Installation and Operation Manual

YS100 Series

YS150
 Single Loop Multi-function Controller
YS170
 Single/Dual Loop Programmable Controller

IOM 1B7C1-01E-YCA

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INSTALLATION

I.   OVERVIEW

The Yokogawa YS100 series control room instruments include a family of micro-processor-based single and dual loop PID controllers. The model numbers include:

   ♦   YS150 Multi-function Loop Controller
   ♦   YS170 Dual Loop Programmable Controller

This installation/operation manual is attended to assist the user in the installation of the instrument and wiring of field devices. A description of the various displays that can be observed from the front panel is presented. The basic setup for process operation is included. More detailed information is available in the instruction manual and any technical information manuals referenced herein.

1.0   Model and Suffix Codes

YS100 SERIES INSTRUMENTS		
MODEL	**DESCRIPTION**	
YS150	Multifunction Loop Controller	
YS170	Dual Loop Programmable Controller	
	POWER REQUIREMENTS	
-011	80-138 VAC, 47-63 Hz, 20-130 VDC	
-012	138-264 VAC, 47-63 Hz, 120-340 VDC	
	INPUT OPTIONS (SELECT ONE ONLY)	
	/A01	mV input
	/A02	Universal thermocouple input
	/A03	RTD input
	/A04	Potentiometer input (slidewire resistance)
	/A05	Isolated input (four-wire transmitter)
	/A06	Two-wire transmitter input (isolated)
	/A07	Two-wire transmitter input (non-isolated)
	/A08	Frequency input
	COMM. OPTIONS (SELECT ONE ONLY)	
	/A31	RS-485 communication
	/A32	DCS communication (Centum-XL or µXL)
	/A33	YS-Net, Peer-to-Peer communication

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1.1 INSTALLATION

Inspect the instrument upon arrival for damage that may have occurred during shipment. All damage claims should be reported to the responsible shipping agent before installation is attempted. Inspect the packing material before discarding to prevent loss of mounting hardware or other special instructions that may have been included in the shipment. Thoroughly examine the packing list to ensure that all items have been received in the shipping containers.

YS100 series instruments are designed for installation in an indoor environment. The typical mounting is in an instrument panel, flush mounted, either as a stand alone unit or side by side in a multiple unit configuration. Refer to the Instruction Manual IM 1B7C1-01E, Section 2., Installation for further details.

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II.   ELECTRICAL INTERCONNECTIONS

2.0   YS150/YS170 Control Strategies

The single and dual loop controllers can be configured in one of three resident control strategies, enabling it to be adapted to various process control requirements. Prior to the electrical connection of any field devices, a suitable control configuration and inputs/outputs must be determined and assigned to assure proper signal routing. The YS170 is a programmable controller, whereby the analog and discrete inputs/outputs can be assigned regarding function. The program and inputs/output assignments must be completed prior to field connections.

2.0.1   Wiring Procedure

Provisions for the electrical and signal connections are provided at the rear of the enclosure. A plastic back plate covers the screw terminals for the power and signal wires. Follow any electrical codes required by federal, state or local agencies when terminating the wires. Field interconnections should be made with two conductor shielded cable. The signal cable shield should be terminated at the chassis ground of the YS100 series instrument. **Do NOT terminate the shield at the field device and the YS150/YS170.** This may create different ground potential that will degrade or distort the signal. The wire gauge is dictated by the cable length required to the field device and the total resistance in the interconnection. Polarity must be observed when using the 24VDC loop power supply in conjunction with two-wire field transmitters. Failure to do so may result in possible malfunction of the instrument.

2.1   Power Input Connections

YS150/YS170 controllers incorporate a universal automatic sensing power supply (P/N E9766YA), i.e., 110VAC or 24VDC can be applied to the same power supply card. If the instrument was specified for 220VAC operation, power supply card P/N E9766YR was installed.

2.1.1   Connect the AC power as follows:
- ♦ Connect the phase or hot leg (L) from a remote circuit breaker or disconnect switch to terminal L.
- ♦ Connect the neutral line (N) to terminal N.
- ♦ Connect power ground to terminal GRD.
- ♦ Maximum power consumption: 22VA/100VAC (80-138VAC)
                              29VA/220VAC (138-264VAC)
NOTE: To minimize any effect from EMI, power wiring should be routed away from signal wiring.

2.1.2   Connect the DC power as follows:
- ♦ Connect the positive (+) line from a remote switch to terminal L.
- ♦ Connect the negative (-) line from the DC power supply to N.
- ♦ Connect the power supply ground to terminal GRD.

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2.1.3   Instrument Grounding

Installations are expected to have access to an independent high quality point of earth reference. The grounding bus should be connected to a dedicated low resistance ($<1\Omega$) lead wire directly to the building earth reference. This ground is typically referred to as instrument ground. If an independent instrument ground reference is not available, one should be established using an earth ground electrode rod or ground grid mesh. Refer to additional technical information manuals for further details.

2.2   Signal Interconnections

2.2.1   Analog Inputs

When an analog input is received from a 4-20mADC current transmitter, a precision 250Ω ($\pm0.1\%$) shunt resistor is required. Up to two are provided in the shipping container with the YS150/YS170 controller. The resistance tolerance is critical, since the resistor is used to accurately convert the DC current to an analog voltage (1-5VDC). If a different current transmitter is used (e.g., 10-50mADC), an appropriate precision resistor must be used to develop the 1-5VDC input. Install the shunt resistor across the appropriate analog input terminals with the field signal wiring.

2.2.2   Contact Inputs

Contact inputs may be dry (without power) or DC voltage input up to 30VDC. The contact inputs are isolated from the instrument circuitry. The contact must provide a sustained closure of at least 220ms to allow recognition. The user must assign each contact to a specific input terminal in the YS170 programmable controller. Other instrument terminations are pre-assigned as to function and the wiring terminal layouts must be observed. Refer to the drawing below.

Wiring Terminations

Dry Contact

CLOSED: <200 ohms
OPEN: >100 K ohms

+ Status Input

- Status Input

+ Status Input

VDC   ON: - 0.5 to +1 VDC
OFF: + 4.5 to 30 VDC

- Status Input

Powered Contact
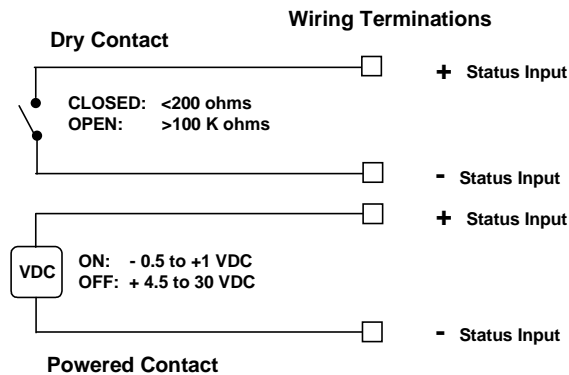
Terminal Numbers

Status Input 1	38	39
Status Input 2	36	37
Status Input 3	34	35
Status Input 4	32	33
Status Input 5	30	31
Status Input 6	28	29

2.2.3 Current or Voltage Outputs

One or two 4-20mADC current outputs are available for transmission to remote controlling devices. 1-5VDC voltage outputs can be transmitted to remote indicating or recording devices. Observe polarity when connecting the analog outputs in the receiving devices. For additional information, refer to the electrical connections diagrams in this section.

NOTE: The YS170 programmable controller may be programmed to allow two independent current outputs. The second current output, if required, must be initialized by placing two jumpers on the main circuit card in the appropriate positions. Refer to the instruction manual, IM 1B7C1-01E, Page 11-9.

2.2.4 Contact Outputs

The contact outputs are solid state TTL transistor switches, rated for 30VDC @ 200mADC maximum. The contacts are referenced to power common and isolated from the computing circuitry. In many cases, an external DC voltage power supply is required and an interposing relay installed for switching of AC power devices. A current surge diode (provided by others) is recommended to be installed in parallel with the contact load. Refer to the drawing below.

	Terminal Numbers	
Status Output 1	28	29
Status Output 2	30	31
Status Output 3	32	33
Status Output 4	34	35
Status Output 5	36	37
Status Output 6	38	39
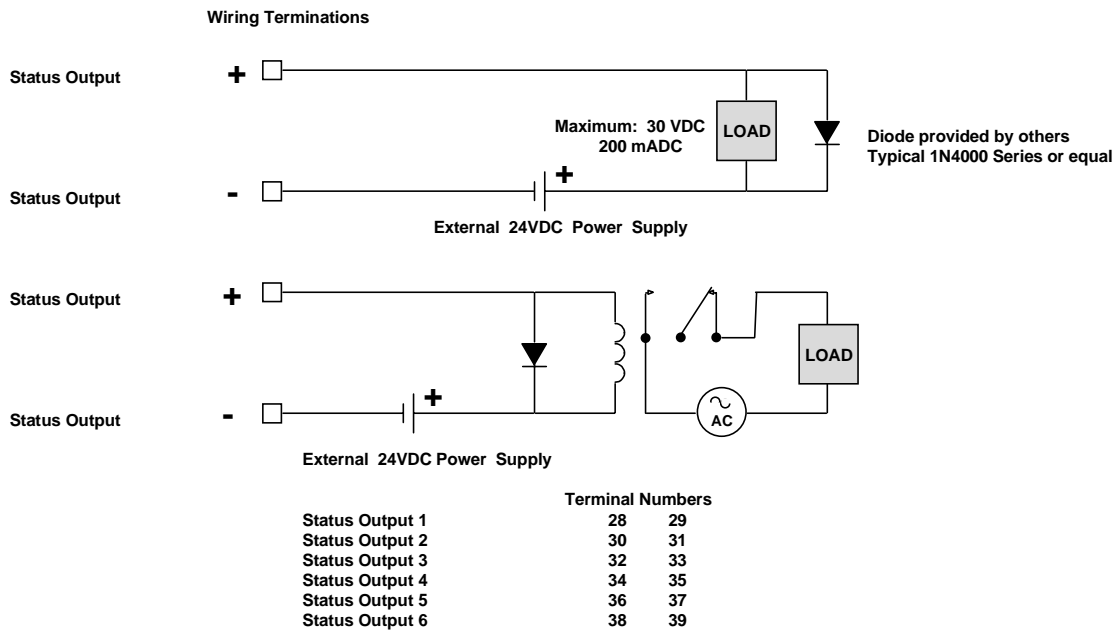
The contact output terminals are assigned and functions vary depending on the type of controller being installed. Using the YS170 in the programmable mode (PROG), the number of contact outputs and function/terminal assignments are developed in programming and configuration. Programming must be implemented and documented prior to actual field wiring.

2.2.5 Direct Input

YS100 series instruments can optionally be provided with a direct input from a mV source, thermocouple, RTD, potentiometer, frequency source, etc. The signal wiring from these devices are connected to terminals 19, 20, and/or 21 at the rear of the instrument. Actual assignments depend upon the type of signal. Refer to the drawing below.

Direct Input Interconnections (Options /A01 - /A08)

19 20	19 21 20	19 21 20	20 21
mV, thermocouple (/A01 & /A02)	**Resistance Temperature Detector (RTD) (/A03)**	**Potentiometer (Slidewire) (/A04)**	**Two Wire Input (/A05) External 24Vdc Loop Power Supply**

19 20	21 19 20	21 19
Isolated Two Wire Input (/A06) Using Integral 24Vdc Loop Power Supply	**Three Wire Input (/A08) Using Direct Input Card Power Supply**	**Two Wire Input (/A08) Using Direct Input Card Power Supply**

Two Wire Input (/A08) Voltage/ Dry Contact Input

NOTE: The direct input signal is converted to a 1-5VDC signal on terminals 9 and 10. These terminals must be hard wired to the process variable input of the YS150, terminals 1 and 2. YS170 does not require the installation unless the direct input is the process variable and the PV is assigned to terminals 1 and 2 in the custom program.

