



OPERATING MANUAL: **PUMP DRIVE**

860-3000 Pump Drive, shown with 960-0000 High Performance I/P Pump Head

Model No.

860-3000



A-1299-7034
Edition 01

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SAFETY PRECAUTIONS

DANGER: *High voltages exist and are accessible in the Console Drive. Use extreme caution when servicing internal components.*



WARNINGS: *Tubing breakage may result in fluid being sprayed from pump. Use appropriate measures to protect operator and equipment.*



Turn drive off before removing or installing tubing. Fingers or loose clothing could get caught in drive mechanism.

CAUTION: *Power must be turned off before connecting the external remote control cable to prevent damage to the drive.*



WARNING

CAUTION: *To avoid electrical shock, the power cord protective grounding conductor must be connected to ground. Not for operation in wet locations as defined by EN 61010-1.*



WARNING: PRODUCT USE LIMITATION

This product is not designed for, nor intended for use in, patient-connected applications, including, but not limited to, medical and dental use, and, accordingly, has not been submitted for FDA approval.

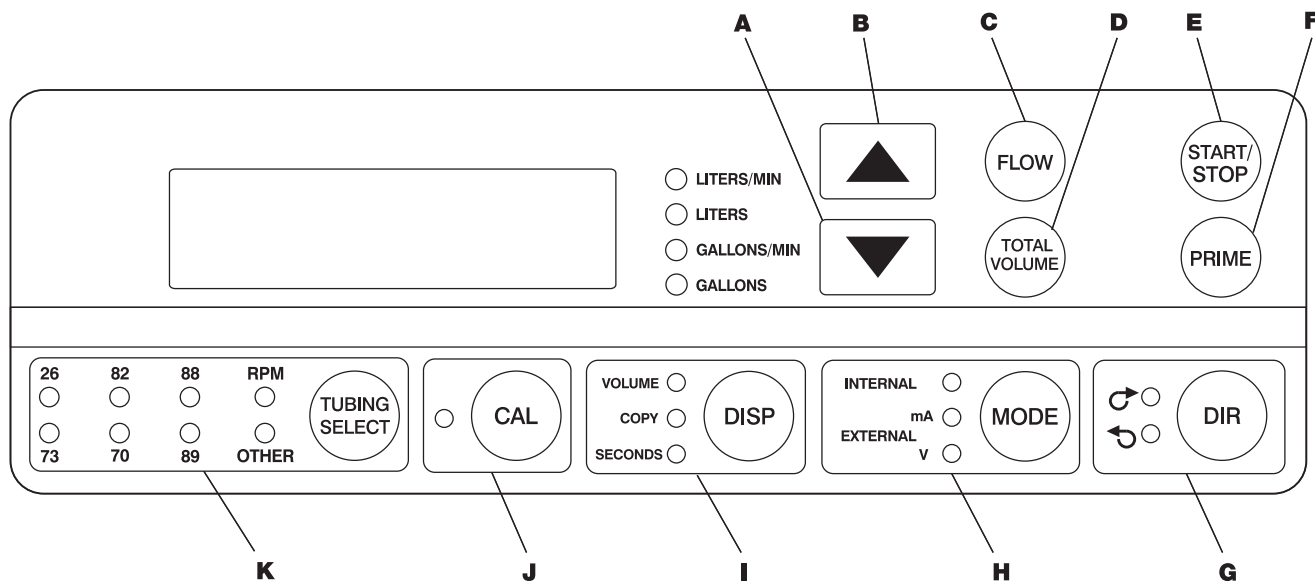
INTRODUCTION

The Console Drive controls the speed of MASTERFLEX® I/P® Pump Heads to provide flow rates from 0.12 to 17 L/min, or 26 L/min with two pump heads.

Mount up to 2 MASTERFLEX® I/P® EASY-LOAD® or Standard Pump Heads or 1 MASTERFLEX High-Performance I/P® Pump Head.

