DM4000 CONTROL SERIES

DART CONTROLS

Instruction Manual

Field Programmable Digital Tachometer for Rate and Time

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LTDM4 (IM-DM4-0501)

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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 Dart DM4000 Series is available in two basic field programmable models:

DM4004 - RATE BASED DISPLAY - Displays the rate of shaft rotation in RPM, GPM, FPM, etc.
DM4005 - PROCESS TIME DISPLAY - Displays the time of the process, based upon shaft rotation.

STANDARD FEATURES

The DM4000 Series features a sturdy 1/8DIN aluminum housing with gasketed faceplate kit for panel mount. It will accept a variety of signal inputs, and is field programmable via dip switches. The compact series provides a five position barrier terminal strip for ease of connection and a large 1/2" four digit LED display, including customer selectable decimal points. Self-contained power supply for transducer of +5VDC and 75mA output.

Works in conjunction with a transducer

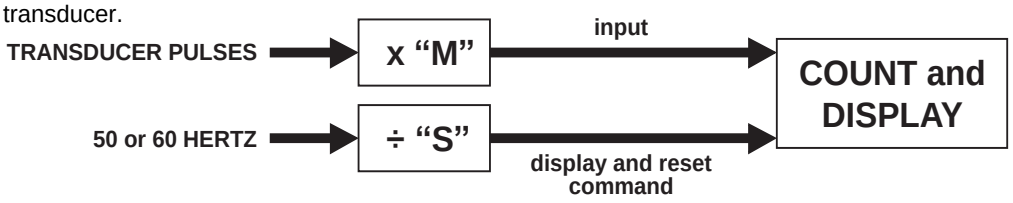
The Dart PU-E pick-up is recommended for use with the DM series, however the DM4000 will accept inputs from a variety of transducer types. Included are hall-effect, photo-electric, magnetic, TTL, or any +5 to 24VDC device. See “Pick-up Selection Chart” on page 3.

Operates on either a 50 or 60 Hertz signal

The DM4000 Series comes standard for a 60 Hertz signal, but can be easily changed to 50 Hertz by using the “Field Programming Formula” on page 4. This program simply changes the time base settings, substituting 3000 for 3600 in the Field Programming Formula. This compensates for the change in the clock frequency from 60 Hertz to 50 Hertz.

THEORY OF OPERATION

The input pulses from the transducer are counted and then multiplied by "M" (input count multiplier). In order to have a steady display, the display is updated every .0167 seconds x "S" (divide by count time) for the DM4004. The multiplier "M" is a phase lock loop, while the divide by, "S", is a simple timer set via binary switches. Thus, we have field programmable scaling. The unit provides +5 VDC for the transducer.



OPTION DESCRIPTION

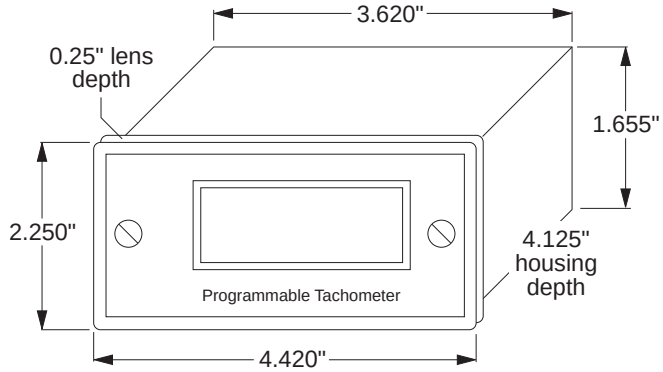
240VAC input (50 or 60 Hertz) ..... -5 OPTION

CUT-OUT & MOUNTING DIMENSIONS

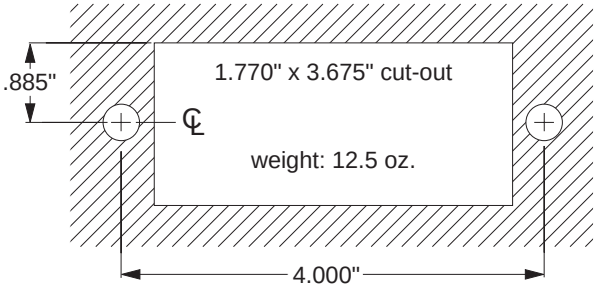
STEP 1: Remove two screws securing red lens.

STEP 2: Mount the DM4000 series meter into the panel cut-out. Note diagram for cut-out dimensions shown below. Allowance for easy insertion of meter into panel must be made.

