NOVA electronics MCX314As/AL

4-Axis Motor Control IC with Interpolation Function

MCX314As/AL are 4-axis motion control ICs which can independently control each 4-axis of either stepper motor driver or pulse type servo motor for position and speed control. In addition, these ICs can perform 2/3-axis linear interpolation, CW/CCW circular interpolation, 2/3-axis bit pattern interpolation and continuous interpolation. The power voltage of MCX314As is +5V and that of MCX314AL is +3.3V.

MCX314As *3

Specification

■Control axis 4 axes
■Data bus width 16/8 bit selectable

Interpolation

2/3-axis linear interpolation, CW/CCW circular interpolation, 2/3-axis bit pattern interpolation
■Interpolation range Each axis -2,147,483,646 ~ +2,147,483,646
■Interpolation speed 1PPS ~ 4 MPPS(*1)
■Interpolation accuracy ±0.5 LSB(Linear interpolation), ±1 LSB(Circular interpolation)
■Related functions for interpolation Any axis selectable, constant vector speed, continuous interpolation, single step interpolation (Command/external signals)

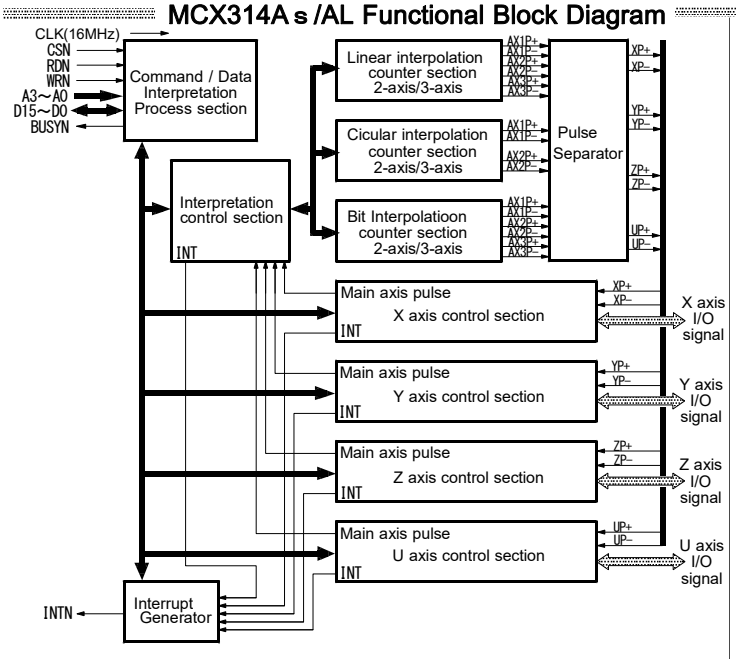
Common specifications of each axis

■Drive output pulse (at CLK=16MHz)
●Pulse output speed range 1PPS ~ 4 MPPS *1
●Pulse output speed accuracy ±0.1% or less(According to the setting speed)
●S-curve jerk 954 ~ 31.25×10^{9}PPS/SEC^2
●Accelerating/decelerating speed 125 ~ 500×10^{6}PPS/SEC
●Initial speed 1 ~ 4×10^{6}PPS
●Drive speed 1 ~ 4×10^{6}PPS
●Output pulse number
0 ~ 4,294,967,295(Fixed pulse drive) or Unlimited(Continuous drive)
●Speed curve
Constant speed, symmetrical/non-symmetrical linear acceleration/deceleration, symmetrical/non-symmetrical parabola S-curve acceleration/deceleration drive
●Fixed pulse drive decelerating mode
Auto(Non-symmetrical linear acceleration/deceleration is also allowed.)/Manual
●Output-pulse numbers and drive speed are changeable during the driving.
●Triangle form prevention of linear acceleration fixed pulse drive and S-curve acceleration/deceleration fixed pulse drive.
●Independent 2-pulse system or 1-pulse 1-direction system is selectable.
●Logical levels of drive pulse is selectable, output pin is switchable.
■Encoder input
●2-phase pulse style or Up/Down pulse style is selectable.
●Pulse of each single,double and quad count edge evaluation is selectable. (2-phase pulse style).
■Position counter
●Logic position counter(for output pulse) range -2,147,483,648 ~ +2,147,483,647
●Real position counter(for feedback pulse) range -2,147,483,648 ~ +2,147,483,647
■Comparison register
●COMP+ register comparison range -2,147,483,648 ~ +2,147,483,647
●COMP- register comparison range -2,147,483,648 ~ +2,147,483,647
●Status and signal outputs for the comparisons of position counters
●To work as software limit
■Synchronous action
●Activation factor
Position counter ≥COMP+ variation, Position counter<COMP+ variation, Position counter<COMP- variation, Position counter ≥COMP- variation,start of driving, terminating of driving, IN3 signal ↑ and ↓ , LP read command.
●Action
Start of +/- fixed pulse drive, start of +/- continuous pulse drive, drive decelerating/instant stop, saving position counter values, setting position counter, setting output pulse number, setting a drive speed, external signal output (DCC) and interrupt occuring.
Any action of other axes can be activated from the factor of the own axis.
■Integral filter built-in
Equipped with integral filters in the input column of each input signal.
One time constant can be selected from eight types.
■Automatic home search
●Automatic of execution of Step1(high-speed near home search) →Step2(low-speed home search)→Step3(low-speed encoder Z-phase search) →Step4(high-speed offset drive).
Enable/disable and search direction for each step are selectable.
●Deviation counter clear output
Clear pulse width within the range of 10μ ~ 20msec and logical level are selectable.
■Interrupt (Interpolations excluded)
..the drive-pulse outputting,
..the start/finish of a constant-speed drive during the acceleration/deceleration driving
..the end of the driving
..transition to “position counter ≥ the volume of COMP-
..transition to “position counter < the volume of COMP-
..transition to “position counter ≥ the volume of COMP+
..transition to “position counter < the volume of COMP+
..terminating of automatic home search, synchronous action
Enable/disable for these factors are selectable.
■External signal for driving
EXPP, EXPM signals for +/- direction of fixed pulse/continuous drive
Driving in manual pulsar mode(encoder input)
■External decelerating/instant stop signal
IN0~3 4 points for each axis
Enable/disable and logical levels are selectable.
■Input signal for servo motor
ALARM(Alarm), INPOS(In position check)
DCC(Deviation counter clear, pin shared with DRIVE)
■General output signal
OUT0~7 8 points for each axis
(Four points of them are pin shared with drive status output signal.)
■Drive status signal output
DRIVE(Drive pulse outputting, pin shared with DCC), ASND(accelerating), DSND(decelerating), CMPP(Position ≥COMP+), CMPM(Position < COMP-).
Drive status is readable by status registers.
■Limit signal input
1 point, for each +/- direction.
Logical levels and decelerating/instant stop is selectable.
■Emergency stop signal input
EMGN 1 point for all axes.
Stop the drive pulse for all axes immediately in Low level.

