YASKAWA

For GPD 503 Adjustable Frequency Drives
230V: 1-100HP CT, 1-150HP VT
460V: 1-400HP CT, 1-500HP VT
575V: 5-200HP CT, 5-200HP VT

PID Software Kit

Part No. SK-PID1-503

DESCRIPTION

The PID Software Kit consists of two EPROMs and this instruction sheet. It allows the user to modify a GPD 503 drive so it will have PID capability; that is, it will be able to regulate a controlled variable such as speed, pressure, flow, etc., by comparing a feedback signal to a reference signal. It then performs the necessary calculations on the difference between the two signals (error) in order to compensate for the dynamic changes in the system. After changing out the EPROMs to introduce the PID algorithm into the GPD 503, some of the functions from the standard EPROM set are no longer available. These include:

- Frequency reference memory settings An-05 through An-08
- Settings ***0C*** and ***05*** for Sn-15 through Sn-18
- Slip compensation (bn-08, Cn-34, Cn-35).

The reference input and feedback input connections needed for PID operation depend on whether or not the AI-14B option card (Model No. DS387) is present. Although the card is not a requirement for PID operation, its presence allows greater flexibility of the reference input connection.

The function of the GPD 503 control circuit with the PID software in place can be understood by studying the block diagrams in Figures 1, 2 or 3.

Figure 1 shows operation without the AI-14B card. The reference (setpoint) is either an input signal at term. 16 or a memory setting (An-01 through An-04, or An-09). The feedback input is at either terminal 13 or 14, depending on the type of signal used. The feedback signal is eventually subtracted from the reference signal to produce an error signal. The PID algorithm processes this error signal. The output from the PID algorithm commands the drive to output a specific frequency.

Operation with the AI-14B card (Figures 2 & 3) is similar. The reference (setpoint) input is either an input signal at terminal 13, 14 or 16, or a memory setting (An-01 thru An-04, or An-09). The feedback input is channel 1, channel 2, and/or channel 3 of the AI-14B card.

INSTALLATION

CAUTION

This option contains electrostatic sensitive devices. Personnel must be properly grounded before removing and installing carton contents.

1. Turn off all electrical power to drive.

2. Remove drive front cover. Verify that CHARGE indicator lamp inside drive is off.

3. Use a voltmeter to verify power has been disconnected at incoming power terminals (L1, L2 & L3).

CHANGE RECORD				
1	STD-5833 8-18-94			
2	STD-5853 9-12-94 KRR			

DWG. NO. 02Y00025-0372
SHEET NO. 1 OF 10
EFF. 4/28/94 (m-df)

