

1000 SERIES CONTROL

DART

CONTROLS

Instruction Manual

Variable Speed Control



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Section 1 General Information

1.1 Warranty

Dart Controls, Inc. (DCI) warrants its products to be free from defects in material and workmanship. The exclusive remedy for this warranty is DCI factory replacement of any part or parts of such product which shall within 12 months after delivery to the purchaser be returned to DCI factory with all transportation charges prepaid and which DCI determines to its satisfaction to be defective. This warranty shall not extend to defects in assembly by other than DCI or to any article which has been repaired or altered by other than DCI or to any article which DCI determines has been subjected to improper use. DCI assumes no responsibility for the design characteristics of any unit or its operation in any circuit or assembly. This warranty is in lieu of all other warranties, express or implied; all other liabilities or obligations on the part of DCI, including consequential damages, are hereby expressly excluded.

NOTE: Carefully check the control for shipping damage. Report any damage to the carrier immediately. Do not attempt to operate the drive if visible damage is evident to either the circuit or to the electronic components.

All information contained in this manual is intended to be correct, however information and data in this manual are subject to change without notice. DCI makes no warranty of any kind with regard to this information or data. Further, DCI is not responsible for any omissions or errors or consequential damage caused by the user of the product. DCI reserves the right to make manufacturing changes which may not be included in this manual.

1.2 Warning

Improper installation or operation of this control may cause injury to personnel or control failure. The control must be installed in accordance with local, state, and national safety codes. Make certain that the power supply is disconnected before attempting to service or remove any components!!! If the power disconnect point is out of sight, lock it in disconnected position and tag to prevent unexpected application of power. Only a qualified electrician or service personnel should perform any electrical troubleshooting or maintenance. At no time should circuit continuity be checked by shorting terminals with a screwdriver or other metal device.

Section 2 Introduction

2.1 Introduction

We at Dart Controls, Inc. appreciate your purchase of a 1000 Series variable speed AC motor control. When properly installed, operated, and maintained, the unit will provide a lifetime of reliable, trouble-free operation.

The 1000 Series represents an innovative new concept in AC motor control. In fact, the 1000 Series offers a broad range of control flexibility normally found only in "high end" AC drives. The use of a sophisticated microprocessor makes it possible to produce high torque at low speeds with smooth rotation for incredible motor performance. The latest generation IGBTs used in the power section offer the added benefit of low noise operation. Following is a partial list of the advanced control features found in the 1000 Series:

- Solid state reversing
- 2-wire or 3-wire control inputs
- Digital output for "Drive Fault"
- Versatile mounting configurations
- Constant torque or variable torque V/Hz patterns
- 100/120 Hz maximum frequency
- +15 Vdc power supply for external devices
- DC braking for quick stop
- 50°C ambient rating
- Triple marked for worldwide use (UL, cUL, CE)
- External inputs for drive enable and fault reset
- Electronic motor overload protection
- Plugable Terminal Strip

2.2 Agency Listings



- UL/cUL recognized under Standard UL508C, File # E204254/ C22.2 No. 14-M91
- CE conformant to EN50081-2: '93, EN50082-2: '95, LVD 73/23/EEC and EMC 89/336/EEC as amended by 92/31/EEC & 93/68/EEC

2.3 Safety/Hazards

The safety of personnel is of utmost importance to Dart Controls, Inc. Variable speed drives (also referred to as drives) and associated option units can be hazardous if they are not correctly installed, maintained and operated.

The manufacturer accepts no liability for any consequences resulting from negligence or incorrect installation or adjustment of the equipment or from mismatching the drive with the motor.

The contents of this manual are believed to be correct at the time of printing. In the interest of a policy of continuous development and improvement, the manufacturer reserves the right to change the specification of the drive or its performance, or the contents of this manual without notice.

WARNING!

The installer is responsible for complying with all relevant regulations, such as national wiring regulations and accident prevention regulations. Particular attention must be given to the cross-sectional areas of conductors, the selection of fuses or other protection, and protective earth/ground connections.

