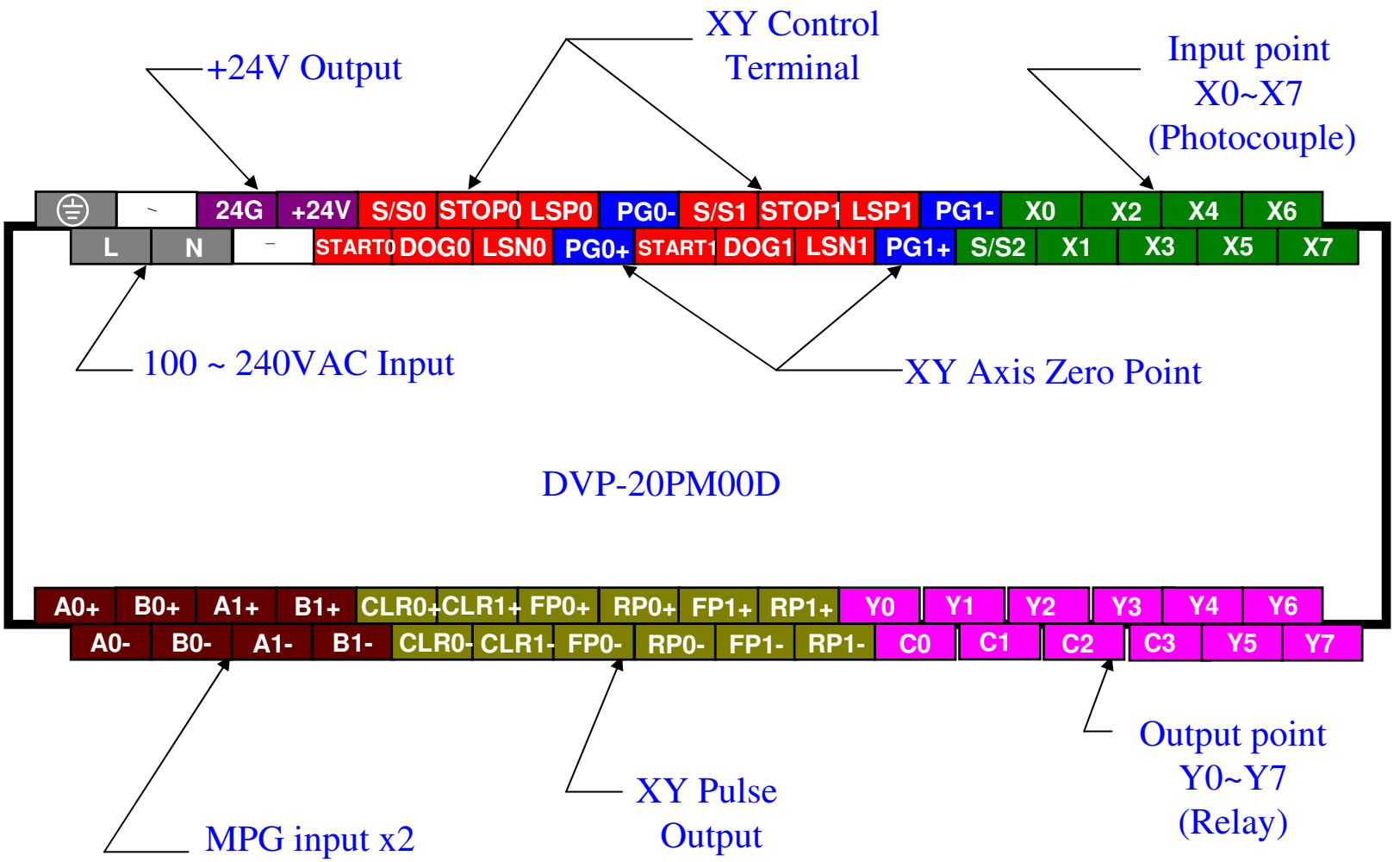
台達電子

20PM Introduction

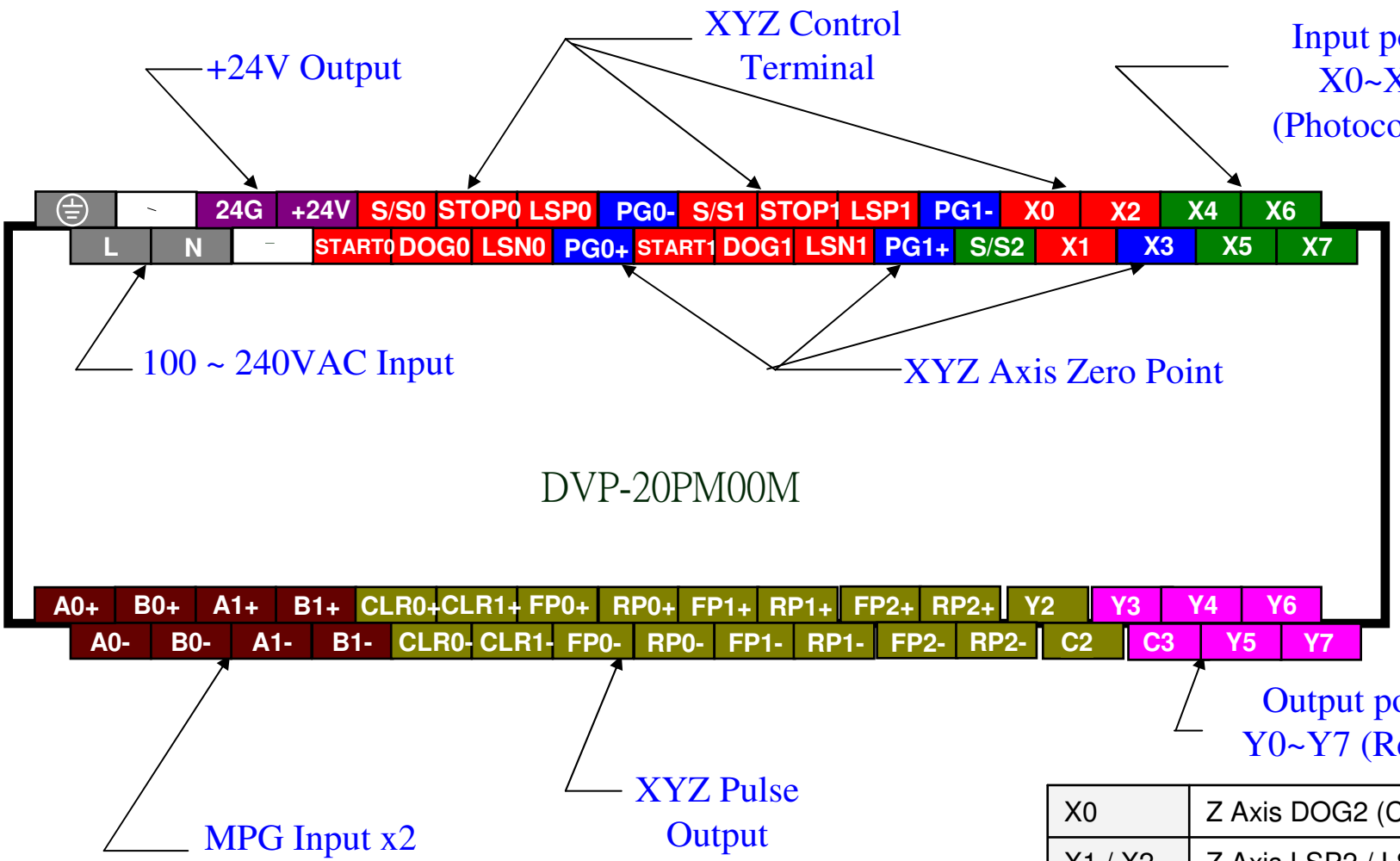
Agenda

- Terminal of 20PM00 D/M
- Functions of PM
- Program structure
- Program executing process
- Special D、M
- Instruction、G-Code

DVP20PM00D Terminal



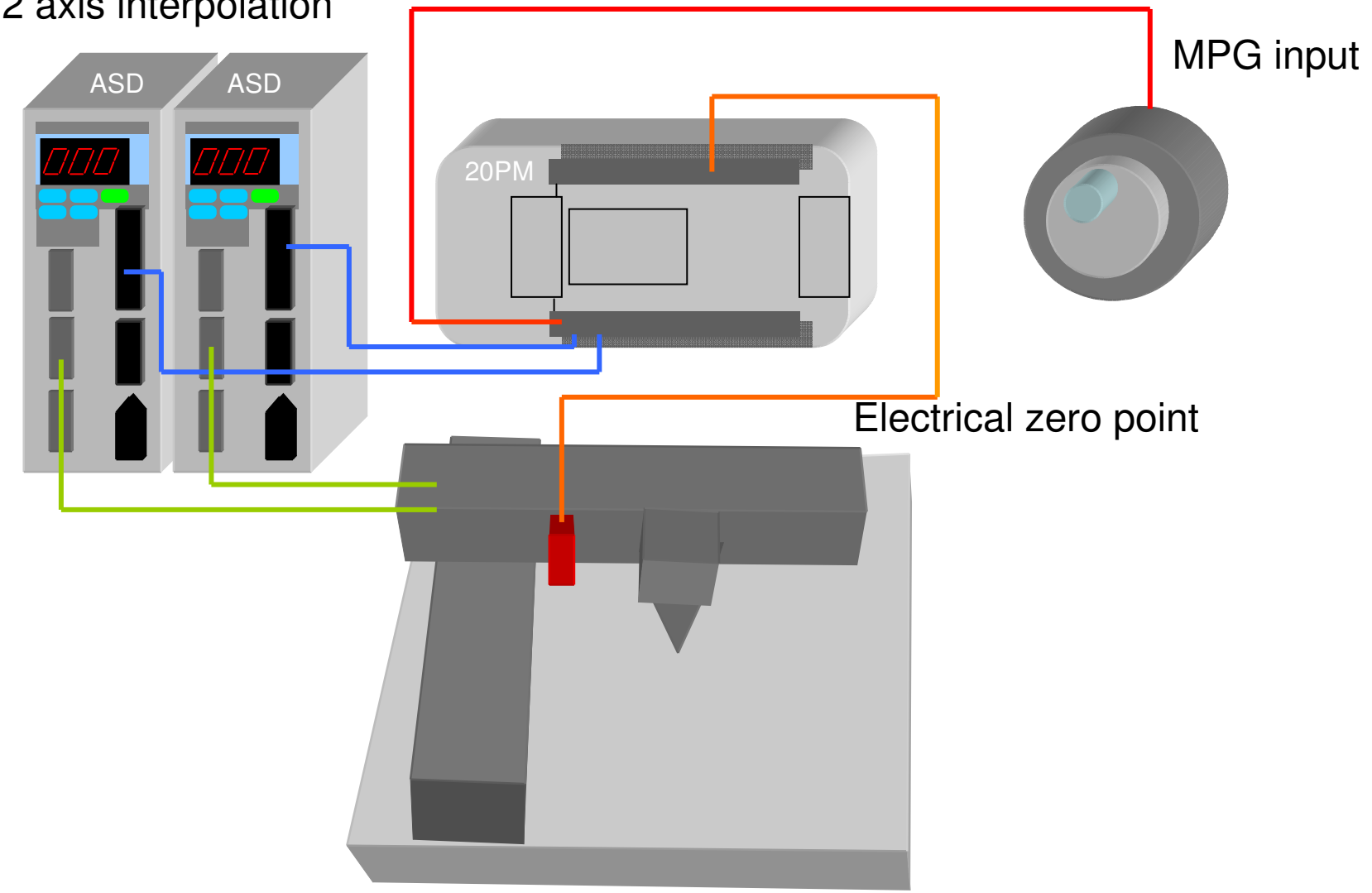
DVP20PM00M Terminal



X0	Z Axis DOG2 (COM)
X1 / X2	Z Axis LSP2 / LSN2 (COM)
X3	Z Axis PG2 (COM)
Y2/ C2	Z Axis CLR2