CONTROL/DISPLAY FUNCTIONS

Press keys to activate function. Use UP/DOWN (▲, ▼) arrow keys to correct/change a flashing display. Press any key to enter new values.



A. DOWN ARROW (DECREMENT)—Decrease value of a flashing display.

B. UP ARROW (INCREMENT)—Increase value of a flashing display.

C. FLOW CONTROL—Set flow rate for selected tubing size. To change flow rate, press ▲ or ▼ arrows. (If pump is running, its speed will change with new settings.)

D. TOTAL VOLUME—Display cumulative dispensed volume.

E. START/STOP—Start/Stop motor.

F. PRIME—Run pump at full speed to fill or clear lines.

G. DIRECTION—To change motor direction.

H. MODE SELECT—**INTERNAL** for internal control; **mA** for remote current control; **V** for remote voltage control.

I. DISPENSE/COPY—Select dispensed volume, number of copies of a dispensed volume, or the dispense interval.

J. CAL CONTROL—Refine built-in calibration using a measured volume.

K. TUBING SELECT—Select tubing size.

SETUP AND DRIVE OPERATION

1. Mount pump head and load tubing. (See pump head manual.)
2. Turn pump on and select tubing size by pressing "TUBING SELECT."

NOTE: If CAL LED is lit, that tubing size has been previously field calibrated. If LED is not lit, the drive is operating with the built-in factory calibration. To clear a field calibration, press and hold the CAL key until the CAL light goes out. This will take about 3 seconds. To recalibrate for better accuracy, see Calibration section.

3. MODE selection (INTERNAL, mA, V).
4. Select MOTOR DIRECTION (CW or CCW).
5. PRIME and CALibrate the pump (if required).
6. Press FLOW key and watch display to set the flow rate with UP/DOWN (▲, ▼) keys.
7. Press START/STOP key to begin pumping.

NOTE: Pump normally will not restart automatically after a brownout or powerout condition.

Automatic Start Enable/Disable

Press and hold START/STOP on power-up. After five (5) seconds, display will change to all dashes. Then, while holding START/STOP, press PRIME five (5) times. Display will flash "ON" or "OFF". Use UP/DOWN (▲, ▼) arrow keys to set automatic start option. Press any other key to exit. When "ON" is selected, pump will start automatically at power-up if it was "ON" when powered down.

CALIBRATION

***Use only MASTERFLEX precision tubing with MASTERFLEX pumps to ensure optimum performance.
Use of other tubing may void applicable warranties.***

1. Select correct tubing size and flow rate.
2. Press CAL; calibration volume appears.
3. Press START/STOP; the pump will use its stored memory to dispense the specified calibration sample quantity. The pump will stop automatically.
4. Weigh/measure the sample.
5. Use UP/DOWN (▲, ▼) arrow keys to correct the flashing display.

NOTE: If the adjusted calibration is too great, "Err" will appear in the display. If this occurs, press the CAL control and repeat the calibration procedure. The microprocessor will retain one special calibration value per tubing size, even when power is turned off. The next calibration will replace the existing value.

6. Press TUBING SELECT to exit the calibration cycle.

Maximum Flow Rate ("OTHER" Tubing)

1. To set the maximum flow rate for non-standard pump heads or "OTHER" tubing sizes, press CAL, then FLOW. The maximum flow rate will then flash on the display.
2. Use UP/DOWN (▲, ▼) arrow keys to set desired flow rate.
3. Press TUBING SELECT to exit.

DISPENSE/COPY

A first press of the DISP key results in the last entered dispense volume being displayed. The VOLUME annunciator will illuminate and flash. The INC/DEC (▲, ▼) keys are used to change the dispense volume, if desired. The START/STOP key then initiates delivery of the set volume. The amount remaining to be dispensed will be displayed during countdown. Resetting cumulative dispensed volume can be done by pressing START/STOP while holding TOTAL VOLUME. Display flashes “999999” when cumulative volume is greater than 999999. The dispense function is exited by pressing any key except Increment (▲), Decrement (▼), DISP, or START/STOP.

