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MagneTek

For Lancer GPD 602
Adjustable Frequency Drives

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CONTROL EXPANSION OPTION

PRECISION CONTROLLER

MODEL DS727

INCLUDING REPLACEMENT EPROM

When properly installed, operated and maintained, this equipment will provide a lifetime of optimum operation. It is mandatory that the person who operates, inspects, and maintains this equipment thoroughly read and understand this instruction sheet.

DESCRIPTION

Precision Controller Model DS727 is installed on the right side of the GPD 602 enclosure. It performs precise drive control, through digital frequency settings and output voltage stabilizer circuits.

IMPORTANT

1. Read the GPD 602 manual thoroughly in conjunction with this instruction sheet.

2. Turn off GPD 602 power and verify that the CHARGE lamp is off, before:

   - Connecting the Precision Controller.

   - Changing operation-mode-setting switch (MODE) notches. (Notch 5 of MODE switch can be changed during operation.)

3. Frequency reference input connector is provided as an accessory.

RECEIVING

All equipment is tested against defect at the factory. Any damages or shortages evident when the equipment is received must be reported immediately to the commercial carrier who transported the equipment. Assistance, if required, is available from the nearest MagneTek Sales Office.

CHANGE RECORD						
1	STD-3455	4	STD-4074	2-21-90 RRR		
2	STD-3523					
3	STD-3602					

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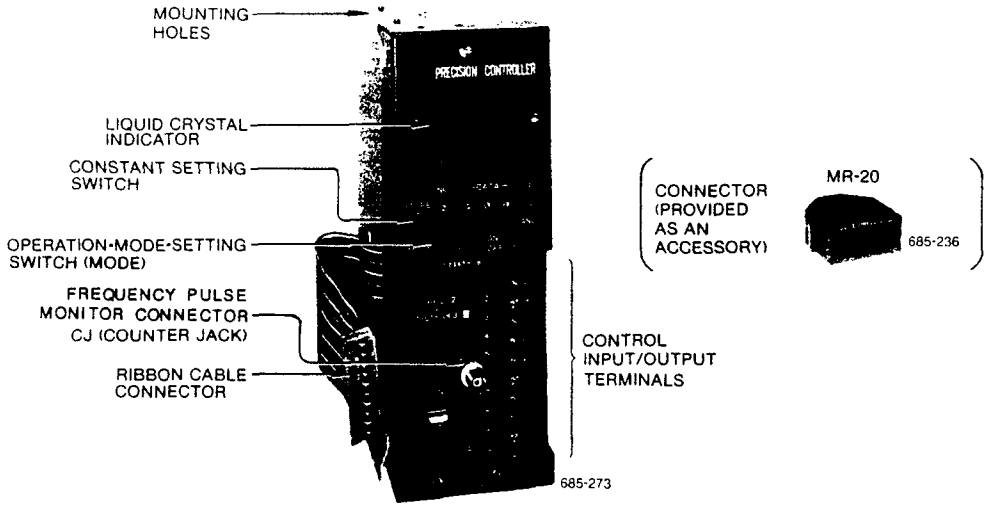


Figure 1. Precision Controller

GPD 602 DRIVE SYSTEM USING PRECISION CONTROLLER

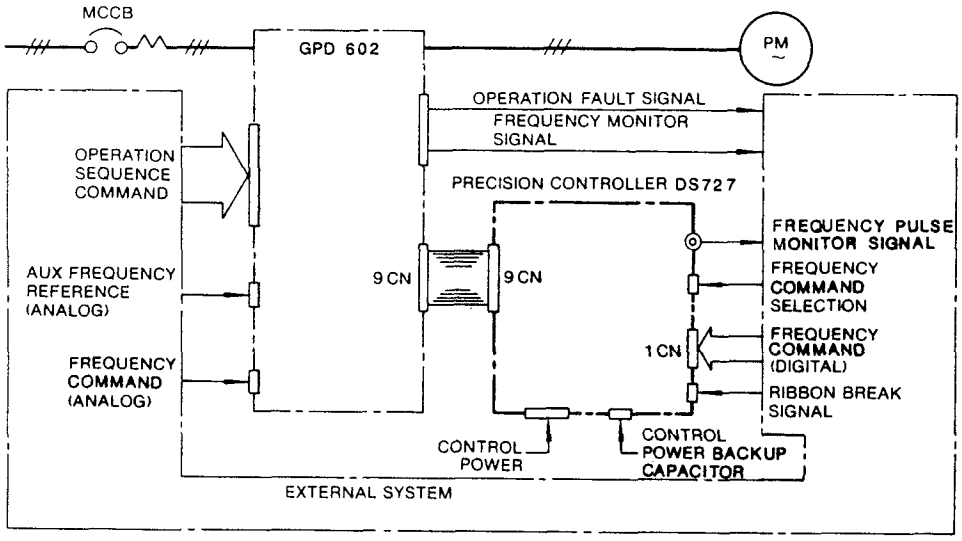


Figure 2. Drive System of GPD 602 Combined with Precision Controller

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INSTALLATION ON GPD 602 CABINET

1. Turn off the power to GPD 602.

2. Verify that the "CHARGE" lamp is off. Then loosen mounting screws and remove the GPD 602 front cover.

3. See Figure 3. Install the Precision Controller on the right side of the GPD 602 (when facing the cabinet) through M4 tapped holes and plug-in the ribbon cable connector to the header 9CN. Make sure to lock the connector, closing the lock levers on both sides of the header.