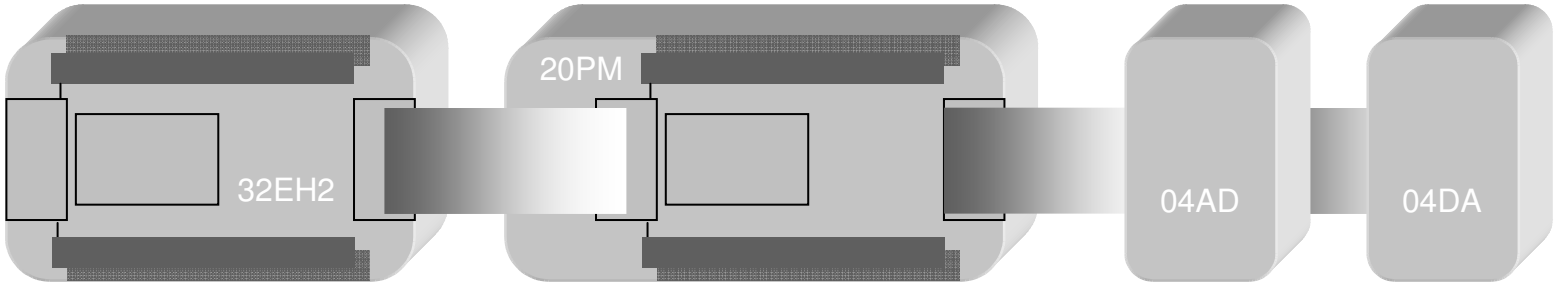
Function

2 axis interpolation



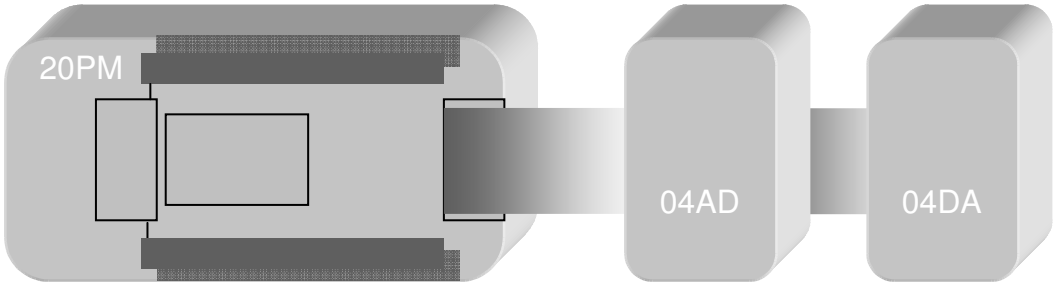
Function

Can be extension module



Use FROM/TO command to read/write the register D1500~D1699 of 20PM

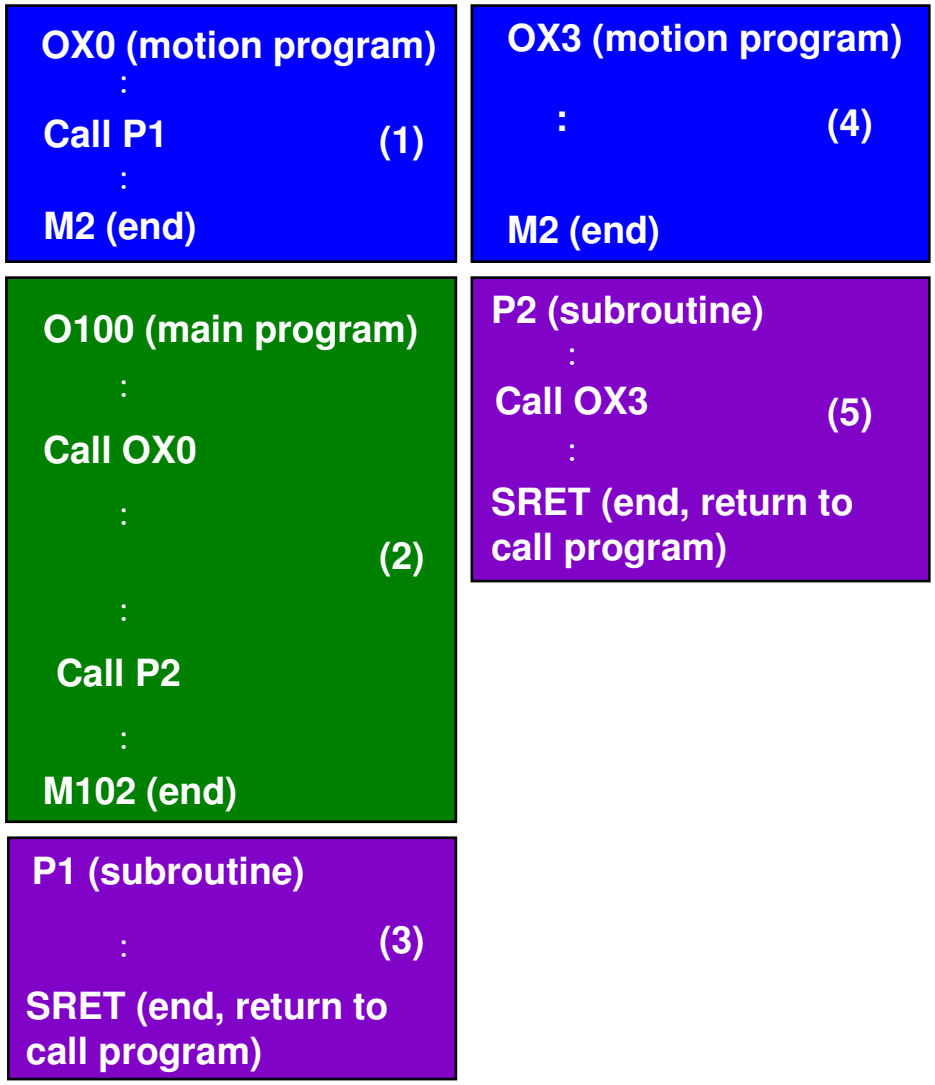
Can be master PLC



The Program Structure

	Main program	Motion program	Subroutine
Start of the program	O100	OXn (n:0 ~ 99)	Pn (n:0 ~ 255)
End of the program	M102	M2	SRET
Placing order	Any	Any	Any
Program Execution	RUN normally	Called by main program or subroutine	Called by main program or motion program
How it operates	cyclic	Executed once when called	Executed once when called
Instruction supported	(1) Basic instruction (2) Application instruction	(1) Basic instruction (2) Application instruction (3) Motion instruction (4) G-Code instruction	(1) Basic instruction (2) Application instruction (3) Motion instruction (4) G-Code instruction P.S. (3) and (4)can be workable only when Motion Program call them.
Quantity	1	Maximum 100	Maximum 256

The Program Structure



1	The program is edited and compiled from (1) to (5). The main program, subroutine and motion program can be placed in any sequence.
2	There is only one main program (2), and it cannot be called. Main program can call subroutine (5) and motion program (1).
3	The motion program can be called by main program (2) and subroutine (5), and it can call subroutine (3) as well.
4	The subroutine can be called by main program (2) and motion program (1), and it can call motion program (4) as well.

O100 Main Program

- Functions of O100:

(1) A control program for the operation of DVP-20PM, same as a PLC.

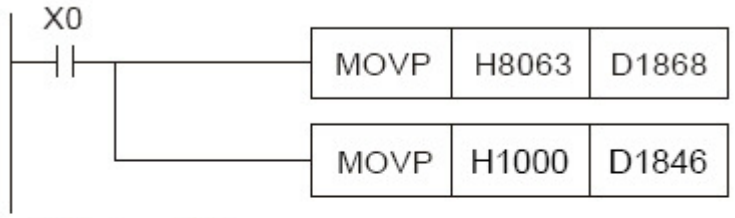
(2) Enables the calling of OXn motion program.

(3) Controls the manual function of X Y and Z axes. D1846、D1926、D2006
Controls the input data of D1875、D1955、D2035

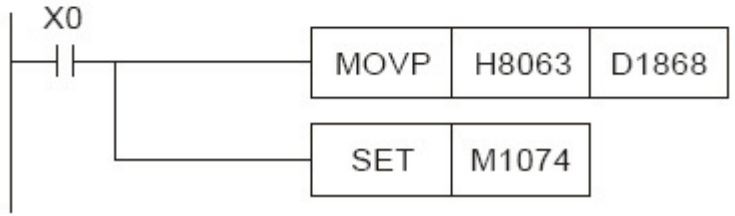
How to call a motion program

Step 1	(1) Set b14 or b15 of D1868 as "1". (2) b0 ~ b13 of D1868 is the No. of motion program (H63=99)
Step 2	Set b12 of D1846 as "1".
To enable OX99 (Method 1) Step 1: Write H' 8063 into D1868. Step 2: Write H' 1000 into D1846.→ bit 12=1	
To enable OX99 (Method 2) Set M1074	

Method 1



Method 2



OXn Motion Program

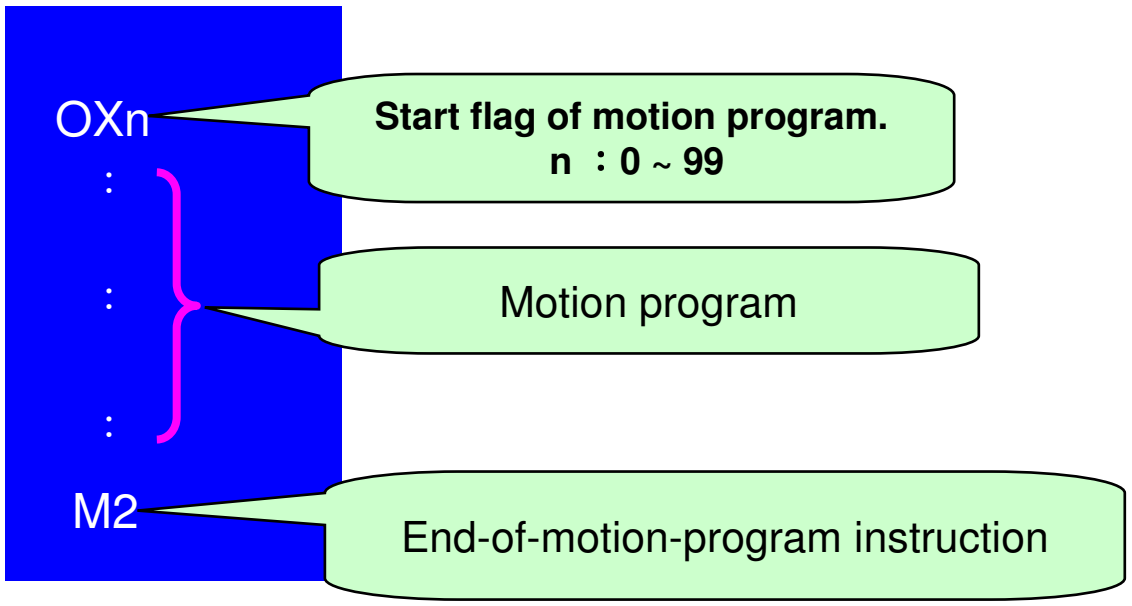
- Functions of Oxn

(1) Allows user to easily design and execute 2.5D or 3D route.

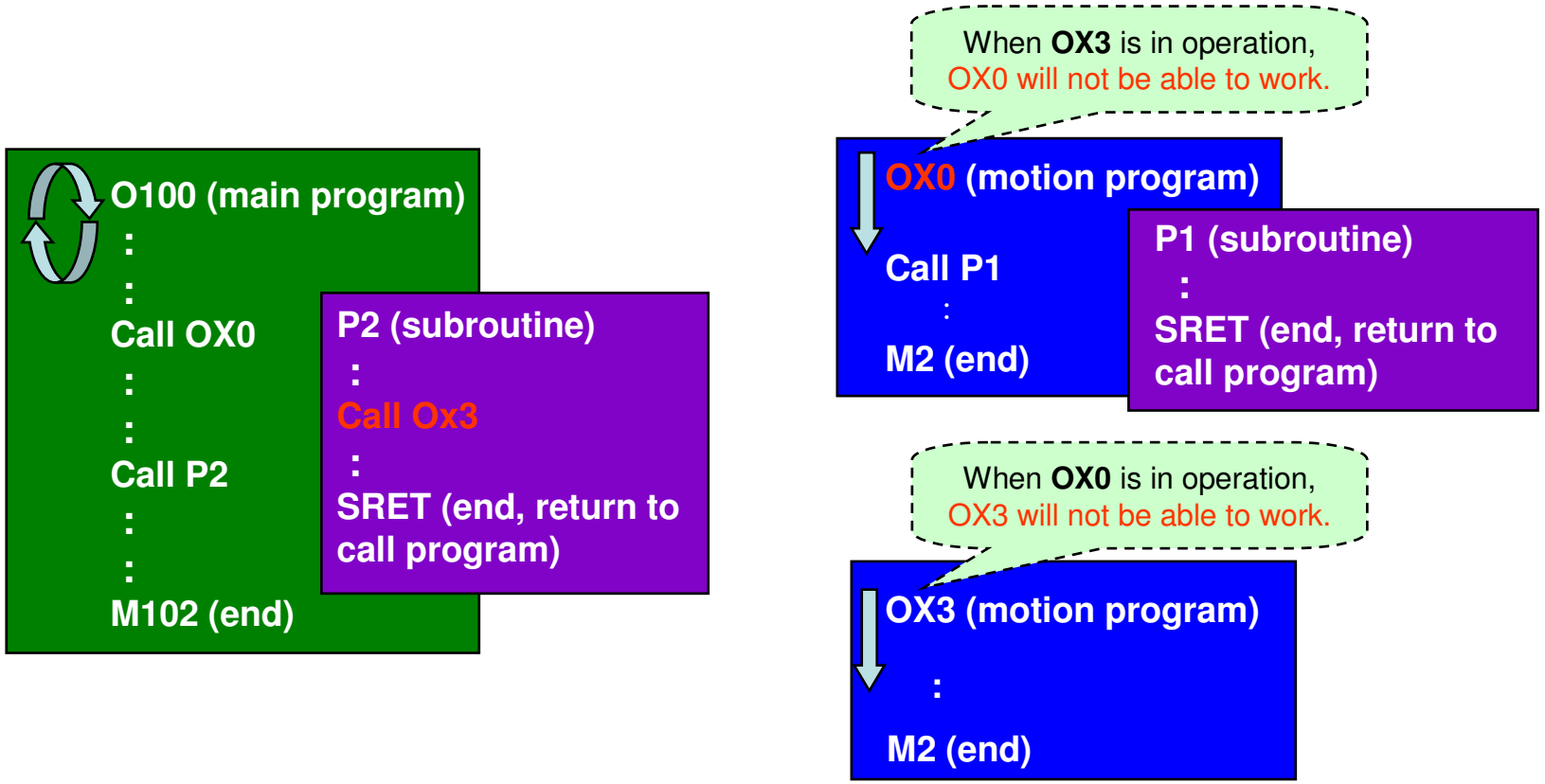
(2) Setting up X, Y, Z axis operation.