STEP 3: Secure meter into panel. The two mounting holes have a diameter of .141 inch. Use #6 hardware to fasten to panel.

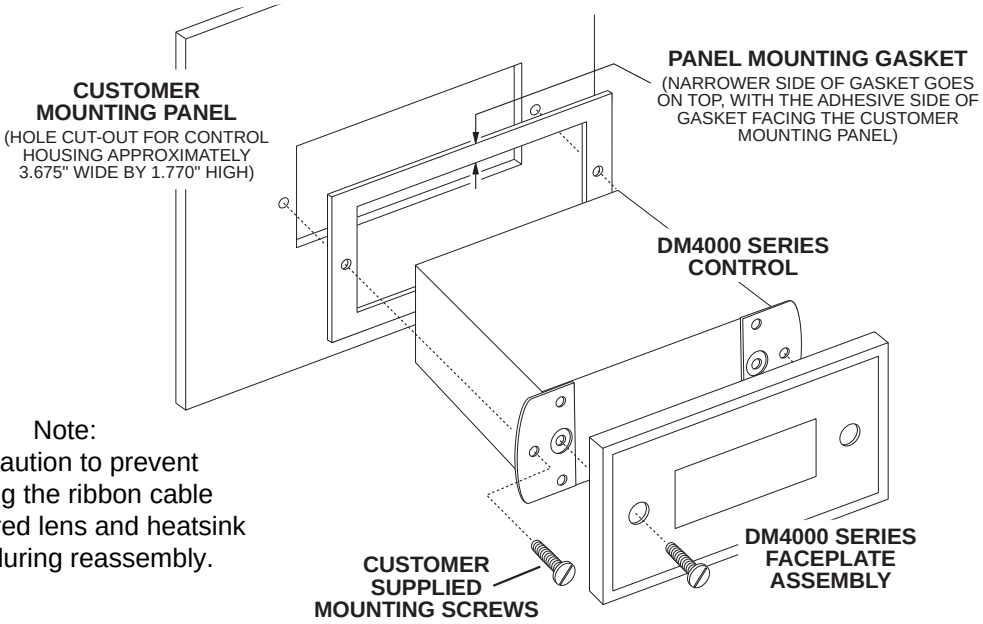


LENS & HOUSING DIMENSIONS



PANEL CUT-OUT DIMENSIONS

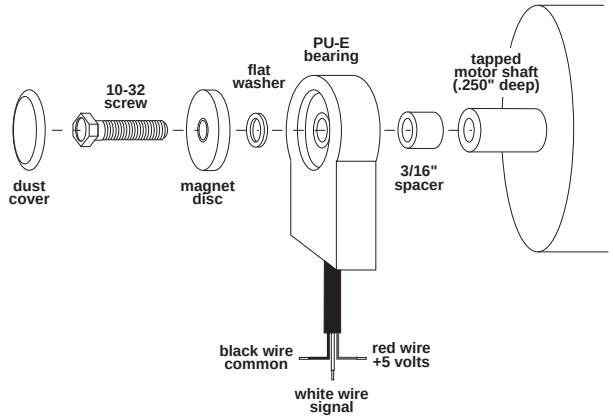
MOUNTING INSTRUCTIONS



Note:
Use caution to prevent pinching the ribbon cable between red lens and heatsink metal during reassembly.

PU-E SERIES PICK-UP INSTALLATION

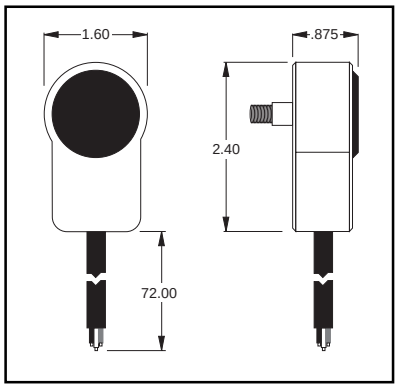
The PU-E series pick-up is an economical way to monitor motor speed. Its patented design provides ease of installation in otherwise difficult to reach areas. The PU-E pick-up operates at a +5 volt level, producing a 5 volt square wave output, which may be fed into Dart's DM4000 series field programmable tachometer, closed loop controls, or any other digital device.



model number	pulses per revolution	minimum RPM	maximum RPM
PU-2E	1	125.0	5000
PU-4E	2	62.5	5000
PU-10E	5	25.0	5000
PU-20E	10	12.5	5000

CAUTION: DO NOT OVER TIGHTEN MOUNTING SCREW !!

