Fuji Electric

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QUICK GUIDE
PUMP CONTROL

FRENIC-Multi

High performance Compact Inverter

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1.0.0	Draft		J. M. Ibáñez	J. Català	
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Thank you for purchasing ***FRENIC-Multi***, Fuji Electric's high performance compact inverter. This guide is structured as follows:

Chapter 0
Introduction to pressure control systems

The target of a pressure control system is to provide a variable flow with a constant pressure for the water system of an apartment building, machine refrigeration systems, mixing liquids in chemical industry, etc.

A very typical example is providing the water supply for a residential building. In this case, the flow (water consumption) is greater in the morning than during the night (when it is almost zero). The pressure control system must be able to provide, at the same pressure, both types of consumption (Daytime→higher flow, and during the night→ almost no flow); in addition, the system has to adapt to the demand variations that occur normally in this kind of application, for example, when people turn taps ON and OFF at the same time.

The ***FRENIC-Multi*** inverter has been provided with some useful functions to fulfill the requirements of a pump control system. Some of its more important functions are:

- Stop function due to low water flow (Sleep Function)
- Start-up function because of water demand (Wake-up Function)
- Operational limits (current, voltage and frequency) to protect the motor and the pump
- Possibility to add an additional pump (FDT Function)
- Many functions to avoid overpressure and water losses (Warnings, alarms, etc.)
- Pressure sensor disconnection detection
- Selecting different warnings (low-pressure, overpressure, etc.)
- Display units and sensor range adjustments
- Multiple frequency command selection (by means of digital inputs)
- Energy Saving Functions

Regulation by means of PID control:

A PID control is a regulation system involving the set value (SV - desired pressure) and a process value (PV - Feedback, measure of real pressure or flow from a transducer). From these two values the difference, or error, is calculated, subtracting one from the other. The PID control then adjusts its output demand (MV - pump's speed) in order to minimize the error:

-If the error is positive (desired pressure greater than real pressure) speed should increase
-If the error is negative (desired pressure lower than the real pressure) speed should decrease
-If the error is zero (desired pressure equal to real pressure) speed should stay at the same level

Parameters (gains) to adjust: Proportional, Integral and Derivative components (though Derivative component is not normally used in this application) help to set how quickly the system will respond to pressure and consumption changes. Normally, a quick (dynamic) response is desired, but pressure peaks and oscillations must be avoided.

Chapter 1
Single pump control

It is necessary to consider certain parameters in order to allow the inverter to control the pump's start-up and stop, controlling speed to maintain the desired pressure, etc.

The connection diagram to implement single pump control using *FRENIC-Multi* inverter is shown in figure 1.1. Please note that the pressure transducer is connected to the inverter's analog input C1 (4-20 mA).

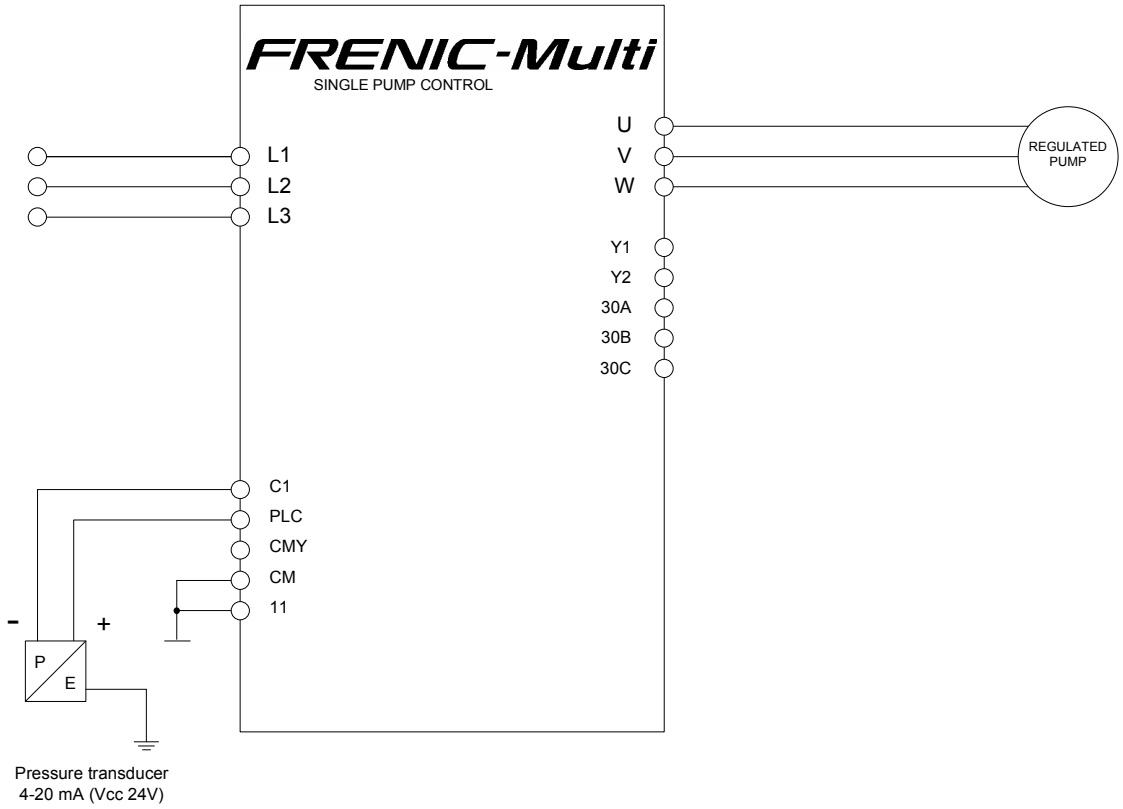


Figure 1.1: Connection diagram for single pump control.

By means of the keypad, digital inputs or analog signal, the pressure set point can be set. Once this pressure is set, inverter will control the pump rotation speed between a minimum (F16 in Hz) and a maximum (F15=F03 in Hz) frequency, in order to stabilize the pressure around the set point value.

To work in this way, the integrated PID control must be enabled (J01) and set properly. Then, the inverter's response will be the required action to control the application.
PID response can be modified by means of parameters J03 and J04 (Proportional gain and Integral time).

When the "RUN" command is given to the inverter (either FWD or REV), the inverter will increase the output frequency. In order to control this frequency rise, some parameters are available: F23 (Hz) determines the starting frequency and F07 (in seconds) the acceleration ramp time. In the same way, when the "RUN" command is removed, the inverter decreases its output frequency to the level defined in F25 (Hz) (the deceleration time is set in F08, in seconds), and stops the PID control.

Sleep Function *(related parameters: J15 in Hz, J16 in seconds)*

Sleep function can be useful to stop one pump when the speed is below a rate where there is no flow (pump doesn't impel).
Once the inverter frequency level below this rate (the frequency value under which the pump moves the water but not enough to create a flow) is known, parameter J15 (Hz) should be set slightly higher than this frequency.

By using this function, is possible to avoid possible mechanical problems that could (after some time) damage pump components or 'boil' the water with the wasted energy causing excess pressure and leaks. In addition, stopping the pump when it's not really needed means, obviously, Energy Saving.
Therefore Sleep Function will be activated if the inverter output frequency is lower than the 'sleep' level set in parameter J15 (Hz) and this condition stays for a time longer than that specified in J16 (s).

In Figure 1.2 the behaviour of the sleep function is shown. The deceleration time to reach the "Stop Frequency" is set in F08 (s).

Important: Sleep frequency (J15 in Hz) must be lower than the wake-up frequency (J17 in Hz) and must be higher than the minimum frequency (F16=J19 in Hz)

Wake-up function *(related parameters J17 in Hz, J23 in %, J24 in seconds)*

The purpose of Wake-up function is to start again the pump that previously was stopped by the sleep function.

In order to wake up a pump, 3 conditions must be accomplished:

MV ≥ J17 (Hz)		**|SV – PV|≥ J23 (%) (*)**		**Delay Time ≥ J24 (s)**
Manipulated value (MV, PID's output) must be greater than the level set in J17 (the current MV value can be read from *3. OPR MNTR* inverter's menu.)	and...	The absolute value of the process error (the subtraction between the process value and the set point value) must be greater than the percentage set in J23	and...	Both conditions must be kept for a time longer than the one specified in J24

(*) J23 is related with E40 and E41 function codes as follows: **(|SV – PV|) / (E40 – E41) ≥ J23 (%)**; E40 and E41 are described on page 15.

As the three conditions have to be met in order for the pump to start, wake-up events due to pipe losses can be avoided. Therefore the inverter does not wake up the pump unnecessarily or too often.

In figure 1.2 is shown how the pump wakes up when accomplishes the three conditions.

Important: Sleep frequency (J15 in Hz) must be lower than the wake-up frequency (J17 in Hz).
In addition, sleep frequency must be higher than minimum frequency (F16 in Hz)

