32-Channel Digital Output Module

(MDO32BNS)

Issue 7 October 2005

The Digital Output Module provides the output control interface between the SC300E processing environment and up to 32 common low voltage field devices. All field outputs from the module are galvanically isolated from the system.

Circuit triplication and voting procedures make the module single-fault tolerant and latent testing ensures that the failure of a normally 'ON' (energised) or 'OFF' channel will be recognised and reported to the system. Front panel indicators show the state of all channels, the circuit 'on-line' status and the health of the module.

The module, which is compatible with 'dual-slot 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 outputs leave 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 Digital Output Module sufficient to enable basic maintenance operations to be effected in the field.

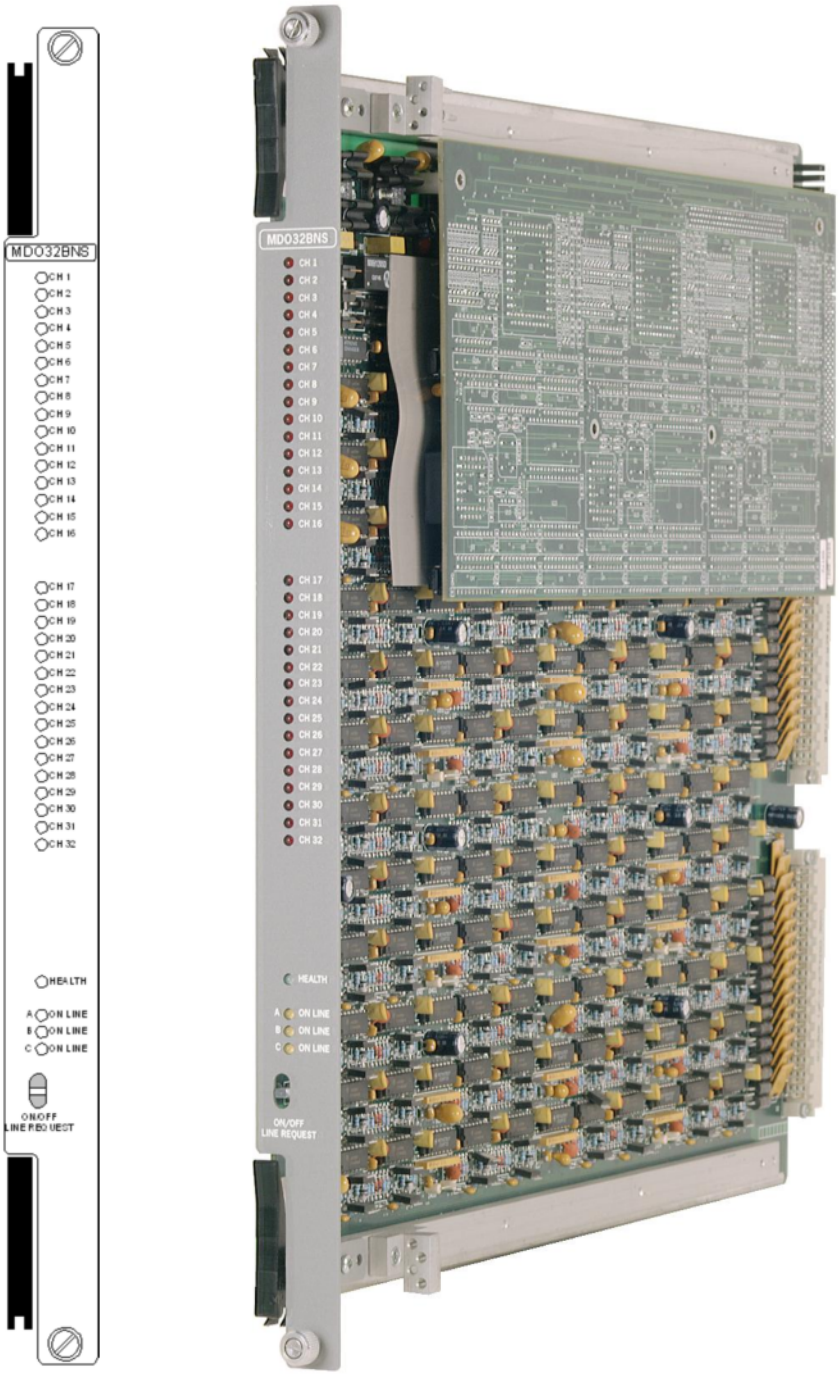


Figure 1-1. MDO32BNS General view and front panel detail

ASSOCIATED DOCUMENTATION

Reference No	Title
008-5097	Chassis User Manual
008-5135	TDO16AIN Digital Output Termination Card, DIN to Screw Terminal Introduced Power User Manual
008-5179	TDO16BIN Digital Output Termination Card DIN to DIN, Introduced Power User Manual

SPECIFICATION

Model	MDO32BNS
Channels	32
Architecture	TMR
Indicators: Input: Module:	One per channel Health, 3 x On Line
Output driver	FED
Voltage range	18 to 30Vdc (24V nominal)
Voltage drop	Less than 2Vdc
Maximum drive	1A per channel
Output rating	0.01A minimum @ 24Vdc, 1.0A maximum @ 24Vdc (continuous) Note: The minimum current increases to 0.02A @ 24Vdc when configured as a dual slot hot repair
Surge	2,5A per channel/second 1% duty cycle
Isolation	1kVdc system, commoned supply
