

FR-F800 series

Instruction Manual Supplement

1 Selection of the operation when a PID measured value error is detected

- The operation when the PID measured value exceeds the upper or lower limit can be selected.

Pr.	Name	Initial value	Setting range	Description
554 A604	PID signal operation selection	0	0 to 7, 10 to 17	The operation when the upper or lower limit for a measured value input is detected or when a limit for the deviation is detected can be selected. The operation for PID output suspension function can be also selected.
1370 A442	Detection time for PID limiting operation	0 s	0 to 900 s	Set the time from when the measured value input exceeds the Pr.131 or Pr.132 setting until the FUP or FDN signal is output.

◆ Operation selection and sleep function stop selection when a value error is detected (FUP signal, FDN signal, Y48 signal, Pr.554)

- Set the operation when the measured value input exceeds the upper limit (**Pr.131 PID upper limit**) or lower limit (**Pr.132 PID lower limit**), or when the deviation input exceeds the permissible value (**Pr.553 PID deviation limit**) in **Pr.554 PID signal operation selection**.
- Set the time from when the measured value input exceeds the **Pr.131** or **Pr.132** setting until the FUP or FDN signal is output in **Pr.1370 Detection time for PID limiting operation**.
- Set **Pr.554** to select the operation when the FUP/FDN or Y48 signal is output, and the operation when the sleep function is activated.

Pr.554 setting	Inverter operation		
	At FUP/FDN signal output*1	At Y48 signal output*1	At sleep function activation
0 (Initial value)	Signal output only	Signal output only	Coasting to stop
1	Signal output + output shutoff (E.PID)*2	Signal output + output shutoff (E.PID)*2	
2	Signal output only		
3	Signal output + output shutoff (E.PID)*2	Signal output only	
4	Signal output + deceleration stop (E.PID)*3		
5	Signal output + deceleration stop (restart)*4	Signal output + output shutoff (E.PID)*2	
6	Signal output + deceleration stop (E.PID)*3		
7	Signal output + deceleration stop (restart)*4	Deceleration stop	
10	Signal output only		Signal output only
11	Signal output + output shutoff (E.PID)*2		Signal output + output shutoff (E.PID)*2
12	Signal output only		
13	Signal output + output shutoff (E.PID)*2		Signal output only
14	Signal output + deceleration stop (E.PID)*3		
15	Signal output + deceleration stop (restart)*4		Signal output + output shutoff (E.PID)*2
16	Signal output + deceleration stop (E.PID)*3		
17	Signal output + deceleration stop (restart)*4		

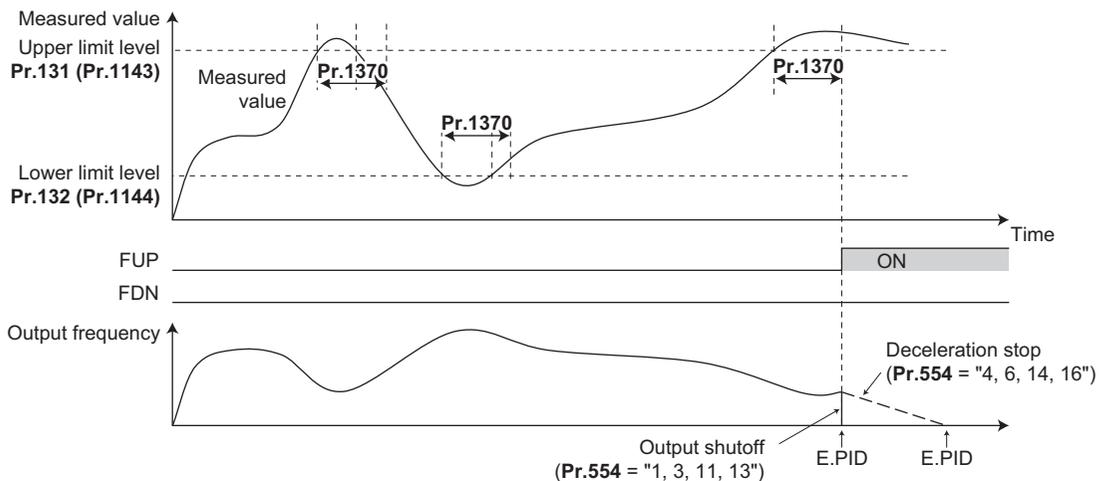
*1 When each of **Pr.131**, **Pr.132** and **Pr.553** settings corresponding to each of the FUP, FDN and Y48 signals is "9999" (no function), signal output and protective function are not available.

*2 At the same time with the signal output, the protective function (E.PID) is activated.

