ABB Safety
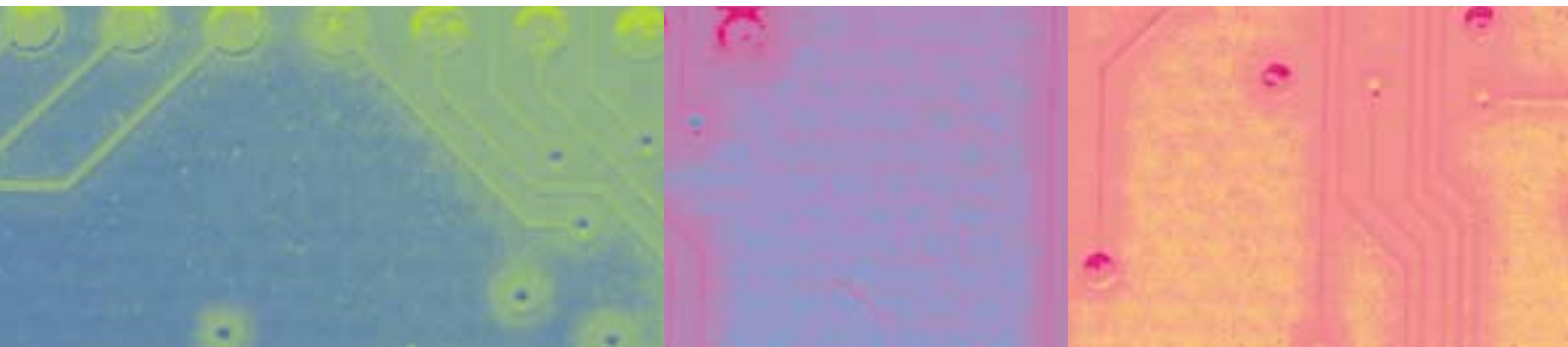
Triguard 2
TMR Safety Products

ABB

ABB

TMR Safety and Control

August Systems, founded in 1978, was the worldwide pioneer in the development of Triple Modular Redundant (TMR) processing for real time, fault tolerant control. August Systems became an ABB company in 1997 adding TMR technology to the well established Dual Redundant Safety systems developed within ABB. The new business group of ABB Safety has been established to offer a broad range of safety solutions to industry.

The Triguard SC300E products are available as engineered systems from ABB or products for integration by third party system integrators and OEMs, enabling the technology to be made available to a wide range of customers and applications.
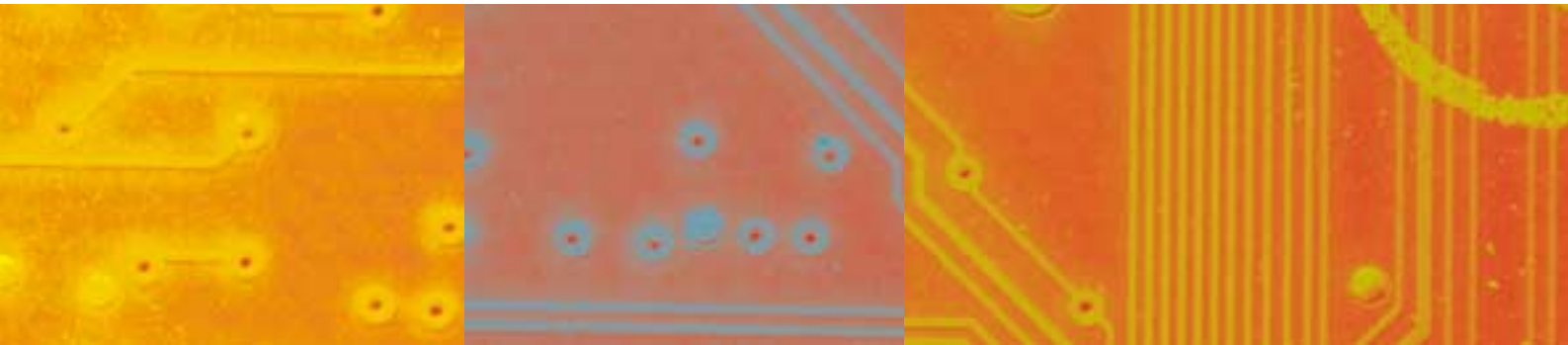
ADNOC	McDermott
AGIP	Pacific Gas & Electric
AMEC	Pemex
Arabian Industrial Fibers	Petrobras
Azot – Russia	Petrokemya
Bechtel	Petromin
BP/AMOCO	Petronas Gas
British Nuclear Fuels	Qatar Gas
Cegelec	QGPC
Chiyoda	Ralph M Parsons
Conoco	Saipem
Crescent Petroleum	SARAS – Italy
Dow	Sarawak Shell
Ecopetrol	Saudi Aramco
Elf Enterprise	Snamprogetti
EPA – Taiwan	Southern Petrochemical
Exxon/Mobil	Technip
Foster Wheeler	Technipgeoproduction
Gas Authority India	Tecnimont
Gazprom	Thai Aromatics
Hanwha Chemical	Torch Energy
Huntsman Chemicals	Total
Hyundai Petrochemical	Toyo Engineering Co
IOCL – India	UK Atomic Energy
KBR	US Steel
KNPC	Westlake Group
Madras Refinery	

Contents

Triguard SC300E

The ABB Triguard SC300E is the evolution of 20 years of combined vendor and customer experience integrated into the design of the ultimate TMR product. Building on a proven platform, the Triguard SC300E combines features that will maintain excellence well into the future.

Today ABB is a global supplier with key operating bases in North America, Europe, Middle East and Asia Pacific. The Company has successfully supplied TMR products and systems to meet an ever increasing diverse range of applications, including:

- Safety Shutdown
- Electrical Stability and Load Control
- Process Shutdown
- Reactor Control
- Emergency Shutdown
- Critical Batch Processing
- Sequence and Interlock Control
- Fire & Gas Protection and Detection
- Critical Process Control
- Burner Management and Control
- Turbine and Compressor Control
- Wellhead/Sub-Sea Control
- Unmanned Installations
- FPSOs

Product Family

The ABB Triguard SC300E TMR product family gives unrivalled performance in areas of reliability, availability, test coverage, diagnostics and simplicity of operation. Advances in technology and improved production methods add cost benefits that give significant price/performance advantages.

- **Fewer unscheduled stoppages**
  highest availability, fault tolerant electronics with transient immunity and 3–2–0 or 3–2–1–0 voting
- **Security for plant, product and people**
  fail-safe operation at all levels provides plant, product and personnel with the highest security
- **Quality data**
  sequence of event and extensive diagnostics keep the operator informed

TRIGUARD SC300E

Highest Availability

The Triguard SC300E achieves the highest possible TMR availability (99.999%) by maximising the Mean Time To Failure (MTTF) and decreasing the Mean Time To Repair (MTTR).

Modern low power integrated technology allows the TMR architecture to be cost effective for an increasing range of high integrity applications.

