32-Channel Analogue Input Module Differential Input

*(MAI32*AD)*

Issue 4 October 2005

INTRODUCTION

PURPOSE

The Analogue Input Module provides up to 32, low voltage or current analogue input signals. All channel inputs into the module are resistively isolated from each other and galvanically isolated from the system environment.

The basic module can be configured to meet a range of input specifications, the different configurations can be identified from the module type number (see Section 1.3, Specification). Circuit triplication and voting procedures make the module single-fault tolerant. A front panel Channel selector and test points enable the metering of any channel, and indicators show the circuit on-line status and the health of the module.

The module, which is compatible with 'hot repair', can be fitted in any of the ten I/O slots in the SC300E Chassis, 'wrong slotting' is prevented by physical coding. The SC300E system software identifies the module via a built-in hardware identifier.

Channel inputs are wired to the module via the DIN 41612 'rear plug-up' system on the chassis backplane. This document is intended to provide a general understanding of the function of the Analogue Input Module, sufficient to enable basic maintenance operations to be effected in the field.

ASSOCIATED DOCUMENTATION

Reference No	Title
008-5097	Chassis User Manual
008-5102	TAI16AEA Termination Card Analogue Input DIN to screw User Manual
008-5155	TAI16AIR Termination Card Analogue Input DIN to screw, 250 Ohm terminated, Internal power, User Manual
008-5156	TAI16BIRTermination Card Analogue Input DIN