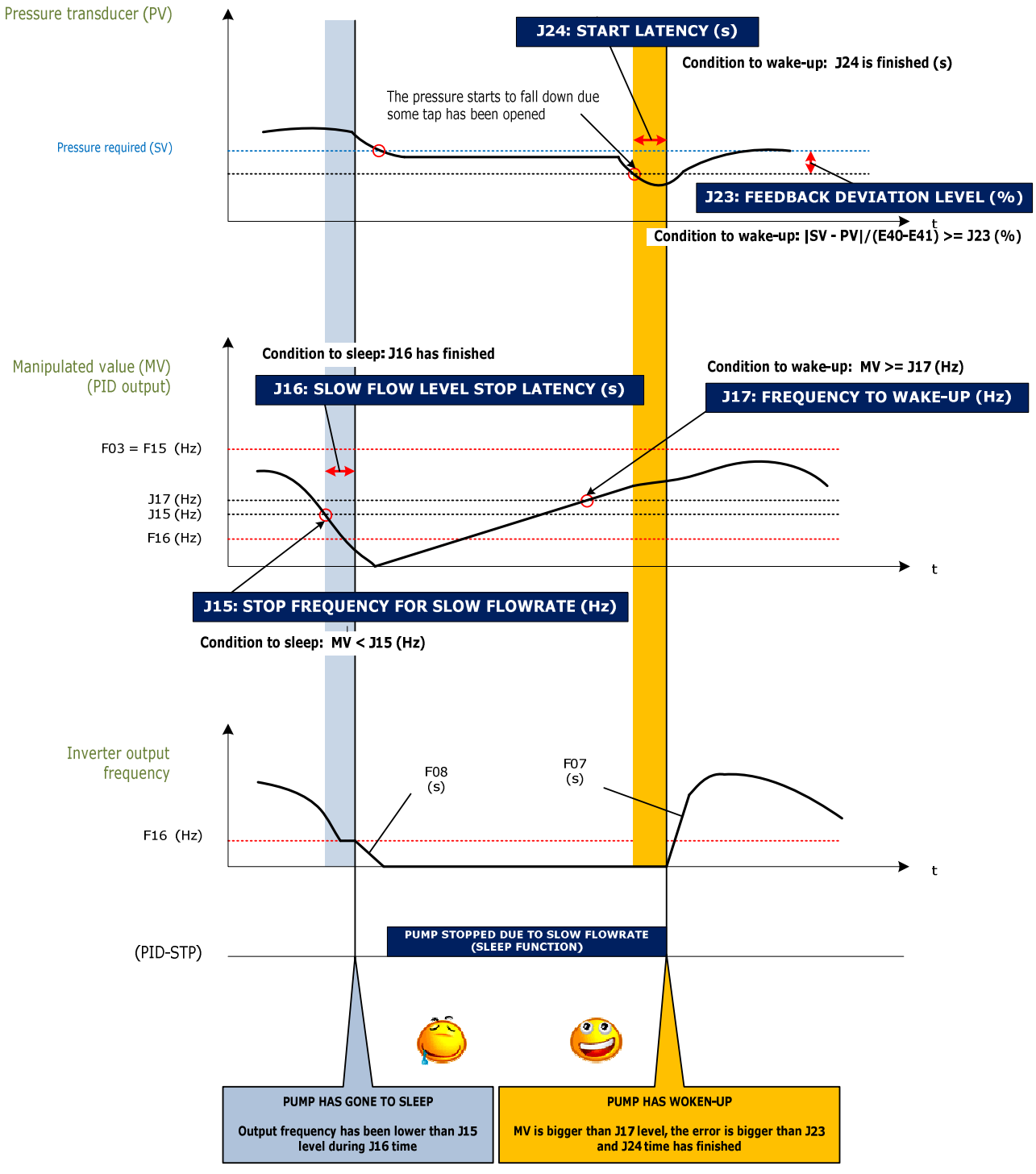


Figure 1.2: Time diagram that describes sleep and wake up functions behaviour

Function codes set-up, 1 pump

The table 1.1, “Parameters Setup in order to control one single pump”, shows the necessary parameters in order to perform a pump control system by means of ***FRENIC-Multi***. These are the basic parameters, common to all pump control systems.

If you are setting up the inverter by means of the TP-M1 keypad, it is recommended to set E52 to “2”, in order to be able to access to all the inverter menus.

Note: The following values are shown as an example and could not work properly in your application.

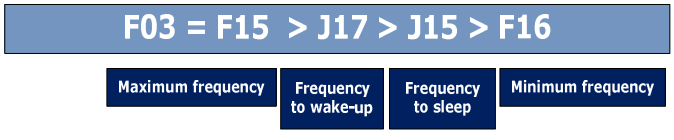
	Parameters setup in order to control one single pump *FRENIC-Multi*			
	Name	Default setting	Example’s Value	**User’s Value**
F02	Run command	2	**1**	
F07	Acceleration Time 1	20.00 s	**3.00 s**	
F08	Deceleration Time 1	20.00 s	**3.00 s**	
F11	Electronic Thermal Overload protection. Overload detection Level	100% of the motor rated current	**13.0 A**	
F12	Electronic Thermal Overload protection. Time constant	5.0 min	**5 min**	
F15	Frequency Limiter. High	70.0 Hz	**50.0 Hz**	
F16	Frequency Limiter. Low	0.0 Hz	**25.0 Hz**	
F26	Motor Sound. Carrier Frequency	15 kHz	**3 kHz**	
E40	PID Display coefficient A	+ 100.00	**Transducer’s pressure**	
E43	LED monitor. Item selection	0	**12**	
E62	Analog Input for [C1]	0	**5**	
P01	Motor. Number of Poles	4	**4**	
P02	Motor. Rated capacity	Rated Capacity Standard Motor	**5.5 kW**	
P03	Motor. Rated current	Rated Current Standard Motor	**13.0 A**	
H91	C1 signal disconnection detection	0.0 s	**0.5 s**	
J01	PID Control. Mode Selection	0	**1**	
J03	PID Control. Gain P	0.100	**2.500**	
J04	PID Control. Gain I	0.0 s	**0.2**	
J15	PID Control. Stop frequency for slow flow rate	0 Hz	**35.0 Hz**	
J16	PID Control. Slow flow rate level stop latency	30 s	**15 s**	
J17	PID Control. Starting Frequency	0 Hz	**38.0 Hz**	
J23	PID Control. Starting From the Slow Flow rate Stop (Dev. Level)	0 %	**5 %**	
J24	PID Control. Starting From the Slow Flow rate Stop (Latency)	0 s	**1 s**	

Table 1.1: Common parameters to all pump control systems

CONDITIONS TO ACHIEVE GOOD CONTROL IN A SINGLE PUMP

If it is necessary to use a different parameter set-up to that shown in the above “Example Values” column, please consider the following conditions:

Sleeping/ Wake-up frequency Conditions



SINGLE PUMP CONTROL PARAMETERS DESCRIPTION

Basic Function

- F02: Run Command

This function code defines the way in what the "RUN" signal will be given to the inverter in order to start the pressure control.

Usually, "Run Command" is given to the inverter by means of the digital input (F02 = 1). That is, switching ON digital inputs FWD or REV (control signal terminals in the inverter) enables the inverter output.

A RUN command can be also activated by means of the keypad, pushing FWD or REV buttons (in TP-G1 keypad) or RUN in TP-M1 keypad.

- F07: Acceleration Time 1
- F08: Deceleration Time 1

These acceleration/deceleration ramps are used in the following cases:

- After the Run Command is ON, F07 ramp is used to achieve the frequency in J19.
- When the Run Command is switched OFF, F08 value defines the deceleration ramp to go from the current frequency to the stop frequency (F25).
- At every change of output frequency, even due to the PID output change.

- F11: Electronic Thermal Overload Protection. Overload detection level
- F12: Electronic Thermal Overload Protection. Thermal time constant

By means of these two parameters is possible to adjust the overload protection function. Normally, F11 will be adjusted to the motor's rated current and F12 to 5 minutes.

- F15: Frequency Limiter. High
- F16: Frequency Limiter. Low

These two parameters define the high and low frequency limits. The output frequency of the inverter will never go outside of these limits during inverter operation.

It's normal to adjust the parameters F15 and F03 with the same value.

Inputs Set-up

- E62: Analog Input for [C1]

This parameter can be used to select the function for analog input [C1].

Usually this parameter is set to E62 = 5, this setting will configure the [C1] analog input as PID Feedback (pressure transducer).

Motor Map

- P01: Motor. Number of poles
- P02: Motor. Rated Capacity
- P03: Motor. Rated Current

In these parameters must be set the number of poles, rated capacity and rated current as are shown in the motor's nameplate.

Special Functions

- H91: C1 Signal disconnection Detection

Disconnection of pressure sensor (cable failure).

When a value is stored in parameter H91 (between 0.1 and 60.0 seconds) the inverter will generate an alarm (**CoF**) when it notices that C1 signal current is missing (C1 current < 2mA) during a time longer than the value in H91.

H91 = 0 → function disabled.
H91 ≠ 0 → function enabled.

PID and pump control

- J01: PID control. Mode selection

When J01 = 1 and the error between Set Point and Process Value is positive (SP - PV > 0), the PID controller makes a positive output action control (increasing MV). Alternatively when the error between Set Point and Process Value is negative (SP - PV < 0), the PID controller makes a negative output action control (decreasing MV).

Alternatively, if J01 = 2 and the error between Set Point and Process Value is negative (SP – PV < 0) the PID controller makes a positive output action control (increasing MV). Alternatively when the error between Set Point and Process Value is positive (SP - PV > 0), the PID controller makes a negative output action control (decreasing MV).

- J03: PID Control. P Gain

This parameter is used to set the PID controller's proportional gain (P). This parameter must be adjusted because its value depends on the application.

A high P value produces a PID controller's quick response. Alternatively, a low P value produces a slow response.

- J04: PID Control. Integral Time I

This parameter is used to adjust PID's integral time (I). This parameter must be adjusted because its value depends on the application

A high integral time value produces a PID slow response. Alternatively, a low I value produces a quicker response.

Chapter 2
Single pump control + 1 additional pump

The connection diagram to implement a single pump control with 1 regulated pump + 1 additional pump with a ***FRENIC-Multi*** inverter is shown in figure 2.1. Please, pay attention on the pressure transducer's wiring, connected to the inverter's analog input C1 (4 – 20 mA).

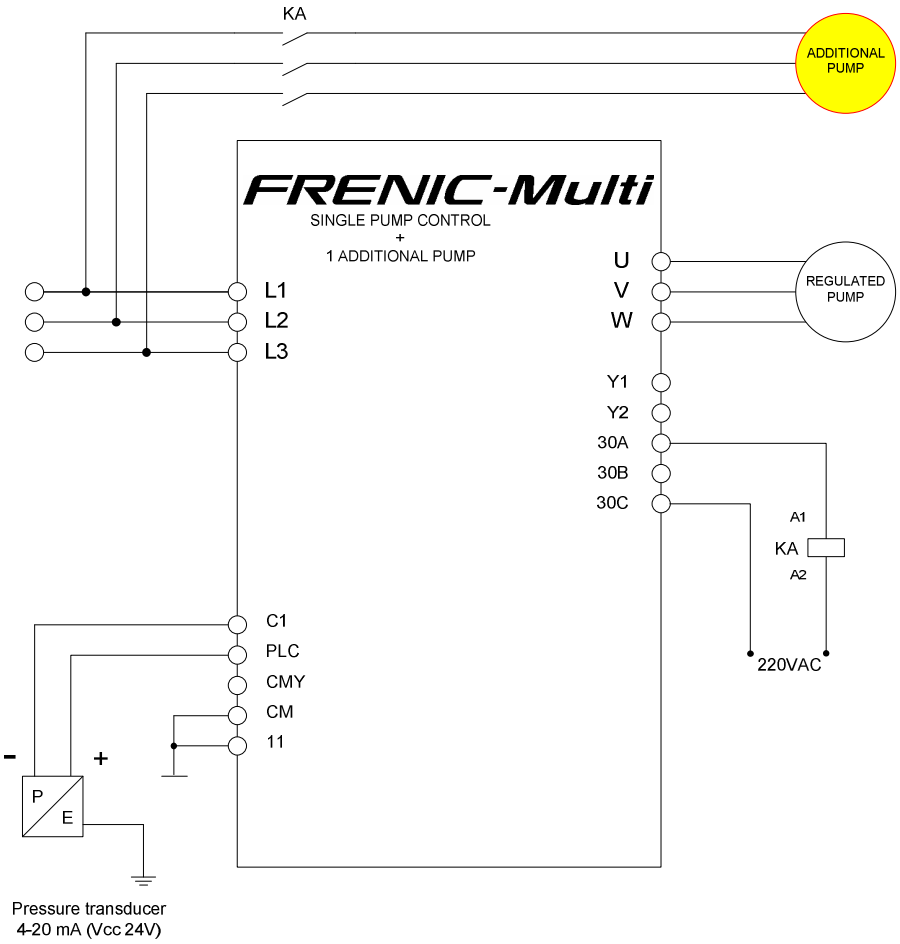


Figure 2.1: Connection diagram for a single pump control + 1 additional pump

This control system consists on a regulated pump controlled exclusively by the inverter and one additional pump working in "ON-OFF control" mode connected directly to the commercial power supply. The inverter will connect/disconnect the additional pump to the commercial power supply in order to achieve the desired pressure.

