Instruction Manual
Field Programmable Digital Tachometer for Rate and Time
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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 technician 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 0.0167 seconds x “S” (divide by count time) for the DM4000. 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.

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.

<table>
<thead>
<tr>
<th>model number</th>
<th>pulses per revolution</th>
<th>minimum RPM</th>
<th>maximum RPM</th>
</tr>
</thead>
<tbody>
<tr>
<td>PU-2E</td>
<td>1</td>
<td>125.0</td>
<td>5000</td>
</tr>
<tr>
<td>PU-4E</td>
<td>2</td>
<td>62.5</td>
<td>5000</td>
</tr>
<tr>
<td>PU-10E</td>
<td>5</td>
<td>25.0</td>
<td>5000</td>
</tr>
<tr>
<td>PU-20E</td>
<td>10</td>
<td>12.5</td>
<td>5000</td>
</tr>
</tbody>
</table>

CAUTION: DO NOT OVER TIGHTEN MOUNTING SCREW !!

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.

**STEP 3** **DM4004 FIELD PROGRAMMING FORMULA:**

\[
M = \frac{R \times 3600}{I_p} \quad \text{(use 3000 for 50 Hertz application)}
\]

- **M** = INPUT COUNT MULTIPLIER (TRIMPOT SETTING OF EITHER 1, 10, OR 100)
- **R** = RATIO OF: DESIRED DISPLAY READING AT KNOWN 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 \( R = \frac{15}{1000} = 0.015 \).

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 \( MS = \frac{435}{990} \times 3600 = 1581.8 \).

**DM4005 FIELD PROGRAMMING FORMULA:**

\[
M = \frac{[A \times (B \times 60 + C)] \times I_p}{3600} \quad \text{(use 3000 for 50 Hertz application)}
\]

- **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)

(Maximum reading of 59 minutes and 59 seconds).

(continued on following page)
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 \[ MS = \frac{1000 \times (8 \times 60 + 31)}{3600} = \frac{1000 \times 511}{3600} = 142. \]

**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 \( S_4 (8) + S_3 (4) + S_2 (2) + S_1 (1) = 15. \)
If S (total) = 226 then \( S_8 (128) + S_7 (64) + S_6 (32) + S_2 (2) = 226. \)

**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.
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

**TRANSUCER POWER SUPPLY VOLTAGE** ................................ +5 VDC, 75 mA. maximum

**TRANSUCER 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))