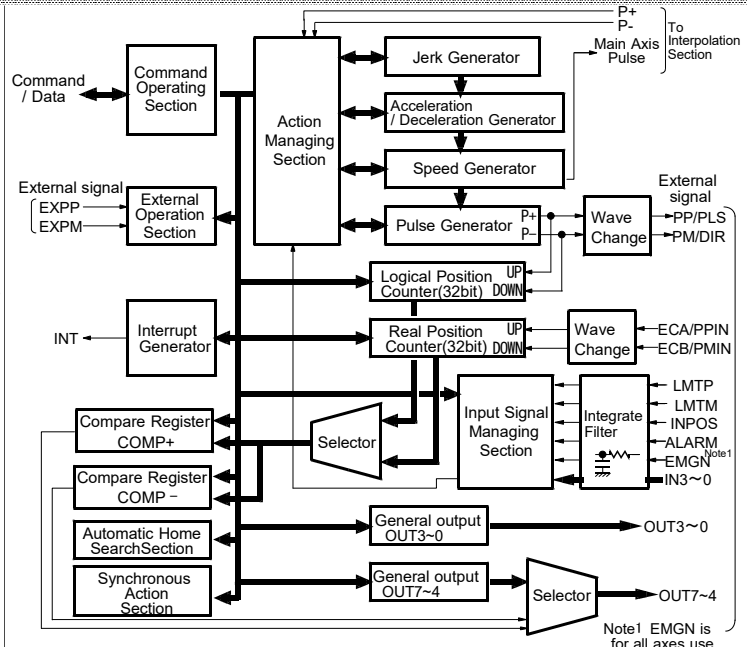
■Electrical characters	MCX314As	MCX314AL
Power voltage	+5V ± 5 %	+3.3V ± 10 %
Consumption current	112 mA max	30 mA max at CLK=16MHz
Clock pulse	16MHz	16MHz or 32MHz(max)
Input signal level	TTL level	TTL level (5V tolerant)
Output signal level	5V CMOS Level	3.3V CMOS Level *2
■Dimension(including pins)	22×22×1.6mm	22×22×1.7mm

■Package 144-pin plastic LQFP, pitch = 0.5mm lead free item
*1 Speed range of MCX314AL becomes 2PPS ~ 8MPPS at CLK=32MHz.
*2 Only TTL can be connected for 5V type.
*3 Pin assignment of MCX314As and that of MCX314AL are different.

MCX314A s /AL Functional Block Diagram



Whole function block diagram of MCX314As/AL

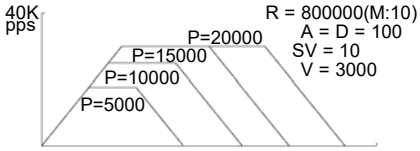


Block Diagram of the X,Y,Z and U-axis Control Section

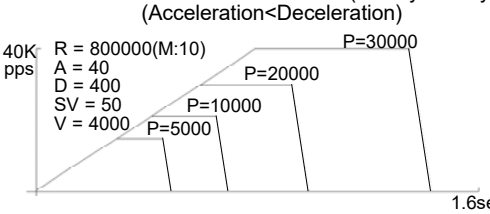
Individual control for 4-Axis

These MCX314As/AL have 32 bit position counter for each X,Y,Z and U axis and can control maximam speed 4MPPS(at CLK=16MHz), drive for constant speed, trapezoidal acceleration/deceleration(symmetry/non-symmetry) and S-curve acceleration/deceleration. There are two kinds of pulse drive, fixed pulse drive which outputs specified pulse number or continuous pulse drive which outputs drive pulse unlimitedly until stop factor is generated. These types of driving can be performed with constant speed, linear acceleration/ deceleration(symmetry/non-symmetry), S-curve acceleration/deceleration(symmetry/non-symmetry) according to the mode setting and the operation parameter value.
Automatic deceleration can be functioned on non-symmmetry trapezoidal acceleration/deceleration drive. Non-symmetry S-curve drive deceleration is operated by manual.