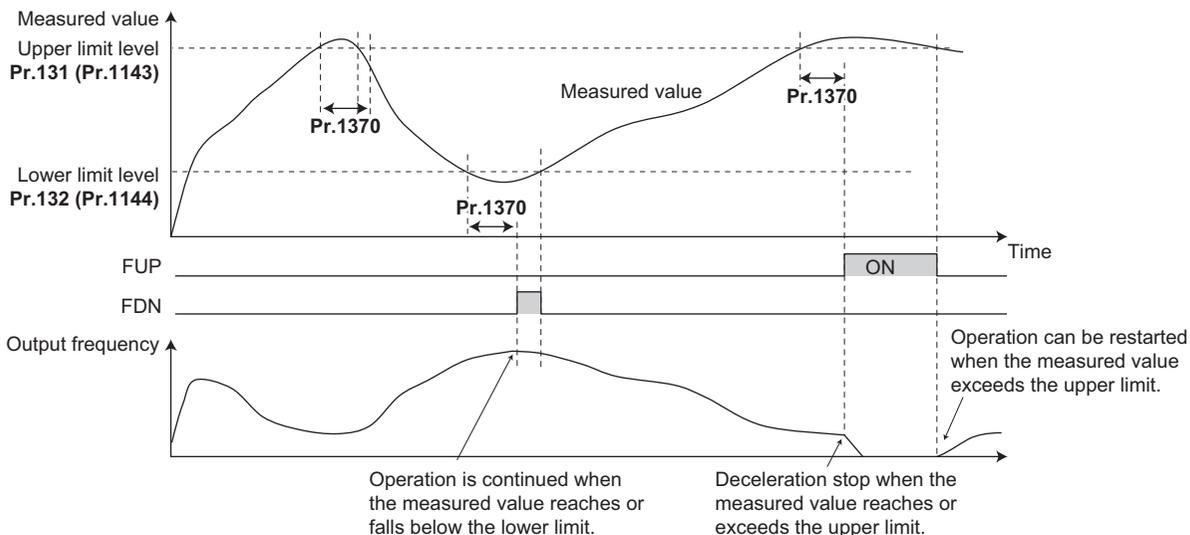
*3 At the same time with the signal output, deceleration is performed using the normal deceleration time. After the deceleration stop, the protective function (E.PID) is activated.

*4 At the same time with the signal output, deceleration is performed using the normal deceleration time. When the measured value returns to normal, operation can be restarted.

- Example chart: Protective function (E.PID) activation at the same time with the signal output (**Pr.554**="1, 3, 11, or 13") / Protective function activation after the deceleration stop (**Pr.554**="4, 6, 14, or 16") (reverse action)



- Example chart: Deceleration stop (restart) at the signal output (**Pr.554**="5, 7, 15, or 17") (reverse action)



2 PID control enhanced functions

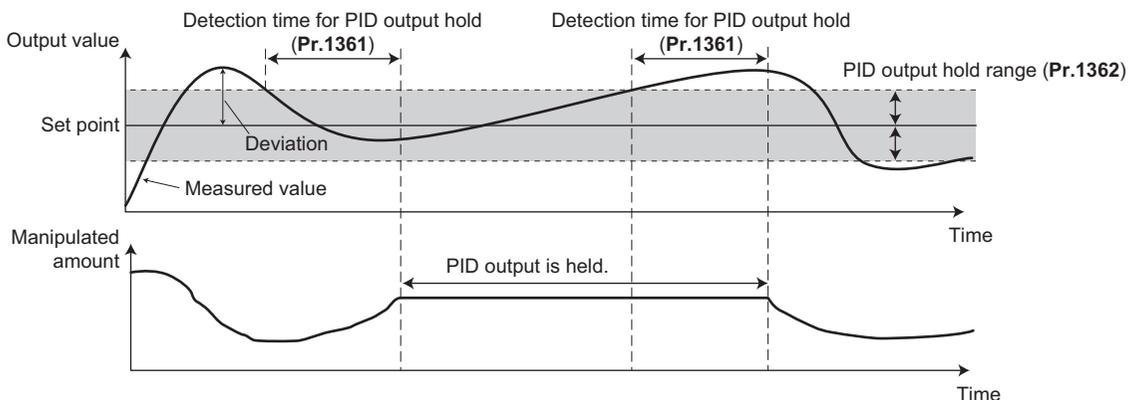
- PID control enhanced functions can be used to perform PID control according to applications. (For the details of the PID control, refer to page 378 of the Instruction Manual (Detailed).)

