DYNETIC SYSTEMS COMPANY

MODEL DYNETIC 750 SERIES

PWM SERVO AMPLIFIER

OPERATION AND

INSTALLATION MANUAL

DYNETIC SYSTEMS
NEW CONCEPTS IN MOTION
19128 Industrial Blvd., Elk River, MN 55330-2496
Phone: 763-441-4300 Fax: 763-441-5217
Website: http://www.dynetic.com

700071 - 06/99

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1.0 DESCRIPTION

Pin Identification

Pins P1-2, 7	circuit common for command return and tachometer command.
Pins P1-4, 5	inputs to the differential pre-amp (use only one). P4 is (+), P5 is (-).
Pins P1-6, 7	tachometer inputs.
Pin P1-8	current monitor, 2 Amperes/Volt.
Pin P1-9	command signal to the internal current-loop. (The maximum peak/current rating of the amplifier always equals 7.5 Volts at this Pin. See "Current Limit Adjustments" for details).
Pin P1-11	input inhibit. (It turns off all four mosfets of the "H" bridge drive when pulled to the common, or amplifier, ground).
Pin P1-12	inhibits the motor for (+) direction only. (This function can be useful to drive the motor off from a limit switch).
Pin P1-13	inhibits the motor for (-) direction only. (This function can be useful to drive the motor off from a limit switch).
Pin P1-14	TTL compatible output. (It goes high in case of output short-circuit, over-voltage, inhibit and during "Initial Power-On Test").
Pins P1-15, 16	synchronizes the switching frequency of several amplifier modules. (Consult factory for this option).

Switch Identification

SW1	activates the internal voltage feedback.
SW2	shorts out the current loop integrator capacitor. It is recommended to leave SW2 in the OFF position.
SW3	shorts out the outer velocity/voltage loop integrator capacitor. This capacitor normally ensures "error free" operation by reducing the error signal (output of summing amplifier) to zero (0).
SW4	increases the effect of the offset potentiometer adjustment by a factor of fifty (50). Used as an on-board reference signal in "Test" mode only.

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2.0 MODE SELECTION

The Dynetic 750 amplifier operates in the follow modes:

- Voltage-to-Voltage Amplifier Mode
- Voltage-to-Speed Amplifier Mode
- Voltage-to-Current Amplifier Mode (Torque Mode)
- Analog Position Loop Mode

Mode	SW1	SW2	SW3	SW4
Voltage	On	Off	Off	Off
Speed	Off	Off	Off	Off
Current	Off	Off	On	Off

Recommended setting for the Current Mode:Potentiometer 1 counterclockwise
Potentiometer 3 clockwise

Voltage-to-Voltage Mode

In the Voltage-to-Voltage Mode, the reference input voltage commands a motor voltage. However, if there is a load torque variation, the motor current will vary as torque is proportional to motor current. Since the motor windings have resistance, the actual motor voltage is reduced by the product of motor current and resistance. Thus motor speed, which is proportional to motor voltage (terminal voltage minus IR drop), varies with the load torque.

In order to compensate for the internal motor voltage drop, a voltage proportional to motor current can be added to the reference voltage. The amount of compensation is adjusted by R8 inside the amplifier. **BE VERY CAREFUL WHEN ADJUSTING THE IR COMPENSATION LEVEL.** If the feedback voltage is high enough to cause a rise in motor voltage with increased motor current, instability will occur. Such result is due to the fact that increased voltage increases motor speed and thus load current which in turn increases motor voltage. For more demanding applications it is recommended to replace R8 with a 100K potentiometer and reduce the resistance until a satisfactory result is obtained. If a great deal of motor torque change is anticipated it may be wise to consider the addition of a tachometer to the motor.

Voltage-to-Speed Mode

The addition of a tachometer to the motor shaft produces the voltage proportional to speed. With this addition, the tachometer output voltage is replaced by the motor terminal voltage as the controlled variable. Since this voltage is proportional to the motor speed, the operating mode is Voltage-to-Speed.

Note that the speed is dependent on terminal voltage and motor current. The motor current is in turn dependent on the load torque which includes both constant friction torque and the torque to accelerate or decelerate the load. Thus the conclusion of these parameters in the control loop may give rise to instability. In general, compensation of a tachometer feedback system is more complex than that of the Voltage-to-Voltage Mode. (See "Compensation Adjustments" for procedure).