The additional pump will be connected to the commercial power supply when the inverter output frequency is higher than the value stored in E31 (Hz).

The additional pump will be disconnected from the commercial power supply when the inverter output frequency is lower than E31 – E32 (Hz).

Using this control, the ***FRENIC-Multi*** inverter is able to control up to 2 pumps.

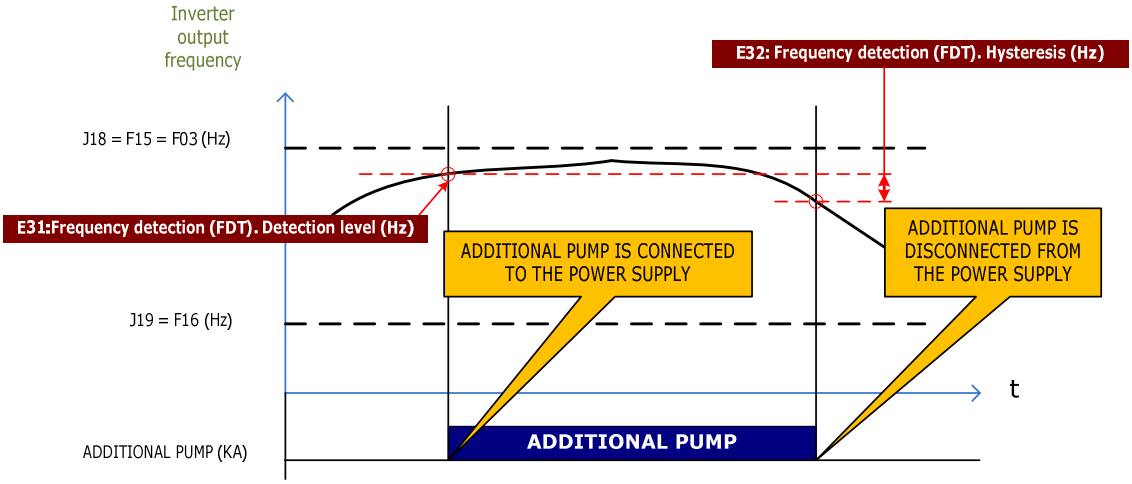


Figure 2.2: Additional pump's connection/disconnection time diagram

Set-up with 1 regulated pump + 1 additional pump

Table 2.1 shows the specific function codes to control a single pump control + 1 additional pump.

	Specific Function Codes for mono-regulated pump control with 1 regulated pump + 1 additional pump			
	Name	Default Setting	Example's value	**User's value**
E27	Status Signal Assignment to 30A/B/C	99	**2 (FDT)**	
E31	Frequency Detection (FDT). Level	50.0 Hz	**47.0 Hz**	
E32	Frequency Detection (FDT). Hysteresis	1.0 Hz	**8.0 Hz**	

Table 2.1: Specific function codes for single pump control + 1 additional pump system

Please consider that, in order to set up correctly the inverter-driven pump, we should use additionally the parameters described in table 1.1.

CONDITIONS TO ACHIEVE GOOD CONTROL WITH A MONO-REGULATED PUMP CONTROL + 1 ADDITIONAL PUMP

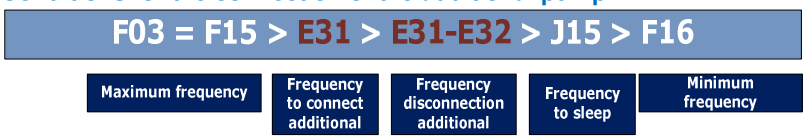
If setting function codes' values different from the "Example's Value" column, it is recommended to keep in mind the following restrictions:

Conditions for Sleep/Wake-up frequency

F03 = F15 > J17 > J15 > F16

Maximum frequency | Frequency to wake-up | Frequency to sleep | Minimum frequency

Conditions for the connection of the additional pump



PARAMETERS DESCRIPTION

Outputs Set-up

- E27: Status Signal Assignment to Y30A/B/C

The function code E27 defines the signal assigned to digital output Y30A/B/C.

In order to implement a mono-regulated pump control system with an additional pump, the Y30A/B/C terminal's signal must be set to 2, corresponding to FDT function.
This digital output should be connected to relay RA (see connection diagram in figure 2.1).
By means of FDT function it is possible to activate the digital output Y30A/B/C when the regulated pump's output frequency raises above the frequency level defined in the function code E31.
Using function code E32 it is possible to define a hysteresis, in order to avoid that the signal Y30A/B/C is switching ON/OFF continuously.

- E31: Frequency Detection (FDT). Level

By means of this function code, it is possible to set the frequency level upon which the FDT signal (function "2") will be activated. Normally, the level set in E31 should be slightly smaller than the value in F03=F15.

In this way, the additional pump will be switched-on when regulated pump is almost at maximum speed.

- E32: Frequency Detection (FDT). Hysteresis

With this parameter it is possible to adjust the hysteresis level for the deactivation of the FDT digital output. The value of E31-E32 must be slightly bigger than the data in J15.

With this setting, it's possible to disconnect the additional pump before being close to the sleeping frequency.

Chapter 3
Additional Functions

Overpressure alarm (related function codes -> J11, J12 and J13)

Target: make the inverter enter a STOP state and display an error code, when the process value (Feedback – pressure transducer) rises above a predefined level.

- Digital Input to use: X4 (with "Enable External alarm Trip" command assigned to it)
- Digital Output to use: Y2 (with "PID Alarm" signal assigned to it)
- Wiring:
  - Connect X4 to Y2
  - Connect CMY to PLC (*)
- Set-up:
  E04 (X4) = *1009: Enable External Alarm Trip (THR)*
  E21 (Y2) = *42: PID Alarm (PID-ALM)*
  J12 = *PID Control. Upper Limit Alarm (AH) (%)*
  J13 = *PID Control. Lower Limit Alarm (AL) (%)*

Error Message: when the process value (Feedback – Pressure transducer) is above the value set in J12 (upper limit) or below the value set in J13 (lower limit), the inverter's output is switched off and the inverter will display *OH2* error code. This error can be reset by means of the keypad or by means of a digital input (*8: "Reset Alarm" (RST)*).

(*) Assuming that the logic of the digital inputs is Active-High Logic (the common of the inputs is PLC (+24VDC) and inputs' logic switch is in SOURCE).
If the common of the inputs is terminal CM (0 VDC) (Active-Low Logic in the inputs), please connect the terminals CMY and CM and set the switch to the SINK position.

Note: In order to select other alarm modes, please see description of function code J11 (PID Control. Select Alarm Output) in the User Manual of the **FRENIC-Multi** inverter.

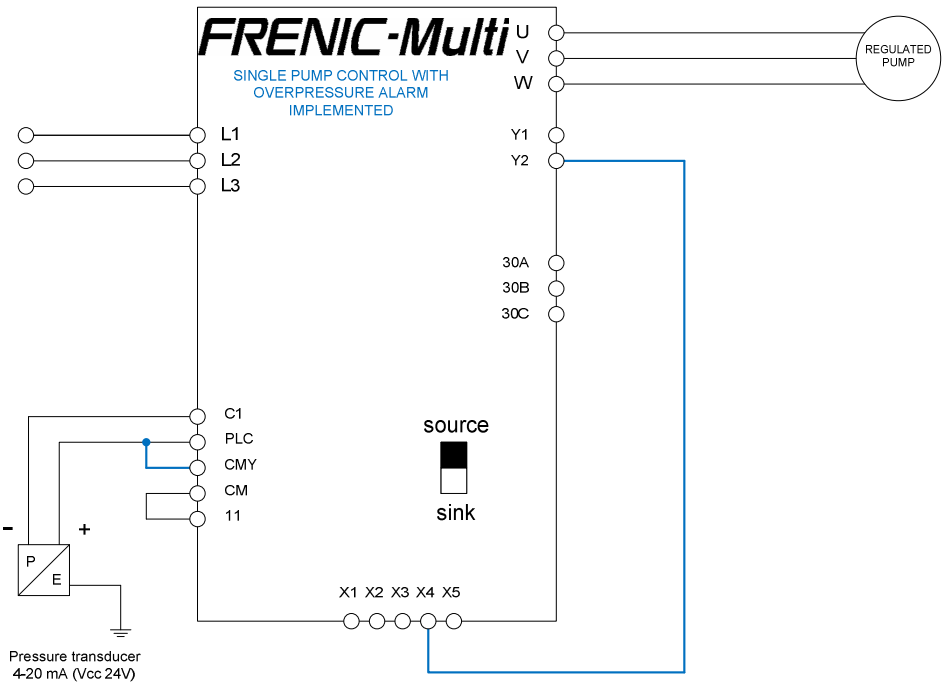


Figure 3.1: Pump Control Schematic for overpressure alarm

PID Display units set-up (related function codes -> E40, E41)

In order to display the values of PID control (SV, PV, MV, etc.) in engineering units, it is needed the adjustment of the value in E40 according to the sensor range.
Therefore the user will be able to enter the Command (set point) Value in user units, instead of percentage (of PID range).

For example, if the transducer used has a 4-20 mA output signal range, where 20mA correspond to 160 bars, the function code E40 must be set to 160.
If the transducer used has a 4-20 mA output signal range, where 20mA correspond to 10 bars, the function code E40 must be set to 10.

The feedback value, in bars, can be seen in parameter *3_11: PID Feedback Value*.
The process command value is displayed in parameter *3_10: PID Process command*.

If you are adjusting the inverter by means of the TP-M1 keypad, it is needed to set E52 to "2" in order to be able to access all the inverter menus.