WARNING!

The voltages in the power cables and certain parts of the drive can result in death. Whenever the drive has been used it must be isolated and disconnected for 5 minutes before any work commences. The drive must be connected to the system earth/ground by the earth/ground connection. (See Power Connections)

WARNING!

Drives are intended as components for incorporation into electrical control systems or machines. It is the responsibility of the installer to ensure that the drive is installed safely and in accordance with any regulations which apply to the end product at the place of use, for example regarding safety or electromagnetic compatibility. To ensure mechanical safety, additional safety devices such as electro-mechanical interlocks may be required.

DANGER!

Only qualified electrical personnel familiar with the construction and operation of this equipment and the hazards involved should install, adjust, operate, and/or service this equipment. Read and understand this manual in its entirety before proceeding. Failure to observe this precaution could result in severe bodily injury or loss of life.

Section 3 Features

3.1 Protection Features

- Overtemperature
- Undertemperature
- Overvoltage
- Undervoltage
- Input AC MOV
- Overcurrent @ 200%
- Electronic Timed Overload ('Ixt')

Section 4 Specifications

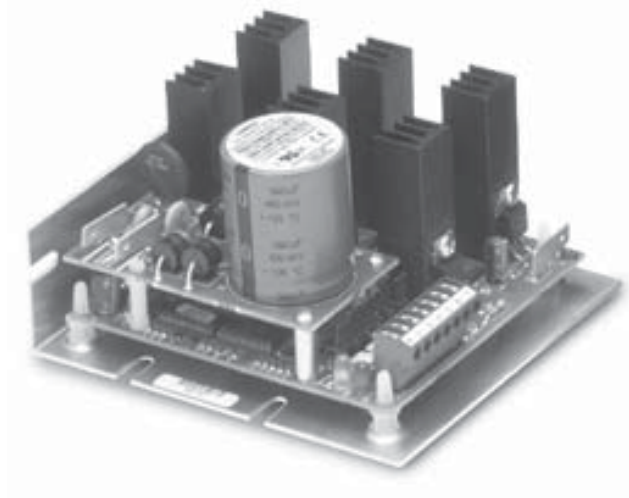
4.1 Specifications

| | 220V 0.5HP Model | 110V Model 0.25HP/0.5HP |
|--|---|----------------------------|
| Power Rating Up to HP (kW) | 0.5 (0.37) | 0.25 (0.19)/0.5 (0.37) |
| AC Input Voltage VAC Single Phase $\pm 10\%$ | 220 | 110 |
| AC Input Frequency | 45 - 65 Hz | |
| AC Input Current (Worst Case 100% load) | 5.0A rms | 6.1A rms/12.2A rms |
| AC Output Voltage | 0 to Input Voltage Three Phase | |
| AC Output Frequency | 0 to 50/60 Hz, or 0 to 100/120 Hz | |
| AC Output Current (100%) | 2.3A rms | 1.4A rms/2.8A rms |
| Overload Capacity (150% for 60 seconds) | 3.5A rms | 2.3A rms/3.5A rms |
| PWM Switching Frequency | 8 kHz Double Edge Modulation | |
| Mounting | Chassis, NEMA 1, AND NEMA 4/12 | |
| Ambient Operating Temperature | 0°C to +50°C (32°F to 122°F) | |
| Storage Temperature | -40°C to +65°C (-40°F to 149°F) | |
| Weight (Chassis) | 0.58lbs (0.26kg) excludes optional brackets | |
| Physical Dimensions (Chassis) | 4.00"x4.25"x2.65" (10.2cm x 10.8cm x 6.7cm) | |
| Certification | UL, cUL & CE | |
| Operating Modes | Speed Mode, 2-wire and 3-wire Modes | |
| Stop Modes | Ramp Stop, or DC Injection | |
| LEDs | Power ON, Fault | |
| Load | Constant Torque or Fan (Variable Torque) | |

