

1 . SPECIFICATIONS & FUNCTIONS

PPMC-112A

1 . SPECIFICATIONS & FUNCTIONS

1-1. Description

PPMC-112 is a programmable stepper motor control LSI developed to meet the varied needs of the times. It is an extension of the basic concepts PPMC-100 series. It is upwardly command with PPMC-111 series, offers high speed operation at 250KppS, and can be remotely controlled via serial communication.

The most important function of a stepper motor controller is to perform accurate and speedy positioning control by smooth acceleration and deceleration. To that end, the controller must be able to set acceleration and deceleration curves best suited to the load and to freely control the output of high-speed and accurate drive pulses.

PPMC-112 is a control LSI that truly meets such requirements. Similar to PPMC-111, PPMC-112 offers three choices for acceleration and deceleration control, namely, "linear", "S-shaped" and "free-curve" acceleration/deceleration control methods. As a result, accurate and speedy positioning control is achieved by smooth acceleration and deceleration. Also, the capability for pulse output control of up to 250kppS enables instantaneous speed change during operation or speed change by acceleration or deceleration.

The operation of PPMC-112 is controlled by a built-in program, and sophisticated control of a stepper motor is realized by simple command codes and data given from the host processor. Thus the burden on the host processor is greatly reduced.

The multi-drop serial communication interface of PPMC-112 enables the remote control function to be used at maximum 125kbpS speed. This function can eradicate any wiring and noise problems arising from controlling multiple motors.

1. SPECIFICATIONS & FUNCTIONS

PPMC-112A

1-2. Specification

Initialization function

- Acceleration/deceleration parameters
(starting speed, high speed, number of acceleration/deceleration pulses)
- Acceleration/deceleration methods (linear, S-shaped, free-curve)

Operation control command

- Acceleration/deceleration operation
- Constant speed operation
- Single step
- Constant speed origin search (constant speed movement to base point)
- Continuous constant speed operation (constant speed movement to limit)
- Continuous high speed operation (high speed movement to high speed limit)
- Instantaneous speed change, Accelerating/decelerating speed change
- Emergency stop, Decelerating stop

Auxiliary command

- Busy check (serial mode)
- Finish status
- Command error code
- Current position read
- Control input
- Auxiliary input
- Current position setting
- Interlock position setting
- High speed limit effective speed limit setting
- Pulse width setting
- Auxiliary output
- Acceleration/deceleration table read
- Version read
- Error counter read (serial mode)

SYNC-101 control function

- Circular interpolation quadrant setting operation (parallel mode)
- Circular/linear interpolation operation (serial mode)
- Single axis operation control
 - Single step
 - Constant speed origin point search
 - Continuous constant speed operation (constant speed up to limit)

Pulse output frequency

- 30.5ppS to 250kppS (2MHz clock mode selection)
- 7.6ppS to 62.5kppS (500kHz clock mode selection)
- 1.9ppS to 15.6kppS (125kHz clock mode selection)
- User defined speed up to maximum 250kppS
(In the external clock mode, high/low speed ratio must be below 8192.)

Number of acceleration/deceleration pulses

- 8 to 65,535 pulse

Maximum number of output pulses

- 16,777,215 pulse
- * Infinite operation in constant speed origin search or continuous operation command

Current position counter

- 3 bytes (800000h to 7FFFFFFh)

Package

- 64-pin QFP

1. SPECIFICATIONS & FUNCTIONS

PPMC-112A

1-3. Concepts & performance of PPMC-112

1-3-1. Pulse rate and motor speed

PPMC-112 uses the value called pulse rate as data to determine the speed of the stepper motor. The relationship between pulse rate and motor speed is as expressed by Equation 1-1:

$$\text{Speed} = \frac{\text{Tclock}}{\text{Rate}} \text{ (ppS)} \quad \text{----- Equation 1-1}$$

Speed : Motor speed (ppS, pulses/sec)

Tclock: Reference clock (selectable from 2MHz, 1/4MHz, 1/16MHz, external clock)