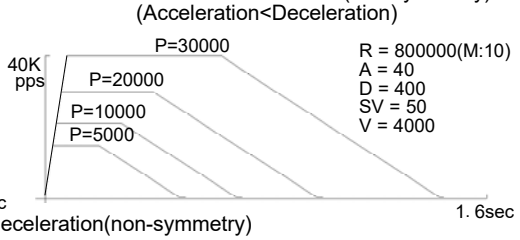
Linear acceleration/deceleration(symmetry)



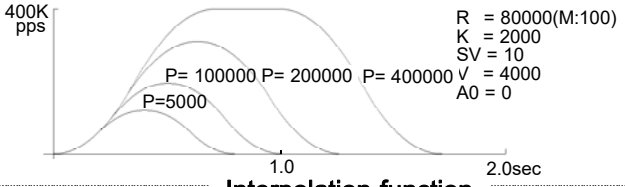
Linear acceleration/deceleration(non-symmetry)
(Acceleration<Deceleration)



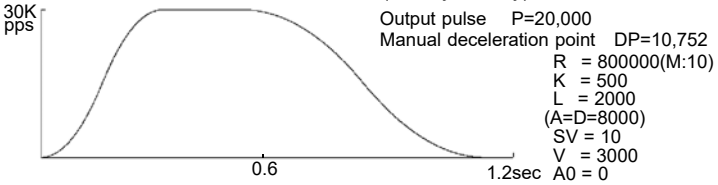
Linear acceleration/deceleration(non-symmetry)
(Acceleration<Deceleration)



S-curve acceleration/deceleration(symmetry)



S-curve acceleration/deceleration(non-symmetry)



Interpolation function

■ 2/3-axis linear intepolation

MCX314As/AL can perform any 2/3 axes linear interpolation from 4 axes. Linear interpolation is executed by setting the speed parameters to main axis(AX1) and the finish point to each axis and writing linear interpolation drive command.
Linear interpolation moves from the present point coordinates to the finish point coordinates. Its range for each axis is -2,147,483,646 ~ +2,147,483,646 and accuracy of specified line is ±0.5LSB or less within the whole range. Interpolation drive speed is 1PPS~4MPPS(at CLK=16MHz).

[Setting procedure for the operation of Fig.1]
① AX1:X, AX2:Y, AX3:Z Specified
② Range R=8,000,000 (Speed multiple:1)
③ Initial speed SV=1000
④ Drive speed V=1000(1000PPS)
⑤ Finish point XP=30000
⑥ Finish point YP=40000
⑦ Finish point ZP=50000
⑧ 3 axes linear interpolation driving

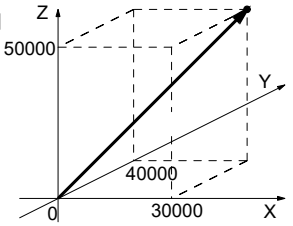


Fig.1 Example of 3-axis linear interpolation

■ Continuous interpolation

Continuous interpolation executes the sequence of interpolation drive continuously. During the continuous interpolation, the driving will not stop;contrarily, the pulses are output continuously. When executing the continuous interpolation, the host CPU has to write the next interpolation segment into MCX314As/AL before the previous interpolation segment is finished.
Fig.4 shows the example of continuous interpolation from segment 1 to segment 8 of which start point is (0,0). In Segment 1,3,5 and 7, linear interpolation is executed. In segment 2,4,6 and 8, circular interpolation is executed of which track are quadrant circle with radius 1500.

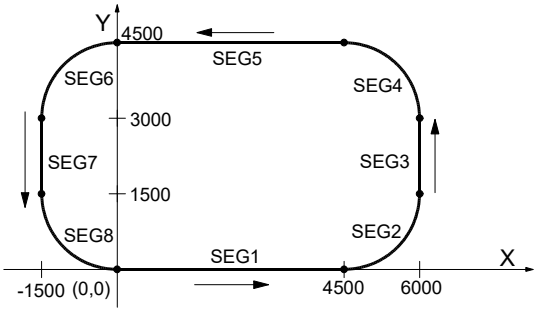


Fig.4 Example of continuous interpolation

■ Circular interpolation

Any 2 axes of the 4 axes can be selected for circular interpolation. Circular interpolation is executed to write the command of CW circular interpolation or CCW circular interpolation after setting the center and the finish point to the current point(start point). CW circular interpolation is starting from the current point to the finish point with clockwise direction, to the contrary, CCW circular interpolation drives to counterclockwise direction. The perfect circle appears by setting (0,0) to the finish point,
The range of interpolation coodinates is -2,147,483,646 ~ +2,147,483,646. The position tolerance for specified cicular curve is ±1 LSB within the whole interpolation range. Interpolation drive speed is 1PPS ~ 4MPPS(at CLK=16MHz).

