

Ethernet-based Open Network

CC-Link IE Field Network

MELSEC-Q series Simple Motion Module QD77GF16

February 2013

New Product Release

SV1302-4E



Mitsubishi's superior Motion performance now available for CC-Link IE Field Network

The QD77GF16 Simple Motion module combines the versatility of Ethernet and highly accurate synchronous operation for Motion control.

CC-Link IE Field Network for Motion Control

- The new industrial Ethernet field network with high flexibility enables intelligent manufacturing systems to perform high speed I/O control and Motion control simultaneously.
- The network wiring layout is highly flexible to best fit the needs of the application. Choose from line, star, or mixed line and star topology.
- QD77GF16 can be used as the master station of CC-Link IE Field Network, and connected to a wide variety of devices, such as I/O devices.
- Shorten tact time by using the 1Gbps CC-Link IE Field Network.
- Based on Ethernet standards, cables and connectors are widely available around the world.

CC-Link IE Field

This new industrial Ethernet field network enables intelligent manufacturing systems to perform high speed I/O control and Motion control. Wiring is done easily thanks to standard Ethernet cables and flexible topology.

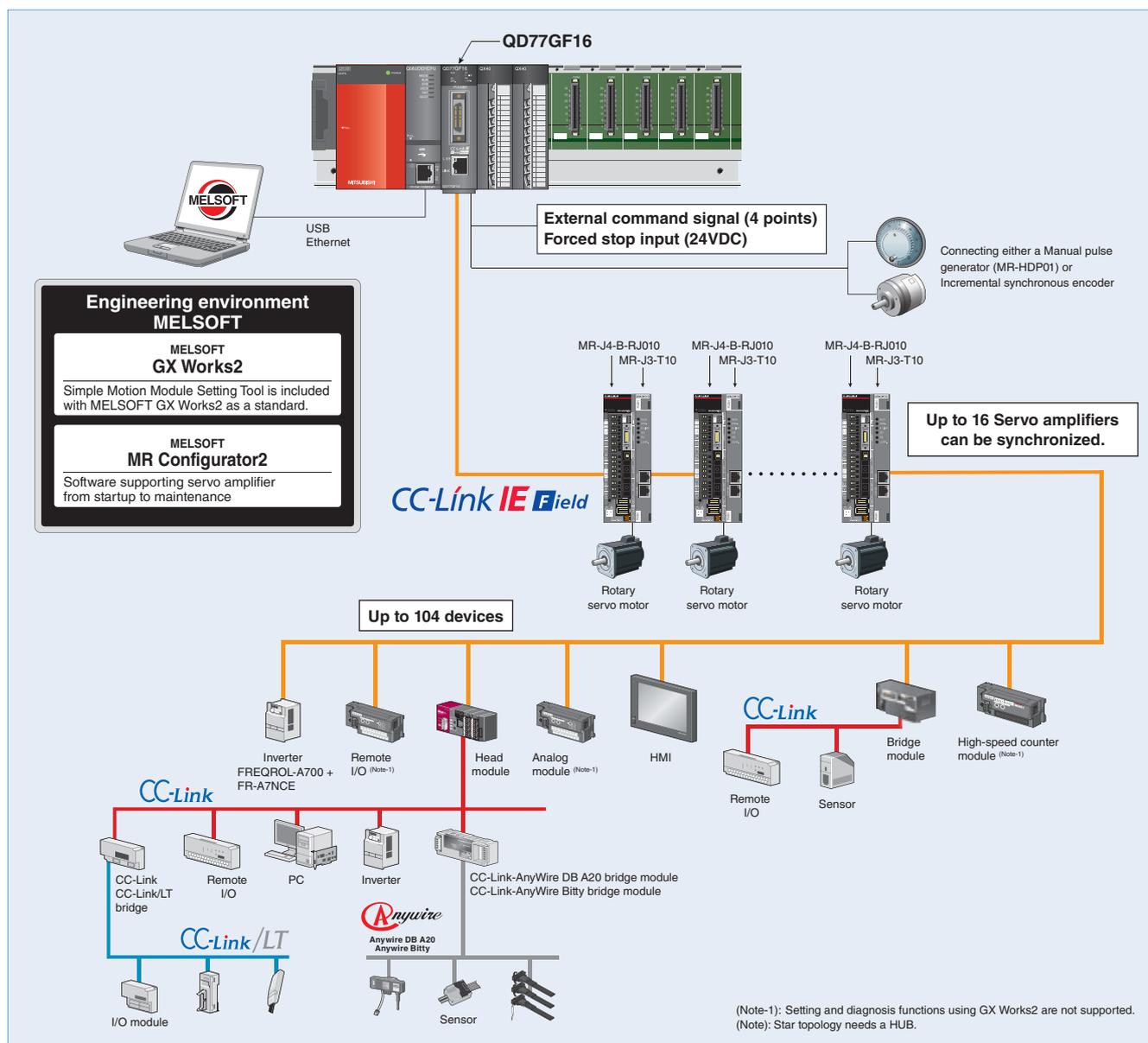
All-rounder network opens up new areas of control introducing "Motion Control" to CC-Link IE Field Network

The CC-Link IE Field Network is now equipped with Motion control to further extend control ranges.