Rate : Pulse rate

1-3-2. Acceleration/deceleration methods

The acceleration/deceleration control of PPMC-112, which is determined by the data sent by the host processor, can be selected from the following three methods:

- (1) Linear acceleration/deceleration method
- (2) S-shaped acceleration/deceleration method
- (3) Free-curve acceleration/deceleration method

1-3-2-1. Linear acceleration/deceleration method

In the linear acceleration/deceleration method, the relationship between the pulse output speed and time during acceleration and deceleration is linear:

$$V = V_0 + K \times t \quad \text{----- Equation 1-2}$$

V : Velocity

t : Time

V₀, K : Constant

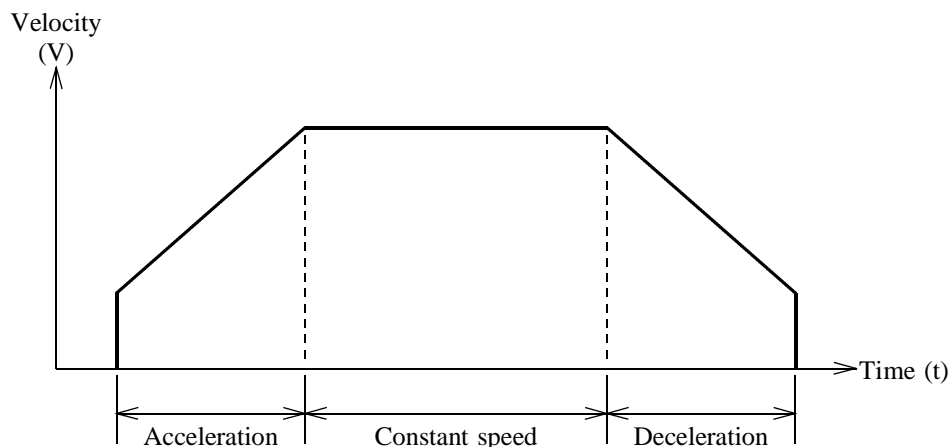


Fig.1-1

1. SPECIFICATIONS & FUNCTIONS

PPMC-112A

1-3-2-2. S-shaped acceleration/deceleration method

In the S-shaped acceleration/deceleration method, the relationship between the pulse output speed and time during acceleration and deceleration is expressed as a "sine curve":

$$V = V_0 + K_1 \times (1 - \cos (K_2 \times t)) \quad \text{----- Equation 1-3}$$

V : Velocity

t : Time

V₀, K₁, K₂: Constant

S-shaped acceleration/deceleration method uses a sine function as shown in Equation 1-3 to determine the velocity against the time. By this method, smooth acceleration and deceleration realize accurate positioning control.

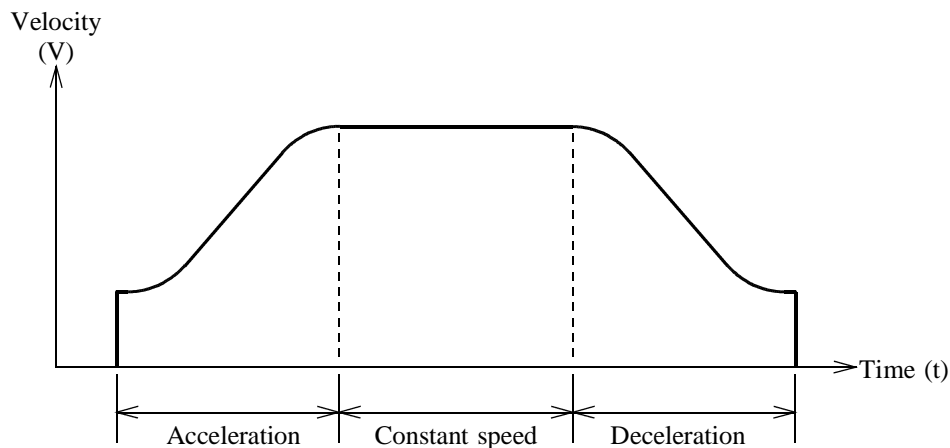


Fig.1-2

1-3-2-3. Free-curve acceleration/deceleration method

The free-curve acceleration/deceleration method allows the user to create his own acceleration/deceleration curve by feeding data by himself.