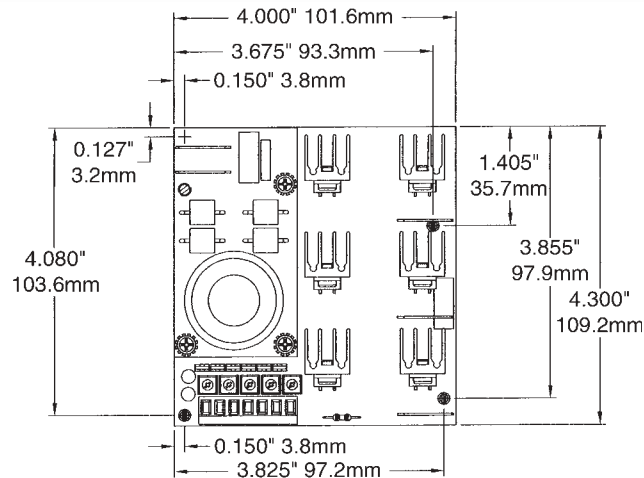
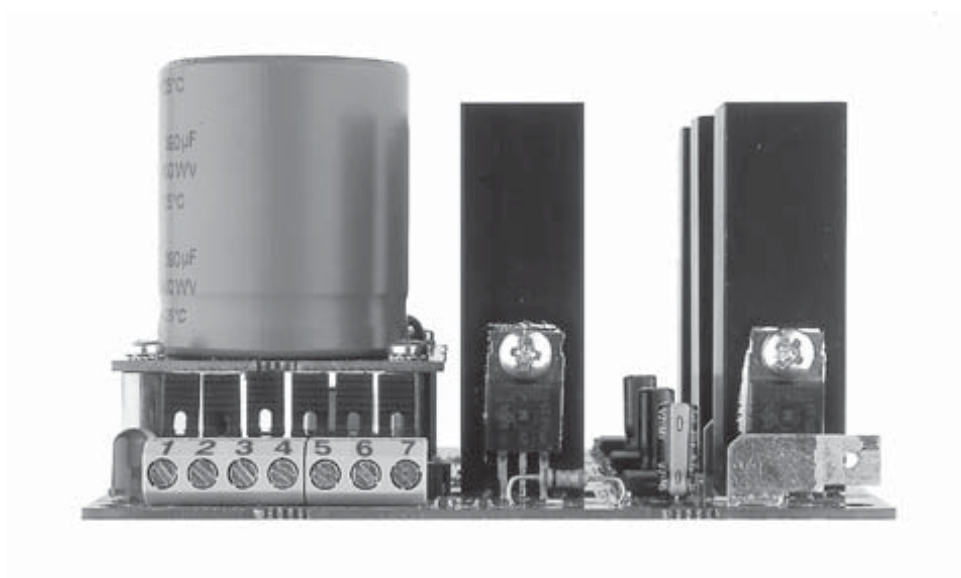
Section 5

Dimensions and Mounting Instructions

5.1 Chassis



| | Width | Length | Depth | Weight (lbs.) |
|-------------|-------|--------|-------|---------------|
| Inches | 2.70 | 4.00 | 4.30 | 0.60 |
| Millimeters | 68.7 | 101.6 | 109.2 | 0.60 |



MOUNTS ON DIA. 0.157" (4mm)
HOLES, 4 PLACES. TOTAL
HEIGHT 2.70" (68.6mm)