- ▶ Deterministic and synchronized communication
- ▶ Faster cycle time
- ▶ Central control with network

System configuration

- Starting from the sequence program, positioning/synchronous/cam control are easily performed with simple parameter settings.
 - QD77GF16 can be used as the master station of CC-Link IE Field Network. (equivalent to QJ71GF11-T2) ^(Note-1)
 - Within one network, QD77GF16 can communicate with servo amplifiers and field devices (Remote I/O, Sensor, etc.).
- (Note-1): QD77GF can be used only as a master station. Line and star topology are available. Up to 104 slave devices can be connected in one network.



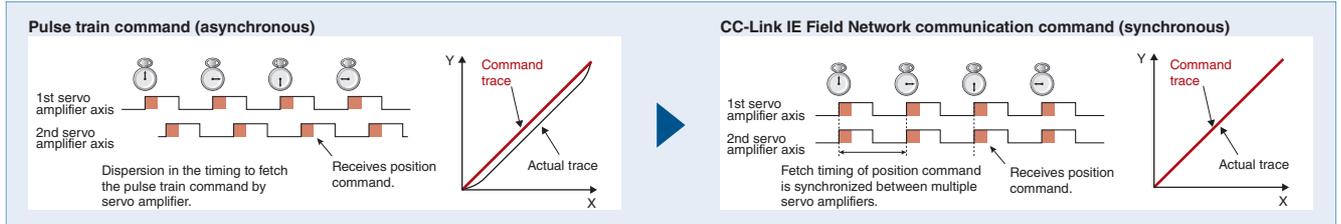
High-response system achieved with CC-Link IE Field Network

CC-Link IE Field Motion

Motion Control

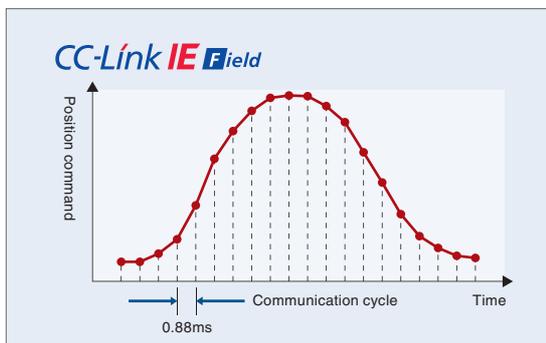
Deterministic and synchronized communication

Synchronous control and interpolation functions are achieved with the synchronized communication of CC-Link IE Field Network, being applied to machines which need synchronous control such as food machineries and processing machines.



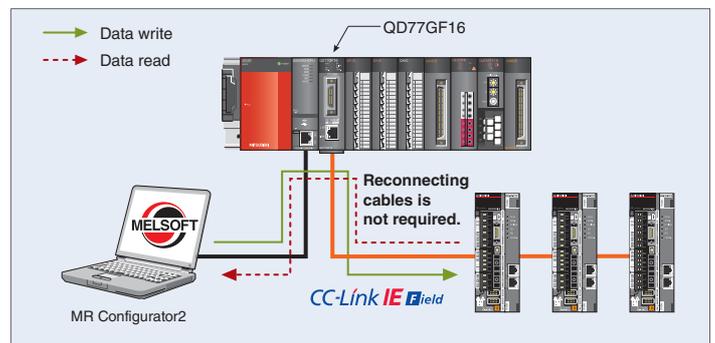
Faster cycle times

Smooth control of machine is possible using high-speed communication with cycle times of 0.88 ms.



Central control with network

Large amounts of servo data are exchanged in real-time between the controller and the servo amplifier. Using MR Configurator2 on a personal computer that is connected to the Simple Motion module QD77GF helps consolidate information such as parameter settings and monitoring for the multiple servo amplifiers.

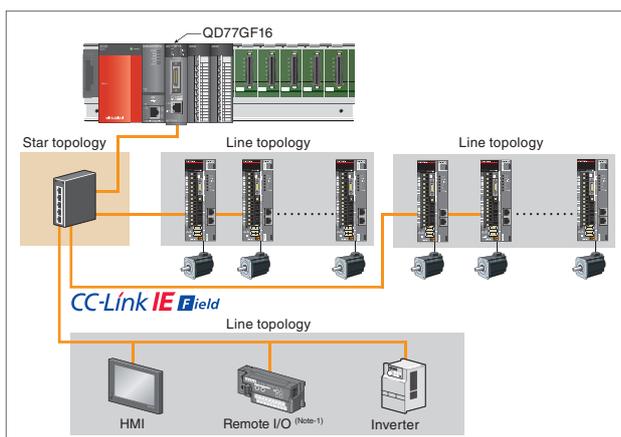


Flexible network topology

Line, Star, or Mixed line and star topology are available for the CC-Link IE Field Network wiring layout.

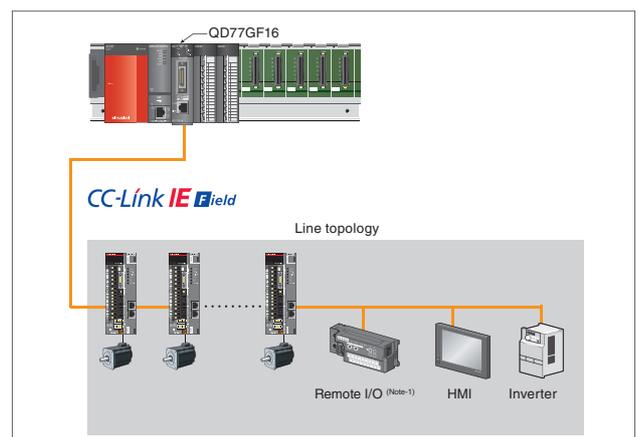
Mixed line and star topology

Star topology is available using an industrial switching HUB. HUB applied: DT135TX (MITSUBISHI CABLE INDUSTRIES, LTD.)



