Instruction Manual US1000 Quick Start Manual

(For single-loop control with a 1-5 V input and 4-20 mA output)

IM 5D1A01-80E 1st Edition Oct. 1998

Introduction

This manual outlines the procedure for using the US1000 controller in single-loop PID control. For the detailed procedure, refer to the US1000 Digital Indicating Controller instruction manual (IM 5D1A01-01E).

Factory-set Defaults

At the time of shipment, the US1000 controller is set for various applications as shown in the table below. This manual mainly describes how to change the settings for the items marked with an asterisk (*).

Item	Factory-set default for US1000-00
PV input signal	1 to 5 V DC
* Measurement range and unit	0.0 to 100.0 (No unit set)
Square-root computation, 10-segment linearizer, PV filter, PV bias, burnout	OFF or 0
Loop power supply for two-wire transmitter	Enabled
Alarm function	PV high limit (2 points), PV low limit (1 point)
Cascade input signal	1 to 5 V DC (CAS mode key is disabled, however)
Controller mode and MV output	Single-loop control, 4 to 20 mA
PID parameters	P = 999.9%, I = 1000 seconds, D = OFF
* Control action	Reverse action
PID control mode	Fixed-point control
Output limiter	Upper limit = 100%, Lower limit = 0%
Preset MV	-5.0%
Auto-tuning and SUPER function	OFF
Control period	200 msec.
Mode switching by external contacts	RUN/STOP switchover, MAN mode selection
Password	0: no password
Key lock	CAS mode key disabled
Action upon power recovery Less than 2 seconds 2 seconds or longer	 Starts in the state prior to power failure Starts in the MAN mode

Terminal Assignments

Terminal code	Terminal No.	US1000-00 (Basic type)	US1000-11 (Enhanced type)	
AIN1	2 - 3	PV input, 1 to 5 V DC	PV input, 1 to 5 V DC	
AIN2	47 - 48	None	Not used	
AIN3	4 - 5	Cascade input, 1 to 5 V DC	Cascade input, 1 to 5 V DC	
DI1	6 - 8	RUN/STOP switchover *1	RUN/STOP switchover *1	
DI2	7 - 8	MAN mode selection *2	MAN mode selection *2	
DI3	31 - 8	None	AUTO mode selection *3	
DI4	32 - 8	None	Bit-0 of SV No. setting	*4
DI5	33 - 8	None	Bit-1 of SV No. setting	
DI6	34 - 8	None	Bit-2 of SV No. setting	
DI7	35 - 8	None	Bit-3 of SV No. setting	
LPS1	19 - 20	Loop power supply for transmitter 1	Loop power supply for transmitter 1	
LPS2	51 - 52	None	Loop power supply for transmitter 2	
OUT1A	16 - 18	MV output, 4 to 20 mA	MV output, 4 to 20 mA	
OUT2A	49 - 50	None	Not used	
OUT3A	17 - 18	Retransmission output, 1 to 5 V DC	Retransmission output	
DO1	9 - 12	PV high limit 1	PV high limit 1	*5
DO2	10 - 12	PV low limit 1	PV low limit 1	
DO3	11 - 12	PV high limit 2	PV high limit 2	
DO4	36 - 40	None	PV low limit 2	
DO5	37 - 40	None	Not used	
DO6	38 - 40	None	Not used	
DO7	39 - 40	None	FAIL output	
OUT1R	55-56-57	None	PV low limit 2	
OUT2R	58-59-60	None	PV high limit 2	
	13-14, 15	Power supply and grounding (No. 15)	Power supply and grounding (No. 15)	

Notes

*1: RUN/STOP switchover:
Contact ON = Operation stopped
(Stops control function and outputs the preset MV.)
Contact OFF = Normal operation

