

**DM8000 CONTROL SERIES**

# **DART**

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## **CONTROLS**

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### **Instruction Manual**

**Field Programmable Digital Tachometer  
for Rate and Time**



**P.O. Box 10  
5000 W. 106th Street  
Zionsville, Indiana 46077**

**Phone (317) 733-2133  
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## 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.

### 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.**

## INTRODUCTION

The DM8000 Series Tachometer is microprocessor based, with field programming as a standard feature. This allows field setting for desired operating parameters.

The DM8000 Series are packaged in a sturdy 1/8DIN aluminum housing for panel mount and are programmed as follows:

### RATE MODE TACHOMETER

Rate mode is used to display RPM, FPM, GPM, or other desired engineering units. The programmability of the DM8000 allows the display to show not only the speed of the motor, but also speeds of shafts driven from the motor. The programming formulas take into account drive train ratios to achieve desired display readings. The decimal point is selectable and may be turned off.

### TIME MODE TACHOMETER

When programmed for the time mode, the DM8000 will display process time in minutes and seconds or hours and minutes. A colon will be lit in the center of the display. In this mode, as in the Rate mode, the programming formulas take into account gear ratios and drive train reductions to display proper process time.

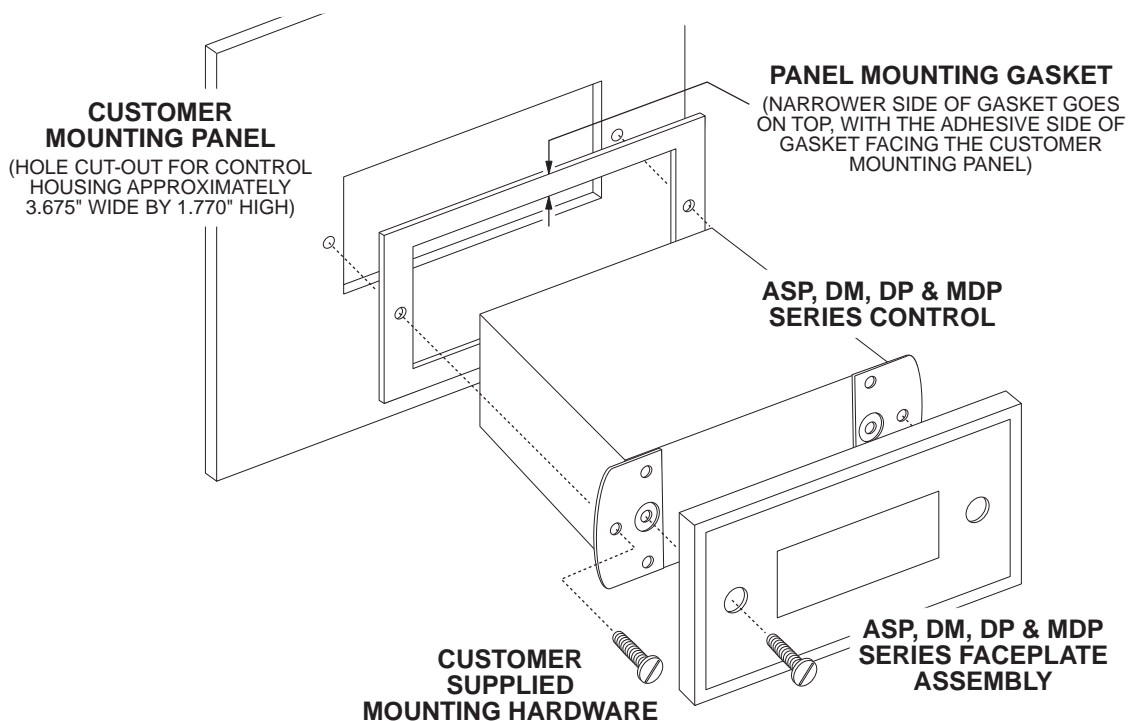
# STANDARD FEATURES AND SPECIFICATIONS

- Microprocessor based, field programmable operating parameters for specific RPM ranges, FPM, GPM, Process time or other engineering units.
- Update rate of 32ms or next pick-up pulse, whichever is longest.
- Capable of measuring shaft speeds as low as 1 RPM.
- Compact 1/8 DIN sturdy aluminum housing for panel mounting.
