MagneTek Drives & Systems

For Lancer GPD 602
Adjustable Frequency Drives

CONTROL EXPANSION OPTION

PG SPEED CONTROLLER

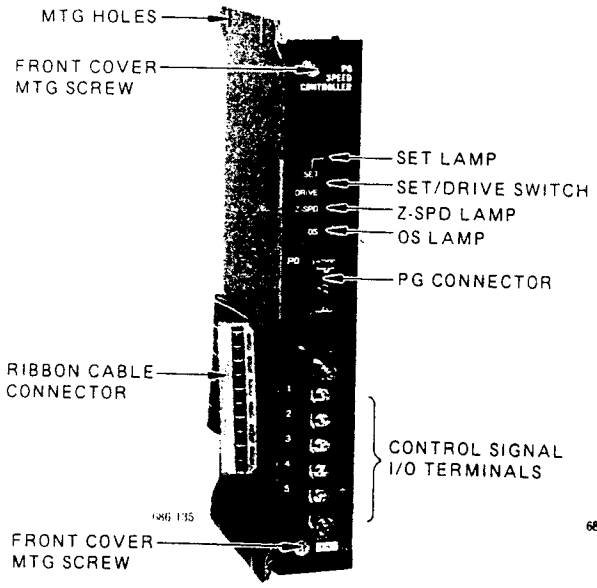
MODELS DS730, DS733 & DS734

INCLUDING REPLACEMENT EPROM

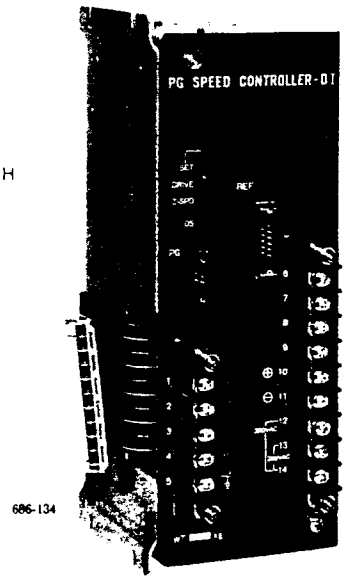
When properly installed, operated and maintained, this equipment will provide a lifetime of optimum operation. It is mandatory that the person who operates, inspects, and maintains this equipment thoroughly read and understand this instruction sheet.

DESCRIPTION

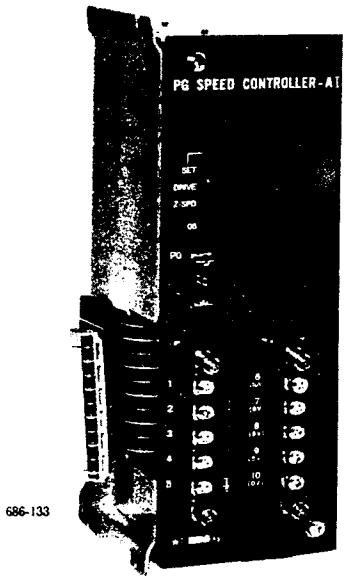
PG Speed Controller is mounted on the right side of the GPD 602 enclosure. It is used to compensate for speed fluctuations due to slip, utilizing a PG (pulse generator) to provide speed feedback.



(a) PG Speed Controller Model DS730



(b) PG Speed Controller-DI Model DS733



(c) PG Speed Controller-AI Model DS734

Figure 1. PG Speed Controllers

CHANGE RECORD						
1	STD-3429	4	STD-3602			DWG. NO. 02Y00025-0276
2	STD-3455	5	STD-3716	7-28-89	RRR	SHEET 1 OF 34
3	STD-3523					EFF. 8/12/88 (P)

PG Speed Controllers are available in three types according to the speed setting method.

Name	Model	Speed Setting Method
PG Speed Controller	DS730	Analog input at GPD 602 inverter terminals 9 and 10, internally converted to 10 bits binary
PG Speed Controller-DI	DS733	Digital input of 4-digit BCD or 15 bits binary at REF connector
PG Speed Controller-AI	DS734	Analog input, converted to 14 bits digital (high-precision)

In this instruction sheet, the term PG Speed Controller, without a model number, applies to any of the 3 types.

IMPORTANT

1. Read the manual for GPD 602 thoroughly in conjunction with this instruction sheet.
2. Turn off GPD 602 AC main circuit power and verify that the CHARGE lamp is off, before:

   - Connecting the PG Speed Controller.

3. PG connector (and frequency reference input connector, for Model DS 733) 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.

INSTALLATION ON GPD 602 CABINET

1. Turn off the power to the GPD 602

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

3. See Figure 2. Install the PG Speed Controller on the right side of the GPD 602 through M4 tapped holes, and plug-in the ribbon cable connector to the GPD 602 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 PG Speed Controller.

5. Replace and secure the GPD 602 front cover.

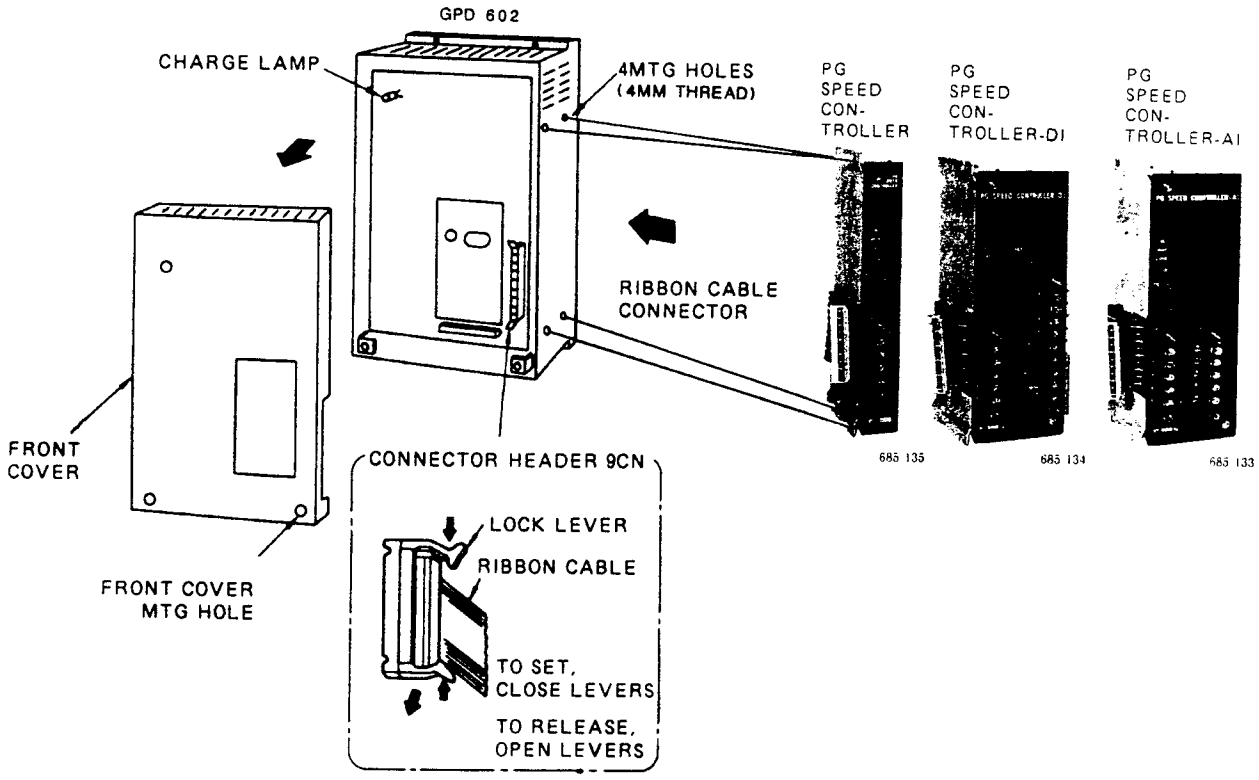


Figure 2. Installation of PG Speed Controller on GPD 602

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WIRING

Figures 3 to 5 show the interconnections of the GPD 602, PG Speed Controller and auxiliary units.

Make correct wiring according to the following instructions.

I/O terminals and PG Speed Controller models are shown in Table 1.