Line topology

The simple Motion modules (Master station) can be connected to slave devices without using a HUB, which reduces cost.



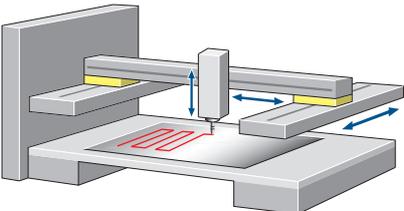
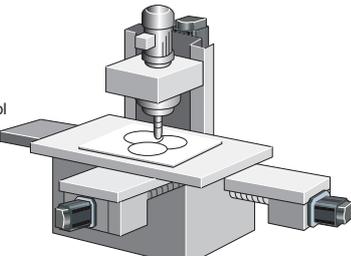
(Note-1): Setting and diagnosis functions using GX Works2 are not supported.

A variety of controls including positioning control, cam control and synchronous control can be achieved easily just with a sequence program.

Positioning control

- Various machines can be extensively controlled by various control methods such as linear interpolation control, 2-axis circular interpolation control, current value change, fixed-pitch feed control and continuous trajectory control.
- Automatic operation is executed by setting the positioning addresses and speeds, etc., to a sequence program.
- Powerful sub functions such as M-codes, skip function, step operation and target position change function.

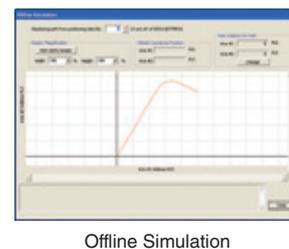
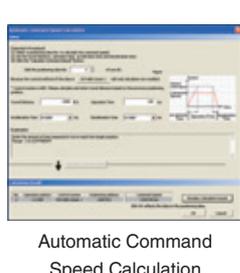
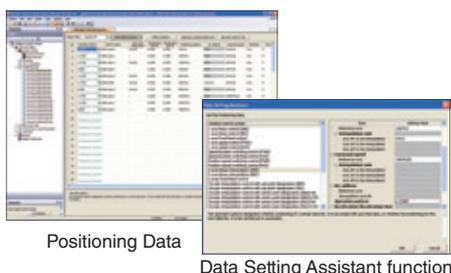
Application examples

<p>Sealing (with a Rotary servo motor)</p> <ul style="list-style-type: none"> ■ Linear interpolation ■ Circular interpolation ■ Synchronous control ■ Continuous trajectory control 	<p>X-Y table</p> <ul style="list-style-type: none"> ■ Linear interpolation ■ Circular interpolation ■ Continuous trajectory control 
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Simple operation for easy use

Execute positioning control with the data table method.

- The Data Setting Assistant function simplifies the setting input process of positioning data.
- Positioning data can be set very simply by using functions such as Automatic Command Speed Calculation, Offline Simulation, and automatic calculation of auxiliary arc, etc.



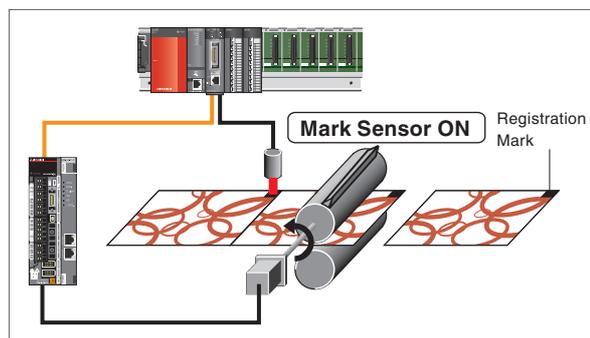
Various functions

Mark detection function

This function detects registration marks on packing material moving at high speed using a sensor, and sets the current position to the buffer memory. Any fluctuation errors between the current sensed position and the standard position are compensated, and the packing material is cut at the set position.

Latch Data

- | | |
|--|--|
| • Current feed value | • Machine feed value |
| • Current value per cycle after main shaft gear | • Current value after composite main shaft gear |
| • Current value per cycle after auxiliary shaft gear | • Real current value |
| • Cam axis current value per cycle | • Cam axis current value per cycle (Real position) |
| • Synchronous encoder axis current value | • Servo input axis current value |
| • Synchronous encoder axis current value per cycle | |



Module error collection function

This function collects errors occurred in the QD77GF in the PLC CPU. Those errors are stored in a memory (latch area) of the PLC CPU as module error logs. The stored error logs are retained even when the PLC CPU is powered off or reset.

(1) Errors occurred.

CPU 🕒 19:33 Error C1 occurred!	QD77GF 🕒 19:29 Error A1 occurred! 🕒 19:36 Error A2 occurred!	Module B 🕒 19:34 Error B1 occurred!
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Error history of PLC CPU (including built-in I/O function and built-in CC-Link function) and intelligent function module is displayed in one screen.
Errors in the entire system can be monitored in reverse chronological order.

GX Works2

(2) Collects and stores the errors.

Error history (CPU module)		Module error log	
Time	Error code	Time	Module in error Error code
19:33	Error C1	19:29	QD77GF Error A1
		19:34	Module B Error B1
		19:36	QD77GF Error A2

(3) Displays the error list.