IMPORTANT

EPROMs are Electrostatic Discharge sensitive devices.
Handle accordingly.

4. Remove the existing EPROM from socket 31ic at the upper right corner of the Main Control Board in the GPD 602. In its place, insert the replacement EPROM (with a different 97SA identification number) received with the Precision Controller.

5. Replace and secure the GPD 602 front cover.

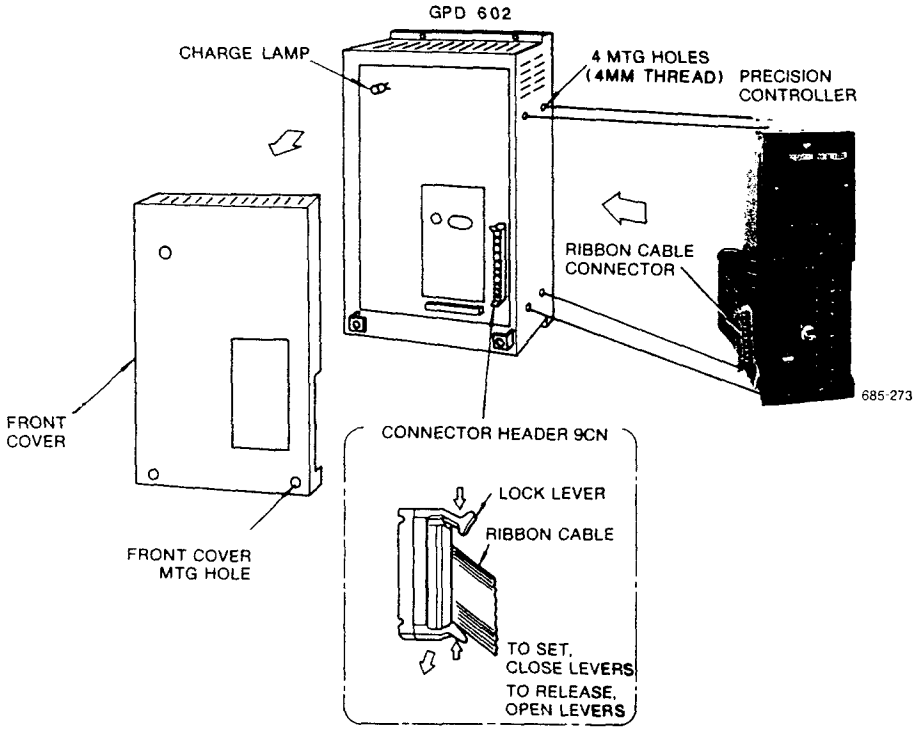


Figure 3. Installation of Precision Controller on GPD 602

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WIRING

Figure 4 shows the interconnections of GPD 602, Precision Controller and auxiliary units.

Make correct wiring according to the following instructions.

