Trusted SC300E Bridge Module

Product Overview

The SC300E Bridge presents a new opportunity to combine the SC300E Triguard Input/Output (I/O) structure with the latest processing and communications features of Trusted®.

The certification of the original SC300E system to SIL 3 IEC 61508 Edition 1 will be maintained for applications migrated to the Trusted Controller in accordance with this manual, the Trusted Triple Modular Redundancy (TMR) System Safety Manual and the guidance in NAMUR 126.

Combining the two products will enable Triguard users to benefit from features such as 3-3-2-0 Processor fault tolerance, IEC 61131 programming suite, Ethernet networks, OPC, Ethernet peer to peer and remote diagnostics. The SC300E Bridge replaces the Triguard MPP in the Triguard Primary chassis.

Any system using the SC300E Bridge and Trusted TMR Processor can also include Trusted Expanders and I/O modules forming a Hybrid system. To the Trusted TMR Processor, the Trusted and SC300E chassis appear in the same system map. All systems using Trusted TMR Processors can be seamlessly integrated together.

Features

- TMR fault tolerant (3-3-2-0) operation
- Dedicated hardware and software test regimes which provide very fast fault recognition and response times
- Automatic fault handling without nuisance alarming
- Hot replacement, self-configuration.
- Interfaces to Trusted TMR Expander Bus
- Front panel indicators that show module health data transmission status
- Certified to SIL 3 IEC 61508 Edition 1

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PREFACE

In no event will Rockwell Automation be responsible or liable for indirect or consequential damages resulting from the use or application of this equipment. The examples given in this manual are included solely for illustrative purposes. Because of the many variables and requirements related to any particular installation, Rockwell Automation does not assume responsibility or reliability for actual use based on the examples and diagrams.

No patent liability is assumed by Rockwell Automation, with respect to use of information, circuits, equipment, or software described in this manual.

All trademarks are acknowledged.

DISCLAIMER

It is not intended that the information in this publication covers every possible detail about the construction, operation, or maintenance of a control system installation. You should also refer to your own local (or supplied) system safety manual, installation and operator/maintenance manuals.

REVISION AND UPDATING POLICY

This document is based on information available at the time of its publication. The document contents are subject to change from time to time. The latest versions of the manuals are available at the Rockwell Automation Literature Library under "Product Information" information "Critical Process Control & Safety Systems".

TRUSTED RELEASE

This technical manual applies to **Trusted Release: 3.6.1**.

LATEST PRODUCT INFORMATION

For the latest information about this product review the Product Notifications and Technical Notes issued by technical support. Product Notifications and product support are available at the Rockwell Automation Support Center at
http://rockwellautomation.custhelp.com

At the Search Knowledgebase tab select the option "By Product" then scroll down and select the Trusted product.

Some of the Answer ID’s in the Knowledge Base require a TechConnect Support Contract. For more information about TechConnect Support Contract Access Level and Features please click on the following link:

https://rockwellautomation.custhelp.com/app/answers/detail/a_id/50871

This will get you to the login page where you must enter your login details.

IMPORTANT	A login is required to access the link. If you do not have an account then you can create one using the "Sign Up" link at the top right of the web page.

DOCUMENTATION FEEDBACK

Your comments help us to write better user documentation. If you discover an error, or have a suggestion on how to make this publication better, send your comment to our technical support group at http://rockwellautomation.custhelp.com

SCOPE

This manual specifies the maintenance requirements and describes the procedures to assist troubleshooting and maintenance of a Trusted system.

WHO SHOULD USE THIS MANUAL

This manual is for plant maintenance personnel who are experienced in the operation and maintenance of electronic equipment and are trained to work with safety systems.

SYMBOLS

In this manual we will use these notices to tell you about safety considerations.

	SHOCK HAZARD: Identifies an electrical shock hazard. If a warning label is fitted, it can be on or inside the equipment.
	WARNING: Identifies information about practices or circumstances that can cause an explosion in a hazardous environment, which can cause injury or death, property damage or economic loss.
	ATTENTION: Identifies information about practices or circumstances that can cause injury or death.
	CAUTION: Identifies information about practices or circumstances that can cause property damage or economic loss.
	BURN HAZARD: Identifies where a surface can reach dangerous temperatures. If a warning label is fitted, it can be on or inside the equipment.
	This symbol identifies items which must be thought about and put in place when designing and assembling a Trusted controller for use in a Safety Instrumented Function (SIF). It appears extensively in the Trusted Safety Manual.
IMPORTANT	Identifies information that is critical for successful application and understanding of the product.
NOTE	Provides key information about the product or service.
TIP	Tips give helpful information about using or setting up the equipment.

WARNINGS AND CAUTIONS

WARNING: EXPLOSION RISK

Do not connect or disconnect equipment while the circuit is live or unless the area is known to be free of ignitable concentrations or equivalent

AVERTISSEMENT - RISQUE D'EXPLOSION

Ne pas connecter ou déconnecter l'équipement alors qu'il est sous tension, sauf si l'environnement est exempt de concentrations inflammables ou équivalente

MAINTENANCE

Maintenance must be carried out only by qualified personnel. Failure to follow these instructions may result in personal injury.

CAUTION: RADIO FREQUENCY INTERFERENCE

Most electronic equipment is influenced by Radio Frequency Interference. Caution should be exercised with regard to the use of portable communications equipment around such equipment. Signs should be posted in the vicinity of the equipment cautioning against the use of portable communications equipment.

CAUTION:

The module PCBs contains static sensitive components. Static handling precautions must be observed. DO NOT touch exposed connector pins or attempt to dismantle a module.

ISSUE RECORD

Issue	Date	Comments
1	Apr 2008	First Issue
2	Feb 2010	TC-322 details
3	Jul 2015	Converted document to Rockwell branding layout Clarified certification status, corrected Operating Humidity range and Operating Temperature
4	Apr 2016	Correction of typographical errors

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Table of Contents

1. Description

1.1. Overview

The SC300E Bridge enables connection between a Triguard SC300E I/O sub system and the Trusted TMR Processor. Three SC300E Bridge modules replace the three MPP modules in a Triguard primary chassis.

The Bridge module has a fast serial ("Hotlink") interface that transfers command and response packets between the two product families via the Trusted Expander Bus. The module uses a Field Programmable Gate Array (FPGA) for decoding instructions from the Trusted TMR processor, accessing the specified Triguard I/O module and returning any data requested.

Command data received by the three Bridge modules and responses to the Trusted TMR Processor are synchronized in accordance with the Lock Step operational characteristics of the Trusted Expander Bus. For this reason, the three bridge modules share their data and arrange their response packets in the same order for simultaneous transmission. The clock signal received from the Expander Bus is used to ensure that data from all three Bridge modules is transmitted on the same clock edge.

The Trusted TMR processor stores and executes the application program, scans and updates the Triguard I/O modules and detects system faults. Each of the three slices of the TMR Processor executes the application program independently, but in lock-step synchronization with the other two.

All Triguard I/O modules are supported. Triguard Serial Communication modules are not supported. All communications to workstations and Distributed Control System (DCS) are enabled through the Trusted Communications Interfaces.

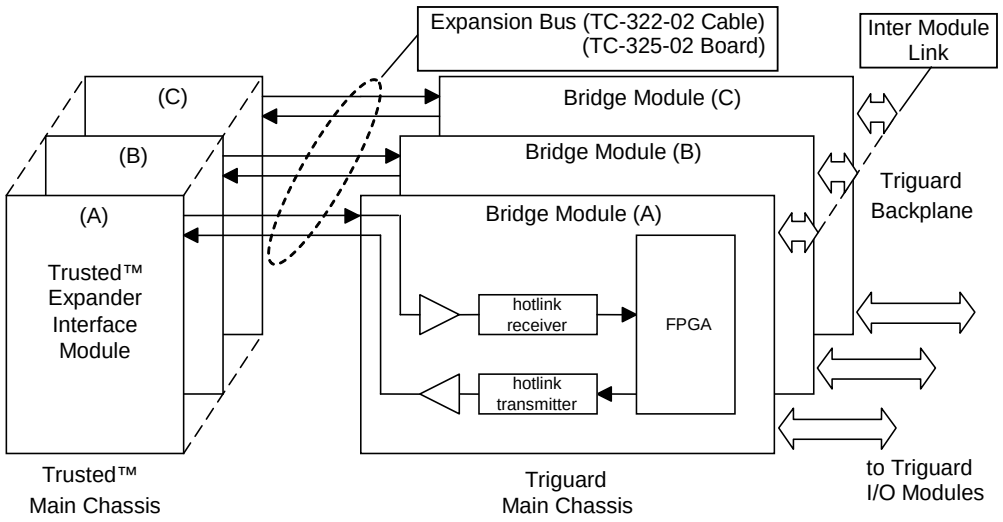

Figure 1 Block Diagram showing interface between Trusted system and Triguard I/O

1.2. Power Distribution

Each of the Bridge modules is powered from dual redundant 5.4 Vdc via the backplane.

1.3. Communication Buses

1.3.1. The Trusted to SCS300E Primary Chassis

Communication between the Trusted Expander Interface Module and the SC300E Primary Chassis is via one of a possible four or seven triplicated two-way interface cables. A single backplane connector card routes the individual links in the cable to the three Bridge modules. Data voting is provided at the Expander Module Interface to ensure that cable faults are detected.

The link handles the following triplicated signals:

- Data - Serial bi-directional bus.
- Control - Bus clocks, module-enables and bus direction control.
- Slot - Indicating the SC300E I/O slot position to the Bridge.
- Expander Chassis ID - 4 bit Trusted chassis address code.