1-4. Differences from PPMC series

PPMC-112 retains the basic ideas of the former PPMC-100 series. Yet, it has no interchangeability with the PPMC-100 series. However, its command function is upwardly compatible with PPMC-111, and acceleration/deceleration characteristics are the same except for the operational speed range. The principal differences from PPMC-111 are as follows:

1-4-1. Addition of serial communication mode

In addition to the parallel communication mode, which is used with the PPMC-112, PPMC-112 offers serial communication mode. This allows users to remotely control PPMC-112 via binary or ASCII protocol communication mode. By assigning 4 bits device addresses, one serial communication line can be used to control up to 16 PPMC-112.

1. SPECIFICATIONS & FUNCTIONS

PPMC-112A

1-4-2. Support for the interpolation function

By combining with SYNC-101, the interpolated operation assist processor, circular/linear interpolation pulse output with operation direction control, and limit detect function can be used. The I/O signal and operational command have been added to support this function.

1-4-3. Higher speed

PPMC-112 is capable of delivering pulse trains at a maximum speed of 250kpps.

1-4-4. Change in Status register bit

Following the additional function and operational command, contents of register bit has been changed.

1-4-5. True logic pulse output

To achieve the higher speed operation, pulse output logic has been changed from former negative logic to true logic.

1-4-6. Reduction of auxiliary I/O signals

The number of auxiliary I/O signals have been reduced to "input 4 + output 8" in parallel mode, and "input 6 + output 5" in serial mode.

1-4-7. Addition of interlock related command and signal

By adding auxiliary commands, INTLK signal now can be canceled at designated position while in operation. This function offers more complex coordinated operation with other axis.

1-4-8. Current position read command

Current position read command, which was valid while in operation in the former series, has now become invalid while in operation.

1-4-9. Addition of acceleration/deceleration table read command

This function allows users to read acceleration/deceleration table data, which was generated at the initial setting, thus helping the numerical understanding of actual acceleration/deceleration curve data. It is also possible to modify a part of the table and upload the data again.

1-4-10. Addition of version code read command

By reading this code from the host computer program, various needs such as future version-up can be supported.

1-4-11. Addition of pulse width setting command

The pulse width required for the driver could be relatively long, therefore to support such a case, the pulse width is now programmable.

1-4-12. Addition of error counter read command

The number of communication errors that occurred in the serial mode operation will be counted internally.

This command lets users know the number of communication errors which have occurred, thus help evaluation on communication line reliability.

1. SPECIFICATIONS & FUNCTIONS

PPMC-112A

1-5. Operational modes of PPMC-112

As explained in the former section, PPMC-112 has basically two operational modes, parallel and serial mode, and the mode will be determined by the operational mode signal MOD0 and MOD1. (Please refers to the signal section of chapter two for the setting details.) I/O signal pins and control flows differ greatly in these two modes. Therefore, after deciding which mode is to be used, there is no need to consider the other mode.

However, there is no difference in the motor control algorithm between the two modes thus the actual operation following the comparative operational commands will be exactly the same. Based on this fact, in this specification, the common operation and mode dependent operation are explained separately.

1-5-1. Parallel communication mode

This operational mode uses the same 8-bit bus interface as used in former PPMC series. In this specification, the operation in parallel communication mode will be the base case. Therefore, for the operation in other mode, please refer to the relevant pages.

When SYNC-101 is jointly used, the directional signal and limit input will be controlled by PPMC-112.

To facilitate this function, a start quadrant setting command has been added. The SYNC-101 will be directly controlled by the host computer by using the same bus lines as PPMC-112 does. Please refer to the SYNC-101's (two axis interpolation processor) specification for the actual control details. Figure 1-3 shows basic connection concepts including SYNC-101.