- Large 4 digit 1/2" LED display.
- Up and down pushbutton switches for field programming - slow / fast sweep.
- Screw type barrier terminal connectors.
- 120VAC + 10%, 50/60 Hz. line voltage input.
- Non-volatile memory retains programmed instructions.
- Resolution from 0.01 RPM.
- Accuracy  $\pm 0.04\%$ ; Display up-date every pulse or every 0.5 second, whichever is longer.
- Isolated high & low alarm output (triac rated to 5 amps); Set range: 0 to maximum.
- Optional RS232 output of display data useful for remote data collection. 300 Baud, 7 data bits, no parity. XON XOFF handshaking.
- Self-contained power supply for AC incoming line and transducer.
- Operating temperature of -10°C to 45°C (15° F to 115° F).
- Accepts a variety of input signals; Hall-effect pick-up, Photoelectric, any TTL, or Magnetic (optional).  
Note: Open collector devices must be capable of sinking 2.3mA.
- 30,000 Pulses per minute - Maximum signal input.
- Lexan® membrane covers faceplate and seals pushbutton switches.
- Field programmable, selected by internal dip switches.
- Can be field programmed to operate as a "rate totalizer" or an "elapsed time indicator".
- Field programmable - auto range mode.

## OPTION DESCRIPTION

Connector for RS232 output .....	-2 Option
Field installable divide by 1, 10 or 100 option board for use with magnetic or Hall-effect pick-up (minimum recognizable signal by magnetic pick-up is 175mV RMS) .....	-3 Option
Factory installed option uses 240VAC 50/60Hz input voltage .....	-5 Option

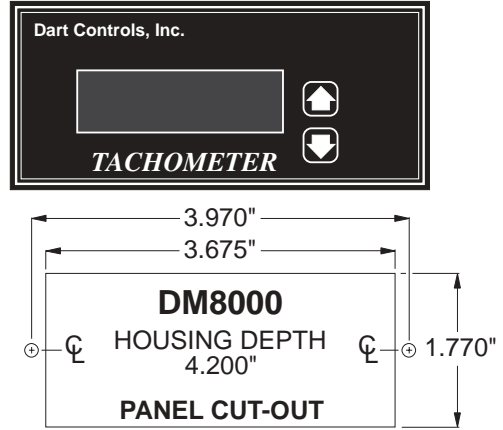
## MOUNTING INSTRUCTIONS



Use caution when reinstalling red lens to prevent pinching of ribbon cable between lens and mounting panel.

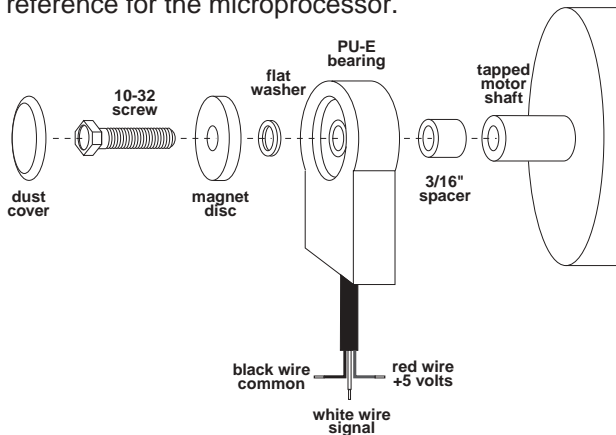
# CUT-OUT & MOUNTING DIMENSIONS

	Height	Width	Depth
English (inches)			
housing	1.660 in.	3.620 in.	4.125 in.
lens	2.250 in.	4.420 in.	0.250 in.
Metric (centimeters)			
housing	4.22 cm.	9.19 cm.	10.48 cm.
lens	5.71 cm.	11.27 cm.	00.64 cm.