2.2.6   Two-Wire Transmitter Power Supply

YS100 series instruments have an integral 24VDC power supply that can be used to provide power to two-wire transmitters. Up to two transmitters can be powered from this supply. If the instrument has been specified with one direct input option (Refer to Section 3.3.5), only one transmitter can be powered. The power supply + terminal is 13, referenced to signal or power common. The supply is non-isolated. Any short or fault on the 24VDC line will cause a short in the power supply and possible malfunction. To prevent this occurrence, a fuse should be installed on the voltage line (nominal 1/8 amp). Further protection can be provided by installing 3 watt 250$\Omega\pm$0.1% (P/N E9760TM) resistors on the analog input terminals. Refer to the drawing below and instruction manual IM 1B7C1-01E for further details.
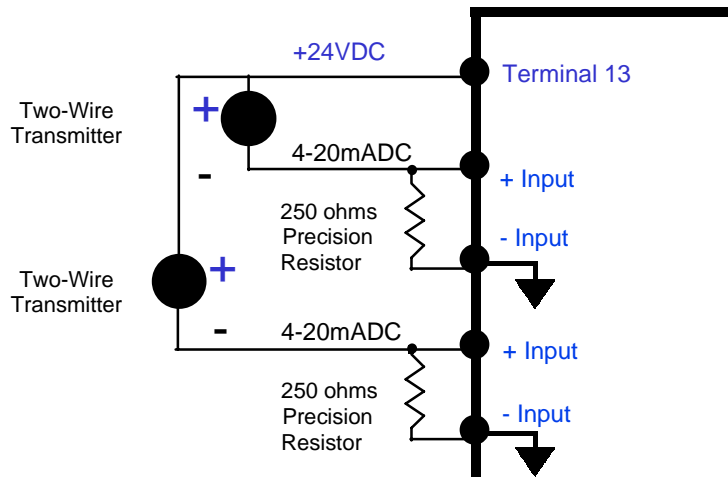
2.2.7   Field Terminations

The YS150 Multifunction Loop Controller can be configured into one of three resident control strategies (SINGLE, CAS, & SELECT). The field wiring differs depending of the control mode selected. The YS170 Programmable Controller has these strategies on-board and allows user programming (PROG) to adapt to specific control requirements. The functions of the analog and discrete I/O are assigned as the program is written. Drawings of the field terminations for the control strategies begin on the next page.

ELECTRICAL INTERCONNECTIONS

FIC-1076
LOOP 1

FAIL
ALM

GPM
300.0

PV:
146.9
SV:
150.0
MV:
77.7

ALARM-1

PF
OFF

0.0

C   O

SHIFT

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C — • **Remote Set Point (CSV)**

A — • **Local Set Point (SV) & Automatic**

M — • **Manual Operation of Output (MV)**

△ — • **Increase Set Point (SV)**

▽ — • **Decrease Set Point (SV)**

PF — • **Programmable Function Key**

⮕ — • **PAGE Key**

• **Manual Output Keys**

YS150/YS170 SINGLE (Loop) Mode

Left terminals		
Current Output (MV)	+	22
Current Output (MV)	-	23
Voltage Output (MV)	+	24
Voltage Output (MV)	-	25
Voltage Output (SV)	+	26
Voltage Output (SV)	-	27
High Limit ALM DO	+	28
High Limit ALM DO	-	29
Low Limit ALM DO	+	30
Low Limit ALM DO	-	31
Dev/Vel ALM DO	+	32
Dev/Vel ALM DO	-	33
Casc/Auto Status DO	+	34
Casc/Auto Status DO	-	35
Auto/Man Status DO	+	36
Auto/Man Status DO	-	37
Operation Mode DI	+	38
Operation Mode DI	-	39
117 VAC Line or + 24 VDC		L
Power Ground		G
Neutral or VDC Common		N

Right terminals		
1	+	Process Variable
2	-	Process Variable
3	+	Cascade Set Point
4	-	Cascade Set Point
5	+	Tracking Input
6	-	Tracking Input
7	+	Feed forward Input
8	-	Feed forward Input
9	+	Output of Direct Input
10	-	Output of Direct Input
11	+	FAIL Contact Output
12	-	FAIL Contact Output
13	+	24 VDC Power Supply
14		Communications (SG)
15		Communications (SA)
16		Communications (SB)
17		Communications (RA)
18		Communications (RB)
19	+	Direct Input
20	-	Direct Input
21		Direct Input

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ELECTRICAL INTERCONNECTIONS

YS150/YS170 CAS (Cascade) Mode

Left Terminal			Right Terminal	
Current Output (MV)	+	22	1	+ Process Variable 1
Current Output (MV)	-	23	2	- Process Variable 1
Voltage Output (MV)	+	24	3	+ Cascade Set Point
Voltage Output (MV)	-	25	4	- Cascade Set Point
Voltage Output (SV)	+	26	5	+ Process Variable 2
Voltage Output (SV)	-	27	6	- Process Variable 2
Primary Loop ALM	+	28	7	+ Feed forward Input
Primary Loop ALM	-	29	8	- Feed forward Input
Secondary ALM DO	+	30	9	+ Output of Direct Input
Secondary ALM DO	-	31	10	- Output of Direct Input
OPN/CLS ALM DO	+	32	11	+ FAIL Contact Output
OPN/CLS ALM DO	-	33	12	- FAIL Contact Output
Casc/Auto Status DO	+	34	13	+ 24 VDC Power Supply
Casc/Auto Status DO	-	35	14	Communications (SG)
Auto/Man Status DO	+	36	15	Communications (SA)
Auto/Man Status DO	-	37	16	Communications (SB)
Operation Mode DI	+	38	17	Communications (RA)
Operation Mode DI	-	39	18	Communications (RB)
117 VAC Line or + 24 VDC	L		19	+ Direct Input
Power Ground	G		20	- Direct Input
Neutral or VDC Common	N		21	Direct Input

YS150/YS170 SELECT (Auto-selector) Mode

Left Terminal			Right Terminal	
Current Output (MV)	+	22	1	+ Process Variable 1
Current Output (MV)	-	23	2	- Process Variable 1
Voltage Output (MV)	+	24	3	+ Cascade Set Point
Voltage Output (MV)	-	25	4	- Cascade Set Point
Voltage Output (SV)	+	26	5	+ Process Variable 2
Voltage Output (SV)	-	27	6	- Process Variable 2
Primary Loop ALM	+	28	7	+ Feed forward Input
Primary Loop ALM	-	29	8	- Feed forward Input
Secondary ALM DO	+	30	9	+ Output of Direct Input
Secondary ALM DO	-	31	10	- Output of Direct Input
PV2 Casc/Auto DO	+	32	11	+ FAIL Contact Output
PV2 Casc/Auto DO	-	33	12	- FAIL Contact Output
PV1 Casc/Auto DO	+	34	13	+ 24 VDC Power Supply
PV1 Casc/Auto DO	-	35	14	Communications (SG)
Auto/Man Status DO	+	36	15	Communications (SA)
Auto/Man Status DO	-	37	16	Communications (SB)
Operation Mode DI	+	38	17	Communications (RA)
Operation Mode DI	-	39	18	Communications (RB)
117 VAC Line or + 24 VDC	L		19	+ Direct Input
Power Ground	G		20	- Direct Input
Neutral or VDC Common	N		21	Direct Input

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ELECTRICAL INTERCONNECTIONS

YS170 PROG (Programmable) Mode

Analog Output (Y1)	+	22	
Analog Output (Y1)	-	23	
Analog Output (Y2)	+	24	
Analog Output (Y2)	-	25	
Analog Output (Y3)	+	26	
Analog Output (Y3)	-	27	
DO1/DI6	+	28	
DO1/DI6	-	29	
DO2/DI5	+	30	
DO2/DI5	-	31	
DO3/DI4	+	32	
DO3/DI4	-	33	
DO4/DI3	+	34	
DO4/DI3	-	35	
DO5/DI2	+	36	
DO5/DI2	-	37	
DO6/DI1	+	38	
DO6/DI1	-	39	
117 VAC Line or + 24 VDC	L	
Power Ground	G	
Neutral or VDC Common	N	

1	+	Analog Input (X1)
2	-	Analog Input (X1)
3	+	Analog Input (X2)
4	-	Analog Input (X2)
5	+	Analog Input (X3)
6	-	Analog Input (X3)
7	+	Analog Input (X4)
8	-	Analog Input (X4)
9	+	Analog Input (X5)
10	-	Analog Input (X5)
11	+	FAIL Contact Output
12	-	FAIL Contact Output
13	+	24 VDC Power Supply
14		Communications (SG)
15		Communications (SA)
16		Communications (SB)
17		Communications (RA)
18		Communications (RB)
19	+	Direct Input
20	-	Direct Input
21		Direct Input

NOTE: Analog and discrete input/output functions are assigned in the user program.

III. Front Panel & Display

3.0 Front Panel Lamps

FAIL

ALM

YS150/YS170 controllers have a front panel that is universal in appearance throughout the product family. Two LED lamps are located at the right upper side of the front panel. The red lamp (FAIL) illuminates if a failure in the CPU or associated digital circuitry occurs. Additionally, a contact output dedicated to this FAIL function is available at the rear terminals. This solid state output can be connected to an annunciator or other device to notify operating personnel that the instrument is malfunctioning. The yellow lamp (ALM) is activated if a process alarm has been initiated. High, low, or deviation alarms cause the yellow LED to illuminate.

3.1 Front Panel Operations

Several operational push buttons are located in a vertical column on the right side of the front panel. These are used to change operating modes, vary the set point or page through the various display screens. The C/A/M buttons illuminate, designating the active operating mode.

C

C button is used to place the controller in the cascade or remote set point operation mode. The set point is transmitted from an external device, such as another controller or a supervisory control system. If the remote set point signal is not present, the controller does not permit C button operation and transfer to cascade set point mode.

A

A push button permits local set point changes and designates that the controller is functioning in the automatic operation mode.

M

M designates and allows manual operation of the control output. The output can be adjusted by pressing the push buttons below the LCD display, described below.

△ ▽

▲ & ▼ keys are used to increase or decrease the set point. This action is available while the controller is in the automatic or manual modes. The push buttons are inoperative in the cascade mode.

PF

PF key is a push button that can be used as a momentary closure switch. Properly configured, the self tuning control (STC) feature can be started using this push button on the YS150 controller. The YS170 PF (programmable function) key can be programmed as to function.

PAGE

PAGE push button is used the scroll through the operations screens, LOOP, TREND, ALARM and DUAL loop. While holding down the **SHIFT** key at the bottom of the front panel and pressing the **PAGE** key, tuning and engineering displays can be viewed.
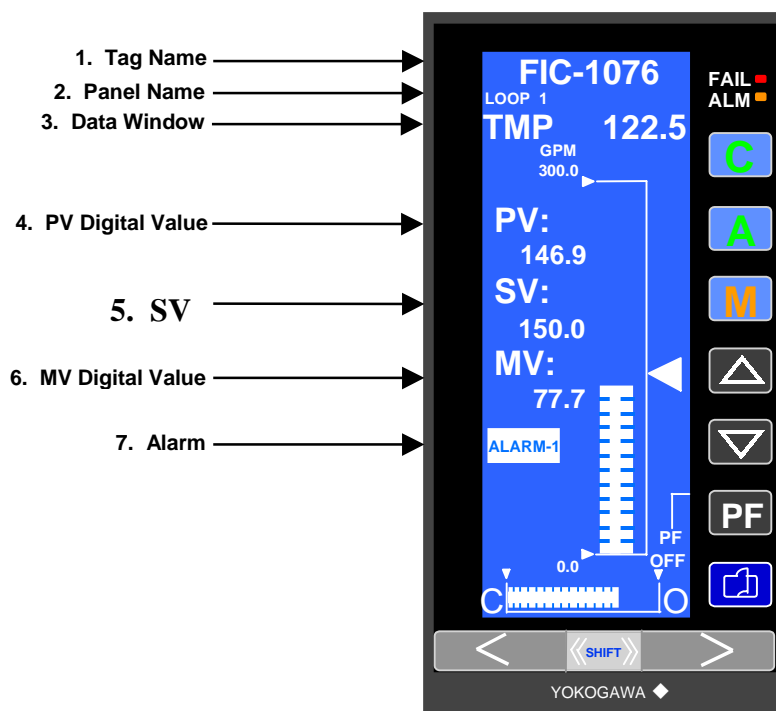
< SHIFT >

< & > push buttons are used to decrease or increase the control output. The time required to fully open or close the final control element from 0 to 100% is 25 seconds. If the **SHIFT** and < or > key are pressed simultaneously, the rate of change is 2.5 seconds.

