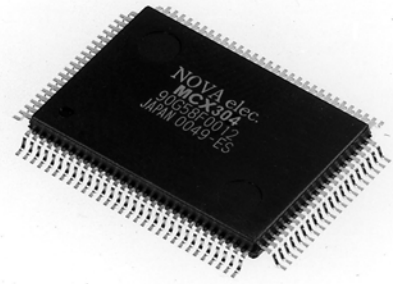


MCX304 is 4-axis motion control IC which can independently control either stepper motor driver or pulse type servo motor for position and speed control.

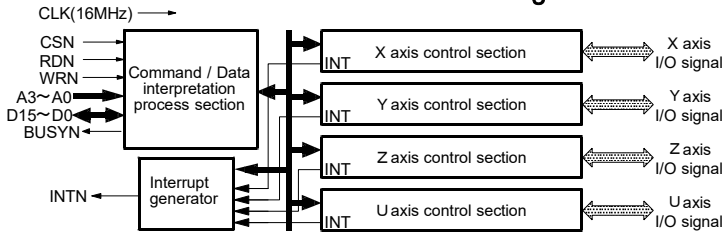
Specification

- Control axis 4 axes
- Data bit bus width 16/8 bit selectable
- Drive output pulse at CLK = 16MHz
- Output speed range 1PPS ~ 4MPPS
- Output speed accuracy ±0.1%(according to the setting value)
- S-curve jerk $954 \sim 31.25 \times 10^5$ PPS/SEC²
- Acceleration/deceleration speed $125 \sim 500 \times 10^6$ PPS/SEC
- Initial speed $1 \sim 4 \times 10^5$ PPS
- Drive speed $1 \sim 4 \times 10^5$ PPS
- Number of output pulse 0 ~ 268,435,455 (Fixed drive) or Unlimited(Continuous drive)
- Speed curve
- Constant, linear acceleration/deceleration or parabola S-curve acceleration/deceleration
- Deceleration mode for fixed pulse drive Auto(non-symmetry trapezoidal drive is allowed)/manual
- The number of output pulse and drive speed during driving are changeable.
- Independent 2 pulse system / 1 pulse 1 direction system is selectable.
- Logical levels of pulse are selectable.
- 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
- Logical position counter(for output pulse) range -2,147,483,648 ~ +2,147,483,647
- Real position counter (for input pulse) range -2,147,483,648 ~ +2,147,483,647
- Comparison register
- COMP+ register range -1,073,741,824 ~ +1,073,741,823
- COMP- register range -1,073,741,824 ~ +1,073,741,823
- Status and signal outputs for the comparisons of position counters.
- To work as software limit.
- 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 of each step and search direction are selectable.
- Interrupt
- ..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+

