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C Series Drive Operator's Manual
Compumotor Corporation
10/16/87
P/N 88-005712-03

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Chapter 1

1. Introduction

1.1. Description

The C-drive is a low cost, compact microstepping drive designed to control standard two phase hybrid step motors. The drive provides pulse width modulated power at a switching frequency of 20Khz for indaudible operation. NEMA size 17 through NEMA size 42 frame size motors may be used, with the drive providing up to 5 amps of current per phase. Torques from 10 to 800 oz.-in. can be obtained.

The C-drive requires two external, unregulated DC voltages for operation. 9-12 volts is required for logic power, and 12-90 volts for motor power. The Compumotor DC1 power supply will provide both of these voltages. The C-drive will provide up to 5 Amps of current per phase. Motors are normally provided by Compumotor and are the two phase, hybrid (permanent magnet) type. 5, 6, an 8 leaded motors may be used provided the motors inductance does not drop below 1.2 millihenries per 30 volts of motor voltage.[1]

1.2. Warranty and Repairs

The A Drive is warranted against manufacturing defects for one year from the date of purchase. Should you have questions about operating the unit, your local Compumotor representatives an distributors are ready to support you individual needs. Call Compumotor at the number below to get the name and number of the representative or field engineer nearest you.

In the event of drive failure you should:

1. Get the serial number of the defective unit.
2. If the unit is out of warranty you should also prepare a purchase order for the repair costs.
3. Call Compumotor for a return authorization. Outside of California call (800) 358-9068, in California call collect (707) 778-1244.
4. Ship the unit to:
   Compumotor Corporation
   1179 N. McDowell Blvd.
   1.3. Petaluma, CA 94952
   ATTN: RMA#____

---

[1]Measured end to end.

1.4. Features

* 25,000 steps per revolution (2000, 5000 and 10,000 steps per rev. jumper selectable)
* Low cost for OEM and volume applications
* High speed operation (to 3000 RPM with low inductance motors)
* Compact (4.1 by 6.5 inch footprint) enclosure with intergral heatsink
* Fully short circuit and brownout protected
* Optically isolated Step, Direction and Shutdown inputs
* Advanced MOSFET design with intergral microprocessor
* User selectable motor current (to 5 amps per phase)
* Requires external power supply (more than one unit cam be run from a single supply)
* Power Supply can be supplied by user or Compumotor
* 9 pin removable screw terminal connector for motor and power
* 25 pin D connector for data inputs (conforms to Compumotor standard)
* Unipolar drive technique provides excellent high speed torque
* Automatic Standby feature reduces motor current when not moving (jumper selectable)
* Controls a wide range of standard 1.8 degree steppers

Chapter 2

2. SPECIFICATIONS

2.1. Performance:

1. Resolution:

Four resolutions are jumper selectable:

25,000 steps per revolution
10,000 steps per revolution
5,000 steps per revolution
2,000 steps per revolution

2. Accuracy: +/- 4 arc minutes typical (unloaded, unidirectional)

3. Repeatability: +/- 1 step typical (unloaded, unidirectional)

4. Hysterisis: less than 4 steps (unloaded, bidirectional)

5. Speed/Torque: refer to the curves in Appendix D

6. Velocity Range: Depends on motor inductance and supply voltage. >3000 RPM possible with 90V supply and 2.5 mH motors.

2.2. Motors

1. Type: 2 phase hybrid permanent magnet. Normally 200 steps/rev.

2. Inductance: 2.5 mH/phase (center tap to end) minimum. No maximum.

3. Breakdown voltage: 750 VDC minimum.

4. Number of leads: 6 or 8

2.3. Amplifiers

1. Type: 20Khz fixed frequency, variable duty cycle pulse width modulated

2. Number: 2

3. Protection: Short circuit (phase to phase, phase to ground, supply to phase, supply to ground)

Brownout (brownout occurs if logic supply drops below 8.0 volts)

Overtemperature (if internal temperature exceeds 65 degrees C)

Drive shuts down upon any of these conditions.

4. Current rating: 0.15 to 5 amps per phase, jumper selectable

2.4. Power Input

1. Logic Supply: +9 to +12 VDC unregulated, 0.25A max.

2. Motor Supply: +12 (min.) to +90V (max.)

2.5. Command Interface

1. Type: Step and Direction with Shutdown. 25 pin D connector is compatible with most Compumotor indexers.

Step Input: High going pulse, 500 nsec. minimum width Maximum pulse rate is 1 MHz.

Direction: Logic High = CW rotation
Logic Low = normal operation

These three inputs are fully optically isolated and require a TTL type signal to operate (>3,5 VDC high, <0.8 VDC low. User's driver must be capable of providing 20 milliamps max.

2.6. Other Functions

1. Autostandby: Jumper selectable. If selected, motor current ramps to 50% of present value if no step pulses are received for 1 second. Rated current levels are resumed upon receipt of next step pulse.

