



# iMASTER – A1

## User's Manual

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# 1. A1 series VFD

## 1.1 Information before Use

### 1.1.1 Check of product

Bring the VFD out of the box, check the rating shown on a side of the product body and whether the VFD type and rated output are exactly what you ordered. Check also whether the product has been damaged during delivery.

**Model:** A1–140A<sup>(Note1)</sup>–2E– 00

| A1   |      | 140A                           |      | 2                         | E                | 00                   |
|------|------|--------------------------------|------|---------------------------|------------------|----------------------|
| name |      | Max. Applicable Motor Capacity |      | Input Voltage             | Keypad           | IP                   |
| A1   | 032A | 7.5                            | [kW] | 2: 3Phase<br>200 ~ 240[V] | E: LED<br>C: LCD | 00: IP00<br>54: IP54 |
|      | 045A | 11                             | [kW] |                           |                  |                      |
|      | 064A | 15                             | [kW] |                           |                  |                      |
|      | 076A | 18.5                           | [kW] |                           |                  |                      |
|      | 090A | 22                             | [kW] |                           |                  |                      |
|      | 114A | 30                             | [kW] |                           |                  |                      |
|      | 140A | 37                             | [kW] |                           |                  |                      |
|      | 170A | 45                             | [kW] |                           |                  |                      |
|      | 205A | 55                             | [kW] |                           |                  |                      |
|      | 261A | 75                             | [kW] |                           |                  |                      |
|      | 310A | 90                             | [kW] |                           |                  |                      |
|      | 016A | 7.5                            | [kW] | 4: 3Phase<br>380 ~ 480[V] |                  |                      |
|      | 023A | 11                             | [kW] |                           |                  |                      |
|      | 032A | 15                             | [kW] |                           |                  |                      |
|      | 038A | 18.5                           | [kW] |                           |                  |                      |
|      | 045A | 22                             | [kW] |                           |                  |                      |
|      | 058A | 30                             | [kW] |                           |                  |                      |
|      | 075A | 37                             | [kW] |                           |                  |                      |
|      | 090A | 45                             | [kW] |                           |                  |                      |
|      | 110A | 55                             | [kW] |                           |                  |                      |
|      | 149A | 75                             | [kW] |                           |                  |                      |
|      | 176A | 90                             | [kW] |                           |                  |                      |
|      | 217A | 110                            | [kW] |                           |                  |                      |
|      | 260A | 132                            | [kW] |                           |                  |                      |
|      | 296A | 160                            | [kW] |                           |                  |                      |

### 1.1.2 Parts

If you have any doubt about the product or found the product damaged, call our company's branch offices (see the back cover of the manual)

### 1.1.3 Preparation of device and Parts for operation

Preparation for operation might slightly vary. Prepare parts according to the use.

### 1.1.4 Installation

Make sure you install the product correctly considering the place, direction or surroundings in order to prevent decrease in the life and performance of the VFD.

### 1.1.5 Distribution

Connect the power supply, electric motor and operating signals (control signals) to the terminal block. If you fail to connect them correctly, the VFD and peripheral devices might be damaged.

## 1.2 Names and Uses of Parts

### 1.2.1 End product



### 1.2.2 Remove the front cover



## 2. Specifications

### 2.1 Specifications

#### 2.1.1 200V class (032A ~ 310A)

| Model A1-xxxA <sup>(Note1)</sup> -2   |                                                |    |      | 032                                 | 045  | 064  | 076  | 090  | 114  |  |
|---------------------------------------|------------------------------------------------|----|------|-------------------------------------|------|------|------|------|------|--|
| Motor Applied [kW] <sup>(Note2)</sup> |                                                |    | HD   | 5.5                                 | 7.5  | 11   | 15   | 18.5 | 22   |  |
|                                       |                                                |    | ND   | 7.5                                 | 11   | 15   | 18.5 | 22   | 30   |  |
| Rated Output                          | Rated Output <sup>(Note3)</sup><br>Current [A] |    | HD   | 24                                  | 32   | 45   | 64   | 76   | 90   |  |
|                                       |                                                |    | ND   | 32                                  | 45   | 64   | 76   | 90   | 114  |  |
|                                       | Rated Capacity [kVA]                           | HD | 200V | 8                                   | 11   | 16   | 22   | 26   | 31   |  |
|                                       |                                                |    | 240V | 10                                  | 13   | 19   | 27   | 32   | 37   |  |
|                                       |                                                | ND | 200V | 11                                  | 16   | 22   | 26   | 31   | 39   |  |
|                                       |                                                |    | 240V | 13                                  | 19   | 27   | 32   | 37   | 47   |  |
|                                       | Output Frequency [Hz]                          |    |      | 0~400Hz <sup>(Note4)</sup>          |      |      |      |      |      |  |
|                                       | Output Voltage [V]                             |    |      | 3 Phase 200~240V <sup>(Note5)</sup> |      |      |      |      |      |  |
| Rated Input                           | Available Voltage [V]                          |    |      | 3 phase 200~240V (±10%)             |      |      |      |      |      |  |
|                                       | Input Frequency [Hz]                           |    |      | 50/ 60Hz (±5%)                      |      |      |      |      |      |  |
|                                       | Rated Input Current [A]                        |    | HD   | 23                                  | 32   | 45   | 64   | 77   | 92   |  |
|                                       |                                                |    | ND   | 31                                  | 45   | 64   | 77   | 91   | 116  |  |
|                                       | Power loss [kW]                                |    | HD   | 0.15                                | 0.21 | 0.31 | 0.42 | 0.52 | 0.62 |  |
| ND                                    |                                                |    | 0.21 | 0.31                                | 0.42 | 0.52 | 0.62 | 0.84 |      |  |
| EMC Filter                            |                                                |    |      | Built-in 61800-3 C3                 |      |      |      |      |      |  |

| Model A1-xxxA <sup>(Note1)</sup> -2   |                                                |      |       | 140                                 | 170   | 205   | 261   | 310 | - |
|---------------------------------------|------------------------------------------------|------|-------|-------------------------------------|-------|-------|-------|-----|---|
| Motor Applied [kW] <sup>(Note2)</sup> |                                                |      | HD    | 30                                  | 37    | 45    | 55    | 75  | - |
|                                       |                                                |      | ND    | 37                                  | 45    | 55    | 75    | 90  | - |
| Rated Output                          | Rated Output <sup>(Note3)</sup><br>Current [A] |      | HD    | 114                                 | 140   | 170   | 211   | 261 | - |
|                                       |                                                |      | ND    | 140                                 | 170   | 205   | 261   | 310 | - |
|                                       | Rated Capacity [kVA]                           | HD   | 200V  | 39                                  | 48    | 59    | 73    | 90  | - |
|                                       |                                                |      | 240V  | 47                                  | 58    | 71    | 88    | 108 | - |
|                                       |                                                | ND   | 200V  | 48                                  | 59    | 71    | 90    | 107 | - |
|                                       |                                                |      | 240V  | 58                                  | 71    | 85    | 108   | 129 | - |
|                                       | Output Frequency [Hz]                          |      |       | 0~400Hz <sup>(Note4)</sup>          |       |       |       |     |   |
|                                       | Output Voltage [V]                             |      |       | 3 Phase 200~240V <sup>(Note5)</sup> |       |       |       |     |   |
| Rated Input                           | Available Voltage [V]                          |      |       | 3 phase 200~240V (±10%)             |       |       |       |     |   |
|                                       | Input Frequency [Hz]                           |      |       | 50/ 60Hz (±5%)                      |       |       |       |     |   |
|                                       | Rated Input Current [A]                        | HD   | 102.9 | 126.9                               | 154.4 | 187.7 | 257.3 | -   |   |
|                                       |                                                | ND   | 126.9 | 154.4                               | 188.7 | 257.3 | 308.8 | -   |   |
|                                       | Power loss [kW]                                | HD   | 0.60  | 0.74                                | 0.90  | 1.10  | 1.50  | -   |   |
| ND                                    |                                                | 0.74 | 0.90  | 1.10                                | 1.50  | 1.80  | -     |     |   |
| EMC Filter                            |                                                |      |       | Built-in 61800-3 C3                 |       |       |       |     |   |

## 2.1.2 400V class (016A ~ 217A)

| Model A1-xxxA <sup>(Note1)</sup> -4   |                                                |    |      | 016 | 023                                 | 032  | 038  | 045  | 058  |      |
|---------------------------------------|------------------------------------------------|----|------|-----|-------------------------------------|------|------|------|------|------|
| Motor Applied [kW] <sup>(Note2)</sup> |                                                |    |      | HD  | 5.5                                 | 7.5  | 11   | 15   | 18.5 | 22   |
|                                       |                                                |    |      | ND  | 7.5                                 | 11   | 15   | 18.5 | 22   | 30   |
| Rated Output                          | Rated Output <sup>(Note3)</sup><br>Current [A] |    |      | HD  | 12                                  | 16   | 23   | 32   | 38   | 45   |
|                                       |                                                |    |      | ND  | 16                                  | 23   | 32   | 38   | 45   | 58   |
|                                       | Rated Capacity [kVA]                           | HD | 380V | 8   | 11                                  | 15   | 21   | 25   | 30   |      |
|                                       |                                                |    | 480V | 10  | 13                                  | 19   | 27   | 32   | 37   |      |
|                                       |                                                | ND | 380V | 11  | 15                                  | 21   | 25   | 30   | 38   |      |
|                                       |                                                |    | 480V | 13  | 19                                  | 27   | 32   | 37   | 48   |      |
|                                       | Output Frequency [Hz]                          |    |      |     | 0~400Hz <sup>(Note4)</sup>          |      |      |      |      |      |
|                                       | Output Voltage [V]                             |    |      |     | 3 Phase 380~480V <sup>(Note5)</sup> |      |      |      |      |      |
| Rated Input                           | Available Voltage [V]                          |    |      |     | 3-phase 380~480V (±10%)             |      |      |      |      |      |
|                                       | Input Frequency [Hz]                           |    |      |     | 50/ 60Hz (±5%)                      |      |      |      |      |      |
|                                       | Rated Input Current [A]                        |    |      | HD  | 12                                  | 16   | 23   | 32   | 38   | 46   |
|                                       |                                                |    |      | ND  | 16                                  | 23   | 32   | 38   | 45   | 59   |
|                                       | Power loss [kW]                                |    |      | HD  | 0.15                                | 0.21 | 0.31 | 0.42 | 0.52 | 0.62 |
|                                       |                                                |    |      | ND  | 0.21                                | 0.31 | 0.42 | 0.52 | 0.62 | 0.84 |
| EMC Filter                            |                                                |    |      |     | Built-in 61800-3 C3                 |      |      |      |      |      |

| Model A1-xxxA <sup>(Note1)</sup> -4   |                                                |    |      | 075                                 | 090  | 110   | 149   | 176   | 217   |
|---------------------------------------|------------------------------------------------|----|------|-------------------------------------|------|-------|-------|-------|-------|
| Motor Applied [kW] <sup>(Note2)</sup> |                                                |    | HD   | 30                                  | 37   | 45    | 55    | 75    | 90    |
|                                       |                                                |    | ND   | 37                                  | 45   | 55    | 75    | 90    | 110   |
| Rated Output                          | Rated Output <sup>(Note3)</sup><br>Current [A] |    | HD   | 58                                  | 75   | 90    | 110   | 149   | 176   |
|                                       |                                                |    | ND   | 75                                  | 90   | 110   | 149   | 176   | 217   |
|                                       | Rated Capacity [kVA]                           | HD | 380V | 38                                  | 49   | 59    | 72    | 98    | 116   |
|                                       |                                                |    | 480V | 48                                  | 62   | 75    | 91    | 124   | 146   |
|                                       |                                                | ND | 380V | 49                                  | 59   | 72    | 98    | 116   | 143   |
|                                       |                                                |    | 480V | 62                                  | 75   | 91    | 124   | 146   | 180   |
|                                       | Output Frequency [Hz]                          |    |      | 0~400Hz <sup>(Note4)</sup>          |      |       |       |       |       |
|                                       | Output Voltage [V]                             |    |      | 3 Phase 380~480V <sup>(Note5)</sup> |      |       |       |       |       |
| Rated Input                           | Available Voltage [V]                          |    |      | 3-phase 380~480V (±10%)             |      |       |       |       |       |
|                                       | Input Frequency [Hz]                           |    |      | 50/ 60Hz (±5%)                      |      |       |       |       |       |
|                                       | Rated Input Current [A]                        |    | HD   | 59.6                                | 73.5 | 89.4  | 109.2 | 149.0 | 178.8 |
|                                       |                                                |    | ND   | 73.5                                | 89.4 | 109.2 | 149.0 | 178.8 | 218.5 |
|                                       | Power loss [kW]                                |    | HD   | 0.60                                | 0.74 | 0.90  | 1.10  | 1.50  | 1.80  |
| ND                                    |                                                |    | 0.74 | 0.90                                | 1.10 | 1.50  | 1.80  | 2.20  |       |
| EMC Filter                            |                                                |    |      | Built-in 61800-3 C3                 |      |       |       |       |       |

## 2.1.3 400V class (260A ~ 296A)

| Model A1 –xxxA <sup>(Note1)</sup> –4  |                                                |      |       | 260                                 | 296 | – | – | – | – |
|---------------------------------------|------------------------------------------------|------|-------|-------------------------------------|-----|---|---|---|---|
| Motor Applied [kW] <sup>(Note2)</sup> |                                                |      | HD    | 110                                 | 132 | – | – | – | – |
|                                       |                                                |      | ND    | 132                                 | 160 | – | – | – | – |
| Rated Output                          | Rated Output <sup>(Note3)</sup><br>Current [A] |      | HD    | 217                                 | 260 | – | – | – | – |
|                                       |                                                |      | ND    | 260                                 | 296 | – | – | – | – |
|                                       | Rated Capacity [kVA]                           | HD   | 380V  | 143                                 | 171 | – | – | – | – |
|                                       |                                                |      | 480V  | 180                                 | 216 | – | – | – | – |
|                                       |                                                | ND   | 380V  | 171                                 | 195 | – | – | – | – |
|                                       |                                                |      | 480V  | 216                                 | 246 | – | – | – | – |
|                                       | Output Frequency [Hz]                          |      |       | 0~400Hz <sup>(Note4)</sup>          |     |   |   |   |   |
|                                       | Output Voltage [V]                             |      |       | 3 Phase 380~480V <sup>(Note5)</sup> |     |   |   |   |   |
| Rated Input                           | Available Voltage [V]                          |      |       | 3–phase 380~480V (±10%)             |     |   |   |   |   |
|                                       | Input Frequency [Hz]                           |      |       | 50/ 60Hz (±5%)                      |     |   |   |   |   |
|                                       | Rated Input Current [A]                        | HD   | 218.5 | 262.2                               | –   | – | – | – |   |
|                                       |                                                | ND   | 262.2 | 317.8                               | –   | – | – | – |   |
|                                       | Power loss [kW]                                | HD   | 2.20  | 2.64                                | –   | – | – | – |   |
| ND                                    |                                                | 2.64 | 3.20  | –                                   | –   | – | – |   |   |
| EMC Filter                            |                                                |      |       | Built-in 61800–3 C3                 |     |   |   |   |   |

Note 1) The number that has included at model name means rated current of VFD

Note 2) Motor Applied indicates the maximum capacity applied to use of a standard 4 pole standard motor.

Note 3) The output of rated current is limited according to setting of the carrier frequency.

Note 4) In case of Sensorless, you can set the frequency at up to 300Hz by selecting 2 as the **'98.01' (Motor control mode)**

Note 5) The maximum output voltage does not go up over the supplied power voltage. You can select the output voltage as you want below the supplied power voltage.

## 2.1.4 Other commons

### 1) Control & Operation

| Features                                  |                            | Performance Specification                                                                                                                                                                                                                                                                                                                                              |
|-------------------------------------------|----------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Control Method <sup>(Note1)</sup>         |                            | V/F control, Sensorless Vector                                                                                                                                                                                                                                                                                                                                         |
| Output Frequency Range <sup>(Note2)</sup> |                            | 0.5 ~ 400Hz (Sensorless Vector Control: 0.5 ~ 300Hz)                                                                                                                                                                                                                                                                                                                   |
| Frequency Accuracy                        |                            | Digital command $\pm 0.01\%$ of Max Frequency /<br>Analog Frequency $\pm 0.1\%$ ( $25 \pm 10^\circ\text{C}$ )                                                                                                                                                                                                                                                          |
| Frequency Resolution                      |                            | Digital Setting : 0.01Hz (below 100Hz), 0.1Hz (above 100Hz)<br>Analog setting: 0.06Hz (DC 0~10V, 4~20mA)                                                                                                                                                                                                                                                               |
| Voltage/ frequency Characteristic         |                            | Constant torque, Variable torque                                                                                                                                                                                                                                                                                                                                       |
| Carrier Frequency                         |                            | 1~10kHz (default: ND 2kHz, HD 3kHz)                                                                                                                                                                                                                                                                                                                                    |
| Overload Current Rate                     |                            | Heavy Duty(150%, 1min), Normal Duty(120%, 1min)                                                                                                                                                                                                                                                                                                                        |
| Acceleration/Deceleration                 |                            | 0.1~3000 sec (Linear, S curve, U curve), 2 <sup>ND</sup> Acceleration and Deceleration                                                                                                                                                                                                                                                                                 |
| DC Injection Braking                      |                            | Separately configurable start and stop up to 10 sec,<br>100 % motor rated current                                                                                                                                                                                                                                                                                      |
| Input Signal                              | Frequency                  | <ul style="list-style-type: none"> <li>Set by Keypad (LED, LCD)</li> <li>Input voltage: DC 0~10V (Input impedance 10K<math>\Omega</math>)</li> <li>Input current: DC 4~20mA (Input impedance 200<math>\Omega</math>)</li> </ul>                                                                                                                                        |
|                                           | Run/Stop                   | <ul style="list-style-type: none"> <li>Run / Stop key</li> <li>Input Terminal: Forward Run/Reverse Run</li> <li>Input Terminal: Start, Stop, FW/RV Selection</li> </ul>                                                                                                                                                                                                |
|                                           | Intelligent Input Terminal | <ul style="list-style-type: none"> <li>Run selection 1~2, Run source 1~3</li> <li>Frequency selection 1~2</li> <li>Multi-speed Inputs 1~3</li> <li>Jogging 1~2</li> <li>External trip 1~5</li> <li>UP/DOWN</li> <li>PID Integral Reset, PID Disable</li> <li>2nd Acceleration / Deceleration</li> <li>Emergency Stop</li> <li>Reset</li> <li>Parameter lock</li> </ul> |

| Features      |                                                               | Performance Specification                                                                                                                                                                                                                                                          |
|---------------|---------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Output Signal | Intelligent Output Terminal<br>(RN0–RN1,RN2–RN3, AL0–AL1–AL2) | <ul style="list-style-type: none"> <li>▪ Run (VFD Running Status Signal)</li> <li>▪ FA1 (Frequency Arrival Signal 1)</li> <li>▪ FA2 (Frequency Arrival Signal 2)</li> <li>▪ OL (Overload Alarm)</li> <li>▪ OD (PID Error Deviation Signal)</li> <li>▪ AL (Fault Signal)</li> </ul> |
|               | FM Output                                                     | Analog Output Meter (DC 0~10V full scale. Max • 1mA)<br>Output Frequency, Output Current, Output Voltage, Output Power and Output Torque                                                                                                                                           |
|               | AMI Output                                                    | Analog Output Meter (4~20mA full scale. Max • 250Ω)<br>Output Frequency, Output Current, Output Voltage, Output Power and Output Torque                                                                                                                                            |

## 2) Application & Protection Functions

| Features                            | Performance Specification                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|-------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Application Specification Functions | <ul style="list-style-type: none"> <li>▪ Curved Acceleration / Deceleration Profile,</li> <li>▪ Upper and Lower Limiters,</li> <li>▪ 8–stage Speed Profile,</li> <li>▪ Carrier Frequency Change (1 to 10Khz),</li> <li>▪ Frequency Skip</li> <li>▪ Process Jogging,</li> <li>▪ Electronic Thermal Level Adjustment,</li> <li>▪ Retry Function,</li> <li>▪ Trip History Monitor,</li> <li>▪ Auto Tuning,</li> <li>▪ V/f Characteristic Selection,</li> <li>▪ Speed Search</li> <li>▪ Automatic Torque Boost,</li> <li>▪ Frequency Conversion Display,</li> </ul> |
| Protection Functions                | <ul style="list-style-type: none"> <li>▪ Over Current / Short Circuit</li> <li>▪ DC link Over Voltage /DC link Under Voltage,</li> <li>▪ Motor Overload,</li> <li>▪ VFD Overload</li> <li>▪ EEPROM Error,</li> <li>▪ Communication Error,</li> <li>▪ IGBT Over Temperature,</li> <li>▪ Input Phase loss,</li> <li>▪ Ground Fault,</li> <li>▪ External Event</li> <li>▪ Fan Fault</li> <li>▪ OVS Control Fail</li> <li>▪ Safety</li> </ul>                                                                                                                       |

### 3) Use Environment & Option

| Feature                   |                     | Performance Specification                                                                                                                                                                                                                                   |
|---------------------------|---------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Environment specification | Ambient Temperature | CT (Heavy Duty) load: – 10 ~ 50°C<br>VT (Normal Duty) load: – 10~ 40°C<br>(It is recommended that you use less than 80% load when you use VT load at 50°C. And if ambient temperature is above 40°C, Carrier frequency should be lower than default value.) |
|                           | Storage temperature | –20~60°C                                                                                                                                                                                                                                                    |
|                           | Ambient humidity    | Below 90% RH (Installed with no dew condensation)                                                                                                                                                                                                           |
|                           | Vibration           | 5.9m/s <sup>2</sup> (0.6G). 10~55Hz                                                                                                                                                                                                                         |
|                           | Shock               | 10 Hz to 20Hz, 9.8m/s <sup>2</sup> Max, 20Hz to 55Hz, 5.9m/s <sup>2</sup> Max                                                                                                                                                                               |
|                           | Location            | Under 1000m above sea level, indoors<br>(Installed away from corrosive gasses dust)                                                                                                                                                                         |
| Standard Compliant        |                     | UL 508C, IEC 61800–3                                                                                                                                                                                                                                        |
| Protective Design         |                     | IP00 open–chassis, NEMA Type 1 enclosure.                                                                                                                                                                                                                   |
| Option                    |                     | Fieldbus, Ext I/O, Encoder, Remote operator, Bracket, AC reactor, Noise filter, Braking resistor, Dynamic braking unit<br>(EMC filter and DC reactor are Built in.)                                                                                         |

Note 1) **'98.01'(Motor control mode)** to 2 (sensorless vector control) Selected, refer to below

- Set a value more than 2kHz at **'98.03'(PWM carrier frequency)**
- Sensorless vector performance will be reduced when using a motor less than half of the rated capacity of the VFD.
- Multiple motors cannot be driven by sensorless vector control.

Note 2) To operate the motor over rated frequency, consult the motor manufacturer about the maximum allowable rotation speed.

## 3. Installation

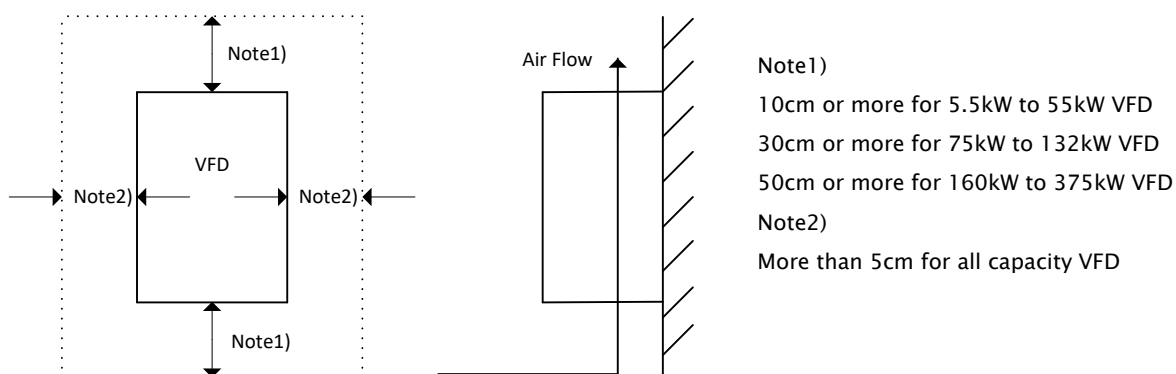
### 3.1 Installation

#### 3.1.1 Cautions before installation

#### CAUTION

Failure to following recommendation may result in VFD damage, Personal Injury, or Fire.

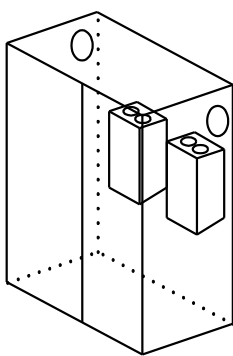
- Be sure to install the unit on flame resistant material such as metal.
- Be sure not to place anything flammable such as corrosive gas, explosive gas, inflammable gas, grinding fluid mist, salt in the vicinity
- Do not carry the unit by the top cover, but always by supporting the base of the unit
- Be sure not to let foreign matter enter such as cut wire refuse, spatter from welding, iron refuse, wire, dust, etc.
- Be sure to install the VFD in a place which can support the weight according to the specification in the manual.
- Be sure to install the unit on a perpendicular wall which is not subject to vibration.
- Be sure not to install and operate a damaged VFD or one with the missed parts
- Be sure to install the unit in an area which is not exposed to direct sunlight and well ventilated. Avoid an environment which tends to be high in temperature, high in humidity or to have condensation.



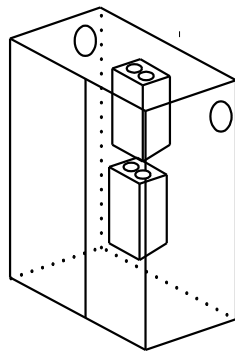
It is critical to mount the VFD to the proper surface in order to prevent any possible risk of fire. The temperature of the VFD heatsink can rise very high. The surface must be made of a non-flammable material (i.e. steel). Attention should also be made to the air gap surrounding the VFD. Especially, when there is a heat source such as a braking resistor or reactor.

**⚠ CAUTION**

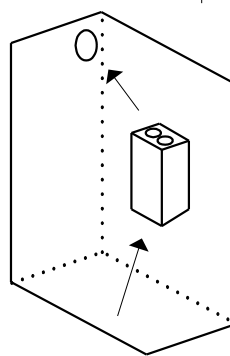
- Avoid direct ray of light or a warm and humid place.
- Install the VFD in a place free from dust, corrosive gas, explosive gas, combustible gas, mist of coolant and sea damage.
- Allowable Temperature range (14 to 122°F, –10 to 50°C).
- Allowable humidity range (Below 90% RH).



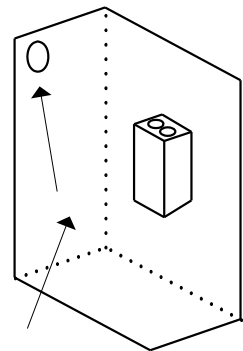
Acceptable (O)



Unacceptable (X)



Acceptable (O)



Unacceptable (X)

Mount the VFD in a vertical position using screws or bolts. The mounting surface should also be free from vibration and can easily hold the weight of the VFD.

### 3.1.2 A1 Dimension (IP00)

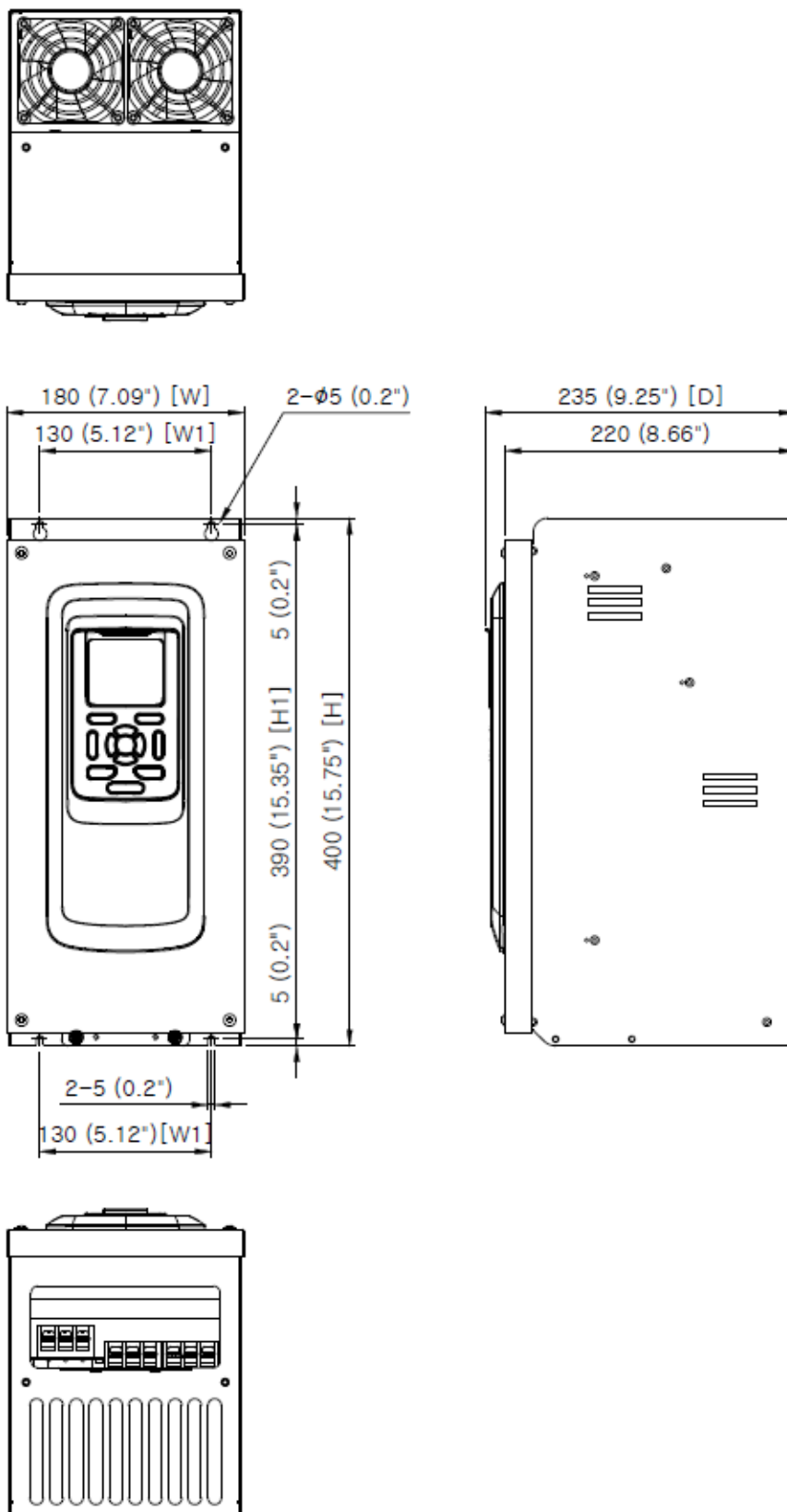
Summarized that is the dimension of A1 models

Respective drawing and sizes are specified in 1) ~ 4)

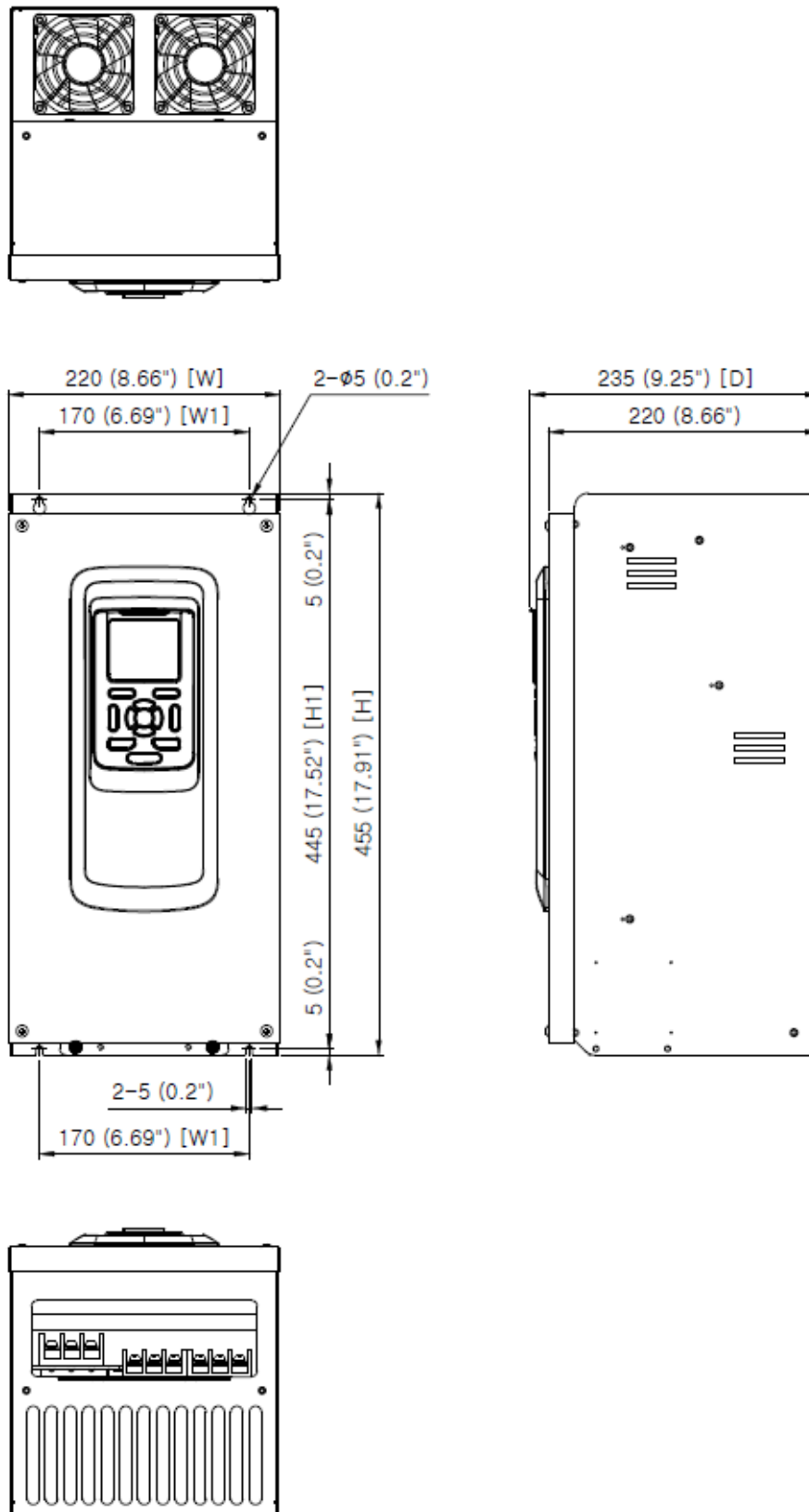
| Model     | Frame | W<br>[mm] | W1<br>[mm] | H<br>[mm] | H1<br>[mm] | D<br>[mm] | Weight<br>[KG] |
|-----------|-------|-----------|------------|-----------|------------|-----------|----------------|
| A1-032A-2 | F1    | 180       | 130        | 400       | 390        | 235       | 8.00           |
| A1-045A-2 | F1    | 180       | 130        | 400       | 390        | 235       | 8.00           |
| A1-064A-2 | F1    | 180       | 130        | 400       | 390        | 235       | 8.00           |
| A1-076A-2 | F2    | 220       | 170        | 455       | 445        | 235       | 11.00          |
| A1-090A-2 | F2    | 220       | 170        | 455       | 445        | 235       | 11.00          |
| A1-114A-2 | F3    | 270       | 200        | 550       | 532        | 265       | 18.30          |
| A1-140A-2 | F3    | 270       | 200        | 550       | 532        | 265       | 24.04          |
| A1-170A-2 | F4    | 295       | 200        | 660       | 642        | 265       | 34.26          |
| A1-205A-2 | F4    | 295       | 200        | 660       | 642        | 265       | 34.26          |
| A1-261A-2 | F5    | 345       | 230        | 760       | 735        | 275       | 45.08          |
| A1-310A-2 | F5    | 345       | 230        | 760       | 735        | 275       | 46.04          |
| A1-016A-4 | F1    | 180       | 130        | 400       | 390        | 235       | 8.00           |
| A1-023A-4 | F1    | 180       | 130        | 400       | 390        | 235       | 8.00           |
| A1-032A-4 | F1    | 180       | 130        | 400       | 390        | 235       | 8.00           |
| A1-038A-4 | F2    | 220       | 170        | 455       | 445        | 235       | 11.00          |
| A1-045A-4 | F2    | 220       | 170        | 455       | 445        | 235       | 11.00          |
| A1-058A-4 | F2    | 220       | 170        | 455       | 445        | 235       | 11.00          |
| A1-075A-4 | F3    | 270       | 200        | 550       | 532        | 265       | 23.30          |
| A1-090A-4 | F3    | 270       | 200        | 550       | 532        | 265       | 23.50          |
| A1-110A-4 | F4    | 295       | 200        | 660       | 642        | 265       | 30.74          |
| A1-149A-4 | F4    | 295       | 200        | 660       | 642        | 265       | 30.94          |
| A1-176A-4 | F5    | 345       | 230        | 760       | 735        | 275       | 44.40          |
| A1-217A-4 | F5    | 345       | 230        | 760       | 735        | 275       | 44.92          |
| A1-260A-4 | F6    | 385       | 280        | 800       | 775        | 275       | 55.48          |
| A1-296A-4 | F6    | 385       | 280        | 800       | 775        | 275       | 56.24          |

| Model     | Frame | W<br>[inch] | W1<br>[inch] | H<br>[inch] | H1<br>[inch] | D<br>[inch] | Weight<br>[lbs] |
|-----------|-------|-------------|--------------|-------------|--------------|-------------|-----------------|
| A1-032A-2 | F1    | 7.09        | 5.12         | 15.75       | 15.35        | 9.25        | 17.63           |
| A1-045A-2 | F1    | 7.09        | 5.12         | 15.75       | 15.35        | 9.25        | 17.63           |
| A1-064A-2 | F1    | 7.09        | 5.12         | 15.75       | 15.35        | 9.25        | 17.63           |
| A1-076A-2 | F2    | 8.66        | 6.69         | 17.91       | 17.52        | 9.25        | 24.25           |
| A1-090A-2 | F2    | 8.66        | 6.69         | 17.91       | 17.52        | 9.25        | 24.25           |
| A1-114A-2 | F3    | 10.63       | 7.87         | 21.65       | 20.94        | 10.43       | 18.3            |
| A1-140A-2 | F3    | 10.63       | 7.87         | 21.65       | 20.94        | 10.43       | 53.00           |
| A1-170A-2 | F4    | 11.61       | 7.87         | 25.98       | 25.28        | 10.43       | 75.53           |
| A1-205A-2 | F4    | 11.61       | 7.87         | 25.98       | 25.28        | 10.43       | 75.53           |
| A1-261A-2 | F5    | 13.58       | 9.06         | 29.92       | 28.94        | 10.83       | 99.38           |
| A1-310A-2 | F5    | 13.58       | 9.06         | 29.92       | 28.94        | 10.83       | 101.50          |
| A1-016A-4 | F1    | 7.09        | 5.12         | 15.75       | 15.35        | 9.25        | 17.63           |
| A1-023A-4 | F1    | 7.09        | 5.12         | 15.75       | 15.35        | 9.25        | 17.63           |
| A1-032A-4 | F1    | 7.09        | 5.12         | 15.75       | 15.35        | 9.25        | 17.63           |
| A1-038A-4 | F2    | 8.66        | 6.69         | 17.91       | 17.52        | 9.25        | 24.25           |
| A1-045A-4 | F2    | 8.66        | 6.69         | 17.91       | 17.52        | 9.25        | 24.25           |
| A1-058A-4 | F2    | 8.66        | 6.69         | 17.91       | 17.52        | 9.25        | 24.25           |
| A1-075A-4 | F3    | 10.63       | 7.87         | 21.65       | 20.94        | 10.43       | 51.37           |
| A1-090A-4 | F3    | 10.63       | 7.87         | 21.65       | 20.94        | 10.43       | 51.81           |
| A1-110A-4 | F4    | 11.61       | 7.87         | 25.98       | 25.28        | 10.43       | 67.77           |
| A1-149A-4 | F4    | 11.61       | 7.87         | 25.98       | 25.28        | 10.43       | 68.21           |
| A1-176A-4 | F5    | 13.58       | 9.06         | 29.92       | 28.94        | 10.83       | 97.89           |
| A1-217A-4 | F5    | 13.58       | 9.06         | 29.92       | 28.94        | 10.83       | 99.03           |
| A1-260A-4 | F6    | 15.16       | 11.02        | 31.50       | 30.51        | 10.83       | 122.31          |
| A1-296A-4 | F6    | 15.16       | 11.02        | 31.50       | 30.51        | 10.83       | 123.99          |

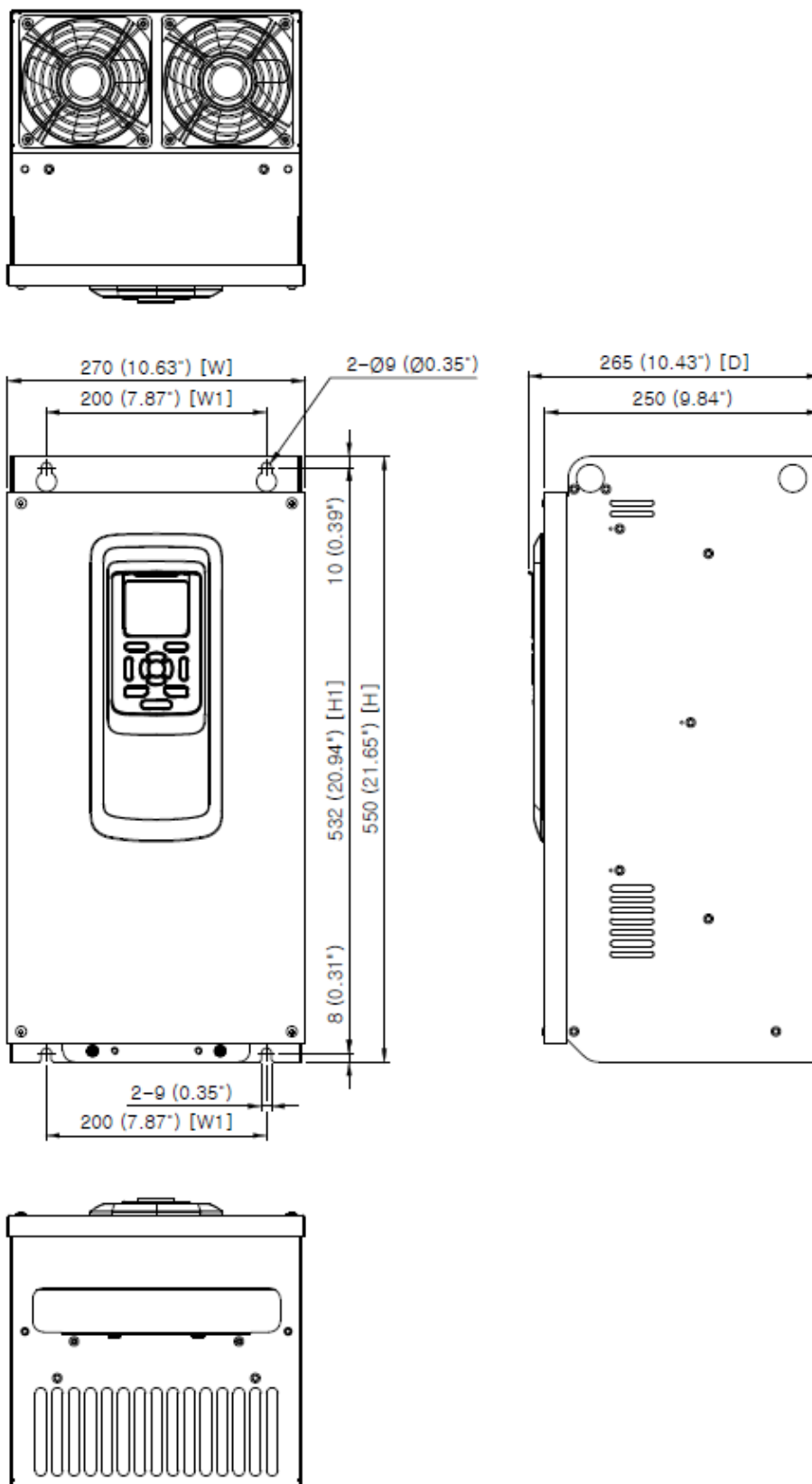
- 1) F1 (A1-032A-2, A1-045A-2, A1-064A-2 / A1-016A-4, A1-023A-4, A1-032A-4)



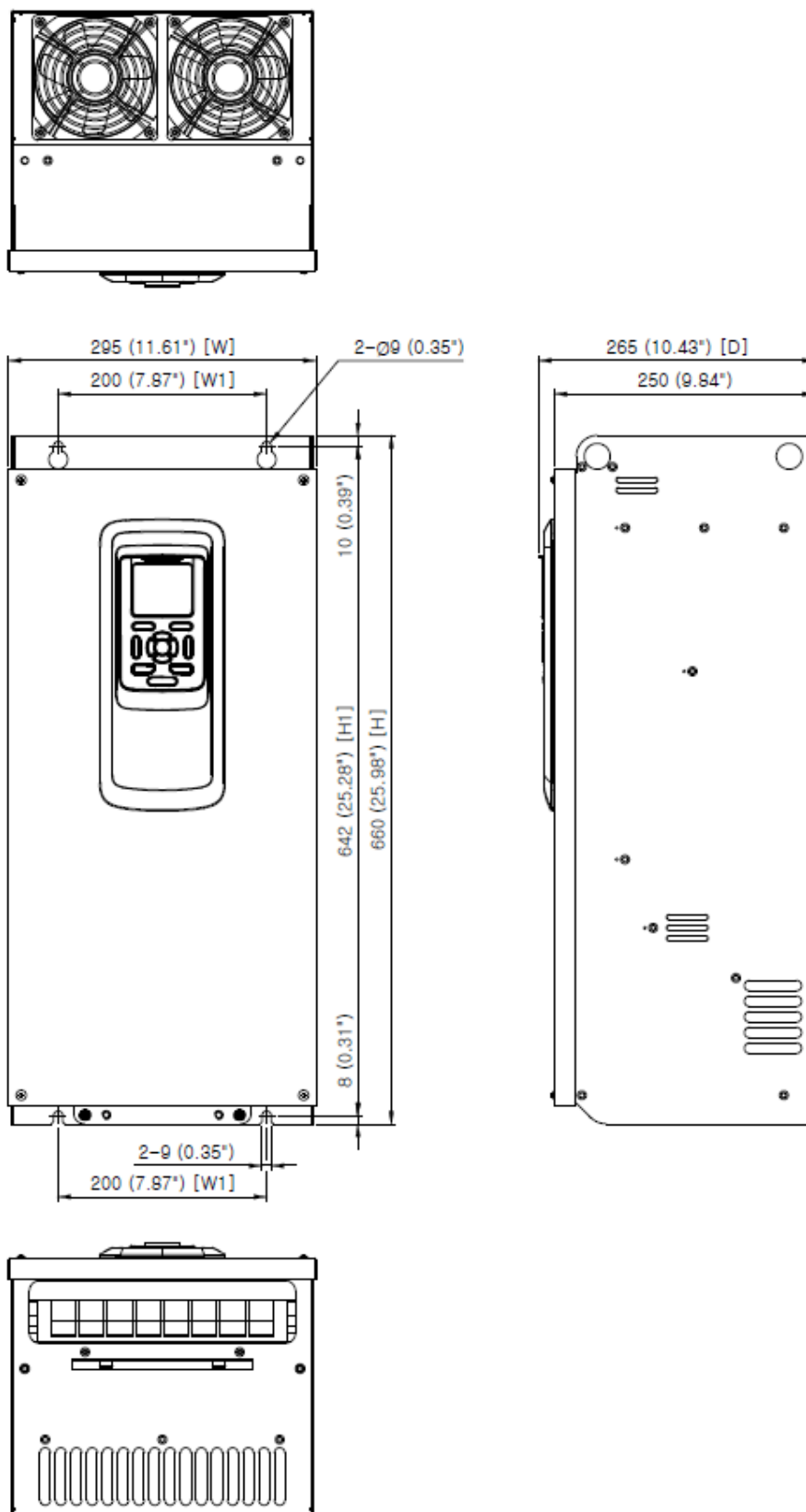
2) F2 (A1-076A-2, A1-090A-2/ A1-038A-4, A1-045A-4, A1-058A-4)



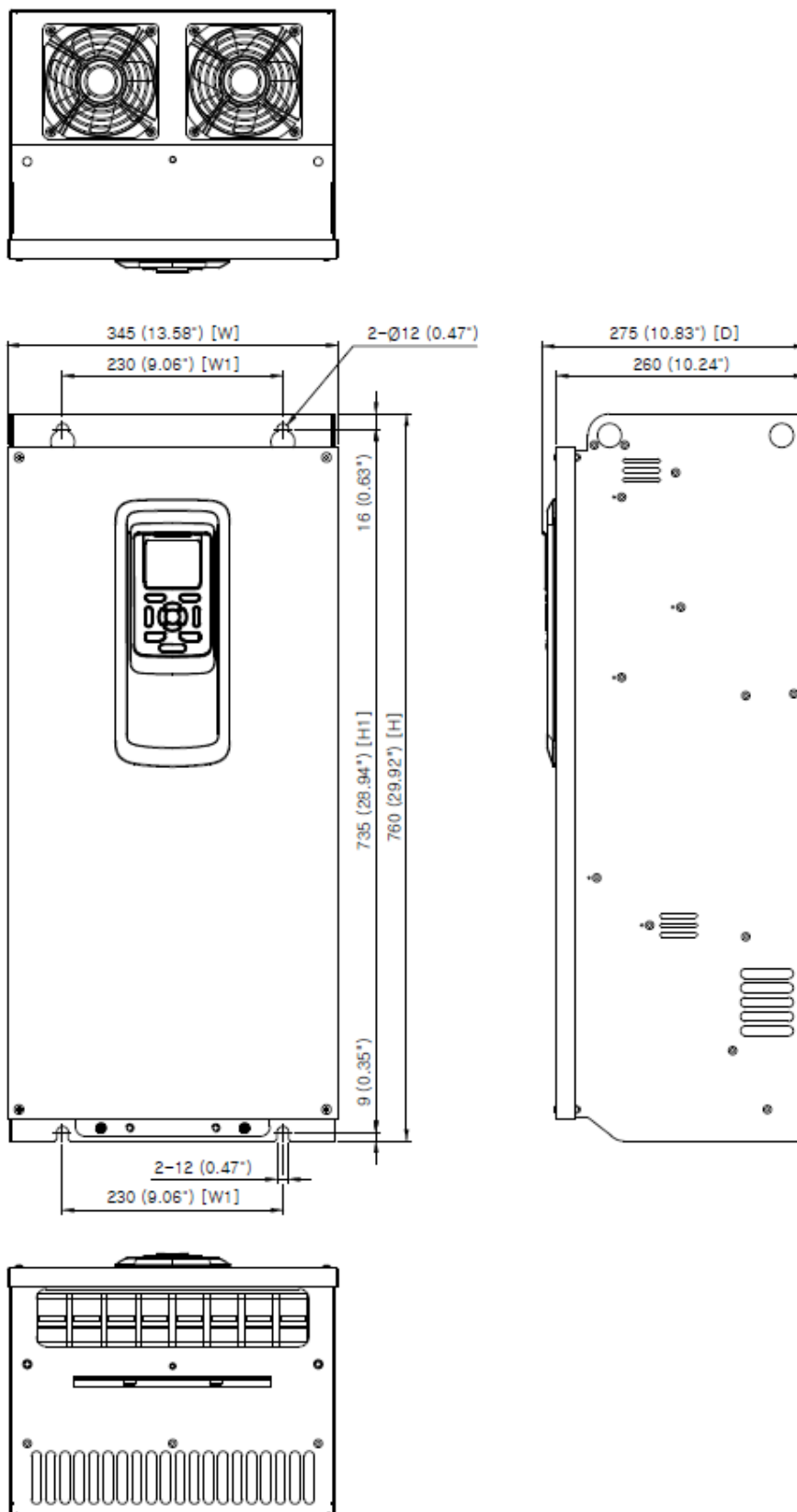
3) F3 (A1-114A-2, A1-140A-2/ A1-075A-4, A1-090A-4)



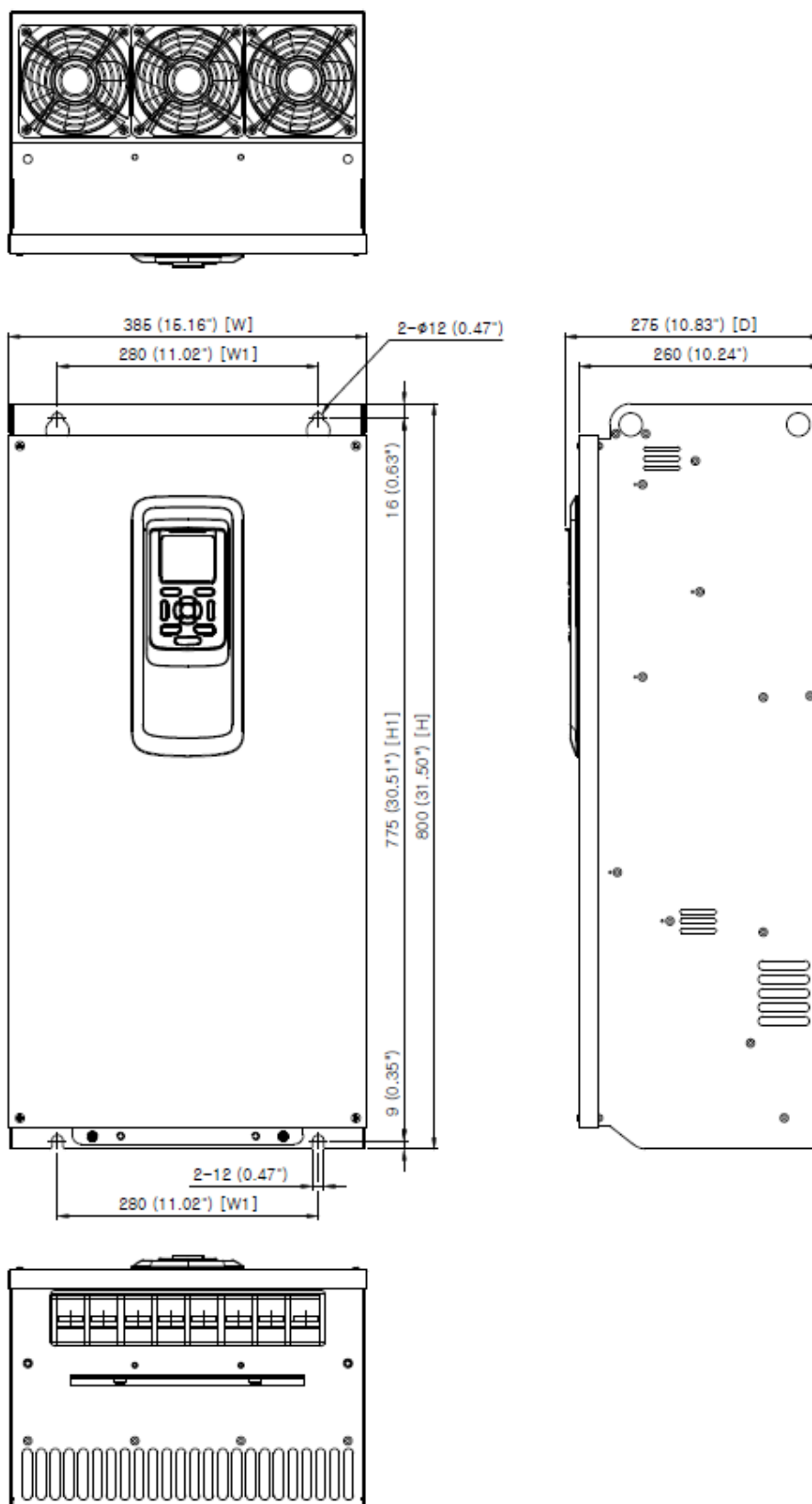
4) F4 (A1-170A-2, A1-205A-2/ A1-110A-4, A1-149A-4)



5) F5 ( A1-261A-2, A1-310A-2/ A1-176A-4, A1-217A-4)



6) F6 (A1-260A-4, A1-296A-4)

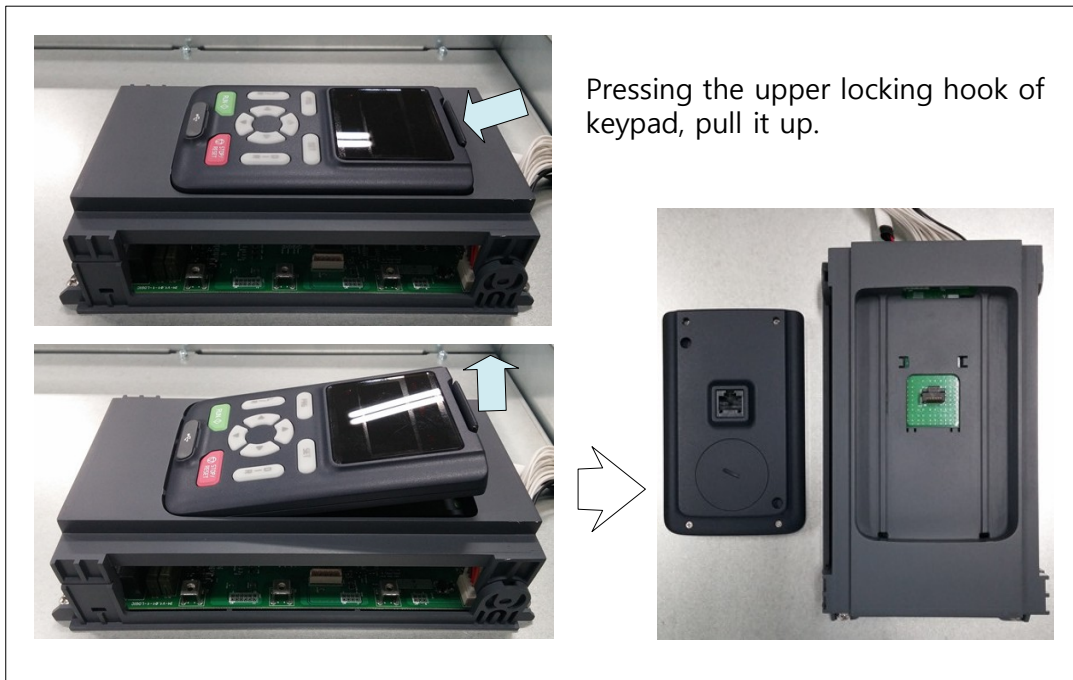


## 4. Wiring

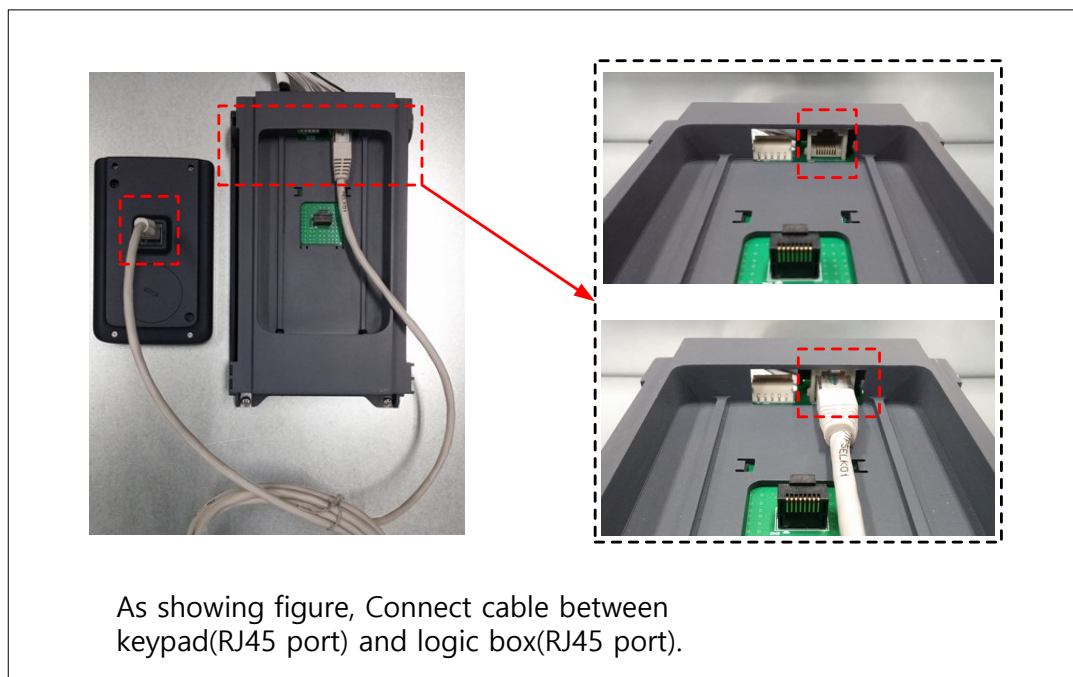
### 4.1 Wiring

#### 4.1.1 Installation method of VFD keypad to panel

- 1) Separate the Keypad from case



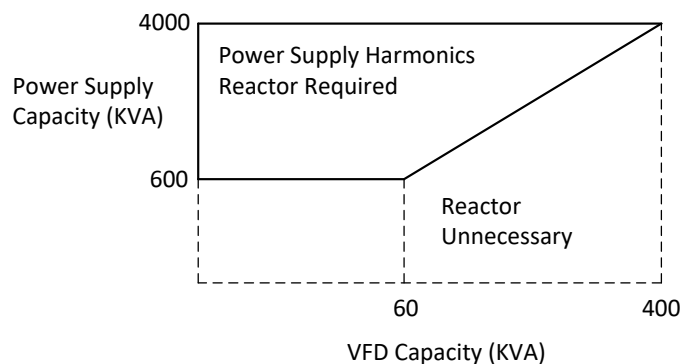
- 2) Connection



### 4.1.2 Wiring precaution

#### 1) Main Power Terminals: R(L1), S(L2), T(L3)

- Connect the main power terminals (R(L1), S(L2) and T(L3)) to the power supply through an electromagnetic contactor or an earth-leakage breaker. These devices isolate the utility power supply from the VFD and prevent the spread of damage.
- This unit is designed to be used on a three-phase power supply. If using on a single phase power supply, please contact ADT for proper sizing.
- Do not operate under the following conditions.
  - Unbalanced power supply voltage more than 3%
  - Power supply capacity more than 10 times of the capacity of VFD and case beyond 600kVA.



