HollySys

HollySys

INTRODUCTION TO HIAGUARD SAFETY INSTRUMENTED SYSTEM

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For Excellence**

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Profile

Founded in 1993, HollySys is a leading supplier of intelligence solutions with more than 4,700 employees and operates in both China and abroad. HollySys is headquartered in Beijing with R&D, production, and service bases in Beijing, Hangzhou, Xi'an, Singapore, and local branches in major cities in China, as well as offices in India, Malaysia and Indonesia, establishing a comprehensive service network across the world.

HollySys business consists of industrial intelligence, transportation intelligence, and food and pharmaceutical intelligence, covering the main industries for the national economy and the people's livelihood. With years of technological accumulation in various fields and continuous capacity building, we can provide customers with customized integrated solutions, stable and reliable products, and full lifecycle services, helping them improve market competitiveness. Over the past three decades, we have served more than 35,000 clients, successfully completed more than 45,000 projects, and gained more than 1,000 new clients each year, making HollySys a world-renowned brand in automation and intelligence filed.

The HOLLiAS industrial control platform of HollySys features a series of advanced, practical and reliable industrial automation systems and HollySys automation instrumentations products. The system products include MACS-K, MACS-S industrial control system DCS, professional control systems such as DEH, ETS and SIS, and whole-process information-based software for manufacturing enterprises. Instrumentation products include isolated safety barriers, signal isolators, surge protectors, power transmitters, pressure transmitters, electromagnetic flowmeters, metal tube float meters, magnetic level gauges, radar level gauges, throttling elements, thermal elements, and pressure gauges.

The company's products have been successfully applied to major projects and key equipment, including 1000MW ultra-supercritical thermal power units, 1.2 million tons of urea and 5 million tons of oil refining main units, earning a good reputation in the industry.

Specializing in HollySys Instrumentation and control system engineering and integration, the company can provide both new and brown field projects of enterprises with HollySys proprietary products, as well as comprehensive engineering services such as customized design and construction & commissioning.

HollySys has always pursued continuous innovation and R&D while sticking to its vision "create the most valuable intelligent company through stable and sustainable development" to provide more reliable, secure, and intelligent technology and products for our customers.

Contents

System Overview

HiaGuard system is a safety instrumented system developed by HollySys Group for the field of industrial automation safety, the first safety instrumented system with all intellectual property rights in China, and was certified by TÜV (Rheinland Industrie Service GmbH) in 2012. HiaGuard is a programmable electronic system (PES) as defined by IEC 61508, which meet the SC3 (system capability level) and SIL3 (hardware safety integrity level) as defined by IEC 61508, and is applicable to safety-related applications in low operating modes up to SIL3 as defined by IEC 61508.

The HiaGuard system uses a 2 out of 3 architecture with diagnostics (2oo3D) , and is applicable to the systems as shown in figure 1:
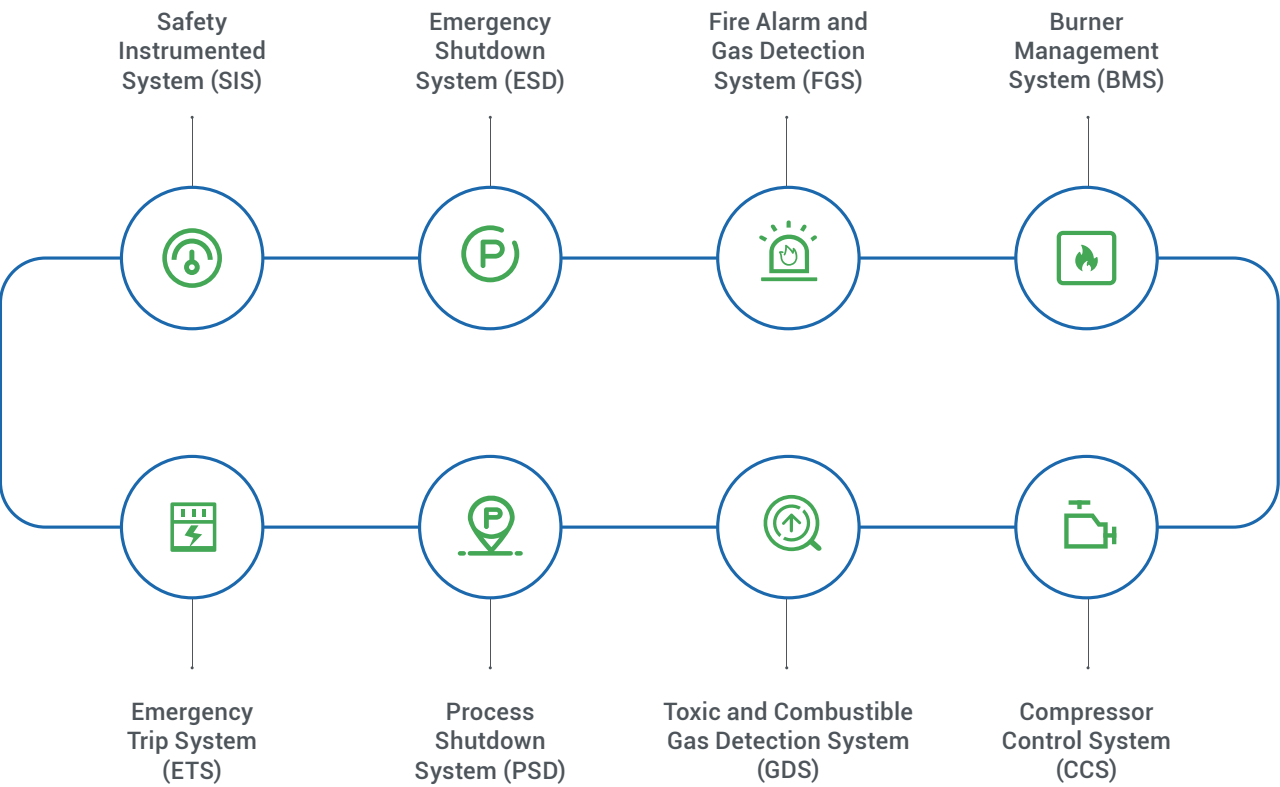
Safety Instrumented System (SIS)

Emergency Shutdown System (ESD)

Fire Alarm and Gas Detection System (FGS)

Burner Management System (BMS)

Emergency Trip System (ETS)

Process Shutdown System (PSD)

Toxic and Combustible Gas Detection System (GDS)

Compressor Control System (CCS)

Figure 1

⮕ System Architecture

HiaGuard system is a system based on the triple modular redundancy fault tolerate (TMR) safety control technology, which is applicable to various complex and dangerous production processes, and is used to perform real-time control, receive from field, implement logical operations, output for control, and drive field execution units.

The HiaGuard system consists of an engineering station and a safety control station.

· In the engineering station, the configuration software Safe-AT is a T3 tool certified by IEC 61508 SC3

· The control station consists of controller module, I/O module and its terminal board, network communication module, etc. that meet the requirements of IEC 61508 SIL3. System racks are divided into Main rack and extension/remote rack, which are connected through trunk/optical fiber. Field instruments are connected to I/O modules through terminal boards and DB cables
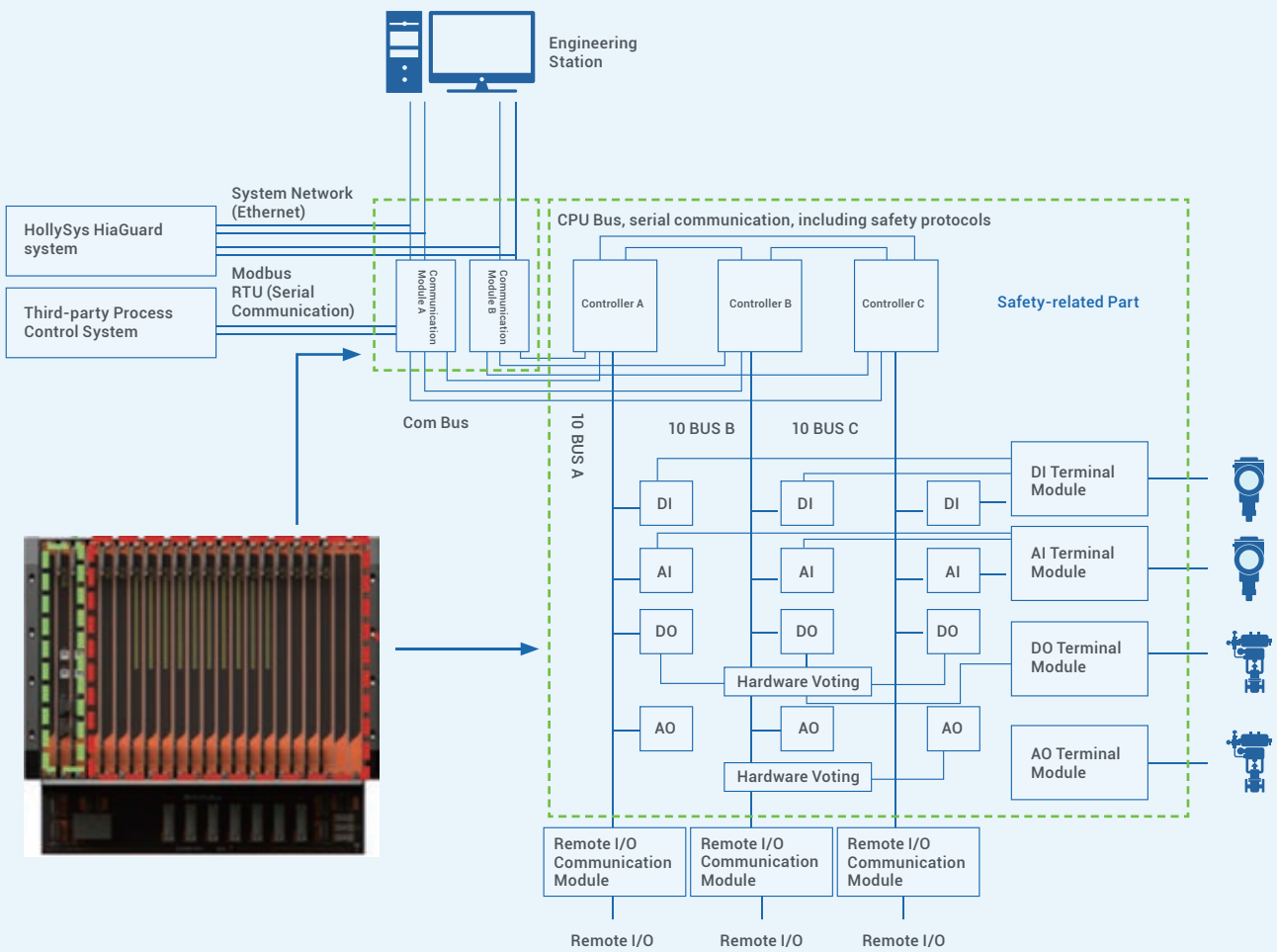
The HiaGuard system structure, including the input module, controller and output module, is completely triple-modular. The triple-modular controller is configured by three independent controller modules running synchronously. Each I/O module is configured with triple-modular I/O channels, is configured independently to meet the requirements of IEC 61508 SIL3, and can be redundantly configured to improve the availability. Safety communication protocol is used to exchange data between triple-modular controllers, and between the controller of each system and the I/O module of this system, so that the safety loop meets the requirements of IEC 61508 SIL3. Many fault diagnosis measures and proper fault handling measures are taken in the controller and each I/O module of the HiaGuard system through software and hardware to ensure safety integrity level of the system. Independent 1+1 system power supply and field power supply, input/output module and communication module support redundant configuration, which improves availability of the system.
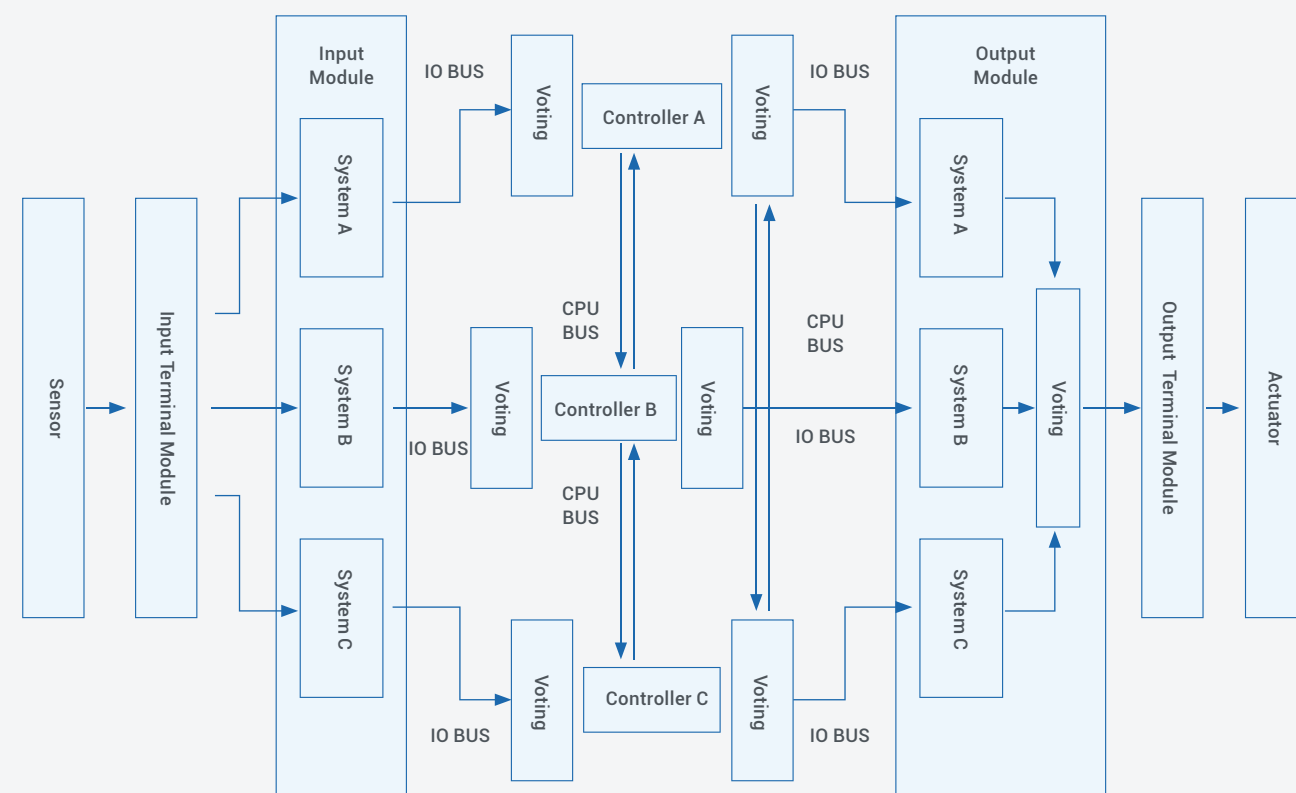
▶ System Characteristics