2. Autorun: Jumper selectable. This feature (used primarily for testing and verification of correct wiring) rotates the motor as approximately 1 revolution/second in a CCW direction if selected,

3. LED: Visible through sheet metal and used to indicate 3 conditions:

Chapter 3

3. UNPACKING & INSTALLATION

3.1. Unpacking

The drive and optional motor should be inspected upon receipt for any signs of damage to its shipping container. Report any such damage to the shipping company as soon as possible. Compumotor cannot be responsible for damage to incurred during transit. The unit should be unpacked and the following items should be present and in good condition:

1. Drive unit
2. Motor (optional)
3. Connector kit
4. This manual
5. Mounting plate

3.2. Installation

3.2.1. Mounting

The C-drive is designed to be convection cooled. The drive should be mounted with the heatsink oriented vertically and in an area that will allow sufficient air to circulate over the heatsink. The heatsink should never be allowed to exceed a temperature of 65 degrees Celcius (150 degrees Farenheit). This will normally not be a problem when the drive is powering 23 and 34 frame size motors. If the unit is driving large motors or is in an enclosed area, providing cooling air over the heatsink may be required to keep the heatsink below 65 degrees C. The drive will automatically shut down if this temperature is exceeded.

3.2.2. Power Supplies

The C-drive requires 2 unregulated DC voltages for operation. The logic supply can vary between 9 and 12 volts DC and each drive uses approximately 250 milliamps of current. An internal brownout circuit will shut down the drive if this voltage falls below 8 volts.

A second voltage is required to power the motor. The C-drive can operate over a wide range of motor voltages. The voltage required is a function of phase inductance and desired top speed. High speed operation (above 1000 RPM) typically requires higher motor voltages. The lowest voltage that produces the desired speed/torque profile is the most desirable. The motor voltage should not exceed 90 volts and may be as low as 12 volts.

The current rating of the supply will vary depending upon the motor used. Because the stepping motor, when switched, circulates currents in and out of the power supply, the phase currents are large compared to the current actually drawn through the supply. A 4 amp/phase motor will pull about 1 amp through the supply ("out of the wall") on a continuous basis. This means that the transformer, rectifier and filter capacitors for the motor supply do not need to be very large for most applications. This means that the C-drive will operate from modestly sized power supplies due to its efficient power conversion. Bulky dropping resistors are not needed.

3.2.2.1. Power Wiring

The logic supply and motor supply wires should be at least 18 ga. for most applications. The return, or ground wires for each supply should be connected together only at the drive. This prevents motor current spikes from entering the unit's logic ground. The pair of wires from the logic supply should be shielded and that shield should be connected to earth ground. The pair of wires from the motor supply should also be shielded (separate shield than the logic supply) and that shield connected to earth ground. Refer to Appendix A for pinout information.

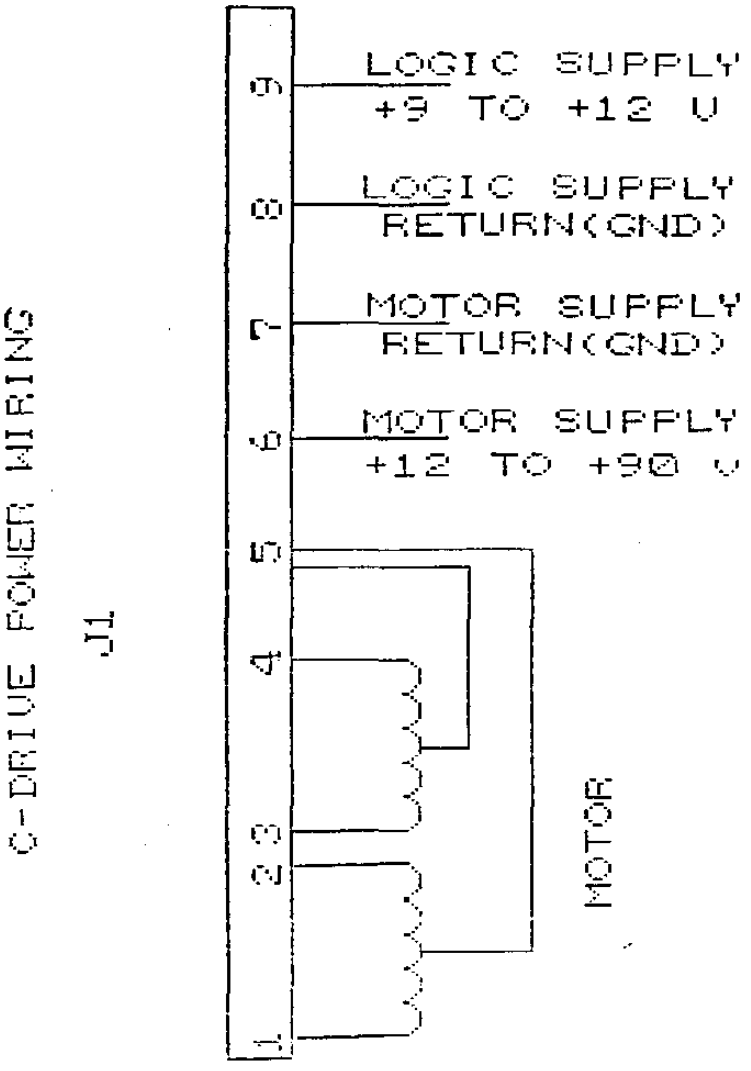
3.3. Motor Compatibility

Most standard 6 or 8 lead 1.8 degree, two phase, hybrid stepping motors will operate with the C-drive. Phase current is jumper selectable in 32 inrements from .15 to 5 amps. This refers to the center tap-to-end current. Most motor manufacturers specify current in this manner for 6 or 8 lead motors.