- Turning on/off the power supply more than three times in one minute, It could be damaged the recharge circuit of the VFD.

#### 2) VFD Output Terminals: U(T1), V(T2), W(T3)

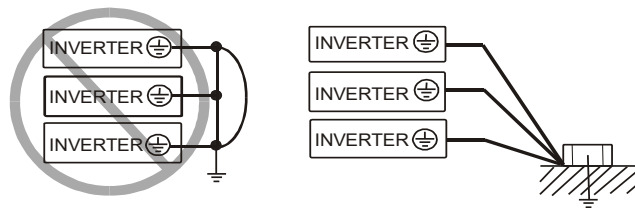
- Make sure to use a heavier gauge wire when you have long motor leads. This will help to reduce the voltage drop.
- Do not install power factor correction capacitors or a surge absorber to the output of the VFD. The VFD will trip or sustain damage to the output transistors.
- If the motor cable length is more than 65 feet, it is possible that a surge voltage will be generated and may damage the motor. This is due to phenomena called "Reflective Wave". Install a dv/dt filter in front of the motor to protect it.
- In the case of two or more motors on the output of a VFD, install an independent overload protection device for each motor. Set the rated current value of the overload device to 1.1 times the motor rated current.

### 3) Regenerative Braking Unit Terminals: P, N ( $\geq 30\text{kW}$ (40HP) Units)

- VFDs rated greater than and equal to 30KW (40HP) do not contain an internal BRD circuit. If regenerative braking is going to occur, then an external BRD circuit (Option) is required along with a resistor. (Option)
- Connect external regenerative braking unit terminals (P,N) to terminals (P,N) on the VFD.
- The braking resistor is then wired into the External BRD board, not directly to the VFD.
- The cable length between the VFD and the BRD board, BRD board and the resistor, should be less than 16 feet and twist the connecting wires to reduce inductance.

### 4) Earth Ground: G

- Make sure that you securely ground the VFD and motor for prevention of electric shock.
- The VFD and motor must be connected to an appropriate safety earth ground and follow all local electrical codes.
- In case connecting 2 or more VFDs, use caution not to create a ground loop situation which may cause the VFD to malfunction. Use a star configuration grounding technique.



Earth Ground (G) Connection

Grounding wire should be as short as possible and should be connected to the ground point as near as possible to the VFD.

| VFD Frame | Grounding Wire Size (mm <sup>2</sup> /kcmil) |             |
|-----------|----------------------------------------------|-------------|
|           | 200V class                                   | 400V class  |
| F1        | 14/27.6                                      | 8/15.9      |
| F2        | 22/43.4                                      | 14/27.6     |
| F3        | 53.5/ 105.6                                  | 33.6/ 66.4  |
| F4        | 85.0/ 167.8                                  | 53.5/ 105.6 |
| F5        | 85.0/ 167.8                                  | 85.0/167.8  |
| F6        | 85.0/ 167.8                                  | 85.0/167.8  |

## 5) Specifications of power terminal block and internal fuse

Tightening torque and wire range for field wiring terminals are marked adjacent to the terminal or the wiring diagram. Select a molded case circuit breaker (MCCB) with a rated current 1.5 to 2 times higher than the VFD rated current

Distribution fuse size information is shown in the table below.

The fuse must be a UL listed (in case of using in the USA), 600V, inverse time rated fuse with the current ratings shown in the table below.

| Class      | Motor Output (kW) | VFD Model | Power lines<br>R,S,T, U,V,W,P,N |            |                     | Screw Size of Terminal | Torque N·m (lb·in)       | FUSE [A] |
|------------|-------------------|-----------|---------------------------------|------------|---------------------|------------------------|--------------------------|----------|
|            |                   |           | AWG                             | kcmil      | Lug width (mm/inch) |                        |                          |          |
| 200V Class | 7.5               | A1-032A-2 | 8                               | 17         | 11.8/0.46           | M4                     | 0.20~0.60                | 40A      |
|            | 11                | A1-045A-2 | 8                               | 17         | 11.8/0.46           | M4                     | 0.20~0.60                | 60A      |
|            | 15                | A1-064A-2 | 6                               | 26         | 13/0.51             | M5                     | 0.40~0.80                | 80A      |
|            | 18.5              | A1-076A-2 | 4                               | 42         | 13/0.51             | M5                     | 0.40~0.80                | 100A     |
|            | 22                | A1-090A-2 | 8 * 2P                          | (17)*2P    | 13/0.51             | M5                     | 0.40~0.80                | 125A     |
|            | 30                | A1-114A-2 | 1/0                             | 106        | 22/0.87             | M8                     | 0.80~1.20<br>(7.08~10.6) | 150A     |
|            | 37                | A1-140A-2 | 3*2P                            | (52.6)*2P  | 22/0.87             | M8                     | 0.80~1.20<br>(7.08~10.6) | FWH-350A |
|            | 45                | A1-170A-2 | 2*2P                            | (66.4)*2P  | 22/0.87             | M8                     | 0.80~1.20<br>(7.08~10.6) | FWH-400A |
|            | 55                | A1-205A-2 | 1*2P                            | (83.7)*2P  | 22/0.87             | M8                     | 0.80~1.20<br>(7.08~10.6) | FWH-400A |
|            | 75                | A1-261A-2 | 2/0*2P                          | (133.1)*2P | 27/1.06             | M10                    | 0.80~1.80<br>(7.08~15.9) | FWH-600A |
|            | 90                | A1-310A-2 | 3/0*2P                          | (167.8)*2P | 27/1.06             | M10                    | 0.80~1.80<br>(7.08~15.9) | FWH-700A |
| 400V Class | 7.5               | A1-016A-4 | 12                              | 6.5        | 11.8/0.46           | M4                     | 0.20~0.60                | 20A      |
|            | 11                | A1-023A-4 | 10                              | 10         | 11.8/0.46           | M4                     | 0.20~0.60                | 30A      |
|            | 15                | A1-032A-4 | 8                               | 17         | 11.8/0.46           | M4                     | 0.20~0.60                | 40A      |
|            | 18.5              | A1-038A-4 | 8                               | 17         | 13/0.51             | M5                     | 0.40~0.80                | 50A      |
|            | 22                | A1-045A-4 | 8                               | 17         | 13/0.51             | M5                     | 0.40~0.80                | 60A      |
|            | 30                | A1-058A-4 | 6                               | 26         | 13/0.51             | M5                     | 0.40~0.80                | 80A      |
|            | 37                | A1-075A-4 | 2                               | 66.4       | 16/0.63             | M6                     | 0.80~1.00<br>(7.08~8.85) | FWH-250A |
|            | 45                | A1-090A-4 | 2                               | 66.4       | 16/0.63             | M6                     | 0.80~1.00<br>(7.08~8.85) | FWH-250A |

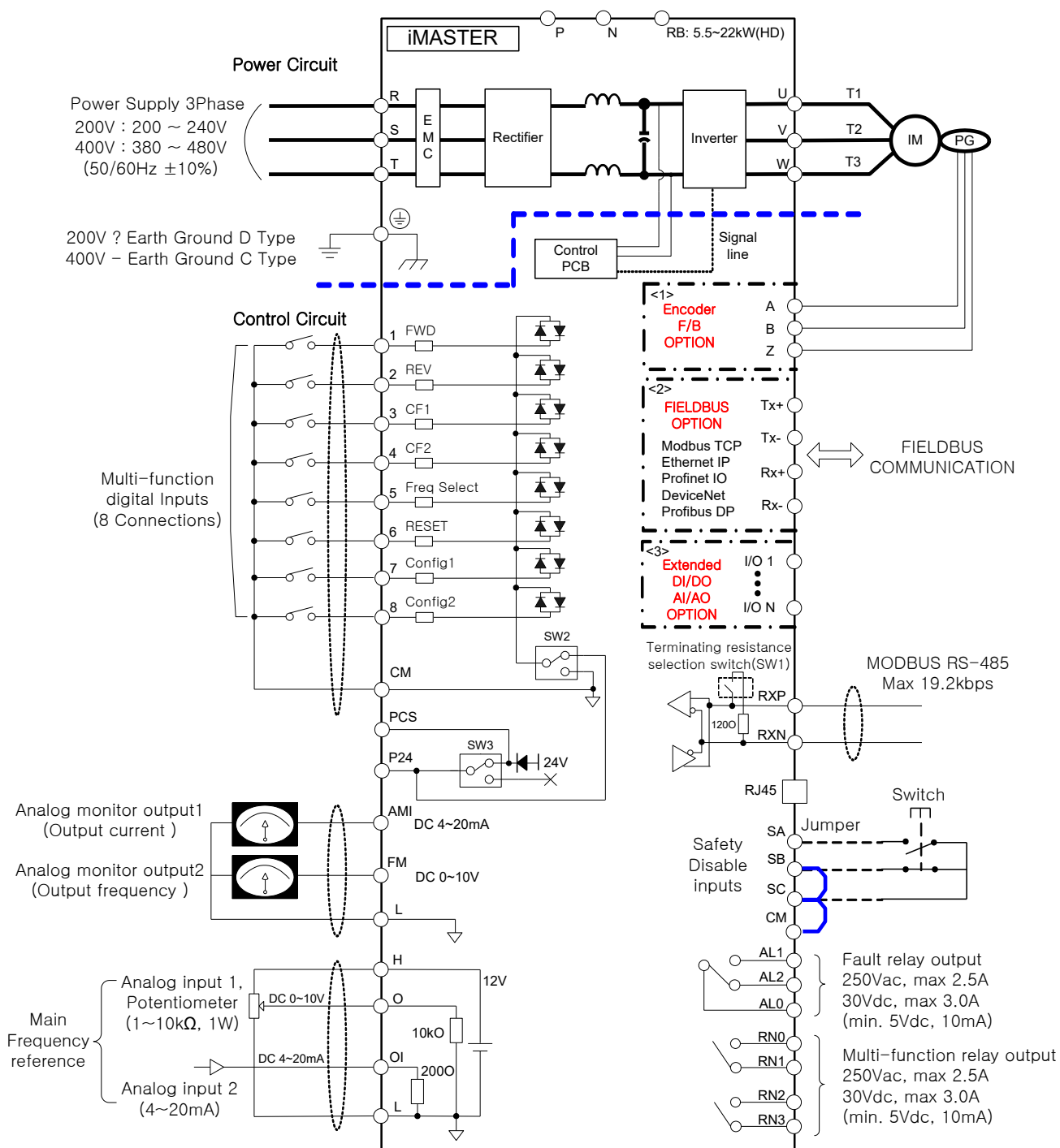
|  |     |           |                |                       |         |     |                          |              |
|--|-----|-----------|----------------|-----------------------|---------|-----|--------------------------|--------------|
|  | 55  | A1-110A-4 | 1/0 or<br>4*2P | 105.5 or<br>(41.7)*2P | 22/0.87 | M8  | 0.80~1.20<br>(7.08~10.6) | FWH-<br>250A |
|  | 75  | A1-149A-4 | 3*2P           | (52.6)*3P             | 22/0.87 | M8  | 0.80~1.20<br>(7.08~10.6) | FWH-<br>350A |
|  | 90  | A1-176A-4 | 2*2P           | (66.4)*2P             | 22/0.87 | M8  | 0.80~1.20<br>(7.08~10.6) | FWH-<br>400A |
|  | 110 | A1-217A-4 | 1/0*2P         | (105.5)*2P            | 22/0.87 | M8  | 0.80~1.20<br>(7.08~10.6) | FWH-<br>500A |
|  | 132 | A1-260A-4 | 2/0*2P         | (133.1)*2P            | 24/0.94 | M10 | 0.80~1.80<br>(7.08~15.9) | FWH-<br>600A |
|  | 160 | A1-296A-4 | 3/0*2P         | (167.8)*2P            | 27/1.06 | M10 | 0.80~1.80<br>(7.08~15.9) | FWH-<br>700A |

\*Fuse of Bussmann was used when UL certified

### 4.1.3 A1 Terminal Connection Diagram and Description

1) A1 VFD terminal connection overview is shown below. There are three segments of Connections

- Power Circuit
- Control Circuit
- Communication Circuit

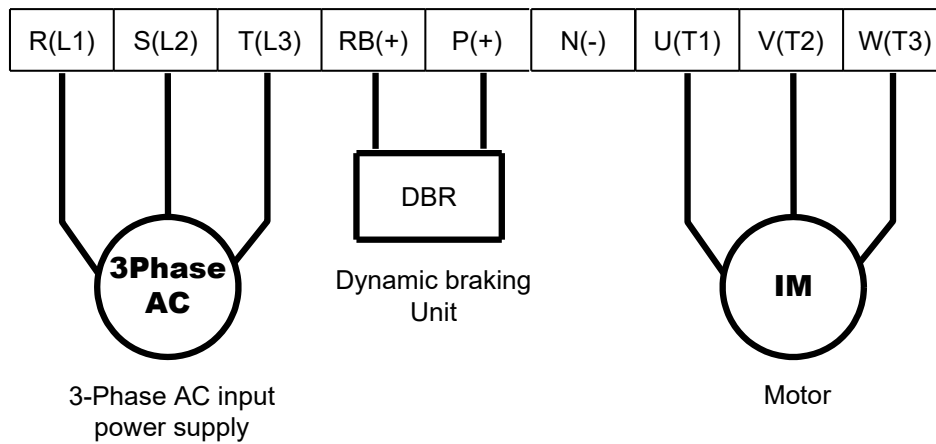


A1 VFD terminal names and descriptions are summarized

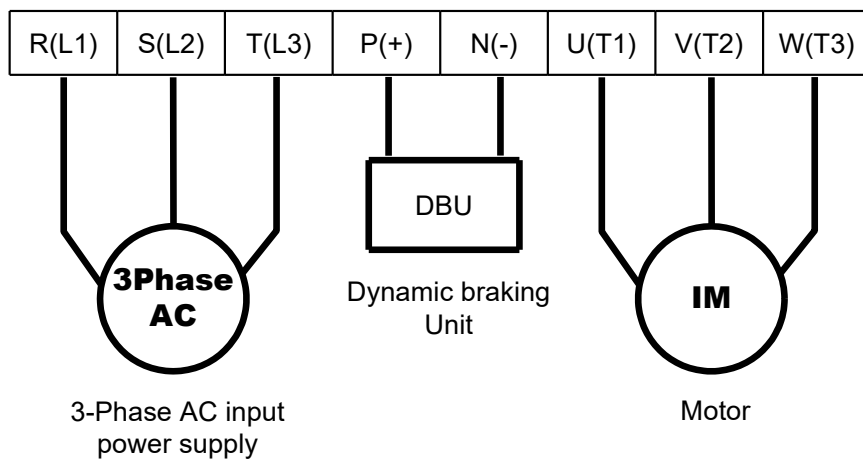
| Terminal Name                        | In/Out | Functional Description                                                                                                                                                                                                                          | Value                                                                                                                     |
|--------------------------------------|--------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------|
| Main Circuit Connector               |        |                                                                                                                                                                                                                                                 |                                                                                                                           |
| R,S,T (L1, L2, L3)                   | IN     | 3 Phase 50/60 Hz, AC input power supply.                                                                                                                                                                                                        | 200 ~240V ±10%<br>380 ~480 V ±10%                                                                                         |
| U,V,W (T1,T2,T3)                     | OUT    | 3 Phase PWM output power for motor                                                                                                                                                                                                              | –                                                                                                                         |
| P,N                                  | –      | Optional External Braking Unit Connector.<br>[1] 30~132 kW (40 ~ 250 HP) models                                                                                                                                                                 | –                                                                                                                         |
| [2] RB                               | –      | [3] Dynamic Braking Resistor connector<br>5.5~22kW                                                                                                                                                                                              | –                                                                                                                         |
| G                                    | –      | Ground Terminal                                                                                                                                                                                                                                 | –                                                                                                                         |
| Control Circuit Connector            |        |                                                                                                                                                                                                                                                 |                                                                                                                           |
| P24                                  | OUT    | Power Supply for external device<br>(Always ON)                                                                                                                                                                                                 | 24VDC ±7%,<br>P24+PCS = 300mA                                                                                             |
| PCS                                  | OUT    | Power Supply for external device such as PLC<br>(Available ON or OFF)                                                                                                                                                                           |                                                                                                                           |
| Multi function<br>digital Input[1:8] | IN     | 8 Bit Intelligent input terminal. By programming the<br>respective terminal, can be used as command                                                                                                                                             | Contact Closed : ON<br>Contact Open : OFF<br>Min ON Time : 12 ms                                                          |
| CM                                   | –      | Common Terminal for Intelligent Input and<br>Monitor Output                                                                                                                                                                                     | –                                                                                                                         |
| AMI                                  | OUT    | Analog Current Output                                                                                                                                                                                                                           | 4~20mA, 250 Ω                                                                                                             |
| FM                                   | OUT    | Analog Voltage Output                                                                                                                                                                                                                           | 0~10Vdc, 1mA                                                                                                              |
| L                                    | –      | DC Power Supply Common                                                                                                                                                                                                                          | –                                                                                                                         |
| H (P1 2)                             | OUT    | Power Supply for Potentiometer                                                                                                                                                                                                                  | 12VDC                                                                                                                     |
| O                                    | IN     | Analog Voltage for Frequency Reference                                                                                                                                                                                                          | 0 ~ 10 VDC, 10 kΩ                                                                                                         |
| OI                                   | IN     | Analog Current for Frequency Reference                                                                                                                                                                                                          | 4~ 20mA, 200 Ω                                                                                                            |
| AL0, AL1, AL2                        | OUT    | Intelligent output terminal:<br>OUTPUT RELAY 1, 2<br>Run status signal(RUN), Frequency arrival<br>signal(FA1),<br>Set frequency arrival signal(FA2),<br>Overload advance notice signal(OL),<br>PID error deviation signal(OD), Alarm signal(AL) | AC 250V /<br>2.5A (resistor load)<br>0.2A (inductor load)<br><br>DC 30V /<br>3.0A (resistor load)<br>0.7A (resistor load) |
| RN0, RN1<br>RN2, RN3                 | OUT    | Intelligent output terminal<br>OUTPUT RELAY 3                                                                                                                                                                                                   |                                                                                                                           |
| SA                                   | IN     | Safety Input terminal:                                                                                                                                                                                                                          | –                                                                                                                         |
| SB                                   |        | SA closed, SB open: Drive output disabled                                                                                                                                                                                                       |                                                                                                                           |
| SC                                   |        | Common terminal for Safety Input, CM connection                                                                                                                                                                                                 |                                                                                                                           |
| Communication Connector              |        |                                                                                                                                                                                                                                                 |                                                                                                                           |
| RXP                                  | IN/OUT | RS 485 Positive Communication Terminal                                                                                                                                                                                                          |                                                                                                                           |
| RXN                                  | IN/OUT | RS 485 Negative Communication Terminal                                                                                                                                                                                                          |                                                                                                                           |

#### 4.1.4 Terminal wiring diagram (Power terminal block)

Terminal view of corresponding VFD are shown below

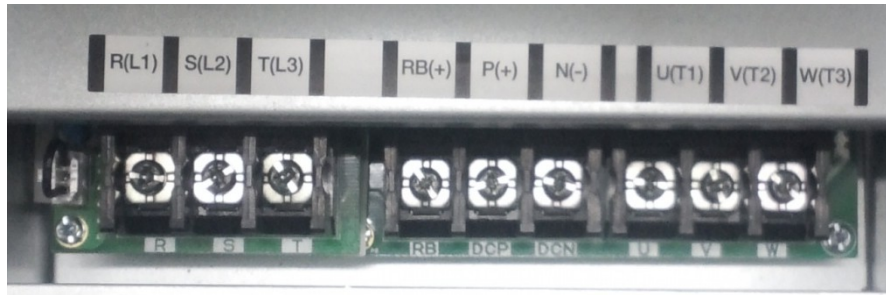


**F1, F2 Power Terminal**

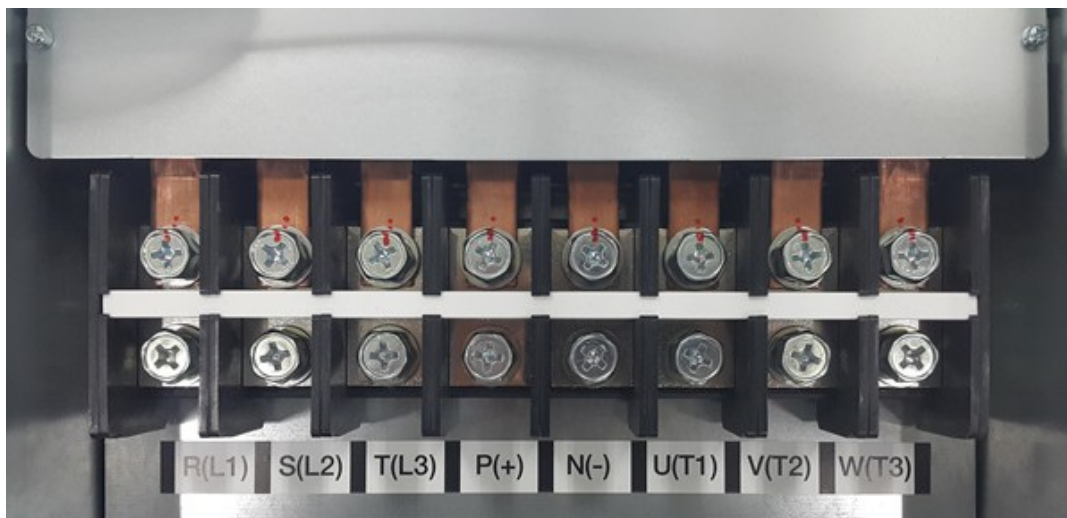


**F3~F6 Power Terminal**

**Power terminal (F1,F2)**



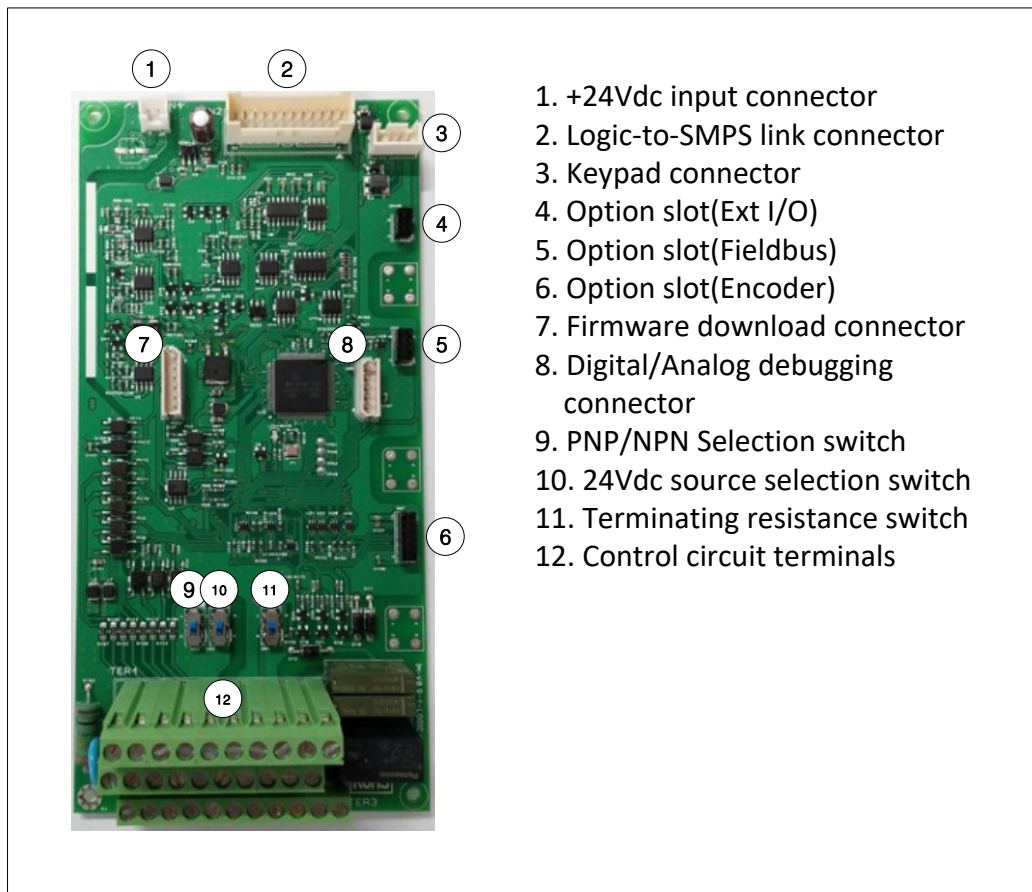
**Power terminal (F3~F6)**



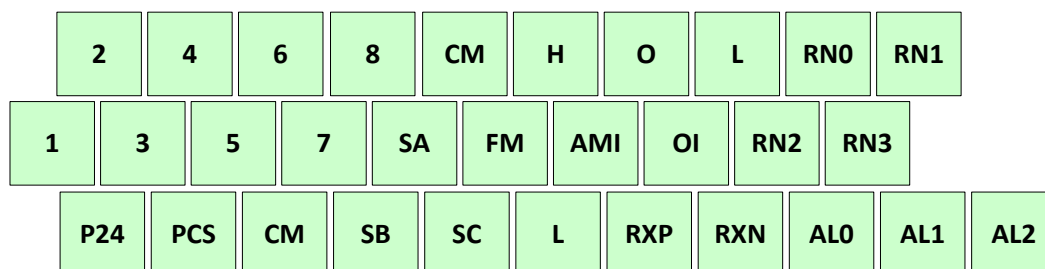
### 4.1.5 Control terminal line diagram (Basic I/O terminal block)

#### 1) External control connection terminals

The layout of external control connection terminals of the drive is shown below.

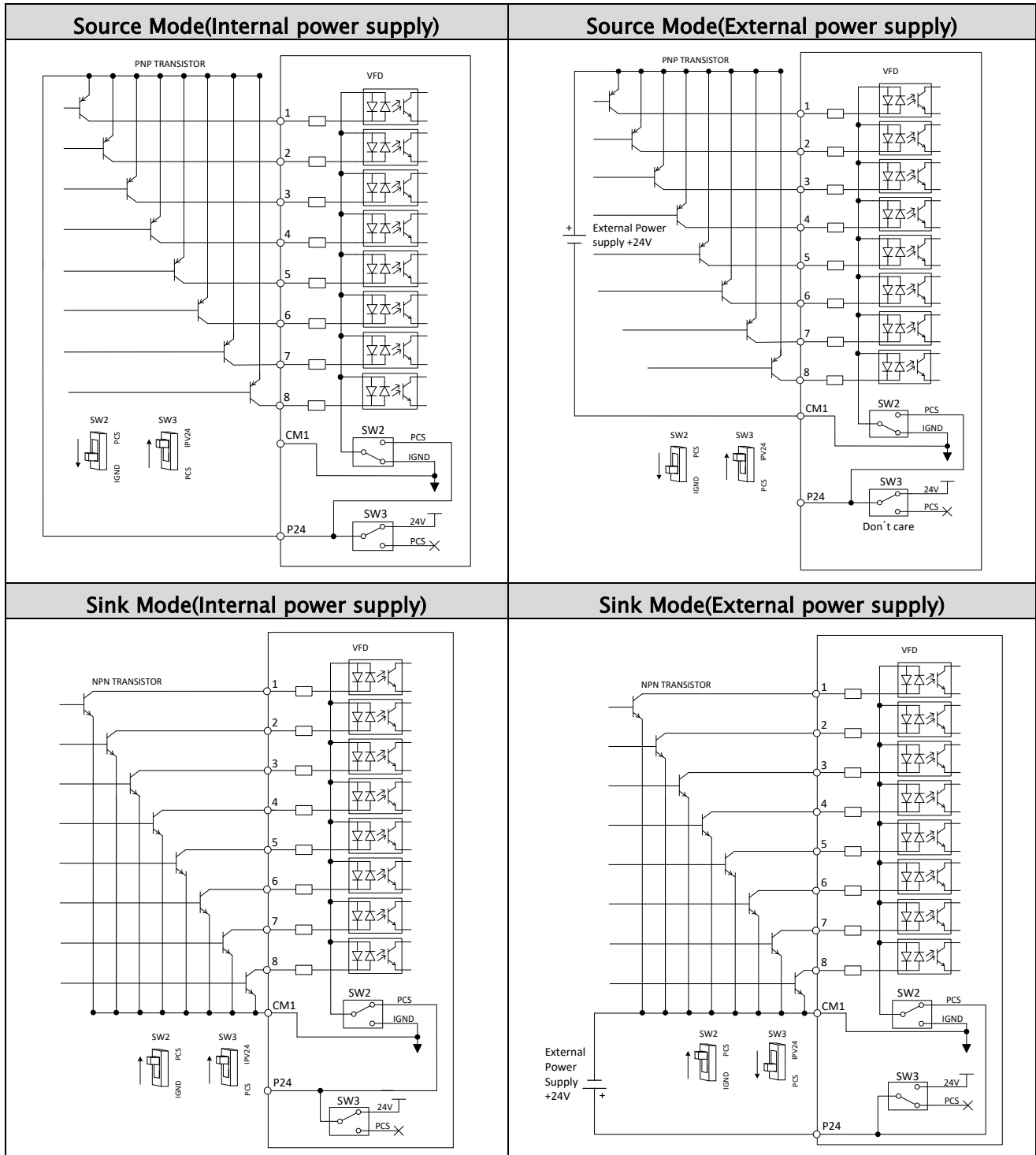


#### 2) Control circuit terminals layout

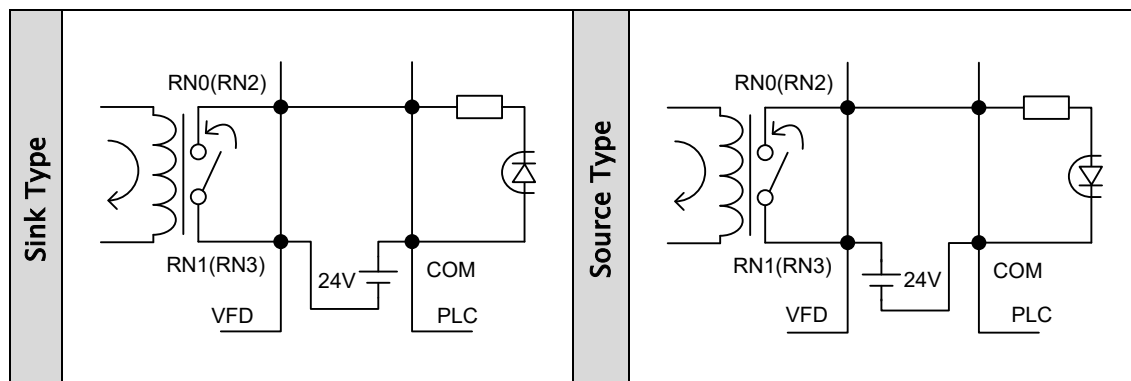


### 3) Configuration for Sinking and Source Modes

- SW2: Sink/Source switch
- SW: Power selection switch (Internal 24V or External 24V)



## 4) Sinking and Source Modes selection (Output signal)



## 5) Communication Connect

| RXP                       | RXN                       |
|---------------------------|---------------------------|
| Transmit/Receive<br>+side | Transmit/Receive<br>-side |

The termination resistor of the RS 485 2nd communication has a purpose of preventing the distortion and attenuation of the communication line. This resistor means the impedance matching resistor in long distance transport of RS 485 data. The termination resistor is inserted only in the final stage in single line.

<Terminating resistance selection switch (SW1)>

Default Status: Terminating resistance ON

Regarding terminating resistance, only applied to RXP–RXN terminals

Turn off the switch when master communicate more than one of VFD

(For example master: PLC, DCS, PC and etc)

RS–485 Terminating resistance SW1 On:

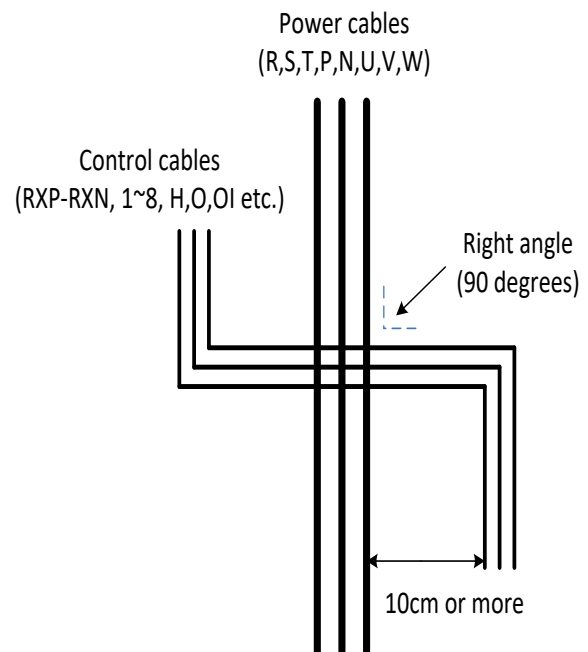


RS–485 Terminating resistance SW1 Off:



### 6) Internal Wiring

- Control circuit wires are insulated from power lines (R,S,T,U,V,W)
- Use twisted screened cable for input and output wires of the control circuit terminals
- Limit the connection wires to 65 feet
- Separate the control circuit wiring from the main power and relay control wiring
- When using relays for the FW terminal or an intelligent input terminal, use a control relay that is designed to work with 24 Vdc.
- When a relay is used as an intelligent output, connect a diode for surge protection parallel to the relay coil.
- Do not short the analog voltage terminals H and L or the internal power terminals P24 and all CM's to prevent any VFD damage
- When connecting a thermistor to the TH and all CM's terminals, twist the thermistor cables and separate them from the rest. Limit the connection wires to 65 feet.



## 5. Peripheral Devices

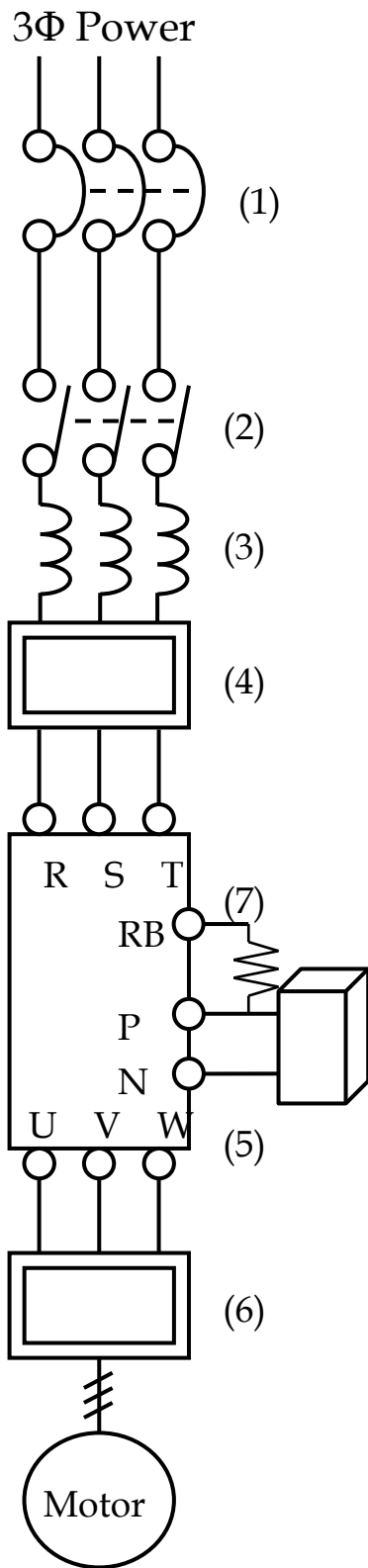
### 5.1 Peripheral Devices

#### 5.1.1 Composition of peripheral devices

For better system performance enhancement, optional accessories may be used with VFD.

- Note1: Be sure to consider the capacity of the circuit breaker to be used.
- Note2: Be sure to use larger wire for power lines if the distance exceeds 20m.
- Note3: Be sure to use a grounding wire same size of power line or similar.

| Name |                      | Function                                                                                                                                                                                                        |
|------|----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| (1)  | Circuit Breaker      | High current flows in the VFD while power is supplied. Be careful when you select the switch because the VFD.                                                                                                   |
| (2)  | Electric contactor   | This does not have to be necessarily installed, but if you do, do not start or stop the VFD frequently with the contactor. It might decrease the life of the VFD.                                               |
| (3)  | Input AC Reactor     | Recommended to use when the unbalance voltage rate is 3% or more and power supply is 500 kVA or more, and there is a rapid change in the power supply. It also reduces harmonics and improves the power factor. |
| (4)  | Input Noise Filter   | Reduces radiation noise emitted from wire at the input.                                                                                                                                                         |
| (5)  | Dynamic Braking Unit | Applied 30~132kW(HD)<br>Used for applications that need to increase the brake torque of the VFD or to frequently start/stop and to run high inertia load.                                                       |
| (6)  | Output Noise Filter  | Reduces noise emitted from the VFD motor leads. This helps to minimize interference with sensitive equipment (ie: sensors or weight scale).                                                                     |
| (7)  | Braking Resistor     | Applied 5.5~22kW(HD)<br>Used for applications that need to increase the brake torque of the VFD or to frequently start/stop and to run high inertia load.                                                       |



## 5.1.2 Dynamic braking unit (DBU) and Resistors

### 1) Dynamic Braking Resistor

| 200V Drive |      | 150% Torque, 5% ED |      | 400V Drive |      | 150% Torque, 5% ED |      |
|------------|------|--------------------|------|------------|------|--------------------|------|
| VFD Model  | kW   | $\Omega$           | W    | VFD Model  | kW   | $\Omega$           | W    |
| A1-032A-2  | 5.5  | 20                 | 800  | A1-016A-4  | 5.5  | 85                 | 800  |
| A1-045A-2  | 7.5  | 15                 | 1200 | A1-023A-4  | 7.5  | 60                 | 1200 |
| A1-064A-2  | 11   | 10                 | 2400 | A1-032A-4  | 11   | 40                 | 2400 |
| A1-076A-2  | 15   | 8                  | 2400 | A1-038A-4  | 15   | 30                 | 2400 |
| A1-090A-2  | 18.5 | 5                  | 3600 | A1-045A-4  | 18.5 | 20                 | 3600 |
| A1-114A-2  | 22   | 5                  | 3600 | A1-058A-4  | 22   | 20                 | 3600 |

### 2) Dynamic Braking Unit

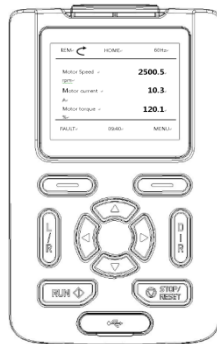
| Input V         | VFD Model | kW  | DB Unit Model | $\Omega$ | kW | Condition for using    |
|-----------------|-----------|-----|---------------|----------|----|------------------------|
| 3 PHASE<br>200V | A1-140A-2 | 30  | FBU100-037-2  | 4.5      | 10 | 150% breaking<br>10%ED |
|                 | A1-170A-2 | 37  |               | 4.5      | 10 |                        |
|                 | A1-205A-2 | 45  | FBU100-075-2  | 2.5      | 10 |                        |
|                 | A1-261A-2 | 55  |               | 2.5      | 20 |                        |
|                 | A1-310A-2 | 75  |               | 2.5      | 20 |                        |
| 3 PHASE<br>400V | A1-075A-2 | 30  | FBU100-037-4  | 12       | 10 |                        |
|                 | A1-090A-2 | 37  |               | 12       | 10 |                        |
|                 | A1-110A-4 | 45  | FBU100-075-4  | 6        | 10 |                        |
|                 | A1-149A-4 | 55  |               | 6        | 20 |                        |
|                 | A1-176A-4 | 75  |               | 6        | 20 |                        |
|                 | A1-217A-4 | 90  | FBU100-090-4  | 5        | 26 |                        |
|                 | A1-260A-4 | 110 | FBU100-132-4  | 3.4      | 40 |                        |
|                 | A1-296A-4 | 132 |               | 3.4      | 40 |                        |

## 6. Keypad

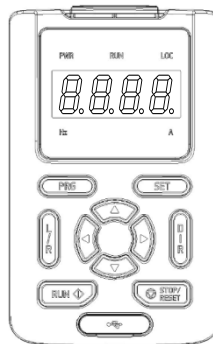
### 6.1 Keypad View & Operation

#### 6.1.1 Keypad View

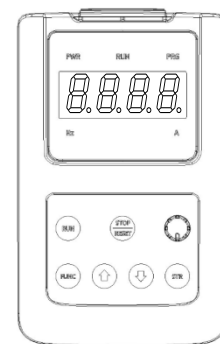
Standard Keypad is used in VFD parameter setting, Monitor display and VFD operations.



LCD TYPE



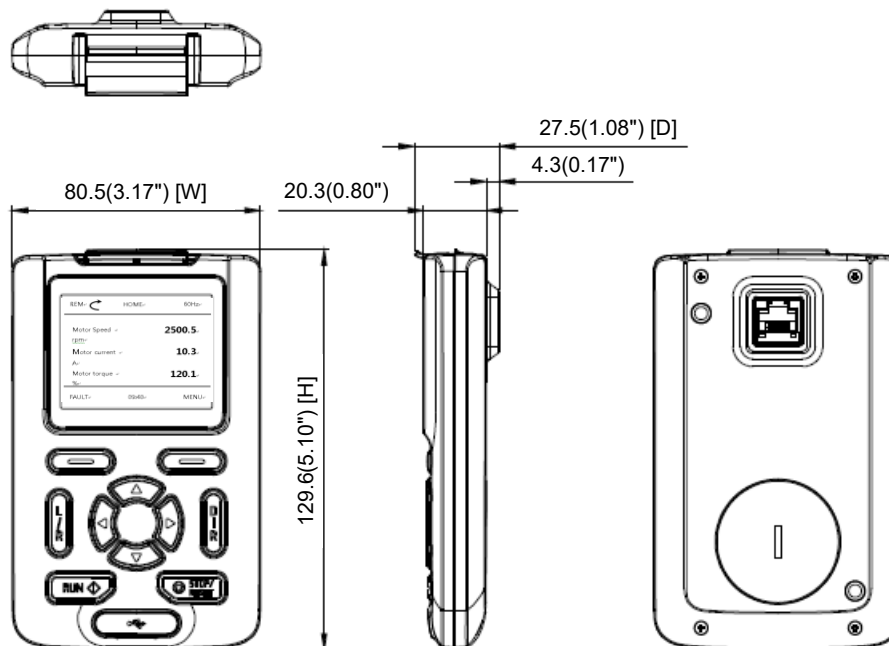
LED TYPE



LED-knob TYPE

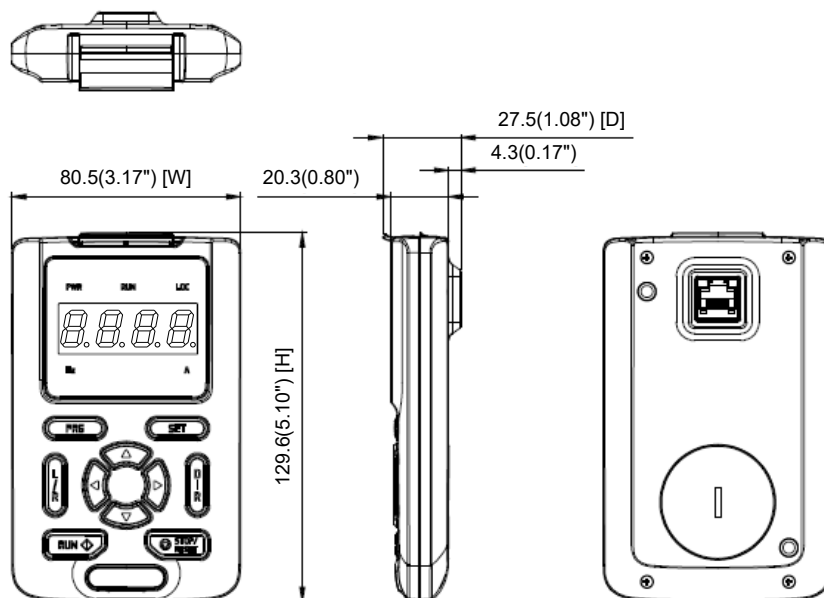
#### 1) Dimensions – LCD TYPE

Unit : mm(inch)



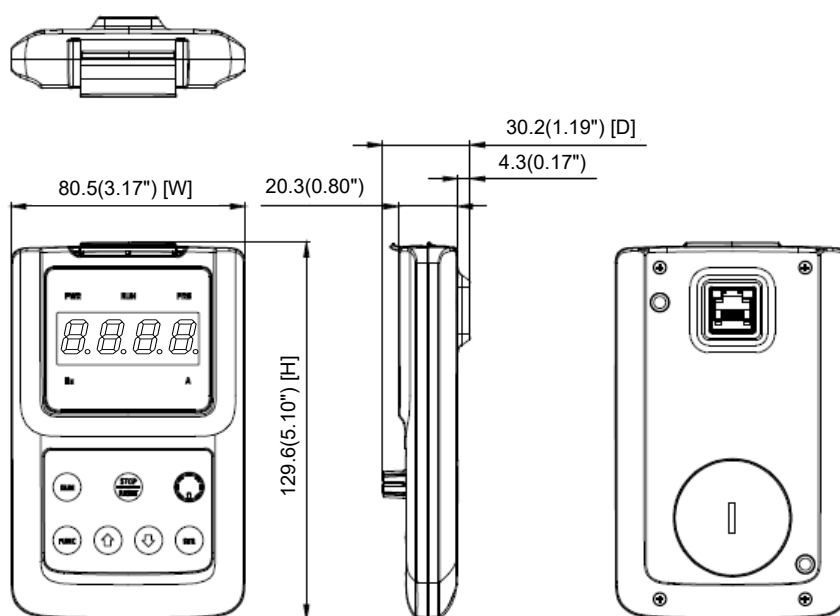
## 2) Dimensions – LED TYPE

Unit : mm(inch)



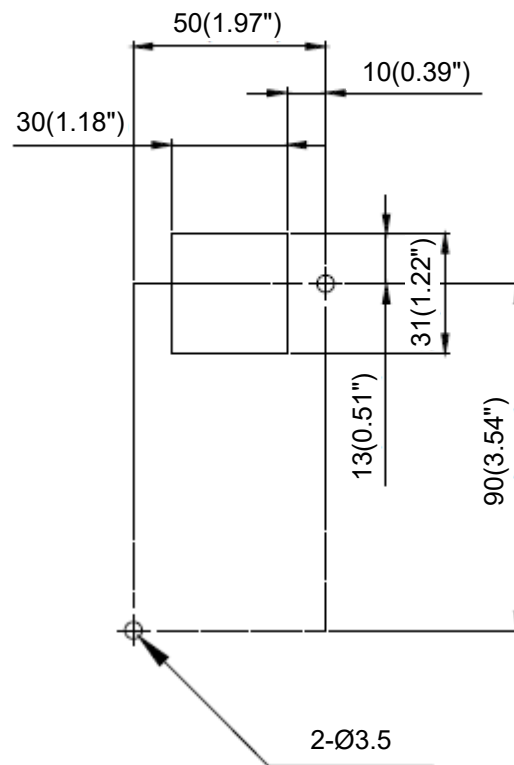
## 3) Dimensions – LED\_KNOB TYPE

Unit : mm(inch)



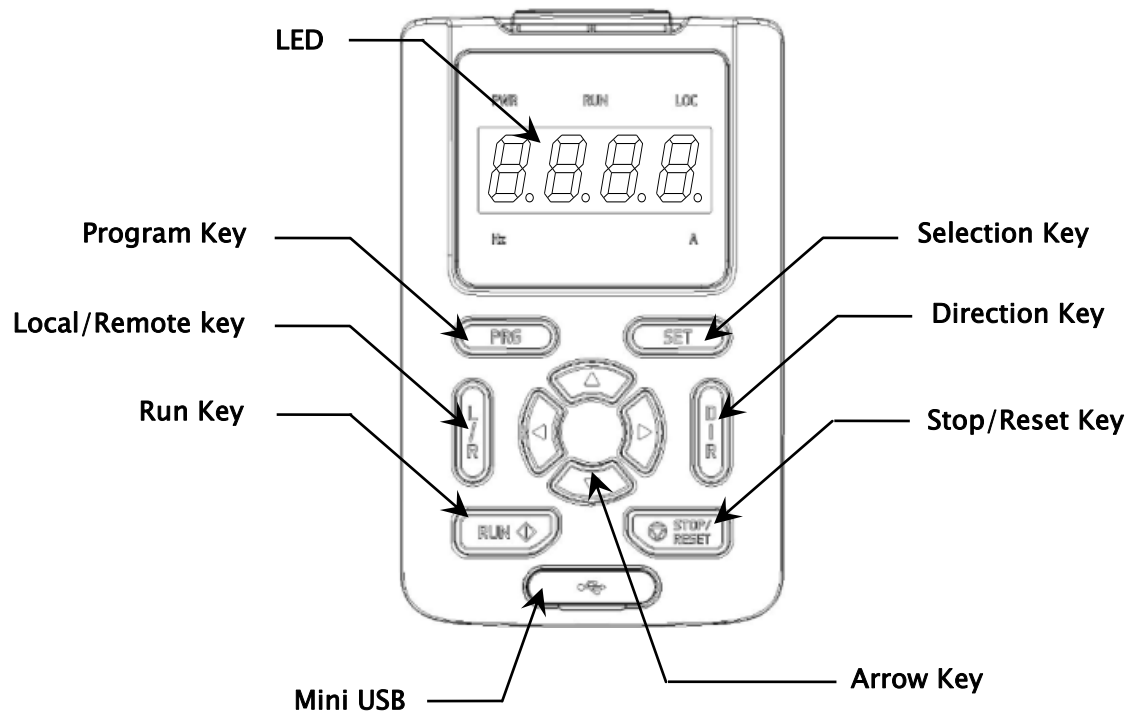
4) Dimensions – Panel Mount

Unit : mm(inch)



## 6.1.2 Keypad operation

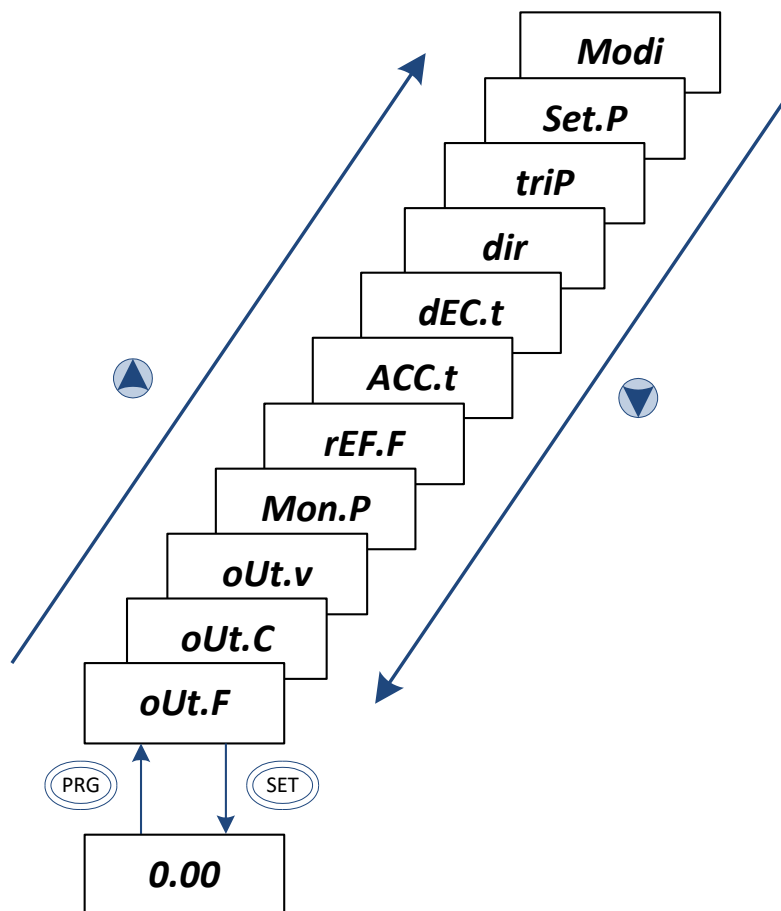
### 1) Configuration of LED Keypad



| KEY        | Function                                                                                                                                                                                       |
|------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| PRG        | <ul style="list-style-type: none"> <li>• Move to fault history</li> <li>• previous</li> <li>• Cancel at setting mode</li> </ul>                                                                |
| SET        | <ul style="list-style-type: none"> <li>• Move to menu</li> <li>• Reset the fault when the fault is occurred</li> <li>• Select the parameters</li> <li>• Save the value of parameter</li> </ul> |
| Arrow keys | <ul style="list-style-type: none"> <li>• Move to display or group</li> <li>• Move the position when set the parameter value</li> </ul>                                                         |
| Dir key    | <ul style="list-style-type: none"> <li>• Change the direction at Remote mode</li> </ul>                                                                                                        |
| Mode key   | <ul style="list-style-type: none"> <li>• Change local or remote mode</li> <li>• Start/Stop/Dir keys enable at remote mode</li> </ul>                                                           |
| Start key  | <ul style="list-style-type: none"> <li>• Start the VFD at Remote mode</li> </ul>                                                                                                               |
| Stop key   | <ul style="list-style-type: none"> <li>• Stop the VFD at Remote mode</li> </ul>                                                                                                                |
| Mini USB   | Communicate with PC tool                                                                                                                                                                       |

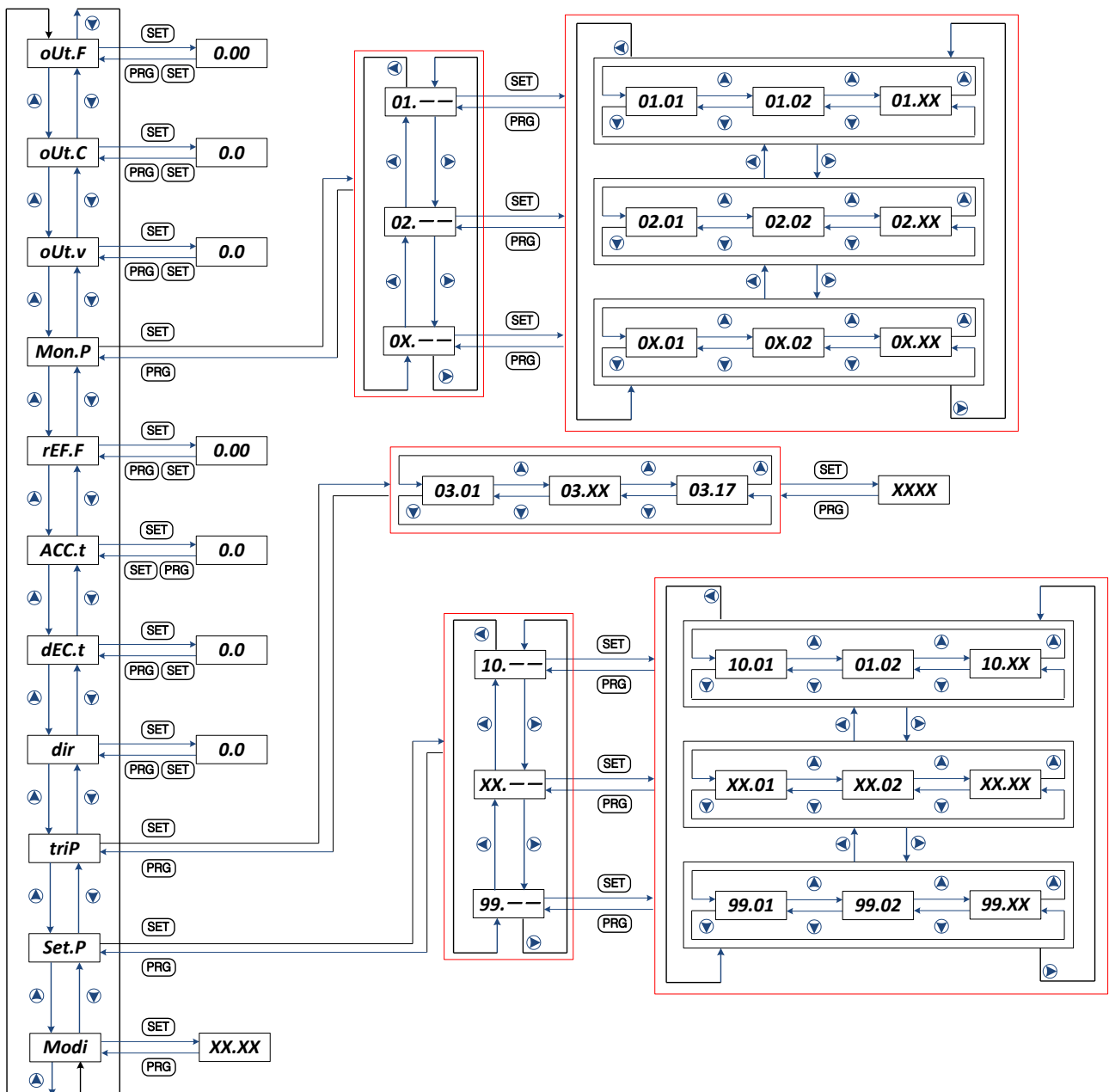
## 2) LED keypad Control method

## (1) Movement in main MENU

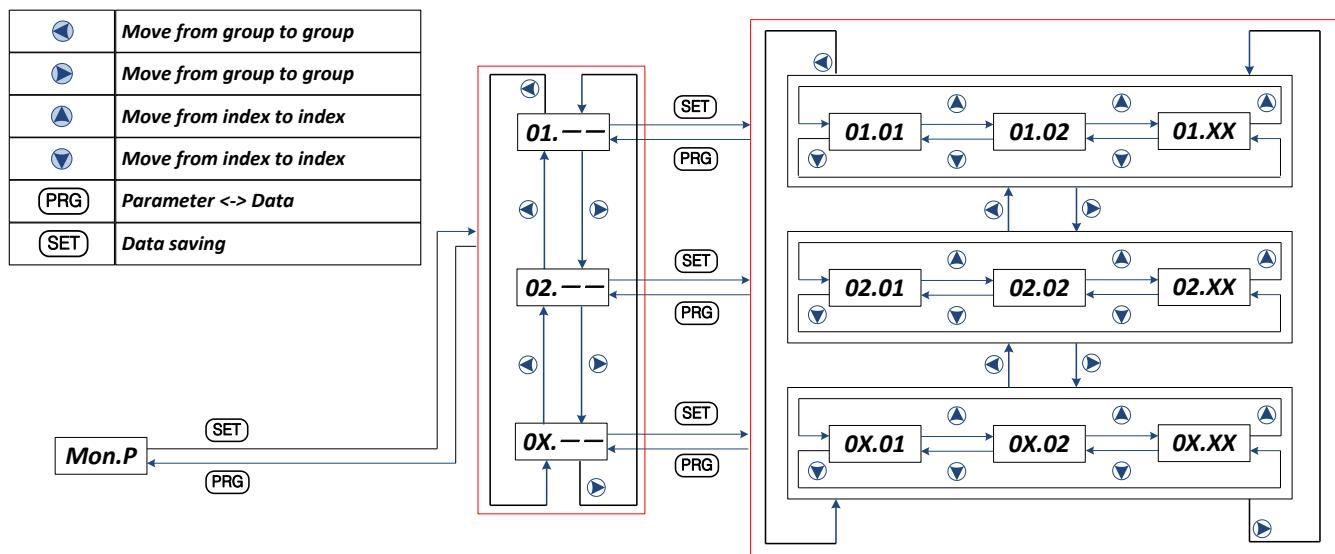


|              |                                            |
|--------------|--------------------------------------------|
| <b>oUt.F</b> | <b>Output frequency monitor (01.01)</b>    |
| <b>oUt.C</b> | <b>Output current monitor (01.05)</b>      |
| <b>oUt.v</b> | <b>Output voltage monitor (01.08)</b>      |
| <b>Mon.P</b> | <b>Parameter monitors (01.XX ~ 05.XX)</b>  |
| <b>rEF.F</b> | <b>Frequency ref input (22.01)</b>         |
| <b>ACC.t</b> | <b>Acceleration time 1 (23.04)</b>         |
| <b>dEC.t</b> | <b>Deceleration time 1 (23.05)</b>         |
| <b>dir</b>   | <b>Direction (20.13)</b>                   |
| <b>triP</b>  | <b>Trip monitoring (03.01 ~ 03.XX)</b>     |
| <b>Set.P</b> | <b>Parameter settings (10.XX ~ 99.XX)</b>  |
| <b>Modi</b>  | <b>Display only be modified parameters</b> |