*2: MAN mode selection: ON = MAN mode, OFF = No function

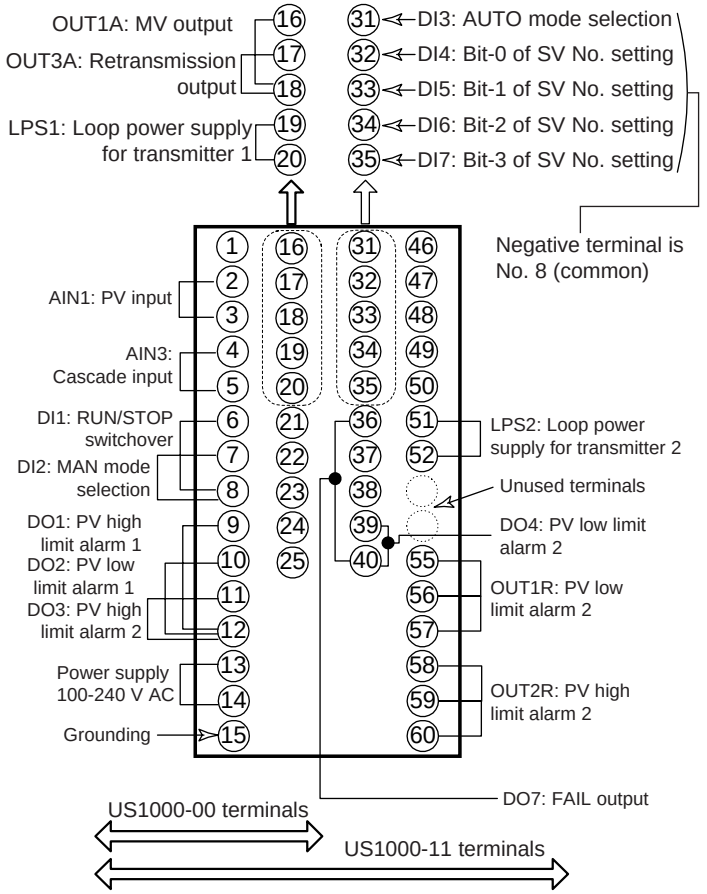
*3: AUTO mode selection: ON = AUTO mode, OFF = No function

*4: SV No. setting: Selects one out of 8 SV settings by combining contact input signals. For information on how to setup this function, refer to the US1000 Digital Indicating Controller Functions instruction manual (IM 5D1A01-02E).

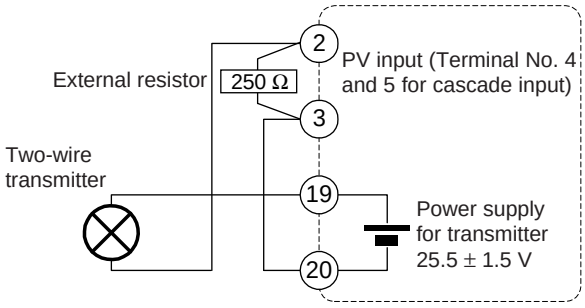
*5: Alarm output
US1000-00: 2 setpoints for the PV high limit alarm and 1 setpoint for the PV low limit alarm
US1000-11: 2 setpoints for each of the PV high limit and PV low limit alarms
The signals assigned to “DO3 and OUT2R” and “DO4 and OUT1R” are identical.

Terminal Arrangement

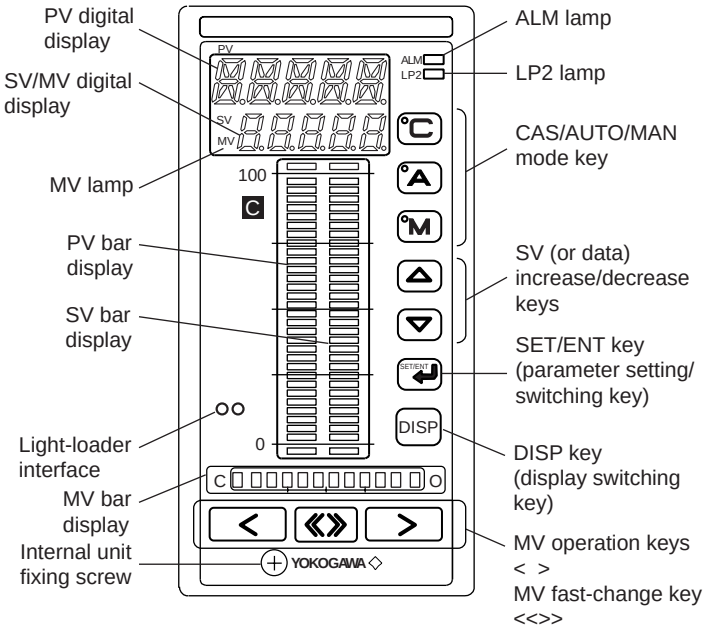
Terminal assignments at time of shipment



Wiring of 2-wire transmitter (for US1000-00)



Setting Up Functions before Operation



Note: The following operation steps are just for initial condition. If some parameters were changed, operation steps might be different.

