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iQ Platform-compatible PAC Process CPU/Redundant System/ SIL2 Redundant System

MELSEC iQ-R series

Story

MELSEC iQ-R Series Broadcast

Highly scalable process control

The MELSEC iQ-R Series enables a process control system through its range of CPU modules (up to 1200K steps) integrating advanced PID and general control into one module providing excellent system scalability (from small to large) for a best-fit solution. When paired with a redundant function module, it realizes a redundant control system ideal for applications that require highly reliable control. Various network modules with redundant functionality embedded are also available, further improving reliability.

Extensive visualization and data acquisition

Through its interconnectivity with supervisory control and data acquisition (SCADA) software, extensive plant-wide monitoring and control can be realized.

Highlights

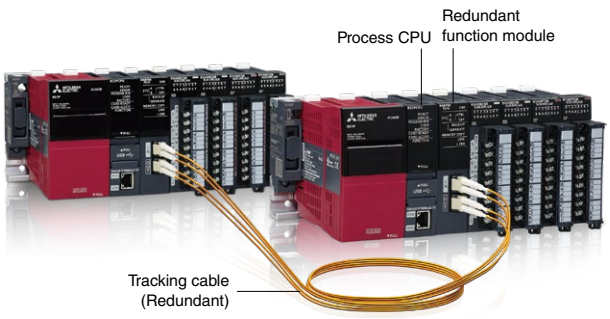
- High availability process control system
- Compliant with the IEC 61508 SIL 2 safety standard
- Excellent scalability with four models available (between 80K-1200K steps memory)
- Extensive visualization and data acquisition with Mitsubishi SCADA MC Works64
- Redundancy across multiple levels reduces single-point failures
- GX Works3 integrated engineering software

High availability across multiple levels

The MELSEC iQ-R Series redundant system enables high availability at multiple levels in the control system hierarchy, from visualization (SCADA) and control to networks, thereby improving system reliability. In addition, the MELSEC iQ-R Series SIL2 process CPU conforms to the IEC61508 SIL 2 safety standard, realizing a SIL 2-compliant redundant control system.

Integrated software simplifies engineering

GX Works3 integrated engineering software enables programming in multiple languages such as function block diagram (FBD) for process control. Intuitive features for simplifying process control system engineering include process tag label (variable) sharing, simple program structures, and easy project upload/download to the process CPU.



Process

High-available process control in a scalable automation solution

MELSEC iQ-R Series process CPU modules are designed to cover wide-ranging process control applications, from small- to large-scale. All models provide high-speed performance coupled with the ability to handle large PID loops utilizing embedded PID control algorithms; integrating both general and process control into one module. When paired with a redundant function module, a redundant control system ideal for applications that require highly reliable control can be easily realized at a low cost.

Redundant power supply module
- Protects system control from power failure

Remote station
Redundant remote network head module
- Enables continuous data communications by switching control between modules

Remote station 1

Remote station 2

CC-Link IE Field

High availability system

- Highly scalable
- Fast system switching
- Dual tracking cable
- Minimize single-point failure
- High-temperature environments (0 to 60°C)

Control system

Standby system

Tracking cable

CC-Link IE Control

Ethernet

SCADA

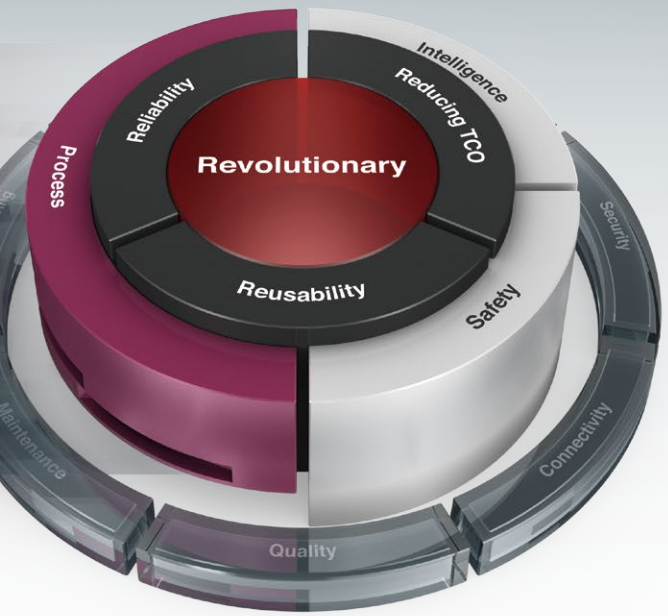
Redundant Ethernet
- Redundant communication line
- Same IP address settable for both control and standby systems

MC Works64

Extensive visualization and data acquisition

SCADA

Mitsubishi SCADA MC Works64 is a next generation supervisory control and data acquisition (SCADA) software providing extensive visualization with its enhanced interconnectivity with the MELSEC iQ-R Series. Advanced features such as energy management, scheduling, alarm and event management, trending, reporting, historian, and Geo-SCADA monitoring realize intuitive factory-wide control.



Mitsubishi Electric PAC MELSEC iQ-R "Process" Movie

Embedded PID algorithms

PID control

The process CPU includes dedicated algorithms such as two-degree-of-freedom PID, sample PI, and auto-tuning support advanced process control.

- I/O module supports disconnection detection
- Multi-channel analog module

Extension base unit
- *Supports Q Series modules (RQ extension base)*

Extension cable

Process control system

Process CPU
- Register up to 1000 tags (execute up to 300 PID loops)
- Fast process scan-type program execution cycle (50 ms)

GX Works3
One Software, Many Possibilities

CPU-embedded ECC memory
- Reliability improved by detection/ correction of data corruption (within 1 bit)

Multi-level redundancy ensuring continuous control

High availability

Highly reliable control systems can be easily realized minimizing the possibility of single-point failure at the visualization (SCADA), control, and network levels, thereby avoiding system downtime and ensuring continuous control and operation of critical systems.