A second press of the DISP key causes the COPY annunciator to illuminate and flash. The START/STOP key is then used to deliver the desired volume without the need to know the volume in specific units. A third press of the DISP key enters the volume dispensed. The COPY annunciator stops flashing. The START/STOP key is then used to initiate delivery of the copied volume. The number of copies dispensed is displayed after each dispense. The maximum number of copies is 999999. The START/STOP key is used to pause the copy dispense during dispensing; copy dispense can then be continued using the START/STOP key.

A fourth press of the DISP key results in the last entered dispense interval being displayed. The SECONDS annunciator will illuminate and flash. The INC/DEC (▲, ▼) keys are used to change the dispense time, if desired, from 1 to 999999 seconds. The START/STOP key then initiates delivery for the set time interval. The remaining time will be displayed during countdown. Pressing the DISP key a fifth time exits this mode.

Keypad Lockout Enable/Disable

Press and hold FLOW. After five (5) seconds, display will change to all dashes. Then, while holding FLOW, press PRIME five (5) times.

REMOTE CONTROL

Selectable input (0–20 mA, 4–20 mA, 0–10V DC)
±0.5% linearity control
±50V common mode range
START/STOP; CW/CCW; PRIME via contact closure

Remote Control Setup

1. Place the power switch in the off position.

CAUTION: *Power must be turned off before connecting the external remote control cable to prevent damage to the drive.*



2. Connect the cable from the external remote control to the mating receptacle on the rear panel.

3. Select type of remote control input and output required as follows:

- a. Press and hold the MODE control while turning the power switch to the on position. After two seconds, release the MODE control. The initial display will show: “inP”. After two seconds, the display shows either 0–20 or 4–20.

NOTE: Press the UP (▲, increment) or DOWN (▼, decrement) arrow keys to select between 4–20 and 0–20 for current loop control.

- b. Press the MODE control again. The initial display will show: “out”. After two seconds, the display shows either 0–10 or 0–20 and 4–20.

NOTE: Press the UP (▲, increment) or DOWN (▼, decrement) arrow keys to select between 4–20 or 0–20 and 0–10 for current loop or voltage output.

4. Press the MODE control to select mode of operation. The LEDs indicate the selected mode. Select either mA or V.

NOTE: If using only remote START/STOP, PRIME and/or CW/CCW, the MODE control can be set to any of the three positions.

CURRENT/VOLTAGE SCALING

Each tube size has its own scaling for the current/voltage inputs and outputs. The factory default scaling for each tube size is zero to maximum flow for minimum to maximum current and voltage. After a tubing calibration is performed, the maximum flow for the tubing will change due to the new calibration.

However, the current/voltage scaling is not changed after a tubing cal so that a given current or voltage will still represent the same flow. To retain control of the entire flow range of a tube after calibration, the current/voltage scaling must be changed after the tubing is calibrated to match the new maximum flow.

To adjust the current/voltage scaling, first select the tube size and perform a tubing calibration, if needed. Next, press and hold the MODE key while pressing the FLOW key. The display will show "LO" for 2 seconds and then flash the low Scale number. The low Scale is the flow at minimum current/voltage. It should be set to zero to control the entire flow range of the tubing. Use the INC/DEC (▲, ▼) arrow keys to change the number. Press the FLOW key again. The display will show "HI" for 2 seconds and then flash the hiScale number. The hiScale is the flow at maximum current/voltage. Press the TUBING SELECT key to set the number to the maximum flow for the selected tube size. This will allow control of the entire flow range of the tubing. Use the INC/DEC (▲, ▼) arrow keys if a different hiScale is desired. Press any other key to save the settings and exit. The same scaling will be used for both input and output levels.