Error history display		
Time	Module in error	Error code
19:29	QD77GF	Error A1
19:33	CPU	Error C1
19:34	Module B	Error B1
19:36	QD77GF	Error A2



Synchronous and cam control

- Achieve synchronous control and cam control by using input pulses from a synchronous encoder or virtual servo amplifier.
- Use an incremental synchronous encoder with the directly built-in interface of QD77GF.
- Further improve the synchronization accuracy with the phase compensation function, designed to compensate for synchronous encoder delays.

Application examples

Horizontal form, fill & seal



Conveyors and product handling equipment



Synchronous control parameter setting

Synchronous control data is easily created with software by placing mechanical modules on screen, such as the gear, shaft, speed change gear and cam.

- Easily perform the Synchronous control with parameter settings. There is no need to create complicated programs.
- You can select a start or stop of Synchronous control for individual axis. The synchronous control axis and positioning control axis can exist together in a program.
- The movement amount of main shaft is transmitted to the output axis via the clutch.



Synchronous control parameter settings

Cam data creation

Cam data is easily created for various patterns.

- Cam control has become more flexible than the conventional ones. Various cam patterns are available.
- You can set the stroke, speed, acceleration, and throb while simultaneously checking the profile on a graph.
- The created cam data can be checked by viewing as thumbnail displays of cam data.
- Import and export cam data in CSV format.

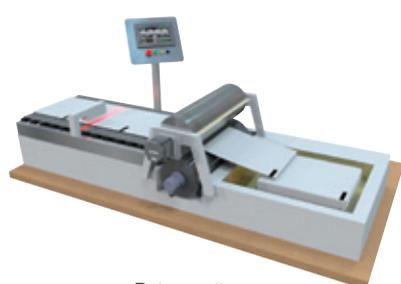


Cam data

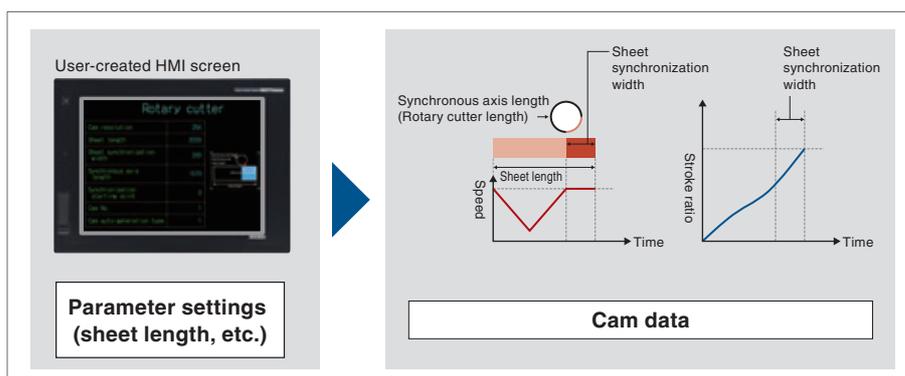
Cam data list

Cam auto-generation function

This function can create a cam automatically according to the sheet length and synchronization width, and the rotary cutter axis dimension, which greatly reduces the designing and programming time.



Rotary cutter



Simple Motion module specifications

Module specification



Item		Specifications		
Servo amplifier connection system		Connection with CC-Link IE Field Network		
Maximum transmission distance between servo amplifiers [m(ft.)]		100 (328.08)		
Peripheral I/F		Via CPU module (USB, RS-232, Ethernet)		
Interface with external devices	External input signal	Number of input points	4 points	
		Input method	Positive common/ Negative common shared (Photocoupler)	
		Rated input voltage/ Rated input current	24 VDC/ Approx. 5 mA	
		Operating voltage range	21.6 to 26.4 VDC (24 VDC \pm 10%, ripple ratio 5% or less)	
		ON voltage/current	17.5 VDC or more/ 3.5 mA or more	
		OFF voltage/current	5 VDC or less/ 0.9 mA or less	
		Input resistance	Approx 5.6 k Ω	
		Response time	1 ms or less	
		Recommended wire size	AWG24 (0.2 mm ²)	
		Forced stop input signal (EMI)	Number of input points	1 point
	Input method		Positive common/ Negative common shared (Photocoupler)	
	Rated input voltage/ Rated input current		24 VDC/ Approx. 2.4 mA	
	Operating voltage range		20.4 to 26.4VDC (24VDC +10%/-15%, ripple ratio 5% or less)	
	ON voltage/current		17.5 VDC or more/ 2 mA or more	
	OFF voltage/current		1.8 VDC or less/ 0.18 mA or less	
	Input resistance		Approx. 10 k Ω	
	Response time		1 ms or less	
	Recommended wire size		AWG24 (0.2 mm ²)	
	Manual pulse generator/ Incremental synchronous encoder signal		Signal input form	Phase A/Phase B (magnification by 4/magnification by 2/magnification by 1), PLS/SIGN
		Differential-output type (equivalent to 26LS31)		Input frequency
High-voltage				2.0 to 5.25 VDC
Voltage-output/ Open-collector type (5VDC)		Low-voltage		0 to 0.8 VDC
		Differential-voltage	\pm 0.2 VDC	
		Cable length [m(ft.)]	Up to 30 (98.43)	
		Input frequency	200 kpps (After magnification by 4, up to 800 kpps)	
		High-voltage	3.0 to 5.25 VDC	
	Low-voltage	0 to 1.0 VDC		
	Cable length [m(ft.)]	Up to 10 (32.81)		
Number of I/O occupying points		32 points (I/O allocation: Intelligent function module, 32 points)		
Maximum number of modules specification		1		
5VDC internal current consumption [A]		0.8		
Mass [kg]		0.26		
Exterior dimensions [mm(inch)]		98.0 (3.86) (H) \times 27.4 (1.08) (W) \times 115 (4.53) (D)		

