ELECTRONICA INDUSTRIAL

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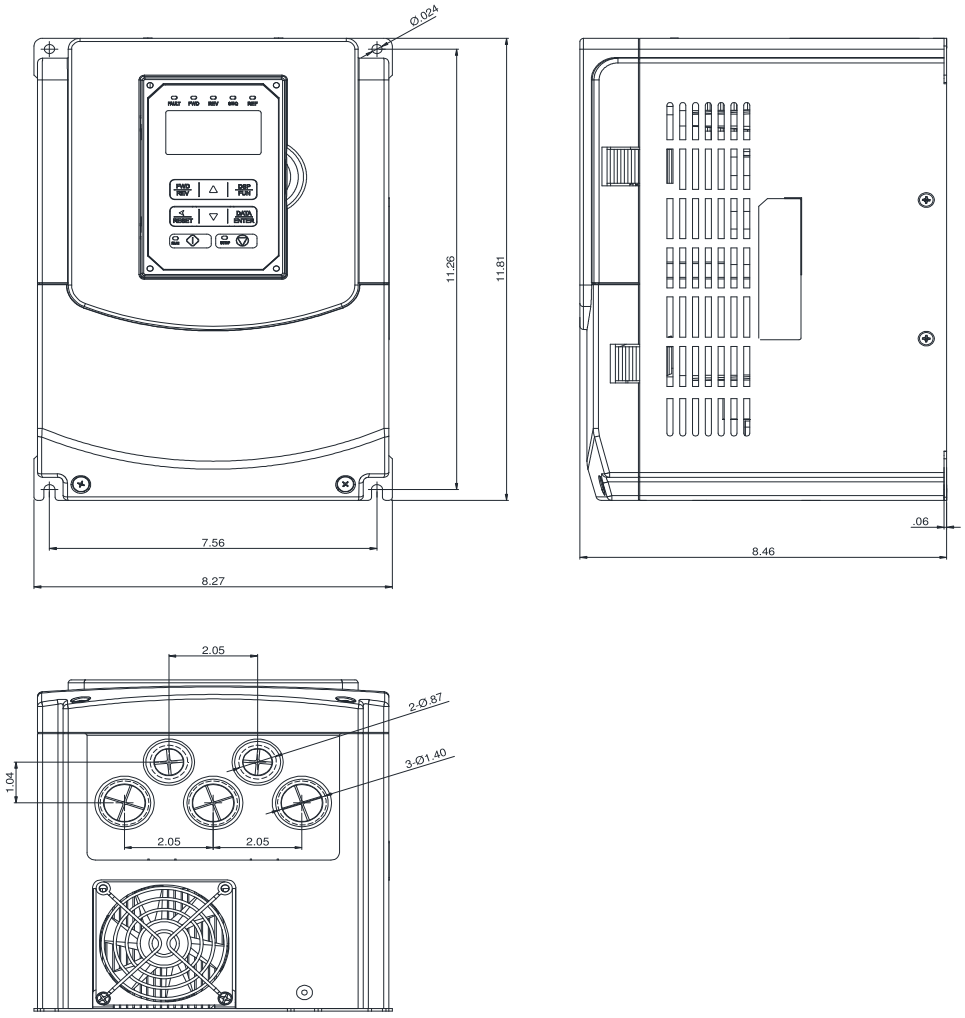
GENERAL DATASHEET
VARIABLE SPEED DRIVE

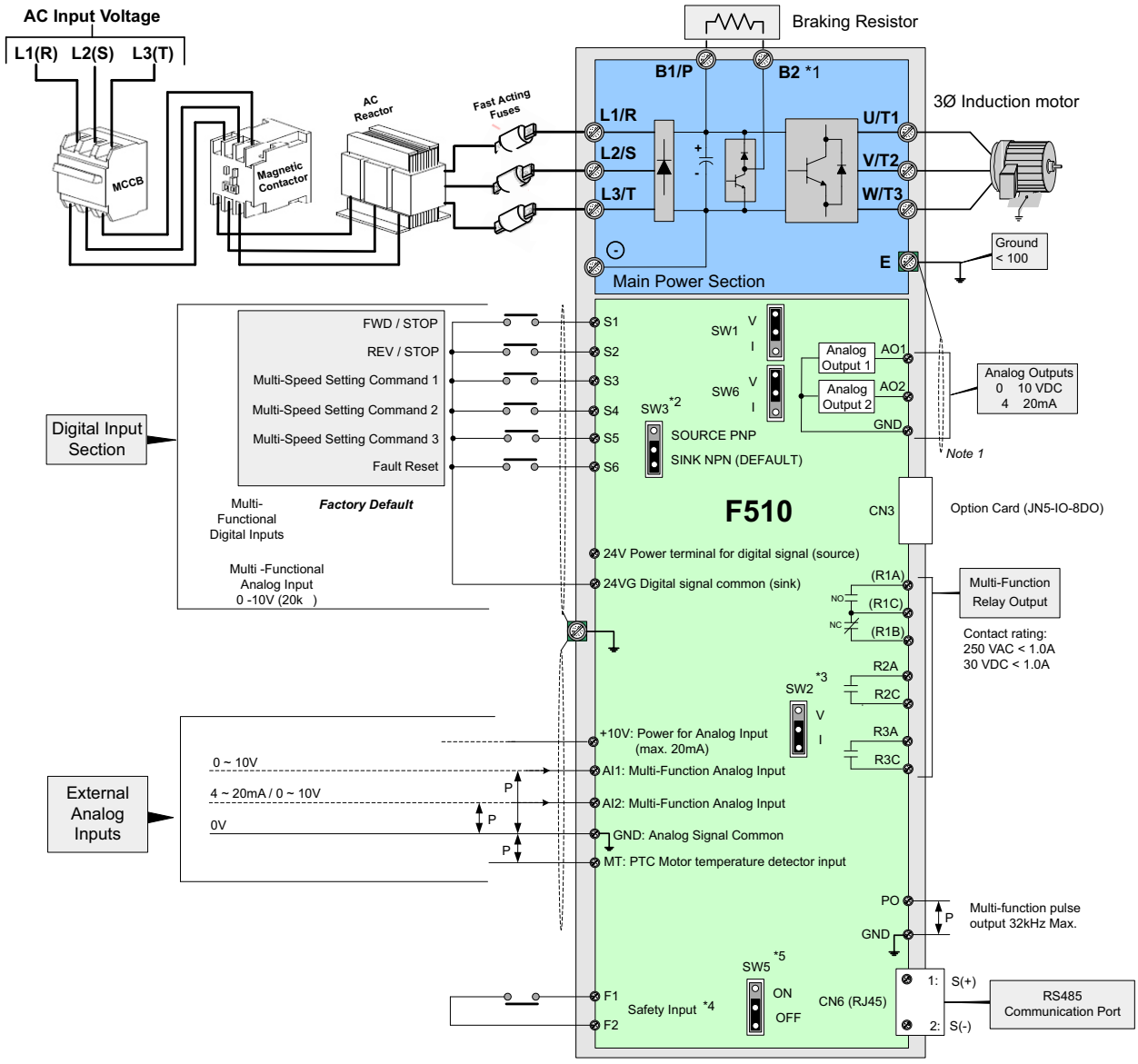
SERIES	MODEL#
F510	44-F3-460-2000
ISSUED	ENCLOSURE/ FRAME
8/26/2016	NEMA 1 (IP20) / F3

INPUT AMPS		AC INPUT VOLTAGE	AC INPUT FREQUENCY	AC INPUT PHASE
ND (VT)				
32.3		380-480	50/60	3
OUTPUT HP	OUTPUT AMPS	AC OUTPUT VOLTAGE	AC OUTPUT FREQUENCY	AC OUTPUT PHASE
ND (VT)	ND (VT)			
20	31	0-480	0-400	3



Approved By:	Brian Smith	**Drawing No:**	F[illegible]3	**Revision:** 0

3.8 General Wiring Diagram



Notes:

*1: Models IP20 200V 1 ~ 30HP, 400V 1 ~ 40HP have a built-in braking transistor. To use this braking transistor a braking resistor can be connected between B1 and B2.

*2: Use SW3 to select between Sink (NPN, with 24VG comm on) or Source (PNP, with +24V common) for multi-function digital input terminals S1~S6.

*3: Use SW2 to switch between voltage and current input for Multi-function analog input 2 (AI2). See parameter 04-00.

*4: Safety input F1 and F2 is a normally closed input. This input should be closed to enable the inverter output. To activate this input remove the jumper wire between F1 and F2.

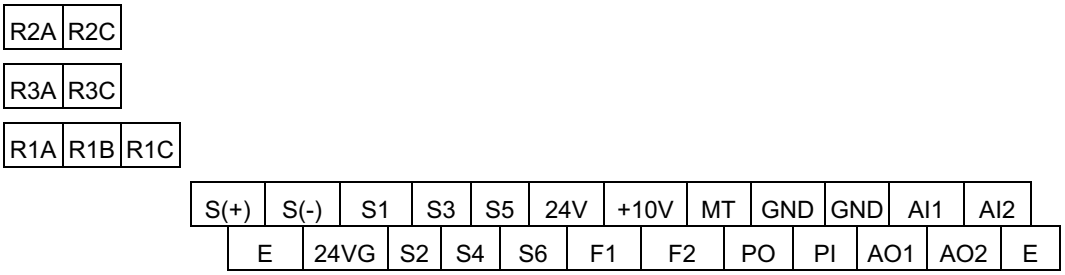
*5. Terminating resistor can be set to ON or bypass (Off). This is used when connecting multiple drives in an RS485 network.

*6. Models IP20 1 ~ 3HP do not support an option card.