Pr.	Name	Initial value	Setting range	Description	Refer to page
1361 A440	Detection time for PID output hold	5 s	0 to 900 s	Set the time from when the deviation falls within the PID output hold range until the PID output is held.	4
1362 A441	PID output hold range	9999	0 to 50% 9999	Set the range in which the PID output is held. The PID output holding is disabled.	
1363 A447	PID Priming time	9999	0 to 360 s 9999	Set the time from when the priming operation starts until the main pump starts. The PID priming pump function is disabled.	6
1364 A448	Stirring time during sleep	15 s	0 to 3600 s	Set the stirring time.	5
1365 A449	Stirring interval time	0 h	0 to 1000 h	Set the interval time for the stirring operation.	
1366 A627	Sleep boost level	9999	0 to 100% 9999	Increase the set point before the PID output suspension function is activated. The PID sleep boost function is disabled.	8
1367 A628	Sleep boost waiting time	0 s	0 to 360 s	Set the waiting time for the sleep boost operation.	
1368 A629	Output interruption cancel time	0 s	0 to 360 s	Set the time from when the deviation reaches the output interruption cancel level until the output is started.	
111 F031	Check valve deceleration time	9999	0 to 3600 s 9999	Set the deceleration time for the check valve deceleration function. The check valve deceleration function is disabled.	9
1369 A446	Check valve closing completion frequency	9999	0 to 120 Hz 9999	Set the frequency at which the check valve deceleration stops. The check valve deceleration function is disabled.	
1370 A442	Detection time for PID limiting operation	0 s	0 to 900 s	Set the time from when the measured value input exceeds the Pr.131 or Pr.132 setting until the FUP or FDN signal is output.	8, 9, 10, 11
1371 A443	PID upper/lower limit pre-warning level range	9999	0 to 50% 9999	Set the operation range for the PID upper/lower limit pre-warning function. The PID upper/lower limit pre-warning function is disabled.	9
1372 A444	PID measured value control set point change amount	5%	0 to 50%	Set the set point change amount for the PID upper/lower limit pre-warning operation.	
1373 A445	PID measured value control set point change rate	0%	0 to 100%	Set the set point change rate for the PID upper/lower limit pre-warning operation.	9, 11
1374 A450	Auxiliary pressure pump operation starting level	1000%	900 to 1100%	Set the deviation level for operating the auxiliary pressure pump.	7
1375 A451	Auxiliary pressure pump operation stopping level	1000%	900 to 1100%	Set the deviation level for stopping the auxiliary pressure pump.	
1376 A414	Auxiliary motor stopping level	9999	0 to 100% 9999	Set the level for stopping the auxiliary motor by the PID overpressure control function. The PID overpressure control function is disabled.	8

Pr.	Name	Initial value	Setting range	Description	Refer to page
1377 A452	PID input pressure selection	9999	1	Terminal 1 pressure input	11
			2	Terminal 2 pressure input	
			3	Terminal 4 pressure input	
			9999	The PID input pressure control function is disabled.	
1378 A453	PID input pressure warning level	20%	0 to 100%	Set the input pressure warning level.	
1379 A454	PID input pressure fault level	9999	0 to 100%	Set the input pressure fault level.	
			9999	The input pressure fault detection is disabled.	
1380 A455	PID input pressure warning set point change amount	5%	0 to 100%	Set the set point change amount when the pressure reaches the input pressure warning level.	
1381 A456	PID input pressure fault operation selection	0	0	The protective function (E.PID) for the input pressure fault is activated.	
			1	A deceleration stop is performed when the input pressure fault occurs.	

◆PID output hold (Pr.1361 and Pr.1362)

- The manipulated amount (PID output) can be fixed when the fluctuation of the deviation is small. This function eliminates unnecessary acceleration/deceleration, which is effective to reduce the power consumption.
- When the deviation falls within the **Pr.1362 PID output hold range** and the elapsed time exceeds the **Pr.1361 Detection time for PID output hold**, the manipulated amount (PID output) is fixed at the output frequency at that time.
- Even if the deviation falls out of the PID output hold range, the manipulated amount (PID output) is kept during the detection time for PID output hold.

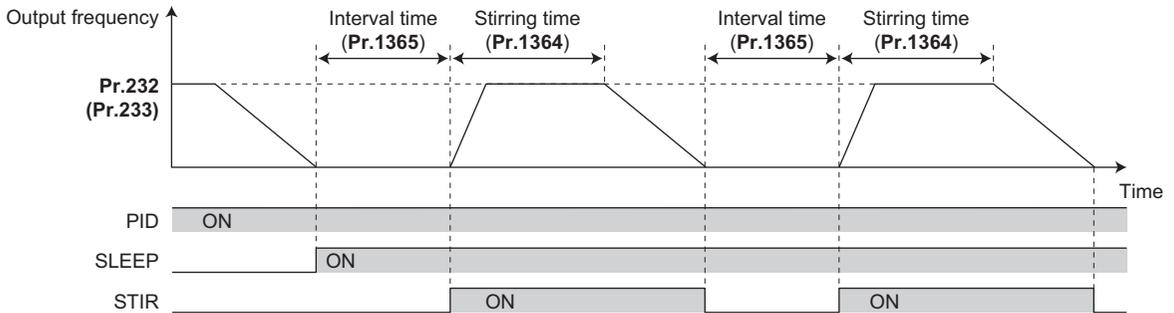


NOTE

- While the PID output is held, calculation is not performed for the P term, I term, and D term. For the P and I terms, the values at the start of the holding period are kept. The D term is set to "0".
- When the control switches between the first PID control and second PID control, the PID output holding state is canceled.
- The PID output holding function is disabled in the following cases:
When Pr.1362="9999", while the PID setting is not applied to the frequency, during the sleep function, at switching to the auxiliary motor in the multi-pump function, during PID gain tuning, and during the sleep boost.