	to DIN, 250 Ohm terminated, Internal power, User Manual

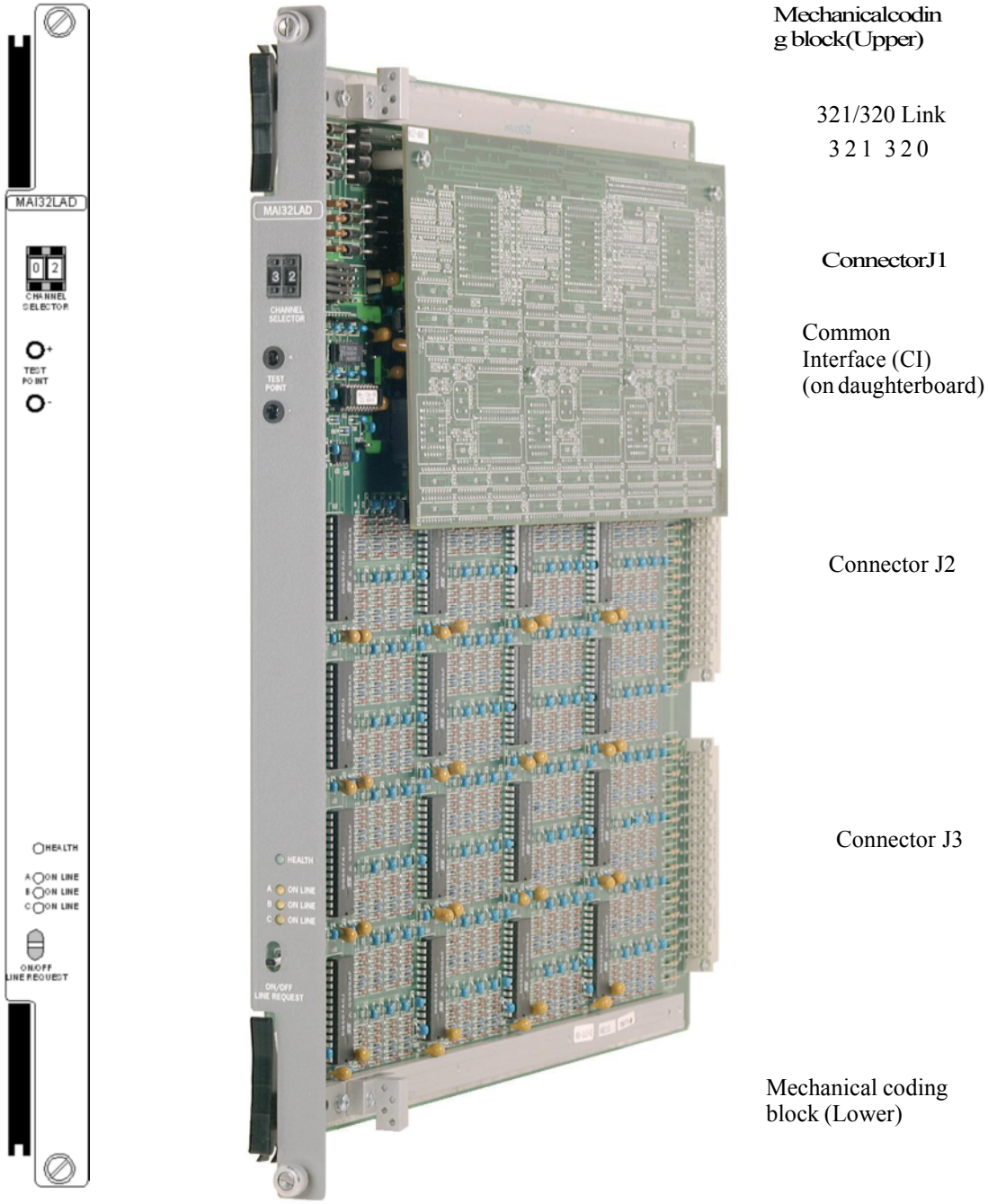

Figure 1-1 General view and front panel detail

SPECIFICATION

Input parameters

All models have 32 input channels configured as follows:

Model number	**Voltage input applications**
MAI32LAD	0 to 5Vdc
MAI32MAD	0 to 10Vdc

Current input applications

0 to 20mA. Use TAI16AIR (BIR) with MAI32LAD

0 to 40mA Use TAI16AIR (BIR) with MAI32MAD

Model	**See under "input range"**
Channels	32
Architecture	TMR
Indicators	Health 3 x On Line
Channel Input Test Ponts	Switch selectable on front panel
Input range	**MAI32LAD**: 0 to 5Vdc **MAI32MAD**: 0 to 10Vdc
Input overrange protection	±40Vdc
Resolution	12 bits
Accurancy @ 25°C	± 0.04% over full signal range
Stability (temperature coefficient)	±20ppm/°C
Analogue to digital converter	SAR (monotonic)
Sample rate	40ms nominal
Input impedance	>20M ohm
Power off impedance	>12k ohm
Common mode range	±11Vdc
Isolation	1kVdc system/channel ±15Vdc channel to channel
Power consumption By system By input loads	 7.5W excluding input loads 3.2W maximum for 20mA module
Overall size (mm) Overall size (inches)	400(9U)H x 397L x 28W 15.75H x 15.63L x 1.1W
Weight	1.6kg

NOTE

For voltage loop inputs TAI16AEA termination cards must be used

ENVIRONMENTAL SPECIFICATIONS

The maximum ambient temperature measured at the hottest point within the Triguard system shall not be greater than 60 degrees centigrade.

Temperature operating	+5°C to +60°C
Temperature storage	-25°C to +70°C
Humidity	5% to 95% non-condensing at ambient <40°C
EMC/RFI Immunity	Tested and certified to IEC 1131-Part 2 1994
Vibration/Shock	Tested and certified to IEC 1131-Part 2 1994

Certification:

General Certification: Ref. SC300E TMR Product Guide (ref 008-5209)

TRANSPORT AND HANDLING

The MAI32*AD must be transported and stored in its original packing material which should be retained for this purpose.

TECHNICAL DESCRIPTION

PHYSICAL

The Analogue Input Module is a 9U high PCB with integral front panel and rear connectors; a plug-in daughter board carries the Common Interface circuits.The general layout, location of the connectors, front panel components and the 321/320 configuration link is shown in Figure 1-1.

Mechanical coding blocks

All Input/Output modules carry two mechanical coding blocks equipped with pins which mate with holes in corresponding blocks in the chassis and prevent the module being inserted into the wrong slot. The pins in the module blocks are factory installed in a pattern determined by the module and corresponding set screws are removed from the chassis coding blocks to enable fitting. Unused holes are plugged with set screws. The chassis mechanical coding block configuration for this module is shown in Figure 2-1.

Figure 2-1 Chassis mechanical coding block configurations

EXTERNAL CONNECTIONS

Field circuits

The field input loop shown in Figure 2-2 is the absolute minimum required for the safe connection of analogue inputs. We however, recommend the use of their 16 Channel Analogue Input termination cards TAI16*** which can offer field power supplies, remote and local alarm indication, transient suppression and signal and protective ground facilities.

