



**System Q**

# Motion Controller MELSEC System Q



**MITSUBISHI ELECTRIC**

**EUROPE B.V.**



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## **Main Features of System Q Motion CPU Modules**

### **Motion CPU Integrated in a Multiple CPU System.**

**Motion CPU, PLC CPU and PC-CPU can be combined in a multiple CPU system.**

**While the Motion CPU controls complicated servo operations, the PLC CPU controls machine operations and communications.**

**By distributing control to independent CPUs the total performance of the system is improved.**

### **Application Tailored Software Packages**

**Motion CPU module operating system software is specifically tailored and packed with functionality specific for your application needs.**



## **Main Features of System Q Motion CPU Modules**

### **Use of SSCNET, the High Speed Synchronous Communication Network**

**SSCNET (Servo System Controller NETwork) allows high speed communication with high performance servo amplifiers with 5.6 Mbps.**

**Through the fast and simple connecting SSCNET up to 32 servo amplifiers can be controlled by one Q173 Motion CPU Module. The Q172CPU controls a maximum of 8 axes.**

**High functionality such as absolute system, torque control, synchronization etc.**

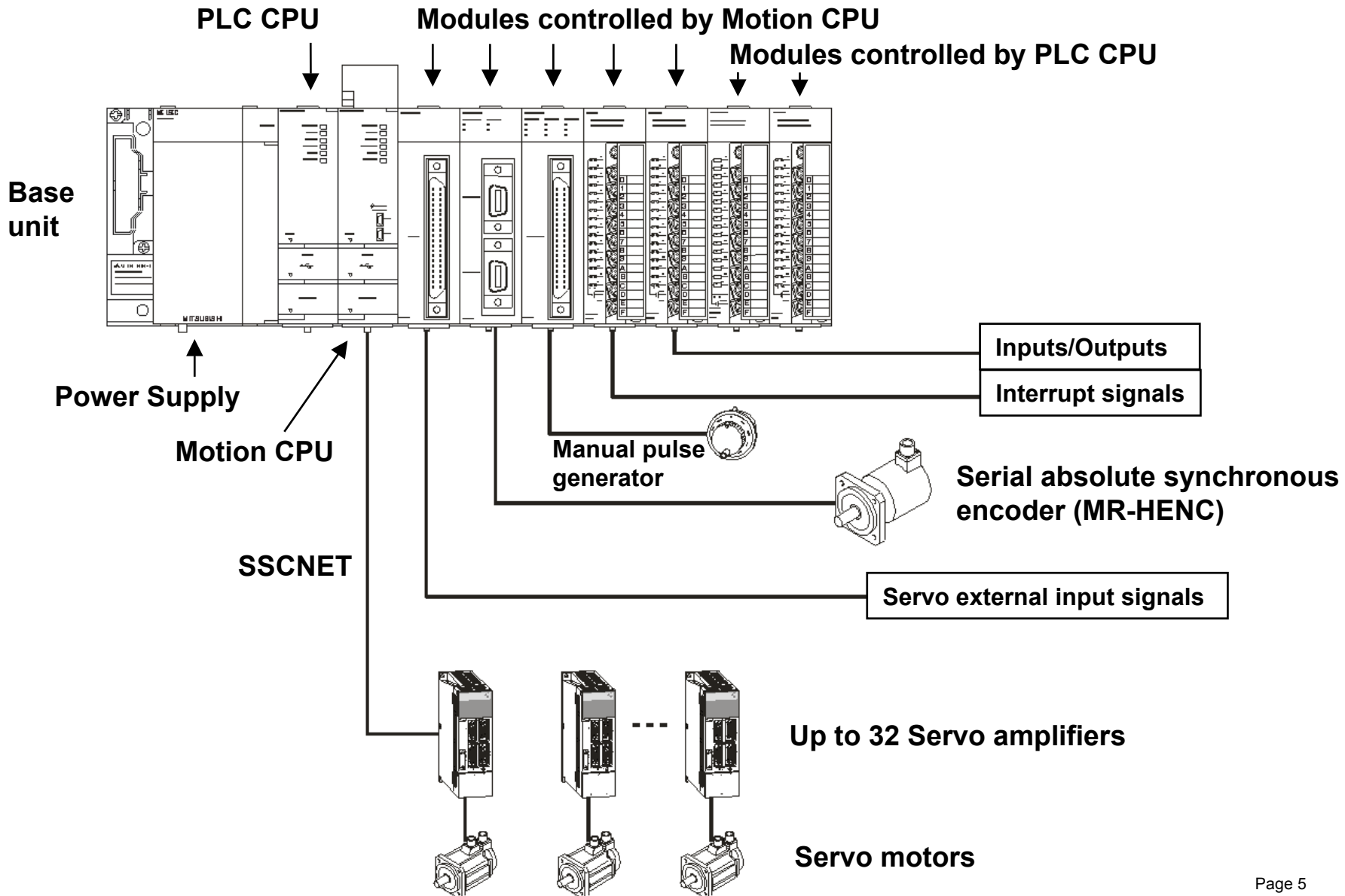
**Programming of the Motion CPU can be performed by connecting a PC with an optional I/F-card to the SSCNET.**