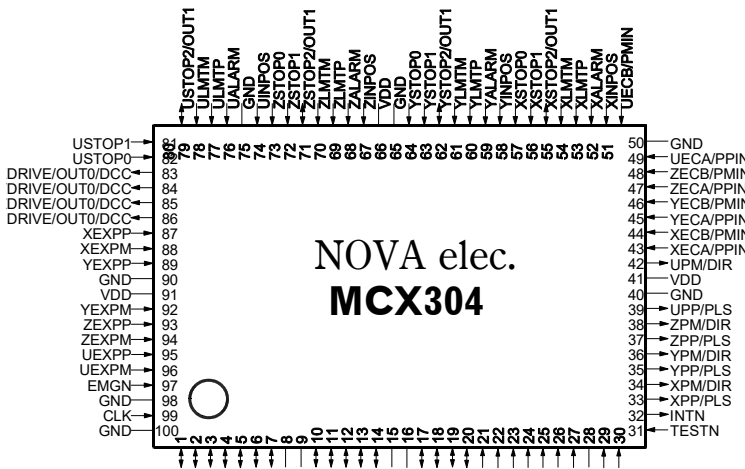


- External signal for driving
- EXPP and EXPM signal for +/- direction fixed/continuous pulse drive.
- Driving in manual pulsar mode(Encoder input).
- External decelerating/instant stop signal
- STOP0 ~ 2 3 points for each axis.
- Enable/disable and logical levels are selectable.
- Input signal for servo motor
- ALARM(Alarm) and INPOS(In position check)
- General input/output signal
- Input 7 points for each axis (all the points are pin sharing with the other functions)
- Output OUT 0~3 4 points for each axis(all the points are pin sharing with the other functions)
- Limit signal input
- 1 point for each +/-direction
- Logical levels and decelerating/instant stop are selectable.
- Emergency stop signal
- EMGN 1 point for all axes
- Stop the drive pulse of all axes immediately in Low level.
- Integral filter built-in.
- Equipped integral filter in the input column of each input signal.
- One time constant can be selected from 8 types.
- Electrical characters
- Temperature range for operating 0 ~ + 85°C (32°F ~181°F)
- Power voltage +5V ± 5%(Consumption current 67 mA max.)
- Input/output signal level TTL / CMOS level
- Input clock 16.000MHz (Standard.)
- Dimension(including pins) 23.8×17.8×3.05mm
- 100-pin plastic QFP, pin pitch=0.65

MCX304 Functional Block Diagram

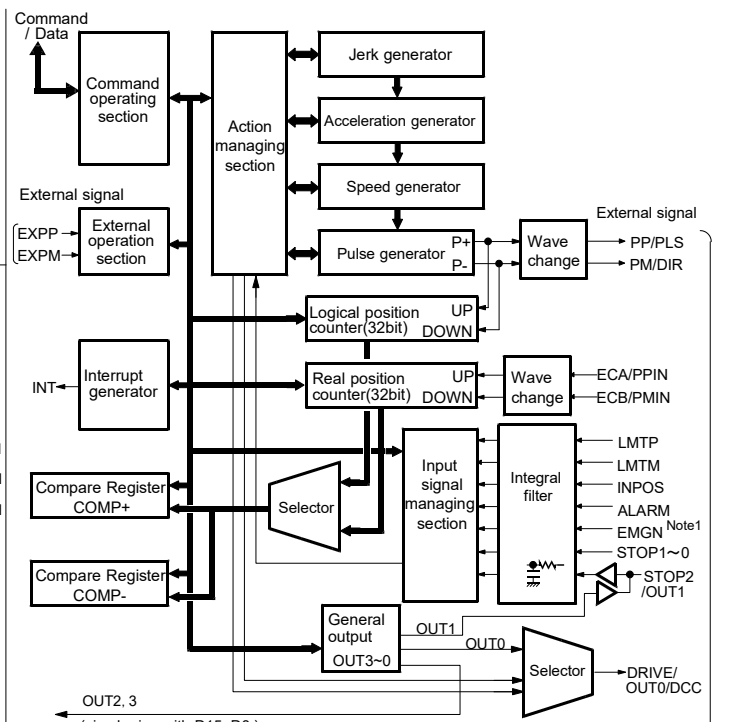


The block diagram of the whole function of MCX304



NOVA elec.
MCX304

Pin assignment



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

- 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.)
- D15~0(B) Data Bus(D15~8 is pin sharing with nOUT2 and 3) ● A3~0(I) Address ● CSN(I) Chip select ● WRN(I) Write strobe ● RDN(I) Read strobe ● RESETN(I) Reset
- H16L8(I) 16/8 Data bit bus width selectable ● INTN(O) Interrupt ● 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 ● nINPOS(I) In-position for servo driver ● nALARM(I) Servo driver alarm
- nLMTM(I) + direction limit ● nLMTM(I) - direction limit ● nSTOP2~0(I) 3points for decelerating/instant stop(nSTOP2 is pin sharing with nOUT1.)
- nDRIVE/OUT0/DCC(O) (DRIVE:Drive pulse outputting status, OUT0:General output, DCC:Sharing pin for Deviation counter clear outputting) ● nEXPP(I) External + direction drive, manual pulsar A-phase ● nEXPM(I) External -direction drive, manual pulsar B-phase ● EMGN(I) Emergency stop ● CLK(I) Clock 16MHz(Standard)