Table 1. I/O Terminals and PG Speed Controller Model Numbers

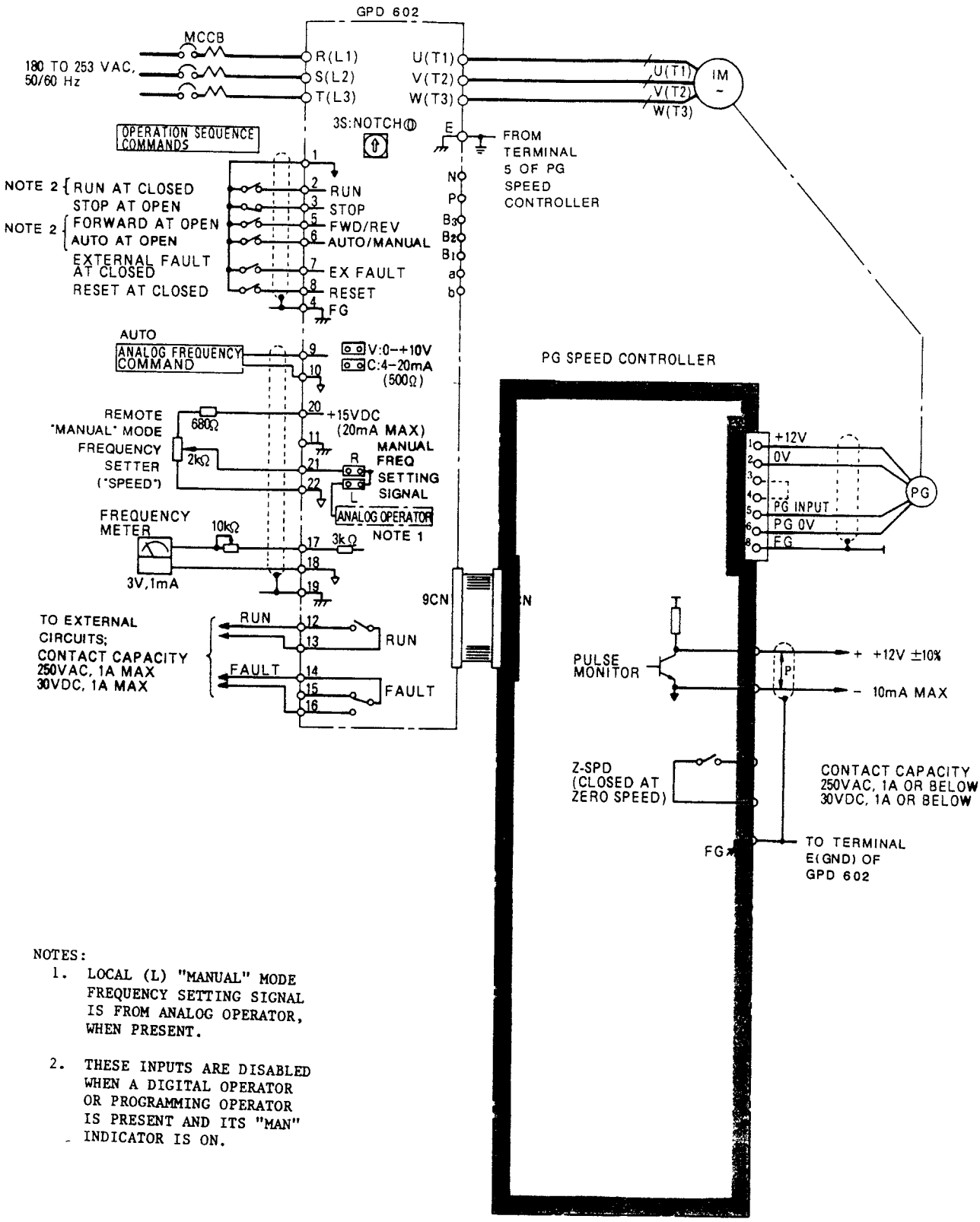
PG Speed Controller Model	External Terminals	PG Connector	REF Connector
DS 730	1 to 5	Provided	Not provided
DS 733	1 to 14	Provided	Provided
DS 734	1 to 10	Provided	Not provided

EXTERNAL TERMINALS (Tables 2 to 4)

Table 2. Common External Terminals, All Models (Terminal screw: M4)

Terminal No.	Function		Remarks
1	+	Pulse monitor output*	Output voltage: 12V ±10% Output current: 20mA max
2	-		
3	Zero-speed contact output (1NO)		Contact capacity: 250 VAC, 1A; 30 VDC, 1A
4			
5	Ground terminal		Connected to terminal E (GND) of GPD 602

* Duty of pulse monitor output is determined by PG waveform.
Note: Use coaxial cable (3C2V or equivalent) or twisted shielded cable.



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 3. Connection Diagram for GPD 602 and PG Speed Controller Model DS 730

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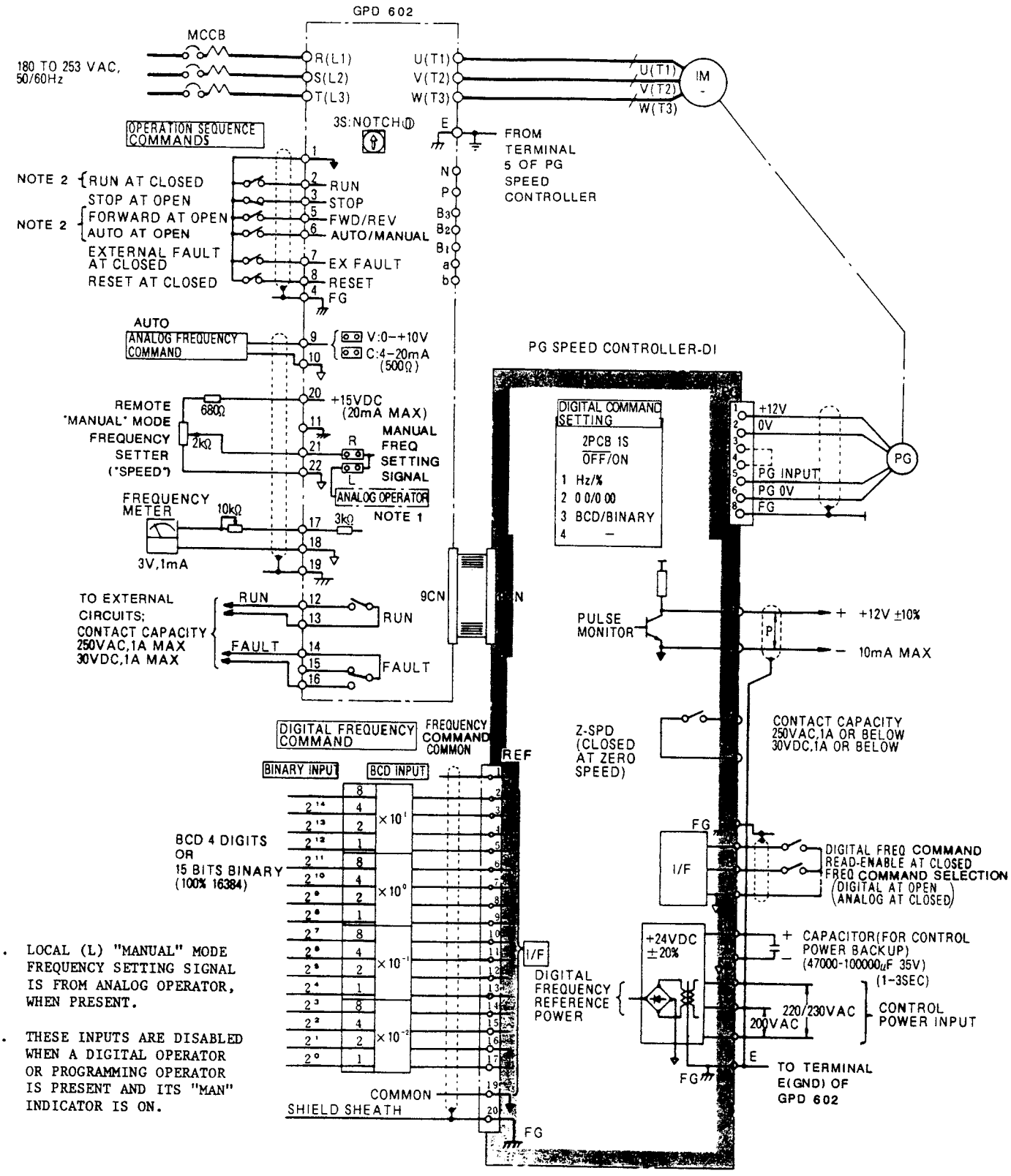
Table 3. Additional External Terminals of PG Speed Controller-DI Model DS 733

Terminal No.	Function		Remarks	
6	Sequence control input common terminal		Sequence control input 0V	
7	Digital signal read-enable command		Read-enable at "Closed"	
8	Speed reference selection		"Closed" - Analog reference "Open" - Digital reference	
9	Shield sheath connection		-	
10	+	Control power backup terminal for momentary power failure	Capacitor: 47,000 to 100,000 uF 35V (1 to 3s)	
11	-			
12,14	Control power (210 to 253 VAC		220 VAC	50/60HZ, 10 VA Voltage fluctuation range ±10%
			230 VAC	
13,14	Control power (180 to 220 VAC)		200 VAC	
			208 VAC	

Table 4. Additional External Terminals of PG Speed Controller-AI Model DS 734

Terminal No.	Function	Remarks
6	Analog speed reference input	0 to + 10V (40K ohms)
7		0 to + 8V (32K ohms)
8		0 to + 6V (24K ohms)
9		0 to + 5V (20K ohms), or 4 to 20mA
10	Analog speed reference input common terminal	0V



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 PG Speed Controller-DI Model DS 733