One package process control software

Integrated engineering

GX Works3, the standard integrated engineering software for the MELSEC iQ-R Series, makes programming redundant process control systems relatively easy. The program editor uses function block diagram (FBD) language for process control and simplifies system configuration with its intuitive features such as process tag label (variables) sharing, simple program structure, and easy project upload/download to the process CPU.

Process CPU, Redundant function module

R08PCPU R32PCPU R6RFM
R16PCPU R120PCPU

- Highly scalable system with four CPU modules available (based on program capacity)
- Realize redundant control system when paired with redundant function module (R6RFM)
- Supports standalone process control when only the CPU is installed
- Dual optical-fiber tracking cable
- Large data tracking capacity up to 1 M word

Specifications

LD: Ladder diagram ST: Structured text FBD: Function block diagram SFC: Sequential function chart

Item	R08PCPU	R16PCPU	R32PCPU	R120PCPU
Control method	Stored program cyclic operation			
I/O control mode	Refresh mode (Direct access I/O is available by specifying direct access I/O (DX, DY))			
Programming language	LD ST FBD SFC			
Extended programming language	Function block (FB), label programming (system/local/global)			
Program execution type	Initial, scan, fixed scan, interrupt, standby			
Number of I/O points [X/Y] (point)	4096	4096	4096	4096
Memory capacity				
Program capacity (step)	80K	160K	320K	1200K
Program memory (byte)	320K	640K	1280K	4800K
Device/label memory (ECC type)*1 (byte)	1188K	1720K	2316K	3380K
Data memory (byte)	5M	10M	20M	40M

*1. Extended SRAM cassette expands the device/label memory area.

Item	R6RFM
Communication cable	Multi-mode optical cable
Max. distance (m)	550 (when the core outer diameter is 50 µm)
Tracking cable data capacity (word)	1M

Redundant power supply base (including extended temperature models)

R310RB (Main base)
R610RB (Extension base)
R38RB-HT (Main base "extended temp.")
R68RB-HT (Extension base "extended temp.")

- Enables the installation of redundant power supply modules
- Standard and extended temperature models available
- Utilize standard MELSEC iQ-R Series modules*2

Specifications

Item	Main base unit		Extension base unit	
	R310RB	R38RB-HT	R610RB	R68RB-HT
Number of I/O modules installed	10	8	10	8
DIN rail mounting adapter type	R6DIN1	R6DIN1	R6DIN1	R6DIN1
Redundant power supply support	●	●	●	●
Extended temperature range (0…60°C)*3	-	●	-	●
External dimensions (H x W x D, mm)	101 x 439 x 32.5	101 x 439 x 32.5	101 x 439 x 32.5	101 x 439 x 32.5

*2. Only these base units support the use of redundant power supply modules.
*3. Enables standard MELSEC iQ-R Series modules to support extended operating ambient temperatures of 0 to 60°C when installed.

Redundant power supply module

R63RP
R64RP

- Same size as standard power supply module
- Able to replace while online (hot-swap)
- Enables installation of up to two modules simultaneously on the same base unit

Specifications

Item	R63RP	R64RP
Input power supply voltage	24 V DC (19.2…31.2 V DC)	100…240 V AC (85…264 V AC)
Input frequency	-	50/60 Hz ±5%
Max. input apparent power (VA)	-	160
Max. input power (W)	50	-
Rated output current (5 V DC, A)	6.5	9
Redundant power supply function	●	●

Network modules supporting redundancy

RJ71EN71 (Ethernet multiple network)
RJ71GP21(S)-SX (CC-Link IE Control)
RJ71GF11-T2 (CC-Link IE Field)
RJ72GF15-T2 (CC-Link IE Field remote head)
RJ71LP21-25 (MELSECNET/H) NEW

- Dual Ethernet ports realizing redundant Ethernet communications
- Redundant CC-Link IE Control network (control station), CC-Link IE Field network (master station)
- Redundant CC-Link IE Field network remote head module supports dual network lines
- Redundant MELSECNET/H network module

Specifications

Item	RJ71EN71*1	RJ71GP21(S)-SX	RJ71GF11-T2*2, RJ72GF15-T2*3	RJ71LP21-25*4
Transmission speed (bps)	1 G	1 G	1 G	25 M/10 M
Network topology	Line topology, star topology, and ring topology	Duplex loop	Line topology, star topology, and ring topology	Duplex loop
Communication cable	Ethernet cable (Category 5e or higher, double shielded/ STP)	Optical cable (1000BASE-SX standard)	Ethernet cable (Category 5e or higher, double shielded/ STP)	Optical cable
Max. station-to-station distance (m)	100	550 (core outer diameter: 50 µm) 275 (core outer diameter: 62.5 µm)	100	1000
Overall cable distance (m)	Line: 12,000 (121 stations) Star: Depends on system configuration Ring: 12,100 (121 stations)	66,000 (120 stations; core outer diameter: 50 µm) 33,000 (120 stations; core outer diameter: 62.5 µm)	Line: 12,000 (121 stations) Star: Depends on system configuration Ring: 12,100 (121 stations)	30,000
Max. number of connectable stations	121 (master station: 1, slave station: 120)	120 (control station: 1, normal station: 119)	121 (master station: 1, slave station: 120)	64 (control station: 1, normal station: 63)
Redundant function	● (Ethernet)	● (CC-Link IE Control network)	● (CC-Link IE Field network)	● (MELSECNET/H)
Maximum link points per network (CC-Link IE Field network)				
Remote input (RX), remote output (RY)	16K points (16384 points, 2K bytes)	-	16K points (16384 points, 2K bytes)	-
Remote register (RWw, RWr)	8K points (8192 points, 16K bytes)	-	8K points (8192 points, 16K bytes)	-
Maximum link points per network (CC-Link IE Control network)				
Link relay (LB)	32K points (32768 points, 4K byte)*5	32K points (32768 points, 4K byte)*5	-	16384 points
Link register (LW)	128K points (131072 points, 256K byte)*5	128K points (131072 points, 256K byte)*5	-	16384 points
Link input (LX), link output (LY)	8K points (8192 points, 1K byte)	8K points (8192 points, 1K byte)	-	8192 points

