# TECO ⊘ ⓦ Westinghouse

## INVERTER

# E510

## PLC - Addendum

Inputs
Outputs
Auxiliary commands
Special registers
Counter function
Timer function
Analog comparison function
Operation control function
Summation and subtraction function
Multiplication and division function

# 1.0 Built-in PLC Function

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

## 1.1 Basic Command

| | ⌐ | ⅄ | ⅋ | P | ⊣⊢ | ⊣/⊢ | NO / NC |
|---|---|---|---|---|---|---|---|
| Inputs | | | | | I | i | I1~I6 / i1~i6 |
| 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 | "--" | |

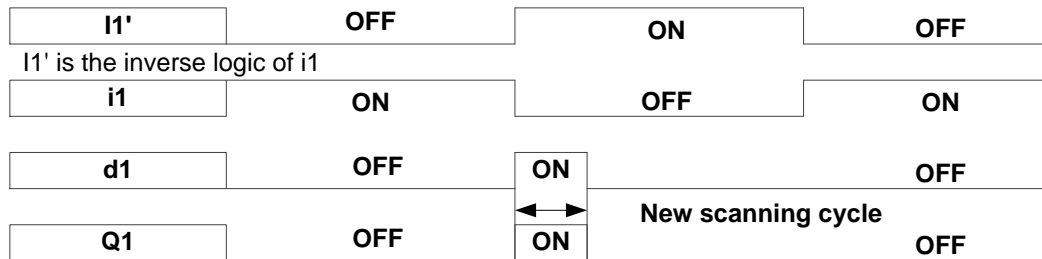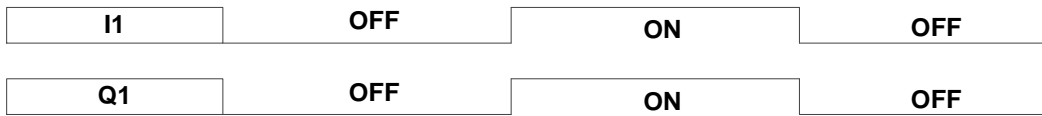| Connection symbol | Definition |
|---|---|
| ─ | Connect components on the left and right side |
| ⊥ | Connects components on the left , right and top side |
| ┼ | Connects components on the left , right , top and bottom side |
| ┬ | Connects components on the left , right and bottom side |

## 1.2 Basic Command Function
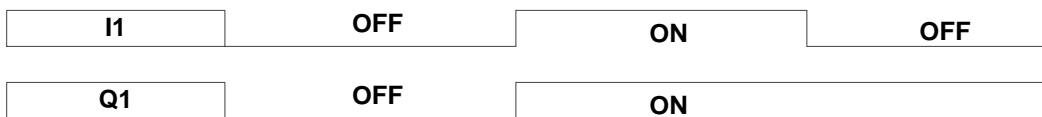
◎ **D (d) command function**
**Example 1**：I1—D ——[ Q1
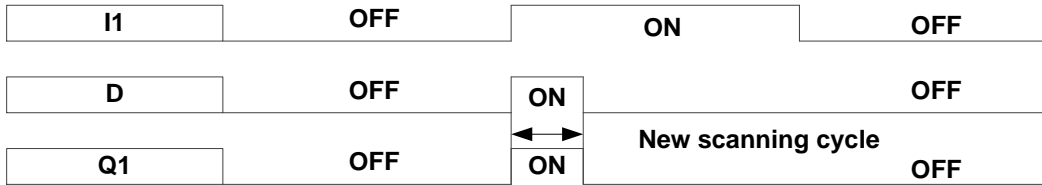
| | | | |
|---|---|---|---|
| **I1** | OFF | ON | OFF |