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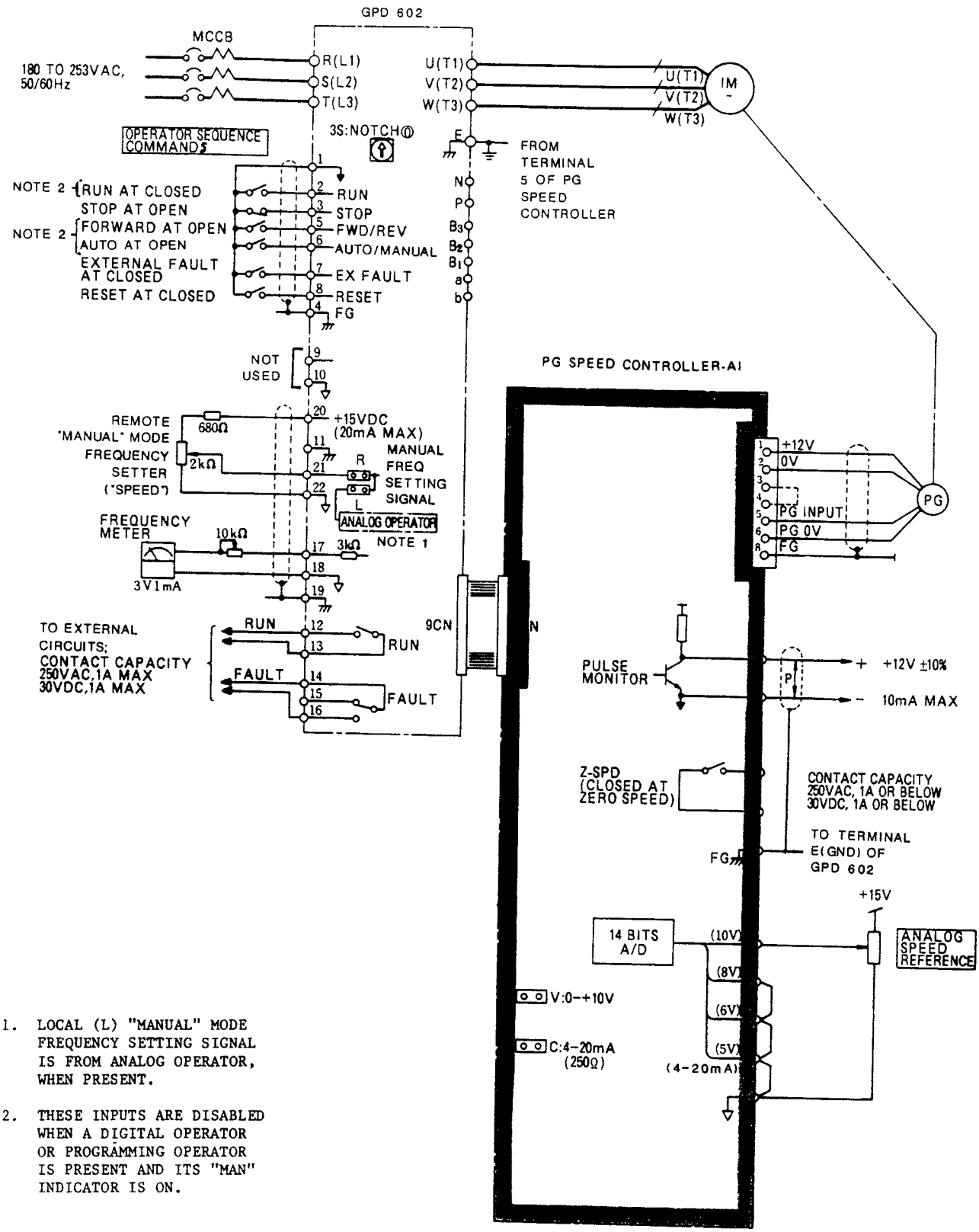

1. LOCAL (L) "MANUAL" MODE FREQUENCY SETTING SIGNAL IS FROM ANALOG OPERATOR, WHEN PRESENT.

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

Figure 5. Connection Diagram for GPD 602 and PG Speed Controller-AI Model DS 734

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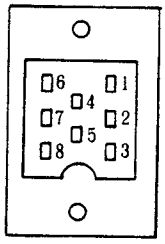
CONNECTORS

Connector PG consists of a receptacle Type MR-8F(G) and a casing Type MR8L. The connector pins and signal arrangement are shown in Table 5.

Table 5. Locations of PG Connector Pins and Signal Arrangement

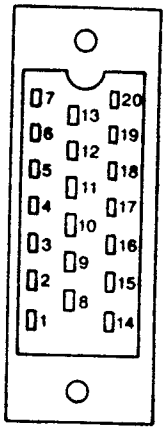
Pin Location	Pin No.	Function		Remarks
	1	+12V	+12V power	PG power 50mA max
	2	0V		
	3,4	For open-collector input, short circuit 3 and 4.		
	5	+	PG input signal	+5 to +12V
	6	-		
	7			Not used
	8	Shielded sheath connection terminal		

- 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 50m (164 ft.).
- If any shielded leads are not used, connect both ends to 0V.
- See Appendix C for information on selecting a PG.

Connector REF (provided with Model DS733 only) consists of a receptacle Type MR-20F (G) and a casing type MR-20L. The connector pins and signal arrangement are shown in Table 6.

Table 6. Location of REF Connector Pins and Signal Arrangement

Pin Location	Pin No.	Type of Input Signal			Remarks
		Binary Input	BCD Input		
	1	Speed reference common (0V)			
	2	Not used	8	$\times 10^{1}$	
	3	2^{14}	4		
	4	2^{13}	2		
	5	2^{12}	1		
	6	2^{11}	8	$\times 10^{0}$	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.)
	7	2^{10}	4		
	8	2^{9}	2		
	9	2^{8}	1		
	10	2^{7}	8	$\times 10^{-1}$	
	11	2^{6}	4		
	12	2^{5}	2		
	13	2^{4}	1		
	14	2^{3}	8	$\times 10^{-2}$	
	15	2^{2}	4		
	16	2^{1}	2		
	17	2^{0}	1		
(Cable Receptacle)	18	Note used	Not used		
	19	Speed reference common (0V)			
	20	To shield sheath			



SWITCH SELECTION

FRONT SWITCH

The SET/DRIVE switch on the front of the PG Speed Controller can be switched over while the Drive is in stopped condition, or the input power is off.

(1) SET position

The Drive will power up in the Constant Setting mode (the SET indicator lamp lights).

To change constant settings, a Programming Operator is required. Refer to "Constant Setting Mode Procedures" in the Programming Operator instruction sheet, 02Y00025-0250.

(2) DRIVE position

The Drive will power up in the normal operation mode (the SET indicator lamp remains off).

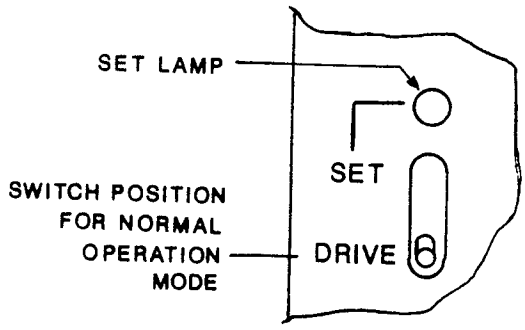


Figure 6. Front Switch

CAUTION

ALWAYS SET THE SET/DRIVE SWITCH TO DRIVE UNLESS SETTING CONSTANTS WITH THE PROGRAMMING OPERATOR.

INTERNAL SWITCHES

PG Speed Controller Model DS730 only contains board 1PCB; Model DS733 and DS734 contain boards 1PCB and 2PCB. Internal switches are present on the 1PCB, which is common in all three types and on the 2PCB of Model DS733.

To change internal switch settings, loosen both mounting screws on the front panel of the PG Speed Controller and pull the front panel/printed circuit board assembly partially out of the case.

A. 1PCB

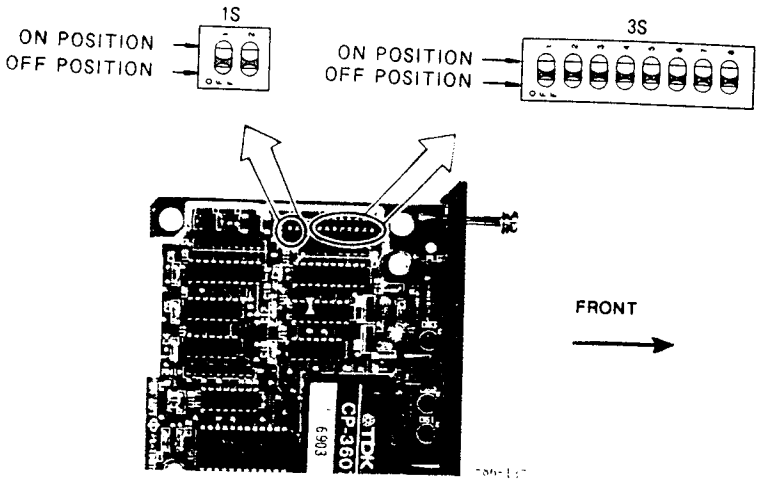


Figure 7. 1PCB Internal Switches 1S and 3S

(1) Notch 1 of switch 1S is for adjustment at the factory before shipping. Do not tamper with it.