*1. Redundant function can be used only when connected with Ethernet.
*2. SIL2-compliant redundant system is supported in the module firmware version of "23" or later.
*3. SIL2-compliant redundant system is supported in the module firmware version of "04" or later.
*4. For details, refer to "MELSEC iQ-R MELSECNET/H Network Module User's Manual (Startup) (SH-082202ENG)".
*5. When "Link points extended setting" is set to "Extend", refer to "MELSEC iQ-R Ethernet/CC-Link IE User's Manual (Startup) (SH-081256ENG)".

Channel isolated analog input module

R60AD6-DG NEW

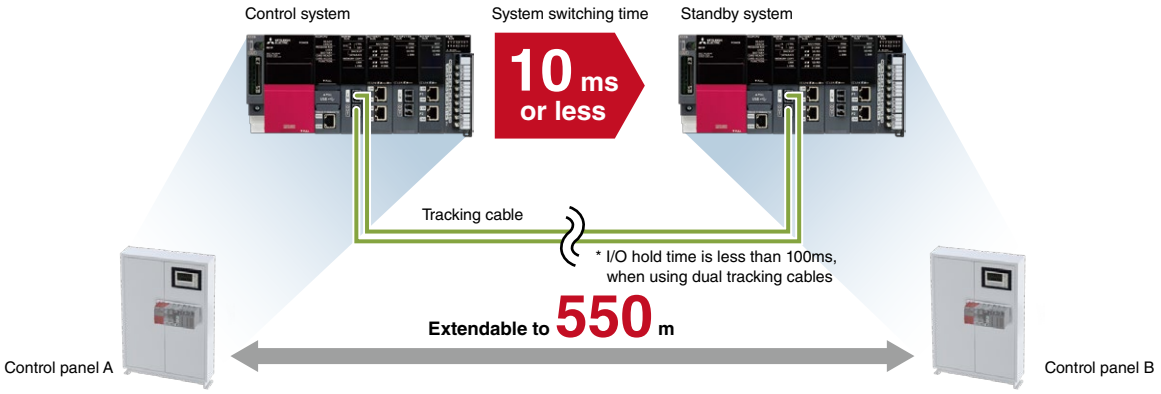
- Supplies power to the 2-wire transmitter
- Wiring to the power supply is unnecessary, reducing wiring cost
- Power supply to the 2-wire transmitter can be temporarily stopped for each channel even when a failure occurs, allowing maintenance without stopping the system

Specifications

Item	R60AD6-DG
Number of analog input channels	6
Accuracy	
Ambient temperature 25±5°C	Within ±0.1%
Temperature coefficient	±35 ppm/°C
Common	
Sampling period	10 ms/CH
Channel isolation	Transformer
Input from 2-wire transmitter	
Analog input current (mA DC)	4…20
Digital output value	0…32000
Current input	
Analog input current (mA DC)	0…20
Digital output value	0…32000

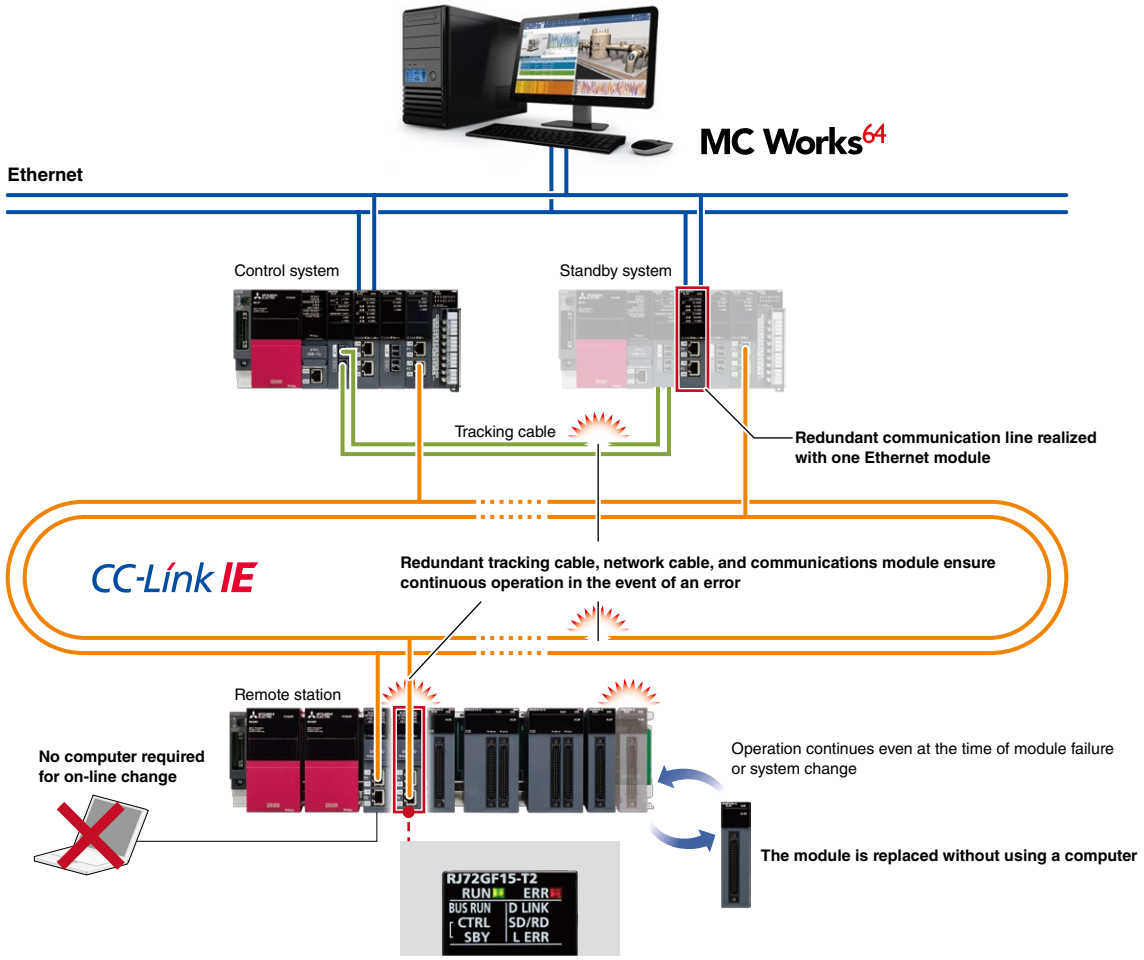
Redundant system remote location and high-speed switching