Performance specifications

Item		Specifications
		Motion station
Maximum number of links per network	RX	8k points (8192 points, 1k bytes)
	RY	8k points (8192 points, 1k bytes)
	RWr	1k points (1024 points, 2k bytes)
	RWw	1k points (1024 points, 2k bytes)
Maximum number of link per station	RX	8k points (8192 points, 1k bytes)
	RY	8k points (8192 points, 1k bytes)
	RWr	1k points (1024 points, 2k bytes)
	RWw	1k points (1024 points, 2k bytes)
Communication speed		1Gbps
Maximum stations per network	I/O devices	105 (1 master plus 104 slave stations)
	Servo amplifier	16
Connectable station type	Local station	x
	Intelligent device station	○
	Remote device station	○
	Remote I/O station	○
Cable type		Ethernet cable (Category 5e or higher)
Overall cable distance (max.)	Line topology	12000m (with 1 master plus 120 slaves connected)
	Star topology	Depends on the system configuration
Station-to-station distance (max.)		100m
Maximum number of networks		239
Topology		Line, star, or mixed line and star topology

○: Able to connect, x: Unable to connect

Cable specifications

Item		Specifications
		Category 5e or higher, (Double shielded/STP) Straight cable
Ethernet cable	Standard	The following conditioning cables: • IEEE802.3 (1000BASE-T) • ANSI/TIA/EIA-568-B (Category 5e)
	Connector	RJ-45 connector with shield

(Note): Use the cables recommended by CC-Link Partner Association for CC-Link IE Field Network.

CC-Link IE Field Network cables are not compatible with CC-Link IE Controller Network.

The cable for CC-Link IE Field Network cable is produced by Mitsubishi Electric System & Service.

For details of Mitsubishi Electric System & Service Co., Ltd. products, contact us by sending an e-mail to the following address.

<Sales office> FA PRODUCT DIVISION mail: osb.webmaster@melsc.jp



Control specification

Item		Specification		
		QD77GF16		
Number of control axes		16 axes		
Operation cycle ^(Note-1)		0.88ms/1.77ms/3.55ms		
Interpolation function		Linear interpolation (Up to 4 axes), 2-axis circular interpolation		
Control system		PTP (Point To Point) control, Trajectory control (both linear and arc can be set), Speed control, Speed-position switching control, Position-speed switching control		
Acceleration/deceleration process		Trapezoidal acceleration/deceleration, S-curve acceleration/deceleration		
Compensation function		Backlash compensation, Electronic gear, Near pass function		
Synchronous control		External encoder, Cam, Phase Compensation, Cam auto-generation function		
Control unit		mm, inch, degree, PLS		
Positioning data		600 data (positioning data No. 1 to 600)/axis (Can be set with MELSOFT GX Works2 or Sequence program.)		
Backup		Parameters, positioning data, and block start data can be saved on flash ROM. (battery-less backup)		
OPR control	Machine OPR control	Near-point dog method, Count method 1, Count method 2, Data set method, Scale origin signal detection method		
	Fast OPR control	Provided		
	Sub functions	OPR retry, OP shift		
Positioning control	Position control	Linear control	1-axis linear control, 2-axis linear interpolation control, 3-axis linear interpolation control, 4-axis linear interpolation control ^(Note-3) (Composite speed, Reference axis speed)	
		Fixed-pitch feed control	1-axis fixed-pitch feed control, 2-axis fixed-pitch feed control, 3-axis fixed-pitch feed control, 4-axis fixed-pitch feed control	
		2-axis circular interpolation control	Sub point designation, Center point designation	
	Speed control	1-axis speed control, 2-axis speed control, 3-axis speed control, 4-axis speed control		
	Speed-position switching control	INC mode, ABS mode		
	Position-speed switching control	INC mode		
	Other control	Current value change	Changing to a new current value using the positioning data, Changing to a new current value using the start No.	
		NOP instruction	Provided	
		JUMP instruction	Unconditional JUMP, Conditional JUMP	
LOOP, LEND		Provided		
High-level positioning control		Block start, Condition start, Wait start, Simultaneous start, Repeated start		
Manual control	JOG operation	Provided		
	Inching operation	Provided		
	Manual pulse generator operation	Possible to connect 1 module (Incremental) Unit magnification (1 to 10000 times)		
Absolute position system		Made compatible by setting battery to servo amplifier		
Synchronous encoder interface		Up to 4 channel (internal interface, via the PLC CPU interface)		
Functions that limit control	Internal interface	1 channel (Incremental)		
	Speed limit function	Speed limit value, JOG speed limit value		
	Torque limit function	Torque limit value_same setting, Torque limit value_individual setting		
	Forced stop function	Valid/Invalid setting		
	Software stroke limit function	Movable range check with current feed value, movable range check with machine feed value		
	Hardware stroke limit function	Provided		
Functions that change control details	Speed change function	Provided		
	Override function	Provided		
	Acceleration/deceleration time change function	Provided		
	Torque change function	Provided		
	Target position change function	Target position address and target position speed are changeable		
Other functions	M-code output function	Provided		
	Step function	Deceleration unit step, Data No. unit step		
	Skip function	Via PLC CPU, Via external command signal		
	Teaching function	Provided		
Mark detection function			Continuous Detection mode, Specified Number of Detections mode, Ring Buffer mode	
	Mark detection signal	4 points		
Digital oscilloscope function ^(Note-2)	Mark detection setting	16		
			Bit data:16 channels, Word data: 16 channels	

(Note-1): Default value is 1.77 ms. If necessary, check the operation time and change to 0.88 ms.