Ensure that notch 2 of 1S is set to OFF (see CAUTION below).

CAUTION

WHEN EEPROM IS INITIALIZED (1S NOTCH 2 SET TO ON), ALL THE CONSTANTS ARE CHANGED TO THE INITIAL SETTING VALUES, SO THAT REQUIRED CONSTANTS MUST BE RESET. THEREFORE, DO NOT INITIALIZE IT EXCEPT WHEN A PROGRAMMING OPERATOR IS PRESENT FOR SETTING CONSTANTS.

(2) The functions of switch 3S of 1PCB are shown in Table 7. Selection of number of motor poles is as follows:

No. of Poles = (Notch 6) x 2 + (Notch 7) x 4 + (Notch 8) x 8
where notch "n" is 1 when notch "n" is ON and 0 when notch "n" is OFF.
When number of poles is 0, operation without PG feedback is selected.

Table 7. Functions of Switch 3S on 1PCB

Notch	Functions	ON	OFF
1	"MONI" (Numerical) display of Digital Operator selected. Setting in HZ.	Motor speed indicated in % when neither no. of poles or no. of PG constants is zero.	Output frequency indicated in HZ.
2	Integral control OFF during acceleration/ deceleration.	Proportional control during acceleration/ deceleration.	Proportional Integral control during acceleration/deceleration.
3	Fault processing selection (PG lead disconnection, speed deviation excessive.)	Fault indication only. (OS lamp blinks. Digital Operator does not display any fault.)	Coasts to a stop. OS lamp blinks. For display of Digital Operator, refer to Table 11.
4	Not used	-	-
5	Not used	-	-
6	No. of poles Selected.	2	0
7		4	0
8		8	0

B. 2PCB of PG Speed Controller-DI Model DS733

The functions of switch 1S of 2PCB (digital input PC board) are shown in Table 8.

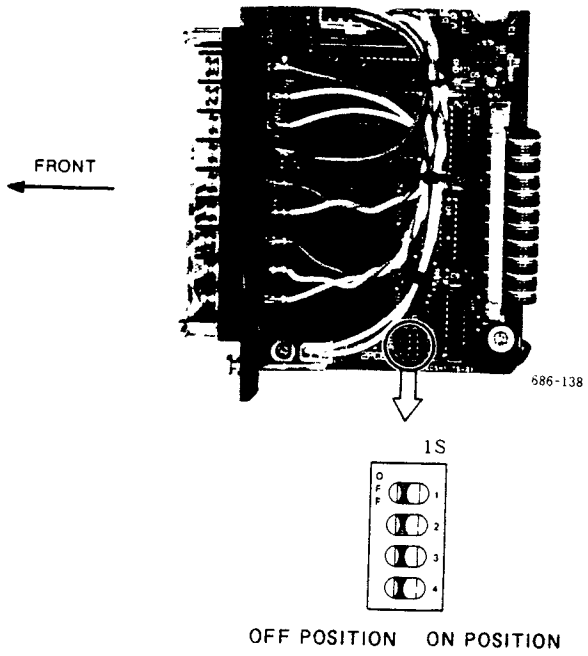


Figure 8. Internal Switch 1S of PG Speed Controller-DI 2PCB

Table 8. Functions of Inside Panel Switch 1S on 2PCB

Notch	Functions	ON	OFF
1	Digital speed setting unit selection.	Setting in %. (Effective with notch 3 OFF).	Setting in HZ. (Effective with notch 3 OFF).
2	Digital speed setting value of HZ decimal point selection.	Two digits after decimal point (effective with notch 1 OFF and 3 OFF). 0.00	One digit after decimal point (effective with notch 1 OFF and 3 OFF). 0.0
3	Digital speed setting code.	Binary code 100%/ 16384 max.	BCD code
4	Not used	-	-

SPEED REFERENCE INPUT

Speed reference input to the PG Speed Controller is inputted as follows. Operation sequence of PG Speed Controller is followed by the sequence of the GPD 602. In this case, sequence mode switch 3S of the GPD 602 should be set at notch 0.

PG SPEED CONTROLLER MODEL DS730

Voltage signal (0 to +10V) or current signal (4 to 20mA) is given across external terminals 9 and 10 of GPD 602.

PG SPEED CONTROLLER-DI MODEL DS733

Either digital or analog frequency command can be inputted. It is selected by opening or closing the external terminals 6 and 8 of PG Speed Controller-DI.

A. Digital Frequency Command Input

External terminals 6 and 8 of PG Speed Controller-DI are open. Input is made through REF connector in form of 4-digit BCD or 15 bits binary. Switch 1S on 2PCB (digital input PC board) can provide the following settings.

Table 9. Mode Selection of Digital Speed Reference Input

Notch of 1SS on 2PCB			Settings
1*	2*	3	
-	-	ON	Binary (100%/16384 max)
ON	-	OFF	BCD 10^{-2} %
OFF	ON	OFF	BCD 10^{-2}HZ
OFF	OFF	OFF	BCD 10^{-1}HZ

* The "-" indicates position does not matter.

Digital frequency input data is read-in while external terminals 6 and 7 of PG Speed Controller-DI are short-circuited (closed). When reading-in is continued for the application requiring no read-in signals, jumper terminal 7 to terminal 6.

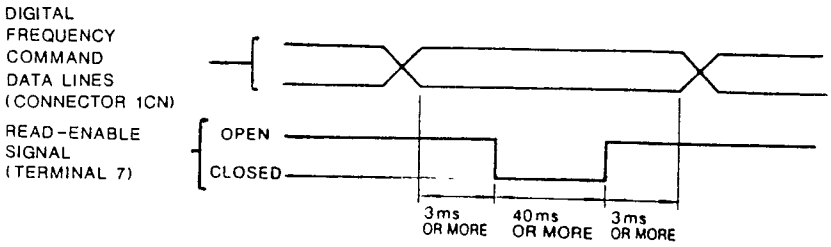


Figure 9. Read-in Timing of Digital Frequency Command

B. Analog Speed Command Input

Closing external terminals 6 and 8 of PG Speed Controller-DI permits inputting analog reference from external terminals 9 and 10 of GPD 602.

PG SPEED CONTROLLER-AI MODEL DS734

When PG Speed Controller-AI Model DS734 is used, external terminals 6-9 (and 10) are effective and the speed reference input across terminals 9 and 10 of the GPD 602 will be ineffective. Analog speed reference voltage level can be selected by input terminals.

External terminal 9 can be used as current reference of 4 to 20mA by setting the 2PCB shunt on "C". Shunt connector location is shown in Figure 10 and selection in Figure 11.

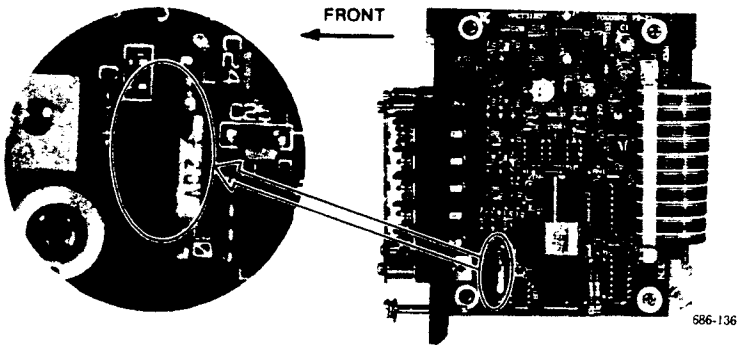
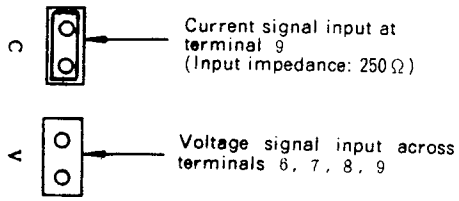


Figure 10. PG Speed Controller-AI 2PCB



Note: Inputting voltage signal at terminal 6, 7, or 8 with connector shunt set on "C" will reduce the voltage low-limit by 20%.

Figure 11. Shunt Connector Selection

SPEED CONTROL CALCULATION

Figure 12 shows internal calculation block diagram.