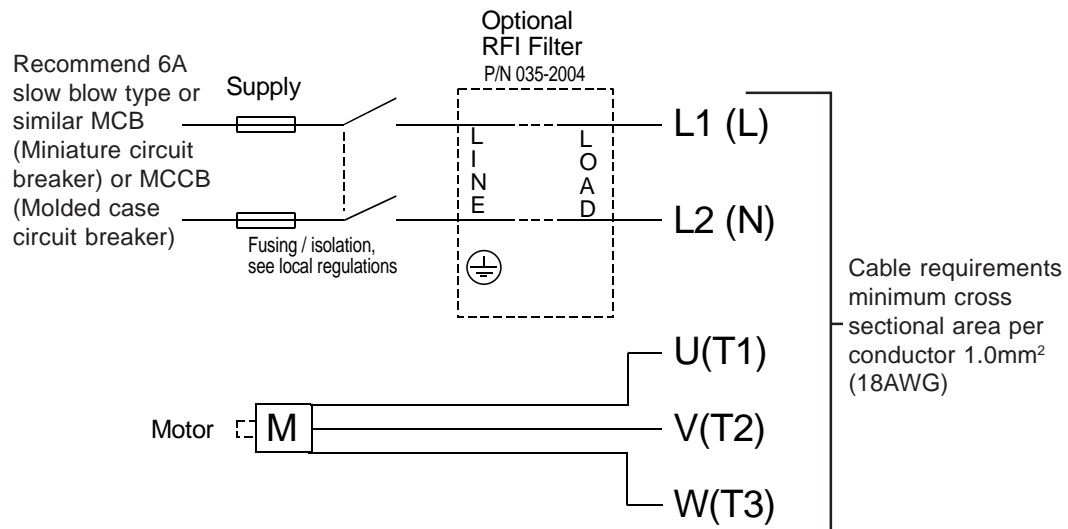
5.2 NEMA 4/12



| | Width | Length | Depth | Weight (lbs.) |
|-------------|-------|--------|-------|---------------|
| Inches | 6.70 | 10.00 | 4.75 | 2.93 |
| Millimeters | 170.2 | 254.0 | 120.7 | 2.93 |