Optical-fiber tracking cables enable the standby system to be installed in a remote location up to 550m from the control (primary) system. The tracking cables are immune to noise interference and support fast data transfer rates. System switching speed has also been improved to speeds of 10 ms or less, enabling high-speed switching of the control system to standby system further improving reliability.



Improve reliability with reduced single-point failure

A multi-level redundant system can be realized by installing dual control systems consisting of the control (primary) and standby CPUs combined with a dual cable topology for the network cabling of the CC-Link IE Field networks, and dual remote stations minimizing the risk of singe-point failure. The Ethernet module is equipped with two communications ports, enabling continuous information level communications with SCADA software even if an error occurs with one of the ports. Only one module is required per control and standby system, reducing overall hardware cost. Online replacement of modules (hot-swapping) is possible without stopping the operating control system.



RUN LED status

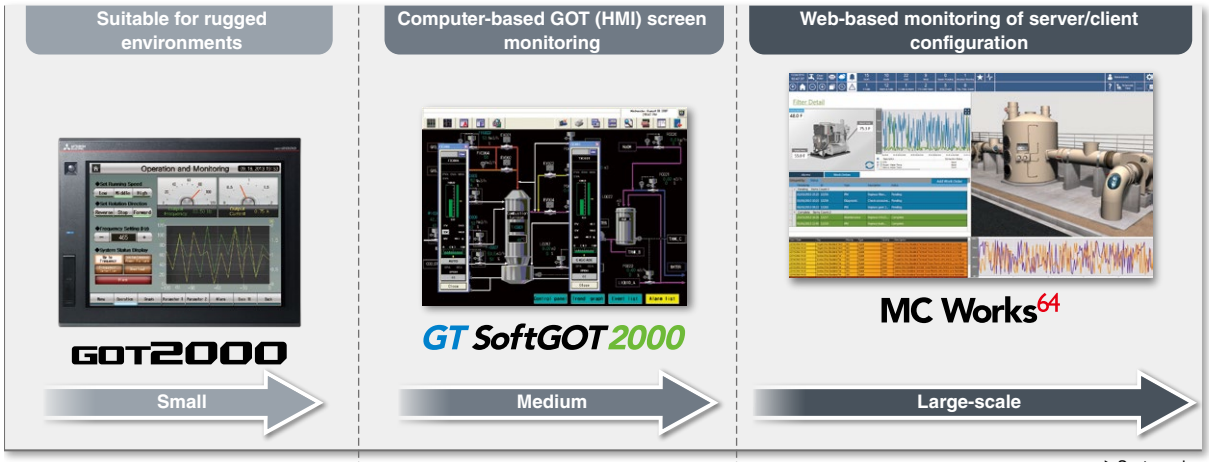
RUN LED on the remote head module is operating intermediately showing that a module is being replaced

Efficient engineering through extensive compatibility between software

An efficient and highly-scalable engineering environment can be realized by the extensive compatibility between GX Works3 together with SCADA software (MC Works64), monitoring software GT SoftGOT and GT Works3 [GOT (HMI)].

• Highly scalable process control visualization

Process tag labels (variables) can be shared between GX Works3, Mitsubishi SCADA MC Works64, GT SoftGOT and GOT (HMI), realizing an efficient engineering environment that makes screen creation easier. In addition, a scalable SCADA control system can be realized combining these products.



Shop floor monitoring

■ Generation of GOT (HMI) screens
Easily create process control monitoring screens (GOT2000/GOT1000)

