6.6.2y Profibus error codes (9Dxx)

CHAPTER 7 TASK ORGANISATION & TUNING

All in-built and user-programmed instructions are performed serially, i.e. one at a time. The first section of this chapter describes these various software functions (tasks) and their scheduling within the instrument. The next section describes user tasks and their associated loops and servers. User task software structure and server operation is also outlined. Finally, user task tuning, by varying minimum repeat rates, is described.

7.1 TASK SCHEDULING

7.1.1 Tasks

A task is a unit of software that is responsible for carrying out particular duties at certain times, usually while the database is running. There are 24 recognisable tasks in the Process Supervisor. Most tasks are fixed and cannot be varied by the user. Others, the user tasks, are programmable and are described in section 7.2, below.

7.1.2 Priorities

Each task has a priority based on its importance to efficient and safe operation Priorities are numbered from 1 (highest) to 24 (lowest). A task, once started, will run to completion unless it is interrupted at any time by a task of higher priority. In this case the lower priority task suspends activities until the higher priority task has finished, at which point it resumes running. These interruptions are hierarchical; several tasks may be held in suspension by higher priority tasks at any one time.

7.1.3 Task Functions

A complete list of task functions is given in table 7.1.3, below. The following paragraphs give explanatory details.

NETWORK TASK

This task is repeat driven every 15 msec (approx.). The task performs 'housekeeping' for all transactions transmitted or received over LIN.

NFS TASK

This event driven (Network Filing System) task processes LIN filing system requests. Filing system requests get a much larger share of CPU time when the database is halted. This is due to the low position of the NFS task in the priority structure.

USER TASKS 1 TO 4

These tasks are responsible for running up to four user tasks. The tasks are repeat driven at the TaskRpt rate set in the instrument header block, subject to the requested repeat rates not exceeding the maximum permitted CPU loading.

User task 1 has the highest priority, followed (in descending order) by user task 2, user task 3 and user task 4 (lowest priority).

CACHE SYNC SERVER

This task is used to maintain synchronisation of cached blocks. The task is repeat driven every 100 msec, but this may be extended depending on the available CPU time available after servicing User Tasks.

CACHE CONN SERVER

This task is responsible for processing LIN network field writes into and out of cached blocks. The task is repeat driven every 100 msec, but this may be extended depending on the available CPU time available after servicing User Tasks.

7.1.3 TASK FUNCTIONS (Cont.)

LLC TASK

This task runs every 100 msec. (approx.) and monitors the low level status of the LIN link. The task applies timeouts to transmitted messages and reprograms the LIN hardware if error conditions are detected.

LOAD TASK

This event-driven task runs only when a remote request to load a database is received.

BGND TASK (SCAN)

This task collates alarm information, and carries out sum-checking of the database, The task runs continuously as long as the database is running.

IDLE TASK

This purpose of this task is to provide a 'task environment' in which the CPU can run when there are no other tasks running. The task is not run whilst the database is running.

1 Tick	Provides system clock.	Every 5 msec. (Note 1)
2 Rx_ICM	Processes messages received over the ICM.	Event driven
3 Rx_LIN	Processes messages received over the LIN.	Event driven
4 ICM_Mgr	Monitors ICM link low level status. Applies timeouts to transmitted messages. Reprograms ICM hardware if errors are detected.	Every 50 msec
5 PRMT	Process Redundancy Management Task. Responsible for effecting and maintaining synchronisation between redundant processors.	Every 100 msec (approx.)
6 Pr_Rx	Processes message received via PRP. Applicable only when using ELIN.	Every 100 msec (approx.)
7 EDBserv (x2)	Manages communications with external databases via cached blocks. Applicable only when using ELIN.	Every 10 msec (approx.)
8 Network	'Housekeeping' for all transactions over the LIN.	Event driven
9 NFS	Network Filing system. Processes LIN filing requests	Event Driven
10 PMC	Profibus Master Comms. Responsible for all transactions with profibus devices.	Profibus cycle time
11 File Sync	Responsible for maintaining synchronisation of filing systems on redundant systems.	Event driven
12 Mod_Rx	Processes messages received via GW Modbus	Event driven
13 Modserv	Modbus database management	Periodic
14 User Task	Runs user tasks 1 to 4	Every TaskRptn secs (Note 2)
15 Cache Sync Server	Responsible for maintaining synchronisation of cached blocks	Every 100 msec (approx.)
16 Cache Conn Server	Responsible for connections into cached blocks (i.e. LIN network field writes)	Every 100 msec (approx.)
17 LLC	Monitors LIN link low level status. Applies timeouts to transmitted messages. Re-programs LIN hardware if errors are detected.	Every 100 msec (approx.)
18 Pr_Maint	PRP database management (applicable only when using ELIN)	Every 500 msec (approx.)
19 Load	Loads a database on remote request	Event driven
20 AMC (x2)	Application master comms. Processes communications with modbus or profibus devices via DCM blocks.	Event driven
21 Config	Runs the terminal configurator	Event driven
22 BatLoad	Responsible for batch load operations (e.g. loading or unloading an SFC).	Event driven
23 Bgnd (scan)	Collates alarm information. Performs database checksum testing.	Event driven
24 Idle	'Null task'. Provides environment for CPU execution, whilst no other tasks run.	Event driven

Note 1: Every 4 msec for units with sofware version prior to version 4/1
Note 2: or less often subject to CPU loading

Table 7.1.3 Task scheduling

7.2 USER TASKS

7.2.1 Terminology

USER TASK

A user task is an element of strategy, (i.e. a piece of software, programmed into the instrument by the control engineer), which is nominally associated with an element of control.

SERVER

A server is a fixed software task, within the Process Supervisor, that executes a user task, or processes cached blocks.

7.2.2 User task servers

SERVER INTERACTIONS

There are six servers within the Process Supervisor, one for each of the user tasks, and two for the cached blocks (see table 7.1.3). The servers are prioritised, repeat-rate driven, and fully coherent (as described in section 7.4). The Processor Supervisor's block structured database is completely compatible with that of the T100/T1000 instruments, and supports cached blocks in the same way.

Server 1 has the highest priority, and server 6 the lowest. Interruption of one server by another of higher priority has already been described in section 7.1.2, above. The user task servers are set to run no more than once every task repeat time, as specified by the corresponding TaskRptn parameter.

Figure 7.2.2a shows schematically how the servers interact with each other according to their priorities. The darker bars represent running tasks and the paler bars represent suspended tasks.

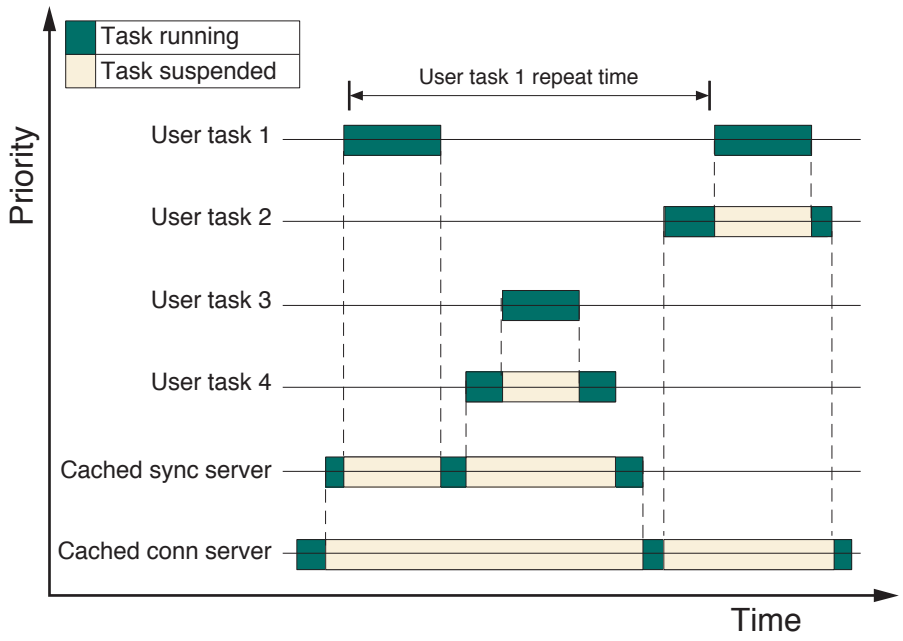

Figure 7.2.2a User task server interactions

7.2.2 USER TASK SERVERS (Cont.)

USER TASK SERVER OPERATION

A higher priority user task server always interrupts the running of a lower priority user task server. Thus, whenever a given user task is running, all higher priority user tasks must have run to completion.

Figure 7.2.2b shows, schematically, the sequence of events that occurs during the running of a user task server. These are as follows:

1. The user task is marked as ‘busy’. During this ‘busy’ period lower priority tasks are suspended.
2. All connections sourced from higher priority tasks are copied into their destination blocks in this user task. This occurs as a single, indivisible, operation.
3. The blocks and their associated intra-task connections are then executed in order.
4. All connections sourced from this user task are now copied into their destination blocks in all higher priority user tasks, as a single, indivisible, operation.
5 The task ‘busy’ flag is removed.

Notes:

1. This structure results in the least work being carried out by the highest priority task.
2. Tasks may be suspended under the control of the strategy (via the Process Supervisor block’s Usr-Taskn parameters) thereby allowing them to be event driven.

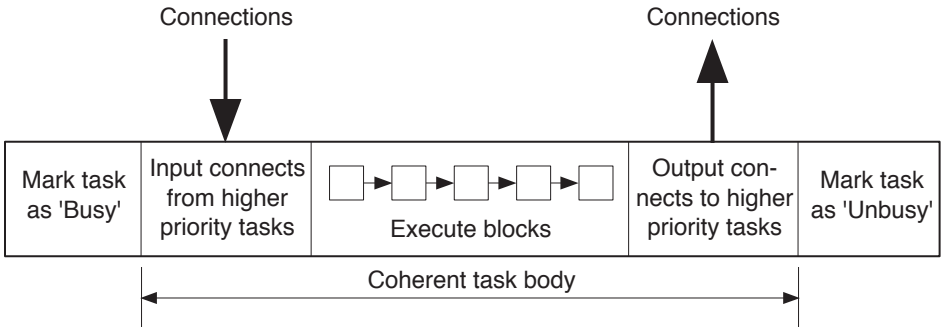

Figure 7.2.2b User task server operation

7.3 USER TASK TUNING

7.3.1 Repeat times & execution times

The Process Supervisor block's parameters TaskRpt1 to TaskRpt4 allow the minimum repeat time for each user task to be specified. When set to zero, the minimum repeat time is 'as short as possible'.

At database startup, the execution time of each user task is estimated and these estimated times are compared with the requested TaskRptNs. An estimated percentage of total CPU power required for each task is then derived. If the required CPU power exceeds what is available, the user task minimum repeat times are increased to workable values.

Note: Many block types have execution times which vary according to operating parameter values, and dynamic changes to LIN loading (for example, increasing numbers of remote instruments starting to cache blocks within the local instrument). Such factors can reduce the accuracy of the original estimates.

7.3.2 Automatic dynamic tuning

To compensate for the variable nature of user task execution times, the spread of CPU loading across user tasks and system tasks is monitored and user task repeat rates are altered, dynamically, to ensure a fair spread of CPU allocation. This 'dynamic tuning' is adequate for most applications, but where task repeat timing is critical, the TaskRptN values in the Process Supervisor block can be adjusted to achieve optimum performance.

Dynamic tuning attempts to adjust user task repeat rates to allow the Bgnd task to complete one database scan typically every 2 seconds, but never less often than once every 4 seconds.

7.3.3 Manual tuning

The USERTASK block allows execution times and repeat times for all the user tasks and the cached block server to be monitored. The PS_TASK block shows the percentage CPU usage by the various user and system tasks in the instrument. The prioritised nature of the user tasks should be allowed for when adjusting repeat rates (1 is the highest priority, 4 the lowest). The reported execution time for a user task may include a period of suspension whilst higher priority tasks execute.

Rapidly fluctuating repeat times for the lower priority tasks usually indicates an attempt to allocate too much total CPU time to the user tasks. A slight increase in some or all of the TaskRpN values should cure this.

The percentage CPU power allocated to the four user tasks should total approximately 80 to 90% (PS_TASK displays units of 0.1%). If the sum is less than this it should be safe to reduce TaskRptN values.

Note: It is recommended that the engineer enters appropriate TaskRpN values. Setting unrealistic values will cause erratic task repeat rates.

7.4 DATA COHERENCE

7.4.1 Data flow between tasks

Coherence is an important aspect of control strategies involving more than one user task. Data flow is defined as being coherent if during any single execution of a task the data input into it from outside the task is a 'snapshot' — unchanging during the execution of the task — and represents the values output from other tasks that have completed their execution.

Data coherence, by definition, refers to connections that are 'remote' (i.e. linking different tasks). Connections that are limited to within a task (i.e. 'local'), are simply dealt with by being copied from source to destination immediately before executing the destination block.

For any task, there are three important types of remote connection. These types, and the way in which data coherence is ensured, are as follows.

CONNECTIONS INTO TASKS (FROM OTHER TASKS IN THE SAME INSTRUMENT (NODE))

In order to ensure that multiple uses (in this task) of the same value (from another task) always use the same iteration of the value, such values are copied prior to the execution of all the executable blocks of this task — i.e. a 'snapshot' is taken of all values external to this task.

Two types of connection apply — those from higher priority tasks to lower priority tasks, and those from lower priority tasks to higher priority tasks:

1. Higher to lower priority. For coherence, whenever connections out of a task are used, all their values must result from the same iteration of that task. Owing to the priority structuring of the tasks, any connections from a higher priority task into a lower priority task meet this requirement. This is because a lower priority task cannot interrupt a higher priority task, which therefore always runs to completion. Hence, these connections are dealt with by a 'snapshot' copying at the start of the lower priority task.
2. Lower to higher priority. A low priority task may be interrupted by a higher priority task before completion, and so be 'caught' with an incoherent set of output values. To avoid such invalid values being passed on, the last action of task execution is for the lower priority task to copy its set of coherent connections as a 'snapshot' to the higher priority task. In this way, the values passed on are always the last set of coherent values from a complete task execution.

CONNECTIONS INTO THIS TASK (FROM OTHER TASKS IN ANOTHER INSTRUMENT)

Connections between nodes are effected by the use of cached blocks. The process of cached block transmission, and reception at the destination end, is coherent for all the data within that block.

At the destination end, the cached block exists on a cached block server. Connections from this cached block to other blocks effectively become inter-server connections within the same node, the coherence of which is guaranteed (as described in 'Connections into tasks...', immediately above).

7.4.1 DATAFLOW BETWEEN TASKS (Cont.)

CONNECTIONS OUT OF THIS TASK TO ANOTHER NODE

This type of connection results in data flow that is not coherent, because the data is transmitted across the network as individual field writes, rather than as whole-block updates. If coherence is required, the block(s) can be cached in the opposite direction, via an AN_CONN block for example. This is illustrated in Figure 7.4, where block A coherently connects to block B across the LIN via the AN_CONN block (bold lines), but the connection is non-coherent when routed via cached block B.

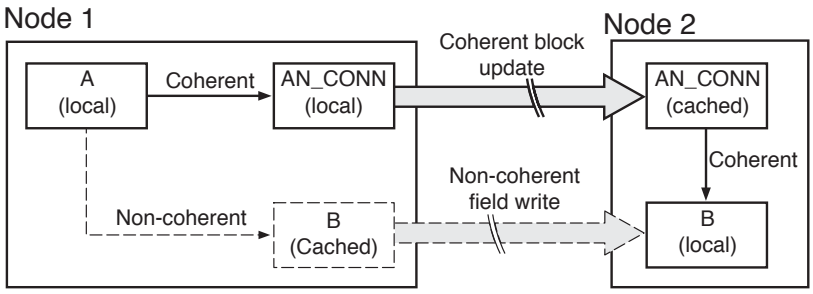

Figure 7.4 Coherent and non-coherent data flow across network

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CHAPTER 8 SERVICE

Note: This section relates to Process supervisors with status levels of G6 or higher. For units with lower status levels, please refer to the relevant earlier issue of this manual.