Section 6 Wiring

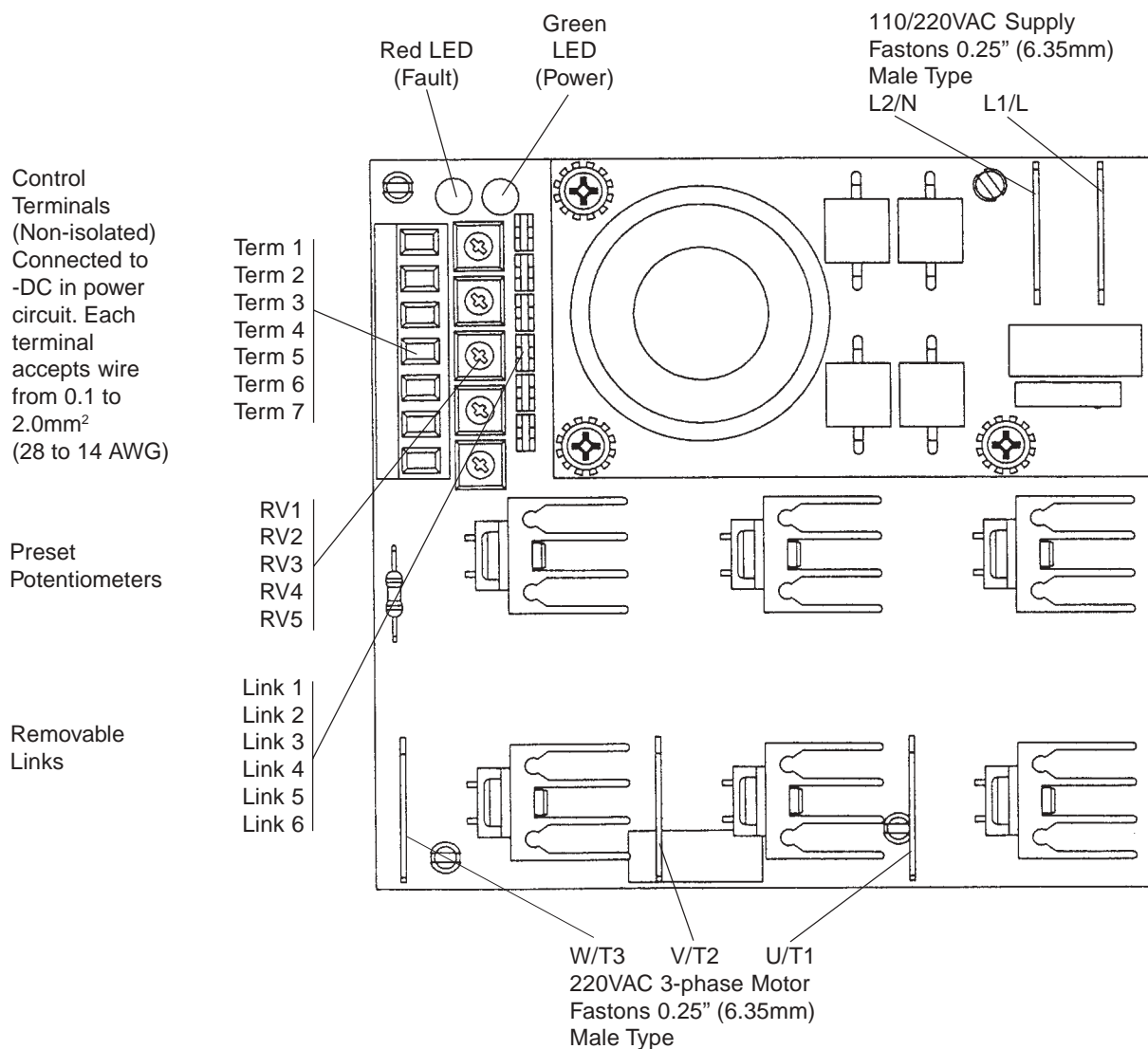
6.1 Power Connections



- L1, L2, U, V, W, need to be cables terminated by a 0.25" (6.35mm) female faston connector.
- Use of shielded/screened cable/conduit is recommended to reduce RFI.