Figure 2-3 shows a termination card for a current input module.

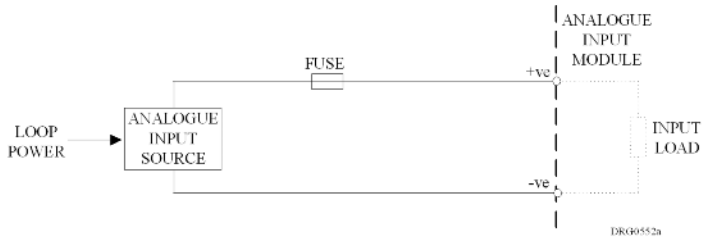

Figure 2-2 Basic field input circuit

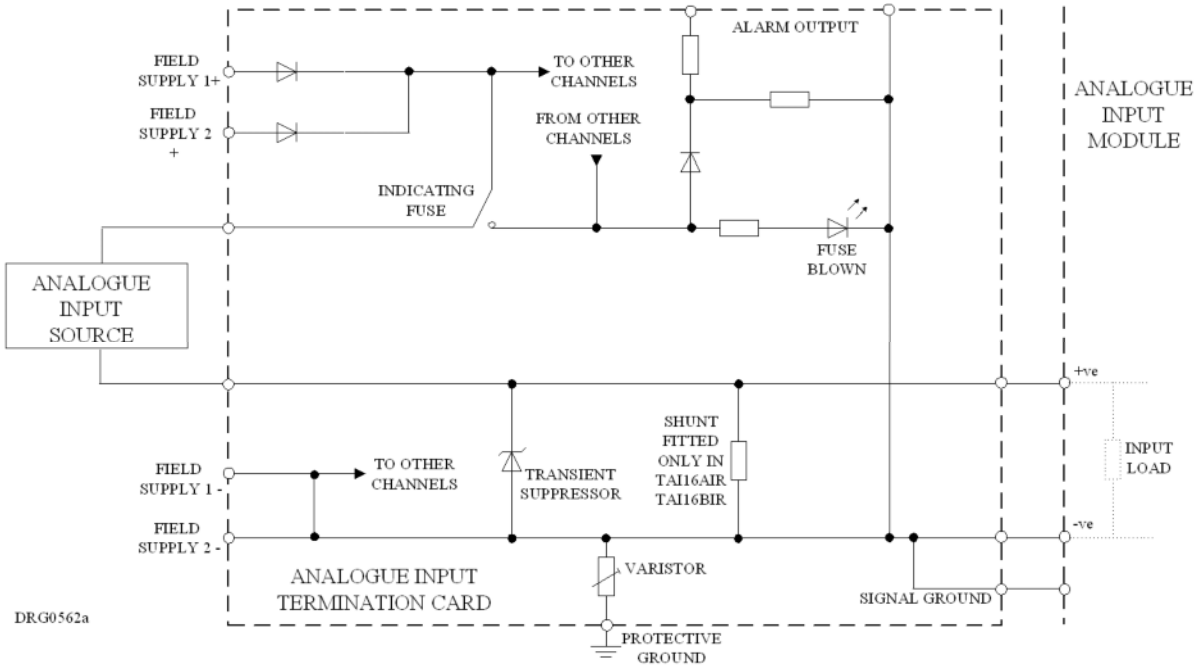

Figure 2-3 Field input using Termination Card

Triguard SC300E

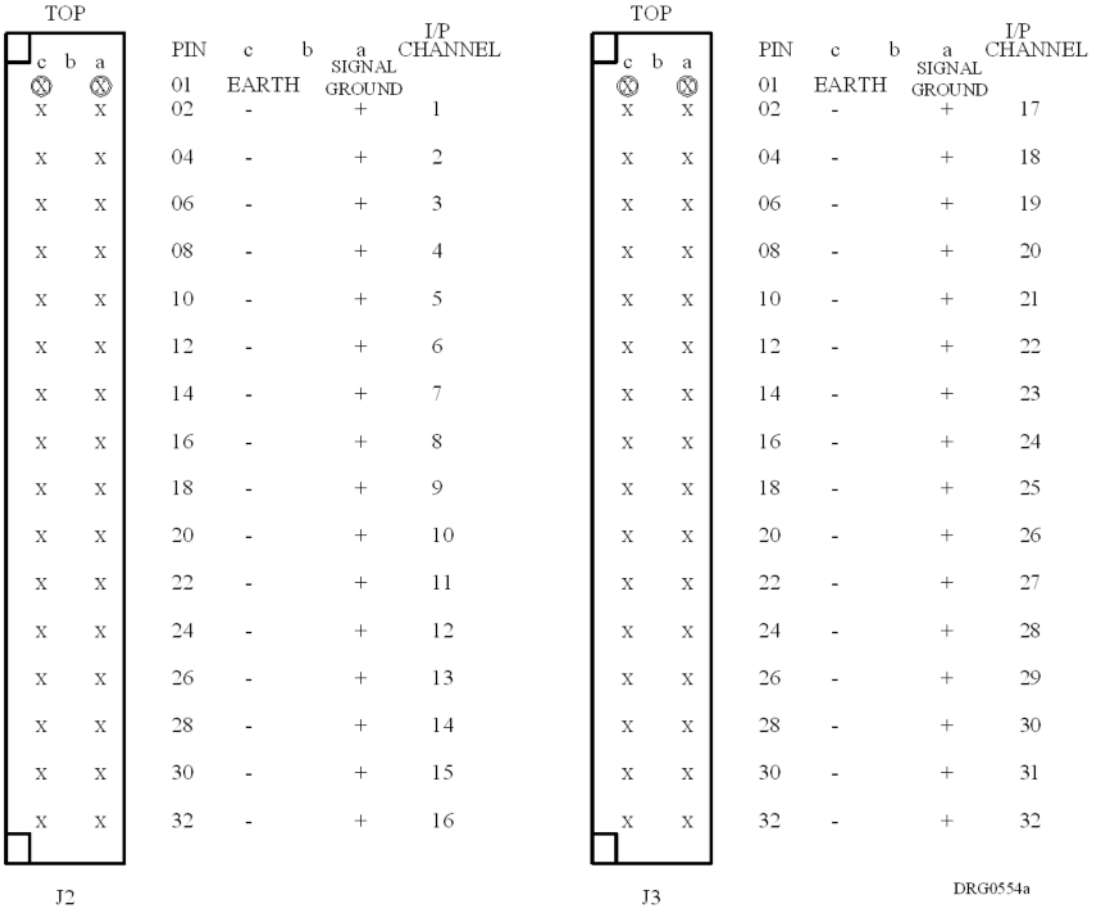

Figure 2-4 Field input connectors J2 and J3 pinouts

Module connectors

The System bus connector is J1 and the Common Interface is connected via J4 and J5 (not shown). In the external connection diagram Figure 2-4 the following symbols are used:

	= First Mate (long pin)
x	= Connector pin
0V	=Instrumentation Earth

THEORY OF OPERATION

Analogue input module

The first part of the block diagram in Figure 2-5 shows the circuit used to process one of the 32 analogue inputs. The field input is connected across a ranging resistor which is selected in accordance with the type of field input to be processed (current or voltage). The channel signal is then distributed along four paths (A to D); paths A, B and C are the triplicated signal processing circuit and path D feeds the metering test point.

In each path the signal is first passed through RF and low-pass filters before being applied to one channel of a 32 channel multiplexer. For paths A, B and C a command from the microcontroller in the Common Interface is isolated, decoded and used to select which input channel will be switched to the output of the multiplexer. The multiplexer output is then buffered and sent to an analogue to digital (ADC) converter which produces a serial data output coded to represent the amplitude of the channel input signal. Factory set links connected to the ADC enable the basic module to be configured for different +5Vdc or +10Vdc voltage ranges. The ADC output is passed via an opto-isolator to the Common Interface for processing.

There is no ADC in path D, the buffered signal is applied directly to the metering test point on the front panel. Channel selection is by means of the adjacent channel selector switches. Power to the module is 5.4Vdc and 12Vdc supplied by each of the dual redundant SC300E power supply units. Each line is divided into four branches to provide a supply to each of the four paths. The dual inputs for both supplies (12V and 5.4V) in each branch are ORed via diodes to provide the dual redundancy. After filtering and surge limitation the output rails VEE* (nominally12V) and VCC* (nominally 5V) provide power to their respective paths. The A, B and C 5V rails also supply power to the corresponding control circuits in the Common Interface. Each of the A, B and C path supplies is also continuously monitored and the monitor outputs A/PSUOK, B/PSUOK and C/PSUOK are sent via the Common Interface to the MPPs for diagnostic purposes.