Computer-based monitoring

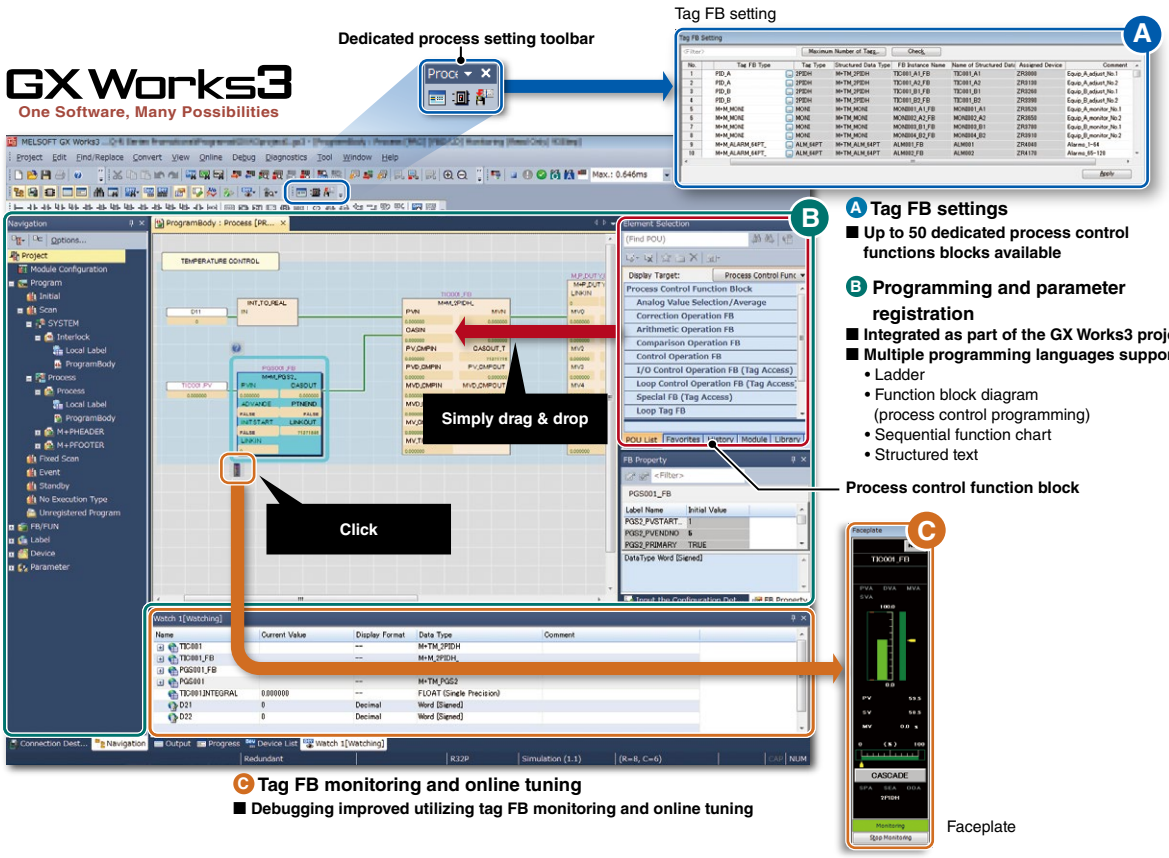
■ Linkage with GT SoftGOT
Monitor tool and GT SoftGOT compatibility enable screens to be called between each software

Integrated monitoring

■ Generating Mitsubishi SCADA MC Works64 screens
Easily create screens using the process linkage tool

• Integrated engineering software realizing easy programming and maintenance

GX Works3 is a centralized programming environment supporting various programming, debug and maintenance features, thereby enabling efficient engineering. Multiple programming languages can be used within the same GX Works3 project, including function block diagram (process control programming), ladder, structured text and sequential function chart.



A Tag FB settings

■ Up to 50 dedicated process control functions blocks available

B Programming and parameter registration

■ Integrated as part of the GX Works3 project
■ Multiple programming languages supported
- Ladder
- Function block diagram (process control programming)
- Sequential function chart
- Structured text