TSA 1570-0011

ORIGINAL

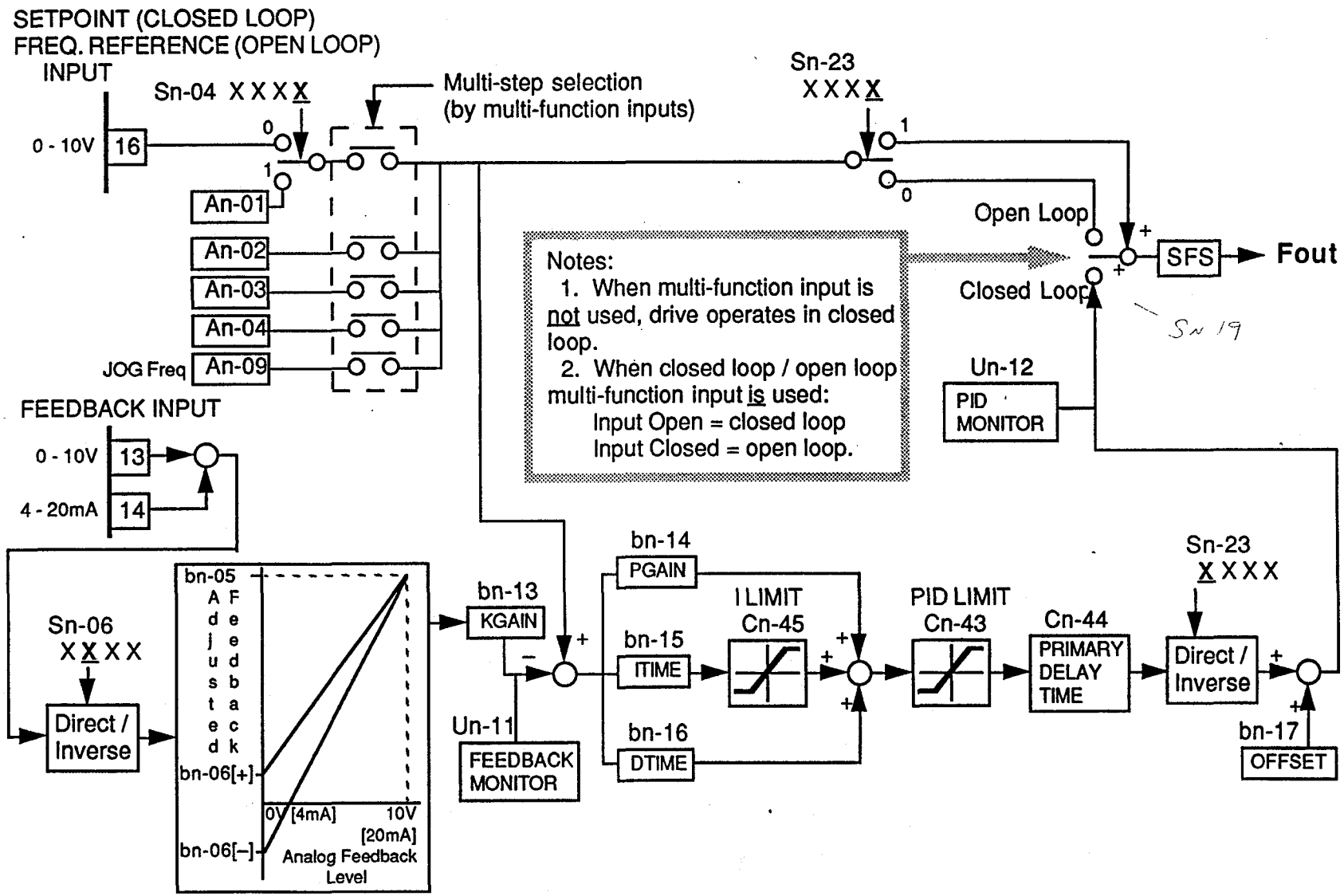

Figure 1. PID Control Block Diagram Without AI-14B, and Sn-19 = b.

Refer to Sheet 1 for latest change.

DWG. NO. 02Y00025-0372
SHEET NO. 2 OF 10
EFF. 4/28/94 (m-df)