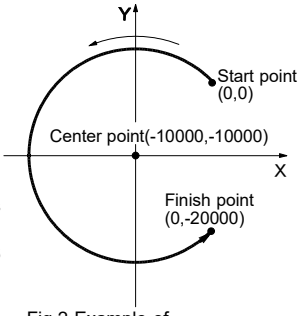


Fig.2 Example of CCW circular interpolation

[Setting procedure for the operation of Fig.2]
① AX1:X, AX2:Y Specified
② Range R= 8,000,000(Speed multiple:1)
③ Initial speed SV= 500
④ Drive speed V= 500(500PPS)
⑤ Center point XC= -10000
⑥ Center point YC= -10000
⑦ Finish point XP= 0
⑧ Finish point YP= -20000
⑨ CCW circular interpolation driving

[Setting procedure for the operation of Fig.3]
①~④ Same as Fig.2
⑤ Center point XC= 5000
⑥ Center point YC= 0
⑦ Finish point XP= 0
⑧ Finish point YP= 0
⑨ CW circular interpolation driving

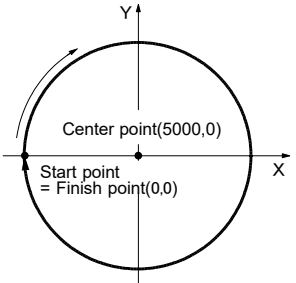
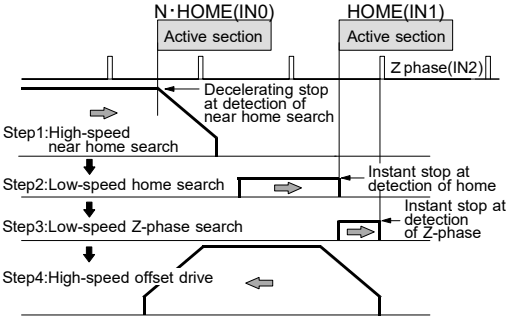


Fig.3 Example of CW circular interpolation

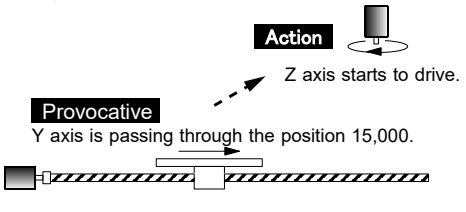
Automatic home search

The automatic home search function executes the home search sequence from step1:high-speed near home search to step4:high-speed offset drive as the following figure. Set execution/non-execution and a search direction mode for each step.



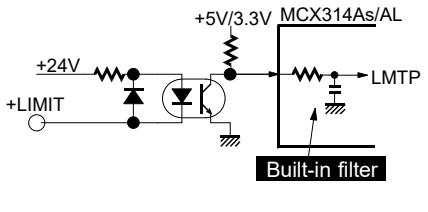
Synchronous action

Synchronous action is a function which performs the specified action such as the starting/stopping of driving, by linking with a provocative when an activation factor occurs in each axis, between some axes or with an external device . It is possible to operate accurate synchronous action since the delay time is generated very few till the action starts.
Ten types of activation factors are available such as the passing of the specified position and the starting/stopping of driving so on. Fourteen types of actions are available, starting/stopping of driving, saving a position counter value, and so on.



Built-in integral filter

The signal of limit and driving stop for each axis are influenced by external noise. To cut these noises, photo coupler or CR integral filter is mounted on the circuit normaly.
However MCX314As/AL are equipped with integral type filters in the input stage of each input signal. It is possible to set a number of input signals whether the filter function is enabled or the signal is passed through. A filter time constant is selectable from eight stages, min.2μsec ~ max.16msec.



■ Input/Output signals ((I): Input (O): Output (B): bidirectional Each X,Y,Z and U axis has nOOOO signal. "n" means each X, Y, Z and U axis.)

●CLK(I) Clock 16MHz(Standard) ●D15~0(B)Data Bus ●A3~0(I)Adress ●CSN(I)Chip select ●WRN(I)Write strobe ●RDN(I)Read strobe ●RESETN(I)Reset ●H16L8(I)16/8 Data bit bus width selection ●EXPLSN(I)External interpolation pulse ●BUSYN(O)Executing the command ●INTN(O)Interrupt ●SCLK(O) 1/2CLK ●nPP/PLS(O) + direction drive pulse/Drive pulse ●nPM/DIR(O) - direction drive pulse/Direction ●nECA/PPIN(I)Encoder A-phase/Up pulse ●nECB/PMIN(I)Encoder B-phase/Down pulse ●nDRIVE/DC C(O)Driving/Deviation counter clear ●nOUT7~4(O) General output (DSND:Decelerating, ASND:Accelerating, Pin sharing with CMPM:P<COMP-, CMPP:P ≥COMP+ signals) ●nOUT3~0(O) General output ●nINPOS(I) In-position for servo driver ●nALARM(I) Servo driver alarm ●nLMTP(I) + direction limit ●nLMTM(I) - direction limit ●nIN3~0(I) Decelerating/Instant stop ●nEXPP(I) External + direction drive ●nEXPM(I) External -direction drive ●EMGN(I) Emergency stop