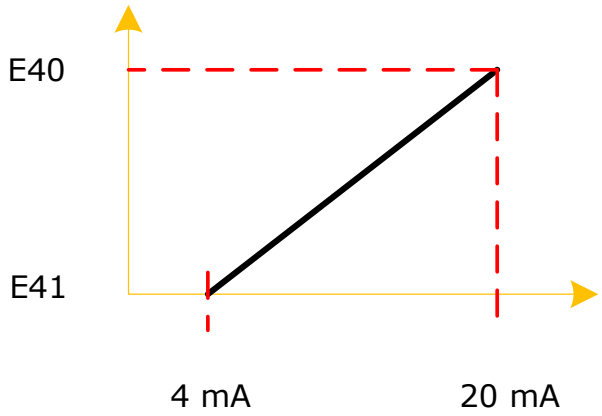


Figure 3.2: PID Display coefficients

Multiple PID set point selection

Using digital inputs, it is possible to select between four PID set point values.
To perform the multiple selection, functions "*2: SS4* " and "*3: SS8* " must be assigned to two digitals inputs among X1, X2, X3, X4 or X5 (using functions E01-E05).
The selected Set Value depends of the combination of these two inputs, as shown in the table 3.1.

SS8	SS4	PID set point selection
0	0	Depending on value J02
0	1	C08 (Hz)
1	0	C12 (Hz)
1	1	C16 (Hz)

Table 3.1: Multiple PID Set Point Selection

To calculate the pressure set point from C08, C12 or C16, please use the following equation:

$$C08, C12, C16 = \frac{Desired\_pressure}{Sensor\_range(E40)} \times Maximum\_frequency(F03)$$

PID Integral component hold

1. Holding PID integral component while pump is in sleep mode

Target: Make the inverter maintain (hold) the PID controller integral component once the regulated pump has gone to sleep.
The main purpose is to avoid overshooting when the pump wakes up.

Applicable when: The installation has a lot of leakage.

Explanation: The pump provides pressure to the installation, and when the pressure command level is reached, and if there is not consumption, the inverter will bring the pump to sleep.
Due to the leakages/losses, the pressure will decrease and the inverter will start up the pump again in order to stabilize it. This cycle can be repeated until real flow consumption appears.

In old installations, this sleep/wake-up cycle is repeated continuously.
If you want to make this repetition slower (to make longer the time between sleep and wake-up), the functions codes J23 and J24 can be useful (two additional conditions to wake up the regulated pump are added).

Normally, by means of using these function codes it is possible to separate the sleep and wake-up events. The idea is to increase J23 (% of error) until the time between sleep and wake-up is long enough.

But, what happens if the value in J23 is too high?

…of course, the pump's wake-up will be delayed enough, but the accumulated process error will cause a bigger integral action, producing a pressure overshoot when the regulated pump wakes up.
The pressure overshoot varies depending on each application, and it can be higher than expected. In addition, it depends also on the values in J23 and J24 and PID gains (J03, J04 and J05).
In order to avoid the overshoot, holding the integral while the pumps sleep can be useful (avoiding the error integration)

- Digital Inputs: X4 (set to hold integral action function)
- Digital Outputs: Y2 (set to "Motor stopping due to slow flow rate under PID control" function)
- Wiring:
  - Bridge X4 and Y2
  - Bridge CMY and PLC (*)
- Set-up:
  E04 (X4) = *34: Hold PID integral component (PID-HLD)*
  E21 (Y2) = *44: Motor stopping due to slow flowrate under PID control (PID-STP)*
  J23 = 20%

(*) Assuming that the logic of the digital inputs is Active-High Logic (the common of the inputs is PLC (+24VDC) and inputs' logic switch is in SOURCE).
If the common of the inputs is terminal CM (0 VDC) (Active-Low Logic in the inputs), please connect the terminals CMY and CM and set the switch to the SINK position.

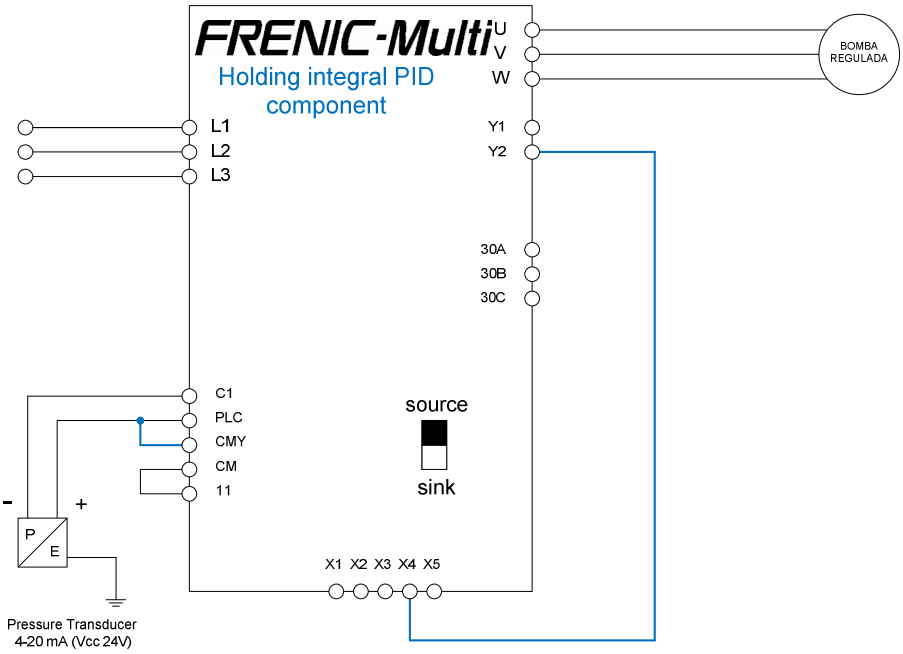


Figure 3.3: Pump control Schematic for integral PID hold management

2. Holding integral PID component during the process (anti-reset wind-up)

J10 function code can be used to hold the integral PID component.
The integral component will be active only when the difference between process value (PV) and set point (SV), that is the error, is inside the limits defined by J10 function code. If bigger than the value set in J10, current integral PID component will be held.

J10 is a percentage related with E40 function code.

For instance, if the transducer installed is 10 bar (E40 = 10) and J10 is set at 10%, integral PID component will be active when the error of the system (error = SV-PV) is less than 1 bar (for errors larger than 1 bar integral PID component will be held at its current value).

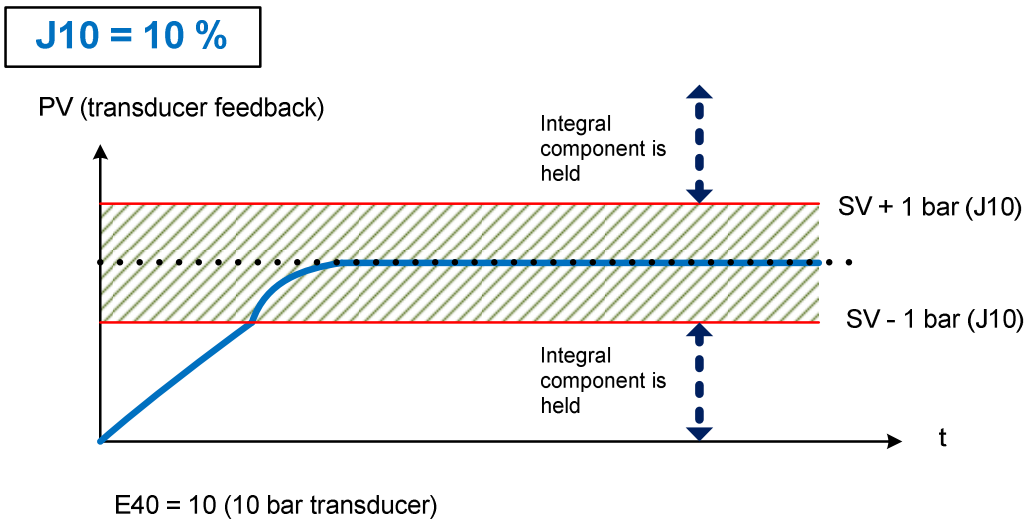


Figure 3.4: PID behaviour when J10 is used.

Auto tuning (related function code -> P04)

It is recommended to perform the auto tuning procedure before running the motor for the first time. There are two auto tuning modes: auto tuning mode 1 (static) and auto tuning mode 2 (dynamic).

- Auto tuning mode 1 (P04 = 1): Values of function codes P07 and P08 are measured.
- Auto tuning mode 2 (P04 = 2): Values of function codes P07 and P08 are measured as well as the value of function code P06 (no load current) and the value of function code P12 (rated slip frequency). ***When choosing this option, please remove the mechanical load from the motor.***

Auto tuning procedure

1. Power on the inverter.
2. Switch the operation mode from remote to local (setting F02 = 2 or 3).
3. If there are any kind of contactors between the motor and the inverter, please close them manually.
4. Set P04 to 1 (Auto tuning mode 1) or to 2 (Auto tuning mode 2), press FUNC/DATA and press RUN (the current flowing through the motor windings will generate a sound). The auto tuning takes a few seconds until it finishes by itself.
5. P07 and P08 will be measured (also P06 and P12 if Auto tuning mode 2 has been selected) and stored automatically in the inverter.
6. The auto tuning procedure has been finished.

Energy saving function (related function code -> F37)

The ***FRENIC-Multi*** inverter has the energy saving function in order to decrease the inverter+motor energy consumption under certain conditions. This function decreases the output voltage while driving the pump at constant speed.

Table 3.2 describes all the values that can be set in this function code. For instance, if we have a variable torque load (typical case when the inverter is driving certain types of pump) then F37 should be set to 3 (variable torque pattern + auto energy saving enabled).

Data for F37	V/f pattern	Torque boost (F09)	Auto energy saving	Applicable load
0	Variable torque V/f pattern	Torque boost specified by F09	Disable	Variable torque load increasing in proportion to square of speed (General purpose fans and pumps)
1	Linear V/f pattern			Constant torque load
2		Auto torque boost		Constant torque load (To be selected if a motor may be over-excited at no load.)
3	Variable torque V/f pattern	Torque boost specified by F09	Enable	Variable torque load increasing in proportion to square of speed (General purpose fans and pumps)
4	Linear V/f pattern			Constant torque load
5		Auto torque boost		Constant torque load (To be selected if a motor may be over-excited at no load.)

Table 3.2: Description of F37 values

There are a few things that we should take into account when using this function:

- When auto energy saving function is active at constant speed (the voltage output has been reduced in order to save energy), the system will become slower to sudden changes in the speed or the load, or the motor torque might be not enough under certain conditions.

- If the system becomes unstable at low speed, or starting torque is insufficient in order to start up the motor, it could be due to the variable torque V/f pattern. Please set F42 = 1 (Dynamic Torque Vector Control). Auto energy saving function will be enabled in this control mode if you set F37 to 3, 4 or 5.

