INLAND MOTOR DIVISION
KOLLMORGEN CORPORATION

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OPERATING INSTRUCTIONS
DCM1-07014Dxx

1000 WATT PWM SERVO AMPLIFIER
WITH VELOCITY LOOP CONFIGURATION
FOR
BRUSH-TYPE DC MOTORS

NO.	ECN NO.	DATE	APPD	NO.	ECN NO.	DATE	APPD

USER INFORMATION

1) Physical Configuration - See outline drawing Figure 1.

2) Signal Connector - 15 Pin Sub-Miniature D (J2)

3) Power Connector - 5 contact Buchanan type TSB-03 (J1)

4) Electrical Interconnection - See Figure 2

5) Adjustments

   The adjustments are as follows:

   a) Command Scaling: Range 0% to 100% (CW to CCW)
   b) System Offset: Range + or - 0.2 Volts (CW to CCW)
   c) Feedback Scaling: Range 0% to 100% (CW to CCW)
   d) AC Gain Range: Min. to Max. (CCW to CW)
   e) Current Limit: 0 to + or - 14 amps. (CW to CCW)

6) Input Filters - The amplifier contains input filters to limit emissions on the power lines. Sufficient capacitance is provided to supply the amplifier RMS current requirements.

   The 70 Volt power line filter has a corner frequency of 5kHz (6 db of attenuation) with a slope of -40 db/decade.

   The 24 volt power line has a corner frequency of 50 kHz (6 db of attenuation) with a slope of -40 db/decade.

7) Input/Output Connection - The following is a description of the various inputs and outputs of the DCM1-07014Dxx servo amplifier.

   J1-1 OUTPUT (-)

   This terminal is used to connect the negative terminal of the motor to the amplifier. Conventional load current flows FROM this terminal when NEGATIVE current is commanded.

   J1-2 OUTPUT (+)

   This terminal is used to connect the positive terminal of the motor to the amplifier. Conventional load current flows FROM this terminal when POSITIVE current is commanded.

   J1-3 CHASSIS GROUND

   Electrical connection to the baseplate. NOTE: The base plate is electrically isolated from all other inputs and outputs.

J1-4 IN (-)

This terminal is used for connecting the return line of the external 70V supply to the amplifier.

J1-5 IN (+)

This terminal is used for connecting the positive line of the external 70V supply to the amplifier.

SIGNAL CONNECTOR J2:

J2-1 CHASSIS GROUND

Electrical connection to the baseplate.

J2-2 -15VDC OUTPUT

A source of both positive and negative voltage is provided at the respective terminals to power auxiliary circuits. The continuous current should not exceed 25 mA. These supplies are referenced to common (J2-5,6,7).

J2-3 +15VDC OUTPUT

See J2-2.

J2-4 FAULT MONITOR

An open collector output referenced to common (J2-5,6,7) is provided. Under normal operating conditions, no current will be sinked. If a fault condition is detected, the output will sink up to 20mA of current. The +15V (J2-3) output and an external resistor(s) can be used to develop the required logic levels (See Figure 3A).

J2-5,6,7 COMMON

Three signal common terminals are provided. The signal common is internally connected to IN (-) (J1-4; 70 volt return)

J2-8 CURRENT SIGNAL OUTPUT

This signal provides an output signal representative of output current. The transfer function of this signal to output current is 0.63 volts/amp (+ or - 5%).

J2-9 +24VDC INPUT

This terminal is used for connecting the positive line of an external power supply. An external power supply is required to power an internal DC-DC converter (20-32VDC @ 0.4 amps max. continuous, 0.8 amps peak at turn on). The external supply is electrically isolated (internally) from all power and signal returns. This allows the user to reference the external supply to a suitable ground.

J2-10 +24VDC RETURN

This terminal is used for connecting the return line of an external power supply. See J2-9.