1.3.2. Inter-Module Link (IML)

When returning data for Trusted Read requests, I/O Module data received by each Bridge module is shared with the other two using the serial IML via the backplane. The three sets of data are then arranged sequentially into the response packet for Trusted. The IML is not used during Write requests.

1.4. Function

When an I/O access is to be performed, the Trusted TMR Processor issues a command packet to an Expander Interface module. The Expander Interface decodes the chassis address and transmits the packet through the Expander bus to receivers in the 8161 Bridge modules.

For short distances of a few metres, a twisted-pair copper cable is used, whilst on longer runs the copper cable is connected to three T8312 fibre optic units at each end of three pairs (Tx and Rx) of fibre optic cable. The Bridge modules, receiving the command signals, decode the packet.

The Bridge modules then implement the read or write access on the SC300E I/O module selected and return a response packet via the Expander Bus. The packet will contain both data and diagnostic information.

2. Installation

2.1. Module

Each of the three Bridge modules replaces one of the Triguard Massively Parallel Processors (MPP). Figure 2 shows the module. The replacement must be carried out with the system offline.

The modules consist of a single Printed Circuit Board (PCB) assembly.

Figure 2 8161 Bridge Module

2.2. TC-322-02 Interface Cable Assembly

The interface cable connects from the Trusted Interface Adapter T8312 to an identical 12 way socket on the interface cable connector card.

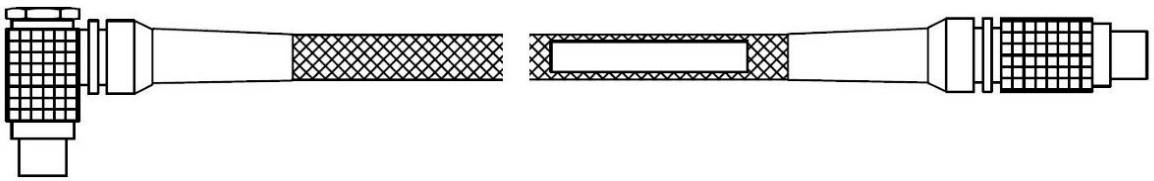

Figure 3 TC-322-02 Interface Cable Assembly

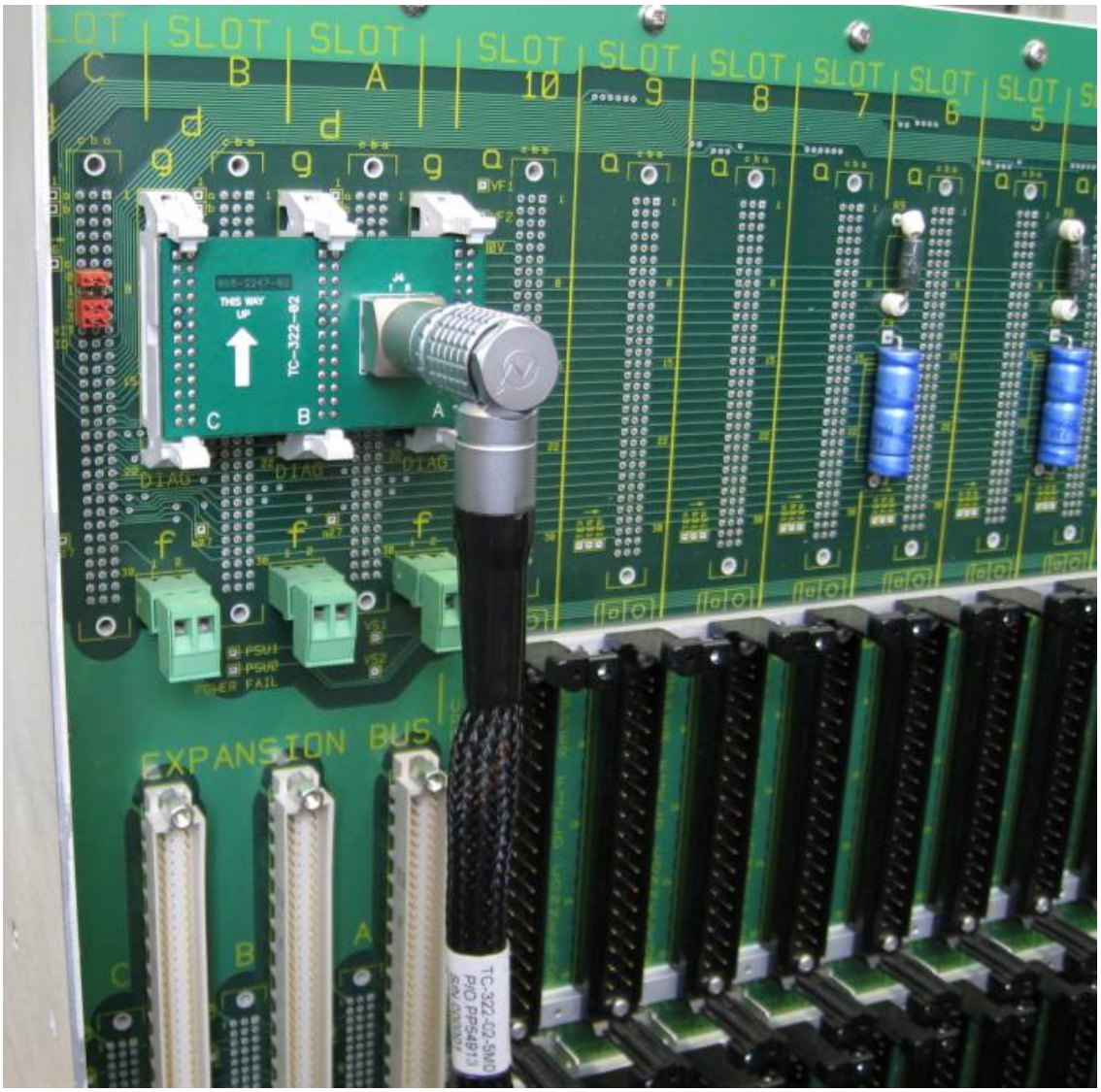

Figure 4 Triguard Main Chassis Rear View

Figure 4 shows the interface cable connector card (top left) fitted to three unused connectors on the rear of the Triguard controller chassis which is connected to the Trusted Expander Interface adapter via the TC-322-02 interface cable (braided cable on left).

Connectors J1-3 on the TC-325-02 card plug into the three 26-way headers on the Triguard backplane. The expander cable, TC-322-02, from the Trusted Expander Interface plugs into 12-way socket J4.

Note that the chassis Unit ID jumpers will need setting before fitting the interface cable connector card (see Section 2.3).

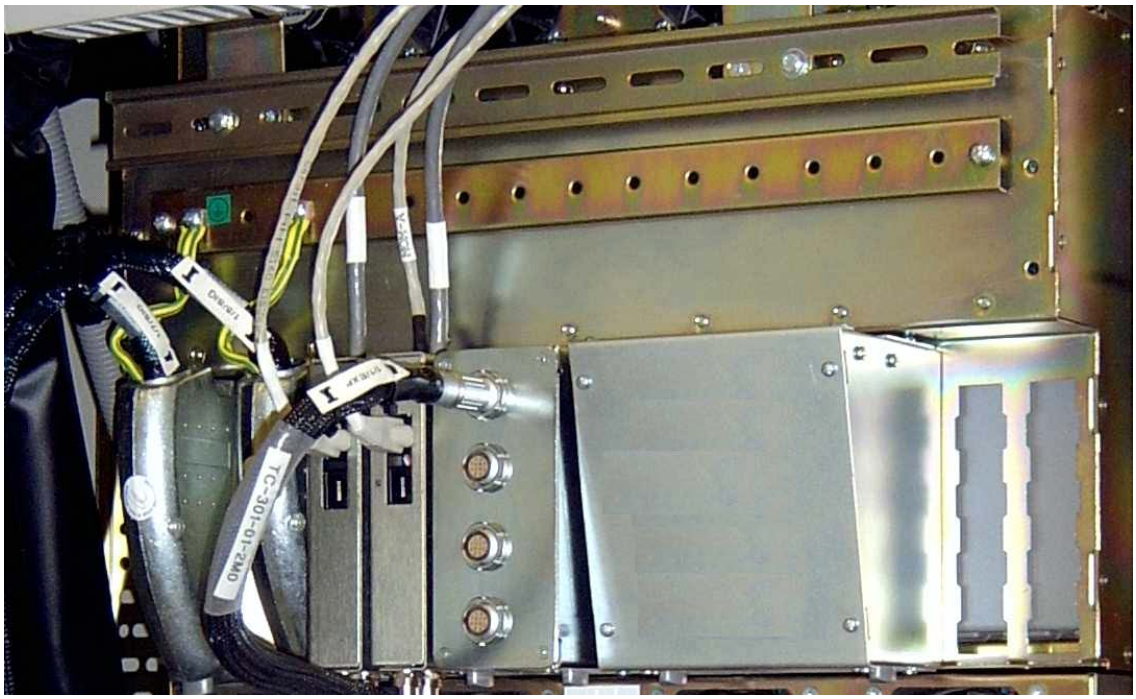

Figure 5 Trusted Controller Chassis Rear View

Figure 5 shows a four socket version of the T8312 Expander Interface Adapter with a TC-301-01 cable attached, which connects to a Trusted expander chassis. The Expander Interface Adapter has four or seven connections available to individual Trusted Expander chassis or to the Triguard controller chassis using the TC-322-02 Interface Cable Assembly.

2.3. Module Configuration

The Bridge module requires minimum configuration, namely the setting of Unit ID jumpers 0 to 3 to define the chassis address to Trusted. These are situated on the Triguard chassis as shown here.