**Download of servo parameters is possible via the Motion CPU.**



## System Q

## System Configuration

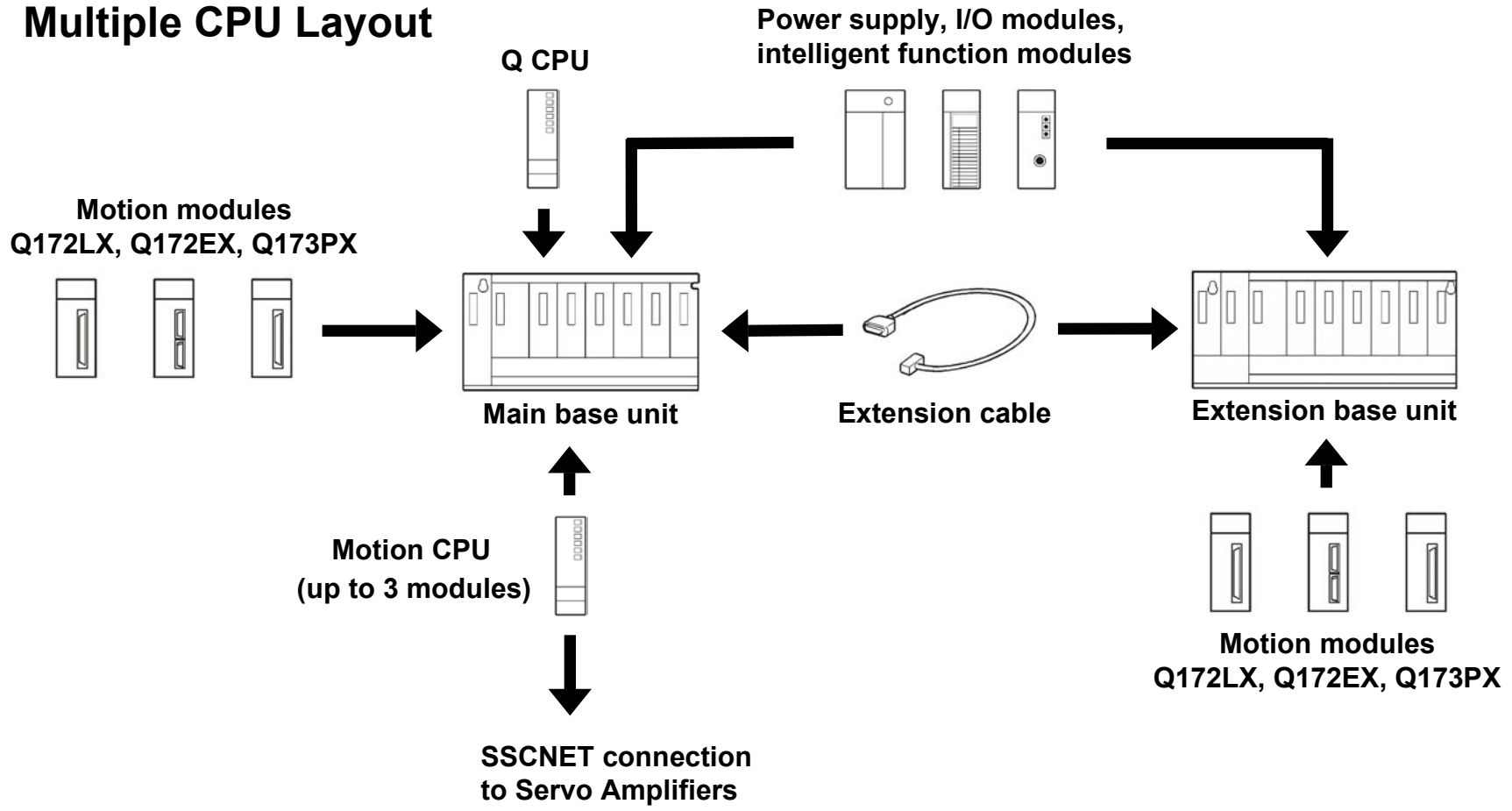




**System Q**

**Multiple CPU Configuration**

**Multiple CPU Layout**





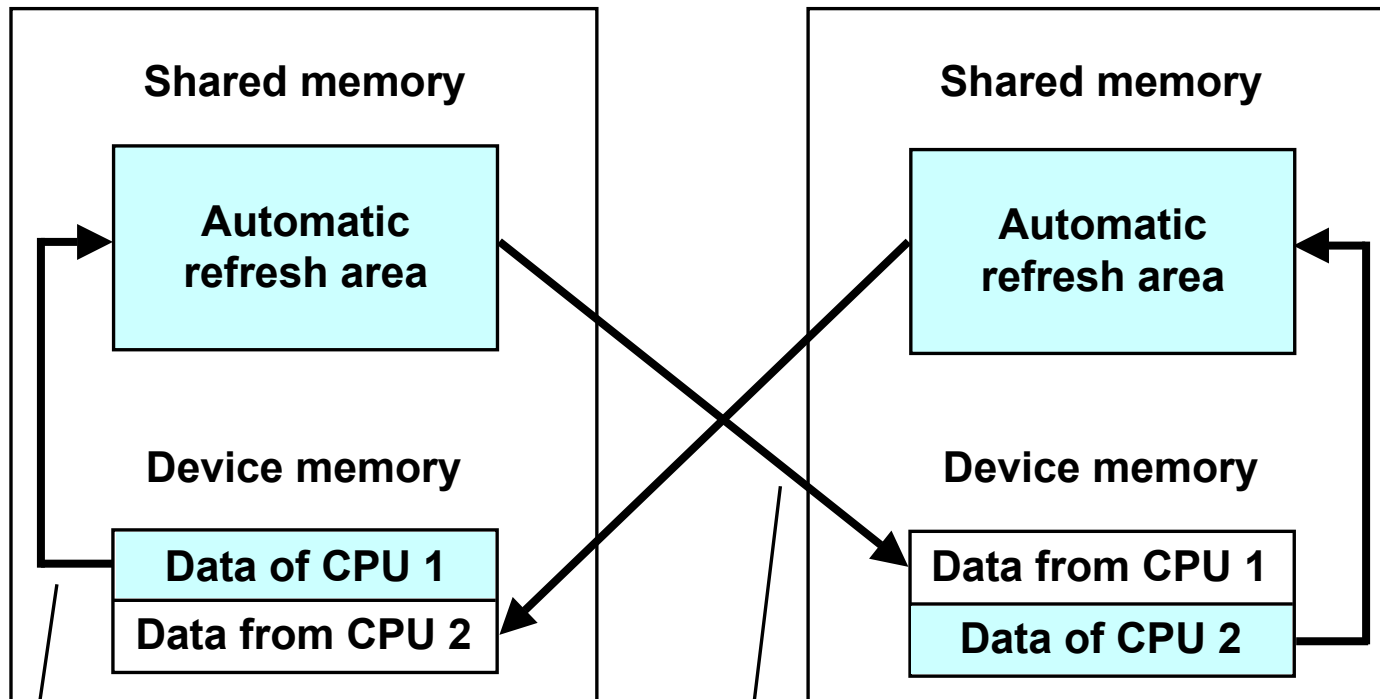
## System Q

## Multiple CPU Configuration

Automatic refresh is used to exchange data between CPUs

**CPU1: PLC CPU**  
(sequence control)

**CPU2: Motion CPU**  
(servo control)

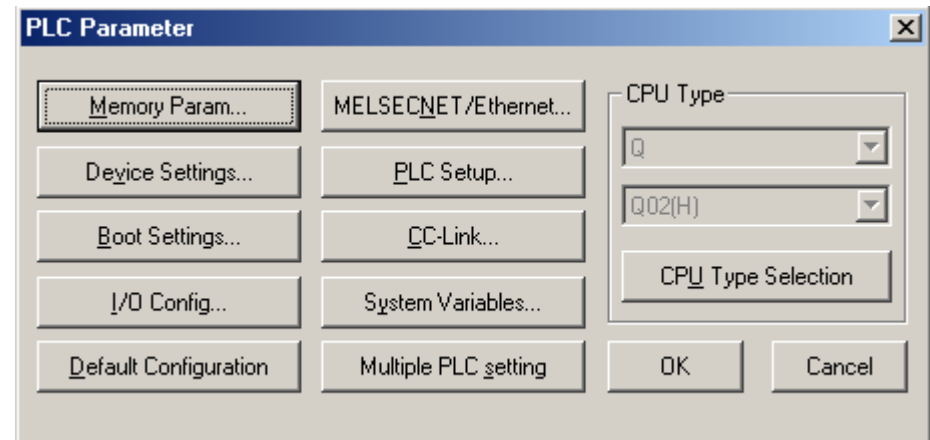
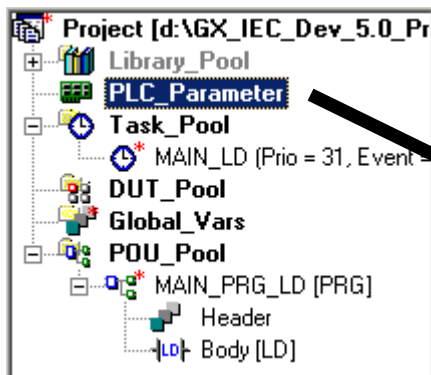


Write is performed at END processing of CPU 1

Read is performed at END processing of CPU 2

# Parameter Setting for Multiple CPU System

As the Motion CPU is one element of the multiple CPU system, it is necessary to set the parameters of the Multiple PLC system for each CPU.