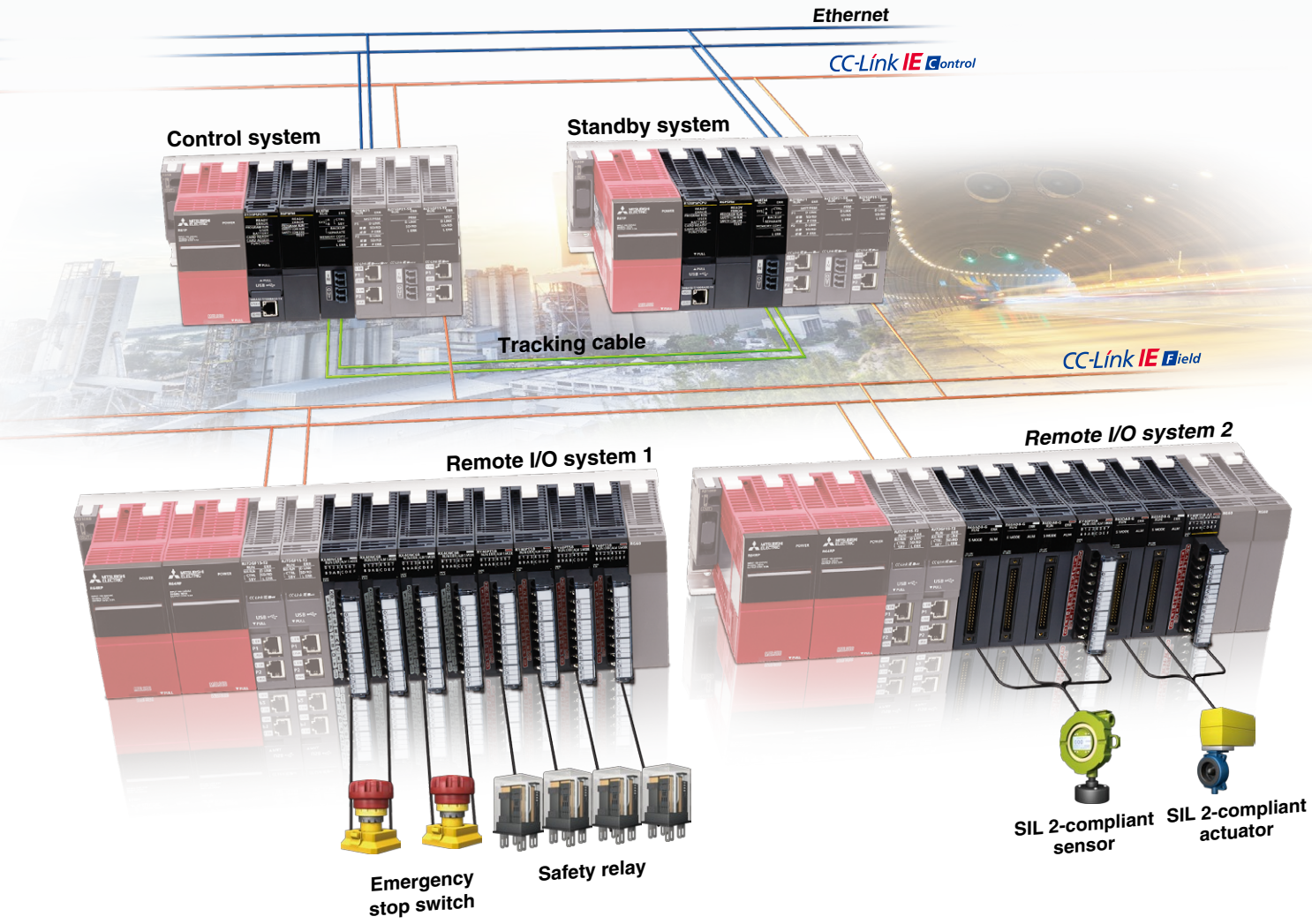
C Tag FB monitoring and online tuning

■ Debugging improved utilizing tag FB monitoring and online tuning

Redundant system complying with IEC 61508 SIL 2

In public infrastructure applications, a highly reliable supervisory and control system is required that conforms to international safety standards. The MELSEC iQ-R Series SIL 2-compliant redundant control system fulfills these stringent requirements by offering a control system compliant with IEC 61508 SIL 2*1, as certified by TÜV Rheinland®.

*1. SIL: Safety integrity level.



Integrate both SIL 2-compliant and non-compliant modules

Installation of SIL 2-compliant modules (SIL2 process CPU, CC-Link IE Field network module) and SIL 2 non-compliant general modules (CC-Link IE Control network, CC-Link, Ethernet) on the same main base unit.

SIL2 process CPU

R08PSFCPU-SET
R16PSFCPU-SET
R32PSFCPU-SET
R120PSFCPU-SET

- Product package includes a SIL2 process CPU module and SIL2 function module, which is necessary for realizing a SIL 2-compliant system
- Redundant control system compliant with SIL 2 when paired with redundant function module (R6RFM)
- Execute generic (process) control and safety control programs on the same CPU

Specifications

LD: Ladder diagram ST: Structured text FBD: Function block diagram

Item	R08PSFCPU-SET*1	R16PSFCPU-SET*1	R32PSFCPU-SET*1	R120PSFCPU-SET*1
Control method	Stored program cyclic operation			
I/O control mode	Refresh mode (Direct access I/O is available by specifying direct access I/O (DX, DY))			
Programming language	LD ST*2 FBD*2			
Extended programming language	Function block (FB), label programming (system/local/global)			
Program execution type	Initial*2, scan*2, fixed scan, interrupt*2, standby*2			
Number of I/O points [X/Y] (point)	4096	4096	4096	4096
Constant scan (ms) (Function for keeping regular scan time)	0.2…2000 (Setting available in 0.1ms increments)			
Memory capacity				
Program capacity (step)	80K*4	160K*4	320K*4	1200K*4
Program memory (byte)	320K	640K	1280K	4800K
Device/label memory (ECC type)*3 (byte)	1178K	1710K	2306K	3370K
Data memory (byte)	5M	10M	20M	40M
Memory interface				
SD memory card	●	●	●	●
Extended SRAM cassette	●	●	●	●
Safety standard				
IEC 61508 SIL 2	●	●	●	●
Function*5				
Multiple interrupt	●	●	●	●
Standard PID control	●	●	●	●
Process control	●	●	●	●
Data logging	-	-	-	-
Security function	●	●	●	●
Inter-modular synchronization*6	-	-	-	-
SLMP communication	●	●	●	●
Online module change	●	●	●	●

*1. Product package includes a SIL2 process CPU (R□PSFCPU) and SIL2 function module (R6PSFM).
*2. Cannot be used for safety control programs.
*3. An extended SRAM cassette expands the device/label memory area.
*4. Program capacity of 40K steps is allocated for safety program.
*5. Memory dump and real-time monitor are not supported.
*6. Inter-modular synchronization is not supported when used in redundant mode.

I/O module (with diagnostic functions)

RX40NC6B
RY40PT5B

- Includes input disconnection, output disconnection, and short-circuit detection
- Supports SIL 2 inputs and outputs by duplexing of each module in the system configuration
- Collects module event errors in the CC-Link IE Field network remote head module

Specifications

Item	RX40NC6B*7	RY40PT5B*7
	Input (with diagnostic functions)	Source output (with diagnostic functions)
Number of I/O points	16	16
Rated input voltage (V DC)	24	-
Rated input current (mA)	6.0	-
Rated load voltage (V DC)	-	24
Max. load current (A/point)	-	0.5
Response time	1 ms…70 ms	≤ 1.5 ms
Common terminal arrangement (points/common)	16 (negative common)	16
Interrupt function	●	-
Protection function (overload, overheat)	-	●
Diagnostic functions*8		
Disconnection detection	●	●
Short-circuit detection	-	●
External interface		
18-point screw terminal block	●	●

*7. When used in the SIL 2-compliant redundant system (SIL 2 is supported in the module firmware version of "02" or later).
*8. For more information about diagnostic functions, please refer to the relevant product manual.

