NPM motion control chips are available in various types including programmable pulse generators, counter chips and high-speed serial communication chips. Selection of proper chips enables configuration of an ideal motion control system for each individual application.

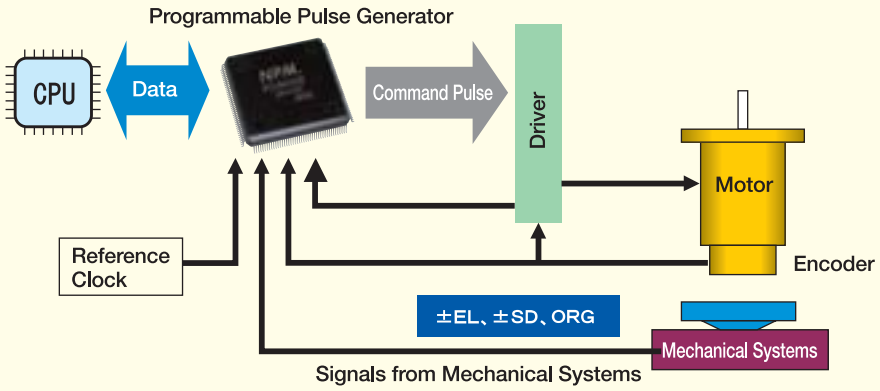
Programmable Pulse Generators

Pages 2 to 8

PCL6000 Series
PCL6100 Series
PCD2112
PCD4500 Series

Receiving commands from CPU, a programmable pulse generator can control a stepping motor or servomotor.
Write operating parameters from CPU and just send START command. Then, the motor control can be committed to the chip, thereby outstandingly reducing burden to CPU.
Since marketing the initial version in 1985, programmable pulse generators have been advanced in cooperation with many users.

Typical System Configuration using Programmable Pulse Generator



High-speed Serial Communication Chips

Pages 13 to 19

G9000 Series
G8000 Series

These chips are designed to configure a high-speed serial communication system.
Besides I/O control functions, motor controls and data communication functions are available.
Designed with "Best Open Field Bus" in mind, these chips are marketed not only as chip level but also as board level products which can be combined with user-designed boards.

Counter Chips

Page 20

CCL Series

Counter chips are designed to connect to CPU bus. They facilitate controlling the present position and deviation in motor position control.

Electronic Cam-Oriented Programmable Pulse Generators

Page 21

PCS Series

These chips are designed to provide cam-like movement .
By setting an operating pattern for the driven shaft, a pulse train for driven shaft control is output in synchronization with encoder signal input of the main shaft.

Major Applications

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

PCL/PCD/G Series Programmable Pulse Generators

Selection Guide

Required Performance/Function \ Model	PCL6046	PCL6045BL PCL6045B PCL6025B	PCL6143 PCL6123 PCL6113	PCD2112	PCD4541 PCD4521 PCD4511 PCD4500	G9103A Soon on sale	G9003	Related Functions Remarks
(Reference Page)	Page 5	Page 5	Page 6	Page 7	Page 8	Page 16	Page 17	
Control stepping motor	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Make simple 2-phase stepping motor drive circuit				Yes	Yes	Yes	Yes	Excitation sequencer function
Control servomotor	Yes	Yes	Yes	Yes		Yes	Yes	Sevomotor I/F, Up/down counter
Control linear motor	Yes	Yes	Yes			Yes	Yes	Servomotor I/F, High max. output frequency
Control 1 axis with 1 chip			PCL6113	Yes	PCD4500/4511	Yes	Yes	
Control max. 2 axes with 1 chip		PCL6025B	PCL6123		PCD4521			
Control max. 4 axes with 1 chip	Yes	PCL6045B/6045BL	PCL6143		PCD4541			
Use 8-bit CPU data bus	Yes	Yes	Yes		Yes			
Compatibility with 16-bit CPU data bus	Yes	Yes	Yes					
Serial CPU data bus				Yes				4-wire serial bus
Standalone operatlon with no CPU connected				Yes				Independent operating system mode
Control 1 axis with Motionnet serlal communication line						Yes	Yes	
Control multiple axes with Motionnet serial communication line using multiple chips						Yes	Yes	
Control multiple axes with Motionnet serial communication line in combination with G9004.	Yes	Yes	Yes		Yes			G9004A CPU emulation mode
High cost-performance			Yes	Yes	Yes			Low unit price per axis
Supply voltage 3.3V	Yes	Yes*1	Yes	Yes		Yes	Yes	
Compatibility of input signal system with 5V interface.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Tolerant buffer
Enable construction of smaller board	Yes			Yes				Small dimensions
Need up/down counter other than positioning control	Yes	Yes	Yes	Yes		Yes	Yes	Up/down counter
Positioning control with encoder signal	Yes	Yes	Yes	Yes		Yes	Yes	Encoder input
Origin return with Z-phase signal	Yes	Yes	Yes	Yes		Yes	Yes	Origin return function
Independent setting of accel/decel time	Yes	Yes	Yes	Yes		Yes	Yes	Accel/decel rate setting
Automatic setting of ramping-down point with accel time = decel time			Yes	Yes				Automatic setting of ramping-down point
Automatic setting of ramping-down point with accel time = decel time and with accel time ≠ decel time	Yes	Yes				Yes	Yes	Automatic setting of ramping-down point
Linear interpolation between 2 or more axes	Yes	Yes	Yes*2			Yes*2		Interpolation function/operation
Circular interpolation between 2 axes	Yes	Yes				Yes*2		Interpolation function/operation
Interpolation between remote boards through serial communication						Yes*2		Interpolation function/operation
Continuous interpolation with no cessation	Yes	Yes	Yes*2 Linear inter-polation only			Yes*2		Continuous interpolation
S-curve acceleration/deceleration	Yes	Yes	Yes	Yes	Yes*3	Yes	Yes	S-curve acceleration/deceleration
Linear accel/decel section on the way of S-curve	Yes	Yes	Yes	Yes		Yes	Yes	Setting S-curve section
Automatic elimination of triangular drive	Yes	Yes	Yes	Yes		Yes	Yes	FH correction function
Manual pulser	Yes	Yes	Yes	Yes		Yes	Yes	Pulser input mode
Comparator function	Yes	Yes	Yes			Yes	Yes	Comparator
General-purpose I/O port	Yes	Yes	Yes	Yes		Yes	Yes	General purpose I/O ports
Out-of-step detection	Yes	Yes				Yes	Yes	Out-of-step detection
Continuous operation from the present to the next	Yes	Yes	Yes			Yes		Prebuffer/preregister
Speed change during operation in progress	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Changing speed during operation/overriding speed
Target position change during operation in progress	Yes	Yes	Yes			Yes	Yes	Overriding target position
Long acceleration/deceleration time	Yes	Yes		Yes		Yes	Yes	Long bit length of accel/decel rate registers
Fine pulse rate setting	Yes	Yes				Yes	Yes	Long bit length of speed register
Programmed soft limit function	Yes	Yes				Yes	Yes	Soft limit function
Output 90° phase deviation pulse	Yes	Yes	Yes	Yes		Yes	Yes	Environmental setting register
Backlash correction function	Yes	Yes				Yes	Yes	Backlash correction function
Start/stop with hardware switch	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Ext. switch operation mode
Ring count function	Yes	Yes	Yes			Yes		Ring count function
Origin search function	Yes	Yes		Yes		Yes	Yes	Origin search function
Increased starting pulse rate with idling pulse	Yes	Yes		Yes	Yes	Yes	Yes	Idling pulse/idling control

