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Motion Control/ Serial Communication

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Motion/Serial Communication

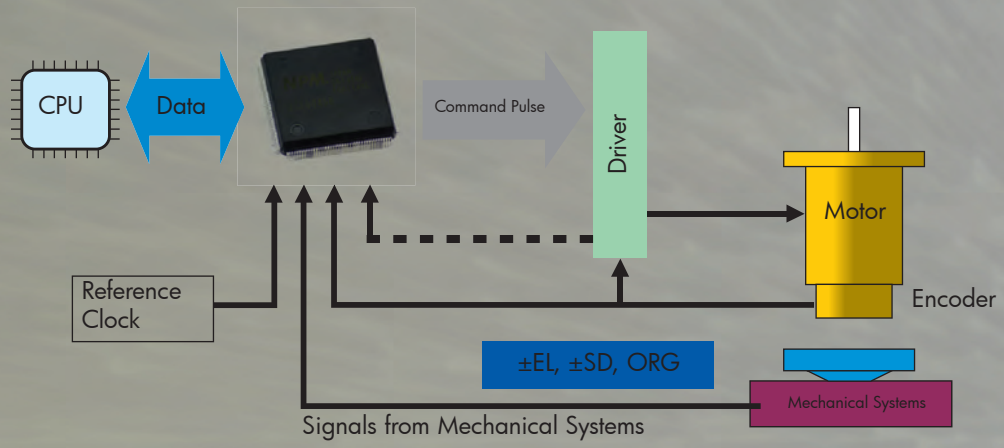
A variety of Nippon Pulse motion control chips and boards are available, including programmable pulse generators, counter chips, and high-speed serial communication chips. Selection of the proper chip/board enables configuration of an ideal motion control system for every application.

Programmable Pulse Generators

Pages 6-9

PCL6000 Series **PCL6100 Series** **PCD2112** **PCD4500 Series**

Receiving commands from a CPU, a programmable pulse generator can control a stepper motor or servomotor. The programmable pulse generator receives operating parameters for operating pattern from the CPU and in turn sends a START command. The motor control can then be committed to the chip, thereby reducing the burden to the CPU. Since being offered by Nippon Pulse for the first time in 1985, these programmable pulse generators have evolved, thanks in part to meeting the needs of various customers. These chips are available with a wide range of variations including ultra high-performance versions with interpolation functions, low-cost versions for simple motion control, and miniature versions.



High-Speed Serial Communications Chips

Pages 10-15

G9000 Series

These chips are designed to configure a high-speed serial communications system with less wiring. Besides I/O control functions, motor controls, and data communications functions are available. Designed with 'best open field bus' in mind, these chips are available not only at chip level but also as DIN rail mounted boards which can be combined with user-designed boards.

Applications

Factory Automation	Semiconductor/Liquid Crystal Mfg.	Healthcare Equipment	Security & Office Automation
Injection molding machine	Exposure system	Blood analyzer	Security camera
Mounter	Membrane forming machine	Liquid injector	Entrance/exit checking machine
Laser processing	Etching machine	CT scanner	Parking management machine
Winding machine	Washing machine	MRI apparatus	Industrial printer
Dispenser	Probing machine	Biopsy instrument	Laser printer
X-Y stage	Dicing machine	X-ray generator	Labeling machine
Knitting machine	Bonding machine	Trial drug processor	Card conveyor
Paper processing	LSI tester	Pre-analysis processor	Bank ATM
Taping machine	Handler	Electronic microscope	Sorting machine
Food processing machine	Molding machine	Care & support instruments	Liquid handling instrument
Robot	Appearance inspection instrument		Amusement equipment
Packinging machine	Dimension measuring instrument		House automation equipment
Automatic soldering machine	Liquid crystal processing		

Motion/Serial Communication

	PCL6046	PCL6025B PCL6045B PCL6045BL	PCL6113 PCL6123 PCL6143	PCD2112	PCD4511 PCD4521 PCD4541	Motionnet		Remarks
						G9103	G9003	
Reference Page	6	6	7	8	9	13	14	
Control stepper motor	Y	Y	Y	Y	Y	Y	Y	
Excitation sequencer function				Y	Y	Y	Y	Make simple 2-phase step motor drive circuit
Control servomotor	Y	Y	Y	Y		Y	Y	Servomotor I/F, up/down counter
Control linear motor	Y	Y	Y			Y	Y	Servomotor, I/F, high max, output freq.
Control 1 axis w/one chip			Y	Y	Y	Y	Y	
Control max. 2 axes w/one chip		Y	Y		Y			
Control max. 4 axes w/one chip	Y	Y	Y		Y			
Use 8-bit CPU data bus	Y	Y	Y		Y			
Compatibility w/16-bit CPU data bus	Y	Y	Y					
Serial CPU data bus (SPI)				Y				
Stand alone operation w/no CPU connected				Y				Independent operating system mode
Control 1 axis w/Motionnet® serial communication						Y	Y	
Control multiple axes w/Motionnet serial communications line in combo w/G9004A	Y	Y	Y		Y			G9004A emulation mode
Control multiple axes w/Motionnet® using multiple chips						Y	Y	
High cost-performance			Y	Y	Y			Low unit price per axis
Supply voltage 3.3V	Y		Y	Y		Y	Y	
Compatibility of input signal w/5V interface	Y	Y	Y	Y	Y	Y	Y	Tolerant buffer
Enable construction of smaller board	Y			Y				Small dimensions
Need up/down counter other than positioning control	Y	Y	Y	Y		Y	Y	Up/Down counter
Positioning control w/encoder signal	Y	Y	Y	Y		Y	Y	Encoder input
Origin return w/Z-phase signal	Y	Y	Y	Y		Y	Y	Origin return function
Independent setting of accel/decel time	Y	Y	Y	Y		Y	Y	Accel/decel rate setting
Automatic setting of ramping-down point w/accel time=decel time			Y	Y				Automatic setting of ramping-down point
Automatic setting of ramping-down point w/accel time≠ decel time and w/accel time=decel time	Y	Y				Y	Y	Automatic setting of ramping-down point
Linear interpolation between 2-plus axes	Y	Y	Y[1]			Y		Interpolation function/operation
Circular interpolation between 2 axes	Y	Y				Y[1]		Interpolation function/operation
Interpolation between remote boards through serial communication						Y[1]		Interpolation function/operation
Continuous interpolation w/no cessation	Y	Y	Y[1] Linear interpolation only			Y[1]		Continuous interpolation operation
S-curve acceleration/deceleration	Y	Y	Y	Y	Y	Y	Y	S-curve acceleration/deceleration
Linear accel/decel section on S-curve	Y	Y	Y	Y		Y	Y	Setting S-curve section
Automatic elimination of triangular drive	Y	Y	Y	Y		Y	Y	FH correction function
Manual pulser	Y	Y	Y	Y		Y	Y	Pulser input mode
Comparator function	Y	Y	Y			Y	Y	
General purpose I/O port	Y	Y	Y	Y		Y	Y	
Out of step detection	Y	Y				Y	Y	
Continuous operation from present to the next	Y	Y	Y			Y		Prebuffer/preregister
Speed change during operation	Y	Y	Y	Y	Y	Y	Y	Overriding speed
Target position change during operation	Y	Y	Y			Y	Y	Override target position
Long acceleration/deceleration time	Y	Y		Y		Y	Y	Long bit length of accel/decel registers
Delicate pulse rate setting	Y	Y				Y	Y	Long bit length of speed register
Programmed soft limit function	Y	Y				Y	Y	
Output 90° phase deviation pulse	Y	Y	Y	Y		Y	Y	Environment setting register
Backlash correction function	Y	Y				Y	Y	
Start/stop w/hardware switch	Y	Y	Y	Y	Y	Y	Y	Ext. switch operation mode
Ring count function	Y	Y	Y			Y		
Origin search function	Y	Y		Y		Y	Y	
Increased starting pulse w/idling pulse	Y	Y		Y	Y	Y	Y	Idling pulse/idling control

1: Interpolation function of PCL6113 and G9103 is usable when two or more units are connected

Specifications of Programmable Pulse Generators

	PCL6046	PCL6025B PCL6045B PCL6045BL	PCL6113 PCL6123 PCL6143	PCD2112	PCD4511 PCD4521 PCD4541	Motionnet®	
						G9103	G9003
Num. of controllable axes	4	2 (PCL6025B) 4 (PCL6045B/BL)	1 (PCL6113) 2 (PCL6123) 4 (PCL6143)	1	1 (PCD4511) 2 (PCD4521) 4 (PCD4541)	1	1
Reference Clock	19.6608 MHz (max 30 MHz)	19.6608 MHz (max 20 MHz)	19.6608 MHz (max 30 MHz)	9.8304 MHz (max 20 MHz)	4.9152 MHz (max 10 MHz)	80 or 40 MHz	80 or 40 MHz
Max. Output Speed[1]	6.5 Mpps (max 10 Mpps)	6.5 Mpps (max 10Mpps)	9.8 Mpps (max 15 Mpps)	2.4 Mpps (max 5 Mpps)	400 Kpps[2]	6.66 Mpps (max 10 Mpps)	6.66 Mpps
# of pulse rates setting registers	3 (FL, FH, FA (for correction))	3 (FL, FH, FA (for correction))	2 (FL, FH)	2 (FL, FH)	2 (FL, FH)	3 (FL, FH, FA (for correction))	3 (FL, FH, FA (for correction))
# of pulse rating setting steps	1 to 65,535 (16-bit)	1 to 65,535 (16-bit)	1 to 16, 383 (14-bit)	1 to 8,191 (13-bit)	1 to 8,191 (13-bit)	1 to 100,000 (17-bit)	1 to 100,000 (17-bit)
Pulse rating multiplication setting range	0.1x to 152.5x	0.1x to 100x	0.3x to 600x	0.5x to 300x	1x to 50x[3]	0.1x to 66.6x	0.1 to 66.6x
Acceleration rate setting range	1 to 65,535 (16-bit)	1 to 65,535 (16-bit)	1 to 16,383 (14-bit)	1 to 65,535 (16-bit)	2 to 1,023 (10-bit) (Common to accel/decel)	1 to 65,535 (16-bit)	1 to 65,535 (16-bit)
Deceleration rate setting range	1 to 65,535 (16-bit)	1 to 65,535 (16-bit)	1 to 16,383 (14-bit)	1 to 65,535 (16-bit)		1 to 65,535 (16-bit)	1 to 65,535 (16-bit)
# of positioning pulse setting range	-2,147,483648 to +2,147,483,647 (32-bit)	-134,217,728 to +134, 217, 727 (28-bit)	-134,217,728 to +134, 217, 727 (28-bit)	0 to 268,435,455 (28-bit)	0 to 16,777,215 (24-bit)	-134,217,728 to +134,217,727 (28-bit)	-134,217,728 to +134,217,727 (28-bit)
CPU interface	8-/16-bit bus	8/16-bit bus	8/16-bit-bus	Serial bus interface (SPI)	8-bit bus	Interface for communication w/G9000	Interface for communication w/G9000
Ramping-down point setting	0 to 16,777,215 (24-bit)	0 to 16,777,215 (24-bit)	0 to 16,777,215 (24-bit)	0 to 16,777,215 (24-bit)	0 to 65,535 (16-bit)	0 to 16,777,215 (24-bit)	0 to 16,777,215 (24-bit)
Package	208-pin BGA	128-pin QFP (PCL6025B) 176-pin QFP (PCL6045B/BL)	80-pin QFP (PCL6113) 128-pin QFP (PCL6123) 176-pin QFP (PCL6143)	48-pin QFP	44-pin QFP (PCD4511) 64-pin QFP (PCD4521) 100-pin QFP (PCD4541)	80-pin QFP	80-pin QFP
External dimension (mm)	12 x 12	24 x 24 (PCL6045B/BL) 20 x 14 (PCL6025B)	12 x 12 (PCL6113) 20 x 14 (PCL6123) 24 x 24 (PCL6143)	7 x 7	10 x 10 (PCD4511) 20 x 14 (PCD4521/4541)	12 x 12	12 x 12
Supply voltage	+3.3V±10%	+5V±10% and +3.3V±10% (6045B/6025B) +3.3V±10% (6045BL)	+3.3V±10%	+3.3V±10%	+5V±10%	+3.3V±10%	+3.3V±10%