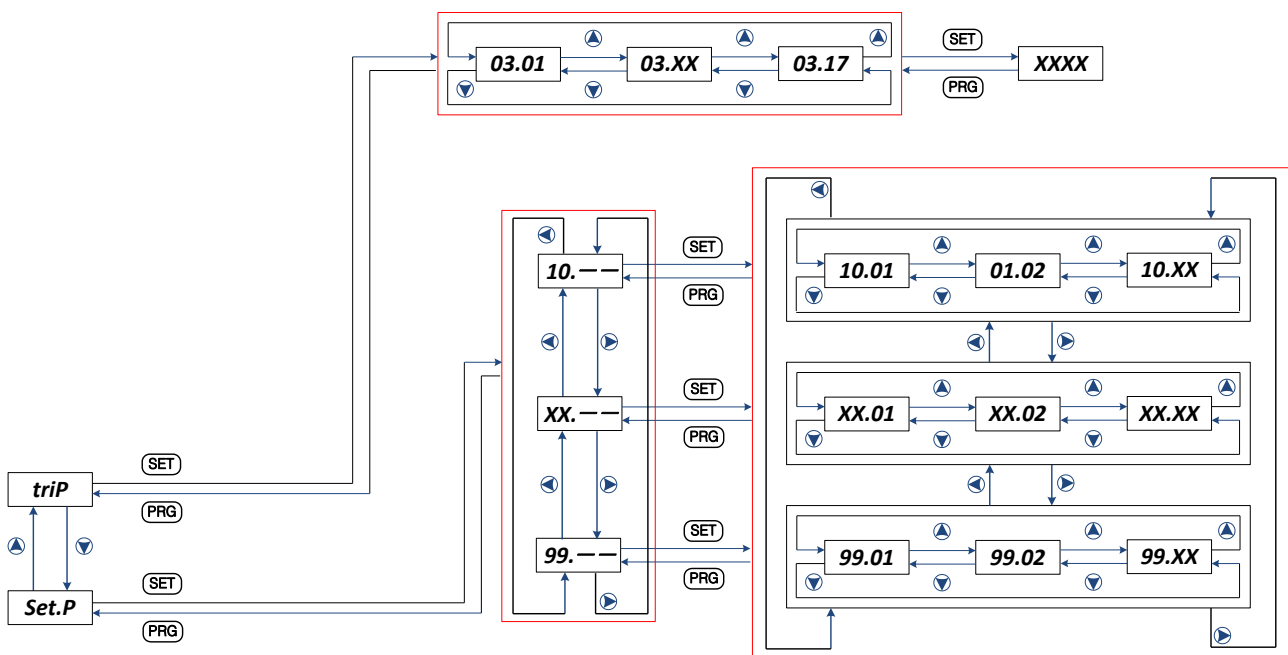
# (1) Parameter movement



## (2) Move to parameters Monitor group



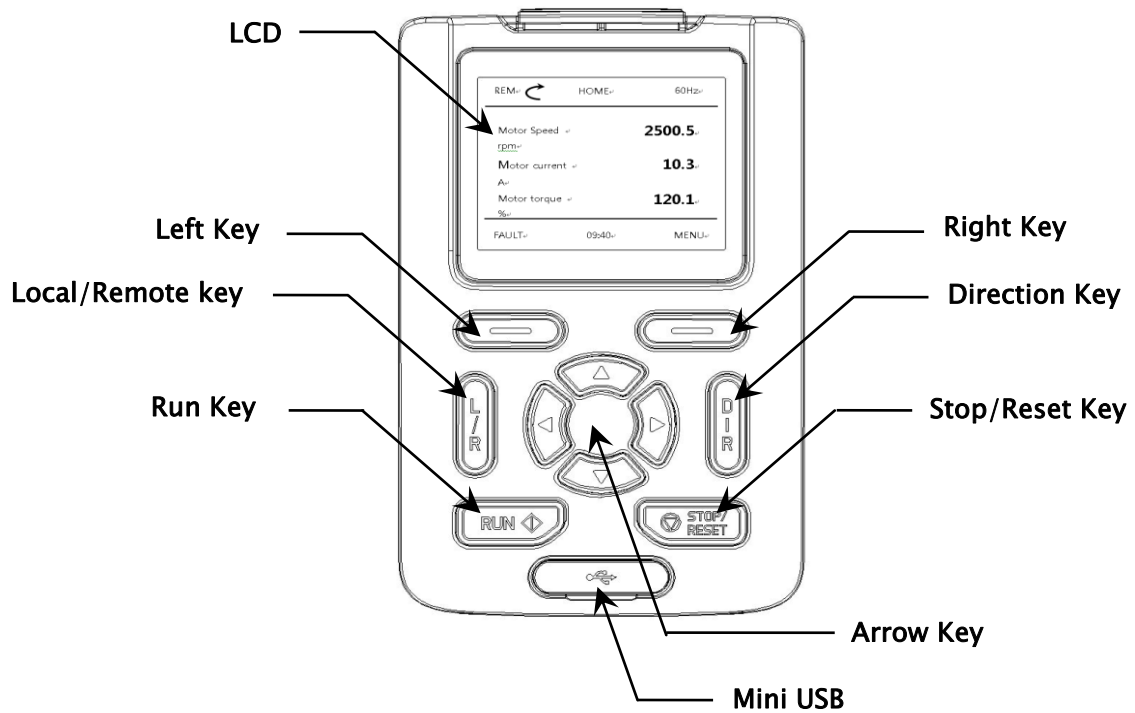
## (3) Move to Trip monitor & Parameters Setting group



## (4) Initialize Trip History or Parameter Setting

- '97.01' (Initialization mode) = 0 saving: Initialize Trip History
- '97.01' (Initialization mode) = 1 saving: Initialize Parameter Setting

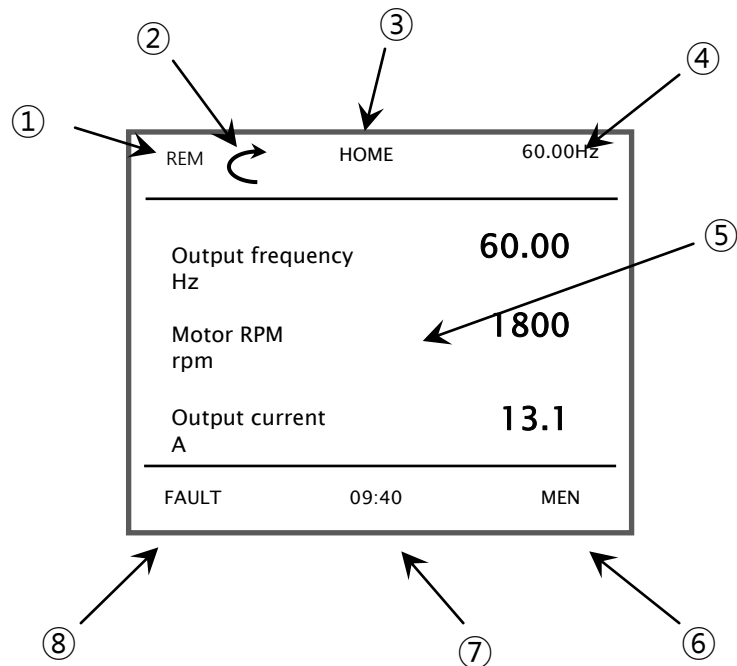
### 3) Configuration of LCD Keypad



| KEY        | Function                                                                                                                                                                                       |
|------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Left key   | <ul style="list-style-type: none"> <li>• Move to fault history</li> <li>• previous</li> <li>• Cancel at setting mode</li> </ul>                                                                |
| Right key  | <ul style="list-style-type: none"> <li>• Move to menu</li> <li>• Reset the fault when the fault is occurred</li> <li>• Select the parameters</li> <li>• Save the value of parameter</li> </ul> |
| Arrow keys | <ul style="list-style-type: none"> <li>• Move to display or group</li> <li>• Move the position when set the parameter value</li> </ul>                                                         |
| Dir key    | <ul style="list-style-type: none"> <li>• Change the direction at Remote mode</li> </ul>                                                                                                        |
| Mode key   | <ul style="list-style-type: none"> <li>• Change local or remote mode</li> <li>• Start/Stop/Dir keys enable at remote mode</li> </ul>                                                           |
| Start key  | <ul style="list-style-type: none"> <li>• Start the VFD at Remote mode</li> </ul>                                                                                                               |
| Stop key   | <ul style="list-style-type: none"> <li>• Stop the VFD at Remote mode</li> </ul>                                                                                                                |
| Mini USB   | Communicate with PC tool                                                                                                                                                                       |

#### 4) LCD keypad Control method

##### (1) LCD keypad monitor



| No | Function         | Display      | Description                            |
|----|------------------|--------------|----------------------------------------|
| 1  | Control location | LOC          | VFD is controlled by VFD Keypad        |
|    |                  | REM          | VFD is controlled by terminal block    |
| 2  | Running Status   | ↻ Rotation   | VFD is stop                            |
|    |                  | ↻ Rotation   | VFD is running to forward              |
|    |                  | ↻ Rotation   | VFD is running to reverse              |
|    |                  | ↻ Flickering | VFD is stopping from forward           |
|    |                  | ↻ Flickering | VFD is stopping from reverse           |
| 3  | Current Status   | Home         | Home mode                              |
|    |                  | Menu         | Menu mode                              |
|    |                  | Fault        | Fault status                           |
| 4  | Reference Value  | 00.00Hz      | Display referenced value               |
| 5  | Current View     | -            | Display selected item                  |
| 6  | Multi Right Key  | Menu         | Move to menu view                      |
|    |                  | Select       | Select the item                        |
|    |                  | Save         | Save the parameter data                |
|    |                  | Reset        | Reset the fault when fault is occurred |
|    |                  | Read         | Read all parameters for copy           |
|    |                  | Write        | Write all parameters for copy          |
| 7  | Time             | 00:00        | Display the current time               |
| 8  | Multi Left Key   | Back         | Move to previous view                  |
|    |                  | Cancel       | Cancel at parameter view               |
|    |                  | Fault        | Move to fault view                     |

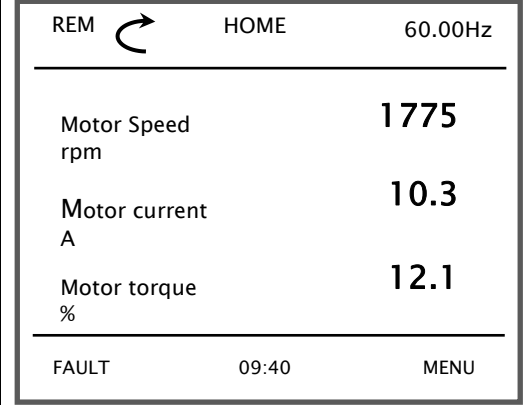
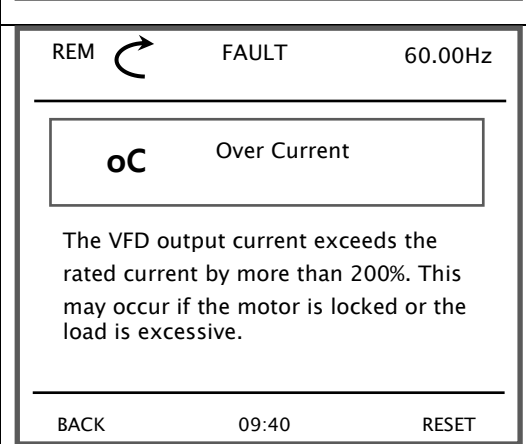
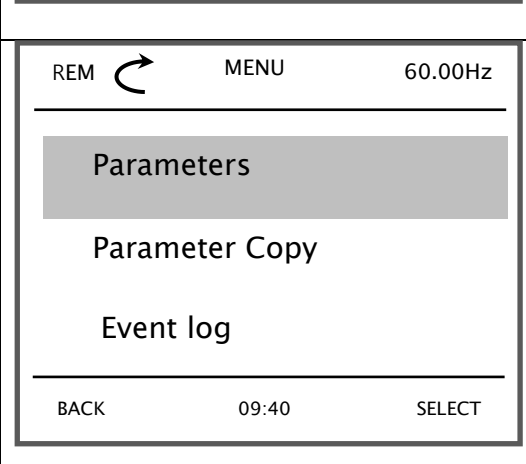
## (2) LCD KEYPAD MAP

| Display Sequence |                 |                        | Comment                                                                                             |
|------------------|-----------------|------------------------|-----------------------------------------------------------------------------------------------------|
| 1                | 2               | 3                      |                                                                                                     |
| HOME             | Parameters      | 01~99 Parameters Group | Set detailed parameters.                                                                            |
|                  | Parameters Copy | Parameter Backup       | Copy the parameters from the main unit to the LCD keypad.                                           |
|                  |                 | Parameter Restore      | Copy parameters from the LCD keypad to the main unit.                                               |
|                  |                 | Parameter Verify       | Compares the parameters of the LCD keypad and the main unit to inform you of the differences.       |
|                  | Auto Tuning     | Auto Tuning Start?     | Auto-tuning is executed.                                                                            |
|                  | Scheduling      | Setup RUN time         | 00:00 (hour : minute)                                                                               |
|                  |                 | Setup STOP time        | When the reserved operation is activated, it operates at the start time and stops at the stop time. |
|                  |                 | Activate/Deactivate    | Reservation operation is available only in LOC state: always available, REM: keypad operation only. |
|                  | Settings        | Data & Time            | 00.00.00 00:00 (Year.month.day hour : minute)                                                       |
|                  |                 | Language               | ENG(영어) / KOR(한글)                                                                                   |
|                  |                 | Background Color       | Blue, Orange, Green, Cyan, Magenta                                                                  |
|                  |                 | Reset to defaults      | Initialize the LCD keypad settings.                                                                 |
|                  | Options         | Reference              | Set the command frequency.                                                                          |
|                  |                 | Edit Home View         | Select 3 parameters to be monitored on the home screen.                                             |
|                  | System info     |                        | Displays system information and firmware version.                                                   |

## ※ Edit Home View Parameters

| View Parameters          | Unit           |
|--------------------------|----------------|
| 01.01 Output frequency   | Hz             |
| 01.02 Motor RPM          | Rpm            |
| 01.03 Encoder Speed      | Rpm            |
| 01.04 Rotation direction | Rpm            |
| 01.05 Output current     | FWD, REV, STOP |
| 01.06 Output current     | A              |
| 01.07 DC voltage         | V              |
| 01.08 Output voltage     | V              |
| 01.09 Output power       | kW             |
| 40.02 PID reference      | %, Hz, Kpa     |
| 40.17 PID FB monitor     | %, Hz, Kpa     |
| 40.18 PID output monitor | %              |

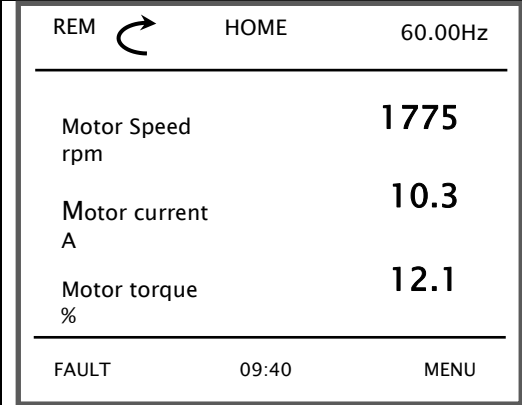
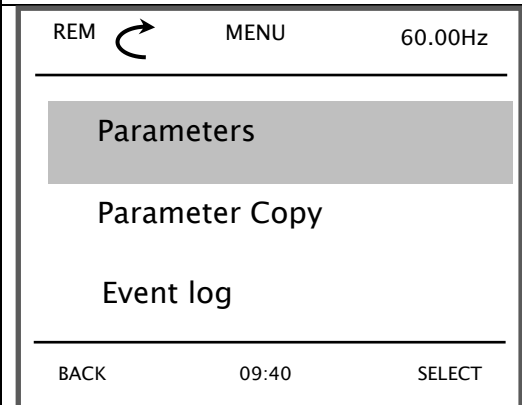
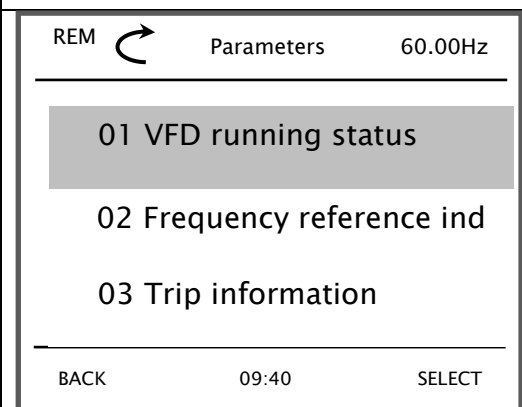
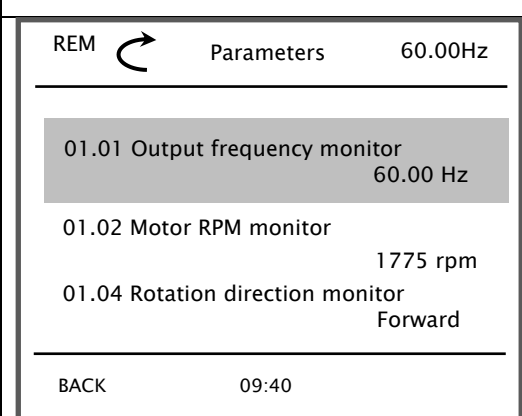
## (3) Mode shift in home mode

|                                                                                     |                                                                                                                                                                                                                                                                                                                                                                     |
|-------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|    | <p>Power on, the display emerges as shown on the left. The present mode is the HOME mode</p> <ol style="list-style-type: none"> <li>1. Press fault key once (left key) <ul style="list-style-type: none"> <li>- Go to below A</li> </ul> </li> <li>2. Press menu key once (right key) <ul style="list-style-type: none"> <li>- Go to below B</li> </ul> </li> </ol> |
|   | <p>A.</p> <p>The display emerges as shown on the left. The present mode is the FAULT mode</p>                                                                                                                                                                                                                                                                       |
|  | <p>B.</p> <p>The display emerges as shown on the left. The present mode is the MENU mode</p>                                                                                                                                                                                                                                                                        |

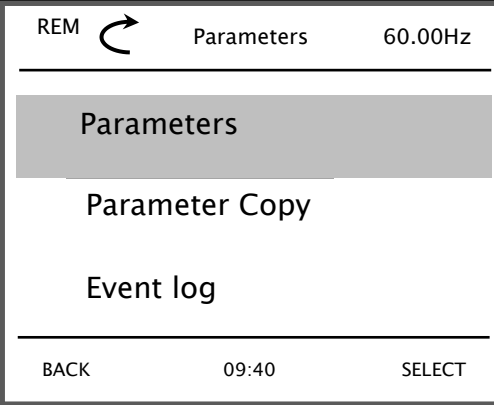
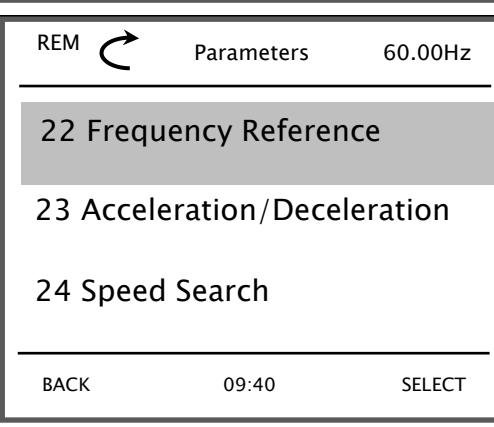
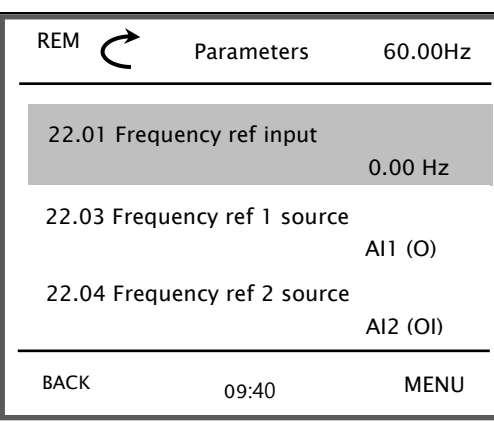
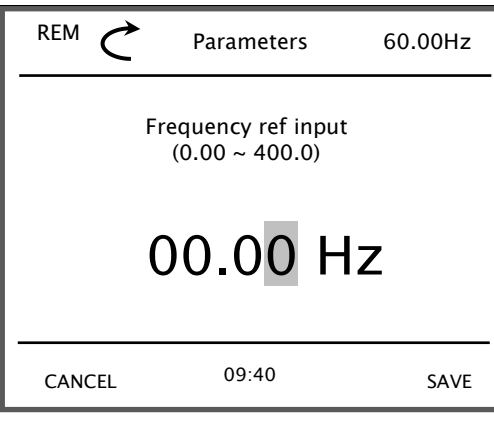
※ Menu mode has six kinds of sub menu

- Parameters: change the value of parameter
- Parameter copy: all parameters read, write and verify
- Event Info: save the fault history automatically
- System info: display the system information
- Settings: configuration of LCD keypad
- Options: home display values

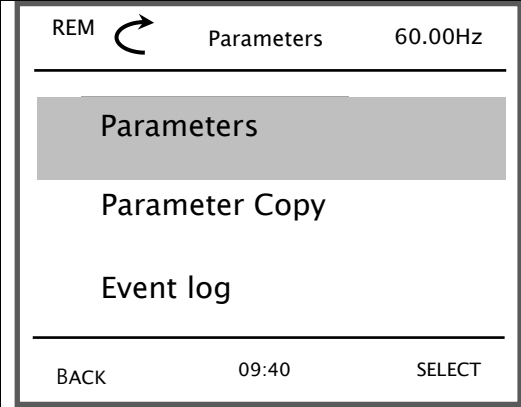
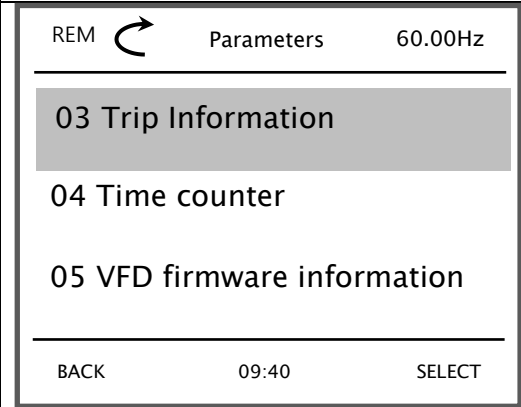
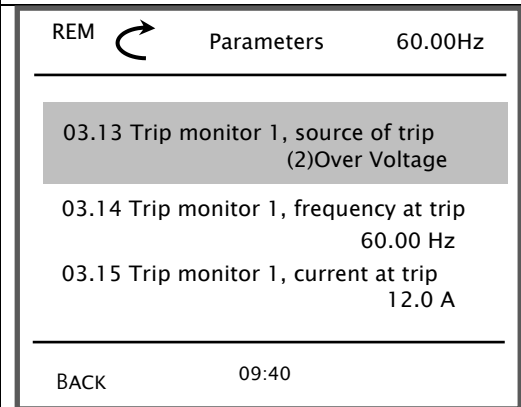
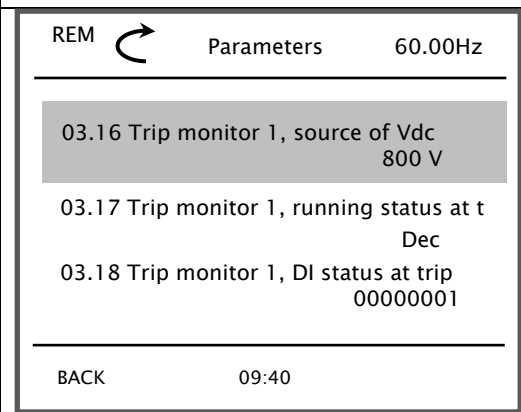
## (4) Group shift in parameters mode

|                                                                                     |                                                                                                                                         |
|-------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------|
|    | <p>Power on, the display emerges as shown on the left. The present mode is the HOME mode</p> <p>–Press the MENU key(right key) once</p> |
|   | <p>You have shifted to Parameters mode</p> <p>–Press the SELECT key(right key) once</p>                                                 |
|  | <p>The Display group of Parameters mode is emerged</p> <p>–Press the SELECT key(right key) once</p>                                     |
|  | <p>The sub menu of Display group mode is emerged</p>                                                                                    |

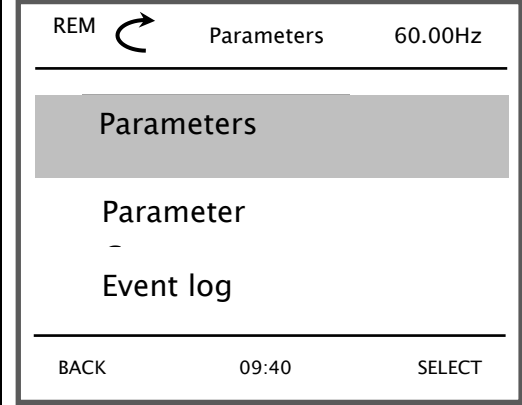
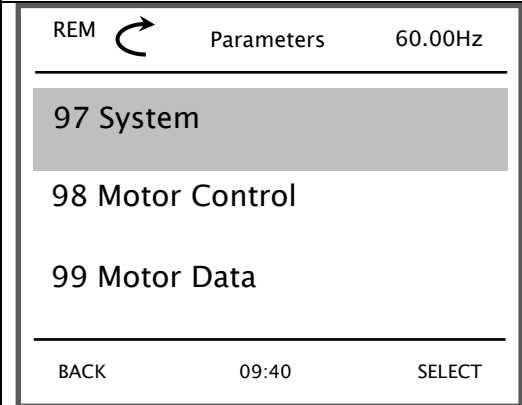
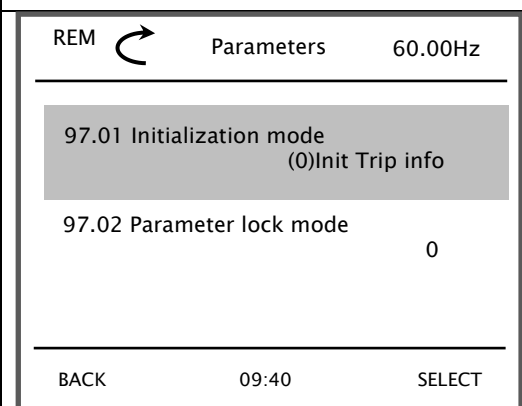
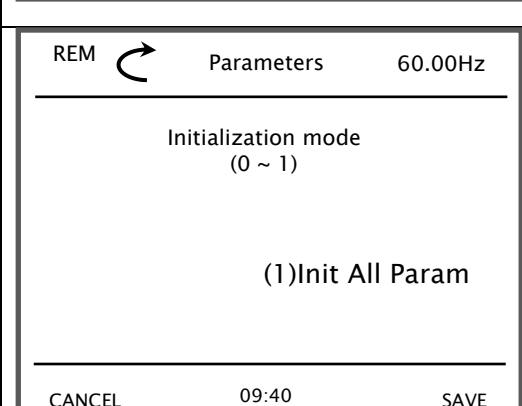
## (5) Set the frequency reference

|                                                                                     |                                                                                                                        |
|-------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|
|    | <p>You have shifted to Parameters mode</p> <p>–Press the SELECT key (right key) once</p>                               |
|   | <p>The Display group of Parameters mode is emerged. Move to 22 group</p> <p>–Press the SELECT key (right key) once</p> |
|  | <p>The sub menu of Display group mode is emerged</p>                                                                   |
|  | <p>Set the value and press the SAVE key (right key)</p>                                                                |

## (6) Fault history monitoring

|                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|    | <p>You have shifted to Parameters mode</p> <p>–Press the SELECT key (right key) once</p>                                                                                                                                                                                                                                                                                                                                                        |
|   | <p>The Display group of Parameters mode is emerged. Move to 03 group</p> <p>–Press the SELECT key (right key) once</p>                                                                                                                                                                                                                                                                                                                          |
|  | <p>There are five of trip history and details</p>                                                                                                                                                                                                                                                                                                                                                                                               |
|  | <p>More details are shown next page as below</p> <p><i>'03.19' (Trip monitor 1, DO status at trip)</i></p> <p><i>'03.20' (Trip monitor 1, IGBT Temperature at trip)</i></p> <p><i>'03.21' (Trip monitor 1, Occurred time – Year)</i></p> <p><i>'03.22' (Trip monitor 1, Occurred time – Month, Day)</i></p> <p><i>'03.22' (Trip monitor 1, Occurred time – Hour, Minute)</i></p> <p><i>'03.23' (Trip monitor 1, Occurred time – Second)</i></p> |

## (7) Parameter setting

|                                                                                     |                                                                                                                                          |
|-------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|
|    | <p>You have shifted to Parameters mode</p> <p>-Press the SELECT key(right key) once</p>                                                  |
|   | <p>The Display group of Parameters mode is emerged.<br/>Move to 97 group</p> <p>-Press the SELECT key(right key) once</p>                |
|  | <p>The details of System mode are emerged.</p> <p>-Press the SELECT key(right key) once</p>                                              |
|  | <p>-Press the up arrow once</p> <p>It change to (1)Init All Param<br/>If you want initialize,<br/>Press the SAVE key(right key) once</p> |

## 7. Quick Start Guide

In order to run the VFD, the run command source and frequency command source must be determined. Select one frequency command source and one run command source from list below and follow the instruction in the section referenced.

Default frequency command source is Analog Input Voltage, default run command source is Intelligent Input Terminal Connector (Input Terminal 1: Fwd, Input Terminal 2: Rev).

Frequency command can be done by

- Keypad – Up/Down Arrow Keys – (7.1)
- Input Terminal –
  - ❖ Analog Input Voltage/Current – (7.2)
  - ❖ Multi Frequency – (7.3)
  - ❖ Up/Down – (7.4)
- Modbus – RS485 (RXN, RXP) – (7.5)

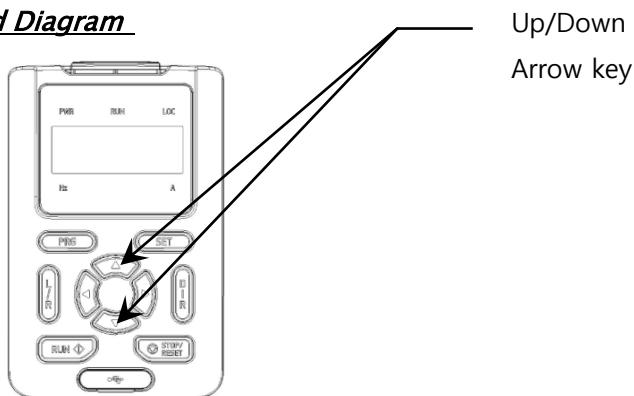
And running/stopping command can be done by

- Keypad RUN/STOP Keys – (7.6)
- Intelligent Input Terminal Connector – (7.7)
- Modbus – RS485 (RXN, RXP) – (7.8)

### 7.1 Frequency Command Source to Up/Down Arrow Keys

- Keypad Diagram
- Programming A1 Parameters

#### ❖ Keypad Diagram



#### ❖ Programming A1 Parameters

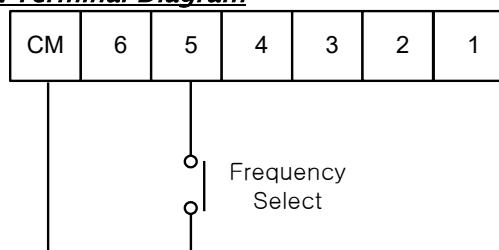
- On Keypad, program following parameters with corresponding values:

| Code  | Set Value | Description                        |
|-------|-----------|------------------------------------|
| 22.03 | 6         | Frequency Command Source to Keypad |

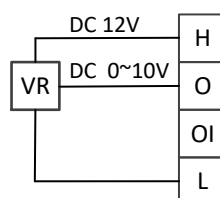
## 7.2 Frequency Command Source to Input Analog Voltage/ Current

- Input Terminal Diagram
- Programming A1 Parameters
- Programming Frequency Set Point

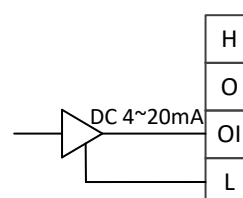
### ❖ Input Terminal Diagram



Input Voltage Source Setup



Input Current Source Setup



### ❖ Programming A1 Parameters

- On Keypad, program following parameters with corresponding values

| Code  | Set Value | Description                                                                                                   |
|-------|-----------|---------------------------------------------------------------------------------------------------------------|
| 22.03 | 1         | Frequency Command Source1 to Input Terminal(0~10V).                                                           |
| 22.04 | 2         | Frequency Command Source2 to Input Terminal(4~20mA).                                                          |
| 22.06 | 0         | Set Terminal 5 to Frequency Select Operation.<br>If Closed, Select Current Source. If opened, Voltage Source. |

### ❖ Setting Frequency Setpoint

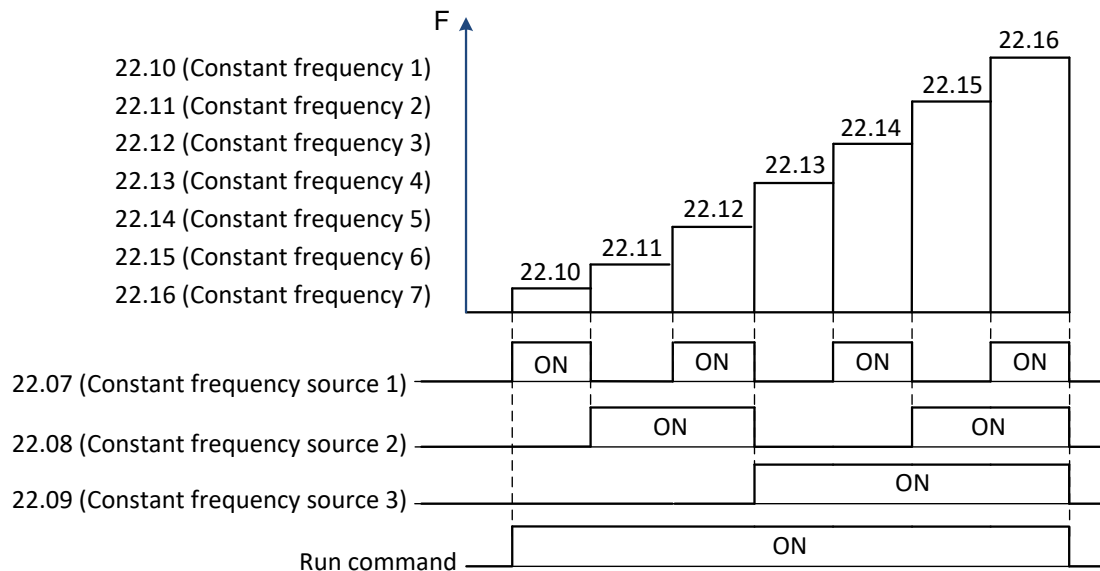
- Program following parameters with specified frequency values.

Frequency setpoint follows analog reference (0 ~ 10V / 4 ~ 20 mA) from 0 to 60 Hz. Analog input settings can be modified using '11.06 ~ 11.08', '11.14 ~ 11.17'.

## 7.3 Frequency Command Source to Input Terminal – Multi Speed Frequency

- Input Terminal Diagram
- Programming A1 Parameters

### ❖ Diagram



### ❖ Programming A1 Parameters

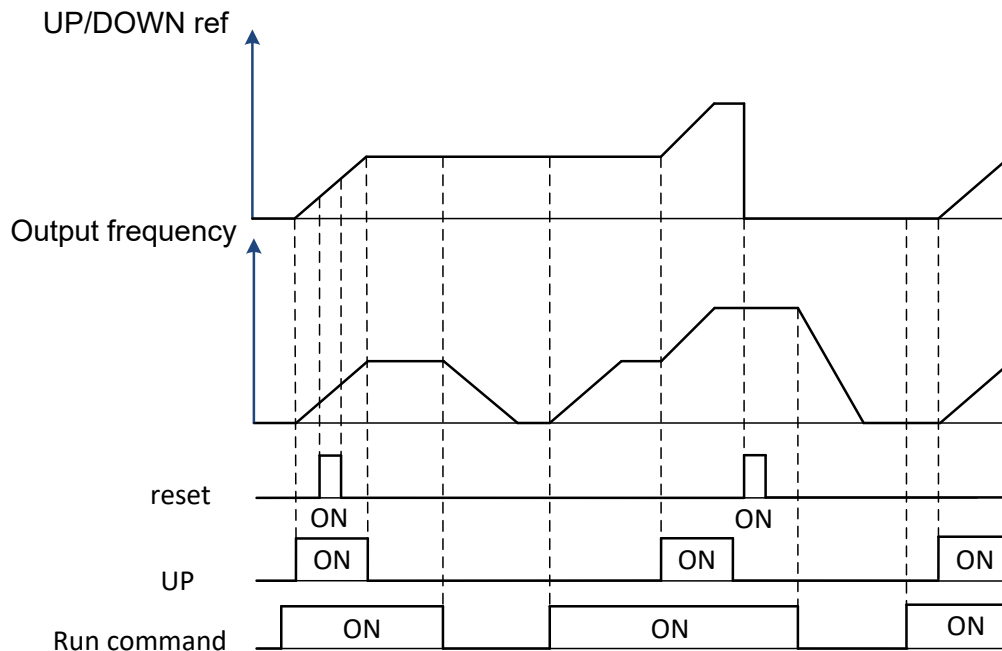
- On Keypad, program following parameters with corresponding values:

| Code  | Set Value | Description                                                     |
|-------|-----------|-----------------------------------------------------------------|
| 22.07 | 0         | Set Terminal 3 to Multi Speed Set CF1                           |
| 22.08 | 0         | Set Terminal 4 to Multi Speed Set CF2                           |
| 22.09 | 8         | Set Terminal 5 to Multi Speed Set CF3                           |
| 22.10 |           |                                                                 |
| ~     | -         | Set Frequency Value to Multi Speed by combination of CF1 ~ CF3. |
| 22.16 |           |                                                                 |

## 7.4 Frequency Command Source to Input Terminal – Up/Down

- Input Terminal Diagram
- Programming A1 Parameters

### ❖ Diagram



### ❖ Programming A1 Parameters

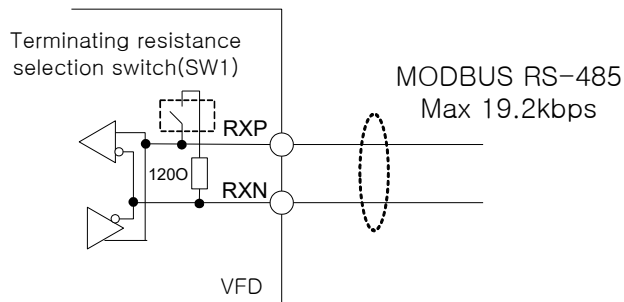
- On Keypad, program following parameters with corresponding values:

| Code  | Set Value | Description                                                       |
|-------|-----------|-------------------------------------------------------------------|
| 22.25 | –         | UP/DOWN Enable, Initial value, Up/Down Source, Reset Source, etc. |
| ~     | –         |                                                                   |
| 22.34 | –         |                                                                   |

## 7.5 Frequency Command Source to Modbus RS-485

- Diagram
- Programming A1 Parameters
- Set Frequency Setpoint

### ❖ Diagram



| Terminal connector | Signal Descriptions |
|--------------------|---------------------|
| RXP                | RS - 485+           |
| RXN                | RS - 485-           |

### ❖ Programming A1 Parameters

- On Keypad, program following parameters with corresponding values:

| Code  | Set Value | Description                             |
|-------|-----------|-----------------------------------------|
| 22.03 | 3         | Frequency Command by Modbus RS-485      |
| 50.01 | 1         | Communication node (1 ~ 32)             |
| 50.02 | 0         | Modbus baud rate (2,400bps ~ 19,200bps) |

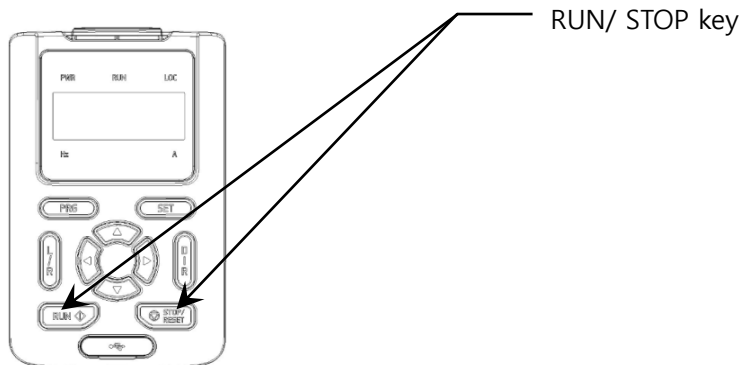
### ❖ Set Frequency Setpoint

- Integer data represents 0.01 Hz (ex: 6000 = 60.00 Hz)
- Ref to '8.2.23 RS-485(Modbus)'.

## 7.6 Run Command Source to Run / Stop Keys on Keypad

- Diagram
- Programming A1 Parameters

### ❖ Diagram



### ❖ Programming A1 Parameters

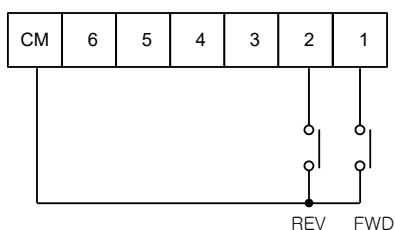
- On Keypad, program following parameters with corresponding values:

| Code  | Set Value | Description                                     |
|-------|-----------|-------------------------------------------------|
| 20.02 | 9         | Run Command Source to RUN / STOP Keys on Keypad |

## 7.7 Run Command Source to Input Terminal

- Diagram
- Programming A1 Parameters

### ❖ Diagram



### ❖ Programming Run Command Source

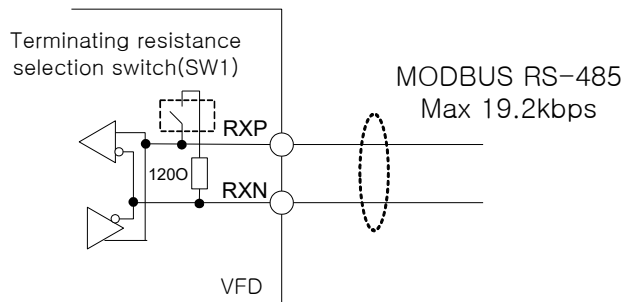
- On Keypad, program following parameters with corresponding values

| Code  | Set Value | Description                                                                              |
|-------|-----------|------------------------------------------------------------------------------------------|
| 20.02 | 3         | Run Command Source to Input Terminal<br>(2 Wire 2, Refer to '8.2.9 Start/Stop/Direction) |

## 7.8 Run Command Source to Modbus RS-485

- Diagram
- Programming A1 Parameters
- Set Frequency Setpoint

### ❖ Diagram



| Terminal connector | Signal Descriptions |
|--------------------|---------------------|
| RXP                | RS - 485+           |
| RXN                | RS - 485-           |

### ❖ Programming A1 Parameters

- On Keypad, program following parameters with corresponding values:

| Code  | Set Value | Description                             |
|-------|-----------|-----------------------------------------|
| 20.02 | 7         | Run Command by Modbus RS-485            |
| 50.01 | 1         | Communication node (1 ~ 32)             |
| 50.02 | 0         | Modbus baud rate (2,400bps ~ 19,200bps) |

### ❖ Set Frequency Setpoint

- Data: (FWD: 0x0001, REV: 0x0002, RST: 0x0004)
- Ref to '8.2.23 RS-485(Modbus)'.

## 8. A1 Parameters

### 8.1 A1 Parameters Overview

A1 parameters are organized to various groups as summarized

| Group | Contents                       | Page |
|-------|--------------------------------|------|
| 01    | VFD running status             | 83   |
| 02    | Frequency reference indication | 85   |
| 03    | Trip information               | 86   |
| 04    | Time counter                   | 88   |
| 05    | VFD firmware information       | 90   |
| 10    | Standard DI, DO                | 91   |
| 11    | Standard AI (O, Ol)            | 100  |
| 12    | Standard AO (FM, AMI)          | 105  |
| 20    | Start/Stop/direction           | 109  |
| 21    | Start/Stop mode                | 114  |
| 22    | Frequency reference            | 117  |
| 23    | Acceleration/Deceleration      | 127  |
| 24    | Speed search                   | 131  |
| 25    | Over voltage suppression       | 132  |
| 26    | KEB                            | 137  |
| 27    | DWELL                          | 138  |
| 30    | Frequency limits               | 139  |
| 31    | Fault functions                | 140  |
| 32    | Motor thermal protection       | 145  |
| 33    | System Overload/Underload      | 146  |
| 40    | PID                            | 148  |
| 41    | DBR duty Cycle                 | 156  |
| 42    | Monitoring/Scaling             | 157  |
| 43    | Droop                          | 158  |
| 50    | RS-485 (Modbus)                | 161  |
| 51    | Fieldbus (option)              | 168  |
| 96    | User parameters                | 169  |
| 97    | System                         | 170  |
| 98    | Motor control                  | 172  |
| 99    | Motor data                     | 181  |

### 8.1.1 VFD running status

| No.   | Name                       | Range              | Page |
|-------|----------------------------|--------------------|------|
| 01.01 | Output frequency monitor   | 0.00 to 400.0 [Hz] | 83   |
| 01.02 | Motor RPM monitor          | 0 to 60000 [rpm]   | 83   |
| 01.03 | Encoder Speed              | 0 to 60000 [rpm]   | 83   |
| 01.04 | Rotation direction monitor | STP / FWD / REV    | 83   |
| 01.05 | Output current monitor     | 0.0 to 2000 [A]    | 83   |
| 01.07 | DC voltage monitor         | 0 to 1000 [V]      | 83   |
| 01.08 | Output voltage monitor     | 0 to 1000 [V]      | 84   |
| 01.09 | Output power monitor       | 0.0 to 1000 [kW]   | 84   |

### 8.1.2 Frequency reference indication

| No.   | Name                                 | Range              | Page |
|-------|--------------------------------------|--------------------|------|
| 02.01 | Final frequency reference monitor    | 0.00 to 400.0 [Hz] | 85   |
| 02.02 | Modbus frequency reference monitor   | 0.00 to 400.0 [Hz] | 85   |
| 02.03 | Fieldbus frequency reference monitor | 0.00 to 400.0 [Hz] | 85   |

### 8.1.3 Trip information

| No.   | Name                                         | Range                    | Page |
|-------|----------------------------------------------|--------------------------|------|
| 03.01 | Current trip, Source of Trip                 | –                        | 86   |
| 03.02 | Current trip, Frequency at Trip              | 0.00 to 400.0 [Hz]       | 86   |
| 03.03 | Current trip, Current at Trip                | 0.0 to 2000 [A]          | 86   |
| 03.04 | Current trip, Vdc at Trip                    | 0 to 1000 [V]            | 86   |
| 03.05 | Current trip, Running Status at Trip         | STP, ACC, STD, DEC       | 86   |
| 03.06 | Current trip, DI Status at Trip              | 0x00 to 0xFF             | 86   |
| 03.07 | Current trip, DO Status at Trip              | 0x00 to 0xFF             | 86   |
| 03.08 | Current trip, IGBT Temperature at Trip       | 0.0 to 160.0 [°C]        | 86   |
| 03.09 | Current trip, Occurred time (Year)           | 2000 to 2099 [Year]      | 87   |
| 03.10 | Current trip, Occurred time (Month, Day)     | 101 to 1231 [Month, Day] | 87   |
| 03.11 | Current trip, Occurred time (Hour, Minute)   | 0 to 2359 [Hour, Minute] | 87   |
| 03.12 | Current trip, Occurred time (Second)         | 0 to 59 [Sec]            | 87   |
| 03.13 | Trip monitor 1, Source of Trip               | –                        | 87   |
| 03.14 | Trip monitor 1, Frequency at Trip            | 0.00 to 400.0 [Hz]       | 87   |
| 03.15 | Trip monitor 1, Current at Trip              | 0.0 to 2000 [A]          | 87   |
| 03.16 | Trip monitor 1, Vdc at Trip                  | 0 to 1000 [V]            | 87   |
| 03.17 | Trip monitor 1, Running Status at Trip       | STP, ACC, STD, DEC       | 87   |
| 03.18 | Trip monitor 1, DI Status at Trip            | 0x00 to 0xFF             | 87   |
| 03.19 | Trip monitor 1, DO Status at Trip            | 0x00 to 0xFF             | 87   |
| 03.20 | Trip monitor 1, IGBT Temperature at Trip     | 0.0 to 160.0 [°C]        | 87   |
| 03.21 | Trip monitor 1, Occurred time (Year)         | 2000 to 2099 [Year]      | 87   |
| 03.22 | Trip monitor 1, Occurred time (Month, Day)   | 101 to 1231 [Month, Day] | 87   |
| 03.23 | Trip monitor 1, Occurred time (Hour, Minute) | 0 to 2359 [Hour, Minute] | 87   |
| 03.24 | Trip monitor 1, Occurred time (Second)       | 0 to 59 [Sec]            | 87   |
| 03.25 | Trip monitor 2, Source of Trip               | –                        | 87   |
| 03.26 | Trip monitor 2, Frequency at Trip            | 0.00 to 400.0 [Hz]       | 87   |
| 03.27 | Trip monitor 2, Current at Trip              | 0.0 to 2000 [A]          | 87   |
| 03.28 | Trip monitor 2, Vdc at Trip                  | 0 to 1000 [V]            | 87   |
| 03.29 | Trip monitor 2, Running Status at Trip       | STP, ACC, STD, DEC       | 87   |
| 03.30 | Trip monitor 2, DI Status at Trip            | 0x00 to 0xFF             | 87   |

| No.   | Name                                         | Range                    | Page |
|-------|----------------------------------------------|--------------------------|------|
| 03.31 | Trip monitor 2, DO Status at Trip            | 0x00 to 0xFF             | 87   |
| 03.32 | Trip monitor 2, IGBT Temperature at Trip     | 0.0 to 160.0 [°C]        | 87   |
| 03.33 | Trip monitor 2, Occurred time (Year)         | 2000 to 2099 [Year]      | 87   |
| 03.34 | Trip monitor 2, Occurred time (Month, Day)   | 101 to 1231 [Month, Day] | 87   |
| 03.35 | Trip monitor 2, Occurred time (Hour, Minute) | 0 to 2359 [Hour, Minute] | 87   |
| 03.36 | Trip monitor 2, Occurred time (Second)       | 0 to 59 [Sec]            | 87   |
| 03.37 | Trip monitor 3, Source of Trip               | –                        | 87   |
| 03.38 | Trip monitor 3, Frequency at Trip            | 0.00 to 400.0 [Hz]       | 87   |
| 03.39 | Trip monitor 3, Current at Trip              | 0.0 to 2000 [A]          | 87   |
| 03.40 | Trip monitor 3, Vdc at Trip                  | 0 to 1000 [V]            | 87   |
| 03.41 | Trip monitor 3, Running Status at Trip       | STP, ACC, STD, DEC       | 87   |
| 03.42 | Trip monitor 3, DI Status at Trip            | 0x00 to 0xFF             | 87   |
| 03.43 | Trip monitor 3, DO Status at Trip            | 0x00 to 0xFF             | 87   |
| 03.44 | Trip monitor 3, IGBT Temperature at Trip     | 0.0 to 160.0 [°C]        | 87   |
| 03.45 | Trip monitor 3, Occurred time (Year)         | 2000 to 2099 [Year]      | 87   |
| 03.46 | Trip monitor 3, Occurred time (Month, Day)   | 101 to 1231 [Month, Day] | 87   |
| 03.47 | Trip monitor 3, Occurred time (Hour, Minute) | 0 to 2359 [Hour, Minute] | 87   |
| 03.48 | Trip monitor 3, Occurred time (Second)       | 0 to 59 [Sec]            | 87   |
| 03.49 | Trip monitor 4, Source of Trip               | –                        | 87   |
| 03.50 | Trip monitor 4, Frequency at Trip            | 0.00 to 400.0 [Hz]       | 87   |
| 03.51 | Trip monitor 4, Current at Trip              | 0.0 to 2000 [A]          | 87   |
| 03.52 | Trip monitor 4, Vdc at Trip                  | 0 to 1000 [V]            | 87   |
| 03.53 | Trip monitor 4, Running Status at Trip       | STP, ACC, STD, DEC       | 87   |
| 03.54 | Trip monitor 4, DI Status at Trip            | 0x00 to 0xFF             | 87   |
| 03.55 | Trip monitor 4, DO Status at Trip            | 0x00 to 0xFF             | 87   |
| 03.56 | Trip monitor 4, IGBT Temperature at Trip     | 0.0 to 160.0 [°C]        | 87   |
| 03.57 | Trip monitor 4, Occurred time (Year)         | 2000 to 2099 [Year]      | 87   |
| 03.58 | Trip monitor 4, Occurred time (Month, Day)   | 101 to 1231 [Month, Day] | 87   |
| 03.59 | Trip monitor 4, Occurred time (Hour, Minute) | 0 to 2359 [Hour, Minute] | 87   |
| 03.60 | Trip monitor 4, Occurred time (Second)       | 0 to 59 [Sec]            | 87   |
| 03.61 | Trip monitor 5, Source of Trip               | –                        | 87   |
| 03.62 | Trip monitor 5, Frequency at Trip            | 0.00 to 400.0 [Hz]       | 87   |
| 03.63 | Trip monitor 5, Current at Trip              | 0.0 to 2000 [A]          | 87   |
| 03.64 | Trip monitor 5, Vdc at Trip                  | 0 to 1000 [V]            | 87   |
| 03.65 | Trip monitor 5, Running Status at Trip       | STP, ACC, STD, DEC       | 87   |
| 03.66 | Trip monitor 5, DI Status at Trip            | 0x00 to 0xFF             | 87   |
| 03.67 | Trip monitor 5, DO Status at Trip            | 0x00 to 0xFF             | 87   |
| 03.68 | Trip monitor 5, IGBT Temperature at Trip     | 0.0 to 160.0 [°C]        | 87   |
| 03.69 | Trip monitor 5, Occurred time (Year)         | 2000 to 2099 [Year]      | 87   |
| 03.70 | Trip monitor 5, Occurred time (Month, Day)   | 101 to 1231 [Month, Day] | 87   |
| 03.71 | Trip monitor 5, Occurred time (Hour, Minute) | 0 to 2359 [Hour, Minute] | 87   |
| 03.72 | Trip monitor 5, Occurred time (Second)       | 0 to 59 [Sec]            | 87   |
| 03.73 | Trip Counter                                 | 0 to 40000               | 87   |

### 8.1.4 Time counter

| No.   | Name                  | Range              | Page |
|-------|-----------------------|--------------------|------|
| 04.01 | Power on–day counter  | 0 to 65535 [Day]   | 88   |
| 04.02 | Power on–time counter | 0 to 1439 [Minute] | 88   |
| 04.03 | Run–day counter       | 0 to 65535 [Day]   | 88   |
| 04.04 | Run–time counter      | 0 to 1439 [Minute] | 88   |
| 04.05 | Fan on–day counter    | 0 to 65535 [Day]   | 88   |
| 04.06 | Fan on–time counter   | 0 to 1439 [Minute] | 88   |
| 04.07 | IGBT temperature      | 0.0 to 160.0 [°C]  | 89   |
| 04.08 | Fieldbus status       | 0x00 to 0xFF       | 89   |

### 8.1.5 VFD firmware Information

| No.   | Name                        | Range                    | Page |
|-------|-----------------------------|--------------------------|------|
| 05.01 | Firmware name               | STD: Standard            | 90   |
| 05.02 | Firmware version            | 0.000 to 9.999           | 90   |
| 05.03 | Current time (Year)         | 2000 to 2099 [Year]      | 90   |
| 05.04 | Current time (Month, Day)   | 101 to 1231 [Month, Day] | 90   |
| 05.05 | Current time (Hour, Minute) | 0 to 2359 [Hour, Minute] | 90   |
| 05.06 | Current time (Second)       | 0 to 59 [Sec]            | 90   |

