Gemini Pulse-Pack 4-QUAD™
PWM DC Drive Instructions

Models 12M8-41000 and 12M8-42000

INTRODUCTION

The pulse width modulated 12M8 series PULSE-PACK 4-QUAD™ is capable of driving DC permanent magnet motors in a single or bi-directional mode. Providing forward and reverse torque in both directions, the series maintain constant speed with overhauling loads and provides rapid deceleration, controlled braking and reversing.
Feedback is selected by an on-board jumper for either armature voltage or tachometer generator. When operating with tach feedback, the control is a true velocity "servo", with the speed of response and accuracy typical of this type of motor control.
The basic unit is capable of 7.5 amps of continuos load current. If additional output (up to 10 amps) is desired, a fan can be added, or the base panel can be mounted to a heat sink or other heat dissipating structure.

Specifications:

Speed Range: 100:1
Overload Capacity: 150% at rated current for 60 seconds
Maximum Speed Adjustment: 50-110% of rated speed

Model	Input Voltage	Output V. Range	HP	Cont.Output Amps
12M8-41000	115VAC	0-120VDC	3/4	7.5
12M8-42000	230	0-180	1 1/2	7.5

GENERAL

These instructions provide basic information for installation and adjustment. Please contact Gemini Corp. if further information is necessary. It is possible to damage the drive through misuse or misapplication. Please read this material thoroughly before proceeding with installation.
Unpack the equipment noting any shortages or damaged equipment. Immediately notify the carrier of any damage. Store in clean, dry location if the product is not used immediately. The relative humidity should not exceed 95%, non-condensing.

INSTALLATION

WARNING: THIS MOTOR CONTROL CONTAINS A HIGH VOLTAGE DC BUS WITH CONSIDERABLE CAPACITANCE AND A LARGE AMOUNT OF STORED ENERGY. DIRECT CONTACT WITH THIS BUS CAN BE VERY DANGEROUS. DO NOT TOUCH ANY CONDUCTORS OR CONNECTIONS TO THE CONTROL WHILE POWER IS ON, FOR AT LEAST FIVE MINUTES AFTER REMOVAL OF POWER. USE INSULATED TOOLS FOR ANY ADJUSTMENTS.

Carefully mount the chassis allowing clearances for access, air flow and conduit entry. The environment should be free of vibration and contaminants. The operating temperature range for the Gemini drive is 32 to 104 degrees Fahrenheit (0-40C). Since the drive produces heat, utilize a source of cooling, such as a fan, when the ambient temperature approaches 104 degrees.
WARNING: Do not drill or file the enclosure or chassis when the controller is installed, as metal particles can cause short circuits and damage.

WIRING

1. **Input Wiring** - Connect the AC line to terminals "L1" and "L2" (note wiring diagram). The 120 VAC hot is wired to the fused terminal "L1". If the 208/240VAC supply has a "neutral" and a "hot", connect the "hot" to "L1". If required, the chassis may be grounded at one of the unused holes. The enclosure is grounded through conduit connection. Input wire size must be in compliance with the National Electrical Code and all local codes and restrictions.
WARNING: Do not connect line power to the motor terminal connections.

The maximum AC current for the control will be somewhat higher than the DC current at the motor terminals, usually about 40% more at full speed. If the drive is operated at full load and full speed for extended periods of time, the AC service should be sized accordingly.

Provisions are made for the connection of external capacitors (terminals QC5 and QC6) to provide additional filtering of ripple in applications with 25 or 40 hertz input. A unitary power factor converter may also be connected to these terminals.