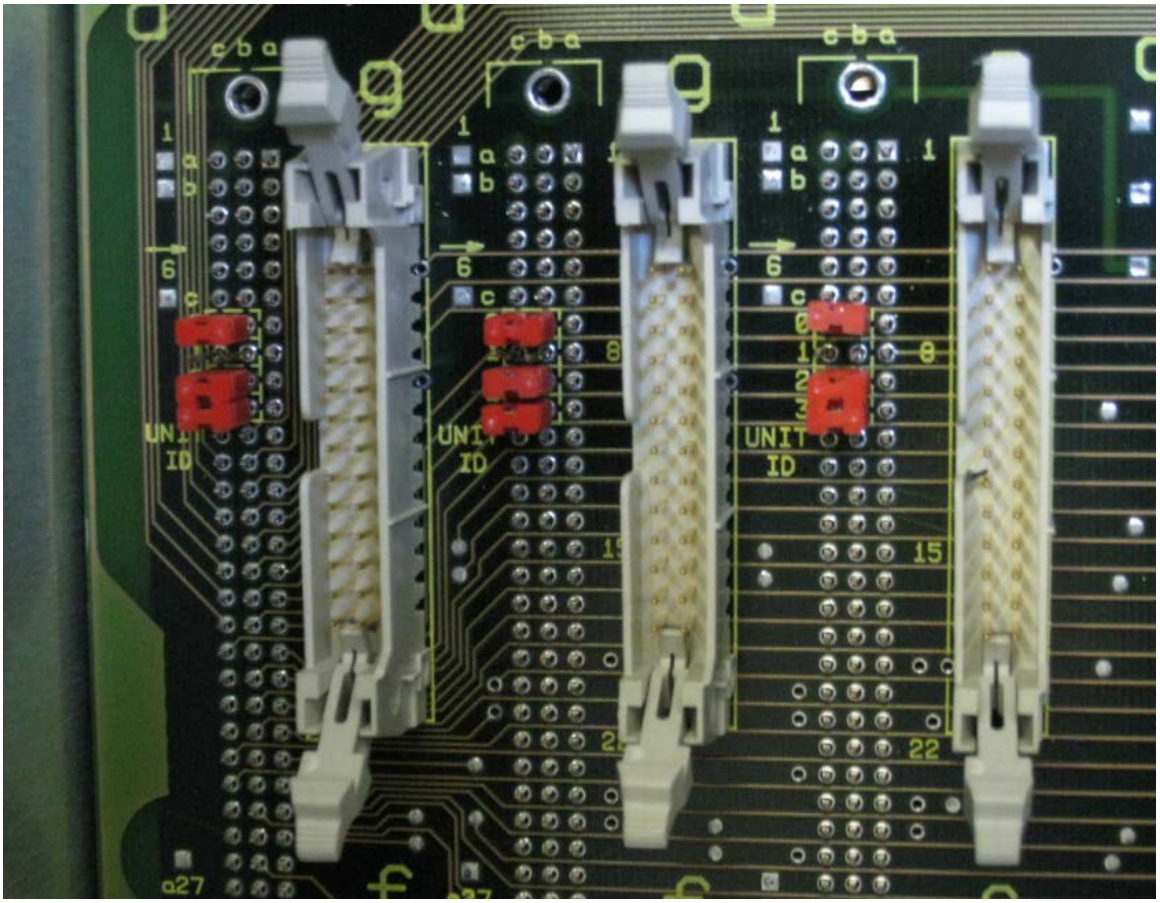

Figure 6 Chassis Address Jumpers

Unit ID jumpers 0,1,2,3 represent the binary address bits 1, 2, 4 & 8 respectively. A removed jumper signals a binary digit ‘1’. The address is set to between 2 and 8. On the first Triguard chassis (containing the SC300E Bridge Modules), remove jumper 1 to represent Trusted address '2' (as shown in the picture). The jumpers on all three sets must be set to the same address. Leave the jumpers as they were on the other Triguard chassis. It is usual to attach the chassis with address 2 to the first Expander Interface Adapter socket, for both Trusted chassis and Triguard chassis. This makes the software configuration easier.

3. Application

All Triguard I/O modules are configured using the IEC 61131 application Toolset provided with Trusted. This configuration requires entries in the System Configuration (System.INI) for the chassis and modules and their hardware operational parameters, and also in the workbench I/O connection table, for software settings and data connection.

3.1. System Configuration

All Trusted systems need a system configuration file, specifying the chassis and modules in the system. For Trusted/Triguard hybrid systems, a T8311 Expander Interface is required in the Trusted controller chassis, as for Trusted-only systems. An example with Expander Interfaces in slots 1 and 2 (companion slots) and communications interfaces in slots 7 and 8, is shown below. For details of the System Configuration Tool please refer to product description PD-T8082.

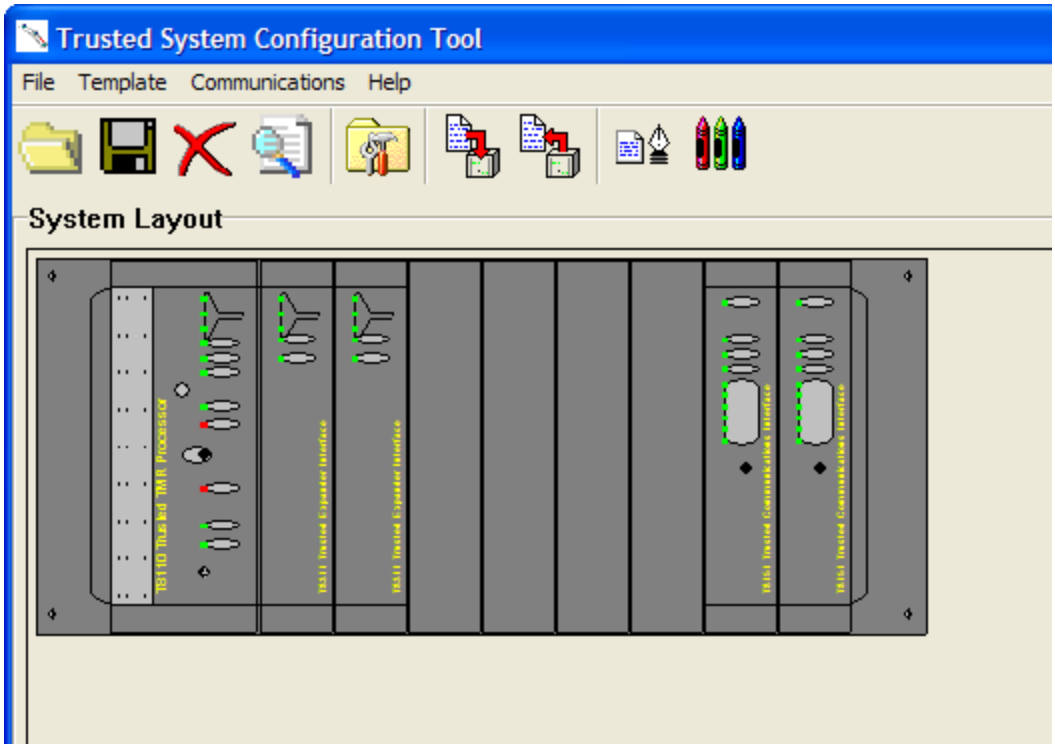

Figure 7 Trusted Processor Chassis with Expander Interface

The Triguard chassis are attached to the Expander Interface as if they were Trusted expander chassis, but the various chassis options for Triguard and CS300 are provided on the 'Insert New Chassis' dialog. Right-click on the grey background of the configurator window to insert a new chassis.

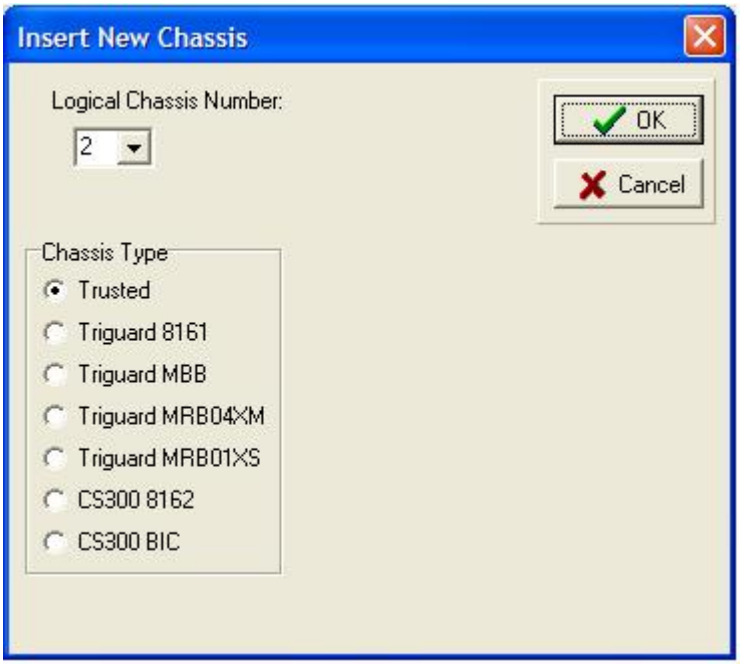

Figure 8 Insert New Chassis

The first chassis to be created is an 8161. This includes the bridge modules in place of the Triguard processors. Choose type Triguard 8161 and select a logical chassis number. This chassis number will define the switch configuration described in section 2.3.