## 8.1.6 Standard DI, DO (RN0~RN3, AL0~AL1~AL2)

| No.   | Name                                                      | Edit | Range                                                 | Default | Page |
|-------|-----------------------------------------------------------|------|-------------------------------------------------------|---------|------|
| 10.01 | DI Status                                                 | –    | 0x00 to 0xFF                                          | –       | 91   |
| 10.02 | DI delayed status                                         | –    | 0x00 to 0xFF                                          | –       | 91   |
| 10.03 | DI forced selection                                       | X    | 0x00 to 0xFF                                          | 0x00    | 91   |
| 10.04 | DI forced data                                            | O    | 0x00 to 0xFF                                          | 0x00    | 91   |
| 10.05 | DI contact type selection                                 | X    | 0x00 to 0xFF                                          | 0x00    | 92   |
| 10.06 | DI1 ON delay time                                         | O    | 0 to 30000 [mSec]                                     | 10 mSec | 92   |
| 10.07 | DI1 OFF delay time                                        | O    | 0 to 30000 [mSec]                                     | 10 mSec | 92   |
| 10.08 | DI2 ON delay time                                         | O    | 0 to 30000 [mSec]                                     | 10 mSec | 92   |
| 10.09 | DI2 OFF delay time                                        | O    | 0 to 30000 [mSec]                                     | 10 mSec | 92   |
| 10.10 | DI3 ON delay time                                         | O    | 0 to 30000 [mSec]                                     | 10 mSec | 92   |
| 10.11 | DI3 OFF delay time                                        | O    | 0 to 30000 [mSec]                                     | 10 mSec | 92   |
| 10.12 | DI4 ON delay time                                         | O    | 0 to 30000 [mSec]                                     | 10 mSec | 93   |
| 10.13 | DI4 OFF delay time                                        | O    | 0 to 30000 [mSec]                                     | 10 mSec | 93   |
| 10.14 | DI5 ON delay time                                         | O    | 0 to 30000 [mSec]                                     | 10 mSec | 93   |
| 10.15 | DI5 OFF delay time                                        | O    | 0 to 30000 [mSec]                                     | 10 mSec | 93   |
| 10.16 | DI6 ON delay time                                         | O    | 0 to 30000 [mSec]                                     | 10 mSec | 93   |
| 10.17 | DI6 OFF delay time                                        | O    | 0 to 30000 [mSec]                                     | 10 mSec | 93   |
| 10.18 | DI7 ON delay time                                         | O    | 0 to 30000 [mSec]                                     | 10 mSec | 93   |
| 10.19 | DI7 OFF delay time                                        | O    | 0 to 30000 [mSec]                                     | 10 mSec | 93   |
| 10.20 | DI8 ON delay time                                         | O    | 0 to 30000 [mSec]                                     | 10 mSec | 93   |
| 10.21 | DI8 OFF delay time                                        | O    | 0 to 30000 [mSec]                                     | 10 mSec | 93   |
| 10.22 | DO (RN0~RN3, AL0~AL2)<br>delayed status                   | O    | 0x00 to 0xFF                                          | –       | 94   |
| 10.23 | DO (RN0~RN3, AL0~AL2)<br>forced selection                 | X    | 0x00 to 0xFF                                          | 0x00    | 94   |
| 10.24 | DO (RN0~RN3, AL0~AL2)<br>forced data                      | O    | 0x00 to 0xFF                                          | 0x00    | 94   |
| 10.25 | DO1 (RN0~RN1),<br>DO2 (RN2~RN3)<br>contact type selection | X    | 0x00 to 0xFF                                          | 0x00    | 94   |
| 10.26 | DO1 (RN0~RN1) source                                      | X    | 0. Run<br>1. FA1<br>2. FA2<br>3. OL<br>4. OD<br>5. AL | 1       | 95   |
| 10.27 | DO1 (RN0~RN1)<br>ON delay time                            | O    | 0.0 to 3000 [Sec]                                     | 0.0 Sec | 98   |
| 10.28 | DO2 (RN0~RN1)<br>OFF delay time                           | O    | 0.0 to 3000 [Sec]                                     | 0.0 Sec | 98   |
| 10.29 | DO2 (RN2~RN3) source                                      | X    | 0. Run<br>1. FA1<br>2. FA2<br>3. OL<br>4. OD<br>5. AL | 0       | 98   |
| 10.30 | DO2 (RN2~RN3)<br>ON delay time                            | O    | 0.0 to 3000 [Sec]                                     | 0.0 Sec | 98   |
| 10.31 | DO2 (RN2~RN3)<br>OFF delay time                           | O    | 0.0 to 3000 [Sec]                                     | 0.0 Sec | 98   |

| No.   | Name                                           | Edit | Range                                                 | Default | Page |
|-------|------------------------------------------------|------|-------------------------------------------------------|---------|------|
| 10.32 | Alarm Relay<br>(AL0–AL1–AL2) source            | X    | 0. Run<br>1. FA1<br>2. FA2<br>3. OL<br>4. OD<br>5. AL | 5       | 98   |
| 10.33 | Alarm Relay<br>(AL0–AL1–AL2)<br>ON delay time  | O    | 0.0 to 3000 [Sec]                                     | 0.0 Sec | 98   |
| 10.34 | Alarm Relay<br>(AL0–AL1–AL2)<br>OFF delay time | O    | 0.0 to 3000 [Sec]                                     | 0.0 Sec | 98   |
| 10.35 | VFD Overload warning level                     | X    | 10.0 to 200.0 [%]                                     | 100.0 % | 99   |
| 10.36 | FA2 reference at acceleration                  | X    | '10.37' to '30.01' [Hz]                               | 0.00 Hz | 99   |
| 10.37 | FA2 reference at deceleration                  | X    | 0.00 to '10.36' [Hz]                                  | 0.00 Hz | 99   |
| 10.38 | PID Error Tolerance                            | X    | 0.0 to 100.0 [%]                                      | 100.0 % | 99   |

### 8.1.7 Standard AI (O, OI)

| No.   | Name                        | Edit | Range                                                    | Default  | Page |
|-------|-----------------------------|------|----------------------------------------------------------|----------|------|
| 11.01 | AI (O, OI) forced selection | X    | 0x00 to 0xFF                                             | 0x00     | 100  |
| 11.02 | AI1 (O) actual value        | –    | 0.0 to 100.0 [%]                                         | –        | 100  |
| 11.03 | AI1 (O) scaled value        | –    | 0.00 to 400.0 [Hz] – Frequency<br>0.0 to 100.0 [%] – PID | –        | 100  |
| 11.04 | AI1 (O) forced value        | O    | 0.0 to 100.0 [%]                                         | 0.00 %   | 100  |
| 11.05 | AI1 (O) filter time         | O    | 0 to 30000 [ms]                                          | 100 ms   | 101  |
| 11.06 | AI1 (O) source min          | X    | 0.0 to 100.0 [%]                                         | 0.00 %   | 101  |
| 11.07 | AI1 (O) source max          | X    | 0.0 to 100.0 [%]                                         | 100.0 %  | 101  |
| 11.08 | AI1 (O) scaled at AI1 min   | X    | 0.00 to 400.0 [Hz] – Frequency<br>0.0 to 100.0 [%] – PID | 0.00 Hz  | 102  |
| 11.09 | AI1 (O) scaled at AI1 max   | X    | 0.00 to 400.0 [Hz] – Frequency<br>0.0 to 100.0 [%] – PID | 60.00 Hz | 102  |
| 11.10 | AI2 (OI) actual value       | –    | 0.0 to 100.0 [%]                                         | –        | 102  |
| 11.11 | AI2 (OI) scaled value       | –    | 0.0 to 100.0 [%]                                         | –        | 102  |
| 11.12 | AI2 (OI) forced value       | O    | 0.0 to 100.0 [%]                                         | 0.00 %   | 103  |
| 11.13 | AI2 (OI) filter time        | O    | 0 to 30000 [ms]                                          | 100 ms   | 103  |
| 11.14 | AI2 (OI) source min         | X    | 0.0 to 100.0 [%]                                         | 0.00 %   | 103  |
| 11.15 | AI2 (OI) source max         | X    | 0.0 to 100.0 [%]                                         | 100.0 %  | 104  |
| 11.16 | AI2 (OI) scaled at AI2 min  | X    | 0.00 to 400.0 [Hz] – Frequency<br>0.0 to 100.0 [%] – PID | 0.00 Hz  | 104  |
| 11.17 | AI2 (OI) scaled at AI2 max  | X    | 0.00 to 400.0 [Hz] – Frequency<br>0.0 to 100.0 [%] – PID | 60.00 Hz | 104  |

### 8.1.8 Standard AO (FM, AMI)

| No.   | Name                          | Edit | Range                                                                                | Default | Page |
|-------|-------------------------------|------|--------------------------------------------------------------------------------------|---------|------|
| 12.01 | AO (FM, AMI) forced selection | X    | 0x00 to 0xFF                                                                         | 0x00    | 105  |
| 12.02 | AO1 (FM) actual value         | –    | 0.0 to 100.0 [%]                                                                     | –       | 105  |
| 12.03 | AO1 (FM) source               | –    | 0. Out Frequency<br>1. Out Ampere<br>2. Out Voltage<br>3. Out Power<br>4. Out Torque | 0       | 105  |
| 12.04 | AO1 (FM) forced value         | O    | 0.0 to 100.0 [%]                                                                     | 0.00 %  | 106  |
| 12.05 | AO1 (FM) filter time          | O    | 0 to 30000 [ms]                                                                      | 100 ms  | 106  |
| 12.06 | AO1 (FM) source min           | X    | 0.0 to 100.0 [%]                                                                     | 0.00 %  | 107  |
| 12.07 | AO1 (FM) source max           | X    | 0.0 to 100.0 [%]                                                                     | 100.0 % | 107  |
| 12.08 | AO1 (FM) out at AO1 min       | X    | 0.0 to 100.0 [%]                                                                     | 0.00 %  | 108  |
| 12.09 | AO1 (FM) out at AO1 max       | X    | 0.0 to 100.0 [%]                                                                     | 100.0 % | 108  |
| 12.10 | AO2 (AMI) actual value        | –    | 0.0 to 100.0 [%]                                                                     | –       | 108  |
| 12.11 | AO2 (AMI) source              | –    | 0. Out Frequency<br>1. Out Ampere<br>2. Out Voltage<br>3. Out Power<br>4. Out Torque | 1       | 108  |
| 12.12 | AO2 (AMI) forced value        | O    | 0.0 to 100.0 [%]                                                                     | 0.00 %  | 108  |
| 12.13 | AO2 (AMI) filter time         | O    | 0 to 30000 [ms]                                                                      | 100 ms  | 108  |
| 12.14 | AO2 (AMI) source min          | X    | 0.0 to 100.0 [%]                                                                     | 0.00 %  | 108  |
| 12.15 | AO2 (AMI) source max          | X    | 0.0 to 100.0 [%]                                                                     | 100.0 % | 108  |
| 12.16 | AO2 (AMI) out at AO2 min      | X    | 0.0 to 100.0 [%]                                                                     | 0.00 %  | 108  |
| 12.17 | AO2 (AMI) out at AO2 max      | X    | 0.0 to 100.0 [%]                                                                     | 100.0 % | 108  |

### 8.1.9 Start/stop/direction

| No.   | Name                 | Edit | Range                                                                                                                                            | Default | Page |
|-------|----------------------|------|--------------------------------------------------------------------------------------------------------------------------------------------------|---------|------|
| 20.01 | Ext1 / Ex2 selection | X    | 0. Ext1<br>1. Ext2<br>2. DI1<br>3. DI2<br>4. DI3<br>5. DI4<br>6. DI5<br>7. DI6<br>8. DI7<br>9. DI8                                               | 0       | 109  |
| 20.02 | Ext1 commands        | X    | 0. Not Selected<br>1. 1 Wire<br>2. 2 Wire 1<br>3. 2 Wire 2<br>4. 2 Wire 3<br>5. 3 Wire 1<br>6. 3 Wire 2<br>7. Modbus<br>8. Fieldbus<br>9. Keypad | 3       | 110  |
| 20.03 | Ext1 in source 1     | X    | 0. Not Selected<br>1. Selected<br>2. DI1<br>3. DI2<br>4. DI3<br>5. DI4<br>6. DI5<br>7. DI6<br>8. DI7<br>9. DI8                                   | 2       | 112  |
| 20.04 | Ext1 in source 2     | X    |                                                                                                                                                  | 3       | 112  |
| 20.05 | Ext1 in source 3     | X    |                                                                                                                                                  | 0       | 112  |
|       |                      |      |                                                                                                                                                  |         |      |

| No.   | Name                   | Edit | Range                                                                                                                                            | Default | Page |
|-------|------------------------|------|--------------------------------------------------------------------------------------------------------------------------------------------------|---------|------|
| 20.06 | Ext2 commands          | X    | 0. Not Selected<br>1. 1 Wire<br>2. 2 Wire 1<br>3. 2 Wire 2<br>4. 2 Wire 3<br>5. 3 Wire 1<br>6. 3 Wire 2<br>7. Modbus<br>8. Fieldbus<br>9. Keypad | 0       | 112  |
| 20.07 | Ext2 in source 1       | X    | 0. Not Selected                                                                                                                                  | 0       | 112  |
| 20.08 | Ext2 in source 2       | X    | 1. Selected                                                                                                                                      | 0       | 112  |
| 20.09 | Ext2 in source 3       | X    | 2. DI1                                                                                                                                           | 0       | 112  |
| 20.10 | Jogging enable         | X    | 3. DI2                                                                                                                                           | 0       | 113  |
| 20.11 | Jogging 1 start source | X    | 4. DI3                                                                                                                                           | 0       | 113  |
| 20.12 | Jogging 2 start source | X    | 5. DI4                                                                                                                                           | 0       | 113  |
| 20.13 | Direction              | X    | 6. DI5                                                                                                                                           | 0       | 113  |
|       |                        |      | 7. DI6                                                                                                                                           | 0       | 113  |
|       |                        |      | 8. DI7                                                                                                                                           | 0       | 113  |
|       |                        |      | 9. DI8                                                                                                                                           | 0       | 113  |
|       |                        |      | 0. Forward                                                                                                                                       | 0       | 113  |
|       |                        |      | 1. Reverse                                                                                                                                       | 0       | 113  |

### 8.1.10 Start/Stop mode

| No.   | Name                             | Edit | Range                                                                                                    | Default | Page |
|-------|----------------------------------|------|----------------------------------------------------------------------------------------------------------|---------|------|
| 21.01 | Torque boost mode                | X    | 0. Manual torque boost<br>1. Automatic torque boost                                                      | 0       | 114  |
| 21.02 | Magnetization time               | X    | 0.0 to 3000 [Sec]                                                                                        | 0.0 Sec | 114  |
| 21.03 | Magnetization Level              | X    | 0.0 to 200.0 [%]                                                                                         | 30.0 %  | 114  |
| 21.04 | Stop mode                        | O    | 0. Ramp (Dec)<br>1. Coast (Free-run)                                                                     | 0       | 114  |
| 21.05 | DC current control<br>(DC brake) | X    | 0. Disable<br>1. Enable                                                                                  | 0       | 115  |
| 21.06 | DC hold frequency                | X    | 0.00 to 10.00 [Hz]                                                                                       | 0.50 Hz | 115  |
| 21.07 | DC hold time                     | X    | 0.0 to 3000 [Sec]                                                                                        | 0.0 Sec | 115  |
| 21.08 | Dc hold delay time               | X    | 0.0 to 50.0 [Sec]                                                                                        | 0.0 Sec | 115  |
| 21.09 | DC current reference             | X    | 0.0 to 100.0 [%]                                                                                         | 10.0 %  | 115  |
| 21.10 | Emergency stop mode              | O    | 0. Ramp (Dec)<br>1. Coast (Free-run)                                                                     | 0       | 116  |
| 21.11 | Emergency stop source            | O    | 0. Active<br>1. Inactive<br>2. DI1<br>3. DI2<br>4. DI3<br>5. DI4<br>6. DI5<br>7. DI6<br>8. DI7<br>9. DI8 | 1       | 116  |

## 8.1.11 Frequency reference

| No.   | Name                               | Edit | Range                                                                                                                                        | Default  | Page |
|-------|------------------------------------|------|----------------------------------------------------------------------------------------------------------------------------------------------|----------|------|
| 22.01 | Frequency ref input (keypad)       | O    | 0.00 to 400.0 [Hz]                                                                                                                           | 0.00 Hz  | 118  |
| 22.03 | Frequency ref 1 source             | X    | 0. Not Selected<br>1. AI1 (O)<br>2. AI2 (OI)<br>3. Modbus<br>4. Field bus<br>5. PID<br>6. Keypad<br>7. UP / DOWN                             | 1        | 118  |
| 22.04 | Frequency ref 2 source             | X    |                                                                                                                                              | 2        | 118  |
| 22.05 | Frequency ref 1 /ref 2 combination | X    | 0. '22.03'<br>1. '22.03' + '22.04'<br>2. '22.03' - '22.04'<br>3. '22.03' x '22.04'<br>4. MIN ('22.03', '22.04')<br>5. MAX ('22.03', '22.04') | 0        | 119  |
| 22.06 | Frequency ref 1 /ref 2 selection   | X    | 0. '22.05' setting value<br>1. '22.04' setting value<br>2. DI1<br>3. DI2<br>4. DI3<br>5. DI4<br>6. DI5<br>7. DI6<br>8. DI7<br>9. DI8         | 6        | 119  |
| 22.07 | Constant frequency source 1        | X    | 0. Not selected<br>1. Selected<br>2. DI1<br>3. DI2<br>4. DI3<br>5. DI4<br>6. DI5<br>7. DI6<br>8. DI7<br>9. DI8                               | 4        | 120  |
| 22.08 | Constant frequency source 2        | X    |                                                                                                                                              | 5        | 121  |
| 22.09 | Constant frequency source 3        | X    |                                                                                                                                              | 0        | 121  |
| 22.10 | Constant frequency 1               | X    | 0.00 to 400.0 [Hz]                                                                                                                           | 5.00 Hz  | 121  |
| 22.11 | Constant frequency 2               | X    | 0.00 to 400.0 [Hz]                                                                                                                           | 10.00 Hz | 121  |
| 22.12 | Constant frequency 3               | X    | 0.00 to 400.0 [Hz]                                                                                                                           | 20.00 Hz | 121  |
| 22.13 | Constant frequency 4               | X    | 0.00 to 400.0 [Hz]                                                                                                                           | 30.00 Hz | 121  |
| 22.14 | Constant frequency 5               | X    | 0.00 to 400.0 [Hz]                                                                                                                           | 40.00 Hz | 121  |
| 22.15 | Constant frequency 6               | X    | 0.00 to 400.0 [Hz]                                                                                                                           | 50.00 Hz | 121  |
| 22.16 | Constant frequency 7               | X    | 0.00 to 400.0 [Hz]                                                                                                                           | 60.00 Hz | 121  |
| 22.17 | Jogging 1 ref                      | X    | 0.00 to 400.0 [Hz]                                                                                                                           | 0.00 Hz  | 122  |
| 22.18 | Jogging 2 ref                      | X    | 0.00 to 400.0 [Hz]                                                                                                                           | 0.00 Hz  | 122  |

| No.   | Name                         | Edit | Range                                                                                                          | Default  | Page |
|-------|------------------------------|------|----------------------------------------------------------------------------------------------------------------|----------|------|
| 22.19 | Skip frequency 1 low         | X    | 0.00 to 400.0 [Hz]                                                                                             | 0.00 Hz  | 123  |
| 22.20 | Skip frequency 1 high        | X    | 0.00 to 400.0 [Hz]                                                                                             | 0.00 Hz  | 123  |
| 22.21 | Skip frequency 2 low         | X    | 0.00 to 400.0 [Hz]                                                                                             | 0.00 Hz  | 123  |
| 22.22 | Skip frequency 2 high        | X    | 0.00 to 400.0 [Hz]                                                                                             | 0.00 Hz  | 123  |
| 22.23 | Skip frequency 3 low         | X    | 0.00 to 400.0 [Hz]                                                                                             | 0.00 Hz  | 123  |
| 22.24 | Skip frequency 3 high        | X    | 0.00 to 400.0 [Hz]                                                                                             | 0.00 Hz  | 123  |
| 22.25 | UP/DOWN function             | X    | 0. Disable<br>1. Enable                                                                                        | 0        | 124  |
| 22.26 | UP/DOWN initial value        | X    | 0.00 to 400.0 [Hz] – frequency<br>0.0 to 100.0 [%] – PID                                                       | 0.00 Hz  | 124  |
| 22.27 | UP/DOWN up source            | X    | 0. Not selected<br>1. Selected<br>2. DI1<br>3. DI2<br>4. DI3                                                   | 0        | 124  |
| 22.28 | UP/DOWN down source          | X    | 5. DI4<br>6. DI5<br>7. DI6<br>8. DI7<br>9. DI8                                                                 | 0        | 124  |
| 22.29 | UP/DOWN ref changing time    | X    | 0.0 to 3000 [Sec]                                                                                              | 10.0 Sec | 125  |
| 22.30 | UP/DOWN min value            | X    | 0.00 to 400.0 [Hz] – frequency<br>0.0 to 100.0 [%] – PID                                                       | 0.00 Hz  | 125  |
| 22.31 | UP/DOWN max value            | X    | 0.00 to 400.0 [Hz] – frequency<br>0.0 to 100.0 [%] – PID                                                       | 60.00 Hz | 125  |
| 22.32 | UP/DOWN ref monitor          | X    | 0.00 to 400.0 [Hz] – frequency<br>0.0 to 100.0 [%] – PID                                                       | –        | 125  |
| 22.33 | UP/DOWN initial value saving | X    | 0. Not saving<br>1. Saving                                                                                     | 0        | 125  |
| 22.34 | UP/DOWN ref reset source     | X    | 0. Not selected<br>1. Selected<br>2. DI1<br>3. DI2<br>4. DI3<br>5. DI4<br>6. DI5<br>7. DI6<br>8. DI7<br>9. DI8 | 0        | 126  |

### 8.1.12 Acceleration/Deceleration

| No.   | Name                                   | Edit | Range                                                                                                                                 | Default  | Page |
|-------|----------------------------------------|------|---------------------------------------------------------------------------------------------------------------------------------------|----------|------|
| 23.03 | Ramp set selection                     | –    | 0. Acc/Dec Time1<br>1. Acc/Dec Time2<br>2. Frequency<br>3. DI1<br>4. DI2<br>5. DI3<br>6. DI4<br>7. DI5<br>8. DI6<br>9. DI7<br>10. DI8 | 0        | 127  |
| 23.04 | Acceleration time 1                    | O    | 0.0 to 3000 [Sec]                                                                                                                     | 30.0 Sec | 128  |
| 23.05 | Deceleration time 1                    | O    | 0.0 to 3000 [Sec]                                                                                                                     | 30.0 Sec | 128  |
| 23.06 | Acceleration time 2                    | O    | 0.0 to 3000 [Sec]                                                                                                                     | 30.0 Sec | 128  |
| 23.07 | Deceleration time 2                    | O    | 0.0 to 3000 [Sec]                                                                                                                     | 30.0 Sec | 129  |
| 23.08 | Acceleration pattern selection         | O    | 0. Linear                                                                                                                             | 0        | 129  |
| 23.09 | Deceleration pattern selection         | O    | 1. S Curve<br>2. U Curve                                                                                                              | 0        | 129  |
| 23.10 | Acceleration time transition frequency | O    | 0.00 to 400.0 [Hz]                                                                                                                    | 0.00 Hz  | 130  |
| 23.11 | Deceleration time transition frequency | O    | 0.00 to 400.0 [Hz]                                                                                                                    | 0.00 Hz  | 130  |
| 23.12 | Jogging acceleration time              | O    | 0.0 to 3000 [Sec]                                                                                                                     | 30.0 Sec | 130  |
| 23.13 | Jogging deceleration time              | O    | 0.0 to 3000 [Sec]                                                                                                                     | 30.0 Sec | 130  |
| 23.14 | Emergency stop time                    | O    | 0.0 to 3000 [Sec]                                                                                                                     | 3.0 Sec  | 130  |

### 8.1.13 Speed search

| No.   | Name                                   | Edit | Range                                                                   | Default | Page |
|-------|----------------------------------------|------|-------------------------------------------------------------------------|---------|------|
| 24.01 | Speed search start mode                | O    | 0. Start from 0 Hz<br>1. Start from frequency corresponding motor speed | 0       | 131  |
| 24.02 | Speed search current Limit             | O    | 50.0 to 180.0 [%]                                                       | 100.0%  | 131  |
| 24.03 | Voltage increment in speed search mode | O    | 10 to 500 [%]                                                           | 100 %   | 131  |
| 24.04 | Speed search delay ratio               | O    | 0.50 ~ 5.00 [x1]                                                        | 1.00    | 131  |

### 8.1.14 Over voltage suppression

| No.   | Name                         | Edit | Range                   | Default  | Page |
|-------|------------------------------|------|-------------------------|----------|------|
| 25.01 | OVS selection                | O    | 0: Disable<br>1: Enable | 0        | 133  |
| 25.02 | Maximum OVS output frequency | O    | "30.01" to 300.0 [Hz]   | 80.00 Hz | 133  |
| 25.03 | OVS P gain                   | O    | 0 to 10000              | 1000     | 133  |
| 25.04 | OVS I gain                   | O    | 0 to 10000 [Sec]        | 100 Sec  | 133  |
| 25.05 | OVS D gain                   | O    | 0 to 10000 [Sec]        | 0 Sec    | 134  |
| 25.06 | q-Current reference          | O    | -100.0 to 100.0         | 0.0      | 134  |
| 25.07 | Filter bandwidth             | O    | 0.0 to 1000 [ms]        | 1 ms     | 134  |
| 25.08 | Limit time                   | O    | 0.0 to 100 [Sec]        | 0.5 Sec  | 135  |

### 8.1.15 KEB

| No.   | Name                       | Edit | Range                                                                                  | Default | Page |
|-------|----------------------------|------|----------------------------------------------------------------------------------------|---------|------|
| 26.01 | KEB selection              | X    | 0: Disable<br>1: Enable ('26.02' decelerating to slope)<br>2: Enable (Voltage control) | 0       | 135  |
| 26.02 | KEB gain                   | X    | 1 to 1000                                                                              | 100     | 135  |
| 26.03 | KEB Voltage control P gain | X    | 0.01 to 10.00                                                                          | 1.00    | 135  |
| 26.04 | KEB Voltage control I gain | X    | 0.01 to 10.00                                                                          | 1.00    | 135  |

### 8.1.16 DWELL

| No.   | Name                     | Edit | Range              | Default | Page |
|-------|--------------------------|------|--------------------|---------|------|
| 27.01 | DWELL reference at start | X    | 0.00 to 400.0 [Hz] | 0.00 Hz | 138  |
| 27.02 | DWELL time at start      | X    | 0.0 to 10.0 [Sec]  | 0.0 Sec | 138  |
| 27.03 | DWELL reference at stop  | X    | 0.00 to 400.0 [Hz] | 0.00 Hz | 138  |
| 27.04 | DWELL time at stop       | X    | 0.0 to 10.0 [Sec]  | 0.0 Sec | 138  |

### 8.1.17 Frequency limits

| No.   | Name              | Edit | Range                                                                        | Default            | Page |
|-------|-------------------|------|------------------------------------------------------------------------------|--------------------|------|
| 30.01 | Maximum frequency | O    | 0.00 to 400.0 [Hz]                                                           | 60.00 Hz           | 139  |
| 30.02 | Minimum frequency | O    | 0.00 to 400.0 [Hz]                                                           | 0.00 Hz            | 139  |
| 30.03 | Start frequency   | X    | 0.10 to 60.00 [Hz] : VF,SLV mode<br>0.00 to 60.00 [Hz] : Vector control mode | 0.50 Hz<br>0.00 Hz | 139  |

## 8.1.18 Fault functions

| No.   | Name                       | Edit | Range                                                                                                                                                                                             | Default             | Page |
|-------|----------------------------|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|------|
| 31.01 | External event 1 source    | –    | 0. Active<br>1. Inactive                                                                                                                                                                          | 1                   | 140  |
| 31.02 | External event 2 source    | –    | 2. DI1<br>3. DI2                                                                                                                                                                                  | 1                   | 140  |
| 31.03 | External event 3 source    | –    | 4. DI3<br>5. DI4                                                                                                                                                                                  | 1                   | 140  |
| 31.04 | External event 4 source    | –    | 6. DI5<br>7. DI6<br>8. DI7                                                                                                                                                                        | 1                   | 140  |
| 31.05 | External event 5 source    | –    | 9. DI8                                                                                                                                                                                            | 1                   | 140  |
| 31.06 | Fault reset selection      | X    | 0. Not Selected<br>1. Selected<br>2. DI1<br>3. DI2<br>4. DI3<br>5. DI4<br>6. DI5<br>7. DI6<br>8. DI7<br>9. DI8                                                                                    | 7                   | 140  |
| 31.07 | Restart mode selection     | X    | 0. No Restart<br>1. Restart from 0Hz<br>2. Resume at frequency corresponding motor speed<br>3. Resume at motor speed, then decelerated stop                                                       | 0                   | 141  |
| 31.08 | Alarm relay operation mode | X    | 0. Inactive for the Under Voltage trip signal<br>1. Inactive during auto reset<br>2. Active every trip<br>3. Inactive during auto reset (Only active for the Under Voltage trip signal endlessly) | 0                   | 141  |
| 31.09 | Restart delay time         | X    | 0.3 to 10.0 [Sec]                                                                                                                                                                                 | 1.0 Sec             | 141  |
| 31.10 | Automatic reset item 1     | X    | 0x00 ~ 0xFF                                                                                                                                                                                       | 0x00                | 142  |
| 31.11 | Automatic reset item 2     | X    | 0x00 ~ 0xFF                                                                                                                                                                                       | 0x00                | 142  |
| 31.12 | User reset item selection  | X    | 0~29                                                                                                                                                                                              | 0                   | 142  |
| 31.13 | Restart trial 1            | X    | 0~10                                                                                                                                                                                              | 0                   | 142  |
| 31.14 | Restart trial 2            | X    | 0~10                                                                                                                                                                                              | 0                   | 142  |
| 31.15 | Earth Fault                | X    | 0.0 to 100.0 [%]<br>0.0: Disable                                                                                                                                                                  | 0.0 %               | 143  |
| 31.16 | Supply phase loss          | O    | 0 to 30 [Sec]<br>0: Disable                                                                                                                                                                       | 10 Sec              | 143  |
| 31.17 | Stall function             | X    | 0. No Operation<br>1. VFD overload<br>2. Over Voltage<br>3. VFD overload and Over Voltage                                                                                                         | 3                   | 143  |
| 31.18 | Stall current limit        | X    | 20.0 to 200.0 [%] : HD rated<br>20.0 to 165.0 [%] : ND rated                                                                                                                                      | 180.0 %<br>150.0 %  | 143  |
| 31.19 | Stall deceleration time    | O    | 0.1 to 30.0 [Sec] : 30kW upper<br>0.1 to 30.0 [Sec] : 22kW lower                                                                                                                                  | 10.0 Sec<br>1.0 Sec | 144  |

| No.   | Name                               | Edit | Range                                              | Default | Page |
|-------|------------------------------------|------|----------------------------------------------------|---------|------|
| 31.22 | RS485 Modbus time out check enable | O    | 0. Always running<br>1. Only During VFD is Running | 0       | 144  |
| 31.23 | RS485 Modbus time out              | O    | 0 to 60 [Sec]<br>0: Disable                        | 0 Sec   | 144  |
| 31.24 | Low voltage fault level            | X    | 90.0 to 180.0 [%]                                  | 100 %   | 144  |

### 8.1.19 Motor thermal protection

| No.   | Name                                | Edit | Range                                                                                    | Default  | Page |
|-------|-------------------------------------|------|------------------------------------------------------------------------------------------|----------|------|
| 32.01 | Electronic thermal overload level   | X    | 20.0 to 120.0 [%]                                                                        | 100.0 %  | 145  |
| 32.02 | Electronic thermal overload profile | X    | 0. Self Cooling<br>1. Forced Cooling<br>2. Disable Electronic thermal overload detection | 1        | 145  |
| 32.03 | Fan operation mode                  | X    | 0. Always running<br>1. Only During VFD is running                                       | 0        | 145  |
| 32.04 | Fan off delay time                  | X    | 0.0 to 1000.0 [Sec]                                                                      | 30.0 Sec | 145  |

### 8.1.20 System Overload/Underload detection

| No.   | Name                                          | Edit | Range                                                                                                                                                                                                                                            | Default  | Page |
|-------|-----------------------------------------------|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|------|
| 33.01 | System Load Detection Selection               | X    | 0: Disabled<br>1: Overload Detection<br>2: Underload Detection<br>3: Overload/Underload Detection<br>4: Overload Detection with Fault(oLdt)<br>5: Underload Detection with Fault(uLdt)<br>6: Overload/Underload Detection with Fault(oLdt, uLdt) | 0        | 146  |
| 33.02 | System Overload Detection Level               | X    | 20.0 to 200.0[%]                                                                                                                                                                                                                                 | 100.0%   | 146  |
| 33.03 | System Underload Detection Level              | X    | 20.0 to 200.0[%]                                                                                                                                                                                                                                 | 100.0%   | 146  |
| 33.04 | System Overload/Underload Detection Time      | X    | 0.0 to 60.0[sec]                                                                                                                                                                                                                                 | 10.0 Sec | 147  |
| 33.05 | System Overload/Underload Detection Safe Zone | X    | 0.0 to '30.01'[Hz]                                                                                                                                                                                                                               | 0.00Hz   | 147  |

## 8.1.21 PID

| No.   | Name                         | Edit | Range                                                                   | Default  | Page |
|-------|------------------------------|------|-------------------------------------------------------------------------|----------|------|
| 40.01 | PID function                 | X    | 0. Disable<br>1. Enable                                                 | 0        | 148  |
| 40.02 | PID reference                | O    | '40.25' to '40.26'                                                      | 0.0 %    | 148  |
| 40.03 | PID reference source         | X    | 0. N/A<br>1. AI1(O), AI2 (OI)<br>2. '40.02'<br>3. Modbus<br>4. Fieldbus | 2        | 149  |
| 40.04 | PID feedback source          | X    | 0. AI1 (O)<br>1. AI2 (OI)                                               | 1        | 149  |
| 40.05 | PID P gain                   | O    | 0.1 to 2000.0 [%]                                                       | 100.0 %  | 149  |
| 40.06 | PID I gain                   | O    | 0.0 to 3600.0 [Sec]                                                     | 1.0 Sec  | 150  |
| 40.07 | PID D gain                   | O    | 0.00 to 10.00 [Sec]                                                     | 0.00 Sec | 150  |
| 40.08 | PID Err limit                | O    | 0.0 to 100.0 [%]                                                        | 100.0 %  | 150  |
| 40.09 | PID output high limit        | O    | –100.0 to 100.0 [%]                                                     | 100.0 %  | 150  |
| 40.10 | PID output low limit         | O    | –100.0 to 100.0 [%]                                                     | 0.0 %    | 150  |
| 40.11 | PID output invert            | X    | 0. Disable<br>1. Enable                                                 | 0        | 150  |
| 40.12 | PID scale factor             | X    | 0.1 to 1000 [%]                                                         | 100.0 %  | 150  |
| 40.13 | Pre PID frequency            | X    | 0.00 to 400.0 [Hz]                                                      | 0.00 Hz  | 151  |
| 40.14 | PID sleep frequency          | X    | 0.00 to 400.0 [Hz]                                                      | 0.00 Hz  | 151  |
| 40.15 | PID sleep/wake up delay time | X    | 0.0 to 30.0 [Sec]                                                       | 0.0 Sec  | 151  |
| 40.16 | PID wake up frequency        | X    | '40.14' to 400.0 [Hz]                                                   | 0.00 Hz  | 152  |
| 40.17 | PID feedback monitor         | –    | 0.0 to 100.0 [%]                                                        | –        | 152  |
| 40.18 | PID output monitor           | –    | 0.0 to 100.0 [%]                                                        | –        | 152  |

| No.   | Name                                    | Edit | Range                                                                                                                                                                                      | Default                            | Page |
|-------|-----------------------------------------|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|------|
| 40.19 | PID integral reset source               | X    | 0. Not selected<br>1. Selected<br>2. DI1<br>3. DI2<br>4. DI3<br>5. DI4                                                                                                                     | 0                                  | 152  |
| 40.20 | PID disable source                      | X    | 6. DI5<br>7. DI6<br>8. DI7<br>9. DI8                                                                                                                                                       | 0                                  | 153  |
| 40.21 | ref source 1 at PID disable             | X    | 0. Not selected<br>1. AI1 (O)<br>2. AI2 (OI)<br>3. Modbus                                                                                                                                  | 1                                  | 153  |
| 40.22 | ref source 2 at PID disable             | X    | 4. Fieldbus<br>5. PID<br>6. Keypad<br>7. UP/DOWN                                                                                                                                           | 2                                  | 154  |
| 40.23 | ref 1 /ref 2 combination at PID disable | X    | 0. <b>'40.21'</b><br>1. <b>'40.21' + '40.22'</b><br>2. <b>'40.21' - '40.22'</b><br>3. <b>'40.21' x '40.22'</b><br>4. MIN ( <b>'40.21', '40.22'</b> )<br>5. MAX ( <b>'40.21', '40.22'</b> ) | 0                                  | 154  |
| 40.24 | ref 1 /ref 2 selection at PID disable   | X    | 0. <b>'40.23'</b> setting value<br>1. <b>'40.22'</b> setting value<br>2. DI1<br>3. DI2<br>4. DI3<br>5. DI4<br>6. DI5<br>7. DI6<br>8. DI7<br>9. DI8                                         | 0                                  | 154  |
| 40.25 | PID Control physics quantity select     |      | 0. %<br>1. Hz<br>2. Kpa                                                                                                                                                                    | 0                                  | 155  |
| 40.26 | PID Control Maximum physics quantity    |      | <b>'40.27'</b> to 200.0 %<br><b>'40.27'</b> to <b>'30.01'</b> Hz<br><b>'40.27'</b> to 200.0 Kpa<br>Setting range determined by <b>'40.25'</b> settings                                     | 100.00 %<br>60.00 Hz<br>100.00 Kpa | 155  |
| 40.27 | PID Control Minimum physics quantity    |      | 0.00 to <b>'40.26'</b>                                                                                                                                                                     | 0.00                               | 155  |

### 8.1.22 DBR Duty Cycle

| No.   | Name           | Edit | Range                                                      | Default | Page |
|-------|----------------|------|------------------------------------------------------------|---------|------|
| 41.01 | DBR Mode       | X    | 0: DBR disabled<br>1: Only during VFD running<br>2: Always | 1       | 156  |
| 41.02 | DBR Duty cycle | X    | 0.0~50.0%                                                  | 10.0    | 156  |

### 8.1.23 Monitoring/Scaling

| No.   | Name                             | Edit | Range              | Default  | Page |
|-------|----------------------------------|------|--------------------|----------|------|
| 42.01 | Frequency scaling                | X    | 0.00 to 400.0 [Hz] | 60.00 Hz | 157  |
| 42.02 | Rpm display scale factor         | O    | 1 to 9999          | 100      | 157  |
| 42.10 | Flux braking operating frequency | X    | 0 to 10.00 [Hz]    | 5.00 Hz  | 157  |

### 8.1.24 Droop

| No.   | Name                  | Edit | Range                                                                    | Default  | Page |
|-------|-----------------------|------|--------------------------------------------------------------------------|----------|------|
| 43.01 | Droop type            | O    | 0: No droop control<br>1: Open loop<br>2: F/B (0~10V)<br>3: F/B (4~20mA) | 0        | 158  |
| 43.02 | Droop start frequency | O    | 0.00 to 400.0 [Hz]                                                       | 0.00 Hz  | 158  |
| 43.04 | Droop gain            | O    | 0.00 to 50.00                                                            | 5.00     | 159  |
| 43.05 | Droop start torque    | O    | 0.0 to 100.0 [%]                                                         | 0.0 %    | 159  |
| 43.06 | Droop ramp time       | O    | 1.0 to 100.0 [Sec]                                                       | 20.0 Sec | 159  |

### 8.1.25 RS-485 (Modbus)

| No.   | Name             | Edit | Range                                                                 | Default | Page |
|-------|------------------|------|-----------------------------------------------------------------------|---------|------|
| 50.01 | Modbus node ID   | X    | 1 to 32                                                               | 1       | 161  |
| 50.02 | Modbus baud rate | X    | 1. 2,400 [bps]<br>2. 4,800 [bps]<br>3. 9,600 [bps]<br>4. 19,200 [bps] | 3       | 161  |

## 8.1.26 Fieldbus (option)

| No.   | Name                       | Edit | Range                                                                                         | Default | Page |
|-------|----------------------------|------|-----------------------------------------------------------------------------------------------|---------|------|
| 51.01 | Fieldbus option type       | X    | 0: Modbus<br>1: Profibus-DP<br>2: Device-Net<br>3: Ethernet series<br>4: CC-Link              | 0       | 168  |
| 51.02 | Fieldbus station number    | X    | 1 to 32: Ethernet series<br>1 to 63: Device-Net<br>1 to 125: Profibus-DP<br>1 to 64 : CC-Link | 1       | 168  |
| 51.03 | Fieldbus byte swap         | X    | 0: Normal<br>1: Swap                                                                          | 0       | 168  |
| 51.08 | Fieldbus input data 1      | X    | 0x0000 to 0xFFFF                                                                              | 0x0603  | 168  |
| 51.09 | Fieldbus input data 2      | X    | 0x0000 to 0xFFFF                                                                              | 0x0001  | 168  |
| 51.10 | Fieldbus input data 3      | X    | 0x0000 to 0xFFFF                                                                              | 0x0202  | 168  |
| 51.11 | Fieldbus input data 4      | X    | 0x0000 to 0xFFFF                                                                              | 0x0203  | 168  |
| 51.12 | Fieldbus input data 5      | X    | 0x0000 to 0xFFFF                                                                              | 0x0201  | 168  |
| 51.13 | Fieldbus input data 6      | X    | 0x0000 to 0xFFFF                                                                              | 0x0101  | 168  |
| 51.14 | Fieldbus input data 7      | X    | 0x0000 to 0xFFFF                                                                              | 0x0102  | 168  |
| 51.15 | Fieldbus input data 8      | X    | 0x0000 to 0xFFFF                                                                              | 0x010C  | 168  |
| 51.16 | Fieldbus input data 9      | X    | 0x0000 to 0xFFFF                                                                              | 0x010d  | 168  |
| 51.17 | Fieldbus input data 10     | X    | 0x0000 to 0xFFFF                                                                              | 0x0111  | 168  |
| 51.18 | Fieldbus input data 11     | X    | 0x0000 to 0xFFFF                                                                              | 0x0115  | 168  |
| 51.19 | Fieldbus input data 12     | X    | 0x0000 to 0xFFFF                                                                              | 0x0000  | 168  |
| 51.20 | Fieldbus output data 1     | X    | 0x0000 to 0xFFFF                                                                              | 0x0202  | 168  |
| 51.21 | Fieldbus output data 2     | X    | 0x0000 to 0xFFFF                                                                              | 0x0203  | 168  |
| 51.22 | Fieldbus output data 3     | X    | 0x0000 to 0xFFFF                                                                              | 0x0201  | 168  |
| 51.23 | Fieldbus output data 4     | X    | 0x0000 to 0xFFFF                                                                              | 0x0002  | 168  |
| 51.24 | Fieldbus output data 5     | X    | 0x0000 to 0xFFFF                                                                              | 0x0000  | 168  |
| 51.25 | Fieldbus output data 6     | X    | 0x0000 to 0xFFFF                                                                              | 0x0000  | 168  |
| 51.26 | Fieldbus output data 7     | X    | 0x0000 to 0xFFFF                                                                              | 0x0000  | 168  |
| 51.27 | Fieldbus output data 8     | X    | 0x0000 to 0xFFFF                                                                              | 0x0000  | 168  |
| 51.28 | Fieldbus output data 9     | X    | 0x0000 to 0xFFFF                                                                              | 0x0000  | 168  |
| 51.29 | Fieldbus output data 10    | X    | 0x0000 to 0xFFFF                                                                              | 0x0000  | 168  |
| 51.30 | Fieldbus output data 11    | X    | 0x0000 to 0xFFFF                                                                              | 0x0000  | 168  |
| 51.31 | Fieldbus output data 12    | X    | 0x0000 to 0xFFFF                                                                              | 0x0000  | 168  |
| 51.32 | Fieldbus status            | X    | 0x0000 to 0xFFFF                                                                              | -       | 168  |
| 51.33 | Fieldbus version           | X    | 0x0000 to 0xFFFF                                                                              | -       | 168  |
| 51.34 | CC-Link baudrate selection | X    | 0 to 4                                                                                        | 0       | 168  |

## 8.1.27 User parameters

| No.   | Name                     | Edit | Range                   | Default | Page |
|-------|--------------------------|------|-------------------------|---------|------|
| 96.01 | User parameter selection | X    | 0. Disable<br>1. Enable | 0       | 169  |
| 96.02 | User para. config 1      | X    | '00.00' ~ '99.99'       | '22.03' | 169  |
| 96.03 | User para. config 2      | X    | '00.00' ~ '99.99'       | '20.02' | 169  |
| 96.04 | User para. config 3      | X    | '00.00' ~ '99.99'       | '01.01' | 169  |
| 96.05 | User para. config 4      | X    | '00.00' ~ '99.99'       | '23.04' | 169  |
| 96.06 | User para. config 5      | X    | '00.00' ~ '99.99'       | '23.05' | 169  |
| 96.07 | User para. config 6      | X    | '00.00' ~ '99.99'       | '99.02' | 169  |
| 96.08 | User para. config 7      | X    | '00.00' ~ '99.99'       | '99.01' | 169  |
| 96.09 | User para. config 8      | X    | '00.00' ~ '99.99'       | '99.04' | 169  |
| 96.10 | User para. config 9      | X    | '00.00' ~ '99.99'       | '99.03' | 169  |
| 96.11 | User para. config 10     | X    | '00.00' ~ '99.99'       | '30.01' | 169  |
| 96.12 | User para. config 11     | X    | '00.00' ~ '99.99'       | '00.00' | 169  |
| 96.13 | User para. config 12     | X    | '00.00' ~ '99.99'       | '00.00' | 169  |
| 96.14 | User para. config 13     | X    | '00.00' ~ '99.99'       | '00.00' | 169  |
| 96.15 | User para. config 14     | X    | '00.00' ~ '99.99'       | '00.00' | 169  |
| 96.16 | User para. config 15     | X    | '00.00' ~ '99.99'       | '00.00' | 169  |
| 96.17 | User para. config 16     | X    | '00.00' ~ '99.99'       | '00.00' | 169  |
| 96.18 | User para. config 17     | X    | '00.00' ~ '99.99'       | '00.00' | 169  |
| 96.19 | User para. config 18     | X    | '00.00' ~ '99.99'       | '00.00' | 169  |
| 96.20 | User para. config 19     | X    | '00.00' ~ '99.99'       | '00.00' | 169  |
| 96.21 | User para. config 20     | X    | '00.00' ~ '99.99'       | '00.00' | 169  |
| 96.22 | User para. config 21     | X    | '00.00' ~ '99.99'       | '00.00' | 169  |
| 96.23 | User para. config 22     | X    | '00.00' ~ '99.99'       | '00.00' | 169  |
| 96.24 | User para. config 23     | X    | '00.00' ~ '99.99'       | '00.00' | 169  |
| 96.25 | User para. config 24     | X    | '00.00' ~ '99.99'       | '00.00' | 169  |
| 96.26 | User para. config 25     | X    | '00.00' ~ '99.99'       | '00.00' | 169  |
| 96.27 | User para. config 26     | X    | '00.00' ~ '99.99'       | '00.00' | 169  |
| 96.28 | User para. config 27     | X    | '00.00' ~ '99.99'       | '00.00' | 169  |
| 96.29 | User para. config 28     | X    | '00.00' ~ '99.99'       | '00.00' | 169  |
| 96.30 | User para. config 29     | X    | '00.00' ~ '99.99'       | '00.00' | 169  |
| 96.31 | User para. config 30     | X    | '00.00' ~ '99.99'       | '00.00' | 169  |
| 96.32 | User para. config 31     | X    | '00.00' ~ '99.99'       | '00.00' | 169  |
| 96.33 | User para. config 32     | X    | '00.00' ~ '99.99'       | '00.00' | 169  |

## 8.1.28 System

| No.   | Name                                   | Edit | Range                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Default | Page |
|-------|----------------------------------------|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|------|
| 97.01 | Initialization mode                    | X    | 0: Clear trip history<br>1: Clear all parameters                                                                                                                                                                                                                                                                                                                                                                                                                              | 0       | 170  |
| 97.02 | Parameter lock mode                    | X    | 0: All parameters are locked except<br><b>'97.02', '97.03'</b> by <b>'97.03'</b><br>1: All parameters are locked except<br><b>'97.02', '97.03', '22.01'</b> by <b>'97.03'</b><br>2: All parameters are locked except<br><b>'97.02', '97.03'</b> by <b>'97.02'</b><br>3: All parameters are locked except<br><b>'97.02', '97.03', '22.01'</b> by <b>'97.02'</b><br>4: All parameters are locked except<br><b>'97.02', '97.03', '22.01', '23.04', '23.05'</b> by <b>'97.02'</b> | 0       | 170  |
| 97.03 | Parameter lock source                  | X    | 0. Not Selected<br>1. Selected <sup>(*)</sup><br>2. DI1<br>3. DI2<br>4. DI3<br>5. DI4<br>6. DI5<br>7. DI6<br>8. DI7<br>9. DI8                                                                                                                                                                                                                                                                                                                                                 | 0       | 170  |
| 97.04 | Current time setting<br>(Year)         | O    | 2000 ~ 2099                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 2016    | 171  |
| 97.05 | Current time setting<br>(Month, Day)   | O    | 101 ~ 1231                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 224     | 171  |
| 97.06 | Current time setting<br>(Hour, Minute) | O    | 0 ~ 2359                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 0       | 171  |
| 97.07 | Current time setting<br>(Second)       | O    | 0 ~ 59                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 0       | 171  |

(\*) If the **'97.02'** code set 0 or 1, please be careful as the parameter prohibition setting is forcibly activated when the **'97.03'** code 1 is set.

## 8.1.29 Motor control

| No.   | Name                                       | Edit | Range                                                             | Default | Page |
|-------|--------------------------------------------|------|-------------------------------------------------------------------|---------|------|
| 98.01 | Motor control mode                         | X    | 0. CT (V/f)<br>1. VT (V/f)<br>2. SLV<br>3. VECTOR(Encoder Option) | 0       | 172  |
| 98.02 | HD/ND (torque type) selection              | X    | 0. HD type<br>1. ND type                                          | 0       | 173  |
| 98.03 | PWM carrier frequency                      | O    | 1.0 to 10.0 [kHz]                                                 | 3.0 kHz | 173  |
| 98.04 | PWM carrier mode                           | O    | 0. Normal<br>1. Swing PWM1                                        | 0       | 173  |
| 98.05 | Voltage gain factor                        | O    | 20.0 to 110.0 [%]                                                 | 100.0 % | 174  |
| 98.06 | Flux braking function                      | O    | 0. Disable<br>1. Enable                                           | 1       | 174  |
| 98.07 | Flux braking reference                     | O    | 100 to 140 [%]                                                    | 110 %   | 174  |
| 98.09 | Manual torque boost voltage<br>reference   | X    | 0.00 to 50.00 [%]                                                 | 1.0 %   | 174  |
| 98.10 | Manual torque boost frequency<br>reference | X    | 0.0 to 100.0 [%]                                                  | 100.0 % | 175  |

| No.   | Name                                                  | Edit | Range                                                                                                                                         | Default | Page |
|-------|-------------------------------------------------------|------|-----------------------------------------------------------------------------------------------------------------------------------------------|---------|------|
| 98.11 | Backward slip compensation                            | X    | 0.0 to 200.0 [%]                                                                                                                              | 0.0 %   | 175  |
| 98.12 | Regeneration slip compensation                        | X    | 0.0 to 200.0 [%]                                                                                                                              | 0.0 %   | 175  |
| 98.13 | Motor type                                            | X    | 0. IM<br>1. PM SLV(Progressing)<br>2. IM SLV(Progressing)<br>3. PM Vector(Progressing)                                                        | 0       | 175  |
| 98.14 | Vector control speed controller P gain                | O    | 0 to 1000                                                                                                                                     | 100     | 175  |
| 98.15 | Vector control speed controller I gain                | O    | 0.0 to 1000.0                                                                                                                                 | 100.0   | 176  |
| 98.16 | Forward torque Limit                                  | O    | 0.0 to 200.0 [%]                                                                                                                              | 150.0 % | 176  |
| 98.17 | Forward regeneration torque limit                     | O    | 0.0 to 200.0 [%]                                                                                                                              | 150.0 % | 176  |
| 98.18 | Reverse torque Limit                                  | O    | 0.0 to 200.0 [%]                                                                                                                              | 150.0 % | 176  |
| 98.19 | Reverse regeneration torque limit                     | O    | 0.0 to 200.0 [%]                                                                                                                              | 150.0 % | 176  |
| 98.20 | Zero speed torque Limit                               | O    | 0.0 to 200.0 [%]                                                                                                                              | 150.0 % | 176  |
| 98.21 | Zero speed regeneration torque limit                  | O    | 0.0 to 200.0 [%]                                                                                                                              | 150.0 % | 176  |
| 98.22 | Torque limit setting method                           | X    | 0. AI1(O - L) : 0 ~ 10 [V]<br>1. AI2(OI - L) : 4 ~ 20 [mA]<br>2. Keypad('98.16' ~ '98.21')<br>3. Modbus<br>4. Feildbus<br>5. UP/DOWN Function | 2       | 176  |
| 98.23 | Speed controller output low pass filter time constant | O    | 0 to 100 [msec]                                                                                                                               | 0 ms    | 177  |
| 98.24 | Zero speed command source select                      | O    | 0. Not Selected<br>1. Selected(forced)<br>2. DI1<br>3. DI2<br>4. DI3<br>5. DI4<br>6. DI5<br>7. DI6<br>8. DI7<br>9. DI8                        | 0       | 177  |
| 98.30 | Speed/Torque Mode select                              | O    | 0. Speed control<br>1. Torque control (without speed control)                                                                                 | 0       | 177  |
| 98.31 | Torque rise time in torque mode                       | O    | 0.0 to 3000.0 [sec]                                                                                                                           | 0.0 s   | 177  |
| 98.32 | Torque fall time in torque mode                       | O    | 0.0 to 3000.0 [sec]                                                                                                                           | 0.0 s   | 177  |
| 98.37 | Speed limit bias in torque mode                       | O    | 0.01 to 10.00 [Hz]                                                                                                                            | 1.00 Hz | 178  |

## 8.1.30 Motor data

| No.   | Name                                                    | Edit | Range                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                       | Default         | Page |
|-------|---------------------------------------------------------|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|------|
| 99.01 | Motor type                                              | X    | 2.2L: 2.2kW<br>3.7L: 3.7kW<br>5.5L: 5.5kW<br>7.5L: 7.5kW<br>11L: 11kW<br>15L: 15kW<br>18.5L: 18.5kW<br>22L: 22kW<br>30L: 30kW<br>37L: 37kW<br>45L: 45kW<br>55L: 55kW<br>75L: 75kW<br>90L: 90kW | 2.2H: 2.2kW<br>3.7H: 3.7kW<br>5.5H: 5.5kW<br>7.5H: 7.5kW<br>11H: 11kW<br>15H: 15kW<br>18.5H: 18.5kW<br>22H: 22kW<br>30H: 30kW<br>37H: 37kW<br>45H: 45kW<br>55H: 55kW<br>75H: 75kW<br>90H: 90kW<br>110H: 110kW<br>132H: 132kW<br>160H: 160kW<br>200H: 200kW<br>220H: 220kW<br>250H: 250kW<br>280H: 280kW<br>320H: 320kW<br>350H: 350kW | 153             | 181  |
| 99.02 | Motor rated voltage                                     | X    | 200V/220V/230V/240V<br>/380V/400V/415V/440V/460V/480V                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                       | Per<br>Capacity | 181  |
| 99.03 | Motor rated frequency                                   | X    | 0.00 to 400.0 [Hz]                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                       | 60.00 Hz        | 181  |
| 99.04 | Motor rated current                                     | X    | 0.1 to 800.0 [A]                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                       | Per<br>Capacity | 181  |
| 99.05 | Motor flux current                                      | X    | 0.1 to 400.0 [A]                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                       | Per<br>Capacity | 182  |
| 99.06 | Motor rated slip frequency                              | X    | 0.01 to 10.0 [%]                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                       | Per<br>Capacity | 182  |
| 99.07 | Motor pole setting                                      | X    | 2: 2 Poles<br>4: 4 Poles<br>6: 6 Poles<br>8: 8 Poles                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                       | 4               | 182  |
| 99.08 | Auto tuning                                             | X    | 0. Disable<br>1. Enable                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                       | 0               | 182  |
| 99.09 | Motor data selection                                    | X    | 0. Standard data<br>1. Auto tuning data                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                       | 0               | 183  |
| 99.10 | Motor<br>resistance R1                                  | X    | 0.1 to 30.0 [Ohm]                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                       | Per<br>Capacity | 183  |
| 99.11 | Motor<br>transient inductance Lsig                      | X    | 0.01 to 100.0 [mH]                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                       | Per<br>Capacity | 183  |
| 99.12 | Motor<br>resistance R1<br>(Auto tuned data)             | X    | 0.1 to 30.0 [Ohm]                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                       | Per<br>Capacity | 183  |
| 99.13 | Motor<br>Transient inductance Lsig<br>(Auto tuned data) | X    | 0.01 to 100.0 [mH]                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                       | Per<br>Capacity | 183  |

| No.   | Name                                             | Edit | Range                                                                                                      | Default | Page |
|-------|--------------------------------------------------|------|------------------------------------------------------------------------------------------------------------|---------|------|
| 99.15 | Encoder PPR                                      | X    | 0 to 9999                                                                                                  | 1024    | 183  |
| 99.16 | Encoder direction setting                        | X    | 0. Counterclockwise<br>1. Clockwise                                                                        | 0       | 183  |
| 99.17 | Encoder low pass filter time constant            | X    | 0 to 10000 [msec]                                                                                          | 0 msec  | 184  |
| 99.18 | Encoder frequency deviation error frequency      | X    | 0.00 to 10.00 [Hz]                                                                                         | 3.00 Hz | 184  |
| 99.19 | Encoder frequency deviation error detection time | X    | 0.0 to 10.0 [sec]                                                                                          | 0.0 sec | 184  |
| 99.20 | Overspeed error detection level                  | X    | 100.0 to 120.0 [%]                                                                                         | 110.0 % | 184  |
| 99.21 | Overspeed error detection time                   | X    | 0.0 to 3.0 [sec]                                                                                           | 0.0 sec | 184  |
| 99.22 | Encoder pulse error detection method select      | X    | 0. Disable detection<br>1. Detect all encoder error<br>2. A and B all pulse error<br>3. A or B pulse error | 0       | 184  |
| 99.23 | Encoder pulse error detection time               | X    | 0.0 to 60.0 [sec]                                                                                          | 3.0 sec | 185  |

## 8.2 Parameter detail

### 8.2.1 VFD running status

- **01.01 Output frequency monitor**

- *Range: 0.00 ~ 400.0 Hz*

Real time display of output frequency of the VFD

It displays in 0.01 unit if the frequency is under 100Hz

It displays in 0.1 unit if the frequency is above 100Hz

- **01.02 Motor RPM monitor**

- *Range: 0 ~ 60000 RPM*

below determined by equation:

$120 \times '01.01' (\text{Output frequency}) \times '42.02' (\text{RPM display scale factor}) / '99.07' (\text{Motor Pole setting})$

ex1)  $'01.01' = 60\text{Hz}$ ,  $'42.02' = 100$ ,  $'99.07' = 4$  :  $'01.02' = 1800\text{rpm}$

ex2)  $'01.01' = 60\text{Hz}$ ,  $'42.02' = 50$ ,  $'99.07' = 4$  :  $'01.02' = 900\text{rpm}$