## **Which Modules can be controlled by Motion CPU ?**

**Control is mandatory for:**

**Modules dedicated for the Motion CPU like Q172LX, Q172EX and Q17PX.  
These Modules will not operate correctly if a Q CPU is set as the control CPU.**

**Control is possible for:**

**I/O modules when using the Motion SFC as the operating system software.**

**Control is not possible for:**

**Link modules and graphic operator terminals (GOT)**



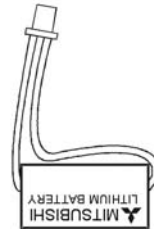
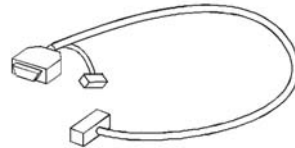
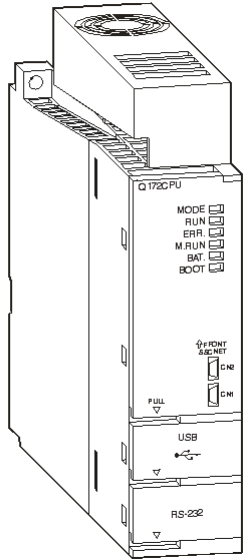
## **Precautions for the Motion Module Mounting Positions**

- **The Motion CPU cannot be used as a standalone module. It must always be used in combination with a PLC CPU.**
- **The first CPU must be mounted on the CPU slot.**
- **No empty slot is allowed between two CPU modules.**
- **Motion CPUs must be mounted on the right side of the PLC CPUs. In turn, no PLC CPU is allowed on the right side of a Motion CPU.**
- **There is no restriction on the positions at which the modules controlled by the Motion CPU (Q172EX, Q172LX etc.) may be installed.**

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**Connection to Servo Amplifiers**

**Q172CPUN**

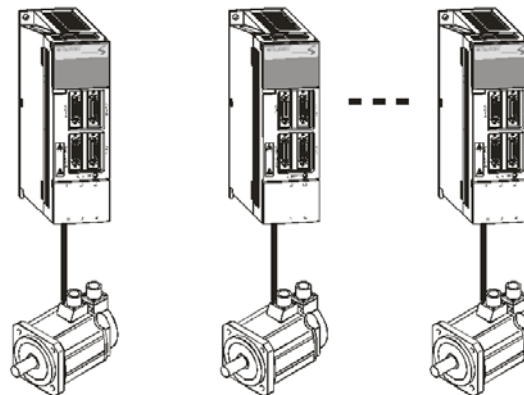


**A external battery can be fitted by using the battery unit Q170BAT and a special SSCNET cable.**

**Compatible servo amplifiers:**

- MR-J2S-B
- MR-J2-B

**SSCNET LINE 1**



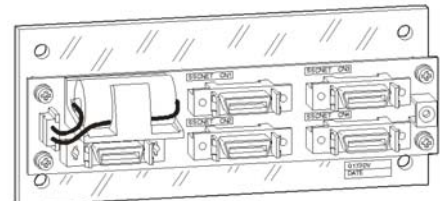
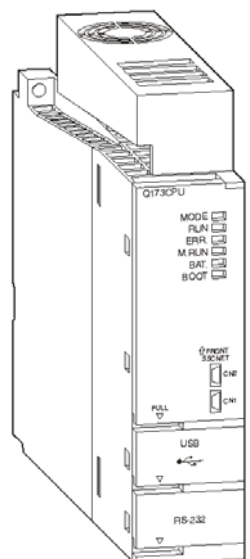
**Servo amplifier,  
max. 8 axes**



## System Q

## Connection to Servo Amplifiers

### Q173CPUN

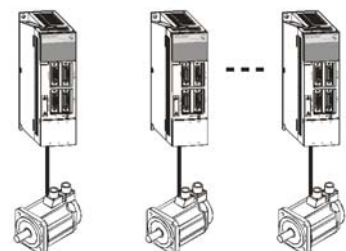
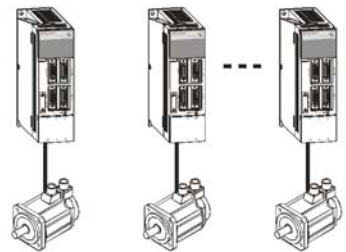
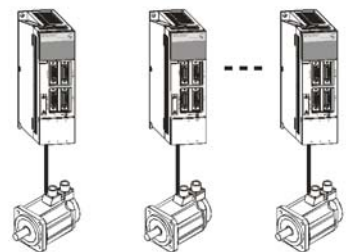
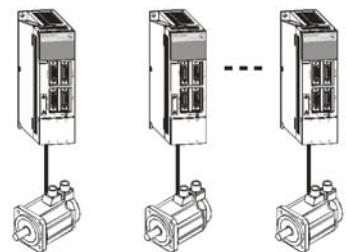