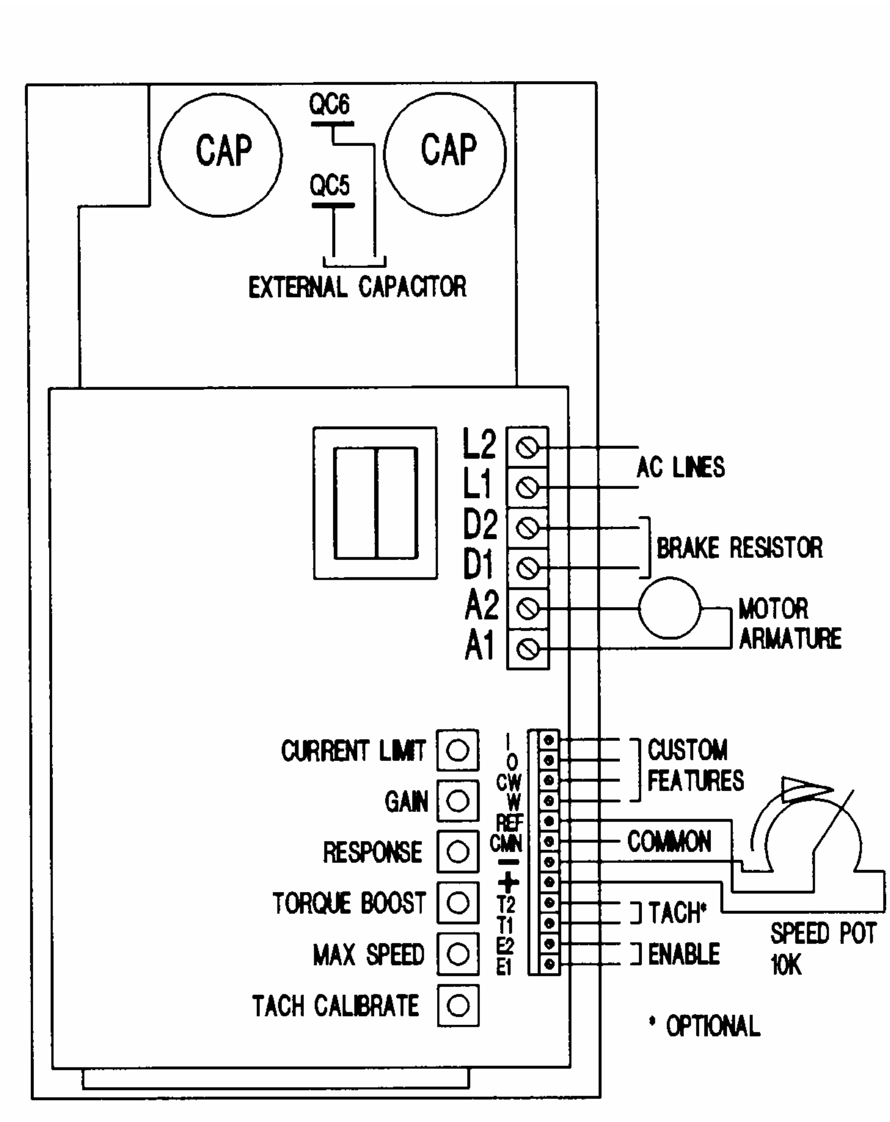
2. **Output Wiring** - Connect the motor armature terminals to “A1” and “A2”. Initially the polarity is not important, and it can be reversed in the setup procedure, if required. Do not operate the drive without connection to the motor.

3. **Braking Resistors** - A 10 ohm braking (dump) resistor is required to dissipate power during a braking operation, when powered by 115VAC. A 20 ohm power resistor is used for 230 volt input. The resistor wattage rating depends on speed, frequency and duration of braking. The following table provides guidelines for selection of the wattage rating:

Operation	Dump Resistor Wattage Rating
Frequent braking at high speed	500 Watts per motor HP
Frequent braking at ½ speed	250 Watts per HP
Intermittent braking at any speed	100 Watt per HP

Example: Use a 20 ohm, 1000 watt dump resistor with a 2 HP motor, operating from 230VAC input, when frequent braking at high speeds is expected.
Note: The wattage rating of the braking resistor is variable, but the ohmic value is not.

Wire the resistor to terminals “1” and “2”. If the braking resistor is not connected, or is the wrong value, the drive will trip out while attempting to brake. The “TRIP LED” gives indication of a tripped condition. To reset the drive, remove power. Most power resistors can operate at several hundred degrees, so there is no reason to suspect overload unless the resistor smokes, smells bad, or glows. Be sure to mount the braking resistor in a location where its high temperature will not damage nearby components.
Note: The “DUMP LED” lights when the brake is active.



4. **Control wiring**:

a. Speed signal - The speed signal can be supplied by a potentiometer connected to the positive and negative (10 volt) terminals, or it can be supplied by an external source, such as a numerical controller or programmable controller. If a pot. is used, it should be 10K or 5K ohms. For bi-directional operation, wire the speed pot. per the wiring diagram, with the CCW end of the speed pot. wired to "-" terminal and the other end to "+" terminal of the terminal strip. Wire the pot. wiper to reference terminal "REF". For unidirectional operation, wire one end of the pot. to the "+" terminal (for clockwise operation) or "-" terminal for counterclockwise operation. Wire the other end of the pot. to common terminal "CMN", and wiper to the "REF" terminal.

If an external 0-10VDC speed reference signal is used, first set-up and adjust the system with a 10K potentiometer as a speed reference. Connect the external source only after satisfactory operation with a potentiometer, as any problem may then be directed toward interfacing. The frequency of a pulse width modulated input signal must exceed 50Hz, otherwise damage may result.