1: Standard maximum output rate is the rate available with the reference clock input and the maximum rate in parenthesis, with the maximum reference clock input
2: For PCD4500 series, the stated maximum output pulse rate is a practical value and output at higher pulse rate is possible by increasing the multiplication factor
3: For PCD4500 series, the stated multiplication factors are a practical range and it is possible to set the multiplication factor higher than 50x

Notes on Specifications

Number of controllable axes	Number of axes a single chip can control
Reference clock	Frequency of the clock, which is programmed into the pulse generator. A frequency other than the standard can be entered, but the output pulse rate may be lower than decimal point
Maximum output pulse rate	Maximum rate at which the chip can output pulses
Number of pulse rate setting registers	There are FL registers to which the starting pulse rate is written and FH registers to which the operating pulse rate is written. The operating pulse rate can be changed during the operation in progress by rewriting it
Number of pulse rate setting steps	Number of steps available for pulse rate setting. The more bits, the finer pulse rate possible
Pulse rate multiplication setting range	Output pulse rate is a product of the value of pulse rate register and of the multiplication setting
Acceleration rate setting range	Pulse rate slope at acceleration is set. Acceleration time can be calculated from the setting value
Deceleration rate setting range	Pulse rate slope at deceleration is set. Deceleration time can be calculated from the setting value
Number of positioning pulses setting range	Number of output pulses for positioning is set
CPU interface	Typical CPUs are stated in User's Manual
Ramping-down point setting range	Starting point of deceleration for positioning is set based on the number of remaining pulses

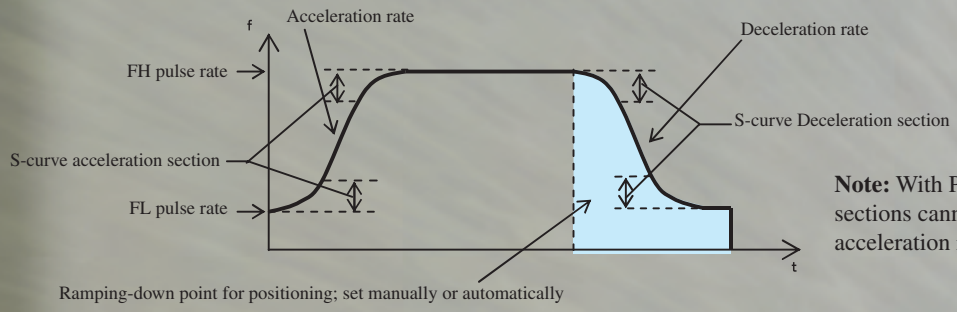
Motion/Serial Communication

	PCL6046	PCL6025B PCL6045B PCL6045BL	PCL6113 PCL6123 PCL6143	PCD2112	PCD4511 PCD4521 PCD4541	Motionnet®	
						G9103	G9003
S-curve acceleration/deceleration	Y	Y	Y	Y	Y	Y	Y
S-curve section setting	Y	Y	Y	Y		Y	Y
Triangular drive correction function	Y	Y	Y	Y		Y	Y
Origin return	Y (13 types)	Y (13 types)	Y (4 types)	Y (4 types)	Y (1 type)	Y (13 types)	Y (13 types)
Origin search, origin escape	Y	Y		Y		Y	Y
Origin return w/moving amount restricted				Y			
Limit positioning	Y	Y				Y	Y
Limit escape	Y	Y		Y		Y	Y
Servomotor interface	Y	Y	Y	Y		Y	Y
Encoder input (up to 4Xs multiplication possible)	Y (for each axis)	Y (for each axis)	Y (for each axis)	Y		Y	Y
Origin return using encoder Z-phase signals	Y (for each axis)	Y (for each axis)	Y (for each axis)	Y		Y	Y
Up/down counter (present position counter)	Y (for each axis) 32-bit x 3 16-bit x 1	Y (for each axis) 28-bit x 3 16-bit x 1	Y (for each axis) 28-bit x 2	Y 32-bit x 1		Y 28-bit x 2 16-bit x 1	Y 28-bit x 2 16-bit x 1
Automatic setting of ramping-down point	Y	Y	Y	Y		Y	Y
Origin return at up/down counter zero (automatic zero return)	Y	Y				Y	Y
Counter latch w/hardware	Y	Y	Y			Y	Y
Comparator	Y (for each axis) 32-bit x 5	Y (for each axis) 28-bit x 5	Y (for each axis) 28-bit x 2			Y (for each axis) 28-bit x 3	Y (for each axis) 28-bit x 3
External mechanical output	Y (for each axis)	Y (for each axis)	Y (for each axis)	Y	Y	Y	Y
Interrupt signal output	Y (37 factors)	Y (37 factors)	Y (23 factors)	Y	Y (6 factors)	Y (27 factors)	Y (27 factors)
Interrupt factor setting	Y	Y	Y			Y	Y
Interrupt status	Y	Y	Y			Y	Y
Status	Y (77 types)	Y (77 types)	Y (44 types)	Y	Y (16 types)	Y (30 types)	Y (30 types)
Prebuffer (preregister) for next operation	Y (2 stages)	Y (2 stages)	Y (1 stage)			Y (1 stage)	
Automatic start of next operation	Y	Y	Y			Y	
Command buffer monitor	Y	Y	Y	Y		Y	Y
Selection of output pulse logic	Y	Y	Y	Y	Y	Y	Y
Selection of output pulse mode	Y	Y	Y	Y	Y	Y	Y
Excitation sequence output for 2-phase stepper motor				Y	Y	Y	Y
Monitor signal output terminal	Y (9 for each axis)	Y (9 for each axis)	Y (6 for each axis)	Y (2)	Y (1)	Y (10)	Y (10)
Pulser input (External Pulse Input)	Y (for each axis) (multiplication by 32 & division by 2048)	Y (each axis) (multiplication by 32 & division by 2048)	Y (each axis) (no multiplication/ division function)	Y (no multiplication/ division function)		Y (each axis) (multiplication by 32 & division by 2048)	Y (each axis) (multiplication by 32 & division by 2048)
Pulser synchronized positioning	Y	Y	Y	Y		Y	Y
Linear interpolation	Y	Y	Y			Y	
Circular interpolation	Y	Y				Y	
Continuous interpolation	Y	Y	Y			Y	
Overriding target position	Y	Y	Y			Y	Y
1-pulse output	Y	Y				Y	Y
Idling pulse	Y (0 to 7 pulses)	Y (0 to 7 pulses)		Y	Y (0 to 7 pulses)	Y (0 to 7 pulses)	Y (0 to 7 pulses)
Output pulse width control	Y	Y				Y	Y
Simultaneous start/stop	Y	Y	Y	Y	Y	Y	Y
External start/stop	Y	Y	Y	Y	Y	Y	Y
Out-of-step detection	Y	Y				Y	Y
I/O port (general-purpose input/output terminal)	Y (8 for each axis)	Y (8 for each axis)	Y (8 for each axis)	Y (4)	Y (1 for each axis)	Y (8)	Y (8)
Operating switch input terminal	Y	Y	Y	Y			
Ring count function	Y	Y	Y			Y	
Backlash correction	Y	Y				Y	Y
Programmed soft limit	Y	Y				Y	Y
Timer operation	Y	Y	Y	Y	Y	Y	Y
Synchronization signal output	Y	Y	Y			Y	Y
Vibration supression	Y	Y				Y	Y
Independent operating mode				Y			
Compatibility to 5V interface	Y	Y	Y	Y	Y	Y	Y

How to Determine Output Pulse Rate

Output Pulse Rate = Pulse Rate Register Value x Multiplication Register Value
The higher the pulse rate register value, the finer the output pulse rate can be set

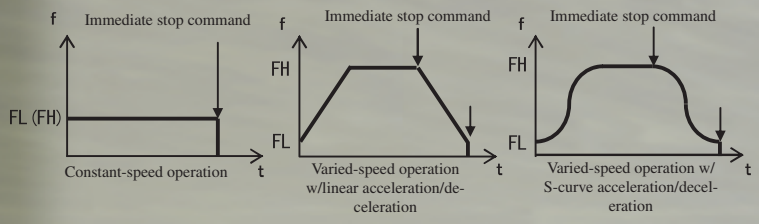
Pulse Output Pattern
Shown below is an example of S-curve acceleration/deceleration and S-curve section



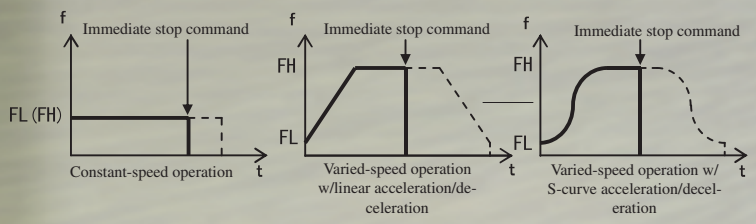
Note: With PCD4500 series, S-curve acceleration/deceleration sections cannot be set, and the deceleration rate is the same as acceleration rate.

Typical Operation Profiles

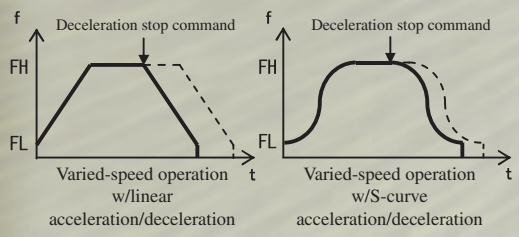
Preset Operation (Positioning)
The chip stops generation of pulses upon outputting to a preset number



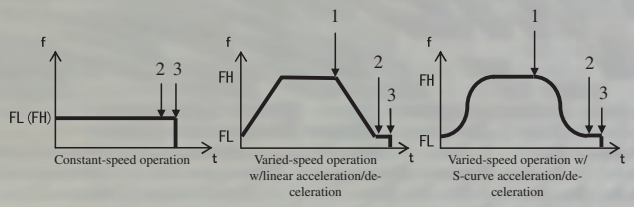
Immediate Stop
Immediate stop command stops the chip from outputting pulses irrespective of operating status.