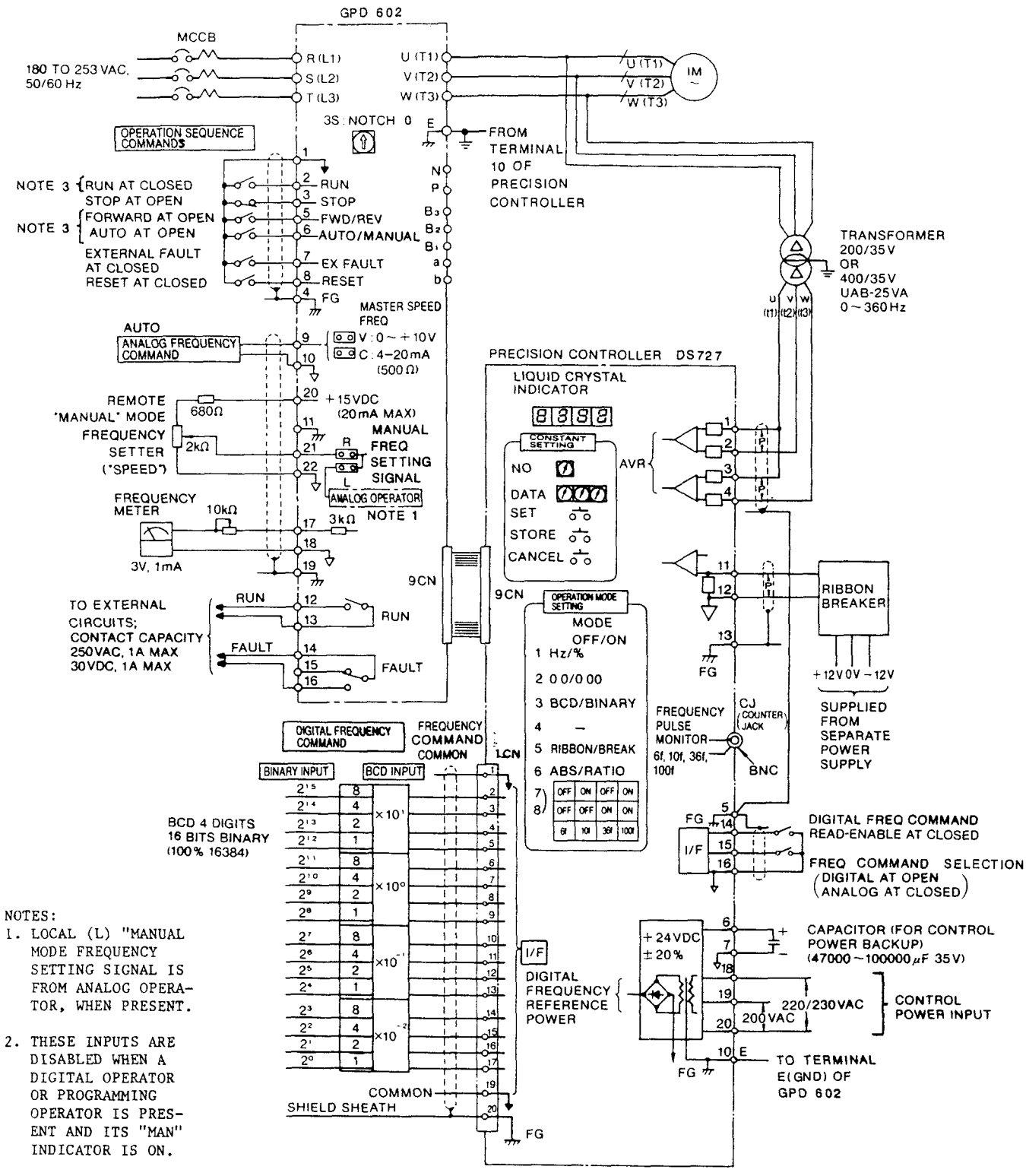
CONTROL SIGNAL AND CONTROL POWER TERMINALS

Table 1. Connections of Control Signal and Control Power Terminals

Terminal	Terminal No.	Lead Type	Wiring Instructions
Control Signals	1-4	Vinyl Lead for Electrical Equipment	Connect shield sheath to terminal 5. Separate wiring leads from large-current (200 VAC) or relay circuits. Wiring distance must not exceed 5 m (16 ft.). (Note 1)
	11,12	Braided Shielded Vinyl Lead	Connect the shield sheath to terminal 13. Separate wiring leads from large-current (200 VAC) or relay circuits. Wiring distance must be within 5 m (16 ft.).
	14-16		Connect the shield sheath to terminal 5. Separate wiring leads from large-current (200 VAC) or relay circuits. Wiring lead must be within 50 m (164 ft.).
Control Power	6,7	Vinyl Lead for Electrical Equipment	If the control power must be augmented at momentary power failure, connect an external capacitor. (Note 2)
	18,20	600V Vinyl Lead	Connect when supply voltage is 210 to 253 VAC.
	19,20		Connect when supply voltage is 180 to 220 VAC.
Ground	10		Connect to ground terminal E (GND) of GPD 602.

1. Transformer, if used, should be 200/35 V or 400/35 V Type UAB-25 VA at 0 to 360HZ.
2. To backup momentary power failure for 1 sec, capacitor rated 35 VDC, 47,000 uF, and code No. C002564 is recommended.

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NOTES:

1. LOCAL (L) "MANUAL MODE FREQUENCY SETTING SIGNAL IS FROM ANALOG OPERATOR, WHEN PRESENT.

2. THESE INPUTS ARE DISABLED WHEN A DIGITAL OPERATOR OR PROGRAMMING OPERATOR IS PRESENT AND ITS "MAN" INDICATOR IS ON.

Figure 4. Connection Diagram for GPD 602 and Precision Controller

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DIGITAL FREQUENCY COMMAND CONNECTOR (1CN)

Connector 1CN consists of a receptacle Type MR-20F(G) and a casing Type MR20L. Lead opening diameter is 9 mm. The connector pins and signal arrangement are shown in Table 2.

- To prevent erroneous operation due to noise, use a shielded lead, and separate the wiring lead from the large-current (200 VAC or higher) or relay drive circuit. The wiring lead length must be less than 50 m (164 ft.).

- Do not apply cable weight or tension to the connector.

- Use braided shielded leads.

Recommended leads are:

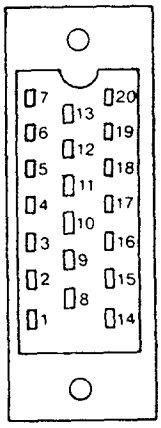
CO-SVV-SB (heat-resistant PVC), CO-SEV-SB (polyethylene) 0.02 mm^2 20C, finished diameter: 9.4 mm (0.03 in.).