Simple to Use, Operate and Maintain

The Triguard SC300E TMR product functions as a single set of hardware and software. The three processors and triplicated I/O circuitry are transparent to the user. Purchasing a Triguard SC300E system will provide:

- Lowest Life Cycle Cost
- The Maximum Safety and Availability
- The Highest Level of Safety and On-Line Maintenance

Fail Safe Operation

Failure modes of the processors, input/output circuitry, control program and watchdog timer circuits are managed so that circuits will default to a predetermined safe state.
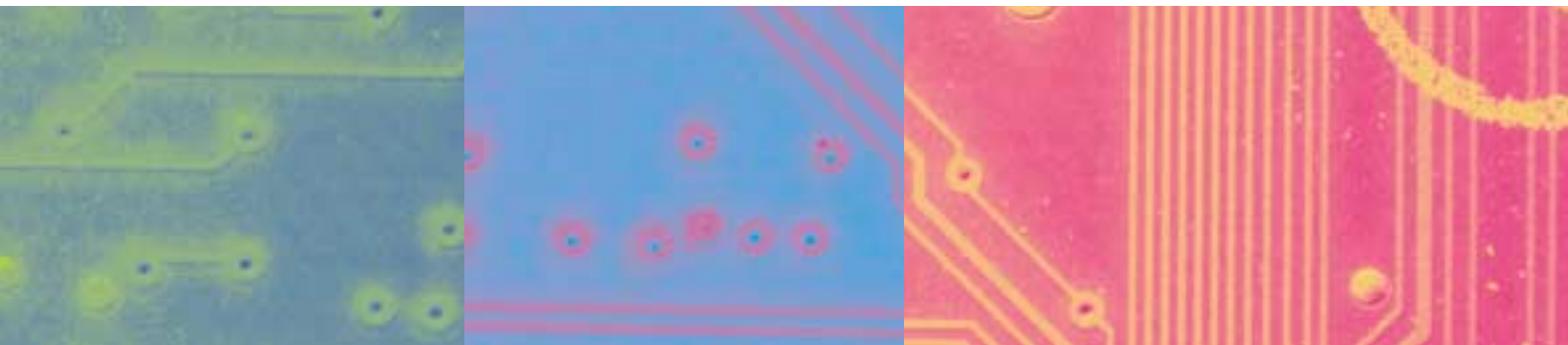
Highest Speed of Response

By using advanced processor technology, whilst maintaining the stability of the original core software, **Triguard SC300E delivers an unrivalled scan time resolution of 10ms.**

SC300E TMR Architecture

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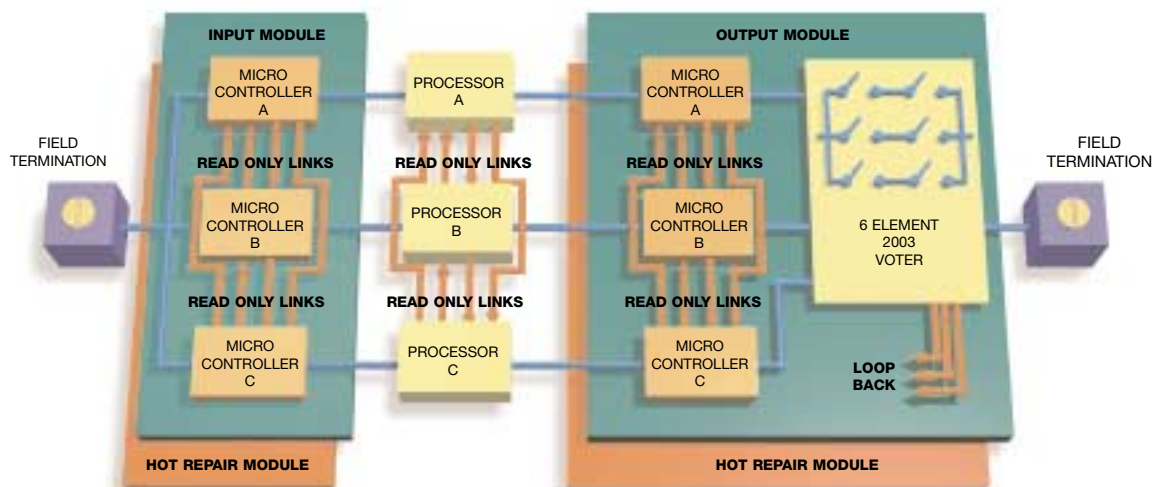
SC300E Chassis

High speed of response benefits the customer application which specifies Sequence of Events recording (SoE) without the cost of additional equipment. It also enables TMR to be used for applications requiring high speed advanced control.

Fault Tolerant Hardware and Software

The system is designed to continue to operate correctly with the presence of a major component fault and is capable of tolerating multiple, non concurrent faults.

Easy to Use Software – Windows™

TriBuild™ configuration and application programming and TriCommand™ Server (WONDERWARE© MMI interface software) are Windows™ compliant, making the system easier to use for the engineer and the operator. For customers with existing ABB equipment "backward compatibility" is provided making upgrading or adding new facilities economic to implement.

TriBuild™ and TriCommand™ Server can be used with Windows NT™. Features include:

- True multitasking capability
- Strategies can be saved on-line without halting the system operation
- Ability to upload the configuration
- Changes can be made on-line without halting the system operation
- Bumpless changeover of hot repair modules
- Comprehensive diagnostic displays for ease of maintenance

Fault Tolerance and Selective Redundancy

Improvements in the system to keep a process plant running safely without the nuisance of false trips have been achieved by full diagnostic coverage of all modules and selective redundancy.

Processors 3–2–1–0

Input/Output Circuits 3–2–1–0 or 3–2–0

Importance of Transient Immunity

Comprehensive physical and electrical isolation combined with asynchronous processors and software voting ensures the Triguard SC300E is immune to transient errors.

Smallest Footprint Size

The Triguard SC300E TMR offers our customers the best utilisation of available space. ABB have developed "plug and play" cabinet layout configurations that offer pre-designed hardware for system applications.

Plug and socketed system cables make marshalling and termination interconnection quick and easy to implement.

Product Hardware and Software Description

The ABB Triguard SC300E TMR product has a fully triplicated system architecture from input module to output module. Each system comprises one or more identical chassis housing the power supplies, processors, I/O and communications modules as required by the application.

Each processor correlates and corrects its memory image of the current state of the system using a software vote, logging any discrepancies in the diagnostic table. Each processor then executes its programmed application logic and sets its respective outputs to the required state.

of the customer application. Extension chassis are always complete with two power supply units and three bus extender modules.

- **A Remote Master Chassis**
Always equipped with two power supply units and three fibre optic

TRIGUARD SC300E

A single system may be as small as one chassis or as large as 15, giving a maximum of 9,500 I/O.

The system is designed to achieve the highest possible reliability, safety and availability and still provide economic advantage. System availabilities in excess of 99.999% can readily be realised, maximising the potential uptime for a customers process plant.

All SC300E input and output modules interface to three isolated I/O communication buses, each being controlled by one of the three processor modules.