High Safety

· 2 out of 3 with diagnostics(2oo3D), which ensures system safety
· Data stream multi-voting
· Triple-modular design, which ensures relative independence physically to avoid common causes
· High diagnostic coverage
· Built-in firewall in communication module

High Availability

· Degraded operation is allowed, with a degraded mode of 3-2-0
· Independent power is supplied at system side and field side
· 1+1 redundant power supply
· Communication module and I/O module support redundant configuration and undisturbed switching
· System availability is up to 99.999%

Powerful SOE Function

· DI module has hard SOE function
· DI module can cache 1000 SOE records
· Control station can store 10,000 SOE records
· SOE accuracy is up to 1 ms

High Diagnostic Coverage

· Fault diagnosis can be located at the channel level
· AI channel supports over-limit, break and short diagnosis
· DI channel supports external cable grounding, disconnection and short diagnosis
· DO channel supports on-site no-load, overload and short diagnosis
· PI channel supports disconnection diagnosis and over-lower limit diagnosis

Optimal System Integration

· Integration with the HOLLiAS-MACS system;
· Support integration with third-party DCS through Modbus interface.
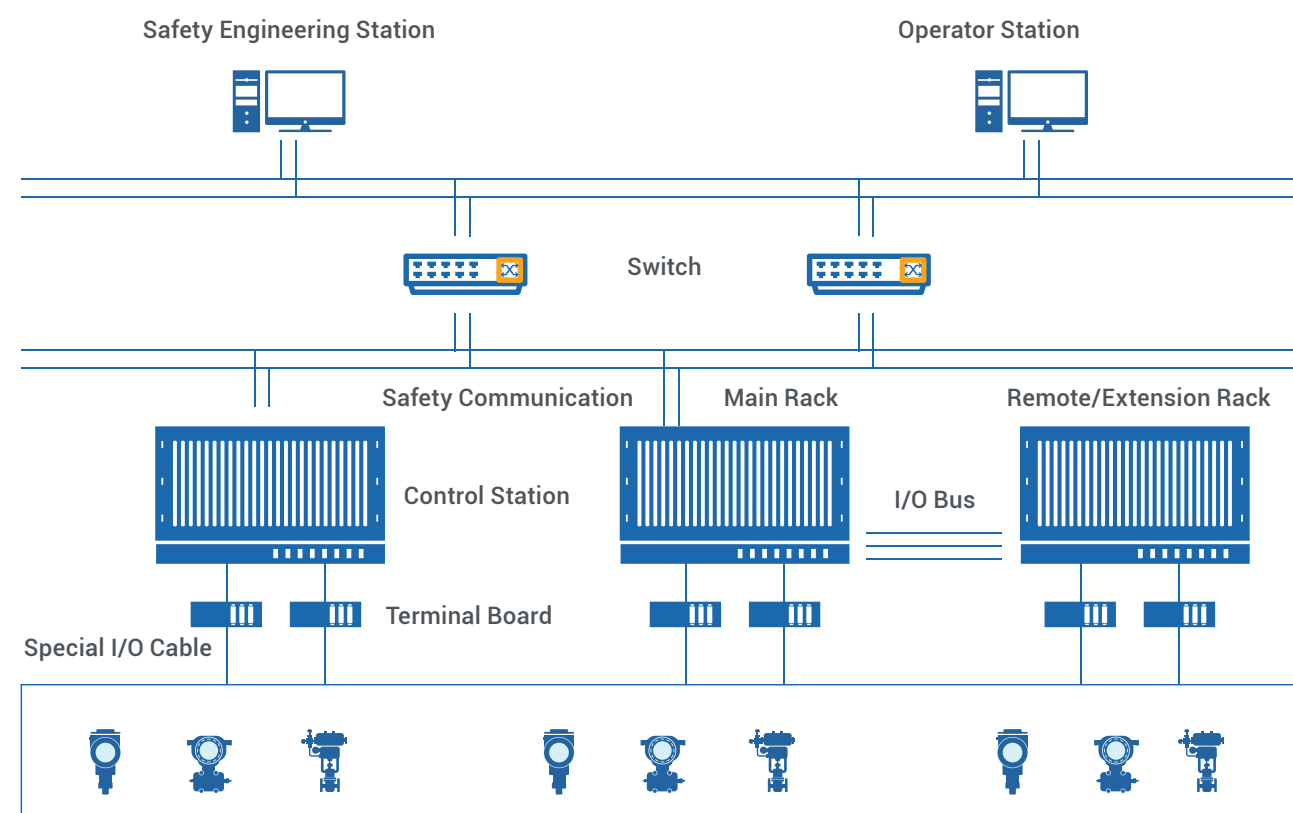
Extendable System Scale

· A single station supports a maximum of 1 Main rack + 6 extension racks, with up to 1856 I/O points
· A single domain supports up to 64 stations and 15 domains

System Network Structure

The HiaGuard system is mainly composed of components such as engineering station, operator station, history station and control station, and is a part of the system network and control network. Nodes of the control network consist of control stations and I/O modules. The HiaGuard system supports 15 domains, each domain supports 64 control stations, a single station supports up to 1856 I/O points, and the Main rack can support 224 I/O points.

Safety Engineering Station　　　　**Operator Station**

Switch

Safety Communication　　Main Rack　　Remote/Extension Rack

Control Station　　I/O Bus

Terminal Board

Special I/O Cable

Specific Functions

Receive and respond to operation commands from the engineering station	Send data to the system control station	Upload monitoring data to the engineering station
Receive synchronization information from NTP server, history station or other control stations in the same domain	Upload monitoring data to the operator station	Receive and send safety communication data between control stations

⇨ System Network (SNET)

The system network (SNET) is a 100BASE-TX Ethernet with a communication rate of 100 Mbps. The communication module provides standard RJ45 system network interface with redundant configuration. The redundant system networks are system network A (SNET A) and system network B (SNET B) respectively, which are used for bidirectional data transmission between the operator station/engineering station and the communication module, as well as for the safety communication between control stations.
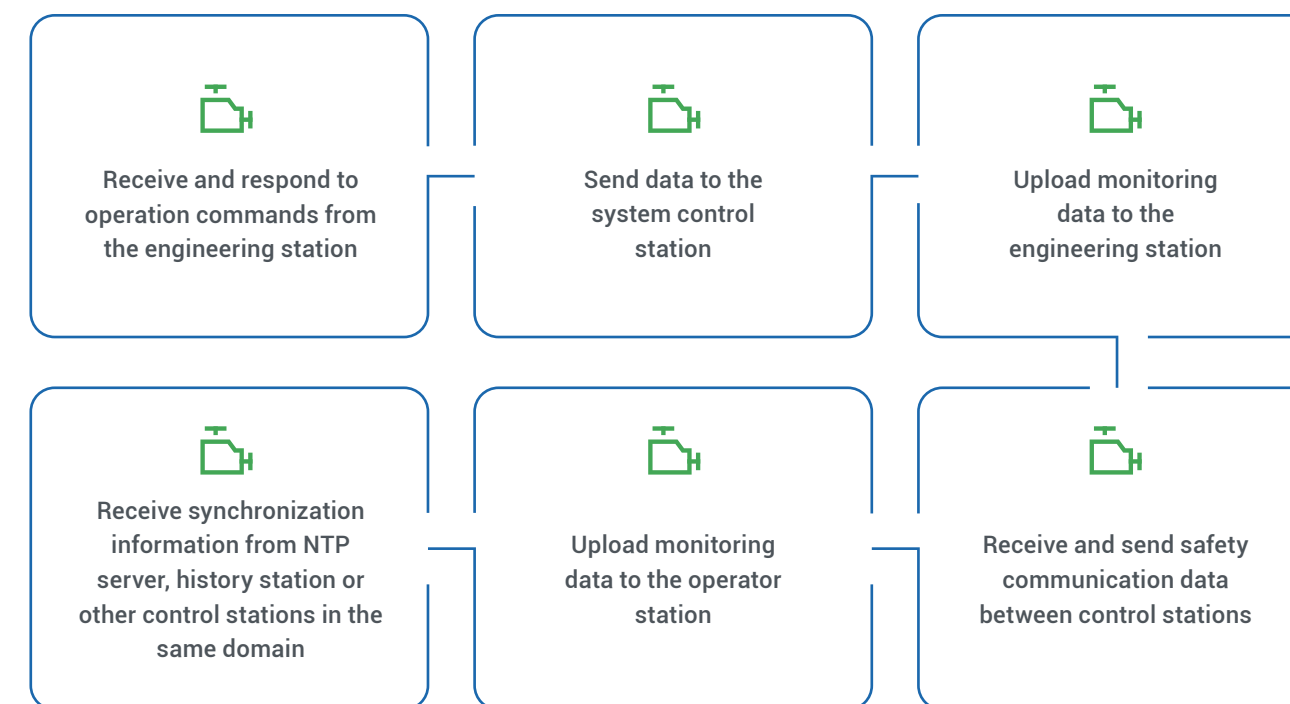
⇨ Control Network (CNET)

· The control network includes the CPU bus between three-system controllers, IO bus between the controller and IO, and COM bus between the controller and communication module

· The interconnection bus between the controller of this system and the controllers of the other two systems is CPU bus, which has a point-to-point topological structure and contains safety protocols

· The communication bus between the controller and I/O module is IO Bus, which contains PROFISafe safety protocol to make the safety loop meet the requirements of IEC61508

· A point-to-point topological structure is adopted for the communication between the controller and the communication module. Operation process data is transmitted to the communication module through the communication bus COM Bus, and then transmitted to the operator station or server through the communication module

System Hardware

The HiaGuard system hardware is mainly composed of components such as rack, power module, controller, communication module, trunk module, optical fiber module, and input/output module.