Deceleration Stop
Deceleration-stop command lets the chip decelerate the pulse output and stop upon decelerating to the starting pulse rate.



Origin Return/Homing
Origin return sequence can be programmed using origin signal (ORG) ramping-down process signal (SD), end limit signal (EL) and encoder Z-phase signal. Listed below are typical origin return sequences in varied-speed operation.



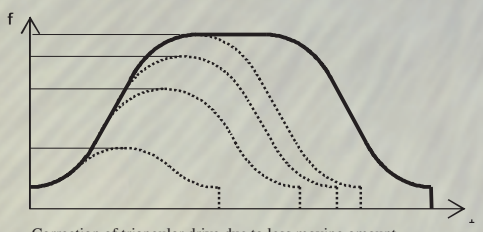
1. SD signal ON starts deceleration (1), and ORG signal ON stops pulse output (3).
2. SD signal ON starts Z-phase signal counting (2), and completion of counting stops pulse output (3).
3. ORG signal ON starts deceleration (1), and pulse rate output stops when decelerated to the FL pulse rate (3).
4. ORG signal ON starts deceleration and Z-phase signal counting (1), and completion of counting stops pulse output (3).

PCL6000 series and G9103/G9003 provide many other origin return sequences including those using EL signal. With PCD4500 series, only the sequence is applicable.

Triangular Drive Correction Function

Applicable models: PCL6000 series, PCL6100 series, PCD2112, G9103, G9003

When positioning and moving amount is minimal, this function automatically lowers the operating pulse rate (FH), thereby eliminating triangular drive and realizing a smooth pulse rate curve.

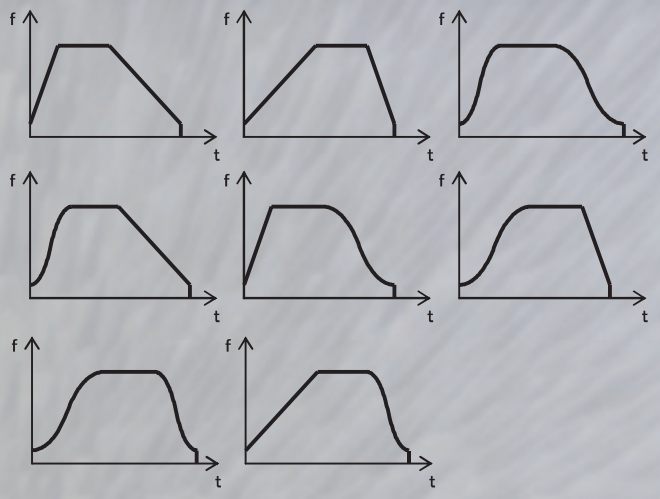


Correction of triangular drive due to less moving amount

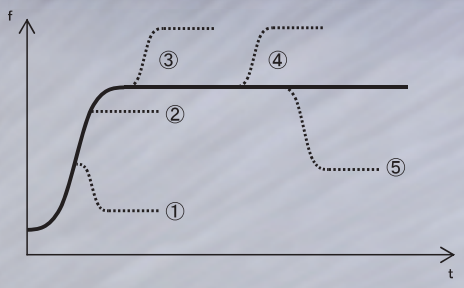
Typical Acceleration/Deceleration Patterns

Applicable models: PCL6000, PCL6100, PCD2112, G9103, G9003

As shown below, various acceleration/deceleration patterns can be programmed.



Changing Pulse Output Pattern During Operation (S-Curve acceleration/deceleration)



The preset FH register value can be changed to a lower value while acceleration is in progress.

1. If the newly set value is lower than the pulse rate at the time of the change, S-curve deceleration is made to the newly set value
2. If the newly set value is equal to or higher than the pulse rate at the time of the change, S-curve acceleration is made to the newly set value.

Change the preset FH register value to a higher value during acceleration in progress.

3. S-curve acceleration is made to the preset pulse rate and then to the newly set value.

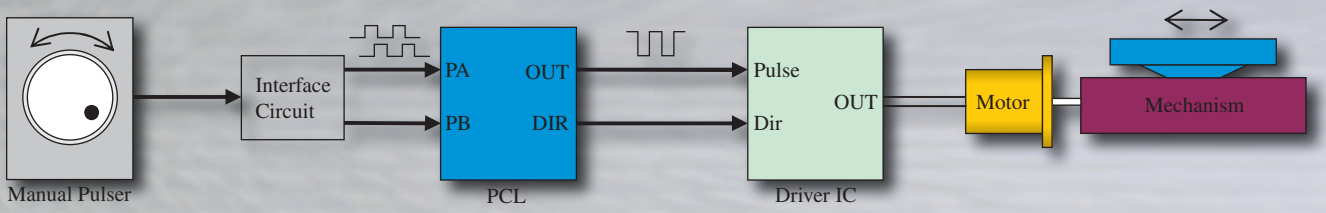
Change the preset FH register value during operation at the FH rate in progress.

4. If the newly set value is higher than the preset FH register value, S-curve acceleration is made to the newly set value.
5. If the newly set value is lower than the preset FH register value, S-curve deceleration is made to the newly set value.

Pulser Input/External Input

Applicable models: PCL6000 series, PCL6100 series, PCD2112, G9103, G9003

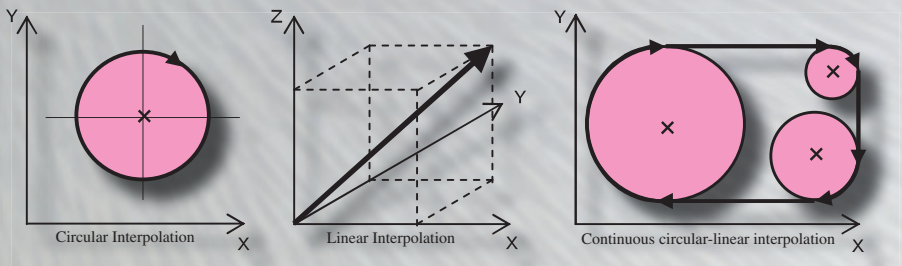
Receiving signal from a manual pulser, the programmable pulse generator outputs to the driver, the pulse signal corresponding to the rotating amount, and speed designated by manual pulse signal. If required, the present position can be controlled using the up/down counter. To prevent the stepping motor from running out-of-step, the operating speed (output pulse rate) can be restricted.



Interpolation

Applicable models: PCL6000 series, G9103 (circular/linear interpolation), PCL series (linear interpolation only)

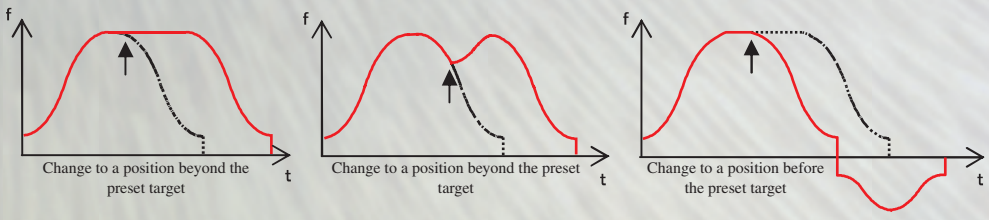
There are chips that provide both circular interpolation and linear interpolation functions and chips that provide only linear interpolation function. Models providing linear interpolation function enable interpolation in three dimensions. Models with circular and linear interpolation functions enable continuous circular-circular or linear-circular interpolation without cessation on the way.



Overriding Target Position

Applicable models: PCL6000 series, PCL6100 series, G9103, G9003

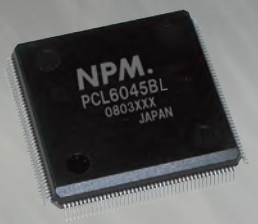
Target position can be changed during operation in progress.



High End Versions

PCL6045B (4-axis)

PCL6025B (2-axis)



PCL6045BL (4-axis)

PCL6046 (4-axis)

Advanced functions in this series include linear/circular interpolation, overriding operating pulse rate and target position during operation, operation correction, backlash correction, supression of vibration at cessation, programmed soft limit, direct input of operating switch, diversified origin return sequences, mechanical signal input, and servomotor interface. These functions enable the user to easily configure a complicated motion control system.

Features

- **Circular interpolation between two desired axes and linear interpolation among two to four desired axes**
  - · Linear interpolation among five or more axes is also possible by using two or more chips (three or more axes for the PCL6025B)
- **Preregisters enable continuous interpolation, circular-to-linear-to-circular...**
- **Maximum output pulse rate: 6.5 Mpps (10 Mpps with PCL6046)**
- **Built-in four up/down counters per axis**
  - · PCL6046: 32-bit x 3 and 16-bit x 1; PCL6045B(L)/PCL6025B: 28-bit x 3 and 16-bit x 1
  - · All counters can be used for various purposes since they can be latched or reset by signal input, conclusion of operation conditions, or the command
- **Built-in five comparators per axis**
  - · PCL6046: 32-bit x 5; PCL6045B/PCL6025B/PCL6045BL: 28-bit x 5
  - · Use of comparators and counters in combination enables the following operations:
    - · Interrupt signal output and external output of comparison results
    - · Starting by internal synchronization signal
    - · Immediate stop of deceleration-stop
    - · Programmed limit
    - · Out-of-step detection
    - · Output of synchronization signal
    - · Ring count function
- **Overriding operating pulse rate and target position during operation in progress**
  - · Directly accessible to registers, not through input/output buffers (PCL6046 only)
  - · 18 major operating modes
  - · Two-stage preregisters are built in to permit writing parameters (moving amount, starting pulse rate, operating pulse rate, acceleration rate, deceleration rate, multiplication factor, ramping-down point, operating mode, center of circular interpolation, S-curve accel/decel) for the succeeding two operations during operation in progress
  - · Composite pulse rate in interpolated operation can be kept constant
  - · Manual pulser input terminal (with functions to multiply by 32 and to divide to 2048)
  - · Seventeen kinds of error factors and 20 kinds of event factors, any of which can initiate interrupt signal output (event factors can be selected by register)

RoHS

PCL6045B-mounted boards

PPCI-7443
Quadraxial Motion Control Board with PCI Bus

Pulse train output type; can control servomotor and stepper motor

NPMC6045A-4104
Quadraxial Motion Control Board with PC/104 Bus

Pulse train output type; can control servomotor and stepping motor

Servo/Stepper Versions

PCL6113 (1-axis)

PCL6123 (2-axis)

PCL6143 (4-axis)

Because these chips have built-in preregisters (one stage), two up/down counters, per axis comparators, linear interpolation function, and servomotor interface, they can serve general motion control applications. This series is recommended for customers who need increased operational control that cannot be achieved with the PCD series. The maximum output pulse rate of 15 Mpps makes these chips compatible with high-resolution linear motors. There are also evaluation boards available that have the ability to reduce the number of development steps.