Field input signals are filtered and split, via isolating circuits on the input modules, into three identical signal processing paths. Each path is controlled by a micro-controller to co-ordinate processing, testing and status reporting to the respective processor.

Each processor communicates with its two neighbours via isolated, read only, high speed links to synchronise input, output and diagnostic status information at least once every scan.

Commanded output status from the processors are received by an output module which, using a 2oo3 hardware voter, sets the outputs to the field. Any discrepancy is detected by the micro-controllers and reported to the processors.

All input and output modules can be optionally configured with a hot spare partner module. This allows repairs to be carried out without affecting the operation of the system.

Triguard SC300E Chassis System

There are four basic types of chassis, all using the same mechanics, each providing 10 slot positions for I/O modules and redundant power supplies.

- **The Main Chassis**
One per system is required and is always complete with two power supply units, three processor modules, the chassis backplane with triple bus systems and plug/socket system module connectors.

- **An Extension Chassis**
Up to 14 chassis can be connected to a main chassis to suit the capacity

master bus extender modules. The master chassis can service up to four remote chassis.

- **A Remote Chassis**
Always equipped with two power supply units and three fibre optic slave bus extender modules. A remote chassis can be sited up to 2km away from a remote master.
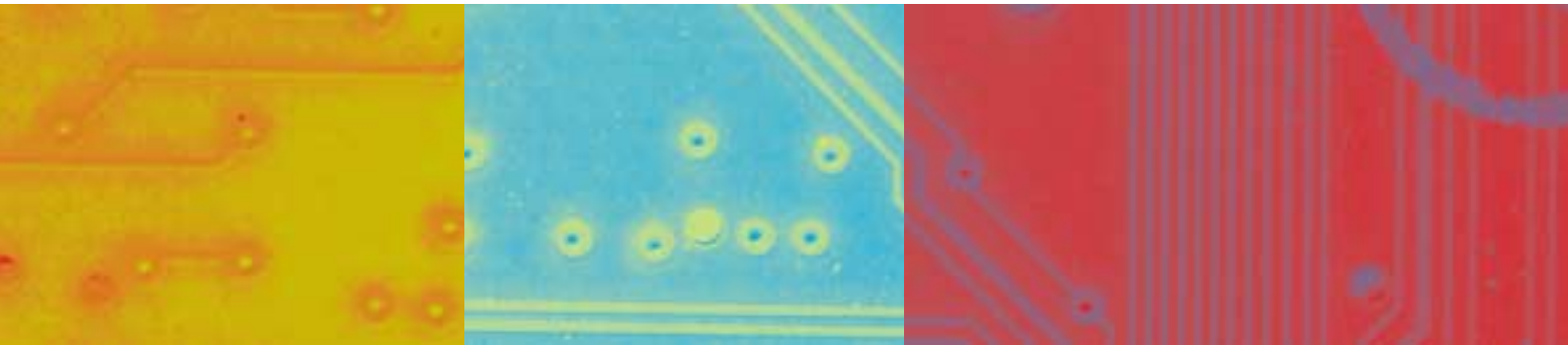
Processor

Each Triguard SC300E TMR system contains three processors. Each processor operates asynchronously in parallel with the other two processor modules and receives power from the redundant power supply units in the main chassis. A triplicated bus system on the chassis backplane connects

Key features of the processor modules:
• Intel processor
• Battery backed static RAM for application logic
• RAM Battery backup supply for six months
• 1 Mbyte of EPROM
• Real time clock for data logging to 10ms resolution

Processor Module

each of the three processors to the I/O and communications modules.

The Triguard SC300E has an operating system known as the Real Time Task Supervisor (RTTS), which is installed in each of the three processors. The operating system has been proven by well over 10 million operational hours. RTTS is transparent to the user, it controls the off-line/start-up and on-line continuous diagnostic and voting functions, and provides a single environment for the application programming.

On power up, comprehensive diagnostic routines check and validate the correct operating parameters of each processor.

The Triguard SC300E operating system, RTTS, will permit the processors to operate in a 3–2–1 format allowing a system to continue to function with one healthy processor. A replaced processor will automatically acquire the data it requires to become operational from the on-line processor before going on-line.

Input/Output Modules

All I/O module types share an element of common design, providing component rationalisation and implementing distributed processing.

The three isolated TMR signal paths of all input/output modules are supervised by a micro-controllers which:

• Provides fault isolation
• Co-ordinate signal processing
• Provides diagnostics
• Provides on-line to off-line switching (hot repair)
• Provides data validation routines
• Provides data to the processor
• Provides latent fault detection

A fault in one signal path cannot be passed to another. I/O modules can be fitted in any of the 10 slots in any chassis. "Hot Repair" is a customer configurable option on a per module basis. All modules are "keyed" to prevent improper installation.

Triguard SC300E Chassis System plus cables and Termination Modules

Product Hardware and Software Description

Digital Input Modules

The types of digital input modules available are:

- 32 channel isolated 24Vdc\120Vdc\120Vac TMR
- 64 channel isolated 24Vdc Simplex

All TMR digital input modules are

Digital Output Modules

The types of digital output modules available are:

- 32 channel – supervised 24Vdc TMR*
- 16 channel – supervised 120Vdc\120Vac TMR*

All TMR digital output modules are equipped with:

- Line monitoring circuits to confirm energised field loop integrity
- Six element voting circuits for maximum safety and availability
- Automatic latent fault testing and diagnostics with 100% coverage (TMR)

TRIGUARD SC300E

100% triplicated to provide maximum availability.

Each signal path conditions signals independently and provides full optical isolation between the field and the SC300E. A fault on one signal path cannot propagate to another. Automatic latent fault testing will detect "stuck on" states.

Line monitored inputs can be implemented using analogue input modules with line monitor termination cards.
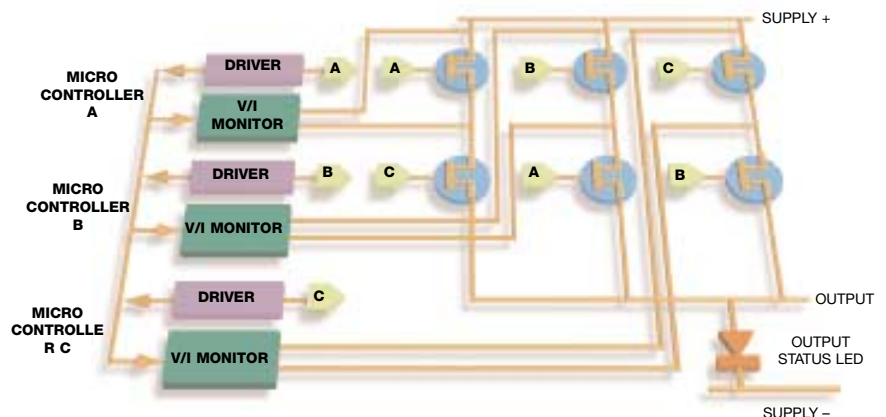
Typical Digital Output Circuit
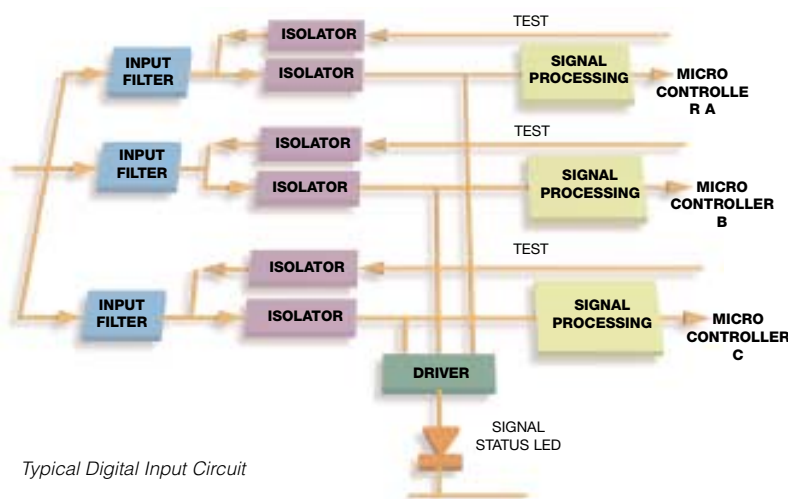
Typical Digital Input Circuit