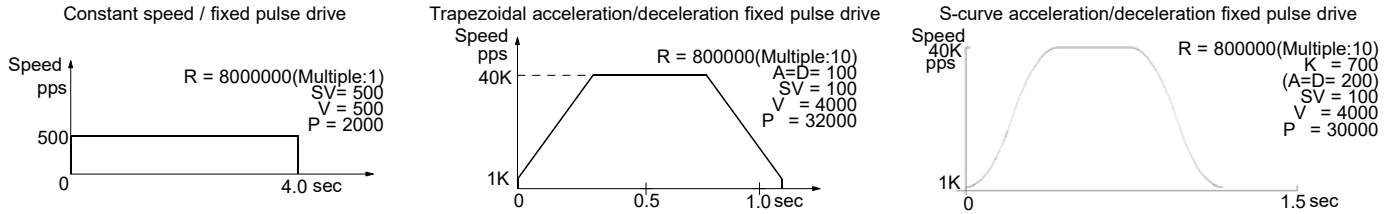
Individual control for 4 Axes

MCX304 has 32 bit position counter for each X,Y,Z and U axis and function to drive constant speed, linear and S-curve acceleration/deceleration to the maximum speed 4MPPS. Drive command is operated by +/- direction fixed pulse drive or continuous drive basically.

● Fixed pulse: Output the specified pulse number.

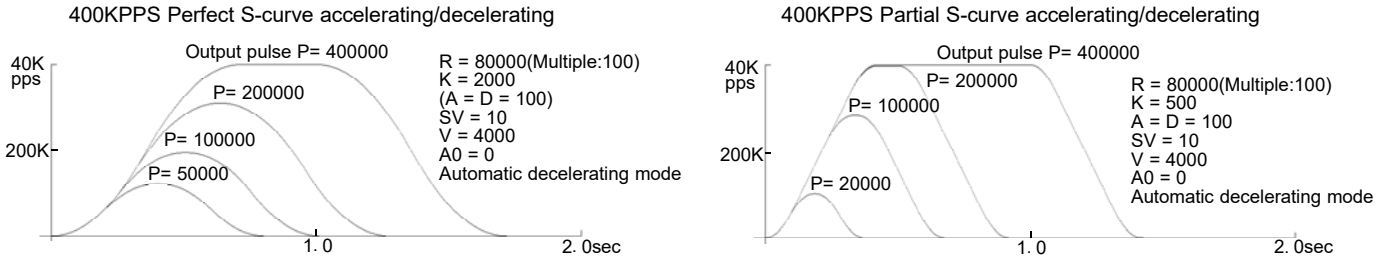
● Continuous pulse: Keep outputting the pulse unlimitedly until the stop factor is generated.

Either drive can be operated in constant speed and linear/S-curve acceleration/deceleration by operation parameter and mode setting.



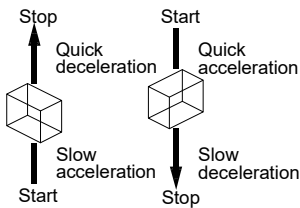
S-curve acceleration/deceleration drive

S-curve acceleration/deceleration has a style to increase or decrease acceleration/deceleration speed by linear function. Therefore, its speed curve moves as parabola S-curve. Triangle forms during S-curve acceleration/deceleration are prevented by a special method as the following figure however the number of output pulse is small. Perfect S-curve acceleration/deceleration drives as quadratic curve without linear acceleration/deceleration at all during accelerating/decelerating, contrarily, partial S-curve acceleration/deceleration drives as combining linear and curve driving during accelerating/decelerating.