◆ Stirring function during the PID sleep (Pr.1364 and Pr.1365)

- This function starts the pump periodically to prevent clogging of the pump while the PID output suspension function (sleep function) is activated.
- When the sleep function is activated and the elapsed time exceeds the **Pr.1365 Stirring interval time**, the pump is operated at the stirring frequency (**Pr.232** or **Pr.233**). The pump decelerates to stop when the elapsed time exceeds the **Pr.1364 Stirring time during sleep**. The interval time count for the second time onward starts after the previous deceleration stop is completed.



- The rotation direction depends on the **Pr.232** and **Pr.233** settings.

Stirring frequency		Rotation direction	Remarks
Pr.232 setting	Pr.233 setting		
9999	9999	—	The stirring function during the PID sleep is disabled.
0 to 590 Hz	Arbitrary	Command direction	Pr.232 frequency is used for stirring.
9999	0 to 590 Hz	Opposite to the command direction	Pr.233 frequency is used for stirring.

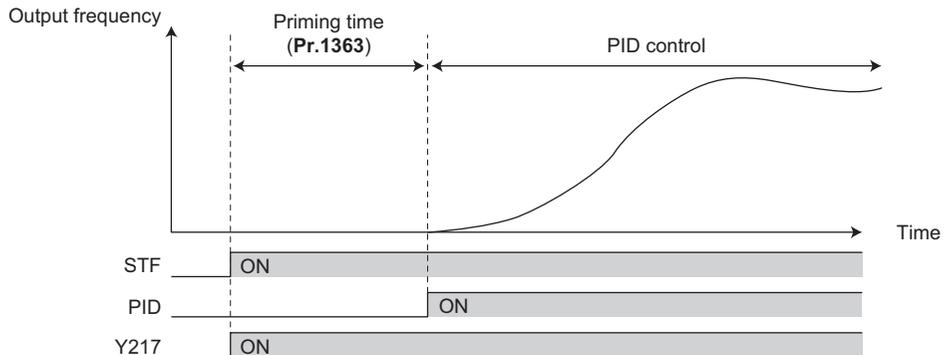
- The stirring signal (STIR) turns ON during the stirring operation. For the STIR signal, set "218 (positive logic)" or "318 (negative logic)" in any of **Pr.190 to Pr.196 (output terminal function selection)** to assign the function.
- When **Pr.579 Motor connection function selection**="1 or 3" (multi-pump function), the starting order of the motors is changed when the sleep function is activated. The stirring operation during the sleep is applied to the motor to be started first next time. For example, when the previous starting order was M1 → M2 → M3 → M4, and the next starting order of motors is M2 → M3 → M4 → M1, stirring operation during the sleep will be applied to the M2 motor.
- When the auxiliary motor starting condition is satisfied by the stirring operation during the sleep while the multi-pump function is used, the stirring operation continues. The auxiliary motor does not start.

NOTE

- When the control switches between the first PID control and second PID control during the sleep function, the interval time and the stirring time timer are carried over.
- When the sleep function cancellation condition is satisfied, the sleep function is cancelled, and the stirring function during the sleep is also cancelled.
- Changing the terminal assignment using **Pr.190 to Pr.196 (output terminal function selection)** may affect the other functions. Set parameters after confirming the function of each terminal.

◆PID priming pump function (Pr.1363)

- This function starts the priming pump first before starting the main pump so that the main pump does not intake air at start.
- When the start command is turned ON after setting **Pr.1363 PID Priming time**≠"9999", the priming pump operation signal (Y217) turns ON to start the priming pump. When the elapsed time exceeds the **Pr.1363** setting, the main pump starts.
- The priming pump continues operation during operation of the main pump. When the STF signal is turned OFF to stop the main pump, the priming pump also stops.
- For the Y217 signal, set "217 (positive logic)" or "317 (negative logic)" in any of **Pr.190 to Pr.196 (output terminal function selection)** to assign the function.