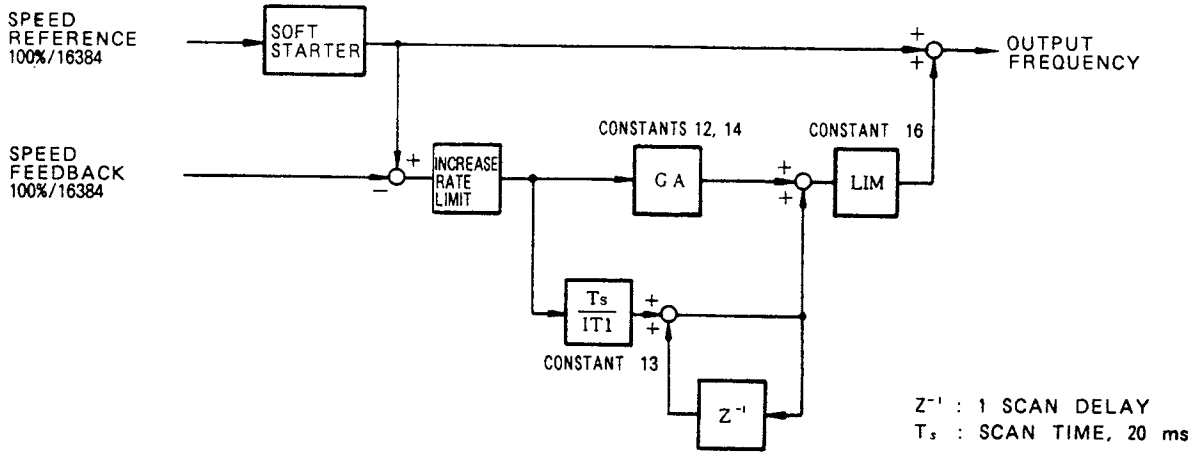


Figure 12. Speed Control Calculation Block

Gain increase according to speed reference is shown in Figure 13.

The curve at the speed reference between 0 and 100% is almost linear.

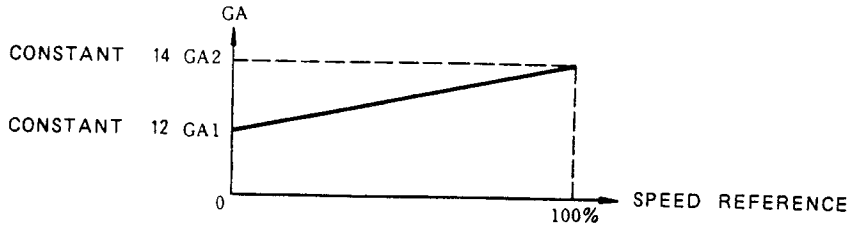


Figure 13. Gain Increase According to Speed Reference

Integral value is reset at zero-cross during stop, momentary power failure detection, or when forward and reverse operation is changed.

NOTE FOR
DIRECTION OF MOTOR RUNNING AND REFERENCE

When a free-running motor is restarted, the direction of reference at operation start is the initial direction of PG speed detection. Direction of motor rotation must match that of reference. If the directions are different, it may cause overcurrent and/or overvoltage.

COUNTERACTING MOMENTARY POWER FAILURE

The GPD 602 inverter with PG Speed Controller responds to momentary power failure as shown in Figure 14, when notch 5 of switch 6S in the GPD 602 is ON (operation continuation after momentary power failure).

When PG Speed Controller-DI Model DS733 is combined with GPD 602, a backup capacitor of 47,000 to 100,000 uF, 35V for 1 to 3 seconds, is required across external terminals 10 and 11.

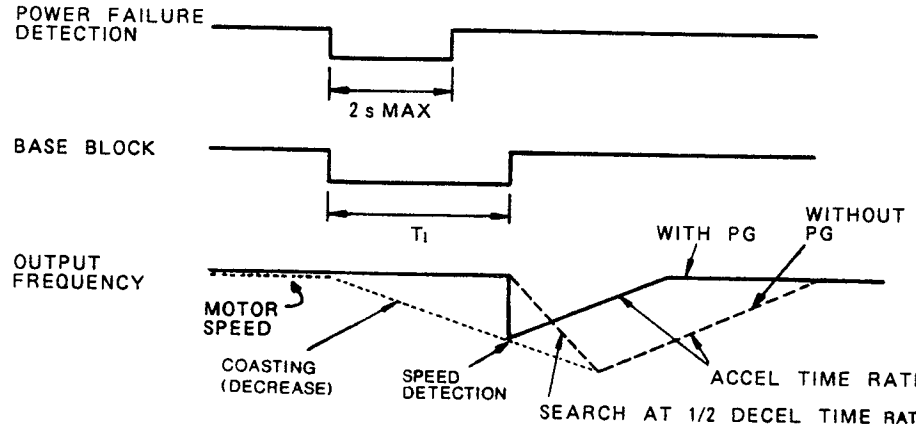


Figure 14. Time Chart When Proceeding for Momentary Power Failure

Minimum time T_1 of base block changes according to inverter rating and notch 6 of GPD 602.

Table 10. Minimum Time T_1 at Momentary Power Failure

Inverter Rating	GPD 602 Switch 6S Notch 6	
	ON	OFF
15 HP or less	0.25 s	0.5 s
20 HP or above	0.5 s	1.0 s

Note: Common in 200V class and 400V class.

WITH PG SPEED CONTROLLER

After a momentary power failure of 2 seconds or less, motor accelerates to the set value at acceleration time rate with motor detection speed as a start point after base block is OFF.

WITHOUT PG SPEED CONTROLLER

Speed search is performed at 1/2 deceleration time rate with the output frequency before power failure as a start, after base block is OFF, as shown by broken line. On completion of speed search, motor accelerates to the set value at the acceleration time rate.

A power failure of 2 seconds or more is indicated as UV (under voltage) in the mode of operation continuation after momentary power failure.

NOTE FOR
CONTROL POWER DURING MOMENTARY POWER FAILURE

Control power is correct even during momentary power failure within 2 seconds. Inputs of stop, forward/reverse operation, external fault, and fault reset are always received.

- In deceleration stop mode, output frequency is held during momentary power failure. Operation can be resumed when operation command is input when power is recovered after momentary power failure.

- In stopping free-running motor mode, output frequency is reset when stop command is received. Operation command after momentary power failure starts the motor at zero speed point.

- External fault and fault reset inputs, once received, will be retained. Signals should be kept in the normal state even during momentary power failure.

FAULT INDICATION

The PG Speed Controller detects the faults listed in Table 11.

Table 11. Fault Indications of PG Speed Controller

○: Lights steadily ◑: Blinking

Item \ Indication	GPD 602 Inverter Fault Lamps F1	F2	OS Lamp	GPD 602 Digital Operator or Programming Operator Display	Stop Condition
Overspeed			○	OS	-
Speed Deviation Too Large			◑	dEU	3S notch 3 OFF
PG Lead Disconnection			◑	PO	3S notch 3 OFF
24V Power Failure	○	○		UU	-
EEPROM Failure	○			CPF (A) (NOTE 1)	-
Connection Failure	○			CPF (9) (NOTE 1)	-
PG Speed Controller-AI A/D Converter Failure	○			CPF (8) (NOTE 1)	-
Constants Setting Value Failure	○			CPF (3) (NOTE 1)	-
Without Programming Operator in Constants Setting Mode	○			CPF (4) (NOTE 1)	-

Note:
1. Depressing GPD 602 "◁" key shows the parenthesized display.
2. Fault items "Speed Deviation Too Large" and "PG Lead Disconnection" are indicated by blinking of OS lamp. Operation will be continued.

GPD 602 FAULT DISPLAY

Although only one fault code is displayed at a time, up to 8 simultaneously occurring faults can be displayed by the trace function.

Depress GPD 602 (△) key to display all the faults and the occurrence sequence No. in turn. GPD 602 inverter with PG Speed Controller traces the 11 faults listed in Table 12.

Table 12. Fault Tracing Items of GPD with PG Speed Controller

No.	Fault	Digital or Programming Operator Display
1	Overcurrent	oC
2	Overvoltage	ou
3	Heat Sink Overheat	oH
4	Overload	oL
5	Undervoltage	uu
6	Fuse Blown	Fu
7	External Fault	Eb
8	Control Function Error	CPF
9	Overspeed	oS
10	Speed Deviation Too Large	dEu
11	PG Lead Disconnection	PO

Note: Fault will be stored when stopping due to fault (free-running to stop).

FAULT DETECTION OF PG SPEED CONTROLLER

Detection of overspeed, speed deviation too large, PG lead disconnection, and zero speed is shown in Figure 15.