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## 3.2   Operation Displays

3.2.1   LOOP Display

1. **Tag Name** – Consists of up to 8 digits of alphanumeric characters and symbols. The tag name (TAG) can be set in the Configuration 2 (CONFIG 2) panel.

2. **Panel Name** – Displays the name of the panel presently viewed.

3. **Data Window – YS170 Only** - Allows a parameter or analog input to be viewed digitally on the upper right corner of the display. Up to 4 digits can be shown with a decimal point and polarity sign. Additionally, a three character alphanumeric descriptor can be viewed on the upper left corner. The example above uses TMP as an acronym for temperature. A temperature analog input is shown to the right.

4. **PV Digital Value** – 4 digit display of engineering units for the process variable (6 digits including decimal point and polarity).

5. **SV Digital Value** – 4 digit display of engineering units for the set point value (6 digits including decimal point and polarity).

6. **MV Digital Display** – 4 digit display in percentage of the manipulated variable (5 digits including decimal point).

7. **Alarm** – If a process alarm has been activated, ALARM 1 or ALARM 2 is shown in reverse video on the screen. ALARM 1 is shown for a LOOP 1alarm while ALARM 2 is for LOOP 2 (only if LOOP 2 is used).
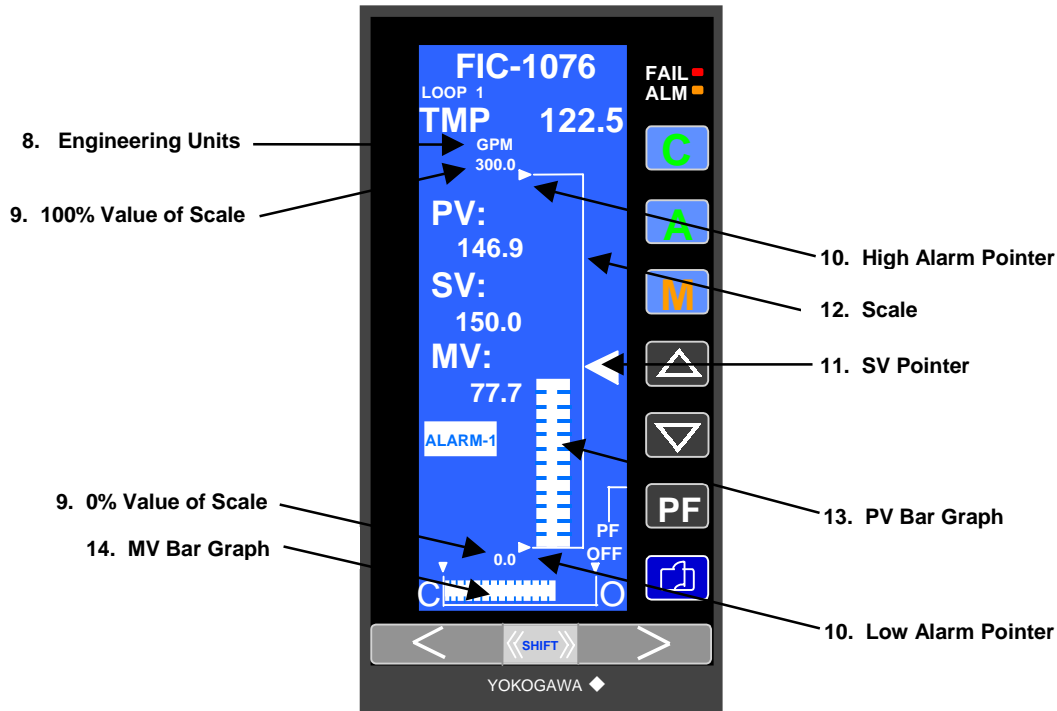
8.   **Engineering Units** – Up to 6 alphanumeric characters displaying the engineering units can be shown. The units are selected in the CONFIG 2 display.

9.   **0%/100% Value of Scale** – The 0% and 100% values of the vertical PV scale are displayed in 4 digit engineering units (6 digits including decimal point and polarity). The 0% value (SCL) and 100% value (SCH) are set in the CONFIG 2 display.

10.   **High and Low Alarm Pointers** – The PH value (process variable high alarm set point) and PL value (process variable low alarm set point) are displayed with triangular pointers. The PH and PL values are set in the PID displays.

11.   **SV Pointer** – The set point value (SV) is displayed with a triangular pointer that moves up and down the scale with a resolution of 0.5% units.

12.   **Scale** – Vertical range scale that represents process variable range in engineering units.

13.   **PV Bar Graph** – A vertical bar where the process variable (PV) is displayed in an analog format. The bar consists of 200 elements divided into 50 segments with incremental changes of ±1 element unit (0.5%).

14.   **MV Bar Graph** – A horizontal bar showing the manipulated variable (MV) or control output value in an analog format. The bar consists of 80 elements divided into 20 segments with incremental changes of ±1 element unit (1.25%).

FRONT PANEL & DISPLAY
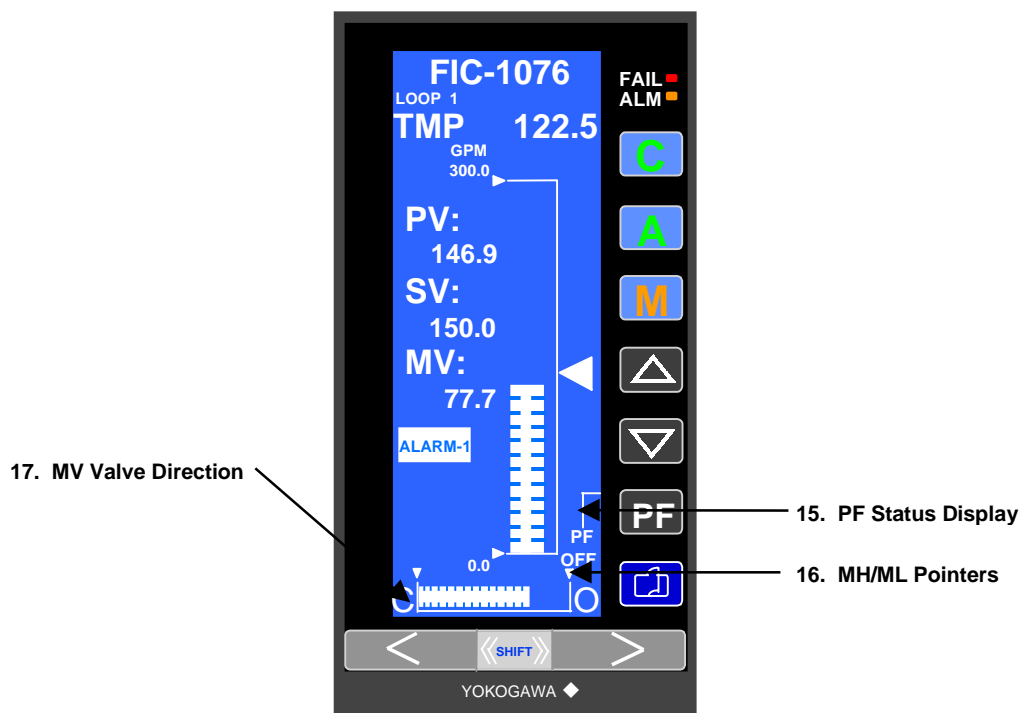
15. **PF Status Display** – Displays the function and status of the PF key. The displays differ when the multifunction and programmable controller models are used.

   ♦ With the multi-function controller (YS150 and YS170 in a pre-configured control strategy), the PF key is defined in the CONFIG 3 display under PFKEY. If the PF key is not defined, the function and status are not displayed (remains PF and OFF). When defined, the function display is STC (instead of PF) and the status is ON or OFF.
   ♦ The YS170 allows the status of the PF function to be determined by a user program. The user program may allow a status change from OFF to ON by pressing the PF key. This could designate a pump running, Start/Stop modes, etc.

16. **MH/ML Pointers** – The MH value (MV high limit) and ML value (MV low limit) are displayed with triangular arrows on the left (ML) and right side (MH) of the horizontal bar graph. For example, if the ML value has been set to 20%, the left arrow would be located at 20% of the bar graph range. The MH and ML values are set in the PID display panel.

17. **MV Valve Direction** – The action of the MV control element is displayed with "C" (Closed) on the left side of the MV bar graph and "O" (Open) on the right side. The action can be reversed in the CONFIG 2 display panel, whereby the "O" is on the left and "C" on the right.

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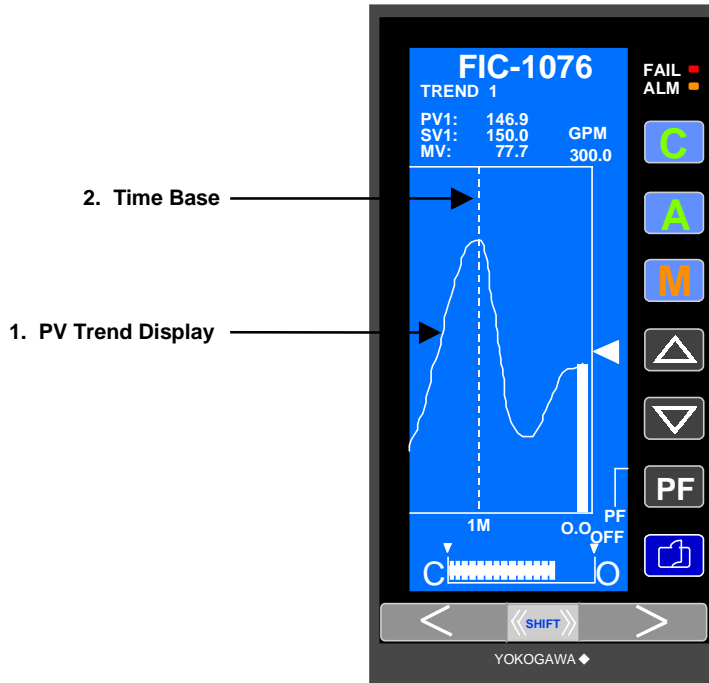
3.2.2 Trend Display

The operational push buttons and display features are the same as the LOOP display. Below are descriptions of the trend and time base for the TREND display screen.

1. **PV Trend Display** – The process variable is observed on the trend display. 90 samples are shown and the time base is selectable. As the trend is updated, the last sample on the far left is deleted.

2. **Time Base** – The "hash mark" on the display screen shows the time base that has been set. The example above shows 1M under the line. One minute PV history is shown to the right of the line and an additional 30 seconds to the left. The trend time base (TRDT1) is set in the CONFIG 2 display screen. The shortest time base is 90 seconds (one sample per second). The longest is 45 hours (one sample every 30 minutes).