Tips:

1. Avoid setting the hiScale too far above the maximum flow for the tube size. This will reduce the resolution of the current/voltage input and output.
2. If you do not need the full flow range of the tubing, setting the lowScale and hiScale to a smaller flow range will improve the resolution of the current/voltage input and output.
3. When lowScale is non-zero and 0-20 mA or 0-10 V inputs are used for control, a zero input will not stop the drive; it will run at the lowScale flow. The START/STOP key or input must be used to stop the drive. Using 4-20 mA control in this case will allow the drive to be stopped by setting the input below 4 mA.
4. The lowScale can be set higher than the hiScale to reverse the slope of the current/voltage input and output.

The following tables show how to calculate flow, current, and voltage for all the various setup options.

Table 1 - Offset On and lowScale set to zero (factory default)

4-20 mA In/Out	0-20 mA In/Out	0-10 V In/Out
mA = Flow x (15.8 / hiScale) + 4.2	mA = Flow x (19.8 / hiScale) + 0.2	Volts = Flow x (9.9 / hiScale) + 0.1
Flow = (mA - 4.2) / (15.8 / hiScale)	Flow = (mA - 0.2) / (19.8 / hiScale)	Flow = (Volts - 0.1) / (9.9 / hiScale)

Table 2 - Offset Off and lowScale set to zero

4-20 mA In/Out	0-20 mA In/Out	0-10 V In/Out
mA = Flow x (16 / hiScale) + 4	mA = Flow x (20 / hiScale)	Volts = Flow x (10 / hiScale)
Flow = (mA - 4) / (16 / hiScale)	Flow = mA / (20 / hiScale)	Flow = Volts / (10 / hiScale)

Table 3 - Non-zero lowScale, offset on or off

4-20 mA In/Out	0-20 mA In/Out	0-10 V In/Out
$\text{mA} = (\text{Flow} - \text{lowScale}) \times (16 / (\text{hiScale} - \text{lowScale})) + 4$	$\text{mA} = (\text{Flow} - \text{lowScale}) \times (20 / (\text{hiScale} - \text{lowScale}))$	$\text{Volts} = (\text{Flow} - \text{lowScale}) \times (10 / (\text{hiScale} - \text{lowScale}))$
$\text{Flow} = (\text{mA} - 4) / (16 / (\text{hiScale} - \text{lowScale})) + \text{lowScale}$	$\text{Flow} = (\text{mA} / (20 / (\text{hiScale} - \text{lowScale}))) + \text{lowScale}$	$\text{Flow} = (\text{Volts} / (10 / (\text{hiScale} - \text{lowScale}))) + \text{lowScale}$

CURRENT/VOLTAGE OFFSET

Since the pump drives go down to 1 rpm, a 0.2 mA and 0.1 V offset is added to the current and voltage inputs and outputs to provide sufficient hysteresis between minimum speed and off. This offset is only added when the current/voltage scaling is set with a lowScale of zero (factory default) and the offset setup option is turned on (factory default). To disable this offset for all conditions, press and hold the MODE key until the display changes to "OFFSET" or "OFSET". Next use the INC/DEC (▲, ▼) arrow keys to change the flashing "ON" to "OFF", and then press the MODE key twice to save the setup. The following tables show the input and output voltages and currents with offset on and offset off. Note that when the offsets are used, there is also a span change when calculating flow, current, or voltage (see formulas in section **Current/Voltage Scaling**).

Table 4 – Offset On and low Scale set to zero (factory default)

Flow rate	4-20 mA In/Out	0-20 mA In/Out	0-10 V In/Out
0	4.00 to 4.20 mA	0.00 to 0.20 mA	0.00 to 0.10 V
Minimum	4.22 mA	0.23 mA	0.12 V
25%	8.15 mA	5.15 mA	2.58 V
50%	12.10 mA	10.10 mA	5.05 V
100%	20.00 mA	20.00 mA	10.0 V

Table 5 – Offset Off or non-zero lowScale

Flow rate	4-20 mA In/Out	0-20 mA In/Out	0-10 V In/Out
0	4.00 mA	0.00 mA	0.00 V
Minimum	4.03 mA	0.03 mA	0.02 V
25%	8.00 mA	5.00 mA	2.50 V
50%	12.00 mA	10.00 mA	5.00 V
100%	20.00 mA	20.00 mA	10.0 V

NOTE: With offsets set to off it may not be possible to get down to zero flow with the 0-20 mA or 0-10 V inputs due to the on/off hysteresis of the inputs. It may be necessary to use the START/STOP key or START/STOP input to stop the pump.