J2-11 ENABLE ANODE

An optically isolated input with internal limiting and reverse voltage protection is provided. This terminal connects to the anode of the optical isolator. To enable the amplifier, apply a voltage (5VDC or larger, 18VDC max.) to this terminal, referenced to enable/reset cathode (J2-12). In the event of a fault condition, reduce the voltage on J2-11 to 2VDC or less for a minimum of 20mS and re-apply the original voltage on J2-11. Input current at 5 volts is 6mA max. See Figure 3B.

J2-12 ENABLE/RESET CATHODE

This terminal connects to the cathode of the optical isolator. See J2-11.

J2-13 TACH INPUT

This terminal is used to connect the velocity feedback signal. It is a non-differential signal input referenced to common (J2-5,6,7). The gain is set by adjusting the feedback scaling potentiometer. CCW rotation increases signal level.

J2-14 COMMAND (-)

This terminal is used as a reference for the command signal when a differential command signal is utilized. When the command signal is single-ended, this pin should be connected to the user's ground. Input impedance is 10K.

J2-15 COMMAND (+)

This terminal is used to receive the velocity command signal from the user`s system. The gain is set by adjusting the command scaling potentiometer. CCW rotation increases signal level. The range of command voltage is + or - 10 volts. Input impedance is 10K.

8) Installation

a) Base plate temperature should not exceed 60 degrees C for rated output currents. If amplifier is to be operated above 60 degrees C, derate current 1 A/5 degrees C. Operation above 85 deg C is not recommended.

Example: T_B = 85 degrees C, I_{max} = 9 amps.

b) The maximum input bus voltage (J1-4,5) is 90VDC.

c) The external low voltage power supply (J2-9,10) to be energized before the input bus voltage supply (J1-4,5). When powering down, remove the input bus voltage supply (J1-4,5) FIRST.

d) Signal wires (24AWG min.). The use of shielded/twisted pairs is recommended for the tach and command inputs. The chassis ground (J2-1) can be used for shield wire termination.

e) Power wires (12AWG min.). The use of twisted pairs is recommended. Twist the power supply leads together (J1-4,5) and the motor leads together (J1-1,2).

f) Motor inductance. The servo amplifier requires a minimum load inductance for stable operation. This amplifier has been tuned for a minimum of 1.5 mH load inductance.

g) Motor and Tach Phasing. A positive command voltage at the amplifier noninverting input relative to the inverting input will cause a net positive voltage to be generated at the +motor terminal relative to the -motor terminal. A negative feedback voltage is required at the tach input (J2-13) relative to the tach reference input (J2-5,6,7).

h) Fault conditions. The amplifier will latch off in the event of a fault condition. The possible fault conditions are overcurrent, armature short and armature short to ground (requires motor frame/chassis to be connected to +70 volt return; J1-4). This protection scheme incorporates a latching circuit, which holds the power stage in a shutdown mode and signals the user via the fault monitor (J2-4). The amplifier is reset using the enable/reset line (J2-11,12).

i) Typical configurations. See Figures 3A and 3B.

9) Set-up Procedure

a) Insure all connections are properly made. Turn the command scaling, feedback scaling, and current limit potentiometers full CW (15 full turns). Turn current limit potentiometer 3 turns CCW (this will set current limit between 2 and 3 amps). Rotate the AC gain potentiometer 15 turns CCW. Energize the +24 volt supply. Next apply the +70 volt bus voltage. Enable the amplifier.

NOTE: If a runaway condition is noticed, disable amplifier with enable/reset input and reverse polarity of motor and tach leads.

b) DC offset adjustment. With the above-stated conditions (zero input command), adjust the DC offset potentiometer for a static motor shaft condition.

c) Current Limit Adjustment. The current limit potentiometer allows the user to adjust the maximum level of current delivered to the motor. The range of adjustment is from 0 to + or - 14 amps. The user is provided with overcurrent protection which is set above the 14 amp level (non-adjustable, factory set) for his system.