Step motors are available in a variety of phase current and inductance ratings. The correct motor winding depends on the individual application. Lower inductance windings offer better high speed performace at increased current. These motors will generally operate from lower voltage power supplies than high inductance motors, but will produce higher heat if operated at high voltages and speeds. Higher inductance motors provide high torques at low currents, but have limited speed. If you have questions concerning motor selection, call us and talk to an Application Engineer at:

800-358-9068 (toll free, except California)
Call 707-778-1244 collect in California

Figure 3-1 - Motor and Power Wiring



NOTE:

Minimum phase inductance (center to end) is 2.5 mH.

3.3.1. Motor Wiring

Motor wires should be of a gauge consistent with the current requirements of the motor being used. The wires should be shielded and the shield should be connected to earth ground. This will help minimize radiated EMI (electro-magnetic interference) from the drives 20 kHz switching amplifiers. Refer to Appendix A for pinout information. The following chart describes the wire colors and pin assignments for C Series step motors:

C57 and C83:

Pin #	Function	Standard 6 Lead Motor	Standard 8 Lead Motor
1	Phase 2	Red	Orange
2	Phase 2	Red/White	Black
3	Phase 1	Green	Red
4	Phase 1	Green/White	Yellow
5	Center taps	Black & White	Orange/White Black/White and Red/White and Yellow/White

C106:

Pin #	Function	Standard 6 Lead Motor
1	Phase 1	Red
2	Phase 1	Black
3	Phase 2	Yellow
4	Phase 2	Green
5	Center Taps	Brown & Orange

CT25-30 and CT32-39:

Pin #	Function	Standard 6 Lead Motor
1	Phase 1	Red
2	Phase 1	Yellow
3	Phase 2	Green
4	Phase 2	Blue
5	Center Taps	Brown/Black/White and Violet

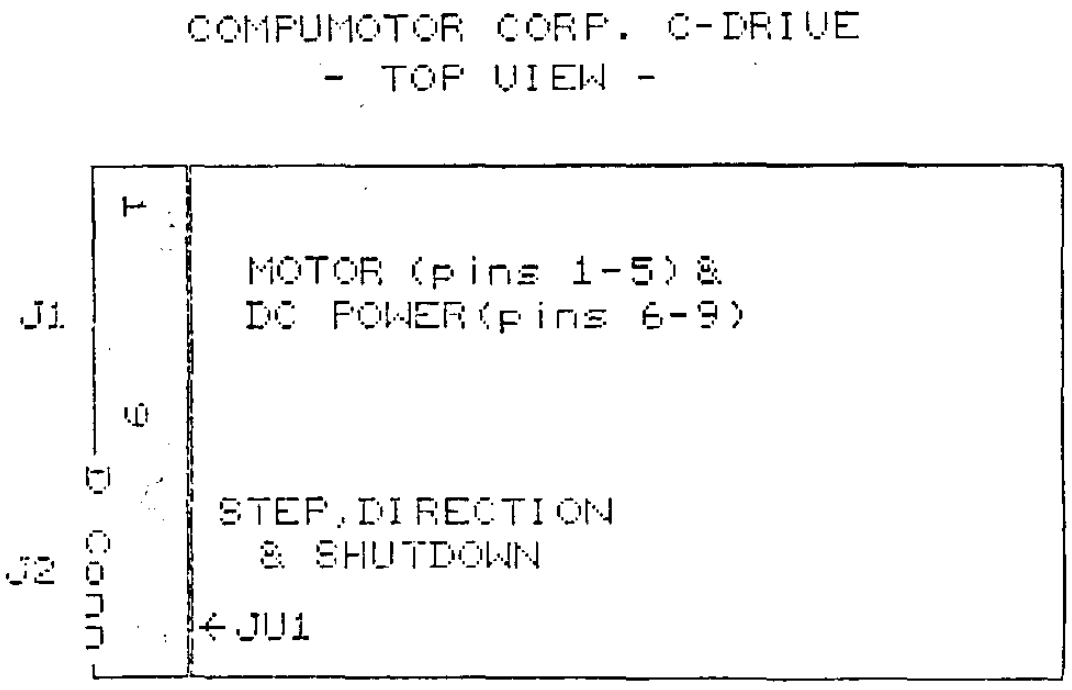
3.4. Grounding

The C-drive chassis should be connected to a reliable earth ground for safety reasons. There is a grounding screw/star washer combination on the side of the drive available for this purpose. This screw should be removed and a ring-tongue terminal or lug connected through a wire to earth ground should be placed under the screw and the screw should be re-inserted.

3.5. Jumper Selection

There are 9 "Berg -Stik" type jumpers at the end of the circuit board behind J2 (see figure 3-2). These must be set by the user to match the motor size (see table 3-1), and the application requirements. These jumpers control motor current, resolution (table 3-2), standby, and the self test function.

Figure 3-2 - Connector and Jumper Location



Note:

Drive only (-DO) units are shipped fromm the factory with all jumpers removed. There are 10 jumpers supplied in the C-series ship kit. For current settings of Compumotor supplied motors refer to table 3-1.