FRONT PANEL & DISPLAY

3.2.3 Alarm Display
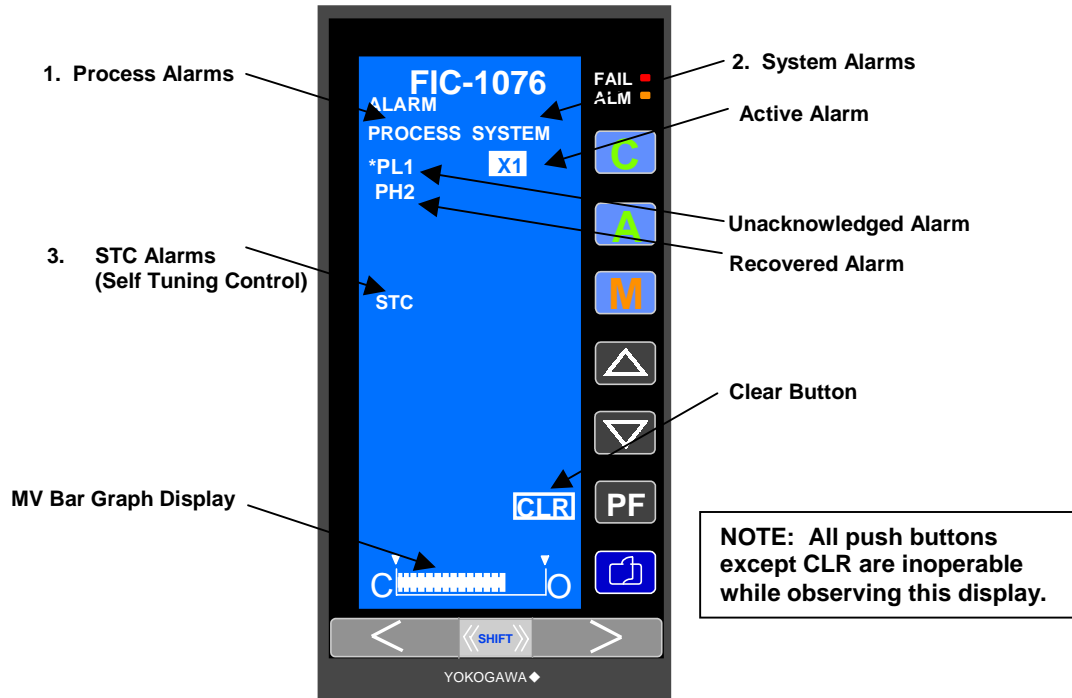
1. **Process Alarms** – Process alarms designate that the process variable (PV) exceeds a high, low, deviation or velocity alarm set point. These set points are set in the PID1 and/or PID2 displays described later in this manual.
    - ♦ **PL1 & PL2** – Process low alarm LOOP 1 & LOOP 2
    - ♦ **PH1 & PH2** – Process high alarm LOOP 1 & LOOP 2
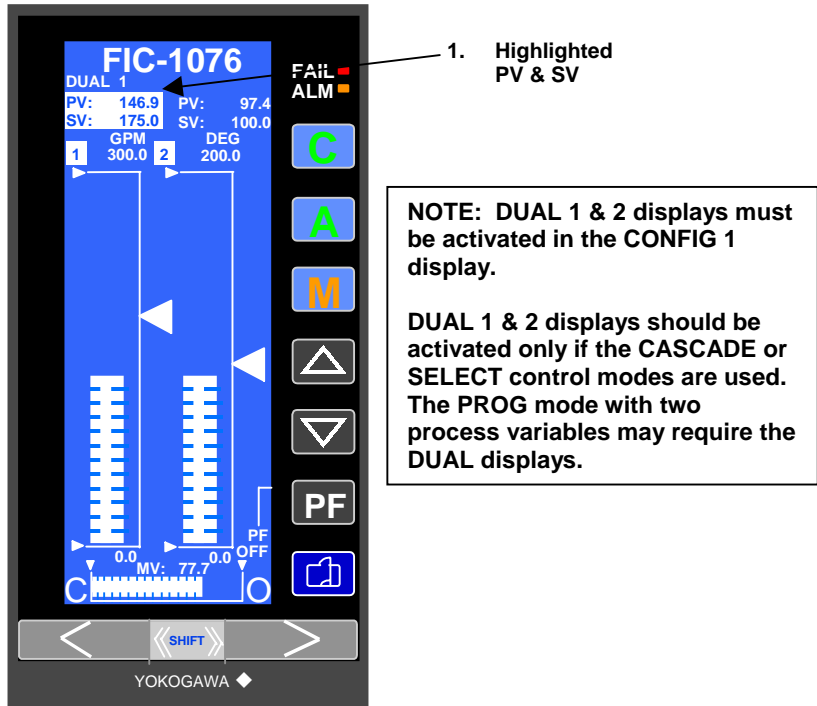   - ♦ **DL1 & DL2** – Deviation limit alarm LOOP 1 & LOOP 2
    - ♦ **VL1 & VL2** – Velocity limit alarm LOOP 1 & LOOP 2

2. **System Alarms** – System alarms designate that analog inputs or outputs are not connected to the controller. Additional alarms are communications failure or a computation error (YS170 only).
    - ♦ **X1 to X5** – Open analog input.
    - ♦ **Y1 to Y3** – Open analog output.
    - ♦ **COMM** – Digital communications failure (Optional communications only).
    - ♦ **CALC** – Computation error (typically if an analog input is used as part of a mathematical computation in a custom program).

3. **STC Alarms** – If the STC function is activated, alarms designate that a error in the self tuning control computation has occurred. Refer to the instruction manual IM 1B7C1-01E, page 5-14 for more details.

A highlighted designates a current active alarm state. Alarms in normal display designate the alarm occurred and recovered automatically. An asterisk (*) to the left of an alarm notes that the alarm has not been cleared by pressing the CLR push button.

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3.2.4 Dual Loop Display

1. Highlighted PV & SV

NOTE: DUAL 1 & 2 displays must be activated in the CONFIG 1 display.

DUAL 1 & 2 displays should be activated only if the CASCADE or SELECT control modes are used. The PROG mode with two process variables may require the DUAL displays.

The operational push buttons are active as in the LOOP and TREND displays. Refer to the LOOP display descriptions for further details.

1. **Highlighted PV & SV** – In the DUAL 1 display, the PV & SV at the left are highlighted. This allows the push buttons on the front panel to operate LOOP 1. LOOP 2 can be observed, but not manipulated. By pressing the PAGE button, DUAL 2 is shown. The PV & SV of LOOP 2 are highlighted. The push buttons operate LOOP 2.

3.3   Tuning Menu

⟨⟨ SHIFT ⟩⟩ **+** [PAGE]   By pressing and holding the SHIFT key and pressing the PAGE key, the Tuning Menu group display may be observed.

3.3.1   Tuning Menu
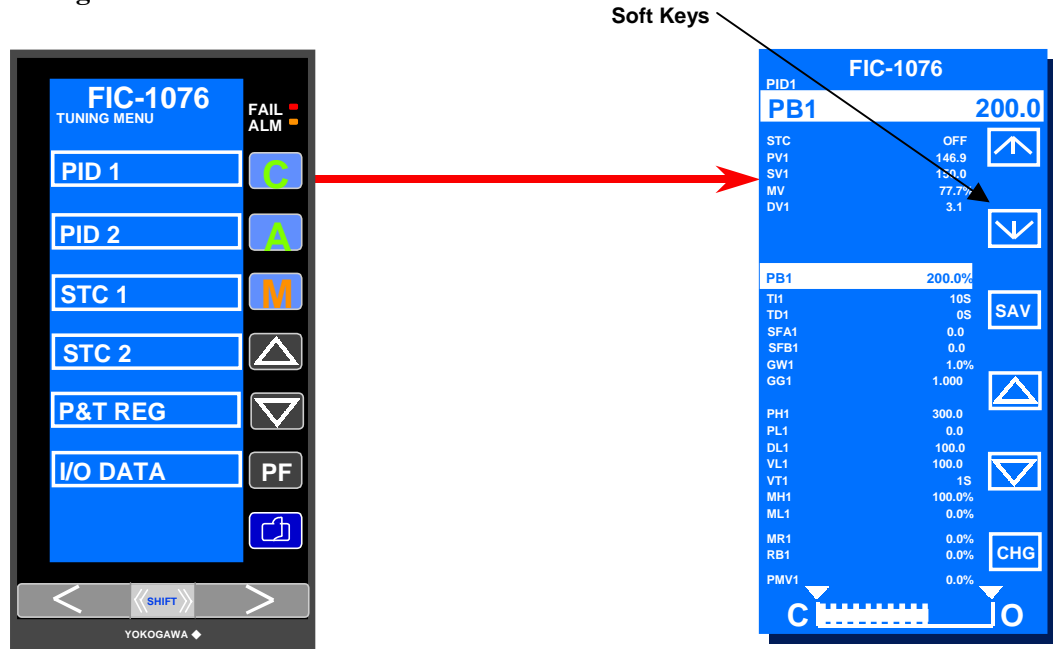
Press the **C** push button to observe PID 1 pull-down menu.

The PID menus provide detailed information regarding the PID function blocks. If a password has not been installed (described later in this manual), soft keys appear on the right side of the display. The ↑ and ↓ keys (adjacent to the **C** & **A** keys) allow you to step upward or downward through the menu. The ▲ and ▼ keys permit changes to the selected line. In the example above, toggle the **A** key until PB1 is highlighted. PB1 is shown at the top of the display below the PID1 title. The PB1 value can be changed by holding down the ▲ or ▼ keys until the desired value is set.

SAV   The SAV soft key next to the M button is used to transfer any changed data to EEPROM. An asterisk (*) will illuminate to the left of the mnemonic after changing any value. While depressing the M button, the asterisk will disappear after about two seconds, indicating the new value has been transferred to EEPROM. If electrical power is lost to the controller prior the performing the SAV function, the new value will be retained over one week by means of an electronic capacitance circuit. After one week, the previous EEPROM value will be restored.

CHG   The CHG soft key adjacent to the PF push button can be used to transfer between the PID 1 menu and the last observed operations display. For example, the last display shown before entering the TUNING menu was the TREND screen. By pressing and holding the CHG soft key, TREND 1 may be observed while working in the PID 1 menu. This function is useful to observe PV reaction after new tuning parameters have been entered, such as proportional band or integral.

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Pressing the PAGE button transfers the display to the Tuning Menu group menu. The **A** button allows access to the PID 2 pull-down menu. This display allows changes to the second PID function block. If this is not used, changes to items in this screen are not required.

3.3.2 PID 1 & PID 2 Tuning Menus

FIC-1076	
PID1	
PB1	**200.0**
STC	OFF
PV1	146.9
SV1	150.0
MV	77.7%
DV1	3.1
PB1	200.0%
TI1	10S
TD1	0S
SFA1	0.0
SFB1	0.0
GW1	1.0%
GG1	1.000
PH1	300.0
PL1	0.0
DL1	100.0
VL1	100.0
VT1	1S
MH1	100.0%
ML1	0.0%
MR1	0.0%
RB1	0.0%
PMV1	0.0%

STC Self Tuning Control – Status of self tuning control. See STC 1 & STC 2 section for details. Refer to TI 1B7C1-03E, Intelligent Self Tuning Controllers.

PV Current value of the process variable in engineering units. The process variable usually is an analog input from a field transmitter (temperature, pressure, flow, etc.) wired to the PV input at the rear of the controller. In AUTO mode, the PID control loop adjusts the control output (MV) to keep the process variable equal to the SV.

SV Current value of the set point value in engineering units. The operator adjusts the set point value on the LOOP, TREND or DUAL displays by using the ▲ or ▼ buttons while the controller is in AUTO or MANUAL mode. In AUTO, the PID control loop adjusts the output (MV) to keep the process variable (PV) equal to the set point value (SV). If the controller is in the CASCADE mode, the set point is adjusted from an external device, such as another controller or a supervisory control system. Local adjustment is not permitted.

MV Current value of the PID control output (manipulated variable) in percentage. The manipulated variable is usually sent as a 4-20mADC output to a final element like a valve or variable speed drive. In the MANUAL mode, the operator sets the MV on the LOOP, TREND or DUAL displays using the < & > keys at the bottom of the front panel. In AUTO or CASCADE mode, the PID control loop adjusts the control output (MV) to

keep the process variable (PV) equal to the set point value (SV). MV cannot be adjusted when the controller is in AUTO or CASCADE.

DV   The current difference (deviation) between the process variable and the set point value in engineering units. DV should be a small value while the controller is in AUTO or CASCADE mode and controlling properly.