Each of the three micro-controllers operate two isolated switches per channel which together form a six element voting network.

* Line monitoring of de-energised field loops may be achieved using alternative termination cards.

The output voting, testing, feedback and diagnostics are co-ordinated by the Triguard SC300E operating system. All modules provide 2oo3 voted outputs.

Selective redundancy operating in 3–2–1 or 3–2–0 modes is available, with selectable fall back to fail safe or retain last value states.

Thermocouple Inputs

Thermocouple and resistance thermometer inputs are provided by the use of third party transmitters or converters mounted in the field or within the marshalling cabinets. Inputs from these devices are then handled by the standard TMR analogue input modules.
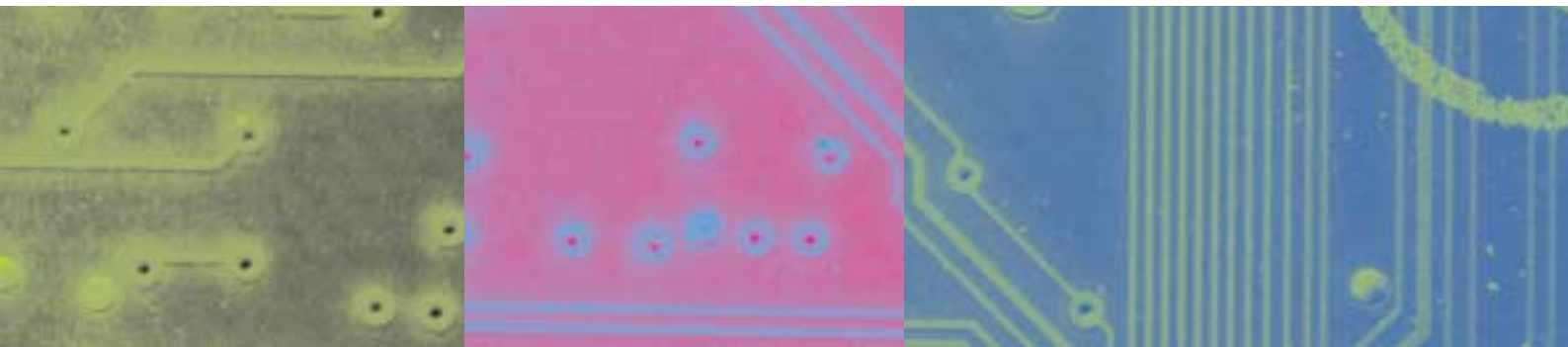
Analogue Input Modules

The types of analogue input modules available are:

• 32 channel isolated 0 to 5Vdc and 0 to 10Vdc TMR
(0 to 40mA and 0/4 to 20mA with burden resistor at the termination card)

Each analogue input signal path contains three identical circuits of:

• Isolation
• Noise Filtering
• Multiplexing
• Amplification
• Analogue to digital conversion

and each of the three circuits is supervised by a micro-controller.

The three circuits synchronously measure the input signals, vote the data and transmit the data to the processors.

The processors condition the input signal data, making any necessary corrections, and then select the mid-value from the three sets of input data. This mid-value is then used by the control program.
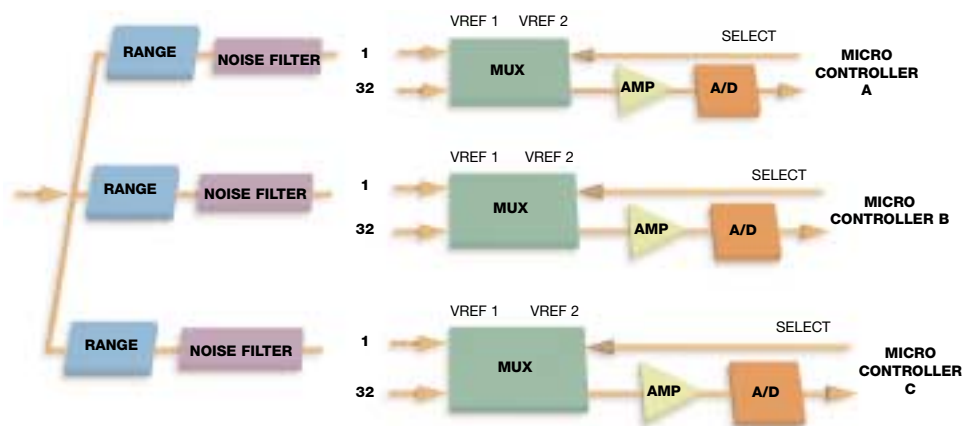
Typical Analogue Input Circuit

# Product Hardware and Software Description

Analogue Output Modules

• 4 channel – 12 bit resolution
  4–20mA TMR

Each of the three Triguard SC300E processors sends voted output voltage data to the analogue output modules. The commands are received via the bus system by the three micro-controllers on each module.

Each micro-controller controls a digital to analogue converter which drives two elements of the six element output voting network. Each element of the six element voter is an isolated field effect transistor operated within its linear range. The final output of the field device is selected as the mid-value from the three circuits of output data.