Product	Model	Description
Power module	QS10	System power module, 24V DC/240W
	QS20	Field power modules, 24V DC/480W
	PRO MAX 240W 24V 10A	System power module, 24V DC/240W
	PRO MAX 480W 24V 20A	Field power module, 24V DC/480W
Rack	SGM101	Main rack
	SGM110	Extension rack
Controller	SGM201	Controller
Communication module	SGM210	System communication module
	SGM220	Remote I/O communication module (multimode optical fiber)
	SGM221	Remote I/O communication module (triple-port mono-mode optical fiber)
	SGM222	Remote I/O communication module (mono -port mono-mode optical fiber)
	SGM230	Modbus communication module
	SGM240	IO communication trunk module
I/O module	SGM410	16-channel analog input module
	SGM410H	16-channel analog input module with HART function
	SGM412H	32-channel analog input module with HART function
	SGM520	8-channel analog output module
	SGM520H	8-channel analog output module with HART function
	SGM610	32-channel DI module
	SGM710	32-channel DO module
	SGM633	Pulse input and overspeed protection module
I/O terminal board	SGM3410	16-channel analog input terminal module
	SGM3410H	16-channel analog input terminal module with HART function
	SGM3412H	32-channel analog input terminal module with HART function
	SGM3520	8-channel analog output terminal module with HART function
	SGM3610	32-channel DI terminal module
	SGM3620	32-channel DI relay terminal module (non-I.S)
	SGM3710	32-channel DO terminal module
	SGM3720	32-channel DO relay terminal module (non-I.S)
	SGM3633	Pulse input and overspeed protection terminal module
Cable	SGX002	2m, 4m, 5m, 10m and 15m IO Bus communication extension cables used to connect two racks
	SGX006-SGX011	1.5m, 2m, 4m, 6m, 10m and 16m 78-core prefabricated cables used to connect rack and terminal module
	SGX012	3m Modbus module communication expansion cable
Fault detection module	SGM8610	External cable fault detection module (used with SGM610 module)
	SGM8611	External cable fault detection module (used with SGM610 module)
Occupancy module	SGM020	Empty slot occupancy panel in rack
	SGM021	Empty slot occupancy module in rack (anti-corrosive European socket)

⤷ Main Rack and Extension Rack

Main Rack

SGM101 is a 19-slot main rack installed with various modules. Slots from left to right are slots 1 and 2 for communication modules, slots 3, 4 and 5 for three-system controllers, and slots 6-19 for I/O modules (which are redundant in pairs), which can be installed with HiaGuard system I/O module or trunk, optical fiber module and Modbus communication module. Every two I/O module slots in the rack are a group of redundant slots, which can be installed with two or one I/O module.
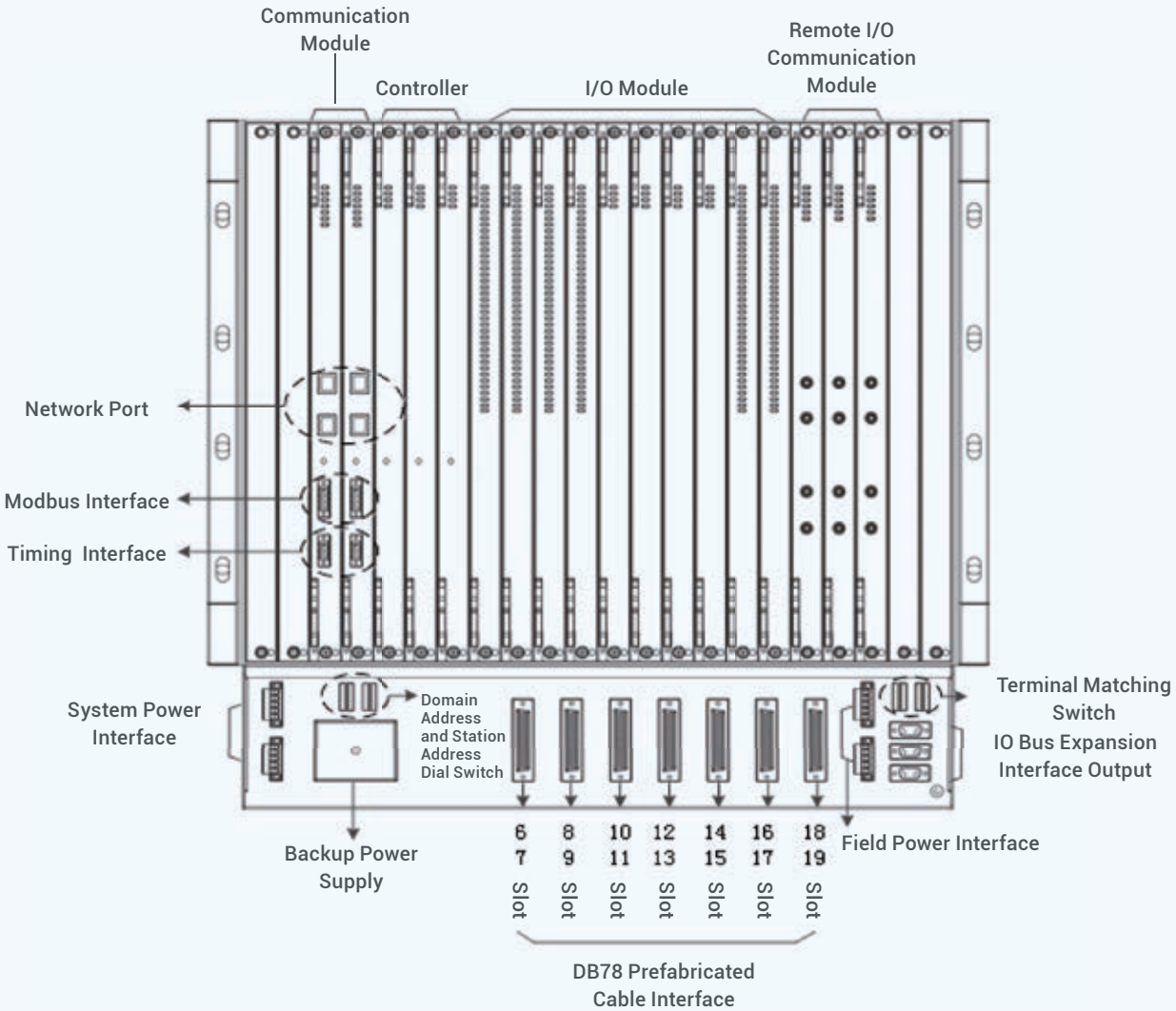
Extension Rack

SGM110 is a 20-slot extension rack. HiaGuard I/O modules or trunk and optical fiber modules can be installed from left to right.

The panel below the extension rack is also provided with redundant 24V DC system power input interface and redundant 24V DC field power input interface, redundant address dial switch of extension rack, IO Bus terminal matching resistance dial switch, synchronization terminal matching resistance dial switch, IO Bus extend interface and ten DB78 prefabricated cable sockets.
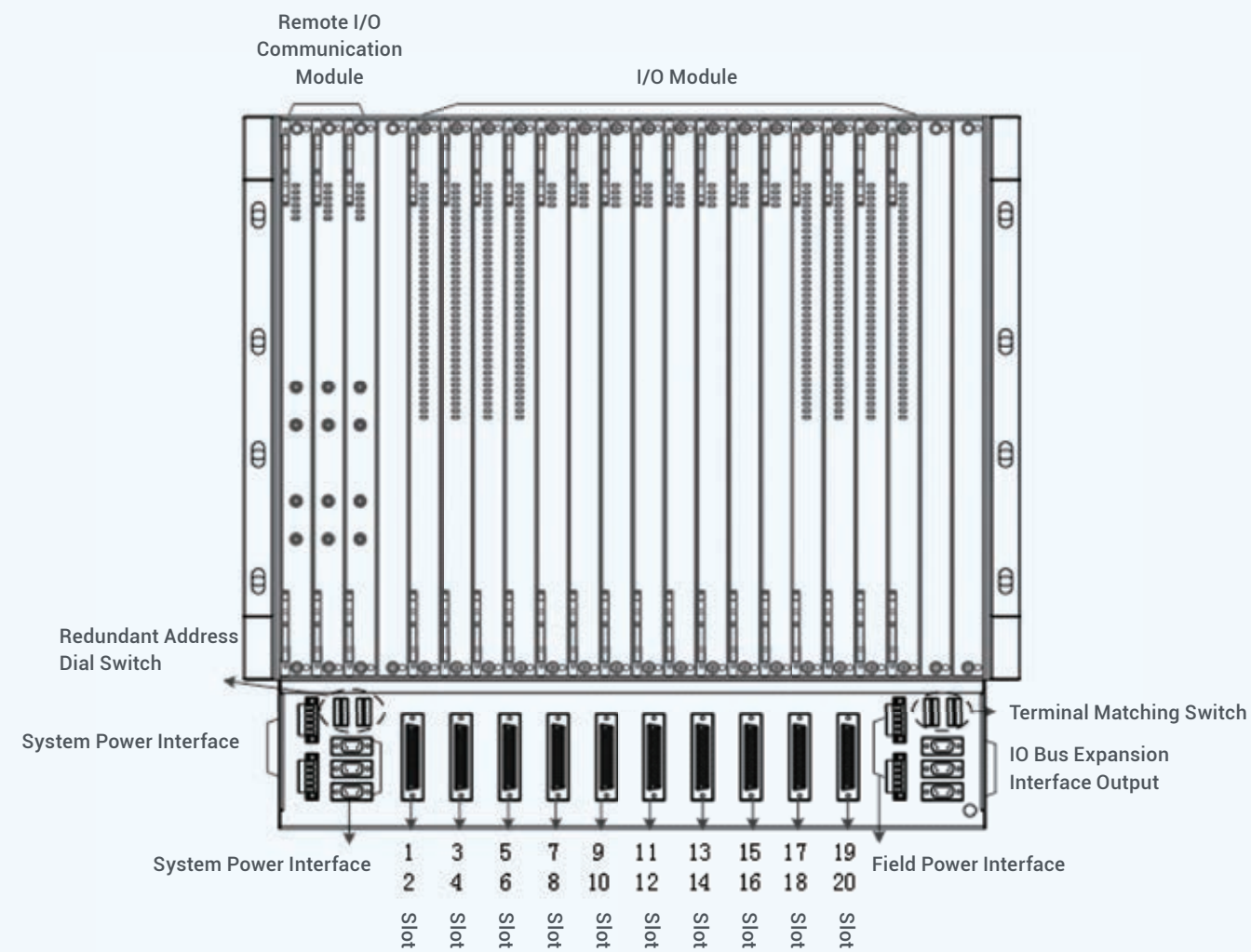

⮞ Controller

SGM201 is a TÜV-certified Controller Module

which reaches SIL3 and with triple modular redundancy configuration. Each triple-modular HiaGuard system includes three independent controller modules, and each module controls an independent channel of the triple-modular system. The triple-modular three-system controllers operate synchronously and support 3-2-0 degraded mode.