Isolated analog I/O module
R60AD8-G
R60DA8-G

SIL2 analog control output module
RY40PT5B-AS

- Internal galvanic channel isolation improves noise interference capabilities (without requiring an additional signal converter) and protects module components from short-circuiting
- Combining isolated analog input and output modules with the SIL2 analog control output module realizes a SIL 2-compliant analog output

Isolated analog I/O module specifications

Item	R60AD8-G*1	R60DA8-G*1
	Analog input	Analog output
Number of analog I/O points (ch)	8	8
Conversion speed (ch)	10 ms	1 ms
Channel isolation	Transformer isolation	Transformer isolation
Absolute max. input	±15 V, 30 mA	-
Output short-circuit protection	-	●
Voltage input/output		
Analog voltage (V DC)	–10…10	–12…12
Digital value	–32000…32000	–32000…32000
Current input/output		
Analog current (mA DC)	0…20	0…20
Digital value	0…32000	0…32000
External interface		
40-pin connector	●	●

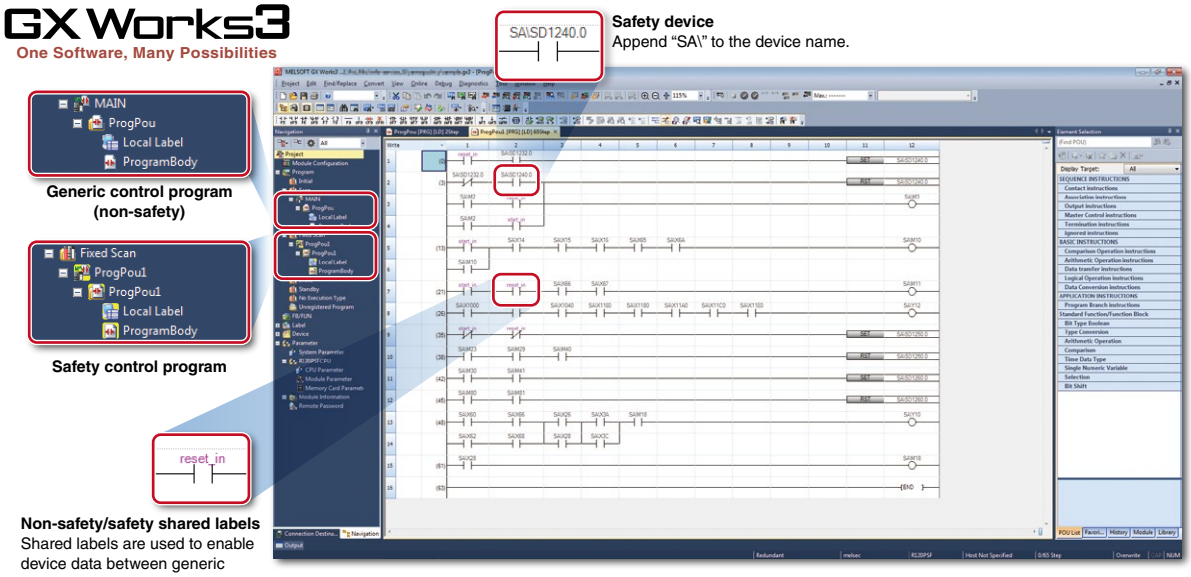
*1. When used in the SIL 2-compliant redundant system (SIL 2 is supported in the module firmware version of "02" or later).

SIL2 analog control output module specifications

Item	RY40PT5B-AS
Number of output points	16
Rated load voltage (V DC)	24
Max. load current (A/point)	0.5
Response time	≤ 1.5 ms
Control cycle time (ms)	2
Common terminal arrangement (points/common)	16
External interface	
18-point screw terminal block	●

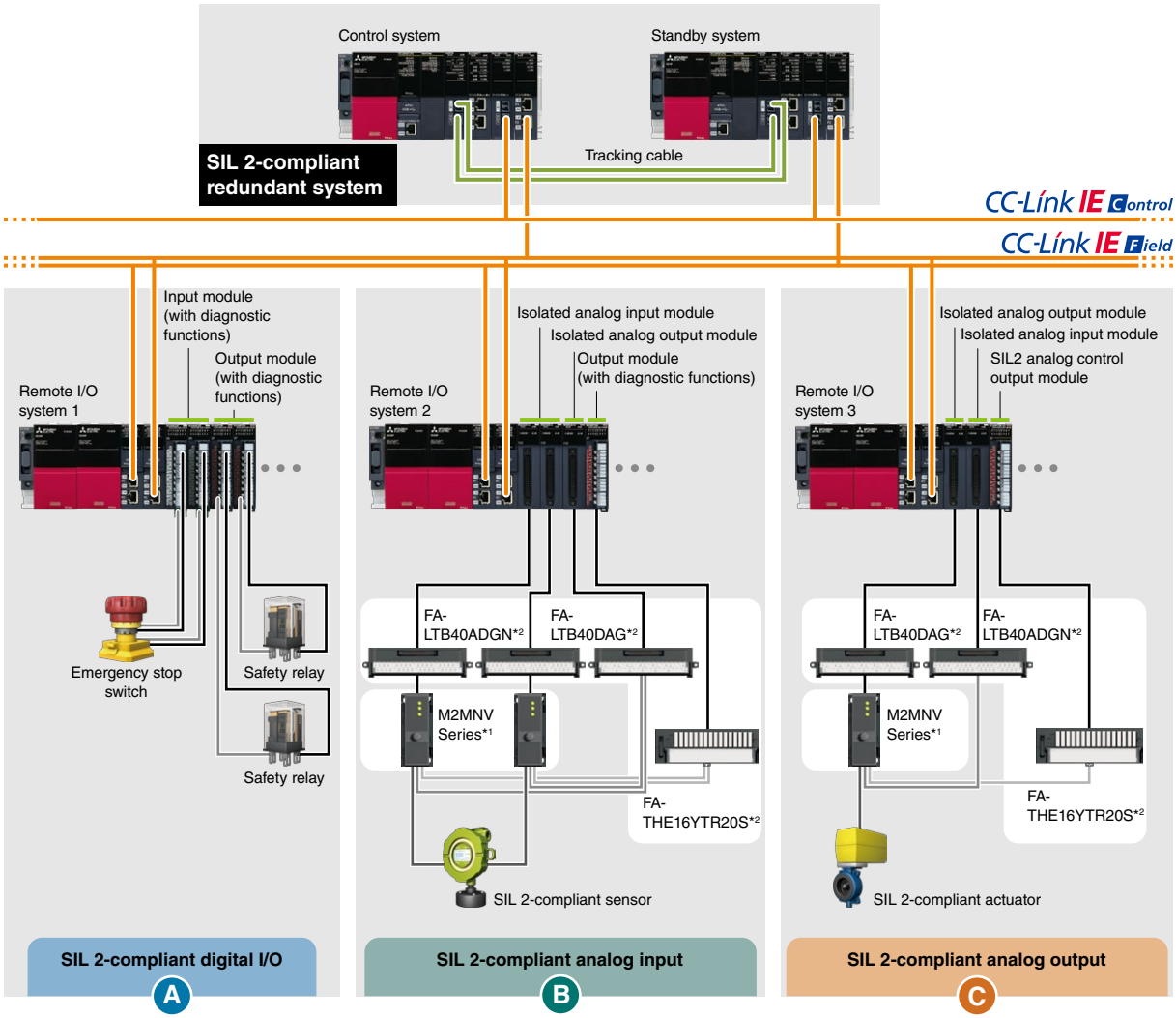
Integration of non-safety and safety control