**SSCNET LINE 1**

**SSCNET LINE 2**

**SSCNET LINE 3**

**SSCNET LINE 4**



**Servo amplifier,  
max. 8 axes**

**Servo amplifier,  
max. 8 axes**

**Servo amplifier,  
max. 8 axes**

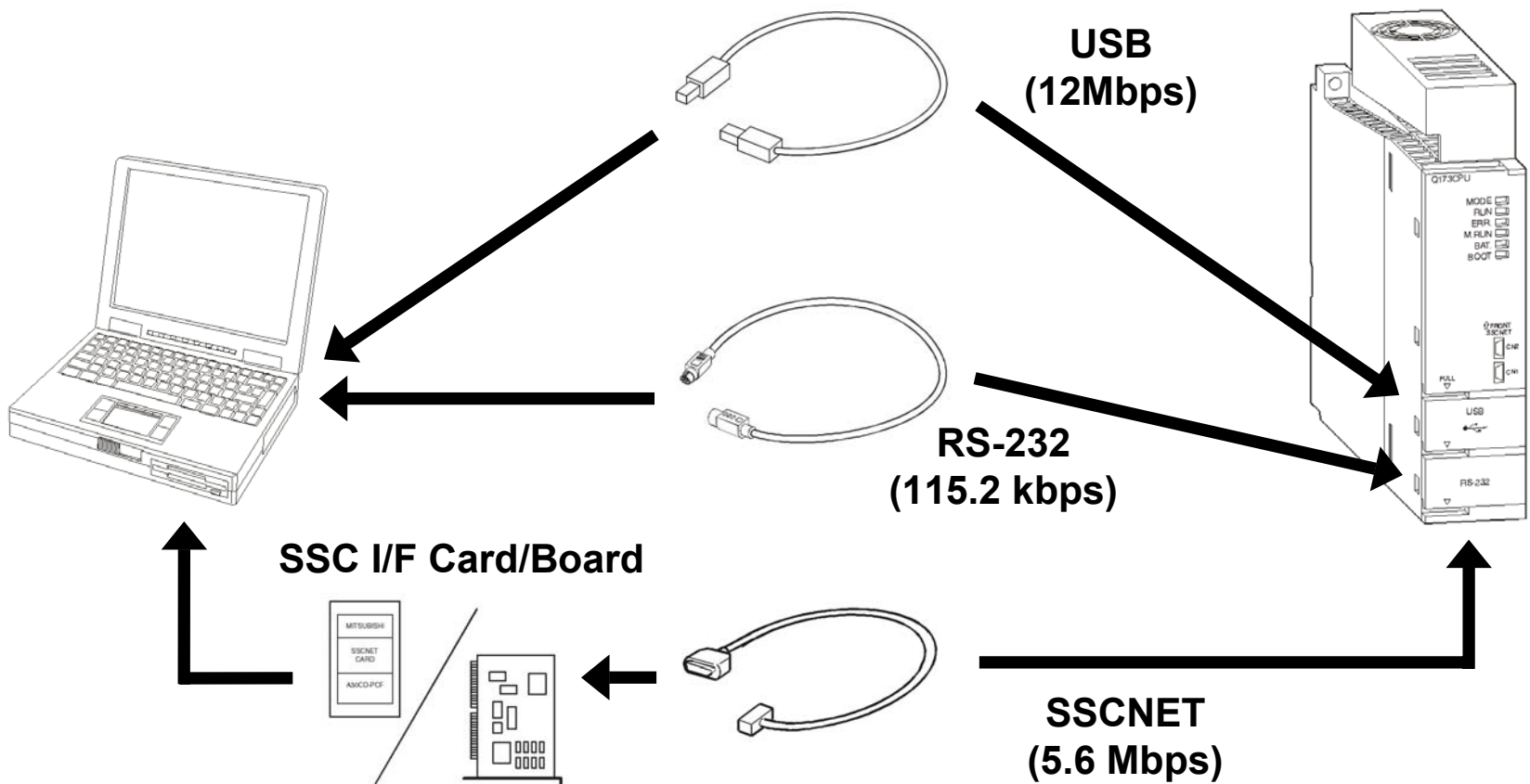
**Servo amplifier,  
max. 8 axes**

**The dividing unit also offers  
a holder for an external battery.**



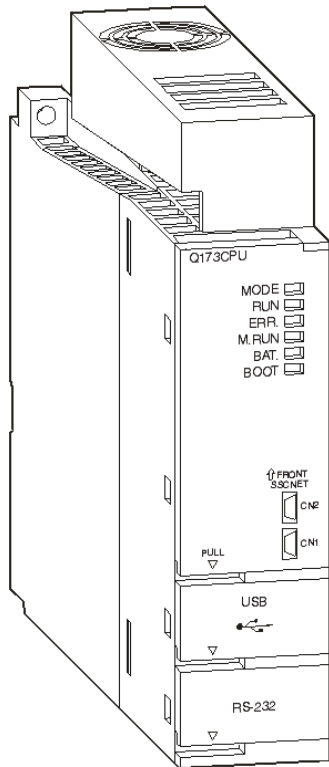
# Connection of Peripheral Devices

A Personal Computer used for programming the Motion CPU can be connected in 3 different ways:





## Q172CPUN, Q173CPUN



**Two types of Motion CPUs are available for your applications.**

**The Q172CPUN is able to control up to 8 axes, the Q173CPUN controls up to 32 axes.**

**Communication with servo amplifiers is performed via the high speed SSCNET.**

**Selectable control frequency and number of axis (Q173CPUN)**



**System Q**

**Motion CPU Modules, Specifications (1)**

**Basic Specifications (1)**

Item		Q172CPU	Q173CPU
Number of control axes		8	32
Operation cycle (default)	SV13	0.88 ms / 1 to 8 axes	0.88 ms / 1 to 8 axes 1.77 ms / 9 to 16 axes 3.55 ms / 17 to 32 axes
	SV22	0.88 ms / 1 to 4 axes 1.77 ms / 5 to 8 axes	0.88 ms / 1 to 4 axes 1.77 ms / 5 to 12 axes 3.55 ms / 13 to 24 axes 7.11 ms / 25 to 32 axes
Interpolation functions		Linear interpolation (4 axes max.) Circular interpolation (2 axes) Helical interpolation (3 axes)	
Control modes		PTP (Point to Point), Speed control, Speed-position control, Fixed-pitch feed, Constant speed control, Position follow-up control, Speed switching control, High-speed oscillation control, Synchronous control (SV22)	
Acceleration / Deceleration control		Automatic trapezoidal acceleration/deceleration S-curve acceleration/deceleration	
Compensation		Backlash compensation, Electronic gear	





**Basic Specifications (2)**

Item	Q172CPU	Q173CPU
Programming language	Motion SFC, dedicated instruction, Mechanical support language (SV22)	
Program capacity	14 k steps	
Number of positioning points	3200 (Positioning data can be designated indirectly)	
Home position return function	Proximity dog type, Count type, Data set type (2 types)	
JOG operation function	Provided	
Connectable manual pulse generators	3	
Connectable synchronous encoders (serial absolute and incremental synchronous encoders combined)	8	12
M-code function	M-code output function is provided M-code completion wait function provided	





**Basic Specifications (3)**

Item	Q172CPU	Q173CPU
Absolute position system	Made compatible by setting battery to servo amplifier For each axis either the absolute data method or the incremental method can be selected.	
Peripheral interfaces	USB (12 Mbps), RS-232 (115.2 kbps), SSCNET (5.6 Mbps)	
Number of SSCNET I/F	5 CH	2 CH
Manual pulse generator / synchronous encoder interface modules	3 modules (Q173PX) usable	4 modules (Q173PX) usable
Serial absolute synchronous encoder interface modules	4 modules (Q172EX) usable	6 modules (Q172EX) usable
Servo external signals interface module	1 module (Q172LX) usable	4 modules (Q172LX) usable
Limit switch output function	Up to 32 output points per axis	



## Program Capacity

Item	Q172CPU/Q173CPU
Code total (Motion SFC chart + Operation control + Transition)	287k bytes
Text total (Operation Control + Transition)	224k bytes

## Motion SFC Program

Item	Q172CPU/Q173CPU
Number of Motion SFC programs	256 (No. 0 to 255)
Motion SFC chart size per program	Max. 64k bytes (Motion SFC chart comments included)
Number of Motion SFC steps per program	Max. 4094 steps
Number of selective branches per branch	255
Number of parallel branches per branch	255
Parallel branch nesting	Up to 4 levels



**Operation control program (F, FS), Transition program (G)**

Item		Q172CPU/Q173CPU
Number of operation control programs		4096 with F (once execution type) and FS (scan execution type) combined F/FS 0 to F/FS 4096
Number of transition programs		4096 (G0 to G4095)
Code size per program		Max. approx. 64k bytes (32766 steps)
Number of blocks (line) per program		Max. 8192 blocks (in the case of 4 steps (min)/block)
Number of characters per program		Max. 128 (comment included)
Number of operands per program		Max. 64 (operands: constants, word devices, bit devices)
Nesting per block		Max. 32
Descriptive Expression	Operation control program	Calculation expression, bit conditional expression
	Transition program	Calculation expression, bit conditional expression, comparison conditional expression



## Execution Specifications

Item		Q172CPU/Q173CPU	
Number of multi executed programs		Max. 256	
Number of multi active steps		Max 256 steps in all programs	
Executed task	Normal task	Executed in motion main cycle	
	Event task (Execution can be masked)	Fixed cycle	Executed in fixed cycle (0.88 ms, 1.77 ms, 3.55 ms, 7.11 ms, 14.2 ms)
		External interrupt	Executed when an input of an interrupt module is ON
		PLC interrupt	Executed at an interrupt from PLC CPU (When PLC CPU dedicated command S(P).GINT is executed)
NMI task		Executed when an input of an interrupt module is ON	



## Number of Devices (Devices in Motion CPU only)

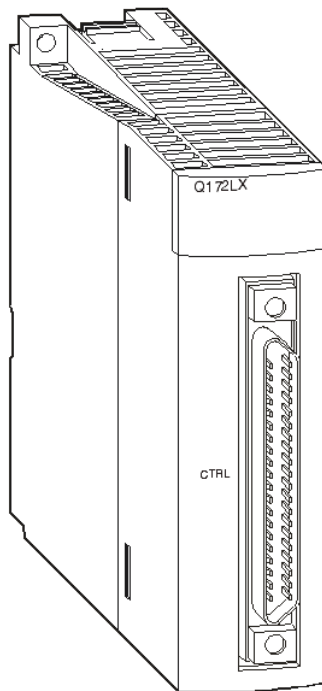
Item	Q172CPU/Q173CPU
Inputs/outputs (X/Y)	8192 points
Real inputs/outputs (X/Y)	Total 256 points
Internal relay (M)	Total 8192 points
Latch relay (L)	
Link relay (B)	8192 points
Annunciators (F)	2048 points
Special relay (M)	256 points
Data register (D)	8192 points
Link register (W)	8192 points
Special register (D)	256 points
Motion register (#)	8192 points
Coasting timer (FT)	1 point (888 $\mu$ s)

The positioning dedicated devices are included in the above table.