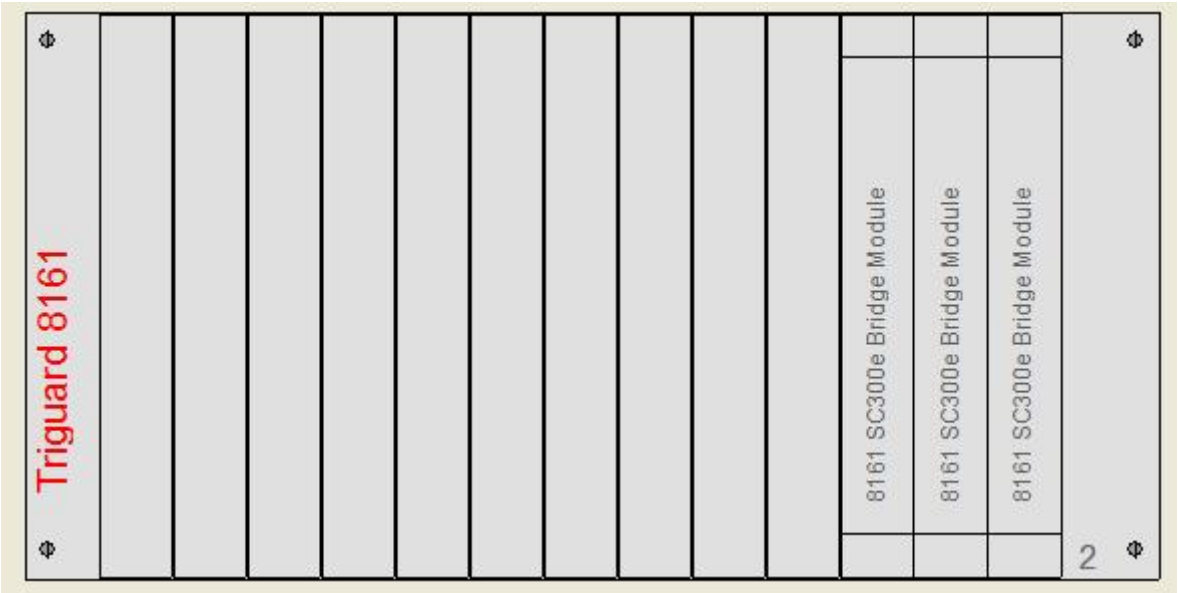

Figure 9 Triguard Main Chassis

The chassis should then be allocated to the Trusted Expander Interface module. Left-click on the left or right end of the Triguard 8161 chassis to open the Chassis Connection dialog. Select the slot number of the left-hand Expander Interface module.

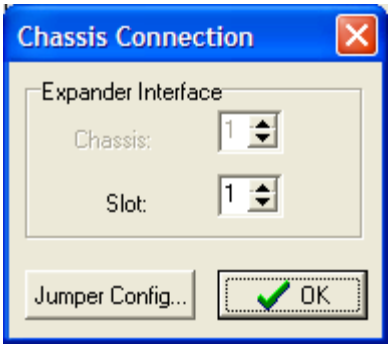

Figure 10 Chassis Connection

On closing this dialog, the Triguard 8161 chassis should have a blue flash symbol on the left. The right hand side shows the chassis address as:

< Trusted expander Interface slot> - <Expander socket number> - <Triguard chassis number>

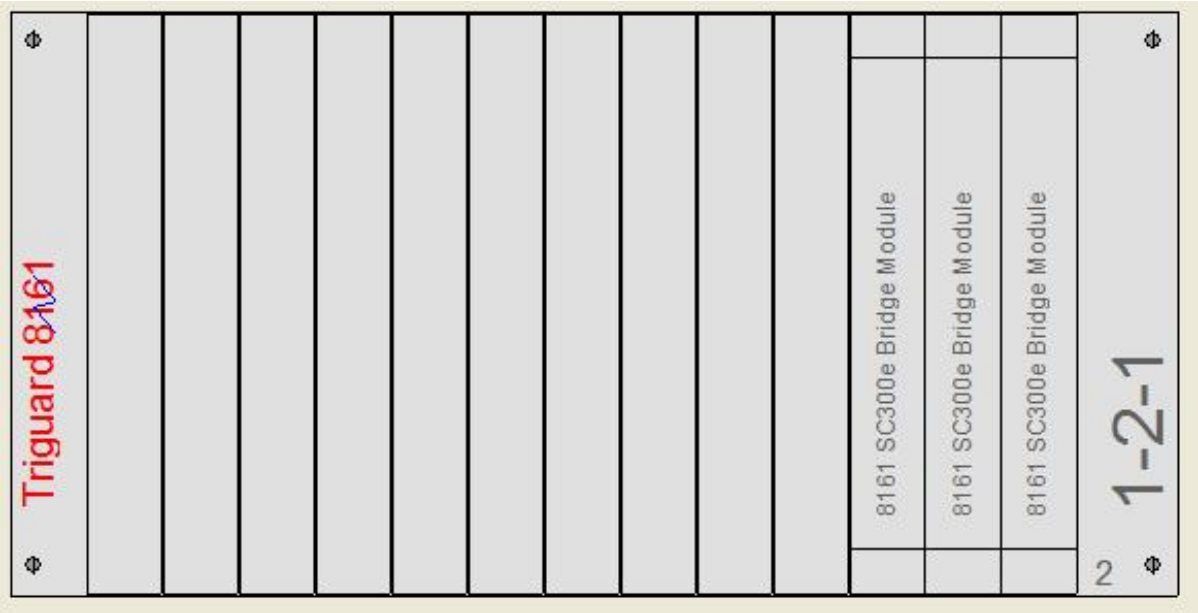

Figure 11 Connected Chassis

Left-click on the left or right end of the 8161 chassis to open the Chassis Connection dialog again. The 'Jumper Config' button now demonstrates how to set the Triguard backplane jumpers.

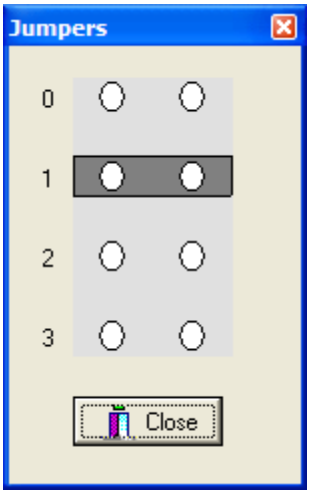

Figure 12 Jumper Setting

This chassis then links into the extension chassis MBB and MRB04XM. MBB is a local extension chassis linked to the main chassis by ribbon cables. MRB04XM is also a local chassis but it provides remote connection via fiber optic cables to slave chassis MRB04XS.

To add an MBB or MRB04XM chassis, right click again on the background and select the chassis type. The jumper settings on these chassis should not be changed from their old configuration in the Triguard system. Select the 8161 chassis to which the new chassis should be connected (Parent 8161 Chassis Number; the list will only show the chassis that exist already), and enter the chassis number as configured on the address jumpers on the chassis (Triguard Chassis Number). Closing this window and left-clicking on the chassis ends will show the Jumper Config button, which will confirm the switch settings that have been selected. For the MRB04XM chassis, the two DIP switch settings are also displayed.

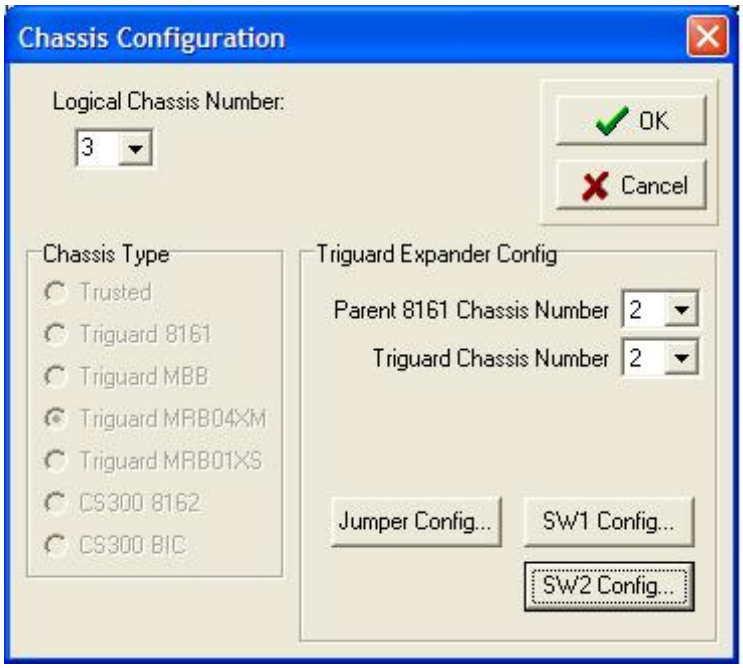

Figure 13 MBB and MRB04XM Chassis Addressing

The chassis will now show its address on the right end as:

< Trusted expander Interface slot> - <Expander socket number> - <Triguard chassis number>

e.g. 1-2-2 in the above example.

Parent 8161 Chassis Number	Address of 8161 chassis on Trusted expander
Triguard Chassis Number	Chassis address jumper setting on MRB04XS
Master Logical Chassis Number	Chassis address jumper setting on MRB04XM
Slave Link Number	MRB04XS connection to MRB04XM (1,2,3,4)

The Jumper Config button will be available on reopening the Chassis Configuration as above. The chassis will now show its address on the right hand end as:

< Trusted expander Interface slot> - <Expander socket number> - <Triguard chassis number> - <Master logical chassis number> - <Slave link number>

e.g. 1-2-2-3-1 in the above example, if the system consists of a 8161 chassis, an MRB04XM chassis and an MRB04XS chassis.

Having added all the chassis in the system, the next step is to insert modules. For each module, right-click on the appropriate chassis slot. Select the module from the list.