*1. Supply voltage for PCL6045BL is 3.3V only. 5V and 3.3V are required for PCL6045B/6025B.
*2. Interpolation function of PCL6113 and G9103A is usable when 2 or more units are connected.
*3. PCD4500 is excluded.

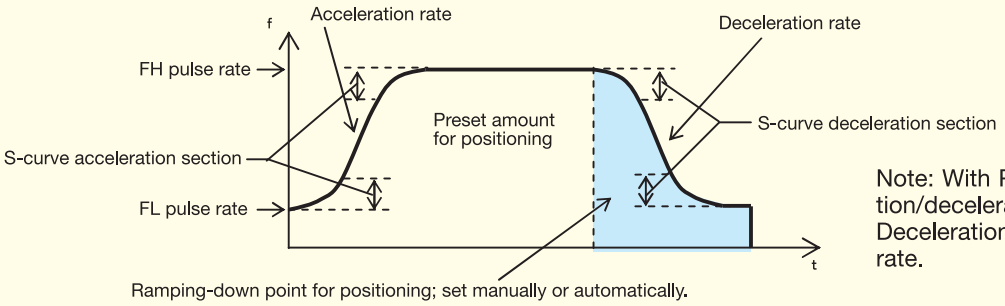
Refer to page 9 to 12 for the detail specifications and functions.

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.

Pulse Output Pattern

Shown below is an example of S-curve acceleration/deceleration and S-curve section.

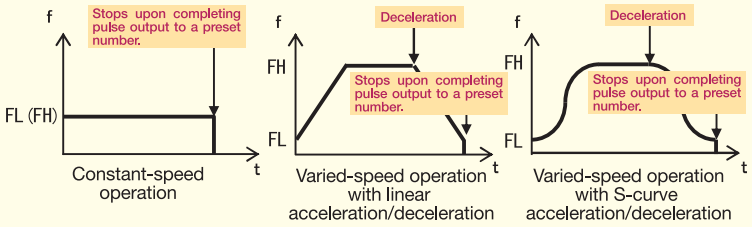


Note: With PCD4500 series, S-curve acceleration/deceleration sections cannot be set. Deceleration rate is the same as acceleration rate.

Typical Operation Profiles

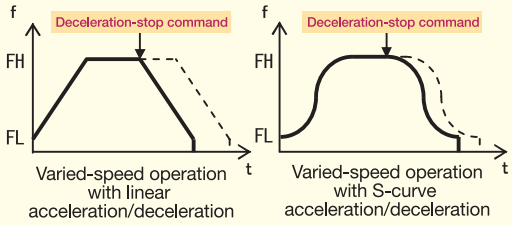
1. Preset Operation (Positioning)

The chip stops outputting pulses upon outputting a preset number.