• Setting display scale

To change the display scale from its initial 0.0 to 100.0 range to 0.0 to 500.0:

1) Press the M key to set the controller to MAN mode.
2) Press the [SET/ENT] key for 3 seconds to display [**O.LP1**].
3) Press the [▽] key to display [**STUP**].
4) Press the [SET/ENT] key to display [**S.LP1**].
5) Press the [▽] key once to display [**USMD**].
6) Press the [SET/ENT] key to display [**MD**].
7) Press the [△] key once to display [**IN**].
8) Press the [SET/ENT] key 5 times to display [**SH1**] (the maximum value of the analog input-1 scale).
9) Press the [△] [▽] keys to adjust the setting to **500.0**.
   Press the [SET/ENT] key to write the setting.
10) To make the written value take effect, execute initialization.
    Press the [DISP] key once to return to [**IN**].
11) Press the [△] key several times to display [**INIT**].
    Press the [SET/ENT] key to display [**OFF**].
12) Press the [△] key once to change to [**ON.**] (the decimal point flashes).
13) Press the [SET/ENT] key to initialize the setting.
14) Press the [DISP] key 3 times to return to the operation display.
    [**USMD**] → [**O.LP1**] → Operation display

• Setting alarm setpoints, PID constants, and control action

1) Set the controller in MAN mode, then press the [SET/ENT] key for 3 seconds to display [**O.LP1**].
2) Press the [SET/ENT] key to display [**PAR**].
3) Press the [△] key once to display [**1.PID**].
4) Press the [SET/ENT] key twice to display [**1.A1**] (PV high limit alarm-1 setpoint).
5) Press the [△] [▽] keys and set the alarm setpoint.
   Press the [SET/ENT] key to write the setting.
6) Press the [SET/ENT] key to display [**1.A2**] (PV low limit alarm-1 setpoint).
7) Set the alarm setpoint in the same way as step 5.
8) Press the [SET/ENT] key several times to display [**1.P**] (proportional band).
9) Press the [△] [▽] keys and set the proportional band.
   Press the [SET/ENT] key to write the setting.
10) Press the [SET/ENT] key again to display [**1.I**] (integral time).
11) Press the [△] [▽] keys and set the integral time.
    Press the [SET/ENT] key to write the setting.
12) Press the [SET/ENT] key again to display [**1.D**] (derivative time).
13) Press the [△] [▽] keys and set the derivative time.
    Press the [SET/ENT] key to write the setting.
14) Press the [SET/ENT] key several times to display [**1.DR**] (direct/reverse action switchover).
15) To change the control action, press the [△] key and change the setting.
    Press the [SET/ENT] key to write the setting.
16) Press the [DISP] key 3 times to return to the operation display.
    [**1.PID**] → [**O.LP1**] → Operation display

Starting Operation

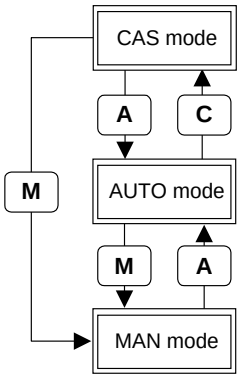
• Starting Operation

1) Turn on the power to the controller, and set the MAN mode (so that the M lamp is lit).
2) Press the [△] [▽] keys and set the target setpoint (SV).
3) Operate MV by pressing the [<] [>] keys until PV reaches SV. The SV/MV digital display automatically shows MV.
4) When you press the [A] key in a stable state, the controller switches to the AUTO mode without producing any sudden changes in MV.

Normal Operations

• Switching between operation modes (CAS/AUTO/MAN)

Change the operation mode using the [C], [A], and [M] keys. The figure on the right shows how the different key operations change the operation mode. As you can see, you cannot change from MAN to CAS mode directly. You must change to AUTO mode first, and then to CAS mode. At the time of shipment, the [C] key operation is disabled. To enable the [C] key, follow the procedure on page 3.