ORIGINAL

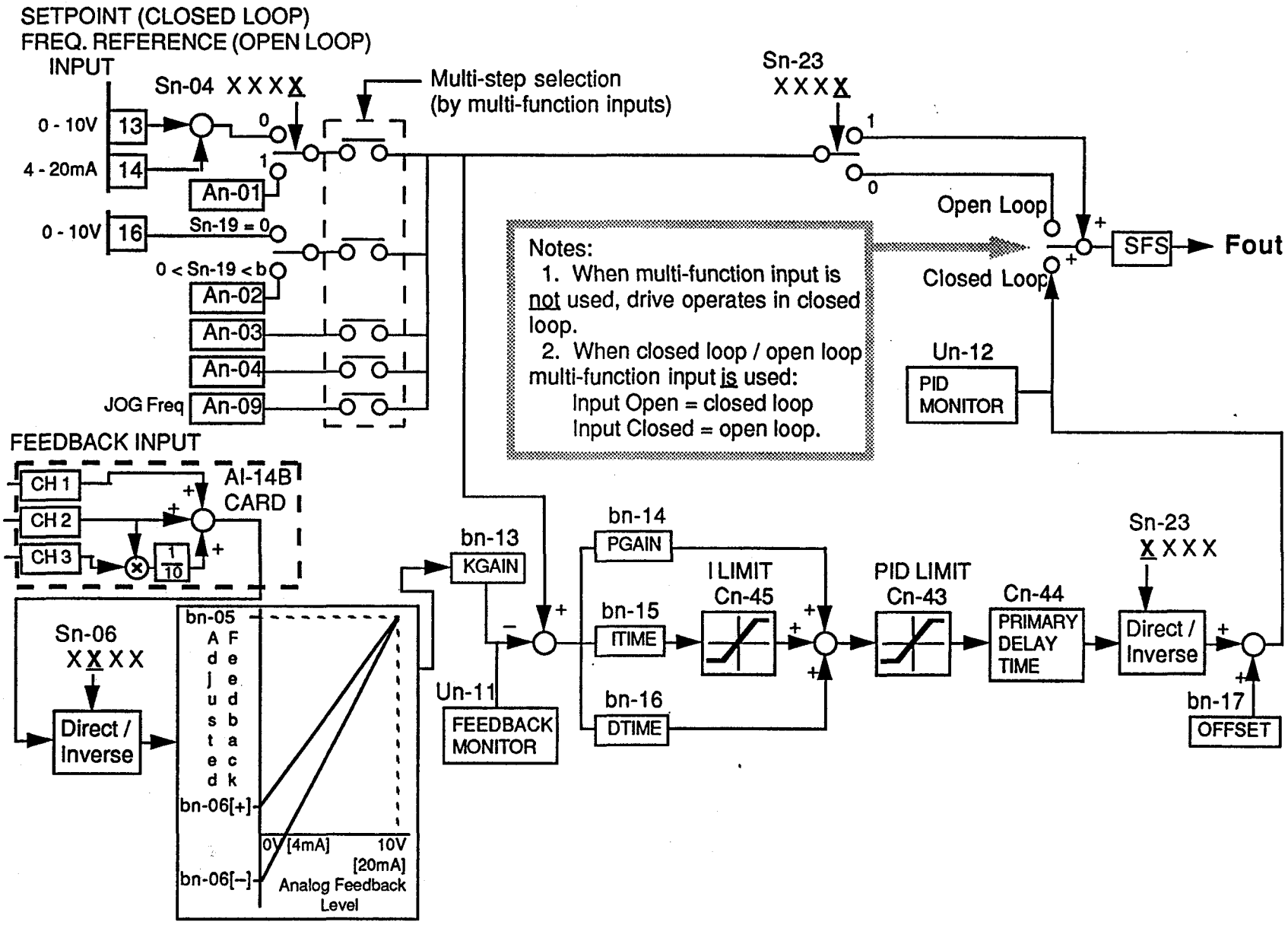

Figure 2. PID Control Block Diagram With AI-14B, and Sn-19 < b

Refer to Sheet 1 for latest change.

DWG. NO. 02Y00025-0372
SHEET NO. 3 OF 10
EFF. 4/28/94
(m-df)