CSV   The current value of the cascade or remote set point in engineering units. A controller can use a remote set point when placed in the CASCADE mode. If two controllers are arranged in a master/slave architecture, the cascade set point is the output (MV) of the master controller. This output becomes the CSV of the slave controller.
NOTE: This parameter is shown in the SINGLE, CAS or SELECT control modes.

FF   The current feed forward input in percentage of full scale. The feed forward input is added to the output of the controller (MV) after the PID computation. Feed forward is an advanced feature that allows the controller to react to a process disturbance when it occurs rather than waiting for the controller to correct when an error is detected.
NOTE: This parameter is shown only in the SINGLE or CAS control modes.

TRK   The current tracking input in percentage of full scale. In the tracking mode, a PID controller ignores the calculated control output and sends the TRK value to the output. Tracking is often used during start up or shutdown procedures when a valve must be in a failsafe position. Tracking is activated by an external discrete input.
NOTE: This parameter is shown only in the SINGLE control mode.

PB   Current value of the proportional band setting in percentage. Proportional band is one of three tuning parameters controlling the response of the PID controller. Decreasing the proportional band speeds up the response to a process variable deviation from set point.

TI   Value of the integral or reset action in seconds/repeat. Integral is the second tuning term. Increasing integral time slows the PID response, while decreasing speeds up the control action.

TD   Value of the derivative setting in seconds. Increasing the derivative rate speeds the response of the controller. Set this value to 0.0 if derivative action is not desired. Derivative is commonly used in control loops with long dead time and lag time, such as temperature and level control. Derivative is typically not used in faster responding loops such as flow or pressure.

SFA   Used only when the SVF (set point filter) control algorithm is initialized in the CONFIG 1 display. The alpha value is a dimensionless number between 0 and 1.000. If alpha is 1.000, the control response is PI-D (PV derivative type PID control). A number < 1.000 allows continuous changes to the control action between PI-D and I-PD. Refer to TI 1B7C1-01E, Control Functions, pages 3-30 to 3-32.

SFB   Used with the SVF (set point filter) control algorithm. If beta is 1.000, the control algorithm is I-PD only. Refer to SFA above.

GW   Gap width value can be set from 0.0 to 100.0% of PV span. This value applies a multiplier less than 1.0, changing the PB setting as the process variable (PB) approaches set point (SV), providing a non-linear action. The bandwidth around the set point value (SV) is this number. For example, 10.0% allows the non-linear action to occur within ±10% of the set point value (SV).

GG   Gap gain is a dimensionless number between 0.0 and 1.000. This multiplier is applied to the proportional band term (PB) within the gap width (GW) setting. Refer to TI 1B7C1-01E, Control Functions, pages 3-21 to 3-22.

PH   Value of the process high alarm in engineering units. This value is shown in the LOOP displays as a small horizontal arrow to the upper left of the vertical range bar. If the process variable (PV) exceeds this value, PH1 is shown on the ALARM display and the ALM LED illuminates. Default value is 106.3% of span.

PL   Value of the process low alarm in engineering units. Default value is –6.3% of span. This value is shown as a small horizontal arrow to the lower left of the vertical range bar on the LOOP display. If the process variable (PV) is below this value, a PL1 indication is shown on the ALARM display and the ALM LED illuminates.

DL   Value of the deviation alarm in engineering units. The DL alarm on the ALARM display is shown if the process variable (PV) deviation from set point exceed this value. The default value is 106.3%. Do not set this value less than 2% of span. The hysteresis value for the deviation alarm is set at 2%. Therefore, a value less than 2% would not allow the alarm to clear.

VL   Value of the velocity alarm limit in engineering units. The VL alarm on the ALARM display is shown if the process variable (PV) rate of change exceeds this absolute value over a time base selected as VT below. Default value is 106.3% of span.

VT   Value of the time base applied to the velocity alarm limit (VL) in engineering units. The value can be set between 1 and 9999 seconds. The default value is 1 second.

MH   Value is the high output (MV) limit. This is also known as an output clamp. When the controller is in the AUTO or CASCADE mode, the calculated output (MV) is not allowed to exceed the MH value. MH is not active in the MANUAL mode. Default value is 106.3% of span.

ML   Value of the low output (ML) limit. This is also known as an output clamp. When the controller is in the AUTO or CASCADE mode, the calculated output (MV) is not allowed to less than the ML value. ML output clamp is not active in the MANUAL mode. Default value is –6.3%.

MR   Manual reset value in percentage.   This is used in proportional only control, compensating for any offset PV from the desired set point value (SV). Default value is –6.3%. Refer to TI1B7C1-01E, Control Functions, page 3-26.

RB   Reset bias value in percentage. This action is used in batch control applications to allow a quicker PV response toward set point (SV). The RB value is added to the control output (MV) value. Default is 0.0%. Refer to TI 1B7C1-01E, Control Functions, page 3-24.

PMV   Value of the preset output (PMV) in percentage. Preset MV operates only in the AUTO or CASCADE modes. Activating the preset MV bypasses the calculated PID output and transmits the preset MV as the control output. Preset MV is often used during a startup or shutdown procedure when a valve must be in a known position. Preset MV is activated by an external contact input or an internal software flag (PMVF1). The default value is –6.3%. Refer to TI 1B7C1-01E, Control Functions, page 4-4.

3.3.3   STC 1 & STC 2 Menus
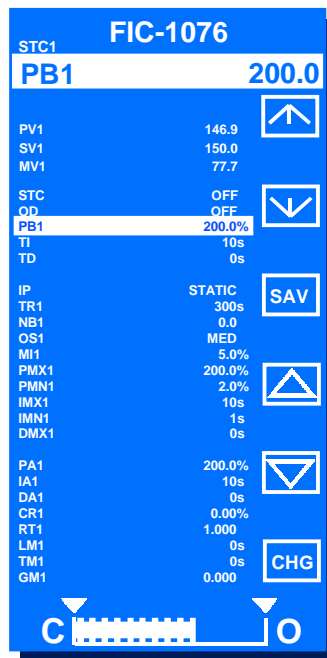
Self tuning is available in the resident on-board control modes (SINGLE, CAS & SELECT) and in a user program (PROG). The intelligent STC function maintains optimum control by following both static and dynamic process characteristics. Pressing the **M** button while observing the TUNING group menu exhibits the STC 1 pull-down menu as shown above. Refer to TI 1B7C0-01E, Intelligent Self Tuning Controllers.

PV, SV & MV Current value of the process variable (PV), set point value (SV) and manipulated variable (MV).

STC   **OFF:** Deactivates the self tuning functionality. The control tuning parameters must be manually applied in the PID1 and/or PID 2 tuning menu(s).

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FRONT PANEL & DISPLAY

DISPLAY: Convenient method of observing the calculated PID parameters without being written to the PID control function block. The values are displayed in the PA, IA and DA locations on the display.

ON: Allows the STC model to write new tuning parameters to the control function block after the controller is placed in the AUTO mode. The STC will recalculate new tuning parameters if the process variable (PV) exceeds the noise band (NB).

ATSTUP: Automatic start up permits the STC function to calculate the PID values when commissioning the controller. After installing the measuring/control elements and wiring to the appropriate terminals on the controller, place the controller in MANUAL and adjust the output until the process variable (PV) reaches the set point value (SV). Place the controller in AUTO and the STC will "bump" the output (MV) 5% for selected time. After returning the MV to the previous value, the ATSTUP observes the change in the process variable (PV) during the output change and writes initial P, I & D parameters to the control function block. This makes start up fast and easy, without knowing the process characteristics required to achieve optimum control. Refer to the instruction manual, IM 1B7C1-01E, Section 10.3, Use of STC Function and TI 1B7C0-01E, Intelligent Self Tuning Controllers.

OD Permits an ON DEMAND STC activation by operator request using a contact input or momentary closure using the PF button. Default mode is OFF. Refer to TI 1B7C01-01E, Intelligent Self Tuning Controllers, page 15.

PB Current value of the proportional band setting in percentage.

TI Current value of the integral time in seconds/repeat.

TD Current value of the derivative time in seconds.

IP Selects the type of self tuning model, STATIC or DYNAMIC. Refer to TI 1B7C0-01E, Intelligent Self Tuning Controllers, page 11.

TR Time in seconds representing a 95% step change in the process variable (PV) to a change in output (MV). This is the "time window" self tuning uses to look at the process. It can be estimated as three process time constants plus one dead time constant. It is better to make this value too large. If it is set too small, self tuning does not have enough time to observe the PV change. Default value is 300 seconds. Refer to TI 1B7C0-01E, Intelligent Self Tuning Controllers, page 12.

NB Value in engineering units of the noise band. This eliminates random noise that may be superimposed on the PV signal to be used in the STC calculation. Default is 0.0 ad the value can be adjusted up to 20.0% of span. Refer to TI 1B7C0-01E, Intelligent Self Tuning Controllers, page 13.

OS Selects the type of STC model to be used. OS represents overshoot. Choices are ZERO, MIN, MED & MAX. ZERO indicates no process variable (PV) overshoot to a set point (SV) change. The PV rises slowly toward SV. MAX allows maximum PV ramp to SV with as much as a 15% overshoot. Default is MED. Refer to TI 1B7C0-01E, Intelligent Self Tuning Controllers, page 13.

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MI During ATSTUP, the control output (MV) is deflected to allow the STC model to observe a step change in the process variable (PV). Self tuning needs to see at least a 2% change in PV before it can work. The MV change is adjustable from 0.0 to 20% of span. The default value is 5.0%. Refer to TI 1B7C0-01E, Intelligent Self Tuning Controllers, page 13.

PMX Value of the STC proportional band high limit. An STC alarm is activated if the calculated PB is higher than this value. Default mode is 999.9%.

PMN Value of the STC proportional band low limit. Default is 2.0%.

IMX Value of the STC integral time high limit. Default is 9999 seconds/repeat.

IMN Value of the STC integral time low limit. Default is 1 second/repeat.

DMX Value of the STC derivative time high limit. Value is adjustable from 1 to 9999 seconds.

PA Calculated value of the proportional band in percentage after the STC estimation as been performed. This value is the same as PB1 if the STC mode is ON or OFF. Range is 1.0 to 999.9%. Refer to TI 1B7C0-01E, Intelligent Self Tuning Controllers, page 13.

IA Calculated integral time in seconds/repeat after STC performs the estimation. Range is 1 to 9999 seconds/repeat.

DA Calculated derivative time is seconds using the STC estimation. Range is to 9999 seconds.

CR Estimated accuracy error of the STC estimation. New PID parameters are displayed if the accuracy error is < 5%.

RT Ratio of the process variable (PV) to the STC calculated output. Any changes in abrupt process characteristics are detected. Displayed value should be near 1.0. If RT is < 0.5 or > 2.0, an STC alarm occurs on the ALARM display. Refer to TI 1B7C0-01E, Intelligent Self Tuning Controller, page 14.

LM Value is the STC calculated first order lag time. Range is 0 to 9999 seconds.

TM Value is the STC calculated dead time. Range is 0 to 9999 seconds.

GM Value of the STC calculated gain. Range is a dimensionless number between 0.0 to 9.999.

3.3.4 Parameter Menu (Shown ONLY in SINGLE, CAS or SELECT Mode)

```
              FIC-1076
PARAMETER
PLC1                    1.0
PLC1              1.0%     ╱┐
PLG1              0.0s    ╱ │
CLC1              1.0%
CLG1              0.0s
CGN1             1.000
CBI1              0.0%    ┌─┐
CBO1              0.0%    │╲│
                         └─┘
FLG               0.0s
FGN              0.000
FBI               0.0%
FBO               0.0%    ┌───┐
                         │SAV│
TLG1              0.0s    └───┘

                         ┌─△─┐

                         ┌─▽─┐
```

The Parameter display is used to configure the computational function blocks in the three on-board control strategies (SINGLE, CAS & SELECT). These include square root extraction, first order lag time, gain, bias, etc. on the process variable (PV), cascade set point (CSV), feed forward input (FF) and tracking (TRK) input. Refer to instruction manual IM 1B7C1-01E, pages 8-16 & 8-17 and TI 1B7C1-01E, Control Functions.