## Q172LX Servo External Signals Interface module

The Q172LX receives external signals of up to 8 axis required for positioning control.



For each axis 4 signals can be connected:

- Upper stroke limit switch (FLS)
- Lower stroke limit switch (RLS)
- Stop signal (STOP)  
For stopping under speed or positioning control
- Proximity dog/Speed-position switching signal (DOG/CHANGE)  
For detection of proximity dog at proximity dog or count type home position return or for switching from speed to position switching control

The status of each input is indicated by a LED

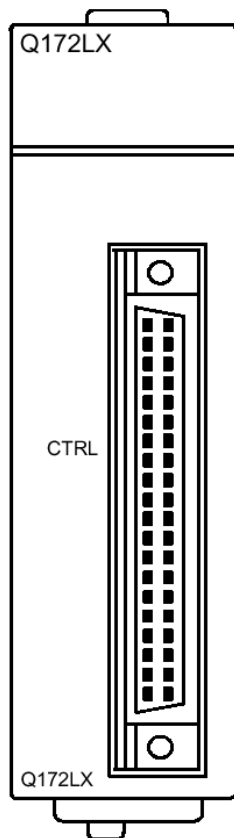


## Specifications

Item	Q172LX Servo External Signals Interface
Number of inputs	32 points (4 servo external signals for each of 8 axis)
Type of servo external signals	<ul style="list-style-type: none"> <li>• Upper stroke limit</li> <li>• Lower stroke limit</li> <li>• Stop input</li> <li>• Proximity dog/Speed-position switching signal</li> </ul>
Input method	Sink/Source type
Isolation method	Photocoupler
Rated input voltage	12/24 VDC
Rated input current	2 mA @ 12 VDC, 4 mA @ 24 VDC
Operating voltage range	10.2 to 26.4 VDC (12/24 VDC +10% / -15%, ripple ratio 5% or less)
ON voltage/current	Min. 10 VDC or more / 2.0 mA or more
OFF voltage/current	Max. 1.8 VDC or less / 0.18 mA or less
Input resistance	Approx. 5.6 kΩ
Response time (OFF to ON / ON to OFF)	Upper/Lower stroke limit and stop signal: 1 ms
	Proximity dog/Speed-position switching signal: 0.4 ms / 0.6 ms / 1 ms (CPU parameter setting, default 0.4 ms)



## Pin Layout of the CTRL Connector



Group	Pin	LED	Signal Name	Group	Pin	LED	Signal Name
1	B20	0	FLS1	5	A20	10	FLS5
	B19	1	RLS1		A19	11	RLS5
	B18	2	STOP1		A18	12	STOP5
	B17	3	DOG1/CHANGE1		A17	13	DOG5/CHANGE5
2	B16	4	FLS2	6	A16	14	FLS6
	B15	5	RLS2		A15	15	RLS6
	B14	6	STOP2		A14	16	STOP6
	B13	7	DOG2/CHANGE2		A13	17	DOG6/CHANGE6
3	B12	8	FLS3	7	A12	18	FLS7
	B11	9	RLS3		A11	19	RLS7
	B10	A	STOP3		A10	1A	STOP7
	B9	B	DOG3/CHANGE3		A9	1B	DOG7/CHANGE7
4	B8	C	FLS4	8	A8	1C	FLS8
	B7	D	RLS4		A7	1D	RLS8
	B6	E	STOP4		A6	1E	STOP8
	B5	F	DOG4/CHANGE4		A5	1F	DOG8/CHANGE8
	B4		No connect		A4		No connect
	B3		No connect		A3		No connect
	B2		COM		A2		No connect
	B1		COM		A1		No connect





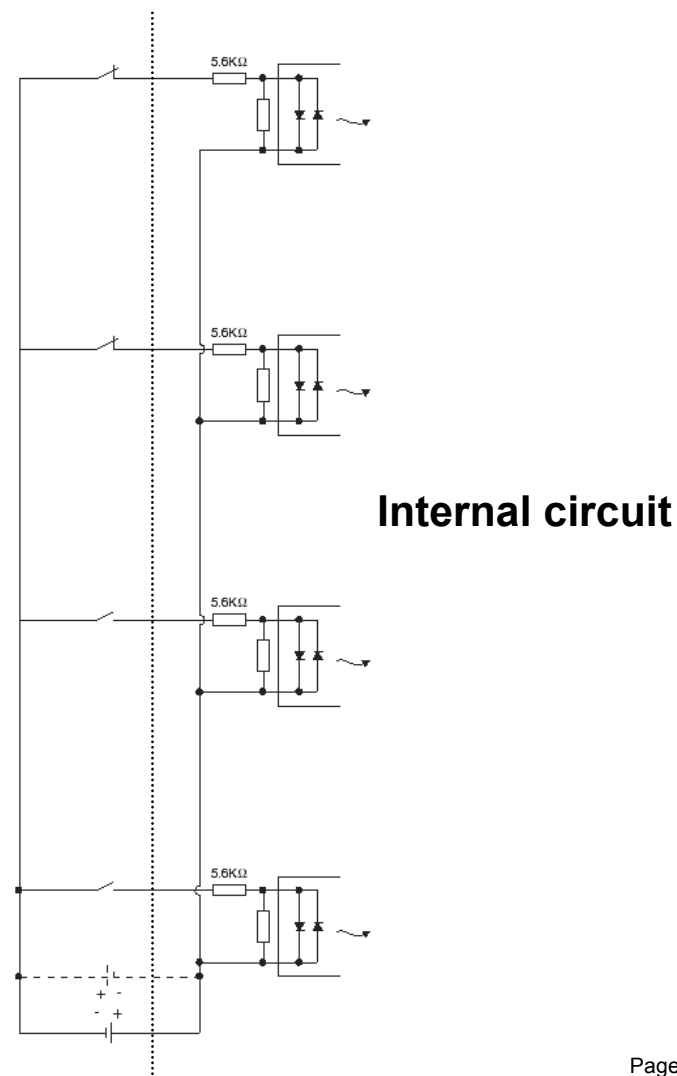
## Example for Wiring the Servo External Signals