| | | | |
|---|---|---|---|
| **D** | OFF | ON | OFF |

New scanning cycle

| | | | |
|---|---|---|---|
| **Q1** | OFF | ON | OFF |

**Example 2**：i1—d ——[ Q1

| | | | |
|---|---|---|---|
| **I1'** | OFF | ON | OFF |

I1' is the inverse logic of i1

| | | | |
|---|---|---|---|
| **i1** | ON | OFF | ON |

| | | | |
|---|---|---|---|
| **d1** | OFF | ON | OFF |

New scanning cycle

| | | | |
|---|---|---|---|
| **Q1** | OFF | ON | OFF |

◎ **NORMAL( -[ ) output**
I1——[Q1

| | | | |
|---|---|---|---|
| **I1** | OFF | ON | OFF |

| | | | |
|---|---|---|---|
| **Q1** | OFF | ON | OFF |

◎ **SET（⋏）output**
I1—— ⋏ Q1

| | | | |
|---|---|---|---|
| **I1** | OFF | ON | OFF |

| | | |
|---|---|---|
| **Q1** | OFF | ON |

◎ **RESET（⋎）output**
I1—— ⋎ Q1

| | | | |
|---|---|---|---|
| **I1** | OFF | ON | OFF |

| | | |
|---|---|---|
| **Q1** | ON | OFF |

◎ **P output**
i1——PQ1

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **I1'** | OFF | ON | OFF | ON | OFF | ON | OFF |

I1' is the inverse logic of i1

| | |
|---|---|
| **i1** | |

| | | | | |
|---|---|---|---|---|
| **Q1** | ON | OFF | ON | OFF |
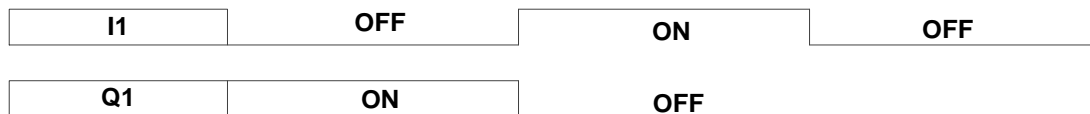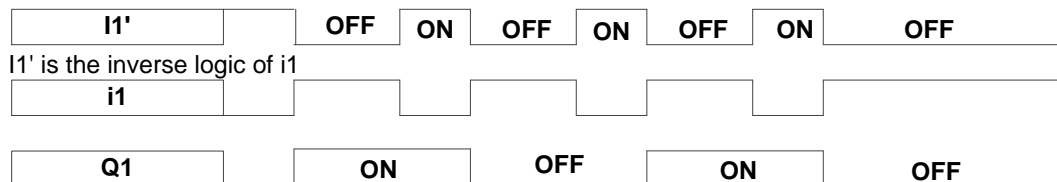
## 1.3 Application Functions

### 1: Counter Function
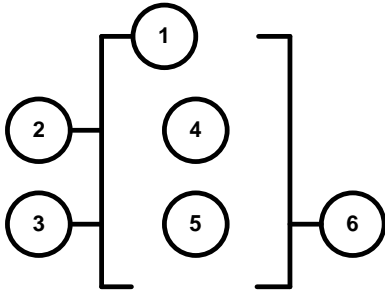
| Symbol | Description |
|---|---|
| ① | Counter mode (1 ~ 4) |
| ② | UP/Down counting modes can be set by (I1 ~ f8). |
| | OFF: Count up (0, 1, 2, 3…) |
| | ON: Count down (…3,2,1,0) |
| ③ | Use (I1~f8) to reset counting value |
| | ON: Internal count value is reset and counter output ⑥ is OFF |
| | 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.
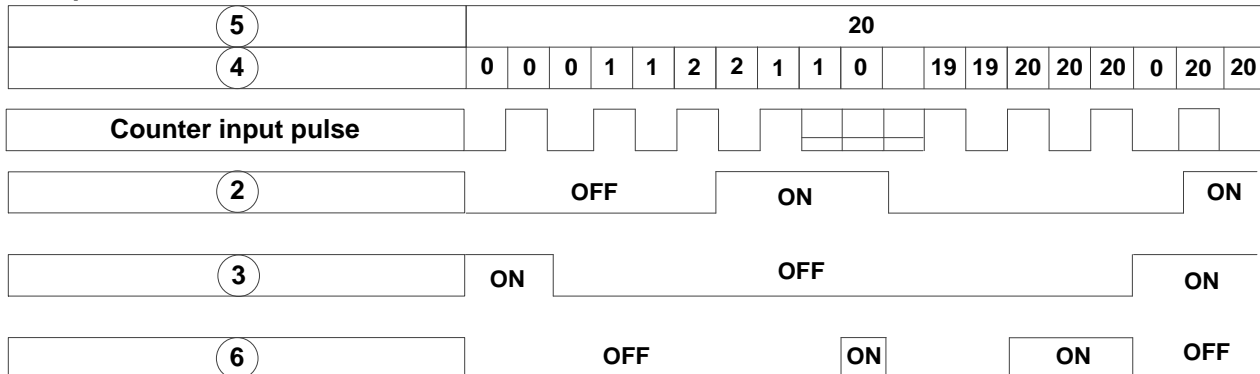Mode 2: Counter value is not locked. The value will not be retained when the power is cut off.
Mode 3: Counter value is locked. The value will be retained when the power is cut off.
Mode 4: Counter value is not locked. The value will be retained when the power is cut off.