■ Write register

Address A2	A1	A0	Symbol	Register name	Contents
0	0	0	WR0	Command register	Writing the command to each axis and interpolation control section D15 D14 D13 D12 D11 D10 D9 D8 D7 D6 D5 D4 D3 D2 D1 D0 RESET 0 0 0 U Z Y X 0 Command code Axis assignment ●D11~ 8 Axis assignment 0:non-select/1:select(Multi-axis are selectable at one time.) ●D15 1:Reset
0	0	1	XWR1 YWR1 ZWR1 UWR1	X-axis mode register 1 Y-axis mode register 1 Z-axis mode register 1 U-axis mode register 1	Setting of the logical levels and enable/disable of external decelerating/instant stop and interruption enable/disable for each axis D15 D14 D13 D12 D11 D10 D9 D8 D7 D6 D5 D4 D3 D2 D1 D0 D-END C-STA C-END P≥C+ P<C+ P<C- P≥C- PULSE IN3-E IN3-L IN2-E IN2-L IN1-E IN1-L IN0-E IN0-L Interrupt enable/disable Drive decelerating/instant stop input signal enable/disable ●D7~0 ***-E 0:disable/1:enable ***-L Logical level 0:Low/1:Hi ●D15~8 0:/1disable:enable ●D8:Drive pulse outputting ●D9:Logical/real position counter ≥COMP-register ●D10:Logical/real position counter<COMP-register ●D11:Logical/real position counter<COMP+register ●D12:Logical/real position counter≥COMP+register ●D13:at the termination of the constant speed drive during acceleration/deceleration driving ●D14:at the start of the constant speed drive during acceleration/deceleration driving ●D15:when the driving is finished
0	1	0	XWR2 YWR2 ZWR2 UWR2	X-axis mode register 2 Y-axis mode register 2 Z-axis mode register 2 U-axis mode register 2	Setting of enable/disable of software limit, the limit input signal mode, driving pulse mode, encoder input signal mode and the logical levels and enable/disable of servo motor signal for each axis. D15 D14 D13 D12 D11 D10 D9 D8 D7 D6 D5 D4 D3 D2 D1 D0 INP-E INP-L ALM-E ALM-L PIND1 PIND0 PINMD DIR-L PLS-L PLSMD CMPSL HLMT- HLMT+ LMTMD SLMT- SLMT+ ●D1, 0 Software limit 0:disable/1:enable ●D2 Hardware limit 0:instant/1:decelerating stop ●D4, 3 Logical level of limit signal 0:Low/1:Hi ●D5 COMP+/- register comparison 0:logical position counter/1:real position counter ●D6 Drive pulse outputting type 0:2-pulse system /1:1-pulse 1-direction system ●D7 Logicai level of drive pulse 0:positive logical pulse /1:negative logical pulse ●D8 Logical level of the direction signal 0:Low level for + direction/1:Hi for + direction ●D9 Encoder input signals 0:2-phase pulse /1:Up/Down pulse ●D11, 10 Encoder input divide 00:1/1, 01:1/2, 10:1/4 ●D12 Logical level of ALARM signal 0:Low/1:Hi ●D13 ALARM signal 0:disable/1:enable ●D14 Logical level of INPOS signal 0:Low/1:Hi ●D15 INPOS signal 0:disable/1:enable
			BP1P		Setting of the + direction bit data for the first axis in bit pattern interpolation
0	1	1	XWR3 YWR3 ZWR3 UWR3	X-axis mode register 3 Y-axis mode register 3 Z-axis mode register 3 U-axis mode register 3	Setting of the manual deceleration, symmmetry/non-symmmetry of acceleration/deceleration, S-curve acceleration/deceleration mode for each axis, external operation mode and general purpose output OUT7~4. D15 D14 D13 D12 D11 D10 D9 D8 D7 D6 D5 D4 D3 D2 D1 D0 0 0 0 0 OUT7 OUT6 OUT5 OUT4 OUTSL 0 0 EXOP1 EXOP0 SACC DSNDE MANLD ●D0 deceleration of fixed pulse drive 0:automatic /1:manual ●D1 symmetry/non-symmetry 0:symmetry(using the value of acceleration and the jerk at decelerating)/1:non-symmetry(using the value of deceleration and increase rate of deceleration at decelerating) ●D2 aceceleration/deceleration mode 0:trapezoidal driving/1:S-curve driving ●D4, 3 external drive operation 00:disable/01:continuous pulse drive/10:fixed pulse drive ●D7 selecting nOUT7~4 output 0:general purpose output OUT7~4/ 1:drive status output (DSND, ASND, CMPM and CMPP) ●D11~8 OUT7~4 general purpose output 0:Low/1:Hi
			BP1M		Setting of the - direction bit data for the first axis in bit pattern interpolation.
1	0	0	WR4	Output register	Setting of general purpose output signal nOUT3~0. 0:Low/ 1:Hi D15 D14 D13 D12 D11 D10 D9 D8 D7 D6 D5 D4 D3 D2 D1 D0 UOUT3 UOUT2 UOUT1 UOUT0 ZOUT3 ZOUT2 ZOUT1 ZOUT0 YOUT3 YOUT2 YOUT1 YOUT0 XOUT3 XOUT2 XOUT1 XOUT0
			BP2P		Setting of the + direction bit data for the second axis in bit pattern interpolation.
1	0	1	WR5	Interpolation mode register	Setting of axis assignment for interpolation drive, the constant vector speed mode, single step interpolation mode and interrupt during the interpolation. D15 D14 D13 D12 D11 D10 D9 D8 D7 D6 D5 D4 D3 D2 D1 D0 BPINT CIINT 0 CMPLS EXPLS 0 LSPD1 LSPD0 0 0 AX31 AX30 AX21 AX20 AX11 AX10 Interrupt Single step Constant vector speed 3rd axis 2nd axis 1st axis Axis code: X 0 0, Y 0 1, Z 1 0, U 1 1 ●D5~0 axis assignment (set the axis code) ●D9,8 constant vector speed 00: invalid/01: 2-axis constant vector speed/11: 3-axis constant vector speed ●D11 1: single step interpolation by external signal ●D12 1:single step interpolation by command interpolation ●D14 interrupt in interpolation 0:disable/1:enable ●D15 interrupt in bit pattern interpolation 0:disable/1:enable
			BP2M		Setting of the - direction bit data for the second axis in bit pattern interpolation.
1	1	0	WR6	Write data register 1	Setting of the low word 16-bit for data writing. (D15~D0)
			BP3P		Setting of the + direction bit data for the third axis in bit pattern interpolation.
1	1	1	WR7	Write data register 2	Setting of the high word 16-bit for data writing. (D31~D16)
			BP3M		Setting of the - direction bit data for the third axis in bit pattern interpolation.