The module adopts embedded fanless design and operates with ultra-low power consumption. The redundant 24V DC power supply supports hot plug function and power failure data protection function. It adopts modular design and plug-in structure, and is installed in rack rail, fastened by bolts and provided with puller.

SGM201 module is connected to the main rack bottom plate by two 96-pin European connectors. It is mainly used to obtain input data of this system from the input module, exchange input data among three systems and vote, perform logical operation, exchange output data and vote, send output data to the output module and perform periodic diagnosis, and exchange data with the upper computer through the communication module.
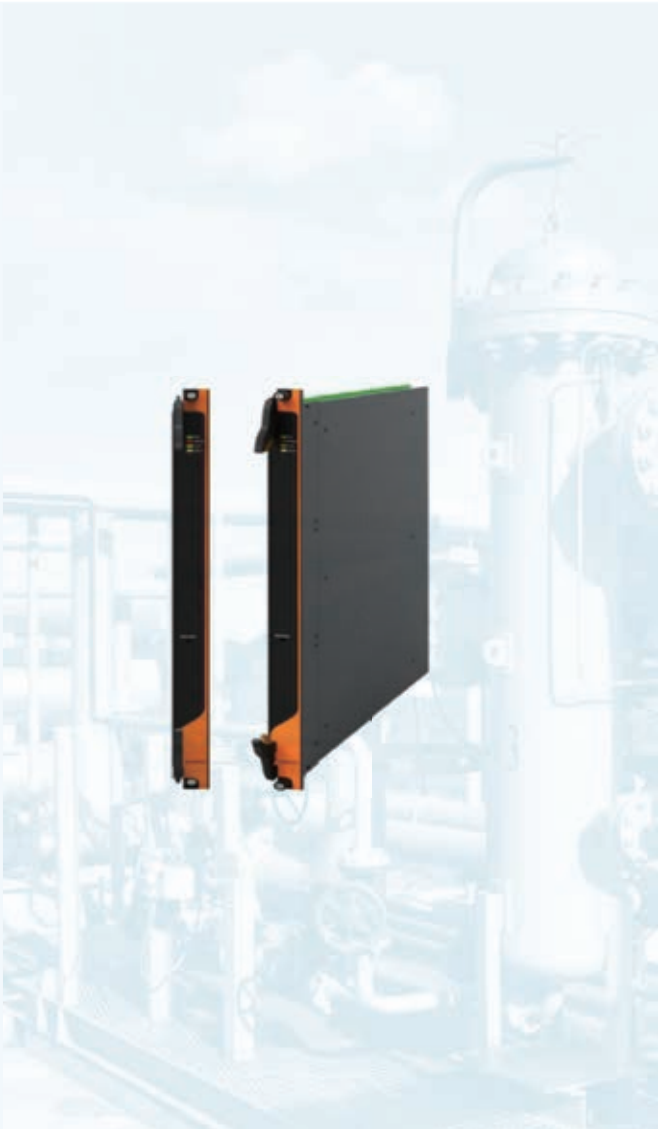
Key Performance:

· Triple modular redundancy configuration
· 3-2-0 degradation
· Data power failure protection
· Redundant power supply
· Rich diagnostic functions: diagnosable power supply, clock, memory, CPU, peripheral interface, etc.
· Online replacement of cards
· Operating temperature: -10~60° C
· G3 corrosion protection specified by ANSI/ISA 71.04-2013
· 3 Mbit/s and 6 Mbit/s optional configuration supported by IO Bus communication bandwidth

⇨ Communication Module

SGM210 System Communication Module

SGM210 is the communication module of HiaGuard system, and is used to exchange data between controller and upper computer. SGM210 communication module supports redundant configuration and undisturbed switching between redundant communication modules

The SGM210 communication module communicates with the engineering station through Ethernet to download the engineering configuration program and report internal information of the system; communicates with the controller through the communication bus to upload the operation data of the controller to the upper computer; communicates with the third-party control system through ModBus RTU to integrate with other systems

SGM210 can receive the synchronization pulse from GPS timing source (FM197) and send it to SGM610 DI module

SGM210 adopts modular design and plug-in structure, and is installed in rack rail, fastened by bolts and provided with puller. Redundant 24V power supply supports hot plug

The SGM210 communication module provides various external communication interfaces to output internal data and the input external safety data of the HiaGuard system

SGM230 Modbus Communication Module

SGM230 is the Modbus communication module of HiaGuard system, which supports the function of Modbus master/slave station and can read and write with third-party Modbus equipment to realize Modbus communication between the HiaGuard system and third-party equipment.

SGM230 adopts modular design and plug-in structure, and is installed in rack rail, fastened by bolts and provided with puller. The SGM230 module is installed on the main rack, with only one module on each main rack.

The external interface of the SGM230 module is connected with the third-party Modbus equipment through four DB9 interfaces, and any DB9 interface of local module can be connected with the third-party Modbus equipment for data interaction. The parameter settings of 4 links are independent of each other, and can be set as master station and slave station separately or at the same time.

Key Performance:

· Modbus interface: It includes four DB9 interfaces which reach the RS485 level standard and support Modbus-RTU protocol
· Support master/slave station reading and writing function
· The size of data area is 8K, and the size of data area between ports can be adjusted.
· Redundant power supply
· Operating temperature: -10~60° C
· G3 corrosion protection specified by ANSI/ISA 71.04-2013

⇨ I/O Module

Description of Characteristics

· All I/O modules of the HiaGuard system are certified by TÜV, and adopt 2oo3 redundancy architecture. The three redundant systems are included in the same module

· The I/O module exchanges data with controller through a communication bus supporting the PROFISafe safety protocol

· The I/O module adopts modular design and plug-in structure, and is installed in rack rail, fastened by bolts and provided with puller

· The I/O module is connected with bottom plate of the rack through European connectors, and used together with the terminal module to collect and output field current

Key Performance:

· Built-in firewall design
· Redundant power supply
· A pair of redundant 100M Ethernet (RJ45) interfaces, which supports peer-to-peer communication
· One MODBUS interface, which reaches the RS485 level standard, and supports Modbus-RTU protocol
· One synchronization pulse interface, which is used to dry contact digital input
· The synchronization mode of pulse per minute and pulse per day may enable alarm.
· Redundancy configuration
· Online replacement of cards
· Operating temperature: -10~60° C
· G3 corrosion protection specified by ANSI/ISA 71.04-2013

· The LED status Specification on the I/O module panel displays current operating, communication and fault status of the module

· I/O modules can be configured redundantly or separately. Mono I/O module can reach SIL3. The system availability is higher and undisturbed switching can be realized within 10 ms in case of redundant configuration

· All I/O modules are supplied with redundant power, the system side is isolated from the field side, and hot plug is supported

· The I/O module has rich diagnostic functions, which can diagnose various faults of power supply, module and external cables, and give a timely alarm

Types of I/O Modules and Terminal Boards

List of I/O Modules

Model	Name	Description of Functions
SGM410	16-channel AI module	TMR, 16-channel, 4-20 mA, and support 2-wire and 4-wire instruments
SGM410H	16-channel with HART function AI module	TMR, 16-channel, 4-20 mA, and support 2-wire and 4-wire instruments as well as HART
SGM412H	32-channel with HART function AI module	TMR, 32-channel, 4-20 mA, and support 2-wire and 4-wire instruments as well as HART
SGM520	8-channel AO module	TMR, 8-channel, 4-20 mA output
SGM520H	8-channel AO module with HART function	TMR, 8-channel, 4-20 mA output, and support HART
SGM610	32-channel DI module	TMR, 32-channel, dry contact, and support 1 ms SOE
SGM710	32-channel DO module	TMR, 32-channel, and single-channel maximum drive current of 0.5A/24 VDC
SGM633	Pulse input and overspeed protection PI module	TMR, 12-channel PI (the first 6 channels are TMR architecture and the last 6 channels are overspeed protection channels), zero-crossing and non-zero-crossing wave self-adaption (square wave and sine wave), 8-channel DO, source type, and single-channel maximum drive current of 0.5A/24 VDC

List of I/O Terminal Boards

Model	Name	Description of Function
SGM3410	16-channel AI terminal module	16-channel, overcurrent protection, and EMC protection
SGM3410H	16-channel AI terminal module with HART function	16-channel, overcurrent protection, EMC protection, and support HART
SGM3412H	32-channel AI terminal module with HART function	32-channel, overcurrent protection, EMC protection, and support HART
SGM3520	8-channel AO terminal module with HART function	8-channel, EMC protection, and support HART
SGM3610	32-channel DI terminal module	32-channel, overvoltage and overcurrent protection, and EMC protection
SGM3710	32-channel DO terminal module	32-channel, overvoltage and overcurrent protection, and EMC protection
SGM3633	Pulse input and overspeed protection terminal module	20-channel, overvoltage and overcurrent protection, and EMC protection

▷ Optical Fiber and Trunk Modules

SGM220 Remote I/O Communication Module (Multimode Optical Fiber)

SGM220 is a remote I/O communication module of the HiaGuard system, and is used for the conversion between optical signal and electrical signal of IO BUS and synchronization pulse (TIMING) and for remote expansion of I/O modules.

SGM220 adopts modular design and plug-in structure, and is installed in rack rail, fastened by bolts and provided with puller.

SGM220 shall be used in pairs, and every two SGM220 modules are interconnected by optical fiber to expand the IO BUS and TIMING of the primary system. A group contains three pairs of modules, which can be used for the expansion of one remote rack.

The SGM220 module supports bus topology, star topology and hybrid topology expansion, with up to 3 cascades and a maximum extension distance of 6 Km.

Indicating the connection by optical fiber
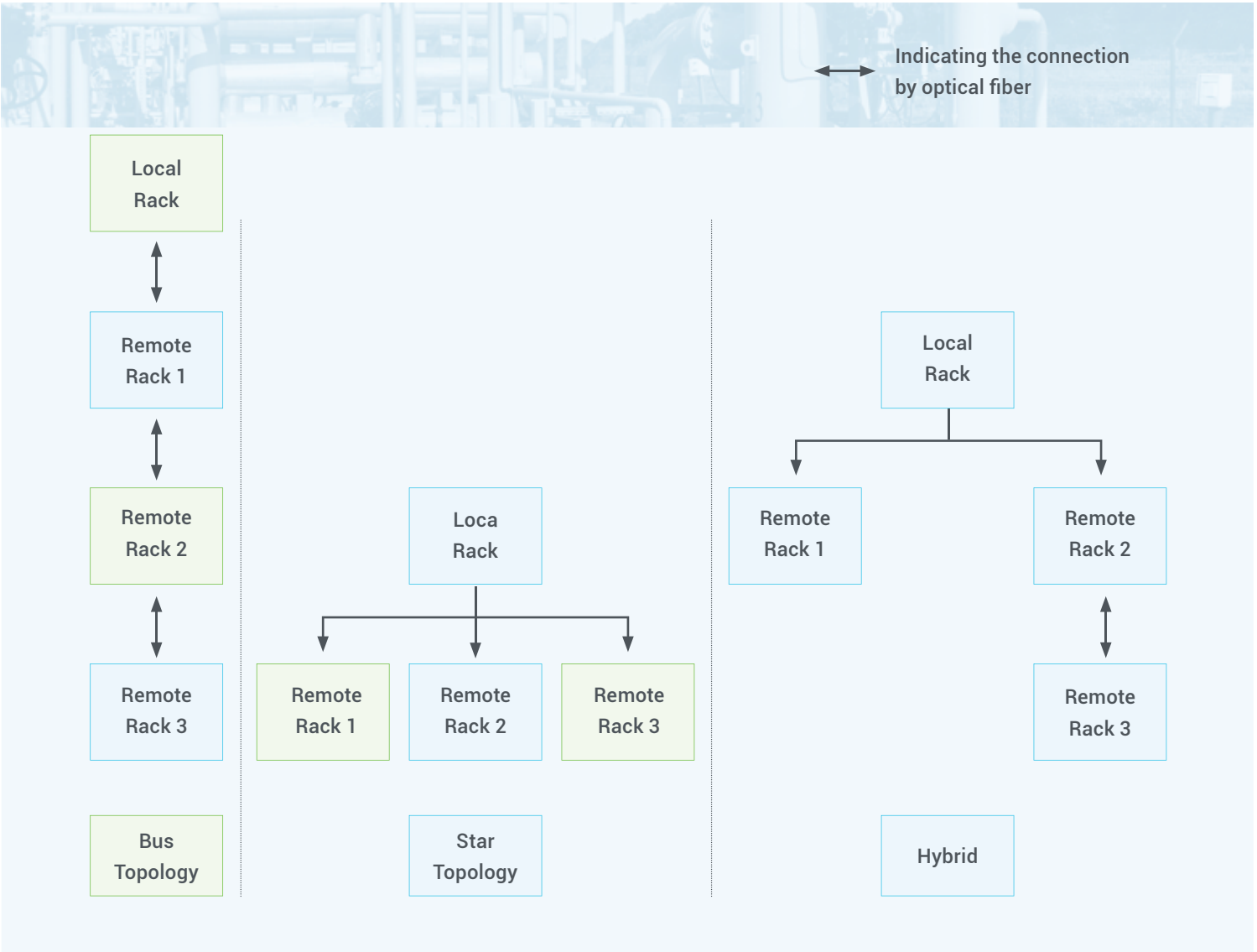
Key Performance:

· Module port: It includes one IOBUS interface (ST type) and one timming synchronization interface (ST type)
· Support bus topology, star topology and hybrid topological structures
· Type of optical fiber: multimode
· Number of cascades: 3, with a maximum extension distance of 6 Km
· Redundant power supply
· Operating temperature: -10~60° C
· G3 corrosion protection specified by ANSI/ISA 71.04-2013

SGM221 Remote I/O Communication Module (Triple-port Mono-mode Optical Fiber)

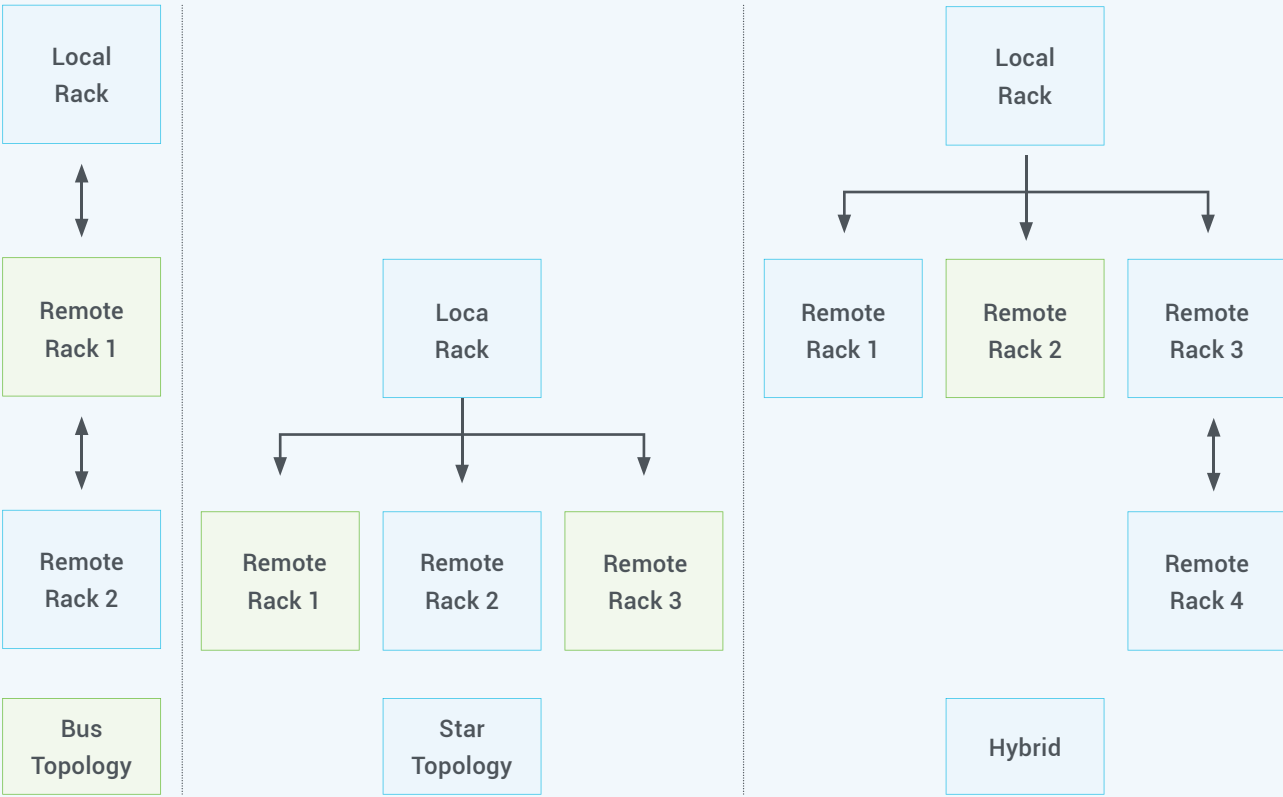SGM221 is a Triple-port single-mode optical fiber remote I/O communication module of the HiaGuard system, and is used for the conversion between optical signal and electrical signal of IO BUS and synchronization pulse (TIMING) and for remote extention of system I/O modules.

SGM221 adopts modular design and plug-in structure, and is installed in rack rail, fastened by bolts and provided with puller.

Remote I/O communication modules shall be used in pairs, and every two of them are interconnected by optical fiber to extention IO Bus and synchronization of the primary system. A group contains three pairs of modules, which can be used for the extend of one remote rack.

The SGM221 can be used in pairs on its own or with the SGM222. The module supports bus topology, star topology and hybrid topology expansion, with up to 2 cascades and a maximum extension distance of 24 Km.

Indicating the connection by optical fiber

Local Rack	Local Rack
Remote Rack 1	Remote Rack 1, Remote Rack 2, Remote Rack 3
Remote Rack 2	Remote Rack 4
Bus Topology	Hybrid

Loca Rack → Remote Rack 1, Remote Rack 2, Remote Rack 3

Star Topology

Key Performance:

· Module port: It includes three IO BUS interfaces (SC type) and three synchronization interfaces (SC type)
· Support bus topology, star topology and hybrid topological structures
· Type of optical fiber: single-mode
· Number of cascades: 2, with a maximum extension distance of 24 Km
· Redundant power supply
· Operating temperature: -10~60° C
· G3 corrosion protection specified by ANSI/ISA 71.04-2013

SGM222 Remote I/O Communication Module (Single-port Single-mode Optical Fiber)

SGM222 is a single-port single-mode optical fiber remote I/O communication module of the HiaGuard system, and is used for the conversion between optical signal and electrical signal of IO BUS and synchronization pulse (TIMING) and for remote expansion of HiaGuard system I/O modules.

SGM222 adopts modular design and plug-in structure, and is installed in Rack rail, fastened by bolts and provided with puller.

Remote I/O communication modules shall be used in pairs, and every two of them are interconnected by optical fiber to expand IO Bus signal and TIMING signal of the primary system. A group contains three pairs of modules, which can be used for the expansion of one remote rack.

The SGM221 can be used in pairs on its own or with the SGM222. It can be used together with SGM221 to support up to 2 cascades of chain topology, and can realize star topology, daisy-chain and hybrid topological structures, with a maximum extension distance of 24 Km.

Indicating the connection by optical fiber

Key Performance:

· Module port: It includes one IO BUS interface (SC type) and one synchronization interface (SC type)
· It can be used together with SGM221 to support bus topology, star topology and hybrid topological structures
· Type of optical fiber: single-mode
· Number of cascades: 2 when used together with SGM221, with a maximum extension distance of 24 Km
· Redundant power supply
· Operating temperature: -10~60° C
· G3 corrosion protection specified by ANSI/ISA 71.04-2013

SGM240 IO Communication Trunk Module

SGM240 is an IO communication trunk module of the HiaGuard system, and is used for transmission of IO Bus and synchronization pulse (TIMING) signals and for local expansion of HiaGuard system I/O modules.

SGM240 adopts modular design and plug-in structure, and is installed in Rack rail, fastened by bolts and provided with puller.

SGM240 does not need to be used in pairs, and only one group is required to expand the three-system IO Bus signal and TIMING signal. A group contains three modules, which is placed in the local rack, and connected directly to other racks through IO Bus communication expansion cables to realize the extension of local Rack and other racks.

Each SGM240 has three DB9 interfaces, which can connect any DB9 interface of the local module with the DB9 interface of the system corresponding to the local extension Rack (A/B/C system), and supports the Level 1 star topology topology.

Indicating the connection by optical fiber
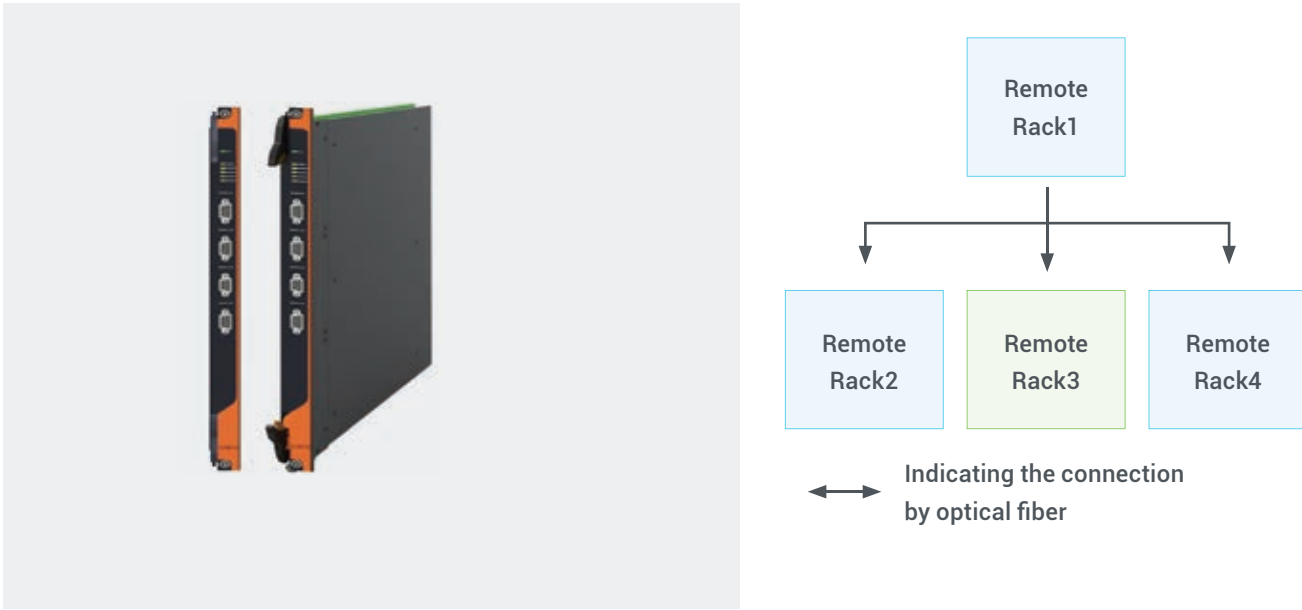
Key Performance:

· Module port: It includes three IOBUS interfaces (DB9 interface)
· Support star topology
· Cable type: standard DB9 prefabricated cable
· Number of cascades: 1, with an extension distance of 15m
· Redundant power supply
· Operating temperature: -10~60° C
· G3 corrosion protection specified by ANSI/ISA 71.04-2013

⤇ System Environmental Requirements

System Power Supply

Two independent 220V AC power supplies, including at least one UPS, shall be introduced to site to supply power for the HiaGuard system. The power supply of each Rack in the cabinet is converted into 24V DC power supply through redundant power modules. The Rack power supply is divided into system side power supply and field side power supply, which are arranged completely independently, so that the operating power supply of the module is completely separated from the query power supply related to the field, thus reducing common cause failure.