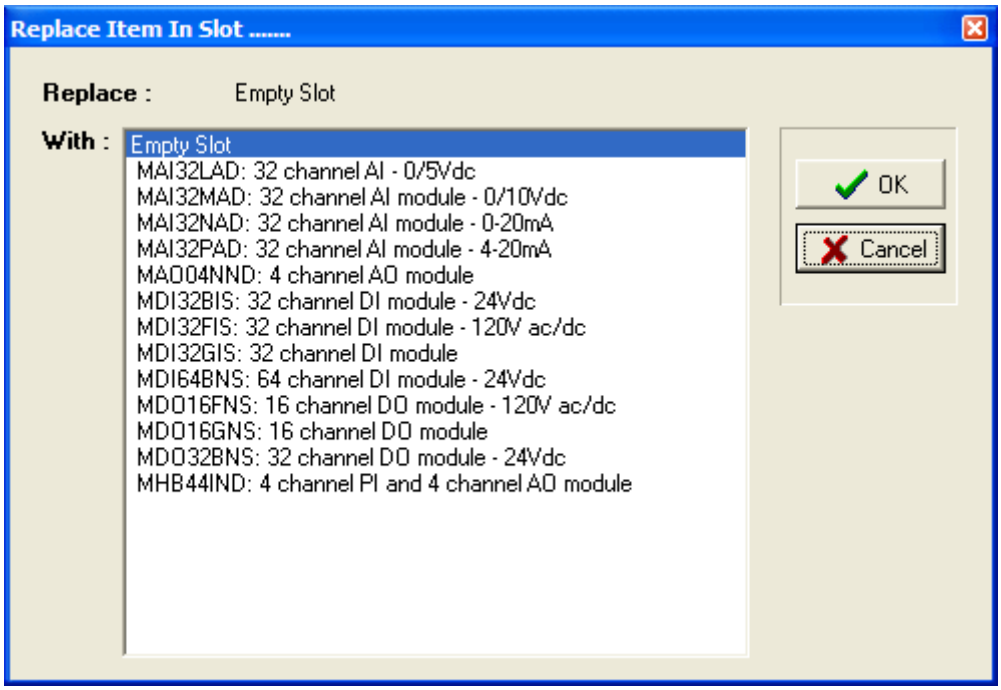

Figure 14 Triguard Modules

On left-clicking the module, the module options are displayed.

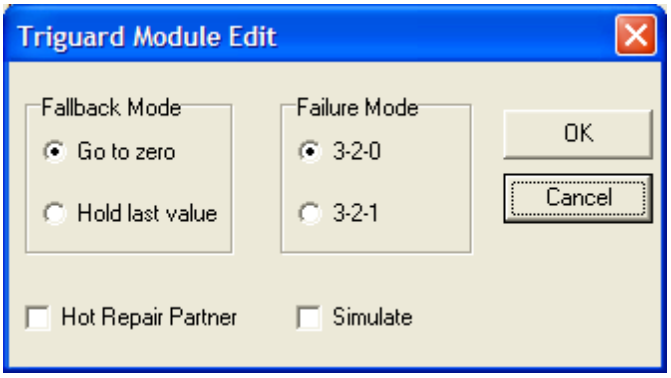

Figure 15 Module Options

For output modules, select the output action on failure (Fallback Mode); either to set all outputs to zero/de-energized or to remain at their last state.

For all modules, select the action on slice failure, either to shut down when only one slice is working (3-2-0) or to continue running on one slice (3-2-1).

To enable hot-repair (on-line replacement), check 'Hot Repair Partner'. This will enable replacement with the module in the slot to the right of this module. There is no need to check the box in the right-hand module.

To allow the system to run with a module absent, check 'Simulate'.

Ensure that the options selected are as configured in the original application.

3.2. Board Definitions

There are no restrictions in the order of the boards set out in the connection table except in cases where TM117-DMX (64-Channel De-Multiplexed Driver) termination cards are configured in the system. These have to be defined before any SC300E I/O modules are specified. The DMX cards are driven from the Trusted serial communications module.

It is also general convention to specify the Trusted main processor at the head of the connection table.

In a true hybrid system including Trusted I/O modules, conventions for entering the various board definitions have to be referred to in the associated Product Description.

3.2.1. Module – 8161 (Bridge Module)

DESCRIPTION

This definition provides module status for a Logical Triguard 8161 primary chassis expansion interface module.

The logical module accounts for the 3 physical modules FCR-A, FCR-B and FCR-C.

OEM PARAMETERS

OEM parameter	Valid numbers	Description
CHASSIS	2-29	Logical chassis number allocated to the primary Triguard chassis in which the 8161 modules are placed.
SLOT	15	Logical slot within the Primary Triguard chassis by which the 8000 system identifies the 8161 module. This cannot be configured.

PHYSICAL MODULE

RACK 1: [STATUS] - 6 BOOL Inputs

Variable 1: TRUE = Logical module responding

Variable 2: TRUE = FCR-A faulted or not responding

Variable 3: TRUE = FCR-B faulted or not responding

Variable 4: TRUE = FCR-C faulted or not responding

Variable 5: TRUE = Power supply 1 faulted

Variable 6: TRUE = Power supply 2 faulted

RACK 2: [INFO] - 12 ANALOGUE Inputs

Word 1: FCR-A fault code (see note 1)

Word 2: FCR-B fault code (see note 1)

Word 3: FCR-C fault code (see note 1)

Word 4: FCR-A hot-link error count

Word 5: FCR-B hot-link error count

Word 6: FCR-C hot-link error count

Word 7: FCR-A IML own-link error count

Word 8: FCR-A IML down-link error count

Word 9: FCR-A IML up-link error count

Word 10: FCR-B IML own-link error count

Word 11: FCR-B IML down-link error count

Word 12: FCR-B IML up-link error count

Word 13: FCR-C IML own-link error count

Word 14: FCR-C IML down-link error count

Word 15: FCR-C IML up-link error count

Note 1 - Fault Codes

0 : No fault

1 : Local backplane fault

2 : Local expansion bus fault

3 : Common fault (applies to both local backplane and expansion buses)

3.2.2. Module – MBB (Bus Interface Module)

DESCRIPTION

This definition provides module status for a logical Triguard MBB local chassis expansion module.

The logical module accounts for the 3 physical modules FCR-A, FCR-B and FCR-C.

OEM PARAMETERS:

OEM parameter	Valid numbers	Description
CHASSIS	2-29	Logical chassis number allocated to the local secondary Triguard chassis in which the MBB modules are placed.
SLOT	15	Logical slot within the local secondary Triguard chassis by which the 8000 system identifies the MBB module. This cannot be configured.

PHYSICAL MODULE:

RACK 1: [STATUS] - 10 BOOL Inputs

Variable 1: FALSE (Not used)

Variable 2: TRUE = FCR-A faulted

Variable 3: TRUE = FCR-B faulted

Variable 4: TRUE = FCR-C faulted

Note:

The status of MBB FCR's can only be determined by the discrepancy status of accesses performed to I/O modules within the chassis of the MBB. If no such modules exist or if no MBB FCR's are fitted then no faults can be reported.

3.2.3. Module – mai32lad (0-5V; Analogue Input Module)

DESCRIPTION

This definition will open a single MAI32LAD.

OEM PARAMETERS

OEM parameter	Valid numbers	Description
CHASSIS	2-29	Logical chassis and slot number where the MAI32LAD is located.

SLOT 1-10

PHYSICAL MODULE:

RACK 1: (AI)

32 INTEGER inputs

RACK 2: (DIAG)

3 INTEGER inputs

Word 1 Health status bits, 0=healthy 1=fault

- bit 0-2 Microcontroller watchdog (bit 0=A, bit 1=B, bit2=C)
- bit 3-5 MP watchdog (bit 0=A, bit 1=B, bit2=C)
- bit 6-8 Microcontroller slice health (bit 0=A, bit 1=B, bit2=C)
- bit 9-11 Combined slice health (bit 0=A, bit 1=B, bit2=C)
- bit 12 Power Fail
- bit 13-15 not used

Word 2 Diagnostic bits

- bit 0 Slice A
  - =1 slice is not responding or there is an error
  - =0 slice is responding
- bit 1 Slice B
  - =1 slice is not responding or there is an error
  - =0 slice is responding
- bit 2 Slice C
  - =1 slice is not responding or there is an error
  - =0 slice is responding
- bit 3 Module offline or missing
  - =1 offline or missing
  - =0 online
- bit 4 Single slot hot repair
  - =1 in progress
  - =0 not in progress
- bit 5 Discrepancy errors
  - =1 faults detected
  - =0 no faults detected

bit 6 LFD faults

=1 faults detected

=0 no faults detected

Word 3 Slot number of active module

RACK 3: (FAULTS)

4 INTEGER inputs

Word 1 Discrepancy errors, channels 1-16 (bit 0 = channel 1)

Word 2 Discrepancy errors, channels 17-32 (bit 0 = channel 17)

Word 3 LFD errors, channels 1-16 (bit 0 = channel 1)

Word 4 LFD errors, channels 17-32 (bit 0 = channel 17)

3.2.4. Module – mai32mad (0-10V; Analogue Input Module)

DESCRIPTION

This definition will open a single MAI32MAD.