PLC Low flow cut off value with square root extraction for the process variable(s). Default is 1.0% of span. Range is 0.0 to 100.0%.

PLG Value of first order lag applied to the process variable(s). Default is 0.0 seconds. This is typically used as an input filter. Range is 0.0 to 800.0 seconds.

CLC Low flow cut off value with square root extraction for the remote or cascade set point (CSV) if applicable. Default value is 1.0% of span. Range is 0.0 to 100.0%.

CLG Value of first order lag applied to the remote or cascade set point (CSV) id applicable. Default value is 0.0 seconds. Range is 0.0 to 800.0 seconds.

CGN Value of a gain multiplier used on the remote or cascade set point (CSV) input (CIN). Default is 1.000. Range is –8.000 to 8.000. {CGN(CIN)}

CBI Value of a bias applied to the remote or cascade set point (CSV) value (CIN). Default value is 0.0% of span. Range is –106.3% to 106.3% (CIN+CBI)

CBO   Value of a bias applied to the product of the remote or cascade set point value (CIN) and the gain multiplier (CGN) + any bias applied (CBI). Default is 0.0%. Range is –800.0% to 800.0%. {CGN(CIN+CBI)}+CBO

FLG   Value of first order lag time applied to the feed forward input (if applicable). Default is 0.0 seconds. This is used as an input filter. Range is 0.0 to 800.0 seconds.

FGN   Value of a gain multiplier applied to the feed forward input value (FIN). Default is 1.000. Range is –8.000 to 8.000. {FGN(FIN)}

FBI   Value of a bias applied to the feed forward input (FIN). This is used to change the input by a fixed value. Default is 0.0%. Range is –106.3% to 106.3%. (FIN+FBI)

FBO   Value of a bias applied to the product of the feed forward input (FIN) and the gain applied (FGN) + any bias applied (FBI). Default is 0.0%. Range is –800.0 to 800.0%. {FGN(FIN+FBI)}+FBO

TLG   Value of first order lag applied to the tracking input (if applicable). Default value is 0.0 seconds. This is used as an input filter. Range is 0.0 to 800.0 seconds.

3.3.5   P & T Registers (YS170 in PROG mode only)

Up to thirty (30) constants can be used in a YS170 user program for calculations and modifications of dynamic inputs (PV), provide alarm limits, set timers, set gains, etc. A P-number register is a read/write parameter. Any P-number can be changed from the P&T REG display or from the YSS10-210 Programming Software Package used to develop user programs. To select a P-number for modification, the **C** or **A** buttons allow scrolling upward or downward through the menu. After selecting the appropriate P-number, the ▲ & ▼ keys allow the value to be increased or decreased.

A T-register (Temporary) is a read-only register. The YS170 writes values to these registers and they can not be changed from this display. These thirty (30) registers can provide temporary storage (updated every scan) of the result of a calculation involving an analog input. An example is a mass flow calculation using volumetric flow, pressure and temperature inputs. The result of the calculation can be stored to a T-register for use in a user program. It can be transmitted to an external instrument or used as the process variable (PV) of the PID control function block.

P01-P30   Value of a P-number register in percentage. Default values are 0.0%. Range is –800.0% to 800.0%.

T01-T30   Value of a T-register in percentage. Default is 0.0%. Range is –800.0% to 800.0%.

3.3.6 Input/Output Data

By pressing the PF key while observing the TUNING group menu, the I/O DATA display is shown. The values of the five analog inputs and the three analog outputs may be observed, as well as the six discrete inputs and outputs.

This display can be used to assist in troubleshooting the controller. If there are analog input values shown, the controller is sensing inputs from the field device(s). The discrete inputs and outputs are shown as a 0 or 1, designating HIGH or LOW. If they do not switch as expected, a trouble can be found in the interconnecting devices.

X1-X5 Value of the five analog inputs in percentage or engineering units. These are read-only displays with a range from –25.0% to 125.0%. If –25.0% is shown, typically an analog input is not connected.

Y1-Y3 Value of the three analog outputs in percentage. These are read-only values with a range of –6.3% to 106.3%. If –6.3% is shown, the analog output is not used.
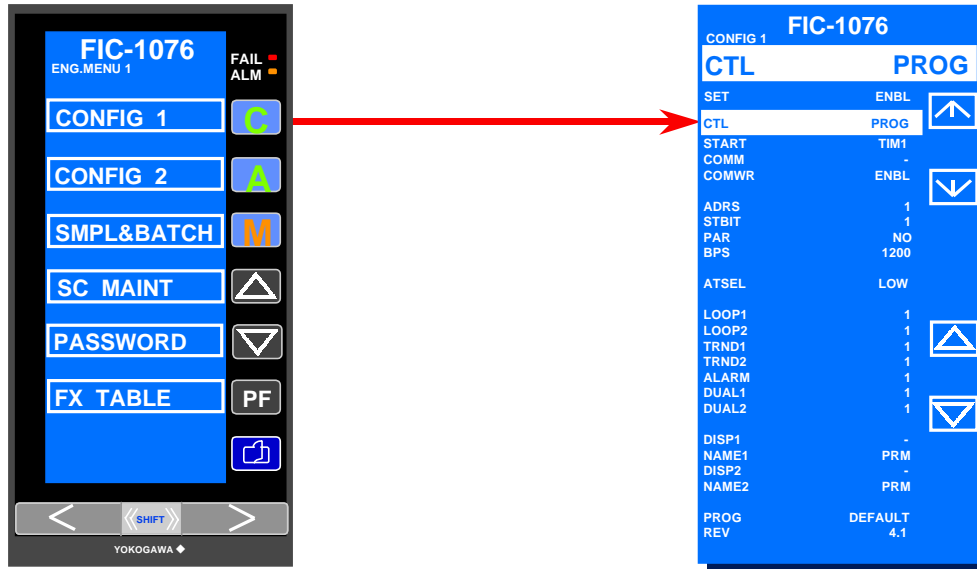
DI/DO1-6 Indication of LOW (0) or HIGH (1) condition of the discrete inputs (DI) or outputs (DO). These are read-only values that can not be changed from this display.

3.4   Engineering Menus

SHIFT + 🖒 While observing the TUNING group menu, press and hold the SHIFT button and press PAGE to observe the ENGINEERING 1 MENU group display.

3.4.1   YS170 Engineering 1 Menu

The C/A/M, ▲ ▼, and PF buttons have the operating functions changed while observing the group display. They are selector keys that allow viewing of the detailed menus.

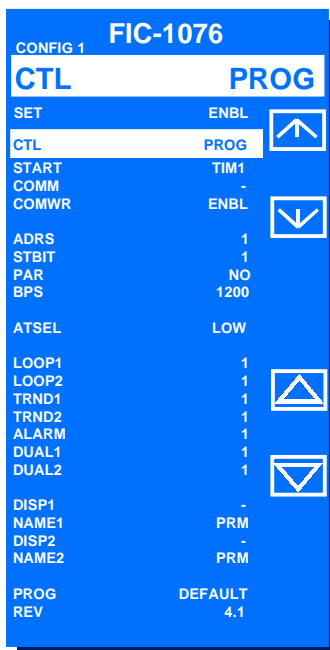Press the **C** button to observe the CONFIG 1 display.

The CONFIG 1 display is used to set various functions within the controller. The push buttons on the front panel change function while observing this display. If a password has not been installed (described later in this manual), soft keys appear on the right side of the display. The ↑ and ↓ keys (adjacent to the **C** & **A** buttons) allow you to step upward or downward through the menu. The ▲ and ▼ keys permit changes to the selected line. In the example on the previous page, changes to the CTL parameter can be made after toggling the **A** button until CTL is highlighted.

To make changes in the CONFIG 1 display, press the **A** button to highlight SET. To the right of SET, the mnemonic INHB (Inhibit) is shown. To change any parameters in any ENGINEERING MENU, the ▲ button must be pressed until the INHB designation is replaced by ENBL (Enable). Other parameters may be selected by toggling the **A** button until the desired parameter is highlighted. Pressing the **C** button allows upward mobility through the menu.

NOTE: After ENBL is initialized, the controller is in a STOP mode, shown in reverse video to the right of the CONFIG 1 designation at the top of the display. The controller is placed in MANUAL and the control output (MV) is positioned at the last calculated output prior to accessing the CONFIG 1 display. Consider this action prior to entry into the display.

3.4.2 CONFIG 1 Menu

```
      CONFIG 1      FIC-1076
      CTL              PROG

      SET              ENBL      ╱◥◣
      CTL              PROG
      START            TIM1
      COMM             -
      COMWR            ENBL      ◢◤╲

      ADRS             1
      STBIT            1
      PAR              NO
      BPS              1200

      ATSEL            LOW

      LOOP1            1
      LOOP2            1
      TRND1            1         △
      TRND2            1
      ALARM            1
      DUAL1            1
      DUAL2            1         ▽

      DISP1            -
      NAME1            PRM
      DISP2            -
      NAME2            PRM

      PROG             DEFAULT
      REV              4.1
```

SET   Permissive must be enabled (ENBL) to allow configuration access to this menu. Pressing the ▲ key allows ENBL to be shown. Default is inhibit (INHB).

CTL   Control mode is selected as follows: PROG (Programmable, YS170 only), SINGLE (single loop), CAS (single station cascade) or SELECT (auto-selector). Press the ▲ or ▼ keys until the appropriate control mode is selected. The button must be pressed at least 5 seconds to change the control mode. Refer to TI 1B7C1-01E, Control Functions, pages 3-1 to 3-9 for more details on the SINGLE, CAS and SELECT modes. Refer to pages 3-10 to 3-18 for the PROG mode.

   NOTE: Changing from the PROG mode to SINGLE, CAS or SELECT deletes any user program (YS170 only). If you place the controller back into PROG, a user default program is installed. The original user program must be installed from a personal computer using the YSS10-210 Programming software package.

START After a power outage, the restart operation can be configured. TIM 1 allows continued operation if the outage < 2 seconds and reverts to MANUAL mode if the outage > 2 seconds. Refer to TI 1B7C1-01E, Control Functions, pages 4-4 to 4-5.

COMM If an optional communication card is provided (/A31, /A32 or /A33), the display reads RS485, LCS or YS-NET (Peer-to-Peer) respectively. If no card is installed, - appears. Not user selectable.

COMWR Allows digital communication such as RS485. Default is ENBL (Enable).

ADRS Instrument address on a communications highway. Default is 1. Up to 16 controllers can be connected to a data highway, such as RS485, LCS (used with a Yokogawa DCS) or YS-Net (Peer-to-Peer).

STBIT RS485 communication stop bits, 1 or 2. Default is 1.

PAR RS485 parity, ODD, EVEN or NO. Default is NO.

BPS Transmission rate of the RS485 communication in bits per second. Selections are 1200, 2400, 4800 or 9600 bps. Default is 1200.

ATSEL Used only if the SELECT control mode is configured under CTL on the prior page. The HIGH or LOW output of the two PID function blocks can be selected as the normal control action. Default is LOW.

LOOP Selects the viewing of the LOOP 1 and LOOP 2 displays. Changing the value to 0 eliminates the display. 1 provides a blue background with white foreground. 2 provides a white background with blue foreground. Default is 1.

TREND Same as above.

ALARM Same as above.

DUAL Same as above.

DISP This parameter allows a P-number (YS170 only) to be shown in the data display area near the top of the LOOP 1 or LOOP 2 displays. Up to four numeric digits can be displayed. P01 to P08 can be selected. Default is no display, -. Refer to TI 1B7C1-01E, Control Functions, page 2-3.