(Note-2): 8ch word data and 8ch bit data can be displayed in real time.

(Note-3): 4-axis linear interpolation control is effective only for the reference axis speed.

Synchronous control specification

Item		Specification
		QD77GF16
Input axis	Servo input axis	16 axes/module
	Synchronous encoder axis	4 axes/module
Composite main shaft gear		1 /output axis
Main shaft main input axis		1 /output axis
Main shaft sub input axis		1 /output axis
Main shaft gear		1 /output axis
Main shaft clutch		1 /output axis
Auxiliary shaft		1 /output axis
Auxiliary shaft gear		1 /output axis
Auxiliary shaft clutch		1 /output axis
Auxiliary shaft composite gear		1 /output axis
Speed change gear		1 /output axis
Output axis (Cam axis)		16 axes/module

Cam specification

Item			Specifications
Memory capacity	Storage area for cam data		256k bytes
	Working area for cam data		1024k bytes
Number of registration			Up to 256 program items (depending on memory capacity, cam resolution and number of coordinates)
Comment			Up to 32 characters for each cam data
Cam data	Stroke ratio data type	Cam resolution	256, 512, 1024, 2048, 4096, 8192, 16384, 32768
		Stroke ratio	-214.7483648 to 214.7483647 [%]
	Coordinate data type	Number of coordinates	2 to 16384
		Coordinate data	Input value: 0 to 2147483647 Output value: -2147483648 to 2147483647
Cam auto-generation			Cam auto-generation for rotary cutter



Simple Motion module configuration

<Simple Motion dedicated device>

Part name	Model name	Specification	Standards
Simple Motion module	QD77GF16	Up to 16 axes control	CE, UL, KC
Connector for external input signal cable	LD77MHIOCON	Manual pulse generator/Incremental synchronous encoder interface, Forced stop input interface, External command signal/Switching signal interface	—
Manual pulse generator	MR-HDP01	Pulse resolution: 25PLS/rev (100PLS/rev after magnification by 4), Permitted speed: 200r/min (Normal rotation)	—

Simple Motion module software

<Engineering environment MELSOFT series>

Product	Model name	Description	Application version
MELSOFT GX Works2	SW1DNC-GXW2-E	Sequence program creation, QD77GF16 setting	1.98C or later
MELSOFT MR Configurator2	SW1DNC-MRC2-E	Servo amplifier MR-J4 series setting and adjustment	1.19V or later

<MELSOFT iQ Works>

Product	Model name	Description
MELSOFT iQ Works ^(Note)	SW1DNC-IQWK-E	CD edition
	SW1DND-IQWK-E	DVD edition

(Note): This product includes the following software.

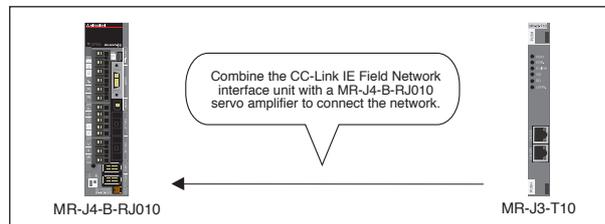
- System Management Software [MELSOFT Navigator]
- Programmable Controller Engineering Software [MELSOFT GX Works2]
- Motion Controller Engineering Environment Software [MELSOFT MT Works2]
- GOT1000 Screen Design Software [MELSOFT GT Works3]
- Robot Total Engineering Support Software [MELSOFT RT ToolBox2 mini]

<Operating environment> IBM PC/AT with which Windows® 7/ Windows Vista®/ Windows® XP/ Windows® 2000 English version operated normally.

Item	Item Description
OS	Microsoft® Windows® 7 (64bit/32bit) (Enterprise, Ultimate, Professional, Home Premium, Starter) Microsoft® Windows Vista® (32bit) (Enterprise, Ultimate, Business, Home Premium, Home Basic) Microsoft® Windows® XP Service Pack2 or later (32bit) (Professional, Home Edition) Microsoft® Windows® 2000 Professional Service Pack4
CPU	Recommended Intel® Core™2 Duo Processor 2GHz or more
Required memory	Recommended 1GB or more
Available hard disk capacity	When installing GX Works2: HDD available capacity is 2.5GB or more. When operating GX Works2: Virtual memory available capacity is 512MB or more.
Optical drive	CD-ROM supported disk drive
Monitor	Resolution 1024 x 768 pixels or higher

MR-J4-B-RJ010 + MR-J3-T10

MR-J4-B-RJ010 servo amplifier can be connected to CC-Link IE Field Network when MR-J3-T10 is combined with it.