This section describes the regular preventive changing of filters, fans, back-up batteries etc., and shows how to replace the flash memory card. Details of the M monitor and of the S monitor are also included

For details of how to update the Profibus board, and how to change the unit's system software, boot ROM and libraries, please contact the nearest manufacturer's service centre.

CAUTION

All circuit boards associated with this unit are susceptible to damage due to static electrical discharges of voltages as low as 60V. All relevant personnel must be aware of correct static handling procedures.

8.1 PREVENTIVE MAINTENANCE SCHEDULE

The following periods are recommended to guarantee maximum availability of the processor unit, for use in what the manufacturer considers to be a normal environment. Should the environment be particularly dirty, or particularly clean, then the relevant parts of the schedule may be adjusted accordingly. For example, the fan filter may need replacing more frequently than every two years, if the unit is located in a dusty area.

The following are recommended:

1. A visual inspection of the chassis-mounted fan inlet (on the bottom plate of the unit) should be made every 6 months. The filter (LA029122) should be replaced if any clogging is evident.
2. Every two to four years, the service consumables listed below should be replaced. The recommended replacement period is a function of the average ambient temperature in which the unit operates. At an ambient of 50 degrees Celsius, the recommended replacement period is two years. For an ambient of 20 degrees Celsius the recommended period is four years. The service consumables are available from the manufacturer as a kit which has the part number LA029126.
   Service consumables are:
   a) Chassis fan and pack of five filters.
   b) Fan/capacitor board.

Whenever the unit is 'opened', it is recommended that a visual inspection of be made, and any deposits of dirt or dust removed using a low-pressure compressed 'air duster' such as are available from most electronics distributors.

8.2 REPLACEMENT PROCEDURES

Note: These procedures relate to Process supervisors with status levels of G6 or higher. For units with lower status levels, please refer to the relevant earlier issue of this manual.

Figure 8.2 is a partial exploded view of the processor unit. The drawing shows one side plate removed, for clarity, but this is not always necessary for the procedures below.

8.2.1 Chassis fan filter replacement

Refer to figure 8.2.1 as necessary.

1. Remove the relevant processor module from the backplane, as shown (for the connection module) in Chapter 2 of this manual.
2. Turn the unit upside-down, so that the filter inlet is accessible.
3. Unclip the cover to reveal the filter.
4. Replace the filter, and refit the cover, ensuring that the slightly embossed face is towards the filter (i.e. the smooth side faces outwards.
5. Re-fit the module to the backplane and secure using the jacking screws. Ensure that the connector is correctly mated before tightening the screws, a few turns at a time each, to a final torque of not more than 2.5 Nm.

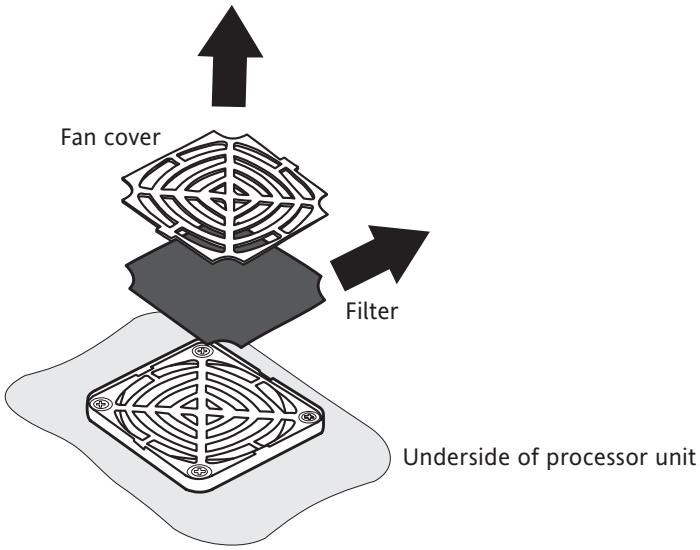


Figure 8.2.1 Filter replacement (view on underside of processor module)

8.2 REPLACEMENT PROCEDURES (Cont.)

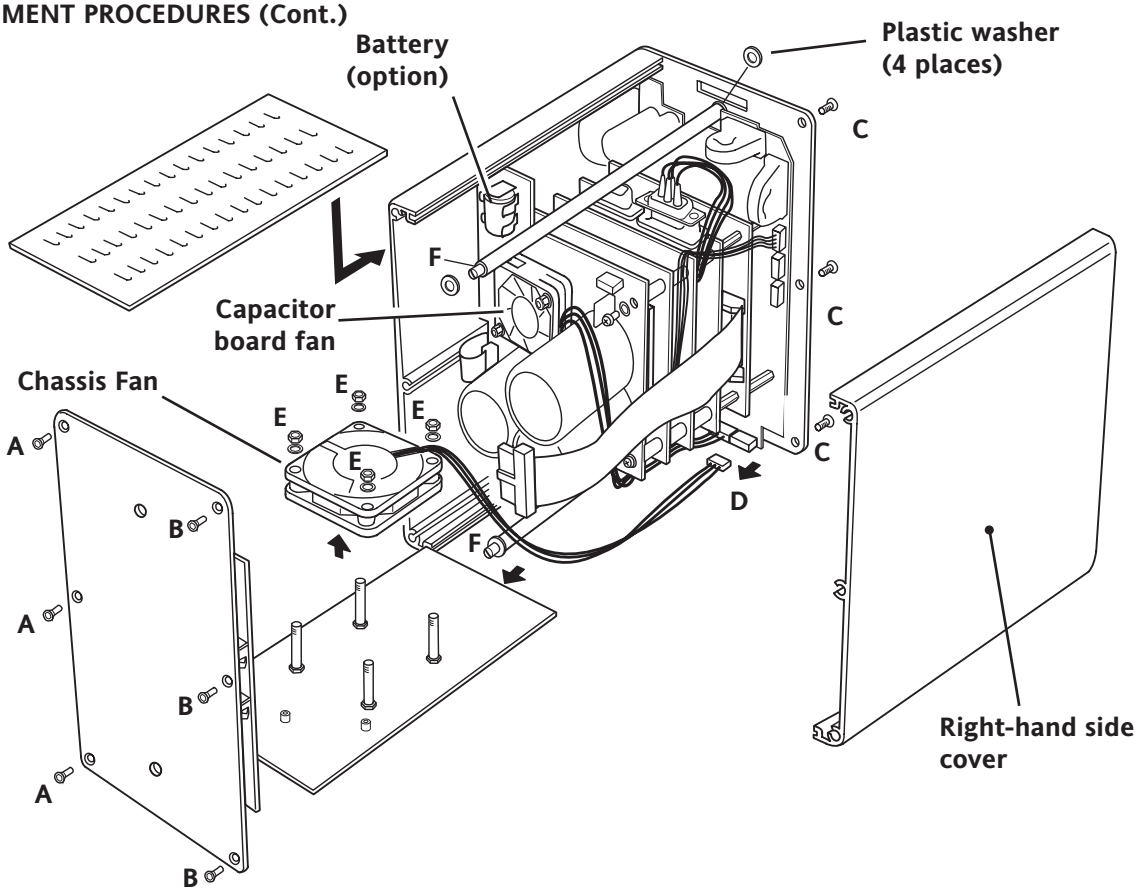


Figure 8.2 Processor module - part explosion

8.2.2 Chassis Fan replacement

Note: When fitting the fan, ensure that it is oriented correctly, with the air-flow direction arrow pointing away from the filter - i.e., the airflow is into the unit. The arrow is to be found on the edge of the fan body, adjacent to the wire aperture.

1. Remove the relevant processor module from the backplane, as shown (for the connection module) in Chapter 2 of this manual.
2. Undo the six Torx-headed screws (B and C) which secure the right-hand side cover to the front and back plates, and remove the right-hand side cover.
3. Lay the module on its left-hand side, and slide the lower panel (containing the external fan) out, disconnecting the fan connector ('D' in figure 8.2 above) as it becomes accessible.
4. Undo the four 4mm (7mm AF) fan securing nuts ('E'), and ensuring all fixings are retained, remove the nuts and washers, and lift the fan off its studs and discard it.
5. Make a visual inspection of the unit, and remove any deposits of dirt or dust using a low-pressure compressed 'air duster' such as are available from most electronics distributors.
6. Replacing all the washers previously removed, fit the new fan and secure it using the M4 nuts ('E').
7. Ensuring that the fan cable harness is not damaged in the process, slide the lower panel back into place, remembering to re-make connector 'D'.
8. Re-fit the right-hand side plate using the screws previously removed.
9. Re-fit the module to the backplane and use the jacking screws to secure it. Ensure that the connector is correctly mated before tightening the screws, a few turns at a time each, to a final torque of not more than 2.5 Nm.

8.2.3 Capacitor board / capacitor board fan replacement

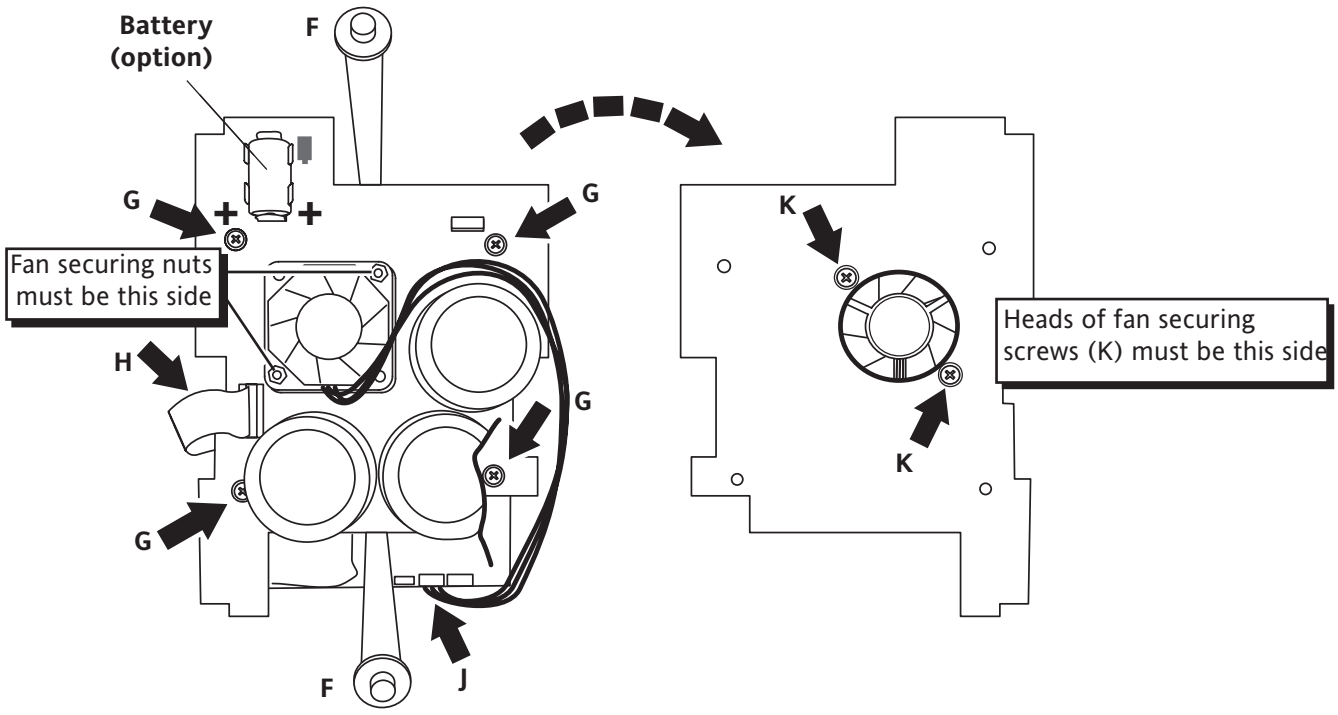


Figure 8.2.3 Capacitor board fan access

Note: When fitting the fan, ensure that it is oriented correctly, with the air-flow direction arrow pointing towards the circuit board. The arrow is to be found on the edge of the fan body, adjacent to the wire aperture.

CAUTION

Ensure that the fan securing screws (K) are oriented as shown in figure 3, above, with their heads bearing on the circuit board, and the associated clamping nuts bearing on the fan body. Incorrect screw orientation will result in damage to the central processing unit on the CPU board.

1. Remove the relevant processor module from the backplane, as shown in Chapter 2 of this manual.
2. Undo the six Torx-headed screws 'B' and 'C' (figure 8.2) and remove the right-hand side cover.
3. Undo the three Torx-headed screws 'A' and carefully remove the front panel, releasing the ribbon cable connector as it becomes accessible. Place the front panel in a static-safe environment.
4. For convenience, remove the jacking screws 'F' and place them to one side for later use in re-assembly.
5. Remove the four securing screws 'G', and carefully remove the capacitor board, disconnecting the ribbon cable connector (H) and the fan connector (J) when accessible.
6. Removed the fan by undoing the two M3 nuts and bolts (K) that secure it to the circuit board.

To replace the fan only, continue at step 7. To replace the capacitor board only, continue at step 8.

7. Discard the old fan and fit the new one to the board, using the fixings (K) previously removed ensuring correct orientation as described in the note above. Continue at step 9.
8. Fit the fan to the new capacitor board using the fixings (K) previously removed ensuring correct orientation as described in the Note and the Caution above.
9. Fit the capacitor board/fan assembly into the unit, ensuring that connectors H and J are re-connected during the process. Secure the capacitor board using the four screws (G) previously removed.
10. Lay the instrument on its left side, and re-fit the jacking screws (F) and associated plastic washers.
11. Re-fit the front panel, ensuring that the jacking screws are correctly located and that the ribbon cable connection is re-made.
12. Refit the right hand side plate, and secure the whole unit using screws A, B and C, previously removed.

8.2.4 Battery fitting

Note: With the battery removed, and with the instrument powered off, real-time clock data is retained by a 'super-cap' for at least 12 hours.

PROCEDURE

1. Remove the relevant processor module from the backplane, as shown (for the connection module) in Chapter 2 of this manual.
2. Undo the six Torx-headed screws (B and C in figure 8.2) which secure the right-hand side cover to the front and back plates, and remove the right-hand side cover.
3. The location of the battery (on the capacitor board) is as shown in figures 8.2 and 8.2.3.
4. Ensure, when fitting the battery that it is oriented correctly (as shown in figure 8.2.3), or the RTC data will not be retained.
5. Dispose of exhausted batteries according to local regulations regarding Lithium thionyl chloride batteries.
6. Re-fit the right-hand side plate using screws B and C previously removed.
7. Re-fit the module to the backplane and use the jacking screws to secure it. Ensure that the connector is correctly mated before tightening the screws, a few turns at a time each, to a final torque of not more than 2.5 Nm.

8.2.5 Flash card Replacement

Figure 8.2.5 shows the replacement of the 'Flash card'. This procedure allows data bases, user configurations etc. to be transferred from one processor module to another, allowing the 'Mean Time to Replace' to be reduced to a minimum.

1. At the rear of the instrument, lift the front edge of the card, and pull it out of its connector.

2. Fit the replacement card.

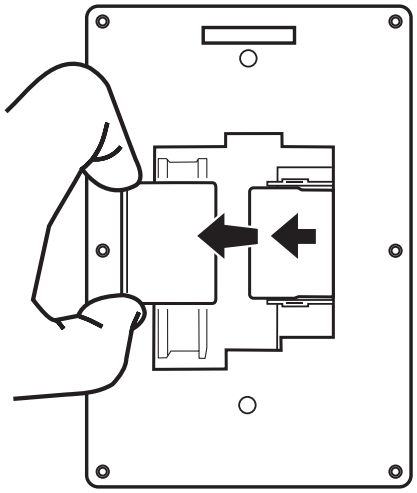


Figure 8.2.5 Flash card removal

8.2.6 Firmware upgrade

The manufacturer can supply replacement memory/flash cards pre-programmed with the latest firmware version. This allows the user to upgrade the unit just by replacing the card. In such cases, the user is responsible for reloading configuration files in the unit.