NAME Allows a descriptor (up to 3 alphanumeric digits) to be displayed on the left side of the data display window. Default is PRM. By highlighting the specific character you want to change, pressing the ▲ or ▼ keys scrolls through the ASCII character set.
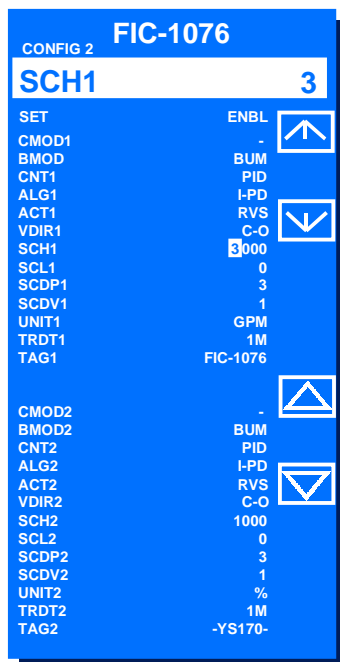
ID Shown only if a YS-Net communication card is installed (/A33). This is the ID number for the communication PROM.

PROG Shown only if a YS170 has a user program installed. This is the file name of the program downloaded from the YSS10-210 Programming Software Package.

REV Software revision of the controller.

3.4.3 CONFIG 2 Menu

The CONFIG 2 display is used to set functions on the LOOP/TREND/DUAL displays, allow cascade (remote set point) operation and select the control algorithm. This detailed menu can be observed by pressing the **A** button while viewing the ENGINEERING 1 group menu.

SET Permissive must be enabled (ENBL) to allow configuration access to this menu. Pressing the ▲ button allows ENBL to be shown. Default is inhibit (INHB).

CMOD Permissive to allow the **C** button (cascade or remote set point) button to be functional. Selections are CAS (cascade) or CMP (supervisory computer). Default is -, cascade or computer modes are inactive.

BMOD Applicable only is the CMP mode is selected above. If a fail signal is received from the supervisory computer, the controller assumes control under BUM (backup – manual) or BUA (backup-automatic). Refer to TI 1B7C8-03E, YS100 Communications Functions, pages 1-7 to 1-9.

CNT Selects the type of control. Default is PID (Proportional + Integral + Derivative). Other selections are PD only, Sample & Hold (S-PI) and BATCH. Refer to TI 1B7C1-01E, Control Functions, pages 3-25 to 3-29.

ALG Selects the control algorithm. Default is I-PD. Other selections are PI-D and SVF (set point filter). Refer to TI 1B7C1-01E, Control Functions, pages 3-19 to 3-20 and 3-30 to 3-32.

ACT Selects the control action, RVS (reverse) or DIR (direct) acting. Default is RVS. RVS decreases the control output as the process variable (PV) increases. Opposite action is in the DIR mode.

VDIR Selects the C (closed) and O (open) designations next to the horizontal output bar at the bottom of the operation displays. A "C" at the left designates the control valve is closed at 0% output. The "O" at the right shows a fully open valve at 100% output. Default is C-O. Pressing the ▲ button changes this parameter to O-C.

SCH Allows the process variable (PV) to be configured in engineering units. This value represents the high scale, i.e., 100.0% input represents XXXX engineering units. Default is 1000 and the range is –9999 to 9999.

SCL Allows the process variable (PV) low scale to be configured in engineering units. The low scale is typically 0.0, but other values can be configured to represent 0.0% input. Default is 0.0 and the range is –9999 to 9999.

SCDP Positions the decimal point location of the values configured in SCH and SCL above. The position is determined from left to right, i.e., 3 represents XXX.X. 2 would be XX.XX. Default value is 3 and the range is 1 to 4.

SCDV Divisions for the TREND displays. The display can show equi-distant vertical and horizontal grids much like a recorder by selecting 2, 4, 5 or 10. The default is 1, no grids appearing on the TREND display(s).

UNIT Up to six (6) alphanumeric characters and symbols can be used as engineering units for the process variable (PV) and set point value (SV). By pressing the ▲ or ▼ buttons, the ASCII character set scrolls through the highlighted position. Release the button as the appropriate character is presented. Default is % in the far right location. The other five positions are "blanks", a selection in the character set.

TRDT Selects the time base for the TREND display(s). Default is 1M (minute). Options are 5M, 10M, 30M, 1H (hour), 5H, 10H, 30H.

TAG Up to eight (8) alphanumeric characters and symbols are available to develop a tag name or descriptor of the controller. By pressing the ▲ or ▼ buttons, the ASCII character set scrolls through the highlighted position. Release the button as the appropriate character is presented. Default tag name is the controller model number, -YS150- or -YS170-.

3.4.4 CONFIG 3 Menu (YS150 and YS170 in SINGLE, CAS or SELECT)
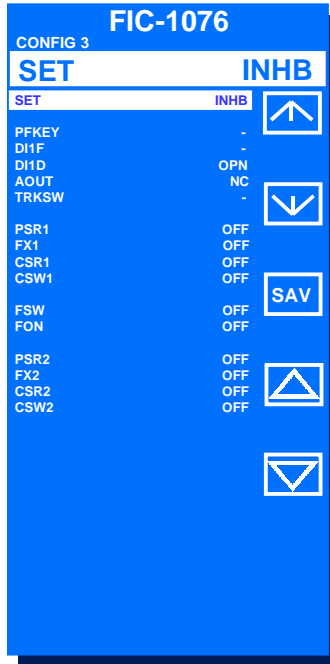
The CONFIG 3 menu appears in the ENGINEERING 1 group menu if one of the on-board control modes is selected in the CONFIG 1 menu: SINGLE, CAS or SELECT. Pressing the **M** button allows the CONFIG 3 menu to be shown. This menu permits the selection of PV square root extraction, PV input characterization, remote set point characterization, feed forward selection, functionality of the PF key and contact input.

The DI1F parameter assigns the function of the contact input for the three on-board control modes. Below are the options:

- SINGLE   E-MAN   Forces controller to MANUAL operation.
              E-AUT   Forces controller to local AUTO operation.
              E-PMV   Forces output to the preset value (PMV).
              E-TRK   Permits selection of the tracking input (TRK) as the output.
              E-STC   Permits self tuning control (STC) operation.

- CAS   E-PMV   Forces output to preset value (PMV).
              E-STC   Permits self tuning control (STC) operation.
              E-O/C   Overrides cascade control.

- SELECT   E-PMV   Forces output to preset output (PMV).
              E-STC   Permits self tuning control (STC) operation.
              E-L/R   Remote/local set point value (SV) selection.

SET   Permissive must the enabled (ENBL) to allow configuration access to this menu. Pressing the ▲ button allows ENBL to be shown. Default is inhibit (INHB).

PFKEY Allows operator access to the self tuning control (STC) function by pressing the **PF** button. The PF lamp indicates ON or OFF, switching alternately as the button is pressed. Pressing the ▲ button while highlighting this parameter allows STC activation using the **PF** button. Default is -, no operation.

DIF1 Selects the discrete input function by pressing the ▲ button. Selections include E-MAN, E-AUTO, E-PMV, E-TRK or E-STC. Default is -, no operation.

DID1 Selects discrete input configuration, OPN (normally open) or CLS (normally closed). Default is OPN.

AOUT Selects the discrete outputs configuration, NC (normally open) or NO (normally closed). Default is NO.

TRKSW Selects the tracking function (SINGLE only). Pressing the ▲ button while highlighting this parameter selects set point tracking (SVTRK) or process variable tracking (PVTRK). Default is -, no operation.

PSR Permits square root extraction of the process variable (PV). Default is OFF.

FX Permits a function generator or characterizer to be applied to the process variable (PV). The function generator values are applied in the FX display described later in this section. Default is OFF.

CSR Permits square root extraction of the cascade or remote set point (CSV). Default is OFF.

CSW Permits scaling of the cascade or remote set point (CSV). Default is OFF.

FSW Permits the feed forward gain to be applied (ON). Default is OFF.

FON Permits the feed forward input to be activated (ON). Default is OFF.

3.4.5 SMPL & BATCH Menu (YS170 in PROG Mode Only)

In lieu of the CONFIG 3 menu, the Sample & Batch menu is shown if the YS170 is used in the PROG mode, i.e., a user program is installed. This configuration menu sets the parameters for two special control modifiers for the PID 1 and/or PID 2 function blocks. These modifiers are activated in the CONFIG 2 menu, CNT set to S-PI or BATCH. Refer to TI1B7C1-01E, Control Functions, pages 3-25 to 3-29.

Sample & Hold is used on processes with inherent long lag times or dead times. P+I (Proportional Band & Integral) control action is performed during the control time span (SWD). The control output (MV) remains constant for the remainder of the sampling time (STM). This action minimizes overshoots in set point value (SV) and hunting.

Batch is used on batching operations where full control output (MV) is desired until the process variable (PV) reaches a preset deviation from set point (SV). The deviation set point where P+I+D control action begins is set by the deviation band (BD). The bias band (BB) is subtracted from the control output (MV) as the process variable (PV) approaches set point value (SV) to

minimize overshoot. A lockup band (BL) acts as a deadband to ensure the control action does not cycle between full output and the P+I+D action near the deviation band (BD) setting.

STM   Value is the time of the duty cycle applied to the P+I sample and hold control action. Time period range is 0 to 9999 seconds. Default is 0.

SWD   Value is the control width applied within the sample time (STM). During this time, P+I control action is applied. During the remainder of the sample time (STM), the last calculated control output (MV) is held until the sample time expires. Range is 0 to 9999 seconds. Default is 0.

BD   Value is the process variable (PV) deviation from set point value (SV) that the P+I+D control action begins. Below this limit the control output (MV) is at 100.0% or the output high limit value (MH). Range is 0.0 to 100.0% of full scale. Default is 0.0%.

BB   Value to be applied to the control output (MV) as the process variable (PV) approaches the deviation band (BD). Range is 0.0 to 100.0%. Default is 0.0%.

BL   Value of the lockup or deadband at the BD value to prevent cycling of the control output (MV). Default is 0.0% of full scale. Range is 0.0 to 100.0%.

3.4.6   SC Maintenance Menu (Signal Conditioning Option /A01 to /A04 & /A08)
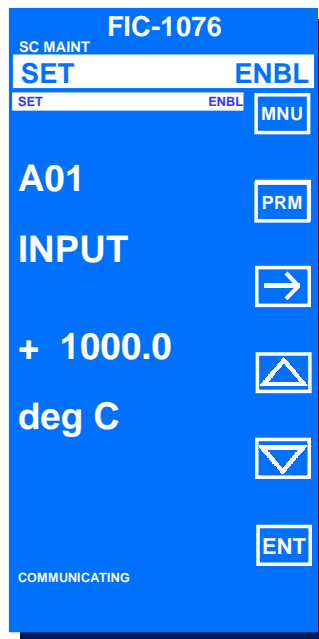
YS150/YS170 controllers can accept one input other than 1 to 5VDC. These are options /A01 through /A08 in the model number sequence. If these options are not installed, configuration in this display is not required. Some of these signal conditioning cards require configuration in the SC MAINT display. This display is viewed by pressing the ▲ button while observing the ENG. MENU 1 display.

Those microprocessor-based cards needing configuration are:
- /A01   Model EM1*B   mV input
- /A02   Model ET5*B   Universal thermocouple input
- /A03   Model ER5*B   RTD input
- /A04   Model ES1*B   Potentiometer input
- /A08   Model EP3*A   Frequency input

Press the **M** button next to the → symbol to highlight SET. Press the ▲ button until ENBL appears to the right of SET. Press the **C** button next to MNU to communicate with the signal conditioning card. A "communicating" prompt appears at the bottom of the display and the model number will appear.

The **A** button next to PRM allows communication to the signal conditioning card. Each time the button is pressed, the parameters listed below are read and shown. If a change to a parameter is desired, press the **M** button next to the → symbol to highlight the desired location. Press the ▲ or ▼ buttons to select the desired number or character. After making a change, the PF button next to the ENT symbol must be pressed twice to write the change to the signal conditioning card.

Model Name   The model number of the signal conditioning card installed.

Tag Number   Up to 16 alphanumeric characters are shown and can be assigned as the tag number using the B01 – B02 parameters described below.

Self Chk   Performs self-diagnostics on the circuit card. Results are GOOD or ERROR. If ERROR is shown, replacement is required.