SET-UP:

1) Disable the amplifier. Remove the +70 volt power to the amplifier.
2) Lock the rotor of the motor. If the rotor can not be locked, an inductor (see section 8f) can be substituted.
3) Connect a voltmeter (+ or - volt range) from the current monitor output (J2-8) to common (J2-5,6,7).
4) Determine the desired value of maximum current. Multiply this value (in amps) by 0.63.

5) Re-apply the +70 volt power (amplifier disabled).
6) Turn command scaling potentiometer 15 turns CCW.
7) Insert a velocity command on the signal command lines (J2-14,15) of 1.0 VDC or larger.
8) Enable amplifier.
9) Adjust the current limit potentiometer until the value calculated in step 4 is read on the voltmeter.
10) Disable amplifier and remove command. Remove 70 volt power; remove lock on rotor; remove voltmeter.

d) Command scaling. The amplifier`s control circuitry operates on a full-scale command range of +10 volts to -10 volts. Under normal conditions, this adjustment is set full CCW. The adjustment is provided, as a user convenience, to reduce the gain of a position loop which may be incorporated in his system. Consult factory if further information is needed.

e) Feedback scaling. This potentiometer allows the user to optimally scale the velocity feedback signal for maximum performance in his system. Ideally, a high degree of tach feedback is desirable for maintaining the accuracy of the output velocity due to load variations. However, the output velocity range varies inversely with the magnitude of the feedback gain for a given input command range. In other words, as the level of the tach feedback increases, the motor's speed will decrease for a given command. Therefore, it is desirable to choose the maximum amount of tach feedback which still allow for the full range of desired shaft velocities.

Set-up:

1) Disable amplifier. Remove +70 volt power.
2) Determine tach voltage at maximum velocity.
3) Select the appropriate range setting of a voltmeter and connect it so as to measure the tach voltage.
4) Insure all connections are properly made and the amplifier is connected to the tach and motor. Command zero velocity.
5) Re-apply the +70 volt power. Enable amplifier.
6) If runaway condition is noticed, check motor and tach connections/phasing.
7) Command maximum velocity.
8) Adjust feedback scaling potentiometer until value calculated in step 2 is measured on the voltmeter.
9) Command zero velocity; disable amplifier; remove +70 volt power; remove voltmeter.

f) AC gain. This potentiometer allows the user to vary the break frequency of the high frequency gain value of the velocity loop's summing amplifier. This adjustment provides the phase lag compensation necessary for stabilizing the user's system in the presence of signal noise, excessive phase shift and unusual load characteristics. The idea in this type of compensation is to insure adequate phase margin when the velocity loop gain is unity. By lowering the break frequency (which is accompanied by a reduced high frequency gain), the amplifier`s phase margin is decreased but the bandwidth is increased. Thus, faster rise times can be expected.

Set-up:

1) Disable amplifier. Remove the +70 volt power.
2) Connect an oscilloscope or chart recorder to the tach.
3) Insure all connections are properly made and the amplifier is connected to the motor and tach.
4) The motor should be mechanically coupled to the user system's load.
5) Command zero velocity. Re-apply the +70 volt power. Enable amplifier.
6) Apply a low frequency (0.1 Hz to 10 Hz) bipolar squarewave via the velocity command input. The squarewave should be centered around 0 volts and have a magnitude of approximately + or - 10% of the full scale command.

IMPORTANT: Insure that the mechanical system has enough range of motion to accommodate this command before applying it. Otherwise, damage or injury may result. If there is a limited range of motion available, the frequency of the command should be increased and/or its magnitude decreased to a level which is within the available range of motion.

7) Slowly adjust the potentiometer CW while observing the signal from the tach. When the signal appears similar to that of the middle curve shown in figure 4, the amplifier is properly adjusted.

Note the following are characteristics of the desired waveform: slight overshoot, minimum ringing, relatively fast rise time. Figure 4 also shows curves typical of those which might be observed with the potentiometer in the extreme positions.

8) Disable amplifier. Remove +70 volt power; remove all test equipment.