Alternatively, the manufacturer's agents can upgrade the firmware version with the card in situ thus retaining the user configuration.

8.3 PHYSICAL ARRANGEMENT INSIDE PROCESSOR MODULE

Figure 8.3 shows the arrangement of circuit boards etc. inside the processor module.

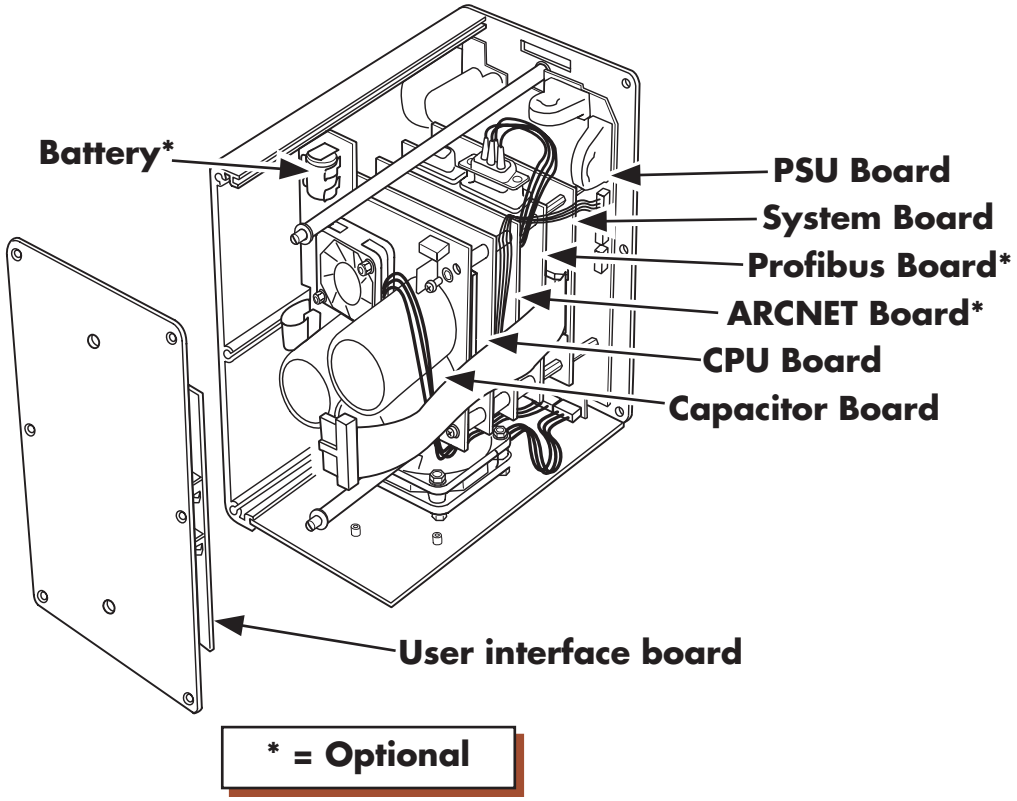


Figure 8.3 Hardware organisation

8.4 THE MONITOR

Note: The 'M' monitor is intended as a diagnostic tool for Commissioning and/or Service Engineers. Access by other personnel is not recommended.

8.4.1 Top level (main) menu access

As described in chapter 4 above, the start up process can be monitored at a suitable computer terminal connected to the Processor unit 'Config' port. During the start-up sequence, the message "Press 'm' key to stop auto-start" appears for one second (or for 10 seconds if this is a TEST start). Operation of the 'm' key stops the start-up sequence and calls the top level menu depicted below. If the message is ignored, the booting-up process continues.

```
Press 'm' key to stop auto-start
m
......Main  menu
......Level 0
 0: Quit
 1: Help
 2: Display saved system features
 3: Diagnostic tests
 4: Manual set-up
 5: Automatic set-up
 6: 'S' Monitor options
......Selection: _
```

8.4.2 Quit

Monitor is quitted, and the unit continues its start-up procedure

8.4.3 Help

To be issued later

8.4.4 Display saved system features

This screen is accessed by typing '2', then 'Y' or 'y' in response to the <Display?> enquiry. (Typing 'N' or 'n' returns to the main menu.) The display lists the current settings for the communications ports associated with this processor unit.

```
Sys Ethernet              -> Single

I/O Chan                  -> Single
I/O chan A configuration -> ArcNet

I/O chan B configuration -> Profibus

EXP chan A configuration -> Serial

EXP chan B configuration -> Serial
```

Sys Ethernet	Displays either 'Single' or 'Redundant' as appropriate for the internal system communications.
I/O Chan A	Displays either 'Single' or 'Redundant'.
I/O chan A configuration	Currently, always set to ArcNet (ALIN)
I/O chan B configuration	Either 'none' or 'Serial' (Modbus) or Profibus
EXP chan A configuration	Either 'none' or 'Serial' (Modbus) or Profibus
EXP chan B configuration	Either 'none' or 'Serial' (Modbus) or Profibus

To return to the main menu, type 'N' or 'n' in response to the <Display?> enquiry.

8.4.5 Diagnostics menu

The diagnostics menu is accessed by typing '3', in the main menu. The menu allows a number of checks to be carried out, as detailed below.

Note: These checks can affect the machine's ability to restart and should be used only to diagnose faults or to clear the memory.

```
......Diag Menu
......Level 1
 0: Quit
 1: Automatic test sequence
 2: PSE comm menu
 3: Net menu
 4: Profibus test
 5: Led Test
......Selection: _
```

8.4.5 DIAGNOSTICS MENU (Cont.)

AUTOMATIC TEST SEQUENCE

Accessed by typing '1' in the diagnostics menu, this carries out a number of tests, and displays the results either as 'OK' or 'ERROR', before returning to the Diagnostics menu.

```
RTC contents check ---> OK
Expansion serial comm port 1 ---> OK
Expansion serial comm port 2 ---> OK
Sys ethernet port 1 ---> OK
DRAM 0x3f00000 bytes = 66060288 bytes status ---> OK
I/O ArcNet port 1 ---> OK
I/O Profibus port 2 ---> OK
......Selection: _
```

PSE COMM TEST MENU

Accessed by typing '2', this allows the Serial Communications to be checked. This test requires that a three- or five-wire cable be connected between Exp1 and Exp2 ports, with a cross over between Rx and Tx lines.

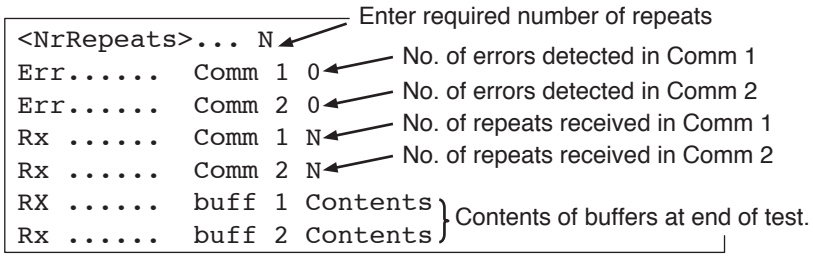
```
......PSE Comm Test
......Level 2
 0: Quit
 1: Set 9600 Baud
 2: Set 19200 Baud
 3: Set 38400 Baud
 4: Set 57600 Baud
 5: Set Modbus Ch 1 to Master
 6: Set Modbus Ch 2 to Master
 7: Start loop test 3W
 8: Start loop test 5W
......Selection: _
```

Baud Rate	Select required Baud rate for this test as required, by typing '1', '2', '3' or '4'. Baud rate is reset after the monitor is quitted.
Master/Slave	Typing '5' displays the message <Ch1 master?>... (Y,y,N,n). Typing 'Y' or 'y' sets EXP1 to Master status. Typing 'N' or 'n' sets it to Slave status. Typing '6' is similar, but for EXP2 port.
Start loop test 3W (5W)	Typing '7' or '8' starts the loop test for 3-wire or 5-wire systems respectively, once the number of repeats has been entered. Note that the number of repeats received should be the same as the number of repeats requested before the start of the test. If this is not the case, there is a problem with the communications link.

(Continued)

8.4.5 DIAGNOSTICS MENU (Cont.)

PSE COMM TEST (CONT.)



The PSE Comms test menu is re-displayed on the screen, allowing the user to quit the test, or to repeat it, perhaps at a different Baud rate.

NET MENU

Not used with this version of software.

PROFIBUS TEST

Accessed by typing '4', this allows profibus communications to be tested, starting with the following screen.

```
Profibus test
-------------
Looking for boards in address range CA000H..CC000H
Found board 1 at CA000H
Select terminal type:
1 ANSI-CRT
>>>
```

Typing <1> calls the Profibus test page, and typing <D> refreshes the page with current data, as shown below, which shows, as an example, node 4 as being the only node on the network.

After positioning the cursor next to node 4, the space bar can be operated to call the master data page, or the carriage return key can be used to call the slave data page, also illustrated below.

8.4.5 DIAGNOSTICS MENU (Cont.)

PROFIBUS TEST (CONT.)

```
                          CYCLC          | ACYCLIC | Maintaining
  Network 1    Output     4500           | 4000    | cyclic ramp
-----------------------------------------|---------|--------------------------------
  Input from node   2    non-existent    |    *    |
                    3    non-existent    |    *    |
                   >4    4000            |  100    | Y
                    5    non-existent    |    *    |
                    6    non-existent    |    *    |
                    7    non-existent    |    *    |
                    8    non-existent    |    *    |
                    9    non-existent    |    *    |
                   10    non-existent    |    *    |
                   11    non-existent    |    *    |
                   12    non-existent    |    *    |
                   13    non-existent    |    *    |
                   14    non-existent    |    *    |
                   15    non-existent    |    *    |             (^ = not activated)
                   16    non-existent    |    *    |             (* = fault
                   17    non-existent    |    *    |
-------------------------------------------------------------------------------
[ ]    - select page,       C - copy  node setup,       X  - remove node,
arrow  - select node,       P - paste node setup,       sp - view master,
return - view node,         A - paste to all,           D  - download & activate
```

MASTER DATA SCREEN

```
                          Board 1 at CA000H                    (^ = not activated)
-------------------------------------------------------------------------------
Date              01.03.2001         Type/model          55/67
Device no.        10704090           O/S code
Serial no.        00000731           Firmware             PB-COMBIC104-PB
DPRAM size        8        kBytes                          V01.058 29.05.01
-------------------------------------------------------------------------------
Baud              12000    kBits/s   Cyclic  ramp itv1  100    ms
TQUI              9        tBit       Acyclic ramp itv1  2000   ms
TSET              16       tBit
Min TSDR          11       tBit
Max TSDR          800      tBit
TSL               1000     tBit
TTR               22923    tBit
GAP update        10       cycles
Min slave itv1    0.1      ms         Protocol error
Data ctrl time    200      ms
Poll timeout      500      ms          Error location
                                       COM-flag not set
Protocol cycle    1        ms         Bus errors
Watchdog ctrl     1000     ms         Rejected telegrams
-------------------------------------------------------------------------------
D      - download & activate,
```

8.4.5 DIAGNOSTICS MENU (Cont.)

PROFIBUS TEST (CONT.)

SLAVE DATA SCREEN

```
                              Network 1  Node 4     (^ = not activated, * = fault)
Id:04B4 (IOS)      Dpv1:Yes
------------------------------------------------------------------------------

   OUT      Type    Len   Idx   ___Data___ |    IN       Type    Len   Idx   ___Data___
Cyc                                        |Cyc
 1 ont1     u16     1     0    4500        | 1 ont1     u16     1     0     4000
 2 rm_sp    dp1     1     0    *0          | 2 L01_PV   f32     1     0     0
 3                                         | 3 Mod1PV   f24u8   8     5     0       132
 4                                         | 4
 5                                         | 5
 6                                         | 6
 7                                         | 7
 8                                         | 8
Acyc                                       |Ayc
 1 ont2     u16     1     0    6000        | 1 ont2     u16     1     0     100
 2                                         | 2
 3                                         | 3
 4                                         | 4
 5                                         | 5
------------------------------------------------------------------------------
[ ]   - select page,          S  - array scroll,     D      - download & activate,
C     - copy node setup,      X  - remove node,       digit - number/address entry
P (A) - paste (to all),      sp - view master,      other - popup menu
```

Note: Positioning the cursor under a field, and pressing any key, except those listed at the bottom of the screen, ('Q' for example), a picklist of available entries appears. The required item is entered by moving the cursor to it (by means of the up/down arrow keys) and pressing 'Enter' or 'Return'.

8.4.5 DIAGNOSTICS MENU (Cont.)

LED TEST

Selecting '6' from the Diagnostic menu allows an LED test sequence to be initiated, as described below. The test is started by selecting '1' from the LED sub menu.

The test sequence is as follows:

1. Duplex LED switched green, red, off.
2. Battery int LED switched green. (Off at step 16)
3. battery ext LED switched green. (Off at step 17)
4. System A LED switched green, red, off.
5. System B LED switched green, red off.
6. i/o A LED switched green, red, off.
7. i/o B LED switched green, red, off
8. Standby LED switched yellow. (Off at step 18)
9. Primary LED switched green. (Off at step 19)
10. Exp1 Tx LED switched yellow. (Off at step 20)
11. Exp1 Rx LED switched yellow. (Off at step 21)
12. Exp2 Tx LED switched yellow. (Off at step 22)
13. Exp2 Rx LED switched yellow. (Off at step 23)
14. rl1 LED switched yellow. (Off at step 24)
15. rl2 LED switched yellow. (Off at step 25)
16. battery int LED switched off.
17. battery ext LED switched off.
18. Standby LED switched off.
19. Primary LED switched off.
20. Exp1 Tx LED switched off.
21. Exp1 Rx LED switched off.
22. Exp2 Tx LED switched off.
23. Exp1 Tx LED switched off.
24. rl1 LED switched off.
25. rl2 LED switched off.

Type 2<CR>
to stop test after step 25

If not stopped, by typing '2 <CR>' during the above sequence, the test continues with the Primary, Standby and Duplex LEDs flashing, and, at the same time, the following LEDs being switched on and off one after the other in an endless loop:

int, sysA, sysB, i/oB, i/o A, ext, rl1, exp1 tx, exp2 tx, exp2 rx, exp1 rx, rl2.

This loop is stopped, and the LED sub-menu redisplayed, by typing '2' <CR> but it should be noted that it will continue until its next conclusion (rl2 off) which can take over 20 seconds.

8.4.6 Manual set-up

This screen is accessed by typing '4' in the main menu.

```
......Manual set-up menu

......Level 1
 0: Quit
 1: - SYS Ethernet
    - I/O A Arcnet

    - Two exp. serial lines

 2: - SYS Ethernet
    - I/O A Arcnet

    - I/O B Profibus
    - Two exp. serial lines

 3: - SYS Ethernet
    - I/O B Profibus

    - Two exp. serial lines

 4: - SYS Ethernet
    - Redundant I/O Profibus

    - Two exp. ArcNet line

......Selection: _
```

8.4.7 Automatic set-up

This screen is accessed by typing '5' in the main menu, then when ready, <CR>.

The carriage return initiates the first of a number of tests, described below. Whilst the test is in progress the message `'testing....'` appears. When the test is complete, a further line appears allowing the user to quit the test procedure, to repeat the previous test, or to move to the next test.

```
testing....
<ESC>to quit, <ENTER>to repeat, <SPACE>for next.
```

Each operation of the space bar (followed by a carriage return) initiates the next test.

Test 1 measures how long it takes to write data to flash. If this exceeds 140 ms, the Compact flash device should be replaced because tepid data may not be stored successfully, causing subsequent hot/tepid start failure.