Leakage current	10mA per channel per module (i.e 20mA when configured as dual slot hot repair)
Maximum load resistance	4.7k ohm (of adequate wattage) for unused channels 1.2k ohm (of adequate wattage) for all other conditions
Module power consumption excluding field power dissipation in module	4W

Model	MDO32BNS
Module power consumption including field power dissipation in module	19W @ minimum load 59W @ maximum load
Overall size (mm) Overall size (inches)	400(9U)H x 397L x 28W 15.75H x 15.63L x 1.1W
Weight	1.8kg

ENVIRONMENTAL SPECIFICATION

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 Product Guide (ref 008-5209)

TRANSPORT AND HANDLING

The MDO32BNS must be transported and stored in its original packing material which should be retained for this purpose

TECHNICAL DESCRIPTION

PHYSICAL

The Digital Output 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 configuration links are 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 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 load circuit shown in Figure 2-2 is the absolute minimum required for the safe connection of field loads to the Digital Output Module. For any unused channel which may never be switched on a dummy field load (4.7k ohm resistor of adequate wattage) must be used. If a channel may be switched on, the total load should not exceed 1.2 k ohm maximum. We however, recommend the use of their 16 Channel Digital Output termination cards TDO16*IN which offer full connection facilities with indicating fuses, alarm outputs and dummy loads (see Associated documentation).

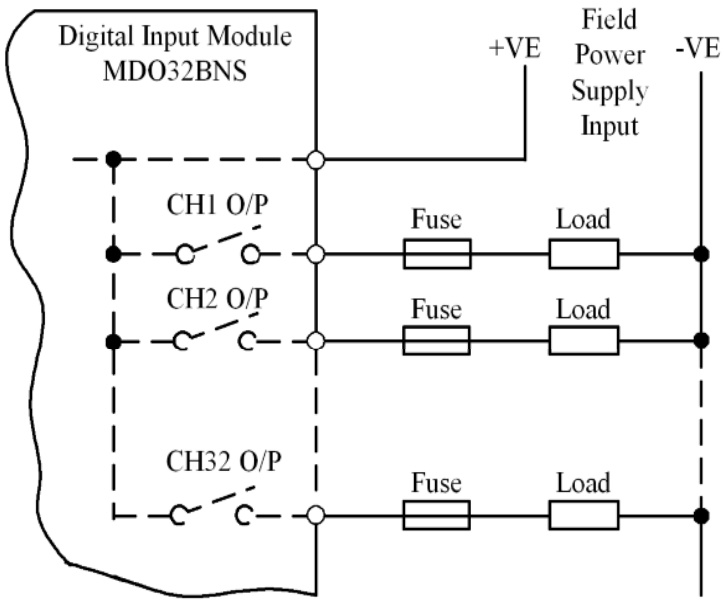


Figure 2-2. Basic field load circuit

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 2-3) the following symbols are used:

O	=	First mate (long pin)
x	=	Connector pin
GND	=	Connected to chassis
+ve	=	Field supply in
-ve	=	Field supply return
O/P	=	Channel output

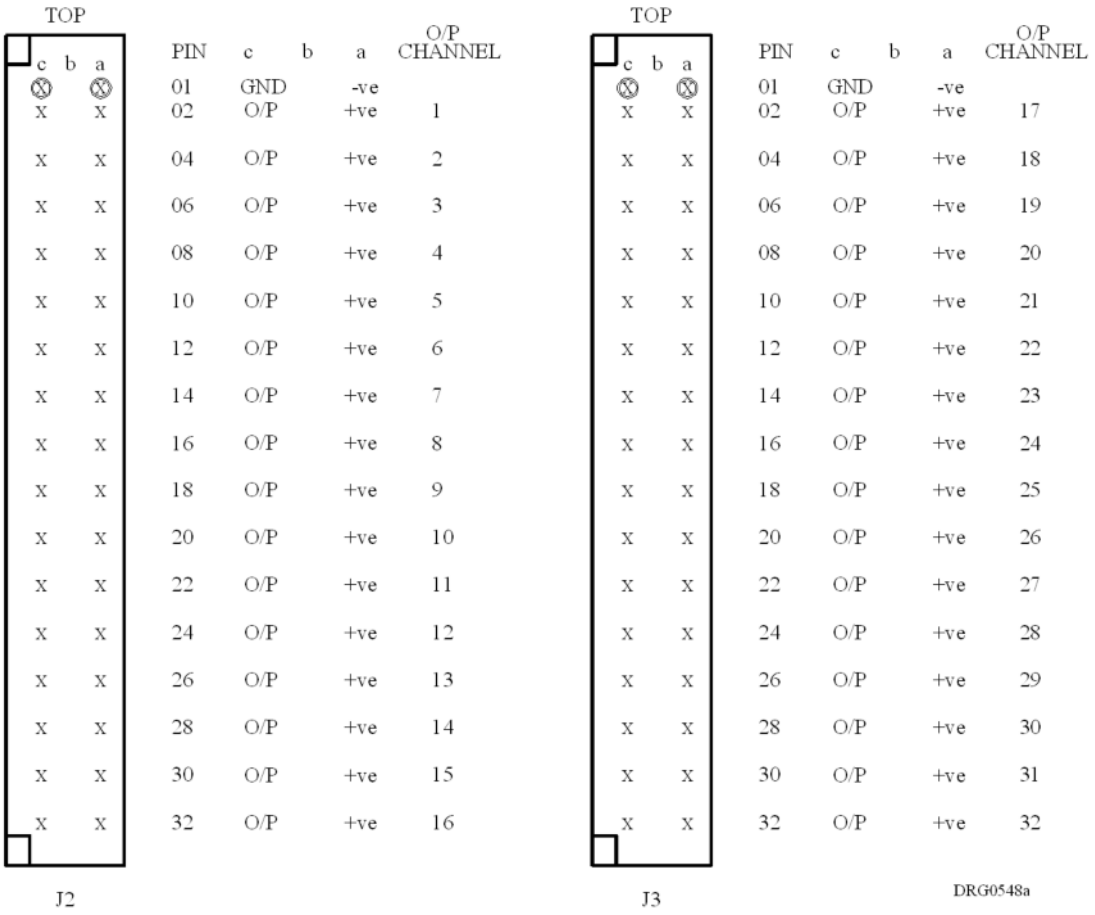


Figure 2-3. Field output connectors J2 and J3 pinouts

THEORY OF OPERATION

In accordance with TMR practice, channel output command information from the system follows three identical paths through the Digital Output Module (Figure 2-4) each path at the command of its own microcontroller in the Common Interface. As the switching speed of the module exceeds the system scan rate the channel data can be converted to serial form before entering the module from the Common Interface. In this manner 32 output channels can be served by just three paths instead of 96.