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Table 2. Locations of 1CN Pins and Signal Arrangement

Locations of 1CN Pins	Pin No.	Type of Input Signal: Binary Input	BCD Input		Remarks
	1	Frequency reference common (0 V)			–
	2	2^{15}	8	x 10^{1}	Transistor (open collector) should have withstand voltage of 35V or more and rated current of 100mA or more. Input signal: 0 = open 1 = closed (short circuited with Pin No. 1 or 19.)
	3	2^{14}	4		
	4	2^{13}	2		
	5	2^{12}	1		
	6	2^{11}	8	x 10^{0}	
	7	2^{10}	4		
	8	2^{9}	2		
	9	2^{8}	1		
	10	2^{7}	8	x 10^{-1}	
	11	2^{6}	4		
	12	2^{5}	2		
	13	2^{4}	1		
	14	2^{3}	8	x 10^{-2}	
	15	2^{2}	4		
	16	2^{1}	2		
	17	2^{0}	1		
(Cable Receptacle)	18	Not Used	Not Used		–
	19	Frequency reference common (0 V)			
	20	To shield sheath			



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FREQUENCY PULSE MONITOR CONNECTOR (CJ)

Use coaxial cables (3C2V or equivalent).

Use a counter-jack (CJ) connector, HIROSE Model 3CV-P2 or BNC-P-3 (DAIICHI DENSHI KOGYO) or equivalent.

PRECAUTIONS FOR USING INPUT/OUTPUT CONTROL SIGNALS

INPUT SIGNALS

(1) When the digital frequency command input signal (connector 1CN) uses a relay contact, the relay contact must have a contact capacity of 30 VDC or higher and 100mA or more.

(2) Transistor (open collector), if used, should have withstand voltage of 35 VDC or higher and rated current of 100mA or higher.

UNUSED LEADS

If any shielded leads are not used, connect both ends to 0 V (pin 1 or 19).

FREQUENCY PULSE MONITOR (CJ)

The output pulse signal is +12V ±20% with a maximum of 20mA output and 50% pulse duty.

Applicable range and accuracy of frequency pulse monitor are different depending on multiplication factor. See Table 3. Output frequency and frequency monitor do not synchronize in phase.

Pulse frequency multiplication factor is selected by operation-mode-setting (MODE) switch notches 7 and 8. See Figure 4.

Table 3. Applicable Range and Accuracy of Frequency Pulse Monitor

Selection	Applicable Range	Accuracy*
6f	2.5 -360HZ	±0.005%
10f	2.5 -360HZ	±0.006%
36f	1.25-360HZ	±0.01%
100f	1.25-360HZ	±0.02%@

* Sampling time: one second
@ ±0.01% at 1.25 to 300HZ

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OPERATIONAL DESCRIPTION

FREQUENCY COMMAND

Either a digital or analog frequency command input can be used. This is selected by the Precision Controller terminals 15 and 16. In either case, a Ribbon Break signal can be inputted (see paragraph C).

A. When digital frequency command is used.

(1) Open the Precision Controller frequency-command-selection terminals 15 and 16.

(2) Enter digital frequency command with 16-bit input through connector 1CN. Use the operation-mode-setting (MODE) switch to select the type of input signals.

Table 4. Selection of Digital Frequency Command

MODE-1*	MODE-2*	MODE-3	Setting
-	-	ON	Binary (100% 16384 MAX)
ON		OFF	BCD 10^{-2}%
OFF	ON		BCD 10^{-2}HZ
	OFF		BCD 10^{-1}HZ

* The "-" indicates position does not matter.

(3) The Precision Controller terminal 14 is for digital frequency command read-enable signal. To read the digital frequency input data, close 14 and 16 for 40 ms or more. See Figure 5. When data is to be continuously read without using the read-enable signal, jumper terminal 14 to terminal 16.

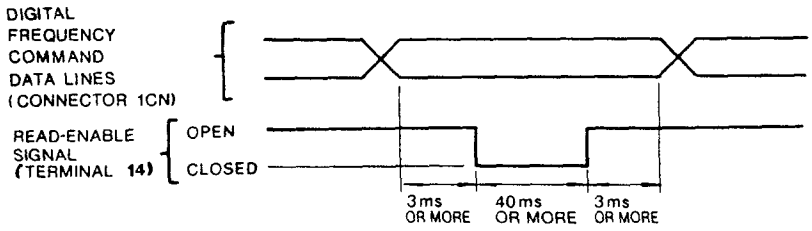


Figure 5. Timing of Digital Frequency Command Read-Enable Signal

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B. When analog frequency command is used.

(1) Close the Precision Controller frequency-command-selection terminals 15 and 16.

(2) Apply a voltage signal (0 to +10V) or a current signal (4 to 20mA) to GPD 602 analog frequency command terminals 9 and 10.

For a voltage signal, set the signal selector shunt in the GPD 602 to (V); for a current signal, set it to (C).

C. Ribbon Break input (±10V = 10%).

When a Ribbon Break signal is inputted to Precision Controller terminals 11 and 12, the signal is added to the digital or analog frequency reference value.