### Counter mode 1

**Example:**

| ⑤ | | | | | 20 | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ④ | 0 | 0 | 0 | 1 | 1 | 2 | 2 | 1 | 1 | 0 | 19 | 19 | 20 | 20 | 20 | 0 | 20 | 20 |

Counter input pulse

| ② | | OFF | | ON | | | | ON |
|---|---|---|---|---|---|---|---|---|

| ③ | ON | | OFF | | | | ON |
|---|---|---|---|---|---|---|---|

| ⑥ | | OFF | | ON | | ON | OFF |
|---|---|---|---|---|---|---|---|

**Input from ladder program**

```
 I1 ── i2 ──────( [C3] )◄────┐
(C3)────    ── ──[Q1]        │
 m1┬─    ──  q1 ─[M2]        │
 M2┴                        │
```

┌─────────────────────────────┐
│ C3 input pulse counter is   │
│ determined by I1 and i2.    │
└─────────────────────────────┘

**Input from the function program**

┌──────────────────┐   ┌──────────────────┐
│ Up/down counting │   │    Internal      │
└──────────────────┘   │ Counter Value    │
                       └──────────────────┘

```
 (M2)   (0000)

 (I3)   (0020)──(C3)
```

┌──────────────────────────────────────────┐
│ C3 turns ON when the counter value        │
│ reaches the set Value and at the same     │
│ time, the C3 input in the ladder program  │
│ turns ON as well.                         │
└──────────────────────────────────────────┘

┌────────────────────┐   ┌────────────────────────┐
│ I3 ON reset        │   │ Counter compare value  │
│ Counter value      │   └────────────────────────┘
└────────────────────┘

**Counter mode 2**

| (5) | 20 | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (4) | 0 | 19 | 19 | 20 | 20 | 21 | 21 | 20 | 20 | 19 | 20 | 18 | 18 | 19 | 19 | 20 | 0 | 20 | 20 |

| Counter input pulse | ⎍⎍⎍⎍⎍⎍⎍⎍⎍⎍⎍⎍ |
|---|---|
| (2) | OFF · ON · ON |
| (3) | OFF · ON |
| (6) | OFF · ON · ON · OFF |

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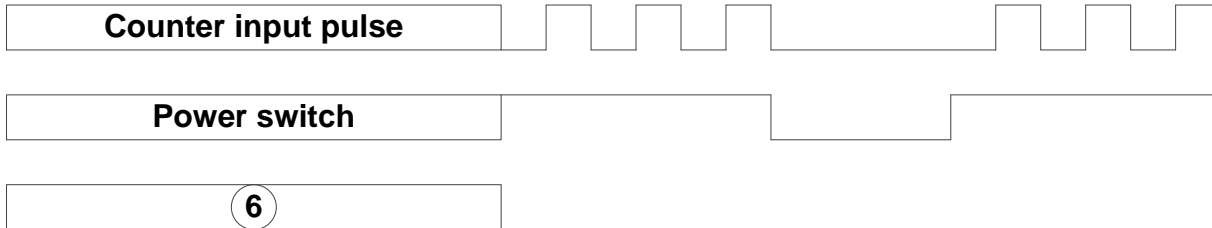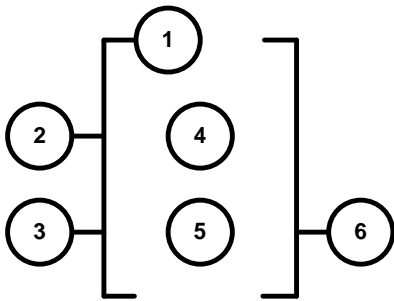
(1) Counter mode 3 is similar to the counter mode 1, with the exception that the counter value is saved when the drive is powered down and reloaded at power up.