●The above table indicates the address for 16-bit data bus. In 8-bit data bus access, the 16-bit data bus are divided into the high word byte (D15~8) and the low word byte (D7~0). ●Each axis has WR1,WR2 and WR3 (mode register 1, 2 and 3). Writing the data in these registers by the same adrress. It depends on the axis assignment of the last command to write the data in the mode register of which axis. Or, uesr can select the axis by writing the NOP command which is assigned an axis just before. ●BP1~3P and BP 1~3M for bit pattern interpolation can not be written just after resetting. It is resolved by operating BP register data writing enabling (36h).
●At resetting, all the bits of nWR1, nWR2, nWR3, WR4 and WR5 registers are cleared to 0(n=X, Y, Z and U). The other registers are undetermined.

■Extension mode setting

Extension mode setting is executed by writing the axis assignmet and the command code 60h in WR0 register after setting each bit of WR6 and 7 registers as the following table.

Address A2	A1	A0	Symbol	Register name	Contents
1	1	0	WR6	Write data register 1	Setting of the built-in filter of the input signal and the others. D15 D14 D13 D12 D11 D10 D9 D8 D7 D6 D5 D4 D3 D2 D1 D0 FL2 FL1 FL0 FE4 FE3 FE2 FE1 FE0 SMOD 0 HMINT VRING AVTRI POINV EPINV EPCLR Filter time constant Filter valid ●D0 real posision counter cleared by IN2 signal 0:disable/1:enable ●D1 inverse of increase/decrease of real position counter 0:disable/1:enable ●D2 replace drive pulse output 0:disable/1:enable ●D3 prevention of triangle form of linear acceleration/ deceleration 0:disable/1:enable ●D4 enable the variable ring function of the position counter 0:disable/1:enable ●D5 interrupt signal (INTN) at termination of automatic home search 0:disable/1:enable ●D7 S-curve accelerating/decelerating speed prior 0:disable/1:enable ●D8 EMGN,LMTP/M,IN0 and IN1 signal filter 0:disable/1:enable ●D9 IN2 signal filter 0:disable/1:enable ●D10 INPOS and ALARM signal filter 0:disable/1:enable ●D11 EXPP/M and EXPLS signal filter 0:disable/1:enable ●D12 IN3 signal filter 0:disable/1:enable ●D15~D13 input filter time constant setting(000:0.002msec/ 001:0.2msec/ 010:0.5/ 011:1/ 100:2/ 101:4/ 110:8/ 111:16msec)
1	1	1	WR7	Write data register 2	Setting of automatic home search. D15 D14 D13 D12 D11 D10 D9 D8 D7 D6 D5 D4 D3 D2 D1 D0 DCCW2 DCCW1 DCCW0 DCC-L DCC-E LIMIT SAND PCLR ST4-D ST4-E ST3-D ST3-E ST2-D ST2-E ST1-D ST1-E Setting of deviation counter clear output Step4 Step3 Step2 Step1 ●D6,4,2 and 0 STm-E step m execution 0:non-execution/1:execcution ●D7,5,3 and 1 STm-D step m search direction 0:+direction/1:-direction●D8 logical/real position counter clear 0:disable/1:enable ●D9 AND for Z-phase signal and home signal0:disable/1:enable ●D10 using limit signal 0:disable/1:enable ●D11 deviation counter clear(DCC) output 0:disable/ 1:enable ●D12 logical level of DCC signal 0:active Hi/1:Low ●D15~13 DCC active pulse width(000:0.01msec/ 001:0.02msec/ 010:0.1/011:0.2/ 100:1/ 101:2/ 110:10/ 111:20msec)

●At resetting, all of the bits of extension mode are cleared to "0" .