Upper stroke limit input

Lower stroke limit input

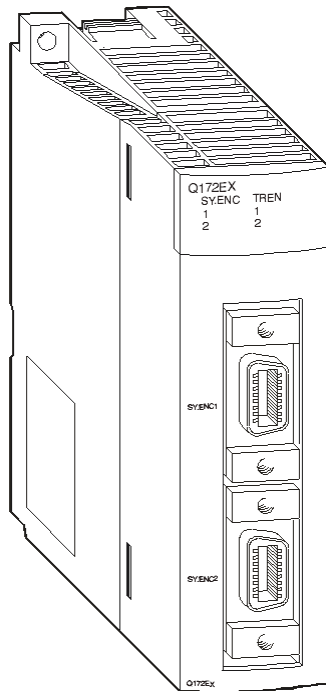
Stop signal input

Proximity dog/Speed-position switching signal





## Q172EX Serial Absolute Synchronous Encoder Interface Module



**Up to 2 encoders of the serial absolute output type (MR-HENC) can be connected to the Q172EX.**

**The module also offers 2 tracking enable signal inputs which are used as a high-speed reading function.**

**Backup of the absolute position is provided by a build-in battery.**



## Specifications (Serial Absolute Synchronous Encoder Input)

Item	Q172EX
Applicable encoder types	MR-HENC
Position detection method	Absolute method
Transmission method	Serial communication
Communication speed	2.5 Mbps
Synchronous method	Counter-clock-wise (viewed from end of shaft)
Resolution	16384 pulses per revolution (14 bit)
Cable length	Max. 30 m (98.36 ft)
Number of encoders per Q172EX	2
Isolation method	Photocoupler
Backup of the absolute position	With integrated battery A6BAT/MR-BAT
Battery service life time	With 1 encoder: 15000 h With 2 encoders: 30000 h (At an ambient temperature of 40 °C (104 °F))

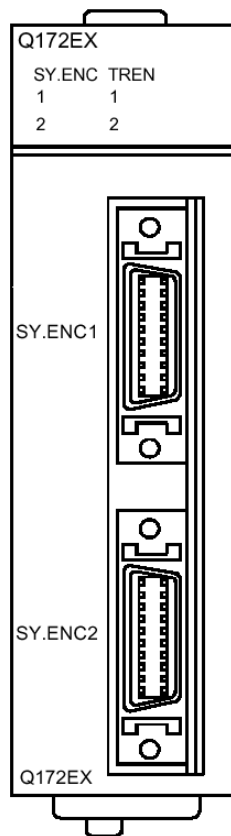


## Specifications (Tracking Enable Signal Inputs)

Item	Q172EX
Number of inputs	2 points
Input method	Sink/Source type
Isolation method	Photocoupler
Rated input voltage	12/24 VDC
Rated input current	2 mA @ 12 VDC, 4 mA @ 24 VDC
Operating voltage range	10.2 to 26.4 VDC (12/24 VDC +10% / -15%, ripple ratio 5% or less)
ON voltage/current	Min. 10 VDC or more / 2.0 mA or more
OFF voltage/current	Max. 1.8 VDC or less / 0.18 mA or less
Input resistance	Approx. 5.6 kΩ
Response time (OFF to ON / ON to OFF)	0.4 ms / 0.6 ms / 1 ms (CPU parameter setting, default 0.4 ms)



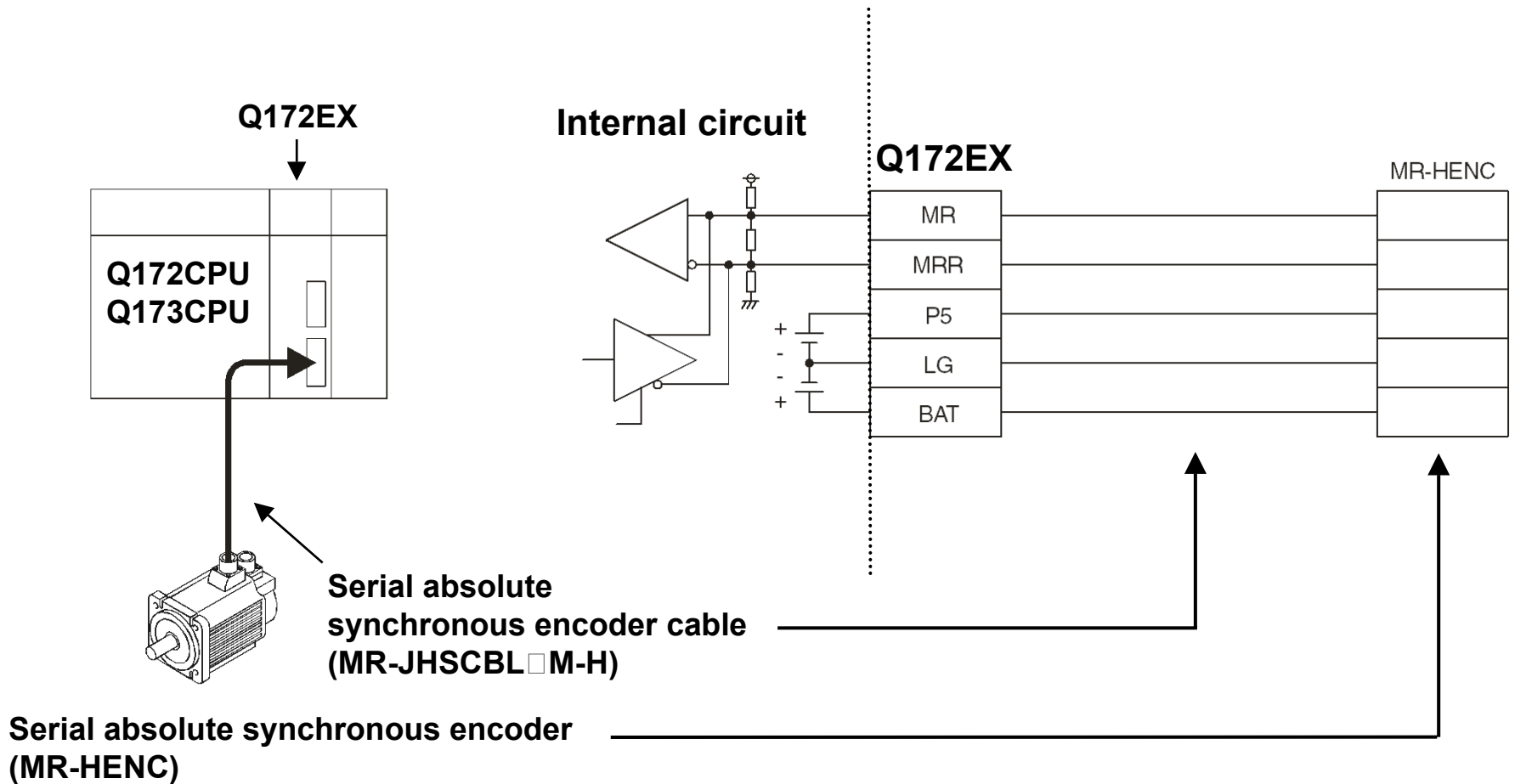
## Pin Layout of the SY.ENC Connectors



Pin	Signal Name	Description	Pin	Signal Name	Description
1	LG	Ground	11	LG	Ground
2	LG		12	LG	
3	LG		13	LG	
4	TREN	Tracking enable input	14	TREN.COM	Tracking enable input
5	NC	No connect	15	NC	No connect
6	MD	Not usable	16	MDR	Not usable
7	MR	Encoder signal input	17	MRR	Encoder signal input
8	NC	No connect	18	P5	5 VDC (+)
9	BAT	Battery voltage (+)	19	P5	
10	P5	5 VDC (+)	20	P5	



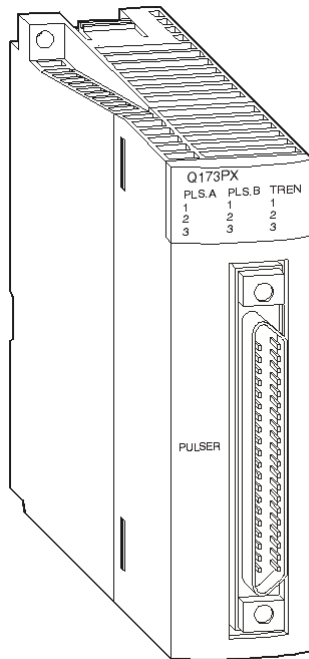
## Interface between SY.ENC Connector and External Equipment





## Q173PX Manual Pulse Generator Interface Module

The Q173PX offers 3 inputs for manual pulse generators or incremental synchronous encoders.