An On/off Line Request switch on the front panel enables a request to be sent to the MPPs that the module be taken off-line for maintenance purposes.

The module contains a hardware identity circuit that enables system identification of the module.

Links

Only user changeable link is identified as LK3 and located in the top right hand corner of the module (see Figure 1-1). The link (LK3) enables the module to be set for 321 or 320 mode.

Modes of operation

The 321 or 320 mode sets the threshold that determines how much of the circuit can be degraded while still preserving overall operation. Setting the 320 mode means that the system will continue to function with two out of three serviceable circuits; if the number falls to one out of three the last read data is maintained. In 321 mode the system will continue to function with one out of three serviceable circuits; if that fails the last read data is maintained and the module is taken off-line.

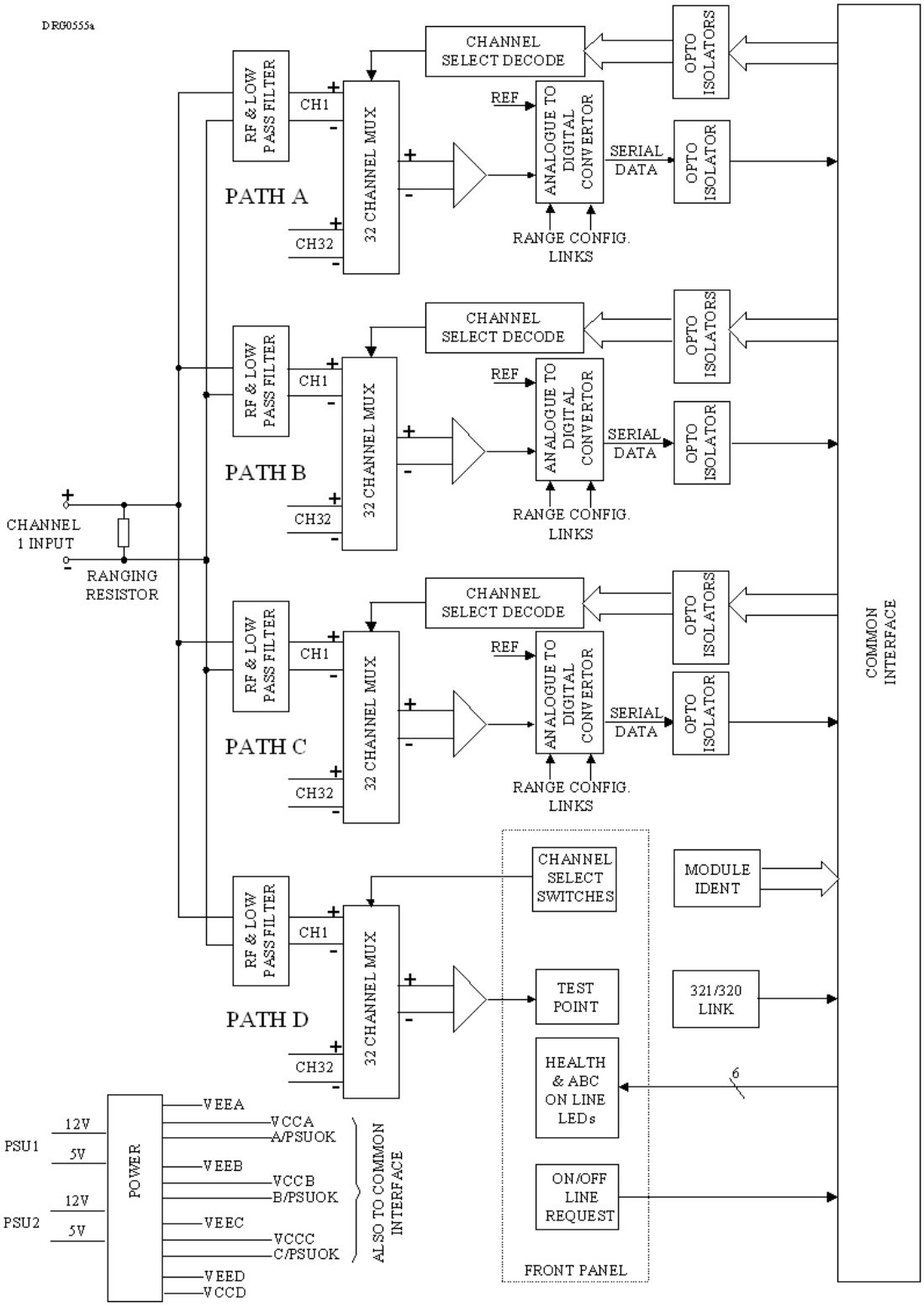

Figure 2-5 Analogue input module- Block diagram

Common interface

The three discrete control circuits in the Common Interface (A, B, and C) are each responsible for the control of the corresponding one third of the I/O module circuits. Each control circuit comprises a microcontroller with a dedicated watchdog, data buffers and shared RAM. The circuit is powered via the module and permits live insertion of replacement modules.