(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.

| | ⑤ | | 20 | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ④ | Mode 1 & 2 | 1 | 1 | 2 | 2 | | | | 0 | 1 | 1 | 2 | 2 |
| | ④ | Mode 3 & 4 | 1 | 1 | 2 | 2 | 3 | | | 3 | 4 | 4 | 5 | 5 |

**Counter input pulse**

**Power switch**

⑥

## 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：**
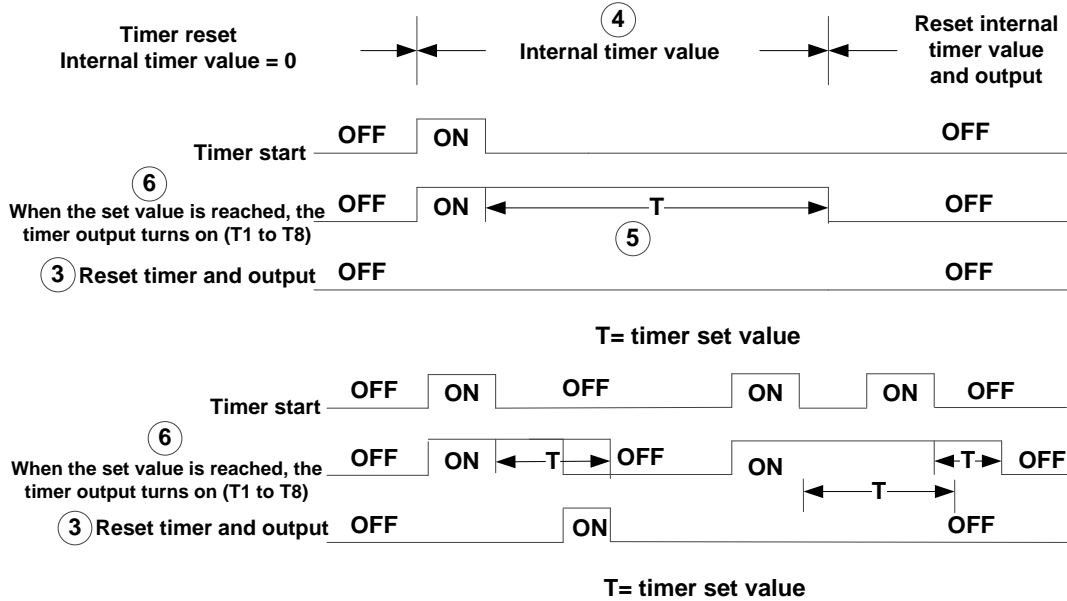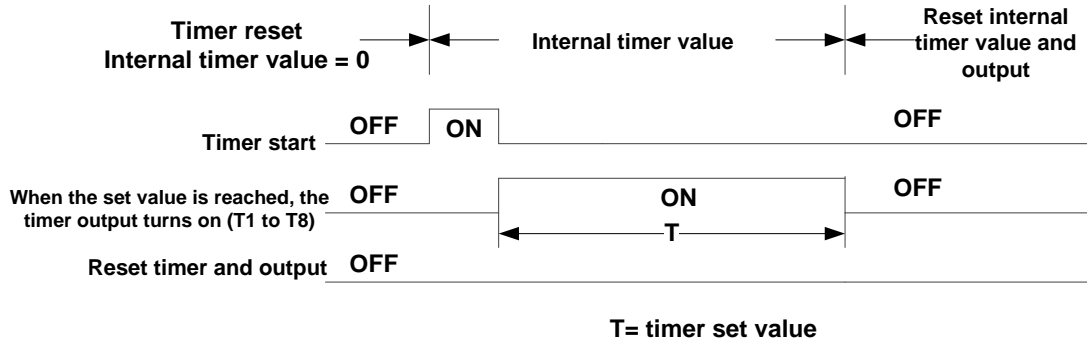
**(1) Timer mode 1 (ON-delay Timer mode 1)**

**Example:**

**Input from the Ladder Program**

I1 —————— [T5] ◄——— When I1= 0, the 5th timer starts

T5 ——— [Q1]

**Input under function Program Mode**

| Timing unit is 0.1 second | Timer Mode1 |

1

1    000.0    ◄——— When the time reaches the set value of 10.0 seconds, output T5 is turned ON.