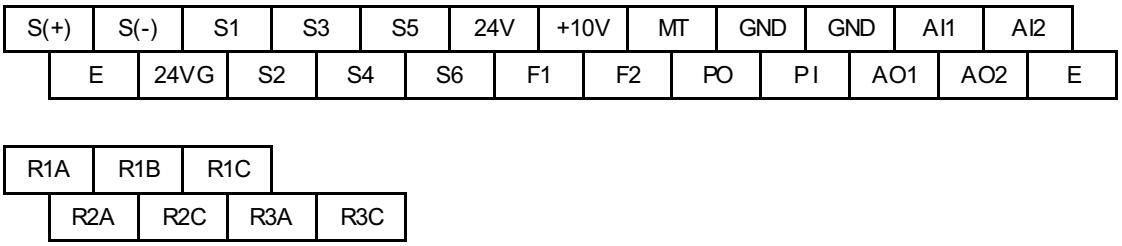
3.9 User Terminals (Control Circuit Terminals)

IP20 Type:

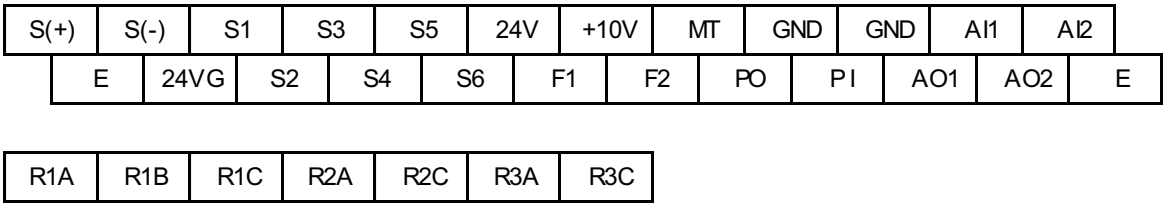
200V: 1 ~ 3 HP, 400V: 1~ 3HP



200V: 5 ~ 50 HP, 400V: 5~ 75HP



200V: 60 ~ 175 HP, 400V: 100 ~ 800HP



Description of User Terminals

Type	Terminal	terminal function	Signal level / Information
Digital input signal	**S1**	2-Wire Forward Run - stop command (default), multi-function input terminals * 1	Signal Level 24 VDC (opto isolated) Maximum current: 8mA Maximum voltage: 30 Vdc
	S2	2-Wire Reverse Run - stop command (default), multi-function input terminals * 1	
	S3	Multi-speed/ position setting command 1 (default), multi-function input terminals * 1	
	S4	Multi-speed/ position setting command 2 (default), multi-function input terminals * 1	
	S5	Multi-speed/ position setting command 3 (default), multi-function input terminal* 1	
	S6	Fault reset input, multi-function input terminal * 1	
24V Power supply	**24V**	Digital signal SOURCE (SW3 switched to mode)	±15%, Max. output current: 250mA (The sum of all loads connected)
	24VG	Common terminal for Digital signals Common point for digital signal SINK (SW3 switched to SINK)	
Analog input signal	**+10V**	Power for external speed potentiometer	±5% (Max. current: 20mA)
	MT	Motor temperature detector for eccternally connected PTC	Range, return
	AI1	Multi-function analog input for speed reference (0-10V input)	Range 0 to +10V Resolution: 12bit
	AI2	Multi-function analog input terminals *2, SW2 switched between voltage or current input (0~10V)/(4-20mA)	Range 0 to +10V Range 4 to 20 mA Input impedance: Resolution: 12bit
	GND	Analog signal ground terminal	----
	E	Shielding wire connecting terminal (Ground)	----
Analog output signal	**AO1**	Multi-function analog output terminals *3 (0~10V/ 4-20mA output)	Range 0 to 10V Max. current: 2mA From 4 to 20 mA
	AO2	Multi-function analog output terminals *3 (0~10V/ 4-20mA output)	
	GND	Analog signals ground terminal	
Type	**Terminal**	**terminal function**	**Signal level / Information**
Pulse output signal	**PO**	Pulse output, Bandwidth 32KHz	Max. Frequency: 32KHz Open Collector output
	GND	Analog signals ground terminal	----

Pulse input signal	**PI**	Pulse command input, bandwidth is 32KHz	L: from 0.0 to 0.5V H: from 4.0 to 13.2V Max. Frequency: 0 - 32KHz
	GND	Analog signals ground terminal	----
Relay output	**R1A-** **R1B-** **R1C-**	Relay A contact (multi-function output terminal) Relay B contact (multi-function output terminal) Relay contact common terminal, please refer to parameter group 03 in this manual for function description.	Rating: 250Vac, 10 mA ~ 1A 30Vdc, 10 mA ~ 1A
	R2A-R2C	Same functions as R1A/R1B/R1C	Rating: 250Vac, 10 mA ~ 1A 30Vdc, 10 mA ~ 1A
	R3A-R3C	Same functions as R1A/R1B/R1C	Rating: 250Vac, 10 mA ~ 1A 30Vdc, 10 mA ~ 1A
Run Permissive Input	**F1**	On: normal operation. Off: stop. (Jumper wired between F1 and F2 has to be removed by using external contact to stop.)	24Vdc, 8mA, pull-up
	F2	Safety command common terminal	24V Ground
RS-485 port	**S (+)**	RS485/MODBUS	Differential input and output
	S (-)		
Grounding	**E (G)**	Grounding to earth Shield the connecting terminal	----

Notes:

*1:Refer to:

- Group 03: External Terminals Digital Input / Output Function Group.

*2:Refer to:

- Group 04 - External Terminal Analog Signal Input (Output) Function Group.

*3:Refer to:

- Group 04 - External Terminal Analog Signal Input (Output) Function Group.

Caution

Maximum output current capacity for terminal 10V is 20mA.

Multi-function analog output AO1 and AO2 are intended as analog output meter signals. Do not use them for feedback control.

V are to be used for internal control only, Do not use the internal power-supply to power external devices.

3.10 Power Terminals

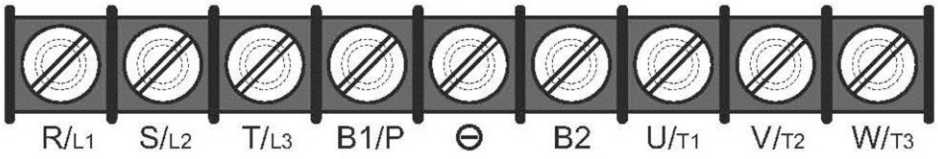
IP00 / IP20 Type

<table>
<tr><th>Terminal</th><th colspan="2">200V: 1 ~ 30HP
400V: 1 ~ 40HP</th><th>200V: 40 ~ 175HP
400V: 50 ~ 800HP</th></tr>
<tr><td>R/L1</td><td colspan="3" rowspan="3">Input Power Supply (For single phase use terminals R/L1 and S/L3)</td></tr>
<tr><td>S/L2</td></tr>
<tr><td>T/L3</td></tr>
<tr><td>B1 P</td><td colspan="2" rowspan="2">B1 P : DC power supply
B1 P B2: external braking resistor</td><td>-</td></tr>
<tr><td>B2</td><td rowspan="2">- : DC power supply or connect braking module</td></tr>
<tr><td></td><td colspan="2">-</td></tr>
<tr><td>U/T1</td><td colspan="3" rowspan="3">Inverter output</td></tr>
<tr><td>V/T2</td></tr>
<tr><td>W/T3</td></tr>
<tr><td>E</td><td colspan="3">Ground terminal</td></tr>
</table>

*1. All models 400V 25HP (18.5KW) and below have a built-in braking transistor.
*2. Before connecting DC reactor, please remove factory supplied jumper between terminal 1 and 2.