DIMENSIONS



In order to obtain a stable reading on the display, the DM4000 series requires a minimum input of 125 pulses per minute, and a maximum output no greater than 600,000 pulses per minute.

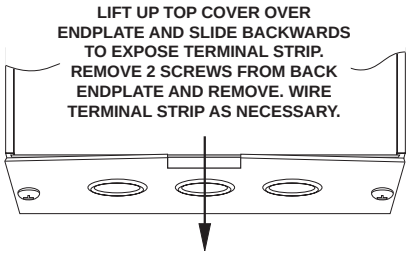
EXAMPLE:
If the motor shaft is rotating at 14 RPM, a PU-20E pick-up, which has 10 pulses per revolution (PPR) out, is recommended. Thus 10 PPR multiplied by 14 RPM equal 140 PPM (pulses per minute), which satisfies the minimum requirement of 125 PPM (ie. 10 pulses/revolution x 14 revolutions/minute = 140 pulses per minute).

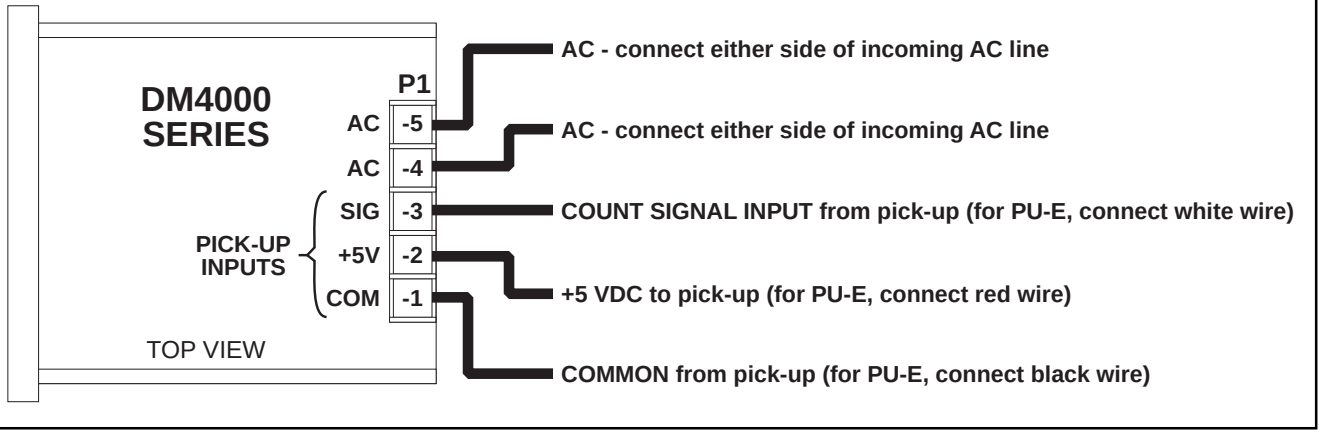
No other mounting screws are necessary, as the cord will keep the unit from rotating. The PU-E gives a high signal when the north pole of the magnetic disk crosses the hall-effect. The signal is switched low when the south pole crosses the same resistor.

Caution: The PU-E cord should not be grouped with any 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 ASP10, leaving the shield on the PU-E end floating.

DM4000 SERIES HOOK-UP & WIRING

The DM4000 series is factory preset to measure an input of one (1) pulse per revolution (PU-E pick-up not included). If a different pulse rate is desired, then field programming is required. Threading wires through back of endplate should be done before connecting wires to the terminal strip of the meter.





CAUTION: Do not connect any other power source to the +5 volt supply!!

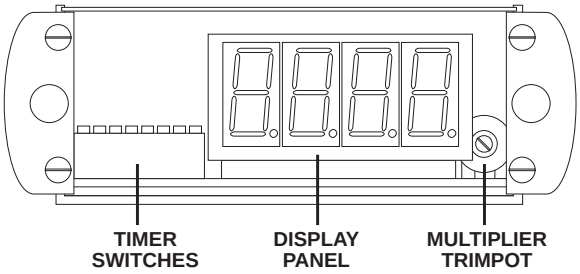
FIELD PROGRAMMING THE DM4000 SERIES

The DM is supplied from the factory preset to measure an input of 1 pulse per revolution - read in RPM (Pick-up not included). If operating with different pulse inputs, field programming is required.

STEP 1 Remove the 2 black screws from the lens face and remove the lens assembly.