Voltage output/open collector type or differential-output type manual pulse generators and incremental synchronous encoders can be used.

To start the input from incremental synchronous encoders, the Q173PX is equipped with 3 tracking enable signal inputs which can also be used as for high-speed reading functions.



## Specifications ( A-phase and B-phase Inputs from Manual Pulse Generator or Incremental Synchronous Encoder)

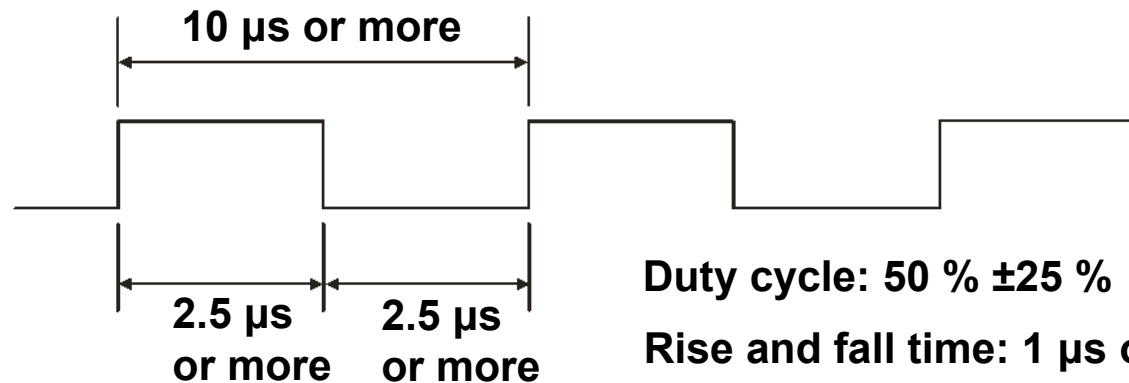
Item		Q173PX
Applicable encoder types		<ul style="list-style-type: none"> <li>• Voltage-output type / Open collector type (5 VDC) (MR-HDP01 is recommended)</li> <li>• Differential-output type (Selectable by connector wiring)</li> </ul>
HIGH level		3.0 to 5.25 VDC / 3 mA or more
LOW level		0 to 1.0 VDC / 0.3 mA or less
Input frequency		Max. 400 kpps (After magnification by 4)
Cable length	Voltage-output/Open collector type	Max. 10 m (32.79 ft)
	Differential-output type	Max. 30 m (98.36 ft)
Number of manual pulse generators / incremental synchronous encoders per Q173PX		3



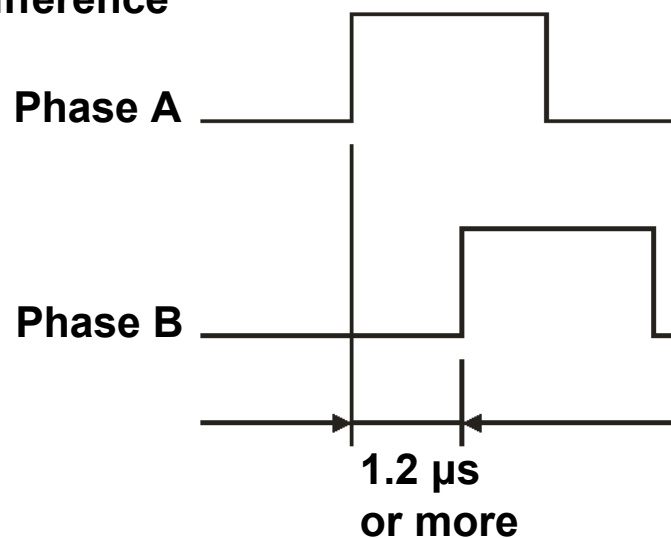


## Specifications for Phases A and B

### Pulse width



### Phase difference



The value of the position is increased when Phase A leads Phase B.

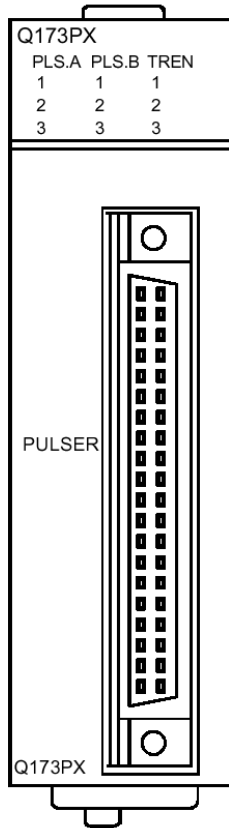
The value of the position is decreased when Phase B leads Phase A.



## Specifications (Tracking Enable Signal Inputs)

Item	Q173PX
Number of inputs	3 points
Input method	Sink/Source type
Isolation method	Photocoupler
Rated input voltage	12/24 VDC
Rated input current	2 mA @ 12 VDC, 4 mA @ 24 VDC
Operating voltage range	10.2 to 26.4 VDC (12/24 VDC +10% / -15%, ripple ratio 5% or less)
ON voltage/current	Min. 10 VDC or more / 2.0 mA or more
OFF voltage/current	Max. 1.8 VDC or less / 0.18 mA or less
Input resistance	Approx. 5.6 kΩ
Response time (OFF to ON / ON to OFF)	0.4 ms / 0.6 ms / 1 ms (CPU parameter setting, default 0.4 ms)