(3) OX can be easily called by O100 and subroutine, or triggered by external signals.

OXn program model



Pn subroutine



Note :
More than one motion programs cannot be executed at the same time.

Program & Motion Axis Control

	O100 main program	Oxn motion program	X-axis	Y-axis	Z-axis	Notes
Program operation	M1072 RUN	D1846[12] RUN	X	X	X	1. O100 enables Oxn. 2. Oxn program controls the movement of X-Y axis.
2st-int	X	X	D1846[11]	D1926[11]	D2006[11]	1. Manual functions for X and Y axes. 2. When Ox is operating, the manual function of X-Y axis cannot be enabled. 3. O100 and Ox controls the manual functions of X-Y axis. 4. The external input signals control part of the manual functions of X-Y axis. (See the table.)
2st	X	X	D1846[10]	D1926[10]	D2006[10]	
1st-int	X	X	D1846[9]	D1926[9]	D2006[9]	
1st	X	X	D1846[8]	D1926[8]	D2006[8]	
ZRN	X	X	D1846[6]	D1926[6]	D2006[6]	
MPG	X	X	D1846[5]	D1926[5]	D2006[5]	
V-speed	X	X	D1846[4]	D1926[4]	D2006[4]	
Jog-	X	X	D1846[3]	D1926[3]	D2006[3]	
Jog+	X	X	D1846[2]	D1926[2]	D2006[2]	
Start	X	X	D1846[1]	D1926[1]	D2006[1]	
Stop	X	X	D1846[0]	D1926[0]	D2006[0]	

ZRN	X Axis D1875	Xn~Xn+3 are 4 continuous input signals H0110= x10~x13
MPG		
Jog -	Y-Axis D1955	
Jog+		

- External input signal polarity setting

Setting corresponding bit # =0 or 1 will change its polarity (Default = 0 = A contact)

Setting up input polarity

D1799 X & Y Axis				D1804 Z Axis	
bit#	Fn of X Axis	bit#	Fn of Y Axis	bit#	Fn of X Axis
0	PG0	8	PG0	0	PG0
1	MPGB	9	MPGB	1	MPGB
2	MPGA	10	MPGA	2	MPGA
3	LSN	11	LSN	3	LSN
4	LSP	12	LSP	4	LSP
5	DOG	13	DOG	5	DOG
6	STOP	14	STOP	6	STOP
7	START	15	START	7	START

Bit # On indicates there is input signal

Reading the status of input terminal

D1800 Input status				D1805 Input status	
bit#	X axis	bit#	Y axis	bit#	Z axis
0	PG0	8	PG0	0	PG0
:	:	:	:	:	:
7	START	15	START	7	START

- Setting up X-Y-Z axis parameter

  Setting up unit, multiplication and pulse type

D1816 D1896 D1976					
bit#	X-Y-Z parameter setting		bit#	X-Y-Z parameter setting	
0	**Unit**	*1	8	Zero return direction	*4
1			9	Zero return mode	*4
2	**Multiplication** of position data	*2	10	Detecting DOG falling edge in zero return	*4
3			11	Pulse rotation direction	*4
4	**Pulse** type	*3	12	Relative/absolute coordinate	*4
5			13	DOG trigger mode	*4
6			14	Selecting curve	*4
7			15		

		*1			*2			*3
b1	b0	Unit	b3	b2	Multiplication	b5	b4	Pulse type
0	0	Motor	0	0	10^0	0	0	CW/ CCW
0	1	Machine	0	1	10^1	0	1	Pulse + direction
1	0	Combined	1	0	10^2	1	0	A/B phase pulse
1	1		1	1	10^3	1	1	

	Motor	Combined	Machine
Position	pulse	um	
	pulse	m deg	
	pulse	10^{-4}inch	
Speed	pulse/sec		cm/min
	pulse/sec		10deg/min
	pulse/sec		inch/min

- Setting up X-Y-Z axis parameter

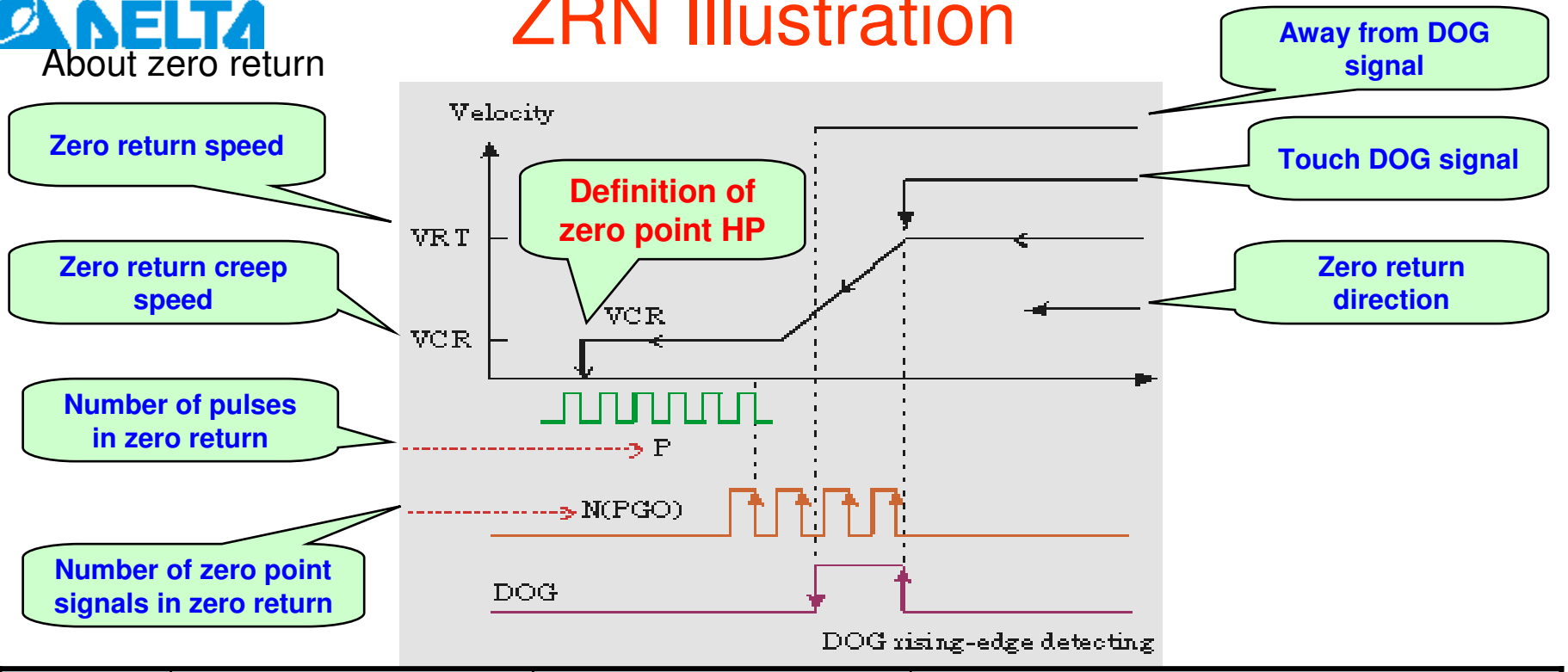
D1816 D1896 D1976 Bit #8~15

*4

bit#	Fn	Explanation
8	Zero return direction	b[8]=0: Decreasing current position (CP) towards to zero b[8]=1: Increasing current position (CP) towards to zero
9	Zero return mode	b[9]=0: Normal mode; b[9]=1: Overwrite mode
10	DOG detecting mode	b[10]=0: Detecting DOG falling edge in zero return b[10]=1: Detecting DOG rising edge in zero return
11	Pulse rotation direction	b[11]=0: Increasing current position (CP) when in forward running b[11]=1: Decreasing current position (CP) when in forward running
12	Absolute Relative	B[12]=0: Absolute coordinate positioning B[12]=1: Relative coordinate positioning
13	DOG trigger mode	b[13]=0: Rising edge trigger b[13]=1: Falling edge trigger （Valid for Inserting single-speed positioning mode and 2-speed positioning mode)
14	Curve selection	b[14]=0: Trapezoid curve acceleration; b[14]=1: S curve acceleration
15	N/A	

ZRN Illustration

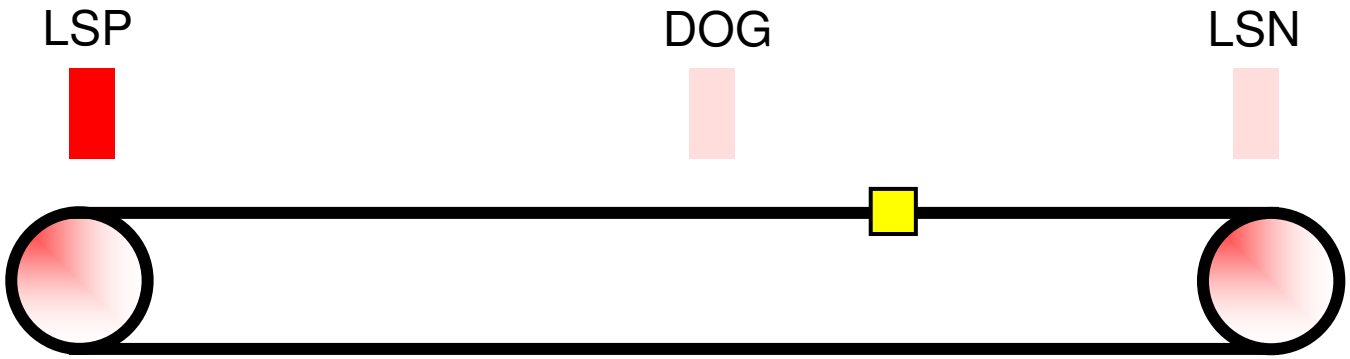
About zero return



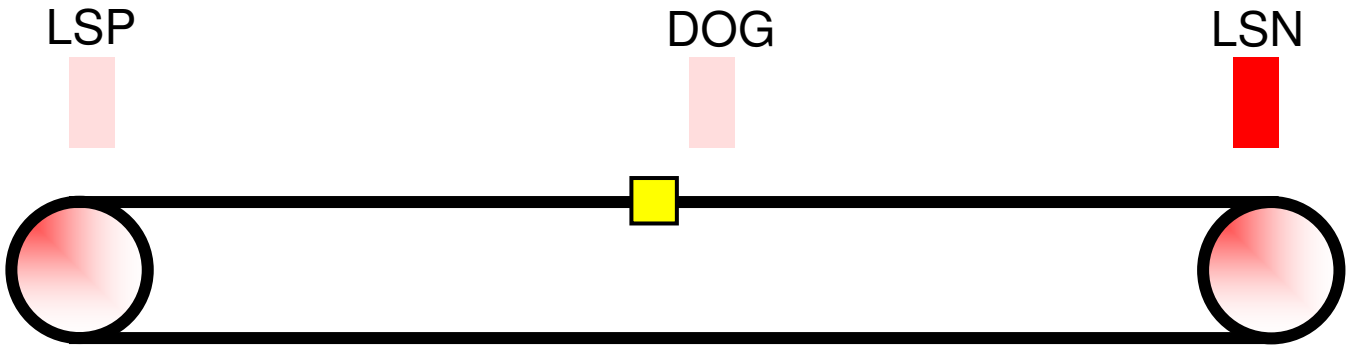
Symbol	Function	Register X Y Z	Explanation
V_{RT}	**Zero return speed**	**DD1828/ DD1908/ DD1988**	1. Range: 0 ~ +2,147,483,647, corresponding to number of pulses 10 ~ 500K 2. Modification is not allowed during the execution.
V_{CR}	**Zero return creep speed**	**DD1830/ DD1910/ DD1990**	
(PG0) N	**Number of PG0 signals in zero return**	**D1832 / D1912/ D1922**	Range: -32,768 ~ 32,767（PULSE）
P	**Number of pulses in zero return**	**D1833/ D1913/ D1993**	
HP	**Definition of zero point HP**	**DD1834/ DD1914/ DD1944**	Range: 0~+/- 999,999