010.0  T5
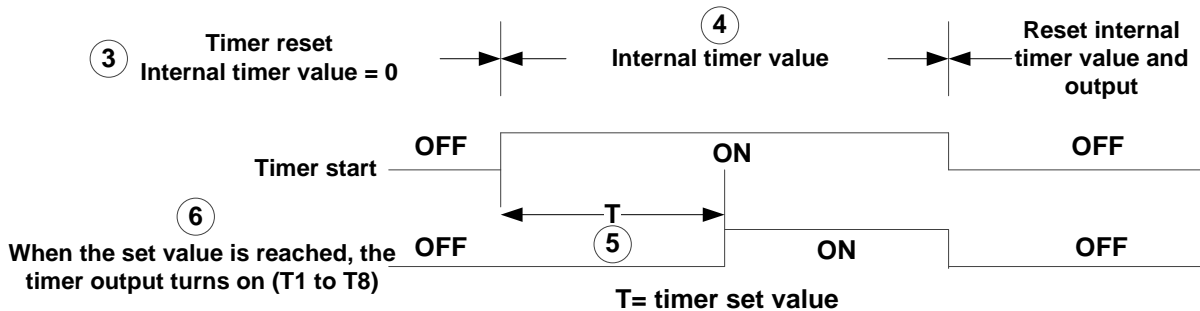
| Timer set value | | Present timing value |
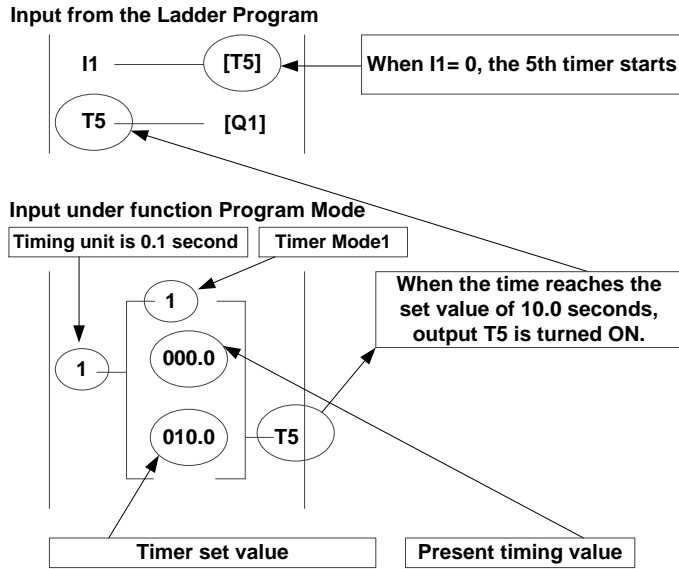
## (2) Timer mode 2 (ON-delay Timer mode 2)



Timer reset
Internal timer value = 0 ——► ◄—— Internal timer value ——► ◄—— Reset internal timer value and output

④

**Timer start**   OFF | ON | ON | OFF
◄t1►  ◄t2►

⑥
When the set value is reached, the timer output turns on (T1 to T8)   OFF | ⑤ T=t1+t2 | ON | OFF

③ Reset timer and output   OFF | ON | OFF

**T= timer set value**
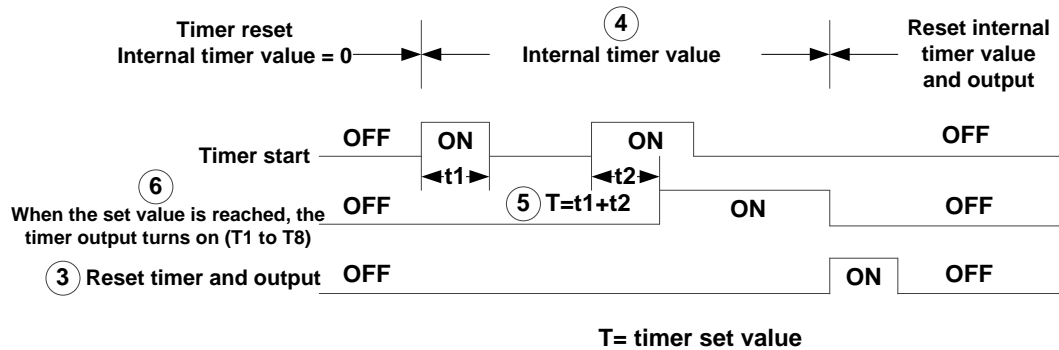
## (3) Timer mode 3 (OFF-delay Timer mode 1)



Timer reset
Internal timer value = 0 ——► ◄—— Internal timer value ——► ◄—— Reset internal timer value and output

④

**Timer start**   OFF | ON | OFF

⑥
When the set value is reached, the timer output turns on (T1 to T8)   OFF | ON ◄——— T ———► | OFF
⑤