OEM PARAMETERS

OEM parameter	Valid numbers	Description
CHASSIS	2-29	Logical chassis and slot number where the MAI32MAD is located.
SLOT	1-10	

PHYSICAL MODULE:

RACK 1: (AI)

32 INTEGER inputs

RACK 2: (DIAG)

3 INTEGER inputs

Word 1 Health status bits, 0=healthy 1=fault

bit 0-2 Microcontroller watchdog (bit 0=A, bit 1=B, bit2=C)

bit 3-5 MP watchdog (bit 0=A, bit 1=B, bit2=C)

bit 6-8 Microcontroller slice health (bit 0=A, bit 1=B, bit2=C)

bit 9-11 Combined slice health (bit 0=A, bit 1=B, bit2=C)

bit 12 Power Fail

bit 13-15 not used

Word 2 Diagnostic bits

bit 0 Slice A

=1 slice is not responding or there is an error

=0 slice is responding

bit 1 Slice B

=1 slice is not responding or there is an error

=0 slice is responding

bit 2 Slice C

=1 slice is not responding or there is an error

=0 slice is responding

bit 3 Module offline or missing

=1 offline or missing

=0 online

bit 4 Single slot hot repair

=1 in progress

=0 not in progress

bit 5 Discrepancy errors

=1 faults detected

=0 no faults detected

bit 6 LFD faults

=1 faults detected

=0 no faults detected

Word 3 Slot number of active module

RACK 3: (FAULTS)

4 INTEGER inputs

Word 1 Discrepancy errors, channels 1-16 (bit 0 = channel 1)

Word 2 Discrepancy errors, channels 17-32 (bit 0 = channel 17)

Word 3 LFD errors, channels 1-16 (bit 0 = channel 1)

Word 4 LFD errors, channels 17-32 (bit 0 = channel 17)

3.2.5. Module – mai32nad (0-20Ma; Analogue Input Module)

DESCRIPTION

This definition will open a single MAI32NAD.

OEM PARAMETERS

OEM parameter	Valid numbers	Description
CHASSIS	2-29	Logical chassis and slot number where the MAI32NAD is located.
SLOT	1-10	

PHYSICAL MODULE:

RACK 1: (AI)

32 INTEGER inputs

RACK 2: (DIAG)

3 INTEGER inputs

Word 1 Health status bits, 0=healthy 1=fault

bit 0-2	Microcontroller watchdog (bit 0=A, bit 1=B, bit2=C)
bit 3-5	MP watchdog (bit 0=A, bit 1=B, bit2=C)
bit 6-8	Microcontroller slice health (bit 0=A, bit 1=B, bit2=C)
bit 9-11	Combined slice health (bit 0=A, bit 1=B, bit2=C)
bit 12	Power Fail
bit 13-15	not used

Word 2 Diagnostic bits

bit 0 Slice A

=1	slice is not responding or there is an error
=0	slice is responding

bit 1 Slice B

=1	slice is not responding or there is an error
=0	slice is responding

bit 2 Slice C

=1	slice is not responding or there is an error
=0	slice is responding

bit 3 Module offline or missing

=1	offline or missing
=0	online

bit 4 Single slot hot repair

=1	in progress

=0 not in progress

bit 5 Discrepancy errors

=1 faults detected

=0 no faults detected

bit 6 LFD faults

=1 faults detected

=0 no faults detected

Word 3 Slot number of active module

RACK 3: (FAULTS)

4 INTEGER inputs

Word 1 Discrepancy errors, channels 1-16 (bit 0 = channel 1)

Word 2 Discrepancy errors, channels 17-32 (bit 0 = channel 17)

Word 3 LFD errors, channels 1-16 (bit 0 = channel 1)

Word 4 LFD errors, channels 17-32 (bit 0 = channel 17)

3.2.6. Module – mai32pad (0-40Ma; Analogue Input Module)

DESCRIPTION

This definition will open a single MAI32PAD.

OEM PARAMETERS

OEM parameter	Valid numbers	Description
CHASSIS	2-29	Logical chassis and slot number where the MAI32PAD is located.
SLOT	1-10	

PHYSICAL MODULE:

RACK 1: (AI)

32 INTEGER inputs

RACK 2: (DIAG)

3 INTEGER inputs

Word 1 Health status bits, 0=healthy 1=fault

bit 0-2 Microcontroller watchdog (bit 0=A, bit 1=B, bit2=C)

bit 3-5 MP watchdog (bit 0=A, bit 1=B, bit2=C)

bit 6-8 Microcontroller slice health (bit 0=A, bit 1=B, bit2=C)

bit 9-11 Combined slice health (bit 0=A, bit 1=B, bit2=C)

bit 12 Power Fail

bit 13-15 not used

Word 2 Diagnostic bits

bit 0 Slice A

=1 slice is not responding or there is an error

=0 slice is responding

bit 1 Slice B

=1 slice is not responding or there is an error

=0 slice is responding

bit 2 Slice C

=1 slice is not responding or there is an error

=0 slice is responding

bit 3 Module offline or missing

=1 offline or missing

=0 online

bit 4 Single slot hot repair

=1 in progress

=0 not in progress

bit 5 Discrepancy errors

=1 faults detected

=0 no faults detected

bit 6 LFD faults

=1 faults detected

=0 no faults detected

Word 3 Slot number of active module

RACK 3: (FAULTS)

4 INTEGER inputs

Word 1 Discrepancy errors, channels 1-16 (bit 0 = channel 1)

Word 2 Discrepancy errors, channels 17-32 (bit 0 = channel 17)

Word 3 LFD errors, channels 1-16 (bit 0 = channel 1)

Word 4 LFD errors, channels 17-32 (bit 0 = channel 17)

3.2.7. Module – mao04nnd (0-22Ma; Analogue Output Module)

DESCRIPTION

This definition will open a single MAO04NND.

OEM PARAMETERS

OEM parameter	Valid numbers	Description
CHASSIS	2-29	Logical chassis and slot number where the MAO04NND is located.
SLOT	1-10	

PHYSICAL MODULE:

RACK 1: (AO)

4 INTEGER outputs

RACK 2: (DIAG)

4 INTEGER inputs

Word 1 Health status bits, 0=healthy 1=fault

bit 0-2	Microcontroller watchdog (bit 0=A, bit 1=B, bit2=C)
bit 3-5	MP watchdog (bit 0=A, bit 1=B, bit2=C)
bit 6-8	Microcontroller slice health (bit 0=A, bit 1=B, bit2=C)
bit 9-11	Combined slice health (bit 0=A, bit 1=B, bit2=C)
bit 12	Power Fail
bit 13-15	not used

Word 2 Diagnostic bits

bit 0 Slice A

=1	slice is not responding or there is an error
=0	slice is responding

bit 1 Slice B

=1	slice is not responding or there is an error
=0	slice is responding

bit 2 Slice C

=1	slice is not responding or there is an error
=0	slice is responding

bit 3 Module offline or missing

=1	offline or missing

=0 online

bit 4 Single slot hot repair

=1 in progress

=0 not in progress

bit 5 Discrepancy errors

=1 faults detected

=0 no faults detected

bit 6 LFD faults

=1 faults detected

=0 no faults detected

Word 3 Slot number of active module

Word 4 Fault flags, 0=healthy 1=fault

bit 0-2 Logic supply power fail fault (ABC, bit0=A, bit2=C)

bit 3-5 Reserved

bit 6 Field power fail fault

bit 7 Output discrepancy error

bit 8-15 Reserved

RACK 3: (FAULTS)

1 INTEGER input

Word 1 LFD errors, channels 1-4 (bit 0 = channel 1)

3.2.8. Module – mdi32bis (24v; digital input Module)

DESCRIPTION

This definition will open a single MDI32BIS.

OEM PARAMETERS

OEM parameter	Valid numbers	Description
CHASSIS	2-29	Logical chassis and slot number where the MDI32BIS is located.
SLOT	1-10	

PHYSICAL MODULE:

RACK 1: (DI)

32 BOOLEAN inputs

RACK 2: (DIAG)

3 INTEGER inputs

Word 1 Health status bits, 0=healthy 1=fault

bit 0-2	Microcontroller watchdog (bit 0=A, bit 1=B, bit2=C)
bit 3-5	MP watchdog (bit 0=A, bit 1=B, bit2=C)
bit 6-8	Microcontroller slice health (bit 0=A, bit 1=B, bit2=C)
bit 9-11	Combined slice health (bit 0=A, bit 1=B, bit2=C)
bit 12	Power Fail
bit 13-15	not used

Word 2 Diagnostic bits

bit 0 Slice A

=1	slice is not responding or there is an error
=0	slice is responding

bit 1 Slice B

=1	slice is not responding or there is an error
=0	slice is responding

bit 2 Slice C

=1	slice is not responding or there is an error
=0	slice is responding

bit 3 Module offline or missing

=1	offline or missing
=0	online

bit 4 Single slot hot repair

=1	in progress
=0	not in progress

bit 5 Discrepancy errors

=1	faults detected
=0	no faults detected

bit 6 LFD faults

=1	faults detected
=0	no faults detected

Word 3 Slot number of active module

RACK 3: (FAULTS)

4 INTEGER inputs

Word 1 Discrepancy errors, channels 1-16 (bit 0 = channel 1)

Word 2 Discrepancy errors, channels 17-32 (bit 0 = channel 17)

Word 3 LFD errors, channels 1-16 (bit 0 = channel 1)

Word 4 LFD errors, channels 17-32 (bit 0 = channel 17)

3.2.9. Module – mdi32fis (120v; Digital Input Module)

DESCRIPTION

This definition will open a single MDI32FIS.