Feedback to each of the three micro-controllers provides continuous checking for correctness. Diagnostics declare any fault to the processors for maintenance information and action.
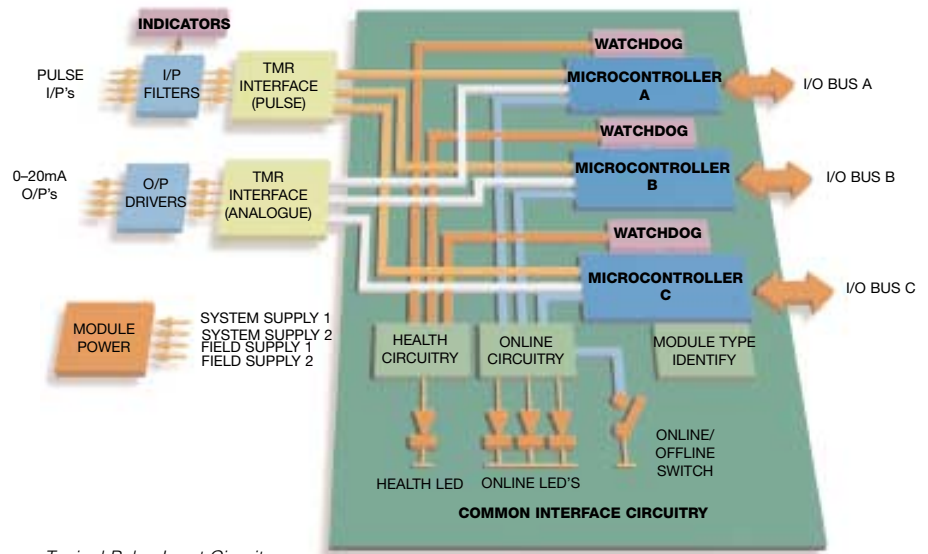
TRIGUARD SC300E
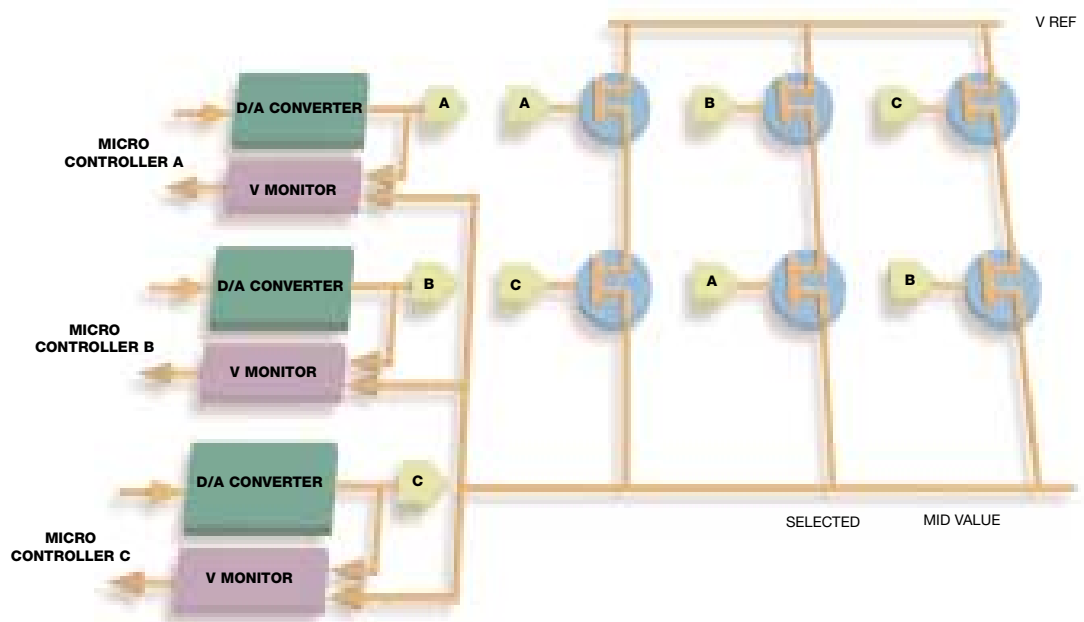
Typical Analogue Output Circuit

Pulse Input Analogue Output Module (PIANO)

• 8 channel, 4 pulse input, 4 analogue output TMR

The PIANO module contains fully triplicated circuits. Each pulse input path receives input pulses, a value equivalent to the number of teeth on

Typical Pulse Input Circuit

a gear wheel for example, and accumulates this data to an accuracy of +_0.01% over 20Hz to 20KHz.

Output values to 12 bit resolution can provide voted and validated data to field devices for control (see analogue output module for output circuit operation).

Serial Communication Module

Communications Module

A four channel serial communications module is always fitted to a Triguard SC300E TMR system to allow communications to the engineering workstation and is installed in I/O slot number 10 of the main chassis. All four channels operate RS232\423 up to 19.2 kbits/sec and all four communication ports are fully isolated.

The four channel communications module is directly addressed by the three Triguard SC300E processors and contains a micro-computer that controls the four programmable multi-protocol ports. Data received from the three processors is voted 2oo3 providing correct data for onward transmission.

High speed network connectivity feature (to be released)

Triguard may be interfaced to standard communications networks such as Ethernet/TCP/IP using approved gateway products.

DCS connectivity includes:
• Yokogawa Electric, Elsag-Bailey, Fisher Rosemount, ABB, Honeywell and Foxboro

Product Hardware and Software Description

Hot Repair Facility

A quick repair procedure, once any fault is revealed, is important in the total fault tolerant product strategy.

The hot repair facility achieves a quick and easy repair by the user and this is

All I/O modules can be programmed for a hot repair facility. A wrong or faulty module in an allocated hot repair I/O slot will not be accepted. Hot repair slots are selected to be next to the system I/O resident module.

Field Termination Cards

The types of termination cards available:

- 16 channel – digital input
- 32 channel – digital input
- 16 channel – digital output

TRIGUARD SC300E

done bumplessly without interrupting the normal operation of the system and process.

The operating system, RTTS, routinely executes a hot repair task, checking and validating that all configuration data is correct, eg. correct I/O module, on-line/off-line hot repair functions.

There are three ways to replace an on-line I/O module:

- Module with no additional hot repair slot – single slot hot repair
- Module has an unpopulated hot repair partner slot – manual hot repair
- Module with a populated hot repair partner slot – hot repair

- 16 channel – analogue input
- 4 channel – analogue output
- 16 channel – digital output with line monitoring
- 4 channel – pulse input

DIN rail mounted termination cards for field wiring can be supplied as an easy to fit method to route field cables to the Triguard SC300E system I/O modules, and distribute field wetting current to each I/O point.

A termination card has an associated system cable fitted with DIN connectors to provide the plug and socket arrangement. Cable lengths can be specified to suit the application.

Alternative cables with Elco connectors or free wires at the field end are available for third party marshalling systems.

Power and fusing for the field circuits are standard. Options are available to suit all field configurations.
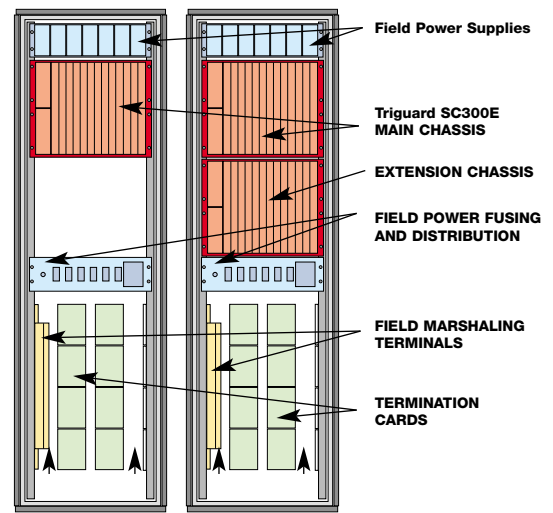
System cables from the Triguard SC300E are also available with free wire ends so that the system may connect to a separate cable marshalling and power/fusing system.