The three data streams are each applied to opto-isolators which mark the interface between the system and output sides of the circuit and provide a system to field channel isolation of 1000V minimum.

The data streams are then applied to the 32-bit output shift registers. The serial bits are clocked successively into the shift registers until the 32nd bit has been received, the registers then latch the data and present it on the 32-bit buses (CHANA, CHANB and CHANC) to the output switches. The data is refreshed in this manner at each scan of the system.

The output switch for each channel comprises six FETs connected in the series/parallel network shown and providing 2 out of 3 majority voting between the three paths A, B and C.

A front panel LED at the switch output is lit when the switch is closed. Voltage and current monitoring circuits are also connected to the switches to provide outputs for the Latent Fault Detection (LFD) system, these are fed back to the microcontrollers via dedicated shift registers and opto-isolators. The feedback information confirms that the output has switched to the commanded state and that the line is not open or short circuit

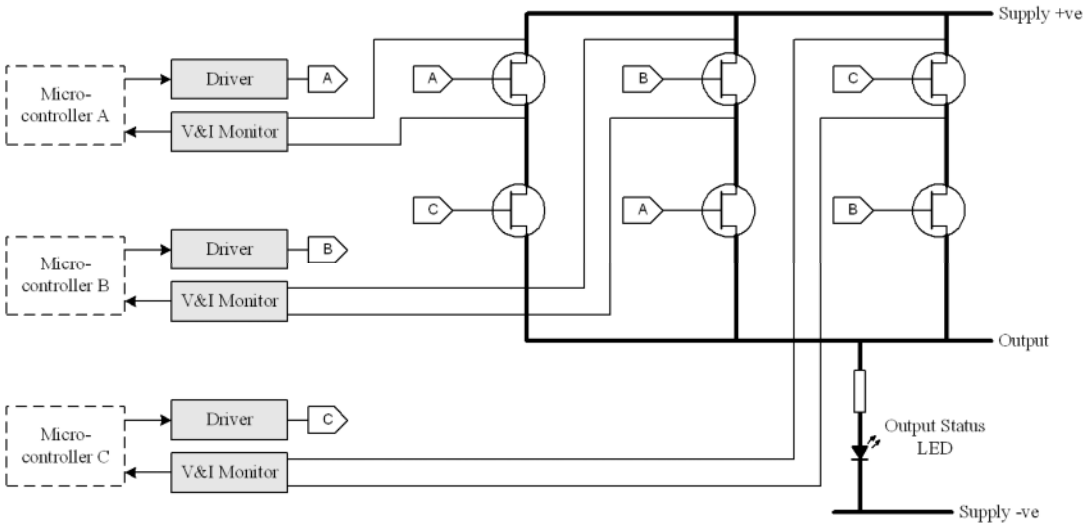


Figure 2-4. FET 'hex' voter

Testing of the output switches using the LFD circuits is co-ordinated by the microcontrollers. When all outputs are in the healthy condition and the microcontrollers confirm no faults present the main processors will instruct each microcontroller in turn to switch its output alone to the opposite state and confirm the correct operation of the output switch. This test also checks the integrity of the output loops for open circuit conditions.

The module power requirements are served from two different sources. The power rails and reference levels for the system-side circuits are derived from the 5.4V and 12V supplies from the system chassis. The power rails and reference levels for the output-side circuits are derived from the field supplies and also serve to confirm that the field circuits are in working order

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

Triguard SC300E

The module uses hardware circuitry and configuration links that enable the system to identify the module type and configuration mode. The configuration links 1, 2 and 3 are located in the top right-hand corner of the module (see Figure 1.1).

Link 1 allows the module to be set up for 321 or 320 mode operation. 320 mode means that the system will continue to function with two out of three serviceable circuits. In 321 mode the system will continue to function with one out of three serviceable circuits. No link; defaults to

320 mode.