Features

- **Linear interpolation among two to four desired axes**
  - · Linear interpolation between chips is also possible
- **Maximum output pulse rate: 15 Mpps**
- **Built-in two up/down counters per axis (28-bit)**
- **Built-in comparators per axis (28-bit)**
  - · Use of comparators and counters in combination enables the following operations:
    - · Interrupt signal output and external output of comparison results
    - · Ring count
    - · Starting by internal synchronization signal
- **Overriding operating pulse rate and target position during operation in progress**
  - · Nine major operating modes
  - · One stage preregisters are built in to permit writing parameters (moving amount, starting pulse rate, operating pulse rate, acceleration rate, deceleration rate, multiplication factor, ramping-down point, operating mode center of circular interpolation, S-curve acceleration/deceleration sections) for the next operation during operation in progress
  - · Manual pulser input terminal (with no muliplier/divider function)
  - · Nine kinds of error factors and 14 kinds of event factors, any of which can initiate interrupt signal output (event factors can be selected by register)

Evaluation Boards for Programmable Pulse Generators in PCL6100 Series

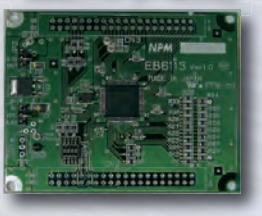
- **EB6113 (1 axis)/EB6143 (4-axis)**

  Through the axis interface connector, these boards input all axis-control input/output signals, enabling the user to sufficiently evaluate PCL6100-based motion control.

- **EB61ISO (Isolation board)**

  In combination with the EB6113/EB6143, the EB61ISO enables the user to evaluate PCL6113/PCL6143-based motion control under approximated practical conditions. The axis interface is isolated from the internal circuit by a photo coupler.

EB6113 (1-axis)

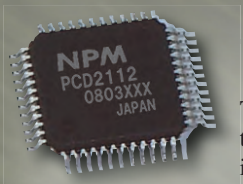


EB61ISO

Features

- · Control board interface enables the user to evaluate PCL6100 series on the user's system
- · CPU interface terminal which can easily be connected to various types of CPUs can be set on the board or externally
- · 4.5 to 5.5V can be applied to the interface (core supply 3.3)
- · Oscillator of reference clock of 19.6608 MHz is provided on the board
- · In combination with uniaxial isolation board EB61ISO, evaluation can be made under approximated practical conditions

Miniature package with SPI

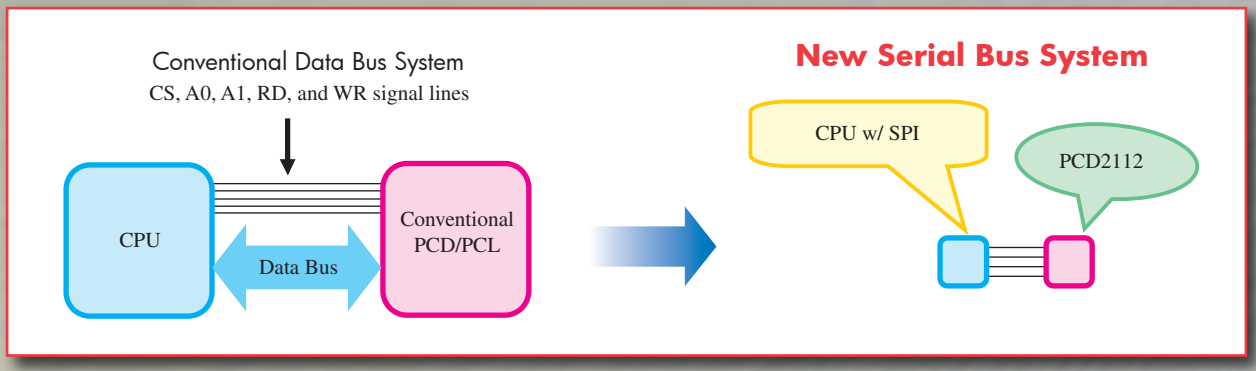


PCD2112

The first of its kind, this miniature package (mold measuring only 7x7mm) adopts a four-wire serial bus that enables downsizing of the board. It can output two-phase stepping motor excitation sequence and is equipped with a servomotor interface. The PCD2112 can control both stepper motors and servomotors.

Features

- **Connection to CPU via four-wire serial bus**
  - · Usable with CPU, which is not provided with external bus terminal
  - · General-purpose I/O terminals can effectively be used with CPU having multipurpose pins for external bus
- **Optimized control parameter arrangement and block transfer**
  - · This enables reduction of transfer time to minimum
- **Independent system mode for operation with no CPU**
  - · Operation with no CPU is made possible by externally connecting EEPROM in which up to 32 operating patterns are written
  - · Maximum output pulse rate: 5Mpps (with reference clock 20MHz)
  - · Pulse output mode: Selectable from 12 types of pulse signal outputs and two-phase stepping motor excitation sequence
  - · 32-bit up/down counter built-in
  - · 11 major operating modes
  - · Manual pulser input terminal (with no multiplier/divider function)
  - · 12 factors are available to initiate interrupt signal output (event factors can be selected by register)
- **Suitable for customers who wish/need to:**
  - · Intelligently control the motor with a CPU with fewer pins
  - · Make the motor control board smaller
  - · Operate the chip like a stand-alone unit without a CPU connected at the time of operation
  - · Enjoy more functions than provided by conventional PCD series



FMC32 Control Board

The FMC32, a compact controller with integrated driver, is equipped with a pulse control LSI PCD2112 for controlling a serial bus. Using the FMC32 board with a USB to 4-wire serial conversion unit (PUSB-3503), you can design a series of execution sequence programs and write the designed execution sequence program to the board. The designed execution sequence program can be verified and confirmed on the PC. Users are able to program up to 32 motion profiles with both linear and s-curve patterns.

By using control software, you can monitor the contents of all registers of the PCD2112 in real time. You can use this function to understand the PCD2112 thoroughly.

A CPU is equipped with the FMC32. You can repeat the execution sequence program written to the FMC 32 automatically. If you use a motor and a driver additionally, you can confirm operation in more detail. The FMC32 board has two operational modes, the PC control mode and the standalone control mode.

Low-cost versions dedicated to stepper motors

PCD4541 (4-axis)

PCD4521 (2-axis)

PCD4511 (1-axis)

RoHS

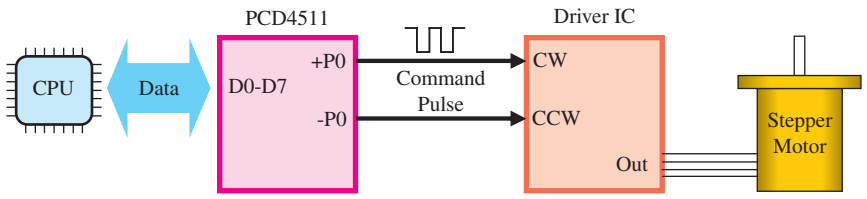
The PCD4500 series chips are low-cost, programmable pulse generators equipped with an excitation sequence generator circuit to drive two-phase stepper motors. Placing a stepper motor drive IC between the PCD and each stepper motor enables the user to easily configure a multiaxial motion control system. Each model can output a pulse train.

Features

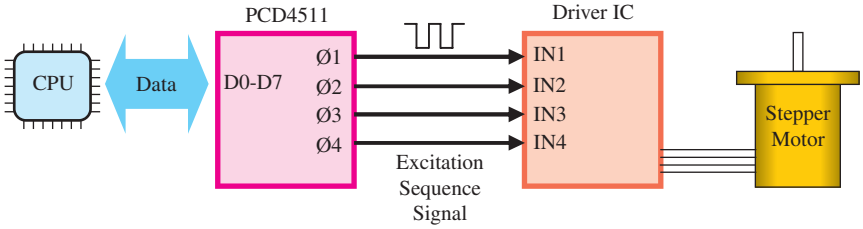
- **Output pulse rate: 400 Kpps**
  · Practical rate; theoretically max. 2.4 Mpps
- **Linear and S-curve acceleration/deceleration**
- **Two-phase stepper motor excitation sequence circuit built-in**
- **Simultaneous start/stop**
  · Pulse output on multiple axes within one chip or on multiple chips can be started simultaneously by the command or external signal. Pulse output on all axes can be stopped by the command, external signal, or failure on any axis
  · Idling pulse output (1 to 7 pulses)
  · Overriding operating pulse rate during operation in progress
  · Four major operation modes

Connection Examples

1. Pulse Train Input Driver IC with Built-in Excitation Sequence Circuit



2. Excitation Sequence Signal Input Driver IC



Best open field bus. I/O chips, pulse generators, and CPU emulators are put on single-line from center device

G9001A
Center Device

G9002
Local Device
I/O

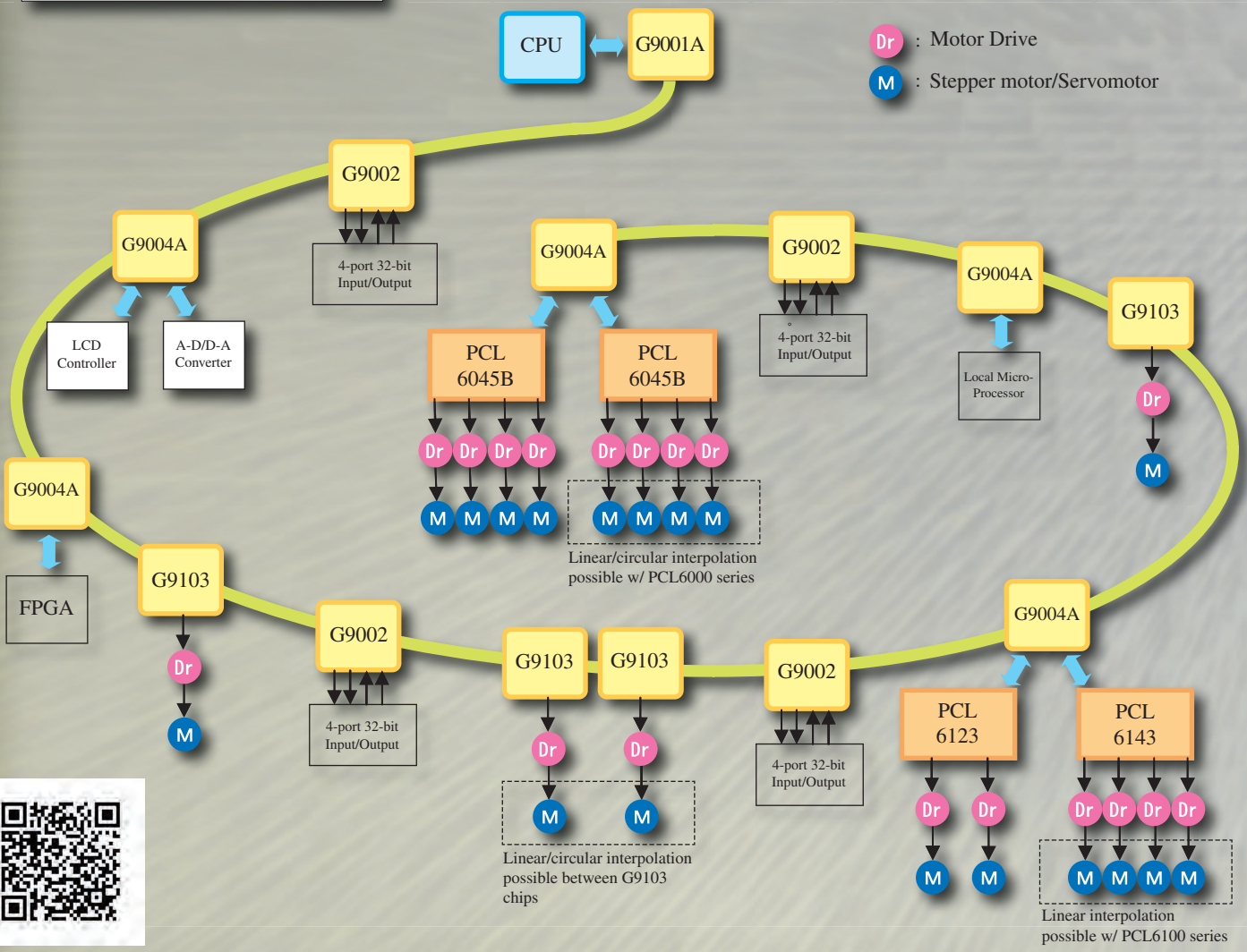
G9103/G9003
PCL Device
Pulse Generator

G9004A
Local Device
CPU Emulator

Motionnet® is a high-speed serial communications system. Configured with Nippon Pulse's unique G9000 series chips, the system satisfies requirements for factory automation by completely enabling remote control of input/output, motors, CPU emulators, and message communication with less wiring. In cyclic communication for input/output control, 4-byte data is constantly transferred in a maximum 15.1μs. It can be interrupted by a maximum 256-byte data in motor or device control. Communication time can be calculated by using the prescribed equation, ensuring the real-time characteristics demanded for factory automation. Motionnet® is recommended for use as a basic communications system for factory automation. These motion control chips are available as independent chips or G9000 series mounted boards (Motionnet® boards) that can be combined with user designed boards.