D1816 D1896 D1976 bit8 Zero return direction

Bit8 =1



Bit8 =0

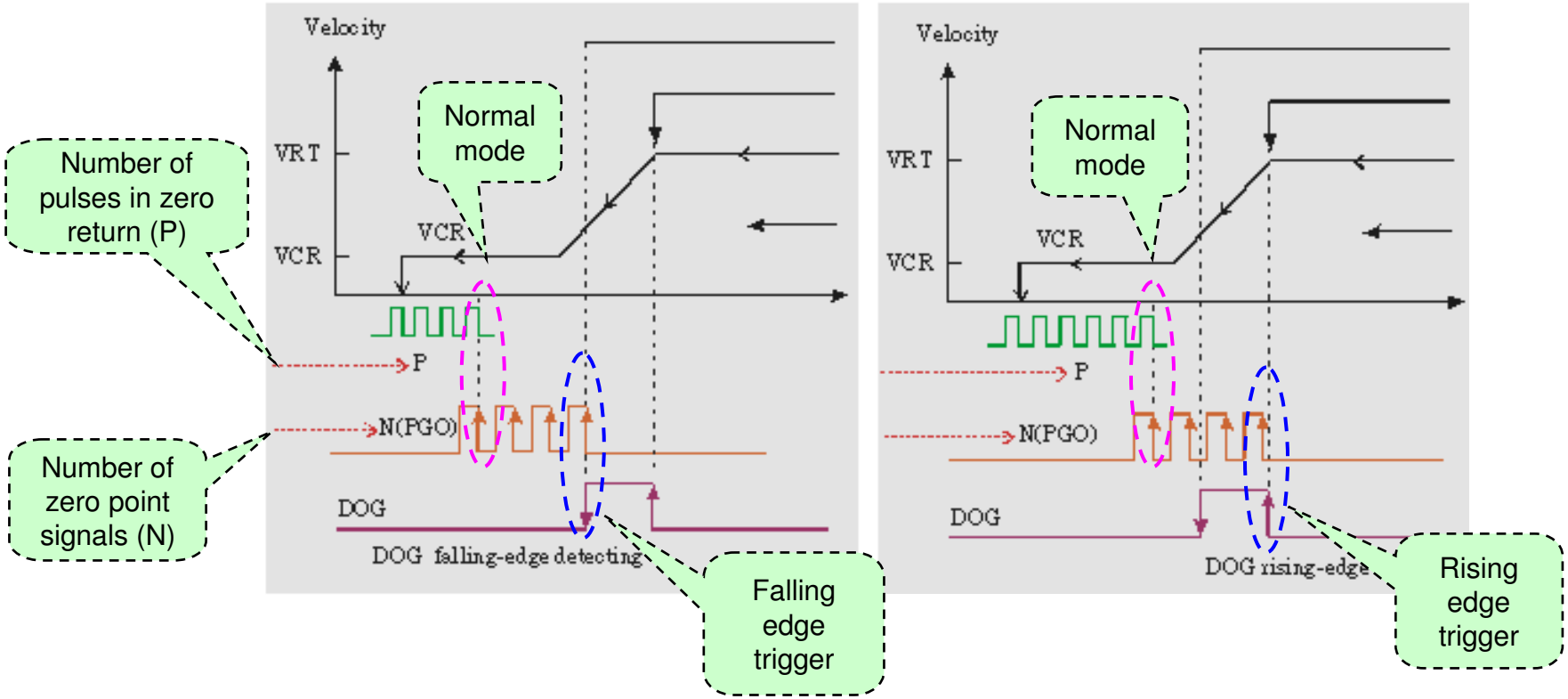


D1816 D1896 D1976 bit 9 bit 10

b9: zero return mode =>b9=0 normal mode.

b10: DOG detecting mode =>b10=0  b10=1 

b9:b10=0:0



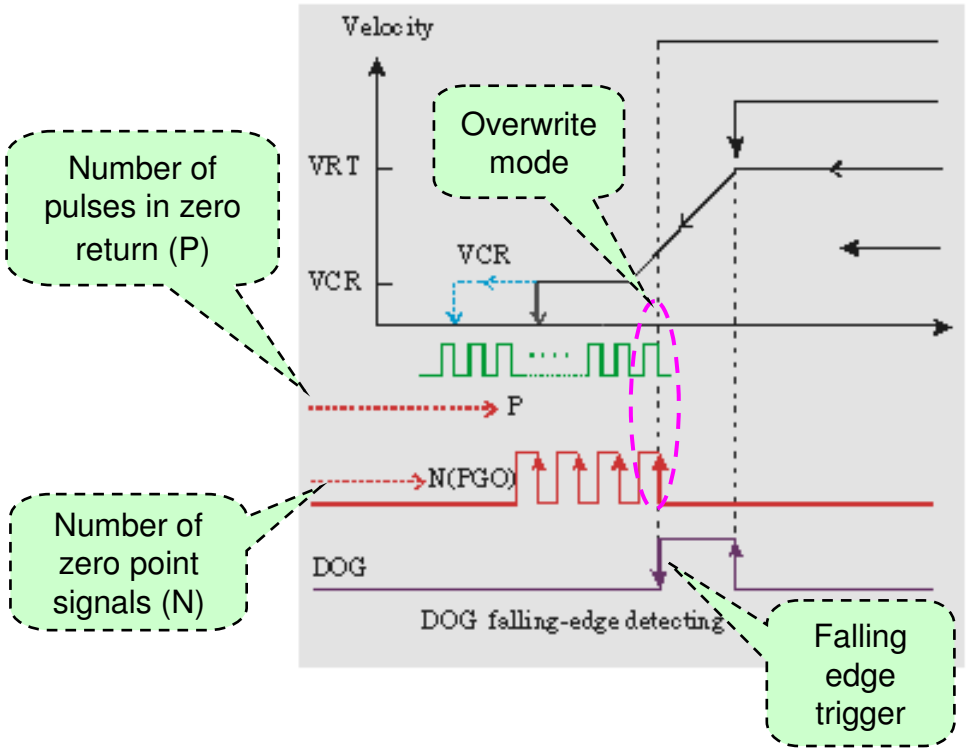
b9:b10=0:1

D1816 D1896 D1976 bit 9 bit 10

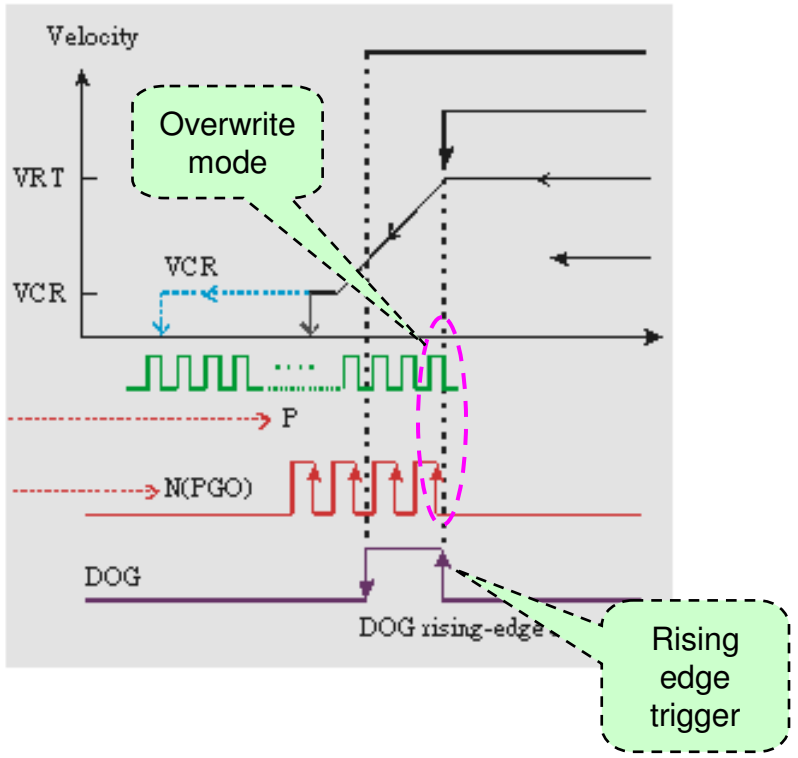
b9: zero return mode =>b9=1 overwrite mode.

b10: DOG detecting mode =>b10=0 b10=1

b9:b10=1:0

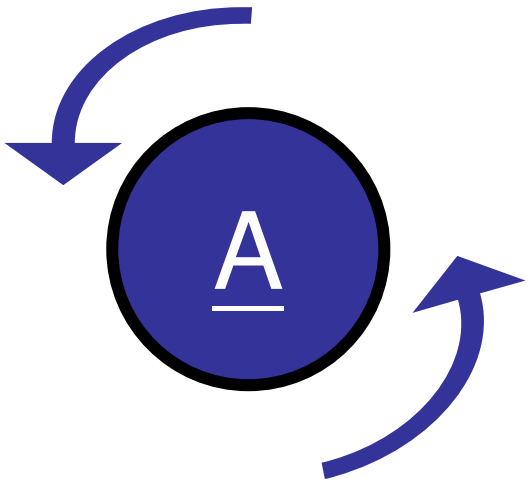


b9:b10=1:1

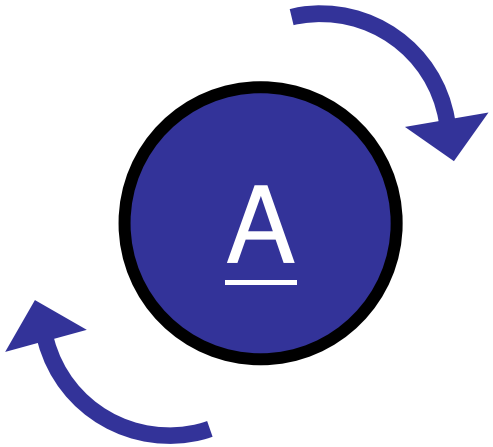


D1816 D1896 D1976 bit 11 Pulse output direction (rotation direction)