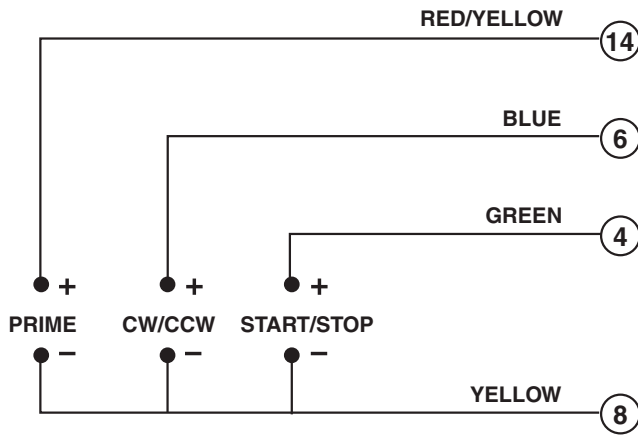
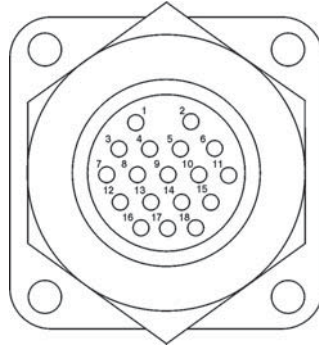
START/STOP INPUT

The START/STOP input can be configured to be optional (factory default), or required for the drive to run. It can also be configured differently for Internal and External (mA or V) modes. For example, the START/STOP input could be optional in Internal mode and required in External mode. To change the START/STOP input configuration, first select the mode for the desired configuration (Internal, mA, or V). Next press and hold the MODE key until the display changes to "OFFSET" or "OFSET". Release the MODE key and press it again to skip over the Offset setup. Now the display should be alternating between "STOP" and "OFF" or "ON". Next use the INC/DEC (▲, ▼) arrow keys to select "ON" for required START/STOP input or "OFF" for an optional START/STOP input. Press the MODE key again to save the setup. If you will be using both Internal and External modes, be sure to perform the START/STOP setup in both modes.

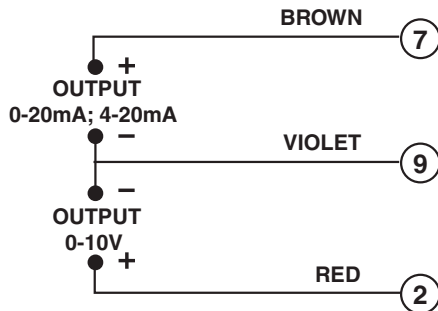
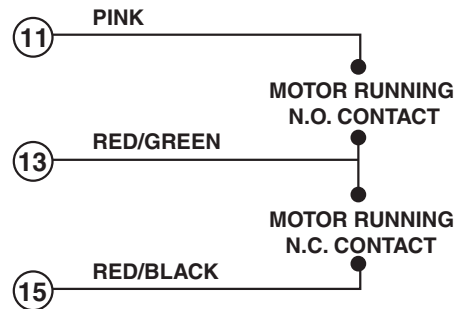
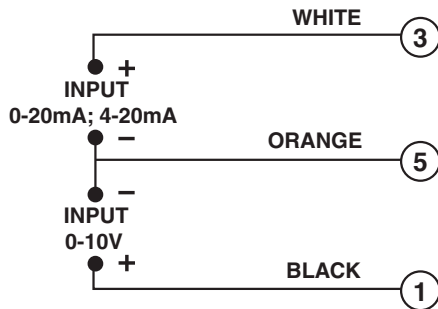
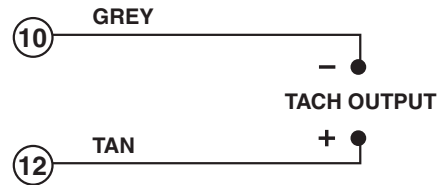
With the "STOP OFF" option selected (factory default), use of the START/STOP input is optional. When the START/STOP input is open, the drive can still be started using the START/STOP key, PRIME key or PRIME input. In external modes the drive will also run if there is sufficient current or voltage at the input. Closing the START/STOP input will cause the drive to run until the START/STOP input opens or the START/STOP key is pressed. In volume dispense, copy dispense, and seconds mode, only a momentary START/STOP closure is needed to start the drive. If the drive is already running in one of the dispense modes, a momentary START/STOP closure will stop the drive. In set copy mode, the START/STOP input functions the same as in normal mode; closing it will cause the drive to run until it opens.