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Voltage-to-Current Mode (Torque Mode)

The Voltage-to-Current Mode produces a torque output from the motor proportional to the reference voltage input. DC motor torque is always proportional to the motor current. This mode is particularly important if the servo amplifier is used with a position controller. Under this condition, a movement of the motor shaft from desired position causes a large correcting torque or "stiffness."

In this mode, the motor and load characteristics are included in the control loop. Thus the compensation of the system is more complex and normally done in controller card software. Some adjustment of the current scaling may be done with Potentiometer 1 and 3.

Analog Position Loop Mode

In this mode the feedback device is an analog sensor mechanically tied to the positioning object. The command is an analog signal. Select Voltage Mode by setting the DIP switches. Use (+) and (-) reference inputs for position feedback and command. Use the reference gain potentiometer for loop response adjustment.

3.0 WIRING INSTRUCTIONS

Precautions

DO NOT install the amplifier without first determining that all chassis power has been removed for at least ten (10) seconds. Never remove an amplifier from an installation with power applied. The following sections must be reviewed before installing to ensure reliable operation.

Plug-In-And-Use Test Mode

The Dynetic 750 Series amplifier can operate in a DIP switch selectable "Test" mode to facilitate evaluation and installation. All amplifiers ship in this mode (SW1 = ON; SW2, SW3, SW4 = OFF). This is "Voltage Amplifier Mode" with on-board potentiometer adjustable reference.

1. Connect motor leads P2-2 (+) and P2-1 (-). A tachometer is not needed in this mode.

2. Power up.

3. Use the TEST/OFFSET potentiometer on the amplifier to change motor speed and direction. If oscillation occurs, turn Potentiometer 1 counterclockwise until oscillation stops.

Motor Wiring

See the following page for complete diagram.

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4.0 AMPLIFIER ADJUSTMENT (TUNING) PROCEDURE

Command Signal

The command signal is a reference voltage which is applied to the amplifier to control the motor direction and speed. Connect to P1-4. Auxiliary input is connected to P1-5.

Feedback Elements

The feedback element can be any device capable of generating a voltage signal proportional to velocity, position or any parameter of interest. Such signals can be provided directly by a tachometer or potentiometer or indirectly by other feedback devices such as resolvers and encoders. These latter devices must have their outputs converted to a DC voltage before being connected to the amplifier. Connect to P1-6.

Initial Power-On Test

CAUTION: These initial adjustments should be performed with the motor shaft decoupled from the application.

With a zero (0) speed command applied, momentarily apply power to the amplifier. If upon application of power the motor rapidly accelerates, a runaway condition exists due most likely to the reversal of either motor or tachometer wiring. If the motor and tachometer are properly connected and the amplifier is functioning normally, the motor shaft will remain stationary or drift slightly in either direction with power applied. Trim the "offset" potentiometer (SW4 = OFF) for minimum amplifier output current by observing motor drift with REF inputs grounded.

If the motor does not runaway but emits a high pitched squeal, turn Potentiometer 1 counterclockwise until motor squeal stops.

Compensation Adjustments (Voltage-to-Speed Mode)

Servo system performance can be judged by the following three characteristics:

- Stability
- Accuracy
- Responsiveness without overshoot

It is a short and straightforward process to meet all three of these criteria. The process involves obtaining a stable servo using the compensation adjustment while optimizing the response of the system.

For this purpose, it is necessary to be able to feed in a small step at the reference input and observe the feedback signal on oscilloscope at Pin P1-6. Set the compensation adjustment to obtain a properly compensated response. This will be the fastest response without overshoot. If the system is undercompensated (slow response without overshoot) turn the compensation potentiometer clockwise (P1). If it is overcompensated (overshoot and oscillation), turn the compensation potentiometer counterclockwise (P1).

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NOTE: In most applications, the compensation can be adjusted by rotating Potentiometer P1 clockwise until the motor oscillates audibly and then backing off until it stops. This simple procedure also applies to Voltage-to-Voltage Mode.

Please contact factory for custom compensation.

Current Limit Adjustments

If overheating occurs due to extremely harsh operating conditions, the internal temperature sensor automatically disables the amplifier.

It is important to set the current limit so that the instantaneous motor current does not exceed the specified motor peak current. Should this occur the motor magnets can be demagnetized or overheated.