Grounding Requirements

The following guidelines apply to all HiaGuard cabinet configurations:

· Do not ground through non-HiaGuard equipment, but can be grounded together with other DCS systems

· Do not ground non-HiaGuard equipment into the cabinet

· The grounding resistance shall be less than 4Ω

· The system power supply and field power supply in the cabinet are grounded separately. The negative end of system power supply is connected to an independent return copper bar, and the negative end of the field power supply is connected to another busbar

· Network interface and DB78 cable enclosure are connected to the protective ground

· Shielding layer of the field current cable is connected directly to the shielded ground busbar

Environmental Conditions

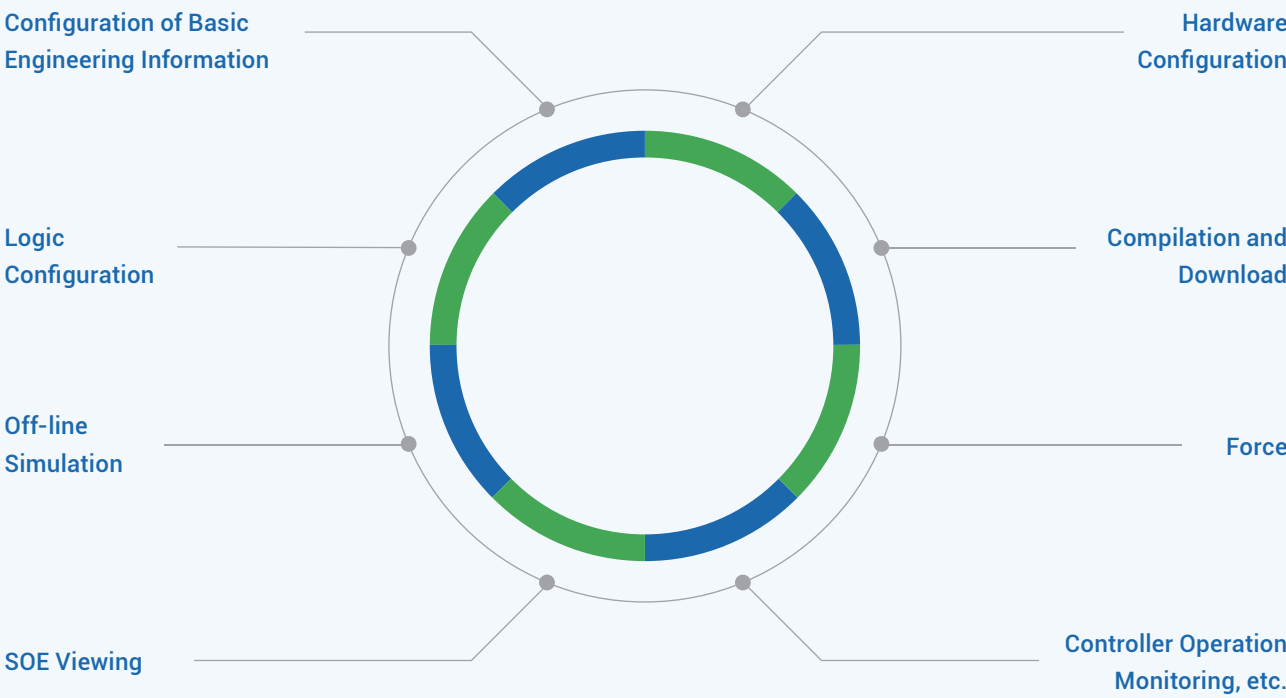|	
Operating temperature	-10~60 ° C
Storage temperature	-40~85 ° C
Relative humidity	5~95%, non-condensing
Altitude	≤ 3000m
Environmental pollution grade	Reach the G3 corrosion protection grade specified by ANSI/ISA 71.04-2013

System Software

Application software of the HiaGuard system consists of two parts: system configuration software (Safe-AutoThink) and system monitoring software (HOLLiAS MACSV6).

⤇ System Configuration Software

It can be used to configure "safety engineering" or "complex algorithm engineering", build "safety engineering", and supports the secure compilation configuration path of restricted FBD and LD languages. It can also be used to build "complex algorithm engineering", and supports non-secure compilation configuration path of restricted FBD, LD and ST languages.

Safe-AutoThink (Safe-AT) is a special configuration software developed by HollySys for industrial safety instrumented systems, and is a part of the control logic configuration software of the HiaGuard system. The software has been certified by TÜV and fully meets the requirements of IEC61508 for SIL3 system T3 tools.

Safe-AT configuration software is a programming tool based on Windows platform, a development platform for interlocking logic scheme, mainly used for controller algorithm programming, and a standard software package for hardware configuration and software programming. It is installed at the engineering station and can run under Windows XP/Windows 7/Windows 10. It mainly performs the following main tasks:

Configuration of Basic Engineering Information

Hardware Configuration

Logic Configuration

Compilation and Download

Off-line Simulation

Force

SOE Viewing

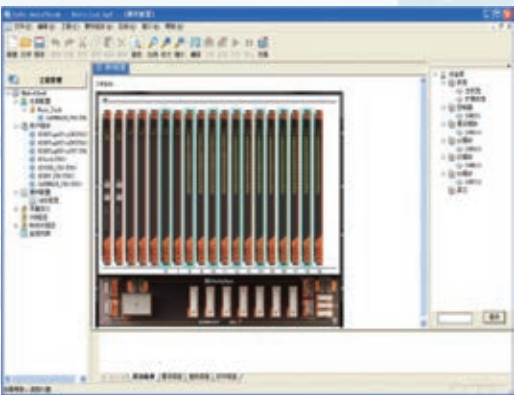Controller Operation Monitoring, etc.

⮕ Configuration Environment

The tree structure chart is adopted to ensure clear management hierarchy, clear structure and convenient management of the whole project.

It is used for task configuration, user program, hardware configuration, variable definition, SOE configuration, MODBUS configuration and watch list configuration.

Graphical hardware module configuration and parameter setting are adopted, with simple configuration mode and intuitive and vivid hardware interface. The operation status and alarm information of each module can be seen on the interface directly in the online monitoring state. The module version can be inquired.

⮕ Safety Programming Language

Safe-AT provides two programming languages complying with the IEC61131-3 standard, which can be used to realize logical schemes.

Ladder Diagram (LD)
Function Block Diagram (FBD)

The system executes the decompilation process automatically at the specified "decompilation timing" to ensure consistency between the source project and the target project. During the decompilation operation, the system displays the source program and the program generated by decompilation to the user to help he/she to check the correctness and integrity of the program, which is called "configuration verification".

Off-line Simulation Function

It is played to realize controller simulation and HMI simulation.
The simulation mode is mainly used to simulate and debug the correctness of user program logic in the experimental environment, facilitate the modification and debugging of interlocking logic, provide a premise for on-line debugging at the production site, and reduce the workload of on-site debugging. During the simulation, the program executes an arithmetic process in locally running simulation software and is not connected to the controller.

Security Permission Function

Security settings are made in Safe-AT to prevent unauthorized users from accessing the system or avoid human errors from causing unexpected modifications to the system when the system runs normally.

· In Safe-AT, different controller operation and access permissions can be granted for users with different permission levels

· Users are required to enter the controller password when downloading the controller, running/stopping IEC tasks and entering the operation mode.

⤷ System Monitoring Software

The HiaGuard system monitoring software is a human-machine interface platform based on the HOLLiASMACSV6 and runs at the operator station. MACSV6 is a set of human-machine interface monitoring software developed based on Microsoft Windows operating system, runs on platforms such as Windows XP/Windows7/Windows10, collects data in the c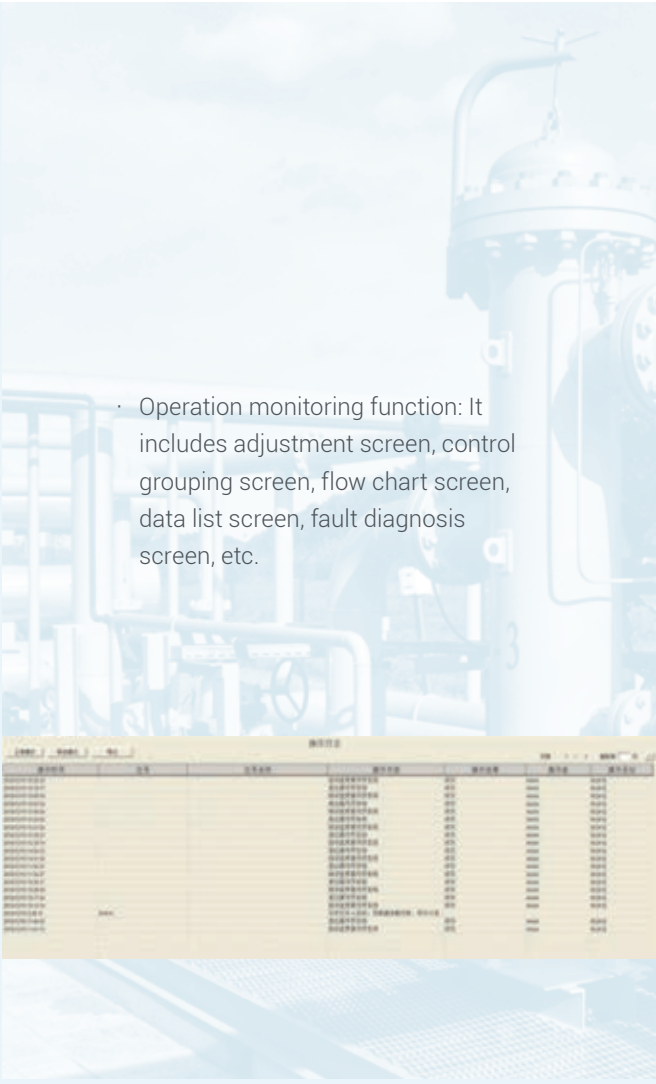ontroller through network communication, and displays production data dynamically by using the powerful graphical function of computer. The operator station monitoring software is the most direct and important human-machine interaction interface, and supports special industrial keyboard, printer and other external equipment. The software has main functions such as flow chart, alarm, log, report, overview, trend, control grouping, parameter grouping, control and system management.

The MACSV6 has powerful and diverse functions, including data acquisition, control , alarm, trend, overview, simulation flow chart, data list, log management, sheet management, events recording sequence, report and data statistics, display management, man-machine dialogue, printing management, system fault diagnosis and fault monitoring, system configuration, operator online parameter setting, offline query of archived data, control grouping, control loop, etc.

· Trend management function: There are two ways of trend display, i.e. curve and number, which are called "trend curve display" and "trend value display". The trend curve is chosen by default. Historical data shall be collected in real time, and trend curve can be inquired.