Input Value   **(A01)**   Input value in engineering units.

Output Value   **(A02)**   Output value of the card in percentage.

Status   **(A03)**   No configuration required.

Rev. No.   **(A04)**   Software revision level of the signal conditioning card.

Tag No. 1   **(B01)**   First eight alphanumeric characters of a tag name assigned to the card.

Tag No. 2   **(B02)**   Last eight characters of a tag number assigned to the card.

Comments 1   **(B03)**   First eight alphanumeric characters of a description which may be applied to identify the functionality of the card.

Comments 2   **(B04)**   Last eight alphanumeric characters of a description which may be applied to identify the functionality of the card.

RTD Type   **(B05)**   Model ER5*B ONLY. Configures the RTD type, PT-100 (ANSI or DIN) or JPT-100. Pressing the ▲ button allows selection of PT-100.

T/C Type   **(B06)**   Model ET5*B ONLY. Selects the type of thermocouple input. Pressing the ▲ or ▼ buttons allows selection of B,E,J,K,T,R,S or N inputs.

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Freq. Low   **(B07)**   Model EP3*A ONLY. Selects the low cutoff for the frequency input in HZ. Pressing the ▲ or ▼ buttons allows selection. Pressing the **M** button next to the → symbol changes the location of the highlighted area to the right.

Resist   **(B08)**   Model ES1*B ONLY. Total resistance of the slidewire resistance input from a motorized valve positioner or similar device. Up to six positions can be configured, XXXXX.X Ω. Pressing the ▲ or ▼ buttons allows selection. Pressing the **M** button next to the → symbol changes the location of the highlighted area to the right.

Unit   **(B09)**   Model ET5*B ONLY. Selects the engineering units of the thermocouple input card. Pressing the ▲ or ▼ buttons allows selection of degrees C/F/K.

Zero   **(B10)**   Selects the zero point of the input range, up to six digits including + or – sign. An example is –0050.0 degrees F. Pressing the ▲ or ▼ buttons allows selection. Pressing the **M** button next to the → symbol changes the location of the highlighted area to the right.

Span   **(B11)**   Selects the span of the input, up to six digits including + or – sign. Span is the upper input range minus the zero point. For example, the range required is –500.0 to 250.0. The span setting is 750.0. Pressing the ▲ or ▼ buttons allows selection. Pressing the **M** button next to the → symbol changes the location of the highlighted area to the right.

Burn Out   **(B12)**   Upscale or downscale burnout is provided. Selections are OFF, UP or DOWN. Pressing the ▲ or ▼ buttons allows selection.

Out 0%   **(C01)**   Output compensation zero bias for the signal conditioning card. Compensates for offset in the D/A converter. Range is ±10%.

Out 100%   **(C02)**   Output compensation span for the signal conditioning card. Compensates for offset in the D/A converter. Range is ±10%.

Wiring R   **(C03)**   Model ET5*B ONLY. Compensates for errors incurred with high T/C wire and BURN OUT current.

Zero Adj.   **(C04)**   Models EM1*B, ET5*B & ER5*B ONLY. Increase, decrease or reset input compensation for the A/D converter.

Span Adj.   **(C05)**   Models EM1*B, ET5*B & ER5*B ONLY. Increase, decrease or reset input compensation for the A/D converter.

Zero Adj.   **(C06)**   Model ES1*B ONLY. Input a resistance value to compensate or an RTD zero offset. Pressing the ▲ or ▼ buttons allows selection. Pressing the **M** button next to the → symbol changes the location of the highlighted area to the right.

Span Adj   **(C07)**   Model ES1*B ONLY. Input a resistance value to compensate or an RTD span offset. Pressing the ▲ or ▼ buttons allows selection. Pressing the **M** button next to the → symbol changes the location of the highlighted area to the right.

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3.4.7   PASSWORD Menu

YS150/YS170 controllers have a security feature to ensure configuration from the front panel display is not inadvertently changed. A four digit numeric password can be installed in the PASSWORD menu. While viewing the ENG. MENU 1 group menu, press the ▼ button to observe the PASSWORD display. If a password is not installed, the word UNLOCK appears in the lower portion of the display. If the word LOCK appears, changes in the TUNING and ENGINEERING menus are not permitted until the password is installed.

Press the **A** button next to SET. 0000 appears at the top of the display and the left position is highlighted. To select the appropriate number for this position, press the ▲ button. Press the **C** button next to the → symbol to highlight the next position. Use the ▲ button to select the next number. Repeat this procedure until all four numbers of the password are installed.

Press the **A** button next to SET twice to enter the password. LOCK appears at the bottom of the display and ENT PASSWORD appears at the top. Only the PASSWORD display can be accessed to UNLOCK the controller and allow changes. The password does not affect the operation of the LOOP, TREND, ALARM or DUAL displays.

3.4.8   FX TABLE Menu

A ten segment line characterization is available to linearize an analog input (two FX blocks are available in the YS150 CAS or SELECT modes and YS170). The input break points to this function generator are set at 0.0 through 100.0% in 10.0% increments. The default mode is linear. For example, a 10% input to the function generator is 10% output. Pressing the PF key from the ENG. MENU 1 allows viewing the FX TABLE menu. Pressing the **A** button next to the ↓ symbol allows highlighting of the desired line. Changes can be made by using the ▲ or ▼ buttons. Refer to the drawing below.

101-111, 201-211 Output setting of the function generator. Default is linear. Range is –6.3% to 106.3%.
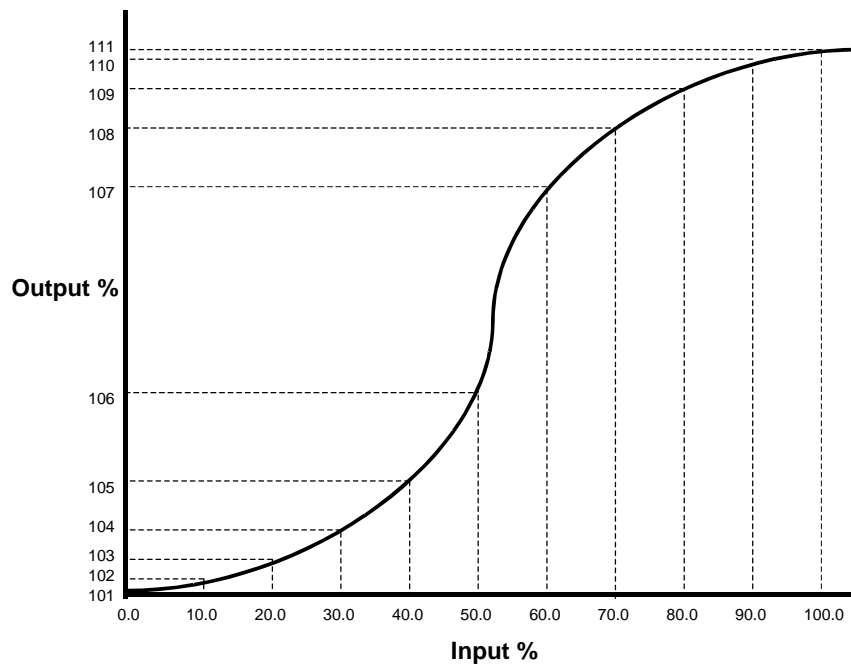
YS170 in the PROG mode ONLY. A second Engineering menu is available to configure function blocks that may be used in a user program (PROG). Pressing the PAGE button allows the ENG. MENU 2 to be viewed.

3.4.9   GX1 & GX2 Table Menu

Two characterizers are available for analog inputs. These differ from the FX function generators. The inputs are not pre-set at specific values. The percentage of input and output percentage can be configured. The default mode is linear, whereby the input and output percentage are equal. To access this menu, press the **C** (GX1) or **A** (GX2) button from the ENG. MENU 2 group display. Press the **A** button to scroll downward through the menu. Use the ▲ or ▼ buttons to change the value of the highlighted parameter. Refer to the drawing above.

Input 101-111, 201-211 Range is –25.0% to 125.0%.
**Output 101-111, 201-211** Range is –25.0% to 125.0%.

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3.4.10   PGM SET Menu (Program Set)

The Program Set menu is used with the PGM function block in a YS170 user program. This menu allows entry of a time base (seconds) and output of the function block in percentage of full scale. The PGM block is commonly used in ramp and soak temperature control set point value (SV) profiling. The set point value (SV) can be changed automatically over time. While viewing the Engineering Menu 2, press the **A** button to observe the PGM SET menu. Press the **A** button to highlight a desired parameter. Use the ▲ or ▼ buttons to change the value. Refer to the drawing below of a typical temperature profile.   Refer to TI 1B7C2-03E, Programming Functions, page 3-37 to 3-39.

Time 01-10   Time base applied to each PGM output segment. Default value is 0. Range is 0 to 9999 seconds.

Output 01-10 Value of the PGM output during the selected time base. Default value is 0.0%. Range is –25.0% to 125.0%.
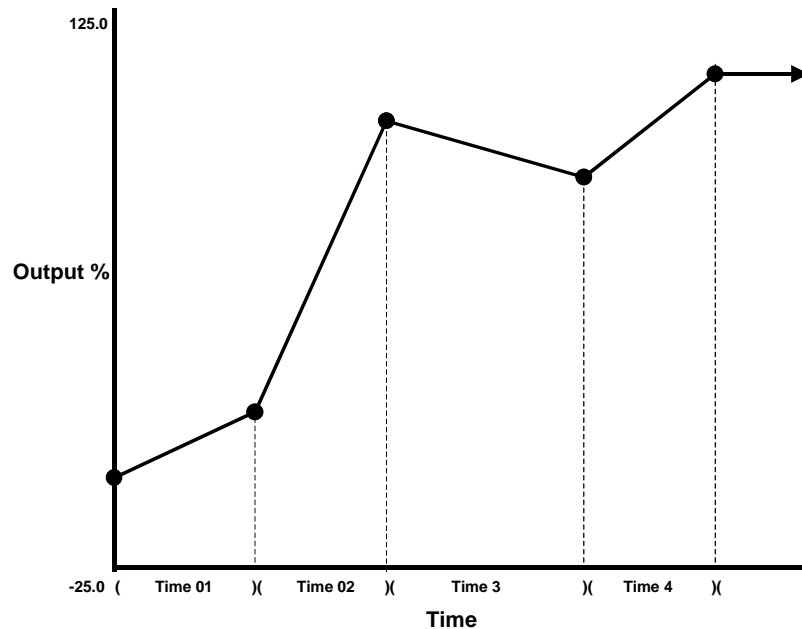
3.4.11   PID TABLE Menu

A Pre-set PID function block is available in YS170 controllers in a user program. This block writes new tuning parameters (P+I+D) to the control function block, depending upon process variable (PV) deviation from set point value (SV). From the ENG. MENU 2, press the ▲ button to view the PID TABLE menu. Press the **A** button to highlight the selected parameter. Use the ▲ or ▼ buttons to change the value. Refer to TI1B7C2-03E, Programming Functions, pages 5-23 to 5-24.

PPB1-8 Value of the proportional band. Default is 999.9%. Range is 2.0 to 999.9%.
PTI1-8 Value of the integral time. Default is 1000. Range is 1 to 9999 seconds/repeat.
PTD1-8 Value of derivative time. Default is 0. Range is 0 to 9999 seconds.

3.4.12 K Constant Menu

A K register is a constant used in a YS170 user program. These constants can be viewed from the K CONSTANT menu, but not changed. Changes can be made only by using the YSS10-210 Programming Software Package and downloading to the YS170. An example of using a K register is calculating mass flow from a volumetric flow measure input. The input can be modified to mass flow by multiplying the input by a K constant. To access the K CONSTANT menu, press the ▼ button from the ENG. MENU 2 display. The thirty K constants are shown. Default values are 0.0%. Range is –800.0% to 800.0%. Refer to TI 1B7C2-03E, Programming Functions, page 3-2.

K01-30 Value of the K constants in a YS170 user program. These are read-only values that can not be changed from the K CONSTANT menu.