Typical Triguard SC300E Cabinet Layouts

Field Power Supplies

Triguard SC300E
MAIN CHASSIS

EXTENSION CHASSIS

FIELD POWER FUSING
AND DISTRIBUTION

FIELD MARSHALING
TERMINALS

TERMINATION
CARDS

Cabinet Layouts

Optional cabinets to house the Triguard SC300E TMR control system are industry standard 19" rack mounted configurations with a width of 600mm and a depth of 800mm. The layouts shown are based on a standard

A fully distributed safety system, using the Triguard SC300E, can be configured by utilising a Safeway 8000 bus structure and the Triguard peer to peer safety approved protocol.
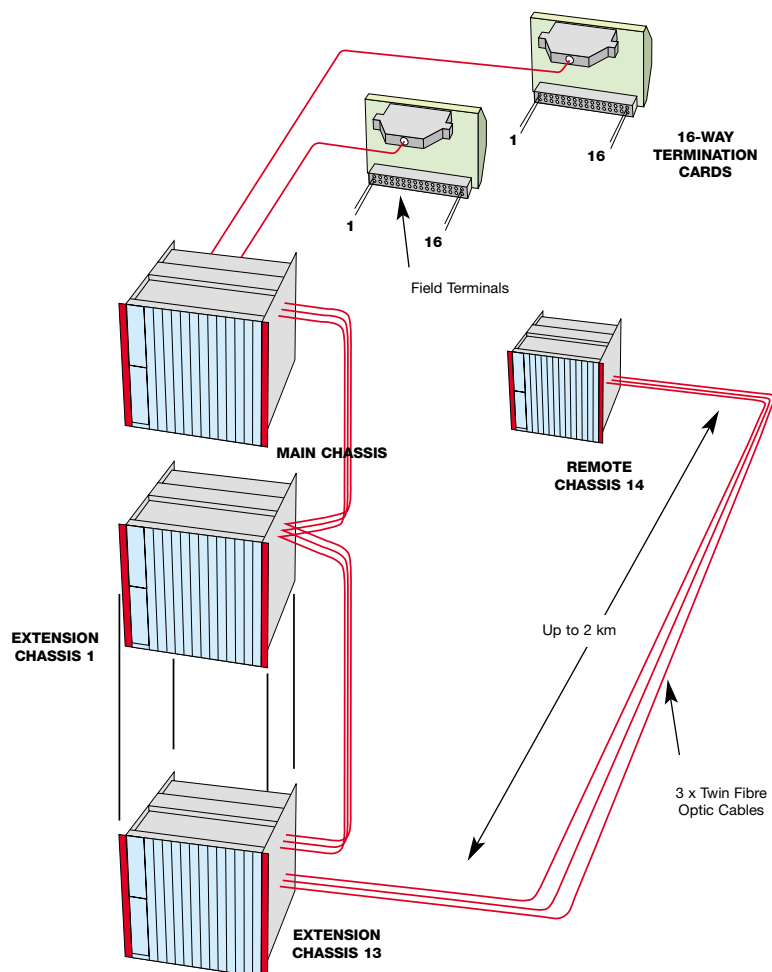
2000mm high cabinets, and provide front and rear access. Front access only configurations are available.

System Structure

A major benefit of the Triguard SC300E system is that it can be as small as one chassis or as large as 15, giving a 9,500 total I/O capacity. The TMR bus extender modules and cable sets are used to size the system to suit the application. Interfacing to remote TMR I/O chassis or gateway modules to connect to DCS networks, can be provided to suit a combined distributed safety and control strategy.

A customer who has a future requirement to add to an existing system will find the Triguard SC300E easy and economical to extend.

Forward and backward compatibility means that users can readily intermix CS300 and Triguard SC300E systems using the same programming tools. Application logic written for a CS300 system will run with minimum modification on the Triguard SC300E.

16-WAY
TERMINATION
CARDS

Field Terminals

MAIN CHASSIS

EXTENSION
CHASSIS 1

EXTENSION
CHASSIS 13

REMOTE
CHASSIS 14

Up to 2 km

3 x Twin Fibre
Optic Cables

Triguard SC300E System Architecture

Software

The Triguard SC300E supports three main application software packages, all are Windows compatible:

- **TriBuild™** for developing and programming application logic
- **TriCommand™** a display and control system workstation (WONDERWARE©)
- **TriLog™** simple PC based alarm/event logger

The TriBuild Workstation is connected to a Triguard SC300E TMR system via the communications module.

TriBuild provides on and off-line configuration, programming, documentation and testing functions. Programming uses both conventional ladder logic displays, function block programming and structured networks.

TriBuild™ software provides:

- A comprehensive library of programming elements, eg logic, arithmetic, data conversion, timers, counters, block elements, bit shift, comparators, mid value select, NooM voting blocks
- An environment for users to develop special functions, function blocks, custom programs for

TRIGUARD SC300E

TriBuild™

TriBuild is an easy to use, menu driven, software package running under Windows NT™. It is used for the creation of system application logic of the Triguard SC300E control system.

Key features of TriBuild:

- *System Configurator* – easy guide for system build
- *Ladder Annotator* – adds notes to the ladder logic
- *Network Editor* – on-line/off-line editing of logic functions
- *On-Line Help* – reduces need to refer to printed manual
- *Ladder Simulator* – allows testing during program development
- *Built-In Compiler* – for high level user functions
- *Password Protection* – selective access and protection
- *Function Block Programming* – using IEC 1131 standard function as applicable to safety

These can be developed quickly and effectively with the assistance of search and replace, cut and paste and a standard library of logic symbols and programming functions. Completed control programs can be loaded into a Triguard SC300E system and the execution of the control program can be monitored on-line with the TriBuild workstation.