• Switching the SV/MV digital display

Press the [DISP] key during operation. The digital display alternates between SV and MV without changing the operation mode.

• Displaying alarms

When either a PV high limit or PV low limit alarm occurs, the ALM lamp comes on. It goes out when the alarm returns to normal. To display the alarm numbers on the PV and SV digital displays, provide the setting for **"To display activated alarm numbers"** on page 2.

• Changing output limiter

You can change the setting of the output limiter using the operation parameters [**1.MH**] and [**1.ML**], and following the same procedure as that under "Setting alarm setpoints, PID constants, and control action."
(Path: [**O.LP1**] → [**1.PID**] → [**1.MH**], [**1.ML**], [**1.PM**])
The output limiter is effective in AUTO and CAS mode. (In the MAN mode, manual operation takes priority and the output limiter becomes ineffective.)

Setting Various Functions (perform as necessary)

This section introduces the procedures for setting parameters that set up various functions. The operation procedures are the same as the example procedures described so far. (For details, refer to the US1000 Digital Indicating Controller instruction manual IM 5D1A01-01E.)
It is useful to read the following procedures together with the "Operation Parameter List" on page 4 and the "Setup Parameter List" in another basic operation manual (IM 5D1A01-81E).

• To use a flow signal for PV input

When you use an orifice flowmeter, use square-root computation, a low signal cut-off point, and a PV filter.
Setup the parameters as follows:
A.SR1 = **ON** (Executes square-root extraction)
(Path: [**CMLP**] → [**AIN**] → [**A.SR1**])
A.LC1 = 0 to 5% (Low signal cut-off point)
(Path: This parameter appears following the **A.SR1**.)
Operation parameters:
FL = OFF, 1 to 120 seconds (Time constant of PV filter)
(Path: [**O.LP1**] → [**PAR**] → [**FL**])
The other available filter is an analog input-1 filter [**A.FL1**], however, the PV filter [**FL**] is convenient because you can change it during operation.

• To change the control period

You can change the control period in single-loop control.
Setup parameter:
SMP = 100 (100 msec.) (Path: [**USMD**] → [**MD**] → [**SMP**])

• To change the PV input type (initialization is required)

This example involves changing the input to thermocouple type T, and setting a measured temperature range of 0 to 300˚C and the burnout action. Set [TYP1] and [RH1], and execute the initialization before setting [R.BO1].
Setup parameters:
TYP1 = 6 (Type T, 0 to 400˚C)
(Path: [**USMD**] → [**IN**] → [**TYP1**])
RH1 = 300.0 (Upper limit temperature is 300.0˚C) (Path: [**USMD**] → [**IN**] → [**RH1**])
You do not need to change **RL1** and **SDP1**.
INIT = ON (Executes initialization.)
(Path: [**USMD**] → [**INIT**] → [**INIT**])
A.BO1 = UPS (Upscale upon burnout)
(Path: [**CMLP**] → [**AIN**] → [**A.BO1**])

• To change alarm-3 to a deviation alarm

Change alarm-3 (DO3), to which the PV high limit alarm 2 is assigned at shipment, to a deviation alarm.
Setup parameter:
AL3 = 7 (Deviation of high and low limits) (Path: [**S.LP1**] → [**ALM**] → [**AL3**])

• To display activated alarm numbers

Add "loop-1 alarm (**U.1AL**)" to USER displays. You can see the alarm numbers of activated alarms on the operation display.
Setup parameter:
U.1AL = ON (Displays USER display of loop-1 alarm)
(Path: [**CONF**] → [**U.OPE**] → [**U.1AL**])

• To use cascade input

Analog input AIN3 can be used for a cascade setpoint signal by enabling the [C] key, whose action is prohibited at shipment.
Setup parameter:
C = OFF (Enables the [C] key.) (Path: [**CMLP**] → [**KLCK**] → [**C**])

• To communicate with a personal computer (set the optional communication function is necessary)

The US1000 controllers with the communication function can exchange parameter data with higher-level equipment, such as personal computers, via communication. To receive a cascade setpoint signal from higher-level equipment, set the communication parameters, and then set the parameter **CMS**. (Note that writing parameter data frequently from higher-level equipment may damage the US1000 controller's memory chip.)
Setup parameters:
R485 (Path: [**CMLP**] → [**R485**] → [Communication parameters])
CMS = CPT (Cascade setting via communication)
(Path: [**S.LP1**] → [**SV**] → [**CMS**])