ORIGINAL

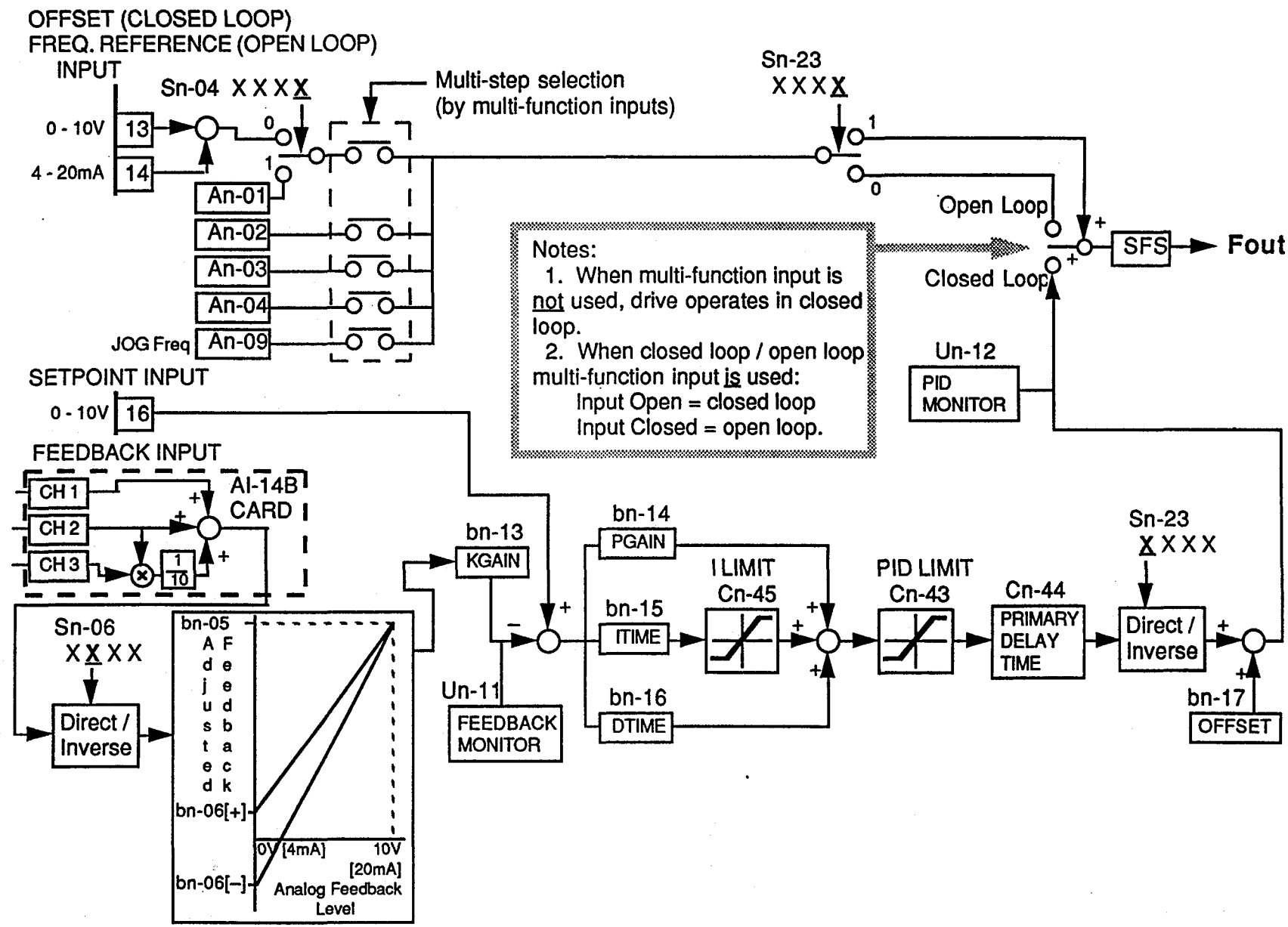

Figure 3. PID Control Block Diagram With AI-14B, and Sn-19 = b

Refer to Sheet 1 for latest change.

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SHEET NO. 4 OF 10
EFF. 4/28/94 (m-dl)

ORIGINAL

INSTALLATION - Continued

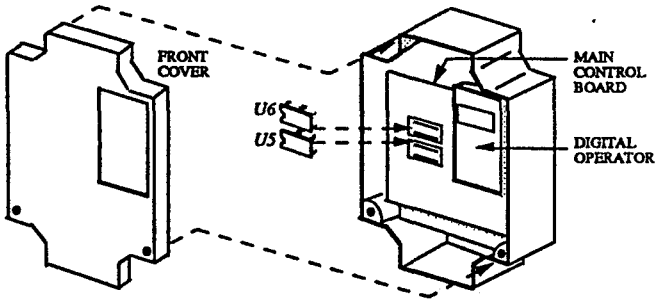


Figure 4. Installation of PID EPROM Set In GPD 503

WARNING

Hazardous voltage can cause severe injury or death. Lock all drive power sources in "OFF " position.

4. See Figure 4. Remove the standard EPROM set and install the PID EPROM set as shown. Be sure to locate U5 and U6 in their proper place **with notches facing left!** Failure to do this will destroy the EPROMs.