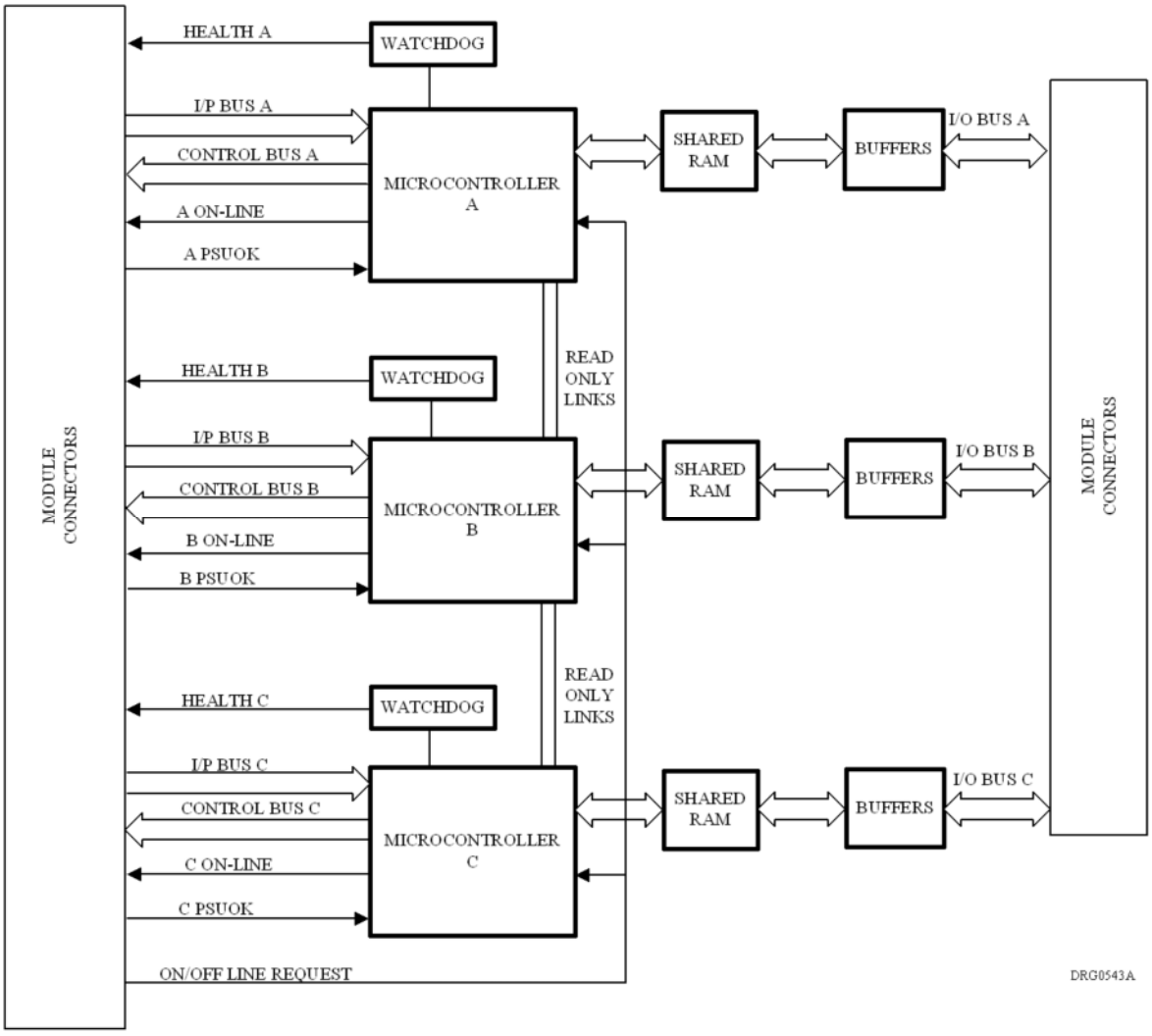

Figure 2-6 Common interface -Block diagram

The microcontroller co-ordinates I/O signal processing, signal path diagnostics, on-line/off-line status and signal status read/write cycles to and from the MPPs via an I/O communications bus. All I/O modules have an identification code which is read by the Common Interface and passed to the MPPs for verification. The on-line/off-line status is determined by the MPPs. If, for maintenance purposes, the On/off Line Request switch on the front of the module is operated, the action is read by all three microcontrollers and the request passed to the MPPs which may then grant the request. The watchdog extinguishes the Health LED on the I/O module front panel in the event of a microcontroller failure, LFD action or a voting discrepancy.

SERVICING

SCOPE

System repair is by module replacement. Faulty modules are not repairable in the field, they should be replaced by new modules and returned for repair.

CAUTION 1

Before fitting a new module ensure that the 321/320 link setting is the same as that on the old module.

CAUTION 2

The module contains components that may be electrostatically sensitive, it should be transported and stored in its original packaging material.

DIAGNOSIS

The TriBuild workstation is used for fault diagnosis. In the case of an Input/Output fault the Health LED on the faulty module will be extinguished.

CAUTION 3

Do not use a mains-powered multimeter on the front panel test points.

CONFIGURATION

The only configuration necessary is the correct location of the 321/320 Link as shown in Figure 1-1 Ensure that the link configuration on the new module is identical to that on the old module.

REMOVAL AND REPLACEMENT

Preparation

Before removal /replacement ascertain if the module under consideration is used in the single or dual hot repair configuration.

CAUTION 4

Failure to take the faulty module off-line before removing it from the chassis could trigger a fault alarm or cause plant shutdown.

CAUTION 5

When inserting a module ensure that it is aligned with the markings on the chassis rails and that it engages with the upper and lower guides. Improper insertion may cause damage to the module and/or chassis connectors.

Single-slot hot repair