Chapter 4
Complete Function Codes List v. E1S10900

	Name		Data Setting range	Default setting	Current Value
F00	Data Protection		0: Disable data protection and Disable digital frequency ref. protection	0	
			1: Enable data protection and Disable digital frequency ref. protection		
			2: Disable data protection and Enable digital frequency ref. protection		
			3: Enable data protection and Enable digital frequency ref. protection		
F01	Frequency Command 1		0: Enable arrow keys on the keypad	0	
			1: Enable voltage input to terminal [12] (-10 to 10V DC)		
			2: Enable current input to terminal [C1] (4 to 20 mA DC)		
			3: The sum of voltage and current inputs terminals [12] and [C1]		
			5: Enable voltage input to terminal [V2] (0 to 10V DC)		
			7: Enable terminal command (UP) / (DOWN) control		
			11: DI option card		
			12: PG/SY option card		
F02	Operation Method		0: Enable RUN / STOP keys on the keypad	2	
			(Motor rotational direction from digital terminals FWD/REV)		
			1: Enable terminal command FWD or REV		
			2: Enable RUN / STOP keys on keypad (forward)		
			3: Enable RUN / STOP keys on keypad (reverse)		
F03	Maximum Frequency 1		25.0 to 400.0 Hz	50.0 Hz	
F04	Base Frequency 1		25.0 to 400.0 Hz	50.0 Hz	
F05	Rated Voltage at base Frequency 1		0: Output a voltage in proportion to input voltage		
			80 to 240V: Output a voltage AVR-controlled (200V AC series)	230V	
			160 to 500V: Output a voltage AVR-controlled (400V AC series)	400V	
F06	Maximum Output Voltage 1		80 to 240V: Output a voltage AVR-controlled (200V AC series)	200V	
			160 to 500V: Output a voltage AVR-controlled (400V AC series)	400V	
F07	Acceleration Time 1		0.00 to 3600 seconds; Note: Entering 0.00 cancels the acceleration time, requiring external soft-start	6.0	
F08	Deceleration Time 1		0.00 to 3600 seconds; Note: Entering 0.00 cancels the deceleration time, requiring external soft-start	6.0	
F09	Torque Boost 1		0.0 to 20.0 % (percentage of the rated voltage at base frequency (F05)). This setting is effective when F37 = 0,1,3 or 4	Depending on capacity	
F10	Electronic Thermal Overload Protection for Motor	Select motor characteristics	1: For general-purpose motors with built-in-self-cooling fan	1	
			2: For inverter-driven motors or high-speed motors with forced-ventilation fan		
F11		Overload detection level	0.0: Disable	100 % of the motor rated current	
			1 to 135% of the rated current (allowable continuous drive current) of the motor		
F12		Thermal time constant	0.5 to 75.0 minutes	5.0	
F14	Restart Mode after Momentary Power Failure	(Mode selection)	0: Disable restart (trip immediately)	0	
			1: Disable restart (trip after a recovery from power failure)		
			4: Enable restart (restart at the frequency at which the power failure occurred, for general loads)		
			5: Enable restart (restart at the starting frequency, for low-inertia load)		
F15	Frequency limiter	High	0 to 400.0 Hz	70.0 Hz	
F16		Low	0 to 400.0 Hz	0.0 Hz	
F18	Bias (Frequency command 1)		-100.00 to 100.00 %	0.00 %	
F20	DC Braking 1	Start freq.	0.0 to 60.0 Hz	0.0 Hz	
F21		Braking level	0 to 100 %	0%	
F22		Braking time	0.00: Disable	0.00 s	
			0.01 to 30.0 s		
F23	Starting Frequency 1	(Level)	0.1 to 60.0 Hz	0.5 Hz	
F24		(Holding time)	0.01 to 10.0 s		
F25	Stop Frequency		0.1 to 60.0 Hz	0.2 Hz	
F26	Motor Sound	Carrier frequency	0.75 to 15 kHz	15 kHz	
F27		Tone	0: Level 0 (Inactive)	0	
			1: Level 1		
			2: Level 2		
			3: Level 3		
F29	Analogue output [FM]	Mode selection	0: Output in voltage (0 to 10V DC) [FMA]	0	
			1: Output in pulse (0 to 6000 p/s) [FMP]		
F30		Voltage adjust.	0 to 300 % [FMA]	100%	
F31		Function	Select a function to be monitored from the followings.	0	
			0 : Output frequency1 (before slip compensation)		
			1 : Output frequency2 (after slip compensation)		
			2 : Output current		
			3 : Output voltage		
			4 : Output torque		
			5 : Load factor		
			6 : Input power		
			7 : PID feedback value (PV)		
			8 : PG feedback value		
			9 : DC link bus voltage		
			10 : Universal AO		
			13 : Motor output		
			14 : analog output (Calibration)		
			15 : PID process command (SV)		
			16 : PID process output (MV)		
F33	Pulse Output [FM]	(Pulse rate)	25 to 6000 p/s (Pulse rate at 100% output)	1440	
F37	Load selection / Auto torque boost / Auto energy saving operation 1		0 : Variable torque load	1	
			1 : Constant torque load		
			2 : Auto-torque boost		
			3 : Auto-energy saving operation (Variable torque load during ACC/DEC)		
			4 : Auto-energy saving operation (Constant torque load during ACC/DEC)		
			5: Auto-energy saving operation (Auto-torque boost during ACC/DEC)		
F39	Stop Frequency	(Level)	0.00 to 10.00 s	0.00	
		Holding time			
F40	Torque Limiter 1	Limiting level for driving	20 to 200 %	999	
			999 : Disable		
F41		Limiting level for braking	20 to 200 %	999	
			999 : Disable		

	Name		Data Setting range	Default setting	Current Value
F42	Select Control Mode 1		0 : Disable (V/f control with slip compensation inactive) 1 : Enable (Dynamic torque vector control)2 : Enable (V/f control with slip compensation active) 3 : Enable (V/f control with optional PG interface) 4 : Enable (Dynamic torque vector control with optional PG interface)	0	
F43	Current Limiter	Mode selection	0: Disable (No current limiter works) 1: Enable at constant speed (Disabled during ACC/DEC) 2: Enable during acceleration and at constant operation	2	
F44		Level	20 to 200 % (The data is interpreted as the rated output current of the inverter for 100%)	180%	
F50	Electronic Thermal Overload Protection for Braking Resistor	(Discharged capability)	1 to 900 kWs 999 : Disable 0: Reserved	999	
F51		(Allowable average loss)	0.001 to 50.000 kW 0.000 : Reserved	0.000	

	Name		Data setting range		Default setting	Current Value
E01	Terminal [X1]Function		Selecting function code data assigns the corresponding function to terminals [X1] to [X5] as listed below.		0	
E02	Terminal [X2] Function				1	
E03	Terminal [X3] Function				2	
E04	Terminal [X4] Function				7	
E05	Terminal [X5] Function		0 (1000): Select multistep frequency	[SS1]	8	
			1 (1001): Select multistep frequency	[SS2]		
			2 (1002): Select multistep frequency	[SS4]		
			3 (1003): Select multistep frequency	[SS8]		
			4 (1004): Select ACC/DEC time	[RT2/RT1]		
			6 (1006): Enable 3-wire operation	[HLD]		
			7 (1007): Coast to stop	[BX]		
			8 (1008): Reset alarm	[RST]		
			9 (1009): Enable external alarm trip	[THR]		
			10 (1010): Ready for jogging	[JOG]		
			11 (1011): Switch frequency command 2/1	[Hz2/Hz1]		
			12 (1012): Select Motor2 / Motor1	[M2/M1]		
			13 : Enable DC braking	[DCBRK]		
			14 (1014): Select Torque Limiter Level	[TL2/TL1]		
			17 (1017): UP (Increase output frequency)	[UP]		
			18 (1018): DOWN (Decrease output frequency)	[DOWN]		
			19 (1019): Enable write from keypad (Data changeable)	[WE-KP]		
			20 (1020): Cancel PID control	[Hz/PID]		
			21 (1021): Switch normal/inverse operation	[IVS]		
			24 (1024): Enable communications link via RS485 or field bus (option)	[LE]		
			25 (1025): Universal DI	[U-DI]		
			26 (1026): Enable auto-search at starting	[STM]		
			27 (1027): Speed feedback control switch	[PG/HZ]		
			30 (1030): Force to stop	[STOP]		
			33 (1033): Reset PID integral and differential components	[PID-RST]		
			34 (1034): Hold PID integral component	[PID-HLD]		
			42 (1042): Position Control limit switch	[LS]		
			43 (1043): Position Control start/reset command	[S/R]		
			44 (1044): Switch to the serial pulse receiving mode	[SPRM]		
			45 (1045): Enter position control return mode	[RTN]		
			46 (1046): Overload stopping effective command	[OLS]		
			Setting the value of 1000s in parentheses () shown above assigns a negative logic input to a terminal.			
			Note: In the case of THR a Stop, data (1009) and (1030) are for normal logic, and “9” and “30” are for negative logic, respectively.			
E10	Acceleration Time 2		0.00 to 3600 s		10.0	
			Note: Entering 0.0 cancels the acceleration time, requiring external soft start			
E11	Deceleration Time 2		0.00 to 3600 s		10.0	
			Note: Entering 0.00 cancels the deceleration time, requiring external softstart.			
E16	Torque Limiter 2	(Limiting level for driving)	20 to 200 %		999	
			999 : Disable			
E17		(Limiting level for braking)	20 to 200 %		999	
			999 : Disable			