5. Connect feedback and external setpoint (if used) signals. If the AI-14B card is not used (see Figure 5), the feedback signal will be at terminal 13 (0-10 Vdc) or terminal 14 (4-20 mA dc), with terminal 17 being common for both. If the AI-14B option card is used, it will be the connection point for the feedback signal (see Figures 2 and 3 and separate instruction sheet 02Y00025-0296).

NOTE

The setpoint (reference) need not come from an external signal; it can also come from an internal memory setting (An-01 through An-04, or An-09) selected by multi-function inputs.

NOTE

If the drive is part of a system such as bypass, its signal connections may be at auxiliary terminal blocks. See schematic diagram supplied with your order.

6. Replace the front cover. Apply power to the drive. A "***CPF04***" fault code will appear on the Digital Operator display. A constant initialization (i.e. reset) must be

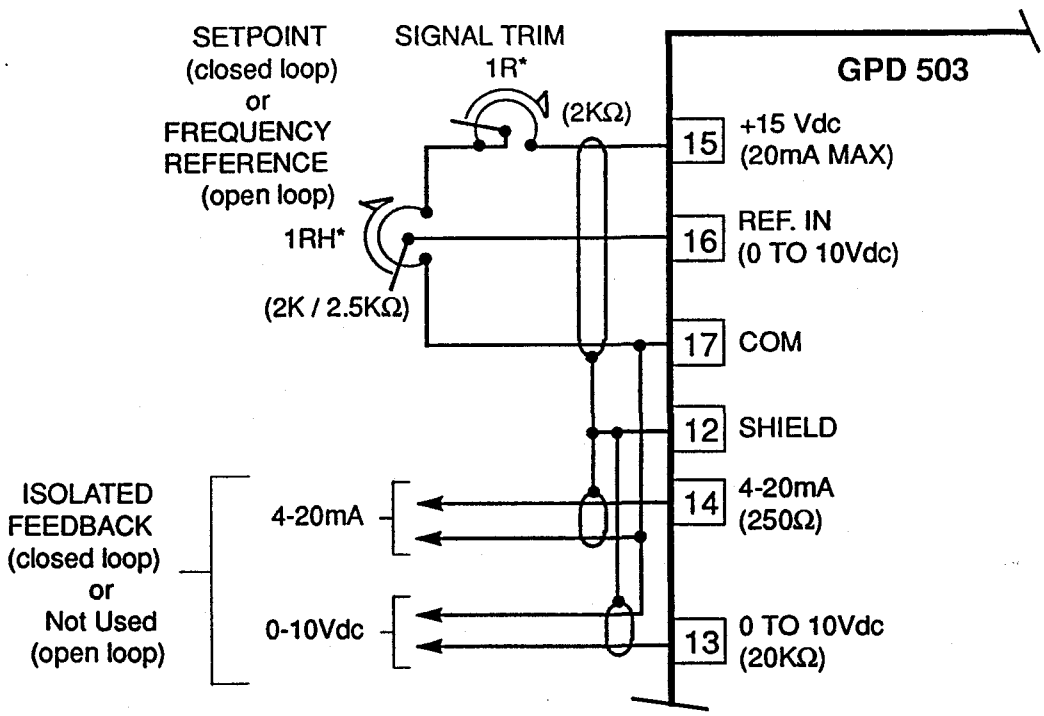


Figure 5. Setpoint (Reference) and Feedback Signal Connections When PID EPROM Set Is Used Without AI-14B Option Card

performed, by entering ***1110*** (for 2-Wire control) or ***1111*** (for 3-Wire control) at Sn-03. (See para. 2.25 in technical manual TM 4231 if not familiar with this procedure.)
2-Wire control is for maintained contact run/stop control;
3-Wire control is for momentary contact run/stop control.

7. Make changes to the constants to suit your application. Refer to programmable features descriptions in Section 2, or constant tables in Appendix 1 of the GPD technical manual, TM 4231.

IMPORTANT

Once the constant initialization for the PID software EPROM set has been performed, certain constants are redefined or given new "factory settings" different from those listed in Appendix 1 or within description paragraphs in Section 2 of the GPD technical manual. Review the **PID CONSTANT SETTINGS** section at the end of this instruction sheet before programming any constants.