STEP 2 Locate the Timer Switches and the Multiplier Trimpot by observing the diagram below.

DM4000 - FRONT VIEW WITHOUT LENS



STEP 3 DM4004 FIELD PROGRAMMING FORMULA:

$$MS = \frac{R \times 3600}{Ip}$$ **(use 3000 for 50 Hertz application)**

M = INPUT COUNT MULTIPLIER (TRIMPOT SETTING OF EITHER 1, 10, OR 100)

R = RATIO OF: $\frac{\text{DESIRED DISPLAY READING AT KNOWN RPM}}{\text{KNOWN RPM}}$

(This is specified by the user. It is necessary to know the desired display readout at a particular RPM).

S = COUNT TIME IN 1 CYCLE PER SECOND INCREMENTS (SWITCH SETTING)

Ip = INPUT PULSES PER REVOLUTION (SEE PICK-UP SELECTION GUIDE - page 3)

Example: Find R - We want the meter to display 15 feet per minute at a shaft speed of 1000 RPM.
Therefore **R = 15 / 1000 = 0.015.**

Example: Use Programming Formula for the DM4004 - A motor drives an auger which moves material and we want displayed lbs/hr. of material moved. We know that at 990 RPM we move 435 lbs. of material per hour. We selected the PU-2E as the appropriate pick-up from the SELECTION CHART on page 3. The PU-2E has an Ip of 1.
Therefore **MS =** $\frac{435/990 \times 3600}{1}$ **= 1581.8**

DM4005 FIELD PROGRAMMING FORMULA:

$$MS = \frac{[A \times (B \times 60 + C)] \times Ip}{3600}$$ **(use 3000 for 50 Hertz application)**

(Maximum reading of 59 minutes and 59 seconds).

A = KNOWN RPM

B = DESIRED DISPLAY (READING IN MINUTES)

C = DESIRED DISPLAY (READING IN SECONDS)

Ip = INPUT PULSES PER REVOLUTION (SEE PICK-UP SELECTION GUIDE - page 3)

M = INPUT COUNT MULTIPLIER (TRIMPOT SETTING OF EITHER 1, 10, OR 100)

S = COUNT TIME IN 1 CYCLE PER SECOND INCREMENTS (SWITCH SETTING)

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Example: Use Programming Formula for the DM4005 - A conveyor oven needs to cook a pizza in 8 minutes and 31 seconds, and we have determined the motor speed is 1000 RPM. A PU-2E with an Ip of 1 is being used.

Therefore **MS = [1000 x (8 x 60 +31)] = 1000 x 511 = 142.**
3600 3600

STEP 4 Establish the "M" (multiplier trimpot setting) and "S" (switch setting) values. Keep "S" as large as possible, but less that 255.

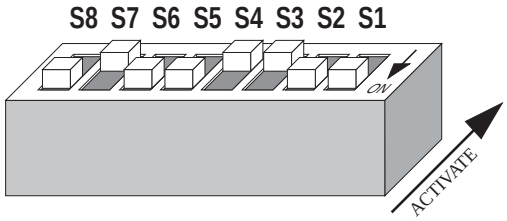
Example: If MS = 1581, then our best choice for "S" would be 158 (it is as large as it can be without being equal to or greater than 255). This makes the Multiplier (M) = 10.

Examples: MS = 12, 235. Therefore S = 122. M = 100.
MS = 123.85. Therefore S = 124. M = 1.

STEP 5 Set the Timer Switches. The value of the switches that are to be activated must add up to the value of "S" (see value chart).

Examples: If S (total) = 15, then S4 (8) + S3 (4) + S2 (2) + S1 (1) = 15.
If S (total) = 226 then S8 (128) + S7 (64) + S6 (32) + S2 (2) = 226.

SWITCHES ARE ACTIVE WHEN OFF !!!