Use the operation-mode-setting (MODE) switch to turn the Ribbon Break signal on or off and to select the Ribbon Break signal entry using absolute value or ratio input.

Table 5. Setting of Ribbon Break Input

MODE-5	MODE-6*	Function	Ribbon Break Input at 10V
OFF	-	Ribbon Break input off	-
ON	OFF	Absolute value	10% of max frequency
	ON	Ratio	1/10 of frequency command value

* The "-" indicates position does not matter.

During acceleration or deceleration, Ribbon Break signal is not added. Sampling time for signal input is 20ms, so the Ribbon Break signal has an allowable period of 0.8 s or more, as shown in Figure 6. If a shorter period is required, contact your sales representative.

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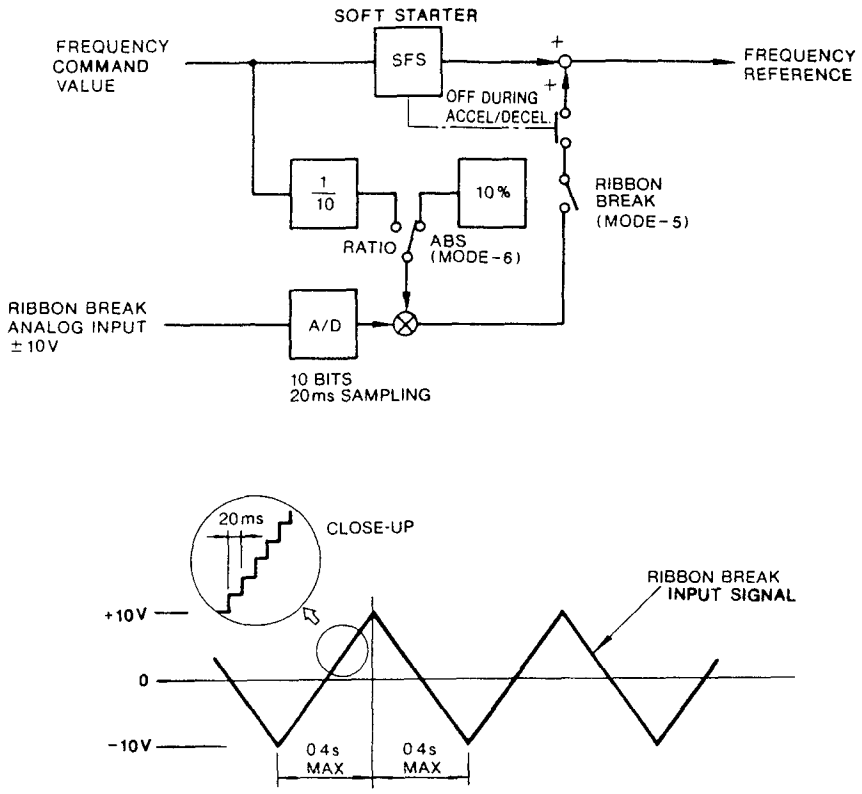


Figure 6. Ribbon Break Function

AVR FUNCTION

As shown in Figure 7, AVR function checks the difference between the voltage feedback value and the voltage reference after V/F conversion, and makes corrections after P/I arithmetic operation.

The P/I arithmetic operation requires setting the following constants:

No. 4 - Gain:	0 to 9.99
No. 5 - Integral Time:	0.1 to 20.0 s
No. 6 - Upper Limit for Compensation:	0 to 20.0%

When AVR function is not used, set the Upper Limit for Compensation to 0 (see "SETTING AND MONITORING CONSTANTS").

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AVR FUNCTION (Continued)

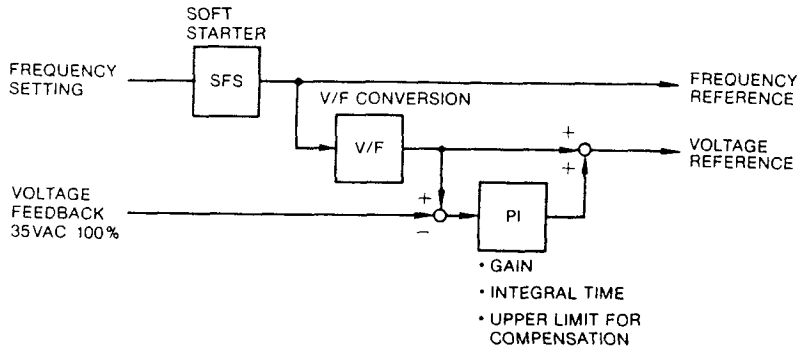


Figure 7. AVR Compensation Block

OPERATION SEQUENCE

The operation sequence commands are entered at GPD 602 terminals 1 to 8. Terminal 4 is for connection to the shielded sheath. When GPD 602 sequence-mode-selector switch 3S is set to notch 0, the operation sequence is as follows:

NOTE

In the following description, "open" means an open state and "closed" means short-circuit to terminal 1.

NOTE

When a transistor (open collector) is used in sequence command, withstand voltage must be 35V or higher and rated current 100mA or higher.

(1) Operation/Stop Commands: Terminals 2 and 3.