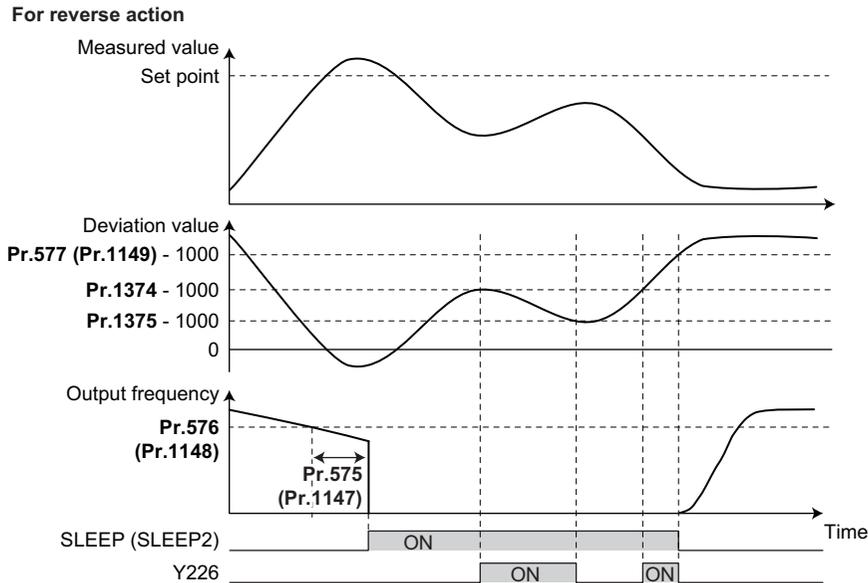


NOTE

- The priming operation is performed at every startup.
- When the operation is restarted after inverter reset by a protective function activation, the priming operation is performed.
- When the control switches between the first PID control and second PID control during the priming time, the priming time is carried over.
- The PID priming pump function is enabled when the PID setting is applied to the frequency.
- Even when the inverter emergency stop operation (output shutoff by the MRS signal, etc.) is performed, the PID priming pump function operation continues while the power is supplied to the control circuit. For the emergency stop operation, configure another circuit to stop the priming pump.
- Changing the terminal assignment using **Pr.190 to Pr.196 (output terminal function selection)** may affect the other functions. Set parameters after confirming the function of each terminal.

◆PID auxiliary pressure pump function (Pr.1374 and Pr.1375)

- This function enables signal output to activate an auxiliary pressure pump when the pump flow rate is low in the system which constantly requires a high pressure.
- When the deviation exceeds the auxiliary pressure pump operation starting level (**Pr.1374 Auxiliary pressure pump operation starting level - 1000%**) after the PID output suspension function (sleep function) is activated, the auxiliary pressure pump starts and the auxiliary pressure pump operation signal (Y226) turns ON.
- When the deviation falls below the auxiliary pressure pump operation stopping level (**Pr.1375 Auxiliary pressure pump operation stopping level - 1000%**) during the auxiliary pressure pump operation, the auxiliary pressure pump stops.
- For the Y226 signal, set "226 (positive logic)" or "326 (negative logic)" in any of **Pr.190 to Pr.196 (output terminal function selection)** to assign the function.



NOTE

- The recommended settings of **Pr.577 (Pr.1149)**, **Pr.1374**, and **Pr.1375** are as follows.
Pr.577 (Pr.1149) > Pr.1374 > Pr.1375
- Even when the inverter emergency stop operation (output shutoff by the MRS signal, etc.) is performed, the PID auxiliary pressure pump function operation continues while the power is supplied to the control circuit. For the emergency stop operation, configure another circuit to stop the auxiliary pressure pump.
- Changing the terminal assignment using **Pr.190 to Pr.196 (output terminal function selection)** may affect the other functions. Set parameters after confirming the function of each terminal.

◆PID overpressure control (Pr.1370 and Pr.1376)

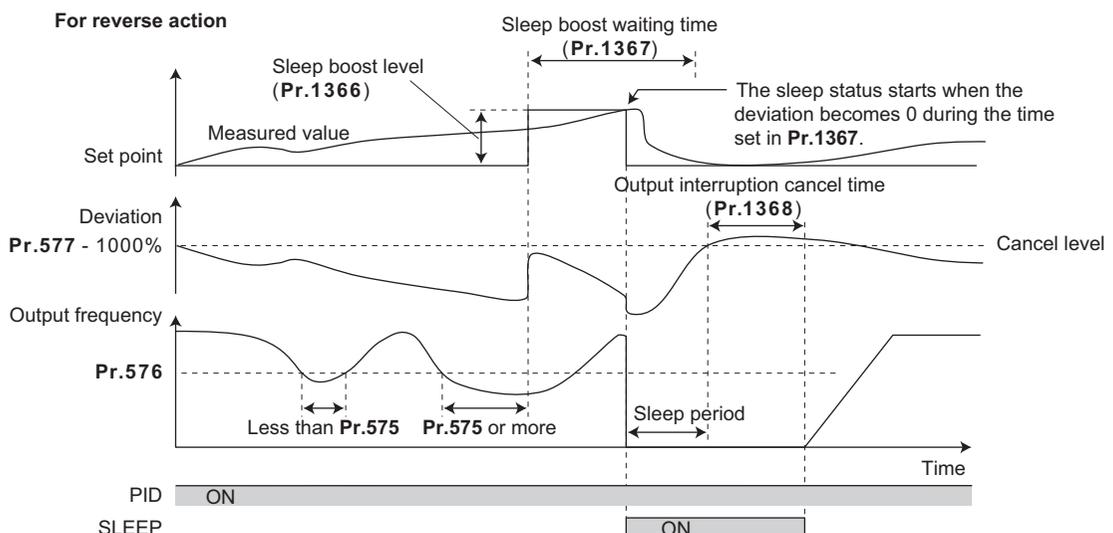
- When the main valve is suddenly closed in the multi-pump function system, a sudden increase of the pipe pressure may occur, and the pipes may be broken. To prevent fracture of the pipes, all auxiliary motors are stopped when the feedback value exceeds the predetermined level.
- When the PID measured value reaches or exceeds the **Pr.1376 Auxiliary motor stopping level** and the elapsed time exceeds the **Pr.1370 Detection time for PID limiting operation** while the multi-pump function is activated, all operating auxiliary motors are disconnected and allowed to coast to a stop regardless of the **Pr.579 Motor connection function selection** setting. The motor driven by the inverter continues its operation. (For the details of **Pr.579**, refer to page 406 of the Instruction Manual (Detailed).)
- When the auxiliary motor is once stopped, the motor operation does not start while the PID measured value is the **Pr.1376** setting or more even when the auxiliary motor starting condition is satisfied.