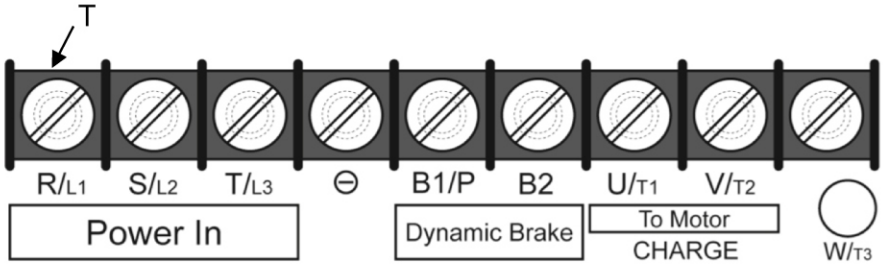
IP20 Type

200V: 1-3HP/ 400V: 1-3HP



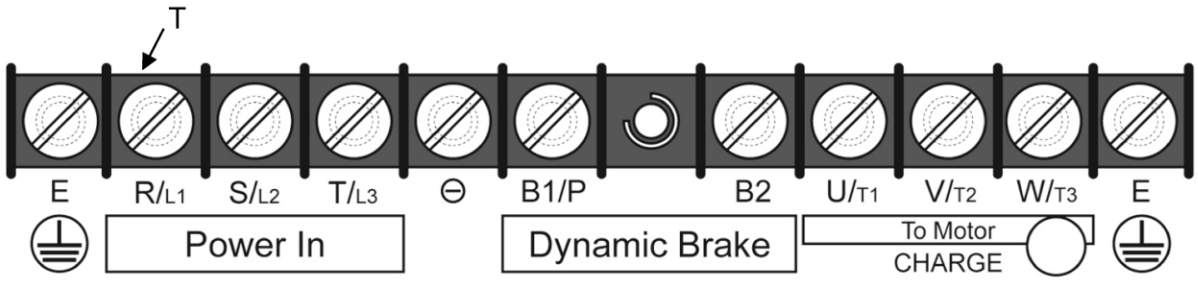
Terminal screw size	
T	⏚
M4	M4

200V: 5-7.5HP/ 400V: 5-10HP



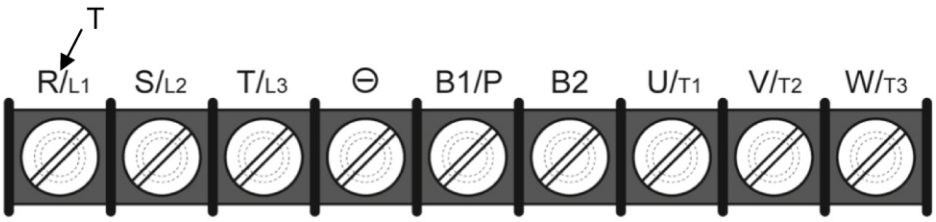
Terminal screw size	
T	⏚
M4	M4

200V: 10-15HP/ 400V: 15- 20HP



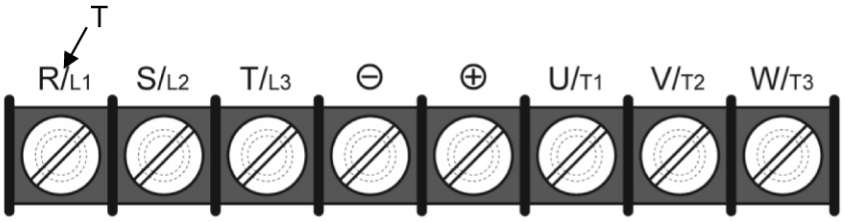
Terminal screw size	
T	⏚
M4	M4

200V: 20-30HP/ 400V: 25-40HP



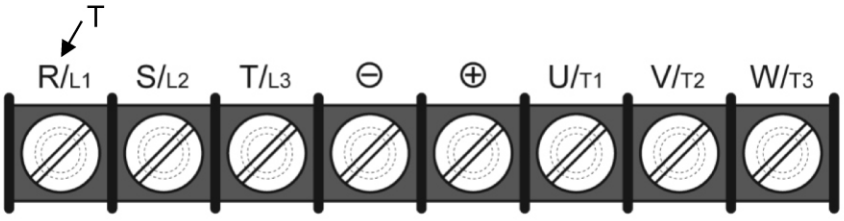
Terminal screw size	
T	⏚
M6	M6

200V: 40-50HP/ 400V: 50-75HP



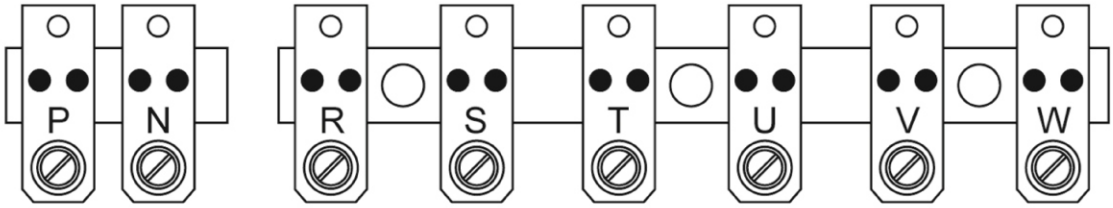
Terminal screw size	
T	⏚
M8	M8

200V: 60-75HP/ 400V: 100-125HP



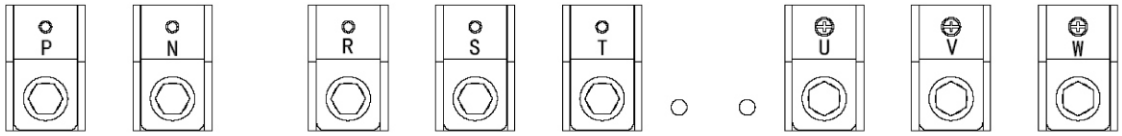
Terminal screw size		
Power supply	T	⏚
400V 100HP	M8	M10
200V 60-75HP/ 400V 125HP	M10	M10

200V: 100-125HP/ 400V: 150-250HP



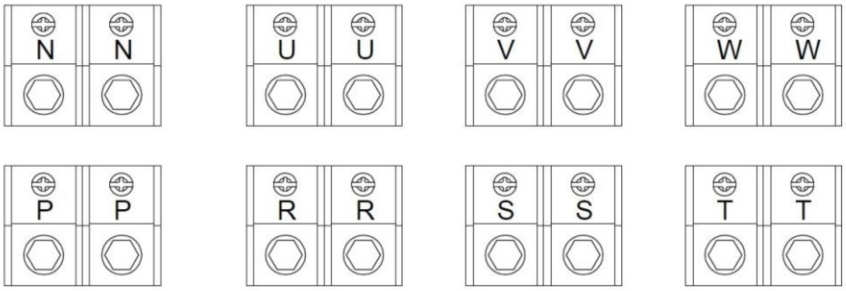
Terminal screw size	
T	⏚
M10	M10

200V: 150-175HP/ 400V: 300-425HP



Terminal screw size	
T	⏚
M12	M10

400V: 530-800HP



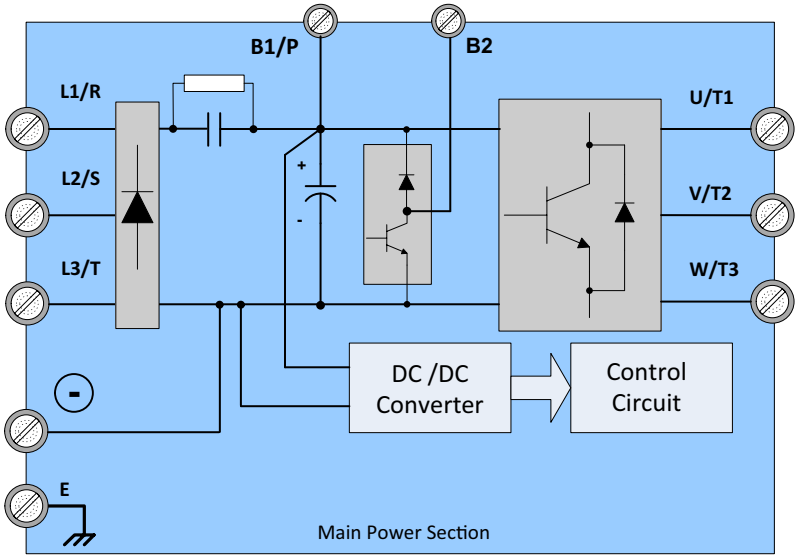
Terminal screw size	
T	⏚
M10	M10

3.11 Input / Output Power Section Block Diagram

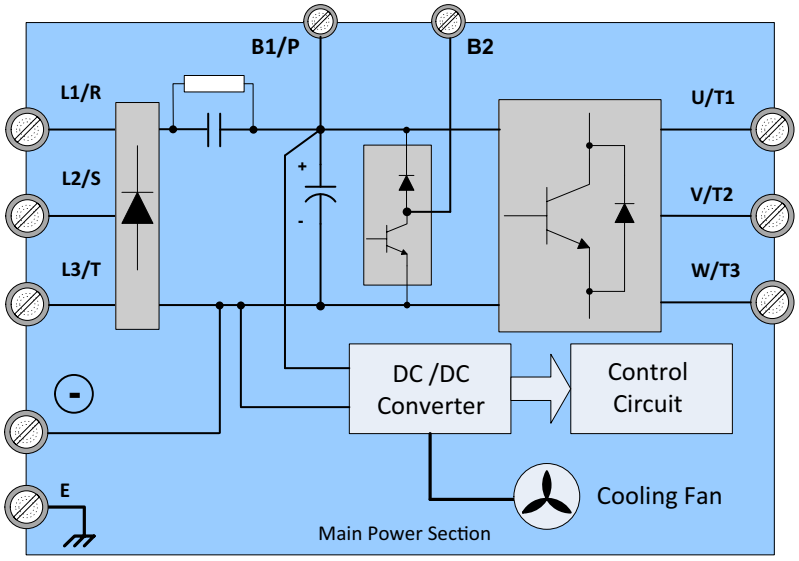
The following diagrams show the basic configuration for IP00/IP20 power sections for the range of horsepower and input voltages. This is shown for reference only and is not a detailed depiction.