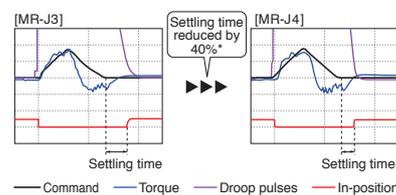


Industry-leading level of servo amplifier basic performance



Our original, ever-evolving high-speed servo control architecture is applied to the dedicated execution engine. **Speed frequency response is increased to 2.5 kHz, achieving the industry-leading level of speed***. Compatible servo motors are equipped with a **high-resolution absolute encoder of 4,194,304 pulses/rev (22-bit)**, improving the processing speed substantially. The performance of the high-end machine is utilized to the fullest.

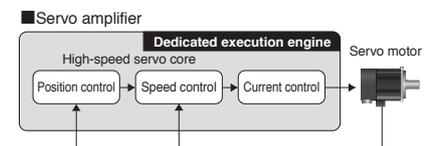
[Settling time comparison with the prior model]



* The result is based on our evaluation condition.

[Dedicated execution engine]

Equipped with the servo control engine with our original architecture.



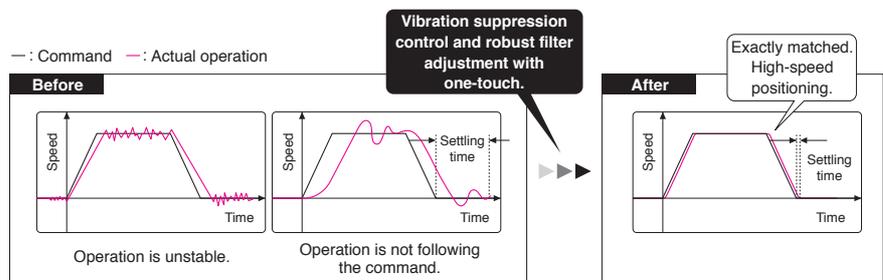
* Based on Mitsubishi Electric research as of January 2013.

Advanced one-touch tuning function



Servo gains including machine resonance suppression filter, advanced vibration suppression control II*, and robust filter are adjusted just by turning on the one-touch tuning function. Machine performance is utilized to the fullest using the advanced vibration suppression control function.

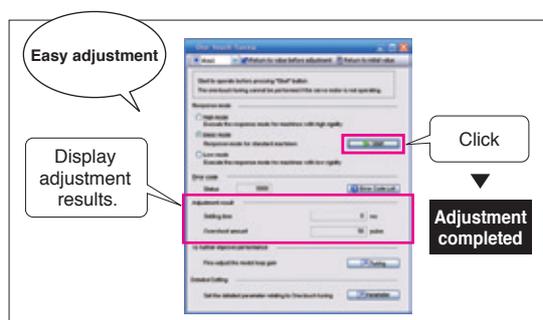
* The advanced vibration suppression control II automatically adjusts one frequency.



One-touch tuning function

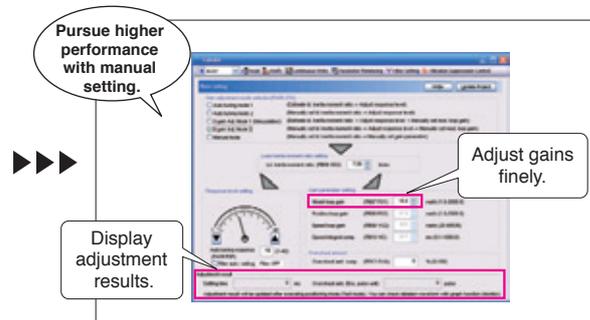
Adjustments including estimating load to motor inertia ratio, adjusting gain, and suppressing machine resonance are automatically performed for the maximum servo performance just by clicking the start button.

Check the adjustment results of settling time and overshoot.



Tuning function

Adjust model control gain finely on [Tuning] window manually for further performance after the one-touch tuning.





CC-Link Partner Association (CLPA) actively promotes the worldwide adoption of CC-Link networks and is working to make new advances in safety systems.

From promotion to specification development, CLPA actively supports CC-Link

CC-Link Partner Association (CLPA) was established to promote the worldwide adoption of the CC-Link open field network. By conducting promotional activities, such as organizing trade shows and seminars, implementing conformance tests, and providing catalogs, brochures, and website information, CLPA has been successfully increasing the number of CC-Link partner manufacturers and CC-Link compatible products. CLPA takes a major role in the globalization of CC-Link.

■Conformance test to support the rapid increase in CC-Link compatible products.



■Exhibitions and seminars are held to recruit new CLPA members.