The system Monitoring Software Has The Following Main Functions:

· Operation monitoring function: It includes adjustment screen, control grouping screen, flow chart screen, data list screen, fault diagnosis screen, etc.
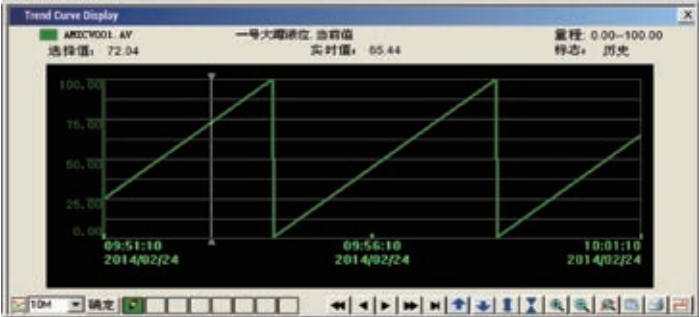
· Alarm management function: It is used by the operator to browse, inquire and confirm alarms, including alarm light indicator, real-time alarm window, historical alarm window, alarm priority, audible alarm, alarm confirmation, alarm operation guidance and alarm deletion. Alarms are divided into "process alarm", "system alarm" and "historical alarm".

· Monitoring log function: It is used by the system to record SOE displacement (if any), so that process operators can check and maintain the operation status of process units in time. The operation log mainly records the login name of the operator, the name of the operator station where the operation occurs, the operation time, the operated tag number, description of the operated tag number, and the operation content and result.

· Report management function: The report management software obtains data from the system historical database and real-time database to realize functions such as log report, statistical report and batch report.
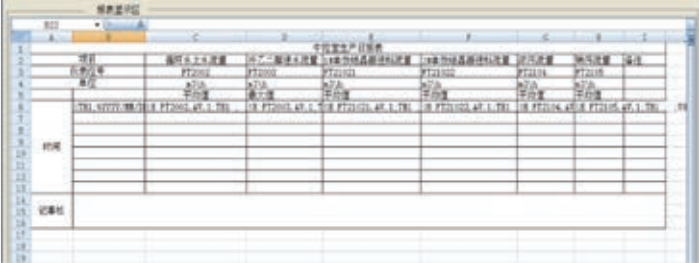
Safety Integration

The HiaGuard system and HollySys DCS system can be integrated seamlessly through system network integration, with physical sharing of networks, logical separation, and different protocols. Failure on the DCS side does not affect safety on the SIS side. The operator station can access DCS and SIS real-time data at the same time through HMI interface, which simplifies the process of data acquisition and management and saves software and hardware costs.
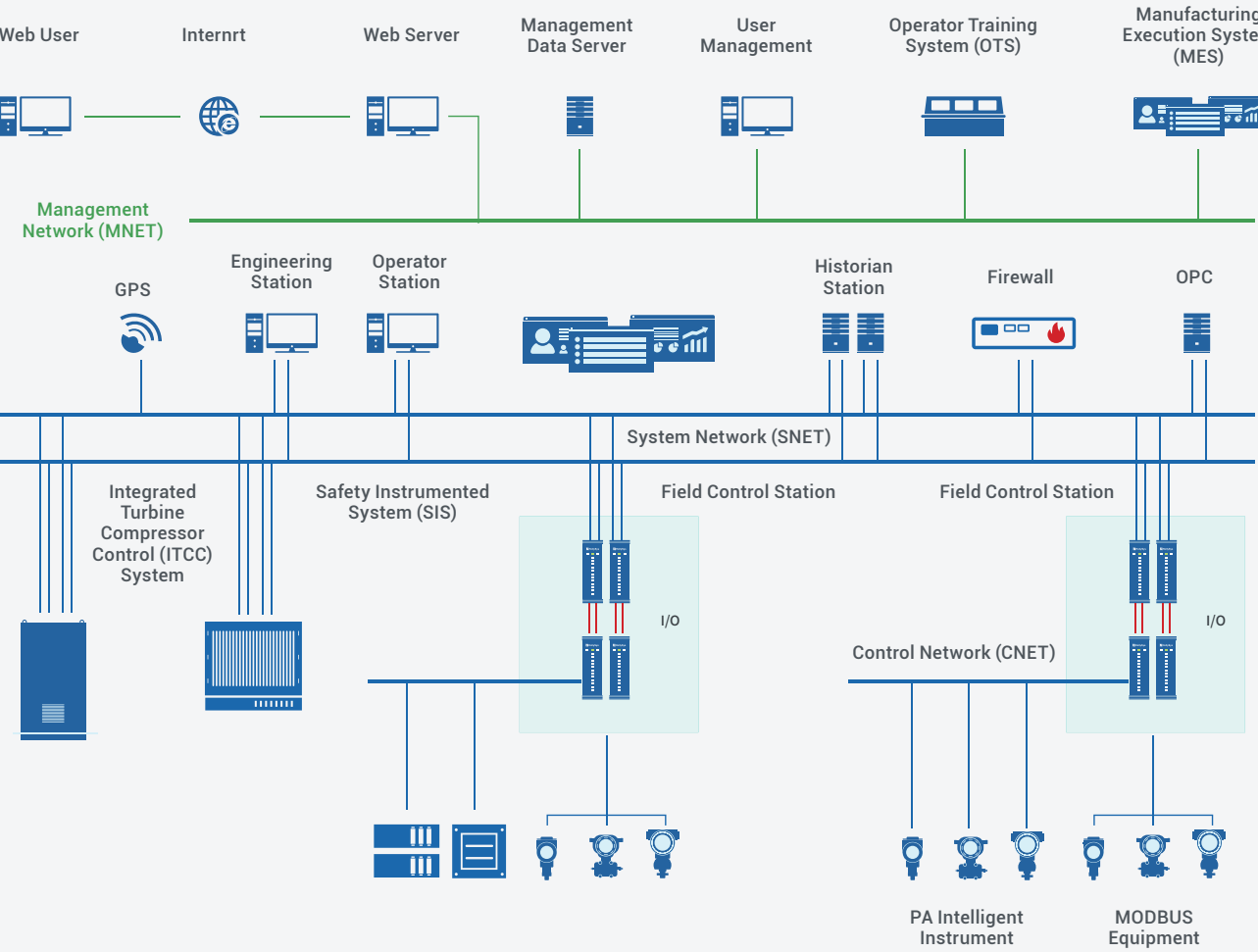
Product Certification

CE Certification

G3 Anti-corrosion Certification

Achilles Certification

SIL3 Level Certification

Classification Society Certification

Appendix 1 Module Specifications

⤷ SGM201 Controller Module

SGM201 Controller	
Power Supply	
Input voltage	24V DC (-15%~+20%)
Power consumption	≤ 5W
Hot plug	Supported
Power supply mode	Bottom plate power bus
Whether the power supply is redundant	Yes
CPU	
Main frequency	330MHz
Number of digits	32-bit
ECC function	Supported
Reset Mode	
Support reset with manual button	
Power Failure Protection	
Battery setting	Backboard installation (power failure data protection will be invalid if the controller leaves the backboard) The storage life is up to 10 years. It is recommended to replace it once every three years if it is used normally.
Physical Property	
Installation mode	Installed in Rack on rail
Module size (W*H*D)	25mm* 439.85mm*294.8mm
Safety Specifications	
System capability	Meet SC3 specified in IEC 61508
Safety integrity level	Up to SIL 3 in accordance with IEC61508.

⤷ SGM210 Communication Module

SGM210 Communication Module	
Power Supply	
Input voltage	24V DC(-15% ~+20%)
Power consumption	≤ 7W
Hot plug	Supported
Power supply mode	Bottom plate power bus
Whether the power supply is redundant	Yes
CPU	
Main frequency	330MHz
Number of digits	32-bit
System Network	
Number of interfaces	2
Type of interface	RJ45
Communication rate	100Mbps
Modbus	
Number of interfaces	1
Type of interface	4-pin Phoenix terminal
Bus protocol	ModBus-RTU Protocol
Communication rate	1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200 bps (Configurable)
Electrical standards	RS485
Master or slave mode	Slave
Synchronization Pulse Input	
Number of interfaces	1
Type of interface	3-pin Phoenix terminal
Interface characteristics	Dry contact
Physical Property	
Installation mode	Installed in Rack on rail
Module size (W*H*D)	25mm* 439.85mm*294.8mm

⬔ SGM230 Modbus Communication Module

SGM230 Modbus Communication Module	
Power Supply	
Input voltage	24V DC (-15% ~+20%)
Power consumption	≤ 8W
Hot plug	Supported
Power supply mode	Bottom plate power bus
Whether the power supply is redundant	Yes
Physical Layer Interface	
Number of interfaces	4
Type of interface	DB9 connector
Interface level	RS485
Communication Function	
Communication protocol	Modbus-RTU protocol
Master or slave mode	Master/slave configured for user software
Communication rate	1200 bps, 2400 bps, 4800 bps, 9600 bps, 19.2 kbps (by default), 38.4 kbps, 57.6 kbps, 115.2 kbps
Check mode	Odd check, even check (by default), no check
Stop bit	1 bit (by default), 2 bits.
Size of input and output data area	8 KB in total for 4 ports, and the data size of each port can be adjusted
Physical Property	
Installation mode	Installed in rack on rail
Module size (W∗H∗D)	25mm∗ 439.85mm∗294.8mm

⬔ SGM410/SGM410H Analog Input Module

SGM410/SGM410H 16-channel Analog Input Module	
Power Supply	
Power consumption (for system)	≤ 6W
Power consumption (for field)	≤ 6W
Input voltage	System power supply: 24V DC (-15%~+20%) power redundancy Field power supply: 24V DC (-15%~+20%) power redundancy
Hot plug	Supported
Power supply mode	Bottom plate power bus
Whether the power supply is redundant	Yes
Input Channel Performance Specification	
Number of channels	16
Software filtering	The configuration can be 0-15 times (default value: 0)
Range	4 ~20mA
Channel measuring range	0~22mA
Accuracy	Accuracy (at 25° C): 0.2% F.S.
Temperature drift	≤100ppm/° C
Upper limit of passband	≥100Hz
Crosstalk suppression	≥ 60dB
Common mode rejection ratio (7Vrms@50Hz)	≥ 80dB
Differential mode rejection ratio (50Hz)	≥ 40dB
Current limit of external power supply	40mA
Full-channel scanning time	≤ 3ms
HART Function (Non-I.S Related)	
HART function	SGM410H module supports HART function
Isolation Withstand Voltage	
Channel and system	≥1500VAC@1min@10mA
Insulation resistance	Above 100 MΩ under normal conditions (temperature +25° C±2° C, relative humidity 30%±5%, non-condensing) Above 10 MΩ in a humid and hot environment (temperature +45° C ± 2° C, relative humidity 95%± 3%, non-condensing)
Active/Standby Switching	
Switching time	≤10ms
Physical Property	
Installation mode	Installed in rack on rail
Module size (W∗H∗D)	25mm∗439.85mm∗294.8mm
Safety Indicators	
System capability	meet SC3 specified in IEC 61508
Safety integrity level	up to SIL 3 in accordance with IEC61508.

⇨ SGM412H Analog Input Module

SGM412H 32-channel Analog Input Module	
Power Supply	
Power consumption (for system)	≤ 6W
Power consumption (for field)	≤ 6W
Input voltage	System power supply: 24V DC (-15%~+20%) power redundancy Field power supply: 24V DC (-15%~+20%) power redundancy
Hot plug	Supported
Power supply mode	Bottom plate power bus
Whether the power supply is redundant	Yes
Input Channel Specification	
Number of channels	32
Software filtering	The configuration can be 0-15 times (default value: 0)
Range	4~20mA
Channel measuring range	0~22mA
Accuracy	Accuracy (at 25° C): 0.2% F.S.
Temperature drift	≤ 100ppm/° C
Upper limit of passband	≥ 100Hz
Crosstalk suppression	≥ 60dB
Common mode rejection ratio (7Vrms@50Hz)	≥ 80dB
Differential mode rejection ratio (50Hz)	≥ 40dB
Current limit of external power supply	40mA
Full-channel scanning time	≤ 3ms
HART Function (Non-I.S Related)	
HART function	Supported
Isolation Withstand Voltage	
Channel and system	≥ 1500VAC@1min@10mA
Insulation resistance	Above 100 MΩ under normal conditions (temperature +25° C±2° C, relative humidity 30%±5%, non-condensing) Above 10 MΩ in a humid and hot environment (temperature +45° C ± 2° C, relative humidity 95%± 3%, non-condensing)
Active/Standby Switching	
Switching time	≤ 10ms
Physical Property	
Installation mode	Installed in rack on rail
Module size (W*H*D)	25mm*439.85mm*294.8mm
Safety Indicators	
System capability	meet SC3 of IEC 61508
Safety integrity level	up to SIL 3 in accordance with IEC61508.