Motionnet®

A maximum of 64 local devices can be connected



Basic Specifications of high-speed serial communication chips in G9000 series

<table>
<tr><th>Name</th><th>Center Device</th><th>Local Device (I/O)</th><th>PCL Device
(Pulse Generator)</th><th>Local Drive
(CPU Emulator)</th></tr>
<tr><td>Model</td><td>G9001A</td><td>G9002</td><td>G9103/G9003</td><td>G9004A</td></tr>
<tr><td>CPU interface</td><td>Z80, 8086, 68000, H8, etc.</td><td>--</td><td>--</td><td>Z80, 8086, 68000, H8, etc.</td></tr>
<tr><td>Reference clock</td><td colspan="4">80 MHz (or 40 MHz)</td></tr>
<tr><td>Communication speed</td><td colspan="4">Selected from 20, 10, 5, or 2.5</td></tr>
<tr><td>Communication protocol</td><td colspan="4">Nippon Pulse original</td></tr>
<tr><td>Communications mode</td><td colspan="4">Cyclic mode for I/O ports and status communication, transient mode for data communication (half-duplex)</td></tr>
<tr><td>Interface</td><td colspan="4">RS-485 + Pulse transformer</td></tr>
<tr><td>Connection system</td><td colspan="4">Multidrop system</td></tr>
<tr><td>Error detection method</td><td colspan="4">CRC12</td></tr>
<tr><td>Features</td><td>· completely controls serial communication, thus minimizing burden to CPU
· cyclic transfer for I/O ports and transient transfer for data communication</td><td>· 32-bit I/O ports
· input/output direction selectable by every 8 bits
· tolerant buffer is used for interface, enabling it to connect to 5V using few componets</td><td>· provides the performance of 1 axis in NPM high-end multiaxial programmable PCL6000 series
· tolerant buffer is used for interface, enabling it to connect to 5V using fewer components
· interpolation possible between multiple units of G9103</td><td>· enables control of remote devices by emulating CPU
· enables data exchange from/to remote local devices</td></tr>
<tr><td></td><td colspan="4">· a maximum of 64 local devices can be connected to one serial line coming from the center device. Maximum 256 input/output control ports (2048 bits), maximum 64 motion control axes, and maximum 128 chip control devices
· input/output and each device status communication time. Input/output and each device information is automatically updated in the RAM of center device by every one cyclic communication
· with communication rate of 20Mbps (cyclic communication 15.1µs/local device)
1. 0.12ms w/8 local devices connected (I/O: 256 bits)
2. 0.24ms w/16 local devices connected (I/O: 512 bits)
3. 0.49ms w/32 local devices connected (I/O: 1024 bits)
4. 0.97ms w/64 local devices connected (I/O: 2048 bits)
· Data communication time, command from CPU lets data communication interrupt cyclic communication
1. 19.3µs to send/receive 3-byte data (to write a moving amount to G9003)
2. 169.3µs to send/receive 256-byte data
· connection cable for serial communication, multidrop connection using a dedicated cable or LAN cable (category 5)
· remarks
<table>
<tr><th></th><th>CPU Emulation Mode</th><th>Message Communication Mode</th></tr>
<tr><td>Data buffer length</td><td>128 words</td><td>128 words
1 word for system booking
127 words for message data</td></tr>
<tr><td>Data communication time</td><td>21.7µs to transfer 5 words</td><td>169.3µs to transfer 128 words</td></tr>
<tr><td>Control address space</td><td>64 bytes</td><td></td></tr>
<tr><td>Communication data length</td><td colspan="2">1 to 128 words/frame (1 word = 16 bits)</td></tr>
</table></td></tr>
<tr><td>Cable length</td><td colspan="4">Max. 100m (min. 0.6m) with 32 local devices connected and communications rate 20Mbps
Max. 50m (min 0.6m) with 64 local devices connected and communications rate 20Mbps</td></tr>
<tr><td>Package</td><td>64-pin QFP</td><td>80-pin QFP</td><td>80-pin QFP</td><td>80-pin QFP</td></tr>
<tr><td>Mold Dimensions (mm)</td><td>10 x 10</td><td>12 x 12</td><td>12 x 12</td><td>12 x 12</td></tr>
<tr><td>Supply Voltage</td><td>+3.3V±10%</td><td>+3.3V±10%</td><td>+3.3V±10%</td><td>+3.3V±10%</td></tr>
</table>

Reduces burden to CPU. Can connect a maximum of 64 local devices.

G9001A

G9001A is the center device that configures the Motionnet® high-speed serial communications system. It contains 256-byte RAM for I/O control and 512-byte RAM for data communication and can also control a maximum of 64 local devices. One data device can perform a maximum 256-byte data communication.

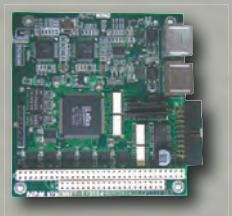
Features

- **Minimizes burden to CPU**
  - · All serial communications are controlled by G9001A
- **Built-in large-capacity RAM**
  - · Enables remote I/O control in the way to access memory
- **Maximum 256-byte data is exchangable to data communication function**
- **Accepts desired combinations of local devices**
  - · I/O device (G9002), programmable pulse generators (G9103/G9003) and CPU emulator (G9004A) can freely be combined in a desired number up to 64
  - · Automatically recognizes setting address and the port status of I/O device
  - · Address area: 512-byte space but 8-byte space can be used depending in the use of input/output buffer
  - · Communication data length: 1 to 128 words/frame (1 word=16 bits)
  - · CPU interface: Four types of interface circuits built-in

RoHS

G9001A-mounted boards/unit

PPCI-L112
PCI Bus Center Board
(G9001A x 2)



NPMCMNET-I/O104
PC/104 Bus Center Board
(G9001A x 2)

MNET-PUSB3601
USB Center Unit
(G9001A x 1)

G9002 – cyclic communication (15.1μs)

G9002

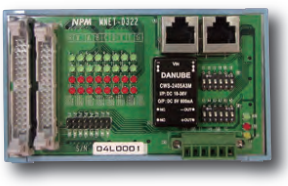
G9002 is the I/O chips used as a local device to configure the Motionnet® high-speed serial communications system. Under the control of the center device G9001A, the four-port, 32-bit input/output signals are cyclically communicated between G9002 and G9001A. The interface adopts a tolerant buffer, enabling it to connect to 5V with few components.

Features

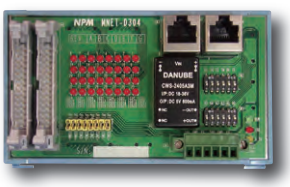
- **2048 I/O bits can be put under the control of the center device**
  - · With 64 units of G9002 connected to a single line
- **Setting address and port status of G9002 are automatically recognized by center device**
  - · Number of general purpose I/O ports: Four (8 bits/port)
  - · Input or output and the logic can be defined for each port
  - · Communication mode: cyclic

G9002-mounted boards

MNET-340
Local Input Board
(Isolated 32 inputs)



MNET-322
Local Input/Output Board
(Isolated 16 inputs/outputs)



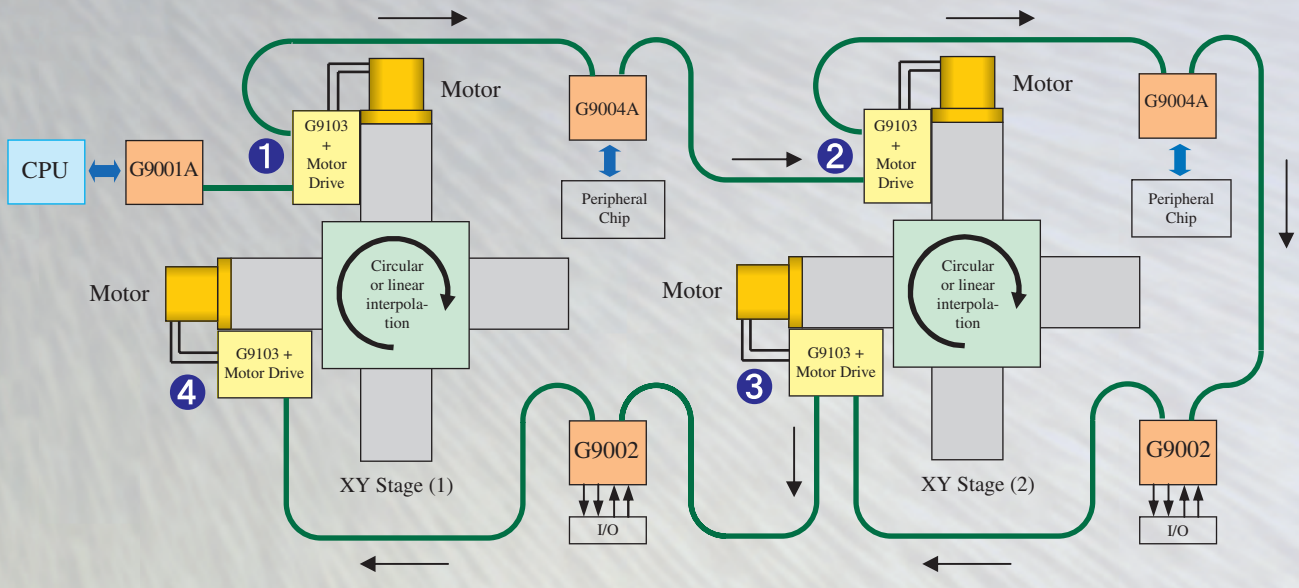
MNET-304
Local Output Board
(Isolated 32 outputs)

G9103 is a one-axis PCL chip used as a local device for the Motionnet® high-speed serial communications system. Except for the number of controllable axes, it provides the same performance as the high-end programmable pulse generators in the PCL6000 series. The use of multiple units for the Motionnet® system enables circular interpolation between two axes or linear interpolation between two or more axes. Various functions include overriding prevailing pulse rate and target position, elimination of triangular drive, backlash correction, suppression of vibration at cessetion, programmed limit, diversified origin return sequences, inputting mechanical signals, and servomotor interface. These functions enable the user to easily configure any complicated motion control system. The status of general-purpose input/output ports and axis control information are cyclically communicated to/from the center device. Axis control commands and register parameters are read or written through data communciation.