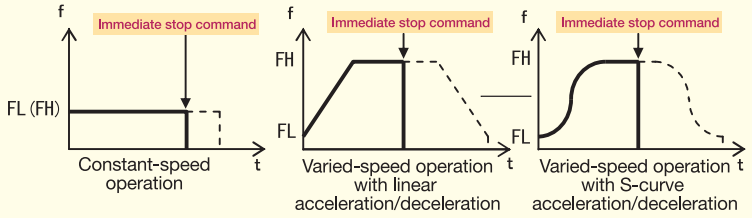
2. Deceleration-Stop

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



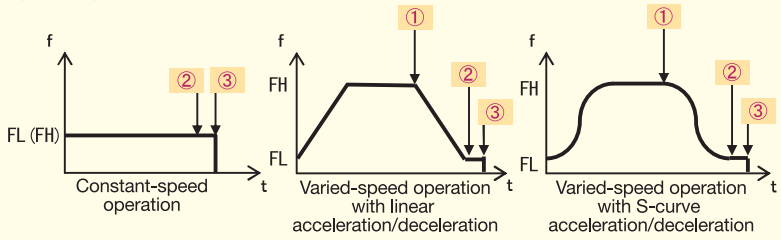
3. Immediate Stop

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



4. Origin Return

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



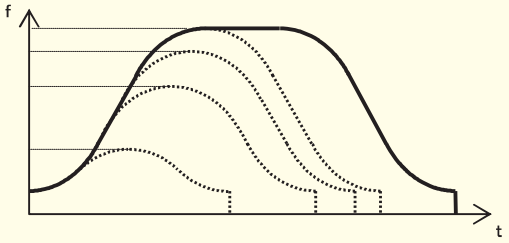
(1) SD signal ON starts deceleration (①), and ORG signal ON stops pulse output (③).
(2) SD signal ON starts deceleration (①), ORG signal ON starts Z-phase signal counting (②), and completion of counting stops pulse output (③).
(3) ORG signal ON starts deceleration (①), and pulse output stops when decelerated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

PCL6000 series and G9103A/G9003 provide many other origin return sequences including those using EL signal.
With PCD4500 series, only the sequence (1) is applicable.

Triangular Drive Correction Function

Applicable Models: PCL6000 series, PCL6100 series, PCD2112, G9103A, G9003

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

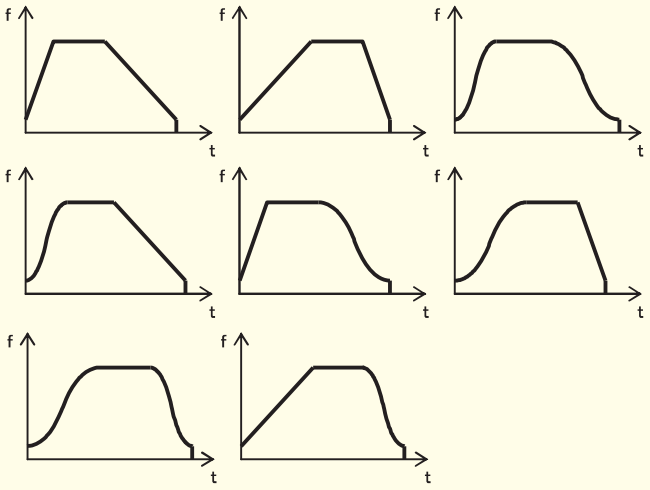


Correction of Triangular Drive

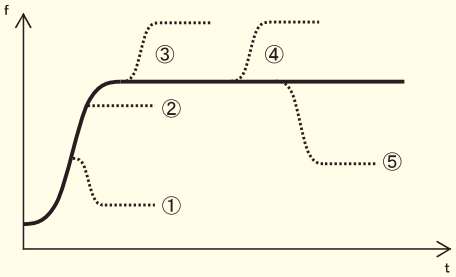
Typical Acceleration/Deceleration Patterns

Applicable Models: PCL6000 series, PCL6100 series, PCD2112, G9103A, G9003

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



Changing Output Pulse Rate during Operation (S-Curve Acceleration/Deceleration)



If you change the preset FH register value to a lower value during acceleration.

① In case the newly set value is lower than the pulse rate at the time of change, S-curve deceleration is made to the newly set value.

② In case the newly set value is equal to or higher than the pulse rate at the time of change, S-curve acceleration is made to the newly set value

If you 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.

If you change the preset FH register value during operation at the FH rate in progress.

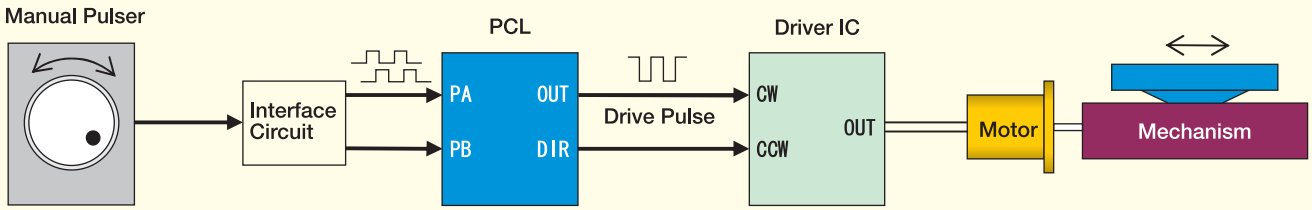
④ In case the newly set value is higher than the preset FH register value, S-curve acceleration is made to the newly set value.

⑤ In case the newly set value is lower than the preset FH register value, S-curve deceleration is made to the newly set value.

Pulser Input

Applicable Models: PCL6000 series, PCL6100 series, PCD2112, G9103A, G9003

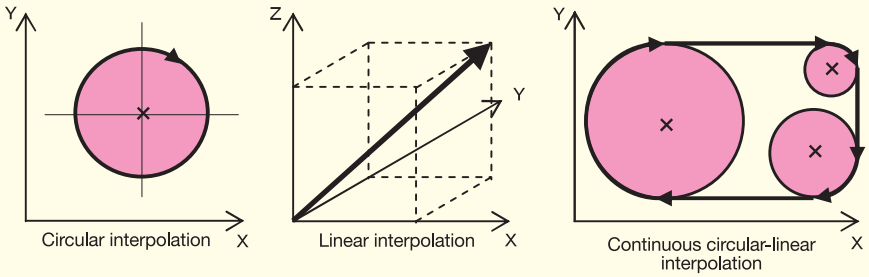
Receiving signal from a manual pulser, the programmable pulse generator outputs to the driver, the pulse signal corresponding to the rotating amount and speed designated by manual pulser signal.
If required, the present position can be controlled using the up/down counter.
To prevent the stepping motor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