Operates when terminal 2 is closed, and stop when terminal 3 is open.

(2) Forward/Reverse Selection Command: Terminal 5.

Forward when terminal 5 is open, and reverse when closed.

(3) AUTO/MAN Selection Command: Terminal 6.

When open, accepts Auto frequency command from GPD 602 terminals 9 and 10 (analog) or from Precision Controller connector 1CN (digital).

When closed, accepts a Manual frequency reference from GPD 602 terminals 21 and 22.

(4) External Fault Signal: Terminal 7.

When closed, indicates to the GPD 602 that a fault exists in external circuits.

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(5) Reset Signal: Terminal 8.

When closed, resets the GPD 602 Fault relay.

SELECTION OF PRECISION CONTROLLER OPERATION MODE

Select the operation modes from Table 6 according to the application. Set the operation-mode-selecting (MODE) switch notches (ON/OFF slide switches) as appropriate. All the switches have been preset to OFF at the factory.

Table 6. Selection of Operation Modes

MODE Notch	Function	ON/OFF	Symbol	Remarks
1	Sets the unit of digital frequency.	OFF	HZ	Valid only when notch 3 is OFF.
		ON	%	-
2	Sets the decimal point for digital frequency HZ.	OFF	0.0	One decimal place. Valid only when
		ON	0.00	Two decimal places. notch 3 is OFF.
3	Sets digital frequency code.	OFF	BCD	BCD Code
		ON	BINARY	Binary
4	Not used	OFF	-	No effect on drive
		ON	-	system operation.
5	Enables/Disables Ribbon Break signal.	OFF	RIBBON	Ribbon Break signal OFF.
		ON	BREAK	Ribbon Break signal ON.
6	Selects Ribbon Break signal.	OFF	ABS	100% level of Ribbon Break input signal is set to 10% of the max frequency.
		ON	RATIO	100% level of Ribbon Break input signal is set to 10% of the set frequency.
7	Frequency monitor multiplication factor (Combination of notches 7 and 8).	7	8	
		OFF	OFF	6f
		ON		10f
8		OFF	ON	36f
		ON		100f

Notch 5 can be set when power is on, but other notches must be set only when power is off. If notches other than 5 are set when power is on, the mark (←—) on the liquid crystal indicator blinks. In this case, the operation will continue with the setting made before the change. For safety, reset the preceding state, and check to be sure the mark (←—) goes out.

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SETTING AND MONITORING CONSTANTS

The Precision Controller can set and monitor seven constants, 0 to 6, as shown in Table 7.

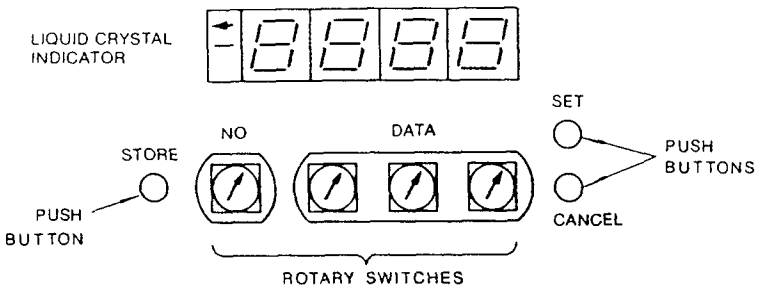


Figure 8. Controls for Monitoring and Setting Constants

Table 7. List of Precision Controller Constants

NO.	Constants		Unit *	Setting Range	Remarks
0	Max Frequency	F_0	HZ	50 to 360	Effective with power ON. New setting does not become effective until power is cycled off and then on again.
1	Max Voltage	V_0	V	0 to 230 at 200V 0 to 460 at 400V	Can be set with power ON.
2	Max Voltage Frequency	A	HZ	0 to 360	
3	1/40 Frequency Voltage	D	V	0 to V_0	
4	Gain	K	-	0 to 9.99	
5	Integral Time	T_I	sec	0.1 to 20.0	
6	Upper Limit for Compensation	L_M	%	0 to 20.0	

* Not displayed.

These constants are set when power is on, but a new setting of constant No. 0 is not acknowledged until the power is turned off and then on again.

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MONITORING CONSTANT

1. Set NO. rotary switch to the constant number.
2. The constant number appears on the liquid crystal indicator for about 0.7 second.
3. Data (constant value stored in EEPROM) appears on the liquid crystal indicator.

SETTING CONSTANT

1. Set NO. rotary switch to the constant number.
2. The constant number appears on the liquid crystal indicator for about 0.7 second.
3. Data (constant value stored in EEPROM) appears on the liquid crystal indicator.
4. With DATA rotary switches, set the desired value.
5. The set value appears on the liquid crystal indicator. Verify that displayed value is correct; if not, repeat step 4.
6. After checking the set value on the liquid crystal indicator, depress SET push button (to set the value in RAM).

NOTE

If an error has been made in selecting a constant value, the data on the liquid crystal indicator will blink. See "CONSTANT SETTING ERROR" below.