Tests 2 to 4 check the operation of the three relays, by opening their contacts for one second, closing them for 1 second, opening again for 1 second, closing again. Open status is indicated by an LED.

WATCHDOG RELAY TEST

Open/Close the watchdog relay twice at 1 second per state. Duplex LED illuminated whilst relay contacts open.

8.4.7 AUTOMATIC SET-UP (Cont.)

RL1 RELAY TEST

Open/Close the relay RL1 twice at 1 second per state. RL1 LED illuminated whilst relay contacts open.

RL2 RELAY TEST

Open/Close the relay RL2 twice at 1 second per state. RL2 LED illuminated whilst relay contacts open.

COMMUNICATIONS HARDWARE CHECK

The unit autodetects whether arcnet and Profibus cards are fitted, and creates a config.txt file.

8.4.8 The ‘S’ Monitor

Note: The ‘S’ monitor is intended only as a diagnostic tool for Commissioning and/or Service Engineers. Because of the unit’s safety-critical requirements, access by other personnel is not recommended.

S MONITOR ACCESS

The S Monitor is accessed by typing <6> from the M Monitor main menu described in section 8.4.1 above.

```
......Main menu.....level 0
 0: Quit
 1: Help
 2: Display basic machine status
 3: Display extended machine status
 4: Diagnostic menu
 5: Memory status
 6: Show boot info
 7: Date/Time set
......Selection: _
```

QUIT

Selecting ‘0’ in this menu quits the ‘S’ monitor. If the watchdog retry enable switch is set ‘on’ (section 2.4.2 above), the unit will re-start. If the switch is set off, the unit must be reset manually, or powered off, then back on again.

HELP

To be issued later

8.4.8 S MONITOR (Cont.)

DISPLAY BASIC MACHINE STATUS

Accessed by typing <2> from the main menu, this page displays the following information:

```
<Display?>...  (Y,y,N,n) Y<CR>

 RTC power                -> Ok (Real-time clock lost power)
 CMOS checksum            -> Ok (CMOS checksum is bad)
 Memory compare           -> Ok (Memory size compare error)
 CMOS time                -> Ok (CMOS time invalid)
<Display?>...  (Y,y,N,n) N<CR>
......Main menu.....level 0
etc.
```

DISPLAY EXTENDED MACHINE STATUS

Accessed by typing <3> from the main menu, this page displays the following information:

```
<Display?>...  (Y,y,N,n) Y<CR>

 Register 0x0F = Reason for shutdown     =>>>    0 = 0

 Register 0x10 = diskette0 set-up        =>>>    1.44 M drive
 Register 0x10 = diskette1 set-up        =>>>    None

 Register 0x12 = HD0 disk set-up         =>>>    Disk type =>>>    1
 Register 0x12 = HD1 disk set-up         =>>>    None type =>>>    0
 Register 0x14,bit5/4 = Primary display  =>>>    EGA/VGA

Date                                      =>>>    DD/MM/YY
Time                                      =>>>    HH:MM:SS

<Display?>...  (Y,y,N,n) N<CR>
......Main menu.....level 0
etc.
```

8.4.8 S MONITOR (Cont.)

DIAGNOSTICS MENU

The diagnostics menu (depicted below) is called by typing '4' from the top level menu above.

```
......Diag Menu
......Level 1
 0: Quit
 1: Watchdog register
 2: System LED
 3: I/O LED
 4: Serial LED
 5: ILOCK WRO Output
 6: Read input status
 7: Connect the interrupts (5,9,11,12,15)
```

WATCHDOG REGISTER

Accessed by selecting '1' from the diagnostics menu, this page displays the following information:

```
......Watchdog menu
......Level 2
 0: Quit
 1: Bit 7 = Enable flash Vpp
 2: Bit 6 = Flash write protection
 3: Bit 5 = Redundancy interrupt
 4: Bit 4 = Watchdog Relay
 5: Bit 3 = Watchdog Pat
 6: Bit 2 = Alarm relay 1
 7: Bit 1 = alarm relay 2
......Selection
```

Notes:

1. Switching the alarm relays also switches their associated LED
2. Switching the watchdog relay has no effect on the watchdog LED

SYSTEM LED

Accessed by selecting '2' from the diagnostics menu, this page allows the two 'battery' LEDs and the 'Duplex' LED to be exercised individually.

I/O LED

Accessed by selecting '3' from the diagnostics menu, this page allows the Comms panel 'system A', and 'B' and i/o 'A' and 'B' LEDs to be exercised individually.

SERIAL LED

Accessed by selecting '4' from the diagnostics menu, this page allows the Comms panel 'exp1' and 'exp 2' Rx and Tx LEDs, the Alarm panel 'rl1' and 'rl2' LEDs and the 'Primary' and 'Standby' LEDs to be exercised individually.

Note: Setting the rl1 or rl2 LED on does not switch the associated relay on. Switching rl1 or rl2 on in the watchdog menu (above) does cause the associated LED to be illuminated.

8.4.8 S MONITOR (DIAGNOSTICS MENU) (Cont.)

ILOCK WR0

Accessed by selecting '5' from the diagnostics menu, this redundancy control monitor page displays the following information:

```
......Ilock wr0
......Level 2
 0: Quit
 1: Bit 5 = Reset minor fault
 2: Bit 2 = A request clocks
 3: Bit 1 = A Ok
 4: Bit 0 = A Req Primary
......Selection: _
```

READ INPUT STATUS

Accessed by selecting '6' from the diagnostics menu, this page displays the following information:

```
<DISPLAY?>...  (Y,y,N,y): Y<CR>
 Byte 1 = ALIN address                =>>>      ffffff60 = -166
 Byte 2 = ADDR_HIGH register               =>>>      88 = 136
 Byte 2,bit7 = Power Fail            =>>>      1
 Byte 2,bit6 = RTC Battery Failure   =>>>      0
 Byte 2,bit5 = Over temperature      =>>>      0
 Byte 2,bit4 = CPU fan stall         =>>>      0
 Byte 2,bit3 = Main Batt failure     =>>>      1
 Byte 2,bit2 = Main fan stall        =>>>      0
 Byte 2,bit1 = Backplane SW2/2       =>>>      0
 Byte 2,bit0 = /Loom detect          =>>>      0

 Byte 3 = DIL register                =>>>      8c = 140
 Byte 3,bit7 = Backplane SW2/6, SRD =>>>      1
 Byte 3,bit6 = mode 4 (Hot=>Cold)    =>>>      0
 Byte 3,bit5 = Hardware Build Lev.1 =>>>      0
 Byte 3,bit4 = Hardware Build Lev.0 =>>>      0
 Byte 3,bit3 = Backplane SW2/5, MDB =>>>      1
 Byte 3,bit2 = /Halt                 =>>>      1
 Byte 3,bit1 = mode 2 (Hot)          =>>>      0
 Byte 3,bit0 = mode 1 (Cold)         =>>>      0

 Byte 4 = OPT register                =>>>      FF = 255
 Byte 4,bit7 = Hardware Build Lev.4 =>>>      1
 Byte 4,bit6 = Hardware Build Lev.3 =>>>      1
 Byte 4,bit5 = Hardware Build Lev.2 =>>>      1
 Byte 4,bit4 = Power Fail interrupt =>>>      1
 Byte 4,bit3 = Backplane SW2/8       =>>>      1
 Byte 4,bit2 = Backplane SW2/7       =>>>      1
 Byte 4,bit1 = Backplane SW2/4       =>>>      1
 Byte 4,bit0 = Backplane SW2/3       =>>>      1

 Byte 5 = ILOCK_RD0 register               =>>>      24 = 36
 Byte 6 = ILOCK_RD1 register          =>>>      8 = 8
<DISPLAY?>...  (Y,y,N,y): N<CR>
......Diag Menu
```

Note:

OPT register is not displayed for units with hardware build levels 0 or 1. In such cases, Bytes 4 and 5 are ILOCK_RD0 and ILOCK RD1 registers respectively.

etc.

8.4.8 'S' MONITOR (Cont.)

CONNECT THE INTERRUPTS

Accessed by selecting '7' in the diagnostics menu, this page is for use only by the Manufacturer.

MEMORY STATUS

This page is accessed by selecting item 5 from theS Monitor Main menu, and presents memory information as follows:

```
<Display?>...  (Y,y,N,n): Y<CR>

 Register 0x15/16 = Base memory in kbyte      =>>>     280 = 640
 Register 0x33    = Extension memory in kbyte =>>>      80 = 128
 Register 0x17/18 = Extension memory in kbyte =>>>     fc00 = 64512
 Total DRAM size in kbyte                      =>>>     ff00 = 65280
<Display?>...  (Y,y,N,n): n<CR>
......Main menu
```

etc.

SHOW BOOT INFO

This page is accessed by selecting item 6 from the Main menu, and presents boot information as follows:

```
<Display?>...  (Y,y,N,n): Y<CR>

 Boot device              -> System A Net
 Boot file               -> /ide0/S/vxWorks
 Host name                -> host's name
 Target name              -> PSE
 Target IP addr           -> 10.1.1.1
 Host IP addr             -> 0.0.0.0
 Gateway IP addr          ->
<Display?>...  (Y,y,N,n): n<CR>
......Main menu
```

etc.

DATE /TIME SET

Accessed by selecting item 7 from the main menu, this allows the user to set the date and time.

CHAPTER 9 SPECIFICATION AND ORDER CODES

INSTALLATION CATEGORY AND POLLUTION DEGREE

This product has been designed to conform to BS EN61010 installation category II and pollution degree 2. These are defined as follows:

Installation category II

The rated impulse voltage for equipment on nominal 230V ac mains is 2500V.

Pollution degree 2

Normally, only non-conductive pollution occurs. Occasionally, however, a temporary conductivity caused by condensation shall be expected.

9.1 SPECIFICATION

This specification defines the Process supervisor components:

Backplane
Connection Module
Processor Module
Software

9.1.1 General specification

Physical

Dimensions		
	Backplane:	402mm wide x 180mm high x 24mm deep
	Connection Module:	120mm wide x 180mm high x 126mm deep
	Processor Module:	120mm wide x 182 mm high (including 2 mm for fan filter) x 186mm deep
	Backplane fixing centres:	382 horizontal x 125 vertical
Weight		
	Backplane without modules:	2kg. max
	Connection module:	1.1kg max.
	Processor module:	2.4kg max. (each)

Environmental

Temperature	Storage:	-25 to +85˚C
	Operation:	0 to + 50˚C
Humidity	Storage/Operation:	5 to 95% RH (non-condensing)
RFI	EMC emissions:	BS EN61326 2002-02
	EMC immunity:	BS EN61326 2002-02
Safety Specification		BS EN61010-1/A2:1993
Vibration		To IEC1131-2 section 2.1.3
		(0.075mm peak amplitude 10 to 57 Hz; 1g 57 to 150 Hz)

Power Requirements

Main supply		24V dc nom. (18 to 36Vdc) at 50W per processor module, maximum. Two supplies can be connected per processor module, to ensure continued operation should one supply fail.
Surge Current		8A max.
Backup supplies	External (option):	2.4 to 5 Volt battery. Typical drain per processor = 300 µA at 3.4V.
	Internal (option):	1/2AA Lithium thionyl chloride. When fully charged, this maintains the real-time clock for approximately 10 years.
Fusing	24V supplies	3A Type T in each positive supply line
	External batteries:	0.5A Type T in each positive supply line

9.1.2 Backplane specification

General

Switches	SW1:	ALIN address
	SW2, segment 1:	Watchdog retry (trip and try again mode)
	SW2, segment 6:	Redundant/non-redundant mode select (duplex/simplex)
	SW2, segment 5:	Modbus select
Safety earth connection		By M4 earth stud on right hand flange of the backplane

Note: In order to comply with the Low Voltage Directive quoted in the Declaration of Conformity at the beginning of this manual, neither the positive nor the negative supply line may exceed 40V peak, with respect to Safety Earth potential.

9.1.3 Connect module specification

ALIN ports

Connectors	Parallel wired pairs of shielded RJ45 connectors per processor unit.
Network medium	ArcNet (screened twisted pair, 100 Ohm)
Network type	Token bus
Speed	2.5 Mbits/sec.
N° of nodes (max)	8, extendable by repeater
Line length (max)	100 metres, extendable by repeater
Isolation	50Vdc / 30V ac; 5.6kΩ to 0V

ELIN ports

Connectors	Pairs of shielded RJ45 connectors per processor unit.
Network medium	Ethernet Cat5
Protocols	LIN over Ethernet / IP (ELIN), Modbus TCP RTU slave, FTP.
Speed	10/100TX
Network Topology	Star connection to a hub
Line length (max):	100 metres, extendable by repeater
Allocation of IP address:	Manual, Link-Local or BootP
Isolation	50V dc; 30V ac.

Modbus/Jbus (EIA422/485)

Connectors	Parallel wired pairs of shielded RJ45 connectors per processor unit.
Protocol	MODBUS/JBUS RTU slave
Data rate	Selectable between 600 and 38,400 Baud
Data format	8-bits, 1 or 2 stop bits, selectable parity
MODBUS data tables	16, configurable as registers or bits
Table length (max.)	200 registers or 999 bits
Memory allocated to tables	6000 bytes
Isolation	50Vdc / 30V ac

Modbus (DCM)

Connectors	Parallel wired pairs of shielded RJ45 connectors per processor unit.
Protocol	MODBUS/JBUS RTU master
Data rate	Selectable between 600 and 38,400 Baud
Data format	8-bits, 1 or 2 stop bits, selectable parity
Isolation	50Vdc / 30V ac

Profibus

Connectors	Parallel wired pairs of shielded RJ45 connectors per processor unit.
Protocol	Profibus DP/DP-V1
Data rate	Selectable between 9600 and 12M Baud
Isolation	50Vdc / 30V ac; 1MΩ to Chassis

Other connections

Supply voltage:	Two 2-way connectors per processor module for connection of 24V (nom.) supply.
Safety Earth:	See backplane specification above
Battery backup:	For each processor unit, one external battery can be connected using two terminals of an eight-way (relay) connector block.
Relay connections:	For each processor module there are one watchdog relay and two ‘alarm’ relays (operation configured by the user). For each relay, only the common and normally open contacts are used, these being short circuit under normal operating conditions, and open circuit under alarm or power-off conditions.

Relay specification

One watchdog and two user configurable relays per processor.

Contact rating (resistive)	30V ac/50V dc at 0.5 Amps
Isolation (Contact-to-ground)	30V ac (RMS) or 50V dc.

9.1.4 Processor Module specification

General

CPU type	Pentium MMX; 266MHz
Flash memory	>8 MByte
Serial Communications	Non-isolated EIA232 terminal configuration port (RJ11 connector)

Panel Indicators

Light emitting diodes (LEDs) for:

- Main supply (24V dc nom)
- External battery (optional)
- Internal battery (optional)
- Alarm relay status
- Serial communications
- ALIN/Profibus status
- Primary processor
- Standby processor
- Watchdog indicator
- Duplex (redundant mode) indicator

Control switches

Push button switches for	Watchdog Halt
	Watchdog Restart
	Processor module synchronisation/changeover
	Processor module desynchronisation
Rotary switch for	Start-up mode selection

9.1.5 Software specification

LIN Block libraries (continuous database function block categories)

I/O:	Analogue and digital input output manual override
Conditioning:	Dynamic signal-processing and alarm collection
Control:	Analogue control, simulation and communications
Timing:	Timing, sequencing, totalisation and events.
Selector:	Selection, switching, alarm and display page management
Logic:	Boolean, latching, counting and comparison
maths:	Mathematical functions and free-format expressions.
Config:	Unit identity blocks
Diag:	Diagnostics
Batch:	Sequencing recipe/record and discrepancy checking.