■Synchronous action mode setting

Each bit of WR6, 7 is set as the following table and an axis assignment with the command code 64h is written in WR0 register. At resetting, all of the bits are cleared to "0".

Address A2	A1	A0	Symbol	Register name	Contents
1	1	0	WR6	Write data register 1	Assignment of the activation factor (Provocative) and the activation of the other axis. 1:enable/0:disable D15 D14 D13 // D9 D8 D7 D6 D5 D4 D3 D2 D1 D0 AXIS3 AXIS2 AXIS1 // CMD LPRD IN3↓ IN3↑ D-END D-STA P≧C- P＜C- P＜C+ P≧C+ Activation of the other axis / Activation factor ●D0 Position counter (P) ≥COMP+ ●D1 P<COMP+ ●D2 P<COMP- ●D3 P≥COMP- ●D4 Starting of drive ●D5 Termination of drive ●D6 IN3 signal↑ ●D7 IN3 signal↓ ●D8 LP reading ●D9 Command operation of the synchronous action(65h) Activation of the other axis own axis / AXIS3 / AXIS2 / AXIS1 X U Z Y Y X U Z Z Y X U U Z Y X
1	1	1	WR7	Write data register 2	Assignmnt of action(Action). 1:enable/0:disable D15 D14 D13 D12 D11 D10 D9 D8 D7 D6 D5 D4 D3 D2 D1 D0 INT OUT 0 0 VLSET OPSET EPSET LPSET EPSAV LPSAV ISTOP SSTOP CDRV- CDRV+ FDRV- FDRV+ ●D0 +fixed pulse drive ●D1 -fixed pulse drive ●D2 +continuous pulse drive ●D3 -continuous pulse drive ●D4 decelerating stop ●D5 instant stop ●D6 saving the logical position counter value ●D7 saving the real position counter value ●D8 set the value of WR6 and 7 in the logical position counter ●D9 set the value of WR6 and 7 in the real position counter ●D10 set the value of WR6 and 7 in output pulse ●D11 set the value of WR6 in drive speed ●D14 DCC signal output ●D15 interrupt occuring

■Read register

Address A2	A1	A0	Symbol	Register name	Contents
0	0	0	RR0	Main status register	Displaying the drive and error status of each axis and interpolation driving status. D15 D14 D13 D12 D11 D10 D9 D8 D7 D6 D5 D4 D3 D2 D1 D0 - BPSC1 BPSC0 ZONE2 ZONE1 ZONE0 CNEXT I-DRV U-ERR Z-ERR Y-ERR X-ERR U-DRV Z-DRV Y-DRV X-DRV Error of each axis / Drive of each axis ●D3~0 1:driving ●D7~4 1:error occuring(become "1" whichever from RR2/D5~0,RR1/D15~12.) ●D8 1:interpolation driving ●D9 1:writable the next data of continuous interpolation ●D12~10 circulation interpolation quadrant 000:0,001:1,010:2,… 111:7 ●D14 and 13 bit pattern interpolation stack counter 00:0,01:1,10:2,11:3
0	0	1	XRR1 YRR1 ZRR1 URR1	X axis status register 1 Y axis status register 1 Z axis status register 1 U axis status register 1	Displaying the comparison of positoin counter and COMP± register, status of aceeleration/deceleration during the driving and driving termination status. D15 D14 D13 D12 D11 D10 D9 D8 D7 D6 D5 D4 D3 D2 D1 D0 EMG ALARM LMT- LMT+ IN3 IN2 IN1 IN0 ADSND ACNST AASND DSND CNST ASND CMP- CMP+ Status of driving termination ●D0 1:position counter≥COMP+ ●D1 1:position counter<COMP- ●D2 1:accelerating ●D3 1:constant speed driving ●D4 1:decelerating ●D5 1:increasing acceleration/deceleration speed ●D6 1:constant accelerating/decelerating ●D7 1 decreasing acceleration/deceleration speed ●D15~8 1:factor of driving termination
0	1	0	XRR2 YRR2 ZRR2 URR2	X axis status register 2 Y axis status register 2 Z axis status register 2 U axis status register 2	Displaying the error information and the state of automatic home search. 1:error occuring D15 D14 D13 D12 D11 D10 D9 D8 D7 D6 D5 D4 D3 D2 D1 D0 - 0 0 HMST4 HMST3 HMST2 HMST1 HMST0 HOME 0 EMG ALARM HLMT- HLMT+ SLMT- SLMT+ Automatic home searching state / Error information ●D0 +direction software limit ●D1 -direction software limit ●D2 +direction limit signal on ●D3 -direction limit signal on ●D4 alarm signal for servo motor on ●D5 emergency stop signal on ●D7 automatic home search error ●D12~8 automatic home searching state(contents of driving)
0	1	1	XRR3 YRR3 ZRR3 URR3	X axis status register 3 Y axis status register 3 Z axis status register 3 U axis status register3	Displaying the factor of interrupt occring (interpolation excluded). 1:interrupt occuring D15 D14 D13 D12 D11 D10 D9 D8 D7 D6 D5 D4 D3 D2 D1 D0 - - - - - - SYNC HMEND D-END C-STA C-END P≥C+ P<C+ P<C- P≥C- PULSE ●Each bit of D7~D0 is applied to D15~D8 bit of WR1(mode register1) ●D8 termination of automatic home search ●D9 synchronous action activated
1	0	0	RR4	Input register 1	Displaying the input signal status of X and Y axis. 0:Low 1:Hi D15 D14 D13 D12 D11 D10 D9 D8 D7 D6 D5 D4 D3 D2 D1 D0 Y-ALM Y-INP Y-EX- Y-EX+ Y-IN3 Y-IN2 Y-IN1 Y-IN0 X-ALM X-INP X-EX- X-EX+ X-IN3 X-IN2 X-IN1 X-IN0
1	0	1	RR5	Input register 2	Displaying the input signal status of Z and U axis. 0:Low 1:Hi D15 D14 D13 D12 D11 D10 D9 D8 D7 D6 D5 D4 D3 D2 D1 D0 U-ALM U-INP U-EX- U-EX+ U-IN3 U-IN2 U-IN1 U-IN0 Z-ALM Z-INP Z-EX- Z-EX+ Z-IN3 Z-IN2 Z-IN1 Z-IN0
1	1	0	RR6	Read data register 1	Displaying the low word 16-bit for the read data.(D15~D0)
1	1	1	RR7	Read data register 2	Displaying the low word 16-bit for the read data.(D31~D16)