- **01.03 Encoder Speed**

- *Range: 0 ~ 60000 RPM*

- **01.04 Rotation direction monitor**

- *STP: Stop*
- *FWD: Forward Run*
- *REV: Reverse Run*

Real time display of rotation of the VFD

- **01.05 Output current monitor**

- *Range: 0.0 ~ 2000 A*

Real time display of output current of the VFD

It displays in 0.1 unit if the output current is under 1000A

It displays in 1 unit if the output current is above 1000A

- **01.07 DC voltage monitor**

- *Range: 0 ~ 1000 V*

Real time voltage on DC bus

- **01.08 Output voltage monitor**

- *Range: 0 ~ 1000 V*

Real time display of output voltage of the VFD

- **01.09 Output power monitor**

- *Range: 0.0 ~ 1000 kW*

Real time display of power consumption of the VFD

It displays in 0.1 unit if the motor current is under 1000kW

It displays in 1 unit if the motor current is above 1000kW

below determined by equation:

Power:  $\sqrt{3} \times V \times I$

ex) **'01.09'** =  $1.37 \times \text{'01.05' (Motor current monitor)} \times \text{'01.08' (Output voltage monitor)}$

## 8.2.2 Frequency reference indication

- **02.01 Final frequency reference monitor**

- *Range: 0.00 ~ 400.0 Hz*

Displays the reference by panel  
refer to '**22.XX**' block diagram

- **02.02 Modbus frequency reference monitor**

- *Range: 0.00 ~ 400.0 Hz*

Displays the reference by modbus  
It can be shown the value even without setting '**22.03**' and '**22.04**'  
❖ *Related Parameters: '**50.01**', '**50.02**'*

- **02.03 Field frequency reference monitor**

- *Range: 0.00 ~ 400.0 Hz*

Displays the reference by Fieldbus  
It can be shown the value even without setting '**22.03**' and '**22.04**'  
❖ *Related Parameters: '**51.01**' ~ '**51.26**'*

### 8.2.3 Trip information

*When fault occurs, the VFD automatically displays this parameter*

*Additional information of the fault can be accessed by using up arrow key*

- **03.01 Current trip, Source of trip**

Displays source of trip

- **03.02 Current trip, Frequency at trip**

Displays frequency at trip

- **03.03 Current trip, Current at trip**

Displays current at trip

- **03.04 Current trip, Vdc at trip**

Displays Vdc at trip

- **03.05 Current trip, Running Status at trip**

Displays VFD status at trip

- **03.06 Current trip, DI Status at trip**

Displays digital input status at trip  
refer to '**10.01**' (DI status)

- **03.07 Current trip, DO Status at trip**

Displays digital output status at trip  
refer to '**10.22**' (DO status)

- **03.08 Current trip, IGBT Temperature at trip**

Displays IGBT temperature at trip

- **03.09 Current trip, Occurred time (Year)**

Displays year at trip  
If today is 2016, it shows 2016

- **03.10 Current trip, Occurred time (Month, Day)**

Displays month and day at trip  
If today is December 31th, it shows 1231

- **03.11 Current trip, Occurred time (Hour, Minute)**

Displays hour and minutes at trip  
If time is 11:59PM, it shows 2359

- **03.12 Current trip, Occurred time (Second)**

Displays second at trip  
If second of time is 59, it shows 59

1. The five of trip history will save in the '**03.13**' ~ '**03.72**' parameter as above
2. If new trip is occurred, it saves and the oldest trip history will be deleted
3. The trip count never be changed if someone will not initialize a value

## 8.2.4 Time counter

- **04.01 Power on–day counter**

- *Range: 0 ~ 65536 Day*

The counter runs when the VFD power is on

- **04.02 Power on–time counter**

- *Range: 0 ~ 1439 min*

The counter runs when the VFD power is on

Whenever the counter rolls over, '**04.01**' (*Power on–day counter*) is incremented and this parameter turns to zero

- **04.03 Run–day counter**

- *Range: 0 ~ 65536 Day*

The counter runs when the VFD modulates

- **04.04 Run–time counter**

- *Range: 0 ~ 1439 min*

The counter runs when the VFD modulates

Whenever the counter rolls over, '**04.03**' (*Run–day counter*) is incremented and this parameter turns to zero

- **04.05 Fan on–day counter**

- *Range: 0 ~ 65536 Day*

The counter runs when the cooling fan is running

- **04.06 Fan on –time counter**

- *Range: 0 ~ 1439 min*

The counter runs when the cooling fan is running

Whenever the counter rolls over, '**04.05**' (*Fan on–day counter*) is incremented and this parameter turns to zero

- **04.07 IGBT temperature**

- *Range: 0.0 ~ 160.0 °C*

It displays IGBT temperature by NCT sensor

- **04.08 Fieldbus status**

- *Range: 0x00 ~ 0xFF*

It displays status of fieldbus option card

## 8.2.5 VFD firmware information

- **05.01 Firmware name**

- *STD: Standard*

It displays firmware name  
General VFD shows STD

- **05.02 Firmware version**

- *Range: 0.000 ~ 9.999*

It displays firmware version

- **05.03 Current time (Year)**

- *Range: 2000 ~ 2099*

It displays current year  
If today is 2016, it shows 2016

- **05.04 Current time (Month, Day)**

- *Range: 101 ~ 1231*

It displays current month and day  
If today is December 31th, it shows 1231

- **05.05 Current time (Hour, Minute)**

- *Range: 0 ~ 2359*

It displays current hour and minute  
If time is 11:59PM, it shows 2359

- **05.06 Current time (Second)**

- *Range: 0 ~ 59*

It displays current second  
If second of time is 59, it shows 59

## 8.2.6 Standard DI, DO

- **10.01 DI status**

- *Range: 0x00 ~ 0xFF*

It displays the status of digital input

Example Data: 0000000000001111

Meaning: DI8~DI5 OFF, DI4~DI1 ON

|                                                  |    |    |    |    |    |   |   |     |     |     |     |     |     |     |     |
|--------------------------------------------------|----|----|----|----|----|---|---|-----|-----|-----|-----|-----|-----|-----|-----|
| 15                                               | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7   | 6   | 5   | 4   | 3   | 2   | 1   | 0   |
| It displays when extension I/O card is connected |    |    |    |    |    |   |   | DI8 | DI7 | DI6 | DI5 | DI4 | DI3 | DI2 | DI1 |

- **10.02 DI Delayed status**

- *Range: 0x00 ~ 0xFF*

It displays the status of digital input that delayed

Example Data: 0000000011110000

Meaning: DI8~DI5 ON, DI4~DI1 OFF

|                                                  |    |    |    |    |    |   |   |     |     |     |     |     |     |     |     |
|--------------------------------------------------|----|----|----|----|----|---|---|-----|-----|-----|-----|-----|-----|-----|-----|
| 15                                               | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7   | 6   | 5   | 4   | 3   | 2   | 1   | 0   |
| It displays when extension I/O card is connected |    |    |    |    |    |   |   | DI8 | DI7 | DI6 | DI5 | DI4 | DI3 | DI2 | DI1 |

- **10.03 DI Forced selection**

- *Range: 0x00 ~ 0xFF*
- *Initial value: 0x00*

The statuses of the digital input can be overridden for example testing purposes

A bit in parameter '**10.04' (DI forced data)** is provided for each digital input and its value is applied whenever the corresponding bit in this parameter is 1

- **10.04 DI Forced data**

- *Range: 0x00 ~ 0xFF*
- *Initial value: 0x00*

Allows the data value of a forced digital input to be changed from 0 to 1

It is only possible to forced an input that has been selected in parameter '**10.03' (DI forced selection)**

### ● 10.05 DI contact type selection

- Range: 0x00 ~ 0xFF
- Initial value: 0x00

It is possible to change the status of DI input type as N.O or N.C

Example Data: 0000000011110000

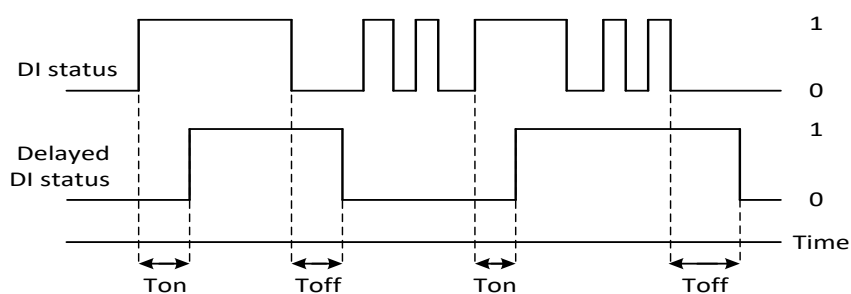
Meaning: DI8~DI5 Normal close type, DI4~DI1 Normal open type

|                                                  |    |    |    |    |    |   |   |     |     |     |     |     |     |     |     |
|--------------------------------------------------|----|----|----|----|----|---|---|-----|-----|-----|-----|-----|-----|-----|-----|
| 15                                               | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7   | 6   | 5   | 4   | 3   | 2   | 1   | 0   |
| It displays when extension I/O card is connected |    |    |    |    |    |   |   | DI8 | DI7 | DI6 | DI5 | DI4 | DI3 | DI2 | DI1 |

### ● 10.06 DI1 ON delay time

- Range: 0 ~ 30000 mSec in 1 mSec
- Initial value: 10 mSec

Defines the activation delay for digital input DI1



- Ton: '10.06' (DI1 On delay time)
- Toff: '10.07' (DI1 Off delay time)

### ● 10.07 DI1 OFF delay time

- Range: 0 ~ 30000 Sec in 1 mSec
- Initial value: 10 mSec

Defines the activation ON delay for digital input DI1

### ● 10.08 DI2 ON delay time

- See the parameter '10.05' (DI1 ON delay)

### ● 10.09 DI2 OFF delay time

- See the parameter '10.06' (DI1 OFF delay)

### ● 10.10 DI3 ON delay time

- See the parameter '10.05' (DI1 ON delay)

### ● 10.11 DI3 OFF delay time

- See the parameter '10.06' (DI1 OFF delay)

- 10.12 DI4 ON delay time
  - See the parameter '10.05' (DI1 ON delay)
- 10.13 DI4 OFF delay time
  - See the parameter '10.06' (DI1 OFF delay)
- 10.14 DI5 ON delay time
  - See the parameter '10.05' (DI1 ON delay)
- 10.15 DI5 OFF delay time
  - See the parameter '10.06' (DI1 OFF delay)
- 10.16 DI6 ON delay time
  - See the parameter '10.05' (DI1 ON delay)
- 10.17 DI6 OFF delay time
  - See the parameter '10.06' (DI1 OFF delay)
- 10.18 DI7 ON delay time
  - See the parameter '10.05' (DI1 ON delay)
- 10.19 DI7 OFF delay time
  - See the parameter '10.06' (DI1 OFF delay)
- 10.20 DI8 ON delay time
  - See the parameter '10.05' (DI1 ON delay)
- 10.21 DI8 OFF delay time
  - See the parameter '10.06' (DI1 OFF delay)

### ● 10.22 DO (RN0~RN3, AL0~AL2) delayed status

- Range: 0x00 ~ 0xFF

It displays the relay outputs Terminal Status

Example Data: 0000000000000011

Meaning: AL OFF, DO2~DO1 ON

|                                                  |    |    |    |    |    |   |   |   |   |   |   |   |    |     |     |
|--------------------------------------------------|----|----|----|----|----|---|---|---|---|---|---|---|----|-----|-----|
| 15                                               | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2  | 1   | 0   |
| It displays when extension I/O card is connected |    |    |    |    |    |   |   |   |   |   |   |   | AL | D02 | D01 |

### ● 10.23 DO (RN0~RN3, AL0~AL2) forced selection

- Range: 0x00 ~ 0xFF
- Initial value: 0x00

The statuses of the digital output can be overridden for example testing purposes

A bit in parameter '**10.22' (DO forced data)** is provided for each digital output and its value is applied whenever the corresponding bit in this parameter is 1

### ● 10.24 DO (RN0~RN3, AL0~AL2) forced data

- Range: 0x00 ~ 0xFF
- Initial value: 0x00

Allows the data value of a forced digital output to be changed from 0 to 1

It is only possible to forced an output that has been selected in parameter '**10.22' (DO forced selection)**

### ● 10.25 DO1 (RN0~RN1), DO2 (RN2~RN3) contact type selection

- Range: 0x00 ~ 0xFF
- Initial value: 0x00

It is possible to change the status of DO1 and DO2 output type as N.O or N.C

Example Data: 0000000000000010

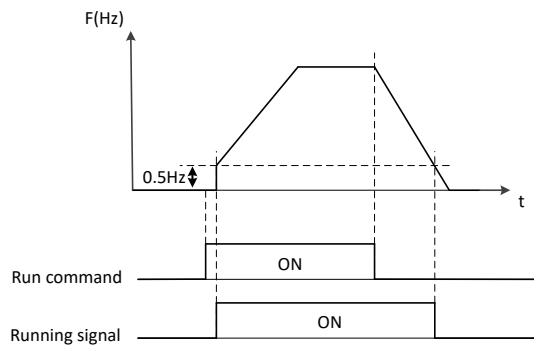
Meaning: DO2 (RN2~RN3) Normal close type, DO1 (RN0~RN1) Normal open type

|                                                  |    |    |    |    |    |   |   |   |   |   |   |   |    |     |     |
|--------------------------------------------------|----|----|----|----|----|---|---|---|---|---|---|---|----|-----|-----|
| 15                                               | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2  | 1   | 0   |
| It displays when extension I/O card is connected |    |    |    |    |    |   |   |   |   |   |   |   | AL | D02 | D01 |

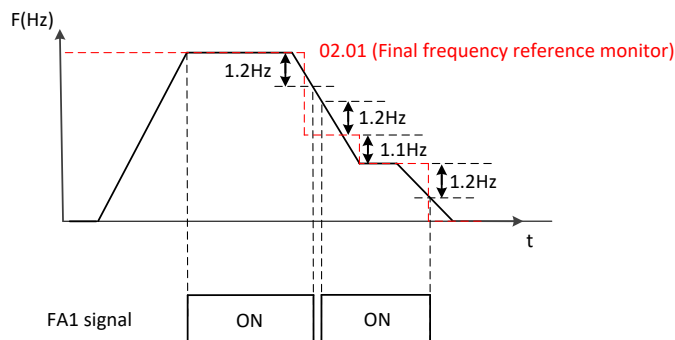
## 10.26 DO1 (RN0–RN1) source

- 0: RUN VFD Run Signal
- 1: FA1 Frequency Arrival 1 ----- Initial value
- 2: FA2 Frequency Arrival 2
- 3: OL Overload Warning Signal
- 4: OD Output Deviation Excess for PID control
- 5: AL Fault Signal
- 6: MO Modbus communication control signal
- 7: SOL System overload detection signal
- 8: SUL System Underload detection signal
- 9: SOL/SUL System overload/Underload detection signal
- 10: External brake control signal

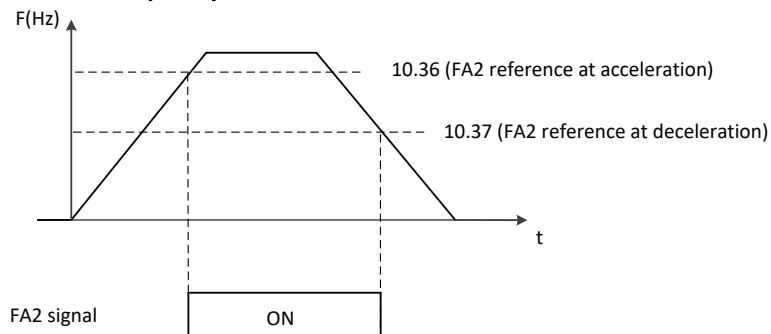
### Set 0: RUN VFD Run Signal



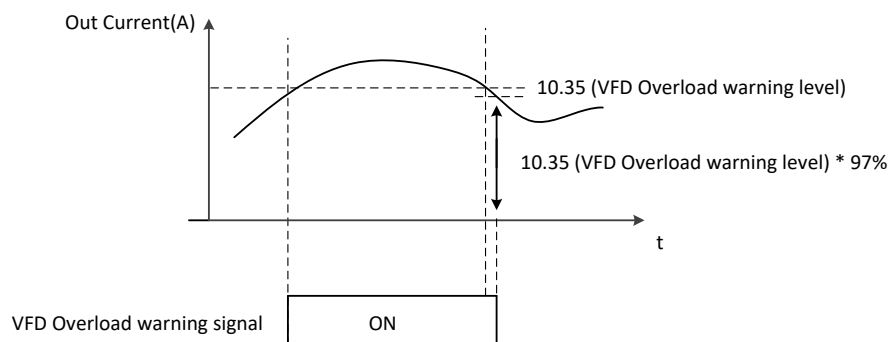
### Set 1: FA1 Frequency Arrival 1



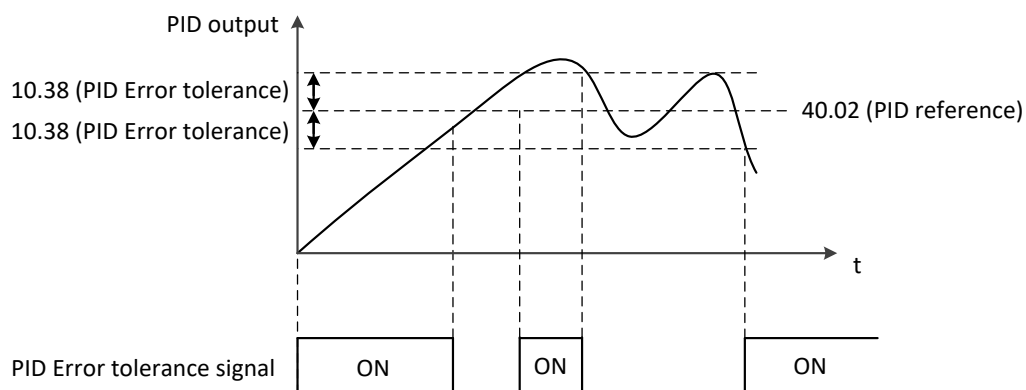
### Set 2: FA2 Frequency Arrival 2



▪ **Set 3: OL    Overload Warning Signal**



▪ **Set 4: OD    Output Deviation Excess for PID control**



▪ **Set 5: AL    Fault Signal**

▪ **Set 6: Modbus communication control signal**

You can control digital output (DO) using the special address 0x1001.  
Check the 50. RS-485 (Modbus) parameter for instructions on how to use the communication frame.

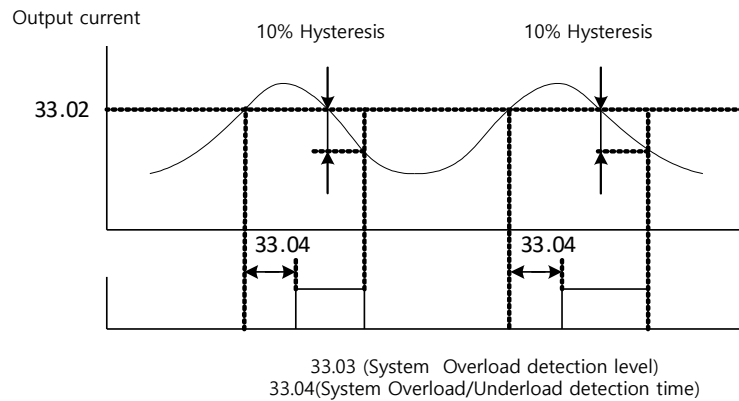
1<sup>st</sup> byte

| Bit7     | Bit6 | Bit5 | Bit4 | Bit3 | Bit2 | Bit1 | Bit0 |
|----------|------|------|------|------|------|------|------|
| Reserved |      |      |      |      |      |      |      |

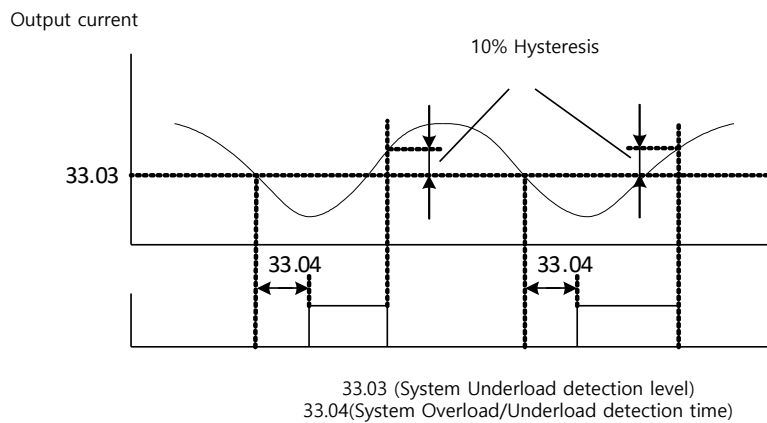
2<sup>nd</sup> byte

| Bit7     | Bit6 | Bit5 | Bit4 | Bit3 | Bit2  | Bit1  | Bit0  |
|----------|------|------|------|------|-------|-------|-------|
| Reserved |      |      |      |      | AL0~2 | RN2~3 | RN0~1 |

- **Set 7: system overload detection signal**



- **Set 8: system Underload detection signal**



- **Set 9: System overload/Underload detection signal**

If the system is under overload or Underload, it is detected and the signal is output.

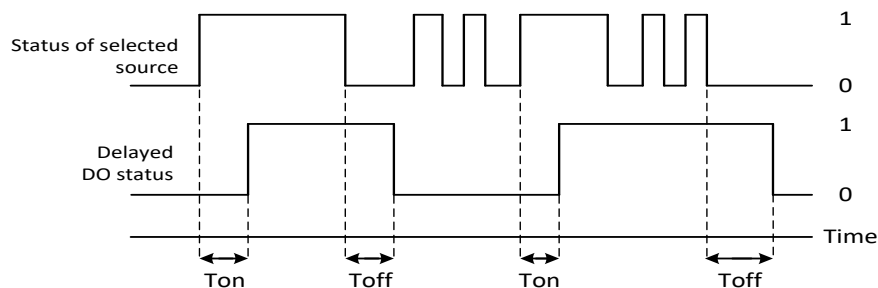
- **Set 10: External brake control signal**

When using the '52.01' external brake parameters, contact signal for external brake control is transmitted depending on the operating condition.

- **10.27 DO1 (RN0–RN1) ON delay time**

- *Range: 0.0 ~ 3000 Sec in 0.1 Sec*
- *Initial value: 0.0 Sec*

Defines the activation delay for relay output DO1



- Ton: '**10.27**' *DO1 (RN0–RN1) On delay time*
- Toff: '**10.28**' *DO1 (RN0–RN1) Off delay time*

- **10.28 DO1 (RN0–RN1) OFF delay time**

- *Range: 0.0 ~ 3000 Sec in 0.1 Sec*
- *Initial value: 0.0 Sec*

Defines the activation ON delay for relay output DO1

- **10.29 DO2 (RN2–RN3) source**

- *See the parameter '**10.26**' (DO1 source)*

- **10.30 DO2 (RN2–RN3) ON delay time**

- *See the parameter '**10.27**' (DO1 ON delay)*

- **10.31 DO2 (RN2–RN3) OFF delay time**

- *See the parameter '**10.28**' (DO1 OFF delay)*

- **10.32 Alarm (AL0–AL1–AL2) relay source**

- *See the parameter '**10.26**' (DO1 source))*

- **10.33 Alarm (AL0–AL1–AL2) relay ON delay time**

- *See the parameter '**10.27**' (DO1 ON delay)*

- **10.34 Alarm (AL0–AL1–AL2) OFF delay time**

- *See the parameter '**10.28**' (DO1 OFF delay)*

- **10.35 VFD overload warning level**

- *Range: 10.0 ~ 200.0 % in 0.1 %*
- *Initial value: 100.0 %*

Program a level of the VFD motor current

- **10.36 FA2 reference at acceleration**

- *Range: '10.37' ~ 400Hz in 0.01 Hz*
- *Initial value: 0.0 Hz*

Program the frequency arrival threshold during acceleration

❖ *Related Parameters: '10.26'*

- **10.37 FA2 reference at deceleration**

- *Range: 0.00 ~ '10.36' Hz in 0.01 Hz*
- *Initial value: 0.0 Hz*

Program the frequency arrival threshold during deceleration

❖ *Related Parameters: '10.26'*

- **10.38 PID Error tolerance**

- *Range: 0.0 ~ 100.0 % in 0.1 %*
- *Initial value: 100.0 %*

Program the allowable PID loop error magnitude

❖ *Related Parameters: '10.26'*

## 8.2.7 Standard AI (O, OI)

- **11.01 AI (O, OI) forced selection**

- *Range: 0x00 ~ 0xFF*
- *Initial value: 0x00*

Example Data: 0000000000000010

Meaning: R01, AI2 ON, AI1 OFF

|                                                  |    |    |    |    |    |   |   |   |   |   |   |   |   |             |            |
|--------------------------------------------------|----|----|----|----|----|---|---|---|---|---|---|---|---|-------------|------------|
| 15                                               | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1           | 0          |
| It displays when extension I/O card is connected |    |    |    |    |    |   |   |   |   |   |   |   |   | AI2<br>(OI) | AI1<br>(O) |

The statuses of the analog input can be overridden for example testing purposes

A bit in parameters '**11.04' (AI1 forced value)**' and '**11.12' (AI2 forced value)**' are provided for each analog input and its value is applied whenever the corresponding bit in this parameter is 1

- **11.02 AI1 (O) actual value**

- *Range: 0.00 ~ 100.0 % in 0.01 %*

Displays the value of analog input AI1 (O) in V

(Depending on the input is set to voltage by a hardware setting)

- **11.03 AI1 (O) scaled value**

- *Range: 0.00 ~ 400.00 Hz in 0.01 Hz – frequency*
- *Range: 0.00 ~ 100.0 % in 0.01 % – PID*

Displays the value of analog input AI1 (O) after scaling

❖ *Related Parameters: '11.08', '11.09'*

- **11.04 AI1 (O) forced value**

- *Range: 0.00 ~ 100.0 % in 0.01 %*
- *Initial value: 0.00 %*

Allows the data value of a forced analog input to be changed from 0.0 to 100.0

It is only possible to forced an input that has been selected in parameter

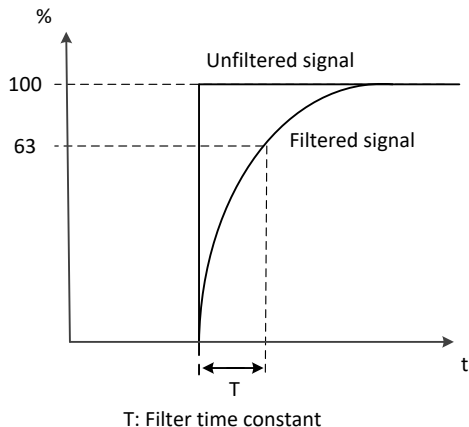
**'11.01' (AI forced selection)**

### ● 11.05 AI1 (O) filter time

- Range: 0 ~ 30000 ms in 1 ms
- Initial value: 100 ms

Defines the filter time constant for analog input AI1 (O)

The filter time is that VFD is realized 63% of 100%

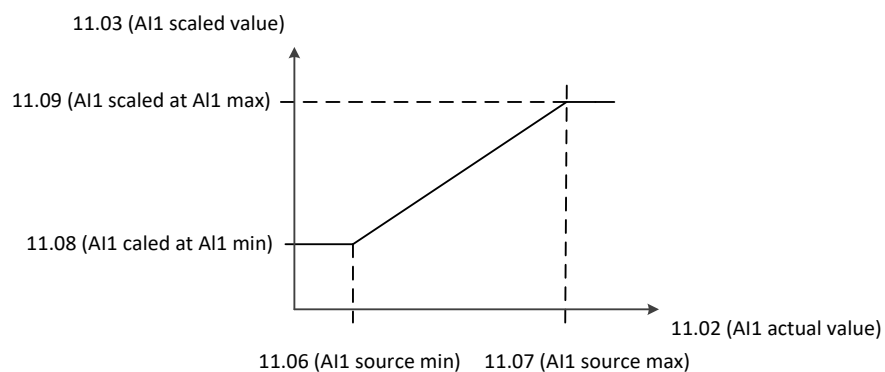


### ● 11.06 AI1 (O) source min

- Range: 0.00 ~ 100.0 % in 0.01 %
- Initial value: 0.00 %

Defines the minimum site value for analog input AI1

Set the value actually sent to the drive when the analog signal from plant is wound to its minimum setting.



### ● 11.07 AI1 (O) source max

- Range: 0.00 ~ 100.0 % in 0.01 %
- Initial value: 100.0 %

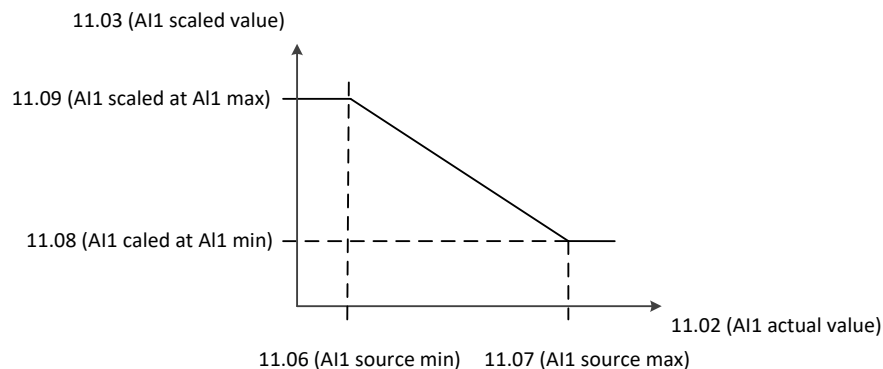
Defines the maximum site value for analog input AI1

Set the value actually sent to the drive when the analog signal from plant is wound to its maximum setting.

● **11.08 AI1 (O) scaled at AI1 min**

- *Range: 0.00 ~ 400.0 Hz in 0.01 Hz – Frequency*
- *Range: 0.0 ~ 100.0 % in 0.1 % – PID*
- *Initial value: 0.00 Hz*

Defines the real internal value that corresponds to the minimum analog input AI1 value defined by parameter **'11.06' (AI1 source min)**



- ✧ Changing the polarity settings of **'11.08' (AI1 scaled at AI1 min)** and **'11.09' (AI1 scaled at AI1 max)** can effectively invert the analog input

● **11.09 AI1 (O) scaled at AI1 max**

- *Range: 0.00 ~ 400.0 Hz in 0.01 Hz – Frequency*
- *Range: 0.0 ~ 100.0 % in 0.1 % – PID*
- *Initial value: 60.00 Hz*

Defines the real internal value that corresponds to the maximum analog input AI1 value defined by parameter **'11.07' (AI1 source max)**

● **11.10 AI2 (OI) actual value**

- *Range: 0.00 ~ 100.0 % in 0.01 %*

Displays the value of analog input AI2 (OI) in mA  
(Depending on the input is set to current by a hardware setting)

● **11.11 AI2 (OI) scaled value**

- *Range: 0.00 ~ 400.00 Hz in 0.01 Hz – frequency*
- *Range: 0.00 ~ 100.0 % in 0.01 % – PID*

Displays the value of analog input AI2 after scaling

- ✧ *Related Parameters: '11.16', '11.17'*

### ● 11.12 AI2 (OI) forced value

- Range: 0.00 ~ 100.0 % in 0.01 %
- Initial value: 0.00 %

Allows the data value of a forced analog input to be changed from 0.0 to 100.0

It is only possible to forced an input that has been selected in parameter

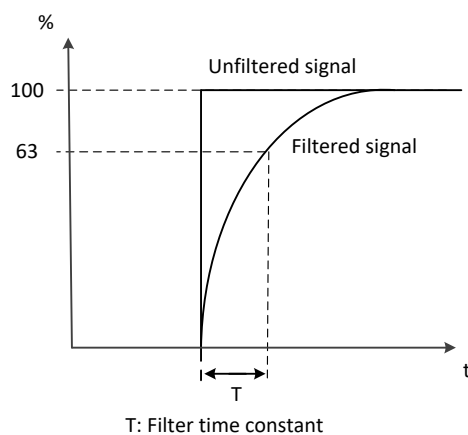
**'11.01' (AI forced selection)**

### ● 11.13 AI2 (OI) filter time

- Range: 0 ~ 30000 ms in 1 ms
- Initial value: 100 ms

Defines the filter time constant for analog input AI2 (OI)

The filter time is that VFD is realized 63% of 100%

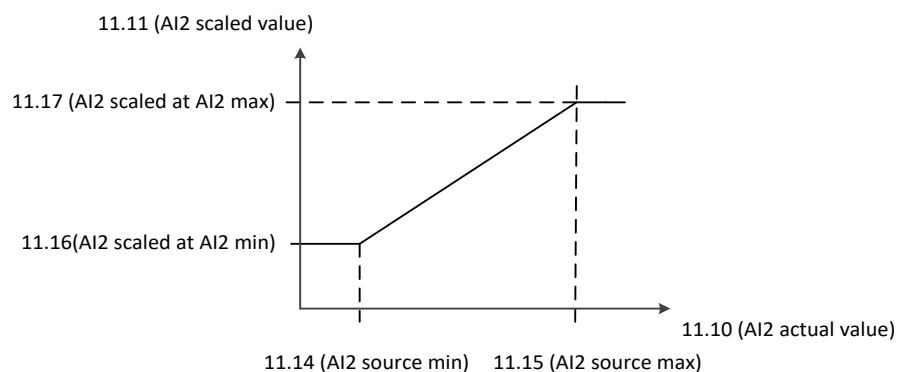


### ● 11.14 AI2 (OI) source min

- Range: 0.00 ~ 100.0 % in 0.01 %
- Initial value: 0.0 %

Defines the minimum site value for analog input AI2 (OI)

Set the value actually sent to the drive when the analog signal from plant is wound to its minimum setting.



- **11.15 AI2 (OI) source max**

- *Range: 0.00 ~ 100.0 % in 0.01 %*
- *Initial value: 100.0 %*

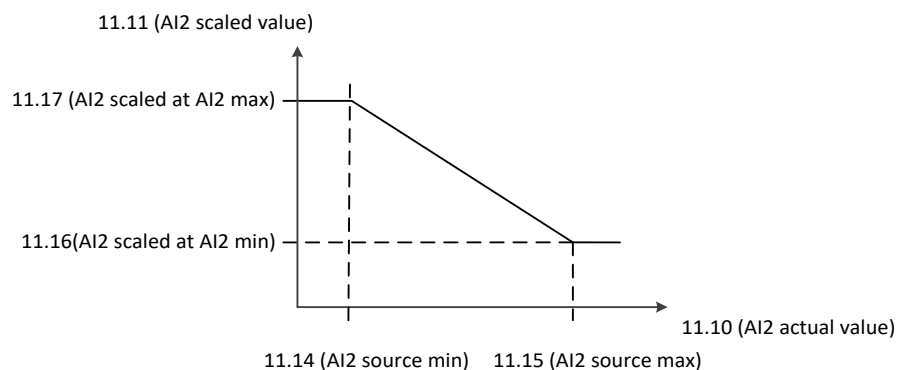
Defines the maximum site value for analog input AI2 (OI)

Set the value actually sent to the drive when the analog signal from plant is wound to its maximum setting.

- **11.16 AI2 (OI) scaled at AI2 min**

- *Range: 0.00 ~ 400.0 Hz in 0.01 Hz – Frequency*
- *Range: 0.0 ~ 100.0 % in 0.1 % – PID*
- *Initial value: 0.00 Hz*

Defines the real internal value that corresponds to the minimum analog input AI2 value defined by parameter '**11.14**' (*AI2 source min*)



✧ Changing the polarity settings of '**11.16**' (*AI2 scaled at AI2 min*) and '**11.17**' (*AI2 scaled at AI2 max*) can effectively invert the analog input

- **11.17 AI2 scaled at AI2 max**

- *Range: 0.00 ~ 400.0 Hz in 0.01 Hz – Frequency*
- *Range: 0.0 ~ 100.0 % in 0.1 % – PID*
- *Initial value: 60.00 Hz*

Defines the real internal value that corresponds to the maximum analog input AI2 value defined by parameter '**11.15**' (*AI 2 source max*)

## 8.2.8 Standard AO (FM, AMI)

- **12.01 AO (FM, AMI) forced selection**

- *Range: 0x00 ~ 0xFF*
- *Initial value: 0x00*

Example Data: 0000000000000010

Meaning: R01, AO2 (AMI) ON, AO1 (FM) OFF

|                                                  |    |    |    |    |    |   |   |   |   |   |   |   |   |              |             |
|--------------------------------------------------|----|----|----|----|----|---|---|---|---|---|---|---|---|--------------|-------------|
| 15                                               | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1            | 0           |
| It displays when extension I/O card is connected |    |    |    |    |    |   |   |   |   |   |   |   |   | AO2<br>(AMI) | AO1<br>(FM) |

The statuses of the analog input can be overridden for example testing purposes

A bit in parameters '**12.04' (AO1 forced value)**' and '**12.12' (AO2 forced value)**' are provided for each analog input and its value is applied whenever the corresponding bit in this parameter is 1

- **12.02 AO1 (FM) actual value**

- *Range: 0.00 ~ 100.0 % in 0.01 %*

Displays the value of AO1 (FM) in V

- **12.03 AO1 (FM) source**

- *0: Out Frequency ----- Initial value*
- *1: Out Ampere*
- *2: Out Voltage*
- *3: Out Power*
- *4: Out torque*

Program what output performance to be monitored from following selections

- **Set 0: Output Frequency**  
The highest analog output value is the maximum frequency value. The indicator accuracy after the adjustment is about +/- 5%.
- **Set 1: Output Current**  
The highest analog value is the 200% of rated VFD current. The indicator accuracy after the adjustment is about +/- 10%.
- **Set 2: Output Voltage**  
The highest analog value is the 100% of rated VFD voltage out. The indicator accuracy after the adjustment is about +/- 10%.

- **Set 3: Output Power**

The highest analog value is the 200% of rated VFD power out. The indicator accuracy after the adjustment is about  $\pm 10\%$ .

- **Set 4: Output Torque**

The highest analog value is the 200% of rated VFD output torque. The indicator accuracy after the adjustment is about  $\pm 10\%$ .

- **12.04 AO1 (FM) forced value**

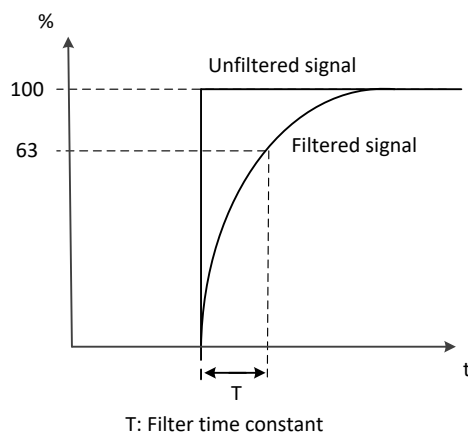
- *Range: 0.00 ~ 100.0 % in 0.01 %*
- *Initial value: 0.0 %*

Allows the data value of a forced analog output to be changed from 0.0 to 100.0  
It is only possible to forced an input that has been selected in parameter  
**'12.01' (AO forced selection)**

- **12.05 AO1 (FM) filter time**

- *Range: 0 ~ 30000 ms in 1 ms*
- *Initial value: 100 ms*

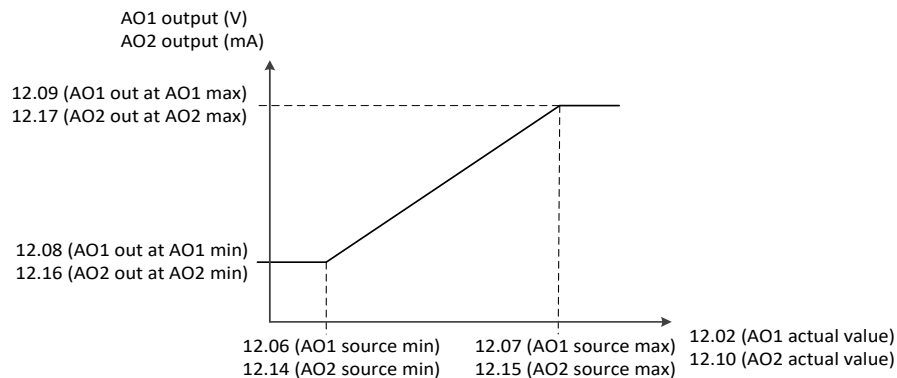
Defines the filter time constant for analog input AO1  
The filter time is that VFD is realized 63% of 100%



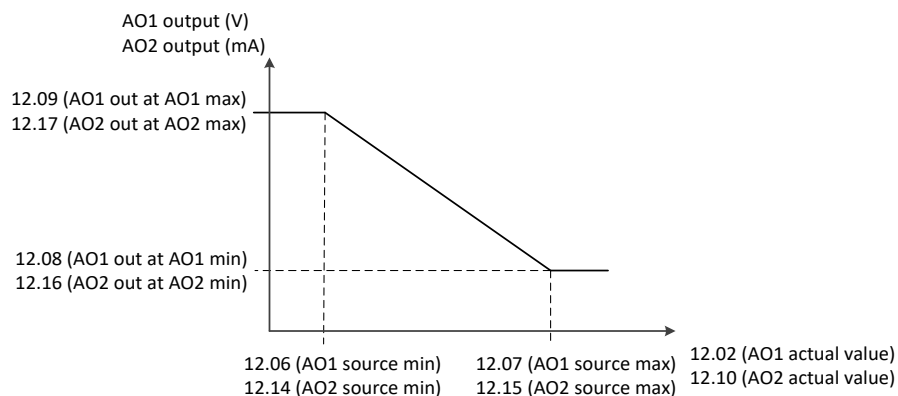
## 12.06 AO1 (FM) source min

- Range: 0.00 ~ 100.0 % in 0.01 %
- Initial value: 0.0 %

Defines the real minimum value of the signal selected by parameter **'12.03' (AO1 source)** that corresponds to the minimum required AO1 output value



- Changing the polarity settings of **'12.08' (AO1 out at AO1 min)** and **'12.09' (AO1 out at AO1 max)** can effectively invert the analog output



## 12.07 AO1 (FM) source max

- Range: 0.00 ~ 100.0 % in 0.01 %
- Initial value: 100.0 %

Defines the real maximum value of the signal selected by parameter **'12.03' (AO1 source)** that corresponds to the maximum required AO1 output value defined by parameter **'12.09' (AO1 out at AO1 max)**

- **12.08 AO1 (FM) out at AO1 min**

- *Range: 0.00 ~ 100.0 % in 0.01 %*
- *Initial value: 0.0 %*

Defines the real minimum output value for analog output AO1  
See also drawing at parameter *'12.06' (AO1 source min)*

- **12.09 AO1 (FM) out at AO1 max**

- *Range: 0.00 ~ 100.0 % in 0.01 %*
- *Initial value: 100.0 %*

Defines the real maximum output value for analog output AO1  
See also drawing at parameter *'12.07' (AO1 source max)*

- **12.10 AO2 (AMI) actual value**

- *Range: 0.00 ~ 100.0 % in 0.01 %*

Displays the value of AO2 (AMI) in mA

- **12.11 AO2 (AMI) source**

- *See the parameter *'12.03' (AO1 source)**

- **12.12 AO2 (AMI) forced value**

- *See the parameter *'12.04' (AO1 forced value)**

- **12.13 AO2 (AMI) filter time**

- *See the parameter *'12.05' (AO1 filter time)**

- **12.14 AO2 (AMI) source min**

- *See the parameter *'12.06' (AO1 source min)**

- **12.15 AO2 (AMI) source max**

- *See the parameter *'12.07' (AO1 source max)**

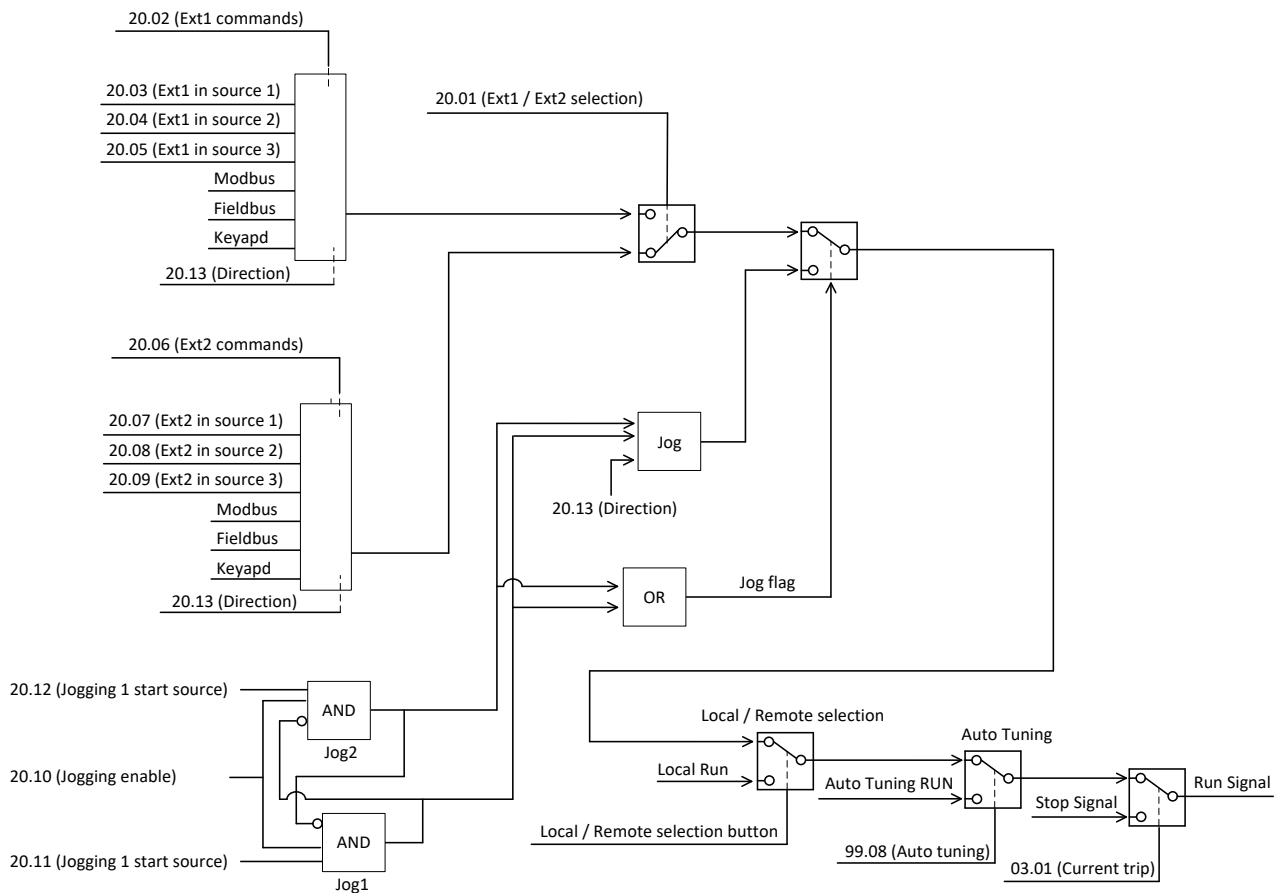
- **12.16 AO2 (AMI) out at AO2 min**

- *See the parameter *'12.08' (AO1 out at AO1 min)**

- **12.17 AO2 (AMI) out at AO2 max**

- *See the parameter *'12.09' (AO1 out at AO1 max)**

## 8.2.9 Start/Stop/Direction



### ● 20.01 Ext1/Ext2 selection

- 0: Ext1 ----- Initial value
- 1: Ext2
- 2: DI1
- 3: DI2
- 4: DI3
- 5: DI4
- 6: DI5
- 7: DI6
- 8: DI7
- 9: DI8

It can use to external commands as local/remote function

- **Set 0: Ext1**  
It works by value at '20.02' (Ext1 commands)
- **Set 1: Ext2**  
It works by value at '20.03' (Ext2 commands)
- **Set 2~9: DI1~DI8**  
It works by digital input which is selected

- **20.02 Ext1 commands**

- *0: Not selected*
- *1: 1 Wire*
- *2: 2 Wire 1 ----- Initial value*
- *3: 2 Wire 2*
- *4: 2 Wire 3*
- *5: 3 Wire 1*
- *6: 3 Wire 2*
- *7: Modbus*
- *8: Fieldbus*
- *9: Keypad*

Selects the source of start, stop and direction commands for external control location 1 (EXT1)

- **Set 0: Not selected**

No start or stop command sources selected.

- **Set 1: 1 Wire**

The source of the start and stop commands is selected by parameter **'20.03' (Ext1 in source 1)**

The state transitions of the source bits are interpreted as follows:

| State of source 1 ('20.03') | Command |
|-----------------------------|---------|
| 1                           | Start   |
| 0                           | Stop    |

- **Set 2: 2 Wire 1**

The source selected by **'20.03' (Ext1 in source 1)** is the start signal

The source selected by **'20.04' (Ext1 in source 2)** determines the direction

The state transitions of the source bits are interpreted as follows:

| State of source 1 ('20.03') | State of source 2 ('20.04') | Command       |
|-----------------------------|-----------------------------|---------------|
| 0                           | Any                         | Stop          |
| 1                           | 0                           | Start forward |
| 1                           | 1                           | Start reverse |

- **Set 3: 2 Wire 2**

The source selected by **'20.03' (Ext1 in source 1)** is the forward start signal

The source selected by **'20.04' (Ext1 in source 2)** is the reverse start signal

The state transitions of the source bits are interpreted as follows:

| State of source 1 ('20.03') | State of source 2 ('20.04') | Command       |
|-----------------------------|-----------------------------|---------------|
| 0                           | 0                           | Stop          |
| 1                           | 0                           | Start forward |
| 0                           | 1                           | Start reverse |
| 1                           | 1                           | Stop          |

- **Set 4: 2 Wire 3**

The source of the start and stop commands are selected by parameters  
*'20.03' (Ext1 in source 1)* and *'20.04' (Ext1 in source 2)*

The state transitions of the source bits are interpreted as follows:

| State of source 1 ( <i>'20.03'</i> ) | State of source 2 ( <i>'20.04'</i> ) | Command |
|--------------------------------------|--------------------------------------|---------|
| 0 → 1                                | 1                                    | Start   |
| Any                                  | 0                                    | Stop    |

- ✧ when *'20.04' (Ext1 in source 2)* is 0,  
The start and stop keys on the control panel are disabled

- **Set 5: 3 Wire 1**

The source of the start and stop commands are selected by parameters  
*'20.03' (Ext1 in source 1)* and *'20.04' (Ext1 in source 2)*

The source selected by *'20.05' (Ext1 in source 3)* determines the direction

The state transitions of the source bits are interpreted as follows:

| State of source 1 ( <i>'20.03'</i> ) | State of source 2 ( <i>'20.04'</i> ) | State of source 3 ( <i>'20.05'</i> ) | Command       |
|--------------------------------------|--------------------------------------|--------------------------------------|---------------|
| 0 → 1                                | 1                                    | 0                                    | Start forward |
| 0 → 1                                | 1                                    | 1                                    | Start reverse |
| Any                                  | 0                                    | Any                                  | Stop          |

- ✧ when *'20.04' (Ext1 in source 2)* is 0,  
The start and stop keys on the control panel are disabled

- **Set 6: 3 Wire 2**

The source of the start and stop commands are selected by parameters  
*'20.03' (Ext1 in source 1)*, *'20.04' (Ext1 in source 2)* and  
*'20.05' (Ext1 in source 3)*

The source selected by *'20.05' (Ext1 in source 3)* determines the direction

The state transitions of the source bits are interpreted as follows:

| State of source 1 ( <i>'20.03'</i> ) | State of source 2 ( <i>'20.04'</i> ) | State of source 3 ( <i>'20.05'</i> ) | Command       |
|--------------------------------------|--------------------------------------|--------------------------------------|---------------|
| 0 → 1                                | Any                                  | 1                                    | Start forward |
| Any                                  | 0 → 1                                | 1                                    | Start reverse |
| Any                                  | Any                                  | 0                                    | Stop          |

- **Set 7: Modbus**

The start and stop command are taken from terminal RXP–RXN

- **Set 8: Fieldbus**

The start and stop command are taken from fieldbus adapter

- **Set 9: Keypad**

The start and stop command are taken from keypad on the VFD

- **20.03 Ext1 in source 1**

- *0: Not selected*
- *1: Selected*
- *2: DI1 ----- Initial value*
- *3: DI2*
- *4: DI3*
- *5: DI4*
- *6: DI5*
- *7: DI6*
- *8: DI7*
- *9: DI8*

Selects source 1 for parameter '**20.02**' (*Ext1 commands*)

- **Set 0: Not selected**  
Always off
- **Set 1: selected**  
Always on
- **Set 2~9 : DI1~ DI8**  
It works by digital input which is selected

- **20.04 Ext1 in source 2**

- *See the parameter '20.03' (Ext1 in source 1)*

- **20.05 Ext1 in source 3**

- *See the parameter '20.03' (Ext1 in source 1)*

- **20.06 Ext2 commands**

- *See the parameter '20.02' (Ext1 commands)*

- **20.07 Ext2 in source 1**

- *See the parameter '20.03' (Ext1 in source 1)*

- **20.08 Ext2 in source 2**

- *See the parameter '20.03' (Ext1 in source 1)*

- **20.09 Ext2 in source 3**

- *See the parameter '20.03' (Ext1 in source 1)*

- **20.10 Jogging enable**

- *0: Not selected ----- Initial value*
- *1: Selected*
- *2: DI1*
- *3: DI2*
- *4: DI3*
- *5: DI4*
- *6: DI5*
- *7: DI6*
- *8: DI7*
- *9: DI8*

Selects the method for a jog enable

- **Set 0: Not selected**  
Always off
- **Set 1: selected**  
Always on
- **Set 2~9 : DI1~ DI8**  
It works by digital input which is selected

- **20.11 Jogging 1 start source**

- *See the parameter '20.10' (jogging enable)*

Selects the source for the activation of jogging function 1

✧ Both of jogging sources have interlocked each other.  
If one of the jogging operates, other jogging can't operate

- **Set 0: Not selected**  
Always off
- **Set 1: selected**  
Always on
- **Set 2~9 : DI1~ DI8**  
It works by digital input which is selected

- **20.12 Jogging 2 start source**

- *See the parameter '20.10' (jogging enable)*

- **20.13 Direction**

- *0: Forward ----- Initial value*
- *1: Reverse*

Sets the direction of VFD to forward or reverse at keypad operation only

## 8.2.10 Start/Stop mode

### ● 21.01 Torque boost mode

- 0: Manual torque boost ----- Initial value
- 1: Automatic torque boost

Select a torque boost mode

It is working only V/F mode at '**98.01**' (*Motor control mode*) and will compensate for starting torque.

If '**21.01**' (*torque boost mode*) = 1, recommended the following

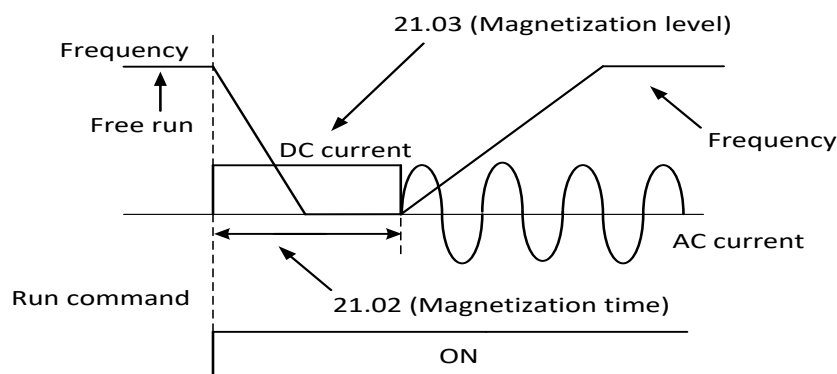
1. Put the plate data of motor in '**99.01**' ~ '**99.07**'
2. Get the motor data by the Auto Tuning
3. Use auto tuning data at '**99.09**' (*Motor data selection*)

### ● 21.02 Magnetization time

- Range: 0.0 ~ 3000 Sec in 0.1 Sec
- Initial value: 0.0 Sec

Set the time for DC Injection Braking duration before VFD start

It will be operated when '**21.02**' (*Magnetization time*) and '**21.02**' (*Magnetization level*) have set above zero



### ● 21.03 Magnetization Level

- Range: 0.0 ~ 200.0 % in 0.1 %
- Initial value: 30.0 %

Set the level for DC Injection Braking duration before VFD start

### ● 21.04 Stop mode

- 0: Ramp to Stop (Deceleration) ----- Initial value
- 1: Coast to Stop (Free Run to Stop)

Select a stop method when Stop command is given.

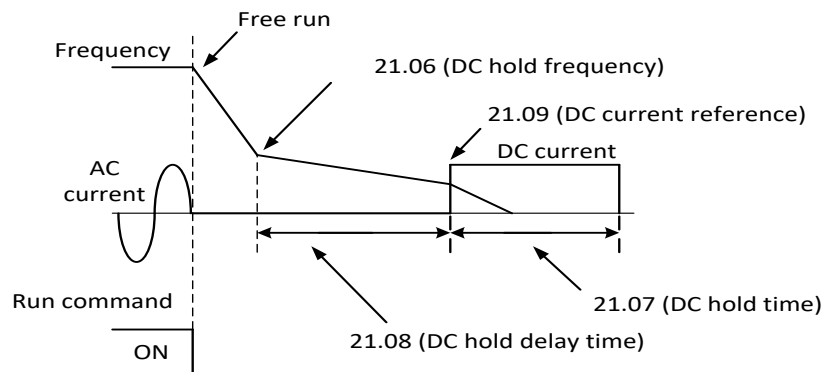
## ● 21.05 DC current control (DC Brake)

- 0: Disable ----- Initial value
- 1: Enable

It can select to use the DC Injection braking function

By adding the forced to the rotor, slowing the motor to stop

❖ Related Parameters: '21.05' ~ '21.09'



## ● 21.06 DC hold frequency

- Range: 0.00 ~ 10.00 Hz in 0.01 Hz
- Initial value: 0.50 Hz

Program the VFD frequency out when DC injection braking function kicks in.

If set '**21.06' (DC hold frequency)** to 0.5Hz, when VFD frequency out reaches to 0.5 Hz, DC braking function is activated.

