5.6 Setting the electronic thermal

RUL	: Overload characteristic selection
tHr	: Motor electronic-thermal protection level 1
OLN	: Electronic-thermal protection characteristic selection
$F173$	: Motor electronic-thermal protection level 2
$F607$	: Motor 150% overload detection time
$F631$	: Inverter overload detection method
$F632$	: Electronic-thermal memory
$F657$	: Overload alarm level

5

● Function
This parameter allows selection of the appropriate electronic thermal protection characteristics according to the particular rating and characteristics of the motor.

[Parameter setting]

Title	Function	Adjustment range				Default setting
RUL	Overload characteristic selection	0: - *4 1: Constant torque characteristic (150%-60s) 2: Variable torque characteristic (120%-60s)				0
tHr	Motor electronic-thermal protection level 1	10 – 100 (%) / (A) *1				100
OLN	Electronic-thermal protection characteristic selection	Setting value		Overload protection	Overload stall	0
		0	Standard motor	valid	invalid	
		1		valid	valid	
		2		invalid	invalid	
		3		invalid	valid	
		4	VF motor (special motor)	valid	invalid	
		5		valid	valid	
		6		invalid	invalid	
		7		invalid	valid	
$F173$	Motor electronic-thermal protection level 2	10 – 100 (%) / (A) *1				100
$F607$	Motor 150% overload detection time	10 – 2400 (s)				300
$F631$	Inverter overload detection method	0: 150%-60s (120%-60s) 1: Temperature estimation				0

[Parameter setting]

Title	Function	Adjustment range	Default setting
$F632$	Electronic-thermal memory	0: Disabled (tHr, $F173$) 1: Enabled (tHr, $F173$) 2: Disabled (tHr) 3: Enabled (tHr)	0
$F657$	Overload alarm level	10-100	50

*1: The inverter's rated current is 100%. When $F701$ (current/voltage unit selection) = 1 (A (amps)/V (volts)) is selected, it can be set at A (amps).

*2: $F632$= 1: Electronic-thermal statuses (cumulative overload value) of motor and inverter are saved when power supply is OFF. It is calculated from the saved value when power supply is ON again.

*3: Parameter AUL is displayed as "0" during reading after this is set.
Present setting of inverter overload characteristic can be confirmed by status monitor.
Refer to monitor "Overload and region setting" of section 8.2.1.

*4: Overload stall operates regardless of the set value of $F631$(Inverter overload detection method), at the setting of (Electronic-thermal protection characteristic selection) OLM = 1, 3, 5, 7.

1) Setting the electronic thermal protection characteristics selection OLM and motor electronic thermal protection level 1 tHr, 2 $F173$

OLM (Electronic-thermal protection characteristics selection) is used to enable or disable the motor overload trip function ($OL2$) and the overload stall function.
The inverter overload trip ($OL1$) can be selected with using the parameter $F631$.
The main module overload trip ($OL3$) is detected constantly by the temperature estimation.

> Explanation of terms
> Overload stall: This is an optimum function for equipment such as fans, pumps and blowers with variable torque characteristics that the load current decreases as the operating speed decreases.
> When the inverter detects an overload, this function automatically lowers the output frequency before the motor overload trip ($OL2$) is activated. With this function, operation can be continued, without tripping, by operating using a frequency balanced by load current.
> Note: Do not use the overload stall function with loads having constant torque characteristics (such as conveyor belts in which load current is fixed with no relation to speed).

[Using standard motors (other than motors intended for use with inverters)]

When a motor is used in the lower frequency range than the rated frequency, that will decrease the cooling effects for the motor. This speeds up the start of overload detection operations when a standard motor is used in order to prevent overheating.

■ Setting of electronic thermal protection characteristics selection

Setting value	Overload protection	Overload stall
0	valid	invalid
1	valid	valid
2	invalid	invalid
3	invalid	valid

■ Setting of motor electronic thermal protection level 1 $t H r$ (Same as $F173$)

When the capacity of the motor in use is smaller than the capacity of the inverter, or the rated current of the motor is smaller than the rated current of the inverter, adjust thermal protection level 1 $t H r$ for the motor in accordance with the motor's rated current.

* When displaying as a percentage, 100% = rated output current (A) of the inverter is displayed.

Output current reduction factor
[%]/[A]

$t H r$ ×1.0

$t H r$ ×0.6

0

30Hz   Output frequency (Hz)
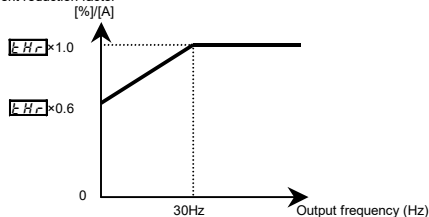
Note: The motor overload protection start level is fixed at 30Hz.