Safety control programs are created using ladder logic. Both generic and safety control programs can be included in a GX Works3 project. A safety control program is created using safety devices and generic/safety shared labels, and its program execution type is specified as a fixed scan program.



SIL 2-compliant redundant system configuration

A SIL 2-compliant redundant control system can be easily realized by utilizing various dedicated modules such as the SIL2 process CPU and digital I/O module (with diagnostic functions).



A SIL 2-compliant digital I/O

SIL 2-compliant safety inputs and outputs are configured by having a set of two input modules (RX40NC6B) and two output modules (RY40PT5B) with diagnostic functions.

B SIL 2-compliant analog input

SIL 2-compliant analog inputs are configured by having four modules in total. This consists of two analog input modules (R60AD8-G) with channel isolation, one analog output module (R60DA8-G) with channel isolation, and one digital output module (RY40PT5B) with diagnostic functions. The resulting digital value is verified with the calculated digital value.

C SIL 2-compliant analog output

SIL 2-compliant analog outputs are configured to have three modules in total. This consists of one analog output module (R60DA8-G) with channel isolation, one analog input module (R60AD8-G) with channel isolation, and one SIL2 analog control output module (RY40PT5B-AS). The resulting analog output value is verified with the set value.

*1. These products are manufactured by a third-party, for further information please contact your local Mitsubishi Electric sales office or representative.
*2. These products are manufactured by Mitsubishi Electric Engineering Co., Ltd.

MELSEC iQ-R Series process control used in industry

MELSEC iQ-R Series process CPU/redundant systems are ideal for various industrial process control applications requiring highly reliable process control solutions that can be easily integrated. Most components are based on the standard range of MELSEC iQ-R Series modules, enabling total cost of ownership to be reduced through utilization of its extensive functions and features.

PID control for stringent control of ingredients mix

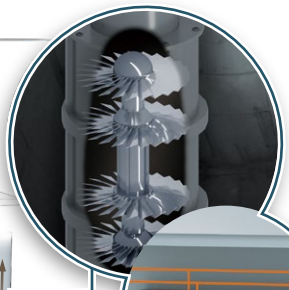
- Extensive PID instructions that are embedded in the CPU can be used for maintaining stringent process parameters such as for beverage ingredient processing.

Facility-wide monitoring and control

- Factory-wide visualization and data acquisition in real-time with status data updated seamlessly.

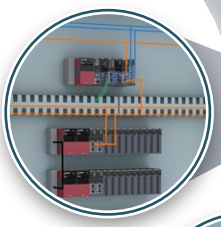
SIL 2 redundant control of ventilation system

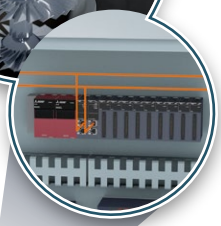
- System configuration compliant with IEC 61508 SIL 2



Extended tracking cable length improves reliability

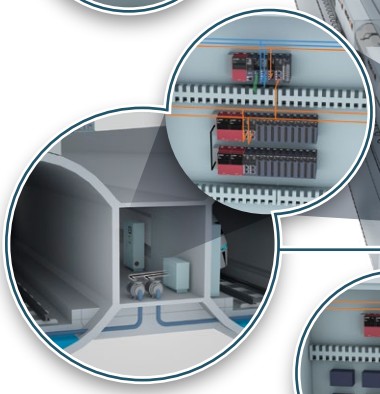
- Improve reliability even further by installing the control (primary) and standby systems in separate control cabinets utilizing long-length tracking cable.





Redundant control of drainage pumping control systems

- Protection against system failures of critical processes can be realized ensuring continuous control in the event of control equipment failure.



Reduce wiring with remote stations closer to processes

- Locate remote stations closer to actual control processes to save on wiring, thereby reducing cost.

Country/Region Sales office

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⚠ For safe use

- To use the products listed in this publication properly, always read the relevant manuals before use.

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