Continuous database resources

Number of function blocks (maximum)	2048
Number of templates (maximum)	50
Number of libraries (maximum)	28
Number of EDBs (maximum)	32
Number of FEATTs (maximum)	1024
Number of TEATTs (maximum)	512
Number of Servers (maximum)	8
Number of connections	1024
Control database size (maximum)	400 kByte

Notes:

1. Apart from database memory sizes, the figures above are default maximums and are the recommended limits for typical situations. Subject to note 2, below, it is possible to exceed some of the above maxima, although if a database with more resources than the default maximum is loaded, then the maximum is set to the new value and there may then be insufficient memory to load the entire database. In such a case, the 'connections' disappear first. (FEATTs are not subject to this problem, since when a database is saved, there are not normally any FEATTs present, so the default maximum cannot be overridden.
2. The EDB maximum must not be exceeded. If it is, some EDBs will malfunction, and this is likely to affect the LINtools VIEW facility.

Continuous database performance

To be issued later

Sequence Control Resources

Sequence memory	Program data:	256 kBytes
	SFC Resources:	512 kBytes
N° of independent sequence tasks:		40 simultaneously active
	SFC actions:	130 (including root SFCs)
	Steps:	640
	Action associations:	2400
	Actions:	1200
	Transitions:	900

9.2 ORDER CODES

9.2.1 Instrument order code

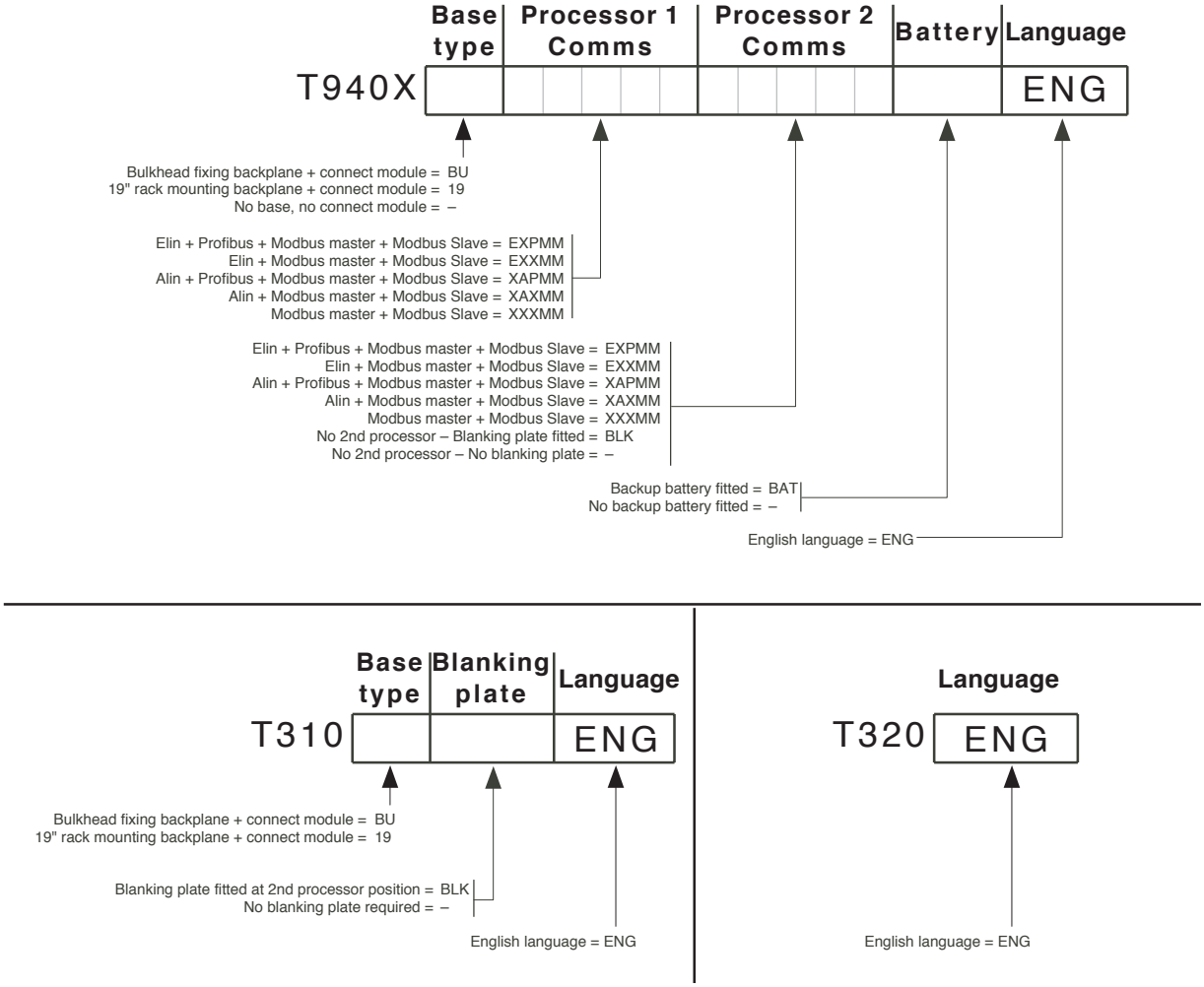


Figure 9.2.1 Instrument ordering guide

9.2.2 Spares and accessories

Battery	PA234093
Blanking Plate (EMC cover for unused backplane/processor connector)	BA260496
Chassis fan assembly (on processor module lower panel)	LA260259
Filter for chassis fan assembly	BH240476
Capacitor board (excluding fan)	AH028035
Capacitor board fan (for cooling CPU)	LA028125
Power supply (Input: mains; Output 24Vdc at 2.5 A. max.)	2500P/2A5
Power supply (Input: mains; Output 24Vdc at 5 A. max.)	2500P/5A0
Power supply (Input: mains; Output 24Vdc at 10 A. max.)	2500P/10A
External 4V battery	S9537
Charger for external battery (Supply voltage = 24Vdc)	S9538/24V
Communications Isolator (EIA232 - EIA232)	LA025519U101

ALIN Cables

1x RJ45 connector and ferrules for screw terminals	S9508-5/1RJ45/xxx/-
RJ45 connectors both ends	S9508-5/2RJ45/xxx/-
Ferrules both ends	S9508-5/2FER/xxx/-
RJ11 connector one end; RJ45 connector at other end	S9508-5/RJ11-45/xxx/-
Cable without termination	S9508-5/ - /xxx/-

(xxx = cable length in 10 cm. increments to 100 metres max.)
(Final hyphen is “connector boot colour = default”. Consult factory for other colours)

Profibus in-cubicle cables

1x RJ45 connector and ferrules for screw terminals	S9508-5/1RJ45/xxx/-
RJ45 connectors both ends	S9508-5/2RJ45/xxx/-

(xxx = cable length in 10 cm. increments to 100 metres max.)
(Final hyphen is “connector boot colour = default”. Consult factory for other colours)

Configuration terminal cables

RJ11 to 9-way D-type	DN026484

Cable accessories

ALIN terminal-mounted line terminator	LA082586U002
ArcNet/MODBUS line terminator (RJ45)	CI026528
Profibus line terminator (RJ45)	CI026529
Feed-through adapter (RJ45)	CI250407
Shielded RJ45 connector, unassembled	CI250449
RJ45 connector assembly handtool	Consult factory
ALIN (ArcNet) hub	S9576

Service consumables (battery board with fan, chassis fan, chassis fan filters)	LA029126
Chassis fan filter (pack of five)	LA029122

Previous models (Processor unit status levels prior to G6)

Service consumables (battery board, capacitor board with fan, chassis fan, chassis fan filter)	LA028325
Battery board	AH261438
Battery board cable harness	DN261448

9.3 COSHH

9.3.1 Lithium thionyl chloride batteries

Product:	BACK-UP BATTERY
Part numbers: PA234093	

HAZARDOUS INGREDIENTS

Name	% Range	TLV	Toxicological data
Lithium (Li)		Not established	
Thionyl Chloride (Li-$SOCl_2$)		1.0ppm (4.9mg/m^3)	
Aluminium Chloride ($AlCl_3$)		2mg/m^3	
Lithium Chloride		Not established	

PHYSICAL DATA

Boiling point	Thionyl Chloride: 77˚C	Specific gravity	Thionyl Chloride: 1.63
Vapour pressure	Thionyl Chloride: 92mm at 20˚C	Solubility in water	Thionyl Chloride decomposes violently on contact with water.
Odour	Thionyl Chloride: Pungent, irritant	Colour	Thionyl Chloride: colourless to pale yellow

FIRE AND EXPLOSION DATA

Flash point (deg C) (Method used)	Not applicable	FLAMMABLE LIMIT	
Extinguishing media	Lith-X powder, Class D fire extinguisher, Dry lithium chloride or carbon powder, Pyrene G-1.	LEL Not applicable	UEL Not applicable
Special fire-fighting procedures	WATER MUST NOT BE USED. Do not use moist sand, CO_2, or Class A, B, C or soda ash extinguisher. A Self Contained Breathing Apparatus (SCABA) or Air Purifying Respirator (APR) must be worn.		
Unusual fire and explosion hazards	Cells may leak, vent or explode. If a bright, white flame is present, lithium content is present and on fire. Use one of the extinguishing media recommended above.		

HEALTH HAZARD DATA

Threshold limit value	Not applicable		
LD 50 Oral	Not applicable	LD 50 Dermal	Not applicable
Skin and eye irritation	Not applicable in normal use. Leakage material is corrosive.		
Over-exposure effects	There are no effects in normal use. If leakage has occurred, vapours are very irritating to skin, eyes and mucous membranes. Inhalation may lead to pulmonary œdema and overexposure may lead to non-fibrotic lung injury.		
Chemical nature	See above. There are no risks in normal use.		

FIRST AID PROCEDURES

Eyes	Flush with running cold water for at least 15 minutes. Hold eyelids apart. Seek immediate medical attention mentioning thionyl chloride. Contact results in acidic burns.
Skin	Rinse with copious quantities of running cold water. Avoid hot water. Do not rub skin. If burns develop, seek medical attention, mentioning thionyl chloride. Contact results in acidic burns.
Ingestion	Seek immediate medical attention. If person is conscious, supply copious amounts of milk or water. Do not induce vomiting. Do not attempt to administer anything by mouth to an unconscious person.
Inhalation	May result in pulmonary œdema. Remove to fresh air. If breathing is difficult, administer oxygen. If breathing has stopped, administer artificial respiration.

REACTIVITY DATA

STABILITY				Conditions to avoid
Stable	Yes	Unstable		Do not short circuit, recharge, over discharge (i.e to below 0.0 Volts), puncture, crush or expose to temperatures above 120˚C. do not store in high humidity environments for extended periods.

Hazardous decomposition products	Decomposes in water to give Sulphur Dioxide (SO_2), Hydrogen Chloride (HCl) and strongly acidic wastewater.
Hazardous polymerisation	Will not occur

SPILL OR LEAK PROCEDURES

Internal contents are extremely hazardous. Leaking Fluid is corrosive. The cell may explode at high temperatures.
Do not breath vapours, or touch liquids with bare hands (see first aid procedures above). Evacuate area. If possible a trained person, wearing suitable breathing apparatus should attempt to stop or contain the leak with soda lime, or baking soda (sodium bicarbonate NaHCO). Once contained, the leaking battery and soda lime/baking soda should be sealed in a polythene bag and disposed of as Hazardous waste

Contact should be avoided

DISPOSAL

Batteries must be disposed of according to current local regulations for Lithium thionyl chloride batteries. They may not be disposed of as normal waste.

SPECIAL PROTECTION INFORMATION

Respiratory	Not applicable in normal use
Ventilation	Not applicable in normal use
Protective clothing	Not applicable in normal use
Other	

ANNEX A CONFIGURATION

Note: This Annex is included for the sake of completeness. It is strongly recommended that configuration be carried out via LINtools rather than by the procedures outlined below.

The main topics of this chapter are:

A.1 Tools: The Configurator and LINtools
A.2 Configurable items
A.3 Preparing to run the Configurator
A.4 Running the configurator
A.5 Database configuration
A.6 Configuring Communications (Modbus only).

A.1 TOOLS: THE CONFIGURATOR AND LINTOOLS

Most configuration will be done before despatch, using the LINtools component of the Eurotherm Project Suite. This chapter explains how databases and communications parameters are configured for the unit using the Configurator program resident within the processor unit(s). (In redundant mode the program is resident only on the Primary processor).

The Configurator program is mainly for adjusting configurations on site, usually to accompany modifications to the processing plant. The T500/550 LINtools Product Manual (HA082377U999) should be referred to for details of the configuration procedure using the LINtools package.

The Configurator employs the standard LIN block-structured approach. The LIN Product Manual gives full details of the software function blocks available for strategies, and how to configure their parameters. The Configurator can also be used to load, start, stop, save and monitor databases, and to perform various filing operations.

A.2 CONFIGURABLE ITEMS

The configurable items depend on whether the database or Modbus communications is to be configured. In either case, it is a menu/item selection procedure. The LINtools package, by comparison, offers an icon-based ‘drawing’ capability.

Configuration of the database consists of carrying out one or more of the following:

1. Installing function blocks in the control strategy (MAKE)
2. Creating duplicates of existing blocks (COPY)
3. Deleting blocks (DELETE)
4. Inspecting and updating blocks (INSPECT)
5. Assigning LIN names and node addresses to external databases* (NETWORK)
6. Accessing the Utilities menu (UTILITIES), from which the user can START and STOP programs, SAVE and LOAD databases and FILE pages, APPLY or UNDO changes and Access the ELIN setup page.

*Note: External databases (EDBs) are databases running in other LIN instruments.

Configuration of Serial Comms consists of carrying out one or more of the following

1. Setting the operating mode of the instrument to either Master or Slave(MODE)** .
2. Accessing the Tables list, which sets register mapping, and allows tables to be viewed (TABLE)
3. Accessing the Utilities menu (UTILITIES), from which you can SAVE or LOAD protocol configurations.

**Note: Master mode is not supported within the configurator.

A.2.1 Configuration Access

The Configurator is accessed by connecting the instrument from its Configuration port on the front panel, to a 'VT100' compatible terminal (for example, an IBM-compatible PC running a terminal emulation package).

A.3 PREPARING TO RUN THE CONFIGURATOR

Getting ready to run the Configurator consists of two main steps:

1. Connecting the processor unit to a PC
2. Setting the control efficiency of the instrument.

A.3.1 Connecting to a PC

The CONFIG port on the primary processor front panel should be connected to the PC EIA232 port using a cable fitted with an RJ11 connector at one end and (typically) a 9-way 'D-type' connector at the other (Eurotherm part no. DN026484). The connector pinouts are detailed in Chapter 2, Installation. If further details are required, refer to the documentation supplied with the PC.

Notes:

1. To configure a redundant-mode instrument (dual synchronised processors), the terminal PC must be linked to the primary processor, not the secondary.
2. It is recommended that if a mains-powered PC is to be used, that it be isolated from the Processor Module by a Comms isolator. (For details, section 2.4.2 Processor Module, should be referred to).

A.3.2 Setting the control efficiency

If the Configurator is to be used without the database running, continue at section A.4.

Running the Configurator with the database running can affect the control efficiency of the instrument. The control efficiency is the percentage of CPU time spent on control tasks (i.e. updating function blocks.) Any diversion from this task will cause a fall in control efficiency.

100% efficiency can never be attained because there will always be minor ancillary tasks occupying the CPU's time but, under normal control activity with no major diversion, typical control efficiency will range from 80% to 95%.

How much the efficiency falls due to diversion to configuration tasks depends upon whether the Supervisor is set up as non-redundant or redundant.

NON-REDUNDANT (SIMPLEX)SYSTEM

The processor spends 80% of its time updating blocks in the control strategy, leaving a fixed 20% available for configuration tasks.

REDUNDANT (DUPLEX)SYSTEM

The primary processor spends up to 70% of its time updating blocks in the control strategy. The synchronisation task leaves the configurator with a small percentage of time in which to run, between higher priority tasks.

A.4 RUNNING THE CONFIGURATOR

This section describes accessing and quitting the Configurator using HyperTerminal®. If a different terminal program is being used, its user documentation should be consulted (if necessary) for the equivalent procedures.