The recommended current setting will provide smooth operation at the torques shown in the speed/torque curves in appendix. If enhanced smoothness is required, reducing the current 10-15% will improve low speed smoothness at the expense of torque. Increasing the current to the motor is not recommended. Current can be increased up to 9% if additional torque is needed. DO NOT use this configuration without first contacting a Compumotor Applications Engineer.

Table 3-1 Current Settings

Phase Current - JU1 through JU5					(0 = OFF / 1 = ON)
Current(amps/phase)	JU1	JU2	JU3	JU4	JU5
.14	0	0	0	0	0
.31	0	0	0	0	1
.47	0	0	0	1	0
.62	0	0	0	1	1
.78	0	0	1	0	0
.94	0	0	1	0	1
1.09	0	0	1	1	0
1.25	0	0	1	1	1
1.41	0	1	0	0	0
1.56	0	1	0	0	1
1.72	0	1	0	1	0
1.87	0	1	0	1	1
2.03	0	1	1	0	0
2.19	0	1	1	0	1
2.34	0	1	1	1	0
2.50	0	1	1	1	1
2.66	1	0	0	0	0
2.81	1	0	0	0	1
2.97	1	0	0	1	0
3.12	1	0	0	1	1
3.28	1	0	1	0	0
3.44	1	0	1	0	1
3.59	1	0	1	1	0
3.75	1	0	1	1	1
3.91	1	1	0	0	0
4.06	1	1	0	0	1
4.22	1	1	0	1	0
4.37	1	1	0	1	1
4.53	1	1	1	0	0
4.68	1	1	1	0	1
4.84	1	1	1	1	0
5.00	1	1	1	1	1

Compumotor Supplied Motor - Recommended Settings

Model	Current	JU1	JU2	JU3	JU4	JU5
C57-51	.94 Amps/Phase	0	0	1	0	1
C57-83	1.56 Amps/Phase	0	1	0	0	1
C57-102	1.72 Amps/Phase	0	1	0	1	0
C83-62	2.03 Amps/Phase	0	1	1	0	0
C83-93	2.50 Amps/Phase	0	1	1	1	1
C83-135	3.44 Amps/Phase	1	0	1	0	1
C106-120	4.53 Amps/Phase	1	1	1	0	0
C106-178	5.00 Amps/Phase	1	1	1	1	1

Table 3-2 CT Current Settings

Phase Current - JU1 through JU5					(0 = OFF / 1 = ON)
Current(amps/phase)	JU1	JU2	JU3	JU4	JU5
0.03	0	0	0	0	0
0.06	0	0	0	0	1
0.09	0	0	0	1	0
0.12	0	0	0	1	1
0.16	0	0	1	0	0
0.19	0	0	1	0	1
0.22	0	0	1	1	0
0.25	0	0	1	1	1
0.28	0	1	0	0	0
0.31	0	1	0	0	1
0.34	0	1	0	1	0
0.37	0	1	0	1	1
0.41	0	1	1	0	0
0.44	0	1	1	0	1
0.47	0	1	1	1	0
0.50	0	1	1	1	1
0.53	1	0	0	0	0
0.56	1	0	0	0	1
0.59	1	0	0	1	0
0.62	1	0	0	1	1
0.66	1	0	1	0	0
0.69	1	0	1	0	1
0.72	1	0	1	1	0
0.75	1	0	1	1	1
0.78	1	1	0	0	0
0.81	1	1	0	0	1
0.84	1	1	0	1	0
0.87	1	1	0	1	1
0.91	1	1	1	0	0
0.94	1	1	1	0	1
0.97	1	1	1	1	0
1.00	1	1	1	1	1

Motor Size	JU1	JU2	JU3	JU4	JU5
CT32-39	1	0	0	1	1
CT25-30	0	1	1	0	0
CT27-38	0	1	0	0	1

Table 3-3 Motor Resolution

Resolution(Steps/Rev)	JU8	JU9
25,000	1	1
10,000	1	0
5,000	0	1
2,000	0	0

Note:

All Resolutions are in steps per revolution, and assume the use of a 1.8° (200 step/revolution) hybrid permanent magnet stepper motor.

Auto Standby

JU7

1 = Auto Standby disabled

0 = Auto Standby enabled. When enabled, the C-drive will automatically reduce the current to the motor by 50% if no step pulses are received for 1 second. Full current will be restored instantaneously upon receipt of the first step pulse. The status of JU7 is checked only at power up.

Auto Test

JU6

1 = Normal operation

0 = Test mode enable (normal operation defeated). In this mode, the motor will rotate @ approximately 1 revolution per second. The status of JU6 is checked only at power up.

Appendix A C-Drive Connector Pinouts

Connector J1 (See figure 3-) provides screw terminal connections to the DC power supply and to the motor. Pinouts and Compumotor wire colors are as follows:

J1 - Motor and Power

Pin	Description
1	Phase 2+ motor output (CT series motors = Red) (C57/C83 series motors = Green) (C106 series motors = Red)
2	Phase 2- motor output (CT series motors = Yellow) (C57/C83 series motors = Green/White) (C106 series motors = Black)
3	Phase 1+ motor output (CT series motors = Green) (C57/C83 series motors = Red) (C106 series motors = Yellow)
4	Phase 1- motor output (CT series motors = Blue) (C57/C83 series motors = Red/White) (C106 series motors = Green)
5	Center Tap. The center tap wires from both phases should be connected to this terminal. (CT series motors = Brown, Black, Violet, White) (C57/C83 series motors = White, Black) (C106 series motors = Orange, Brown)
6	+12 to +90 VDC input (motor supply).
7	Motor supply gnd.
8	Logic supply Gnd
9	+9 to +12 VDC logic supply

Appendix A (cont.)