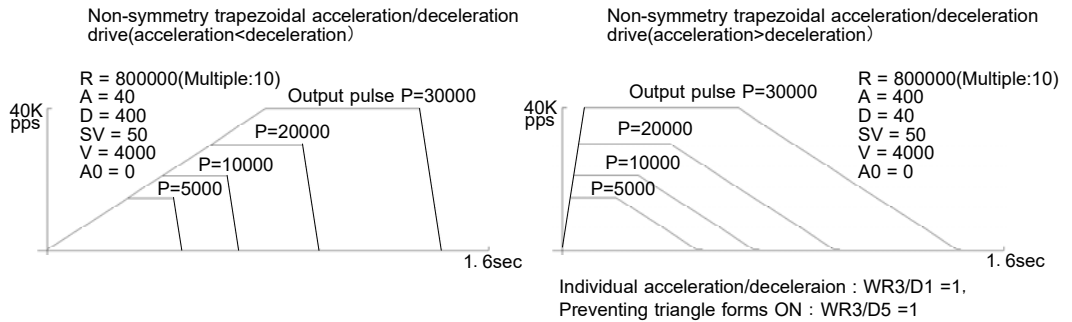


Automatic deceleration for non-symmetrical trapezoidal drive

In non-symmetrical trapezoidal acceleration/deceleration drive whose accelerating and decelerating speed are different, automatic decelerating is started since the start point of decelerating is calculated inside MCX304. There is no need to set the start point of decelerating from CPU for users.



As the above figure shows, when the objects are moved in up/down direction, gravity acceleration is added. For effective transporting, non-symmetry trapezoidal drive is needed.



[Note] In acceleration > deceleration, there is limitation for the rate of acceleration and deceleration which can be operated by automatic deceleration. The limitation depends on the value of driving speed. For example, when the driving speed is 100kpps, its rate is to 1/40.

Automatic home search

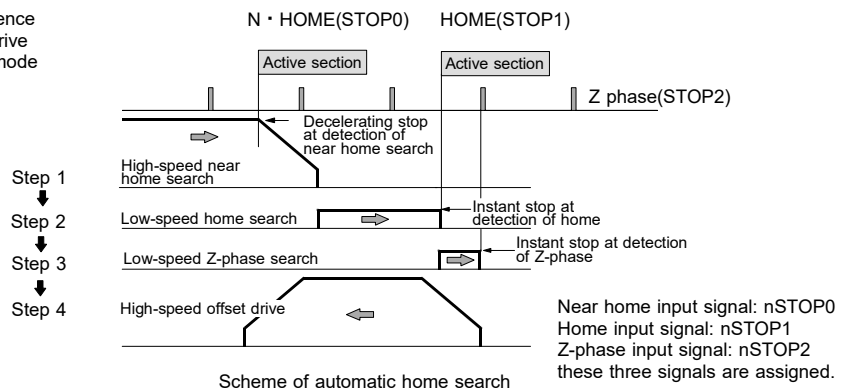
The automatic home search function executes the home search sequence from step1:high-speed home search to step4:high-speed offset drive as the right figure. Set execution/non-execution and search direction mode for each step.

Search speed

In step 1 and 4, search action is executed by high speed which is set as the drive speed (V). Or, in step 2 and 3, search action is executed by low speed which is set as the home detection speed (HV)

Irregular operation

In irregular case, for example, the signal is already active in sensor active part before the searching starts or which is detecting the limit for the direction of movement during searching, the correct home search is executed.

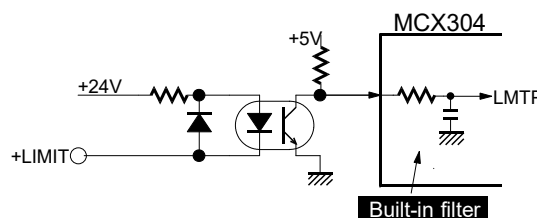


Built-in integral filter

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 normally.

However MCX304 is 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. 2.2μsec ~ max. 16msec.