	Name		Data setting range	Default setting	Current Value
E20	Terminal Y1 function		Selecting function code data assigns the corresponding function to terminals [Y1] to [Y2] and [30A/B/C] as listed below.	0	
E21	Terminal Y2 function			7	
E27	Terminal 30A/B/C function (Relay output)			99	
			0 (1000): Inverter running [RUN]		
			1 (1001): Frequency arrival signal [FAR]		
			2 (1002): Frequency detected [FDT]		
			3 (1003): Undervoltage detected (inverter stopped) [LU]		
			4 (1004): Torque polarity detected [B/D]		
			5 (1005): Inverter output limiting [IOL]		
			6 (1006): Auto-restarting after momentary power failure [IPF]		
			7 (1007): Motor overload early warning [OL]		
			10 (1010): Inverter ready to run [RDY]		
			21 (1021): Frequency arrival signal 2 [FAR2]		
			22 (1022): Inverter output limiting with delay [IOL2]		
			26 (1026): Auto-resetting [TRY]		
			27 (1027): Universal Digital Output [U-DO]		
			28 (1028): Heat sink overheat early warning [OH]		
			30 (1030): Service life alarm [LIFE]		
			33 (1033): Command loss detected [REF OFF]		
			35 (1035): Inverter output on [RUN2]		
			36 (1036): Overload prevention control [OLP]		
			37 (1037): Current detected [ID]		
			38 (1038): Current detected 2 [ID2]		
			42 (1042): PID alarm (PID-STP)		
			44 (1044): Motor Stopping due to slow flowrate under PID control [PID-ALM]		
			49 (1049): Switched to motor 2 (THM)		
			56 (1056): Termistor Level Detection [SWM2]		
			57 (1057): Brake signal (C1OFF)		
			59 (1059): Breaking Detection of Terminal C1 [BRKS]		
			76 (1076): PG error signal [PG-ERR]		
			80 (1080): Stop position override (Over Travelling) [OT]		
			81 (1081): Indication of total elapsed time for one positioning cycle [TO]		
			82 (1082): Completion of positioning [PSET]		
			83 (1083): Current position pulse overflow (FARFDT)		
			87 (1087): Logical AND of (FAR) and (FDT) [POF]		
			99 (1099): Alarm output (for any alarm) [ALM]		
			Setting the value of 1000s in parentheses () shown below assigns a negative logic input to a terminal.		
E29	Frequency arrival delay time		0.01 to 10.00 s	0.10	
E30	Frequency Arrival	(Hysteresis width)	0.0 to 10.0 Hz	2.5	
E31	Frequency detection (FDT)	Detection level	0.0 to 400.0 Hz	50	
E32		Hysteresis Width	0.0 to 400.0 Hz	1.0	
E34	Overload early warning/Current detection	Level	0.00: Disable	100% of the motor rated current	
			Current value of 1% to 200% of the inverter rated current		
E35		Timer	0.01 to 600.00 s	10.00 s	
E37	Current Detection 2	Level	0.00: Disable	100% of the motor rated current	
			Current value of 1 to 200% of the inverter rated current		
E38		Timer	0.01 to 600.0 s	10.00 s	
E39	Coefficient of Constant Feeding Rate Time		0.000 to 9.999 s	0.000	
E40	PID display coefficient A		-999 to 0.00 to 9990	100	
E41	PID display coefficient B		-999 to 0.00 to 9990	0.00	
E42	LED display filter		0.0 to 5.0 s	0.5	
E43	LED monitor	Item selection	0: Speed monitor (Select by E48)		
			3: Output current		
			4: Output voltage		
			8: Calculated torque		
			9: Input power		
			10: PID process command (Final)		
			12: PID feedback value	0	
			13: Timer		
			14: PID output		
			15: Load factor		
			16: Motor output		
			21: Current position pulse count (position control)		
			22: Position deviation pulse count (position control)		
E45	LCD monitor (only with multi-functional keypad TP-G1)	Item selection	0: Running status, rotational direction and operation guide	0	
			1: Bar charts for output frequency, current and calculated torque		
E46		Language selection	0: Japanese		
			1: English		
			2: Germany	1	
			3: French		
			4: Spanish		
			5: Italian		
E47		Contrast control	0 (Low) to 10 (High)	5	
E48	LED monitor	Speed monitor item	0: Output frequency (Before slip compensation)		
			1: Output frequency (After slip compensation)		
			2: Reference frequency		
			3: Motor speed in r/min	0	
			4: Load shaft in r/min		
			5: Line speed in m/min		
			6: Constant feeding rate time		
E50	Coefficient for speed indication		0.01 to 200.00	30.00	

	Name		Data setting range	Default setting	Current Value
E51	Display coefficient for input		0.000: (Cancel / reset) 0.001 to 9999	0.010	
E52	Keypad (menu display mode)		0: Function code data editing mode (Menus #0 and #1) 1: Function code data check mode (Menus #2) 2: Full-menu mode (Menus #0 through #6)	0	
E59	Terminal [C1] Signal Definition (C1/V2 Function)		0 : Current input (C1 function), 4 to 20 mA DC) 1: Voltage input (V2 function), 0 to +10V DC)	0	
E61	Analogue input for (Extension function selection)	[12]	Selecting function code data assigns the corresponding function to terminals [12], [C1] and [V2] as listed below 0: None 1: Auxiliary frequency command 1	0	
E62		[C1]	2: Auxiliary frequency command 2	0	
E63		[V2]	3: PID process command 1 5: PID feedback value	0	
E65	Reference Loss Detection (Continuous running frequency)		0: Decelerate to stop 20 to 120 % 999: Disable	999	
E98	Terminal [FWD] Function		Selecting function code data assigns the corresponding function to terminals [FWD] and [REV] as listed below.	98	
E99	Terminal [REV] Function			99	

0 (1000): Select multistep frequency	[SS1]
1 (1001): Select multistep frequency	[SS2]
2 (1002): Select multistep frequency	[SS4]
3 (1003): Select multistep frequency	[SS8]
4 (1004): Select ACC/DEC time	[RT2/RT1]
6 (1006): Enable 3-wire operation	[HLD]
7 (1007): Coast to stop	[BX]
8 (1008): Reset alarm	[RST]
9 (1009): Enable external alarm trip	[THR]
10 (1010): Ready for jogging	[JOG]
11 (1011): Switch frequency command 2/1	[Hz2/Hz1]
12 (1012): Select Motor 2 / Motor1	[M2/M1]
13 : Enable DC braking	[DCBRK]
14: (1014): Select Torque Limiter Level	[TL2/TL1]
17 (1017): UP (Increase output frequency)	[UP]
18 (1018): DOWN (Decrease output frequency)	[DOWN]
19 (1019): Enable write from keypad (Data changeable)	[WE-KP]
20 (1020): Cancel PID control	[Hz/PID]
21 (1021): Switch normal/inverse operation	[IVS]
24 (1024): Enable communications link via RS485 or field bus (option)	[LE]
25 (1025): Universal DI	[U-DI]
26 (1026): Enable auto-search at starting	[STM]
27 (1027): Speed feedback control switch	[PG/HZ]
30 (1030): Force to stop	[STOP]
33 (1033): Reset PID integral and differential components	[PID-RST]
34 (1034): Hold PID integral component	[PID-HLD]
42 (1042): Position Control limit switch	[LS]
43 (1043): Position Control start/reset command	[S/R]
44 (1044): Switch to the serial pulse receiving mode	[SPRM]
45 (1045): Enter position control return mode	[RTN]
46 (1046): Overload stopping effective command	[OLS]
98 : RUN forward	[FWD]
99 : RUN reverse	[REV]
Setting the value of 1000s in parentheses () shown below assigns a negative logic input to a terminal.	
Note: In the case of THR a Stop, data (1009) and (1030) are for normal logic, and “9” and “30” are for negative logic, respectively.	

	Name		Data setting range	Default setting	Current Value
C01	Jump frequency	1	0.0 to 400.0 Hz	0.0	
C02		2		0.0	
C03		3		0.0	
C04		Hysteresis width	0.0 to 30.0 Hz	3.0	
C05	Multistep frequency	1	0.00 to 400.00 Hz	0.00	
C06		2		0.00	
C07		3		0.00	
C08		4		0.00	
C09		5		0.00	
C10		6		0.00	
C11		7		0.00	
C12		8		0.00	
C13		9		0.00	
C14		10		0.00	
C15		11		0.00	
C16		12		0.00	
C17		13		0.00	
C18		14		0.00	
C19		15		0.00	

	Name		Data setting range	Default setting	Current Value
C20	Jogging Frequency		0.00 to 400.00 Hz	0.00	
C21	Timer Operation	Mode Selection	0 : Disable	0	
			1 : Enable		
C30	Frequency command 2		0 : Enable arrow keys on the keypad	2	
			1 : Enable voltage input to terminal [12] (-10 to 10V DC)		
			2 : Enable current input to terminal [C1] (4 to 20 mA)		
			3 : The sum of voltage and current inputs terminals [12] and [C1]		
			5 : Enable voltage input to terminal [V2] (0 to 10V DC)		
			7 : Enable terminal command (UP) / (DOWN) control		
			11 : DI interface card (option)		
			12 : PG / SY interface card (option)		
C31	Analogue input adjustment for [12]	Offset	-5.0 to 5.0 %	0.0	
C32		Gain	0.00 to 200.00 %	100.0 %	
C33		Filter time constant	0.00 to 5.00 s	0.05	
C34		Gain base point	0.00 to 100.00 %	100.0 %	
C35		Polarity	0 : Bipolar	1	
			1 : Unipolar		
C36	Analogue input adjustment for [C1]	Offset	-5.0 to 5.0 %	0.0	
C37		Gain	0.00 to 200.00 %	100.0	
C38		Filter time constant	0.00 to 5.00 s	0.05	
C39		Gain base point	0.00 to 100.00 %	100.0	
C41	Analogue input adjustment for [V2]	Offset	-5.0 to 5.0 %	0.0	
C42		Gain	0.00 to 200.00 %	100.0	
C43		Filter time constant	0.00 to 5.00 s	0.05	
C44		Gain base point	0.00 to 100.00 %	100.0	
C50	Bias base point (Frequency command 1)	Bias base point	0.00 to 100.00 %	0.00	
C51	Bias for PID command	Bias value	-100.00 to 100.00 %	0.00	
C52		Bias reference point	0.00 to 100.00 %	0.00	
C53	Selection of normal/inverse operation (Frequency command 1)		0: Normal operation	0	
			1: Inverse operation		

	Name		Data setting range	Default setting	Current Value
P01	Motor	No. of poles	2 to 22	4	
P02		Rated capacity	0.01 to 30.00 kW (where P99 is 0, 3 or 4)	Rated capacity of the motor	
			0.01 to 30.00 HP (where P99 is 1)		
P03		Rated current	0.00 to 100.0 A	Rated current of Fuji standard motor	
P04		Auto-tuning	0: Disable	0	
			1: Enable (Tune %R1 and %X while the motor is stopped)		
			2: Enable (Tune %R1 and %X while the motor is stopped and no-load current while running)		
P05		Online Tuning	0 : Disable	0	
			1 : Enable		
P06		No-load current	0.00 to 50.00 A	Rated value of Fuji standard motor	
P07		%R1	0.00 to 50.00 %		
P08		%X	0.00 to 50.00 %		
P09		Slip compensation gain for driving	0.0 to 200.0 %	100.0	
P10		Slip compensation response time	0.01 to 10.00 s	0.50	
P11		Slip compensation gain for braking	0.0 to 200.0 %	100.0	
P12		Rated slip frequency	0.00 to 15.00 Hz	Rated value of Fuji standard motor	
P99		Motor selection	0: Characteristics of motor 0 (Fuji standard motors, 8-series)	0	
			1: Characteristics of motor 1 (HP-rated motors)		
			3: Characteristics of motor 3 (Fuji standard motors, 6-series)		
			4: Other motors		