Shielding

Motor leads should be shielded to reduce emitted EMI. This shield must be returned to EARTH GROUND, NOT DC GROUND.

Power supply wires should also be shielded. A greater degree of noise immunity will be attained if logic and power lines are shielded seperately. This shield must be returned to EARTH GROUND, NOT DC GROUND.

NOTE:
THE COMPUMOTOR DC1 POWER SUPPLY'S PINOUT IS NOT IDENTICAL TO THE PINOUT OF J1. CLOSE ATTENTION IS REQUIRED WHEN WIRING THE DC1 TO THE C-DRIVE. PINOUTS OF THE DC1 ARE INDICATED ON THE REAR OF THE POWER SUPPLY UNIT.

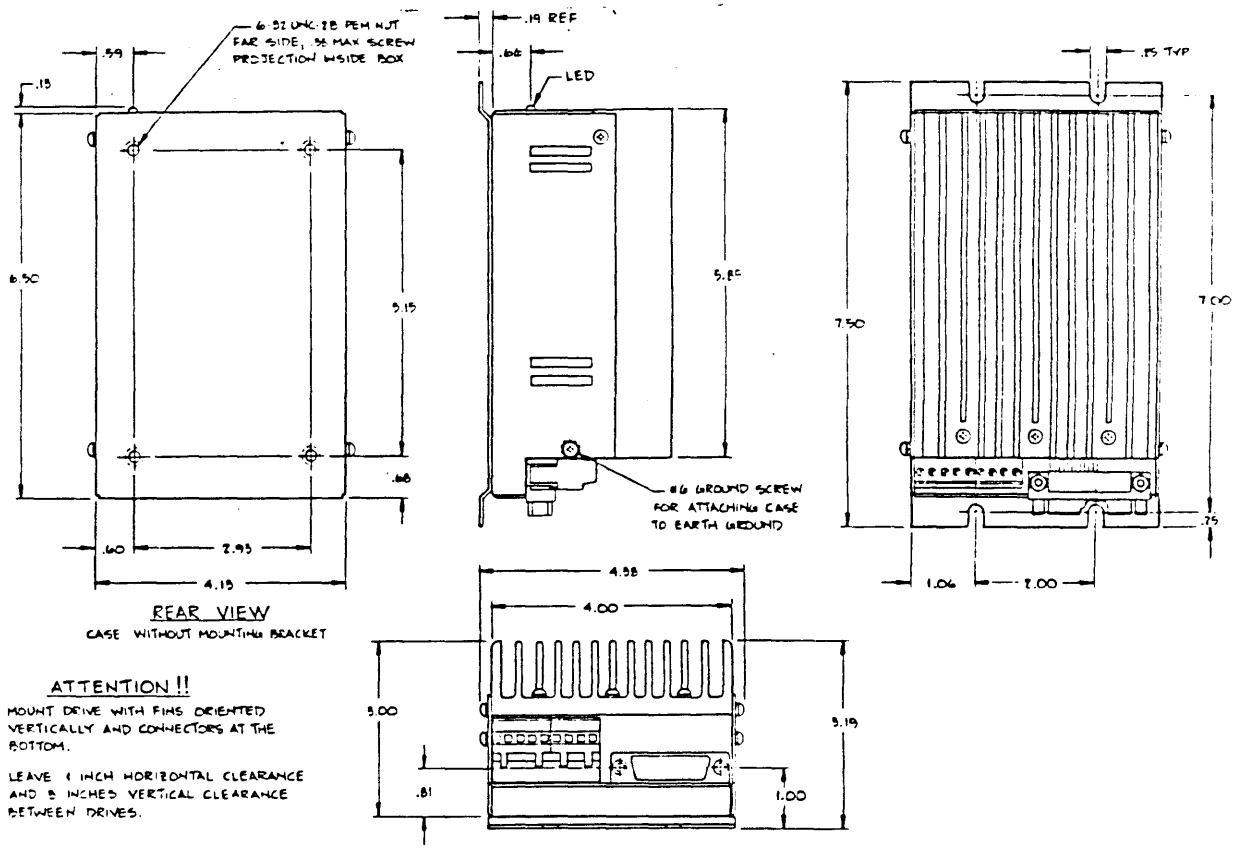
J2 Step, Direction, and Shutdown Inputs

J2 is a 25 pin "D" style connector providing all indexer control inputs. All inputs are optically isolated, and require 20 ma to turn on @ a minimum of 3.5 volts (5.5 volts max). Pinout is as follows:

Pin	Description
1	Step Input (positive going with reference to pin 14).
14	Step Return.
2	Direction Input (positive going with reference to pin 15).
15	Direction Return.
16	Shutdown Input (positive going with reference to pin 17).
17	Shutdown Return.