Link 2 (HLV/GTZ) determines whether, in the event of a failure due to 321/320 action, the last read values are held (HLV) or are set to zero (GTZ). No link; defaults to GTZ mode.

Link 3 is factory set to HW and if changed to ICCB (see Note) or removed the module defaults to GTZ.

(NOTE: ICCB is a silk screen identifier used on output modules only)

Table 2-1. Link settings versus operation

Link settings (see Notes)			**Processor and interface status**		
Link 1	**Link 2**	**Link 3**	**3 MPPs & associated path CI operating**	**2 MPPs & associated path CI operating**	**1 MPP & associated path CI operating**
321	X	X	Normal	Normal	Normal
320	HLV	HW	Normal	Normal	HLV
320	HLV	ICCB	Normal	Normal	GTZ
320	GTZ	X	Normal	Normal	GTZ
320	Missing	X	Normal	Normal	GTZ

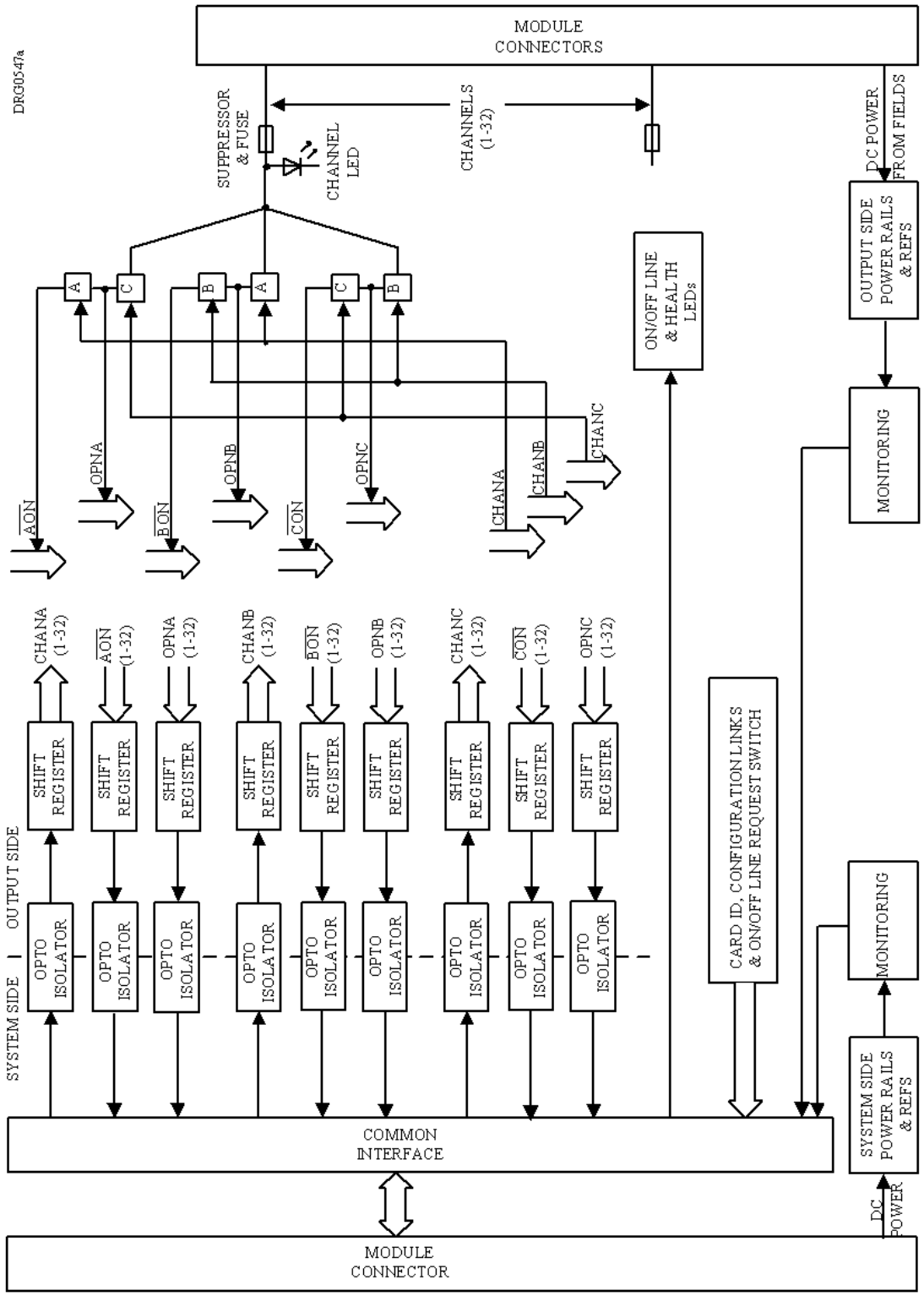
Notes:

X = Don’t care or missing link

Link 1 missing = 320 operation

HL = Last valid output held (Output maintained) GTZ = Go To Zero (Output turned off)

Triguard SC300E



COMMON INTERFACE

The three discrete control circuits in the Common Interface (A, B, and C) (Figure 2-6) 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. The microcontrollers co-ordinate I/O signal processing, signal path diagnostics, on-line/off-line status and signal status read/write cycles to and from the system processors 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 on each microcontroller extinguishes the Health LED on the I/O module front panel in the event of a microcontroller failure, LFD failure, a voting discrepancy, loss of field supply or open circuit conditions.

SYSTEM CONFIGURATION

The Digital Output module requires a 'dual-slot hot repair' configuration in order to maintain any normally energised field loops during repair. We recommend that the 'dual-slot hot repair' configuration is used for all output modules. The 'dual-slot' configuration does not require the hot repair slot to be populated. If the hot repair partner module is fitted during normal operation, the output module pair should be de-rated by 50%; unless forced air-cooling is used.

NOTE

Fitted Hot Repair partner modules should be bought on-line as part of a regular maintenance cycle to allow full diagnostic reporting for both modules.

The Digital Output module has a relatively high power dissipation which places some constraints on its use in convection cooled systems. As each Digital output module will dissipate 59W when run at full capacity we recommend that these modules are configured in the lowest chassis within each cabinet bay. If Digital Output modules are configured in slots located above a fully loaded Digital Output module we recommend that the module is de-rated by 50%. When forced air-cooling is applied to a system to aid heat dissipation then these limitations are removed. When configuring a system care should be taken to ensure that the maximum working temperature of 60 C is not exceeded in the applications maximum ambient conditions.