advanced fault tolerant control applications

- Application specific control functions, eg auto-test routines, gas detection calibration tables, advanced control
- System interrogation
- Control and user changes with date and time
- Off-line configuration, simulation and applications testing of the control programs
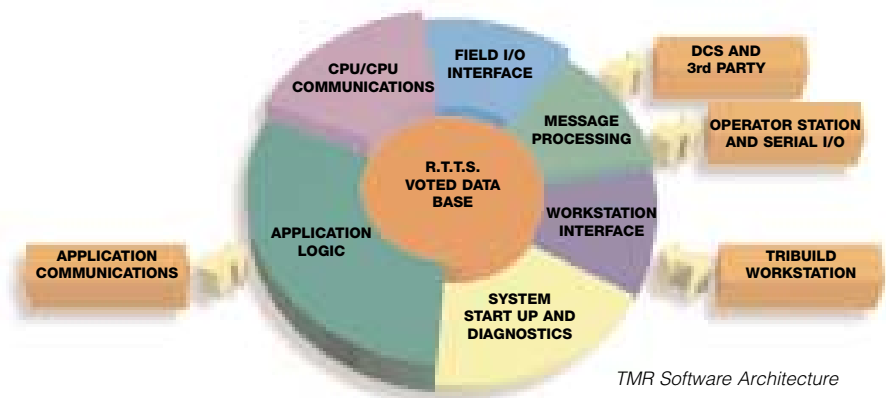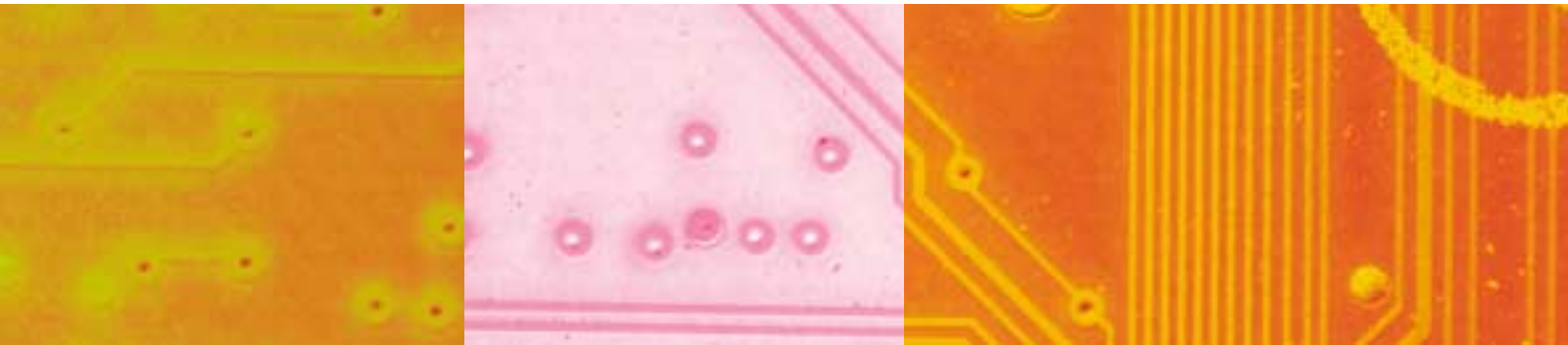

TMR Software Architecture

TriBuild provides a secure environment to make program changes on-line and without interrupting the normal process operations.

TriCommand™

TriCommand is a PC-based operator workstation, utilising Wonderware's InTouch™ products. TriCommand

TRIBUILD Windows Workstation

provides real time system control and monitoring facilities. It can operate as part of a Triguard SC300E system in a single station configuration or as multiple TriCommand stations for distributed applications. TriCommand workstations can be connected to a Triguard SC300E system via peer to peer, single, or dual serial communication links, networked via single or dual redundant LANs.

TriCommand is Windows NT™ compliant. Standard off-the-shelf hardware makes customer ownership and support easy to achieve. TriCommand workstations may be installed in the control room for operator display and control or at a remote location where there may be a need for local information and control.

TriCommand allows a user to start small and expand into an integrated environment providing a single seamless network. Expansion is simple and cost effective.

Key features of TriCommand:
- A real time database of up to 32,000 points that can be mapped to field or virtual I/O points
- Dynamic Data Exchange (DDE) allowing TriCommand to pass data to other Windows applications, eg Excel™
- Supports a comprehensive range of industry standard protocols, such as TCP/IP via the DDE server library
- Can display an almost unlimited number of mimic pages
- Extensive alarm handling capabilities, including accept, reset, cross functions (for multiple systems), zone hierarchy, first out, status, prioritising, displays, summaries
- Data logging, data archiving, data trending
- Event status, event history, event display, event printing
- Fault diagnostics – communication, systems
- Advanced control – digital, analogue
- Multi-level security access

The Graphical User Interface for operators, engineers and managers is a multiple Windows display on a single screen. Displays can however be locked on full screen making the Windows feature unavailable.

Operators can choose different means of navigating and interacting with the system, from full keyboard to a restricted pushbutton selection pad. Engineers can develop graphical displays using a powerful display builder which can be tailored to the needs of the process operation.

TriLog™

TriLog is a message logger, it is designed to monitor up to four Triguard SC300E systems accepting and storing sequence of event and alarm messages from each system. It uses a dedicated PC with Windows NT™ compliance. Windows are allocated to display time and date together with current and archived information from each system.

International Standards

Quality

ABB quality system meets International Standards and is certified to the requirements of BS EN ISO 9001 1994, Certificate Number FM 1353 for safety systems and products. The certification for Quality Assurance at ABB, covers all aspects of design, manufacturing, testing, software verification, software validation and service activities.

TRIGUARD SC300E

Third Party Certification

With the ever increasing demand for independent international certification and end user specific approvals, ABB's products meet the requirements outlined in the standards and guide lines as follows:

TUV Rheinland/Berlin Brandenburg (and Product Services)
    Safety Related Applications –
    Requirement Class 5 and 6/VDE 0801
    Suitable up to Safety Integrity
    Level 3 (SIL 3)/IEC61508
    see http://www.tuvasi.com

European Union CE Mark
    Low voltage directive
    EMC directive

USA/Canada
    UL/C Industrial Control Equipment

GOST
    Russian guidelines for safety
    related systems

IEC 61508
    Functional safety requirements to
    Safety Integrity Levels 1 to 3

NFPA 72
    8501 and 8502

    EN54

Increased awareness of safety integral design has been brought about by the introduction of international legislation IEC 61508. These standards require formal assessment of hazards to take place and the use of certified systems for all hazardous processes.

Comprehensive product testing is performed at board and system levels including temperature and power cycling to eliminate infant mortality failures.

Rigorous control of any hardware or software change is maintained and internal and external audits are performed at regular intervals to ensure the highest quality of product prior to shipment.