The C-Drive steps the motor one microstep for every pulse received on it's step input. The state of the Direction input at the time the first step pulse is received determines the rotational direction of the motor shaft. The Direction input must be stable for at least 20 microseconds before receipt of the first step pulse. Shutdown will remove all current from the motor windings when enabled, allowing the shaft to freewheel.

Appendix B Dimensional Drawings



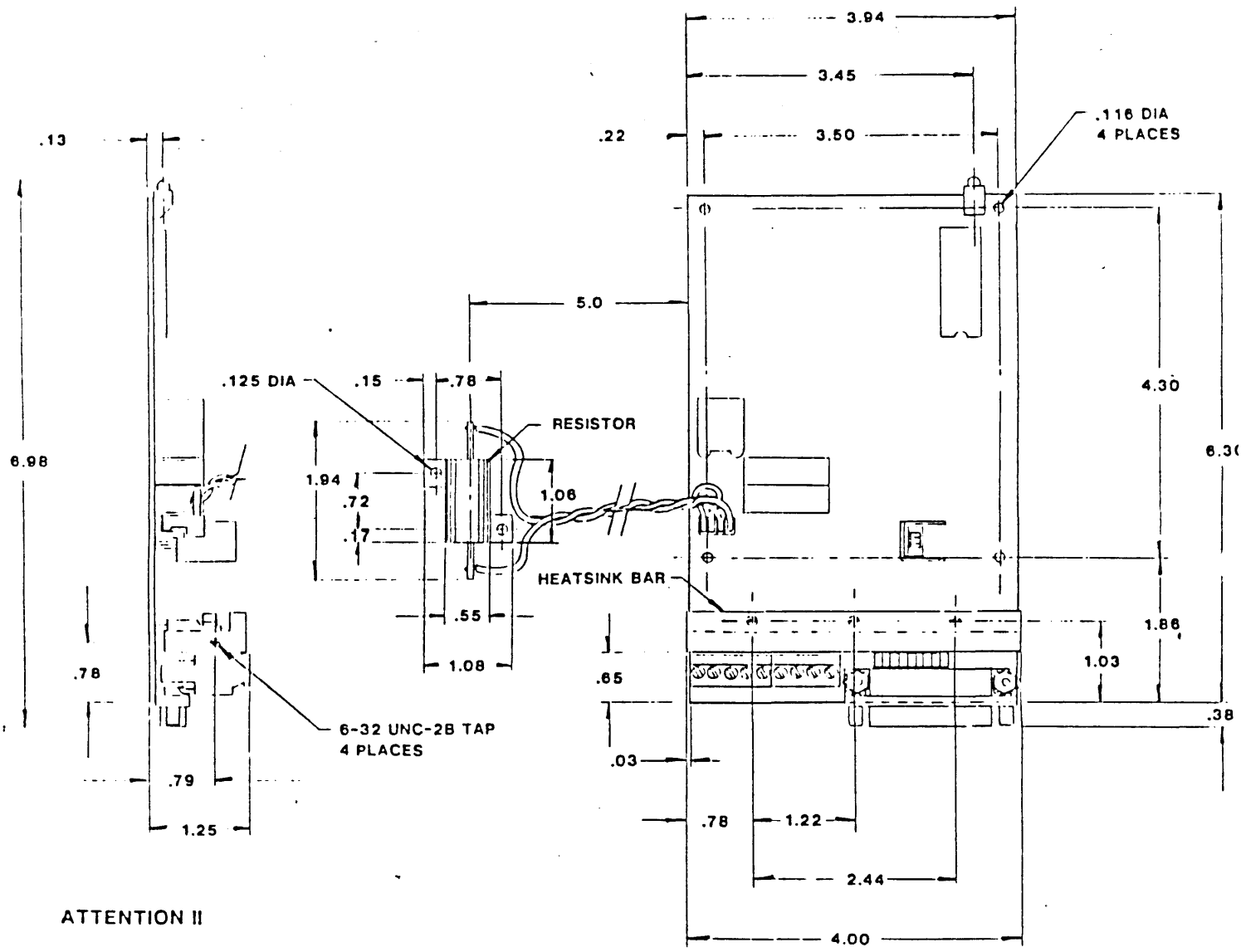
REAR VIEW
CASE WITHOUT MOUNTING BRACKET

ATTENTION !!

MOUNT DRIVE WITH FINS ORIENTED VERTICALLY AND CONNECTORS AT THE BOTTOM.

LEAVE 1 INCH HORIZONTAL CLEARANCE AND 3 INCHES VERTICAL CLEARANCE BETWEEN DRIVES.

Appendix B (cont.)

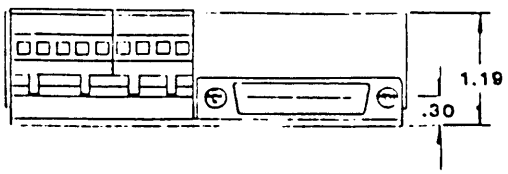


ATTENTION !!