## ● 21.07 DC hold time

- Range: 0.0 ~ 3000 Sec in 0.1 Sec
- Initial value: 0.0 Sec

Program the DC Injection Braking duration

## ● 21.08 DC hold delay time

- Range: 0.0 ~ 50.0 Sec in 0.1 Sec
- Initial value: 0.0 Sec

Program the delay time when the DC braking function actually starts form when VFD out is the frequency value in '**21.06' (DC hold frequency)**

## ● 21.09 DC current reference

- Range: 0.0 ~ 100.0 % in 0.1 %
- Initial value: 10.0 %

Program the level of DC injection braking forced of rated electric power of A1

- **21.10 Emergency stop mode**

- *0: Ramp to Stop (Deceleration) ----- Initial value*
- *1: Coast to Stop (Free Run to Stop)*

Selects the way the motor is stopped when an emergency stop command is received. The source of the emergency stop signal is selected by '**21.11**' (*Emergency stop source*)

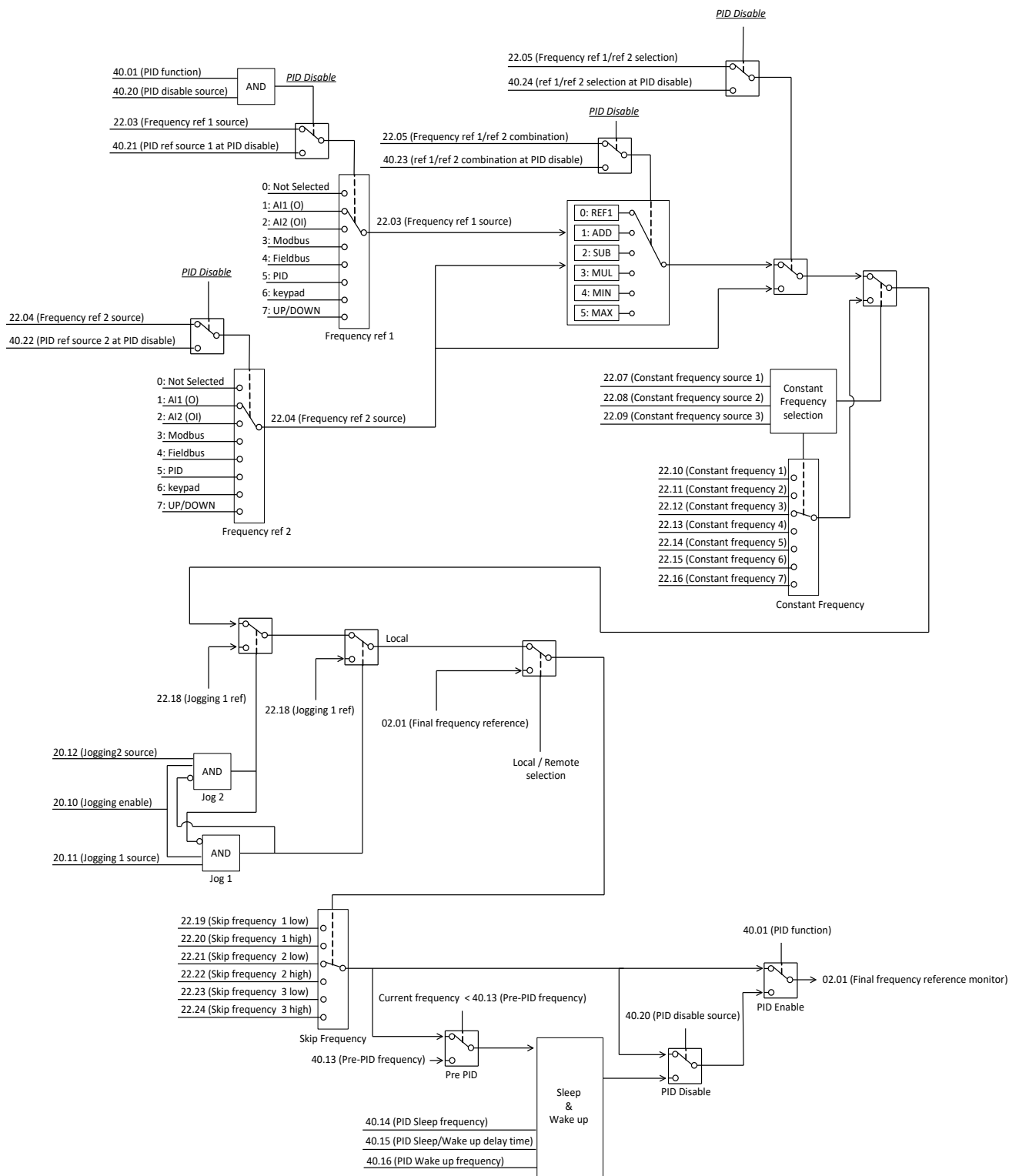
- **21.11 Emergency stop source**

- *0: Active*
- *1: Inactive ----- Initial value*
- *2: DI1*
- *3: DI2*
- *4: DI3*
- *5: DI4*
- *6: DI5*
- *7: DI6*
- *8: DI7*
- *9: DI8*

Selects the source of the emergency stop signal

- **Set 0: Active**  
Always on
- **Set 1: Inactive**  
Always off
- **Set 2~9 : DI1~ DI8**  
It works by digital input which is selected

## 8.2.11 Frequency reference



- **22.01 Frequency reference input (Only Keypad)**

- *Range: 0.00 ~ 400Hz in 0.01 Hz*
- *Initial value: 0.00 Hz*

Program the frequency reference that can be used at local mode

If it is remote mode, the parameter has to be keypad as below

*'22.03' (Frequency ref 1 source) = keypad or '22.04' (Frequency ref 2 source) = keypad*

- **22.03 Frequency ref 1 source**

- *0: Not selected*
- *1: AI1 (O) scaled ----- Initial value*
- *2: AI2 (OI) scaled*
- *3: Modbus*
- *4: Fieldbus*
- *5: PID*
- *6: Keypad*
- *7: UP/DOWN*

Selects the source of the Frequency ref 1

- **Set 0: Not selected**  
Always off
- **Set 1: AI1 (O) scaled**  
It can set the frequency reference by the DC 0~10V
- **Set 2: AI2 (OI) scaled**  
It can set the frequency reference by the DC 4~20mA
- **Set 3: Modbus**  
It can set the frequency reference by the modbus communication
- **Set 4: Fieldbus**  
Always on It can set the frequency reference by the fieldbus communication
- **Set 5: PID**  
Always on It can set the frequency reference by the PID control
- **Set 6: Keypad**  
Always on It can set the frequency reference by the Keypad
- **Set 7: UP/DOWN**  
Always on It can set the frequency reference by the UP/DOWN function

- **22.04 Frequency ref 2 source**

- *See the parameter '22.03' (Frequency ref 1 source)*

- **22.05 Frequency ref 1 /ref 2 combination**

- 0: '22.03' ----- Initial value
- 1: '22.03' + '22.04'
- 2: '22.03' – '22.04'
- 3: '22.03' x '22.04'
- 4: MIN ('22.03', '22.03')
- 5: MAX ('22.03', '22.03')

Selects a mathematical function between the reference sources selected by parameters  
'22.03' (Frequency ref 1 source) and '22.04' (Frequency ref 2 source)

- Set 0: '22.03'  
'22.03' (Frequency ref 1 source)
- Set 1: '22.03' + '22.04'  
'22.03' (Frequency ref 1 source) + '22.04' (Frequency ref 2 source)
- Set 2: '22.03' – '22.04'  
'22.03' (Frequency ref 1 source) – '22.04' (Frequency ref 2 source)
- Set 3: '22.03' x '22.04'  
'22.03' (Frequency ref 1 source) x '22.04' (Frequency ref 2 source)
- Set 4: MIN ('22.03' + '22.04')  
MIN '22.03' (Frequency ref 1 source), '22.04' (Frequency ref 2 source)
- Set 5: MAX ('22.03' + '22.04')  
MAX '22.03' (Frequency ref 1 source), '22.04' (Frequency ref 2 source)

- **22.06 Frequency ref 1 /ref 2 selection**

- 0: '22.05' setting value
- 1: '22.04' setting value
- 2: DI1
- 3: DI2
- 4: DI3
- 5: DI4
- 6: DI5 ----- Initial value
- 7: DI6
- 8: DI7
- 9: DI8

Configures the selection between frequency references 1 and 2

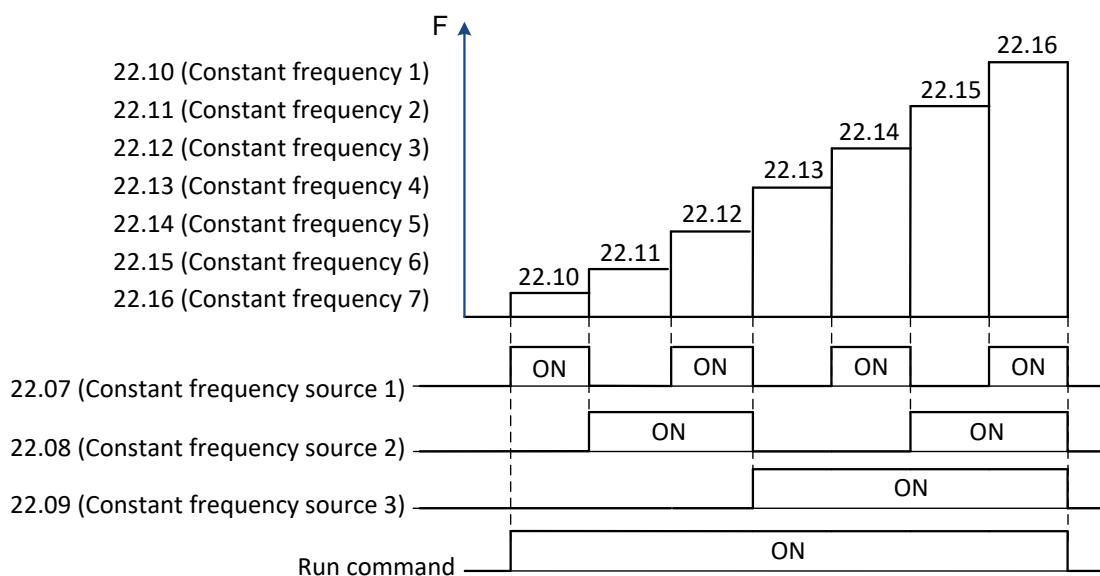
- Set 0: '22.05' setting value  
The frequency is used by '22.05' (Frequency ref 1 /ref 2 combination) set value
- Set 1: '22.04' setting value  
The frequency is used by '22.04' (Frequency ref 2 source)
- Set 2~9 : DI1 ~ DI8  
If the digital input which is selected has OFF, it will applied by ref 1  
If the digital input which is selected has ON, it will applied by ref 2

## ● 22.07 Constant frequency source 1

- 0: Not selected
- 1: Selected
- 2: DI1
- 3: DI2
- 4: DI3 ----- Initial value
- 5: DI4
- 6: DI5
- 7: DI6
- 8: DI7
- 9: DI8

Selects the source of the constant frequency

- **Set 0: Not selected**  
Always off
- **Set 1: selected**  
Always on
- **Set 2~9 : DI1~ DI8**  
It works by digital input which is selected



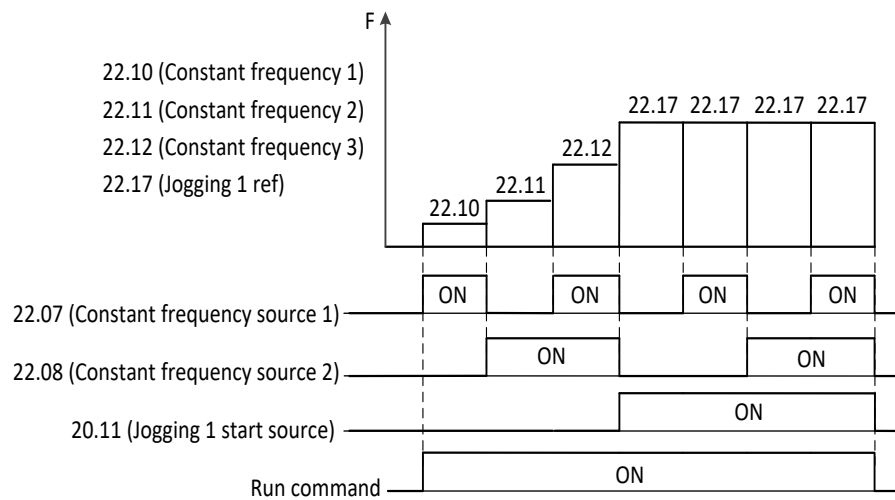
| Source defined<br>by par '22.07' | Source defined<br>by par '22.08' | Source defined<br>by par '22.09' | Constant frequency<br>active  |
|----------------------------------|----------------------------------|----------------------------------|-------------------------------|
| OFF                              | OFF                              | OFF                              | None                          |
| ON                               | OFF                              | OFF                              | '22.10' (Constant frequency1) |
| OFF                              | ON                               | OFF                              | '22.11' (Constant frequency2) |
| ON                               | ON                               | OFF                              | '22.12' (Constant frequency3) |
| OFF                              | OFF                              | ON                               | '22.13' (Constant frequency4) |
| ON                               | OFF                              | ON                               | '22.14' (Constant frequency5) |
| OFF                              | ON                               | ON                               | '22.15' (Constant frequency6) |
| ON                               | ON                               | ON                               | '22.16' (Constant frequency7) |

- **22.08 Constant frequency source 2**
  - *See the parameter '20.07' (Constant frequency source 1)*
- **22.09 Constant frequency source 3**
  - *See the parameter '20.07' (Constant frequency source 1)*
- **22.10 Constant frequency 1**
  - *Range: 0.00 ~ 400Hz in 0.01 Hz*
  - *Initial value: 5.00 Hz*
  - *See the parameter '20.07' (Constant frequency source 1)*
- **22.11 Constant frequency 2**
  - *See the parameter '20.07' (Constant frequency source 1)*
- **22.12 Constant frequency 3**
  - *See the parameter '20.07' (Constant frequency source 1)*
- **22.13 Constant frequency 4**
  - *See the parameter '20.07' (Constant frequency source 1)*
- **22.14 Constant frequency 5**
  - *See the parameter '20.07' (Constant frequency source 1)*
- **22.15 Constant frequency 6**
  - *See the parameter '20.07' (Constant frequency source 1)*
- **22.16 Constant frequency 7**
  - *See the parameter '20.07' (Constant frequency source 1)*

- **22.17 Jogging 1 ref**

- *Range: 0.00 ~ 400Hz in 0.01 Hz*
- *Initial value: 0.00 Hz*

Jogging frequency is used to move/rotate the motor in small increment at low frequency. It is selected using input terminal.



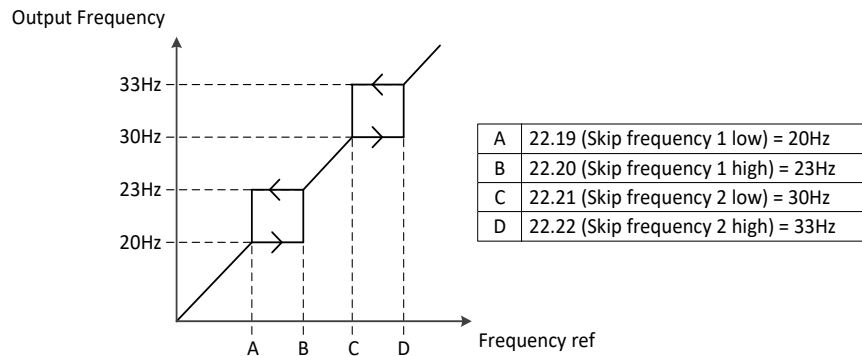
- **22.18 Jogging 1 ref**

- *See the parameter '20.17' (jogging 1 ref)*

- **22.19 Skip frequency 1 low**

- *Range: 0.00 ~ 400Hz in 0.01 Hz*
- *Initial value: 0.00 Hz*

Program 3 output frequency values to mitigate different resonance points at which vibration can cause damages to the equipment such as fans or pumps.



- **22.20 Skip frequency 1 high**

- *See the parameter '20.19' (Skip frequency 1 low)*

- **22.21 Skip frequency 2 low**

- *See the parameter '20.19' (Skip frequency 1 low)*

- **22.22 Skip frequency 2 high**

- *See the parameter '20.19' (Skip frequency 1 low)*

- **22.23 Skip frequency 3 low**

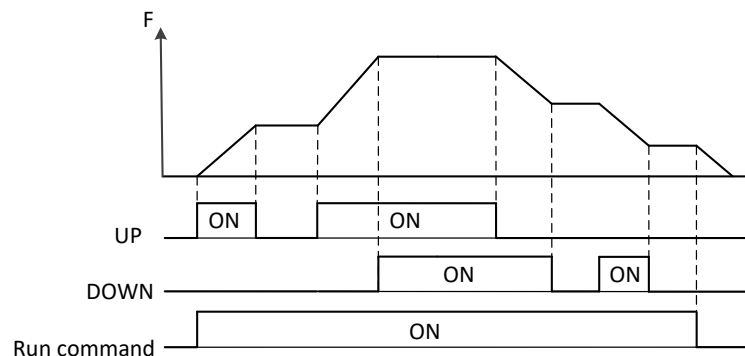
- *See the parameter '20.29' (Skip frequency 1 low)*

- **22.24 Skip frequency 3 high**

- *See the parameter '20.19' (Skip frequency 1 low)*

### ● 22.25 UP/DOWN function

- 0: Disable ----- Initial value
- 1: Enable



### ● 22.26 UP/DOWN initial value

- Range: 0.00 ~ 400 Hz in 0.01 Hz – frequency
- Range: 0.0 ~ 100 % in 0.1 % – PID
- Initial value: 0.00 Hz

Program the UP/DOWN initial value

When run command is input, VFD is running to initial value without up or down source

### ● 22.27 UP/DOWN up source

- 0: Not selected ----- Initial value
- 1: Selected
- 2: DI1
- 3: DI2
- 4: DI3
- 5: DI4
- 6: DI5
- 7: DI6
- 8: DI7
- 9: DI8

Selects the source of the UP/DWON up

- **Set 0: Not selected**  
Always off
- **Set 1: selected**  
Always on
- **Set 2~9 : DI1~ DI8**  
It works by digital input which is selected

### ● 22.28 UP/DOWN down source

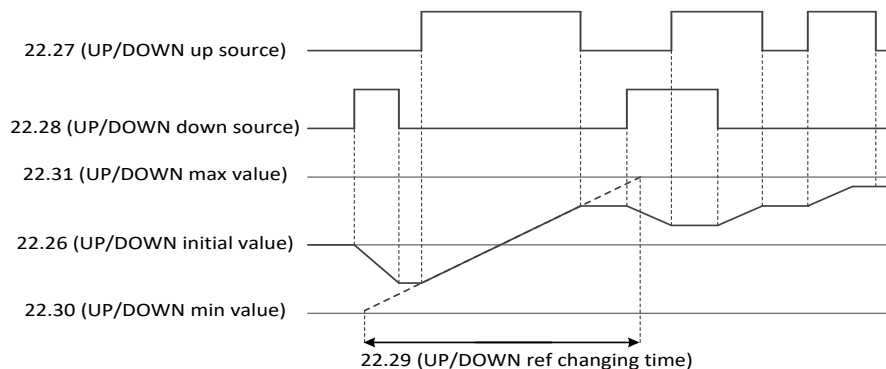
- See the parameter '20.27' (UP/DOWN up source)

### ● 22.29 UP/DOWN ref changing time

- Range: 0.0 ~ 3000 Sec in 0.1 Hz Sec
- Initial value: 10.0 Sec

It can change the time that UP/DOWN reference is respond

When run command is input, VFD can run to initial value without up or down source



### ● 22.30 UP/DOWN min value

- Range: 0.00 ~ 400 Hz in 0.01 Hz – frequency
- Range: 0.0 ~ 100 % in 0.1 % – PID
- Initial value: 0.00 Hz

This parameter works when the '**22.25' (UP/DOWN function)** is 1(Enable)

UP/DOWN can't operate below the min value

### ● 22.31 UP/DOWN max value

- Range: 0.00 ~ 400 Hz in 0.01 Hz – frequency
- Range: 0.0 ~ 100 % in 0.1 % – PID
- Initial value: 60.00 Hz

This parameter works when the '**22.25' (UP/DOWN function)** is 1(Enable)

UP/DOWN can't operate above the max value

### ● 22.32 UP/DOWN ref monitor

- Range: 0.00 ~ 400 Hz in 0.01 Hz – frequency
- Range: 0.0 ~ 100 % in 0.1 % – PID

This parameter displays UP/DOWN reference value

### ● 22.33 UP/DOWN initial value saving

- 0: Not saving ----- Initial value
- 1: Saving

Selects that whether initial value going to save or not

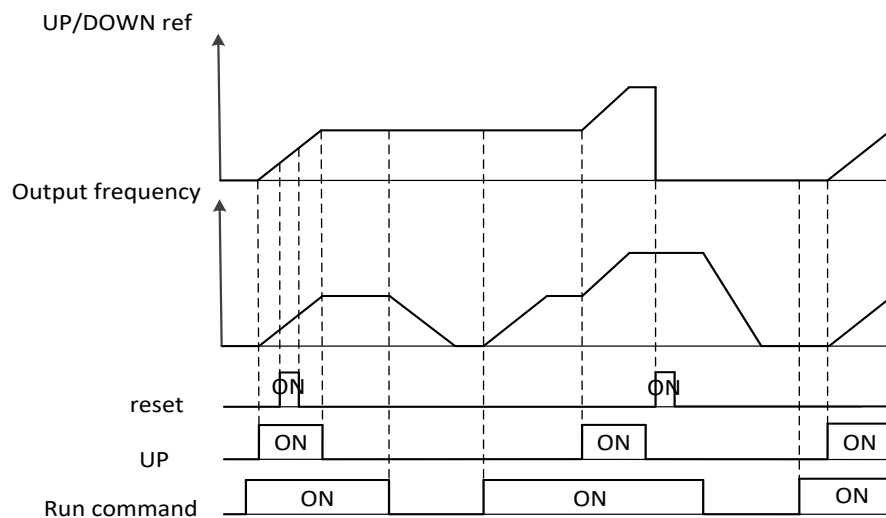
### 22.34 UP/DOWN ref reset source

- 0: Not selected ----- Initial value
- 1: Selected
- 2: DI1
- 3: DI2
- 4: DI3
- 5: DI4
- 6: DI5
- 7: DI6
- 8: DI7
- 9: DI8

Selects the source of the UP/DOWN ref reset

It is not works when the up or down source has inputted

- **Set 0: Not selected**  
Always off
- **Set 1: selected**  
Always on
- **Set 2~9 : DI1~ DI8**  
It works by digital input which is selected



## 8.2.12 Acceleration/Deceleration

### ● 23.03 Ramp set selection

- 0: Acc/Dec time 1 ----- Initial value
- 1: Acc/Dec time 2
- 2: Frequency
- 3: DI1
- 4: DI2
- 5: DI3
- 6: DI4
- 7: DI5
- 8: DI6
- 9: DI7
- 10: DI8

#### ▪ Set 0: Acc/Dec time 1

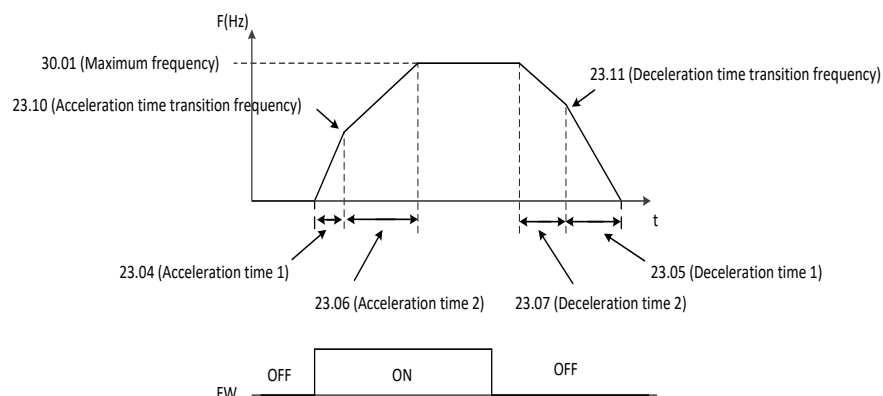
It uses the time '23.04' (Acceleration time 1) and '23.05' (Deceleration time 1)

#### ▪ Set 1: Acc/Dec time 2

It uses the time '23.06' (Acceleration time 2) and '23.07' (Deceleration time 2)

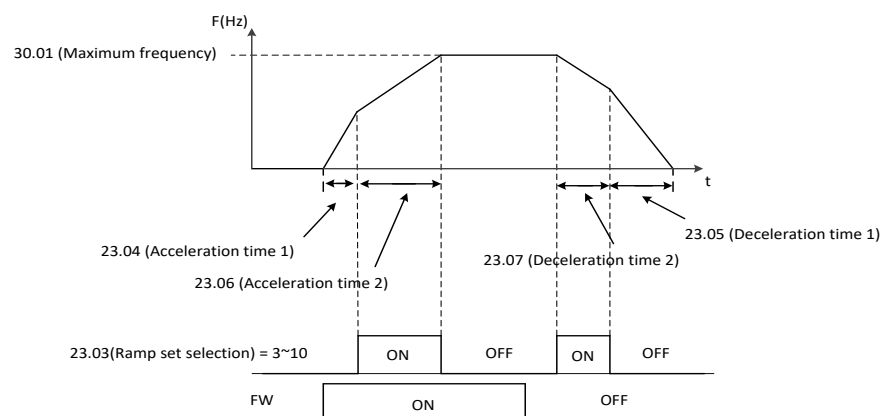
#### ▪ Set 2: Frequency

It changes by the frequency as below picture



#### ▪ Set 3~10 : DI1~DI8

It changes by the digital input as below picture



- **23.04 Acceleration time 1**
  - *Range: 0.1 ~ 3000 Sec in 0.1 Sec*
  - *Initial value: 30.0 Sec*
  - **'23.03' (Ramp set selection)** is 0  
Always on
  - **'23.03' (Ramp set selection)** is 1  
Always off
  - **'23.03' (Ramp set selection)** is 2  
It not works if the output frequency is above  
**'23.10' (Acceleration time transition frequency)**
  - **'23.03' (Ramp set selection)** is 3~9  
It works by digital input which is selected
    - ❖ Related Parameters: **'23.06', '23.07', '23.10', '23.11'**
  
- **23.05 Deceleration time 1**
  - *Range: 0.1 ~ 3000 Sec in 0.1 Sec*
  - *Initial value: 30.0 Sec*
  - **'23.03' (Ramp set selection)** is 0  
Always on
  - **'23.03' (Ramp set selection)** is 1  
Always off
  - **'23.03' (Ramp set selection)** is 2  
It not works if the output frequency is above  
**'23.11' (Deceleration time transition frequency)**
  - **'23.03' (Ramp set selection)** is 3~9  
It works by digital input which is selected
    - ❖ Related Parameters: **'23.06', '23.07', '23.10', '23.11'**
  
- **23.06 Acceleration time 2**
  - *Range: 0.1 ~ 3000 Sec in 0.1 Sec*
  - *Initial value: 30.0 Sec*
  - **23.03' (Ramp set selection)** is 0  
Always off
  - **'23.03' (Ramp set selection)** is 1  
Always on
  - **'23.03' (Ramp set selection)** is 2  
It not works if the output frequency is below  
**'23.10' (Acceleration time transition frequency)**
  - **'23.03' (Ramp set selection)** is 3~9  
It works by digital input which is selected
    - ❖ Related Parameters: **'23.06', '23.07', '23.10', '23.11'**

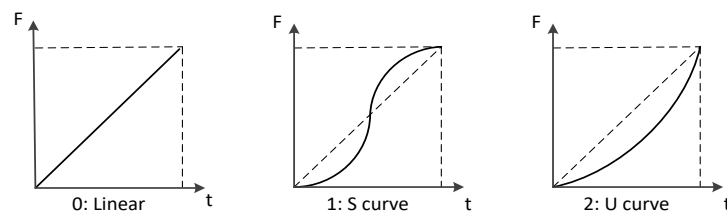
### ● 23.07 Deceleration time 2

- *Range: 0.1 ~ 3000 Sec in 0.1 Sec*
- *Initial value: 30.0 Sec*
  
- **'23.03' (Ramp set selection)** is 0  
Always off
- **'23.03' (Ramp set selection)** is 1  
Always on
- **'23.03' (Ramp set selection)** is 2  
It not works if the output frequency is below  
**'23.11' (Deceleration time transition frequency)**
- **'23.03' (Ramp set selection)** is 3~9  
It works by digital input which is selected
  - ❖ Related Parameters: **'23.06'**, **'23.07'**, **'23.10'**, **'23.11'**

### ● 23.08 Acceleration pattern selection

- *0: Linear ----- Initial value*
- *1: S Curve*
- *2: U Curve*

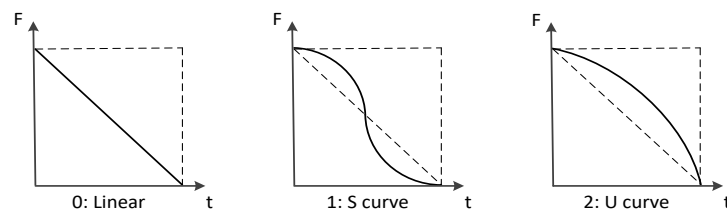
Select acceleration curve type



### ● 23.09 Deceleration pattern selection

- *0: Linear ----- Initial value*
- *1: S Curve*
- *2: U Curve*

Select deceleration curve type



- **23.10 Acceleration time transition frequency**

- *Range: 0.00 ~ 400Hz in 0.01 Hz*
- *Initial value: 0.00 Hz*

In addition to acceleration time 1 in '**23.04**' (*Acceleration time 1*), '**23.06**' (*acceleration time 2*) can be specified. Its value can also be entered by '**23.03**' (*Ramp set selection*)

❖ Related Parameters: '**23.03**', '**23.04**', '**23.06**'

- **23.11 Deceleration time transition frequency**

- *Range: 0.00 ~ 400Hz in 0.01 Hz*
- *Initial value: 0.00 Hz*

In addition to deceleration time 1 in '**23.05**' (*Deceleration time 1*), '**23.07**' (*Deceleration time 2*) can be specified. Its value can also be entered by '**23.03**' (*Ramp set selection*)

❖ Related Parameters: '**23.03**', '**23.05**', '**23.07**'

- **23.12 Jogging acceleration time**

- *Range: 0.0 ~ 3000 Sec in 0.1 Sec*
- *Initial value: 30.0 Sec*

It works when the jogging is operated

❖ Related Parameters: '**22.17**', '**22.18**'

- **23.13 Jogging deceleration time**

- *Range: 0.0 ~ 3000 Sec in 0.1 Sec*
- *Initial value: 30.0 Sec*

It works when the jogging is ON

❖ Related Parameters: '**22.17**', '**22.18**'

- **23.14 Emergency stop time**

- *Range: 0.0 ~ 3000 Sec in 0.1 Sec*
- *Initial value: 3.0 Sec*

It works when the emergency source is ON

❖ Related Parameters: '**21.11**'

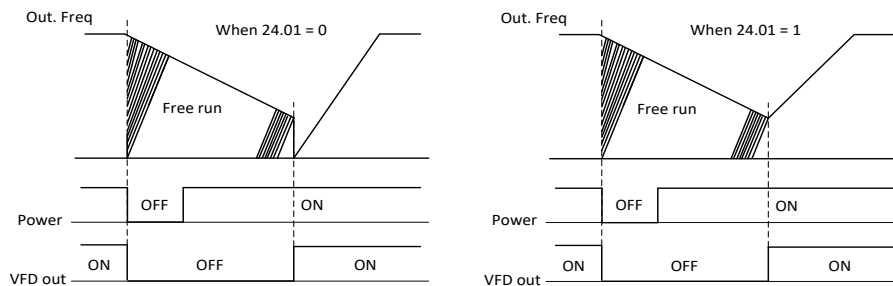
## 8.2.13 Speed Search

### ● 24.01 Speed search start mode

- 0: Start from 0 Hz ----- Initial value
- 1: Start from frequency corresponding motor speed

In case of VFD starting operation, the start frequency of the VFD can be selected as follows

❖ Related Parameters: '**24.03**'



### ● 24.02 Speed search current limit

- Range: 50.0 ~ 180.0 % in 0.1 %
- Initial value: 100.0 %

limits excessively increasing current during speed search. When current reached to the setting level, it controls the voltage increasing level to prevent the overcurrent trip.

### ● 24.03 Voltage increment in speed search mode

- Range: 10 ~ 500 % in 1 %
- Initial value: 100 %

In case of the lower starting current level during speed search motion on the basis of the motor rated current, the increase level of the output voltage is set from 10% to 300%

### ● 24.04 Speed search delay ratio

- Range: 0.50 ~ 5.00 x1 in x0.01
- Initial value: 1.00

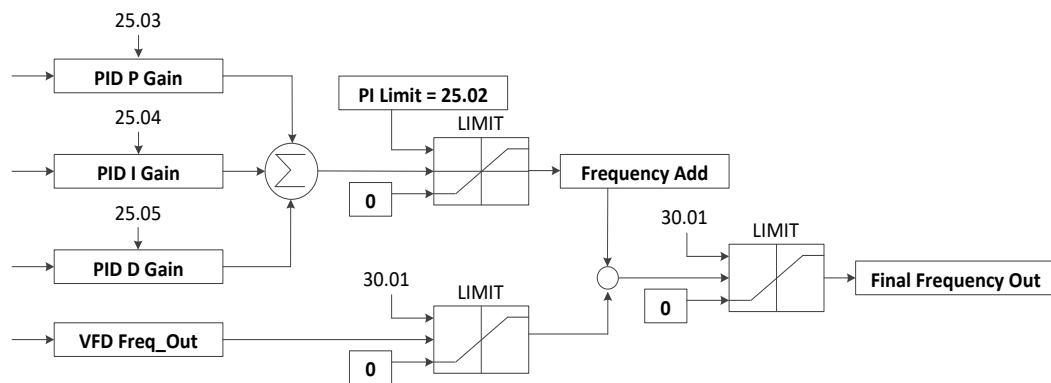
Set the pause time to prevent surge current due to residual magnetic flux before speed search.

## 8.2.14 Over voltage suppression

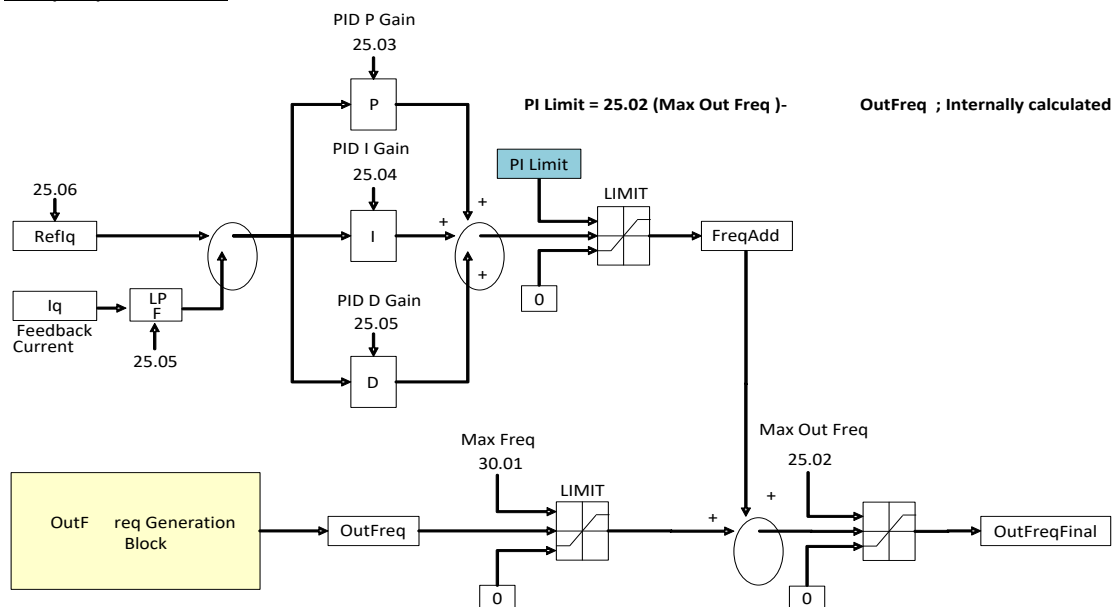
The Overvoltage Suppression (OVS) feature will over speed the motor up to the '**25.02**' (**Maximum OVS Output Frequency**) to prevent motor regeneration and creating an Overvoltage Fault. If the OVS runs at maximum frequency for longer than the '**25.08**' (**Limit Time**), the unit will fault on ovFS.

### OVS Functional Description

- By calculating torque in real time, reduce regeneration energy by increasing speed.
- For speed control, PI controller is applied.
- If torque is bigger than 0, "PI Out" become 0 by "PI Limiter"; no increase in frequency value
- If torque is lower than 0, "PI Out" would be increased to "Max Add Req"; frequency value increased
- If output of PI controller is reached to '**25.02**' (**Max Add Freq**) the counter is started.
- When the value of counter is reached to '**25.08**' (**wRegen Time**), the trip (ovFS) will be occur.



### Sample parameters



Meaning of 25.02 is changed from Max Add Freq to Max Out Freq

● **25.01 OVS selection**

- *0: Disable ----- Initial value*
- *1: Enable*

Select to enable the Voltage Suppression Control function.

● **25.02 Maximum OVS output frequency**

- *Range: “30.01”(Maximum Frequency) ~ 300.0 Hz in 0.01 Hz*
- *Initial value: 80.00 Hz*

Real time editable a maximum frequency limit for OVS function

❖ Related Parameters:

● **25.03 OVS P gain**

- *Range: 0 ~ 10000 in 1*
- *Initial value: 1000*

Real time editable P gain for OVS PID loop

- $PIOut = err * Kp$
- $Hz = err(\%) * Kp * scalefactor(50 * 1e-6)$

Example

- err 10%,  $Kp = 1000$   
 ⇒  $PIOut = 0.5Hz$
- ✓ Recommended Value in test bench  
 ⇒ 1000 or less than 5000

● **25.04 OVS I gain**

- *Range: 0 ~ 10000 Sec in 1 Sec*
- *Initial value: 100 Sec*

Real time editable I gain for OVS PID loop

- $PIOut = \int(err * Ki)$
- $Hz += err(\%) * Ki * scalefactor(50 * 1e-6), \quad dT = 1ms$

Example ( Integration Time to 10Hz on Error)

- err 10%,  $Ki = 1000$   
 ⇒ Time to 10Hz on 10% Error = 20ms
- err 10%,  $Ki = 100$   
 ⇒ Time to 10Hz on 10% Error = 200ms
- err 10%,  $Ki = 10$   
 ⇒ Time to 10Hz on 10% Error = 2000ms
- ✓ Recommended Value in test bench  
 ⇒ 100 or less than 500

### ● 25.05 OVS D gain

- *Range: 0 ~ 10000 Sec in 1Sec*
- *Initial value: 0 Sec*

Real time editable D gain for OVS PID loop. Its value depends on '**25.07' (Filter bandwidth)**', filter bandwidth. Thus, if '**25.07' (Filter bandwidth)**' is not changed, no need to change '**25.05' (OVS D gain)**' value. Most application, this value should not be set over 3000

✓ Recommended Value as a function of '**25.07' (Filter bandwidth)**

- ⇒ If '**25.07' < 10** → '**25.05'** : 0 ~ 500
- ⇒ If '**25.07' < 30** → '**25.05'** : 500 ~ 1000
- ⇒ If '**25.07' < 50** → '**25.05'** : 1000 ~ 1500

### ● 25.06 q-Current reference

- *Range: -100.0 ~ 100.0 in 0.1*
- *Initial value: 0.0*

Real time editable q axis reference current compensates Torque Estimate Error.

- If Torque estimate offset is bigger than 0
  - ⇒ No increase in output frequency even if regeneration is occurred.
  - ⇒ This situation could be end with OV Trip.
  - ⇒ If so, set '**25.06' (q-Current reference)**' to a positive value
- If Torque estimation offset smaller than 0
  - ⇒ No increase in output frequency even if regeneration is not occurred.
  - ⇒ Output Frequency could be increased to Max. Freq (Reference Frequency + '**25.02' (Maximum OVS output frequency)**) and end up with ovFS (OVS control Fail)
  - ⇒ If so, set '**25.06' (q-Current reference)**' to a negative value

### ● 25.07 Filter bandwidth

- *Range: 0.0 ~ 1000 milliseconds in 0.1 ms*
- *Initial value: 1 ms*

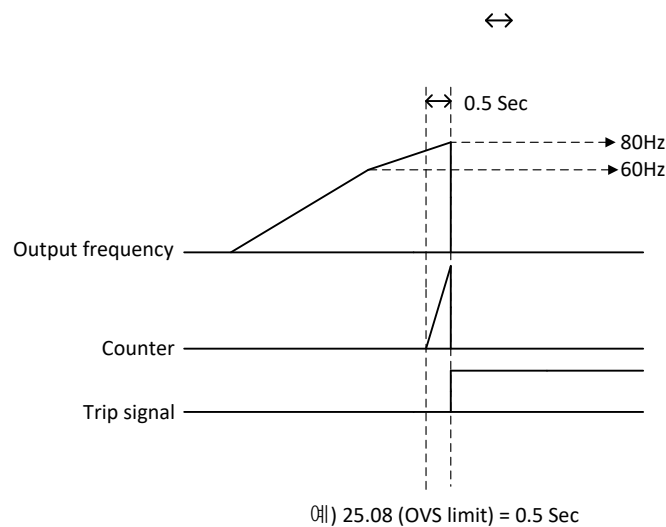
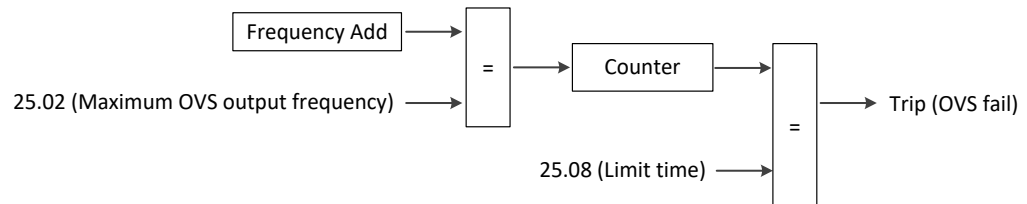
Real time editable Iq feedback Low Pass Filter time constant

- If output Frequency is not stable,
  - ⇒ Increase '**25.07' (Filter bandwidth)**' value
- Recommended Value as a function of '**25.05' (OVS D gain)**', '**25.07' (Filter bandwidth)**' value should be set accordingly
  - ⇒ Not set over 50

## 25.08 Limit time

- Range: 0.0 ~ 100 Sec in 0.1 Sec
- Initial value: 0.5 Sec

Real time editable OVS control fails check time. If PID output is saturated to '**25.02**' (**Maximum OVS output frequency**) during this time period, VFD will stop and ovFS will be occurred.



Case1) if frequency is increased at no regeneration condition,

- Cause: when a current feedback value is corrupted by noise.
  - Measures:
    - ✓ Change a '**25.07**' (**Filter bandwidth**) and '**25.05**' (**OVS D gain**)
    - ✓ Please set the '**25.07**' (**Filter bandwidth**) between 5 and 30 (ex 5, 10, 20, 30ms)
- Increasing '**25.07**' (**Filter bandwidth**) results the delay in calculating torque so '**25.05**' (**OVS D gain**) should be set
- Please set the '**25.05**' (**OVS D gain**) between 500 to 1000
- ✓ Experimental values on MG–Set test are
- '25.07' (Filter bandwidth) = 30, '25.05' (OVS D gain) = 1000**

Case2) if overvoltage trip is occurred at normal operation,

- Cause: Torque is over estimated due to motor parameter error or current sensing error.
  - Measures :
    - ✓ Change a '**25.06**' (**q–Current reference**)
- Please set the '**25.07**' (**Filter bandwidth**) between 30 to 100
- If this value is set too high, Frequency output can be saturated to maximum frequency.

## Calculated torque output

User can monitor calculated torque by 2 methods

■ Parameters

| No.     | Name                 | Description | default | Run-time Edit |
|---------|----------------------|-------------|---------|---------------|
| '12.03' | wAODef (AO1 source)  | 0 ~ 4       | 0       | X             |
| '12.11' | wAODef2 (AO2 source) | 0 ~ 4       | 1       | X             |

■ Analog output (DC voltage)

➤ '12.03' (AO1 source)

Set '12.03' = 4 display calculated torque value (-150% ~ +150%) by analog output.

| AO1 output | Torque |
|------------|--------|
| 0V         | -150%  |
| 5V         | 0%     |
| 10V        | +150%  |

(※ '12.03' = 0~3 are the same as existed function)

■ Analog output (current)

➤ '12.11' (AO2 source)

Set '12.11' = 4 display calculated torque value (-150% ~ +150%) by analog output.

| AO2 output | Torque |
|------------|--------|
| 4mA        | -150%  |
| 12mA       | 0%     |
| 20mA       | +150%  |

(※ '12.11' = 0~3 are the same as existed function)

➤ Special parameter: Calculated torque read frame by Modbus

- CMD : 03 (Read)

- Parameter : 10 (Calculated Torque)

|    | Communication Number | CMD | Parameter | Data         | CRC |
|----|----------------------|-----|-----------|--------------|-----|
| TX | 01                   | 03  | 000A      | 0001         |     |
| RX | 01                   | 03  | 000A      | Torque value |     |

-

※This document are written by result of test bench.

Field engineer should be tuned for each field situation by consider above case study.

## 8.2.15 KEB

If a power outage occurs, the DC link voltage goes down and a low voltage failure occur blocking output. This function maintains the DC link voltage by controlling the VFD output frequency during the outage, thereby helping maintain the VFD between the instantaneous outage and the low voltage failure for a longer time.

- **26.01 KEB selection**

- *0: Disable ----- Initial value*
- *1: Enable ('26.02' decelerating to slope)*
- *2: Enable (Voltage control)*

Select KEB with when the input power off.

If disable, normal decelerating operation is carried out until low voltage

If enable, VFD DC part is charged with the regenerative energy that is generated from the motor by controlling the VFD output frequency

- **26.02 KEB gain**

- *Range: 1 ~ 1000 in 1*
- *Initial value: 100*

If '26.01' is set to 1, the KEB gain can be control

This is the gain used for controlling the KEB operation by using the inertia moment amount of the load.

If the inertia of load is high, decrease the gain

If the inertia of load is low, increase the gain

- **26.03 KEB Voltage control P gain**

- *Range: 0.01 ~ 10.00 in 0.01*
- *Initial value: 1.00*

KEB voltage control is available when '26.01' is selected as 2.

The P gain must be increased in case of Low voltage trip Occur

Setting the P gain too high may result in an over voltage trip

- **26.04 KEB Voltage control I gain**

- *Range: 0.01 ~ 10.00 in 0.01*
- *Initial value: 1.00*

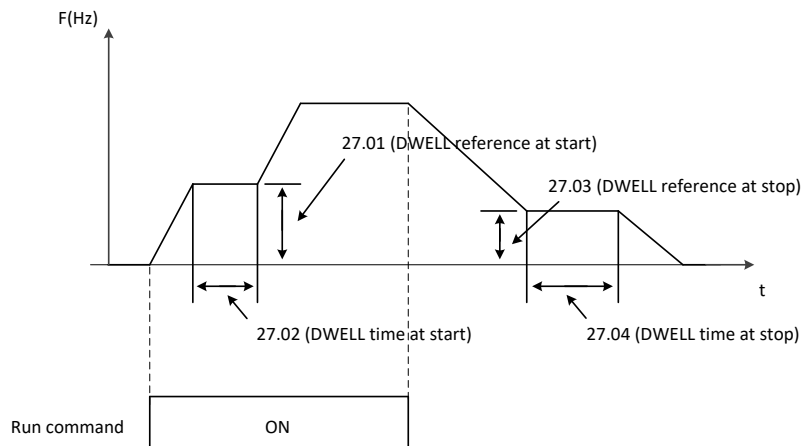
KEB voltage control is available when '26.01' is selected as 2.

If the DC link voltage does not remain at the KEB level, you can raise the I gain to prevent low voltage tripping

## 8.2.16 DWELL

The DWELL function temporarily holds the frequency reference at a predefined value for a set time then continues accelerating or decelerating.

The DWELL function helps prevent speed loss when starting and stopping a heavy load with induction motors. When running a PM motor in V/f control, the pause in acceleration allows the PM motor rotor to align with the stator field of the motor and reduce the starting current.



- **27.01 DWELL reference at start**

- Range: 0.00 ~ 400.0 Hz in 0.01
- Initial value: 0.00 Hz

Program DWELL frequency at start

- **27.02 DWELL time at start**

- Range: 0.0 ~ 10.0 Sec in 0.1
- Initial value: 0.0 Sec

Program DWELL time at start

- **27.03 DWELL reference at stop**

- Range: 0.00 ~ 400.0Hz in 0.01
- Initial value: 0.00 Hz

Program DWELL frequency at stop

- **27.04 DWELL time at stop**

- Range: 0.0 ~ 10.0 Sec in 0.1
- Initial value: 0.0 Sec

Program DWELL time at stop

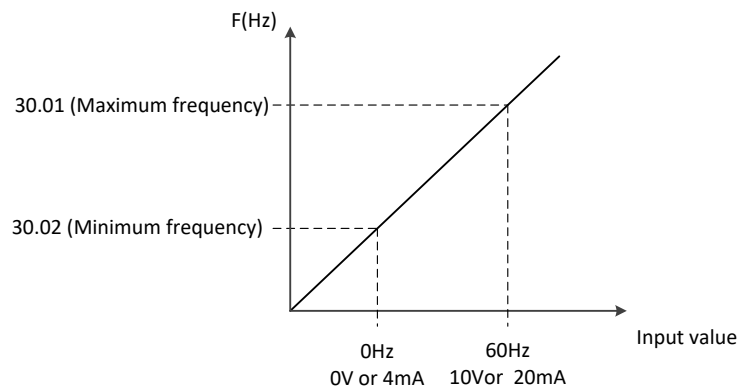
## 8.2.17 Frequency limits

### ● 30.01 Maximum frequency

- *Range: 0.00 ~ 400.0 Hz in 0.01 Hz (Sensorless Vector: 0.00 ~ 300.00Hz)*
- *Initial value: 60.00 Hz*

Define the maximum allowed frequency

If Frequency command is analog input, Max freq must also be set to '**11.09**', '**11.17**'.



### ● 30.02 Minimum frequency

- *Range: 0.00 ~ 400.0 Hz in 0.01 Hz*
- *Initial value: 0.00 Hz*

Define the minimum allowed frequency

If Frequency command is analog input, Min freq must also be set to '**11.08**', '**11.16**'.

### ● 30.03 Start frequency

- *Range:*  
*VF, SLV : 0.50 ~ 60.00 Hz in 0.01 Hz*  
*Vector control : 0.00 ~ 60.00 Hz in 0.01 Hz*
- *Initial value: 0.50 Hz (VF, SLV), 0.00 Hz (Vector control)*

Define the start frequency

\*Caution: If the start frequency is set too high, it operates the same as direct start, and overcurrent and overload errors may occur.

## 8.2.18 Fault functions

- **31.01 External event 1 source**

- 0: Active (Active high signal)
- 1: Inactive (Active low signal) ----- Initial value
- 2: DI1
- 3: DI2
- 4: DI3
- 5: DI4
- 6: DI5
- 7: DI6
- 8: DI7
- 9: DI8

Define the source of external event 1

- **31.02 External event 2 source**

- See the parameter '31.01' (External event 1 source)

- **31.03 External event 3 source**

- See the parameter '31.01' (External event 1 source)

- **31.04 External event 4 source**

- See the parameter '31.01' (External event 1 source)

- **31.05 External event 5 source**

- See the parameter '31.01' (External event 1 source)

- **31.06 Fault(Trip) reset selection**

- 0: Not selected
- 1: Selected
- 2: DI1
- 3: DI2
- 4: DI3
- 5: DI4
- 6: DI5
- 7: DI6 ----- Initial value
- 8: DI7
- 9: DI8

Selects the source of an external fault reset signal

The signal resets the drive after a fault trip if the cause of the fault no longer exists.

### ● 31.07 Restart mode selection

- 0: No Restart ----- Initial value
- 1: Restart from 0Hz
- 2: Resume at frequency corresponding motor speed
- 3: Resume at motor speed, then decelerated stop

Select what action to take when a trip occurs that has set at '**31.10**' (**Automatic reset item 1**) and '**31.11**' (**Automatic reset item 2**) if the consecutive trip does not occur within 60 seconds, an accumulated trip count is reset to 0

❖ Related Parameters: '**31.09**' ~ '**31.14**'

### ● 31.08 Alarm relay operation mode

- 0: Inactive for the Under voltage trip signal ----- Initial value
- 1: Inactive during auto reset
- 2: Active every trip
- 3: Inactive during auto reset (Only active for the Under voltage trip signal endlessly)

Select what action to take when a trip occur that alarm relay

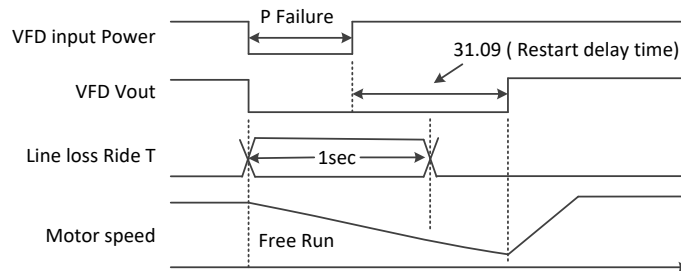
❖ Related Parameters: '**31.07**'

### ● 31.09 Restart delay time

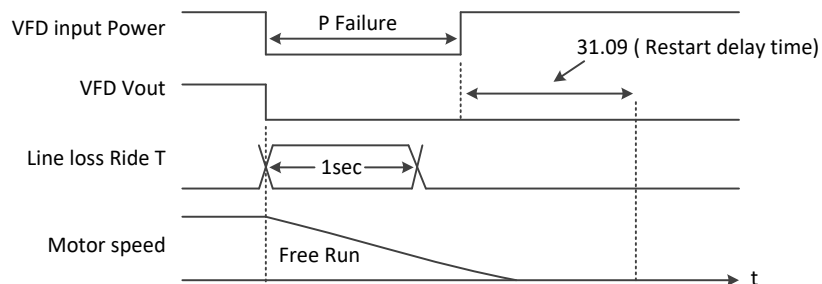
- Range: 0.3 ~ 10.0 Sec in 0.1 Sec
- Initial value: 1.0 Sec

Program delay time when VFD restarts

#### 1) Momentary Power Failure Period < 1 Sec



#### 2) Momentary Power Failure Period > 1 Sec



### ● 31.10 Automatic reset item 1

- Range: 0x00 ~0xFF
- Initial value: 0x00

Selects faults that are automatically reset the parameter is a 16-bit word with each bit corresponding to a fault type. Whenever a bit is set to 1, the corresponding fault is automatically reset. The bits of this binary number correspond to the following faults

|      |      |      |      |      |      |   |   |   |   |   |   |    |    |    |    |
|------|------|------|------|------|------|---|---|---|---|---|---|----|----|----|----|
| 15   | 14   | 13   | 12   | 11   | 10   | 9 | 8 | 7 | 6 | 5 | 4 | 3  | 2  | 1  | 0  |
| EE 5 | EE 4 | EE 3 | EE 2 | EE 1 | User | – | – | – | – | – | – | Sc | Lv | ov | oC |

### ● 31.11 Automatic reset item 2

- See the parameter '31.10' (Automatic reset item 1)

### ● 31.12 User reset item selection

- Range: 0~29
- Initial value: 0

Defines the fault that can be automatically reset using parameter '31.10' (Automatic reset item 1) or '31.10' (Automatic reset item 1), bit 10

| Value | Type of Trip                | Value | Type of Trip               |
|-------|-----------------------------|-------|----------------------------|
| 0     | –                           | 16    | –                          |
| 1     | oC (Over Current)           | 17    | SAFE (Safety Fault)        |
| 2     | ov (Over Voltage)           | 18    | –                          |
| 3     | Lv (low Voltage)            | 19    | ovSF (OVS Fail)            |
| 4     | Sc (Short circuit)          | 20    | –                          |
| 5     | –                           | 21    | –                          |
| 6     | ot (Over Temperature)       | 22    | EE2 (External Emergency 2) |
| 7     | EtH(Motor Over Load)        | 23    | EE3 (External Emergency 3) |
| 8     | EE1 (External Emergency 1)  | 24    | EE4 (External Emergency 4) |
| 9     | E2PE (EEPROM Error)         | 25    | EE5 (External Emergency 5) |
| 10    | CE (Communication Error)    | 26    | –                          |
| 11    | –                           | 27    | FF (Fan Fault)             |
| 12    | GF (Ground Fault)           | 28    | Profibus–DP Trip           |
| 13    | –                           | 29    | Device–Net trip            |
| 14    | Iolt (VFD Over Load)        | 30    | System OL trip             |
| 15    | PF (Input Phase Loss Fault) | 31    | System UL trip             |

### ● 31.13 Restart trial 1

- Range: 0 ~10 in 1
- Initial value: 0

Defines the number of automatic fault resets at '31.10' (Automatic reset item 1)

### ● 31.14 Restart trial 2

- Range: 0 ~10 in 1
- Initial value: 0

Defines the number of automatic fault resets at '31.11' (Automatic reset item 2)

- **31.15 Earth Fault**

- *0: Disabled*
- *Range: 0.0 ~ 100.0 % in 0.1 %*
- *Initial value: 0.0 %*

Program to enable the Ground fault detection and its fault level as a percentage of rated current

- **31.16 Supply phase loss**

- *0: Disabled*
- *Range: 0 ~ 30 Sec in 1 Sec*
- *Initial value: 10 Sec*

Enables & sets the time period to determine if an Input Phase Loss occurs. The VFD monitors the ripple on the DC bus voltage and if it occurs for the programmed magnitude and time period an Input Phase Loss fault will occur. The ripple on the DC bus will cause heating to the DC Bus capacitors which will shorten their life.

- **31.17 Stall function**

- *0: No Operation*
- *1: VFD overload*
- *2: Over voltage*
- *3: VFD overload and Over voltage ----- Initial value*

Select a overload or overvoltage restriction modes

- **Set 0: No Operation**  
*Overload Restriction Mode=Off, Overvoltage Restriction Mode=Off*
- **Set 1: VFD overload**  
*Overload Restriction Mode=On, Overvoltage Restriction Mode=Off*
- **Set 2: Over voltage**  
*Overload Restriction Mode=Off, Overvoltage Restriction Mode=On*
- **Set 3: VFD overload and Over voltage**  
*Overload Restriction Mode=On, Overvoltage Restriction Mode=On*  
❖ Related Parameters: **'31.18', '31.19'**

- **31.18 Stall current limit**

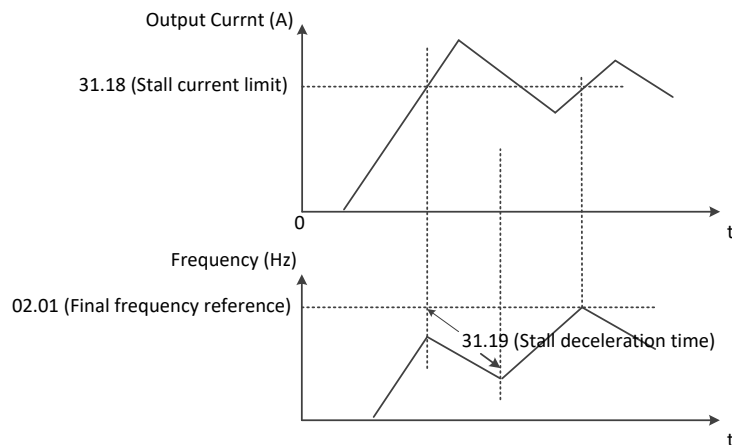
- *Range: 20.0 ~ 200.0 % in 0.1 %*
- *Initial value: 180.0 % (HD), 150.0 % (ND)*

Program the level for overload restriction of the VFD rated current

### ● 31.19 Stall deceleration time

- Range: 0.1 ~ 30.0 Sec in 0.1 Sec
- Initial value: 10.0 Sec (30kW upper) / 1.0 Sec (22kW lower)

Program the deceleration time for rate when the VFD detects the overload



### ● 31.22 RS485 Modbus time out check enable

- 0: Always Running ----- Initial value
- 1: Only during VFD is Running

Select a time out detection mode.

❖ Related Parameters: '31.23'

### ● 31.23 RS485 Modbus time out time

- 0: Disable
- Range: 0 ~ 60 Sec in 1 Sec
- Initial value: 0 Sec

Select a time out detection period when communication discontinues. If no communication event occurs during this time period, a communication fault will occur.

### ● 31.24 Low voltage fault level

- Range: 90.0 ~ 180.0 % in 0.1 %
- Initial value: 100.0 %

HF : Set as 31.24 code based on DC voltage 400V

LF : Set as 31.24 code based on DC voltage 200V

\*Caution : if it is set below the initial value, it is recommended to install an AC reactor at the input stage because there is a risk of inverter damage due to excessive inrush current caused by instantaneous power failure.