[Example of setting: When the VFS15-2007PM-W1 is running with a 0.4kW motor having 2A rated current]

Operation panel action	LED display	Operation
	0.0	Displays the output frequency. (Perform during operation stopped.) (When standard monitor display selection $F710$ is set to 0 [output frequency])
MODE	AUH	The first basic parameter "AUH" (history function) is displayed.
	$t H r$	Turn the setting dial to change the parameter to $t H r$.
	100	Parameter values can be read by pressing the center of the setting dial (default setting is 100%).
	42	Turn the setting dial to change the parameter to 42% (= motor rated current/inverter rated output current ×100=2.0/4.8×100)
	$42 \Leftrightarrow t H r$	Press the center of the setting dial to save the changed parameter. $t H r$ and the parameter are displayed alternately.

Note: The rated output current of the inverter should be calculated from the rated output current for frequencies below 4kHz, regardless of the setting of the PWM carrier frequency parameter ($F300$).

[Using a VF motor (motor for use with inverter)]

■ Setting of electronic thermal protection characteristics selection OLM

| Setting value	Overload protection	Overload stall
4	valid	invalid
5	valid	valid
6	invalid	invalid
7	invalid	valid

VF motors (motors designed for use with inverters) can be used in frequency ranges lower than those for standard motors, but their cooling efficiency decreases at frequencies below 6Hz.

■ Setting of motor electronic thermal protection level 1 tHr (Same as $F173$)

If the capacity of the motor is smaller than the capacity of the inverter, or the rated current of the motor is smaller than the rated current of the inverter, adjust the electronic thermal protection level 1 tHr so that it fits the motor's rated current.

* If the indications are in percentages (%), then 100% equals the inverter's rated output current (A).

Output current reduction factor [%]/[A]

tHr×1.0

tHr×0.6

0

6Hz

Output frequency (Hz)
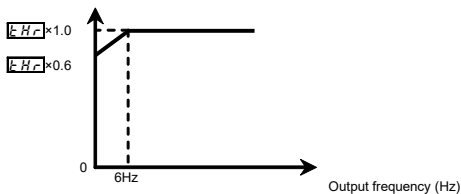
Note) The start level for motor overload reduction is fixed at 6 Hz.

2) Motor 150%-overload detection time $F607$

Parameter $F607$ is used to set the time elapsed before the motor trips under a load of 150% (overload trip $OL2$) within a range of 10 to 2400 seconds.

3) Inverter overload detection method $F631$

As this function is set to protect the inverter unit, this function cannot be turned off by parameter setting. The inverter overload detection method can be selected using parameter $F631$ (Inverter overload detection method).
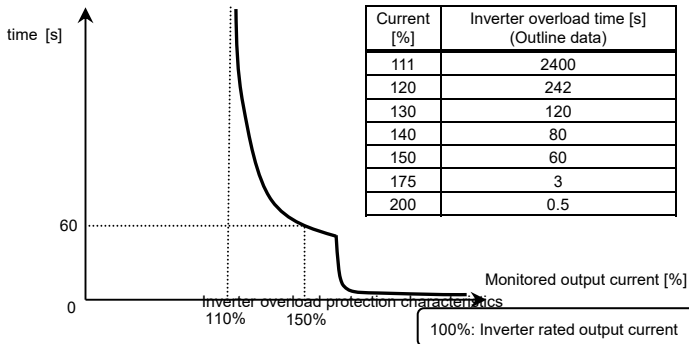
[Parameter setting]

Title	Function	Adjustment range	Default setting
$F631$	Inverter overload detection method	0: 150%-60s (120%-60s) 1: Temperature estimation	0

If the inverter overload trip function ($OL1$) is activated frequently, this can be improved by adjusting the stall operation level $F601$ downward or increasing the acceleration time ACC or deceleration time dEC.

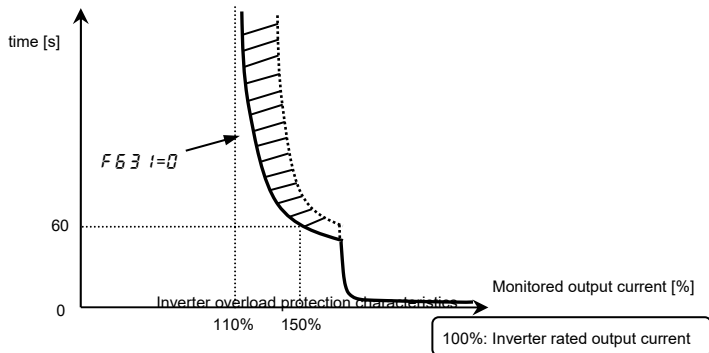■ $F63\ 1=0$ (150%-60s), $RUL = 1$ (Constant torque characteristic)

Protection is given uniformly regardless of temperature, as shown by the 150%-60 sec overload curve in the figure below.

Inverter overload

Current [%]	Inverter overload time [s] (Outline data)
111	2400
120	242
130	120
140	80
150	60
175	3
200	0.5

time [s]

60

0

Inverter overload protection characteristics
110%   150%

Monitored output current [%]

100%: Inverter rated output current

■ $F63\ 1= 1$ (Temperature estimation), $RUL = 1$ (Constant torque characteristic)

This parameter adjusts automatically overload protection, predicting the inverter internal temperature rise. (diagonally shaded area in the figure below)

time [s]

$F63\ 1=0$

60

0

Inverter overload protection characteristics
110%   150%

Monitored output current [%]

100%: Inverter rated output current

Note 1: At extremely low speeds of 1 Hz or less, an overload trip ($OL3$) can occur in a short time to protect the inverter.