■ Data writing commnads

●The above table indicates the address for 16-bit data bus. In 8-bit data bus access, the 16bit data bus are divided into the high word byte (D15~8) and the low word byte (D7~0). ●Each axis has RR1,RR2 and RR3 (status register 1,2 and 3). It can be read the data in these registers by the same address. It depends on the axis assignment of the last command to read the data in the mode register of which axis. Or, user can select the axis by writing the NOP command which is assigned an axis just before .

Code	Setting Command	Symbol	Data range	Data length (byte)
00	Range	R	R8,000,000(multiple=1) ~ 16,000(=500)	4 bytes
01	Jerk	K	1 ~ 65,535	2
02	Acceleration	A	1 ~ 8,000	2
03	Deceleration	D	1 ~ 8,000	2
04	Initial speed	SV	1 ~ 8,000	2
05	Drive speed	V	1 ~ 8,000	2
06	Output pulse numbers	P	Output pulse numbers:0 ~ 268,435,455	4
	Interpolation finish point		Finish point:-2,147483,646~+2,147483,646	4
07	Manual deceleration point	DP	0 ~ 4,294,967,295	4
08	Center point of circulate	C	-2,147,483,646 ~ +2,147,483,646	4
09	Logical position counter	LP	-2,147,483,648 ~ +2,147,483,647	4
0A	Real point counter	EP	-2,147,483,648 ~ +2,147,483,647	4
0B	COMP+ register	CP	-2,147,483,648 ~ +2,147,483,647	4
0C	COMP- register	CM	-2,147,483,648 ~ +2,147,483,647	4
0D	Acceleration counter offset	AO	-32,768 ~ +32,767	2
0E	Increase of deceleration	L	1 ~ 65,535	2
60	Expansion mode	EM	(Bit data)	4
61	Home search speed	HV	1 ~ 8,000	2
64	Synchronous action mode	SM	(Bit data)	4

■Driving commands

Code	Commands
20	+direction fixed pulse drive
21	-direction fixed pulse drive
22	+direction continuous drive
23	-direction continuous drive
24	drive start holding
25	drive start holding release /termination status clear
26	decelerating stop
27	instant stop

■Other commnands

Code	Commands
62	Automatic home search execution
63	Deviation counter clear output
65	Synchronous action activation
0F	NOP (for axis switching)

■Interpolation commands

Code	Commands
30	2-axis linear interpolation
31	3-axis linear interpolation
32	CW circulate interpolation
33	CCW circulate interpolation
34	2-axis bit pattern interpolation
35	3-axis bit pattern interpolation
36	BB register writable
37	BP register unwritable
38	BP data stack
39	BP data clear
3A	1 step interpolation
3B	deceleration enable
3C	deceleration disable
3D	interpolation interrupt clear

*BP= bit pattern

■Data reading commands

Code	Reading Command	Symbol	Data range	Data length (byte)
10	Logical position counter	LP	-2,147,483,648~+2,147,483,647	4 bytes
11	Real position counter	EP	-2,147,483,648~+2,147,483,647	4
12	Current drive speed	CV	1 ~ 8,000	2
13	Acceleration / deceleration	CA	1 ~ 8,000	2
14	Synchronous buffer register	SB	-2,147,483,648~+2,147,483,647	4

■Parameter caluculation

at CLK= 16MHz

Multiple(M)= $\frac{8,000,000}{R}$

Accelerating speed(PPS/SEC)^2= $\frac{62.5\times10^6}{K}\times M$ increasing

Decelerating speed(PPS/SEC)^2= $\frac{62.5\times10^6}{L}\times M$ increasing

Accelerating speed(PPS/SEC)=A×125×M

Decelerating speed(PPS/SEC)=D×125×M

Drive speed(PPS)=V×M

Initial speed(PPS)=SV×M

The Specifications are subject to change without notice due to the technical development. 2019.4

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