6.2 Controls and Connections

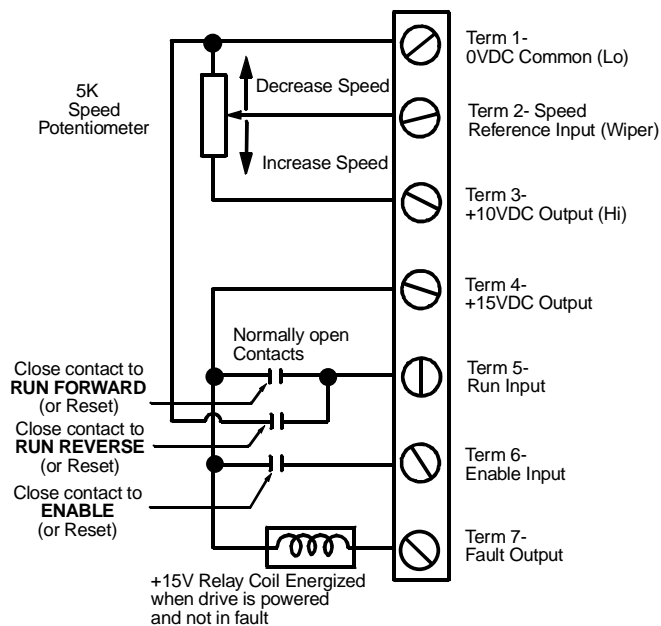
PLAN VIEW SHOWING POSITIONS OF CONTROL AND POWER CONNECTIONS



6.3 Controls Connections (NON ISOLATED)

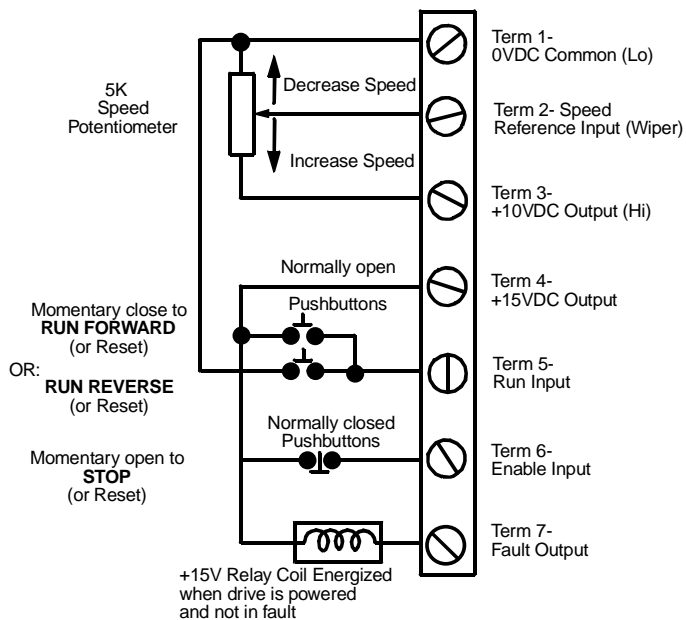
2-WIRE MODE (LINK 6 IN)

DRIVE



3-WIRE MODE (LINK 6 OUT)

DRIVE



- Caution: care must be taken to prevent shorting 15V supply to 0VDC.
- For all control cables recommend using shielded/screened 0.50 mm² (20AWG) cable.
- Do **NOT** connect Terminal 1, 0VDC Common, or any other control terminal, to earth/ground or any other external circuit or component which is not suitable for direct connection to the incoming supply lines.
- Shielded/screened cable must have suitable voltage rating from shield/screen to earth/ground potential (i.e. ≈240VAC)

Section 7 Operation

7.1 Set-Up and Operation

Power Connections (See diagram)

- Connect the fused/protected 220 (or 110VAC) volt 50/60Hz supply to the 2 supply 0.25" fastons. Polarity is not important. Ensure the supply is adequately fused/protected depending on the latest codes of practice for electrical installation.
- Connect the 220 volt (even for 110VAC input) 3 phase 0.5HP (or 0.25HP) motor to the 3 motor 0.25" fastons. Polarity determines direction.

Control Connections (See diagrams)

- The control inputs are as follows:
 Term 1 0 volt or control common (connected to -DC of power circuit) (NOT isolated)
 Term 2 Speed reference input from 0 to 10 volts.
 Term 3 +10 volt output for the 5kW Speed potentiometer
 Term 4 +15 volt output for Term 5 and 6, and the fault output Term 7

| Terminals | Link 6 | Actions +15V connected | 0V connected | Disconnect from 0V or +15V |
|-----------|---------------------------|---|---|-------------------------------|
| Term 5 | 2-wire Mode Link 6 in | Run Forward and Reset | Run Reverse and Reset | Stop and Reset |
| Term 6 | | Enable output and Reset | Disable output and Reset | Disable output and Reset |
| Term 5 | 3-wire Mode Link 6 out | (momentary) Run Forward and Reset | (momentary) Run Reverse and Reset | No action |
| Term 6 | | Allow to Run and Reset | Stop and Reset | Stop and Reset |

Term 7 fault output, open collector energized when drive powered and not in fault i.e.: Red LED not flashing and Green LED On continuously

Control Preset Potentiometers

The 5 pre-set potentiometers adjust the following parameters

- RV1** Sets the minimum speed available and has a range from 0Hz (fully counterclockwise) to Base Speed (or X2) (fully clockwise) depending on Link 1 and 2.
- RV2** Sets the maximum speed available and has a range from 0Hz (fully counter-clockwise) to Base Speed (or X2) (fully clockwise) depending on Link 1 and 2. The maximum speed must be larger than the minimum speed setting.
- RV3** Sets the acceleration time from 0.5 secs (fully counter-clockwise) to 65 secs (fully clockwise) to attain Base Speed (or X2) from 0Hz depending on Link 1 and 2.
- RV4** Sets the deceleration time from 0.5 secs (fully counter-clockwise) to 65 secs (fully clockwise) to achieve 0Hz from Base Speed (or X2) depending on Link 1 and 2. RV4 also adjusts the DC injection braking time when Link 4 is out. The braking time is identical to the time to decelerate to zero speed when Link 4 is in.
- RV5** Sets the 100% current value for the 'Ixt' calculation. (Red LED is On continuously when measured motor current is greater than 100% value set by RV5, and thus 'Ixt' is integrating up.) Fully counter-clockwise equals zero current for 'Ixt' setting and fully clockwise equals 2.3A (0.5HP/220VAC) or 1.4A (0.25HP/110VAC) current for 'Ixt' setting.