NOTE

- The PID overpressure control function can be used when PID control is performed (reverse action only) by the set point or measured value input using the multi-pump function.
- Either the first or the second PID measured value is used according to the PID control selection. When the control switches between the first PID control and second PID control, the measured value to be used is also switched to continue the control operation.

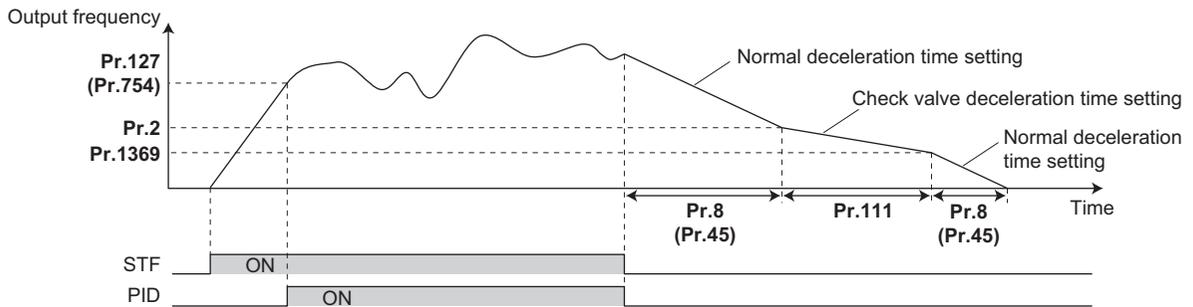
◆PID sleep boost (Pr.1366 to Pr.1368)

- The pump pressure can be increased before the PID output suspension function (sleep function) is activated. This function is useful to prevent frequent repetition of starting and stopping of the pump, and to keep the sleep state for a long period of time.
- When the normal condition to activate the sleep function is satisfied (the output frequency is less than **Pr.576** setting for the time set in **Pr.575** or longer), the PID set point automatically increases by the amount set in **Pr.1366 Sleep boost level**.
- When the measured value reaches to the set point during **Pr.1367 Sleep boost waiting time**, the sleep function is activated. Then, the set point returns to its original value from the sleep boost set point.
- When the measured value does not reach to the sleep boost set point after the time set in **Pr.1367** passes, PID control continues without activating the sleep function.
- When the deviation remains at the **Pr.577** setting or higher for the time set in **Pr.1368 Output interruption cancel time**, the inverter output restarts.



◆ Check valve deceleration function (Pr.111 and Pr.1369)

- When the pump is stopped, slow deceleration can be applied to the predetermined section to prevent the water hammer sound caused by closing the valve.
- The **Pr.111 Check valve deceleration time** setting is applied to the section between **Pr.2 Minimum frequency** and **Pr.1369 Check valve closing completion frequency**.



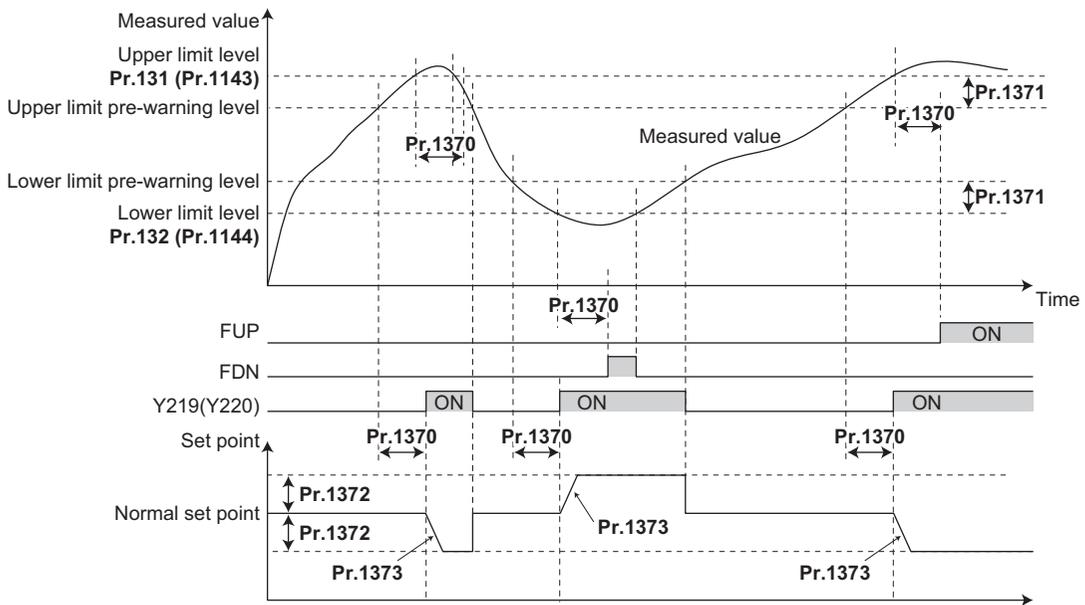
NOTE

- The check valve deceleration function is enabled when the PID setting is applied to the frequency.
- When the **Pr.1369** setting is higher than the **Pr.2** setting, the normal deceleration time (**Pr.8** or **Pr.45**) setting is applied.