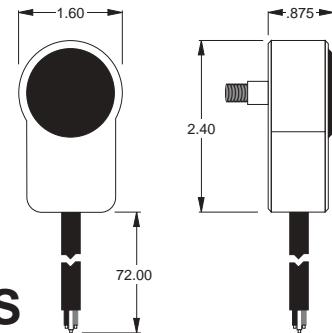


## PU-E SERIES PICK-UP INSTALLATION

The PU-E series pick-up is an economical way to monitor motor speed. Its patented design provides for ease of installation in otherwise difficult to reach areas. The PU-E operates from a +5V power supply, producing a 5 volt square wave whose frequency is proportional to speed. This signal is fed into the DM8000 control as a speed reference for the microprocessor.



model number	pulses per revolution
PU-2E	1
PU-4E	2
PU-10E	5
PU-20E	10



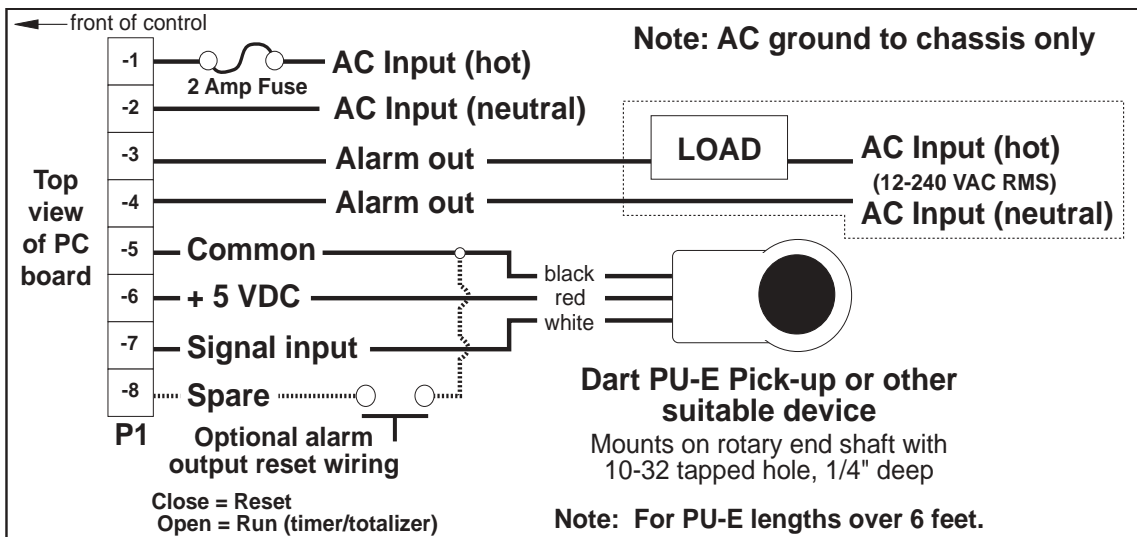
## DIMENSIONS

No other mounting screws are necessary, as the cord will keep the unit from rotating. The PU-E gives a high signal when the north pole of the magnetic disc crosses the Hall-effect transistor. The signal is switched low when the south pole crosses this same transistor.