Interpolation

Applicable Models: PCL6000 series, G9103A (circular/linear interpolation), PCL6100 series (linear interpolation only)

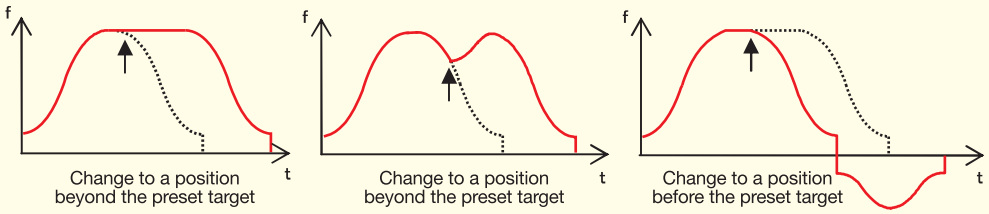
PCL6000 series and G9103A provide both circular and linear interpolation functions. PCL6100 series provide only linear interpolation function.
Linear interpolation function enable interpolation in 3 dimensions. Circular and linear interpolation functions enable continuous circular-circular or linear-circular interpolation without cessation on the way.



Overriding Target Position

Applicable Models: PCL6000 series, PCL6100 series, G9103A, G9003

Target position can be changed during operation in progress.

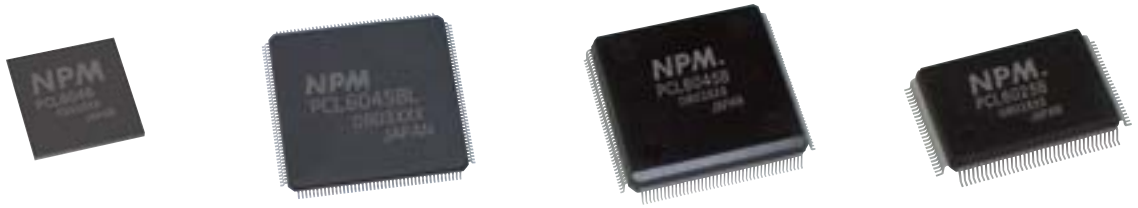


Highly Functional Programmable Pulse Generators in PCL6000 Series

High-end Versions

RoHS Lead-Free

PCL6046 (4-axis) | **PCL6045BL (4-axis)** | **PCL6045B (4-axis)** | **PCL6025B (2-axis)**



PCL6000 series provides varieties of advanced functions including linear/circular interpolation, overriding operating pulse rate and target position during operation, operation correction function, backlash correction, suppression of vibration at cessation, programmed soft limit, direct input of operating switch, diversified origin return sequences, mechanical signal input, and servomotor interface.
PCL6046 adopts BGA package, enabling down-sizing of the board. PCL6045BL is a lower cost version of PCL6045B and is 3.3V single voltage input.

Features

◆ **Circular interpolation between 2 desired axes and linear interpolation among 2 to 4 desired axes**
Linear interpolation among 5 or more axes is also possible by using 2 or more chips (3 or more axes in the case of PCL6025B).

◆ **Preregisters enable continuous interpolation, circular-to-linear-to-circular...**

◆ **Maximum output pulse rate: 6.5 Mpps (10 Mpps with PCL6046)**

◆ **Built-in 4 up/down counters per axis**
• PCL6046: 32-bit x 3 and 16-bit x 1 • PCL6045BL/PCL6045B/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 operating conditions or the command.

◆ **Built-in 5 comparators per axis**
• PCL6046: 32-bit x 5 • PCL6045BL/PCL6045B/PCL6025B: 28-bit x 5
Use of comparators and counters in combination enables the following operations.
• Interrupt signal output and output of comparison results
• Starting by internal synchronization signal
• Immediate stop or deceleration-stop
• Automatic pulse rate change during operation in progress
• Programmed soft limit
• Detection of stepping motor's out-of-step
• 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
- 2-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-cuve acceleration/deceleration sections) for the succeeding 2 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 by 2048)
- 17 error factors and 20 event factors, any of which can initiate interrupt signal output (event factors can be selected by register)

PCL6045B-mounted Boards

PPCI-7443
RoHS compliant

4-axis Motion Control Board with PCI Bus
Pulse train output type
Can control servomotor and stepping motor.

NPMC6045A-4104
RoHS compliant

4-axis Motion Control Board with PC/104 Bus
Pulse train output type
Can control servomotor and stepping motor.

MNET-M204-DUM
RoHS compliant

Motionnet® Local 4-axis Motion Control Board with PCL6045B and G9004A (page 18) mounted
Pulse train output type
Can control servomotor and stepping motor.

For **Motionnet**®, refer to pages 13 to 18.

Programmable Pulse Generators in PCL6100 Series

Servomotor-compatible Low-cost Versions

RoHS Lead-Free

PCL6143 (4-axis)

PCL6123 (2-axis)

PCL6113 (1-axis)

PCL6100 series provides built-in pre-register (1 stage), 2 each up/down counters and comparators per axis, linear interpolation function and servomotor interface.
This series is recommended for the customers who require more advanced operations than PCD series.
The maximum output pulse rate of 15 Mpps makes them compatible with high-resolution linear motors.

Features

- **Linear interpolation among 2 to 4 desired axes**
  Linear interpolation between chips is also possible.
- **Maximum output pulse rate: 15 Mpps**
- **Built-in 2 up/down counters per axis** (28-bit)
- **Built-in 2 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**
  - 9 major operating modes
  - 1-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-cuve acceleration/deceleration sections) for the next operation during operation in progress.
  - Manual pulser input terminal (with no multiplier/divider function)
  - 9 error factors and 14 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)
The board for PCL6113 and 6143 are available.