EX) 31.24 = 90.0%

HF :  $400V \times 31.24 = 400V \times 90.0\% = 360V$

LF :  $200V \times 31.24 = 200V \times 90.0\% = 180V$

## 8.2.19 Motor thermal protection

- **32.01 Electronic thermal overload level**

- *20.0 ~ 120.0 % in 0.1 %*
- *Initial value: 100.0 %*

Program a level of the rated motor current (VFD Rated Current)

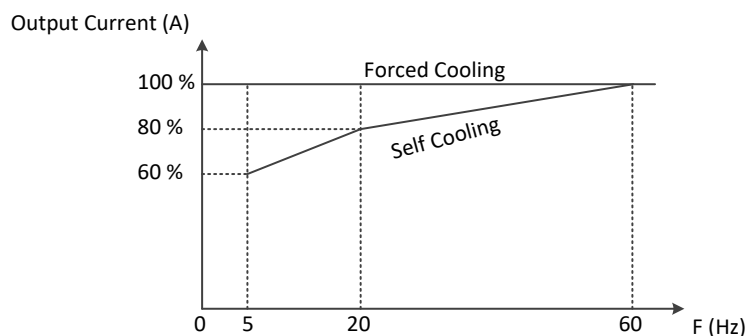
❖ Related Parameters: **'32.02'**

- **32.02 Electronic thermal overload profile**

- *0: Self Cooling*
- *1: Forced Cooling ----- Initial value*
- *2: Disable Electronic thermal overload detection*

Select a cooling method

- **Set 0: Self Cooling**  
*Fan is mounted on the motor shaft*
- **Set 1: Forced Cooling**  
*Fan is powered by external power source*



- **Set 2: Disable Electronic thermal overload detection**  
*Do not detect ETH fault*

- **32.03 Fan operation mode**

- *0: Always running ----- Initial value*
- *1: Only during VFD is running*

Select fan operation

- **32.04 Fan off delay time**

- *0.0 to 1000.0 Sec 0.1 Sec*
- *Initial value: 30.0 Sec*

Run only When the **'32.03'(Fan operation mode)** is 1

❖ Related Parameters: **'32.04'**

## 8.2.20 System Overload/Underload detection

The drive provides two independent torque detection functions that trigger an alarm or fault signal when the load is too heavy or suddenly drops

### ● 33.01 System Load Detection Selection

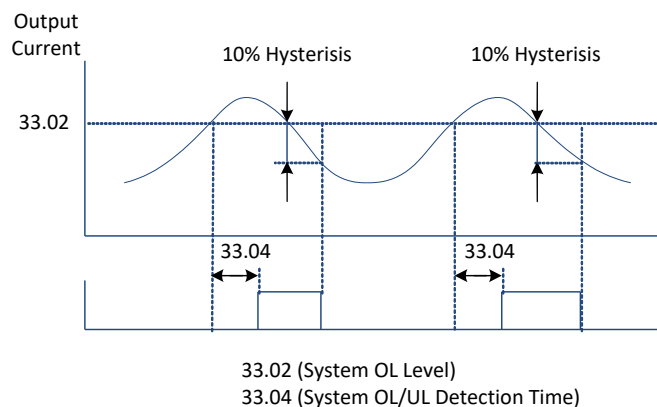
- 0: Disabled
- 1: Overload Detection
- 2: Underload Detection
- 3: Overload/Underload Detection
- 4: Overload Detection with Fault (oLdt)
- 5: Underload Detection with Fault (uLdt)
- 6: Overload/Underload Detection with Fault (oLdt, uLdt)

### ● 33.02 System Overload Detection Level

- Range: 20.0 ~ 200.0 % in 0.1 %

Sets the System Overload level. This feature is triggered when the motor current exceeds this level. 100% level is based off of the value in 99.04(Motor rated current)

#### System Overload Detection

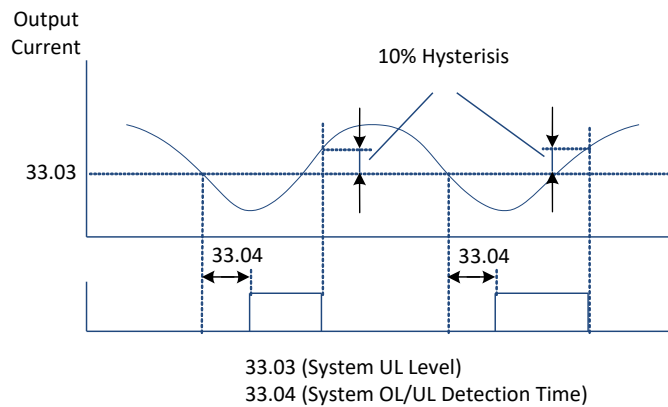


### ● 33.03 System Underload Detection Level

- Range: 20.0 ~ 200.0 % in 0.1 %

Sets the System Underload level. This feature is triggered when the motor current exceeds this level. 100% level is based off of the value in H05.

### System Underload Detection



- **33.04 System Overload/Underload Detection Time**

- *Range: 0.0 ~ 60.0 Sec in 0.1 Sec*
- *Initial value : 10.0 sec*
- Sets the System Overload/Underload Detection time.

- **33.05 System Overload/Underload Detection safe zone**

- *Range: 0.00 ~ Max frequency (30.01) in 0.01 Hz*
- *Initial value : 0.00Hz*

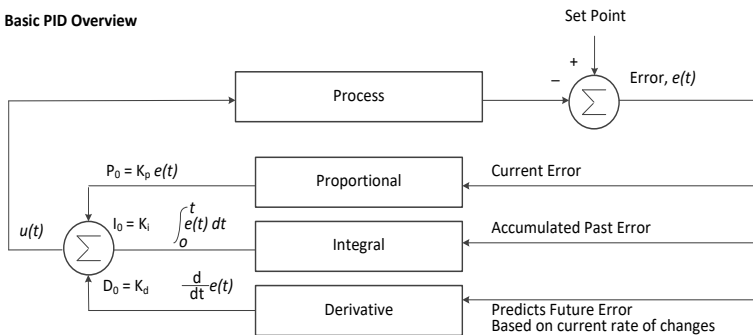
Sets the level at which this feature is disabled.

System Overload/Underload detection doesn't work below '33.05' value

## 8.2.21 PID

The PID function enables the system running at the reference automatically by regulating the process using the system feedback, error term. It is used for Cubic Feet of Air it moves per minute (CFM) for fan application, Gallons per minute (GPM) for pump application, pressure control, heating application, etc.

Basic PID Overview



### PID Functional Description

- Reference: Desired System Output Value
- Error: Difference between System output and reference
- Proportional (P) Term: Current Error
- Integral (I) Term: Accumulated Past Error
- Derivative (D) Term: Predicted Future Error based on current rate of changes

#### ● 40.01 PID function select

- 0: Disable ----- Initial value
- 1: Enable

Select PID function type

❖ Related Parameters: '40.01' ~ '40.24'

#### ● 40.02 PID reference

- The range of settings varies depending on the '40.25'(PID Controlled physics quantity) setting.
- Range if '40.25' is 0 : '40.27' ~ '40.26' [%]
- Range if '40.25' is 1 : '40.27' ~ '40.26' [Hz]
- Range if '40.25' is 2 : '40.27' ~ '40.26' [Kpa]
- ❖ Related Parameter : '40.26' (PID Control Maximum physical quantity)
- ❖ Related Parameter : '40.27' (PID Control Minimum physical quantity)
- Initial value: 0.0 %

It can be worked when '40.03'(PID reference source) set 2

❖ Related Parameters: '40.03'

- **40.03 PID reference source**

- 0: AI1 (O)
- 1: AI2 (OI)
- 2: Keypad ----- Initial value
- 3: Modbus
- 4: Fieldbus
- 5: UP/DOWN

Select PID Reference source

- **Set 0: N/A**  
*This code is not used (It is recommended not to set)*
- **Set 1: AI1(O), AI2 (OI)**  
*This code is determined by '40.04'(PID feedback source)*  
  
*if '40.04' is 0 : Set to AI2 (OI)*  
*Set the PID reference by DC 4~20mA through at OI–L terminals*  
*if '40.04' is 1 : Set to AI1 (O)*  
*Set the PID reference by DC 0~10V through at O–L terminals*
- **Set 2: Keypad**  
*Set the PID reference by '40.02'(PID reference) parameter*
- **Set 3: Modbus**  
*Set the PID reference by Modbus communication through at RXP–RXN terminals*
- **Set 4: Fieldbus**  
*Set the PID reference by Fieldbus through at option card adapter*
- **Set 5: UP/DOWN**  
*Set the PID reference by UP/DOWN through external command*

- **40.04 PID feedback source**

- 0: AI1 (O)
- 1: AI2 (OI) ----- Initial value

Select the source how to get feedback

- **Set 0: AI1 (O)**  
*Get the PID feedback by DC 0~10V*
- **Set 1: AI2 (OI)**  
*Get the PID feedback by DC 4~20mA*

- **40.05 PID P gain**

- *Range: 0.1 ~ 2000 % in 0.1 %*
- *Initial value: 100.0 %*

Select the PID P gain value

- It sets the output rate of error between reference value and the feedback value
- For faster response speed, enlarge the P gain value
- If P gain is set too large, oscillation or over shooting may occur

- **40.06 PID I gain**

- *Range: 0.0 ~ 3600 Sec in 0.1 Sec*
- *Initial value: 1.0 Sec*

Select the Integral time to accumulate PID error value

- For faster response speed, shorten the accumulate time
- If I gain time is set too short, oscillation or over shooting may occur

- **40.07 PID D gain**

- *Range: 0.0 ~ 10.00 Sec in 0.01 Sec*
- *Initial value: 0.0 Sec*

Program the derivative time for PID function

- For faster response speed, lengthen the D gain time
- If D gain time is set too long, system may become unstable

- **40.08 PID Err limit**

- *Range: 0.0 ~ 100.0 % in 0.1 %*
- *Initial value: 100.0 %*

Program error limit level, ratio to the maximum error

- **40.09 PID output high limit**

- *Range: -100.0 ~ 100.0 % in 0.1 %*
- *Initial value: 100.0 %*

Program the maximum PID output as percentage of the maximum output frequency

- **40.10 PID output low limit**

- *0: Disable the low limit*
- *Range: -100.0 ~ 100.0 % in 0.1 %*
- *Initial value: 0.0 %*

Program the minimum PID output as a percentage of the minimum output frequency

- **40.11 PID output invert**

- *0: Disable ----- Initial value*
- *1: Enable*

Program to enable the PID output invert

- **40.12 PID scale factor**

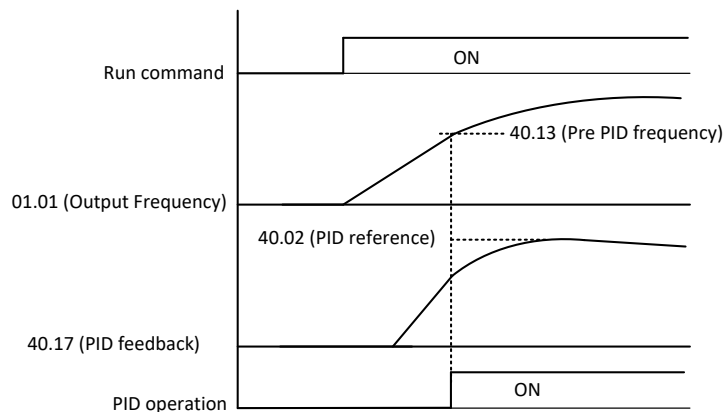
- *Range: 0.1 ~ 1000 % in 0.1 %*
- *Initial value: 100.0 %*

Program the minimum PID output as a percentage of the minimum output frequency

### ● 40.13 Pre PID frequency

- 0: Disable Pre PID function
- Range: 0.00 ~ 400.0 Hz in 0.01 Hz
- Initial value: 0.00 Hz

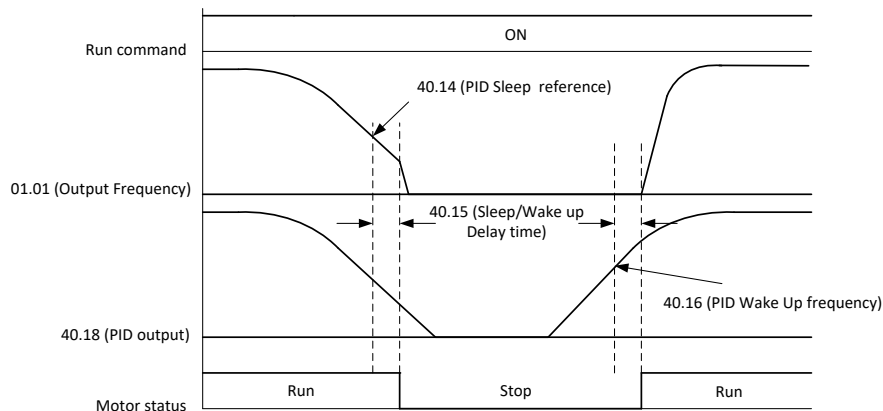
Program the frequency reference when PID function is activated. Once the VFD frequency out reaches this value in '**40.13**' (**Pre PID frequency**) PID control function is enabled and the VFD is operated in closed loop control.



### ● 40.14 PID sleep frequency

- Range: 0.00 ~ 400.0 Hz in 0.01 Hz
- Initial value: 0.00 Hz

Program the frequency reference when the VFD goes sleep



### ● 40.15 PID sleep/wake delay time

- Range: 0.0 ~ 30.0 Sec in 0.1 Sec
- Initial value: 0.0 Sec

Program the frequency reference when the VFD goes sleep

- **40.16 PID wake frequency**

- *Range: '40.14' ~ 400.0 Hz in 0.01 Hz*
- *Initial value: 0.00 Hz*

Program the frequency reference when the VFD wakes up from the sleep mode for the specified operation

- **40.17 PID feedback monitor**

- *Range: 0.00 ~ 100.0%*

Real time display of PID feedback

- **40.18 PID output monitor**

- *Range: 0.00 ~ 100.0%*

Real time display of PID output

- **40.19 PID integral reset source**

- *0: Not selected ----- Initial value*
- *1: Selected*
- *2: DI1*
- *3: DI2*
- *4: DI3*
- *5: DI4*
- *6: DI5*
- *7: DI6*
- *8: DI7*
- *9: DI8*

Selects the source of the PID integral reset

- **Set 0: Not selected**  
Always off
- **Set 1: selected**  
Always on
- **Set 2~9 : DI1~ DI8**  
It works by digital input which is selected

● **40.20 PID disable source**

- *0: Not selected ----- Initial value*
- *1: Selected*
- *2: DI1*
- *3: DI2*
- *4: DI3*
- *5: DI4*
- *6: DI5*
- *7: DI6*
- *8: DI7*
- *9: DI8*

Selects the source of the PID disable

- **Set 0: Not selected**  
Always off
- **Set 1: selected**  
Always on
- **Set 2~9 : DI1~ DI8**  
It works by digital input which is selected

● **40.21 ref source 1 at PID disable**

- *0: Not selected*
- *1: AI1 (O) scaled ----- Initial value*
- *2: AI2 (OI) scaled*
- *3: Modbus*
- *4: Fieldbus*
- *5: PID*
- *6: Keypad*
- *7: UP/DOWN*

Selects the source of the ref 1 at PID disable

- **Set 0: Not selected**  
Always off
- **Set 1: AI1 (O) scaled**  
It can set the frequency reference by the DC 0~10V
- **Set 2: AI2 (OI) scaled**  
It can set the frequency reference by the DC 4~20mA
- **Set 3: Modbus**  
It can set the frequency reference by the modbus communication
- **Set 4: Fieldbus**  
Always on It can set the frequency reference by the fieldbus communication
- **Set 5: PID**  
Always on It can set the frequency reference by the PID control
- **Set 6: Keypad**  
Always on It can set the frequency reference by the Keypad
- **Set 7: UP/DOWN**  
Always on It can set the frequency reference by the UP/DOWN function

- **40.22 ref source 2 at PID disable**
  - See the parameter *'40.21' (ref source 1 at PID disable)*
- **40.23 ref 1 /ref 2 combination at PID disable**
  - 0: *'40.21' ----- Initial value*
  - 1: *'40.21' + '40.22'*
  - 2: *'40.21' - '40.22'*
  - 3: *'40.21' x '40.22'*
  - 4: *MIN ('40.21', '40.22')*
  - 5: *MAX ('40.21', '40.22')*

Selects a mathematical function between the reference sources selected by parameters *'40.21' (ref source 1 at PID disable)* and *'40.22' (ref source 2 at PID disable)*

- Set 0: *'40.21'*  
*'40.21' (ref source 1 at PID disable)*
- Set 1: *'40.21'+ '40.22'*  
*'40.21' (ref source 1 at PID disable) + '40.22' (ref source 2 at PID disable)*
- Set 2: *'40.21'- '40.22'*  
*'40.21' (ref source 1 at PID disable) - '40.22' (ref source 2 at PID disable)*
- Set 3: *'40.21'x '40.22'*  
*'40.21' (ref source 1 at PID disable) x '40.22' (ref source 2 at PID disable)*
- Set 3: *MIN ('40.21', '40.22')*  
*MIN '40.21' (ref source 1 at PID disable), '40.22' (ref source 2 at PID disable)*
- Set 5: *MAX ('40.21', '40.22')*  
*MAX '40.21' (ref source 1 at PID disable), '40.22' (ref source 2 at PID disable)*
- **40.24 ref 1 /ref 2 selection at PID disable**
  - 0: *'40.23' setting value ----- Initial value*
  - 1: *'40.22' setting value*
  - 2: *DI1*
  - 3: *DI2*
  - 4: *DI3*
  - 5: *DI4*
  - 6: *DI5*
  - 7: *DI6*
  - 8: *DI7*
  - 9: *DI8*

Configures the selection between frequency references 1 and 2

- **Set 0: '40.23' setting value**  
The frequency is used by *'40.23'(ref 1 /ref 2 combination at PID disable)* set value
- **Set 1: '40.22' setting value**  
The frequency is used by *'40.22'(ref source 2 at PID disable)*
- **Set 2~9 : DI1~ DI8**  
If the digital input which is selected has OFF, it will applied by ref 1  
If the digital input which is selected has ON, it will applied by ref 2

### ● 40.25 PID Control physics quantity select

- 0: % ----- Initial value
- 1: Hz
- 2: Kpa

### ● 40.26 PID Control Maximum physics quantity

- Initial
- If '40.25' is 0 : 100 [%]
- If '40.25' is 1 : 60.00 [Hz]
- If '40.25' is 2 : 100.00 [Kpa]

#### Range

- If '40.25' is 0 : '40.27' [%] ~ 200.0 [%]
- If '40.25' is 1 : '40.27' [Hz] ~ '30.01' [Hz]
- If '40.25' is 2 : '40.27' [Kpa] ~ 200.0 [Kpa]

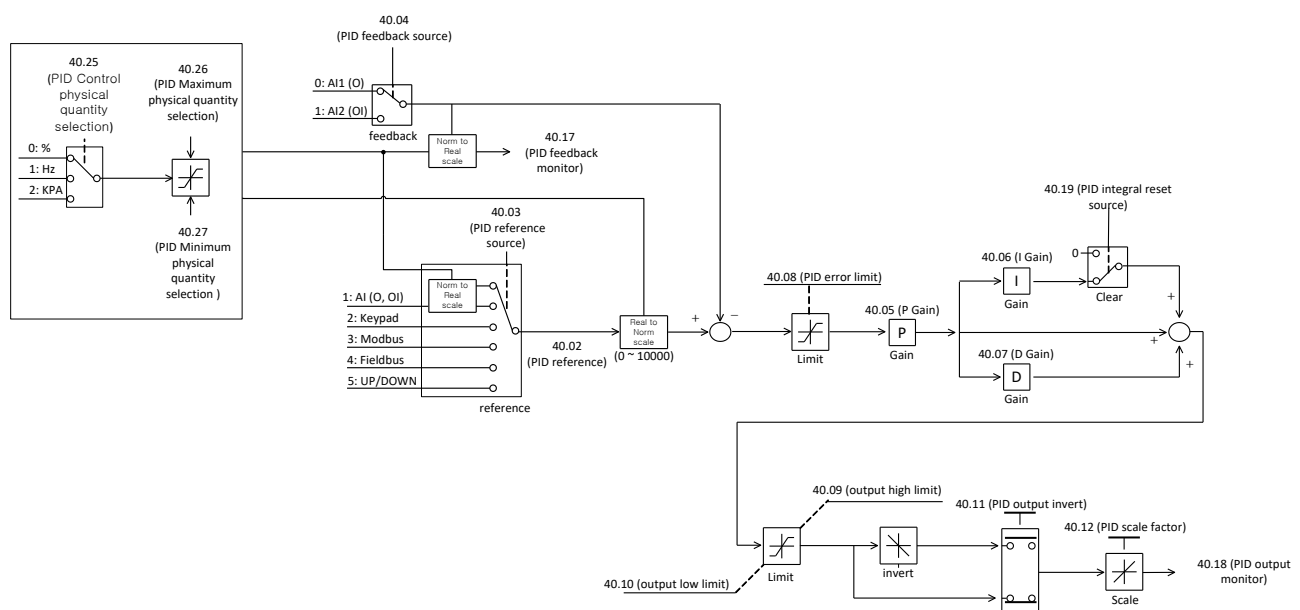
❖ Related parameter : '30.01'(Maximum frequency)

### ● 40.27 PID Control Minimum physics quantity

- Initial : 0.00
- Range : 0.00 ~ '40.26'

## PID Control Diagram

The overall PID control diagram with respective parameters is shown in below



### 8.2.22 DBR Duty cycle

The DBR function is only applicable under 22kW model.

Regenerative energy from the motor is dissipated by the heat through this braking resistor.

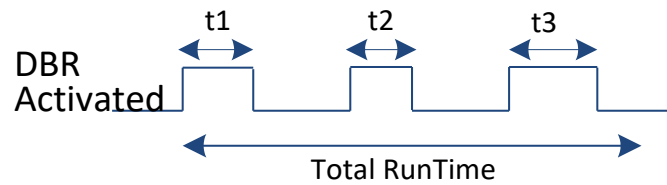
- **41.01 DBR Mode**

- *0: DBR disabled*
- *1: Only during VFD Running (Default)*
- *2: Always*

- **41.02 DBR Duty Cycle**

- *Range: 0.0 ~ 50.0% in 0.1%*
- *Initial value: 10.0*

Select a percentage value of total DBR on time before the overheating fault occurs.



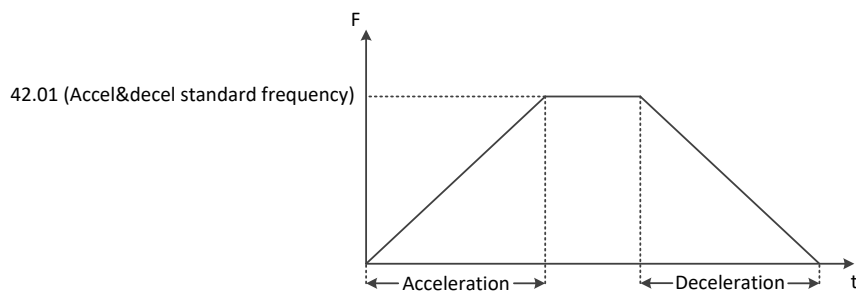
$$\text{DBR Usage Rate} = \frac{t1 + t2 + t3}{\text{Total RunTime}}$$

## 8.2.23 Monitoring/Scaling

### ● 42.01 Accel&decel Standard frequency

- Range: 0.00 ~ 400.0 Hz in 0.1 Hz
- Initial value: 60.00 Hz

This parameter is standard of all acceleration and deceleration



### ● 42.02 RPM display scale factor

- Range: 1 ~ 9999 in 1
- Initial value: 100

Program RPM scale factor for '01.02' (Motor RPM monitor)

Below determined by equation:

$120 \times '01.01' (\text{Output frequency}) \times '42.02' (\text{RPM display scale factor}) / '99.07' (\text{Motor Pole setting})$

ex1) '01.01' = 60Hz, '42.02' = 100, '99.07' = 4: '01.02' = 1800rpm

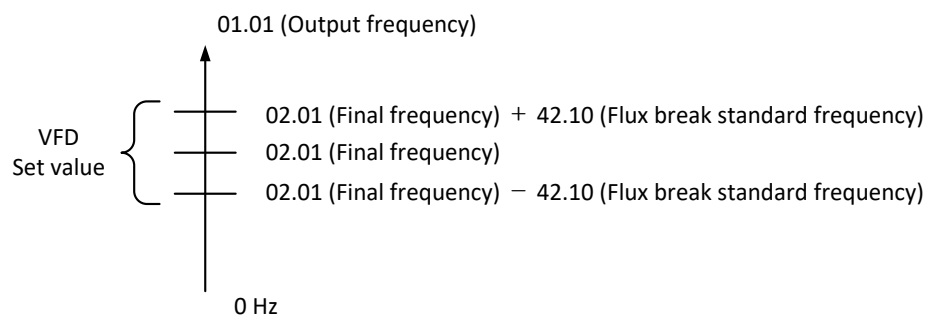
ex2) '01.01' = 60Hz, '42.02' = 50, '99.07' = 4: '01.02' = 900rpm

❖ Related Parameters: '01.02'

### ● 42.10 Flux break Standard frequency

- Range: 0.00 ~ 10.00Hz in 0.01
- Initial value: 5.00 Hz

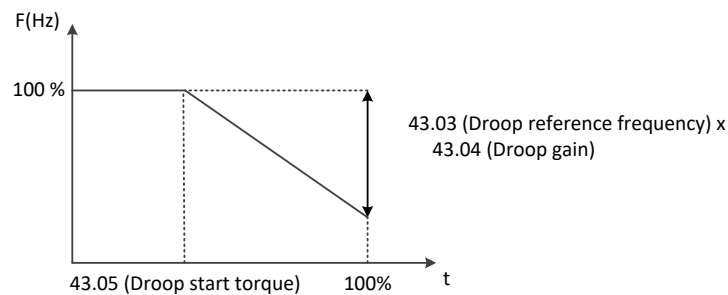
The absolute value that '01.02' (Final frequency reference) – '01.01' (Output frequency) is smaller than '42.10' (Flux break standard frequency), Flux break is disable during deceleration



## 8.2.24 Droop

Droop control automatically balances the load level between two motors driving the same load. Output frequency is changed by the amount of output torque.

Output frequency decreased or increased depends on the amount of load that detects the output torque in real time.



$$\text{Control frequency} = \frac{(\text{Output torque} - \text{Droop Start Torque})}{100\% - \text{Droop Start Torque}} \times \text{Droop Gain} \times \text{Droop Ref. Freq}$$

### ● 43.01 Droop type

- 0: No droop control ----- Initial value
- 1: Open loop
- 2: F/B (0~10V)
- 3: F/B (4~20mA)
  
- **Set 0: No droop control**  
Droop control disable
- **Set 1: Open loop**  
Droop control without feedback (Open loop)
- **Set 2 : F/B (0~10V)**  
Connected the torque output of VFD A to the voltage input (O) of VFD B
- **Set 3 : F/B (4~20mA)**  
Connected the torque output of VFD A to the voltage input (OI) of VFD B

### ● 43.02 Droop start frequency

- Range: 0.00 ~ 400.0 Hz in 0.01 Hz
- Initial value: 0.00 Hz

Set the droop control starting frequency.

The droop control doesn't work under B50 value.

- **43.04 Droop gain**

- *Range: 0.00 ~ 50.00 in 0.01*
- *Initial value: 5.00*

Sets the reduced rate of output frequency when at the 100% output torque gain while operating in the droop control

- **43.05 Droop start torque**

- *Range: 0.0 ~ 100.0 % in 0.1 %*
- *Initial value: 0.0 %*

Set the amount of output torque at start in droop control

- **43.06 Droop ramp time**

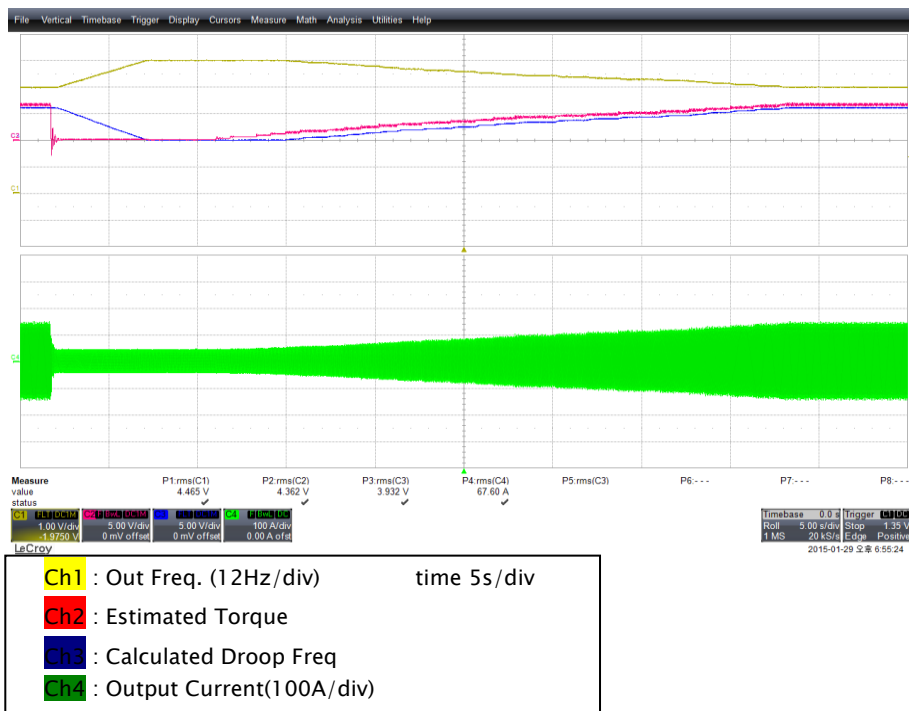
- *Range: 1.0 ~ 100.0 Sec in 0.1 Sec*
- *Initial value: 20.0 Sec*

Set the response time of output change when operating droop control

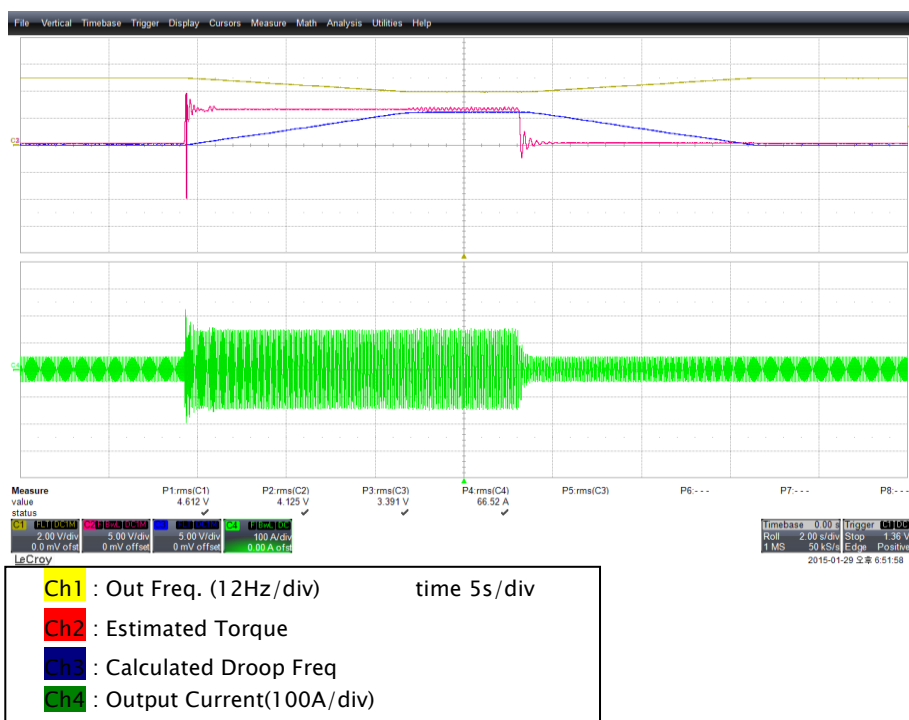
- If this time is short, it occur the vibration
- If this time is long, it occur the delayed response of droop control

Example

- 1) Increased the load ratio up to 100%  
Output frequency decreased by the amount of load



- 2) Put 100% step load and removed 100% load in a moment  
Put the step load (100%) for 8 seconds and then remove the step load.  
The droop control decreased the output frequency for '**43.06'** (*Droop ramp time*) =5s at step load.  
The droop control increased the output frequency for '**43.06'** (*Droop ramp time*) =5s at no step load.



### 8.2.25 RS-485 (Modbus)

- **50.01 Modbus node ID**

- *Range: 1 ~ 32 in 1*
- *Initial value: 1*

Node ID for Modbus communication

❖ Related Parameters: '**50.02**'

- **50.02 Modbus baud rate**

- *1: 2,400 bps*
- *2: 4,800 bps*
- *3: 9,600 bps ----- Initial value*
- *4: 19,200 bps*

Select a baud rate for Modbus communication

## 1) RXP / PXN / Connector

- RXP: + Transmit/Receive Port
- RXN: – Transmit/Receive Port

Program A1 Parameters to enable remote control

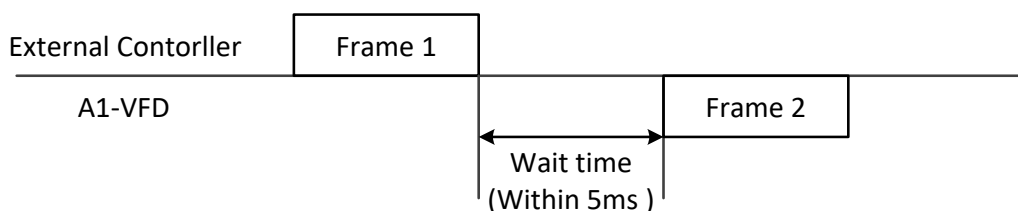
| Code    | Minimum | Maximum | Initial Value | Unit | Description    |
|---------|---------|---------|---------------|------|----------------|
| '50.01' | 1       | 32      | 1             | –    | Modbus node ID |
| '50.02' | 0       | 4       | 0             | –    | 9600bps        |

## 2) RS485 Interface Description

| Item                 | Description                            | Remark                                      |
|----------------------|----------------------------------------|---------------------------------------------|
| Interface            | RS485                                  |                                             |
| Communication method | Half duplex                            |                                             |
| Communication speed  | 9600                                   | Fixing                                      |
| Communication code   | Binary code                            |                                             |
| Data bits            | 8                                      | Fixing                                      |
| Parity               | No.                                    | Fixing                                      |
| Stop bit             | 1                                      | Fixing                                      |
| Starting method      | External request                       | VFD is only slave part.                     |
| Wait time            | 10~1000ms                              |                                             |
| Connection type      | 1 : N (Max32)                          |                                             |
| Error check          | Frame / CRC / CMD / MAXREQ / parameter | Communication number is selected at '50.01' |

### Communication sequence

The communication sequence is as follows



- Frame Start: Frame start is recognized by signal line data transmitted
- Frame Complete: Frame completion is recognized by no data during 4, 5-character time
- Frame 1: Transmit from external controller to VFD
- Frame 2: Indication reflects from VFD to external controller

### 3) Communication Frame Type and Form

#### External Controller Transmit Frame

|                |         |           |                 |        |        |
|----------------|---------|-----------|-----------------|--------|--------|
| Modbus node ID | Command | Parameter | Parameter Count | CRC Hi | CRC Lo |
|----------------|---------|-----------|-----------------|--------|--------|

|                  | Description                  | Data size | Specifications                                                      |
|------------------|------------------------------|-----------|---------------------------------------------------------------------|
| Modbus node ID   | Target VFD<br>Modbus node ID | 1 byte    | 1~32                                                                |
| Command          | Frame type                   | 1 byte    | 0x03                                                                |
| Parameter        | Parameter                    | 2 byte    | 1 <sup>st</sup> byte : Group<br>2 <sup>nd</sup> byte : Index(Note1) |
| Parameter number | Request parameter number     | 2 byte    | 1 <sup>st</sup> byte : 0x00<br>2 <sup>nd</sup> byte : N(0x01~0x08)  |
| CRC Hi           | -                            | 1 byte    | Higher 8bit of 16bit CRC                                            |
| CRC Lo           | -                            | 1 byte    | Lower 8bit of 16bit CRC                                             |

#### VFD response frame

|                |       |             |        |     |        |        |        |
|----------------|-------|-------------|--------|-----|--------|--------|--------|
| Modbus node ID | Order | Byte Number | Data 1 | ... | Data N | CRC Hi | CRC Lo |
|----------------|-------|-------------|--------|-----|--------|--------|--------|

|                | Description                  | Data size | Specifications               |
|----------------|------------------------------|-----------|------------------------------|
| Modbus node ID | Target VFD<br>Modbus node ID | 1 byte    | 1~32                         |
| Command        | Frame type                   | 1 byte    | 0x03                         |
| Byte Number    | Data Byte number             | 1 byte    | Request parameter number x 2 |
| Data 1         | Parameter 1                  | 2 byte    | Parameter value              |
| Data N         | Parameter N                  | 2 byte    | Nth parameter value          |
| CRC Hi         | -                            | 1 byte    | Higher 8bit of 16bit CRC     |
| CRC Lo         | -                            | 1 byte    | Lower 8bit of 16bit CRC      |

\* Frame Size = 5 + Request parameter number x 2

**External transmit frame**

|                |       |           |      |        |        |
|----------------|-------|-----------|------|--------|--------|
| Modbus node ID | Order | Parameter | Data | CRC Hi | CRC Lo |
|----------------|-------|-----------|------|--------|--------|

|                | Description                  | Data size | Specifications                                               |
|----------------|------------------------------|-----------|--------------------------------------------------------------|
| Modbus node ID | Target VFD<br>Modbus node ID | 1 byte    | 1~32                                                         |
| Command        | Frame type                   | 1 byte    | 0x06                                                         |
| Parameter      | Parameter                    | 2 byte    | 1 <sup>st</sup> byte : Group<br>2 <sup>nd</sup> byte : Index |
| Data           | Data                         | 2 byte    | Setting value                                                |
| CRC Hi         | -                            | 1 byte    | Higher 8bit of 16bit CRC                                     |
| CRC Lo         | -                            | 1 byte    | Lower 8bit of 16bit CRC                                      |

**VFD response frame**

|                |       |           |      |        |        |
|----------------|-------|-----------|------|--------|--------|
| Modbus node ID | Order | Parameter | Data | CRC Hi | CRC Lo |
|----------------|-------|-----------|------|--------|--------|

|                | Description                  | Data size | Specifications                                               |
|----------------|------------------------------|-----------|--------------------------------------------------------------|
| Modbus node ID | Target VFD<br>Modbus node ID | 1 byte    | 1~32                                                         |
| Command        | Frame type                   | 1 byte    | 0x06                                                         |
| Parameter      | Parameter                    | 2 byte    | 1 <sup>st</sup> byte : Group<br>2 <sup>nd</sup> byte : Index |
| Data           | Data                         | 2 byte    | Setting value is response                                    |
| CRC Hi         | -                            | 1 byte    | Higher 8bit of 16bit CRC                                     |
| CRC Lo         | -                            | 1 byte    | Lower 8bit of 16bit CRC                                      |

**4) Parameter Setting & Trip information****Parameter Setting**1<sup>st</sup> byte: Group number2<sup>nd</sup> byte: Parameter number

Ex) The case of '99.01' parameter reading or writing

1<sup>st</sup> byte: 0x632<sup>nd</sup> byte: 0x01**Data value is transmitted except decimal point.**

Ex1) Frequency reference 60Hz (Parameter: 0x0004, Data: 0x1770)

| Command | Parameter | Communication Data    | Data<br>(Conversion hexa to decimal)                       |
|---------|-----------|-----------------------|------------------------------------------------------------|
| 0x0006  | 0x0004    | 6000(60.00Hz => 6000) | 1 <sup>st</sup> byte : 0x17<br>2 <sup>nd</sup> byte : 0x70 |

Ex2) Acceleration time 1 (Parameter: 0x1704, Data: 0x0064)

| Command | Parameter | Communication Data  | Data<br>(Conversion hexa to decimal)                       |
|---------|-----------|---------------------|------------------------------------------------------------|
| 0x0006  | 0x1704    | 100(10.0sec => 100) | 1 <sup>st</sup> byte : 0x00<br>2 <sup>nd</sup> byte : 0x64 |

Ex3) Run command (Parameter: 0x0002, Data: FWD)

| Bit7     | Bit6 | Bit5 | Bit4 | Bit3 | Bit2 | Bit1 | Bit0 |
|----------|------|------|------|------|------|------|------|
| Reserved |      |      |      |      | RST  | REV  | FWD  |

| Command | Parameter | Data                                          |
|---------|-----------|-----------------------------------------------|
| 0x0006  | 0x0002    | 0x0001(FWD: 0x0001, REV: 0x0002, RST: 0x0004) |

### Trip information items

| Value | Type of Trip                | Value | Type of Trip                              |
|-------|-----------------------------|-------|-------------------------------------------|
| 0     | –                           | 19    | ovSF (OVS Fail)                           |
| 1     | oC (Over Current)           | 20    | –                                         |
| 2     | ov (Over Voltage)           | 21    | –                                         |
| 3     | Lv (low Voltage)            | 22    | EE2 (External Emergency 2)                |
| 4     | Sc (Short circuit)          | 23    | EE3 (External Emergency 3)                |
| 5     | –                           | 24    | EE4 (External Emergency 4)                |
| 6     | ot (Over Temperature)       | 25    | EE5 (External Emergency 5)                |
| 7     | EtH(Motor Over Load)        | 26    | –                                         |
| 8     | EE1 (External Emergency 1)  | 27    | FF (Fan Fault)                            |
| 9     | E2PE (EEPROM Error)         | 28    | FE1 (Profibus–DP Trip)                    |
| 10    | CE (Communication Error)    | 29    | FE2 (Device–Net trip)                     |
| 11    | –                           | 30    | oLdt (System Overload Detection Fault)    |
| 12    | GF (Ground Fault)           | 31    | ULdt (System Underload Detection Fault)   |
| 13    | –                           | 32    | dL (Running Time Out)                     |
| 14    | Iolt (VFD Over Load)        | 33    | FE3 (CC–link Communication Failure Fault) |
| 15    | PF (Input Phase Loss Fault) | 34    | dEv (Encoder Frequency Deviation Fault)   |
| 16    | –                           | 35    | oS (Encoder Overspeed Fault)              |
| 17    | SAFE (Safety Fault)         | 36    | EnC1 (Encoder Pulse Error1)               |
| 18    | –                           | 37    | EnC2 (Encoder Pulse Error2)               |

### Trip information Parameter

|                      | Current Trip | Previous Trip1 | Previous Trip2 | Previous Trip3 | Previous Trip4 | Previous Trip5 | Trip count |
|----------------------|--------------|----------------|----------------|----------------|----------------|----------------|------------|
| 1 <sup>st</sup> byte | 0x03         | 0x03           | 0x03           | 0x03           | 0x03           | 0x03           | 0x03       |
| 2 <sup>nd</sup> byte | 0x01         | 0x0D           | 0x19           | 0x25           | 0x31           | 0x3D           | 0x49       |

**Exception Code**

| Code | Description                                                                                                                                                                                                                            |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0    | ILLEGAL_FUNCTION :<br>When an invalid function command is applied                                                                                                                                                                      |
| 1    | ILLEGAL_DATA_ADDRESS :<br>1. In case Read/Write command is applied to non-existent parameter<br>2. In case more than 12 parameter continuous reading commands are applied                                                              |
| 2    | ILLEGAL_DATA_VALUE :<br>When a data Write command outside the MAX/MIN value is applied                                                                                                                                                 |
| 3    | SLAVE_DEVICE_FAILURE :<br>1. When a Write command is applied to a parameter that is prohibited from being changed during running(in running state)<br>2. In case Write command is applied to Write-Protected or Display-Only parameter |

**Exception Code Response**

When responding to Exception code data, it responds by “SET” the highest bit of the function command frame data.

| Frame          | Example Response |      |      |      |      |
|----------------|------------------|------|------|------|------|
| Comm.No        | 0x01             | 0x01 | 0x01 | 0x01 | 0x01 |
| Command        | 0x85             | 0x83 | 0x86 | 0x86 | 0x86 |
| Excetpion Code | 0x01             | 0x02 | 0x03 | 0x04 | 0x04 |
| CRC Lo         | 0x83             | 0xC0 | 0xC3 | 0x02 | 0x43 |
| CRC Hi         | 0x50             | 0xF1 | 0xA1 | 0x61 | 0xA3 |

**5) 16 bit CRC generation**

The step of CRC generation is as follows:

1. All of 16-bit Parameter is 1.0xffff
2. The exclusive OR of 16-bit Parameter and 8-bit Parameter.
3. Shift right side 1bit 16-bit Parameter
4. If the result of step 3 is 1, exclusive OR 16-bit Parameter and 0xa001.
5. Execute 8 times step 3 and step 4.
6. Execute step 2~6 until data completion.
7. Exchange the step 6 result of higher 8bit and lower 8bit.

Ex) the case of d01 output frequency reading.

| Byte 1               | Byte 2  | Byte 3    | Byte 4 | Byte 5           | Byte 6 |
|----------------------|---------|-----------|--------|------------------|--------|
| Communication Number | Command | Parameter |        | Parameter number |        |
| 0x01                 | 0x03    | 0x01      | 0x01   | 0x00             | 0x01   |

### The sequence of addition Byte (01x01)

| 16-BIT PARAMETER | MSB  |      | Flag |      |
|------------------|------|------|------|------|
| (Exclusive OR)   | 1111 | 1111 | 1111 | 1111 |
| 01               | 0000 | 0001 |      |      |
|                  | 1111 | 1111 | 1111 | 1110 |
| Shift 1          | 0111 | 1111 | 1111 | 1111 |
| Shift 2          | 0011 | 1111 | 1111 | 1111 |
| Polynomial       | 1010 | 0000 | 0000 | 0001 |
|                  | 1001 | 1111 | 1111 | 1110 |
| Shift 3          | 0100 | 1111 | 1111 | 1111 |
| Shift 4          | 0010 | 0111 | 1111 | 1111 |
| Polynomial       | 1010 | 0000 | 0000 | 0001 |
|                  | 1000 | 0111 | 1111 | 1110 |
| Shift 5          | 0100 | 0011 | 1111 | 1111 |
| Shift 6          | 0010 | 0001 | 1111 | 1111 |
| Polynomial       | 1010 | 0000 | 0000 | 0001 |
|                  | 1000 | 0001 | 1111 | 1110 |
| Shift 7          | 0100 | 0000 | 1111 | 1111 |
| Shift 8          | 0010 | 0000 | 0111 | 1111 |
| Polynomial       | 1010 | 0000 | 0000 | 0001 |
|                  | 1000 | 0000 | 0111 | 1110 |

| Byte 1~6 | CRC of operation results |
|----------|--------------------------|
| 0x01     | 0x807e                   |
| 0x03     | 0x3364                   |
| 0x01     | 0x30e1                   |
| 0x01     | 0x8831                   |
| 0x00     | 0xd449                   |
| 0x01     | 0x36d4                   |

Change upper and lower 8 bit of result 0x36d4: 0xd436

Byte7: Upper 8 bit of CRC = 0xd4

Byte8: Lower 8 bit of CRC = 0x36

## 8.2.26 Fieldbus (option)

Fieldbus card is option to buy addition

More information refer to extra manual of fieldbus

- **51.01 Fieldbus option type**
  - *0: Modbus-RTU ----- Initial value*
  - *1: Profibus-DP*
  - *2: Device-Net*
  - *3: Ethernet series*
  - *4: CC-link option*
  
- **51.02 Fieldbus station number**
  - *1 ~ 32: Modbus-RTU----- Initial value*
  - *1 ~ 63: Device-Net*
  - *1 ~ 125: Profibus-DP*
  - *1 ~ 64: CC-link option*
  
- **51.03 Fieldbus byte swap**
  - *0: Normal*
  - *1: Swap ----- Initial value*
  
- **51.08 ~ 51.19 Fieldbus input data 1~12**
  - *0x0000 ~ 0xFFFF*
  
- **51.20 ~ 51.31 Fieldbus output data 1~12**
  - *0x0000 ~ 0xFFFF*
  
- **51.32 Fieldbus status**
  - *0x0000 ~ 0xFFFF*
  
- **51.33 Fieldbus version**
  - *0x0000 ~ 0xFFFF*
  
- **51.34 CC-link option baudrate selection**
  - *Range: 0 ~ 4*
  - *0 : 156 Kbps ----- Initial value*
  - *1 : 625 Kbps*
  - *2 : 2.5 Mbps*
  - *3 : 5 Mbps*
  - *4 : 10 Mbps*

## 8.2.27 User parameters

- **96.01 User parameter selection**

- *0: Disable ----- Initial value*
- *1: Enable*

If set 1, it will display only user parameter that has registered  
So when user parameter adds or changes, it has to be set 0

- **96.02 ~ 96.33 User parameter configuration 1~32**

- *Range: '01.01'~'99.99'*

It can register maximum 32ea

## 8.2.28 System

### ● 97.01 Initialization mode

- 0: Clear trip history ----- Initial value
- 1: Clear all parameters

If set 0, all parameters will reset to initial value except '99.02' (Motor rated voltage)

### ● 97.02 Parameter lock mode

- 0: All parameters are locked except '97.02', '97.03' by '97.03' ----- Initial value
- 1: All parameters are locked except '97.02', '97.03', '22.01' by '97.03'
- 2: All parameters are locked except '97.02', '97.03'
- 3: All parameters are locked except '97.02', '97.03', '22.01'
- 4: All parameters are locked except '97.02', '97.03', '22.01', '23.04', '23.05'
- ❖ Related Parameters: '97.03'

This parameter used to protect that changes parameter by other person

### ● 97.03 Software lock source

- 0: Not selected ----- Initial value
- 1: Selected
- 2: DI1
- 3: DI2
- 4: DI3
- 5: DI4
- 6: DI5
- 7: DI6
- 8: DI7
- 9: DI8

Selects the source of software lock

- **Set 0: Not selected**  
Always off
- **Set 1: selected**  
Always on
- **Set 2~9 : DI1~ DI8**  
It works by digital input which is selected

\*Caution: If the '97.02' code set 0 or 1, please be careful as the parameter prohibition setting is forcibly activated when the '97.03' code 1 is set.

- **97.04 Current time setting (Year)**

- *Range: 2000 ~ 2099*
- *Initial value: 2016*

Put the value of current year

- **97.05 Current time setting (Month, Day)**

- *Range: 101 ~ 1231*
- *Initial value: 224*

Put the value of current month and day

- **97.06 Current time setting (Hour, Minute)**

- *Range: 0 ~ 2359*
- *Initial value: 0*

Put the value of current hour and minute

- **97.07 Current time setting (Second)**

- *Range: 0 ~ 59*
- *Initial value: 0*

Put the value of current second

## 8.2.29 Motor control

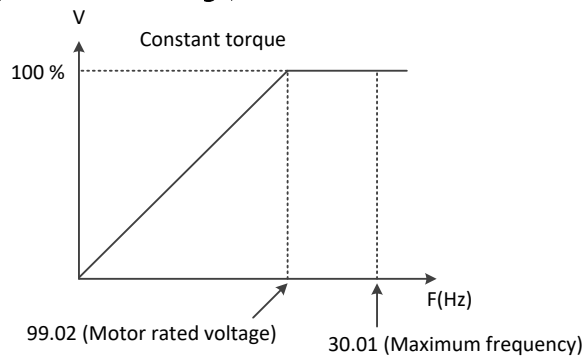
### ● 98.01 Motor control mode

- 0: CT (V/f) ----- Initial value
- 1: VT (V/f)
- 2: SLV
- 3 : VECTOR(Encoder Option)

#### ▪ Set 0: CT(V/f) – Constant Torque

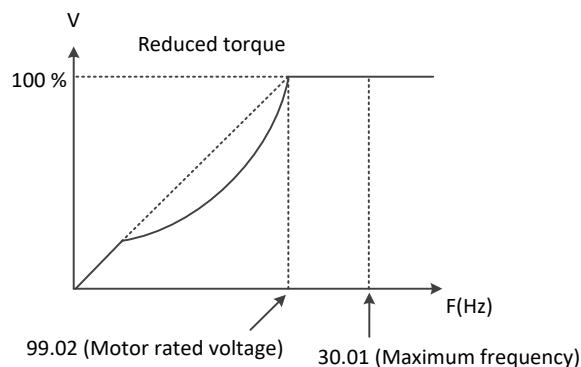
Frequency and voltage are controlled proportionately

Frequency rises until '**30.01**' (**Maximum frequency**) and voltage never rises above '**99.02**' (**Motor rated voltage**)



#### ▪ Set 1: VT(V/f) – Variable Torque

Reduced torque is effective for fan or pump application which do not require high torque at low frequency. By reducing the output voltage, increased efficiency, lower noise, and lower vibration.



#### ▪ Set 2: SLV – Sensorless Vector

For Sensorless Vector method, per specified output voltage, current, motor parameters, motor rpm, the corresponding torque value is calculated. At very low frequency up to 0.5 Hz, high torque operation is possible

#### ▪ Set 3: Vector – Encoder Option

You can control the motor speed and instantaneous torque by using the encoder option. The encoder option is mandatory.

### ● 98.02 HD/ND (torque type) select

- 0: Heavy duty (HD) ----- Initial value
- 1: Normal duty (ND)

Depending on this parameter, VFD rated current, PWM carrier frequency and Stall level will be changed

- **Set 0: Heavy duty (HD)**  
Hoists, conveyors, pump process; select HD
- **Set 1: Normal duty (ND)**  
Fans, or centrifugal pump applications; select ND  
❖ Related Parameters: '31.18', '98.03',

### ● 98.03 PWM carrier frequency

- Range: 1.0 ~ 10.0 kHz in 0.1 kHz
- Initial value: 3.0 kHz

Select Heavy Duty or Normal Duty factory setting per VFD model and loading type  
If the value is high, noise of motor is decreased and noise and temperature of VFD is increased

| Model                                                                                    | HD ('98.02' = 0) | HD ('98.02' = 1) | Range          |
|------------------------------------------------------------------------------------------|------------------|------------------|----------------|
| A1-032A-2 A1-045A-2<br>A1-064A-2 A1-076A-2<br>A1-090A-2 A1-114A-2                        | 5.0 kHz          | 3.0 kHz          | 1.0 ~ 16.0 kHz |
| A1-140A-2 A1-170A-2<br>A1-205A-2 A1-261A-2<br>A1-310A-2                                  | 5.0 kHz          | 3.0 kHz          | 1.0 ~ 10.0 kHz |
| A1-016A-4 A1-023A-4<br>A1-032A-4 A1-038A-4<br>A1-045A-4 A1-058A-4                        | 5.0 kHz          | 3.0 kHz          | 1.0 ~ 16.0 kHz |
| A1-075A-4 A1-090A-4<br>A1-110A-4 A1-149A-4<br>A1-176A-4 A1-217A-4<br>A1-260A-4 A1-296A-4 | 5.0 kHz          | 3.0 kHz          | 1.0 ~ 10.0 kHz |

### ● 98.04 PWM carrier mode

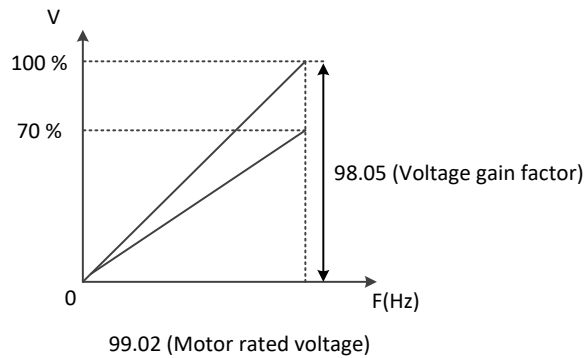
- 0: Normal ----- Initial value
- 1: Swing PWM1

Swing PWM1 is used to decrease noise of motor  
It changes the PWM carrier frequency in between 2.25 kHz and 2.75 kHz

### ● 98.05 Voltage gain factor

- *Range: 20.0 ~ 110.0 % in 0.1 %*
- *Initial value: 100.0 %*

The output voltage cannot exceed the input voltage



### ● 98.06 Flux braking function

- *0: Disable*
- *1: Enable ----- Initial value*

It can select to use Flux braking Function

❖ Related Parameters: '**42.10**', '**98.07**'

### ● 98.07 Flux braking reference

- *Range: 100 ~ 140 % in 1*
- *Initial value: 110 %*

It can program a Flux braking reference

### ● 98.09 Manual torque boost voltage reference

- *Range: 0.00 ~ 50.00 % in 0.01 %*
- *Initial value: 1.0 %*

For Manual Torque Boost mode, program the value in % of an output voltage

It not works in auto torque mode or sensorless mode

❖ Related Parameters: '**21.01**', '**98.01**', '**98.10**'

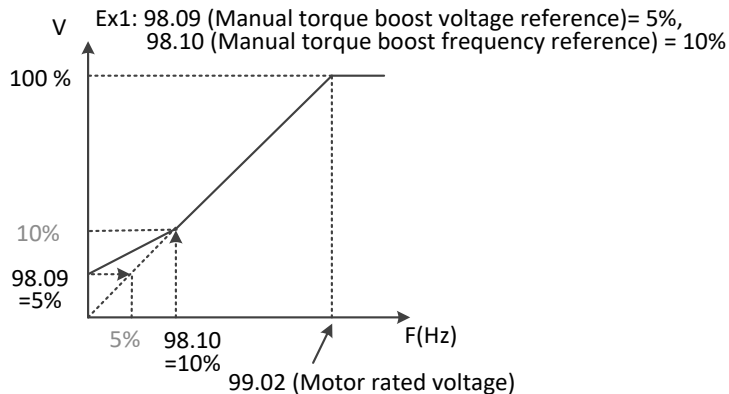
- **98.10 Manual torque boost frequency reference**

- *Range: 0.0 ~ 100.0 % in 0.1 %*
- *Initial value: 100.0 %*

Program the frequency breakpoint

It not works in auto torque mode or sensorless mode

❖ Related Parameters: '**21.01**', '**98.01**', '**98.09**'



- **98.11 Backward slip compensation**

- *Range: 0.0 ~ 200.0 % in 0.1 %*
- *Initial value: 100.0 %*

- **98.12 Regeneration slip compensation**

- *Range: 0.0 ~ 200.0 % in 0.1 %*
- *Initial value: 100.0 %*

- **98.13 Motor Type**

- *0: IM ----- Initial value*
- *1: PM SLV(progressing)*
- *2: IM SLV(progressing)*
- *3 : PM VECTOR(progressing)*

- **98.14 Vector control speed controller P-gain**

- *Range: 0 ~ 1000 in 1*
- *Initial value: 100*

Set the proportional controller gain required for speed control when using vector control.

If it is set too high, it may diverge, so be careful when setting it.

The encoder option is mandatory. Please refer to the manual attached to the encoder option box and use it after correct installation.

- **98.15 Vector control speed controller I-gain**

- *Range: 0 ~ 1000.0% in 0.1%*
- *Initial value: 100.0%*

Set the integral controller gain required for speed control when using vector control.  
If it is set too high, it may diverge, so be careful when setting it.

The encoder option is mandatory. Please refer to the manual attached to the encoder option box and use it after correct installation.

- **98.16 Forward torque limit**

- *Range: 0 ~ 200.0% in 0.1%*
- *Initial value: 150.0%*

- **98.17 Forward regeneration torque limit**

- *Range: 0 ~ 200.0% in 0.1%*
- *Initial value: 150.0%*

- **98.18 Reverse torque limit**

- *Range: 0 ~ 200.0% in 0.1%*
- *Initial value: 150.0%*

- **98.19 Reverse regeneration torque limit**

- *Range: 0 ~ 200.0% in 0.1%*
- *Initial value: 150.0%*

- **98.20 Zero speed torque limit**

- *Range: 0 ~ 200.0% in 0.1%*
- *Initial value: 150.0%*

- **98.21 Zero speed regeneration torque limit**

- *Range: 0 ~ 200.0% in 0.1%*
- *Initial value: 150.0%*

- **98.22 Torque limit Setting method**

- *0: AI1 (O)*
  - *0 ~ 10V -> 0.0% ~ 200.0% torque limit configuration*
  - *98.16 ~ 98.21 code value is changed equally*
- *1: AI2 (OI)*
  - *4 ~ 20mA -> 0.0% ~ 200.0% torque limit configuration*
  - *98.16 ~ 98.21 code value is changed equally*
- *2: Keypad ----- Initial value*
- *3 : Modbus*
- *4 : Feildbus*
- *5 : UP/DOWN function*

- **98.23 Speed controller output low pass filter time constant**

- *Range: 0 ~ 100 ms in 1ms*
- *Initial value: 0 ms*

During vector control operation, a low-pass filter is applied to the output of the speed controller to smooth the torque change. Excessive filter application destroys vector control, so it is recommended to set it to 0 msec as much as possible. Also, when it is set to torque mode, it operates with the filter time constant of the torque reference.