Features

- **64 axes can be controlled on a single line**
  - · By connecting 64 units of G9103 to the line
- **Circular interpolation between two desired axes or linear interpolation between two or more axes via Motionnet®**
- **Maximum output pulse rate: 6.66 Mpps**
- **Built-in three up/down counters**
  - · Two 28-bit and one 16-bit
- **Built-in three comparators**
  - · Use of comparators and up/down counters in combination enables the following:
    - · Interrupt signal output and external output of comparison results
    - · Immediate stop or deceleration stop
    - · Programmed limit
    - · Out-of-step detection
    - · Synchronization signal output
- **Overriding prevailing pulse rate and target position**
  - · Number of general-purpose input/output ports: One (8 bits), input or output can be defined for each bit
  - · Communication data length: One to four words/frame (1 word = 16 bits)
  - · Communication mode: Cyclic for I/O port and transient for parameter transfer
  - · Pulse output mode: selectable from 12 types of pulse signal outputs and two-phase stepping motor excitation sequence
  - · Twelve major operation modes
  - · Built-in one-stage preregisters which enable writing of the next operation's parameters (moving amount, starting pulse rate, operating pulse rate, acceleration rate, deceleration rate, multiplication factor, ramping down point, operating mode, S-curve sections in acel/decel, and interpolation parameters) during present operation in progress.
  - · Manual pulser input terminal with functions to multiply by 32 and to divide by 2048
  - · Fourteen types of error factors and 13 types of event factors are available to initiate an interrupt signal (event factor can be selected by the register)

G9103 Interpolation Schematic



As shown above, if each G9103 is not connected adjacently, circular/linear interpolation is possible between 1 and 4 and between 2 and 3. Linear interpolation of all four axes is possible.

G9003

G9003 is the one-axis programmable pulse generator used as a local device for the Motionnet® high-speed serial communications system. Various functions include overriding prevailing pulse rate and target position, elimination of triangular drive, backlash correction, suppression of vibration at cessetion, programmed limit, diversified origin return sequences, inputting mechanical signals, and servomotor interface. These functions enable the user to easily configure any complicated motion control system. The status of general-purpose input/output ports and axis control information are cyclically communicated to/from the center device. Axis control commands and register parameters are read or written through data communciation.

RoHS

Features

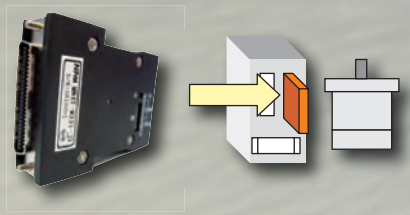
- **Four axes can be controlled on a single line**
  - · By connecting 64 units of G9003 to the line
- **Maximum outputpulse rate: 6.66 Mpps**
- **Built-in three up/down counters**
  - · Two 28-bit and one 16-bit
- **Built-in three comparators**
  - · Use of comparators and up/down counters in combination enables the following:
    - · Interrupt signal output and external output of comparison results
    - · Immediate stop or deceleration stop
    - · Programmed limit
    - · Out-of-step detection
    - · Synchronization signal output
- **Overriding prevailing pulse rate and target position**
  - · Number of general-purpose input/output ports: One (8 bits), input or output can be defined for each bit
  - · Communication data length: One to four words/frame (1 word = 16 bits)
  - · Communication mode: Cyclic for I/O port and transient for parameter transfer
  - · Pulse output mode: selectable from 12 types of pulse signal outputs and 2-phase stepping motor excitation sequence
  - · Twelve major operation modes
  - · Manual pulser input terminal with functions to multiply by 32 and to divide by 2048
  - · Fourteen types of error factors and 13 types of event factors are available to initiate an interrupt signal (event factor can be selected by the register)

G9003-mounted Boards

MNET-M101-DUM

Local Uniaxial Motion Control Board

Pulse train output type; can control servomotor and stepper motor

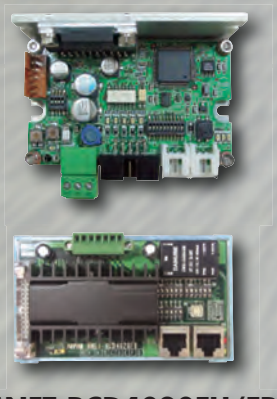


MNET-M3X1

Local Uniaxial Motion Control Board

Can directly connect to input/output of motor drives of various manufacturers. Models vs. compatible motors are as follows:

MNET-M321-MIA
Panasonic AC servo drive MINAS A/AIII/A4
MNET-M331-J3
Mitsubishi Electric AC servo drive MR-J3
MNET-M341-S23
Yaskawa Electric AC servo drive SII/III/V
MNET-M351-SAN
Sanyo Denki AC servo drive Q
MNET-M361-VPS
Nikki Denso AC servo drive VPS
MNET-M371-AS
Oriental Motor Step AS(C)



MNET-BCD4020FU/FB

Local two-phase Stepper Motor Drive

G9003 and stepper motor drive are incorporated into a board

MNET-BCD4020FU
Unipolar, 1/16 microstep

MNET-BCD4020FB
Bipolar, 1/256 microstep

Control peripheral chips as a remote CPU

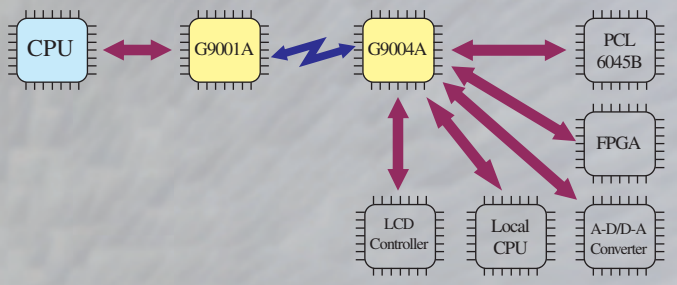
G9004A

G9004A is the CPU emulator used as a local device for Motionnet®. It can control various peripheral chips by performing like a local CPU. It can also communicate with an additional CPU installed at the local site.

- According to commands sent from the center device, G9004A generates CPU terminal signals including control signals, address/data bus signals
- Connecting CPU terminal signals to high-performance devices enables remote control from the center device
- Device status information such as interrupt and FIFO is cyclically transferred to the center device and CPU terminal signals are transiently transferred through data communication
- Available as a local device or PCL-incorporated board for Motionnet® system

Features

- Can communicate a maximum 256-byte data
- Up to 64 units can be connected to a single line
- Communication failure detection circuit ensures safe operation (watchdog timer built in)



Quadraxial pulse generator chips

User interface
User logic circuit

Analog interface
Other CPU peripheral devices (bus interface)

- Can control various CPU peripheral chips
- Can connect to two PCL6045B quadaxial pulse generators. If 64 units of G9004A are connected as local devices to one G9001A, 512 axes can be controlled on a single line. (4 axes (PCL6045B) x 2 units of PCL6045B per one G9004A x 64 units of G9004A = 512)

Pulse Transformer NPT102F (recommended for G9000 series)

DIL 4-pin surface mounted small-sized pulse transformer featuring high dielectric strength (made by JPC). It is suited for use in combination with G9000 series.

Primary inductance: 1000μH ±30% 100 kHz 100mV
Winding ratio: N1:N2 = 1:1
Leakage inductance: 2.0 μH max
Winding Capacitance: 20pF max
DC winding resistance: N1 1.5 Ω, N2 1.5 Ω
ET product: 6V-μs PRF 1 kHz 3V
Insulation resistance: 100MΩ min. 1000 Vdc
Dielectric strength: 1500 Vac rms for one minute
Dimensions: 7.0 x 5.6 mm (mold)

Serial Communications Cable

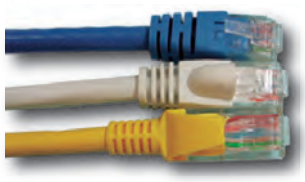
For the Motionnet® system, a slender, dedicated Nippon Pulse cable (or commercially available ethernet LAN cable) ensures high-quality communication at high speed and is recommended.

Motionnet®-dedicated cable (one-pair)

The slender and flexible harness cable, which is easily installed, is available with RJ connector, DF connector, RF and DF connectors or with no connector and is 10m long. Wiring standard: STP cable equivalent to category 5.