IMPORTANT

The constant initialization performed in step 6 sets Sn-19 to ***00***; PID software is disabled. Sn-19 must be set to value ***0b***, or AI-14B card must be installed, in order to enable the PID algorithm.

PID ADJUSTMENTS

Constants related to the PID algorithm (as identified in Figures 1, 2 and 3) have default values (i.e. "factory settings") as listed in the **PID CONSTANT SETTINGS** section at the end of this instruction sheet. It may be necessary to adjust these to suit your application. Proportional Gain, Integral Time and Derivative Time adjustments are interactive. Fine tuning may be required. In general, the Proportional Gain will affect the rise time; the Integral Time will affect the steady state error; and the Derivative Time will affect the overshoot. Each of these settings also has a significant effect on system stability.

One of the most useful constants related to the PID function is the ability to scale the setpoint (F) and feedback (Un-11) displays. This is accomplished by programming constant Cn-20. It is most useful to program this constant in units of your controlled variable (e.g. inches of water, psi, RPM, etc.). This requires that you know the relationship between the input and output of your sensor (e.g. 0" = 4mA, 4" = 20mA). See the following table for an example.

DATA	CONTROLLED VARIABLE
0	Frequency (meaningless for most applications) 10V or 20mA = 60
1	Same as ***0***
2 to ***39***	Motor speed ($N_S = \frac{120F}{P}$) in increments of 1 RPM (39999 max.) NOTE: When motor synchronous speed exceeds 39999 RPM, display holds at ***39999***.
00040 to ***39999***	Duct Static Pressure or other parameter. Setting must be 5 digits. X X X X X └ Parameter value at maximum analog feedback (10V or 20mA) (include leading zeroes, if necessary) └ Location of decimal point: ***0*** = XXXX ***1*** = XXX.X ***2*** = XX.XX ***3*** = X.XXX **EXAMPLE:** To display Duct Static Pressure based on 4.000 inches of water at 10V or 20mA, Cn-20 setting = ***34000***

Additionally, it is sometimes necessary to use the analog feedback gain constant (bn-05) to correct for a signal that is less than 10V or 20mA at full scale (e.g. set bn-05 = 200% for a sensor that outputs 5V at full scale).

PID CONSTANT SETTINGS

The following is a listing of changes in constants and programmable features as a result of installing the PID Software EPROM set and performing constant initialization.

All of these changes should be noted in your TM 4231. In addition, it may be helpful to also annotate those reference paragraphs in Section 2 where the change in constant definition or factory setting will have some effect.

for Page 2-2:

Slip Compensation – (Not available in PID)	2.26	2-41
PID Control	♦	

♦ Refer to separate Option Instruction Sheet 2Y25-0372.

for Page 2-21:

10	Control Section PROM (last 5 digits of PROM Part No. : NSG 6XXXXX	*I82 I I* (PID)
11	Feedback Signal Monitor	*I00.00*
12	PID Monitor	*– I00.0*

for Page 2-22:

0b	PID algorithm enabled	GPD 503 controls output frequency using PID algorithm (see instruction sheet 2Y25-0372)
0C - FF	Not Used	

* FBIAS1 and FBIAS2 are based on Fmax (Cn-02).

(Continued)

for Page 2-25:

03	Multi-step speed ref. 1	**See paragraph 2.24**
04	Multi-step speed ref. 2	
05	Not Used	
0C	Not Used	

for Page 2-26:

64	Not Used	
65	Integral Value Reset	Closed = Integral Value Reset
66	Closed Loop / Open Loop	Closed = Open Loop
67 to *FF*	Not Used	

for Page 2-30:

0C	Feedback signal lost	Closed = Feedback signal is lost (when feedback signal loss detection is enabled)
0d	Braking resistor fault	Closed = Braking resistor is overheating or has faulted
0E	Fault	Closed = GPD 503 fault has occurred (except CPF00, CPF01)
0F	Not Used	

for Page A1-1:

An-05	Not Used					
An-06	Not Used					
An-07	Not Used					
An-08	Not Used					

for Page A1-2:

bn-05	Auto Signal Gain	0.1 %	0 - 1000.0	100.0		(2)
bn-06	Auto Signal Bias	1 %	-100 to 100	0		(2)
bn-08	Not Used					

for Page A1-2 (continued):

bn-13	PID Feedback Signal Gain	0.01	0.00 - 10.00	1.00		(2)
bn-14	PID Proportional Gain	0.1	0.0 - 25.5	1.0		(2)
bn-15	PID Integral Time	0.1 s	0.0 - 450.0	10.0		(2)
bn-16	PID Derivative Time	0.01 s	0.00 - 1.00	0.00		(2)
bn-17	PID Output Offset	1 %	0 - 100	0		(2)

(1) Refer to separate Option Instruction Sheet.
(2) Refer to Option Instruction Sheet 2Y25-0372.

for Page A1-8: (addition between Sn-22 and Sn-25)

Sn-23	PID Characteristics	XXXX	0	Freq. reference = PID output when PID performs.			- -
			1	Freq. ref. = PID output + setpoint when PID performs.			
		XXXX	0	P value is calculated after open loop is selected by multi-function input.			
			1	P value is zero after open loop is selected by multi-function input.			
		XXXX	0	I value is calculated after open loop is selected by multi-function input.			
			1	I value is zero after open loop is selected by multi-function input.			
		XXXX	0	PID output is direct			
			1	PID ouptut is inverted			
Sn-24		XXXX	0	Analog monitor is directly proportional			- -
			1	Analog monitor is inversely proportional			
		XXXX	0	Feedback loss detection is enabled when drive is operating in closed loop			
			1	Feedback loss detection is disabled			
		XXXX	0	Operation stops wheen feedback loss is detected. " *LoSFb* " is displayed.			
			1	Operation continues when feedback loss is detected.			
		XXXX	0	Frequency output display is not affected by Cn-20.			
			1	Frequency output display is affected by Cn-20.			

(Continued)

for Page A1-4:

Sn-06	Operation Mode Select 3	XXXX	00 = S-curve at Accel/Decel,- with 0.2 second delay 01 = S-curve at Accel/Decel disabled 10 = S-curve at Accel/Decel With 0.5 second delay 11 S-curve at Accel/Decel with 1.0 second delay	0000		2.27
		XXXX	0 Auto signal input directly proportional			■
			1 Auto signal input inversely proportional			
		XXXX	0 Auto Reference - Loss Detection disabled			2.4
			1 Auto Reference - Loss Detection enabled			

ADD THIS ABOVE PAGE NUMBER

■ Refer to Option Instruction Sheet 2Y25-0372.

for Page A1-12:

Cn-34	Loss of Feedback Delay Time	1 s	0 - 255	10		♦
Cn-35	Not Used					

for Page A1-13:

Cn-43	PID Output Limit	1 %	0 - 109	100		♦
Cn-44	PID Output Delay Time	0.1 s	0.0 - 2.5	1.0		♦
Cn-45	Integral Value Limit	1 %	0 - 100	100		♦

♦ Refer to Option Instruction Sheet 2Y25-0372.

for Page A1-14:

Un-10	Control Section Software PROM No. Lower 5 Digits : NSG 6XXXXX	*1821* (PID1)	
Un-11	Feedback Signal Monitor	*60.00*	Units per Cn-20 setting ∇ (sh. 6 of 10)
Un-12	PID Monitor	*- 100.0*	Units in % ∇