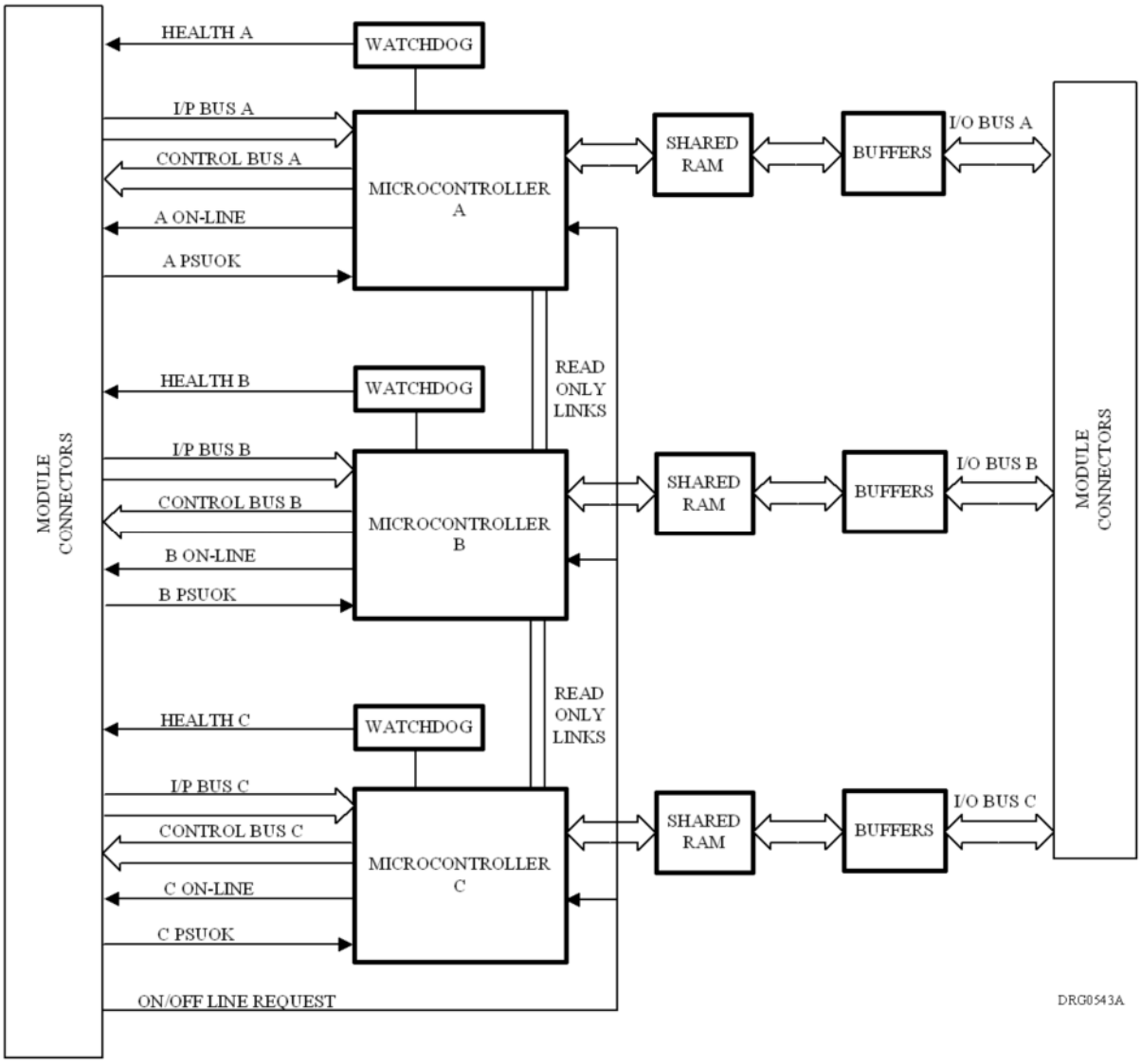


Figure 2-6. Common interface - Block diagram

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

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

CAUTION 2

Before fitting a new module ensure that the setting of all three links is the same as that on the old module.

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

Preparation

To ascertain whether the chassis I/O slot containing the faulty module has been allocated a hot repair partner use one of the following methods:

- Check the system drawings
- Check the chassis wiring configuration
- Use the I/O chassis configuration report on the TriBuild workstation.

Where there is a Hot Repair partner allocation, use the ‘dual-slot hot repair’ procedure;

otherwise use the ‘single-slot hot repair’ procedure.

Configuration

The only configuration necessary is the correct setting of the three links which are shown in Figure 1-1. Ensure that the link configuration on the new module is the same as that on the old module.

Removal and replacement

CAUTION 3

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

CAUTION 4

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 outputs will be de-energised 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. All outputs that are required to be energised by the system logic will be re-energised. If the LEDs do not illuminate either the first or second time or fail to remain illuminated, then the module must be considered faulty.

NOTE

If the replacement board comes on-line but the health LED is extinguished a fault still exists. If the failure is LFD this may indicate a field fault (open circuit) and the field loops should be investigated.

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 black 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.

NOTE

If the replacement board comes on-line but the health LED is extinguished a fault still exists. If the failure is LFD this may indicate a field fault (open circuit) and the field loops should be investigated.

PREVENTIVE MAINTENANCE

No preventive maintenance is necessary.

SERVICE SUPPORT

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