IP00/IP20 Type

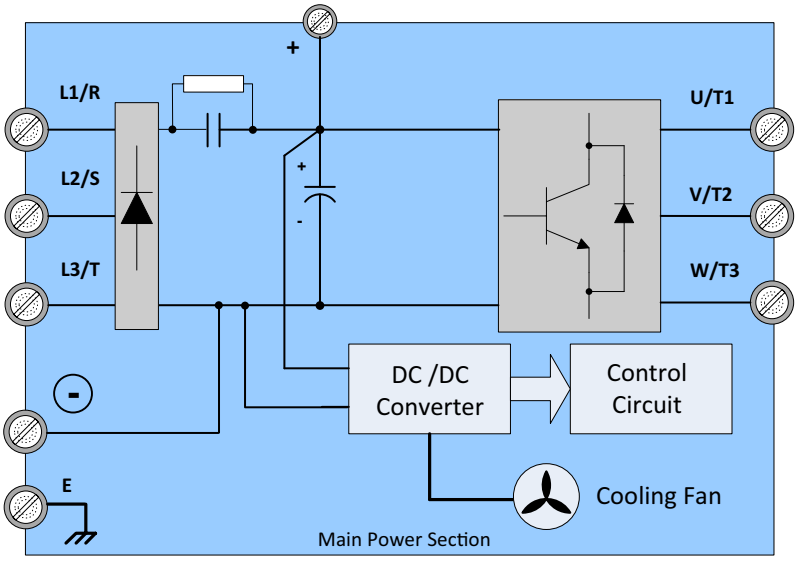
1: 200V: 1 HP / 400V: 1 ~ 2 HP



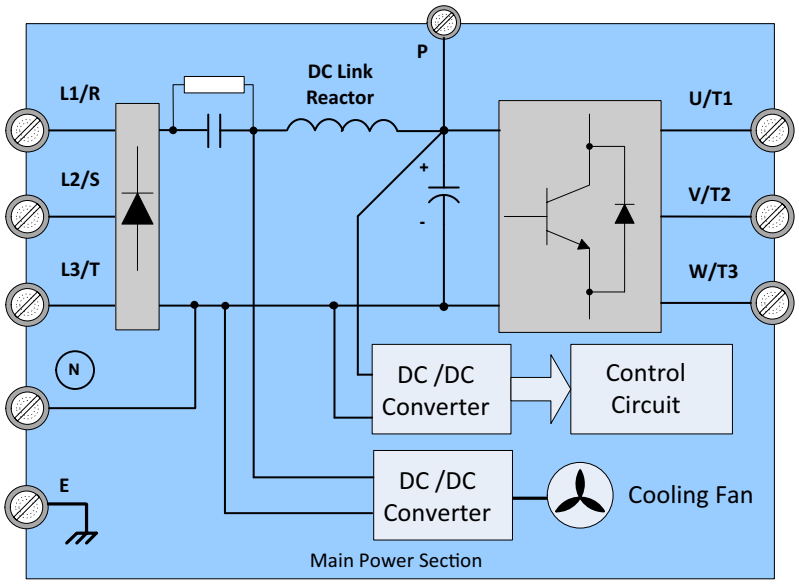
2: 200V: 2 ~ 30 HP / 400V: 3 ~ 40 HP



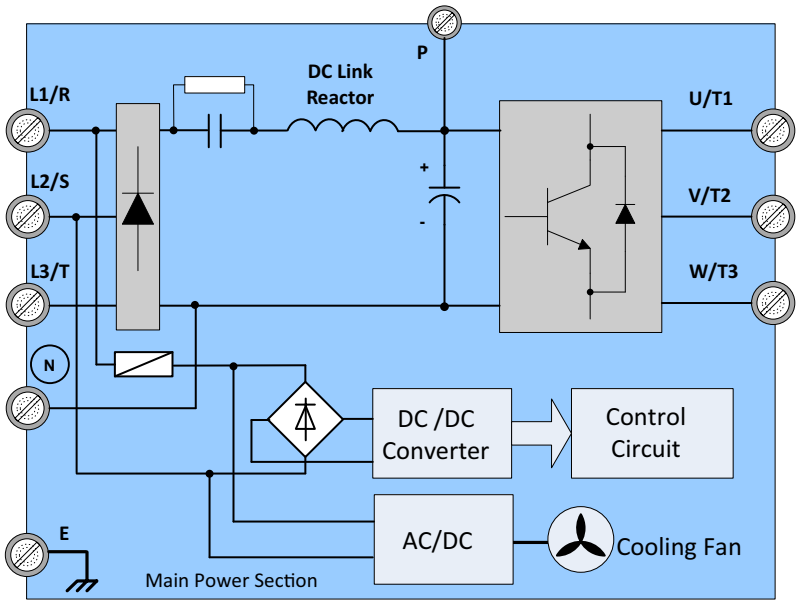
3: 200V: 40 ~ 50 HP / 400V: 50 ~ 75 HP



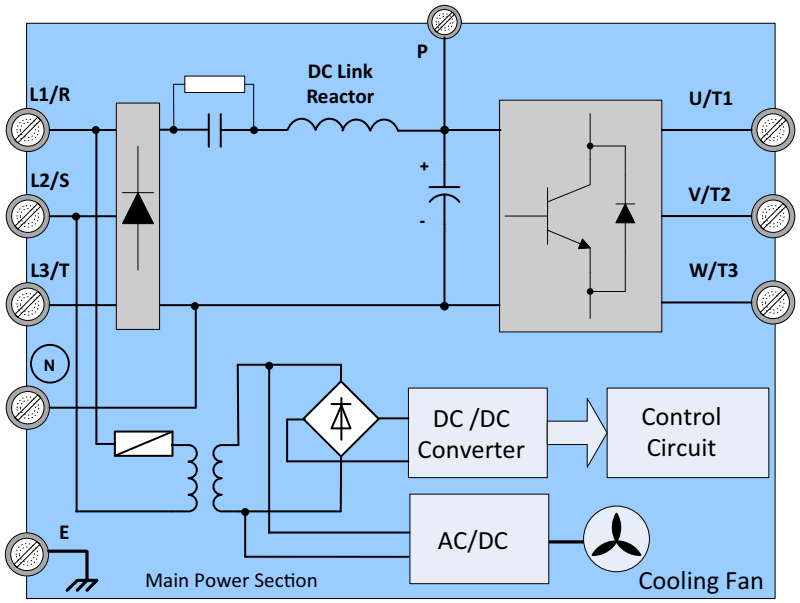
4: 200V: 60 ~ 75 HP / 400V: 100 ~ 125 HP



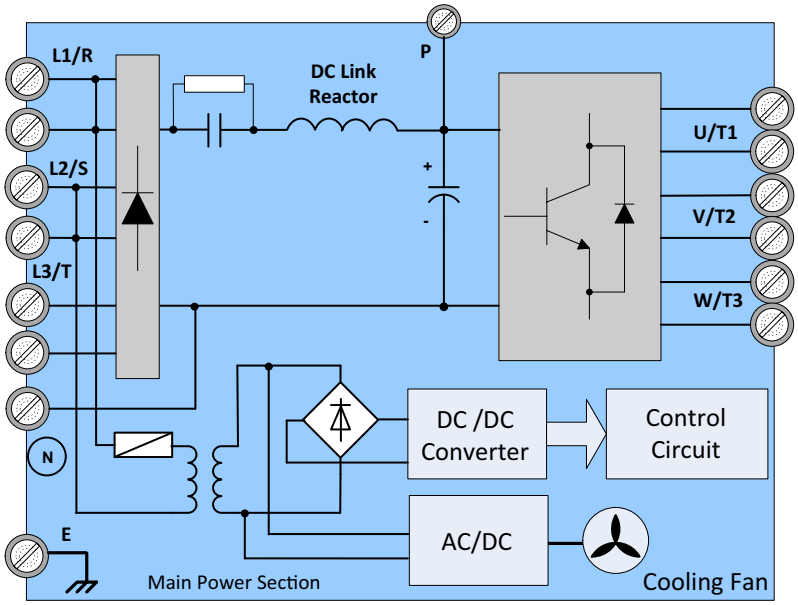
5: 200V: 100 ~ 175 HP

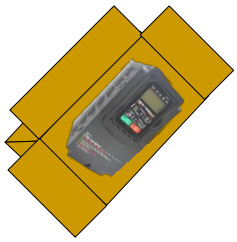


6: 400V: 150 ~ 425 HP



7: 400V: 535 ~ 800 HP





OUT of the Box Startup – Overview

This document is intended as a quick setup guide for the F510 PID function. Please note this document is not a substitute for the F510 User Manual and it is important that you reference the F510 user manual before proceeding.

Introduction to PID Control

The PID function in the inverter can be used to maintain a constant process variable such as pressure, flow, temperature by regulating the output frequency (motor speed).

A feedback device (transducer) signal is used to compare the actual process variable to a specified setpoint. The difference between the set-point and feedback signal is called the error signal.

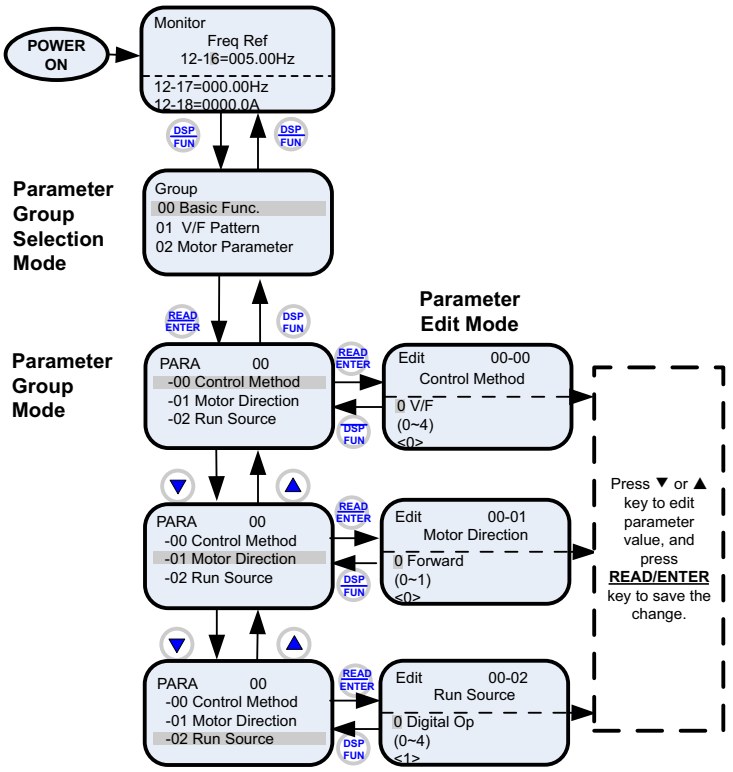
The PID control tries to minimize this error to maintain a constant process variable by regulating the output frequency (motor speed). The amplitude of the error can be adjusted with the Proportional Gain parameter ***10-05*** and is directly related to the output of the PID controller, so the greater the gain the larger the output correction.

However, in any system as the gain is increased there is a point that the system becomes unstable (oscillation).