EB61ISO (Isolation Board)
EB61ISO enables the user to evaluate PCL6113/PCL6143 under practical conditions.
The axis interface is isolated from the internal circuit by photo coupler.

EB6113 (1-axis)

EB61ISO

Features

- Control board interface enables the user to evaluate PLC6100 series on the user's system.
- It can easily be connected to various types of CPUs.
- 4.5 to 5.5 V can be applied to the interface (core supply 3.3V).
- Oscillator of reference clock of 19.6608 MHz is provided on the board.
- In combination with 1-axis isolation board EB61ISO, evaluation can be made in near-actual conditions.

PCL6143-mounted Boards

MNET-BCDC5030A4

RoHS compliant

Motionnet® Local 4-axis 5-Phase Stepping Motor Drive with PCL6143 and G9004A (page 18) mounted
PCL6143 and 4-axis 5-phase stepping motor drive are integrated.

MNET-BCD4020FUA4

RoHS compliant

Motionnet® Local 4-axis 2-Phase Stepping Motor Drive with PCL6143 and G9004A (page 18) mounted
PCL6143 and 4-axis 2-phase stepping motor drive (unipolar 1/16 microstep) are integrated.

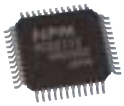
For **Motionnet®**, refer to pages 13 to 18.

Programmable Pulse Generator with Serial Bus

Miniature Package Incorporating 4-wire Serial Bus

RoHS Lead-Free

PCD2112



Miniature package (mold measuring only 7 x 7 mm) adopting 4-wire serial bus enables downsizing of the board. It can output 2-phase stepping motor excitation sequence and is equipped with servomotor interface.

Features

Connection to CPU via 4-wire serial bus

- Usable with CPU without any external bus terminals.
- General-purpose I/O terminals can effectively be used with CPU having multipurose pins for external bus.

Optimized control parameter assignment and block transfer

- This enables reduction of transfer time to minimum.

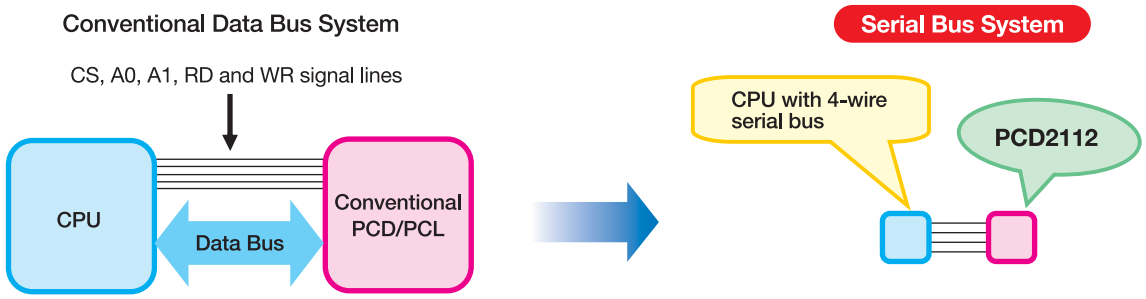
Independent operation system mode without CPU

Operation without CPU is made possible by externally connecting EEPROM in which up to 32 operating patterns are written.

- Maximum output pulse rate: 5 Mpps (with reference clock 20 MHz)
- Pulse output mode: Selectable from total 12 types of pulse signal output including 2-phase stepping motor excitation sequence output.
- 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 to:

- Intelligently control the motor with CPU having fewer pins.
- Make the motor control board smaller.
- Design a stand-alone unit without CPU connected at the time of operation.
- Enjoy more functions than provided by PCD series.



< Evaluation Board for PCD2112 >

PCD2112(1-axis) Evaluation Board

- Most of the terminals of PCD2112 are connected to a 2.54mm pitch connector.
- EEPROM for standalone motion system mode is loaded. The user can evaluate PCD2112 in near actual condition.

USB Serial Conversion Board

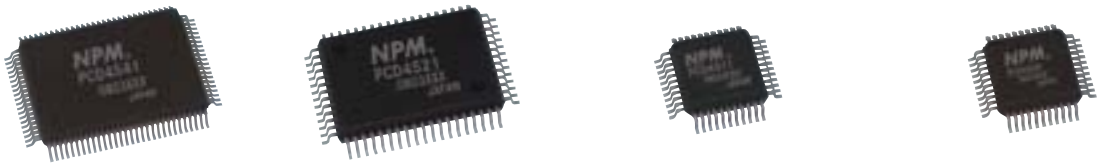
- This board connects the Evaluation Board to USB port of PC.
- PCD2112 evaluation software is available with PC through USB.

Programmable Pulse Generators in PCD4500 Series

Low-cost Versions Dedicated to Stepping Motors

RoHS Lead-Free

PCD4541 (4-axis) **PCD4521 (2-axis)** **PCD4511 (1-axis)** **PCD4500 (1-axis)**



PCD4500 series is low-cost programmable pulse generators equipped with an excitation sequence generator circuit to drive 2-phase stepping motors. Placing a stepping motor drive IC between PCD and each stepping motor enables the user to easily configure a multiaxial motion control system. Also, each model is equipped with pulse train output.