RESISTOR MUST BE MOUNTED TO A THERMALLY CONDUCTIVE HEATSINK SUCH THAT THE RESISTOR HEATSINK CASE TEMPERATURE DOES NOT EXCEED 80 DEGREES CELSIUS

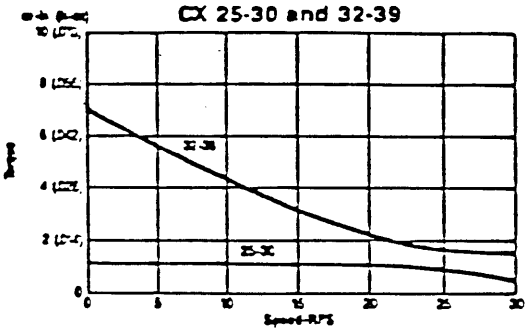
HEATSINK BAR MUST BE MOUNTED TO A THERMALLY CONDUCTIVE HEATSINK SUCH THAT THE HEATSINK BAR TEMPERATURE DOES NOT EXCEED 70 DEGREES CELSIUS

SCREWS USED FOR MOUNTING THE HEATSINK BAR TO THE HEATSINK THAT PROJECT MORE THAN .19 INCHES INTO THE HEATSINK BAR MAY RESULT IN AN ELECTRICAL SHORT TO THE TABS OF THE POWER TRANSISTORS

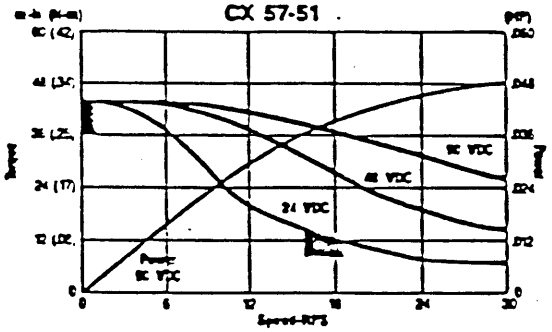


Appendix C Speed/Torque Curves

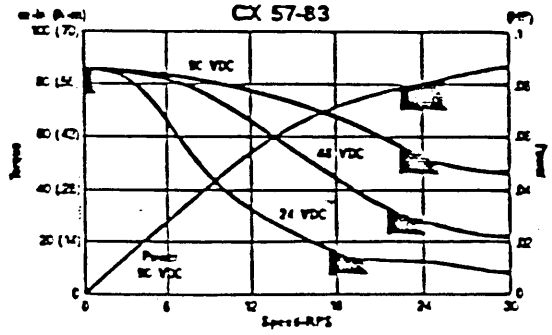
CX 25-30 and 32-39



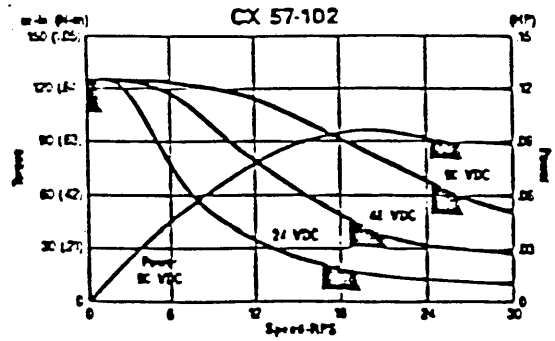
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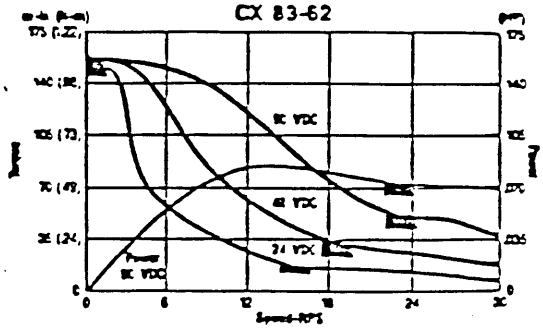
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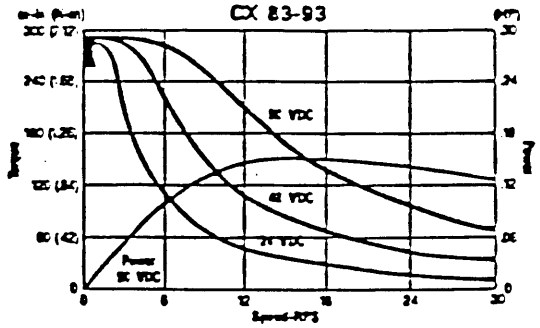
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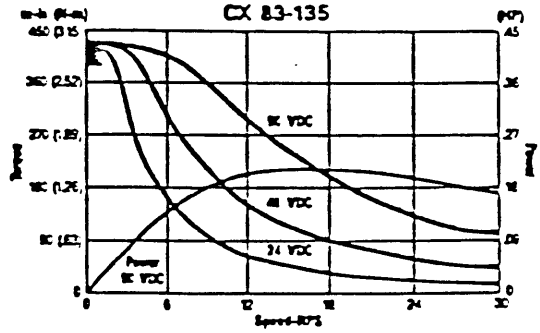
CX 83-62