To compensate for instability, the response time of the system may be ***slowed*** down by increasing the ***Integral Time*** set by parameter ***10-06***. Slowing the system down too much may be unsatisfactory for the process.

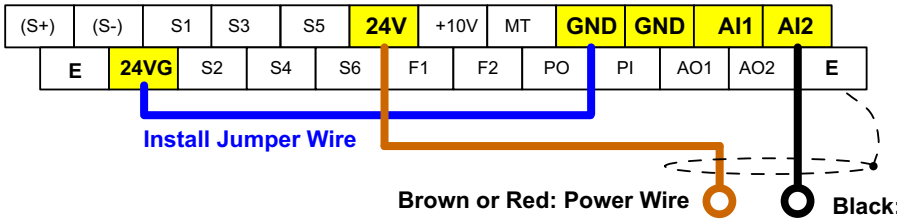
The end result is that these two parameters in conjunction with the acceleration (***00-14***) and deceleration (***00-15***) times require to be adjusted to achieve optimum regulation of the process.

STEP 1 How to Change Parameters

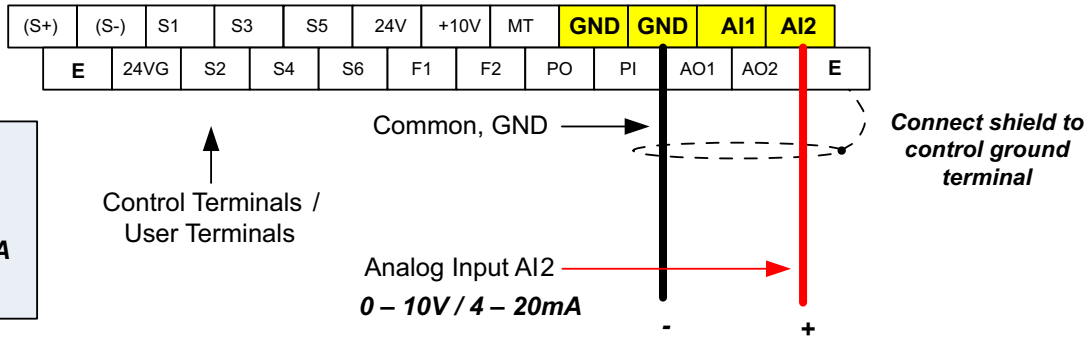


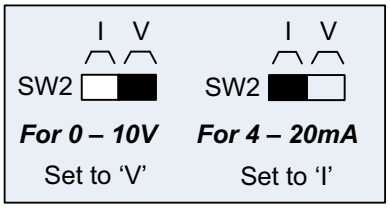
STEP 2 Transducer Wiring

2 Wire / 4-20mA Transducer



0-10V or 4-20mA Transducer w/ Ext. Power Supply





Step 3 Enable PID Control

The PID control mode 10-03 has to be enabled, as well as the correct settings for the setpoint 10-00 and feedback source 10-01.
10-00 = 4; Setpoint 10-02/12-28
10-01 = Set to 1 for 0-10VDC and 2 for 4-20mA; Transducer
10-03 = 0001b; PID Control Enable

Application Example:

Maintain 60.0 PSI with a feedback transducer maximum of 150.0PSI (4-20mA) and use the keypad as the setpoint source.

Step 4 PID Setpoint

10-00 = 4 (10-02/12-38); the main keypad display or actual parameter 10-02 will be the PID setpoint source.

Step 5 Scaling of PID Feedback Signal

10-01 = 2; 4-20mA Transducer
10-33 = 1500; Maximum Feedback Value
10-34 = 1; Maximum Feedback Value Scaling
10-35 = 3; Engineering Units

After setting 10-33~35 this display will scale to a maximum of 150.0 and will show 'PSI' as the engineering units. When you return to the main screen you can set 12-38 = 0060.0PSI.

Step 6 PID Tuning

10-05 = 1.00; Proportion Gain
10-06 = 10.00; Integral Time
00-14 = 10.00; Acceleration Time
00-15 = 10.00; Deceleration Time

Slowing the system down too much may be unsatisfactory for the process. The end result is that these two parameters (10-05 and 10-06) in conjunction with the acceleration (00-14) and deceleration (00-15) times are adjusted to achieve optimum performance for a particular application.

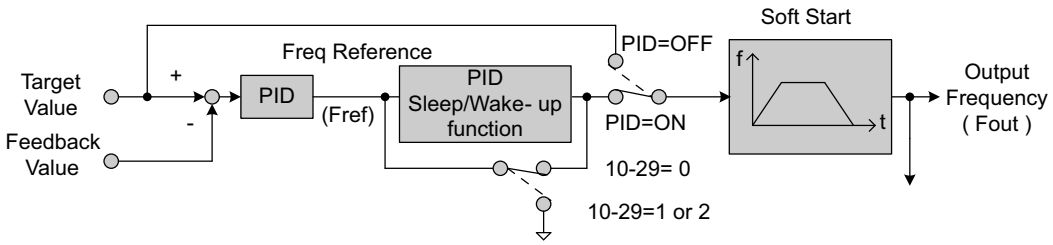
For typical fan and pump applications a Proportional Gain (10-05) of 2.0 and an Integral Time (10-06) of 5.0 seconds is recommended. Increase or decrease these values in small increments.

Step 7 Sleep / Wakeup Function (Optional)

The PID Sleep function can be used to prevent a system from running at low speeds and is frequently used in pumping applications. The PID Sleep function is turned on by setting parameter 10-29 to 1. The inverter output turns off when the PID output falls below the PID sleep level (10-17) for the time specified in the PID sleep delay time parameter (10-18).

The inverter wakes up from a sleep condition when the PID output (Reference frequency) rises above the PID wake-up frequency (10-19) for the time specified in the PID wake-up delay time (10-20).

10-17 = Set to minimum motor Sleep frequency; PID Sleep Frequency
10-19 = Set to the motor Wake-Up frequency; PID Wake-Up Frequency
10-29 = 1; PID Sleep Function



1.0 Built-in PLC Function

The PLC ladder logic can be created and downloaded using the TECO link software.

1.0.1 Basic Command

	⌐	▲	▼	P	⊣⊢	⊣/⊢	NO / NC
Inputs					I	i	I1~I8 / i1~i8
Outputs	Q	Q	Q	Q	Q	q	Q1~Q2 / q1~q2
Auxiliary command	M	M	M	M	M	m	M1~MF / m1~mF
Special registers							V1~V7
Counter function	C				C	c	C1~C8 / c1~c8
Timer function	T				T	t	T1~T8 / t1~t8
Analog comparison function	G				G	g	G1~G8 / g1~g8
Operation control function	F				F	f	F1~F8 / f1~f8
summation and subtraction function	AS						AS1~4
Multiplication and division function	MD						MD1~4

Description of registers

V1: Set frequency Range: 0.1~1200.0Hz
V2: Operation frequency Range: 0.1~1200.0Hz
V3: AI1 input value Range: 0~1000
V4: AI2 input value Range: 0~1000
V5: Keypad input value Range: 0~1000
V6: Operation current Range: 0.1~999.9A
V7: Torque value Range: 0.1~200.0%

Command	Upper Differential	Lower Differential	Other command symbol
Differential command	D	d	
SET command			▲
RESET command			▼
P command			P

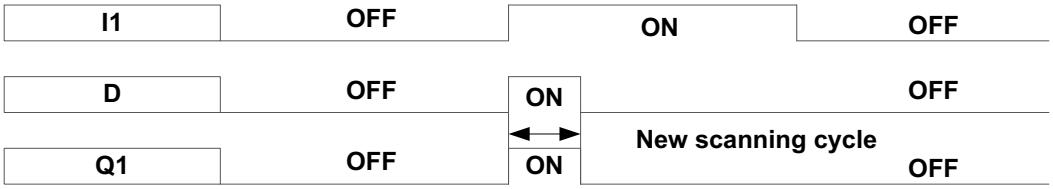
Open circuit	" "	
Short circuit	"--"	

Connection symbol	Definition
─	Connect components on the left and right side
⊥	Connects components on the left , right and top side
┼	Connects components on the left , right , top and bottom side
┬	Connects components on the left , right and bottom side