Which screen appears at start-up depends on whether the Instrument is running before HyperTerminal ® is running or, as described below, it is switched on after HyperTerminal®. In the former case, the 'sign-on' screen described below does not appear, neither does the `1 ANSI-CRT` message. To get to the initial menu, type <1> (one) and wait for the menu to be displayed.

Note: The sign-on screen also appears when quitting the terminal configurator.

A.4.1 Initial menu access

Note: The detail of the following procedure varies according to the Windows version in use.

1 Power up the PC and start Hyperterminal® (All Programs/Accessories/Communications/Hyperterminal®). After entering a name for the link (if necessary) and defining the computer port (e.g. COM1) enter the port settings tab and set up the communications parameters as follows:

Baud rate = 9600, Data bits = 7, Stop bits = 1, Parity = 'Even', Flow control = Xon/Xoff.

2 When the hyperterminal starts, go into the file menu and click on 'Properties'. In the 'Settings' tab select 'Emulation' = 'VT100', then click OK.

3. Power up the instrument. The sign-on screen appears. Figure A.4.1a, below shows a typical display. Type <1> to call the 'initial menu'.

```
T940X Process Supervisor  - V5/1 - 51M at 266 MHz
(Hardware Build: 00001)
Profibus card: PB-COMBIC104-PB  Version: T01.069a14.09.02
Ethernet (MAC) address = 00:30:59:01:86:E9
IP address = 10.1.1.2
Subnet mask = 255.255.255.0
Default gateway = 149.121.164.253
POST result (0000) = SUCCESS
Hotstart failed because: Warmstart switch is disabled
Last shutdown because: Successful Power Down

1 ANSI-CRT
>>>
```

Figure A.4.1a Typical sign-on screen

Ethernet (MAC) address	Shows the address of the Ethernet interface. This value is unique and is permanently fixed for an individual instrument.
IP address	Gives the IP address currently assigned to this instrument. This address must be entered manually.
Subnet Mask	Gives the subnet mask currently assigned to this instrument. An IP host uses the subnet mask, in conjunction with its own IP address, to determine if a remote IP address is on the same subnet (in which case it can talk directly to it), or a different subnet (in which case it must talk to it via the Default Gateway). Please see 'IP Subnets', below.
Default Gateway	Gives the IP address of the Default Gateway. It is the address via which this instrument must talk in order to communicate with IP addresses on other subnets. If undefined then this instrument can talk only to other IP hosts on this same subnet.

® Hyperterminal is a trademark of Hilgraeve Inc.

A.4.1 INITIAL MENU ACCESS (Cont.)

If Modbus is enabled, the configurator Initial menu appears, as shown in figure A.4.1b. If Modbus is disabled, the Main menu appears instead, as shown in figure A.5. (Modbus in enabled/disabled by means of the Options switch (SW2) on the backplane as described in section 2.4.2.)

```
INIT          Choose option
(Running)
                        >DATABASE - General configuration
                          GATEWAY  - MODBUS configuration
```

Figure A.4.1b Configurator initial menu

Note: If the Initial or Main menu appears, this indicates that the Processor module has entered configuration mode.

Locate the cursor (**>**) at a menu item using the cursor keys, then press <Enter> to display the next level in the menu hierarchy. This is called selecting an item. In general, to access the next lower level of the menu hierarchy <Enter> is pressed. To return to the next higher level menu or close a 'pop-up' options menu the <Escape> key is pressed. <PageUp> and <PageDown> allow hidden pages in long tables to be accessed.

For keyboards without cursor-control keys, equivalent 'control' character combinations may be used, as indicated in Table A.4.1. To use these, the <Ctrl> key is held down and the specified character typed.

Function	Key combination
Clear screen	<Ctrl> + W
Cursor Up	<Ctrl> + U
Cursor Down	<Ctrl> + D
Cursor Left	<Ctrl> + L
Cursor Right	<Ctrl> + R
Page Up	<Ctrl> + P
Page Down	<Ctrl> + N
Stop automatic update	<Ctrl> + V

Table A.4.1 Cursor-control — equivalent key combinations

Some tables allow a value to be entered directly, or via a called-up menu. For direct entry, the first character(s) of the chosen option is (are) typed, followed by <Enter>. Alternatively, the menu can be accessed with <Enter> or <Tab> as the first character after the field is selected.

IP SUBNETS

The current IP address system is known as Classless Inter-domain Routing (CIDR). The process supervisor predates this standard and divides the internet address space into a number of classes (see table A.4.1, below). For this type of addressing the subnet masks are on byte (as opposed to bit) boundaries. Therefore a subnet mask for a class C address such as 255.255.252.0 is converted to 255.255.255.0. In order to avoid misinterpretation of the information in the NETWORK.UNH always use valid pre-CIDR subnet masks.

Class	Address	Example	Default subnet mask
A	0 network: 7 bits; host: 24 bits	90.1.2.3	255.0.0.0
B	10 network: 14 bits; host: 16bits	128.0.1.2	255.255.0.0
C	110 network: 21 bits; host: 8 bits	192.0.0.1	255.255.255.0
D	1110 multicast group ID: 28 bits	224.0.0.1	None

Table A.4.1 Address space class definitions

A.4.2 The Initial menu

The Initial menu (figure A.4.1 above) lists two options viz 'Database' and 'Gateway'. Database allows access to the Main menu for configuring a LIN database. This is described in section A.5, below. Gateway allows access to the Gateway menu, for setting up a Modbus configuration, described in section A.6.

A.4.3 Quitting the terminal emulation program

Exit from configuration mode must be done from the terminal by pressing <Escape> repeatedly until the main menu screen appears, then again to clear the screen. The processor is now out of configuration mode.

Note: It is not possible to stop/start/download/upload files via Network explorer (E-suite package) for a processor in configuration mode. Any attempt to do so results in error 8333 ('Configurator in use') being reported. Processor configuration mode must be quitted before these operations are attempted.

CAUTION

Always quit the primary processor from configurator mode after use. If this is not done, an operator unaware that the Processor module is still in configurator mode might subsequently plug in a terminal and type <Enter> <Enter> — hoping to see the version and power-up/shutdown messages. The result could be totally unexpected because the configurator would react according to where it was left, e.g. if last used to start a database it would execute the start sequence (twice).

A5 DATABASE CONFIGURATION

Figure A5 shows the Main menu.

```
MAIN MENU  Select option

(Running)

          >MAKE       - Create block
           COPY       - Copy block
           DELETE     - Delete block
           INSPECT    - Inspect block
           NETWORK    - Network setup
           UTILITIES  - Engineering utilities
           ALARMS     - Current Alarms
```

Figure A.5 Configurator Main menu

A.5.1 MAKE

Notes

1 Every control strategy must contain a 'header' block; initially, the only LIN function block available for a new control strategy.

2. Any function blocks added whilst the control strategy is running (online) are made as 'tentative'. Such blocks do not become part of the running control strategy until 'TRY' or 'APPLY' is selected from the 'Utilities' menu.

3 Blocks may not be configured if processor modules are synchronised

Installs function blocks in the control strategy. Select MAKE to display the SET MENU — the processor's resident library of function block categories, detailed in the LIN Blocks Manual (HA082375U003). Figure A.5.1a shows part of the screen display when LOGIC is selected, as an example.

Figure A.5.1a Logic category menu (upper part)

Select the block to be installed. The block Overview appears listing the block parameters, default values and units in a double 3-column format. Figure A.5.1b shows the (default) overview for the PID block as an example.

A.5.1 MAKE (Cont.)

BLOCK OVERVIEW

Refer to Figure A.5.1b, below, which shows the main features of a typical function block overview, used to monitor and update function block parameters. (Overviews can also be accessed via the COPY and INSPECT main menu options.) The overview is equivalent to a LINtools Object Properties pane and its fields have the same meanings, although data entry is different. Note that parameters being updated by incoming connections from other function blocks are not specially indicated in a function block overview.

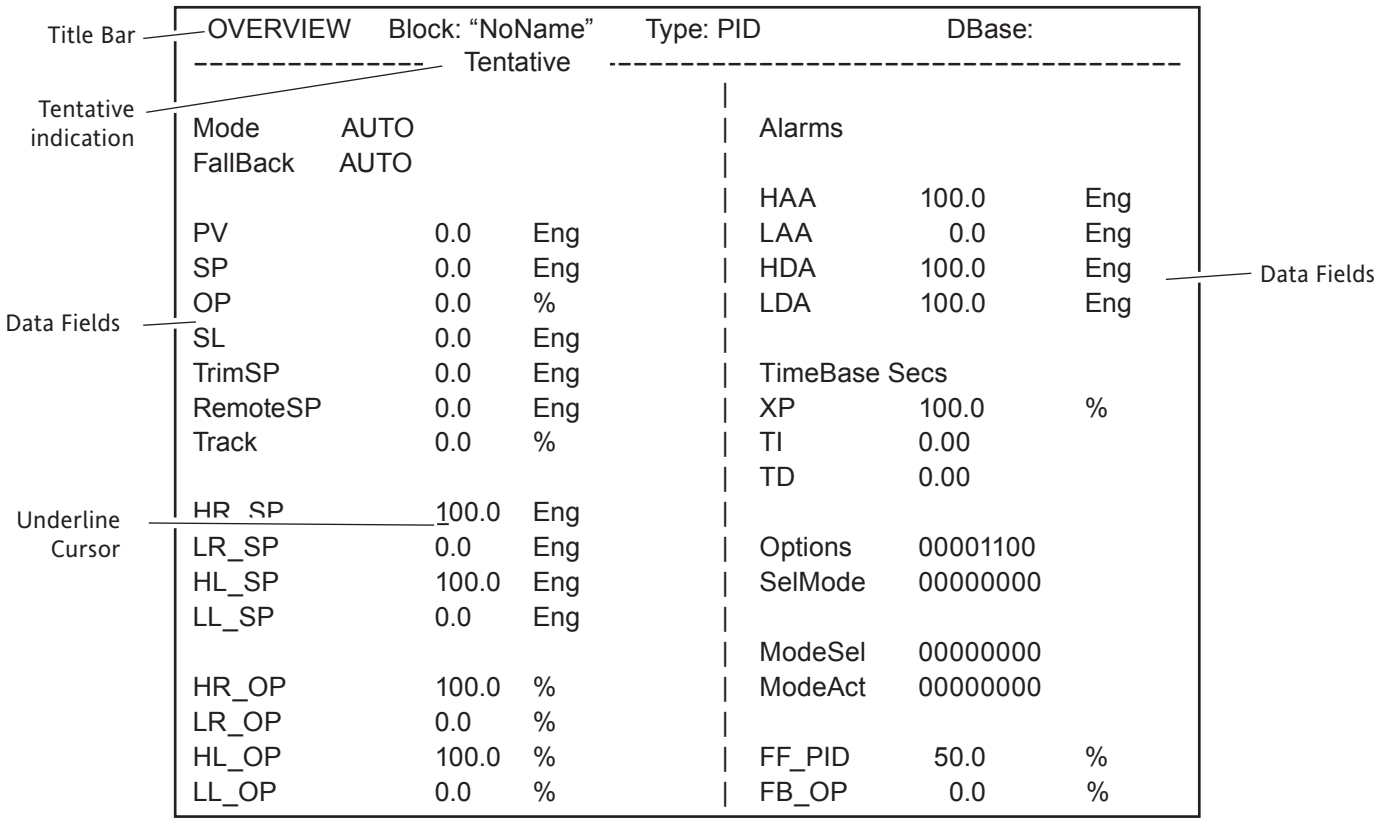


Figure A.5.1b Overview — PID block

TITLE BAR

Contains fields common to all overviews: Block, Type, and DBase. Details of these fields are to be found in the LIN Blocks Reference Manual (HA082375U003)). A blank DBase field denotes that the LIN database is local.

> Note: The function block is not installed into the control strategy until (at the minimum) its Block field has been assigned a value — i.e. tagname — and either the database has been restarted or APPLY operated in the 'Utilites' menu.

OVERVIEW DATA FIELD ENTRY

To update a parameter field, move the flashing 'underline' cursor (_) to the field using the arrow keys, then proceed as described next for the different data field types. Some data fields display further nested levels of data when entered, as detailed in the following sections. Press <Enter> to access a deeper level; press <Escape> to return to a higher level.

> Note: Refer to 'Configurable items' (section A.2 above) for Online Reconfiguration commands

A.5.1 MAKE (Cont.)

1 User-defined names.
Type in a name (8 characters max.) and press <Enter> to overwrite existing data. To insert characters, locate the cursor at the character to follow and type the insertions. A 'beep' warns that excess characters have been typed. To abort the current entry and leave the LIN database unchanged, move the cursor to a function block field above or below the current field before pressing <Enter>, or press the <Escape> key.

Note: Remote LIN database names entered in the DBase field must be prefixed by an 'equals' sign (=) which is included in the character count.

Pressing <Enter> with the cursor on the first character of the Block or DBase fields (before starting to type) accesses a Full Description page (Figure A.5.1c shows an example). This page gives general information about the block and has a common format.

```
FULL DESCRIPTION      Block: INP01      Type: ANIN
------------------------------------------------------
              Request refresh                0.1040
              Server number                  5
              DBase:                         =Alpha
              Rate ms                        10
              Execution time                 1234
```

Figure A.5.1c FULL DESCRIPTION page for block (example)

Block	Block tagname (Read/write)
Type	Block type (Read-only).
Request refresh	Configured time period (secs) for running the LIN function block. For a control function block the PID algorithm is not necessarily recalculated every time it is scheduled. (Read-only).
Server number	The function block's time scheduled task priority (Read/write). There are four User Tasks numbered from User Task 1 (highest priority) to User Task 4 (lowest priority). See Chapter 7 for more details.
DBase:	Name of the function block's LIN database. A blank field means that the LIN database is local, i.e. resident in the current processor. (LIN Database names and their LIN addresses are specified via the main menu NETWORK option, described in section A.5.5.) (Read/write) Note that the LIN database name entered in the 'DBase' field must be preceded by an 'equals' character (=).
Rate ms.	For cached function blocks: Rate is the minimum update period (i.e. maximum rate) at which an individual cached function block is transmitted across the Local Instrument Network (LIN). The default is 10ms minimum, i.e. 100Hz maximum. Rate can be set between 10ms and 64s. Note that rate values are minimum update times only, and heavily loaded networks may not be able to reach the faster update rates. For DCM blocks: Rate is the target period at which the block's data is to be updated via Modbus. A minimum value of 1000 ms is normally needed. The default value of 100 ms is acceptable for Profibus working, but can cause problems with Modbus.
Execution time	This is the time taken in microseconds to execute a LIN function block (including connections etc.).

Note: If the control strategy is running (online), the 'DBase' and 'Rate ms' fields cannot be edited. Only local function blocks can be 'Made'.

A.5.1 MAKE (Cont.)

2. Parameter values.

   Type in a value and press <Enter> to update the LIN database. (Read-only parameters do not accept new values.) The processor module automatically adds a following decimal point and padding zeros if needed, but before a decimal point a zero must always be typed, e.g. 0.5, not .5.

   Pressing <Enter> with the field selected, before starting to type, accesses a Full Description page for the parameter (Figure A.5.1d shows an example).

```
FULL DESCRIPTION   Field: PV          Block:  PID_1      Type:  ANIN
-------------------------------------------------------------------
     Value         80.1                                    Real32
     Input         SIM 1.OP
```

Figure A.5.1d FULL DESCRIPTION page for parameter (example)

Field, Block, Type	Read-only fields.
Value	Parameter value, editable as for the Overview. (Read/write)
Real32	Value type (Real32 = floating point number) (Read Only)
Input	Defines the source of any connection to the parameter from another function block, as Block Tagname.Output Mnemonic. A blank function block field means no connection. To make or edit a connection, type in the source function block tagname and output mnemonic (e.g. SIM 1.OP, or SEQ.DIGOUT.BIT3), then press <Enter>. Invalid data is 'beeped' and is not accepted. The field is not case sensitive. To delete a connection, type <space> then press <Enter>. (Read/write)

Note: See CONNECTION TYPES... (below) for information and advice on types of database connections.