7. The mark (←) appears on the liquid crystal indicator.

NOTE

After a value for a constant has been set in RAM, it cannot be changed; the constant must be cancelled (see "CANCELLING CONSTANT VALUES DURING SETTING") before a different value can be set.

8. If necessary, set other constants using steps 1 to 6 above.
9. After setting all constants, depress STORE push button.
10. Approximately 2 seconds later the mark (←) disappears, and all data on RAM are written in EEPROM.

CONSTANT SETTING ERROR

In setting constants, the following two errors may be indicated by numerical data blinking on the liquid crystal indicator.

(1) The upper or lower limit for the constant is exceeded when the SET push button is depressed. (The set value data is not accepted; return to "SETTING CONSTANT" Step 4 above.)

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(2) Constants 0-3 are found unmatched (see "ADJUSTMENT" section) when the STORE push button is depressed. (The set values are cancelled and not written in EEPROM; return to "SETTING CONSTANT" Step 1 above.)

CANCELLING CONSTANT VALUES DURING SETTING

Even after they have been set in RAM, constant values can be cancelled before the STORE push button is depressed ("SETTING CONSTANT" Step 9). To cancel a set value, set NO. rotary switch to the desired constant number. Then depress the CANCEL push button. The value set in RAM will be removed and the current value stored in EEPROM will again be displayed. (Note that if values for other constants are still set in RAM, the mark (←) will still be displayed. It will only disappear when all constant values in RAM have been cancelled, or after constants have been stored in EEPROM.) To enter a new value for the constant, return to "SETTING CONSTANT" Step 4 above.

After the STORE push button has been depressed ("SETTING CONSTANT" Step 9), the constants have been written in EEPROM, so constants must be reset from the beginning.

FREQUENCY INDICATION

The set value of frequency reference and the current value of output frequency can appear on the liquid crystal indicator (Figure 9).

Select which value will appear by using the NO. rotary switch as shown in Table 8. Note that these positions of the NO. rotary switch do not represent constants; therefore the DATA rotary switches will have no effect.

NOTE

Position 7 of the NO. rotary switch is not used; at that position the liquid crystal indicator will not show any display.

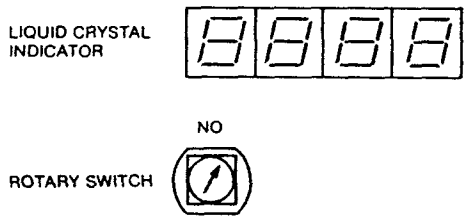


Figure 9. Controls for Frequency Indication

Table 8. Data Indication

NO.	Indication
8	Frequency reference value
9	Output frequency

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The unit of indicated data is selected by setting the operation-mode-setting (MODE) switch notches 1 and 2 (see Table 9). When digital frequency reference uses BCD as input, the unit of input signal is also selected.

Table 9. Unit of Data Indication

MODE-1	MODE-2	Unit of Indication
OFF	OFF	000.0HZ
OFF	ON	00.00HZ
ON	OFF	000.0%
ON	ON	00.00%

ADJUSTMENT

NOTE

Constants 0-3 define a V/F pattern for Drive output as shown in Figure 10.

CONSTANT NUMBER 0, MAXIMUM FREQUENCY (F_0)

Set the maximum frequency to a value from 50 to 360HZ. A new setting value cannot be acknowledged until the power is turned off and then on again.

CONSTANT NUMBER 1, MAXIMUM VOLTAGE (V_0)

Sets the maximum voltage. $V_{SET} = \frac{V_{IN}}{V_{OUT}} \times 200^*$ (*400 for 460V units).

The set value can be 0 to 230V for 200V class and 0 to 460V for 400V class. The actual output, however, may be limited by the supply voltage.

CONSTANT NUMBER 2, MAXIMUM VOLTAGE FREQUENCY (A)

CONSTANT NUMBER 3, 1/40 FREQUENCY VOLTAGE (D)

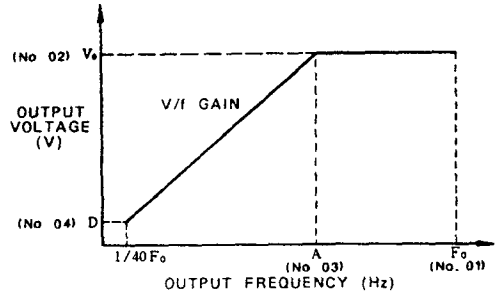


Figure 10. V/F Characteristics

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Figure 10 shows the relationship between the maximum frequency F_0, maximum voltage V_0, maximum voltage frequency A, and 1/40 frequency voltage D. The setting range is 0 to 360HZ for the maximum voltage frequency A, and 0 to V_0 for the 1/40 frequency voltage D. The following relationships are necessary between these four constants. If the conditions are not satisfied, depressing the STORE push button detects the error and prevents set values from being written in EEPROM.

(1) $F_0 \geq A \geq 1/40\ (F_0)$

(2) $V_0 > D$

(3) V/F gain $\neq 0$

Note that the following are not in error range:

For 200V class $V_0 - D \geq 1$

For 400V class $V_0 - D \geq 2$

CONSTANT NUMBER 4, GAIN (K)

This is the gain in the AVR correction loop and can be set from 0 to 9.99.