9) This completes the set-up process.

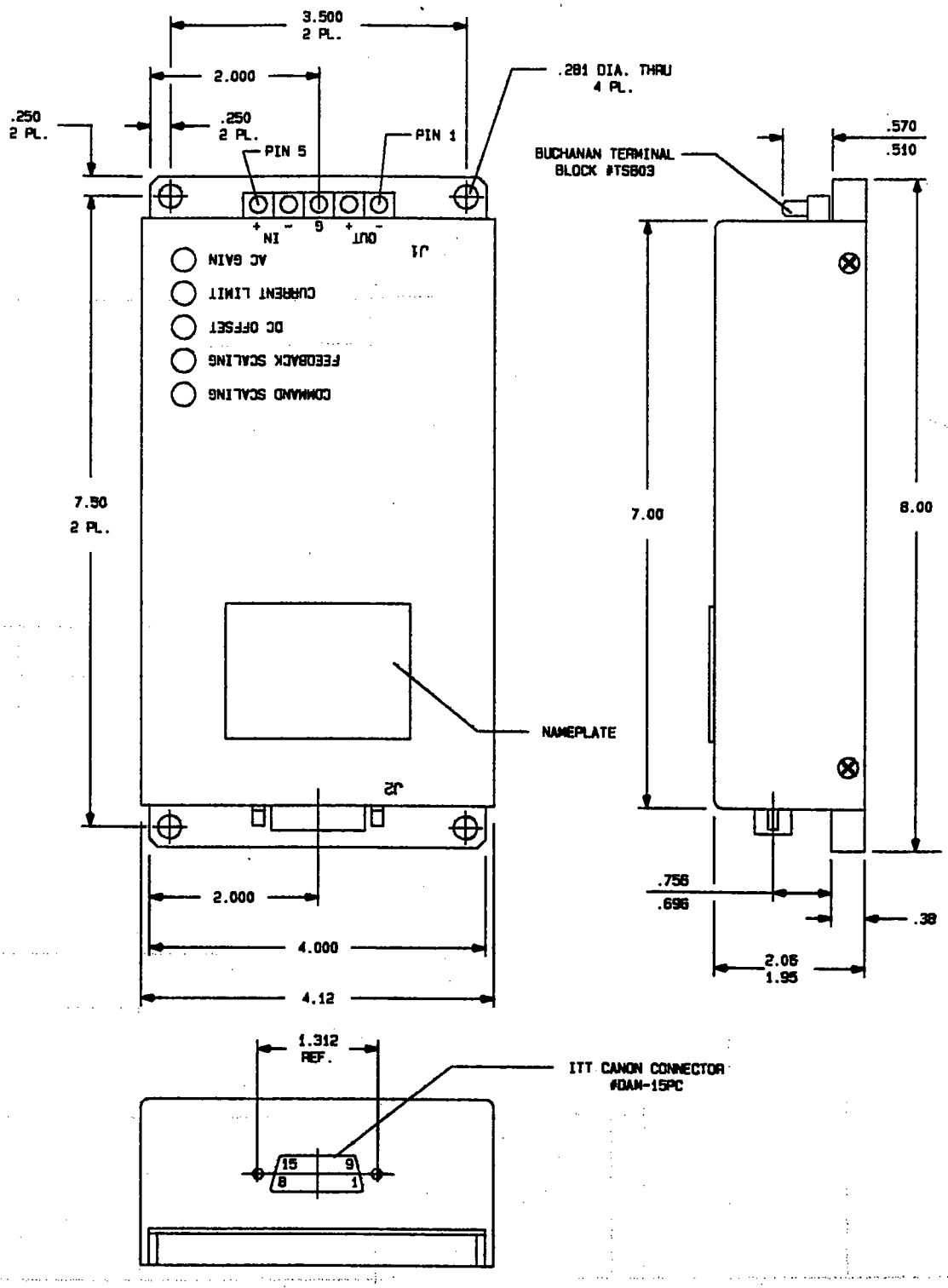