b11=0



b11=1

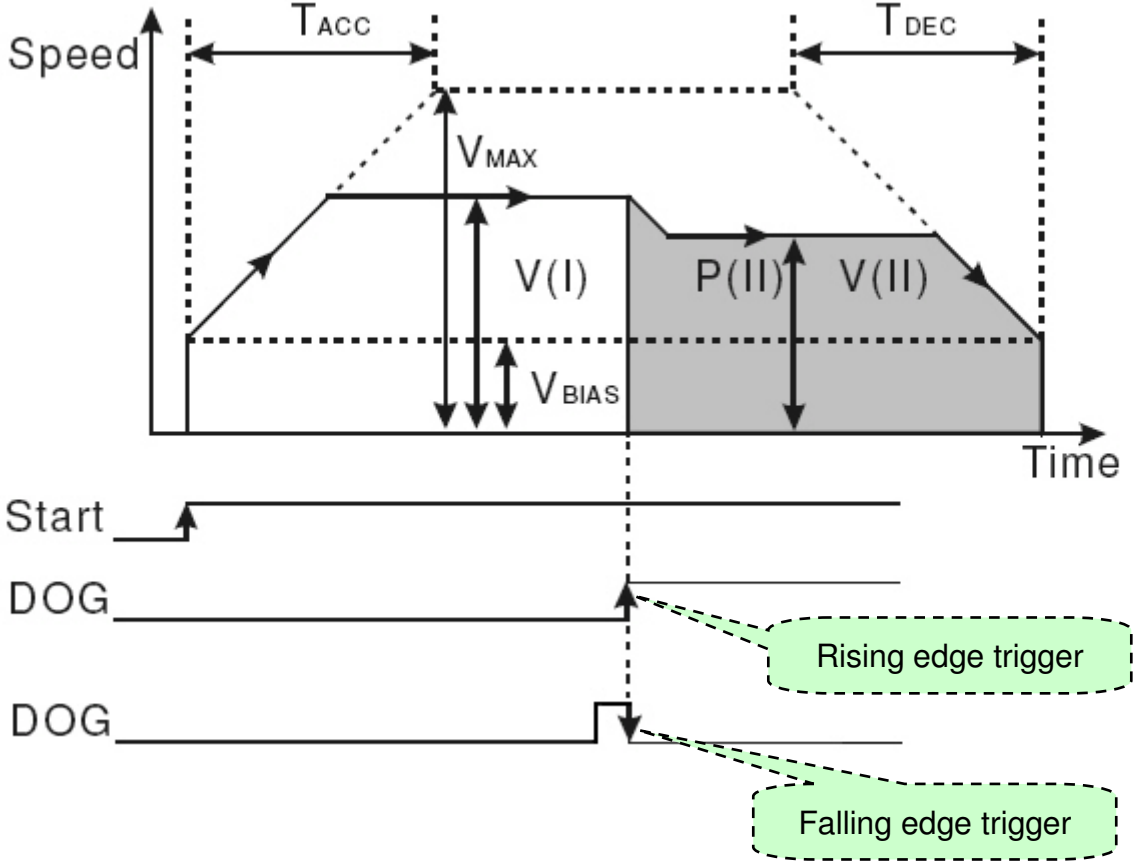


PS: Current position (CP) increases or decrease

D1816 D1896 D1976 bit 13 DOG trigger mode

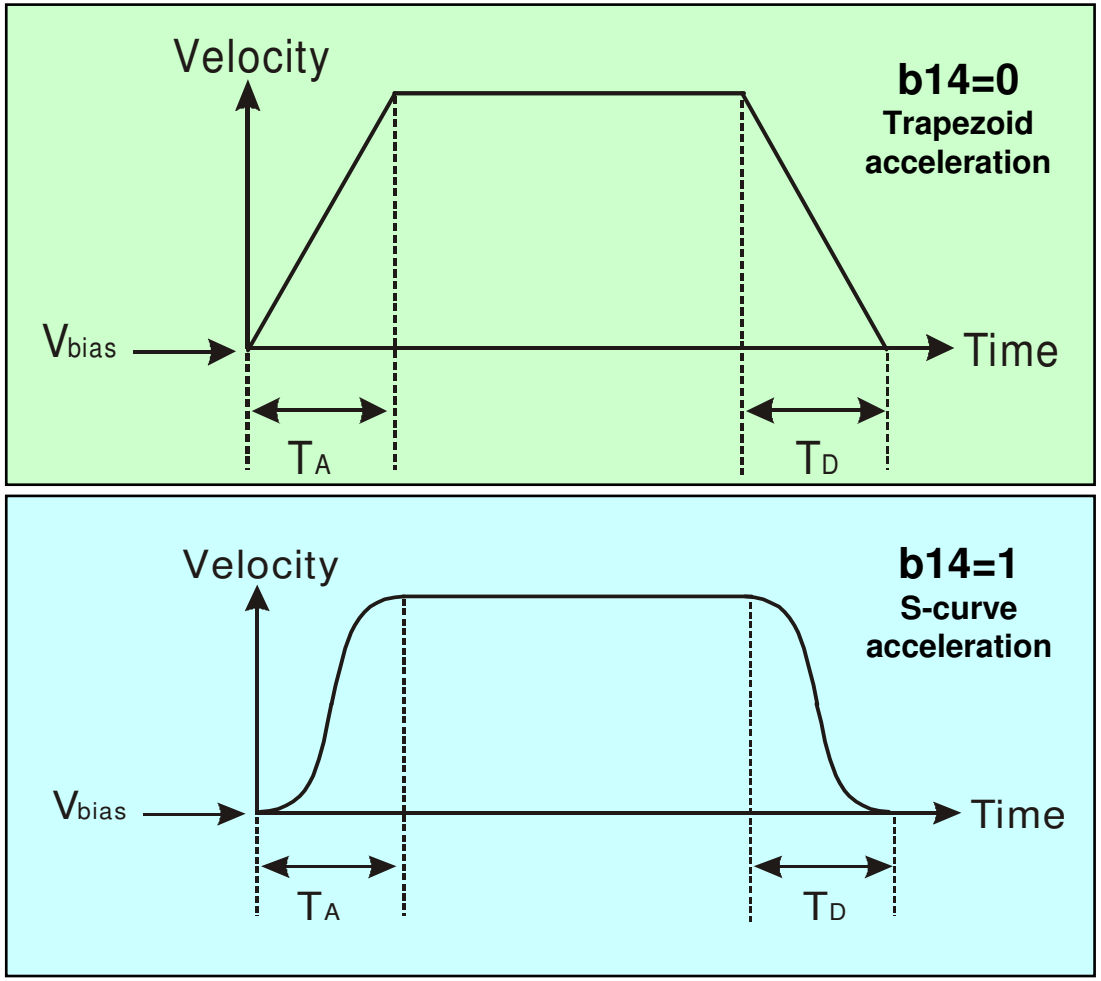
b13: DOG trigger mode =>b13 =0 b13=1

Valid for inserting single-speed positioning and 2-speed positioning mode



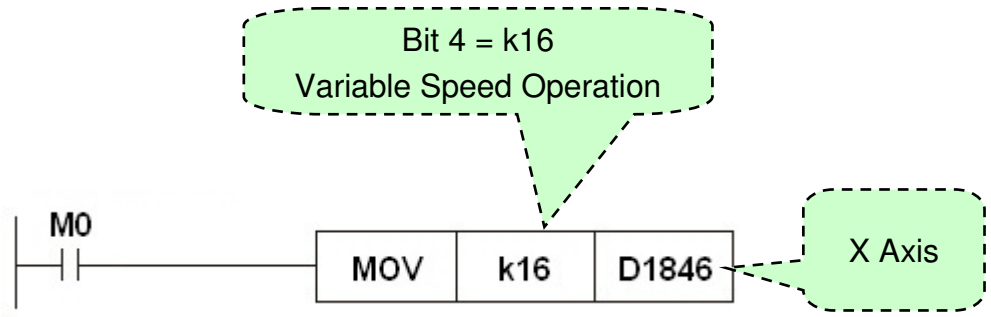
D1816 D1896 D1976 bit 14 Curve selection

b14= 0 Trapezoid acceleration b14= 1 S-curve acceleration



- X-Y-Z Operation setting

D1846 D1926 D2006			
Bit 0	Software STOP	Bit 8	Enable single-speed positioning
Bit 1	Software Start	Bit 9	Enable inserting single-speed positioning
Bit 2	JOG+ Operation	bit10	Enable 2-speed positioning
Bit 3	JOG - Operation	Bit 11	Enable inserting 2-speed positioning
Bit 4	Variable Speed Operation	Bit 12	0: Stop OXn ; 1 Start Oxn
Bit 5	MPG input Operation	Bit 13	Synchronous CAM
Bit 6	Enable Zero Return Mode	Bit 14	Asynchronous CAM
Bit 7	N/A	Bit 15	N/A



- Parameter setting for X-Y-Z operation

D1847 D1927 D2007 for X Y X axis		
Bit 2	CLR signal output mode	When b[2] = 0, CLR will output 130ms signal to Servo when the zero return is completed as the clear signal for the error counter in Servo. When b[2] = 1, CLR will be a general output point, and its status will be controlled by On/Off of b[3].
Bit 3	CLR output On/Off control	When b[3] = 0, output point CLR will be Off. When b[3] = 1, CLR will be On.
Bit 4	CLR polarity setting	When b[4] = 0, CLR signal will be A contact. When b[4] = 1, CLR signal will be B contact.
Bit 5	STOP mode setting	b[5]=0: During the running of motor, when encountering STOP input signal, the motor will decelerate to stop. When the next motion instruction comes in, the motor will ignore the unfinished distance and immediately execute the distance in the next step. b[5]=1: During the running of motor, when encountering STOP input signal, the motor will decelerate to stop. When the next motion instruction comes in, the motor will complete the unfinished distance before executing the next positioning step.
Bit 6	Range for MPG	b[6]=0: No limitation on MPG pulse input b[6]=1: The range for MPG pulse output is limited within P(I and P(II). When the range is exceeded, the pulse will stop.
Bit 7	LSP/LSN stop mode	b[7]=0: During the running of motor, the motor decelerates to stop when encountering LSP/LSN signal input. b[7]=1: During the running of motor, the motor stops immediately when encountering LSP/LSN signal input.
Bit 8 ~ 10	MASK selection	MASK settings (single-speed positioning, 2-speed positioning, inserting single-speed positioning, inserting 2-speed positioning) b[10~8]=K0（000）or other values: No MASK function b[10~8]=K1（001）: Triggering MASK by the rising edge of input terminal ΦA± b[10~8]=K2（010）: Triggering MASK by the falling edge of input terminal ΦA± b[10~8]=K3（011）: Triggering MASK by the rising edge of input terminal ΦB± b[10~8]=K4（100）: Triggering MASK by the falling edge of input terminal ΦB±
Bit 15	Return to default setting	B [15]=1 Return to default setting (factory setting)

- Status of X-Y-Z operation

D1856 D1936 D2016 X-Y-Z execution status			
bit 0	Forward pulse output in progress	bit 8	Reverse MPG input
1	Reverse pulse output in progress	9	N/A
2	Operation in progress	10	N/A
3	Error occurs	11	N/A
4	Operation pauses	12	N/A
5	Error occurs	13	N/A
6	Operation pauses	14	N/A
7	Forward MPG input	15	N/A

- Error code for X-Y-Z axis Operation

(1) Error of O100 → M1953 D1802 D1803

(2) Error of OXn

Motion axis	X	Y	Z
Error flag	M1973	M1873	M2033
Error register	D1857	D1937	D2017

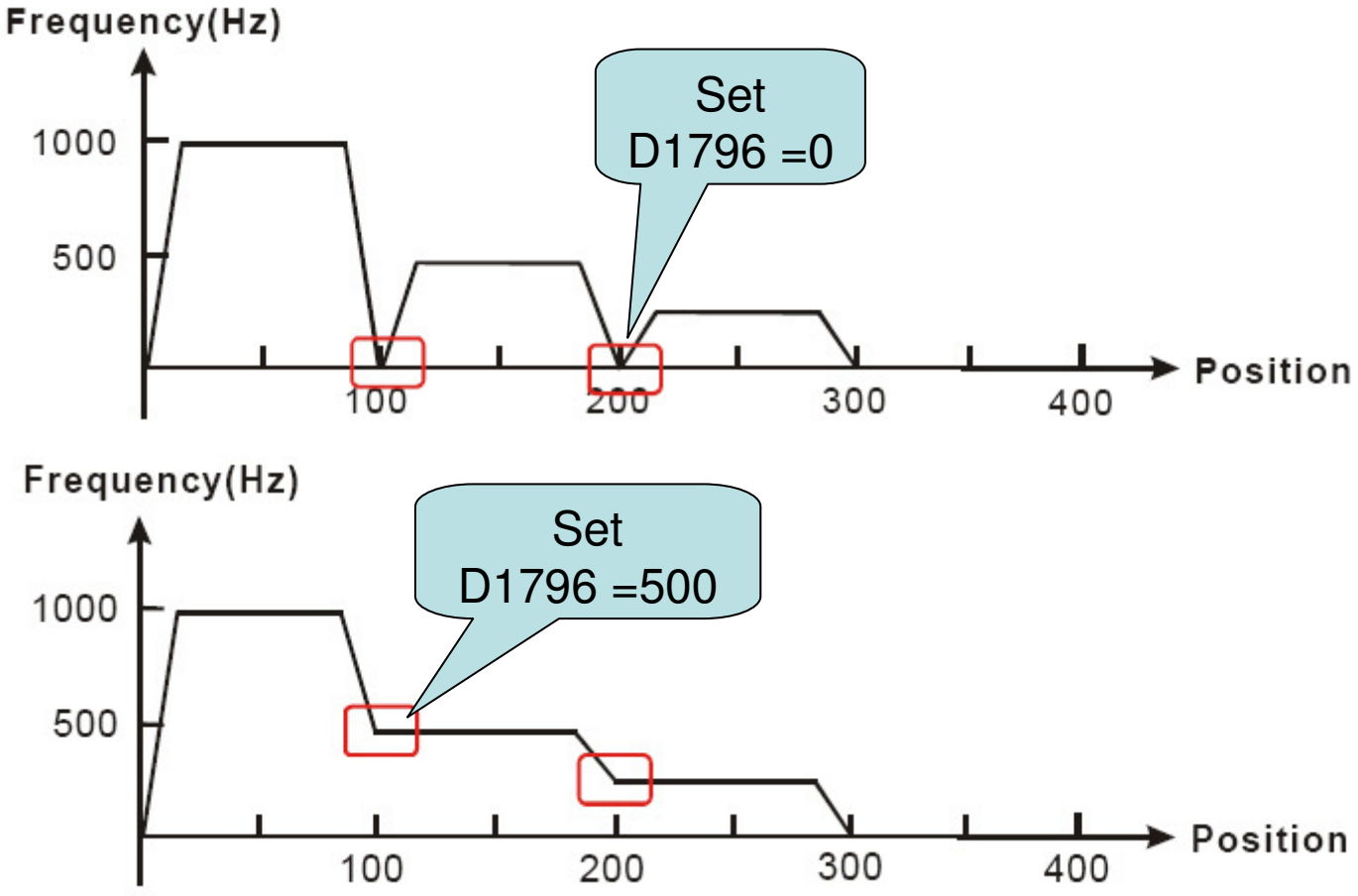
(3) Error code table

Code	Cause	Code	Cause
0011	Incorrect target position (I)	0031	Forward pulse is forbidden
0012	Incorrect target position (II)	0032	Reverse pulse is forbidden
0021	Incorrect operation speed (I)	0033	Left/right limit is reached
0022	Incorrect operation speed (II)	0040	Incorrect range of the device in use
0023	Incorrect zero return deceleration speed V_{RT}	0044	Incorrect V/Z modification
0024	Incorrect zero return deceleration speed V_{CR}	0045	Incorrect floating point conversion
0025	Incorrect JOG speed		

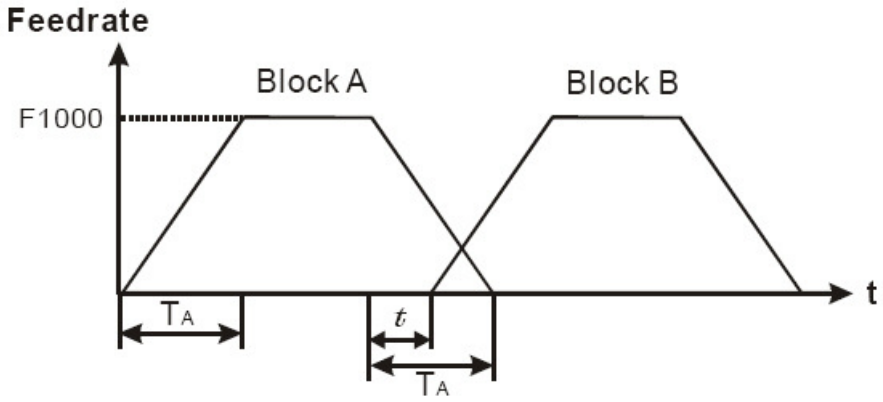
- Continuous path function

  D1796: only avail for G01/G02/G03/LIN/CW/CCW

  M1036: to let application instruction have continuous path function

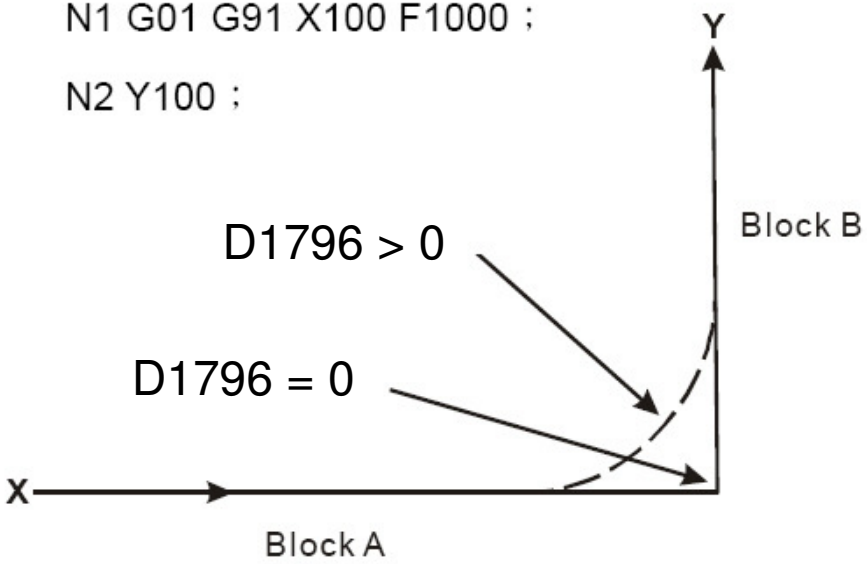


- Illustration of continuous path function



N1 G01 G91 X100 F1000 ;