③ Reset timer and output   OFF | OFF

**T= timer set value**

**Timer start**   OFF | ON | OFF | ON | ON | OFF

⑥
When the set value is reached, the timer output turns on (T1 to T8)   OFF | ON ◄—T—► OFF | ON | ◄T► OFF
◄——— T ———►

③ Reset timer and output   OFF | ON | OFF

**T= timer set value**

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

Timer reset
Internal timer value = 0
Internal timer value
Reset internal timer value and output

Timer start  OFF  ON  OFF

When the set value is reached, the timer output turns on (T1 to T8)  OFF  ON  OFF

T

Reset timer and output  OFF

**T= timer set value**

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

Timer reset
Internal timer value = 0
Present timing value starts change for timing
Reset internal timer value and output

Timer start

T  T  T  T

When the set value is reached, the timer output turns on (T1 to T8)

**T= timer set value**
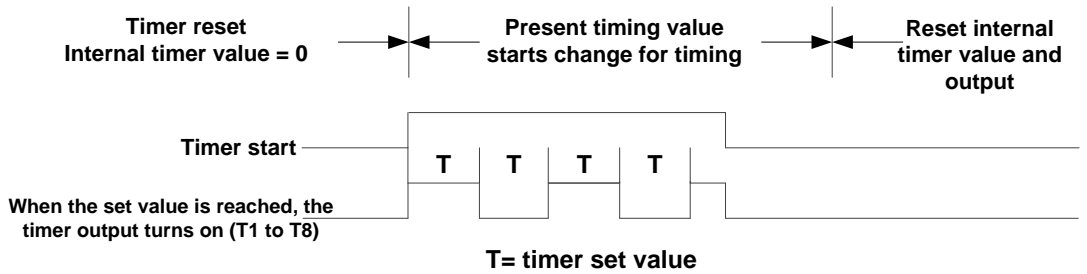
## (6) Timer mode 6 (FLASH Timer mode 2)

Timer reset
Internal timer value = 0
Internal timer value
Reset internal timer value and output

Timer start

T  T  T  T

When the set value is reached, the output point (T1 to T8)

Reset timer and output

**T= timer set value**
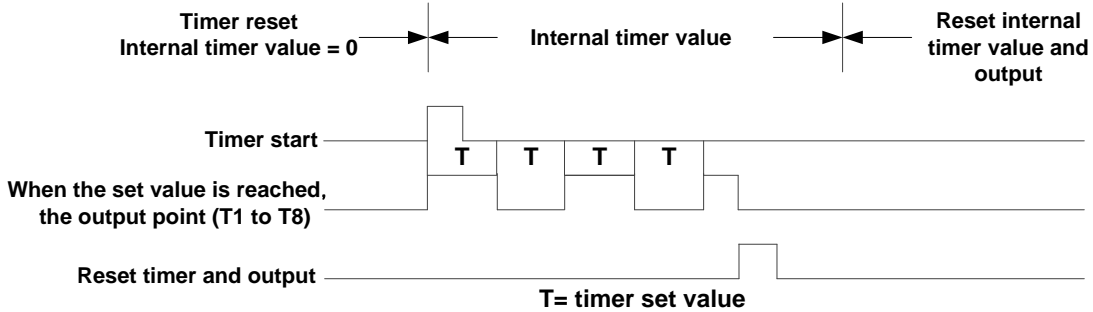
## (7) Timer mode 7 (FLASH Timer mode 3)

Timer reset
Internal timer value = 0
Internal timer value
Reset internal timer value and output

Timer start

t1  t2

When the set value is reached, the timer output turns on (T1 to T8)
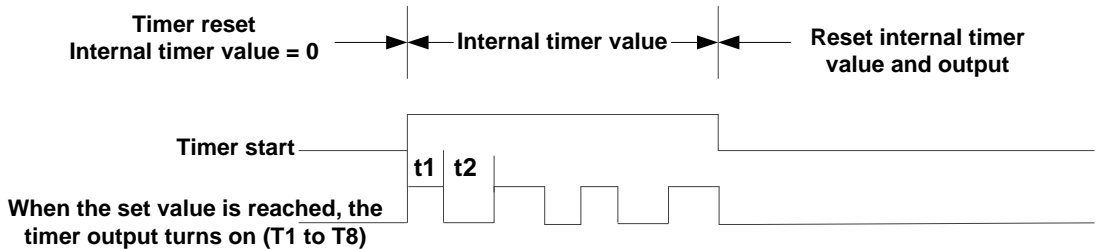
## 3: Analog comparator function
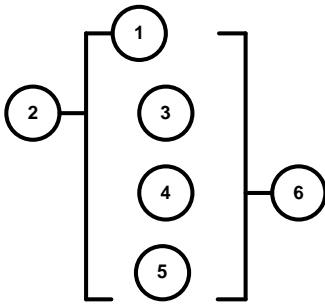