OEM PARAMETERS

OEM parameter	Valid numbers	Description
CHASSIS	2-29	Logical chassis and slot number where the MDI32FIS is located.
SLOT	1-10	

PHYSICAL MODULE:

RACK 1: (DI)

32 BOOLEAN inputs

RACK 2: (DIAG)

3 INTEGER inputs

Word 1 Health status bits, 0=healthy 1=fault

bit 0-2	Microcontroller watchdog (bit 0=A, bit 1=B, bit2=C)
bit 3-5	MP watchdog (bit 0=A, bit 1=B, bit2=C)
bit 6-8	Microcontroller slice health (bit 0=A, bit 1=B, bit2=C)
bit 9-11	Combined slice health (bit 0=A, bit 1=B, bit2=C)
bit 12	Power Fail
bit 13-15	not used

Word 2 Diagnostic bits

bit 0 Slice A

=1 slice is not responding or there is an error

=0 slice is responding

bit 1 Slice B

=1 slice is not responding or there is an error

=0 slice is responding

bit 2 Slice C

=1 slice is not responding or there is an error

=0 slice is responding

bit 3 Module offline or missing

=1 offline or missing

=0 online

bit 4 Single slot hot repair

=1 in progress

=0 not in progress

bit 5 Discrepancy errors

=1 faults detected

=0 no faults detected

bit 6 LFD faults

=1 faults detected

=0 no faults detected

Word 3 Slot number of active module

RACK 3: (FAULTS)

4 INTEGER inputs

Word 1 Discrepancy errors, channels 1-16 (bit 0 = channel 1)

Word 2 Discrepancy errors, channels 17-32 (bit 0 = channel 17)

Word 3 LFD errors, channels 1-16 (bit 0 = channel 1)

Word 4 LFD errors, channels 17-32 (bit 0 = channel 17)

3.2.10. Module – mdi32gis (48v; Digital Input Module)

DESCRIPTION

This definition will open a single MDI32GIS.

OEM PARAMETERS

OEM parameter	Valid numbers	Description
CHASSIS	2-29	Logical chassis and slot number where the MDI32GIS is located.
SLOT	1-10	

PHYSICAL MODULE:

RACK 1: (DI)

32 BOOLEAN inputs

RACK 2: (DIAG)

3 INTEGER inputs

Word 1 Health status bits, 0=healthy 1=fault

bit 0-2	Microcontroller watchdog (bit 0=A, bit 1=B, bit2=C)
bit 3-5	MP watchdog (bit 0=A, bit 1=B, bit2=C)
bit 6-8	Microcontroller slice health (bit 0=A, bit 1=B, bit2=C)
bit 9-11	Combined slice health (bit 0=A, bit 1=B, bit2=C)
bit 12	Power Fail
bit 13-15	not used

Word 2 Diagnostic bits

bit 0 Slice A

=1	slice is not responding or there is an error
=0	slice is responding

bit 1 Slice B

=1	slice is not responding or there is an error
=0	slice is responding

bit 2 Slice C

=1	slice is not responding or there is an error
=0	slice is responding

bit 3 Module offline or missing

=1	offline or missing
=0	online

bit 4 Single slot hot repair

=1	in progress
=0	not in progress

bit 5 Discrepancy errors

=1	faults detected
=0	no faults detected

bit 6 LFD faults

=1 faults detected

=0 no faults detected

Word 3 Slot number of active module

RACK 3: (FAULTS)

4 INTEGER inputs

Word 1 Discrepancy errors, channels 1-16 (bit 0 = channel 1)

Word 2 Discrepancy errors, channels 17-32 (bit 0 = channel 17)

Word 3 LFD errors, channels 1-16 (bit 0 = channel 1)

Word 4 LFD errors, channels 17-32 (bit 0 = channel 17)

3.2.11. Module – mdi64bns (24v simplex; digital input Module)

DESCRIPTION

This definition will open a single MDI64BNS.

OEM PARAMETERS

OEM parameter	Valid numbers	Description
CHASSIS	2-29	Logical chassis and slot number where the MDI64BNS is located.
SLOT	1-10	

PHYSICAL MODULE:

RACK 1: (DI)

64 BOOLEAN inputs

RACK 2: (DIAG)

3 INTEGER inputs

Word 1 Health status bits, 0=healthy 1=fault

bit 0-2 Microcontroller watchdog (bit 0=A, bit 1=B, bit2=C)

bit 3-5 MP watchdog (bit 0=A, bit 1=B, bit2=C)

bit 6-8 Microcontroller slice health (bit 0=A, bit 1=B, bit2=C)

bit 9-11 Combined slice health (bit 0=A, bit 1=B, bit2=C)

bit 12 Power Fail

bit 13-15 not used

Word 2 Diagnostic bits

bit 0 Slice A

=1 slice is not responding or there is an error

=0 slice is responding

bit 1 Slice B

=1 slice is not responding or there is an error

=0 slice is responding

bit 2 Slice C

=1 slice is not responding or there is an error

=0 slice is responding

bit 3 Module offline or missing

=1 offline or missing

=0 online

bit 4 Single slot hot repair

=1 in progress

=0 not in progress

bit 5 Discrepancy errors

=1 faults detected

=0 no faults detected

bit 6 LFD faults

=1 faults detected

=0 no faults detected

Word 3 Slot number of active module

RACK 3: (FAULTS)

8 INTEGER inputs

Word 1 Discrepancy errors, channels 1-16 (bit 0 = channel 1)

Word 2 Discrepancy errors, channels 17-32 (bit 0 = channel 17)

Word 3 Discrepancy errors, channels 33-48 (bit 0 = channel 33)

Word 4 Discrepancy errors, channels 49-64 (bit 0 = channel 49)

Word 5 LFD errors, channels 1-16 (bit 0 = channel 1)

Word 6 LFD errors, channels 17-32 (bit 0 = channel 17)

Word 7 LFD errors, channels 33-48 (bit 0 = channel 33)

Word 8 LFD errors, channels 49-64 (bit 0 = channel 49)

3.2.12. Module – mdo16fns (120v; Digital Output Module)

DESCRIPTION

This definition will open a single MDO16FNS.

OEM PARAMETERS

OEM parameter	Valid numbers	Description
CHASSIS	2-29	Logical chassis and slot number where the MDO16FNS is located.
SLOT	1-10	

PHYSICAL MODULE:

RACK 1: (DO)

16 BOOLEAN outputs

RACK 2: (DIAG)

4 INTEGER inputs

Word 1 Health status bits, 0=healthy 1=fault

bit 0-2	Microcontroller watchdog (bit 0=A, bit 1=B, bit2=C)
bit 3-5	MP watchdog (bit 0=A, bit 1=B, bit2=C)
bit 6-8	Microcontroller slice health (bit 0=A, bit 1=B, bit2=C)
bit 9-11	Combined slice health (bit 0=A, bit 1=B, bit2=C)
bit 12	Power Fail
bit 13-15	not used

Word 2 Diagnostic bits

bit 0 Slice A

=1	slice is not responding or there is an error
=0	slice is responding

bit 1 Slice B

=1	slice is not responding or there is an error
=0	slice is responding

bit 2 Slice C

=1	slice is not responding or there is an error
=0	slice is responding

bit 3 Module offline or missing

=1	offline or missing

=0 online

bit 4 Single slot hot repair

=1 in progress

=0 not in progress

bit 5 Discrepancy errors

=1 faults detected

=0 no faults detected

bit 6 LFD faults

=1 faults detected

=0 no faults detected

Word 3 Slot number of active module

Word 4 Fault flags, 0=healthy 1=fault

bit 0-2 Logic supply power fail fault (ABC, bit0=A, bit2=C)

bit 3-5 Field supply power fail fault (ABC)

bit 6 Bias supply 1 power fail fault

bit 7 Bias supply 2 power fail fault

bit 8 Logic supply power fail fault

bit 9-10 Reserved

bit 11-13 Drive supply power fail fault (ABC)

bit 14 Field supply power fail fault

bit 15 Over temperature fault

RACK 3: (FAULTS)

1 INTEGER inputs

Word 1 LFD errors, channels 1-16 (bit 0 = channel 1)

3.2.13. Module – mdo16gns (48v; Digital Output Module)

DESCRIPTION

This definition will open a single MDO16GNS.

OEM PARAMETERS

OEM parameter	Valid numbers	Description
CHASSIS	2-29	Logical chassis and slot number where the MDO16GNS is located.
SLOT	1-10	

PHYSICAL MODULE:

RACK 1: (DO)

16 BOOLEAN outputs

RACK 2: (DIAG)

4 INTEGER inputs

Word 1 Health status bits, 0=healthy 1=fault

bit 0-2	Microcontroller watchdog (bit 0=A, bit 1=B, bit2=C)
bit 3-5	MP watchdog (bit 0=A, bit 1=B, bit2=C)
bit 6-8	Microcontroller slice health (bit 0=A, bit 1=B, bit2=C)
bit 9-11	Combined slice health (bit 0=A, bit 1=B, bit2=C)
bit 12	Power Fail
bit 13-15	not used

Word 2 Diagnostic bits

bit 0 Slice A

=1	slice is not responding or there is an error
=0	slice is responding

bit 1 Slice B

=1	slice is not responding or there is an error
=0	slice is responding

bit 2 Slice C

=1	slice is not responding or there is an error
=0	slice is responding

bit 3 Module offline or missing

=1	offline or missing
=0	online

bit 4 Single slot hot repair

=1	in progress
=0	not in progress

bit 5 Discrepancy errors

=1	faults detected
=0	no faults detected

bit 6 LFD faults

=1 faults detected

=0 no faults detected

Word 3 Slot number of active module

Word 4 Fault flags, 0=healthy 1=fault

bit 0-2	Logic supply power fail fault (ABC, bit0=A, bit2=C)
bit 3-5	Field supply power fail fault (ABC)
bit 6	Bias supply 1 power fail fault
bit 7	Bias supply 2 power fail fault
bit 8	Logic supply power fail fault
bit 9-10	Reserved
bit 11-13	Drive supply power fail fault (ABC)
bit 14	Field supply power fail fault
bit 15	Over temperature fault

RACK 3: (FAULTS)

1 INTEGER inputs

Word 1 LFD errors, channels 1-16 (bit 0 = channel 1)

3.2.14. Module – mdo32bns (24v; Digital Output Module)

DESCRIPTION

This definition will open a single MDO32BNS.