◆ PID upper/lower limit pre-warning (Pr.1370 to Pr.1373)

- The set point can be changed to prevent increase of the measured value before PID upper limit (FUP) or PID lower limit (FDN) is detected.
- When the measured value reaches and remains at the pre-warning level set in **Pr.1371 PID upper/lower limit pre-warning level range** for the time set in **Pr.1370 Detection time for PID limiting operation**, the PID upper/lower limit pre-warning signal (Y219) or the second PID upper/lower limit pre-warning signal (Y220) is output. Also, the set point is changed by the amount set in **Pr.1372 PID measured value control set point change amount**.
- Set the rate (%/s) for changing the set point by the **Pr.1372** setting value in **Pr.1373 PID measured value control set point change rate**. When the measured value falls within the normal range, the set point returns to its original value.
- For the Y219 and Y220 signals, assign the functions to output terminals using the **Pr.190 to Pr.196 (output terminal function selection)**.

Output signal	Pr.190 to Pr.196 setting	
	Positive logic	Negative logic
Y219	219	319
Y220	220	320

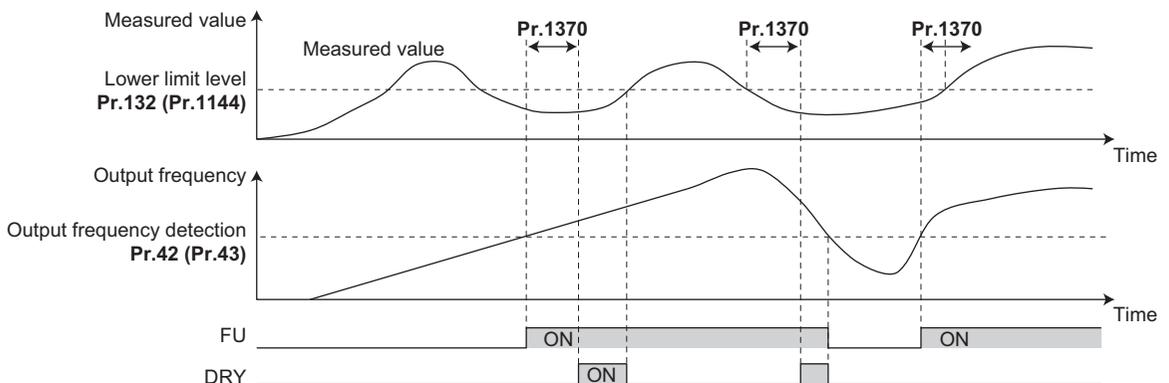


NOTE

- When Pr.554="5, 7, 15, or 17" and a deceleration stop is performed by the FUP/FDN signal detection, the set point changed by the Pr.1372 setting value remains effective.
- The set point change by the PID upper/lower limit pre-warning function is enabled when the PID setting is applied to the frequency.
- When the control switches between the first PID control and second PID control while the set point is changed by the Pr.1372 setting value or while the Y219 (Y220) signal is output, the set point returns to its original value.

◆PID dry run monitoring function (Pr.1370)

- This function can prevent operation without water in the pipes by monitoring the flow rate (measured value) inside the pipes. When the flow rate decreases while the FU signal is ON, an output signal is sent for notification.
- The dry run signal (DRY) is output during PID control when the measured value is lower than the lower limit (Pr.132 or Pr.1144) and the output frequency is higher than the setting in Pr.42 Output frequency detection or Pr.43 Output frequency detection for reverse rotation (FU signal ON) for the time set in Pr.1370 Detection time for PID limiting operation.
- For the DRY signal, set "228 (positive logic)" or "328 (negative logic)" in any of Pr.190 to Pr.196 (output terminal function selection) to assign the function.
- The PID dry run monitoring function is enabled for the reverse action.



NOTE

- The PID dry run monitoring function is enabled when the PID setting is applied to the frequency.

◆PID input pressure control (Pr.1370, Pr.1373, and Pr.1377 to Pr.1381)

- This function controls the pump inlet pressure to prevent water shortage that may cause air intake or cavitation on the pump.
- To enable the PID input pressure control function, set the terminal for the pressure input in **Pr.1377 PID input pressure selection**.