	Name		Data setting range	Default setting	Current Value
H03	Data initialization		0: Disable initialization	0	
			1: Initialize all function code data to the factory defaults		
			2: Initialize motor parameters (motor 1)		
			3: Initialize motor parameters (motor 2)		
H04	Auto-resetting	Times	0: Disable	0	
			1 to 10		
H05		Reset interval	0.5 to 20.0 s	5.0	
H06	Cooling fan ON/OFF control		0: Disable (Always in operation)	0	
			1: Enable (ON/OFF controllable)		
H07	Acceleration/Deceleration pattern		0: Linear	0	
			1: S-curve (Weak)		
			2: S-curve (Strong)		
			3: Curvilinear		
H08	Rotational Direction Limitation		0 : Disable	0	
			1 : Enable (Reverse rotation inhibited)		
			2 : Enable (Forward rotation inhibited)		
H09	Select starting characteristics (Auto search)		0 : Disable	0	
			1 : Enable (At restart after momentary power failure)		
			2 : Enable (At restart after momentary power failure and at normal start)		
H11	Deceleration mode		0: Normal deceleration	0	
			1: Coast-to-stop		

	Name		Data setting range		Default setting	Current Value
H12	Instantaneous overcurrent limiting		0: Disable		1	
			1: Enable			
H13	Restart mode after momentary power failure	Restart time	0.1 to 10.0 s		Depending on the inverter capacity	
H14		Frequency fall rate	0.00: Selected deceleration time		999	
			0.01 to 100.0 Hz/s			
			999: Follow the current limit command			
H16		Allowable momentary power failure time	0.0 to 30.0 s			
			999: The longest time automatically determined by the inverter		999	
H26	PTC Thermistor	Mode selection	0: Disable		0	
			1: Enable (Upon detection of PTC, the inverter immediately trips and stops with OH4 displayed)			
			2: Enable (with PTC, the inverter issues output signal THM and continues to run)			
H27		Level	0.00 to 5.00 V		1.60	
H28	Droop Control		-60.0 to 0.0 Hz		0.0	
H30	Communication link function (Mode selection)		Frequency command	RUN command	0	
			0: F01/C30	F02		
			1: RS485 link	F02		
			2: F01/C30	RS485		
			3: RS485 link	RS485		
			4: RS485 link (option)	F02		
			5: RS485 link (option)	RS485 link		
			6: F01/C30	RS485 link (option)		
			7: RS485 link	RS485 link (option)		
			8: RS485 link (option)	RS485 link (option)		
H42	Capacitance of DC link bus capacitor		Indication for replacing DC link bus capacitor (0000 to FFFF: Hexadecimal)		-	
H43	Cumulative run time of cooling fan		Indication of cumulative run time of cooling fan for replacement		-	
H44	Startup Times of Motor 1		Indication of cumulative startup times		-	
H45	Mock Alarm		0: Disable		0	
			1: Enable (Once a mock alarm occurs, the data automatically returns to 0)			
H47	Initial capacitance of DC link bus capacitor		Indication for replacing DC link bus capacitor (0000 to FFFF: Hexadecimal)		Set at factory shipping	
H48	Cumulative Run Time of Capacitors on the Printed Circuit Board		Indication for replacing capacitors on the printed circuit board (0000 to FFFF: Hexadecimal). Resetable		-	
H49	Starting mode		0.0 to 10.0 s		0.0	
H50	Non-linear V/f pattern	Frequency	0.0: Cancel		0.0	
			0.1 to 400.0 Hz			
H51		Voltage	0 to 240V: Output a voltage AVR-controlled (for 200V AC series)		0	
			0 to 500V: Output a voltage AVR-controlled (for 400V AC series)			
H52	Non-linear V/f Pattern 2	Frequency	0.0: Cancel		0	
			0.1 to 400.0 Hz			
H53		Voltage	0 to 240V: Output a voltage AVR-controlled (for 200V AC series)		0	
			0 to 500V: Output a voltage AVR-controlled (for 400V AC series)			
H54	ACC/DEC time	Jogging operation	0.00 to 3600 s		6.0	
H56	Deceleration time for forced stop		0.00 to 3600 s		6.0	
H61	UP/DOWN Control (Initial frequency setting)		0: 0.0		1	
			1: Last UP/DOWN cammand value on releasing run command			
H63	Low limiter	Mode selection	0: Limit by F16 (Frequency Limiter: Low) and continue to run		0	
			1: If the output frequency lowers less than the one limited by F16 (Frequency limiter: Low), decelerates to			
H64		Lower limiting frequency	0.0 (Depends on F16 (Frequency limiter: Low)		1.6	
			0.1 to 60.0 Hz			
H68	Slip Compensation	(Operating conditions)	0: Enable during ACC/DEC and enable at base frequency or above		0	
			1: Disable during ACC/DEC and enable at base frequency or above			
			2: Enable during ACC/DEC and disable at base frequency or above			
			3: Disable during ACC/DEC and disable at base frequency or above			
H69	Automatic deceleration	(Mode selection)	0: Disable		0	
			2: Enable (Canceled if actual deceleration time exceeds three times the one specified by F08/E11)			
			4: Enable (Not canceled if actual deceleration time exceeds three times the one specified by F08/E11)			
H70	Overload Prevention Control		0.00: Follow deceleration time specified by F08 / E11		999	
			0.01 to 100.00 Hz/s			
			999: Disable			
H71	Deceleration characteristics		0: Disable		0	
			1: Enable			
H76	Torque Limiter (Frequency increment limit for braking)		0.0 to 400.0 Hz		5.0	
H80	Output Current Fluctuation Damping Gain for Motor 1		0.00 to 0.40		0.20	
H89	Reserved					
H90	Reserved					
H91	C1 Disconnection Detection Time (PID control feedback line)		0.0: Disable 0.1 to 60.0s: Detection Time		0,0	
H94	Cumulative run time of motor		Change or reset the cumulative data		-	
H95	DC braking (braking response mode)		0: Slow		1	
			1: Quick			
H96	STOP key priority/start check function		STOP key priority	Start check function	0	
			0: Disable	Disable		
			1: Enable	Disable		
			2: Disable	Enable		
			3: Enable	Enable		
H97	Clear alarm data		0: Does not clear alarm data		0	
			1: Clear alarm data and return to zero			
H98	Protection/maintenance Function (Mode selection)		0 to 31: Display data on the keypad's LED monitor in decimal format (In each bit, "0" for disabled, "1" for enabled)		19(Bits 4,1,0 = 1)	
			Bit 0: Lower the carrier frequency automatically			
			Bit 1: Detect input phase loss			
			Bit 2: Detect output phase loss			
			Bit 3: Select life judgment criteria of DC link bus capacitor			
			Bit 4: Judge the life of DC link bus capacitor			

	Name		Data setting range	Default setting	Current Value
A01	Maximum Frequency 2		25 to 400.0 Hz	50.0	
A02	Base Frequency 2		25 to 400.0 Hz	50.0	
A03	Rated Voltage at Base Frequency 2		0: Output a voltage in proportion to input voltage	230	
			80 to 240: Output an AVR-controlled (for 200V class series)	400	
			160 to 500: Output an AVR-controlled (for 400V class series)		
A04	Maximum Output Voltage 2		80 to 240V: Output an AVR-controlled (for 200V class series)	200	
			160 to 500V: Output an AVR-controlled (for400V class series)	400	
A05	Torque Boost 2		0.0 to 20.0 %		
			(percentage with respect to "A03: Rated Voltage at Base Frequency 2")	Depending on the inverter capacity	
			Note: This setting takes effect when A13 = 0, 1, 3 or 4.		
A06	Electronic Thermal Overload Protection for Motor 2	(Select motor Characteristics)	1: general-purpose motor with shaft driven cooling fan		
			2: For an inverter-driven motor, non ventilated motor, or motor with separately powered fan	1	
A07		(Overload detection level)	0.00 : Disable	100% of the motor rated current	
			1 to 135% of the rated current (allowable continuous drive current) of the motor		
A08		(Thermal time constant)	0.5 to 75.0 min	5.0	
A09	DC Braking 2	(Braking starting frequency)	0.0 to 60.0 Hz	0.0	
A10		(Braking level)	0 to 100%	0	
A11		(Braking time)	0.00 : Disable		
			0.01 to 30.00 s	0.00	
A12	Starting Frequency 2		0.01 to 60.0 Hz	0.05	
A13	Load Selection/ Auto Torque Boost/ Auto Energy Saving Operation 2		0: Variable torque load		
			1: Constant torque load		
			2: Auto torque boost		
			3: Auto energy saving operation (Variable torque during ACC/DEC)		
			4: Auto energy saving operation (Constant torque during ACC/DEC)		
			5: Auto energy saving operation (Auto-torque boost during ACC/DEC)	1	
A14	Control Mode Selection 2		0: V/f operation with slip compensation inactive		
			1: Dynamic torque vector operation		
			2: V/f operation with slip compensation active		
			3: V/f operation with optional PG interface		
			4: Dynamic torque vector operation with optional PG interface	0	
A15	Motor2	(No. of poles)	2 to 22	4	
A16		(Rated capacity)	0.01 to 30.00 kW (where A39 data is 0, 3 or 4)		
			0.01 to 30.00 HP (where A39 data is 1)	Rated capacity of motor	
A17		(Rated current)	0.00 to 100.0 A	Rated value of Fuji standard motor	
A18		(Auto Tuning)	0: Disable		
			1: Enable (Tune %R1 and %X while motor is stopped)		
			2: Enable (Tune %R1 and %X while motor is stopped and no load current while running)	0	
A19		(Online Tuning)	0: Disable		
			1: Enable	0	
A20		(No load current)	0.00 to 50.00 A	Rated value of Fuji standard motor	
A21		(%R1)	0.00 to 50.00 %	Rated value of Fuji standard motor	
A22		(%X)	0.00 to 50.00 %	Rated value of Fuji standard motor	
A23		(Slip compensation gain for driving)	0.0 to 200.0 %	100.0	
A24		(Slip compensation response time)	0.01 to 10.00 s	0.50	
A25		(Slip compensation gain for braking)	0.0 to 200.0 %	100.0	
A26		(Rated slip frequency)	0.00 to 15.0 Hz	Rated value of Fuji standard motor	
A39	Motor 2 Selection		0: Motor characteristics 0 (Fuji standard motors, 8-series)		
			1: Motor characteristics 1 (HP rating motors)		
			3: Motor characteristics 3 (Fuji standard motors, 6 series)		
			4: Other motors	0	
A40	Slip Compensation 2 (Operating conditions)		0: Enable during ACC/DEC and enable at base frequency or above		
			1: Disable during ACC/DEC and enable at base frequency or above		
			2: Enable during ACC/DEC and disable at base frequency or above		
			3: Disable during ACC/DEC and disable at base frequency or above	0	
A41	Output Current Fluctuation Damping Gain for Motor 2		0.00 to 0.40	0.20	
A45	Cumulative Motor Run Time 2		Change or reset the cumulative data	-	
A46	Startup Times of Motor 2		Indication of cumulative startup times	-	