OEM PARAMETERS

OEM parameter	Valid numbers	Description
CHASSIS	2-29	Logical chassis and slot number where the MDO32BNS is located.
SLOT	1-10	

PHYSICAL MODULE:

RACK 1: (DO)

32 BOOLEAN outputs

RACK 2: (DIAG)

4 INTEGER inputs

Word 1 Health status bits, 0=healthy 1=fault

bit 0-2	Microcontroller watchdog (bit 0=A, bit 1=B, bit2=C)
bit 3-5	MP watchdog (bit 0=A, bit 1=B, bit2=C)

bit 6-8 Microcontroller slice health (bit 0=A, bit 1=B, bit2=C)

bit 9-11 Combined slice health (bit 0=A, bit 1=B, bit2=C)

bit 12 Power Fail

bit 13-15 not used

Word 2 Diagnostic bits

bit 0 Slice A

=1 slice is not responding or there is an error

=0 slice is responding

bit 1 Slice B

=1 slice is not responding or there is an error

=0 slice is responding

bit 2 Slice C

=1 slice is not responding or there is an error

=0 slice is responding

bit 3 Module offline or missing

=1 offline or missing

=0 online

bit 4 Single slot hot repair

=1 in progress

=0 not in progress

bit 5 Discrepancy errors

=1 faults detected

=0 no faults detected

bit 6 LFD faults

=1 faults detected

=0 no faults detected

Word 3 Slot number of active module

Word 4 Fault flags, 0=healthy 1=fault

bit 0-2 Logic supply power fail fault (ABC, bit0=A, bit2=C)

bit 3-5 Field supply power fail fault (ABC)

bit 6 Bias supply 1 power fail fault

bit 7 Bias supply 2 power fail fault

bit 8	Logic supply power fail fault
bit 9-10	Reserved
bit 11-13	Drive supply power fail fault (ABC)
bit 14	Field supply power fail fault
bit 15	Over temperature fault

RACK 3: (FAULTS)

2 INTEGER inputs

Word 1 LFD errors, channels 1-16 (bit 0 = channel 1)

Word 2 LFD errors, channels 17-32 (bit 0 = channel 17)

3.2.15. Module – mhb44ind (Pulse-In/Analogue Output Module)

DESCRIPTION

This definition will open a single MHB44IND.

OEM PARAMETERS

OEM parameter	Valid numbers	Description
CHASSIS	2-29	Logical chassis and slot number where the MHB44IND is located.
SLOT	1-10	

PHYSICAL MODULE:

RACK 1: (PI)

4 INTEGER inputs

RACK 2: (AO)

4 INTEGER outputs

RACK 3: (DIAG)

4 INTEGER inputs

Word 1 Health status bits, 0=healthy 1=fault

bit 0-2	Microcontroller watchdog (bit 0=A, bit 1=B, bit2=C)
bit 3-5	MP watchdog (bit 0=A, bit 1=B, bit2=C)
bit 6-8	Microcontroller slice health (bit 0=A, bit 1=B, bit2=C)
bit 9-11	Combined slice health (bit 0=A, bit 1=B, bit2=C)
bit 12	Power Fail
bit 13-15	not used

Word 2 Diagnostic bits

bit 0 Slice A

=1 slice is not responding or there is an error

=0 slice is responding

bit 1 Slice B

=1 slice is not responding or there is an error

=0 slice is responding

bit 2 Slice C

=1 slice is not responding or there is an error

=0 slice is responding

bit 3 Module offline or missing

=1 offline or missing

=0 online

bit 4 Single slot hot repair

=1 in progress

=0 not in progress

bit 5 Discrepancy errors

=1 faults detected

=0 no faults detected

bit 6 LFD faults

=1 faults detected

=0 no faults detected

Word 3 Slot number of active module

Word 4 Fault flags, 0=healthy 1=fault

bit 0-2 Logic supply power fail fault (ABC, bit0=A, bit2=C)

bit 3-5 Reserved

bit 6 Field power fail fault

bit 7 Output discrepancy error

bit 8-15 Reserved

RACK 4: (FAULTS)

3 INTEGER inputs

Word 1 Discrepancy errors

bits 0-3 PI channels 1-4 (bit 0 = channel 1)

Word 2 LFD errors

bits 0-3 PI channels 1-4 (bit 0 = channel 1)

bits 4-7 AO channels 1-4 (bit 4 = channel 1)

3.2.16. Module – mrb01xs (Remote Slave Module)

DESCRIPTION

This definition provides module status for a logical Triguard MRB01XS remote slave chassis expansion module.

The logical module accounts for the 3 physical modules FCR-A, FCR-B and FCR-C.

OEM PARAMETERS:

OEM parameter	Valid numbers	Description
CHASSIS	2-29	Logical chassis number allocated to the remote slave Triguard chassis in which the MRB01XS modules are placed.
SLOT	15	Logical slot within the remote slave Triguard chassis by which the 8000 system identifies the MRB01XS module. This cannot be configured.

PHYSICAL MODULE:

RACK 1: [STATUS] - 10 BOOL Inputs

Variable 1: FALSE (Not used)

Variable 2: TRUE = FCR-A faulted (see note 1)

Variable 3: TRUE = FCR-B faulted (see note 1)

Variable 4: TRUE = FCR-C faulted (see note 1)

Note 1:

The status of MRB01XS FCR's can only be determined by the discrepancy status of accesses performed to I/O modules within the chassis of the MRB01XS. If no such modules exist or if no MRB01XS FCR's are fitted then no faults can be reported.

3.2.17. Module – mrb04xm (Remote Master Module)

DESCRIPTION

This definition provides module status for a logical Triguard MRB04XM remote master chassis expansion interface module.

The logical module accounts for the 3 physical modules FCR-A, FCR-B and FCR-C.

OEM PARAMETERS:

OEM parameter	Valid numbers	Description
CHASSIS	2-29	Logical chassis number allocated to the secondary Triguard chassis in which the MRB04XM modules are placed.
SLOT	15	Logical slot within the secondary Triguard chassis by which the 8000 system identifies theMRB04XM module. This cannot be configured.

PHYSICAL MODULE:

RACK 1: [STATUS] - 4 BOOL Inputs

Variable 1: FALSE (not used)

Variable 2: TRUE = FCR-A faulted (see note 2)

Variable 3: TRUE = FCR-B faulted (see note 2)

Variable 4: TRUE = FCR-C faulted (see note 2)

RACK 2: [INFO] - 3 ANALOGUE Inputs

Word 1: FCR-A fault code (see note 1)

Word 2: FCR-B fault code (see note 1)

Word 3: FCR-C fault code (see note 1)

Note 1 - Fault Codes:

0 : No Fault

1 : Local Backplane fault

2 : Remote Expansion fault

3 : Common fault (applies to both Local and Remote busses)

Note 2 - Fault Detection:

The status of MBB FCR's can only be determined by the discrepancy status of accesses performed to I/O modules within the chassis of the MRB04XM and to Remote Slave chassis connected to this Remote Master. If no such modules exist or if no MRB04XM FCR's are fitted then no faults can be reported.

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4. Operation

Figure 16 Front Panel Layout

4.1. Front Panel Indicators and Controls

4.1.1. *Tx* & *Rx* Indicators

Flashing amber Light Emitting Diodes (LEDs) indicate active transmit and receive communications on the Expander Bus.

4.1.2. *Health* Indicator

A steady green Light Emitting Diode (LED) indicates a fault-free Bridge module; an extinguished Light LED indicates a fault.

4.1.3. *On-Line* Indicator and Switch

Raising and releasing the on/off-line switch momentarily takes the module off-line, which is mirrored by the steady On/Off state of the amber On-Line LED. Repeating the action brings the module back on-line.

Prior to hot-swapping the module for repair, it should be taken off-line using this feature to ensure a clean exit from the system. The replacement module is then placed on-line using the switch.

5. Fault Finding and Maintenance

The Trusted TMR Processor provides fault monitoring, self-test and diagnostics functions.

Fault Detection within a Trusted / SC300E system can be categorized into four regions:

- Trusted TMR Processor and Expander Hardware
- SC300E Bridge Hardware
- SC300E I/O Hardware
- User Application

Using current Trusted methods for detection of faults, the TMR Processor can monitor for failures up to the Expander section. The TMR Processor is also able to separate Bridge hardware faults from SC300E I/O module faults. The Triguard I/O modules carry out on-board diagnostic tests which are relayed back to the TMR Processor via the Bridge module.

The user application can also be programmed to read error flags in the I/O module fault registers to annunciate the detection of module faults. Second faults that leave the system unable to confirm healthy operation will result in the TMR Processor stopping all communication with the 8161 bridge modules, ensuring that critical outputs go to a safe state when the internal watchdogs time out.

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6. Specifications

Supply Voltage	5.4 Vdc ± 5 %
Heat Dissipation	3 W_{max}
Operating Temperature (convection cooling)	0 °C to +60 °C (+32 °F to +140 °F)
Storage Temperature	-25 °C to +70 °C (-13 °F to +158 °F)
Relative Humidity range (operating, storage and transport)	10 % – 95 %, non-condensing
Vibration 10 Hz to 500 Hz peak to peak	1 g
Shock Operating:11 ms, ½ sine wave	15 g
Height:	400 mm (15.7 in)
Width:	27 mm (1.1 in)
Depth:	404 mm (15.9 in)
Weight (approx.)	900 g (2.0 lb.)

Table 1 Module Status LEDs