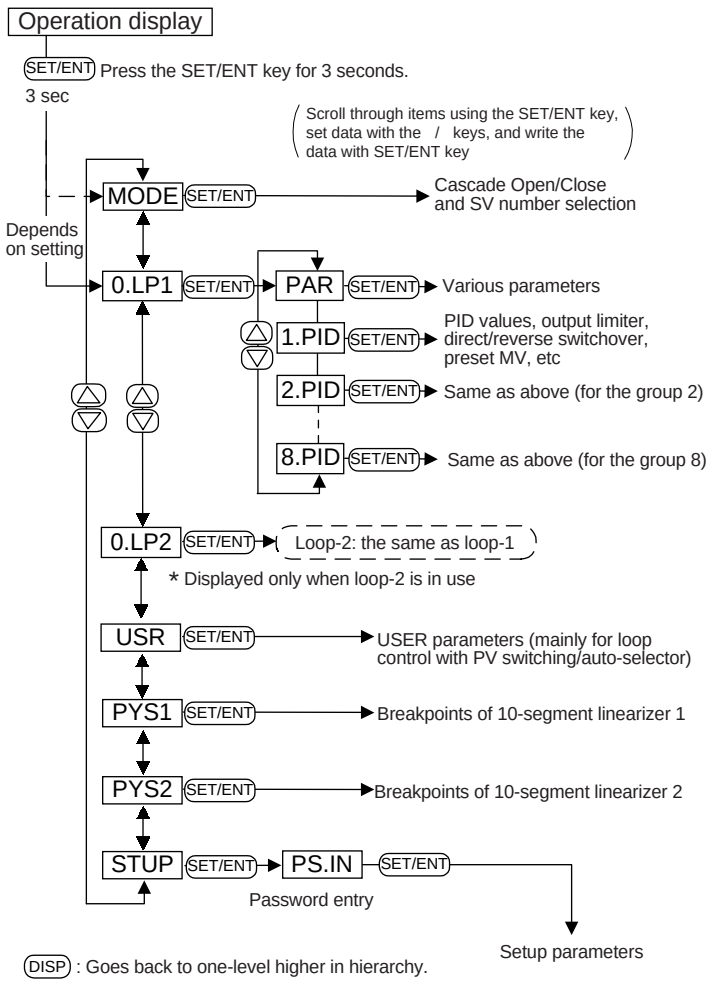
• To set a password (and hide the setup parameters)

Setting a password can disable any operation to setup parameters. Set a password using the parameter **PWD**.
Once you have set a password, [**PS.IN**] will be displayed after the setup parameter menu [**STUP**]. Enter the password at [**PS.IN**].
Setup parameter:
PWD = Any value from 1 to 30000 (**PWD** = 0: no password)
(Path: [**CMLP**] → [**MLCK**] → [**PWD**])

Note 1: If you forget the password, you cannot cancel the password setting yourself.
Note 2: All setup parameters except for the password parameter can be accessed via communication regardless of whether a password has been set.

Operation Parameters

Operation parameters are such as PID constants and alarm setpoints.



■ Operation Parameter List

Parameters marked with an asterisk (*): Be sure to check (and change) their settings.
Other parameters: Use their default settings for general use, and change as necessary.
The controller only displays the operation parameters in use, according to the functions configured using the setup parameters.