The wide range of settings of RV1 and RV2 provides for full rotation of the external Speed Potentiometer to operate over a band width of 1 Hz or more over any part of the speed range, to Base Speed X2. Setting RV1 greater than RV2 causes the red LED to turn on continuously. When the red LED is On the minimum speed will be equal to the maximum speed set by RV2.

Control Preset Links

The 6 links determine the functions as follows: (All links fitted as default)

| | | | |
|-----------|-------------------------|------------|---------------------------|
| Link 1 in | Base Speed 60 Hz | Link 1 out | Base Speed 50 Hz |
| Link 2 in | Base Speed X1 (60/50Hz) | Link 2 out | Base Speed X2 (120/100Hz) |
| Link 3 in | Constant Torque + Boost | Link 3 out | Fan Curve |
| Link 4 in | Ramp to stop | Link 4 out | DC injection brake stop |
| Link 5 in | Manual start | Link 5 out | Auto start |
| Link 6 in | 2-wire mode | Link 6 out | 3-wire mode |

With power on the drive, Manual Start requires the Run Switch to be operated in order to start the drive. Auto Start will result in the drive starting on Power-up if the run switch is closed. In both cases the drive will only run if Term 6 is Enabled with +15 volts applied. Links 1 to 6 only take effect at Power-up.

Control Indicator LED's: Two LED's give the drive status as follows.

The Green LED lights continuously when the DC link voltage is greater than 50 volts (35VAC supply). The LED will flash below this threshold as the voltage reduces to zero.

The Red LED indicates that the drive is about to Trip, has tripped or has been set-up incorrectly. When the drive is operating within its specification, the Red LED is not illuminated. The only condition that can be detected before the fault occurs is Motor Over Current. The LED will illuminate as the motor current equals or exceeds the level set by RV5, and it will remain illuminated until the current reduces below the level set by RV5, or until the drive trips on 'lxt'.

The drive will Trip when operating conditions outside its specified limits are reached. The 1000 Series has 6 protection functions.

| | |
|---------|--|
| 1 and 2 | DC Link Under and Over Voltage ($\leq 133\text{VDC}$, $\geq 397\text{VDC}$). |
| 3 and 4 | Drive Temperature Low and High ($\leq -5^{\circ}\text{C}$ 23°F) ($\geq 100^{\circ}\text{C}$ 212°F) |
| 5 | Instantaneous Over Current ($\geq 7.0\text{A}$ $0.5\text{HP}/220\text{VAC}$ or $\geq 4.1\text{A}$ $0.25\text{HP}/110\text{VAC}$) due to phase to phase output short circuit. |
| 6 | Motor Current output greater than RV5 setting, for a minimum time of 60 seconds |

Under any of these conditions, the drive will Trip and the Red LED will flash. If the fault condition persists, DC Link voltage or Drive Temperature too low or too high, then the LED will flash at a fast rate (6Hz) and the drive cannot be Reset. When the Fault condition has recovered, the LED will flash at a slow rate (1.5Hz) and the drive may be Reset. A low-voltage fault condition will automatically reset once the DC link voltage has entered its normal operating range of 133-397 VDC.

The Red LED is also activated if the Minimum Speed (RV1) is set higher than the Maximum Speed (RV2). The drive will continue to Run but at the Maximum Speed (RV2) setting and with the Red LED illuminated.