Figure 1: DCM1-07014 Outline Drawing

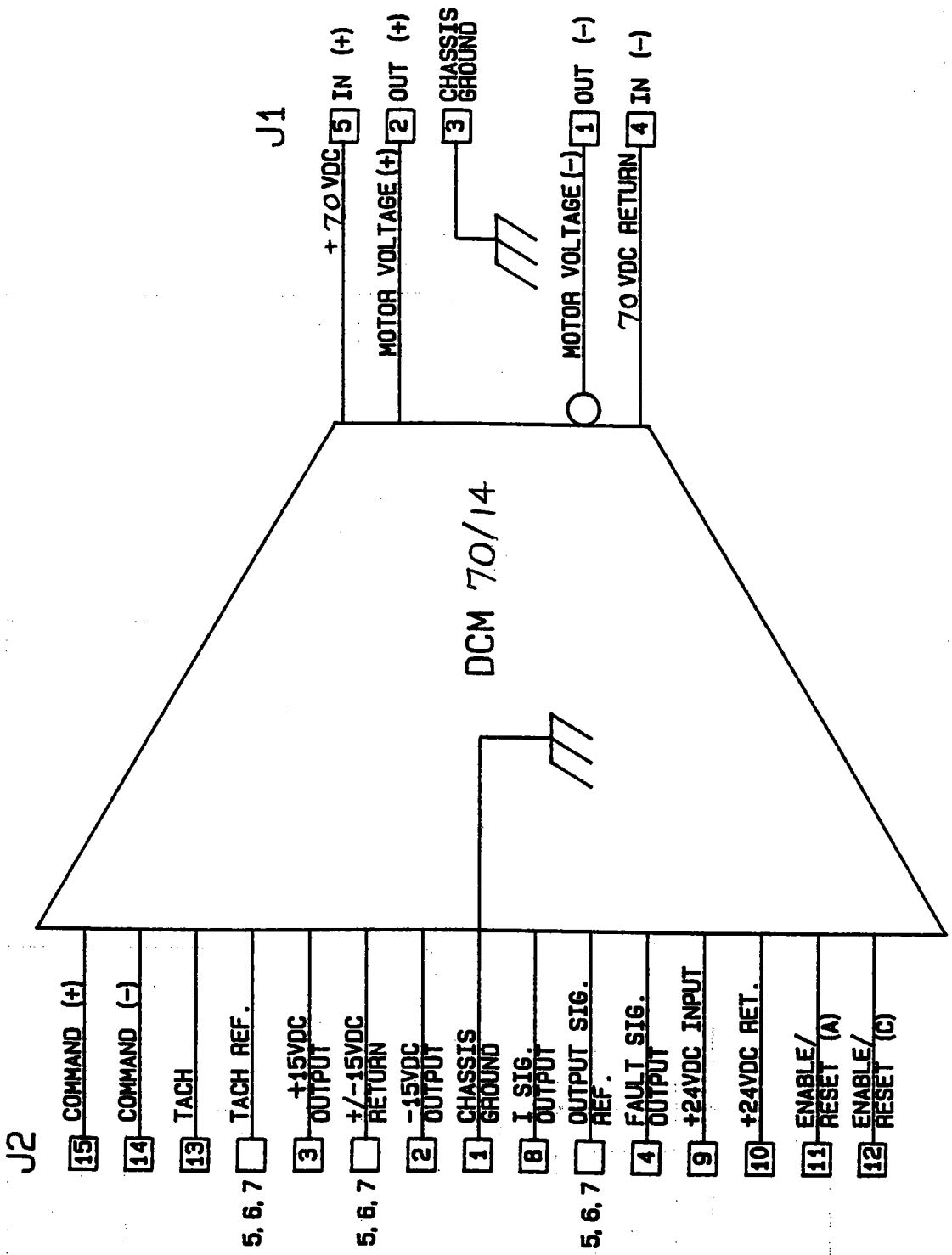
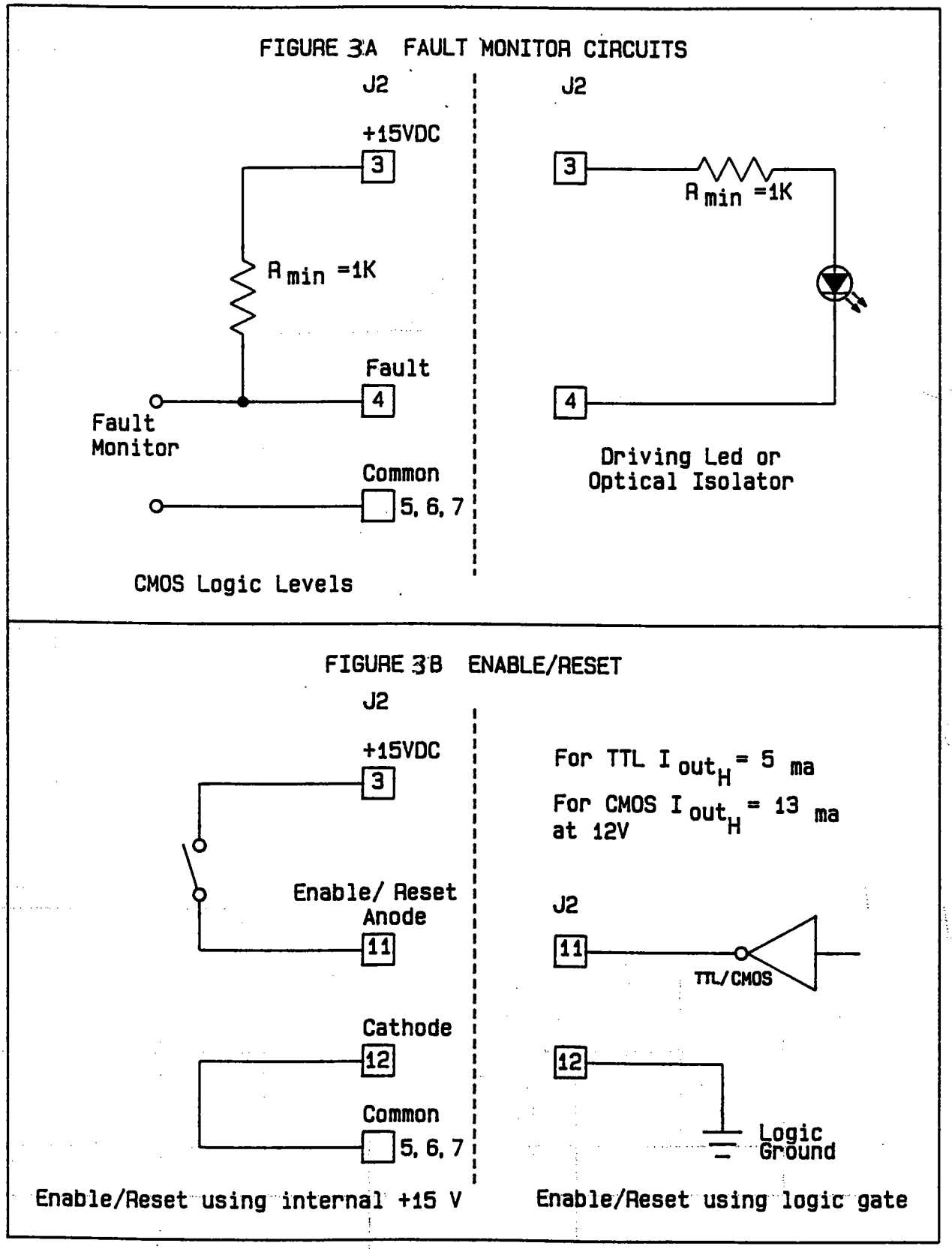