Commercially available LAN cable

Wiring standard: TIA/EIA-568-B, UTP/STP cable conforming to category 5 or higher



Function	Description
S-curve acceleration/deceleration	Pulse rate is accelerated or decelerated in S-curve, which enables reduction of mechanical vibration caused by conventional linear accel/decel. The degree of vibration suppression differs depending on conditions including the applied motor, mechanism, and operating pattern
S-curve section setting	To shorten the S-curve accel/decel time, the S-curve can be made linear. Setting S-curve sections lets acceleration or deceleration be made in the S-curve at the start and end, with a linear section in the middle
Triangular drive correction function	When operated with parameters which cause triangular drive (abrupt change from accel to decel), operating pulse rate (FH) is automatically decreased to eliminate triangular drive
Origin return	Movement is made to the origin. Various origin return modes are available depending on models
Origin search, origin escape	Origin Search: Origin return is made from the designated direction while reciprocating between plus and minus end limits Origin escape: When origin signal is ON, pulse output returns OFF position once. At that time, it can be stopped by counting encoder Z-phase signals
Origin return w/moving amount restricted	When origin signal is ON or when pulses are outputted in the number designated by the register, the chip stops outputting pulses
Limit positioning	Movement is made to mechanical or programmed end limit position, and then stops normally
Limit escape	Movement is made to limit OFF position from the mechanical or programmed end limit position
Servomotor interface	The following signals are available for servomotor control: 1. In-position: Until receiving in-position signal from servomotor drive, the chip does not complete the operation 2. Deviation counter clear: The chip outputs one-shot signal to clear deviation counter of servomotor drive 3. Alarm: When receiving alarm signal from servomotor drive, the chip stops outputting pulses[1]
Encoder input (up to 4Xs multiplication possible)	The chip can input encoder signal for present position management. The input signal can be selected from two-pulse signal or 90˚ phase difference signal (1, 2, or 4 times multiplied)
Origin return using encoder Z-phase signals	The chip stops outputting pulses regarding origin return complete when several encoder Z-phase are counted after origin signal ON. The number of counting encoder Z-phase signals can be changed in a prescribed range
Up/down counter (present position counter)	Up/down counter can be used for present position management, etc. It can count output pulses or signals of encoder, pulser, etc. The input signal can be selected from two-pulse signal or 90˚ phase difference signal (1, 2, or 4 times multiplied)[3]
Automatic setting of ramping-down point	The number of pulses used for acceleration or calculated number of pulses is automatically written to the ramping-down point setting register[2]
Origin return at up/down counter zero	The chip continues outputting pulses until up/down counter value is zero. The function enables a single command to perform such operation that 'read the present up/down counter value, set the value to the zero direction and start'
Counter latch w/hardware	Input signal latches designated counter value(s). (Input logic can be changed by software technician)
Comparator	Enables comparison between register value and counter value. When the comparison result satisfies comparison conditions, the level of CMP pin changes. Also, satisfaction of comparison conditions can be used to stop the chip from outputting pulses or to generate interrupt signal. Functions differ depending on modules
External mechanical output	As mechanical position detection signals, the chip can input the following signals: 1. EL signal: Mechanical end limit signal. The chip immediately stops outputting pulses when the end limit signal in moving direction is turned on, and continues stopping if the end limit signal is turned off. Some modules can be set so that EL signal ON causes deceleration stop 2. SD signal: Mechanical ramping-down signal. When made valid, the SD signal ON lets the chip decelerate pulse output to the starting pulse rate (FL). When the signal is turned off thereafter, the chip accelerates pulse output 3. ORG signal: Mechanical origin signal used for origin return. Some models can be set so that ORG signal ON stops pulse output after counting encoder Z-phase signals or ORG signal causes deceleration-stop without using SD signal
Interrupt signal output	Interrupt signal to CPU. Some models can read the interrupt factor (Number of interrupt factors differs depending on model)[4]
Interrupt factor setting	Enables selection of only necessary interrupt factors (event-based interruption)
Interrupt status	Enables monitoring of the factor initiating output of interrupt signal to CPU
Status	Present operating status and external signal input status can be monitored from CPU. Depending on models, status can be monitored from the status address or via registers
Prebuffer (pre-register) for next operation	Buffer for continuous operation with different patters. Writing operating parameters (preset amount, starting pulse rate, operating pulse rate, acel/decel rates, etc.) to preregisters during operation in progress enables the start command to copy the parameters from preregisters to operating registers and the start the chip outputting pulses according to new parameter. Thus, by preparing preregisters for next operation, continuous operation with different patterns is made possible
Automatic start of next operation	With parameter for the next operation written to preregisters, the chip can automatically be started based on parameters of preregisters upon completion of the present operation, thereby enabling continuous operation with no pulse
Command buffer monitor	Enables monitoring of written command
Selection of output pulse logic	Output pulse logic can be changed
Selection of output pulse mode	Output pulse mode can be selected from common pulse mode (command pulse and direction pulse), two-pulse mode (pulse in plus direction and pulse in minus direction) or 90˚ phase difference signal mode[5]
Excitation sequence output for 2-phase stepper motor	By connecting the output to a stepper motor drive IC or transistor array, a stepper motor controller/drive system can easily be configured
Monitor signal output terminal	Enables the user to monitor the status of operation, constant speed operation, acceleration/deceleration, etc.
Pulser input	Enables the user to output pulses from the pulse output pin by operating the manual pulser at the mechanism. Input pulser signal is 2-pulse signal (plus and minus pulses) or 90˚ phase difference signal. 90˚ phase signal can be multiplied by counting
Pulser synchronized positioning	Positioning is made in synchronization with pulser signal. The chip stops outputting pulses after outputting pulses for the present moving amount. If receiving pulses more than the present amount from the pulser, the chip ignores them
Linear interpolation	Linear interpolation is possible between desired axes of one or multiple chips[6]
Circular interpolation	Circular interpolation is possible between two desired axes[7]
Continuous interpolation	Use of preregisters enables successive linear or circular interpolation
Overriding target position	Target position (moving amount) can be changed during positioning operation progress. If the newly written parameter designates a position already passed, the chip decelerates and stops pulse output (immediately stops when operating at conteant speed), and then moves in reverse direction. Also, pulse output can be stopped by outputting a preset number of pulses based on exteral signal input timing
1-pulse output	One pulse can be outputted w/one command. Starting with a value one preset can be made w/one command
Idling pulse	Enables acceleration to be started after outputting several pulses at the starting pulse rate (FL). This function enables the user to set the starting pulse rate near upper limit of the self-starting pulse rate of the stepper motor

Output pulsewidth control	Output pulsewidth can be controlled to quicken stop timing. When the output pulse rate is lower than the reference value, the pulsewidth is constant. When it is higher than the reference value, the pulsewidth duty is 50%. If positioning is complete at the low starting pulse rate (FL), in-positioning can be quickened by making the width of the last pulse shorter
Simultaneous start/stop	Simultaneous start/stop in multiaxial control with multiple chips can be made by connecting all concerned chips through STA pins
External start/stop	Enables the user to start or stop pulse output using external signal
Out-of-step detection	Made possible by mounting a feedback encoder to the stepper motor
I/O port (general-purpose input/output terminal)	Input or output can be defined by setting. If set for output, the port can be used for excitation ON/OFF and stepping motor drive, count-down signal, etc. With some models the I/O port can output interrupt signal to CPU based on level charge
Operating switch input terminal	Enables the user to directly drive the motor by inputting forward or reverse direction signal
Ring count function	Use of counters and comparators in combination enables repetitive operation in a designated counting range. The function can be utilized for such a purpose as counting a rotating table
Backlash correction	Backlash is corrected every time the moving direction is changed (except when making interpolation)
Programmed soft limit	Limit can be programmed by using two comparator circuits. Entering the programmed limit causes immediate stop of deceleration-stop. Thereafter, operation is possible only in reverse direction
Timer operation	The chip can be used as a timer by allowing it to internally perform positioning operation without outputting any pulse
Synchronization signal output	The chip can output a timing pulse signal at designated intervals
Vibration supression	With a control constant designated in advance, one pulse each is added in reverse and forward directions just before stop. This function enables reduction of vibration at the time of stopping the stepping motor. The setting time can be shortened
Independent operating mode	This mode enables the chip to operate with no CPU connected. Write parameters for up to 32 operating patterns from CPU to EEPROM in advance. Then, the chip can operate with CPU removed. Also, mounting to a board the EEPROM in which parameters for operating patterns are written, enables operation without CPU removed
Compatibility to 5V interface	If the supply voltage is 3.3V, each chip uses tolerant buffer for interface, thereby enabling it to connect to 5V with fewer components

1: PCD2112 inputs the alarm signal at the reset terminal
2: With PCL6000 series and G9103/G9003 automatic setting of ramping down point is possible in a range of (decleration time) ≤ (acceleration x 2)
3: PCL6000 series and G9103/G9003 are equipped w/a counter which is usable as a deviation counter
4: G9103/G9003 have no interrupt signal output bin, but allows interrupt CPU by changing the level at port 0
5: With PCD4500 series 90° phase difference signal can be outputted using the 2-phase stepper motor excitation sequence output
6. With PCL6113 and G9103 linear interpolation is made possible by using two or more units
7: With G9103 circular interpolation is made possible by using two or more units

List of Boards

Motion Control Boards

Product	Model	Mounted Chip	RoHS Compliant
4-axis Motion Control Board (PCI)	PPCI7443	PCL6045B	Yes
4-axis Motion Control Board (PC/104)	NPMC6045A-4104	PCL6045B	Yes

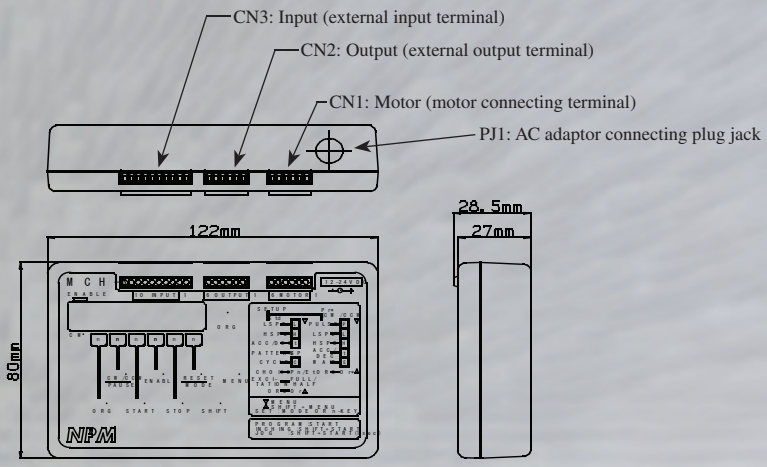
Motionnet®

Product	Model	Mounted Chip	RoHS Compliant
Center Board (PCI)	PPCI-L112	G9001A x 2	No
Center Board (PC/104)	NPMCMNET-I/O104	G9001A x 2	No
Center Unit (USB)	MNET-PUSB3601	G9001A	Yes
Center Module (Yokogawa Electric PLC FA-M3)	MNETF3-C2	G9001A	Yes
Local Input Board (IN 32)	MNET-D340	G9002	No
Local Input/Output Board (IN 16/OUT 16)	MNET-D322	G9002	No
Local Output Board (OUT 32)	MNET-D304	G9002	No
Compact Local Input Board (IN 16)	MNET-D420	MNET-D4xx-dedicated chip	Yes
Compact Local Input/Output Board (IN 8/OUT 8)	MNET-D411	MNET-D4xx-dedicated chip	Yes
Compact Local Output Board (OUT 16)	MNET-D402	MNET-D4xx-dedicated chip	Yes
Local 1-axis Motion Control Board	MNET-M101-DUM	G9003	No
Local 1-axis Motion Control Board (for Panasonic AC servo drive MINAS A/AIII/A4)	MNET-M321-MIA	G9003	Yes
Local 1-axis Motion Control Board (for Mitsubishi Electric AC servo drive MR-J3)	MNET-M331-J3	G9003	Yes
Local 1-axis Motion Control Board (for Yaskawa Electric AC servo drive ∑II/III/V)	MNET-M341-S23	G9003	Yes
Local 1 axis Motion Control Board (for Sanyo Denki AC servo drive Q)	MNET-M351-SAN	G9003	Yes
Local 1-axis Motion Control Board (for Nikki Denso AC servo drive VPS)	MNET-M361-VPS	G9003	Yes
Local 1-axis Motion Control Board (for Oriental Motor AC servo drive AS(C))	MNET-M371-AS	G9003	Yes
Local 2-phase Stepper Motor drive (Bipolar)	MNET-BCD4020FB	G9003	No
Local 2-phase Stepper Motor drive (Unipolar)	MNET-BCD4020FU	G9003	Yes

MotionChecker 5

Features

- Equipped with memory feature to retain program settings
- Program operation (repetitive operation of six steps/pattern including zero return) enabled
- Inching operation (one-step operation) enabled
- Jog operation (continuous operation only while operating switch) enabled
- Easy-to-use, compact, and lightweight mobile type with built-in 2-phase stepper motor driving circuit
- Enabled settings include rotation direction, speed control, position control, operation mode, and stop time of stepper motor
- Connecting other external driving circuits enabled by pulse output signals
- Connecting and integrating external device enabled with external input/output signals
- All-in-one type for easy operation checking