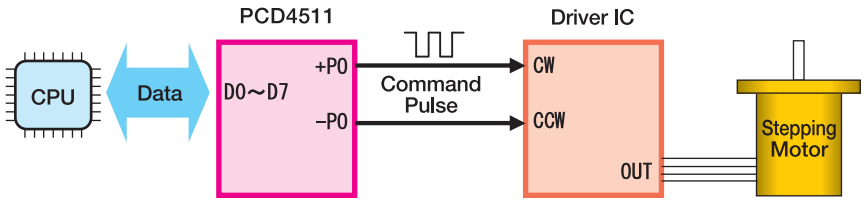
Features

- **Output pulse rate: 400 Kpps** (practical rate; theoretically max. 2.4 Mpps)
- **Linear and S-curve acceleration/deceleration** (Linear only with PCD4500)
- **2-phase stepping motor excitation sequence circuit built in**
- **Simultaneous start/stop**

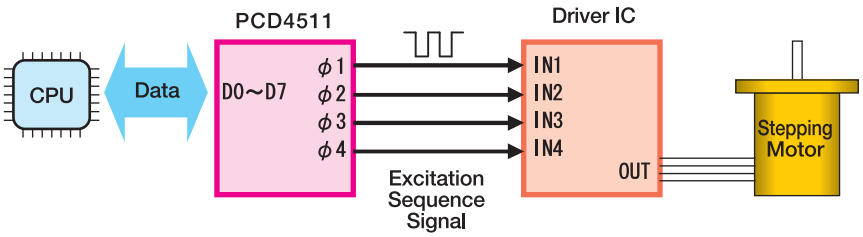
  Pulse outputs within one multi-axis chip or of two or more of 1-axis chips can be started simultaneously by the command or external signal.
  Pulse output on all axes can be stopped by the command, external signal or failure on any axis.
  - Idling pulse output (1 to 7 pulses)
  - Overriding operating pulse rate during operation in progress
  - 4 major operation modes

Connection Examples

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



(2) Excitation Sequence Signal Input Driver IC



Basic Specifications of Programmable Pulse Generators

Specification \ Model	PCL6046	PCL6045BL PCL6045B PCL6025B	PCL6143 PCL6123 PCL6113	PCD2112	PCD4541 PCD4521 PCD4511 PCD4500	G9103A Soon on Sale	G9003
Number of controllable axes	4	4 (PCL6045BL/6045B) 2 (PCL6025B)	4 (PCL6143) 2 (PCL6123) 1 (PCL6113)	1	4 (PCD4541) 2 (PCD4521) 1 (PCD4500/4511)	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
Maximum output speed*1	6.5 Mpps (Max. 10 Mpps)	6.5 Mpps	9.8 Mpps (Max. 15 Mpps)	2.4 Mpps (Max. 5 Mpps)	400 Kpps*2	6.66 Mpps (Max. 10 Mpps)	6.66 Mpps
Number of pulse rate 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)]
Number of pulse rate 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 rate 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	0.1x 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)
Positioning pulse setting range	–2,147,483,648 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 to16,777,215 (24-bit) (PCD4511/4421/4541) 1 to 262,143 (18-bit) (PCD4500)	–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	8-bit bus	Interface for communi- cation with G9000	Interface for communi- cation with G9000
Ramping-down point setting range	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	176-pin QFP (PCL6045BL/6045B) 128-pin QFP (PCL6025B)	176-pin QFP (PCL6143) 128-pin QFP (PCL6123) 80-pin QFP (PCL6113)	48-pin QFP	100-pin QFP (PCD4541) 64-pin QFP (PC4521) 44-pin QFP (PCD4500/4511)	80-pin QFP	80-pin QFP
External dimension (mm)	12 x 12	24 x 24 (PCL6045BL/6045B) 20 x 14 (PCL6025B)	12 x 12 (PCL6113) 20 x 14 (PCL6123) 24 x 24 (PCL6143)	7 x 7	10 x 10 (PCD4500/4511) 20 x 14 (PCD4521/4541)	12 x 12	12 x 12
Supply voltage	+3.3 V ±10%	+5 V ±10% and +3.3 V ±10% (PCL6045B/6025B) +3.3 V ±10% single (PCL6045BL)	+3.3 V ±10%	+3.3 V ±10%	+5 V ±10% (PCD4511/4521/4541) +5 V ±5% (PCD4500)	+3.3 V ±10%	+3.3 V ±10%
Ambient Temperature	-40 ~ +85 ˚C	-40 ~ +85 ˚C (PCL6045BL) -40 ~ +70 ˚C (PCL6045B/6025B)	-40 ~ +85 ˚C	-40 ~ +85 ˚C	0 ~ +85 ˚C (PCL4541/4521/4511) 0 ~ +70 ˚C (PCL4500)	-40 ~ +85 ˚C	-40 ~ +85 ˚C

*1. Maximum output pulse rate is the rate available with the standard reference clock input. Maximum rate in parentheses is with the maximum reference clock input.
*2. For PCD4500 series, 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, multiplication range is a practical range and it is possible to set the mulitplication range at higher than 50x.

Notes on Specificaion Particulars

Number of controllable axes	Number of axes the single chip can control.
Reference clock	Frequency of reference clock which is input to the programmable pulse generator. While a frequency other than the standard one can be input, the resultant output pulse rate may have figures below decimal point.
Maximum output pulse rate	Maximum output pulse freguency.
Number of pulse rate setting registers	There are FL register to which the starting pulse rate is written and FH register to which the operating pulse rate is written. The operating pulse rate can be changed during operation in progress.
Number of pulse rate setting steps	Number of steps available for pulse rate setting. The more the bits, the finer the pulse rate setting is possible.
Pulse rate multiplication setting range	Output pulse rate is a multiplication of the value of pulse rate register and of multiplication factor.
Acceleration rate setting range	Pulse rate slope at acceleration is set. Acceleration time can be calculated from the setting value.
Dceleration 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.
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.