N2 Y100 ;

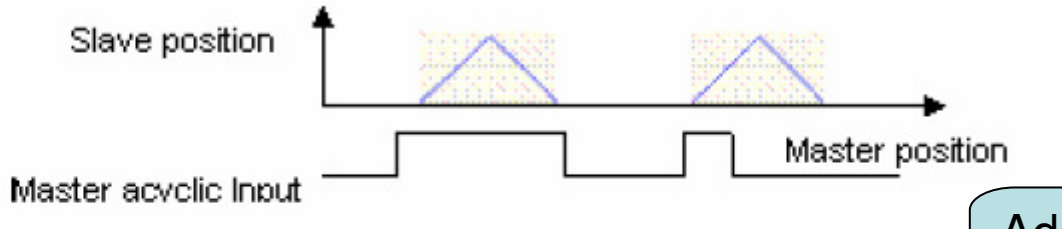


E-CAM

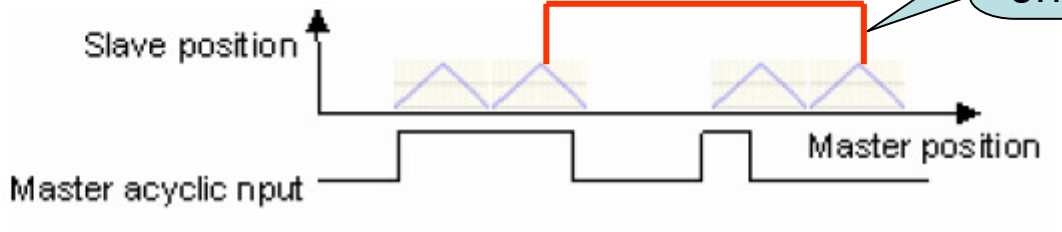
CAM repeat count Fn

If D1832 = H8000 (Bit 15=1), E-CAM will become periodical CAM

D1832 = 0



D1832 = 1



Additional one Cam

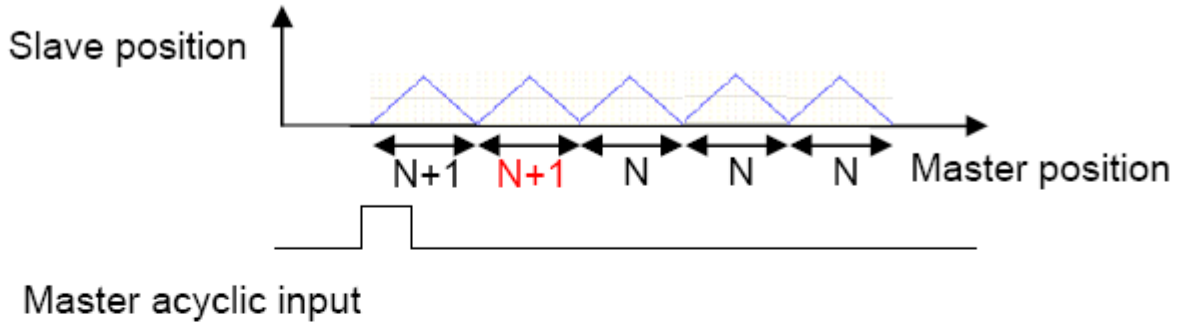
E-CAM

CAM Remainder

Ex1: Master axis = 202 pls
Slave axis = 40 pls
Remainder = 2 pls

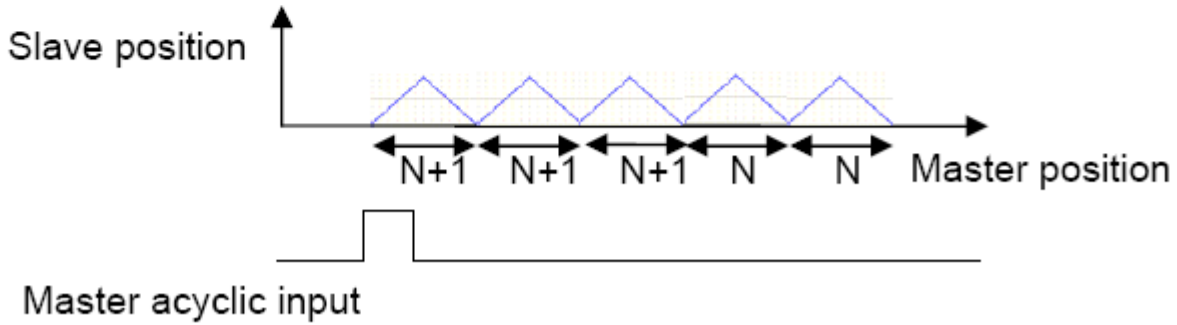
D1832=4，D1833=2

Additional 4 Cam



Ex2: Master axis = 203 pls
Slave axis = 40 pls
Remainder = 3 pls

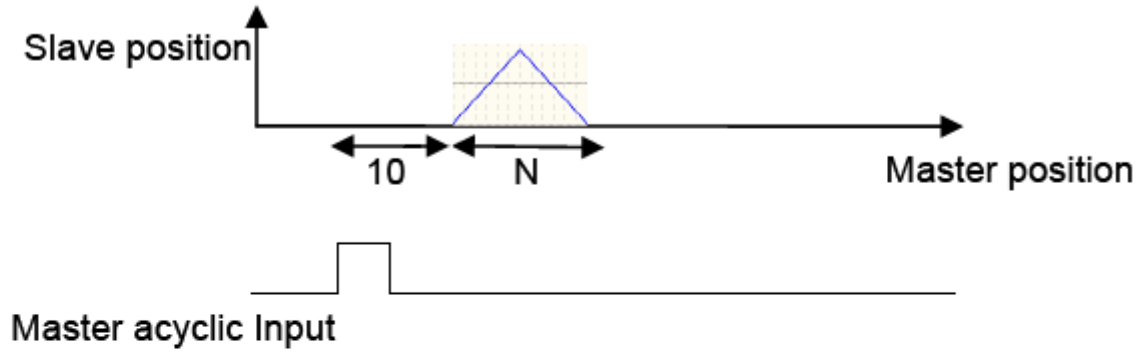
D1832=4，D1833=3



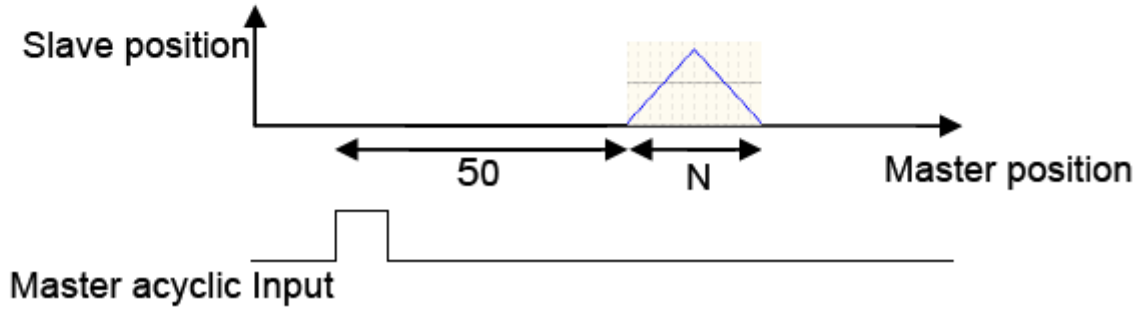
E-CAM

CAM Offset

D1834=10



D1834=50



The most common used parameters of PM

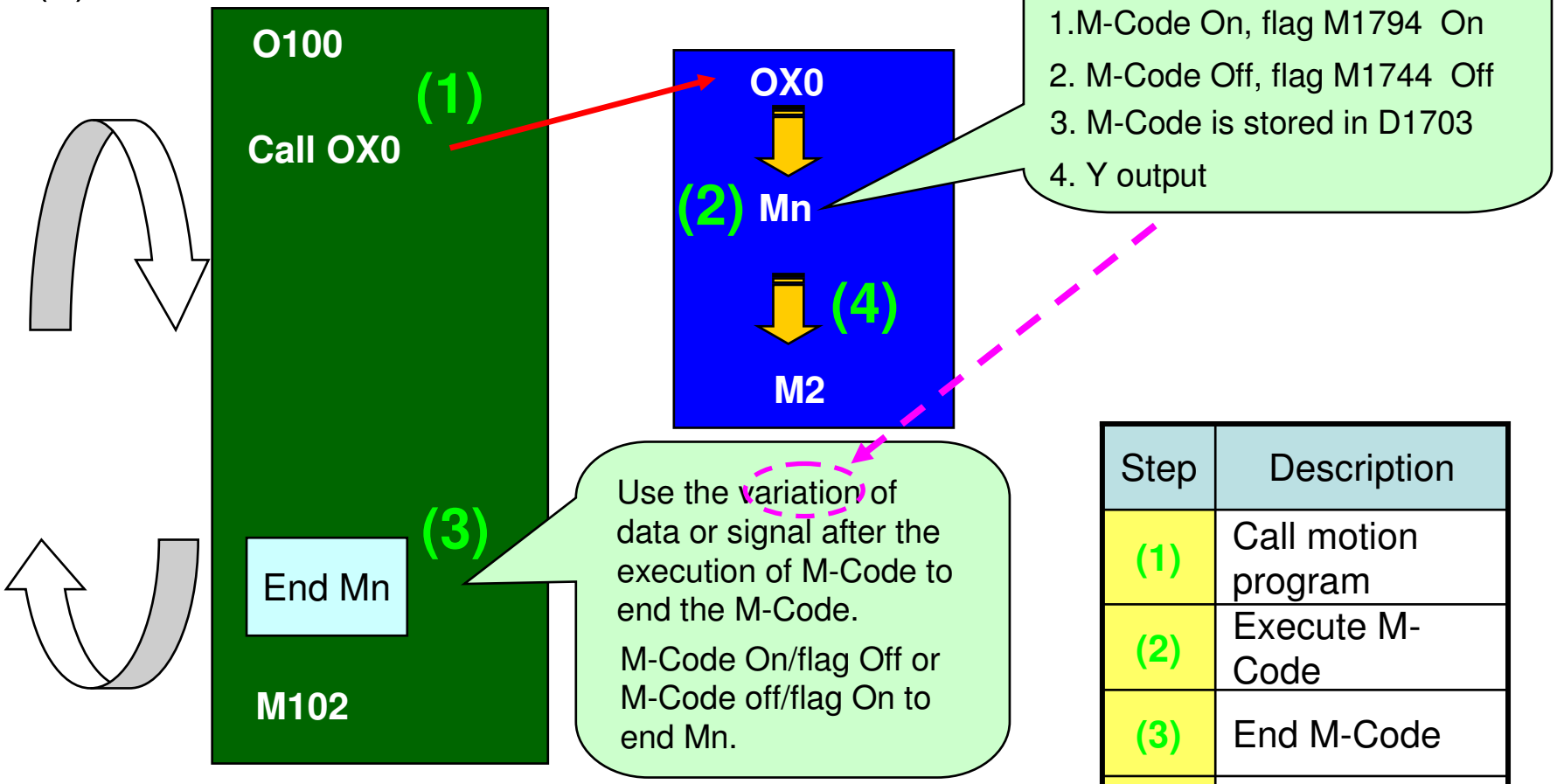
Special D						Contents	Range	Default setting
X Axiz		Y Axis		Z Axis				
HW*1	LW*1	HW	LW	HW	LW			
	D1816		D1896		D1976	Parameter setting	b0 ~ b15	H0
D1819	D1818	D1899	D1898	D1979	D1978	# of pulses required per revolution of the Motor (A)	1 ~ +2,147,483,647 PLS/REV	K2,000
D1821	D1820	D1901	D1900	D1981	D1980	Distance created for 1 motor revolution (B)	1 ~ +2,147,483,647 *2	K1,000
D1823	D1822	D1903	D1902	D1983	D1982	Maximum speed	0 ~ +2,147,483,647 *3	K500,000
D1825	D1824	D1905	D1904	D1985	D1984	Bias speed	0 ~ +2,147,483,647 *3	K0
D1827	D1826	D1907	D1906	D1987	D1986	JOG speed VJOG	0 ~ +2,147,483,647 *3	K5,000
D1829	D1828	D1909	D1908	D1989	D1988	Zero return speed VRT	0 ~ +2,147,483,647 *3	K50,000
D1831	D1830	D1911	D1910	D1991	D1990	Zero return deceleration speed VCR	0 ~ +2,147,483,647 *3	K1,000
	D1832		D1912		D1992	Number of PG0 signals N	0 ~ +32,767 PLS	K0
	D1833		D1913		D1993	Number of pulse signals P	-32,768 ~ +32,767 PLS	K0
D1835	D1834	D1915	D1914	D1995	D1994	Definition of zero point HP	0 ~ ±999,999 *1	K0
	D1836		D1916		D1996	Acceleration time TACC	10 ~ +32,767 ms	K100
	D1837		D1917		D1997	Deceleration time TDEC	10 ~ +32,767 ms	K100
D1839	D1838	D1919	D1918	D1999	D1998	Target position (I) P(I)	-2,147,483,648 ~ +2,147,483,647 *1	K0
D1841	D1840	D1921	D1920	D2001	D2000	Operation speed (I) V(I)	-2,147,483,648 ~ +2,147,483,647 *1	K1000
D1843	D1842	D1923	D1922	D2003	D2002	Target position (II) P(II)	-2,147,483,648 ~ +2,147,483,647 *1	K0
D1845	D1844	D1925	D1924	D2005	D2004	Operation speed (II) V(II)	0 ~ +2,147,483,647 *2	K2,000