FL2~0	Input delay time
0	2μSEC
1	256μSEC
2	512μSEC
3	1.024mSEC
4	2.048mSEC
5	4.096mSEC
6	8.192mSEC
7	16.384mSEC

Read register

Address			Symbol	Name	Contents
A2	A1	A0			
0	0	0	RR0	Main status register	Displaying the drive and error status and automatic home search execution status of each axis . D15 D14 D13 D12 D11 D10 D9 D8 D7 D6 D5 D4 D3 D2 D1 D0 - 0 0 0 U-HOM Z-HOM Y-HOM X-HOM U-ERR Z-ERR Y-ERR X-ERR U-DRV Z-DRV Y-DRV X-DRV Automatic home search execution Error Drive ●D3~0 1:driving ●D7~4 1:error occurring(become "1" whichever from RR2/D7~0, RR1/D15~12.) ●D11~8 1:automatic home search executing
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 aacceleration/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+ - STOP2 STOP1 STOP0 ADSND ACNST AASND DSND CNST ASND CMP- CMP+ Driving termination status ●D0 1:position counter>COMP+ ●D1 1:position counter<COMP- ●D2 1:accelerating ●D3 1:constant speed driving ●D4 1:decelerating ●D5 1:increasing accelerating/decelerating speed ●D6 1:constant accelerating/decelerating speed ●D7 1 decreasing accelerating/decelerating 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. D15 D14 D13 D12 D11 D10 D9 D8 D7 D6 D5 D4 D3 D2 D1 D0 - - - HMST4 HMST3 HMST2 HMST1 HMST0 HOME 0 EMG ALARM HLMT-HLMT+ SLMT-SLMT+ Automatic home searching state Error information ●D0 1:+direction software limit ●D1 1:-direction software limit ●D2 1:+direction limit signal on ●D3 1:-direction limit signal on ●D4 1:alarm signal for servo motor on ●D5 1:emergency stop signal on ●D7 1:automatic home search error ●D12~8 1: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 register 3	Displaying the factor of interrupt occring. 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- - 1: interrupt occurring Each bit of D7~D0 is corresponding to D15~D9 bit of WR1(mode register1)
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-ST2 Y-ST1 Y-ST0 X-ALM X-INP X-EX-X-EX+ EMG X-ST2 X-ST1 X-ST0]
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-ST2 U-ST1 U-ST0 Z-ALM Z-INP Z-EX-Z-EX+ - Z-ST2 Z-ST1 Z-ST0]
1	1	0	RR6	Read register 1	Displaying the low word 16-bit for the read data.(D15~D0)
1	1	1	RR7	Read register 2	Displaying the high word 16-bit for the read data.(D31~D16)

●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) by using address signal A3~A0.

●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.

Data writing commands

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	0 ~ 268,435,455	4
07	Manual deceleration point	DP	0 ~ 268,435,455	4
09	Logical position counter	LP	-2,147,483,648 ~ +2,147,483,647	4
0A	Real position counter	EP	-2,147,483,648 ~ +2,147,483,647	4
0B	COMP+ register	CP	-1,073,741,824 ~ +1,073,741,823	4
0C	COMP- register	CM	-1,073,741,824 ~ +1,073,741,823	4
0D	Acceleration counter offset	AO	-32,768 ~ +32,767	2
0F	NOP(for switching)			
60	Automatic home search mode	HM		2
61	Home search speed	HV	1 ~ 8,000	2

Parameter calculation at CLK= 16MHz

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

$$\text{Initial speed(PPS)} = SV \times M$$

$$\text{Drive speed(PPS)} = V \times M$$

$$\text{Accelerating speed(PPS/SEC)} = A \times 125 \times M$$

$$\text{Jerk(PPS/SEC}^2) = \frac{62.5 \times 10^6}{K} \times M$$

$$\text{Decelerating speed(PPS/SEC)} = D \times 125 \times M$$

$$\text{Decelerating speed increasing (PPS/SEC}^2) = \frac{62.5 \times 10^6}{L} \times M$$

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

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
26	/termination status clear
27	decelerating stop
27	instant stop

Other commands

Code	Commands
62	Automatic home search execution
63	Deviation counter clear output

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

Distributor



NOVA electronics, Inc.

4F Belle plaza II, 3-2-15 Sasazuka, Shibuya-Ku, Tokyo 151-0073, Japan
 WEB SITE <http://www.novaelec.co.jp/eng>
 EMAIL ADDRESS novaelec_info@novaelec.co.jp
 TEL 81-3-6300-0615 FAX 81-3-6300-0617