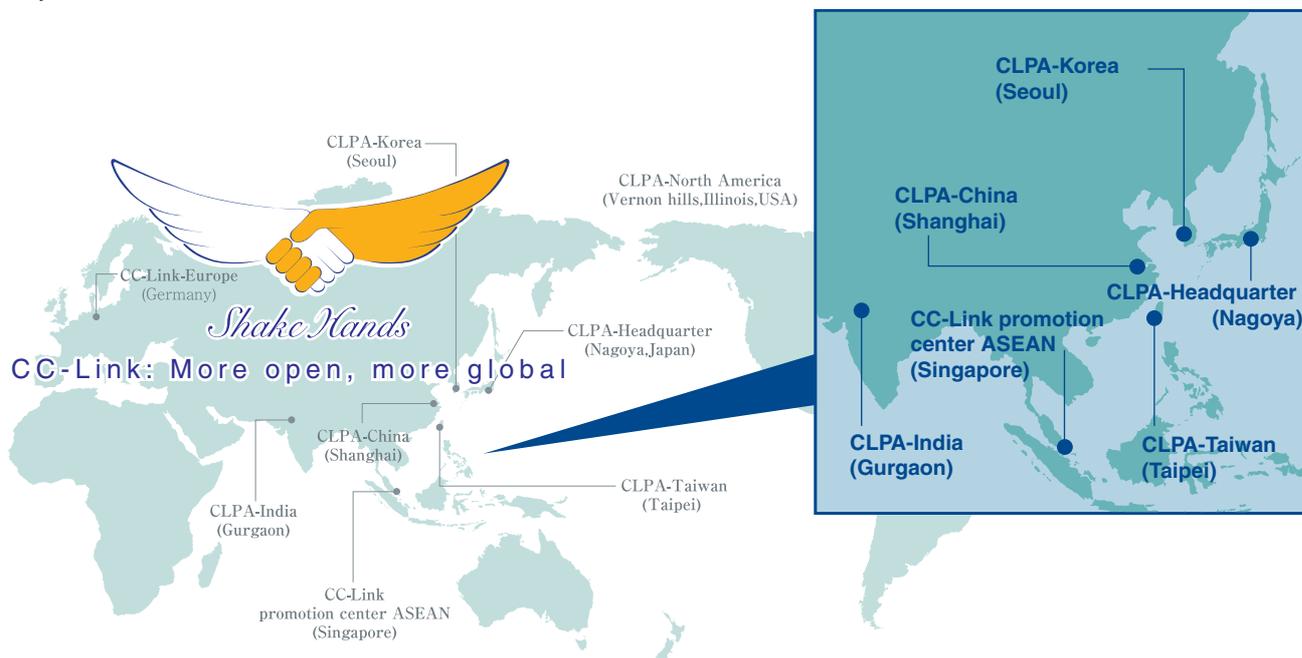
CC-Link Partner Association

The latest CC-Link information is posted on the website.

6F Ozone Front Bldg. 3-15-58 Ozone, Kita-ku, Nagoya 462-0825, Japan
 TEL: +81-52-919-1588 FAX: +81-52-916-8655 URL: <http://www.cc-link.org/> E-mail: info@cc-link.org

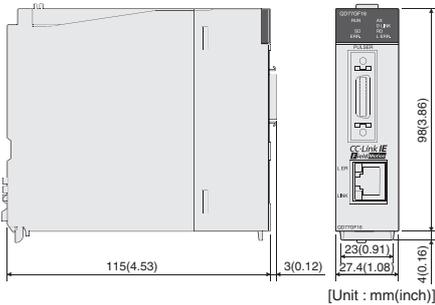
CC-Link continues to increase its global influence

CC-Link is supported globally by CLPA. With offices throughout the world, support for partner companies can be found locally. Each regional CLPA office undertakes various support and promotional activities to further the influence of the network in that part of the world. For companies looking to increase their presence in Asia, CLPA is well placed to assist these efforts through offices in all major Asian economies.

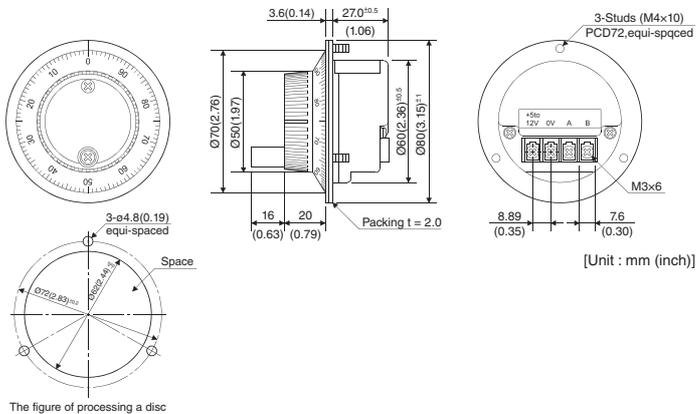


Exterior Dimensions

Simple Motion module QD77GF16



Manual pulse generator MR-HDP01



The figure of processing a disc

Item	Specifications
Pulse resolution	25PLS/rev (100PLS/rev after magnification by 4)
Phase A/Phase B Output voltage	Input voltage : -1V or more ^(Note)
Output method	Output voltage
Output current	Up to 20mA
Life time	1,000,000 revolutions or more (at 200r/min)
Permitted axial loads	Radial load: Up to 19.6N
	Thrust load: Up to 9.8N
Maximum rotation speed	600r/min (Instantaneous maximum), 200r/min (Normal rotation)
Ambient temperature	-10 to 60 °C (14 to 140°F)
5VDC consumption current	0.06A
Mass	0.4kg

(Note): When using an external power supply, use 5V power supply.

Mitsubishi Electric Corporation Nagoya Works is a factory certified for ISO14001 (standards for environmental management systems) and ISO9001(standards for quality assurance management systems)



⚠ Safety Warning

To ensure proper use of the products listed in this catalog, please be sure to read the instruction manual prior to use.

MITSUBISHI ELECTRIC CORPORATION

HEAD OFFICE: TOKYO BUILDING, 2-7-3, MARUNOUCHI, CHIYODA-KU, TOKYO 100-8310, JAPAN
NAGOYA WORKS: 1-14, YADA-MINAMI 5, HIGASHI-KU, NAGOYA, JAPAN