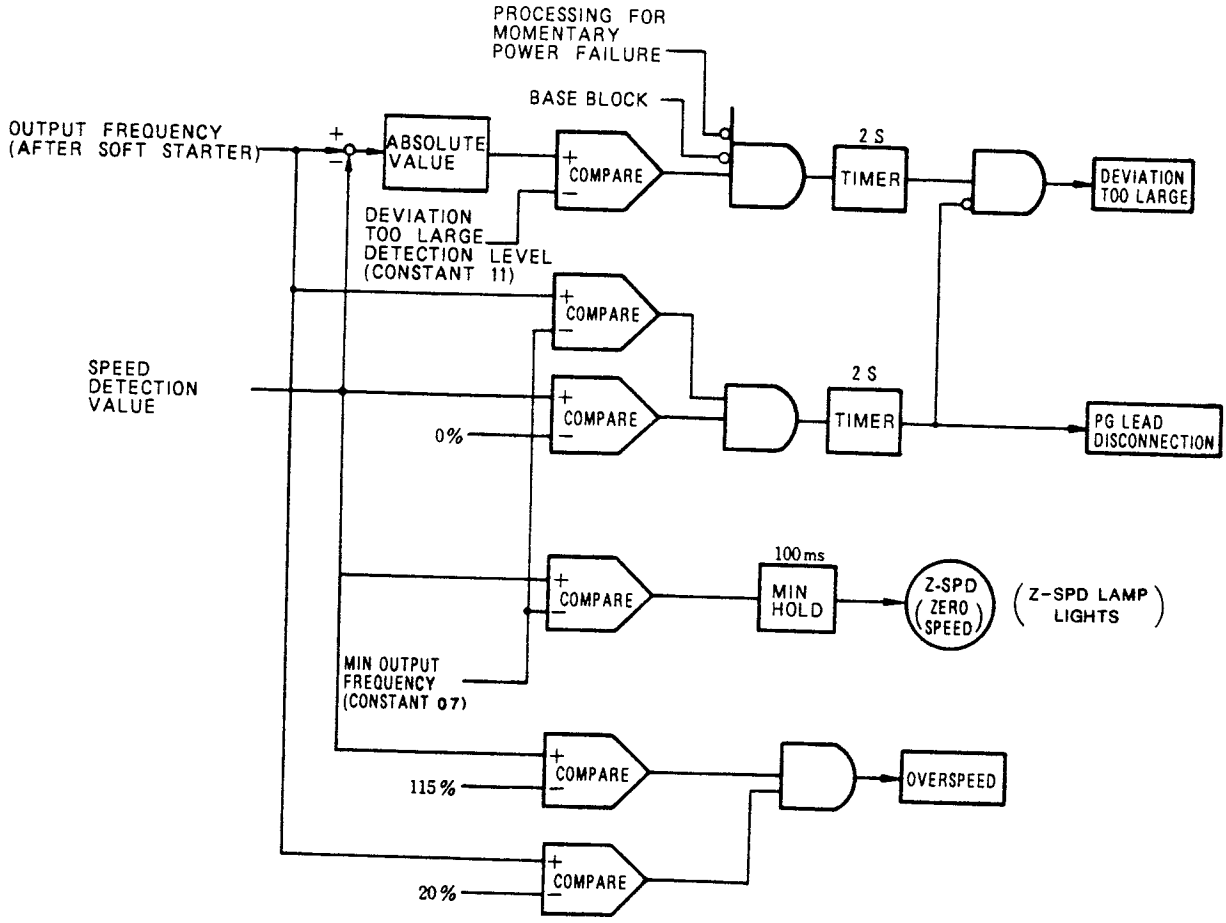


Figure 15. Detection of Speed Relation of PG Speed Controller (With PG Mode)

CONSTANT SETTING VALUE FAILURE

Constant setting value failure is detected under the following conditions and displayed by "CPF" on the Digital Operator or Programming Operator.

(1) V/f Constant Condition

If the relation between maximum frequency and V/f constants is not correct.

(2) PG Constant Condition

If the relation between PG Constant, No. of poles, and maximum frequency is not correct.

$$\text{PG Constant (constant No. 10)} \times \frac{2}{\text{No. of Poles}} \times \text{Fo (constant 1)} \quad 32767$$

FUNCTION OF MEMORY

When a PG Speed Controller is connected, the V/f pattern selector switch (1S) in the GPD 602 unit is disabled, and the constants in internal memory of the PG Speed Controller become effective.

With some special specifications, the acceleration/deceleration time setting switches (2S, ACC, DEC) and the electronic thermal setting switch (4S) of GPD 602 are also disabled and the alternate constants in internal memory of the PG Speed Controller become effective.

Table 13. List of Setting Constants

No.	Constant	Unit	Setting Range	Initial Value
01	Max Frequency (Fo)	0.1HZ	50.0 to 360.0	60.0
02	Max Voltage (VMAX)	1V	208 to 230V: 0 to 230	200
			380 to 460V: 0 to 460	400
03	Max Voltage Frequency (VFA)	0.1HZ	20.0 to Fo	60.0
04	1/40 Frequency Voltage (VFD)	1V	0 to Vo	208 to 230V 8
				380 to 460V 16
05	Accel Time (TACC)	0.1 s#	0.1 to 1800.0	10.0
06	Decel Time (TDEC)	0.1 s#	0.1 to 1800.0	10.0
07	Min Output Frequency (FMIN)	0.1HZ	0.2 to 10.0	1.5
08	DB Time (TDB)	0.1 s#	0.0 to 5.0	1.0
09	DB Voltage (VDB)	1V	0 to 20	20
10	PG Constant* (PLG)	1 P/R#	0/20 to 1200	0
11	Speed Deviation Too Large (SDEV)	0.1%	0.0 to 50.0	10.0
12	ASR Gain 1 @ (GA1)	-	0.00 to 2.55	0.00
13	ASR Integral Time 1 (IT1)	0.1 s#	0.0 to 10.0	1.0
14¶	ASR Gain 2¶ (GA2)	-	0.00 to 2.55	0.20
15¶	ASR Integral Time 2 (IT2)	0.1 s#	0.0 to 10.0	1.0
16	ASR Limitter (LIM)	0.1%	0.0 to 10.0	5.0

* For GPD 602 without PG, set PG Constant to 0. (PG constant low limit: 20P/R)
@ Without integral control, set ASR Integral Time 1 to 0.
¶ PG speed controller is not used.
# Unit "s" or "P/R" will not be displayed.

Note: When PG Speed Controller only is delivered, setting has been made for 200V class. Readjustment is required for 400V class setting.

The EEPROM (Electrically Erasable Programmable Read Only Memory) incorporated in the PG Speed Controller provides various functions: customer-designated constant setting, Digital or Programming Operator command back-up, alternate constant setting, etc. The PG Speed Controller is installed on the inverter either by itself or in combination with Digital Operator or Programming Operator according to the required function (see Table 14).

Table 14. PG Speed Controller Functions

Variations	Customer-Designated Constant Setting	Back-up Memory	Alternate Constant Setting
PG Speed Controller only	YES	-	-
With Digital Operator	YES	YES	-
With Programming Operator	YES	YES	YES

INDEPENDENT INSTALLATION

Maximum frequency, V/f pattern, etc. are preset at the factory according to customer specifications.

Some other constants are sometimes set according to customer specifications (refer to the setting table separately provided).

COMBINATION WITH DIGITAL OPERATOR

When a PG Speed Controller is used in combination with a Digital Operator, some commands for the operation functions to be performed with the Digital Operator are stored (back-up function), in addition to the functions for independent connection described in "INDEPENDENT INSTALLATION".

When the GPD 602 AC main circuit power is turned off (the CHARGE lamp goes off), then turned on again, the drive system starts from the operation command state immediately prior to turning off. The following settings of Digital Operator are stored.

(1) Frequency setting value
(2) AUTO/MAN mode selection
(3) MONI/SET function selection
(4) FWD/REV setting

RUN and JOG commands are not stored.

COMBINATION WITH PROGRAMMING OPERATOR

When a Programming Operator is used in combination, the constant setting and reference function is added (alternate constant setting change), in addition to the "INDEPENDENT INSTALLATION" functions and the back-up function under "COMBINATION WITH DIGITAL OPERATOR".

(1) Constant reference
(2) Constant setting

For details of constant setting procedure, refer to the Programming Operator instruction sheet, 02Y00025-0250.

NOTE

Figure 16 illustrates the relationship of constants No. 01 thru No. 04 to the Drive V/f profile.

Constant No. 01, Maximum Frequency (Fo)
The 100% output frequency of the inverter is set in increments of 0.1HZ.

Constant No. 02, Maximum Voltage (Vo)
The maximum output voltage of the inverter is set in increments of 1V. Note that the setting range for the maximum output voltage is 0 to 230V at 208 to 230V input, and 0 to 460V output at 380 to 460V input, subject to some restrictions in the actual output voltage by the supply voltage.

Constant No. 03, Maximum Voltage Frequency (A)
The inverter frequency at the maximum output voltage is set in increments of 0.1HZ.

Constant No. 04, 1/40 Frequency Voltage (D)
The output voltage at 1/40 the maximum frequency is set in increments of 1V. The relationship among constant Nos. 01 to 04 is as shown in Figure 16.