Pr.1377 setting	Pressure input terminal	Remarks
1	Terminal 1	Set Pr.868 ="0 (initial value)".
2	Terminal 2	—
3	Terminal 4	Set Pr.858 ="0 (initial value)".
9999 (Initial value)	The PID input pressure control function is disabled.	—

- When the input pressure measured at the inlet remains lower than the **Pr.1378 PID input pressure warning level** for the time set in **Pr.1370 Detection time for PID limiting operation**, the PID input pressure warning signal (Y229) is output. Also, the set point is changed by the amount set in **Pr.1380 PID input pressure warning set point change amount**.
- Set the rate (%/s) for changing the set point by the **Pr.1380** setting value in **Pr.1373 PID measured value control set point change rate**. When the input pressure falls within the normal range, the set point returns to its original value.
- When the input pressure measured at the inlet remains lower than the **Pr.1379 PID input pressure fault level** for the time set in **Pr.1370 Detection time for PID limiting operation**, the operation for the abnormal input pressure starts and the PID input pressure fault signal (Y230) is output.
- Select the operation for the abnormal input pressure in **Pr.1381**.

Pr.1381 setting	Operation for the abnormal input pressure	Y230 signal
0 (Initial value)	Output shutoff by the protective function (E.PID) activation	The signal is output at the same time with the protective function.
1	Deceleration stop (Operation can be restarted when the input pressure returns to normal.)	The signal is output after a deceleration stop.

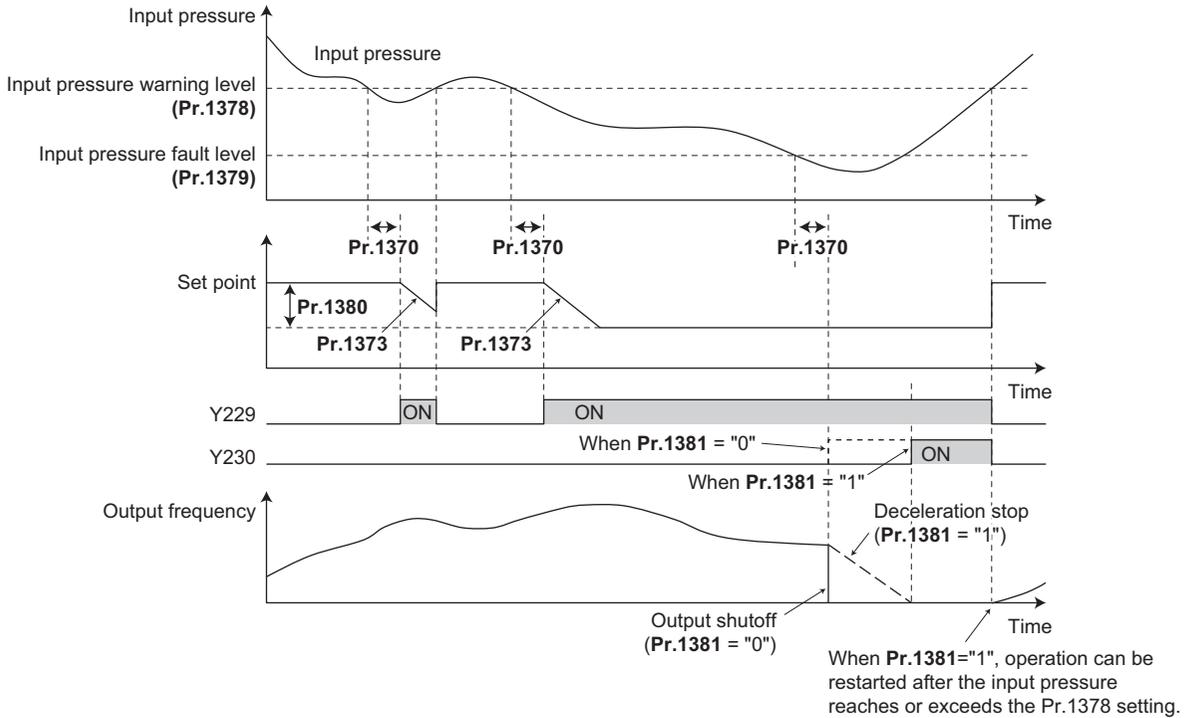
- For the Y229 and Y230 signals, assign the functions to output terminals using the **Pr.190 to Pr.196 (output terminal function selection)**.

Output signal	Pr.190 to Pr.196 setting	
	Positive logic	Negative logic
Y229	229	329
Y230	230	330

- To monitor the input pressure, set "69" in the monitor selection parameters. (0.1% increments)

Monitor type	Parameter setting			Communication monitor code	
	Pr.52, Pr.774 to Pr.776, and Pr.992 (Operation panel indication)	Pr.54 (Terminal FM/CA output)	Pr.158 (Terminal AM output)	RS-485 communication dedicated monitor (hexadecimal)	MODBUS RTU real time monitor
PID input pressure value	69	69	69	H45	40269

For reverse action



NOTE

- When the control switches between the first PID control and second PID control while the set point is changed by the **Pr.1380** setting value or while the Y229/Y230 signal is output, the set point returns to its original value or the signal turns OFF, and the detection restarts.
- When the PID input pressure control function and the PID upper/lower limit pre-warning function are used simultaneously, each function may change the set point. When the set point change is attempted by both functions, the change by the PID input pressure control function has priority.
- When the PID input pressure control function and the PID sleep boost function are used simultaneously, each function may change the set point. When the set point change is attempted by both functions, the change by the PID input pressure control function has priority. (The sleep state is established without applying the set point change by the PID sleep boost function.)