- **98.24 Zero speed command source select**

- *0: Disable----- Initial value*
- *1: Activate(Be careful with force activation)*
- *2 ~ 9: DI1 ~ DI8*

- **98.30 Speed/Torque Mode select**

- *0: Speed control mode----- Initial value*
- *1: Torque control mode*

*Speed control mode* – A general encoder uses the actual motor speed to control the desired command speed. At this time, the output of the speed controller is a torque reference to follow the command speed and is used to control the torque in the current controller.

*Torque control mode* – Torque command can be set as a torque limit of 98.16 ~ 98.21, and only torque is controlled. At this time, if the torque is controlled constant, the motor can continue to accelerate in the direction of the applied torque. To prevent this, the command speed acts as a speed limit, and the torque is reduced so as not to accelerate beyond the speed limit. 98.37 (Speed Limit Bias) makes the torque decrease in the vicinity of the speed limit, so that the torque shock is alleviated.

- **98.31 Torque rise time in torque mode**

- *Range: 0.0 ~ 3000.0 s in 0.1s*
- *Initial value: 0.0 s*

When the inverter run command is applied in the torque mode setting, the torque is gradually increased to alleviate the torque shock.

- **98.32 Torque fall time in torque mode**

- *Range: 0.0 ~ 3000.0 s in 0.1s*
- *Initial value: 0.0 s*

When the inverter stop command is applied in the torque mode setting, the torque is gradually reduced to alleviate the torque shock.

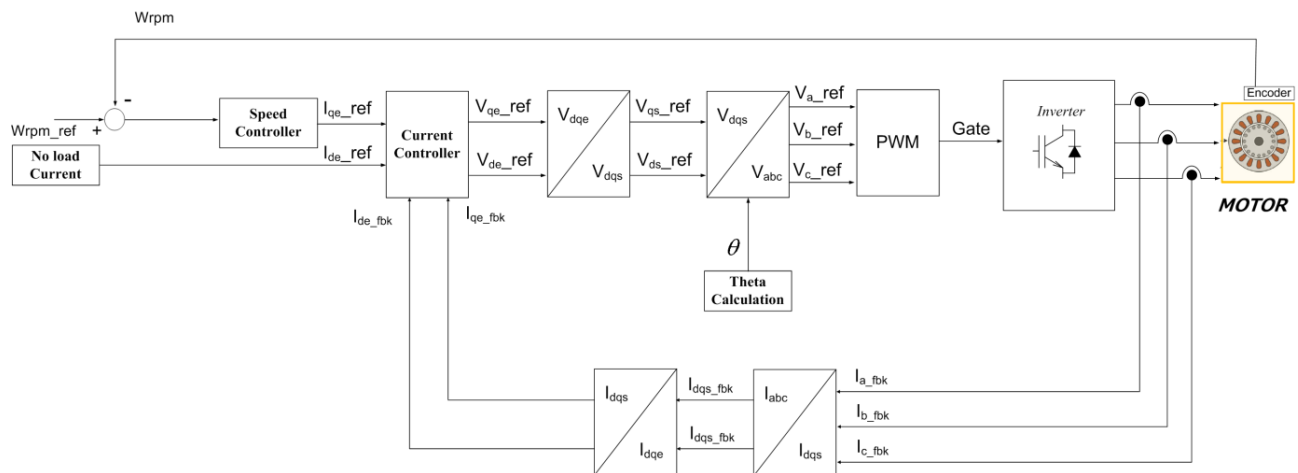
- **98.37 Speed limit bias in torque mode**

- *Range: 0.01 ~ 10.00 Hz in 0.01 Hz*
- *Initial value: 1.0 Hz*

In the torque control mode, if a torque command greater than the load torque is applied, the motor can continue to accelerate. To prevent this, the torque is linearly reduced from near the speed limit to the speed limit bias to prevent the motor from continuing to accelerate. If the speed limit bias is too small, the torque may change rapidly and torque shock may occur.

## –Vector Control

- 1) Controls the motor speed and instantaneous torque using an encoder.
- 2) Vector control block diagram



- 3) Vector control related parameters

| code  | Function                             | Min      | Max        | default  |
|-------|--------------------------------------|----------|------------|----------|
| 98.01 | Control mode                         | 0 (V/f)  | 3 (VECTOR) | 0 (V/f)  |
| 98.13 | Motor type                           | 0 (IM)   | 3(PM SLV)  | 0 (IM)   |
| 98.14 | Speed Controller Kp                  | 0        | 1000       | 100      |
| 98.15 | Speed controller Ki                  | 0.0      | 1000.0     | 100.0    |
| 98.16 | Forward torque limit                 | 0.0 %    | 200.0 %    | 150.0 %  |
| 98.17 | Forward regeneration torque limit    | 0.0 %    | 200.0 %    | 150.0 %  |
| 98.18 | Reverse torque limit                 | 0.0 %    | 200.0 %    | 150.0 %  |
| 98.19 | Reverse regeneration torque limit    | 0.0 %    | 200.0 %    | 150.0 %  |
| 98.20 | Zero speed torque limit              | 0.0 %    | 200.0 %    | 150.0 %  |
| 98.21 | Zero speed regeneration torque limit | 0.0 %    | 200.0 %    | 150.0 %  |
| 98.22 | Torque limit setting method          | 0        | 5          | 2        |
| 98.23 | Speed controller output LPF tow      | 0.0 msec | 100.0 msec | 0.0 msec |
| 98.24 | Zero speed command source            | 0        | 9          | 0        |
| 98.30 | Speed/Torque Mode select             | 0        | 1          | 0        |
| 98.31 | Torque rise time in torque mode      | 0.0 s    | 3000.0 s   | 0.0 s    |
| 98.32 | Torque fall time in torque mode      | 0.0 s    | 3000.0 s   | 0.0 s    |
| 98.37 | Speed limit bias                     | 0.01 Hz  | 10.00 Hz   | 1.00 Hz  |
| 99.15 | Encoder PPR                          | 0        | 9999       | 1024     |

### ► Speed Controller

#### 98.14 P–Gain

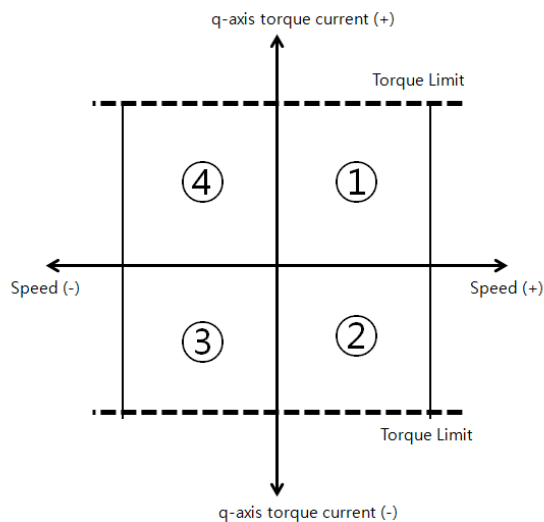
- The larger the P gain value, the faster the response speed.
- Be careful because too high P–gain value may cause vibration or overshoot.

### 98.15 I-Gain

- The larger the I gain value, the faster the response speed.
- Be careful because too high I-gain value may cause vibration or overshoot.

### ► Torque Limit

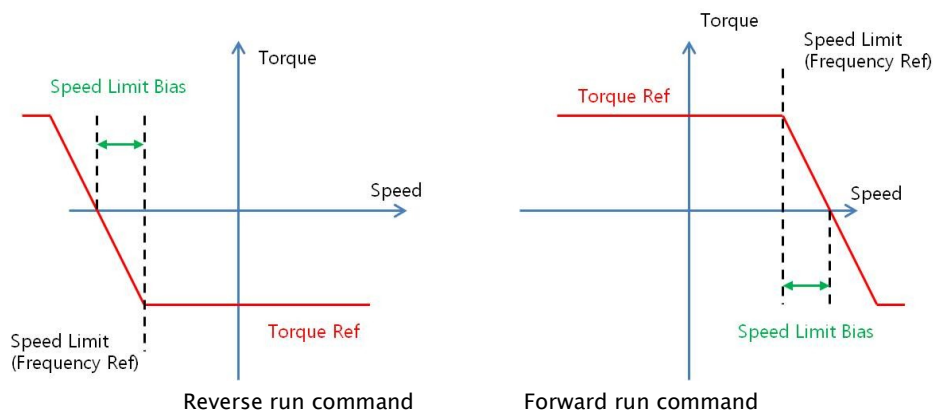
- As shown in the figure below, when the motor is driven in the forward or reverse direction, you can set the motoring and regenerative torque limits.



- Forward Motoring Torque limit :  $\sqrt{i} \times \text{motor rated current} \times 98.16 \%$
- Forward Regeneration Torque limit :  $\sqrt{2} \times \text{motor rated current} \times 98.17 \%$
- Reverse Motoring Torque limit :  $\sqrt{2} \times \text{motor rated current} \times 98.18 \%$
- Reverse Regeneration Torque limit :  $\sqrt{2} \times \text{motor rated current} \times 98.19 \%$
- Zero Speed Motoring Torque limit :  $\sqrt{2} \times \text{motor rated current} \times 98.20 \%$
- Zero Speed Regeneration Torque limit :  $\sqrt{2} \times \text{motor rated current} \times 98.21 \%$

### ► Torque Mode Operation

- In case torque control mode is set using 98.30 code, torque limit(98.16~98.21) is set as torque reference and speed reference is set as speed limit. The speed limit bias set in code 98.37 reduces the torque command near the speed limit to prevent infinite acceleration of the motor. Please note that if the speed limit bias is small, system failure may occur due to sudden torque change.



## 8.2.30 Motor data

### ● 99.01 Motor capacity

- 2.2kW, 3.7kW, 5.5kW, 7.5kW, 11kW, 15kW, 18.5kW, 22kW, 30kW, 37kW, 45kW, 55kW, 75kW, 90kW, 110kW, 132kW, 160kW, 200kW, 220kW, 250kW, 280kW, 320kW, 350kW
- Initial value: depend on VFD models

Program a capacity of motor  
 Ex) 30L: 30kW–200V, 30H: 30kW–400V

### ● 99.02 Motor rated voltage

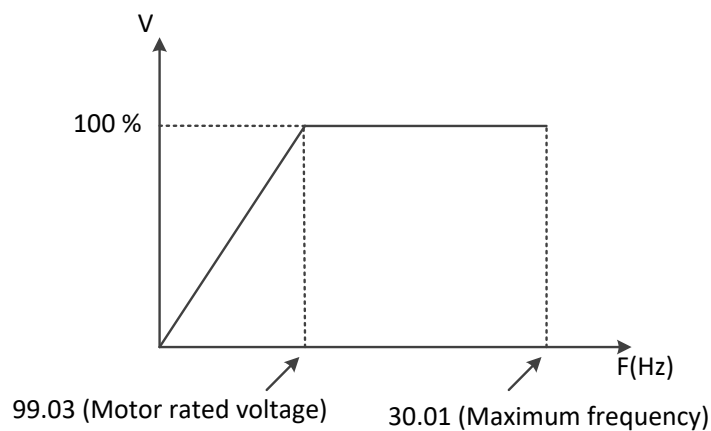
- 200V Class setting: 200/220/230/240
- 400V Class setting: 380/400/415/440/460/480
- Initial value: depend on VFD models

Program a rated voltage of the motor nameplate

### ● 99.03 Motor rated frequency

- Range: 0.00 ~ 400Hz in 0.01 Hz
- Initial value: 60.00 Hz

Program a rated frequency of the motor nameplate



### ● 99.04 Motor rated current

- Range: 0.1 ~ 800.0 A in 0.1 A
- Initial value: depend on VFD models

Program a rated current of the motor nameplate

● **99.05 Motor flux current**

- *Range: 0.1 ~ 400.0 A in 0.1 A*
- *Initial value: depend on VFD models*

Program the no load (flux) current value

Not all motors will have this information on the nameplate

✧ The value is approximately 30% of rate current

● **99.06 Motor rated slip**

- *Range: 0.01 ~ 10.0 % in 0.1 %*
- *Initial value: depend on VFD models*

Program the slip percent of the motor rated nameplate rpm

Rated slip frequency: [(rated speed – speed of nameplate) / rated speed] x 100

Ex) [(1800rpm – 1750rpm) / 1800rpm] X 100 = 2.78%

● **99.07 Motor Pole setting**

- *2: 2 Poles*
- *4: 4 Poles ----- Initial value*
- *6: 6 Poles*
- *8: 8 Poles*

Program a number of poles to the corresponding motor used with the VFD

*Ex1) 2 Poles for 3600rpm (60Hz), 3000rpm (50Hz)*

*Ex2) 4 Poles for 1800rpm (60Hz), 1500rpm (50Hz)*

*Ex3) 6 Poles for 1200rpm (60Hz), 1000rpm (50Hz)*

*Ex4) 8 Poles for 900rpm (60Hz), 750rpm (50Hz)*

● **99.08 Auto tuning**

- *0: Disable ----- Initial value*
- *1: Enable*

Program to enable auto tuning function

Motor parameters are calculated using the internal auto tuning algorithm and automatically set for sensorless vector control design

Auto tuning process

1. Put the data at '**99.01' (Motor capacity) ~ '99.07' (Motor Pole setting)**
2. Set 1 at '**99.08' (Auto tuning)**
3. Push the Run button on the keypad

- Complete successful: 

- Occurred error: 

- **99.09 Motor data selection**

- *0: Standard motor data ----- Initial value*
- *1: Auto tuning data*

Program to select between standard motor data and auto tuned data

- **99.10 Motor resistance R1**

- *Range: 0.1 ~ 30.0 Ohm in 0.001 Ohm*
- *Initial value: depend on VFD models*

The initial value is Hyundai motor data

- **99.11 Transient inductance**

- *Range: 0.01 ~ 100.0 mH in 0.01 mH*
- *Initial value: depend on VFD models*

The initial value is Hyundai motor data

- **99.12 Motor resistance R1 (Auto tuned data)**

- *Range: 0.1 ~ 30.0 Ohm in 0.001 Ohm*
- *Initial value: depend on VFD models*

Value determined during auto tuning process

- **99.13 Transient inductance (Auto tuned data)**

- *Range: 0.01 ~ 100.0 mH in 0.01 mH*
- *Initial value: depend on VFD models*

Value determined during auto tuning process

- **99.15 Encoder PPR(Pulsea per revolution)**

- *Range: 0 ~ 9999*
- *Initial value: 1024*
- *Encoder option required*

- **99.16 Encoder direction setting**

- *0: Counterclockwise ----- Initial value*
- *1: Clockwise*
- *Encoder option required*

- **99.17 Encoder low pass filter time constant**

- *Range: 0 ~ 10000 ms*
- *Initial value: 0 ms*
- *Encoder option required*

A low-pass filter can be applied to the motor speed measured by the encoder. To prevent speed hunting due to noise, set the filter time constant. In vector control, feedback speed delay may cause controller divergence, so set it to 0msec as much as possible

- **99.18 Encoder frequency deviation error frequency**

- *Range: 0.00 ~ 10.00 Hz*
- *Initial value: 3.00 Hz*
- *Encoder option required*

- **99.19 Encoder frequency deviation error detection time**

- *Range: 0.0 ~ 10.0 sec*
- *Initial value: 0.0 sec*
- *Encoder option required*

During vector control operation, if the difference between the speed reference and the actual motor speed measured by the encoder is greater than the value set in code 99.18 and maintained for the time set in code 99.19, the inverter stops and displays an error.

- **99.20 Over speed error detection level**

- *Range: 100.0 ~ 120.0 %*
- *Initial value: 110.0 %*
- *Encoder option required*

- **99.21 Over speed error detection time**

- *Range: 0.0 ~ 3.0 sec*
- *Initial value: 0.0 sec*
- *Encoder option required*

During vector control operation, if the actual motor speed measured by the encoder is higher than [Speed reference \* "99.20"] and maintained for the set time "99.21", the inverter stops and an error is displayed.

- **99.22 Encoder pulse error detection method select**

- *0: Disable detection ----- Initial value*
- *1: Detection all encoder pulse error*
- *2: A and B all pulse error*
- *3: A or B pulse error*
- *Encoder option required*

- **99.23 Encoder pulse error detection time**
  - *Range: 0.0 ~ 60.0 sec*
  - *Initial value: 3.0 sec*
  - *Encoder option required*

## 9. Checking and Trouble shooting

### 9.1 Error code

#### 9.1.1 Error code list

| Name                  | Cause(s)                                                                                                                                                                                                                                | Error Code |
|-----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|
| Over Current          | When the VFD output current exceeds the rated current by more than approximately 200% during the motor locked or reduced in speed. Protection circuit activates, halting VFD output.                                                    | oC         |
| Short Circuit         | The VFD output was short-circuited.<br>This condition causes excessive current for the VFD, so the VFD output is turned off.                                                                                                            | oC or SC   |
| Motor Overload        | When the VFD output current causes the motor to overload, the electronic thermal trip in the VFD cuts off the VFD output.                                                                                                               | EtH        |
| VFD Overload          | The power IGBT is protected from over heat. The operating time of VFD is 1 minute with 150% load of HD or 120% load of ND.<br>The operating time is changed depending on carrier frequency, load, ambient temperature and power rating. | IoLt       |
| DC link Over Voltage  | If regenerative energy from the motor or the main power supply voltage is high, the protective circuit activates to cut off the VFD output when the voltage of DC link exceeds the specification                                        | ov         |
| DC link Under Voltage | When input voltage drops below the low-voltage detection level, the control circuit does not function normally.<br>So when the input voltage is below the specification, the VFD output is cut off.                                     | Lv         |
| EEPROM Error          | The VFD output is cut off when EEPROM in the VFD has an error due to external noise, excessive temperature rise, or other factor                                                                                                        | E2PE       |
| Communication Error   | Communication error between VFD and its operator.<br>If the Reset signal persists for more than 4 seconds, it will occur.                                                                                                               | CE         |
| IGBT Over Temperature | When the temperature in the main circuit increases due to cooling fan stop, the VFD output is cut off.<br>(only for the model type with cooling fan)                                                                                    | ot         |

| Name                             | Cause(s)                                                                                                                                                                                                            | Error Code |
|----------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|
| Input Phase Loss                 | A function that detects phase loss in the input AC source. Detection is performed using the fluctuation in the main circuit's DC voltage. Also, in the case of degradation of main capacitors it could be occurred. | PF         |
| Ground Fault                     | When ground fault is detected on running condition, the output is cut off.                                                                                                                                          | GF         |
| Fan Fault                        | The Fan fault is indicated when the fan is not rotated                                                                                                                                                              | FF         |
| OVS control fail                 | The OVS output frequency is higher than maximum OVS output frequency during the setting time when the OVS function is enabled                                                                                       | ovSF       |
| External Event                   | When the external equipment or unit has an error, the VFD receives the corresponding signal and cuts off the output.                                                                                                | EE1~EE5    |
| Safety input trip                | When the terminal of safety has opened                                                                                                                                                                              | SAFE       |
| System Overload Detection Fault  | The output current of the drive is greater than the detection level set for this feature when it enabled                                                                                                            | oLdt       |
| System Underload Detection Fault | The output current of the drive is less than the detection level set for this feature when it enabled                                                                                                               | uLdt       |
| Braking Resistor Overload Trip   | When DBR exceeds the duty cycle of the braking resistor this fault will occur. The circuit is designed to calculate and protect the braking resistor from thermally overheating                                     | brot       |
| Running Time Out Trip            | When using the inverter beyond the set maximum operating time                                                                                                                                                       | dL         |
| CC-Link Communication Trip       | In case communication error is detected for 2 seconds when CC-Link option card is used                                                                                                                              | FE3        |
| Encoder Frequency Deviation Trip | When using the encoder option card, if it exceeds the set speed deviation and is maintained for as long as the detection time                                                                                       | dEv        |
| Encoder Overspeed Trip           | When the encoder option card is used, if it exceeds the set overspeed level and is maintained for as long as the detection time                                                                                     | oS         |
| Encoder Pulse Error1 Trip        | When using an encoder option card, if both A and B pulses of the encoder or encoder option card remain uninput for the detection time                                                                               | EnC1       |
| Encoder Pulse Error2 Trip        | When using an encoder option card, if only one of the A or B pulses is input and maintained for as long as the detection time                                                                                       | EnC2       |

## 9.2 Trouble Shooting

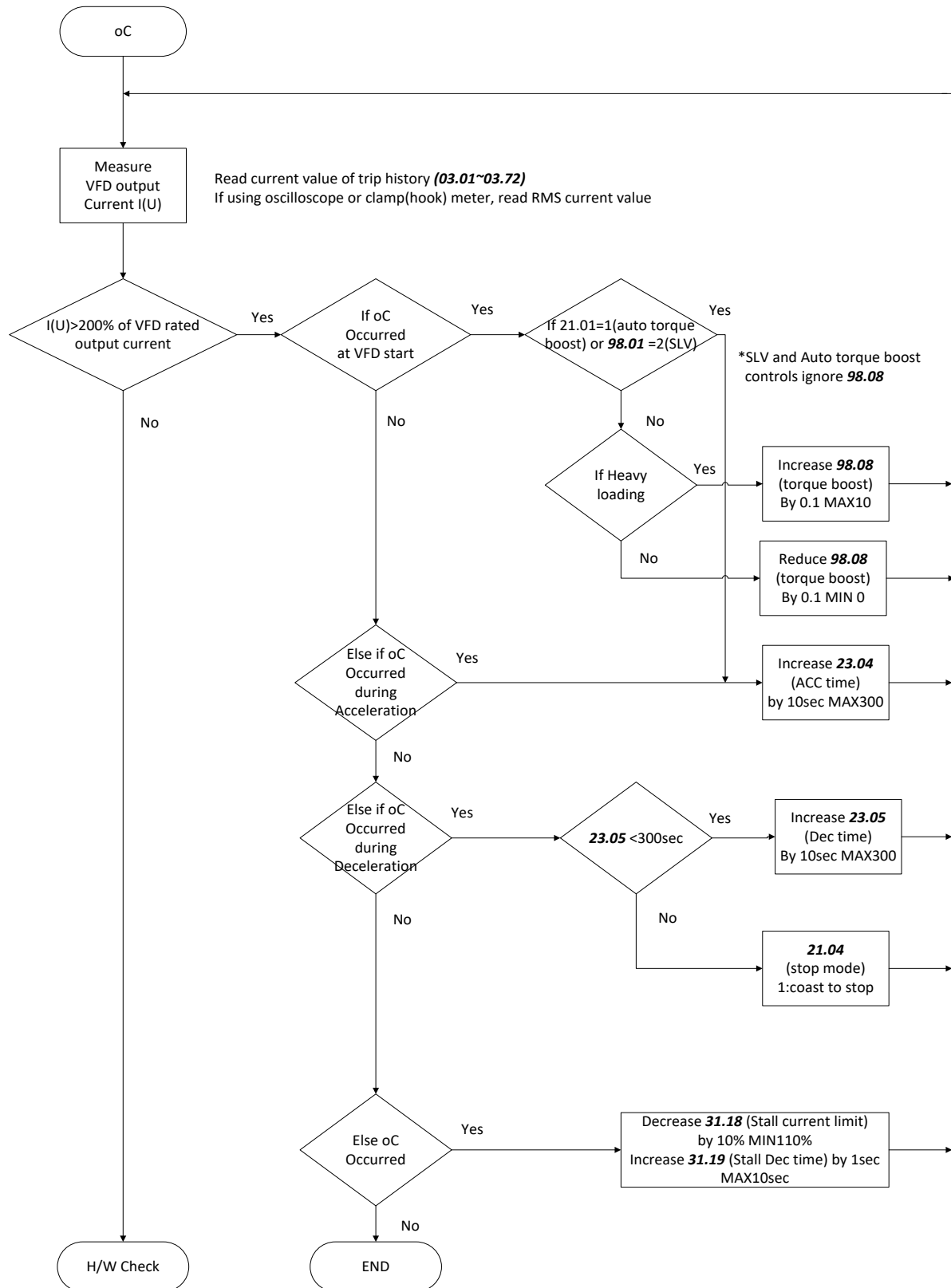
### 9.2.1 Trip monitor display

- Display the trip source and operation status when occurred the trip
- Display until the previous five trip event in *'03.13' ~ '03.72'*
- Each trip contents are displayed below flow
  - 1) Source of trip
  - 2) Frequency at trip
  - 3) Current at trip
  - 4) Vdc at trip
  - 5) Running status at trip
  - 6) DI status at trip
  - 7) DO status at trip
  - 8) Temperature at trip
  - 9) Torque at trip

| Trip event     | Contents                 | Description                                                                                |
|----------------|--------------------------|--------------------------------------------------------------------------------------------|
| Trip monitor 1 | <i>'03.13' ~ '03.24'</i> | Source, Frequency, Current, Vdc, Running status, DI status, DO status, Temperature, Torque |
| Trip monitor 2 | <i>'03.25' ~ '03.36'</i> | Same with the Trip monitor 1                                                               |
| Trip monitor 3 | <i>'03.37' ~ '03.48'</i> | Same with the Trip monitor 1                                                               |
| Trip monitor 4 | <i>'03.49' ~ '03.60'</i> | Same with the Trip monitor 1                                                               |
| Trip monitor 5 | <i>'03.61' ~ '03.72'</i> | Same with the Trip monitor 1                                                               |
| Trip counter   | <i>'03.73'</i>           | Displays the trip accumulation count                                                       |

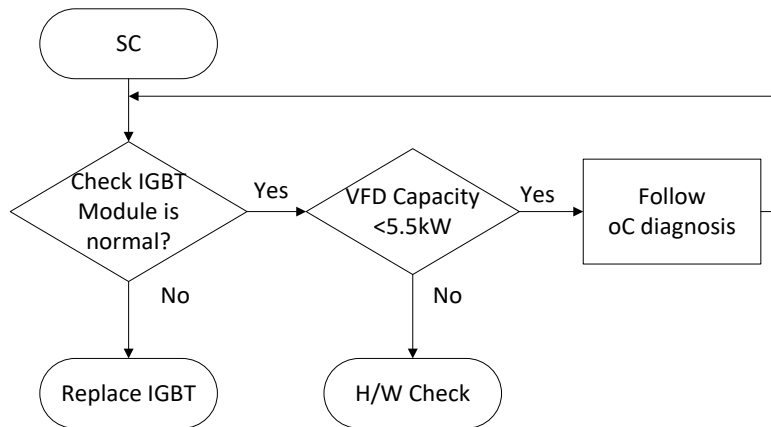
## 9.2.2 oC (Over Current)

### 1) Diagnostic flow chart



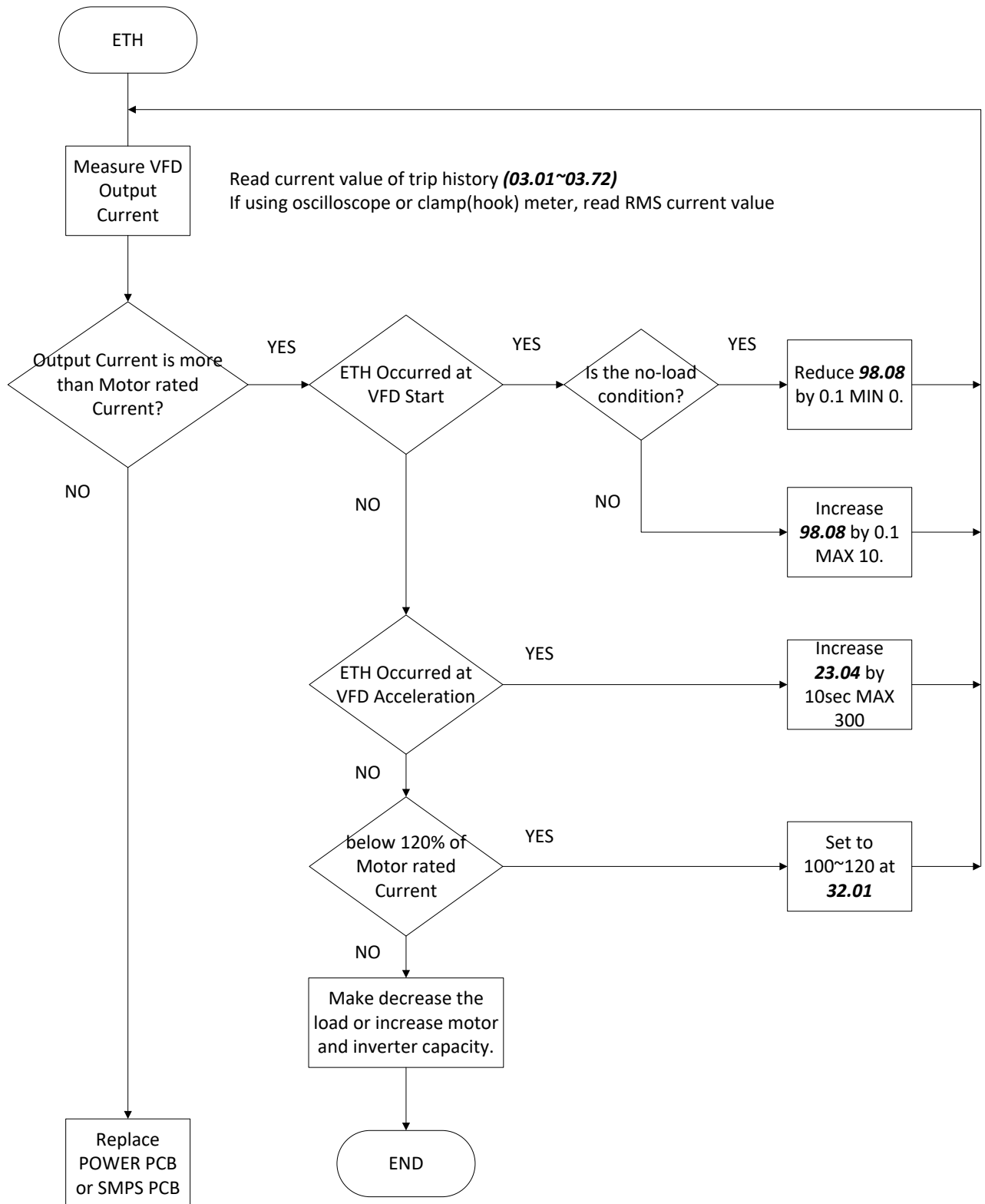
### 9.2.3 SC (Short Circuit)

#### 1) Diagnostic flowchart



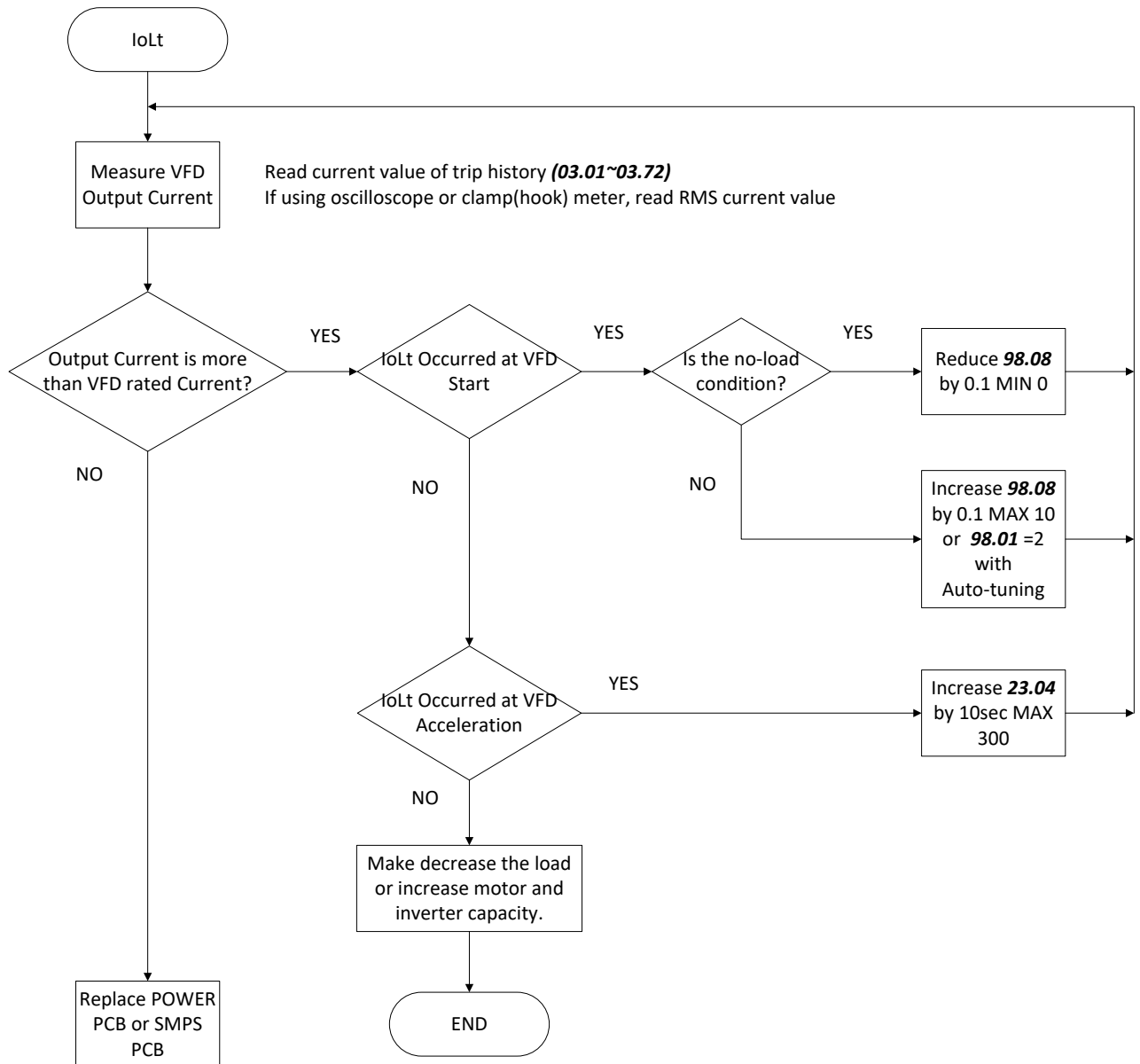
## 9.2.4 ETH (Motor Overload)

## 1) Diagnostic flowchart



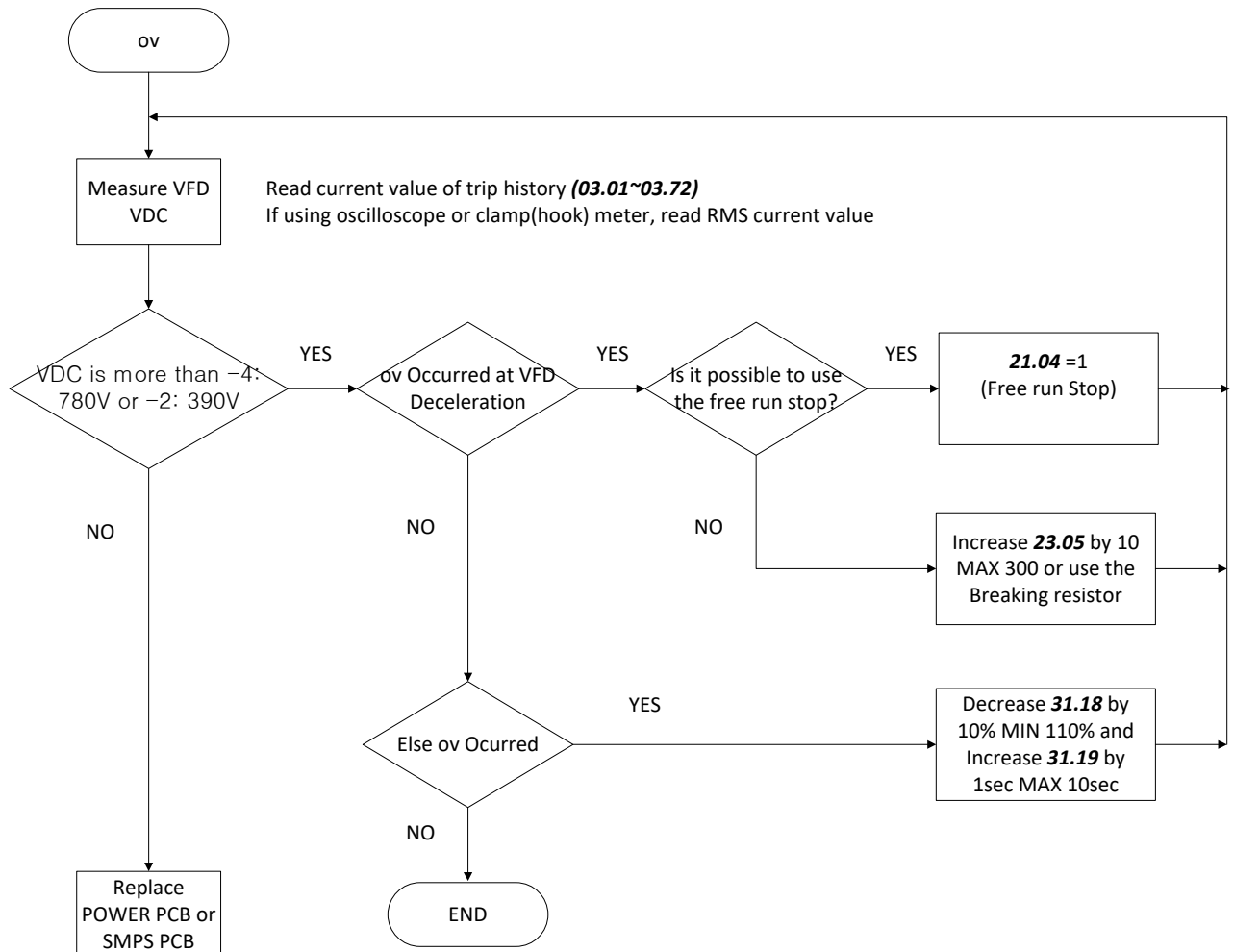
## 9.2.5 IoLt (VFD Overload)

### 1) Diagnostic flowchart



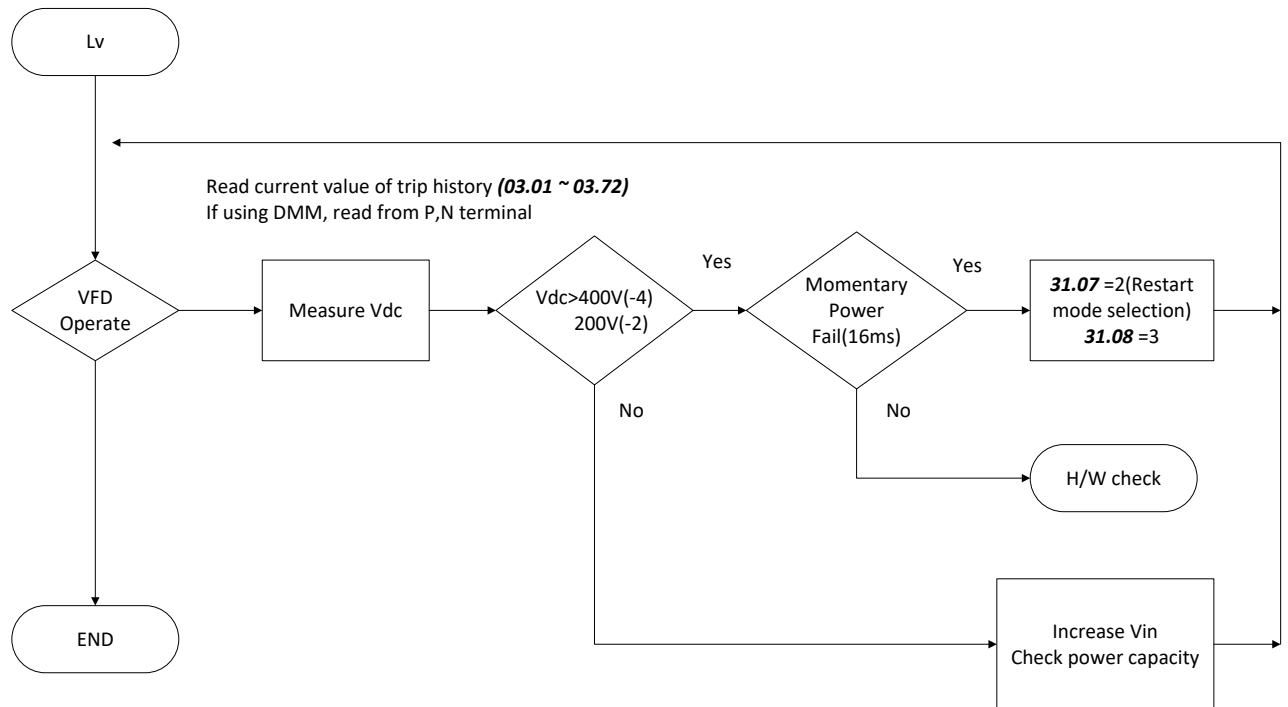
## 9.2.6 ov (DC link Over Voltage)

### 1) Diagnostic flow chart



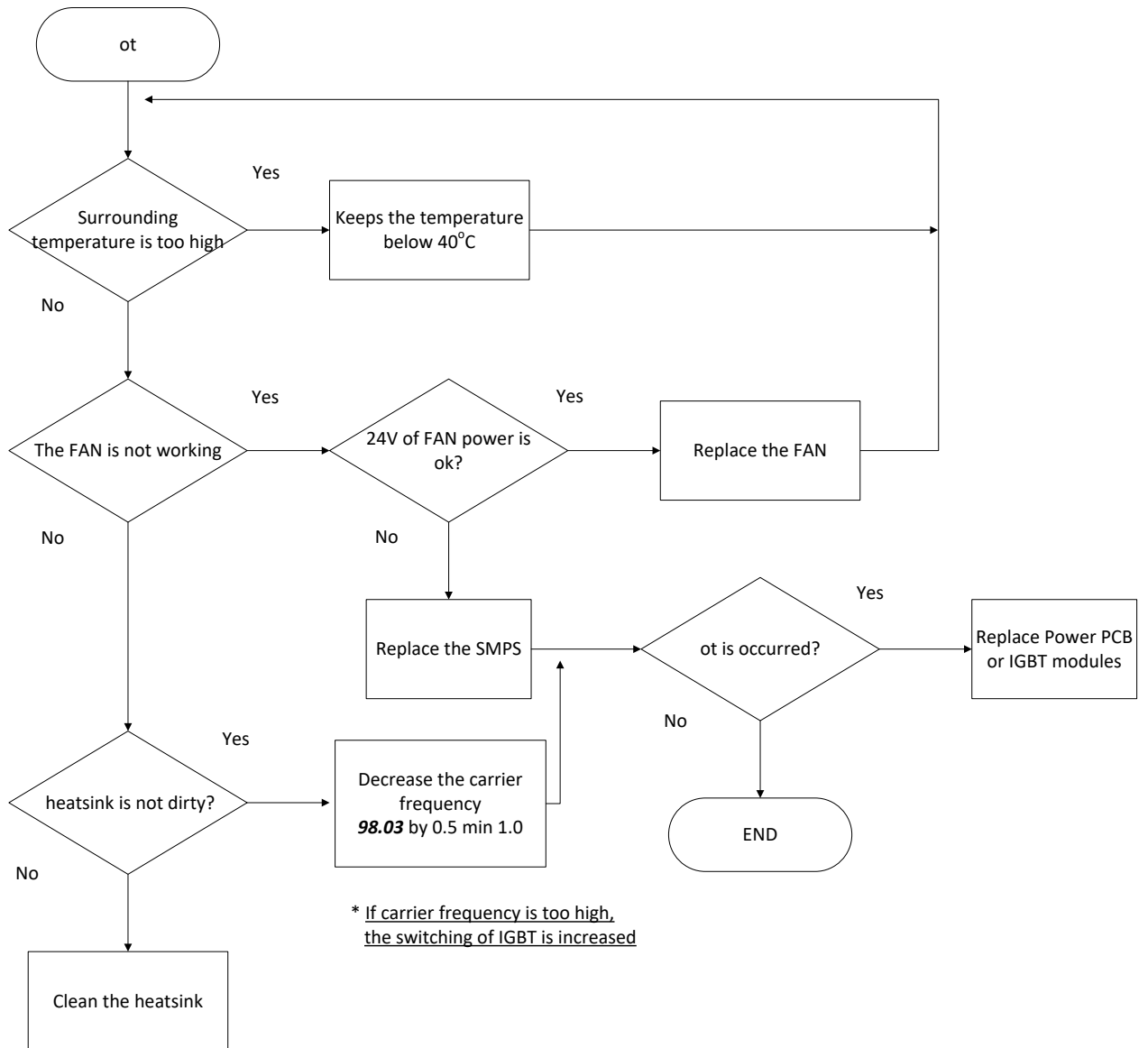
## 9.2.7 Lv (DC link Under Voltage)

## 1) Diagnostic flow chart



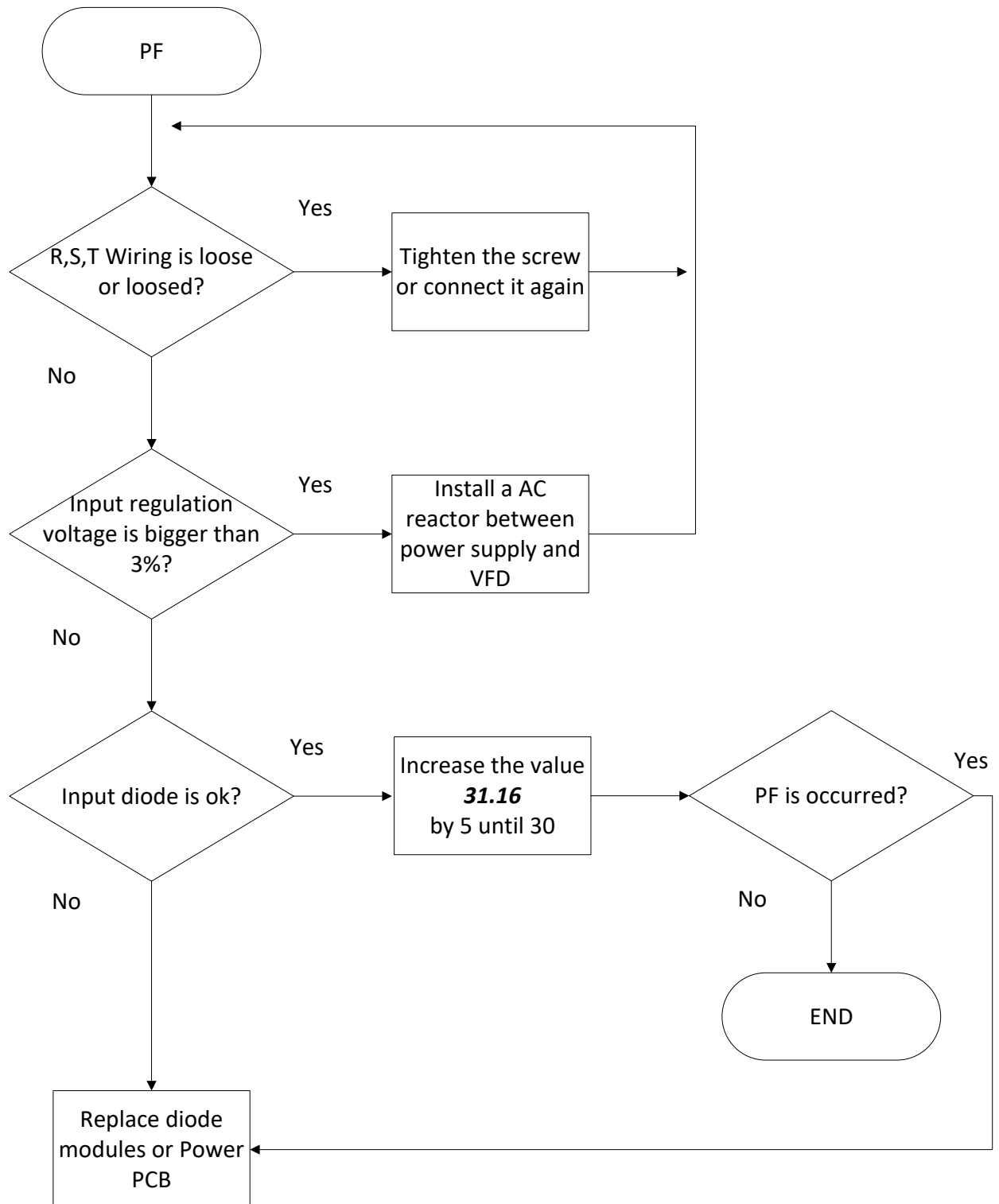
## 9.2.8 ot (Over Temperature)

## 1) Diagnostic flow chart



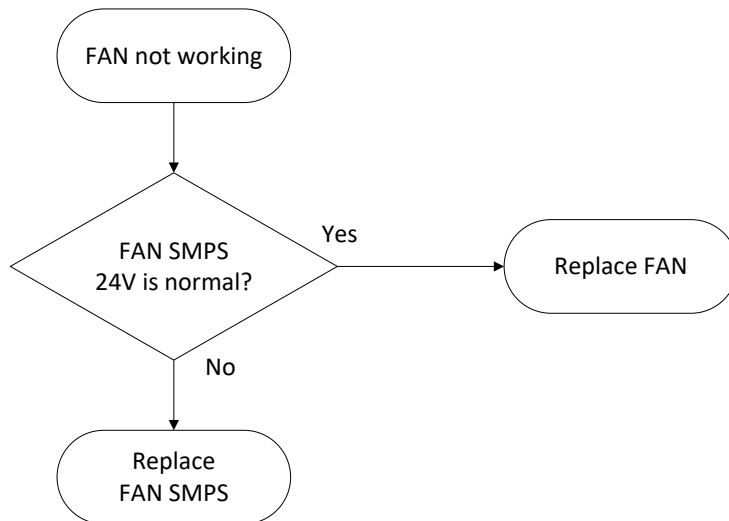
## 9.2.9 PF (Input Power Loss)

## 1) Diagnostic flow chart



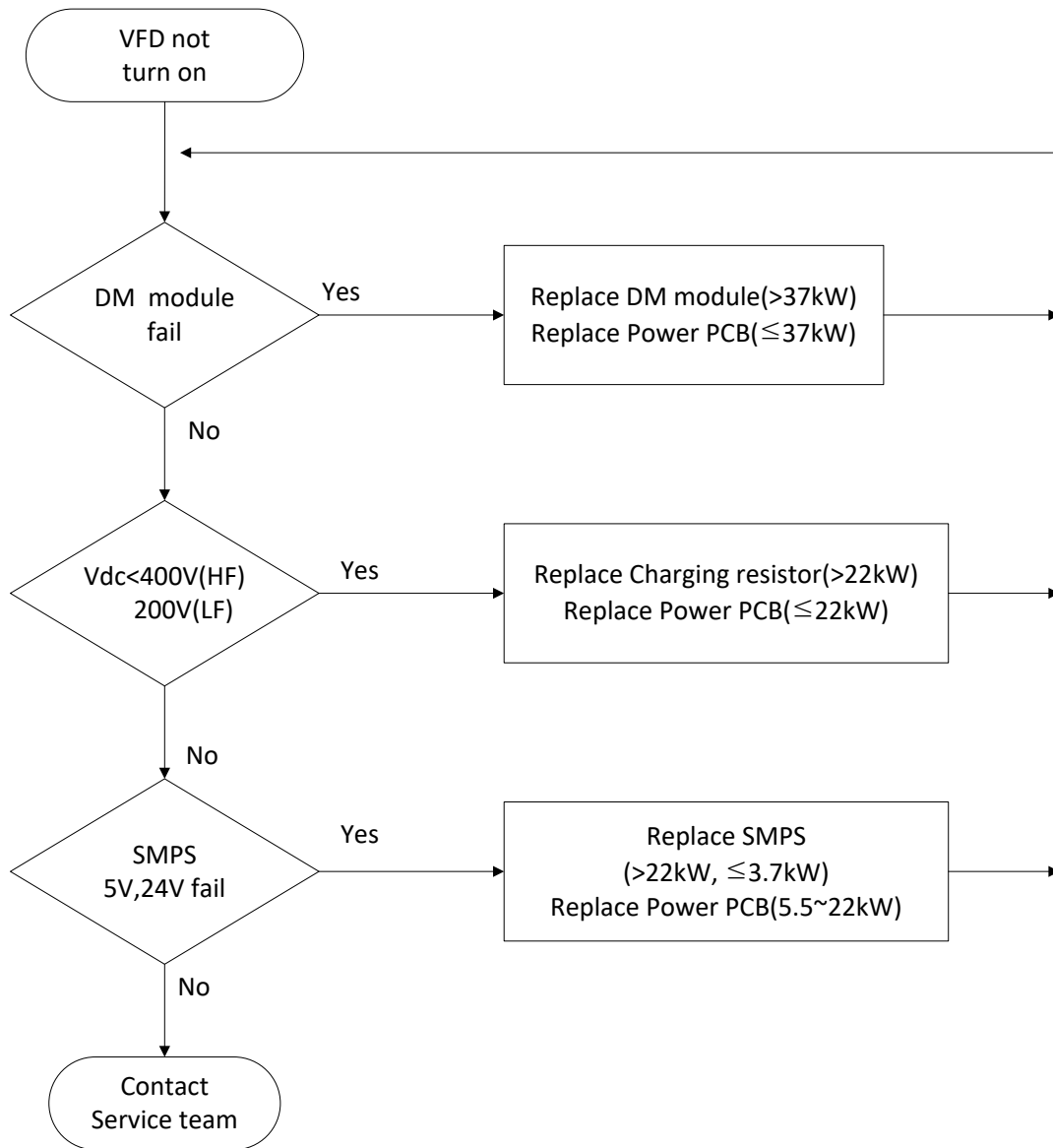
### 9.2.10 FF (Fan Fault)

#### 1) Diagnostic flow chart



## 9.2.11 VFD doesn't turn on

## 1) Diagnostic flow chart



# 10. Functional Safety

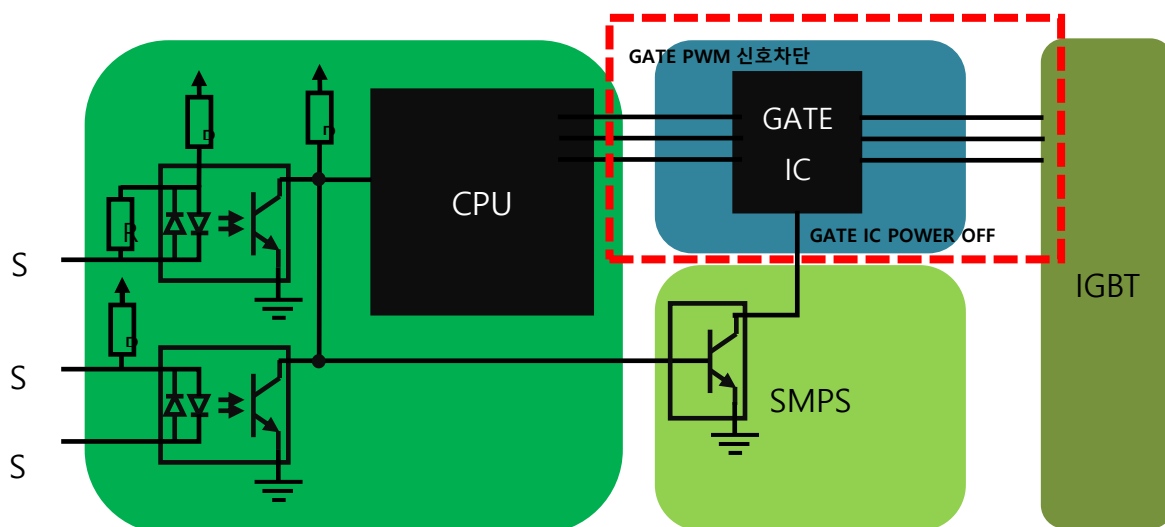
## 10.1 Functional Safety

### 10.1.1 Safety standard product

- A1 offers safety option to reduce the risk of an emergency situation by off the VFD output to protect the operator when using the machine. Performance level of safety features are as follows
  - EN 61508: SIL 2
- When using the safety function, make sure that the system of risk assessment need to be carried out and if it meets the safety requirements
- Operating wiring or maintenance, VFD must be turned off  
Safety function is not electrically isolated or completely blocks the power of motor

### 10.1.2 Safety function description and wiring diagram

- Safety function is STO function to cut off power supply from motor (Cutting off VFD output current) by impeding gate with hard-wired and not to cause a torque
- VFD cut off output when SA input closed or SB input open
- STO function has 2 channels (SA, SB) the input signal is connected to independently. The signal cut off the output of the VFD control circuit drive signal and power module. During operation, safety function is activated, the VFD cut off the output and the status of motor is "Free run" and message is displayed on the keypad ("Safety Opt Err" message) to turn off the trip, when VFD of state is normal, press the reset key





|                                   |                                  |                          |  |
|-----------------------------------|----------------------------------|--------------------------|--|
| <b>Maker</b>                      | <b>Advanced Drive Technology</b> | <b>Installation Date</b> |  |
| <b>Model No.</b>                  | <b>imaster – A1</b>              | <b>Warranty Period</b>   |  |
| <b>Customer Information</b>       | <b>Name</b>                      |                          |  |
|                                   | <b>Address</b>                   |                          |  |
|                                   | <b>Tel.</b>                      |                          |  |
| <b>Sales Office (Distributor)</b> | <b>Name</b>                      |                          |  |
|                                   | <b>Address</b>                   |                          |  |
|                                   | <b>Tel.</b>                      |                          |  |

- Warranty period is 12 months after installation or 18 months after manufactured when the installation date is unidentified. However, the guarantee term may vary on the sales term

**IN-WARRANTY service information**

- If the defective part has been identified under normal and proper use within the guarantee term, contact your local authorized ADT distributor or Service center

**OUT-WARRANTY service information**

- The guarantee will not apply in the following cases, even if the guarantee term has not expired
  - Damage was caused by misuse, negligence or accident
  - Damage was caused by abnormal voltage and peripheral device' malfunction (failure)
  - Damage was caused by an earthquake, fire, flooding, lightning, or other natural calamities
  - When ADT nameplate is not attached
  - When the warranty period has expired

## *Revision History*

| No | Date    | Edition                 | Changes                                                                                                                                                                                                            |
|----|---------|-------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1  | 2016.06 | First Edition           | –                                                                                                                                                                                                                  |
| 2  | 2016.12 | 2 <sup>nd</sup> Edition | Add 5.5~22kW(HD) Specification, DBR Duty cycle                                                                                                                                                                     |
| 3  | 2017.05 | 3 <sup>rd</sup> Edition | Add Quick start guide                                                                                                                                                                                              |
| 4  | 2020.04 | 4 <sup>th</sup> Edition | Add PID Function, KEB Function                                                                                                                                                                                     |
| 5  | 2021.01 | 5 <sup>th</sup> Edition | Add LCD KEYPAD MAP, Motor Control Method(VECTOR)                                                                                                                                                                   |
| 6  | 2022.10 | 6 <sup>th</sup> Edition | Add LV Trip level, CC-link, Encoder, ETH Trip Off, Vector Control, Emergency Dec Stop mode, Modify Reset Terminal Detect, Modify Stall Level, Add Start Frequency, DI input Filter Constant initial value set 10ms |
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