Programmable Pulse Generators – List of Functions

Function \ Model	PCL6046	PCL4045BL PCL6045B PCL6025B	PCL6143 PCL6123 PCL6113	PCD2112	PCD4541 PCD4521 PCD4511 PCD4500	G9103A Soon on Sale	G9003
S-curve acceleration/deceleration	Yes	Yes	Yes	Yes	Yes (excluding PCD4500)	Yes	Yes
S-curve section setting	Yes	Yes	Yes	Yes		Yes	Yes
Triangular drive correction function (FH correction function)	Yes	Yes	Yes	Yes		Yes	Yes
Origin return	Yes (13 types)	Yes (13 types)	Yes (4 types)	Yes (4 types)	Yes (1 type)	Yes (13 ypes)	Yes (13 types)
Origin search, origin escape	Yes	Yes		Yes		Yes	Yes
Origin return with moving amount restricted				Yes			
Limit positioning	Yes	Yes				Yes	Yes
Limit escape	Yes	Yes		Yes		Yes	Yes
Servomotor interface	Yes	Yes	Yes	Yes*1		Yes	Yes
Encoder input (up to 4 times multiplication possible)	Yes (for each axis)	Yes (for each axis)	Yes (for each axis)	Yes		Yes	Yes
Origin return using encoder Z-phase signals too	Yes (for each axis)	Yes (for each axis)	Yes (for each axis)	Yes		Yes	Yes
Automatic setting of ramping-down point	Yes*2	Yes*2	Yes	Yes		Yes*2	Yes*2
Up/down counter (present position counter)	Yes (for each axis) 32-bit x 3 16-bit x 1*3	Yes (for each axis) 28-bit x 3 16-bit x 1*3	Yes (for each axis) 28-bit x 2	Yes 32-bit x 1		Yes 28-bit x 2 16-bit x 1*3	Yes 28-bit x 2 16-bit x 1*3
Origin return at up/down counter zero (programmed automatic origin return)	Yes	Yes				Yes	Yes
Counter latch with hardware	Yes	Yes	Yes			Yes	Yes
Comparator	Yes (for each axis) 32-bit x 5	Yes (for each axis) 28-bit x 5	Yes (for each axis) 28-bit x 2			Yes 28-bit x 3	Yes 28-bit x 3
External mechanical signal input	Yes (for each axis)	Yes (for each axis)	Yes (for each axis)	Yes	Yes	Yes	Yes
Interrupt signal output	Yes (37 factors)	Yes (37 factors)	Yes (23 factors)	Yes	Yes (6 factors)	Yes (27 factors)*4	Yes (27 factors)*4
Interrupt factor setting	Yes	Yes	Yes			Yes	Yes
Interrupt status (interrupt factor monitor)	Yes	Yes	Yes			Yes	Yes
Status	Yes (77 types)	Yes (77 types)	Yes (44 types)	Yes	Yes (16 types)	Yes (30 types)	Yes (30 types)
Prebuffer (preregister) for next operation	Yes (2 stages)	Yes (2 stages)	Yes (1 stage)			Yes (1 stage)	
Automatic start of next operation	Yes	Yes	Yes			Yes	
Command buffer monitor	Yes	Yes	Yes	Yes		Yes	Yes
Selection of output pulse logic	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Selection of output pulse mode	Yes	Yes	Yes	Yes	Yes*5	Yes	Yes
Excitation sequence output for 2-phase stepping motor				Yes	Yes	Yes	Yes
Monitor signal output terminal	Yes (9 for each axis)	Yes (9 for each axis)	Yes (6 for each axis)	Yes (2)	Yes (1)	Yes (10)	Yes (10)
Pulser input	Yes (for each axis) (Multiplication by 32 & division by 2048)	Yes (for each axis) (Multiplication by 32 & division by 2048)	Yes (for each axis) (No multiplication/ division function)	Yes (No multiplication/ division function)		Yes (Multiplication by 32/ division by 2048)	Yes (Multiplication by 32/ division by 2048)
Pulser synchronized positioning	Yes	Yes	Yes	Yes		Yes	Yes
Linear interpolation	Yes	Yes	Yes*6			Yes*6	
Circular interpolation	Yes	Yes				Yes*7	
Continuous interpolation	Yes	Yes	Yes			Yes	
Overriding target position	Yes	Yes	Yes			Yes	Yes
1-pulse output	Yes	Yes				Yes	Yes
Idling pulse	Yes (0 to 7 pulses)	Yes (0 to 7 pulses)		Yes	Yes (0 to 7 pulses)	Yes (0 to 7 pulses)	Yes (0 to 7 pulses)
Output pulsewidth control	Yes	Yes				Yes	Yes
Simultaneous start/stop	Yes	Yes	Yes	Yes	Yes	Yes	Yes
External start/stop	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Out-of-step detection	Yes	Yes				Yes	Yes
I/O port (general-purpose input/output terminal)	Yes (8 for each axis)	Yes (8 for each axis)	Yes (8 for each axis)	Yes (4)	Yes (1 output for each axis)	Yes (8)	Yes (8)
Operating switch input terminal	Yes	Yes	Yes	Yes			
Ring count function	Yes	Yes	Yes			Yes	
Backlash correction	Yes	Yes				Yes	Yes
Programmed soft limit	Yes	Yes				Yes	Yes
Timer operation	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Synchronization signal output	Yes	Yes	Yes			Yes	Yes
Vibration suppression	Yes	Yes				Yes	Yes
Independent operating mode				Yes			
Compatibility to 5V interface	Yes	Yes	Yes	Yes	Yes	Yes	Yes

For asterisked items, refer to Explanation of Functions, page 11 and 12.