The initial values of constants No. 02 and No. 04 output voltages are determined at the input voltage of 200V. To output the voltage at an input voltage other than 200V, calculate the setting voltage. $V_{SET} = V_{out} \times \frac{200^*}{V_{IN}}$ (*400 for 460V units)

Example: To obtain 160V output at 220V input, the setting value is $160V \times \frac{200}{220} = 145V$

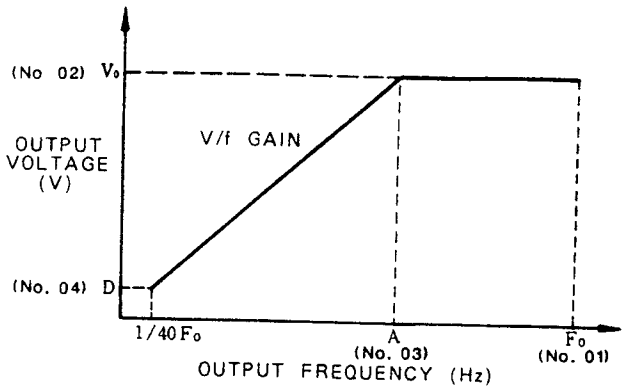


Figure 16. V/f Characteristics for Constant Nos. 01 to 04

Constant No. 05, Accel Time (TACC)
Sets the acceleration time of inverter output frequency accelerating from 0% to 100%. Setting is in increments of 0.1s.

Example: Acceleration time from N1% to N2% is expressed as follows:

$$TACC(N1 \rightarrow N2) = \frac{TACC \times (N2-N1)\ \%}{100\%}$$

Constant No. 06, Decel Time (TDEC)
Sets the deceleration time of inverter output frequency decelerating from 100% to 0%. Setting is in increments of 0.1s.

Example: Deceleration time from N2% to N1% is expressed as follows:

$$TDEC(N2 \rightarrow N1) = \frac{TDEC \times (N1-N2)\ \%}{100\%}$$

Constant No. 07, Minimum Output Frequency
The minimum frequency for outputting voltage from the inverter is set in increments 0.1HZ. When the frequency is below this limit during frequency deceleration by stop command, the following will result, according to the setting of notch 1 of GPD 602 operation mode selector switch 6S.

Notch 1 of 6S	OFF	DB operation
	ON	Coasting to a stop

Constant No. 08, DB Time (TDB)
The time for DB operation is set in increments of 0.1s. When the DB time is set at 0, no DB is effective, and at frequencies below the minimum output frequency of constant No. 07, the drive system operates in the free run mode.

Constant No. 09, DB Voltage (VDB)
The DC voltage output by the inverter during DB is set in increments of 1V. Set this constant in conformance with the motor capacity. If the overcurrent protection unit trips during DB, lower the DB voltage setting.

$$\text{DB Current} = \frac{\text{DB voltage}}{r_0 + r_1} \times \sqrt{\frac{2}{3}}$$

Where: r_0 = wire resistance

r_1 = motor primary resistance

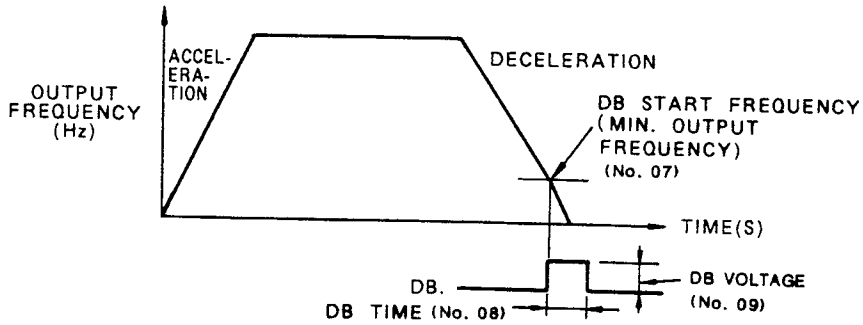


Figure 17. DB Start Frequency and DB Time

Constant No. 10, PG Constant
Sets number of output pulses per rotation of pulse generator (PG). Setting is in increments of 1 P/R.

(1) 0: V/f control (open loop)
(2) Integer from 20 to 1200: Speed control (closed loop)

Constant No. 11, Speed Deviation Too Large (SDEV)
Sets the speed deviation value to be detected, based on the motor synchronous speed determined by maximum frequency (Fo). Setting is in increments of 0.1%.

$$\text{Set value} = \frac{\delta \text{ rpm} \times P}{Fo \times 120} \times 100\%$$

Where,

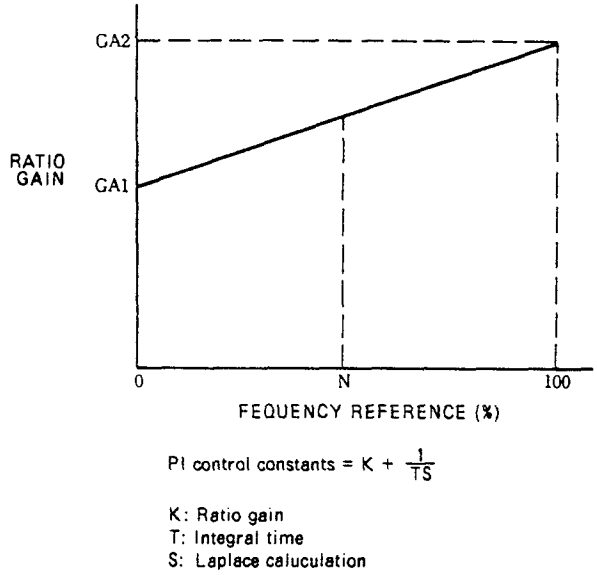
δ rpm: Speed deviation to be detected
P: No. of motor poles
Fo: Maximum frequency

Constant No. 12, ASR Gain 1 (GA1)
Sets proportional gain at speed reference of 0%. Setting is in increments of 1%.

Constant No. 13, ASR Integral Time 1 (IT1)
Sets the integral time of PI control. Setting is in increments of 0.1s.

Constant No. 14, ASR Gain 2 (GA2)
Sets the proportional gain at speed reference of 100%. Setting is in increments of 1%.

Constant No. 15, ASR Integral Time 2 (IT2)
Sets the integral time of PI control. Setting is in increments of 0.1 s. Not incorporated in PG Speed Controller.



PI control constants = $K + \frac{1}{TS}$

K: Ratio gain
T: Integral time
S: Laplace caluculation

Figure 18. Ratio Gain Setting

Constant No. 16, ASR Limitter (LIM)
Sets the upper limit of PI control compensation value, in increments of 0.1%.

APPENDIX A SPECIFICATIONS OF PG SPEED CONTROLLERS

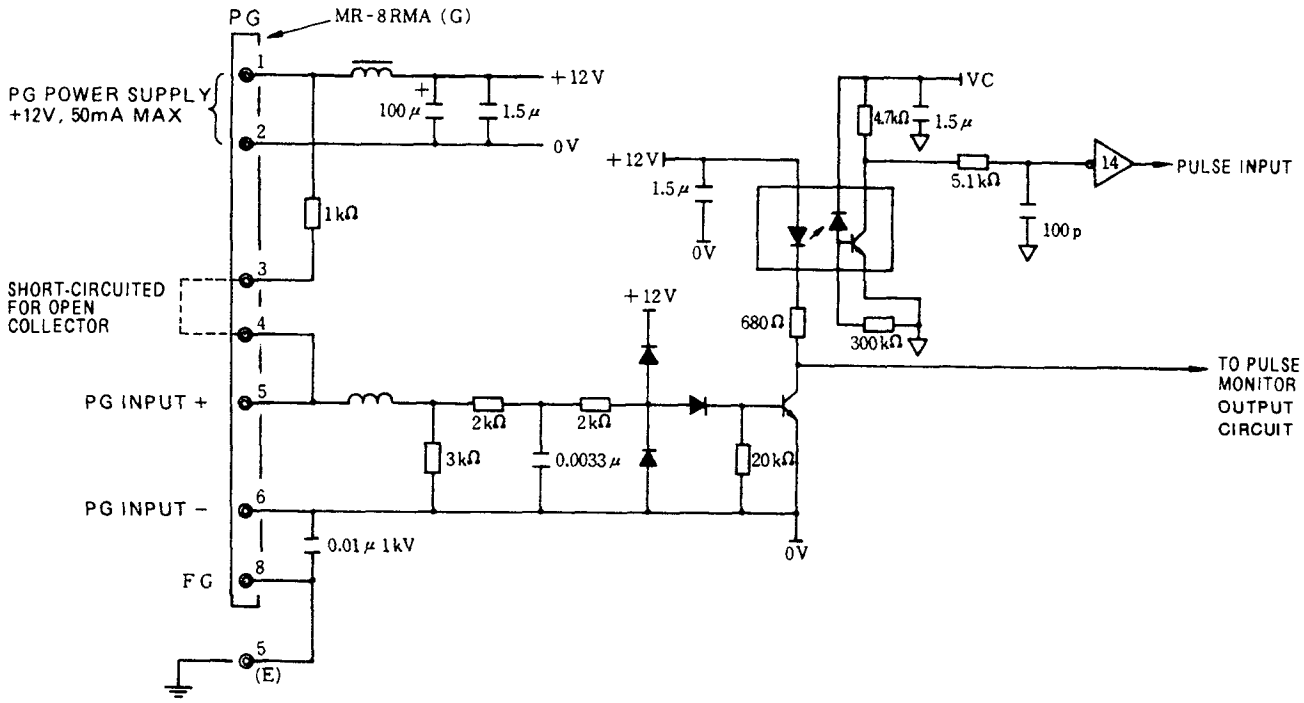
For the items other than listed below, refer to the specifications of GPD 602