Note 2: At over 150% current , an overload trip ($OL1$) can occur in a short time to protect the inverter.

Note 3: Overload detection level is variable by condition of output frequency and carrier frequency.

Note 4: Regarding to characteristic for $AUL=2$ setting, refer to section 5.6.5).

4) Electronic thermal memory $\boxed{F632}$

When the power is OFF, it is possible to reset or maintain the overload totaling level.

This parameter's settings are applied both to the motor's electronic thermal memory and the electronic thermal memory for inverter protection.

[Parameters settings]

Title	Function	Adjustment range	Default setting
$F632$	Electronic thermal memory	0: Disabled (tHr, $F173$) 1: Enabled (tHr, $F173$) 2: Disabled (tHr) 3: Enabled (tHr)	0

● $F632 = 1$ is a function for complying with the U.S. NEC standards.

5

5) Overload characteristic selection RUL

Overload characteristic of inverter can be selected to 150%-60s or 120%-60s.

[Parameters settings]

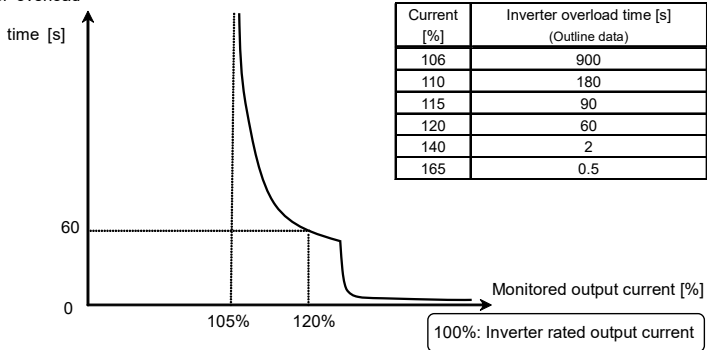| Title	Function	Adjustment range	Default setting
RUL	Overload characteristic selection	0: - 1: Constant torque characteristic（150%-60s) 2: Variable torque characteristic（120%-60s)	0

● Regarding to characteristic for $RUL = 1$ setting, refer to section 5.6.3).

Note) In case of $RUL = 2$ setting, be sure to install the input AC reactor (ACL) between power supply and inverter, to remove the protective label on the top of the inverter, and to connect the grounding capacitors by pressing the grounding capacitor switch.

Then, to use the inverter at 40°C or less of the ambient temperature with setting $F300$ to 4.0 kHz or less.

■ $RUL = 2$ (Variable torque characteristic), $F631 = 0$ (120%-60s)

Current [%]	Inverter overload time [s] (Outline data)
106	900
110	180
115	90
120	60
140	2
165	0.5

100%: Inverter rated output current

Inverter overload protection characteristic

■ $RUL=2$ (Variable torque characteristic), $F631=1$ (Temperature estimation)
This parameter adjusts automatically overload protection, predicting the inverter internal temperature rise. (diagonally shaded area in the figure below)
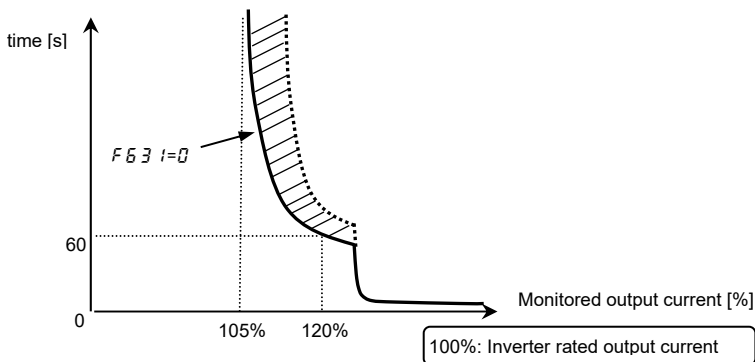
Note 1: The rated output current of inverter is changed by setting of $RUL=1$ or 2.
　　　　Refer to page L-1 about each rated output current.
Note 2: Parameter RUL is displayed as "0" during reading after this is set.
Note 3: Present setting of inverter overload characteristic can be confirmed by status monitor.
　　　　Refer to monitor "Overload and region setting" of section 8.2.1.

6) Overload alarm level　$F657$

When the motor overload level reaches to $F657$ setting value (%) of overload trip ($OL2$) level, "L" will be displayed on the left side digit and the "L" and output frequency monitor will be blinking alternately on overload alarm status.
Overload alarm signal can be output from output terminal.

[Parameters settings]

Title	Function	Adjustment range	Default setting
$F657$	Overload alarm level	10-100 (%)	50

[Example of setting]: Assigning the overload alarm to the OUT terminal.

Title	Function	Adjustment range	Setting
$F131$	Output terminal selection 2A (OUT)	0-255	16: POL

17 is reverse signal.