Programmable Pulse Generators – Explanation of Functions

S-curve acceleration/deceleration	S curve acceleration/deceleration enable reduction of the mechanical vibration caused by conventional linear acceleration/deceleration. (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 acceleration/deceleration time, linear section's inserted on the way. That is, setting S-curve sections lets acceleration or deceleration be made in S curve at the start and end with a linear section in between.
Triangular operation correction function	When operated with parameters which cause triangular drive (abrupt change from acceleration to deceleration), operating pulse rate (FH) is automatically decreased to eliminate triangular drive.
Origin return	Movement is made to the origin position. Various origin return modes are available depending on models. Refer to respective User's Manuals.
Origin search, origin escape	Origin search: Origin return is made from the designated direction while reciprocating between plus and minus end limits to locate the origin. Origin escape: When origin signal is ON, move out of origin position. At that time, it can be stopped by counting encoder Z-phase signals.
Origin return with moving amount restricted	When origin signal is ON or when pulses are output 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: Input of positioning complition signal. Until receiving in-position signal from sevomotor 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. PCD2112 inputs the alarm signal at the reset terminal.
Encoder input	The chip can input encoder signal for present position management. The input signal can be selected from 2-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 signals are counted after origin signal ON. The number of counting encoder Z-phase signals can be changed in a prescribed range.
Automatic ramp-down point setting	The number of pulses used for acceleration or calculated number of pulses is automatically written to the ramping-down point setting register. *2. With PCL6000 series and G9103A/G9003, automatic setting of ramping-down point is possible in a range of (deceleration time) ≤ (acceleration time x 2).
Up/down counter (current 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 2-pulse signal or 90° phase difference signal (1, 2 or 4 times multiplied) *3. PCL6000 series and G9103A/G9003 are equipped with a counter which is usable as deviation counter.
Up/down counter Origin return (Software origin position auto return)	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 hardware latch	Input signal latches designated counter value(s). (Input logic can be changed by software technic.)
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 models. For details, refer to respective User's Manuals.
External mechanical signal input	As mechanical position detection signals, the chip can input the following signals: (1) EL signal: Mechanical end limit signal. Basically, the chip immediately stops outputting pulses when the end limit signal in moving direction is turned on, and continues stopping even if the end limit signal is turned off. Some models can be set so that EL signal ON causes deceleration-stop. (2) SD signal: Mechanical ramping-down signal. 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 withoung using SD signal.
Interrupt signal output	Interrupt signal to CPU. Some models can read the interrupt factor. (Number of interrupt factors differs depending on models.) *4. G9103A/G9003 have no interrupt signal output pin but interrupt CPU by changing the level at port 0.
Interrupt factor setting	Enables selection of only necessary interrupt factors. (Event-based interrupt)
Interrupt status (interrupt factor monitor)	Enables monitoring of the factor initiating output of interrupt signal to CPU.
Status (monitor)	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. For details, refer to respective User's Manuals.
Preliminary buffer for next operation (Pre-register)	Buffer for continuous operation with different patterns. Writing operating parameters (preset amount, starting pulse rate, operating pulse rate, acceleration/deceleration rates, etc.) to preregisters during operation in progress enables the start command to copy the parameters from preregisters to operating registers and then start the chip outputting pulses according to new parameters. Thus, by preparing preregisters for the next operation, continuous operation with different patterns is made possible.
Automatic start of next operation	With parameters 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 pause.
Command buffer monitor	Enables monitoring of command written.
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), 2-pulse mode (pulse in plus direction and pulse in minus direction) or 90° phase differece signal mode. *5. With PCD4500 series, 90° phase difference signal can be output using the 2-phase stepping motor exciation sequence output.
Excitation sequence output for 2-phase stepping motor	By connecting the output to a stepping motor drive IC or transistor array, a stepping 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.
Pulsar 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 for counting.
Pulsar synchronized positioning	Positioning is made in synchronization with pulser signal. The chip stops outputting pulses after outputting pulses for the preset moving amount. If receiving pulses more than the preset amount from the pulser, the chip ignores them.
Linear interpolation	Linear interpolation is possible between desired axes of one or multiple chips. *6. With PCL6113 and G9103A, linear interpolation is made possible by using 2 or more units.
Circular interpolation	Circular interpolation is possible by coodination of 2 desired axes. *7. With G9103A, circular interpolation is made possible by using 2 or more units.
Continuous interpolation	Use of preregisters enables successive linear or circular interpolation.
Overriding target position	Target position (moving amount) can be changed during positioning operation in progress. If the newly written parameter designates a position already passed, the chip decelerates and stops pulse output (immediately stops when operating at constant speed), and then moves in reverse direction. Also, pulse output can be stopped by outputting a preset number of pulses based on external signal input timing.
1-pulse output	One pulse can be output with one command. That is, "starting with value 1 preset" can be made with 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 starting pulse rate of the stepping motor.
Output pulse length 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 is duty 50%. Especially, 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 an external signal.
Out-of-step detection	Out-ot-step detection is made possible by mounting a feedback encoder to the stepping motor. This function is done by deviation counter and comparator. The movement after the out of step can be defined based on comparator result condition.
I/O port (general-purpose input/output terminal)	Input or output can be defined by setting. If set for output, for example, the port can be used for excitation ON/OFF of stepping motor drive, count-down signal, etc. With some models, the I/O port can output interrupt signal to CPU based on level change.
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).
Soft limit function	Limit can be programmed by using 2 comparator circuits. Entering the programmed limit causes immediate stop or deceleration-stop. Thereafter, operation is possible only in reverse direction.
Timer operation	The chip can be used as a timer by letting it internally perform positioning operation without outputting any pulse.
Synchronization signal output	The chip can output a timing pulse signal at designated intervals.
Vibration reduction function	With a control constant designated in advance, 1 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. For example, the settling 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.
Compatibility to 5V interface	If the supply voltage is 3.3 V, each chip uses tolerant buffer for interface, thereby enabling it to connect to 5 V with few components.