The function of the START/STOP input is considerably simplified when the "STOP ON" option is selected. The drive will not run under any condition unless the START/STOP input is closed.

REMOTE CONTROL WIRING SCHEMATIC



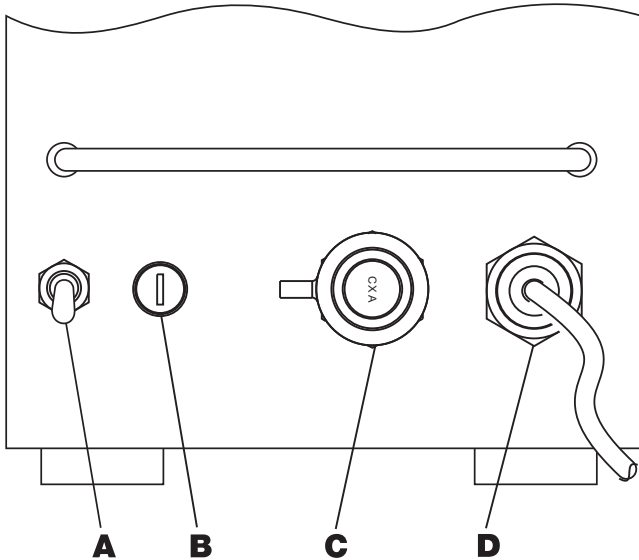
NOTE: Colors are those of Remote Cable, Catalog number 77300-32.



TROUBLESHOOTING AND MAINTENANCE

Fuse Replacement

1. Place the power switch in the off position.
2. Disconnect the AC power input line cord from the receptacle.
3. Remove and check the fuse and replace if defective.
4. Reconnect the AC power input line cord to the receptacle.



- A.** Power Switch - All settings are retained in memory.
- B.** T6.3A Fuse
- C.** External Receptacle
- D.** IEC 320 Power Cord

Troubleshooting

SYMPTOM	CAUSE	REMEDY
A. Motor does not rotate. Display does not light.	A. No power.	<ol style="list-style-type: none"> 1. Check fuse and replace if defective. 2. Check that unit is plugged into a live line. 3. Check connection of power cord. 4. Check the line cord for continuity and replace if defective. 5. Return for servicing.
B. Motor does not rotate. Display lights.	B1. Defective remote control.	<ol style="list-style-type: none"> 1. Place power switch in off position. 2. Check that remote cable connector is inserted fully into the receptacle. 3. If motor still does not rotate, select INTERNAL with the MODE control and press the START/STOP control. 4. If the motor rotates, replace the remote control with similar unit. If motor does not rotate, return drive for servicing.

Troubleshooting (cont.)