These amplifiers feature peak and continuous current limit adjustments with one adjustment. The maximum peak current is needed for fast acceleration and deceleration. The amplifier is capable of supplying the maximum peak current for two (2) seconds and then the current limit is reduced gradually to the continuous value. The purpose of this is to protect the motor in stalled condition by reducing the current limit to the maximum continuous value. The current limit adjustment Potentiometer P2 has ten (10) turns and is linear. Thus, to adjust the current limit, turn the potentiometer counterclockwise to zero (0), then turn clockwise to the appropriate value.

If the peak current is lower than the peak set point, the peak time will be longer than two (2) seconds according to the RMS value of the current.

P1-8 is the current monitor of the current amplifier stage to the motor. Since the output current is proportional to P1-8 the adjusted current limit can easily be observed at this pin. The maximum peak current value equals 7.5V at this pin. The actual current can be monitored at Pin P1-8. The scaling at this pin is two (2) A/V.

If the desired limit is six (6) Amperes and the servo amplifier peak current is 12 Amperes, turn the potentiometer five (5) turns clockwise from zero (0). If the desired limit is three (3) Amperes, turn the potentiometer clockwise two and one half (2-1/2) turns.

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5.0 TROUBLESHOOTING

Overload Fault:

1. Verify to see if the motor shaft freely rotates with no power applied. The load on the motor must be free of jams.

2. Verify that the minimum inductance requirement is met.

Heatsink Temperature:

1. Verify that the heatsink temperature is less than 75° C.

Over-Voltage Shutdown:

1. Check the power input voltage for a value in excess of those listed in the Specifications. If larger than listed, check the AC power line connected to the power supply for proper value.

2. Check the regenerative energy absorbed during deceleration. This is done with a voltmeter or scope monitor of the power supply voltage. If the supply voltage increased above specified value then additional power supply capacitance is necessary. Additional capacitors must be electrolytic type and located as close to the amplifier as possible.

Under-Voltage Shutdown:

1. Verify power supply voltages for minimum conditions per Specifications.

Short Circuit Fault:

1. Check each motor lead with respect to motor housing and power ground for shorts.

2. Measure motor armature resistance with the amplifier disconnected between motor leads.

Status:

1. Check positive inhibit, negative inhibit and inhibit inputs for proper input.

Causes of Erratic Operation:

1. Improper grounding.

2. Noisy command signal. Check for system ground loops.

3. Mechanical backlash, deadband, slippage, etc.

4. Excessive tachometer noise.

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6.0 CAUTIONARY NOTES

DO NOT reverse the power supply leads.

DO NOT spin the motor without power. The motor acts as a generator and will charge up the power supply capacitors through the amplifier. Too high of a speed may cause over-voltage breakdown in the power transistors. Note that an amplifier having an internal power converter that operates from the high voltage supply will become operative.

DO NOT short the motor at a high speed. When the motor is shorted its own voltage may produce a current flow as high as ten (10) times the amplifier peak current. The short itself should not damage the amplifier but may be bad for the motor. If the connection arcs or opens while the motor is spinning rapidly, this high current flows back into the amplifier due to stored energy in the motor's inductance and may damage the amplifier.

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7.0 MOUNTING DIMENSIONS

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Dynetic 752, 753

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8.0 WARRANTY

Dynetic Systems Company warrants its product to be free from defects under normal use and is limited to replacing or repairing at its factory any of its products which are returned to the factory of origin within one (1) year after shipment, transportation charges prepaid, which are disclosed to Dynetic Systems Company's satisfaction to be defective. This warranty supersedes all other warranties, express or implied, including any implied warranty or fitness for a particular purpose, and all other obligations or liabilities on the part of Dynetic Systems Company and it neither assumes nor authorizes any other person to assume for the seller any other liabilities in connection with the sale of the said articles.

The original warranty period is not extended by the above mentioned provisions for any replaced or repaired articles. This warranty shall not apply to any products that have been subjected to misuse, negligence or accident.

9.0 SPECIFICATIONS

1.	Input Voltage:	115/230 VAC; 50/60 HZ
2.	Output power:	60 VDC at 6 Amps continuous 12 Amps peak, two (2) seconds
3.	Reference voltages:	± 5 VDC
4.	Output switching frequency:	33 kHz
5.	Inhibits:	Motor and direction Logic low (OV)
6.	Shutdowns:	Over-voltage and under-voltage
7.	Adjustments:	Loop gain Peak current limit Continuous current limit
8.	Faults:	Output logic: TTL high for an inhibit or shutdown
9.	LED indicators:	Red - fault Green - normal

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