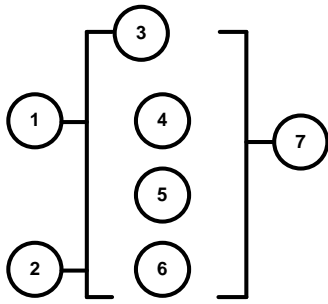| Symbol | Description |
|--------|-------------|
| ① | Analog comparator mode (1~3) |
| ② | Input comparison value selection (AS1~AS4,MD1~MD4,T1~T8,C1~C8,V1~V7) |
| ③ | Current analog input value |
| ④ | Set the reference comparison value (Upper limit) (AS1~AS4,MD1~MD4,T1~T8,C1~C8,V1~V7, constant ) |
| 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
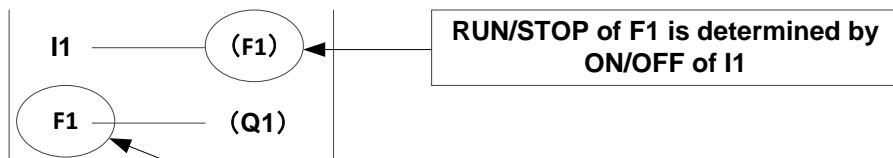(7) Input comparison value selection = V7: Torque value
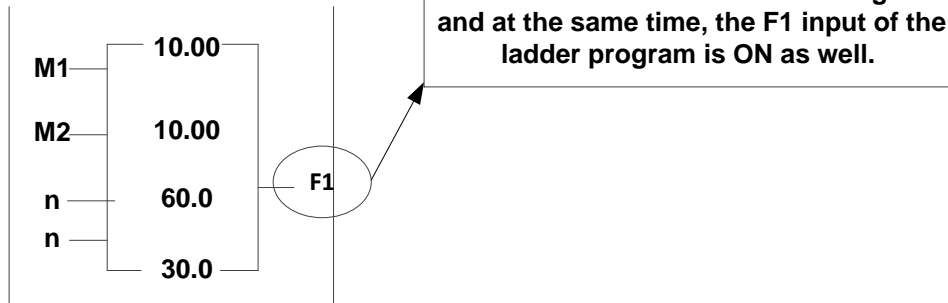
## 4: Operation control function



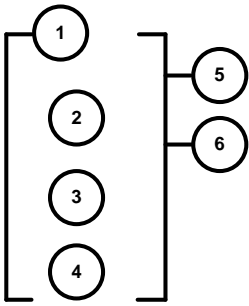| Symbol | Description |
|---|---|
| ① | Forward /Reversal control can be set by ( I1~f8 ) |
| | OFF: Forward(FWD) |
| | ON: Reversal(REV) |
| ② | Speed terminal control can be set by ( I1~f8 ) |
| | OFF: Operation based on ③ set frequency |
| | ON: Operation based on frequency of speed ④ |
| ③ | Set 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**



RUN/STOP of F1 is determined by
ON/OFF of I1

**Input from Function Program**

F1 is ON inverter starts running
and at the same time, the F1 input of the
ladder program is ON as well.

## 5: Summation and subtraction functions



RESULT (calculation result) = V1+ V2- V3

| Symbol | Description |
|--------|-------------|
| ① | Calculation result : RESULT |
| ② | Addition V1(AS1~AS4,MD1~MD4,T1~T8,C1~C8,V1~V7, constant ) |
| ③ | Addition V2(AS1~AS4,MD1~MD4,T1~T8,C1~C8,V1~V7, constant ) |
| ④ | Subtraction  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
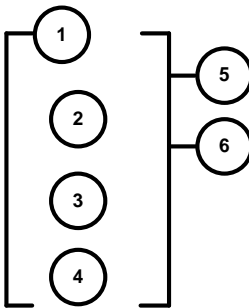


RESULT（calculation result）=V1*V2/V3

| 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) |

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