CONSTANT NUMBER 5, INTEGRAL TIME (T_I)

This integral time in the AVR correction loop can be set from 0.1 to 20.0 seconds.

CONSTANT NUMBER 6, UPPER LIMIT OF COMPENSATION (L_M)

The upper limit of compensation value in the AVR correction loop can be set in the limited range of from 0 to 20.0%. When the AVR correction loop is not used, set at 0.

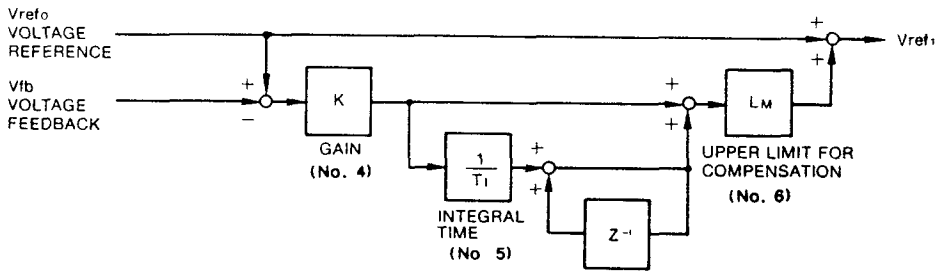


Figure 11. AVR Compensation Block

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VOLTAGE FEEDBACK ADJUSTMENT GAIN (VARISTOR 1RH)

To adjust the voltage feedback, loosen both mounting screws on the front panel of the Precision Controller and pull the front panel/printed circuit board assembly partially out of the case.

IMPORTANT

Restrict test lead lengths between the check terminals and voltmeter to 6.4 to 9.6 ft.

See Figure 12. Connect a voltmeter to check terminals VAL (+) and AG (-). Adjust 1RH using a screwdriver, so that the voltmeter reads 3.91V when the output Drive voltage is 100% (V_o).

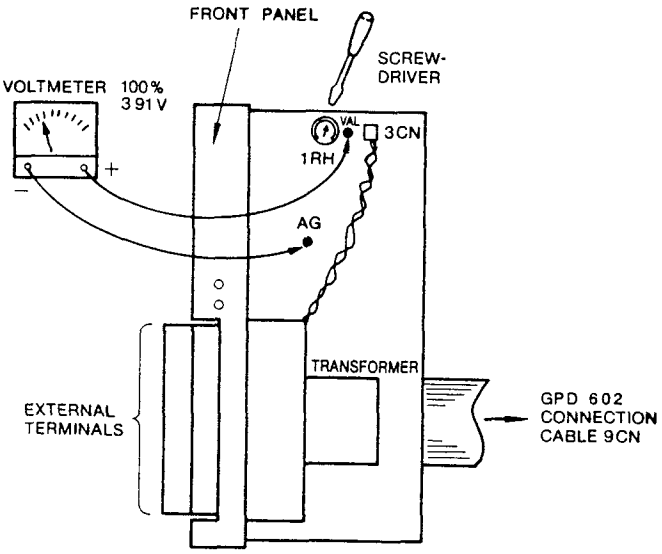


Figure 12. Printed Circuit Board of Precision Controller

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FAULT INDICATION

The Precision Controller indicates faults as shown in Table 10. These faults have been described already, except for Type 1.

Table 10. Fault Indications

Type	Fault Indication on Liquid Crystal Indicator	Cause
1	Constant No., blinking (Note 1)	Error detected when power is turned on. - EEPROM check error - While power was off, the GPD 602 mainframe 6S (8) selection switch was changed between 200-V class (OFF) and 400-V class (ON).
2	Numerical data, blinking (Note 2)	Error detected when SET push button is depressed in setting constants. - Upper/lower limit check error.
3	Numerical data, blinking (Note 2)	Error detected when STORE push button is depressed in setting constants. - Constants 0 to 3 data-matching check error.
4	Mark (--), blinking (Note 3)	With power on, a switch other than the operation-mode-selection switch notch 5 is changed.

1. For type 1, depress the STORE push button to reset the constant: check that the constant number stops blinking.

NOTE

After an EEPROM check error, a constant is reset to its initial value (see Table 11). Note the operation is not accepted before the blinking stops.

2. For types 2 and 3, data has not been written in EEPROM, so reset the constants.

3. For type 4, return the operation-mode-selection switch notch to the original selection.

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INITIAL VALUES OF CONSTANTS

Initial values of constants (i.e. setting value automatically entered when clearing a Type 1 fault indication) are listed in Table 11.

Table 11. Initial Values of Constants

No.	Constant		Initial Value
0	Max Frequency	F_0	60HZ
1	Max Voltage	V_0	200V
2	Max Voltage Frequency	A	60HZ
3	1/40 Frequency Voltage	D	5V
4	Gain	K	0
5	Integral Time	T_I	2.0s
6	Upper Limit of Compensation	L_M	20.0%