FRONT VIEW
ACTIVATE SWITCH BY TURNING OFF

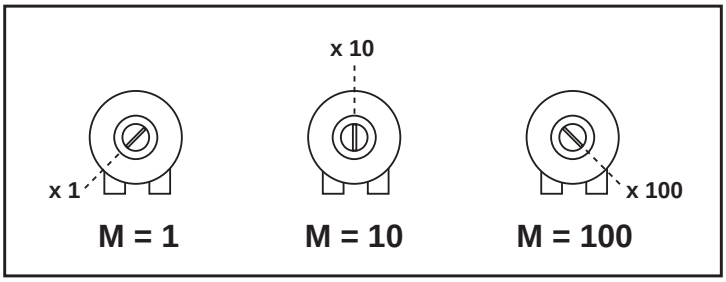
" S " VALUE CHART

S1 = 1	**S2 = 2**	**S3 = 4**	**S4 = 8**
S5 = 16	**S6 = 32**	**S7 = 64**	**S8 = 128**

EXAMPLE: SWITCHES 3, 4, AND 7 HAVE BEEN ACTIVATED

SINCE S3 = 4, S4 = 8, S7 = 64
THEREFORE: 4 + 8 + 64 = 76 = S

STEP 6 Set the Multiplier trimpot using the "M" value determined in STEPS 3, 4 and 5.



DECIMAL POINT SELECTION

All decimal points are illuminated and are covered with black adhesive backed dots. If a decimal point is needed, remove dot to illuminate the desired decimal point.

COMMONLY ASKED QUESTIONS

Q. Can the DM4000 Series be used above 9,999 RPM?

A. Yes, there will be only a 4 digit display. Note: The bearings of the Dart PU-E Pick-up are not rated above 5,000 RPM.

Q. I want a stable reading, but the last digit fluctuates. What should be done?

A. The reading can be multiplied by ten using the "M" adjustment with the last digit covered.

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Q. Can I use the Dart PU-E pick-up located more than 6 feet from the display?

A. The PU-E pick-up operates at a 5 Volt level, producing a 5 volt Square Wave. If noise is present on the line to or from the pick-up, some information may be lost and the DM4000 Series may not be able to distinguish between the noise and the relatively small 5 Volt square wave. For this reason, we would recommend that in a "normal" environment the PU-E pick-up not be located more than six (6) feet from the display. In a particularly noisy environment, six feet may exceed the cord length necessary for an error free signal from the PU-E pick-up. If it is absolutely necessary to exceed six feet, or in a particularly noisy application, shielded cable should be used, connecting the shield to the COMMON terminal on the wire end of the PU-E housing. In such cases, the PU-E pick-up cord should not be grouped with any other wires or cords in the shielded cable.

Q. Can the decimal point be easily changed?

A. Yes, all decimal points are illuminated and have been masked with a black sticker to make them invisible. Remove the front lens and remove the appropriate sticker.

Q. How many displays can one PU-E pick-up operate at once?

A. We recommend no more than nine.

Q. Can the DM4000 Series be switched between inputs?

A. Yes. On the PU-E pick-up, switch the "SIG" wire and leave the "COM" and "+V" connected to each pick-up (do not exceed nine PU-E pick-ups per DM unit).

Q. Can I tie the DM4000 Series to a computer?

A. No, there are no computer outputs available from the DM4000 Series.

Q. What is the update time?

A. This varies with the programming of the "S" value setting, which ranges from .0167 through 4.25 seconds. The DM4004 update time = .0167 x "S" (in seconds). See SPECIFICATIONS section shown below.

Q. How can I program "MS" in order to display RPM using a DM4004 and a PU-2E?

A. Activate switches 3 and 6 in the DM4004 [M(100) x S(36) = 3600].

SPECIFICATIONS

INPUT VOLTAGE ..... 120VAC ±10% (optional 240VAC input); 50/60 Hertz

AC CURRENT - MAXIMUM ..... 225 mA

DECIMAL POINT ..... Illuminated, covered with adhesive dots (field removable)

DISPLAY ..... 1/2" red L.E.D. 4 digit

DISPLAY ACCURACY ..... ± 1 count

DISPLAY RANGE ..... 125 to 9999

INPUT PULSE RATE ..... Minimum required: 125 pulses per minute
Maximum allowed: 600,000 pulses per minute

MINIMUM SINE WAVE ..... 175 mV RMS
(that can be recognized as a signal when used with Proximity Pick-ups)

MOUNTING ..... Panel mounted (screws not provided)

TEMPERATURE ..... -10° to +45° C. (15° to 115°F.)

TIME BASE ..... A.C. line frequency

TRANSDUCER POWER SUPPLY VOLTAGE ..... +5 VDC, 75 mA. maximum

TRANSDUCER TYPES (capable of sinking 3mA) ..... Hall-Effect, Photo-Electric, Magnetic (Proximity),
TTL, or any +5 to +24VDC NPN open collector device

UPDATE TIME ..... Range .0167 thru 4.25 seconds
Varies with programming of "S" value setting (DM update time = .0167 x S (in seconds))