Figure 2: System Outline



Figures 3A and 3B: Typical Configurations

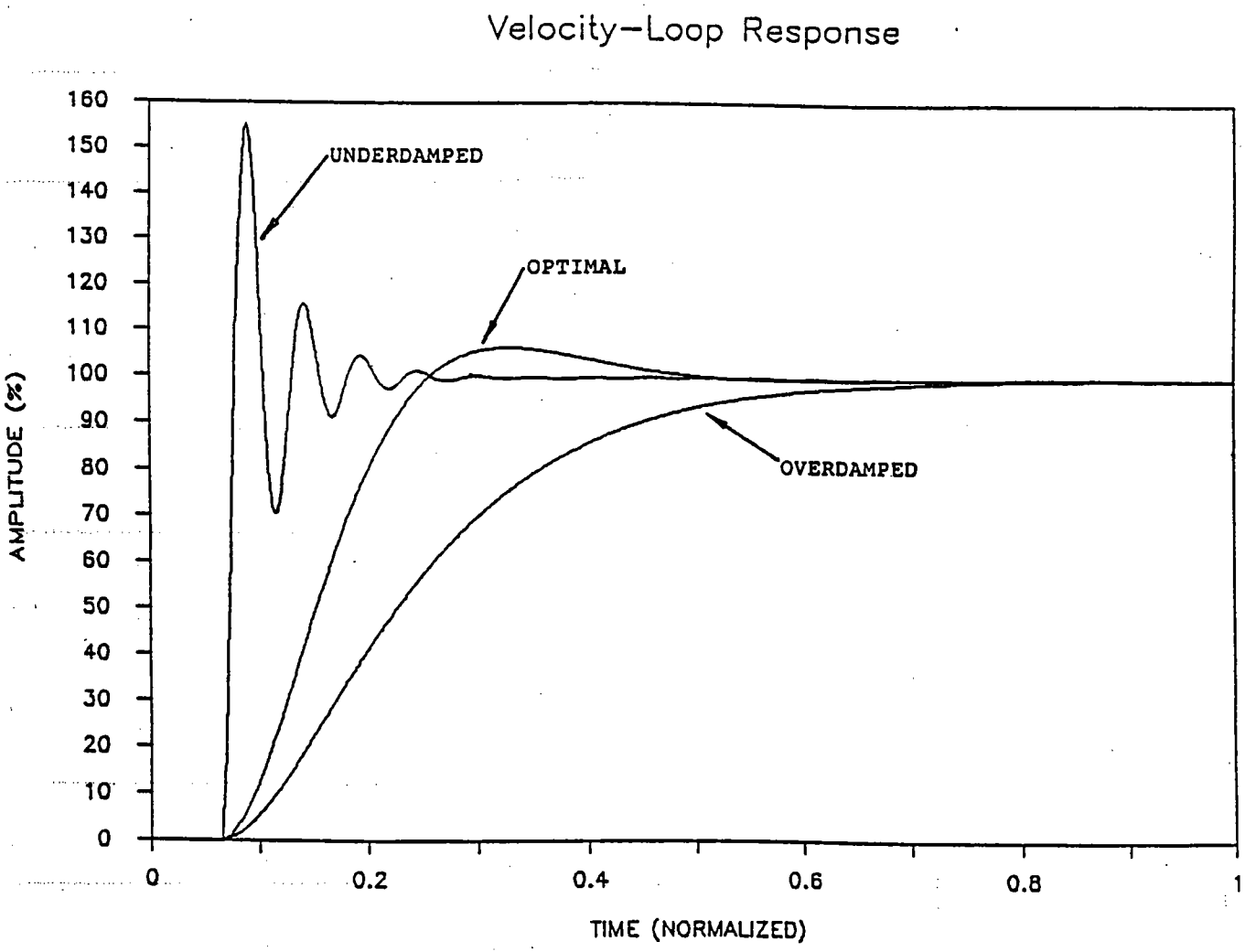


Figure 4: Typical Velocity Response Waveforms