**CAUTION:**  
**DO NOT OVER TIGHTEN MOUNTING SCREW !!**

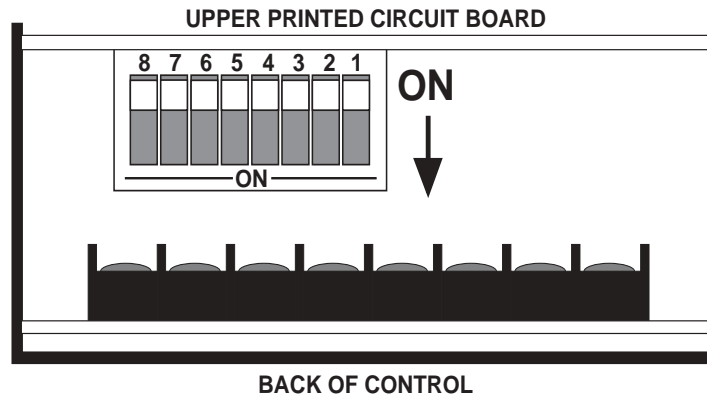
**Caution:** The PU-E cord should not be grouped with other wires or cords. For applications with PU-E wire over 6 feet long, or noisy environments, a shielded cable is recommended. Connect the shield to the common terminal on the DM8000, leaving the shield on the PU-E end floating.

## TERMINAL STRIP WIRING & HOOK-UP



# DIP SWITCH ACCESS

In order to program the DM8000, you must first gain access to the internally mounted dip switch. Remove the top cover from the control and note switch, located next to the transformer.



## DM8000 SERIES FIELD PROGRAMMING

The DM8000 is set at the factory to display motor RPM with one pulse per revolution from the motor shaft.

### RATE MODE - to display rate expressed in RPM, FPM, GPM ,etc.

Calculate the values to program for the multiplier "M" and divider "D" using the formulas below:

$$K = \frac{A \times 100}{PPM}$$

where: K = constant

A = desired digital display reading

(ignore any decimal points - ie. desired display of 525.0 is entered as 5250)

PPM = pick-up pulses per minute (PPM = shaft speed being monitored by pick-up is multiplied by pulses per revolution of the pick-up - see top of page 3 for Dart PU-E)

Example: A conveyor is running at 525 FPM (feet per minute) at a motor speed of 1800 RPM. A Dart PU-2E pick-up is mounted on the motor shaft.

Analysis: The Dart PU-2E uses 1 pulse per revolution (as shown on page 3). Shaft speed being monitored is 1800 RPM, which is multiplied by 1 pulse per revolution equaling "PPM". The digital display reading "A" is 5250.

Use the above formula to calculate the constant "K":  $K = \frac{5250 \times 100}{1800 \text{ (PPM = } 1800 \times 1)} = 291.66 \text{ rounded off} = 291.7$

Use the following formula to calculate "D", which should be rounded down to the next lower whole number:

$$D = \frac{9999}{K}$$

$$D = \frac{9999}{291.7} = 34.2; \text{ Therefore } D = 34$$

After finding "K" and "D", use the following formula to find "M", which should be rounded to the nearest whole number:

$$M = K \times D$$

$$M = 291.7 \times 34 = 9917.8; \text{ Therefore } M = 9918$$

To program values into DM8000 for Rate mode:

Switch 7 ON = Program.

Switch 1 ON = Enter value for "M" into display, switch 1 OFF.

Switch 2 ON = Enter value for "D" into display, switch 2 OFF.

Switch 5 ON = enter desired decimal place into display, switch 5 OFF.

Switch 7 OFF

(continued on following page)

## **TIME MODE - to display rate of travel expressed in time**

To program for time operation, use the formula below:

$$K = \frac{36864000}{A \times \text{PPM}}$$

where: **K** = constant in seconds  
**D** = "K" value converted into minutes and seconds - to be programmed into DM8000  
**A** = desired display reading in seconds  
**PPM** = pick-up pulses per minute (PPM = shaft speed being monitored by pick-up is multiplied by pulses per revolution of the pick-up - see top of page 3 for Dart PU-E)

Example: In a conveyor oven a motor runs 568 RPM for a bake time of 15 minutes 45 seconds.  
 A Dart PU-2E pick-up is mounted on the motor shaft.