The most common used parameters of PM

Special D						Contents	Range	Default setting
X Axiz		Y Axis		Z Axis				
HW*1	LW*1	HW	LW	HW	LW			
	D1846		D1926		D2006	Operation instruction	b0 ~ b15	H0
	D1847		D1927		D2007	Work mode	b0 ~ b15	H0
D1849	D1848	D1929	D1928	D2009	D2008	Current position CP (PLS)	-2,147,483,648 ~ +2,147,483,647 *1	K0
D1851	D1850	D1931	D1930	D2011	D2010	Current speed CS (PPS)	0 ~ +2,147,483,647 PPS	K0
D1853	D1852	D1933	D1932	D2013	D2012	Current position CP (unit *2)	-2,147,483,648 ~ +2,147,483,647 *1	K0
D1855	D1854	D1935	D1934	D2015	D2014	Current speed CS (unit *2)	0 ~ +2,147,483,647 PPS	K0
	D1856		D1936		D2016	Execution status	b0 ~ b15	H0
	D1857		D1937		D2017	Error code		H0
	D1858		D1938		D2018	Electronic gear (numerator)	1 ~ +32,767	K1
	D1859		D1939		D2019	Electronic gear (denominator)	1 ~ +32,767	K1
D1861	D1860	D1941	D1940	D2021	D2020	MPG input frequency		K0
D1863	D1862	D1943	D1942	D2023	D2022	Accumulated # of MPG input pulses		K0
	D1864		D1944		D2024	Response speed of MPG input		K5
D1865						Stop mode		K0
D1867	D1866	D1947	D1946	D2027	D2026	Electrical HP		K0
D1868						OX program selection		K0
D1869						Steps of OX Error		K0
D1872						Ready flag		K0
D1873						M code output		K0
D1874						Input X # for M code off		K0
D1875		D1955				External input for ZRN, MPG, JOG+/-		K0

Use of M-Code

(1) Execution of M-Code



Step	Description
(1)	Call motion program
(2)	Execute M-Code
(3)	End M-Code
(4)	Execute the next program

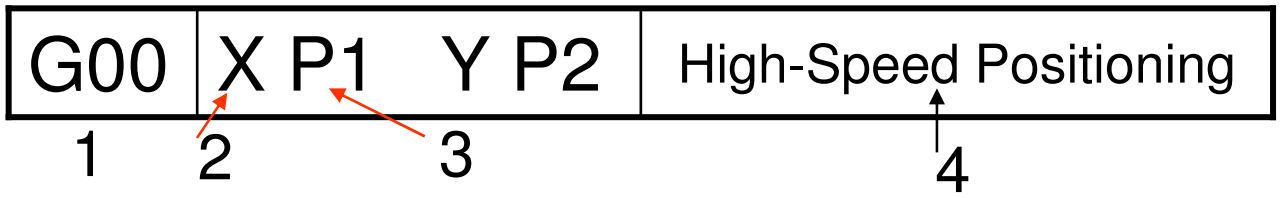
G-Code & Motion Instructions

G-Code & Motion Instruction		
G-Code	**Motion instruction**	**Function**
G00 (cannot define speed)	**DRV (Speed can be designated)**	**High-speed positioning**
G01	**LIN**	**2-axis synchronous linear interpolation**
G02	**CW**	**Clockwise arc movement (set the position of the center)**
G03	**CCW**	**Counterclockwise arc movement (set the position of the center)**
G02	**CW**	**Clockwise arc movement (set the radius)**
G03	**CCW**	**Counterclockwise arc movement (set the radius)**
G04	**TIM**	**Pause time**
G90	**ABS**	**Set up absolute coordinate system**
G91	**INC**	**Set up relative coordinate system**

Motion Instructions

Motion Instruction List			
Instruction	Function	Instruction	Function
DRV	High-speed positioning	INTR	2-axis synchronous single-speed interpolation (ignore the remaining distance)
LIN	2-axis synchronous linear interpolation	SINTR	Inserting single-speed
CW	Clockwise arc movement (set the position of the center)	DINTR	Inserting 2-speed
CCW	Counterclockwise arc movement (set the position of the center)	MOVC	Set up linear movement compensation
CW	Clockwise arc movement (set the radius)	CNTC	Arc center compensation
CCW	Counterclockwise arc movement (set the radius)	RADC	Arc radius compensation
TIM	Pause time	CANC	Cancel motion compensation
DRVZ	Return to mechanical zero point (zero return)	ABST	Set up absolute coordinate system
SETR	Set up electrical zero point	INCT	Set up relative coordinate system
DRVR	Return to electrical zero point	SETT	Set up current position

How to Use G-Code



1) G-Code instruction No.

2) Motion instruction operand

3) Parameter value of the motion instruction operand

4) Function of motion instruction

Explanation:

(1) Many functions can be placed in the same row in a program:G91G01 X100.0 Y300.0 F500.0 M8

G91G01 relative coordinate and fast positioning

(2) The last instruction of the same group in the same row is the most significant G02 G00 G03 G01 X100.0 Y300.0 F500.0; => G01 X100.0 Y300.0 F500.0;

(3) Fast movement instruction (G00) does not need to use parameter V_{MAX}: G00 X100.2 Y500.0;

(4) Fast movement (G00) and linear interpolation (G01) instructions are extendable

N0000 G00 X500.0 Y125.0;

N0001 X-400.0 Y-500.0;=> G00 X-400.0 Y-500.0;

N0002 G01 X100.0 Y25.0 F200.0;

N0003 X-200.0 Y50.0;=> G01 X-200.0 Y50.0 F200.0;

(5) Speed parameter F of G01 G02 G03 is extendable.

N0000 G01 X500.0 Y125.0 F200.0;

N0001 G03 X-40.0 Y-50.0 R100.0;=> G03 X-40.0 Y-50.0 R100. F200.0;

(6) G90 (absolute coordinate) and G91 (relative coordinate) have the highest priority

G01G90 X100.0 Y300.0 F500.0;=> G90 G01 X100.0 Y300.0 F500.0;

(7) Program codes with or without blank are all recognizable.

G01G91X500.0 Y125.0F200.0; => G01 G91 X500.0 Y125.0 F200.0;

(8) The coordinate and speed are all converted to 32 bits.

G01 X-125.5 F200.0; => G01 X-125500 F200000;

(9) Unit of pause instruction: 10ms

G04 X4.5 (pauses for 4.5 seconds). => TIM 450;

(10) Ignore the G-Codes which is not supported

G21G54G01 X-125.5 F200.0;=> G01 X-125500 F200000;

Motion Instruction DRV

MON	DRV X_{P1}, F_{V1},Y_{P2},F_{V2}	High-Speed Positioning
00	**P_1**: Target position for X axis **V_1**: Moving speed of X axis **P_2**: Target position for Y axis **V_2**: Moving speed of Y axis (does not support Z axis)	

	Word			Double word			D0 ~ D9998 K (-32,768 ~ 32,767), H (0 ~ FFFF), D (0 ~ 9999), occupying 16 bits; KK (-2,147,483,648 ~ 2,147,483,647), HH (0 ~ FFFFFFFF), DD (0 ~ 9998), occupying 32 bits.
P1	H	K	D	HH	KK	DD	
V1	H	K	D	HH	KK	DD	
P2	H	K	D	HH	KK	DD	
V2	H	K	D	HH	KK	DD	

- **Acceleration/deceleration time setting: D1386 (X-acceleration), D1387 (X-deceleration), D1916 (Y-acceleration), D1917 (Y-deceleration)**
- **Start frequency of X axis: D1825 (high word), D1824 (low word)**
- **Start frequency of Y axis: D1905 (high word), D1904 (low word)**
- **Example: DRV XK13.57 F100 YK24.68 F100 (point-to-point control)**
- **Instructions: 000 OX1, 0001 DRV X13.57 F100 Y24.68 F100 , 0002 M2**

Motion Instruction LIN

MON	LIN X_{P1}, Y_{P2},F_V	2-axis Synchronous Linear Interpolation
01	**P_1**: Target position for X axis **P_2**: Target position for Y axis **V**: Speed for 2-axis linear interpolation	

	Word			Double word			D0 ~ D9998 K (-32,768 ~ 32,767), H (0 ~ FFFF), D (0 ~ 9999), occupying 16 bits; KK (-2,147,483,648 ~ 2,147,483,647), HH (0 ~ FFFFFFFF), DD (0 ~ 9998), occupying 32 bits
P1	H	K	D	HH	KK	DD	
P2	H	K	D	HH	KK	DD	
V	H	K	D	HH	KK	DD	

- **Acceleration/deceleration time: D1386 (X-acceleration), D1387 (X-deceleration), D1916 (Y-acceleration), D1917 (Y-deceleration)**
- **Monitoring operation speed by special register: X axis: D1850 ~ D1851; Y axis: D1930 ~ D1931**
- **Example: LIN XK289.998 YK138.167 F200.0 (point-to-point linear interpolation)**
- **Instructions: 000 OX1, 0001 LIN X289.998 YK138..167 F200.0 , 0002 M2**

Motion Instruction CW/CCW

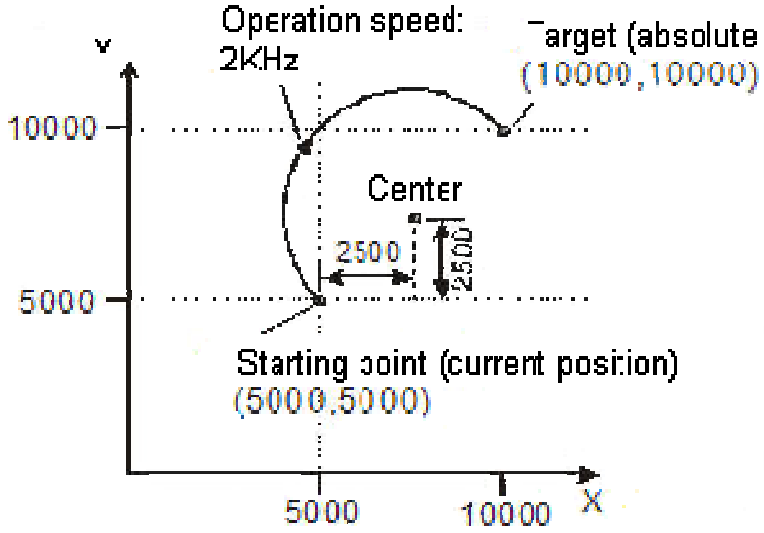
MON	CW(CCW) X_{P1}, Y_{P2},I_{P3} ,J_{p4},F_V	**Clockwise/Counter-clockwise Arc Movement (Setting Up Position Of Center)**
02 03	**XP_1**: Target position for arc on X axis **YP_2**: Target position for arc on Y axis **IP_3**: Center position of arc on X axis **JP_4**: Center position of arc on Y axis **FV**: Arc interpolation speed	

	Word			Double word			D0 ~ D9998 K (-32,768 ~ 32,767), H (0 ~ FFFF), D (0 ~ 9999), occupying 16 bits; KK (-2,147,483,648 ~ 2,147,483,647), HH (0 ~ FFFFFFFF), DD (0 ~ 9998), occupying 32 bits.
P1	H	K	D	HH	KK	DD	
P2	H	K	D	HH	KK	DD	
I(P3)	H	K	D	HH	KK	DD	
J(p4)	H	K	D	HH	KK	DD	
V	H	K	D	HH	KK	DD	

- **Acceleration/deceleration time: D1386 (X-acceleration), D1387 (X-deceleration), D1916 (Y-acceleration), D1917 (Y-deceleration)**
- **FV: Maximum operation speed 500KHz**

CW/CCW-Example

1. Set up the absolute coordinate at the beginning of the program. From zero point to (X10000.0, Y10000.0), CW is a clockwise arc instruction, ending the arc at (X10000.0 Y1000.0). The center of the arc is at (2500, 2500) relative to the starting point of the arc. The output speed is 2,000Hz.