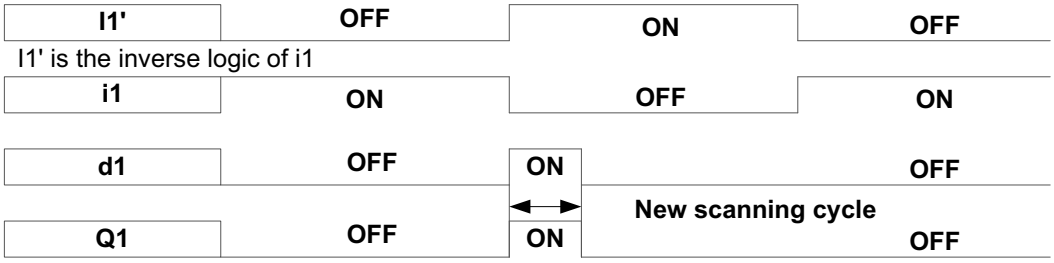
1.0.2 Basic Command Function

◎ D (d) command function

Example 1： I1—D ——[Q1

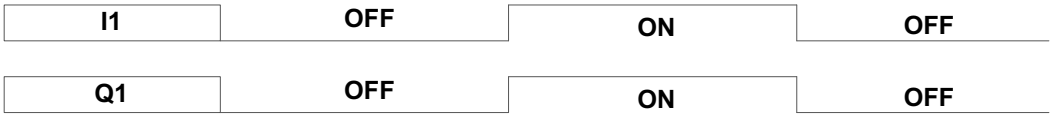


Example 2： i1—d ——[Q1



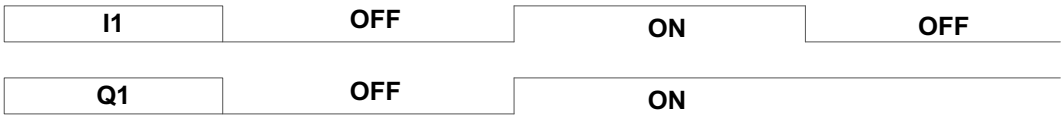
◎ NORMAL(-[ ) output

I1——[Q1



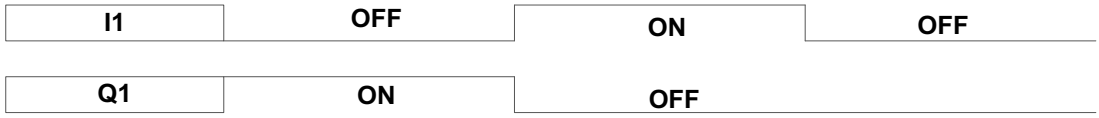
◎ SET（ ）output

I1—— Q1



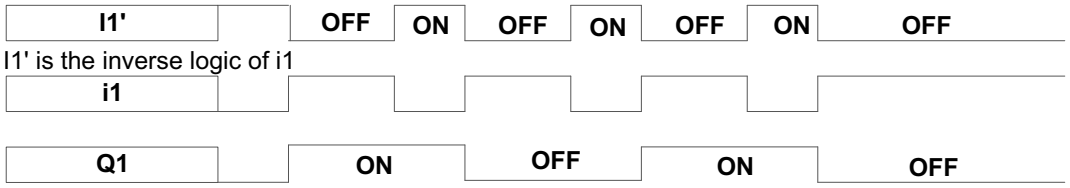
◎ RESET（ ）output

I1—— Q1



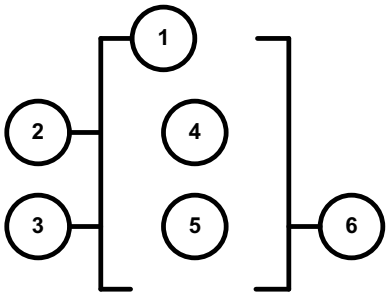
◎ P output

i1——PQ1



1.0.3 Application Functions

1: Counter Function



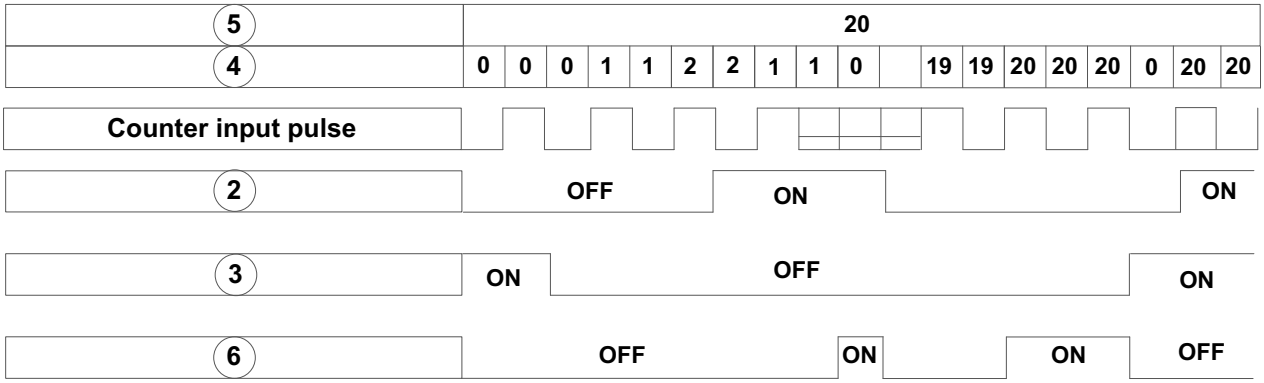
Symbol	Description
①	Counter mode (1 ~ 4)
②	UP/Down counting modes can be set by (I1 ~ f8).
	OFF: Count up (0, 1, 2, 3…)
	ON: Count down (…3,2,1,0)
③	Use (I1~f8) to reset counting value
	ON: Internal count value is reset and counter output ⑥ is OFF
	OFF: Internal counter value retained
④	Internal counter value
⑤	Counter compare value (AS1~AS4,MD1~MD4,T1~T8,C1~C8,V1~V7,constant)
⑥	Counter output (C1 to C8, there are a total of 8 counters)

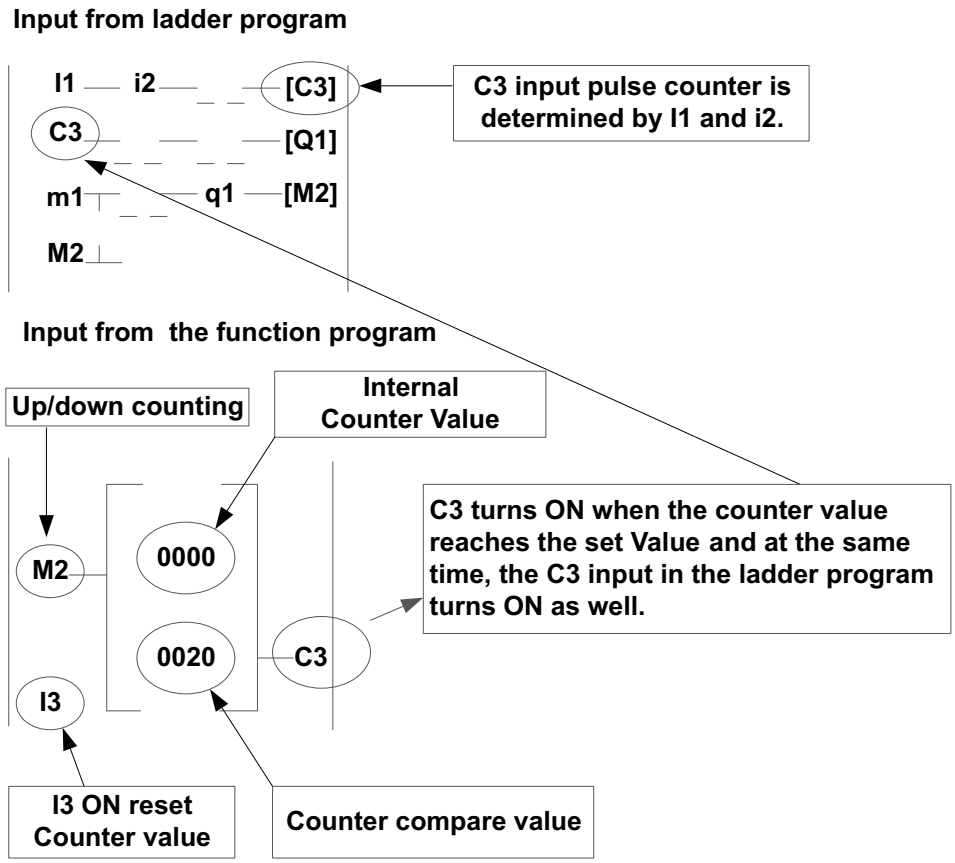
Counter modes:

Mode 1: Counter value is locked to the set value. The value will not be retained when the power is cut off.
Mode 2: Counter value is not locked. The value will not be retained when the power is cut off.
Mode 3: Counter value is locked. The value will be retained when the power is cut off.
Mode 4: Counter value is not locked. The value will be retained when the power is cut off.

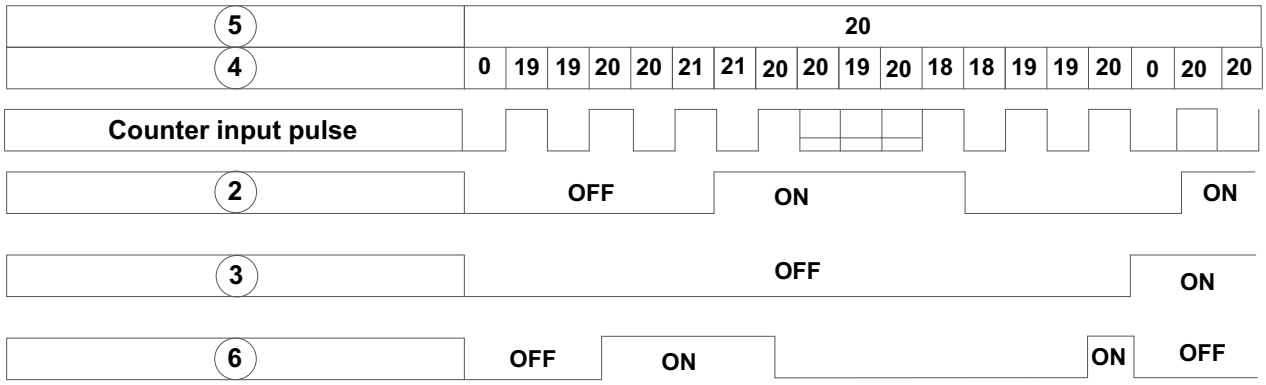
Counter mode 1

Example:



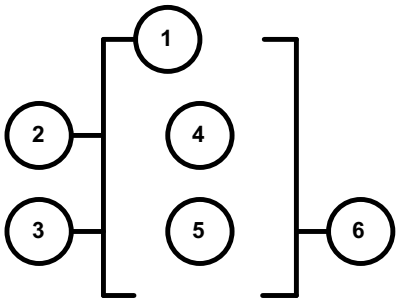


Counter mode 2



Note: In this mode the internal counter may increase past the counter compare value, unlike mode 1 where the internal counter value is limited to the counter compare value.