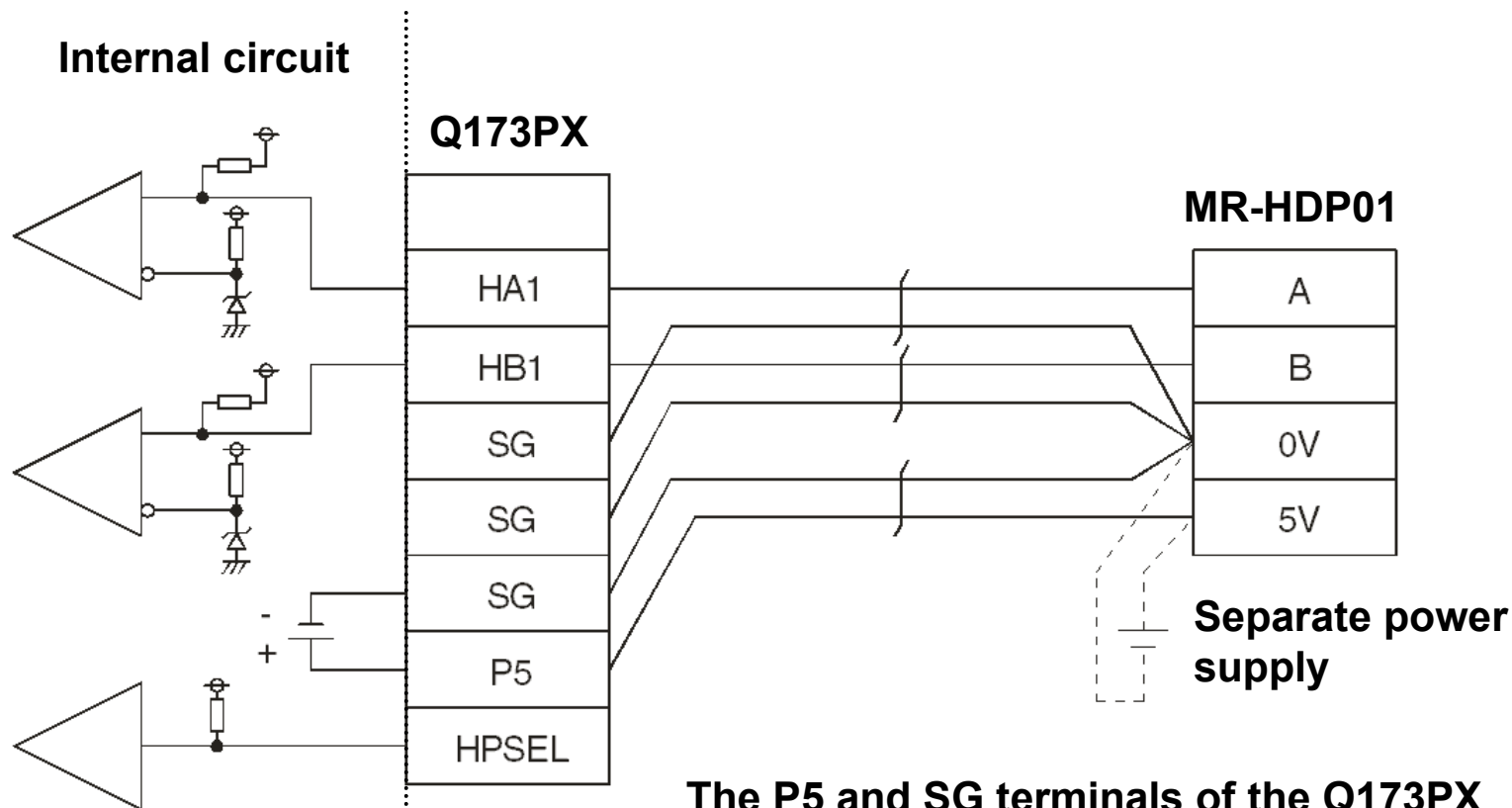
## Pin Layout of the PULSER Connector



Pin	Signal Name	Pin	Signal Name	Description
B20	HB1	A20	HA1	Input for a voltage output/open collector type
B19	SG	A19	SG	
B18	P5	A18	HPSEL1	5 VDC out / output type selection
B17	HA1N	A17	HA1P	Inputs for differential-output type
B16	HB1N	A16	HB1P	
B15	HB2	A15	HA2	Input for a voltage output/open collector type
B14	SG	A14	SG	
B13	P5	A13	HPSEL2	5 VDC out / output type selection
B12	HA2N	A12	HA2P	Inputs for differential-output type
B11	HB2N	A11	HB2P	
B10	HB3	A10	HA3	Input for a voltage output/open collector type
B9	SG	A9	SG	
B8	P5	A8	HPSEL3	5 VDC out / output type selection
B7	HA3N	A7	HA3P	Inputs for differential-output type
B6	HB3N	A6	HB3P	
B5	NC	A5	NC	No connect
B4	TREN1-	A4	TREN1+	Tracking enable signal inputs
B3	TREN2-	A3	TREN2+	
B2	TREN3-	A2	TREN3+	
B1	FG	A1	FG	Frame ground (for shielding)



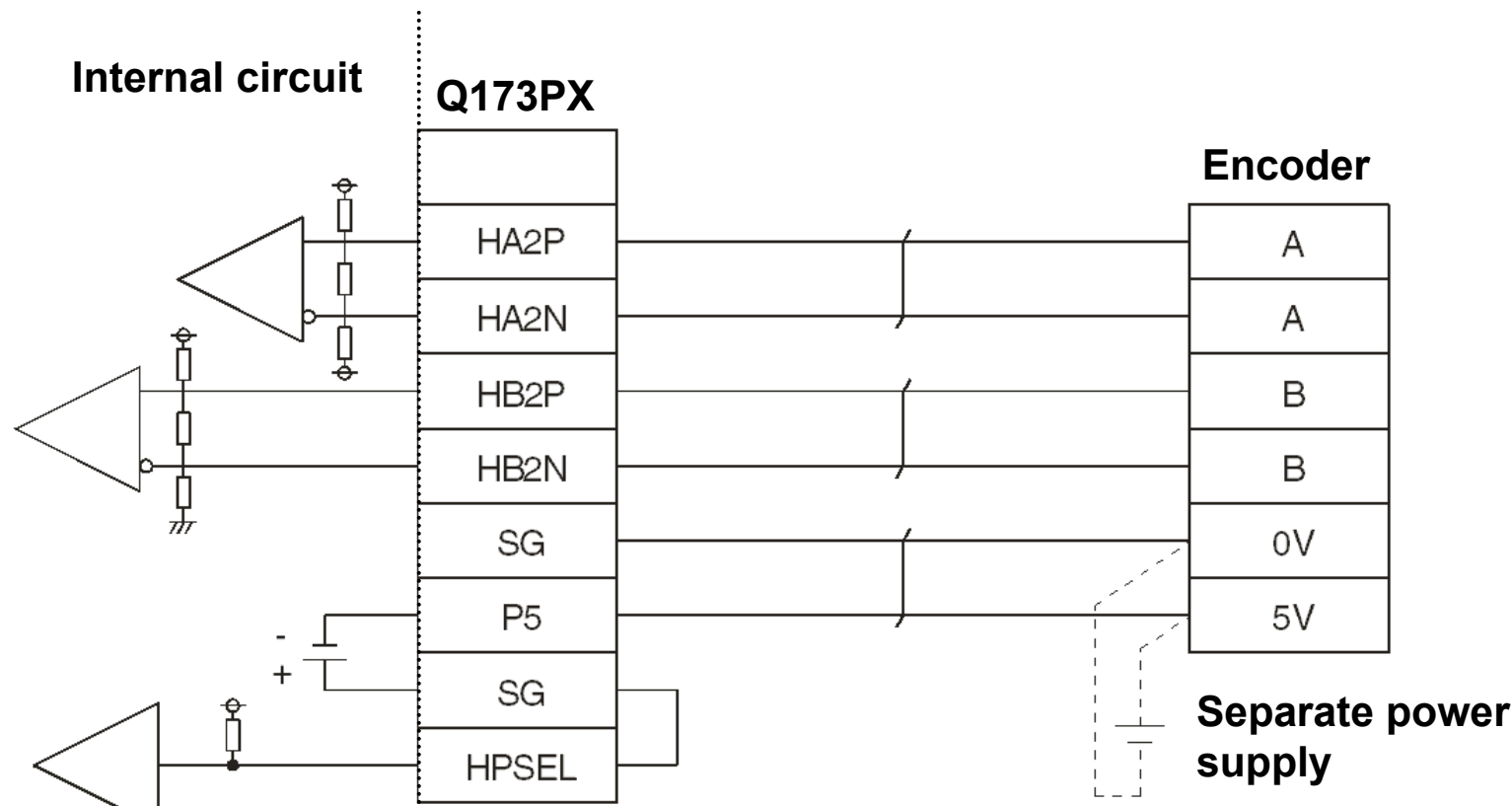
## Connection of a Manual Pulse Generator (Voltage-output/Open collector type)



**The P5 and SG terminals of the Q173PX must not be connected is a separate power supply is used.**



## Connection of a Differential-Output Type Incremental Synchronous Encoder



**The P5 and SG terminals of the Q173PX must not be connected is a separate power supply is used.**



## Connection of Tracking Enable Signals