Analysis: To determine "A" (in seconds), multiply minutes x (  $\frac{60 \text{ seconds}}{1 \text{ minute}}$  ) and add with remaining seconds, as below:

$$\left( \frac{60 \text{ seconds}}{1 \text{ minute}} \times 15 \text{ minutes} \right) + 45 \text{ seconds} = 900 \text{ seconds} + 45 \text{ seconds} = 945 \text{ seconds ("A" value)}$$

The Dart PU-2E uses 1 pulse per revolution (as shown on page 3). Shaft speed being monitored is 568 RPM, which is multiplied by 1 pulse per revolution equaling "PPM". The "PPM" is 568.

Use the formula on the preceding page to calculate ÒKÓ value:

$$K = \frac{36864000}{945 \times 568} = 68.6787 \text{ (round up to nearest whole number)} = 69 \text{ seconds}$$

Convert ÒKÓ value (in seconds) to ÒDÓ value (in minutes and seconds) as follows:

69 seconds (ÒKÓ value) converts to 1 minute 09 seconds or 1:09 (ÒDÓ value).

To program values into DM8000 for Time mode:

**Switch 7 ON = Program.**  
**Switch 5 ON = Enter value of 5 to activate colon (Dip Switch Function Table below).**  
**Switch 1 ON = Enter value of 0 for ÒMÓ into display\*, switch 1 OFF**  
**Switch 2 ON = Enter value for ÒDÓ into displayswitch 2 OFF.**  
**Switch 7 OFF**

\* Note: Always set multiplier ÒMÓ (switch 1) to a value of 0 when using time mode.

### **DIP SWITCH FUNCTION TABLE**

SWITCH 1	PROGRAM MULTIPLIER	
SWITCH 2	PROGRAM DIVIDER	
SWITCH 3	PROGRAM LOWER LIMIT SET POINT	NOT AVAILABLE WITH AUTO RANGING ; A SETTING OF ZERO DEFEATS LIMIT CHECK
SWITCH 4	PROGRAM UPPER LIMIT SET POINT	
SWITCH 5	RATE/TIME MODE DISPLAYED DECIMAL POINT SELECT	0 thru 4 = RATE MODE/DECIMAL POINT 5 = TIME MODE/COLON
SWITCH 6	AUTO RANGE	OFF = NO AUTO RANGING
SWITCH 7	PROGRAM SELECT	OFF = RUN                      ON =PROGRAM
SWITCH 8	DO NOT USE - SET TO OFF	

### **USING THE UPPER / LOWER LIMITS**

The upper/lower limits are used in conjunction with the alarm output to indicate when the display has exceeded the range defined by the upper/lower limits. In tachometer modes, the alarm output will turn ON when the range is exceeded. In timer and totalizer modes, the alarm output turns ON when reset, and OFF when the upper limit is exceeded. In the RATE mode the alarm output can signal that speed is lower than the lower limit or higher than the upper limit. In the TIME mode the limits set up minimum and maximum display times and, again, the alarm output turns on when these limits are exceeded. Setting either limit to a value of zero defeats the checking of that limit. In the TIMER and TOTALIZER modes the lower limit is **always** set to zero and the upper limit is set to the desired setting to indicate when the limit has been reached. The lower limit is set via switch 3, and the upper limit via switch 4 - when in the programming mode. Note: This feature is not available with Auto Ranging selected.

# ALARM OUTPUT

In the tachometer mode, the alarm output is a normally open solid state switch (triac output). The output is electrically isolated and is capable of switching from 100mA to 5A load, at 12 - 240 VAC RMS. The output is reset by pushing either front panel button, or by momentarily connecting the spare input to the common terminal, or by applying a TTL "low" signal to the spare input. See "Terminal Strip Wiring & Hook-up" diagram for more information.

# AUTO RANGING

Auto ranging is used when the display will exceed the maximum value that the display will show. This maximum value is dependent upon programming, but an example is when you are displaying RPM of a shaft in a range of 50 to 12,000 RPM. Since the DM8000 has a four digit display, we cannot normally show any speed above 9999 RPM. With auto ranging selected, the display would show 1200 and the right most decimal point will flash on and off, indicating that auto range has shifted the decimal point to the right and least significant digit is not displayed.