3. Parameter units.

   Type in a value and press <Enter>. All other related units in the LIN database automatically copy the edited unit. Pressing <Enter> with the field selected, before starting to type, accesses the parameter Full Description page (as for the value field).

A.5.1 MAKE (Cont.)

4 Options menu fields.
Press <Enter> to display a pop-up menu of options for the field. Figure A.5.1e shows an example (PID Mode) in part of an overview page.

```
 OVERVIEW    Block: "NoName"      Type: PID                DBase:
-------------------------------------------------------------------

                 +-------+                    |
Mode             | >HOLD |                    | Alarms
FallBack         |  TRACK|                    |
                 |  MANUAL                    | HAA        100.0     Eng
PV               |  AUTO |  Eng               | LAA          0.0     Eng
SP               |  REMOTE  Eng               | HDA        100.0     Eng
OP               |  F_MAN|  %                 | LDA        100.0     Eng
SL               |  F_AUTO  Eng               |
TrimSP           +-------+  Eng               | TimeBase Secs
RemoteSP            0.0     Eng               | XP         100.0     %
Track               0.0     %                 | TI         0.00
                                               | TD         0.00
HR_SP               100.0   Eng               |
LR_SP               0.0     Eng               | Options    00101100
HL_SP               100.0   Eng               | SelMode    00000000
LL_SP               0.0     Eng               |
                                               | ModeSel    01000001
HR_OP               100.0   %                 | ModeAct    01000001
LR_OP               0.0     %                 |
HL_OP               100.0   %                 | FF_PID       50.0    %
LL_OP               0.0     %                 | FB_OP        0.0     %
```

Figure A.5.1e Pop-up options menu (example)

Using the 'arrow' keys, move the cursor (**>**) to a menu option and select it by pressing <Enter>. (Disabled options may not respond to selection.) A quicker alternative to accessing the pop-up options menu is to type the required option, or enough of its initial letters to uniquely specify it, directly into the selected field and then press <Enter>. E.g. entering just **H** selects HOLD; entering **F_M** selects F_MAN (Forced Manual).

5 Alarms field.
Press <Enter> to display a 4-column Alarms page listing alarm name (e.g. HighAbs), acknowledgement (e.g. Unackd), status (e.g. Active), and priority (0 to 15). Update the acknowledgement or priority fields (the only editable ones) by typing in a value and pressing <Enter>. (Any single letter can be used for the acknowledgement field.) Figure A.5.1f shows an example Alarms page.

```
Alarms                  Block: PID_1      Type: PID
-------------------------------------------------------------
 Software               Unackd            Active      15
 HighAbs                Unackd            Active      15
 LowAbs                                               0
 HighDev                                  Active      10
 LowDev                                               2
 Combined                                             0
```

Figure A.5.1f Alarms page (example)

A.5.1 MAKE (Cont.)

6. Bitfields

   Contain eight (or sixteen) binary digits showing the logic states of a corresponding set of up to eight (or sixteen) parameters. To edit the bitfield directly, type in a bit-pattern then <Enter> it. Alternatively, press <Enter> to display a Full Description page listing the parameter TRUE/FALSE or HIGH/LOW states (in the same format used for LINtools Object Properties pane bitfields). Figure A.5.1g shows an example. Alter a logic state by locating the cursor on the state, typing in T(rue) or F(alse), and pressing <Enter>. (A bit may be read-only.)

```
FULL DESCRIPTION    Field: ModeAct      Block: PID_1        Type:PID
------------------------------------------------------------------
  NotRem        TRUE
  HoldAct       FALSE
  TrackAct      FALSE
  RemAct        FALSE
  AutoAct       FALSE
  ManAct        FALSE
  FAutoAct      TRUE
  FManAct       FALSE
```

Figure A.5.1g FULL DESCRIPTION page for bitfield (example)

To connect an input to a bitfield, press the → key and type in the LIN function block name/field name from which the connection is to be made. A connection can be deleted by replacing the LIN function block name/field name in the bitfield, by a space.

CAUTION

Any connections deleted whilst the control strategy is running (online) are marked as 'DeleteReq'. Such connections can be further edited, but the new version will not become effective until 'TRY' or 'APPLY' is selected from the 'Utilities' menu described in section A.5.6.

Note: See CONNECTION TYPES... (below) for information and advice on types of database connections.

7 Two- and four-digit 'combined' hexadecimal status fields.
Hex fields are marked with a '>' sign and have the same format and significance as those found in LINtools specification menus. The digits show the logic states of a corresponding set of parameters, up to four per hex digit. To edit the field directly, type in new values then press <Enter>. Alternatively, press <Enter> to display a Full Description page listing the parameter TRUE/FALSE states and edit this list (as described for Bitfields, above).

CONNECTION TYPES IN A PROCESSOR MODULE DATABASE

There are three types of connection used in a LIN database: local connections, connections writing to a cached function block, and connections from a cached function block to a local function block. The following explains how and when they are evaluated.

1. Local connections.

   These are connections between two function blocks that are both local to the LIN database. The connection is always evaluated immediately prior to the execution of the destination LIN function block's update procedure, regardless of whether the source data has changed between iterations. With this sort of connection, any attempt to write to the connection destination is immediately 'corrected' by the next connection evaluation.

A.5.1 CONNECTION TYPES IN A PROCESSOR MODULE DATABASE (Cont.)

2. Connections writing to cached function block

   These are connections whose destination function block is a cached copy of a function block in another instrument. The source of the connection can be either a local function block or another cached function block. Such connections are evaluated only if the source and destination data do not match. All cached function blocks in the LIN database are processed at regular intervals, and whenever a change is detected, a single field write is performed over the communications link.

3. Connections from cached function block to local function block

   These are connections where the source function block is a cached copy of a function block in another instrument, and the destination function block is local to the LIN database. All cached function blocks in the LIN database are tested at regular intervals, and if a change in the function block data is detected, then all such connections out of the cached function block into local function blocks are evaluated. The connections are not evaluated if the source data has not changed.

   This third type of connection is unique to redundant (duplex) instruments. Such connections are evaluated in this way to minimise the load involved in synchronising the LIN databases of a duplex pair, whilst ensuring the coherence of the data between the primary and secondary processor units.

CAUTION

With this third type of connection, tasks can write to the connection destination, leaving the source and destination of the connection with different values. It should be ensured that the control strategy in use does not write to connection destinations.

A.5.2 COPY command

Creates duplicates of existing function blocks. Select COPY from the main menu to display all the function blocks in the control strategy, in semi-graphical format as shown in Figure A.5.2. The function blocks are displayed from left to right in order of creation. Move the cursor (>) to a function block and press <Enter>. The function block is duplicated and added to the strategy, and its Overview page automatically appears ready for parameterising. The duplicate retains all the original parameter values except for the Block field, which has the default tagname “NoName”. Input connections are not copied; nor are I/O function block site numbers.

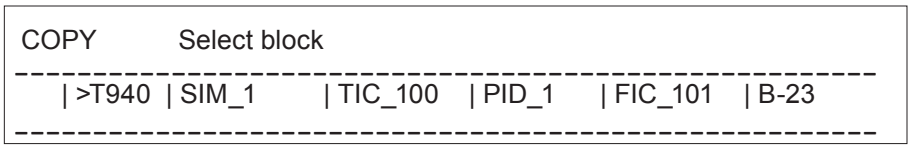


Figure A.5.2 COPY display (example)

Pressing <Escape> returns the COPY display, where the copied function block can be seen added to the list. Press <Escape> again to return to the top level menu.

Note: Any function blocks copied whilst the control strategy is running (online) are made as ‘tentative’. Such function blocks do not become part of the running control strategy until ‘TRY’ or ‘APPLY’ is selected from the ‘Utilities’ menu.

A.5.3 DELETE command

Notes

1. Any function blocks deleted whilst the control strategy is running (online) are marked as 'DeleteReq'. Such blocks are not deleted until 'TRY' or 'APPLY' is selected from the 'Utilities' menu.
2. A function block cannot be deleted unless its input connections have been cleared. This is achieved by clearing the source fields of each affected connection

Deletes function blocks from the control strategy.

Select DELETE from the main menu to display all the function blocks in the control strategy, in the same format as for the COPY option described in section A.5.2, above. Select a function block and press <Enter>. The function block and any connections from it are deleted, and the main menu returns to the screen.

A.5.4 INSPECT command

Allows function blocks in the control strategy to be inspected and updated. Select INSPECT from the main menu to display all the function blocks in the control strategy, in the same format as for the COPY and DELETE options already described. Select a function block and press <Enter> to display its overview page, ready for monitoring or updating.

Pressing <Escape> returns the INSPECT display, where other blocks can be selected for inspection. Press <Escape> again to return to the top level menu.

A.5.5 NETWORK

Allows LIN databases to be assigned names and node addresses on the Local Instrument Network so that they can be configured as 'cached' function blocks and run in a remote instrument. (The overview page of the cached block DBase field specifies the remote database name.)

Note: It is good practice when using cached function blocks, to cache at least one block in each direction. This allows the status of the comms link between the nodes to be monitored from both ends via the cached blocks' software alarms. This 'bidirectional caching' also eliminates the fleeting software alarms that may otherwise be seen during processor changeover in a redundant mode (duplex) system.

Select NETWORK from the main menu to display the Network setup page (initially blank). Figure A.5.5 shows the top part of an example page with several databases already assigned.

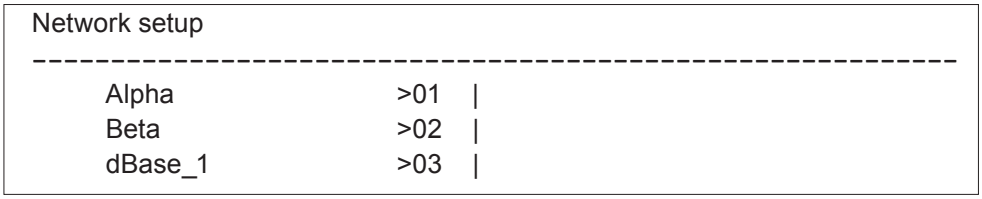


Figure A.5.5 NETWORK setup page (example)

To assign a new database name and address, locate the underline cursor at the left hand column of a blank row, type in a unique name (7 characters max.) and press <Enter>. The name appears added to the list together with a default node address **>00**. (Non-unique or invalid names are 'beeped' and not accepted. Do not use 00 or FF as node addresses). Move the cursor to the default address and type in the required node address (two hex digits). Press <Enter> to complete the assignation.

A.5.5 NETWORK (Cont.)

To edit an existing name or address, locate the cursor at a field, type in the new value, and press <Enter>. Invalid entries are not accepted.

To delete a complete name and address entry, edit its name field to a space character. Configurations downloaded from LINtools will have a Network page set up automatically.

A.5.6 UTILITIES

Allows program control, I/O calibration, and filing. Select UTILITIES from the main menu to display the Utilities options, shown in Figure A.5.6.

```
UTILITIES  Select option

                >START      - Start runtime system
                 STOP       - Stop runtime system
                 SAVE       - Save database
                 LOAD       - Load database
                 FILE       - File page
                 TRY        - Try Changes
                 UNTRY      - Untry Changes
                 APPLY      - Apply Changes
                 UNDO       - Undo Changes
                 ELIN       - Elin Setup
```

Figure A.5.6 UTILITIES options menu

START, STOP COMMANDS

Select START or STOP from the UTILITIES options menu and press <Enter> to start or stop the control program running in the processor.

> Note: When you START a LIN database in RAM it is automatically saved to the file in E: drive called filename.DBF, where filename is indicated in the filename.RUN file. It is then reloaded and started.

SAVE COMMAND

Names and saves a control program to a specified memory area. Select SAVE from the UTILITIES options menu — the default filename specification, E:T940.DBF is displayed. (The prefix E: directs the save to the local E: drive area of the processor; this is the only available memory area. To save a database to a remote instrument, prefix the filename specification by the node address of the instrument separated by a double colon, e.g. FC::E:T940.DBF).

Type in a new specification if needed, then press <Enter> to execute the save. After a short pause the processor module signals completion with the message: 'Type a key to continue'. Typing any key returns the UTILITIES menu.

An invalid filename specification aborts the save, and an error message is sent, e.g. 'Save failed — Invalid device'.

> Note: Modifications to a control database are carried out on the RAM image only, not directly to the .DBF file in E: drive. They are copied to E: drive (overwriting the existing .DBF file) automatically as you restart the database, or when you do a SAVE operation.

A.5.6 UTILITIES (Cont.)

LOAD COMMAND

Retrieves a control program from a specified memory area and loads it to the processor RAM.

> Note: A LOAD operation can be performed using the 'Load Delta' option during on line configuration.

Select LOAD from the UTILITIES options menu — the default filename specification, E:T940.DBF is displayed. Edit the specification if needed (to alter the filename or its source, as described in 'SAVE utility' above), then press <Enter>. After a short pause the processor signals completion as described for the SAVE option. Typing any key returns the UTILITIES menu.

An invalid filename specification aborts the load, and an error message is sent, e.g. 'Load failed — File not found'.

FILE COMMAND

Permits access to the processor file page, allowing files to be deleted or copied, and the E: device to be formatted. The file page displays files in the E-device and also in a configurable remote ??::?: device. To access a remote device, move the cursor to the ??::?: field and type in the required node and device letter, e.g. FA::M:. Press <Enter> to display its files (up to a maximum of 20).

Move the cursor up and down the file list and tag files with an asterisk (*) using <Enter>. Then move the cursor to the top column-head field and press <Enter> to display the function menu: Copy, Delete, Find, and — for E-device only — Format. Finally, select a function and press <Enter> to carry it out. Press <Escape> to return to the UTILITIES menu.

> Note that the Find function has wild-card characters (**?**) to aid in locating filenames containing known character strings.

TRY/UNTRY CHANGES COMMAND

LIN Database changes can be Tried and Untried on a running LIN Database from the Configurator. If the control strategy has 'Tentative' changes, 'Changes' appears below the first line in the Configurator, but will change to 'Trying' when testing the strategy. Any such changes made whilst the LIN Database is running are 'Tentative', as indicated on the Configurator screen and are not applied until APPLY is selected. These 'Tentative' changes can be discarded by selecting UNTRY, before APPLY has been selected. UNTRY has no effect once APPLY has been used.

> Note. If changes have been applied, and a synchronisation is attempted, it will fail unless the LIN Database running in the primary instrument has been saved using either the root LIN function block's full save option, or it is stopped, saved and started from the Configurator program.

Select TRY or UNTRY from the UTILITIES options menu and press <Enter> to try or untry the 'Tentative' changes to the control strategy running in the instrument.

APPLY/UNDO COMMAND

LIN database changes can be executed on-line from the terminal configurator. Any such changes made whilst the database is running are 'Tentative' and are not applied until APPLY is selected. 'Tentative' changes can be discarded by selecting UNDO, before APPLY has been selected. UNDO has no effect once APPLY has been used.

> Note: If changes have been applied, and a sync. is attempted, it will fail unless either the primary LIN database is saved using the root block's full save option, or it is stopped, saved and started from the configurator program.

A.5.6 UTILITIES (Cont.)

APPLY/UNDO COMMAND (CONT.)

APPLY DCM BLOCKS

For DCM blocks, not only must the blocks themselves be added to the executing database, but also, the Communications parameters must be passed to the AMC data groups.