Code	Description	Setting range	Default
MODE			
O/C	Open/Close switchover (internal cascade loop)	OPEN, CLOSE	CLOSE
* SVNO	SV number selection	1 to 8	1
PAR			
AT	Auto-tuning selection	OFF, 1 to 8, 9	OFF
SC	SUPER function selection	OFF, ON	OFF
BS	PV bias	EUS(-100.0 to 100.0%)	0.0%
FL	PV filter	OFF, 1 to 120 seconds	OFF
UPR	Setpoint ramp-up	OFF, EUS(0.1 to 100.0%)	0.0%
DNR	Setpoint ramp-down	OFF, EUS(0.1 to 100.0%)	0.0%
CRT	Cascade ratio	0.001 to 9.999	1.000
CBS	Cascade bias	EUS(-100.0 to 100.0%)	0.0%
CFL	Cascade input filter	OFF, 1 to 120 seconds	OFF
FGN	Feedforward gain	-9.999 to 9.999	1.000
FBI	Feedforward input bias	-100.0 to 100.0%	0.0%
FBO	Feedforward output bias	-999.9 to 999.9%	0.0%
FFL	Feedforward input filter	OFF, 1 to 120 seconds	OFF
1.PID (and the same for 2.PID to 8.PID)			
* 1.SV	Target setpoint	EU(0.0 to 100.0%)	EU(0.0)%
* 1.A1	Alarm 1 setpoint	PV alarms: EU(-100.0 to 100.0%) Deviation and PV velocity alarms: EUS(-100.0 to 100.0%) SV alarms: EU(0.0 to 100.0%) MV alarms: -5.0 to 105.0%	PV high limit: EU (100.0%) Deviation alarm: EUS(0.0%) MV high limit: 100.0% MV low limit: 0.0% PV Velocity:EUS (100.0%) Other Alarms: EU (0.0%)
* 1.A2	Alarm 2 setpoint		
* 1.A3	Alarm 3 setpoint		
* 1.A4	Alarm 4 setpoint		
* 1.P	Proportional band	0.1 to 999.9% For heating/cooling: 0.1 to 999.9%	999.9%
* 1.I	Integral time	OFF, 1 to 6000 seconds	1000 seconds
* 1.D	Derivative time	OFF, 1 to 6000 seconds	OFF
1.MH	Upper limit of output	(1.ML+0.1) to 105.0%; 0.0 to 105.0% for heating-side limiter	100.0%
1.ML	Lower limit of output	-5.0 to (1.MH-0.1)%; 0.0 to 105.0% for cooling-side limiter	0.0%; 100.0% for cooling
1.MR	Manual reset	-5.0 to 105.0%	50.0%
1.H	Hysteresis	EUS(0.0 to 100.0%) for ON/OFF; 0.0 to 100.0% for position proportional PID or heating/cooling	0.5%
* 1.DR	Direct/reverse action switchover	0 = Reverse, 1 = Direct	0
1.Pc	Cooling-side proportional band	0.0 to 999.9%	999.9%
1.Ic	Cooling-side integral time	OFF, 1 to 6000 seconds	1000 seconds
1.Dc	Cooling-side derivative time	OFF, 1 to 6000 seconds	OFF
1.Hc	Cooling-side relay hysteresis	0.0 to 100.0%	0.5%
1.DB	Deadband	-100.0 to 50.0% for heating/cooling; 1.0 to 10.0% for position proportional	3.0%
1.RP	Zone PID reference point (1.PID to 6.PID)	EU(0.0 to 100.0%)	EU(100.0%)
RHY	Zone PID hysteresis (7.PID only)	EUS(0.0 to 100.0%)	EUS(0.5%)
RDV	Zone PID reference deviation (8.PID only)	OFF, EU(0.0 to 100.0%)	OFF
* 1.PM	Preset MV	-5.0 to 105.0%	-5.0%
1.PMc	Cooling-side preset MV	-5.0 to 105.0%	-0.0%
USR			
U1 - U8	USER parameter 1	-19999 to 31500	0
The default value depends upon the mode of the controller.			
PYS1 (the same for PYS2: 2.Xn, 2.Yn, 2.PMD)			
1.X1	10-segment linearizer-1 input 1	EU(-66.7 to 105.0%)	EU(0.0%)
1.Y1	10-segment linearizer-1 output 1	EUS(-66.7 to 105.0%)	EUS(0.0%)
1.X2	10-segment linearizer-1 input 2	EU(-66.7 to 105.0%)	EU(0.0%)
1.Y2	10-segment linearizer-1 output 2	EUS(-66.7 to 105.0%)	EUS(0.0%)
Repeated until the 11th breakpoint			
1.X11	10-segment linearizer-1 input 11	EU(-66.7 to 105.0%)	EU(0.0%)
1.Y11	10-segment linearizer-1 output 11	EUS(-66.7 to 105.0%)	EUS(0.0%)
1.PMD	10-segment linearizer-1 mode	0 = biasing, 1 = approximation	0
STUP			
PS.IN	Password input	0 to 30000; Input the password set at the setup parameter MLCK-PWD.	0 (No password)