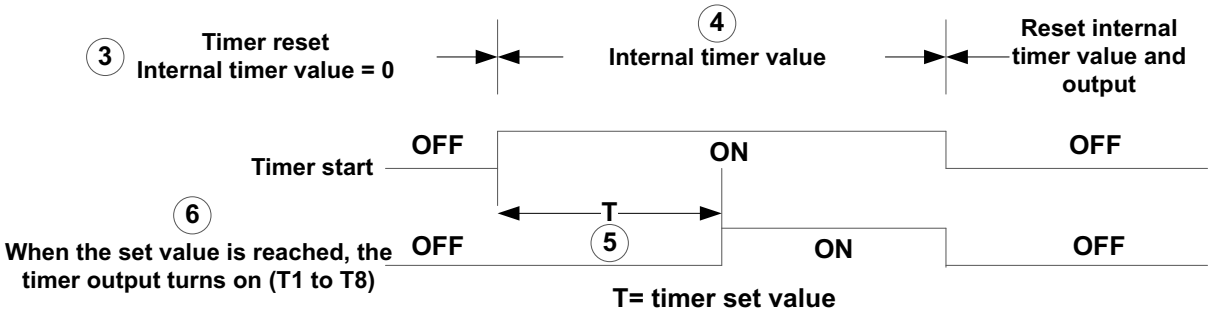
2: Timer Function



Symbol	Description
①	Timer mode (1-7)
②	Timing unit: 1:0.0~999.9 second
	2:0~9999 second
	3:0~9999 minute
③	Use (I1~f8) to reset timing value
	ON: Internal timing value is reset and timer output ⑥ is OFF
	OFF: Internal timer stays running
④	Internal timer value
⑤	Timer set value (AS1~AS4,MD1~MD4,T1~T8,C1~C8,V1~V7,constant)
⑥	Timer output (T1 to T8, there are a total of 8 timers)

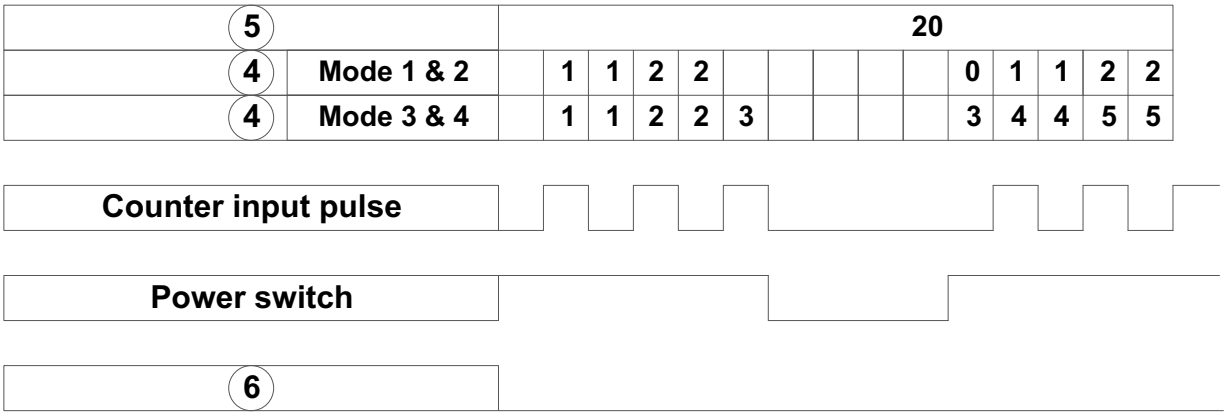
Timer mode description：

(1) Timer mode 1 (ON-delay Timer mode 1)

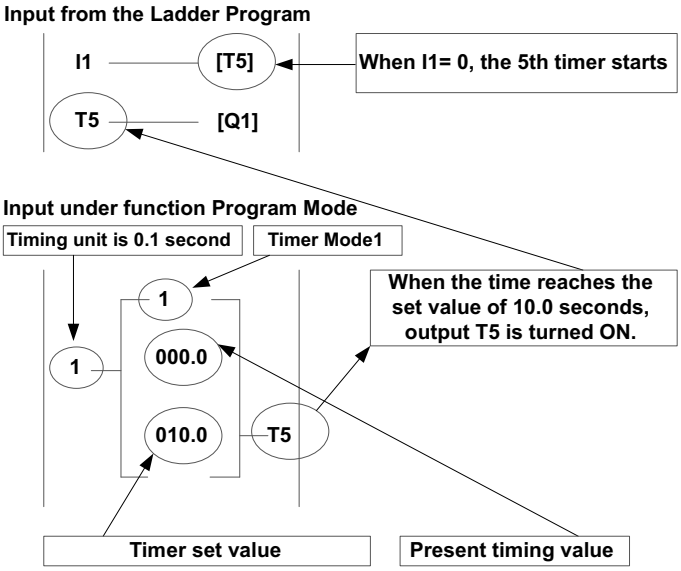


(1) Counter mode 3 is similar to the counter mode 1, with the exception that the counter value is saved when the drive is powered down and reloaded at power up.

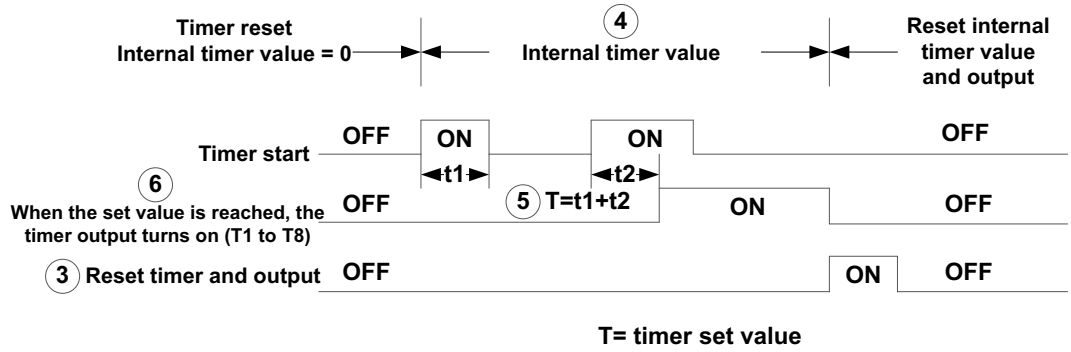
(2) Counter mode 4 is similar to the counter mode 2, with the exception that the counter value is saved when the drive is powered down and reloaded at power up.



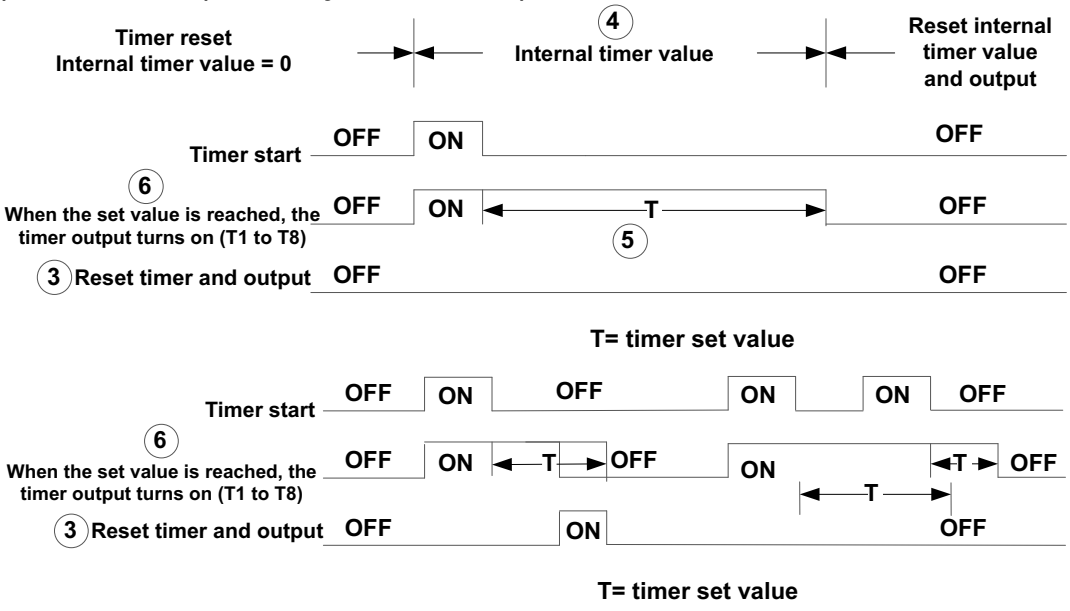
Example:



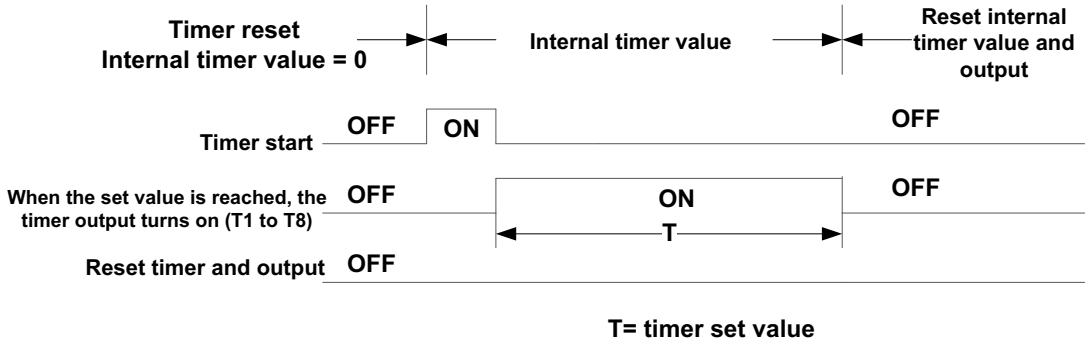
(2) Timer mode 2 (ON-delay Timer mode 2)