Product pre-delivery quality assurance includes a 100% test to ensure product quality to the customer on delivery.
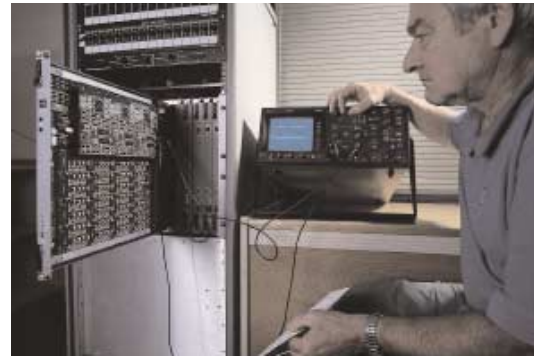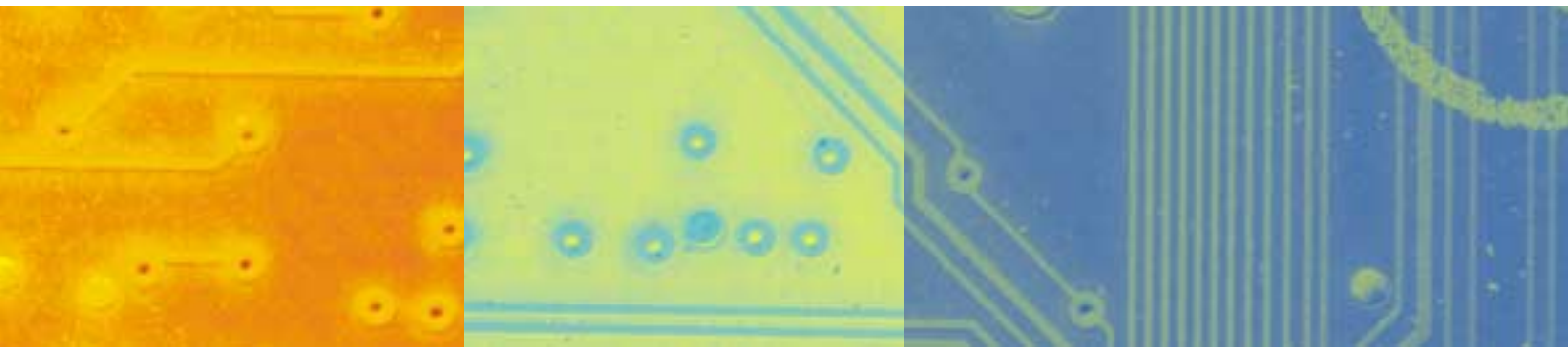
Global Support

Support services can be obtained from any of the ABB Worldwide Business and Engineering Centres. The resources and expertise within the company can be channelled into any region as required to suit a particular customer demand. Each region can support the following range of services:

Product Test Facility

Product Technical Support

ABB operates a worldwide product technical support service for all OEM's and System Integrators. Additionally, where required, ABB can provide installation supervision, commissioning and site acceptance testing.

Consultancy and Application

Engineering consultancy services are designed to provide assistance with the assessment of reliability and availability applied to the use and application of TMR Systems. Suppliers of systems are frequently requested to provide:

- Markov modelling
- Fault tree analysis
- Failure mode effects and criticality analysis
- Reliability/availability calculations
- Life cycle cost analysis
- Functional design specifications
- Engineering assessments

Application engineering support and assistance is available pre-sales and post-sales, and includes advice on:

- Correct hardware configuration
- Communications and interfacing
- Programming

- Software/firmware upgrades
- Remote diagnostics and problem solving
- Maintenance and operations

Spares and Repairs

All regions carry a quantity of product inventory to support the installed base. Each region has sufficient Triguard SC300E equipment to perform customer demonstrations, hardware and software application testing, and first line troubleshooting for any product problem solving.

Spares and repairs policies can be recommended to provide customers with the support necessary to maximise the performance of their TMR system, minimising life-cycle cost.

Recommendations may include:

- All spares held by the customers
- Minimum spares held by customer, guaranteed replacement times from ABB
- Planned maintenance contracts
- Total support contracts by ABB
- Emergency callouts

Product Training

Comprehensive training facilities and training courses are available and can cover every aspect of the maintenance and application of TMR technology.

Courses are available for:

- OEM/Integrator Configurations
- Project Design Engineers
- Plant Technicians/Maintenance Engineering
- Operations Personnel
- Management Teams

Training Facility

Product Summary

Description	Model
SC300E MAIN Chassis, complete with 3 processors and 2 PSUs	
SC300E main chassis, 110/240Vac	CXP 10A 11
SC300E main chassis, 24Vdc	CXP 10D 24
SC300E Extension I/O Chassis, complete with 3 bus extender modules and 2 PSUs	
SC300E extension chassis – 110/240Vac	CXB 10A 11
SC300E extension chassis, 24Vdc	CXB 10D 24

TRIGUARD SC300E

Description	Model
SC300E Remote I/O Chassis, complete with 3 fibre optic bus extender modules and 2 PSUs	
SC300E master remote I/O chassis, 110/240Vac	CXM 10A 11
SC300E master remote I/O chassis, 24Vdc	CXM 10D 24
SC300E slave remote I/O chassis, 110/240Vac	CXS 10A 11
SC300E slave remote I/O chassis, 24Vdc	CXS 10D 24
SC300E Input/Output Modules	
Serial communications module, 4 port, RS232	MSR 04 XI
32 channel digital input module, 24Vdc	MDI 32 BIS
32 channel digital input module, 120Vac/dc	MDI 32 FIS
32 channel digital input module, line monitored, 24Vdc	MDI 32 SNL
64 channel digital input module, simplex, 24Vdc	MDI 64 BNS
32 channel digital output module, line monitored, 24Vdc	MDO 32 BNS
16 channel digital output module, line monitored, 120Vac/dc	MDO 16 FNS
32 channel analogue input module, isolated, 0/5Vdc	MAI 32 LAD
32 channel analogue input module, isolated, 0/10Vdc	MAI 32 MAD
4 channel analogue output module, non isolated, 4/20mA	MAO 04 NND
4 Channel pulse input/4 channel analogue output module (PIANO), 4/20mA	MHB 44 IND
64 channel display driver, motherboard (single/dual)	TM117–DMxM/B
64 channel display driver, daughterboard (single)	TM117–DMxD/B
Hot repair adaptor (set of two)	THR
Blanking plate	ML

General Product Specifications

Overall Sizes

All Chassis Types	19" Rack Mounted x 398mm height x 474mm depth
All I/O Module Types	365.8mm high x 28mm width x 394mm depth
All Termination Cards Types	DIN Rail mounted 162mm high x 110mm width x 56mm depth
All Power Supply Types	198mm high x 67mm width x 417mm depth

Approximate Weights

Main Chassis with two PSU's and three Processors	16.8kg	(37.0lb)
Extension/Remote Chassis with two PSU's and Three Extender Modules	17.1kg	(37.7lb)
Power Supply Module	2.3kg	(5.1lb)
Processor Module	1.4kg	(3.1lb)
I/O Module	1.6kg	(3.5lb)
Communication Module	1.1kg	(2.4lb)
Termination Cards	310gm	(0.7lb)
Fully Populated Chassis	32.3kg	(71.2lb)

Fabrication and Paint Finish

Aluminium Chassis with Dusty Grey, Front Panel Finish (RAL 7037)

Environment Specifications

Operating Temperature	0–60˚C
Storage Temperature with Battery	–30˚C to +75˚C
Relative Humidity	5 to 95% Non-Condensing
Vibration	1g at 5 to 500 Hz Sinusoidal
Shock	20G for 12ms
Electro-static Discharge	8kV (IEC 801-4, level 3)

EMC

Immunity	EN50082-2
Emissions	EN50081-2

Power Supply Modules

Nominal Input Voltage	24Vdc	120/240Vac
Input Voltage Range	20-36Vdc	92-132V & 192-276Vac
Input Power	200W Max	235W Max
Output Power	150W Max	175W Max
Outputs	5.35V, 12Vdc	5.35V, 12Vdc
Output Hold Up Time	20ms	20ms
Fuse Ratings	10A	5A
Isolation	2500Vdc	3750Vac
Output Current	23A, 4A	23A, 4A

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