Operate the On/Off Line Request switch on the faulty module, the three On Line LEDs should all go out to indicate that the MPPs have recognised the request and taken the module off-line. The last read data input from the module will be maintained until the new module is on-line. Slacken the two module securing screws and use the black ejection levers (top and bottom) to draw the module from its slot.

Insert the new module ensuring that it engages properly in the upper and lower guides in the chassis, the top and bottom chassis rails carry alignment marks to assist. Pull out the ejection levers and as the module is pushed back engage the levers on the chassis rails. The levers should then be used to draw the module into position, some resistance will be felt as the rear connector pins engage. The module should be fixed in position with the securing screws.

Operate the On/Off Line Request switch and check that the three On Line LEDs illuminate for one second, extinguish for one second and then illuminate permanently to indicate that the module has been put on-line. If the LEDs do not illuminate either the first or second time or fail to remain illuminated, then the module must be considered faulty.

Dual-slot hot repair

Insert the new module into the vacant hot repair slot ensuring that it engages properly in the upper and lower guides in the chassis, the top and bottom chassis rails carry alignment marks to assist. Pull out the ejection levers and as the module is pushed back engage the levers on the chassis rails. The levers should then be used to draw the module into position, some resistance will be felt as the rear connector pins engage. The module should be fixed in position with the securing screws.

Operate the On/Off Line Request switch on the new module. Ascertain that the three On Line LEDs on the new module illuminate for one second, extinguish for one second and then illuminate permanently as the LEDs on the old module extinguish. This sequence indicates that the new module has been put on line and the old module taken off line. If the LEDs on the new module do not illuminate either the first or second time or fail to remain illuminated, the new module must be regarded as faulty. The old module LEDs should remain illuminated indicating that it is still on-line.

If the new module is serviceable slacken the screws on the old module and use its ejection levers to remove it from the chassis.

PREVENTIVE MAINTENANCE

No preventive maintenance is necessary.

SERVICE SUPPORT

SPARE PARTS

Spare parts and technical advice can be obtained from the your local area office.