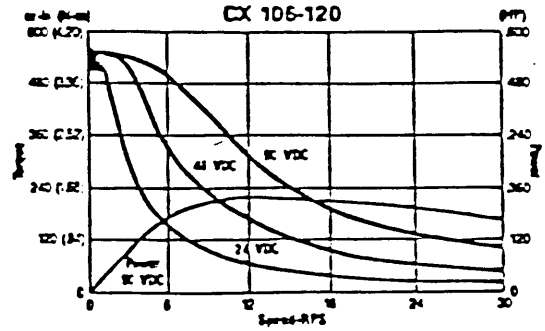
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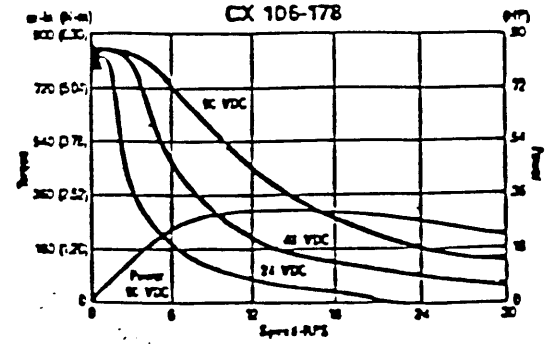
CX 83-135



CX 106-120



CX 106-178



Quick Reference Guide

Motor Wiring:

C57 and C83:

Pin #	Function	Standard 6 Lead Motor	Standard 8 Lead Motor
1	Phase 2	Red	Orange
2	Phase 2	Red/White	Black
3	Phase 1	Green	Red
4	Phase 1	Green/White	Yellow
5	Center taps	Black & White	Orange/White Black/White and Red/White and Yellow/White

C106:

Pin #	Function	Standard 6 Lead Motor
1	Phase 1	Red
2	Phase 1	Black
3	Phase 2	Yellow
4	Phase 2	Green
5	Center Taps	Brown & Orange

CT25-30 and CT32-39:

Pin #	Function	Standard 6 Lead Motor
1	Phase 1	Red
2	Phase 1	Yellow
3	Phase 2	Green
4	Phase 2	Blue
5	Center Taps	Brown/Black/White and Violet

Motor Resolutions

Resolution(Steps/Rev)	JU8	JU9
25,000	1	1
10,000	1	0
5,000	0	1
2,000	0	0

Current Settings:

Phase Current - JU1 through JU5 (0 = OFF / 1 = ON)

Current(amps/phase)	JU1	JU2	JU3	JU4	JU5
.14	0	0	0	0	0
.31	0	0	0	0	1
.47	0	0	0	1	0
.62	0	0	0	1	1
.78	0	0	1	0	0
.94	0	0	1	0	1
1.09	0	0	1	1	0
1.25	0	0	1	1	1
1.41	0	1	0	0	0
1.56	0	1	0	0	1
1.72	0	1	0	1	0
1.87	0	1	0	1	1
2.03	0	1	1	0	0
2.19	0	1	1	0	1
2.34	0	1	1	1	0
2.50	0	1	1	1	1
2.66	1	0	0	0	0
2.81	1	0	0	0	1
2.97	1	0	0	1	0
3.12	1	0	0	1	1
3.28	1	0	1	0	0
3.44	1	0	1	0	1
3.59	1	0	1	1	0
3.75	1	0	1	1	1
3.91	1	1	0	0	0
4.06	1	1	0	0	1
4.22	1	1	0	1	0
4.37	1	1	0	1	1
4.53	1	1	1	0	0
4.68	1	1	1	0	1
4.84	1	1	1	1	0
5.00	1	1	1	1	1

Compumotor Supplied Motor - Recommended Settings

Model	Current	JU1	JU2	JU3	JU4	JU5
C57-51	.94 Amps/Phase	0	0	1	0	1
C57-83	1.56 Amps/Phase	0	1	0	0	1
C57-102	1.72 Amps/Phase	0	1	0	1	0
C83-62	2.03 Amps/Phase	0	1	1	0	0
C83-93	2.50 Amps/Phase	0	1	1	1	1
C83-135	3.44 Amps/Phase	1	0	1	0	1
C106-120	4.53 Amps/Phase	1	1	1	0	0
C106-178	5.00 Amps/Phase	1	1	1	1	1

Phase Current - JU1 through JU5 (0 = OFF / 1 = ON)

Current(amps/phase)	JU1	JU2	JU3	JU4	JU5
0.03	0	0	0	0	0
0.06	0	0	0	0	1
0.09	0	0	0	1	0
0.12	0	0	0	1	1
0.16	0	0	1	0	0
0.19	0	0	1	0	1
0.22	0	0	1	1	0
0.25	0	0	1	1	1
0.28	0	1	0	0	0
0.31	0	1	0	0	1
0.34	0	1	0	1	0
0.37	0	1	0	1	1
0.41	0	1	1	0	0
0.44	0	1	1	0	1
0.47	0	1	1	1	0
0.50	0	1	1	1	1
0.53	1	0	0	0	0
0.56	1	0	0	0	1
0.59	1	0	0	1	0
0.62	1	0	0	1	1
0.66	1	0	1	0	0
0.69	1	0	1	0	1
0.72	1	0	1	1	0
0.75	1	0	1	1	1
0.78	1	1	0	0	0
0.81	1	1	0	0	1
0.84	1	1	0	1	0
0.87	1	1	0	1	1
0.91	1	1	1	0	0
0.94	1	1	1	0	1
0.97	1	1	1	1	0
1.00	1	1	1	1	1

Motor Size	JU1	JU2	JU3	JU4	JU5
CT32-39	1	0	0	1	1
CT25-30	0	1	1	0	0
CT27-38	0	1	0	0	1

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