For Profibus blocks:

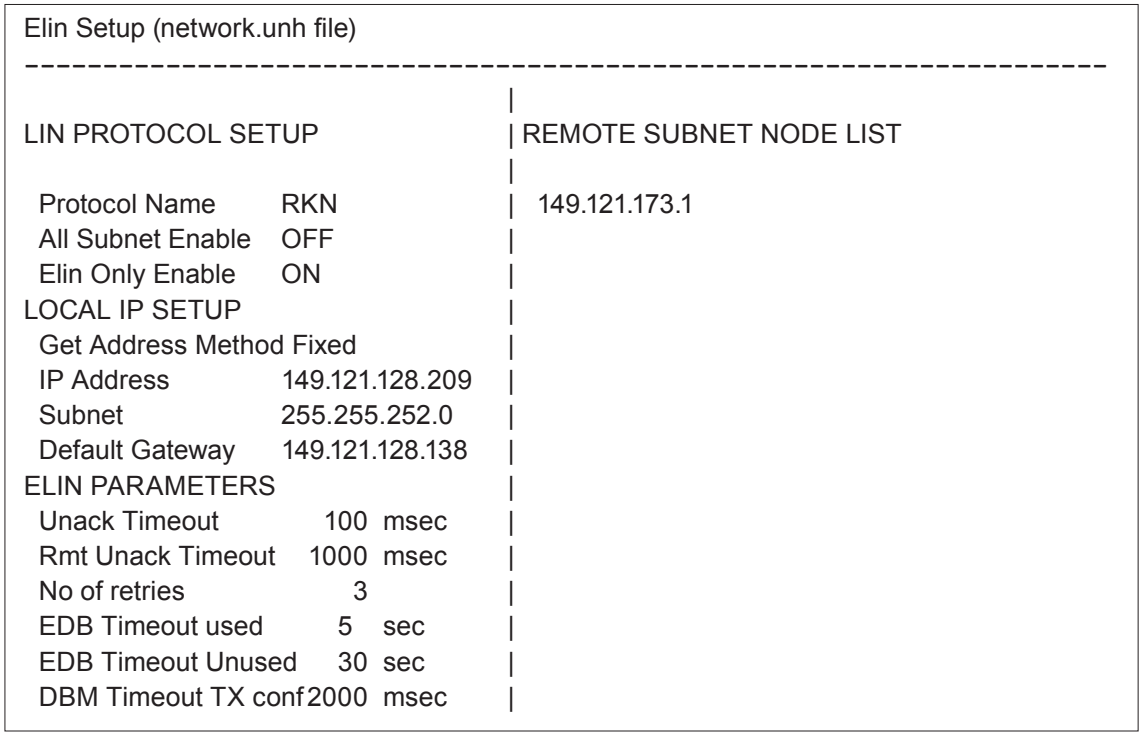
1. The DCM block must refer to a Profibus node that is already 'known' to the system. (I.E. There must already be other, running, DCM blocks referring to the node.) If the node is not known, the DCM block enters Config Alarm, and a suitable error message is added to the .UYC file.
2. The new communications parameters are added for Acyclic operation only. The database must be restarted, or a changeover must be forced on a synchronised unit in order to install the parameters for Cyclic use.

The restrictions above do not apply to Modbus blocks.

ELIN SETUP PAGE COMMAND

This page allows the instrument's network.unh file to be configured.

> Note: The network configuration can be edited using the Instrument Properties dialogue via the Project Environment or the instrument folder. The 'network.unh' file can also be edited using an appropriate text editor, e.g. 'notepad.exe'.



LIN PROTOCOL SETUP	This area of the screen allows specification of those items in the "[LIN]" section of the network.unh file.
LOCAL IP SETUP	Allows the specification of those items in the "[IP]" section of the network.unh file. The IP address etc. is entered using data obtained from the network administrator.
REMOTE SUBNET NODE LIST	Allows the user to enter the IP addresses of all the nodes with which it is required to communicate. (The "[PR]" section of the network.unh file.)

A.5.6 UTILITIES (Cont.)

ELIN SETUP PAGE COMMAND (CONT.)

Once all the required entries have been made, the ESC key should be operated. A confirmation message asks if the network.unh file is to be updated. If 'Y', the file is updated and a power cycle is requested.

CROSS SUBNET WORKING

With 'All Subnet Enable' set 'OFF' (default), the instrument will not communicate ELIN cross subnet. This can be overridden in the network.unh file by setting 'All Subnet Enable' to 'ON'. This defines the behaviour when the Process Supervisor powers on. The ability to communicate cross subnet can be modified at run time by using the "Options.AllSubnt" bit in the instrument's header block. Set to TRUE, this bit enables cross-subnet working. When set to FALSE, cross-subnet working is disabled.

Note: This bit may be set FALSE, remotely, from a cross-subnet connection. If this is done, communications will be lost, and it will thus not be possible to reset it to TRUE from the cross-subnet connection.

LOCAL IP SETUP

Allows the IP address etc. to be set up for the instrument. Some of the information may need to be

ELIN PARAMETERS

Allows ELIN timeout and retry parameters to be edited

A.5.7 ALARMS

Select ALARMS to view the currently active alarms in the instrument. Move the cursor up and down the list. Type <Enter> to acknowledge an individual alarm; Type <I> to inspect the block containing the alarm.

A.6 MODBUS CONFIGURATION

Figure A.6 shows the Gateway menu.

Note: The resident Modbus configurator works in a similar way to the Modbus configurator in the T500 LINtools package. Refer to the T500/T550 LINtools Product Manual (HA082377U999) for more information.

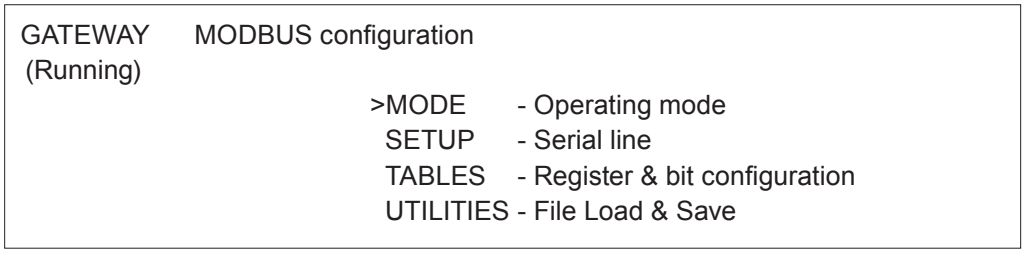


Figure A.6 Gateway menu

A.6.1 MODE

Displays the operating mode as 'Master' or 'Slave'.

A.6.2 SETUP

Displays parameters for serial link operation. The items are not editable. Select SETUP to see a menu of items — Baud rate, Parity, Stop bits, and Time out. The user can select new values for the parameters, but these new values are not saved.

Baud rate.	Displays the current setting. Highlight and 'Enter' this item to see a menu of possible baud rates — 110, 150, 300, 600, 1200, 2400, 4800, 9600, 19200 and 38400.
Parity.	Displays current setting (None, Odd, or Even).
Stop bits.	Displays the current setting (1 or 2).
Time out.	Displays the Time out value, in the range 0 to 65.5 seconds. In slave mode, this parameter specifies a timeout period for all tables. That is, if a table has not been accessed for Time out seconds, the Online bit in the slave mode diagnostic register for that particular table resets to zero. In master mode, Time out specifies a maximum period between the end of a master's request for data to the start of the slave's response. If this time is exceeded, the Online bit in the master mode diagnostic register for the particular table concerned resets to zero.

When SETUP viewing is complete, press <Escape> return to the Gateway menu. Any changes will be ignored.

A.6.3 Tables

To view the tables list, highlight TABLES and press <Enter>.

TABLES LIST

The tables list provides an overview of the sixteen tables in the Modbus configuration, through which tables are created and their types, offsets and sizes. The tables list also accesses individual table menus for detailed configuration (database mapping) — see 'TABLE MENUS' below.

Figure A.6.3a shows an example tables list with Table 1 configured as a register table.

Table	Type	Offset	Count
1	Register	0	16
2	Unused	0	0
3	Unused	0	0
4	Unused	0	0
5	Unused	0	0
6	Unused	0	0
7	Unused	0	0
8	Unused	0	0
9	Unused	0	0
10	Unused	0	0
11	Unused	0	0
12	Unused	0	0
13	Unused	0	0
14	Unused	0	0
15	Unused	0	0
16	Unused	0	0

Figure A.6.3a Modbus tables list

Table — Table number (non editable). The table menu (described below) for any table is accessed by highlighting the table number field and pressing <Enter>.

Type — This field, which defaults to **Unused**, lets you create a new table or change the type of an existing table. Enter a Type field, select a type, and press <Enter> . Other fields in the tables list associated with your selection automatically adopt default values. The Type options are:
Unused. The table is deleted.
Register. Maps LIN database parameters onto standard 16-bit Modbus registers.
Digital. Maps LIN digital, boolean or alarm values onto bits in the Modbus address space.
Diagnostic. This is a special table, similar to a register table, but the values in the table have pre-defined values that are used to control Modbus operation, or present diagnostic information to the database.

Offset. — Selects the start address of the table on the Modbus network. The values used here are the actual values used in the address field of the Modbus messages, i.e. the 'protocol addresses'. Note that PLCs differ in the correspondence between their register or bit addresses and the protocol addresses.

Count. — This field specifies the number of registers or bits in a table. It allows the size of register and digital tables to be changed from their default values of 64 registers or bits, respectively, to optimise the use of memory. Diagnostic tables are fixed at 32 registers.

A.6.3 TABLES (Cont.)

TABLE MENUS

A table menu is accessed from the tables list by highlighting the required table number (in the first column headed Table) and pressing <Enter>. To highlight fields you can move the arrow cursor around a table menu using the mouse, or the PC's <Home>, <End>, and cursor keys.

Table menus allow the mapping between the LIN database fields and the Modbus addresses to be configured. Figure A.6.3b shows the default table menu for a register (or diagnostic) table. Note that table headings differ for register and digital tables, but that some fields are common to both — Field, DB Write, and MOD Write.

Register	Field	DP	Format	DB Write	MOD Write	Value
0		0	Normal	Enable	Enable	>0000
1		0	Normal	Enable	Enable	>0000
2		0	Normal	Enable	Enable	>0000
3		0	Normal	Enable	Enable	>0000
4		0	Normal	Enable	Enable	>0000
5		0	Normal	Enable	Enable	>0000
6		0	Normal	Enable	Enable	>0000
7		0	Normal	Enable	Enable	>0000
8		0	Normal	Enable	Enable	>0000
9		0	Normal	Enable	Enable	>0000
10		0	Normal	Enable	Enable	>0000
11		0	Normal	Enable	Enable	>0000
12		0	Normal	Enable	Enable	>0000
13		0	Normal	Enable	Enable	>0000
14		0	Normal	Enable	Enable	>0000
15		0	Normal	Enable	Enable	>0000

Figure A.6.3b Register table menu — default

Register. (Register and diagnostic tables only) This column shows the Modbus address of the particular register. The first register in the table takes its address from the Offset value given to the table via the tables list (described above). The remaining (read-only) addresses follow on consecutively.

Digital (Digital tables only) This column shows the Modbus address of the digital bit on that particular line of the table. If the line contains a bitfield rather than a single bit, the address shown is that of the first bit in the bitfield. Mappings may be made for a single bit, or for an 8- or 16-bit field, according to the value defined in the Width parameter (see later). The very first bit address in the table takes its value from the Offset given to the table via the tables list. The remaining (read-only) addresses follow on according to the numbers of bits on each successive line of the table (1, 8, or 16).

Field This is the LIN database field which can be mapped onto the Modbus address, or left blank. Select a field with the cursor and type in and enter a block name plus parameter (and subfield if needed), separated by full stops (periods), e.g. PV1.Alarms.Software. Note that if an attempt is made to enter an analogue parameter into a digital table Field, the entry is ignored. Any type of parameter can, however, be entered into a register (or diagnostic) table. Note also that in a digital table database parameters cannot be entered or overwritten if to do so would force an entry lower down the table to change its address (Digital value).

DP (Register and diagnostic tables only) This column can be used for either of two functions: specifying a decimal point position, or creating a 32-bit register.
Decimal point position. Represents the number of decimal places (0 to 4 inclusive) to be used when converting floating point numbers to 16-bit Modbus registers.

A.6.3 TABLES (Cont.)

32-bit register

(Register tables only) A 32-bit register is created by 'joining' a consecutive pair of 16-bit registers, as described below. Note the restrictions that are applied to ensure that the 32-bit value created is transferred indivisibly:

a) The multiread function (3) and multiwrite function (16) must both be enabled.
b) The scan count must be even.
c) The first register of the pair must be at an even offset within the table.
d) The first register of the pair must not be the last register in the table.
e) The second register of the pair must not already be assigned to a database field.
f) The field type of the 32-bit register pair must be 32-bit long signed or unsigned, 32-bit real or a string. For a string, only the first four characters are transferred.

To create a 32-bit register pair, enter 'd' or 'D' in the DP field of the first register of the pair. This causes the register's DP to adopt the value 'D', and the following register the value 'd'.

If any of the above restrictions are violated, the entry will be rejected.

When the first register of the 32-bit pair is assigned to a database field, the second register automatically copies the same field name; assigning the name and the DP can be done in either order. You can restore a 32-bit register pair to individual 16-bit registers by changing the first register's DP to 0 to 4.

Format

(Register and diagnostic tables only) This column specifies the format of the data in the register as normal or BCD (binary coded decimal). Normal format means that the data is a simple 16-bit integer. In BCD format the value is first limited to the range 0 to 9999, and then stored as four 4-bit nibbles in the register. The units are stored in the low order nibble, the tens in the second nibble, the hundreds in the third, and the thousands in the high-order nibble. BCD format allows the data to be used with certain devices such as displays.

Note: Format is ignored in 32-bit registers.

Width

(Digital tables only) This column indicates the number of bits contained in the associated field. The default Width is 16, but it automatically updates when a parameter is allocated to the field. Allocated field 'widths' are read-only, but the width of an unallocated field can be edited by highlighting its Width value and entering a number in the range 1 to 16, (normally 1, 8, or 16). Note that a Width value cannot be edited if to do so would force an entry lower down the table to change its address (Digital value).

DB Write

This column allows selected values in the LIN database to be protected from being overwritten by values received across the serial link. Highlight the required DB Write field and press <Enter>. Select 'Protect' to write-protect the LIN database parameter, or 'Enable' to allow overwriting.

Note: For a 32-bit register pair, DB Write applies only to the first register. The DB Write-value of the second register is ignored.

MOD Write

This column allows the user to prevent selected values in the LIN database being written to their associated Modbus registers or bits. Highlight the required MOD Write field and press <Enter>. Select 'Protect' to write-protect the Modbus register/bit(s), or 'Enable' to allow overwriting.

Notes:

1. The easiest way to protect an entire table in a gateway operating in master mode is to disable its write function codes (5 and 15, or 6 and 16) in the tables list.
2. For a 32-bit register pair, MOD Write applies only to the first register. The MOD Write-value of the second register is ignored.

Value

This column shows the current 16-bit value of the field in 4-digit hexadecimal representation. 'Value' is read-only.

A.6.4 Utilities

The Utilities menu allows Modbus configurations to be saved and loaded. Files may be copied to and retrieved from the local processor module, or from a remote instrument across the LIN. The Modbus configuration is stored in a file with extension .GWF, and the root filename should be the same as that of the corresponding database .DBF file.

Select UTILITIES in the Gateway menu to see the options shown in Figure A.6.4.

```
UTILITIES   File Load & Save
(Running)

                    >SAVE     - MODBUS Configuration
                     LOAD     - MODBUS Configuration
```

Figure A.6.4 UTILITIES menu

SAVE

Select SAVE and press <Enter> to see the default filename specification E:T940 .GWF. To save the current Modbus configuration under the default filename press <Enter> again. To save it under a different filename, edit the file name before carrying out the save operation.

Note: An existing file with the same filename is overwritten without warning.

LOAD

Select LOAD and edit the default E:T940.GWF if required to the filename to be loaded. Press <Enter> to load the specified configuration.
An error message appears if the specified file cannot be found.

Note: The current Modbus configuration is overwritten without warning.

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