(3) Timer mode 3 (OFF-delay Timer mode 1)

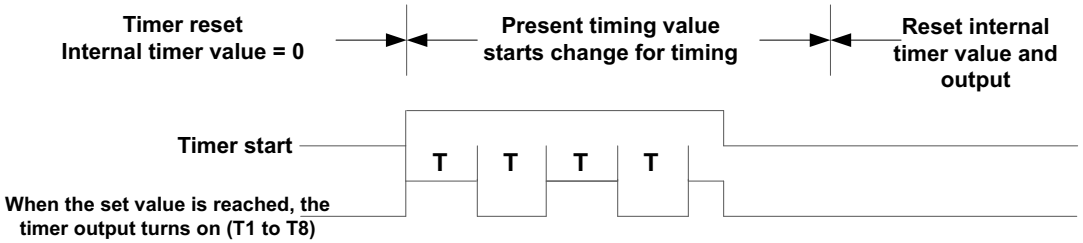


(4) Timer mode 4 (OFF-delay Timer mode 2)



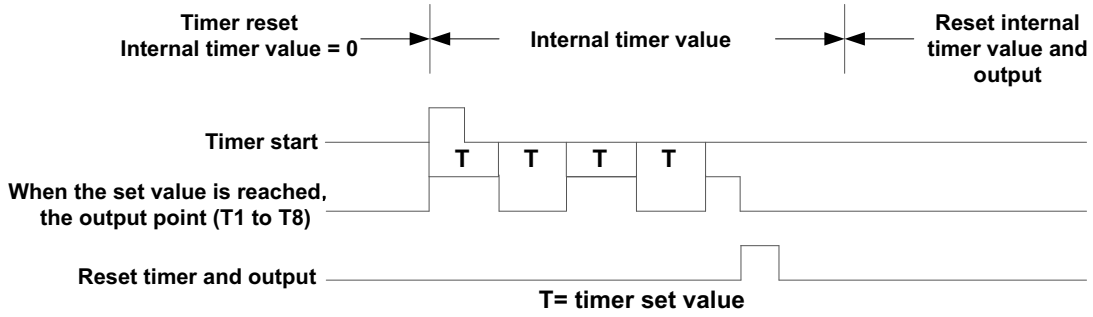
T= timer set value

(5) Timer mode 5 (FLASH Timer mode 1)



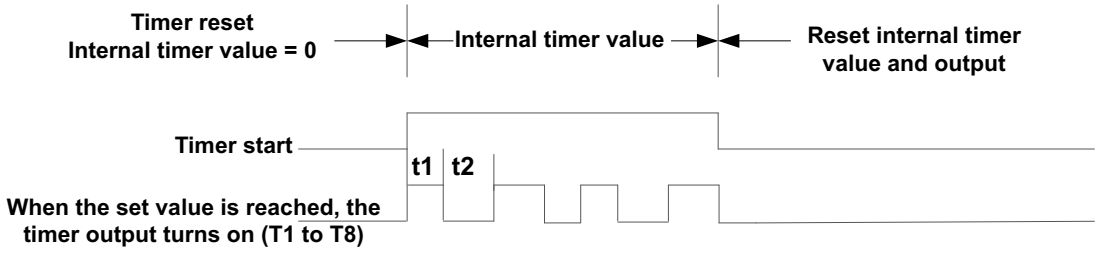
T= timer set value

(6) Timer mode 6 (FLASH Timer mode 2)

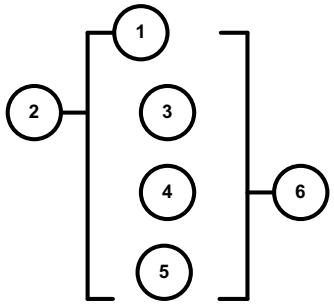


T= timer set value

(7) Timer mode 7 (FLASH Timer mode 3)



3: Analog comparator function



Symbol	Description
①	Analog comparator mode (1~3)
②	Input comparison value selection (AS1~AS4,MD1~MD4,T1~T8,C1~C8,V1~V7)
③	Current analog input value
④	Set the reference comparison value (Upper limit) (AS1~AS4,MD1~MD4,T1~T8,C1~C8,V1~V7, constant)
⑤	Set the reference comparison value (lower limit) (AS1~AS4,MD1~MD4,T1~T8,C1~C8,V1~V7, constant)
⑥	Comparator output (G1 to G8, there are a total of 8 comparators)

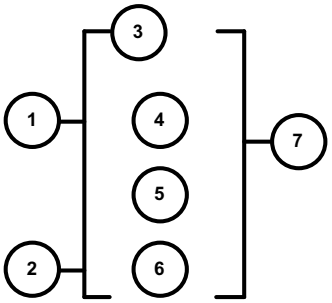
The description of analog comparison mode:

(1) Analog comparison mode 1 (③ ≤ ⑤, ⑥ ON)
(2) Analog comparison mode 2 (③ ≥ ④, ⑥ ON)
(3) Analog comparison mode 3 (⑤ ≤ ③ ≤ ④, ⑥ ON)

Input comparison value selection (V1~V7)

(1) Input comparison value selection = V1: Set frequency
(2) Input comparison value selection = V2: Operation frequency
(3) Input comparison value selection = V3: AI1 input value
(4) Input comparison value selection = V4: AI2 input value
(5) Input comparison value selection = V5: Keypad input value
(6) Input comparison value selection = V6: Operation current
(7) Input comparison value selection = V7: Torque value

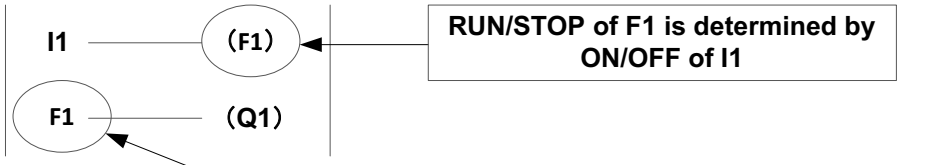
4: Operation control function



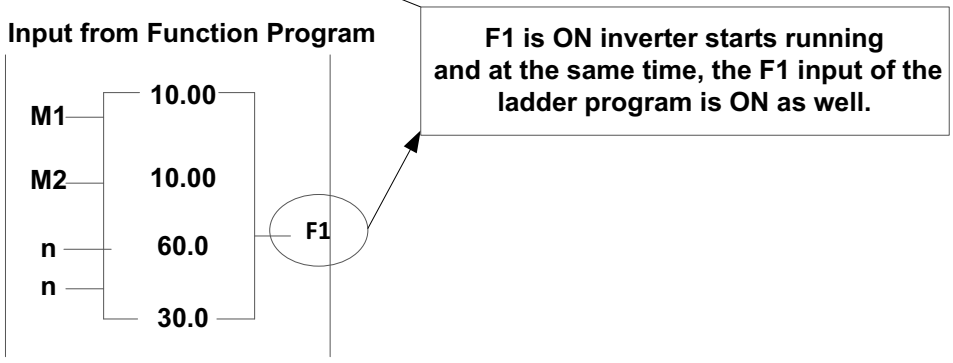
Symbol	Description
①	Forward /Reversal control can be set by (I1~f8) OFF: Forward(FWD) ON: Reversal(REV)
②	Speed terminal control can be set by (I1~f8)
	OFF: Operation based on ③ set frequency
	ON: Operation based on frequency of speed ④
③	Set frequency (can be constant or V3、V4，V5)
④	Speed frequency (can be constant or V3、V4，V5)
⑤	Acceleration time (ACC Time)
⑥	Deceleration time (DEC Time)
⑦	Operation command output (F1 to F8, there are a total of 8 operation control functions)

Example:

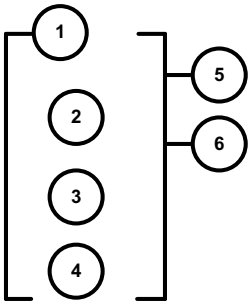
Input from the Ladder Program



Input from Function Program



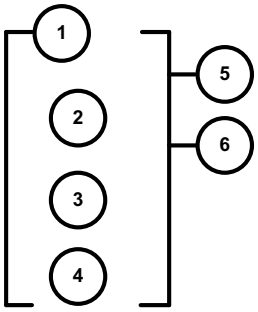
5: Summation and subtraction functions



RESULT (calculation result) = V1+ V2- V3

Symbol	Description
①	Calculation result : RESULT
②	Addend V1(AS1~AS4,MD1~MD4,T1~T8,C1~C8,V1~V7, constant)
③	Addend V2(AS1~AS4,MD1~MD4,T1~T8,C1~C8,V1~V7, constant)
④	Subtrahend V3(AS1~AS4,MD1~MD4,T1~T8,C1~C8,V1~V7, constant)
⑤	Coil output of error signal (M1~MF)
⑥	Addition and subtraction modes number (AS1~AS4)

6: Multiplication and division modes



RESULT（calculation result）=V1*V2/V3

Symbol	Description
①	Calculation result : RESULT
②	Multiplier V1(AS1~AS4,MD1~MD4,T1~T8,C1~C8,V1~V7, constant)
③	Multiplier V2(AS1~AS4,MD1~MD4,T1~T8,C1~C8,V1~V7, constant)
④	Divisor V3(AS1~AS4,MD1~MD4,T1~T8,C1~C8,V1~V7, constant)
⑤	Coil output of error signal（M1~MF）
⑥	Multiplication and division modes number (MD1~ MD4)