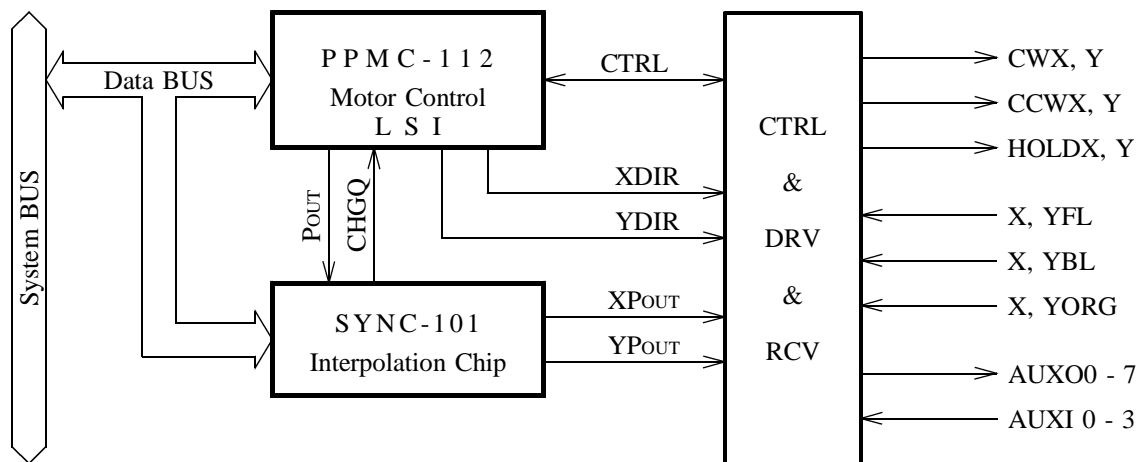


Fig.1-3. Basic connection diagram in parallel mode operation

1-5-2. Serial communication mode

In serial mode, MOD2 signal will set the communication protocol to either ASCII or binary mode.

However, there will be no change in hardware specification in the two modes. Yet, as in the binary communication mode PPMC-112 uses its own 9-bit asynchronous communication protocol, the host processor needs to be equipped with such interface capability. To facilitate this type of communication, we offer MWSC-101 LSI chip and evaluation purpose ISA bus module.

In serial mode, SYNC-101 will be controlled via PPMC-112's output bus, by mainly the interpolation operation commands. Fig 1-4 shows system concepts diagram in serial mode.

1. SPECIFICATIONS & FUNCTIONS

PPMC-112A

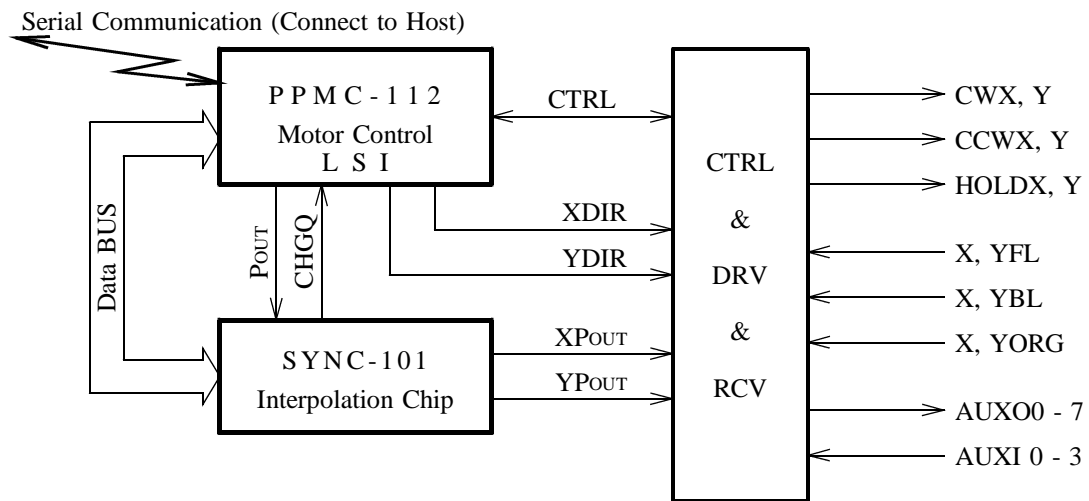


Fig.1-4. System concepts diagram in serial mode