If the DM8000 is programmed to display one of the first three decimal points and auto range is selected, the decimal point will move one place right and the least significant digit will not be shown. If auto range moves the decimal beyond the number four decimal point, then decimal point four will flash.

In the TIME mode auto range changes min:sec to hours:min. When the change is made to hours:min, the upper colon will flash. The DM8000 also has instructions in the microprocessor to permit operating in two additional modes; totalizer and timer modes.

# TOTALIZER MODE

When used in this mode, the DM8000 will count input pulses applied to the signal input. The display counts up from zero and increments one count for each input pulse. The display is reset to zero and counting begins when either of the up/down pushbutton switches are depressed or the spare input is momentarily connected to the common terminal, or brought "low" by any TTL compatible signal.

When used with the alarm output, the alarm out is turned ON when reset and turns OFF when the upper limit is exceeded by one count. To adjust the upper limit, see "Using Upper/Lower Limits". Note: This feature is not available in Auto Ranging mode. To program the DM8000 for Totalizer mode, perform the following steps:

- 1) Apply AC power to DM8000.
- 2) Turn ON switches 1 and 7, set display to zero.
- 3) Turn OFF switch 1, turn ON switch 2, set display to zero.
- 4) Turn OFF switch 2, turn ON switch 3, set display to zero, then turn OFF switch 3.
- 5) If auto ranging is desired, turn ON switch 6 and leave on (see "Auto Ranging").
- 6) If alarm output is desired, turn ON switch 4 and set to desired upper limit, then turn OFF switch 4. If alarm output is not needed OR auto ranging is selected, set to zero.
- 7) Turn OFF switch 7.

The DM8000 is now in totalizer mode and will begin counting when reset (via up-down pushbutton switches or spare input).

# TIMER MODE

**TO DISPLAY ELAPSED TIME** - The DM8000 may be used as a timer to display minutes and seconds **elapsed** since the last reset. If used with auto ranging (page 5), the display will show "min:sec" up to 59:59, then automatically switch to hours:min. The display is reset to 00:00 and timing begins when either the up or down pushbutton switch is depressed or the spare input is momentarily connected to the common terminal, or brought "low" by any TTL compatible signal. When used with the upper limit setting, the alarm output is turned ON when the display is reset and turns OFF one second **after** the upper limit is reached. Note: This feature is not available in Auto Ranging mode. To program the DM8000 for timer mode, perform the following steps:

- 1) Apply AC power to DM8000.
- 2) Turn ON switch 7.
- 3) Turn ON switch 5 and set display to :05, then turn OFF switch 5.
- 4) Turn ON switch 1 and set display to zero, then turn OFF switch 1.
- 5) Turn ON switch 2 and set display to zero, then turn OFF switch 2.
- 6) Turn ON switch 3 and set display to zero, then turn OFF switch 3.
- 7) If auto ranging is desired, turn ON switch 6 and leave ON.
- 8) If alarm output is desired, turn ON switch 4 and set to desired upper limit, then turn OFF switch 4. If alarm output is not needed OR auto ranging is selected, turn ON switch 4, set to zero, then turn OFF switch 4.
- 9) Turn OFF switch 7.

The DM8000 will begin timing when reset by the up-down pushbutton switch or spare input.

# 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.

## ALSO AVAILABLE FROM DART CONTROLS, INC.



**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



**500 SERIES**  
AC INPUT - VARIABLE DC OUTPUT  
1/50 HP through 3.0 HP



**MDP SERIES**  
PROGRAMMABLE  
CLOSED LOOP DC  
SPEED CONTROL



**DM SERIES**  
FIELD PROGRAMMABLE  
DIGITAL TACHOMETER

**Dart offers the industry's broadest range of electronic DC and AC motor speed controls rated to 3 horsepower, as well as speed control accessories.**

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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