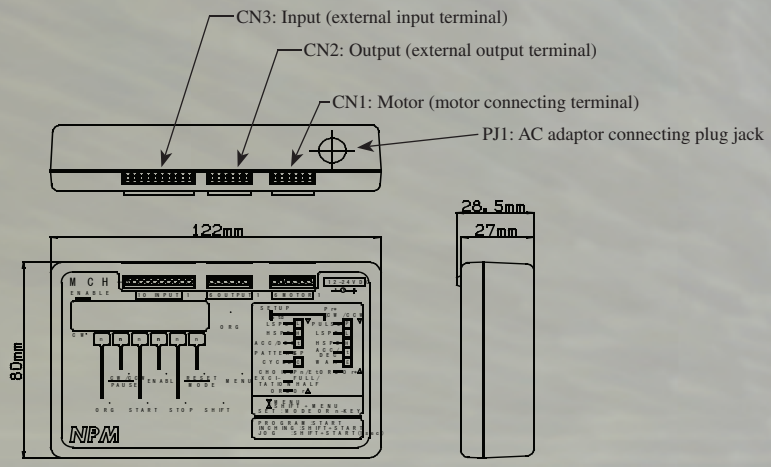
Specification	MCH-5U	MCH-5B
Power Input[1]	12VDC (2A) to 24VDC (1A), 24 watt maximum power supply by AC adaptor	
Protective Fuse	2A fuse mounted on motor power line	
Output Current	250mA/phase (400mA maximum)	400mA/phase (700mA maximum)
Driving System	Unipolar constant voltage	Bipolar constant voltage
Excitation Mode	Full step (2-2 phase), Half step (1-2 phase)	
Operating Temperature	0˚C ~ 40 ˚C	
Operating Humidity	0% ~ 80% RH (no condensation)	
Storage Temperature	-10˚C ~ +70˚C	
External Dimensions	122mm x 80mm x 27mm	
Weight	140g or less	
Environmental Quality	RoHS compliant parts used	
Cooling Method	Air cooling without blowing	
Motor AC Adaptor	Input: 100V ~ 240VAC, Output: 12VDC (2A)	
Motor Part Number	PFCU25-24C1G (1/20)	PFCU20-40S4GA2 (1/10)
Motor Step Angle	0.75˚/step (at 2-2 phase excitation)	0.90˚/step (2-2 phase excitation)
Coil Resistance	120ohms ±7%	160ohms ±7%
Rated Voltage	Terminal voltage: 12.5V (rated 12.5V)	Terminal voltage: 11.0V (rated 12V)
Other	Motor leads (L=250mm), screwdriver, instruction manual	

1: MotionChecker 5 supports up to 24VDC. However, the attached AC adaptor and motor are 12VDC power input specification. If you use this unit at a higher voltage, prepare an appropriate AC adaptor and motor.

MotionChecker 3

Features

- Compact and lightweight mobile motion checker with an integrated driving circuit
- Checking the motion of stepper motors is simplified with the MCH3
- Speed pattern, feed amount, operation mode, number of repeat motion, wait time, excitation mode, etc. can be set
- Other driving circuits can be connected externally to take advantage of its pulse output signals
- The MotionChecker 3 can be connected to an external device and can receive data using external input/output signals

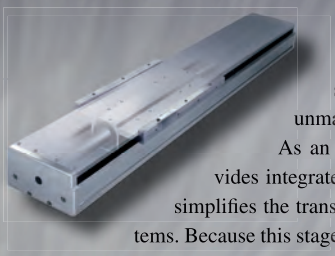


Specification	MCH-3U	MCH-3B
Power Input[1]	12VDC (2A) to 24VDC (1A), 24 watt maximum power supply by AC adaptor	
Protective Fuse	2A fuse mounted on motor power line	
Output Current	250mA/phase (400mA maximum) Driver chip: NP2671	400mA/phase (700mA maximum) Driver chip: NP3775
Driving System	Unipolar constant voltage	Bipolar constant voltage
Excitation Mode	Full step (2-2 phase), Half step (1-2 phase)	
Operating Temperature	0˚C ~ 40 ˚C	
Operating Humidity	0% ~ 80% RH (no condensation)	
Storage Temperature	-10˚C ~ +70˚C	
External Dimensions	122mm x 80mm x 27mm	
Weight	130g or less	
Cooling Method	Air cooling without blowing	
Motor AC Adaptor	Input: 100VAC, Output: 12VDC (2A)	Input: 100V ~ 240VAC, Output: 12VDC (2A)
Motor Part Number	PFCU25-24C1G (1/20)	PFCU20-40S4GA2 (1/10)
Motor Step Angle	0.75˚/step (at 2-2 phase excitation)	0.90˚/step (2-2 phase excitation)
Coil Resistance	120ohms ±7%	160ohms ±7%
Rated Voltage	Terminal voltage: 12.5V (rated 12.5V)	Terminal voltage: 11.0V (rated 12V)
Other	Motor leads (L=200mm), screwdriver, instruction manual	

1: The MotionChecker can be powered by up to 24VDC. The included motor and AC adaptor work at 12VDC. If you want to use MCH at a high voltage, you will need to get an AC adaptor and motor

Other Nippon Pulse Products

SLP Stage System



A high-precision stage for industrial applications, the SLP Acculine Series stages offer superior technology that is unmatched in the industry.

As an all-inclusive stage, the SLP stage provides integrated shaft support within the housing and simplifies the transition from conventional ball-screw systems. Because this stage system features a lightweight, compact linear shaft drive, the SLP is a low-profile, high-precision product.

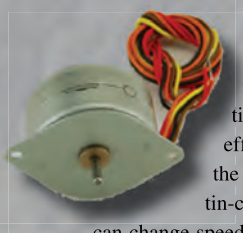
There are no stages on the current market that match the SLP series' force-to-volume ratio, making it an outstanding solution for those with space limitations.

SCR Stage System

The SCR Nanopositioning Series offers the accuracy of piezo driven stages with the speed and performance of servo stages. Through complex motion profiles, the SCR series produces extremely accurate results with no loss in stability.

The SCR stage also includes an integrated cross-roller guide. With a simple, lightweight, compact shaft-type linear motor comprised of only a magnet and a coil, large drive force is gained with an efficient and short coil length, allowing for high speed and high precision applications.

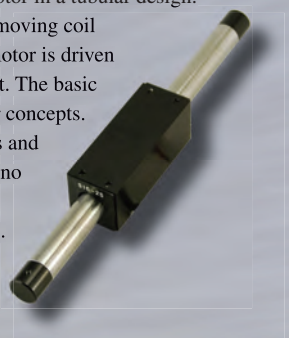
Tin-Can Stepper Motors



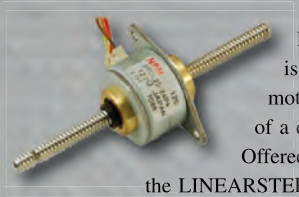
The cornerstone of Nippon Pulse, the tin-can rotary stepper is our most recognizable product. A conventional, magnet-driven rotary stepper motor, the tin-can offers a high-performance yet cost efficient solution. Rotating in proportion to the number of pulses sent to the motor, the tin-can series is frequency synchronized and can change speed depending on the frequency of the pulse signal.

Linear Shaft Motor

Nippon Pulse's Linear Shaft Motor (LSM) is a brushless, high-precision direct drive linear servomotor in a tubular design. Consisting of a magnetic shaft and moving coil assembly (forcer), the linear shaft motor is driven and controlled by the flow of current. The basic design of this motor has three major concepts. The design is simple (only two parts and a non-critical air gap), non-contact (no sound, dust; maintenance free), and high precision (no iron, no cogging). This product is offered with 11 unique shaft diameters, from 4mm to 50mm, and can span lengths ranging from 20mm to 4.6M.



Linear Stepper Motors



A tin-can linear actuator, the PFL/PFCL series (LINEARSTEP®) is designed to provide a simple linear motion system at a fraction of the cost of a conventional rotary stepper motor. Offered in diameters of 25mm and 35mm, the LINEARSTEP® series can also be ordered with one of three pitches on the lead thread screw (0.48mm, 0.96mm, and 1.2mm). This series can be ordered with a choice of windings on a unipolar or bipolar configuration.

Hybrid Stepper Motors

Hybrid Rotary Steppers (PR series) are high torque motors with superior response characteristics. Available in sizes from 20mm (NEMA SIZE 8) to 57mm (NEMA SIZE 23) with step angles of 0.9 deg or 1.8 deg.

NPM Nippon Pulse

Your Partner in Motion Control

www.nipponpulse.com … info@nipponpulse.com

phone: 1-540-633-1677 … fax: 1-540-633-1674

The Nippon Pulse Advantage

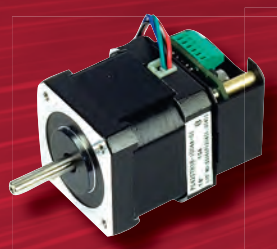
For 60 years, Nippon Pulse has built state-of-of-the-art products based on a solid foundation of advancing technology and thorough product research.

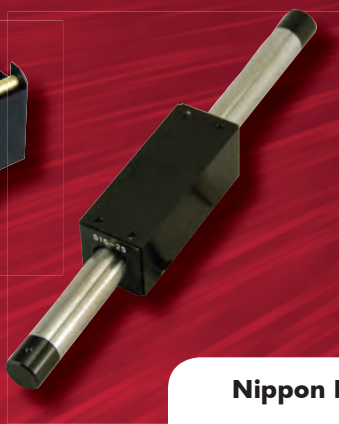
Nippon Pulse faithfully provides these high-quality products to a wide range of industries in North and South America and Europe. Nippon Pulse has established itself as a leader in stepper motor, driver, and controller technology while introducing innovative products such as the Linear Shaft Motor and Motionnet®. At Nippon Pulse, we believe by bringing products to market which not only meet customers' requirements, but actually impress them, we contribute to the progression of technology and its positive impact on our society. We pride ourselves on the reputation of our high-quality products that provide that impact. A wholly owned subsidiary of Nippon Pulse Motor Co., Ltd., Nippon Pulse America is headquartered in Radford, Va.

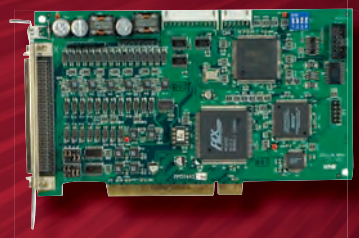
Nippon Pulse has representatives throughout North and South America and Europe to directly assist customers. Limited quantities of stock on standard motors and electronics are available to allow faster response to customer needs. In addition, Nippon Pulse has a model shop in its Radford, Va. headquarters for quick turnaround on custom prototypes and special orders. Nippon Pulse's mission is to faithfully create new products sought by its customers and to contribute to the development of society from a global viewpoint.

When you choose a Nippon Pulse motor, driver, controller, network or stage, you're doing more than just buying a quality product. You're benefitting from what we call the Nippon Pulse Advantage. This includes superior prototyping, complete system engineering, proper compliance and certification according to international guidelines, and exceptional tailoring to your needs. It also includes product support unmatched in the motion control industry.

Our biggest asset at Nippon Pulse is our people, both our employees and our customers. We ensure we have the best people working for us so we are able to build loyalty among our customers. It's an advantage you won't find at any of our competitors and why we take pride in our products and in our company.







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