An external speed signal of zero to 10 volts DC (20VDC max.) either negative or positive, or both for bi-directional operation, is connected between "CMN" and "REF", with zero connected to "CMN". The signal will see an input resistance of 10K to 35K ohms, depending on the setting of the maximum speed pot. The signal inputs of the control circuit are "impedance" isolated from the AC line by a resistance of at least 1 megohm, and the control circuitry works with either ground-based signals or floating signals that are no more than 150 volts above earth ground. If the input signal is earth grounded, there will be some leakage current from the AC line through the one megohm isolation resistance to the ground connection, and the signal ground must be able to accept approximately 200 microamperes of this current.

b. Enable - An enable function is provided for remote ON-OFF control. Wire the contact to "E1" and 'E2". Jumper the terminals if the function is not used, as the control will not operate without continuity between "E1" and "E2".

c. Feedback - Either armature voltage or tachometer feedback may be used, as determined by jumper "J1", located an inch from the "TORQUE BOOST" pot. Armature feedback provides speed regulation of approximately 1%. Regulation is improved to .1% with a tachometer. Regardless of the type of feedback used, the control should be initially set up in the armature voltage mode, with jumper 1 set in position "A". If tach feedback is used, wire the tach to terminals "T1" and "T2". The tachometer should generate from 10 to 100 VDC at full speed. Until initial adjustment has been performed , polarity is not important, and can be reversed later.

Note: The control may be operated in a "torque" mode, independent of speed. Removing the jumper between terminal "W" and "I" enables this mode. Consult the factory for details.

ADJUSTMENT AND START-UP

1. With power off, rotate the "MAX SPEED" and "TORQUE BOOST" pots. to their full counterclockwise position (minimum). Turn the "RESPONSE" and "GAIN" pots. to mid-position and the "CURRENT LIMIT" to approximately 10% from the full counterclockwise position. Note: do not adjust the "NULL" pot., as it is factory set.

2. Adjust the speed input signal to zero and turn on the AC power. The motor should not turn. Apply a small speed signal and turn the "CURRENT LIMIT" pot. to mid-position. The motor shaft should turn slowly and smoothly. If the direction of rotation is incorrect, turn off power, wait 5 minutes for the DC bus to discharge, and reverse connections to the armature. Check the enable circuit if the motor does not turn.

3. Increase the speed signal to maximum. Adjust the "MAX SPEED" pot. to the desired speed for the application, or for rated maximum speed. If it is not possible to measure speed, adjust the pot. to 90% of rated full load voltage, as noted on the nameplate. The motor speed, and direction, should now follow the input signal.

4. The current limit should now be set to the desired armature current. If a DC ammeter is available, connect it in series with the armature and stall the motor shaft, with speed set at approximately 20%. Adjust "CURRENT LIMIT" to the desired amount. If no current measurement is possible, set the pot. at the same ratio as the desired current relates to 15 amps. For example, if 10 amps current is desired, set the pot. at 67% (10/15 = .666).

This completes the basic setup procedure. Depending on whether armature voltage or tach generator feedback is being used, follow the appropriate instructions.

Armature Voltage Feedback
The only adjustment necessary for armature voltage feedback is that of torque boost. With "JUMPER 1" in the"A" position, run the motor at approximately 10% speed. Turn the "TORQUE BOOST" pot. clockwise slowly until the motor speed becomes unstable. Then reduce the setting to a point where stability returns. This will provide the best regulation. If a softer regulation is desired, where the speed sags under load, reduce the pot. setting.
This completes the adjustment procedure.

Tach Generator Feedback
1. Turn the "TORQUE BOOST" pot. fully counterclockwise. Apply a full speed signal to the speed signal input. The motor should be running at full speed. Measure the voltage from the signal common terminal "CMN" to "TEST POINT 2" located near the "TACH CALIBRATE" pot. Note its magnitude and polarity.

2. Connect a meter to "TEST POINT 1"(located 2" from "TEST POINT 2", near the board edge), and the common "CMN" terminal. If its polarity is not the same as the polarity at "TEST POINT 2", turn off power, wait 5 minutes, and reverse the connections to the tachometer generator. Reapply power and adjust the"TACH CALIBRATE" pot. so that the voltage magnitude and polarity at "TEST POINT 1" is the same as "TEST POINT 2".

3. Remove power, wait 5 minutes, and move jumper "J1" from position "A"to position "B". Restore power and run the drive.

4. Transient performance of the motor is determined by the setting of the "RESPONSE" and "GAIN" pots. Trial and error adjustment is best to obtain the type of performance desired, but some basic considerations will aid in knowing how to adjust each pot. The "GAIN" pot. primarily adjusts for differences in load inertia. If set to low, motor speed will oscillate slowly, even with steady input. If set too high, the motor may be heard to "rattle" as it becomes unstable at a high frequency, and the shaft may twitch rapidly. The best setting is halfway between the two conditions, or as high as possible without high frequency stability. Low inertia generally requires low settings, and high inertia high setting.

5. The "RESPONSE" pot. determines how "tight" the regulation will be. When set low, the regulation will be very firm, and the control will respond almost immediately to load changes. When set higher, regulation will be softer, and the control will take longer to recover from a load change. If set too low, the drive may become unstable at high frequency, and if too high the instability may show up as slow swings in speed. In most applications, the response should be set as low as good stability will permit. There is some interaction between the "GAIN" and "RESPONSE" adjustments, but normally neither one is all that critical. Do not hesitate to adjust freely until the desired motor response is obtained.

This completes the adjustment procedure.

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