⇨ SGM520/SGM520H Analog Output Module

SGM520/SGM520H 8-channel Analog Output Module	
Power Supply	
Power consumption (for system)	≤ 6W
Power consumption (for field)	≤ 8W
Input voltage	System power supply: 24V DC (-15%~+20%) power redundancy Field power supply: 24V DC (-15%~+20%) power redundancy
Hot plug	Supported
Power supply mode	Bottom plate power bus
Whether the power supply is redundant	Yes
Output Channel Performance Specification	
Number of channels	8
Type	Current output
Channel on-load capacity	Max .800ohms@ ≥ 24VDC F.S.(0 ° C ~60 ° C) Max .700ohms@>20.4VDC F.S.(0° C~60° C)
Output step response	10%~90% step <10 ms resistive load
Range	4~20mA
Output range	0~22mA
Accuracy	Accuracy (at 25° C): 0.2% F.S.
Temperature drift	≤ ±22uA/10° C
Full-channel assignment time	≤ 3 ms
Safe state	0mA
HART Function (Non-I.S Related)	
HART function	SGM520H supports HART function
Isolation Withstand Voltage	
Channel and system	≥ 1500VAC@1min@10mA
Insulation resistance	Above 100 MΩ under normal conditions (temperature +25° C±2° C, relative humidity 30%±5%, non-condensing) Above 10 MΩ in a humid and hot environment (temperature +45° C ± 2° C, relative humidity 95%± 3%, non-condensing)
Active/Standby Switching	
Switching time	<10ms
Physical Property	
Installation mode	Installed in rack on rail
Module size (W*H*D)	25mm*439.85mm*294.8mm
Safety Specifications	
System capability	Reach SC3 specified in IEC 61508
Safety integrity level	up to SIL 3 in accordance with IEC61508.

⇥ SGM610 Digital Input Module

SGM610 32-channel DI Module	
Power Supply	
Power consumption (for system)	≤ 6W
Power consumption (for field)	≤ 24W
Input voltage	System power supply: 24V DC (-15%~+20%) Field power supply: 24V DC (-15%~+20%)
Hot plug	Supported
Power supply mode	Bottom plate power bus
Whether the power supply is redundant	Yes
Input Channel Performance Specification	
Number of channels	32
Debounce time	0~32 ms (10 ms by default) optional configuration
Type	Contact-type DI
Contact type	Dry contact
Channel type	Double-ended input
Query voltage	24V DC (provided by module)
Full-channel scanning time	≤ 2ms
Input overvoltage protection	±36V DC, 1 min
Isolation Withstand Voltage	
Isolation Withstand Voltage	1500VAC@1min@10mA
SOE Indicator	
Synchronization mode	Hard synchronization
Accuracy	1 ms in the station and 1 ms between stations
Active/Standby Switching	
Switching time	≤10ms
Physical Property	
Installation mode	Installed in rack on rail
Module size (W*H*D)	25mm*439.85mm*294.8mm
Safety Specifications	
System capability	meet SC3 of IEC 61508
Safety integrity level	up to SIL 3 in accordance with IEC 61508.

⇥ SGM710 Digital Output Module

SGM710 32-channel DO Module	
Power Supply	
Power consumption (for system)	≤ 6W
Power consumption (for field)	≤ 3W
Input voltage	System power supply: 24V DC (-15%~+20%) Field power supply: 24V DC (-15%~+20%)
Hot plug	Supported
Power supply mode	Bottom plate power bus
Whether the power supply is redundant	Yes
Channel Specification	
Number of channels	32
Channel type	Source type
Full-channel assignment time	≤ 2ms
Overvoltage protection	±30V DC
On-state voltage drop	≤ 3V
Maximum output low voltage	≤ 2.4V
Driving capacity	Channel 24V DC@0.5A; Total drive current of module is ≤ 8A
Isolation Withstand Voltage	
Channel and system	≥ 1500VAC@1min@10mA
Active/Standby Switching	
Switching time	≤10ms
Physical Property	
Installation mode	Installed in rack on rail
Module size (W*H*D)	25mm*439.85mm*294.8mm
Safety Specifications	
System capability	meet SC3 specified in IEC 61508
Safety integrity level	up to SIL 3 in accordance with IEC61508.

⤷ SGM633 Pulse Input and Overspeed Protection Module

SGM633 Pulse Input and Overspeed Protection Module	
Power Supply	
Power consumption (for system)	≤ 11W
Power consumption (for field)	≤ 5W
Input voltage	System power supply: 24V DC (-15%~+20%) Field power supply: 24V DC (-15%~+20%)
Hot plug	Supported
Power supply mode	Bottom plate power bus
Whether the power supply is redundant	Yes
PI Input Channel Specification	
Number of channels	12-channel (the first 6 channels are TMR architecture, and the last 6 channels are overspeed protection channels)
Type	Zero-crossing and non-zero-crossing wave self-adaptation (square wave, sine wave)
Input probe type	Passive magnet-resistant probe/active proximity probe/eddy current probe
Passive magnet-resistant probe	Measurement frequency range: 0.5 Hz-32 KHz Acquisition voltage range: 0.5 Vpp-50 Vpp for TMR_PI channel 1 Vpp-50 Vpp for OSP_PI channel Disconnection detection range: >30 kΩ
Active proximity probe/eddy current probe	Measurement frequency range: 0.5 Hz-32 KHz Input amplitude: 24V DC±20% Max Power supply: 24V DC±20%@1W
OPS Function Specifications	
SOE variability	Record the channel action time
Overspeed protection response time (when overspeed protection in the module is enabled)	≤ 20 ms (@3KHz@60 teeth)
DO Output Channel Specification	
Number of channels	8
Channel type	Source type
Overvoltage protection	±30VDC
On-state voltage drop	≤ 3V
Maximum output low voltage	≤ 2.4V
Driving capacity	Single-channel 24V DC@0.5A, Total drive current of module is ≤ 4A Inductive load capacity: conforming to IEC60947-5-1 DC-13
Isolation Withstand Voltage	
Isolation withstand voltage	1500VAC@1min@10mA
Active/Standby Switching	
Switching time	≤10ms
Physical Property	
Installation mode	Installed in rack on rail
Module size (W∗H∗D)	25mm∗439.85mm∗294.8mm
Safety Specifications	
System capability	Meet SC3 specified in IEC 61508
Safety integrity level	Module PI channel acquisition and DO channel output comply with SIL3 specified by IEC61508 OSP loop function of the module complies with SIL3 specified by IEC62061

⤷ SGM220 Remote I/O Communication Module (Multimode Optical Fiber)

SGM220 Remote I/O Communication Module (Multimode Optical Fiber)	
Power Supply	
Input voltage	24V DC (-15%~+20%)
Power consumption	≤ 2W
Hot plug	Supported
Power supply mode	Bottom plate power bus
Whether the power supply is redundant	Yes
Power-on Reset	
Power-on reset time	≤ 5s
IO BUS Interface	
Number of interfaces	One TX interface, one RX interface
Bus protocol	Profisafe V1.3
Communication rate	3Mbps
Delay (I/O)	≤ 1Bit
Type of interface	ST
Type of optical fiber	Multimode fiber (62.5/125 μm)
Communication distance	0 ~2Km
Topological structure	Bus topology and star topology (realized by inserting multiple groups of remote I/O communication modules into a monorack)
Maximum number of cascades	3
Synchronization Pulse Interface	
Number of interfaces	One TX interface, one RX interface
Delay (I/O)	200ns
Type of interface	ST
Type of optical fiber	Multimode optical fiber (62.5/125 μm)
Communication distance	0~2Km
Topological structure	Bus topology and star topology (realized by inserting multiple groups of remote I/O communication modules into a mono rack)
Maximum number of cascades	3
Physical Property	
Installation mode	Installed rack on rail
Module size (W∗H∗D)	25mm∗439.85mm∗294.8mm

⤷ SGM221 Remote I/O Communication Module (Triple-port Mono-mode Optical Fiber)

SGM221 remote I/O communication module (Triple-port mono-mode optical fiber)	
Power Supply	
Input voltage	24V DC (-15%~+20%)
Power consumption	≤ 14W
Hot plug	Supported
Power supply mode	Bottom plate power bus
Whether the power supply is redundant	Yes
Power-on Reset	
Power-on reset time	≤ 5s
IO Bus and Timing Interface	
Number of ports	3
Input from port	One IO Bus and one Timing
Output from port	Three SC fibers, each with one IO Bus and one Timing
Delay (I/O)	≤ 4us
Type of interface	Dual-channel SC interface
Type of optical fiber	Single-mode fiber
Communication distance	≤ 12km
Network topology	Support star topology, daisy-chain and hybrid topology
Maximum number of cascades	Support up to 2 levels of expansion when being used together with SGM222
Physical Property	
Installation mode	Installed in rack on rail
Module size (W*H*D)	25mm*439.85mm*294.8mm

⤷ SGM222 Remote I/O Communication Module (Single-port Single-mode Optical Fiber)

SGM222 Remote I/O Communication Module (Single-port Single-mode Optical Fiber)	
Power Supply	
Input voltage	24V DC (-15%~+20%)
Power consumption	≤ 6W
Hot plug	Supported
Power supply mode	Bottom plate power bus
Whether the power supply is redundant	Yes
Power-on Reset	
Power-on reset time	≤ 5S
IO Bus and Timing Interface	
Number of ports	1
Input from port	One IO Bus and one Timing Input
Output port	One SC optical fiber, each with one IO Bus and one Timing Output
Delay (I/O)	≤ 4us
Type of interface	Dual-channel SC interface
Type of optical fiber	Single-mode fiber
Communication distance	≤ 12km
Network topology	Support point-to-point topology (which can realize star topology, daisy-chain and hybrid topological structures when being used together with SGM221)
Maximum number of cascades	Support up to 2 levels of expansion when being used together with SGM221
Physical Property	
Installation mode	Installed in rack on rail
Module size (W*H*D)	25mm*439.85mm*294.8mm

SGM240 I/O Communication Trunk Module

SGM240 I/O Communication Trunk Module	
Power Supply	
Input voltage	24V DC (-15%~+20%)
Power consumption	≤ 4W
Hot plug	Supported
Power supply mode	Bottom plate power bus
Whether the power supply is redundant	Yes
Power-on Reset	
Power-on reset time	≤ 5S
IO Bus and Timing Interface	
Number of ports	3
Input port	One IO Bus and one Timing Input
Output port	Three DB9, each with one IO Bus and one Timing Output
Delay (I/O)	≤ 4us
Type of interface	DB9 standard DP interface
Type of optical fiber	Standard DB9 prefabricated cable
Communication distance	15m
Network topology	Support star topology
Maximum number of cascades	Support 1 level of expansion
Physical Property	
Installation mode	Installed in rack on rail
Module size (W∗H∗D)	25mm∗439.85mm∗294.8mm

Abbreviations

SIS	Safety Instrumented System
CCS	Compressor Control System
SIL	Safety Integrity Level
SC	Systematic Capability
2oo3D	Two Out of Three with Diagnostic
PFD	Average Probability of a Dangerous Failure on Demand
Safe-AT	Safe-Auto Think
AI	Analog Input
AO	Analog Output
DI	Digital Input
DO	Digital Output
PI	Pulse Input
OSP	Over Speed Protection