Control Terminal Specifications

| | |
|------------------------------|--|
| 0VDC -Term 1 | Non-isolated, connected to -DC bus of power circuit via 1Ω fusible resistor (≈240VAC to PE earth/ground) |
| Speed Reference Input-Term 2 | 20kΩ input impedance to 0VDC, working range 0V to +10V, will tolerate +/-30 VDC continuously |
| +10V Output-Term 3 | +/-6% absolute accurate (+/-2% relative accuracy if used for Speed Reference), will source up to +5mA |
| +15V Output-Term 4 | +/-10% accurate, will source up to +50mA. Run Input-Term 5 7.1kΩ input impedance connected via a 7.6V source relative to 0VDC, working range 0V to +24V, will tolerate +30VDC/-15VDC continuously. Logic low - input voltage less than 2.0VDC (or less than 2.2kΩ impedance to 0VDC). Logic high - input voltage greater than 12.6VDC (or less than 2.2kΩ impedance to +15VDC) |
| Enable/Stop Input-Term 6 | 7.1kΩ input impedance connected via a 7.6V source relative to 0VDC, working range 0V to +24V, will tolerate +30VDC/-15VDC continuously. Logic low - input open circuited or input voltage less than 2.0VDC (or less than 2.2kΩ impedance to 0VDC) Logic high - input voltage greater than 12.6VDC (or less than 2.2kΩ impedance to +15VDC) |
| Fault Output-Term 7 | Open collector output with internal protection diodes for relay coil driving. Output is internally switched to 0VDC (Term 1) with a capability of sinking up to 50mADC (with a 1.5VDC volt drop maximum) from a supply of +15V from Term 4. |

Section 8

Repair Procedure

8.1 Repair Procedure

In the event that a Product manufactured by Dart Controls Incorporated (DCI) is in need of repair service, it should be shipped, freight paid, to: Dart Controls, Inc., 5000 W. 106th Street, Zionsville, IN. 46077, ATTN: Repair Department.

Please include with each order a P.O. number to cover any repair charges (a P.O. is needed even on warranty returns to cover misuse or other failures that have voided warranty), and include a note with a brief description of the problem experienced. **NO WORK WILL BE DONE ON ANY ORDER WITHOUT A P.O. NUMBER.**

Completed repairs are returned with a Repair Report that states the problem with the control and the possible cause. Repair orders are returned via UPS Ground unless other arrangements are made. If you have further questions regarding repair procedures, contact your Dart Distributor or Representative.

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YOUR MOTION SYSTEMS SOLUTION PROVIDER



125D SERIES
AC INPUT - VARIABLE DC OUTPUT
1/50 HP through 1.0 HP



250G SERIES
AC INPUT - VARIABLE DC OUTPUT
1/50 HP through 2.0 HP



65 SERIES
DC INPUT - VARIABLE DC OUTPUT
CURRENT RATINGS OF 20, 40, AND
60 AMPS



700/COMMUTROL SERIES
DC BRUSHLESS
5 & 20 Amp for
12,24,& 36VDC Inputs



MDP SERIES
PROGRAMMABLE
CLOSED LOOP DC
SPEED CONTROL



DM SERIES
FIELD PROGRAMMABLE
DIGITAL TACHOMETER

Dart Controls, Inc. is a designer, manufacturer, and marketer of analog and digital electronic variable speed drives, controls, and accessories for AC, DC, and DC brushless motor applications.

Shown above is just a sampling of the expanded line of Dart controls that feature the latest in electronic technology and engineering. Products are manufactured in the U.S.A. at our Zionsville (Indianapolis,

Indiana) production and headquarters facility - with over 2,000,000 variable speed units in the field.

In addition to the standard off-the-shelf products, you can select from a wide variety of options to customize controls for your specific application. For further information and application assistance, contact your local Dart sales representative, stocking distributor, or Dart Controls, Inc.

Dart Controls, Inc.

Manufacturer of high quality DC and AC motor speed controls and accessories since 1963.

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