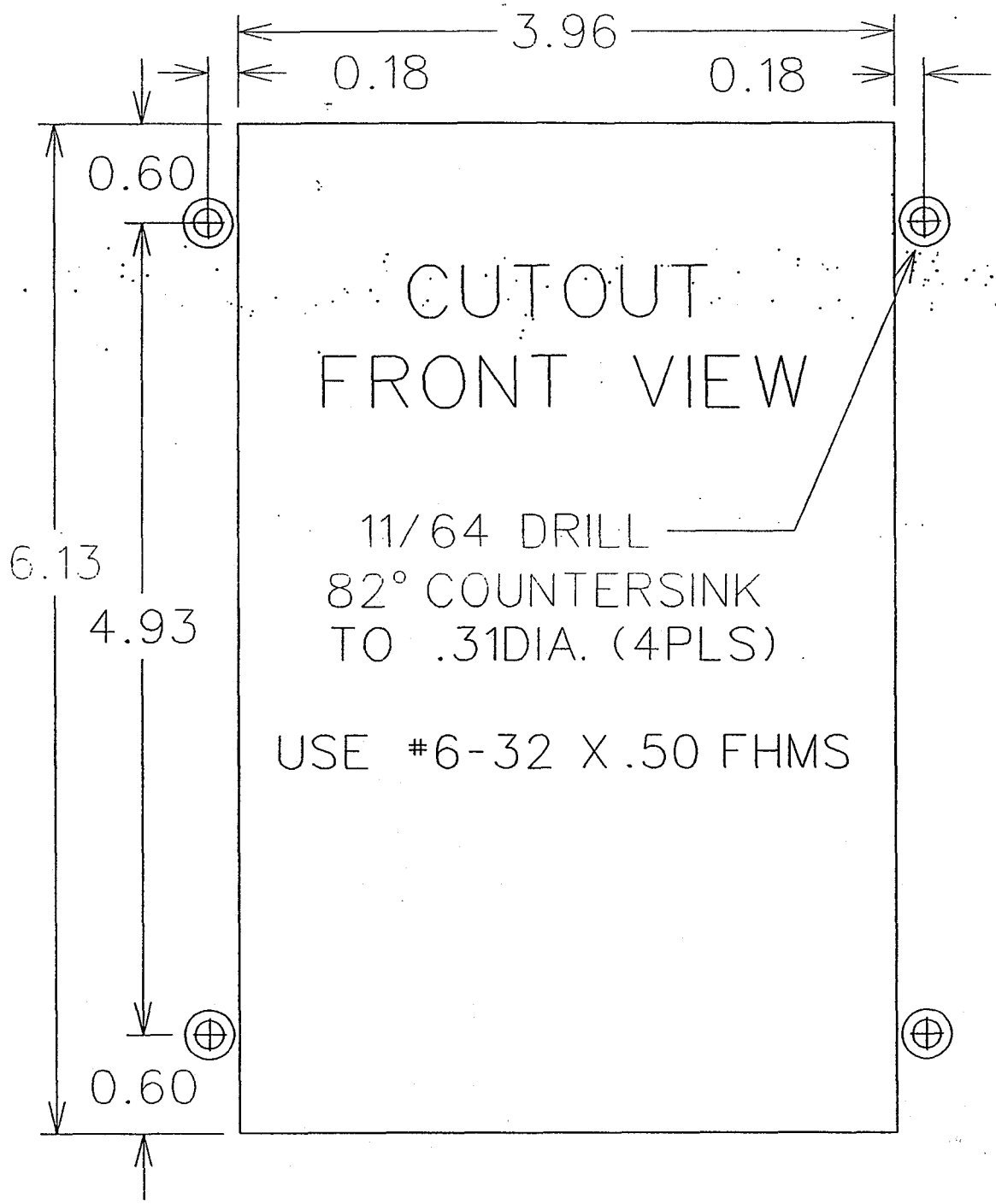
ADD THIS BELOW EXISTING "♦" NOTE

∇ Refer to Option Instruction Sheet 2Y25-0372.

DWG. NO. 02Y00025-0372
SHEET NO. 10 OF 10
EFF. 4/28/94 (m-df)

Refer to Sheet 1 for latest change.

ORIGINAL



CHANGES		
NO.	REMARKS	DATE

MagneTek

DR BY RJP	DATE 7.7.96	APPVL	DATE
CH BY RJS	DATE	APPVL	DATE
ENG SR	DATE	ISSUED	DATE

GPD 505/515
DIGITAL OPERATOR
DOOR MOUNTING
MODIFICATION DRAWING

A

02Y00025-0411