	Name		Data setting range	Default setting	Current Value
J01	PID control	Mode selection	0: Disable 1: Enable (Process control, normal operation) 2: Enable (Process control, inverse operation) 3: Enable (Dancer control)	0	
J02		Remote process command SV	0: Enable arrow keys on keypad 1: PID process command 1 3: Enable terminal command UP/DOWN control 4: Command via communications link	0	
J03		P (Gain)	0.000 to 30.000	0.100	
J04		I (Integration time)	0.0 to 3600.0 s	0.0	
J05		D (Differential time)	0.00 to 600.0 s	0.00	
J06		Feedback filter	0.0 to 900.0 s	0.5	
J10		Anti reset windup	0 to 200 %	200	
J11		Select alarm output	0: Absolute-value alarm 1: Absolute-value alarm (with Hold) 2: Absolute-value alarm (with Latch) 3: Absolute-value alarm (with Hold and Latch) 4: Deviation alarm 5: Deviation alarm (with Hold) 6: Deviation alarm (with Latch) 7: Deviation alarm (with Hold and Latch)	0	
J12		Upper limit alarm (AH)	-100 % to 100 %	100	
J13		Lower limit alarm (AL)	-100 % to 100 %	0	
J15		Stop Frequency for slow flowrate	0: Disable 1 to 400	0	
J16		Slow flowrate level stop	0 to 60	30	
J17		Starting Frequency	0: Disable 1 to 400	0	
J18		Upper limit of PID process output	-150 % to 150 % 999: Depends on setting of F15	999	
J19		Lower limit of PID process output	-150 % to 150 % 999: Depends on setting of F16	999	
J23		Starting feedback deviation level from the slow flowrate	0 to 100	0	
J24		Starting latency from the slow flowrate stop	0 to 60	0	
J56		(Speed command filter)	0.00 to 5.00 s	0.10	
J57		(Dancer reference position)	-100 % to 100 %	0	
J58		(Detection width of dancer position deviation)	0: Disable switching PID constant 1 % to 100 %	0	
J59		P (Gain) 2	0.000 to 30.00	0.100	
J60		I (Integral time) 2	0.0 to 3600.0 s	0.0	
J61		D (Differential time) 2	0.00 to 600.0 s	0.0	
J62		(PID control block selection)	Bit 0: PID output pole 0 = addition, 1 = substraction Bit 1: PID Select compensation of output ratio 0 = Speed command, 1 = ratio	0	
J63	Overload Stop	(Detection value)	0: Torque 1: Current	0	
J64		(Detection Level)	20 to 200 %	100	
J65		(Mode selection)	0: Disable 1: Decelerate to stop 2: Coast to a stop 3: Hit mechanical stop	0	
J66		(Operation condition)	0: Enable at constant speed and during deceleration 1: Enable at constant speed 2: Enable anytime	0	
J67		(Timer)	0.00 to 600.00 s	0	
J68	Braking Signal	(Brake OFF current)	0 to 200 %	100	
J69		(Brake OFF frequency)	0.0 to 25.0 Hz	1.0	
J70		(Brake OFF timer)	0.0 to 5.0 s	1.0	
J71		(Brake ON frequency)	0.0 to 25.0 Hz	1.0	
J72		(Brake ON timer)	0.0 to 5.0 s	1.0	
J73	Position control	(Start timer)	0.0 to 1000.0 s	0.0	
J74		(Start point MSD)	-999 to 999 p	0	
J75		(Start point LSD)	[P], 0 to 9999 p	0	
J76		(Preset position MSD)	-999 to 999	0	
J77		(Preset position LSD)	[P], 0 to 9999 p	0	
J78		(Creep speed switch point	0 to 999 p	0	
J79		(Creep speed switch point	0 to 9999 p	0	
J80		(Creep speed)	0 to 400Hz	0	
J81		(End position MSD)	-999 to 999 p	0	
J82		(End position LSD)	0 to 9999 p	0	
J83		(Completion width)	0 to 9999 p	0	
J84		(End timer)	0.0 to 1000.0 s	0	
J85		(Coasting compensation)	0.0 to 9999 p	0	
J86		(Stopping position specifying method)	0: B phase pulse input 1: Pulse input with polarity	0	
J87		(Position pre-set condition)	0: Forward rotation direction 1: Reverse rotation direction 2: Both forward / reverse rotation direction	0	
J88		(Position detecting direction)	0: Forward direction 1: Invert the current direction (x -1)	0	
J90	Overload stopping Function	torque limit P (Gain)	0.000 to 2.000, 999	999	
J91		torque limit I (Integral time)	0.001 to 9.999 s, 999	999	
J92		Current control level	50.0 to 150.0 %	100.0	

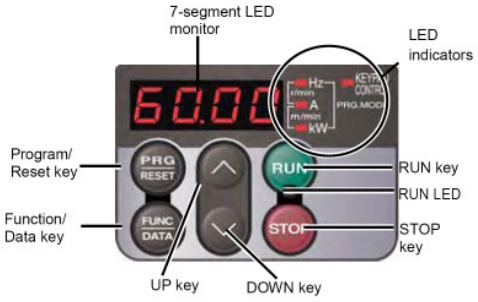
	Name		Data setting range		Default setting	Current Value
Y01	RS485 communication (standard)	(Station address)	1 to 255		1	
Y02		Communications error (processing)	0: Immediately trip with alarm Er8		0	
			1: Trip with alarm Er8 after running for the period specified by timer y03			
			2: Retry during the period specified by timer y03. If retry fails, trip and alarm Er8. If it succeeds, continue to			
			3: Continue to run			
Y03		(Timer)	0.0 to 60.0 s		2.0	
Y04		(Baud rate)	0: 2400 bps		3	
			1: 4800 bps			
			2: 9600 bps			
			3: 19200 bps			
			4: 38400 bps			
Y05		(Data length)	0: 8 bits		0	
			1: 7 bits			
Y06		(Parity check)	0: None (2 stop bits for Modbus RTU)		0	
			1: Even parity (1 stop bit for Modbus RTU)			
			2: Odd parity (1 stop bit for Modbus RTU)			
			3: None (1 stop bit for Modbus RTU)			
Y07		(Stop bits)	0: 2 bits		0	
			1: 1 bit			
Y08		(No-response error detection time)	0 : No detection		0	
			1 to 60 s			
Y09		(Response latency time)	0.00 to 1.00 s		0.01 seconds	
Y10		(Protocol selection)	0: Modbus RTU protocol		1	
			1: FRENIC Loader protocol (SX protocol)			
			2: Fuji general-purpose inverter protocol			
Y11	RS485 communication (option)	(Station address)	1 to 255		1	
Y12		(Communications error processing)	0: Immediately trip with alarm ErP		0	
			1: Trip with alarm ErP after running for the period specified by timer y13			
			2: Retry during the period specified by timer y13. If retry fails, trip and alarm ErP. If it succeeds, continue to			
			3: Continue to run			
Y13		Error processing(Timer)	0.0 to 60.0 s		2.0	
Y14		(Baud rate)	0: 2400 bps		3	
			1: 4800 bps			
			2: 9600 bps			
			3: 19200 bps			
			4: 38400 bps			
Y15		Data length	0: 8 bits		0	
			1: 7 bits			
Y16		(Parity check)	0: None (2 stop bit for Modbus RTU)		0	
			1: Even parity (1 stop bit for Modbus RTU)			
			2: Odd parity (1 stop bit for Modbus RTU)			
			3: None (1 stop bit for Modbus RTU)			
Y17		(Stop bits)	0: 2 bits		0	
			1: 1 bit			
Y18		(No-response error detection time)	0 : No detection		0	
			1 to 60 s			
Y19		(Response latency time)	0.00 to 1.00 s		0.01 seconds	
Y20		(Protocol selection)	0: Modbus RTU protocol		0	
			2: Fuji general-purpose inverter protocol			
Y98	Bus Link Function	(Mode selection)	Frequency command	Run command	0	
			0: Follow H30 and Y98 data	Follow H30 data		
			1: Via field bus option	Follow H30 data		
			2: Follow H30 data	Via field bus option		
			3: Via field bus option	Via field bus option		
Y99	Loader Link Function	(Mode selection)	Frequency command	Run command	0	
			0: Follow H30 and Y98 data	Follow H30 data and y98 data		
			1: Via RS-485 link (Loader)	Follow H30 data and y98 data		
			2: Follow H30 data and y98 data	Via RS-485 link (Loader)		
			3: Via RS-485 link (Loader)	Via RS-485 link (Loader)		

Shaded function codes cannot be changed while running

Chapter 5
Operation using the TP-M1 keypad

The keypad consists of 4 digit LED monitor, 5 LED indicators and 6 keys, as shown in the figure.

The keypad allows you to start and stop the motor, monitor running status and switch to the menu mode. In the menu mode you may set the function code data, monitor I/O signal states and check the maintenance information as well as the alarm information.



The keypad has 3 operation modes: programming, running and alarm modes.

Operation mode / Monitor, keys		Programming Mode		Running Mode		Alarm Mode
		STOP	RUN	STOP	RUN	
Monitor	8888 Function	Display the function code or data		Displays the output frequency, set frequency, loader motor speed, required power, output current and output voltage		Alarm code, which identifies the alarm factor if the protective function is activated
	8888 Display	ON		Blinking	ON	Blinking/ ON
	Hz r/min A m/min kW Function	The program mode is indicated		Displays the unit of frequency, output current, required power, speed and line speed		----------
	Hz r/min A m/min kW Display	Hz r/min A m/min kW		Frequency indication: Hz r/min A m/min kW		OFF
				Current indication: Hz r/min A m/min kW	Power indication: Hz r/min A m/min kW	
	KEYPAD CONTROL Function	Operation Mode (keypad operation/terminal operation) is displayed				
	KEYPAD CONTROL Display	Lit in keypad operation mode (F02 = 0, 2 or 3)				
	RUN Function	Absence of operation command is displayed	Presence of operation command is displayed	Absence of operation command is displayed	Presence of operation command is displayed	
	RUN Display	☐RUN	■RUN	☐RUN	■RUN	

Keys	PRG RESET Function	Switches to running mode Digit shift (cursor movement) in data setting		Switches to programming mode		Releases the trip and switches to stop mode or running mode
	FUNC DATA Function	Determines the function code, stores and updates data		Switches the LED monitor display		Displays the operation information
	▲ ▼ Function	Increases/decreases the function code and data		Increases/decreases the frequency, motor speed and other settings		Displays the alarm history
	RUN Function	----------		Starts running (switches to running mode (RUN))	----------	----------
	STOP Function	----------	Deceleration stop (switches to programming mode STOP)	----------	Deceleration stop (switches to running mode STOP)	----------

- If F02 = 1, the RUN key will not be enabled (RUN command by digital input terminals)
- If H96 = 1 or 3, the STOP key will not be enabled (RUN/STOP command by digital input terminals).