Compiling motion instruction:

	Compiling G-Code:
Ox1	
DRV X10000.0 Y10000.00 F200.0	G90
LIN Z0.000 F100.0	G1 X10.0 Y10.0
CW X10000.0 Y10000.0 I2500.0 J2500.0 F2000.0	G2 X10.0 Y10.0 I2.5 j2.5
	G0 X1.0 Y1.0
LIN Z000.0 F100.0	G0 X0 Y0
DRV X9000.0 Y9000.0 F200.0	
LIN Z0.000 F100.0	
M2	

Motion Instruction CW/CCW

MON	CW(CCW) X_{P1}, Y_{P2},R_L ,F_V	**Clockwise/Counter clockwise Arc Movement (Setting Up Position Of Radius)**
04 05	**P_1**: Target position for arc on X axis **P_2**: Target position for arc on Y axis **L**: Radius of arc (less than 180 degree) **V**: Speed for arc to move to target position	

	Word			Double word			D0 ~ D9998 K (-32,768 ~ 32,767), H (0 ~ FFFF), D (0 ~ 9999), occupying 16 bits; KK (-2,147,483,648 ~ 2,147,483,647), HH (0 ~ FFFFFFFF), DD (0 ~ 9998), occupying 32 bits.
P1	H	K	D	HH	KK	DD	
P2	H	K	D	HH	KK	DD	
L	H	K	D	HH	KK	DD	
V	H	K	D	HH	KK	DD	

- **Acceleration/deceleration time: D1386 (X-acceleration), D1387 (X-deceleration), D1916 (Y-acceleration), D1917 (Y-deceleration)**
- **FV: Maximum operation speed 500KHz**

CW/CCW & Example

1. Set up the absolute coordinate at the beginning of the program. CW is a clockwise arc instruction, and the arc ends at (1000, 1000). Radius = 500, Arc < 180 degree (+arc), moving with the speed of 1,000 output pulses per second.

Compiling motion instruction:

Ox1

DRV X10000.0 Y10000.00 F200.0

LIN Z0.000 F100.0

CW X10000.0 Y10000.0 R5000.0 F1000.0

LIN Z000.0 F100.0

DRV X9000.0 Y9000.0 F200.0

LIN Z0.000 F100.0

M2

Compiling G-code:

G90

G1 Z0.0000 F200.0

G0 X1000.0 Y1000.0

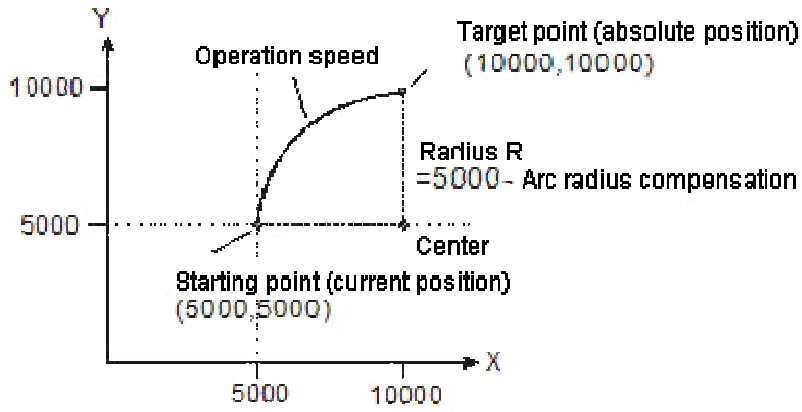
F350.0 G1 Z0.0000

G2 X1000.0 Y1000.0 R250.0

G0 Z1.0000

M07

M2



Motion Instruction TIM

<table>
<tr><td>MON
06</td><td colspan="6">TIM T
Unit: 10ms. K100 refers to pausing for 1 second.</td><td>Pause Time</td></tr>
<tr><td></td><td colspan="3">Word</td><td colspan="3">Double word</td><td rowspan="3"></td></tr>
<tr><td>T</td><td>H</td><td>K</td><td>D</td><td>HH</td><td>KK</td><td>DD</td></tr>
<tr><td colspan="7">D0 ~ D9998, K (-32,768~32,767), H (0 ~ FFFF), D (0 ~ 9999), occupying 16 bits; KK (-2,147,483,648 ~ 2,147,483,647), HH (0 ~ FFFFFFFF), DD (0 ~ 9998), occupying 32 bits.</td></tr>
</table>

Program Example:

- **000 OX0**
- **0001 DRV X13.57 F100 Y24.68 F100 , 0002 M2**
- **0002 TIM 100 (G04 100.0)**
- **LIN X289.998 YK138..167 F200.0**
- **0002 M2**

Motion Instruction DRVZ

MON	DRVZ	**Returning to Mechanical Zero Point (Zero Return)**
07		

1. Before enabling DRVZ instruction, you have to set up relevant parameters first.

   a. Zero return speed V_{RT}

   b. Zero return deceleration speed V_{CR}

   c. Acceleration time

   d. Deceleration time:

   e. Number of zero point signals (PGO) in zero return N

   f. Number of pulses in zero return P

   g. Disabling zero return of X and Y axes

2. The parameters below are set in special registers (X-axis D1816, Y-axis D1896)

   a. Zero return direction (b8); b. Zero return mode (b9); c. Detecting DOG falling edge in zero return (b10)

Motion Instruction SETR

MON	SETR	**Setting Up Electrical Zero Point**
08	When SETR is executed, you can set the current position of X and Y axis as electrical zero point, i.e. moving the content in the current position register into electrical zero point register.	The current position is recorded in D1848(X), D1828(Y).
D1848, D1849: current position of X axis D1828, D1829: current position of Y axis D1866, D1867: electrical zero point on X axis D1946, D1947: electrical zero point on Y axis		

Program Example:

```
▪0000 G90                        0006  G00 X35.0 Y30.0
▪0001 G00 X0.00 Y0.00   /*triangle*/   0007  TIM 300
▪0002 TIM 300                    0008  SETR
▪0003 G01 X1.0 Y1.5 F10.0
▪0004 G00 Z0.0
▪0005 TIM 300
```

Motion Instruction DRVR

MON	DRVR	**Returning to Electrical Zero Point**
09	When DRVR instruction is executed, X and Y axes will return to electrical zero point at maximum speed V_{MAX} (0 ~ 500KHz).	The electrical zero point is the one recorded after SETR is executed. When DRVR is executed, X and Y will return to the previously recorded zero point.
	D1848, D1849: current position of X axis D1828, D1829: current position of Y axis D1866, D1867: electrical zero point on X axis D1946, D1947: electrical zero point on Y axis	

Program Example:

```
▪0000 G90                    0006  G00 X35.0 Y30.0
▪0001 G00 X0.00 Y0.00   /*triangle*/   0007  TIM 300
▪0002 TIM 300                0008  SETR
▪0003 G01 X1.0 Y1.5 F10.0          0009  G01 X20.0 Y45.0 F45.0
 0004 G00 Z0.0               0010  TIM 300
▪0005 TIM 300                0011  DRVR
```

Motion Instruction INTR

MON	INTR X_{P1}, Y_{P2}, V_{MAX}	**2-Axis Synchronous Single-Speed Interpolation**
10	**P_1**: Target position for X axis **P_2**: Target position for Y axis **V**: Speed for 2-axis linear interpolation	

	Word			Double word			The way of using this instruction is the same as using LIN instruction, except that LIN is able to set up stop mode. The interpolation speed can be monitored by special registers. X: D1850 ~ D1851 Y: D1930 ~ D1931
P1	H	K	D	HH	KK	DD	
P2	H	K	D	HH	KK	DD	
V	H	K	D	HH	KK	DD	

Motion Instruction SINTR

MON	SINTR X_{P1}, F_{V1}/Y_{P1} ,F_{V1}	**Inserting Single-Speed Operation**
11	**P_1**: Additional distance on X axis **P_1**: Additional distance on Y axis **V1**: Speed **V**: Max. speed V_{MAX}	

	Word			Double word			X axis accelerates by100ms to the single-speed operation speed 500KHz. When DOG signal is triggered and after the output of 500,000 additional pulses, the positioning will be completed.
P1	H	K	D	HH	KK	DD	
V1	H	K	D	HH	KK	DD	

G90

G00 X0.000 Y0.000

TIM KK300

G01 X1.000 Y1.500 F10.000

SINTR XKK30.0

G00 Z0.000

TIM KK300

G00 X35.000 Y30.000

TIM KK300

SETR

G01 X20.000 Y45.000 F45.000

TIM 300F15.00

G01 X5.0 Y30.0

TIM 300

G01 X35.0

M2

Motion Instruction DINTR

MON	DINTR X_{P1},F_{V1},F_{V2} / Y_{P1},F_{V1},F_{V2}	**Inserting 2-Speed Operation**
12	**P_1**: Target position for X axis **P_2**: Target position for Y axis **V_1**: The first operation speed **V_2**: The second operation speed	

	Word			Double word			When DINTR instruction is enabled, the operation speed will start to accelerate from V_{BIAS} to the first speed V(1) and operate stably. When DOG signal is triggered, it will accelerate to the second speed V(2) and operate by the additional distance. .
P1	H	K	D	HH	KK	DD	
V1	H	K	D	HH	KK	DD	
V2	H	K	D	HH	KK	DD	

```
G90
G00 X0.000 Y0.000
TIM KK300
G01 X1.000 Y1.500 F10.000
G00 Z0.000
TIM KK300
G00 X35.000 Y30.000
TIM KK300
SETR
G01 X20.000 Y45.000 F45.000
TIM 300
DINTR XKK30.0 F20.00  F15.0
G01 X5.0 Y30.0
TIM 300
G01 X35.0
M2
```

Motion Instruction MOVC

MON	MOVC X_{L1} Y_{L2}						**Setting Up Linear Movement Compensation**
13	**L_1**: Compensation for X axis **L_2**: Compensation for Y axis						
	Word			Double word			MOVC is the instruction to add linear compensation into the program. As long as the program has DRV, LIN and INTR instruction, the coordinate value will be accumulated with the value designated in MOVC instruction.
L1	H	K	D	HH	KK	DD	
L2	H	K	D	HH	KK	DD	

```
G90
G00 X0.00 Y0.00
/*triangle*/
TIM 300
G01 X1.0 Y1.5 F10.0
TIM 300
MOVC X1.0 Y1.0
G00 Z0.0
TIM 300
G00 X35.0 Y30.0
TIM 300
G01 X20.0 Y45.0
F45.0
TIM 300
G01 X5.0 Y30.0
TIM 300
G01 X35.0
M2
```

Motion Instruction CNTC

MON	CNTC I_{L1} J_{L2}	**Arc Center Compensation**
14	**L_1**: Center compensation for X axis **L_2**: Center compensation for Y axis	

	Word			Double word			Arc center compensation can be used in CW and CCW instructions. When the compensation value is written into the compensation register and arc instruction is executed, the compensation will be conducted according to the settings. The example below G0 X1.8529 Y1.6315 will accumulate CNTC I1.0 J1.02 into X2.85,Y1.63
L1	H	K	D	HH	KK	DD	
L2	H	K	D	HH	KK	DD	

```
G90
G1 Z0.0000 F100.0
/*circle*/
G0 X50.0 Y50.0
TIM 300
G1 Z0.0000
G2 X50.0 Y50.0 I12.50
j12.50 F300.0
CNTC I1.0 J1.0
G0 Z1.0000
G0 X1.8529 Y1.6315
TIM 300
TIM 300
G0 Z1.0000
G0 X0 Y0
TIM 300
M2
```

Motion Instruction RADC

MON	RADC RL						**Arc Radius Compensation**
15	**L**: Compensation for X-Y arc radius						
L1	H	K	D	HH	KK	D D	

D0 ~ D9998, K (-32,768 ~ 32,767), H (0 ~ FFFF), D (0 ~ 9999), occupying 16 bits; KK (-2,147,483,648 ~ 2,147,483,647), HH (0 ~ FFFFFFFF), DD (0 ~ 9998), occupying 32 bits.	Arc radius compensation can be used in CW and CCW instructions. When the compensation value is written into the compensation register and arc instruction is executed, the compensation will be conducted according to the settings.

```
G90
G00 X0 Y0
/*circle*/
G01 Z10.0 F80.0
G00 X15.0 Y60.0
G00 X15.0 Y15.0
G00 Z5.0
G01 Z-5.5 F80.0
TIM 300
G02 X30.0 Y50.0
R5.0
TIM 300
G02 X15.0 Y15.0 R5.0
RADC R2.0
TIM 300
G00 X0.0 Y0.0
M2
```

Motion Instruction

MON	CANC	Canceling Compensation
16	When CANC instruction is executed, all compensations will be cancelled, i.e. special registers D1708 ~ D1709, D1724 ~ D1725, D1710 ~ D1711, D1726 ~ D1727, and D1712 ~ D1713 will be cleared.	

D1708, D1709: Compensation for X moving distance
D1724, D1725: Compensation for Y moving distance
D1710, D1711: Compensation for the center of X
D1726, D1727: Compensation for the center of Y
D1712, D1713: Compensation for arc radius

MON	**ABST**	**Setting Up Absolute Coordinate**
17		

MON	**INCT**	**Setting Up Relative Coordinate**
18		

Motion Instruction SETT

MON	SETT X_{p1}, Y_{p2} ,	**Setting Up Current Position**
19	**P_1**: Current position of X axis **P_2**: Current position of Y axis	
When SETT is executed, the current position will be automatically written into special registers. X: D1848 ~ D1849; Y: D1928 ~ D1929		

Program Example:

- **G90**
- **G00 X0.00 Y0.00 /*star*/**
- **G01 Z0.000 F200.0**
- **G01 Z10.000**
- **G00 Z12.000**
- **G00 X35.0 Y30.0**
- **TIM 300**
- **G01 Z0.000**
- **G01 X27.5 Y45.0**
- **G01 X20.0 Y30.0**

```
SETR
TIM 300
G01 X35.0
G01 Z10.000
G00 Z12.000
G00 X35.0 Y37.5
TIM 200
SETT X10.0 Y11.0
```

```
TIM 300
G01 Z0.0
G01 X20.0 Y37.5
G01 X27.5 Y22.5
TIM 300

G01 X35.0  Y37.5
G01 Z12.0
```

Thank you