Item			Specifications
Control Characteristics	Control Method		Speed control - Fully digital control
	Rated Output Frequency		50 to 360HZ (Constant setting)
	Frequency Accuracy		0.01% (-10 to +40°C)
	Internal Calculation Resolution		1/16384
	Speed Setting Signal	DS730	0 to +10 VDC (20K ohm) or 4 to 20mA (500 ohm) (Analog input to GPD 602
		DS733	4 digits BCD (100%/16384 max) or 15 digits binary Digital input to REF connector)
		DS734	0-5 VDC, 0-6 VDC, 0-8 VDC, 0-10 VDC or 4 to 20mA (250 ohm) (High-precision analog input)
	Speed Setting Resolution	DS730	Analog reference 1/1024
		DS733	Binary reference 1/16384
		DS734	Analog reference 1/16384
	Frequency Control Range		40:1 (Constant setting for minimum output frequency)
	Speed Control	Speed Detection Accuracy	0.02% (Detection of direction of rotation impossible)
		Speed Control Accuracy	0.03% (Control range: 10:1)
		PG Frequency Range	50 to 32767HZ
		No. of PG Output Pulses	20 to 1200 pulses/rev
	Accel/Decel Time		0.1 to 1800 sec (Constant setting)
	Direction of Rotation		Reversible operation
	Overload Capacity		150% for 1 minute
	DB Braking Function	DB Start Frequency	0.2 to 10HZ (Set by constant as minimum output frequency.)
		DB Voltage	0 to 30V (0 to 60V at 380 to 460V) (Constant setting)
		DB Time	0 to 20.0 seconds (Constant setting)
Protective Function	Overspeed Detection		Provided (115% standard) (Constant setting)
	Deviation Too Large		Provided (10% standard) (Constant setting)
	PG Lead Disconnection		Provided
Connection Operator			Analog Operator, Digital Operator, Programming Operator

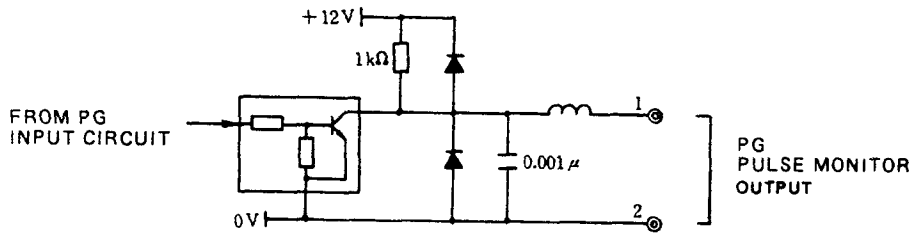
Note: Select the V/f so that PG output frequency is almost 20K HZ at 100% speed.

APPENDIX B INTERFACE CIRCUITS

(1) PG input circuit



(2) Pulse monitor output circuit



Vo : +12 V ±10%
Io : 20 mA MAX

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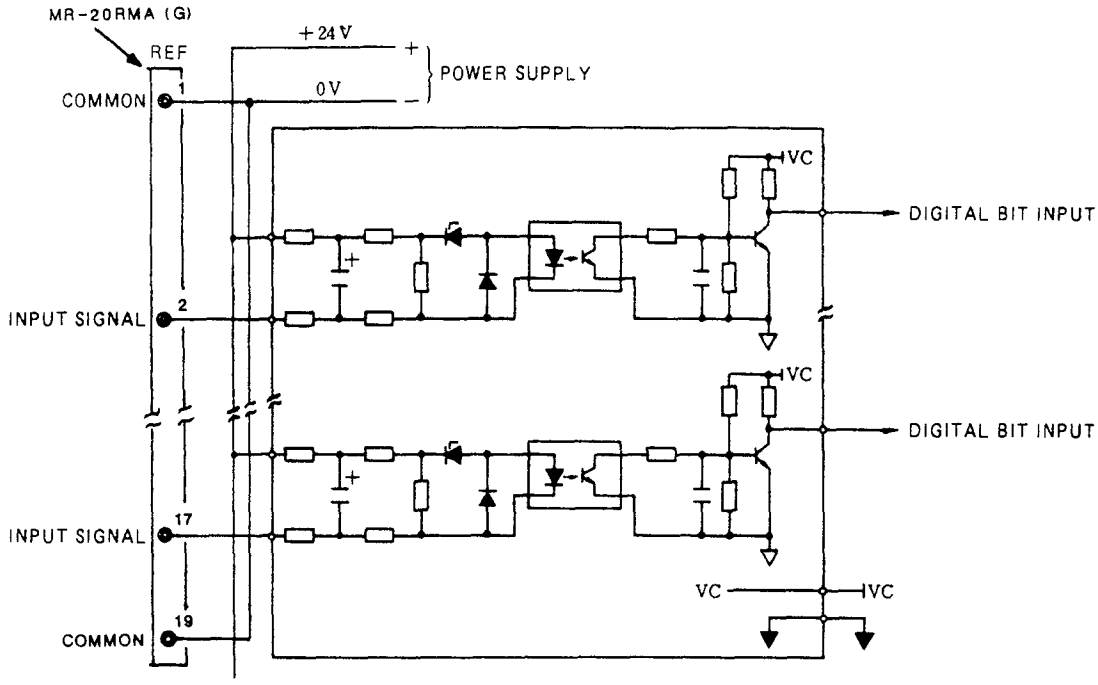
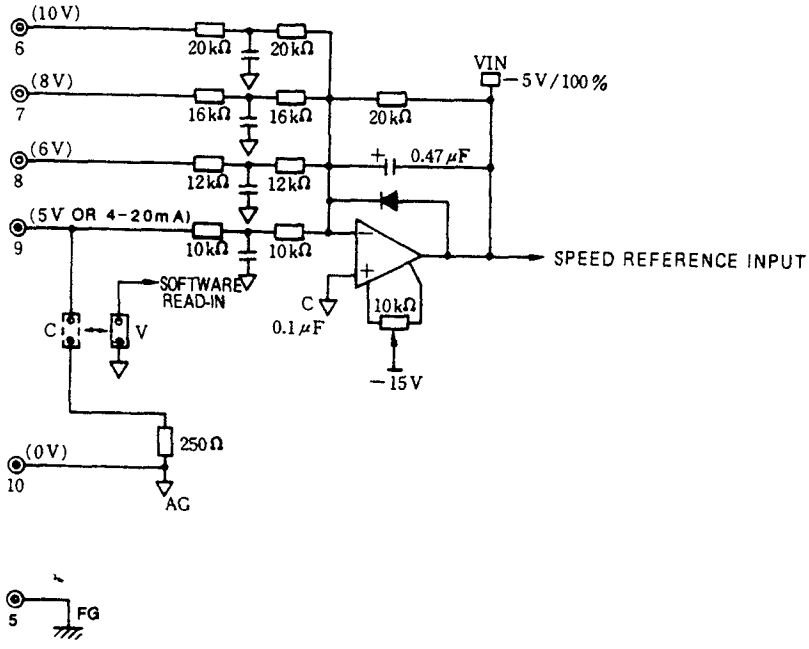
(3) Digital input circuit (PG Speed Controller-DI)



(4) Analog input circuit (PG Speed Controller-AI)



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APPENDIX C SELECTION OF PG

Maximum PG output pulse detection is 32767HZ.

Select a PG which outputs approximately 20K HZ at the motor speed of maximum frequency output.

$$\frac{\text{Motor Speed at Max Frequency Output}}{60} \times \text{PG rating} = 20{,}000\text{HZ}$$

PG Selection

Motor Speed at Max Frequency Output (rpm)	PG Rating (P/R)	PG Output Frequency at Max Frequency Output (HZ)
1,800	600	18,000
1,500	800	20,000
1,200	1,000	20,000
900	1,500	22,500

Note:

1. Motor speed at max frequency output is indicated by synchronous speed.
2. PG power is +12V.
3. When PG power capacity is 50mA or more, separate power supply must be provided. (If momentary power failure must be counteracted, backup capacitor is required.)

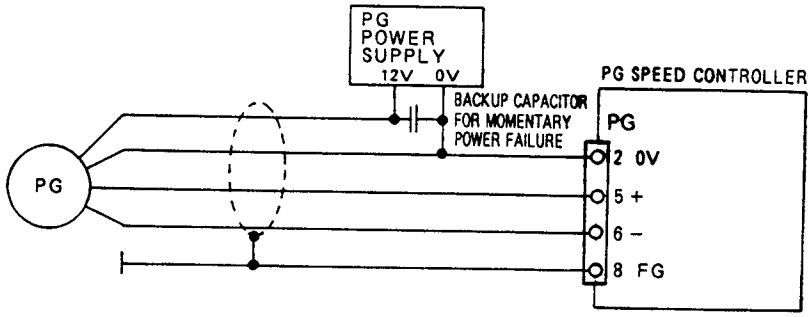

Figure A.C.1. PG Connections With Separate Power Supply