SYMPTOM	CAUSE	REMEDY
B. (cont.) Motor does not rotate. Display lights.	B2. MODE control not properly set.	<ol style="list-style-type: none"> 1. Check that the MODE control is set to INTERNAL for operation with front panel control or to mA or V for operation with remote control. 2. If motor still does not rotate, return for servicing.

If an **error message** is displayed, refer to the following list for possible corrective actions you can take. If these do not correct the problem, contact your dealer.

ERROR MESSAGE	CAUSE	REMEDY
"Err 2"	Motor over-speed	<ol style="list-style-type: none"> 1. Clear by pressing any key. 2. Check for proper tube loading and pump operation. 3. Return unit for repair if the error persists.
"Err 3" "Err 5" "Err 12"	Overload	<ol style="list-style-type: none"> 1. Clear by pressing any key. 2. Check for proper tube loading and pump operation. 3. Return unit for repair if the error persists.
"Err 7"	Bad data. Operator parameters set to default values.	<ol style="list-style-type: none"> 1. Clear by pressing any key. 2. Reprogram operator parameters. 3. Return unit for repair if the error persists.
"Err 10" "Err 11"	Voltage out of range	<ol style="list-style-type: none"> 1. Clear by pressing any key. 2. Check that AC line voltage is within specified voltage ranges. 3. Return unit for repair if AC line voltage is correct and the error persists.
"Err 13" "Err 14"	Over temperature	<ol style="list-style-type: none"> 1. Check for heat sources or obstructions to cooling. 2. Check for proper tube loading and pump operation. 3. Allow unit to cool. Clear by pressing any key. 4. Return unit for repair if no cause for overheating is found and the error persists.
All other errors	Internal error or failure.	<ol style="list-style-type: none"> 1. Clear (if possible) by turning power off and on. 2. Return unit for repair if the error persists.

Cleaning

Keep the drive enclosure clean with mild detergents. Do not immerse.

Replacement Parts and Accessories

Description	Part Number
Fuse—T6.3A	77500-24
Hand-held remote control	07592-83
Remote control cable, 25 ft (7.62 m)	77300-32
Caster Kit	77420-01
Replacement Seal	77420-03

SPECIFICATIONS

Output:

Speed:	1 to 650 r/min
Torque output, Maximum:	
Continuous	580 oz-in (41.8 kg•cm)
Start-up	1750 oz-in (126 kg•cm)
Speed regulation:	
Line	±0.25% F.S.
Load	±0.25% F.S.
Drift	±0.25% F.S.
Display:	Six-digit, seven-segment LED
Remote outputs:	Voltage speed output (0–10V DC @ 1 kΩ min) Current speed output (0–20 mA or 4–20 mA @ 0–600 Ω) Tach output (TTL, 10 to 6500 Hz, 50% duty cycle 10 Hz/rpm) Motor running output (N.O. & N.C. contact closure, 1A @ 28V AC/DC)

Input:

Supply voltage limits:	Dual voltage—Automatically selected 90 to 130 Vrms @ 50/60 Hz, or 200 to 260 Vrms @ 50/60 Hz
Current, max.:	4.5A @ 115 Vrms, or 2.5A @ 230 Vrms
Remote Inputs:	START/STOP, CW/CCW, PRIME (Contact closure) Voltage input (0–10V DC @ 10 kΩ) Current input (0–20 mA or 4–20 mA @ 250 Ω)

Construction:

Dimensions (L × W × H):	18 3/8 in × 11 in × 17 in (467 × 279 × 432 mm)
Weight:	70 lb (31.7 kg)
Enclosure Rating:	IP 66 per IEC 529/NEMA 4V (Indoor use)

Environment:

Temperature, Operating:	0° to 40°C (32° to 104°F)
Temperature, Storage:	–25° to 65°C (–13° to 149°F)
Humidity (non-condensing):	10% to 100%
Altitude:	Less than 2000 m
Pollution Degree:	Pollution Degree 3 (Indoor use—sheltered locations)

Chemical Resistance: Enclosure is 316 stainless steel

Compliance:

UL508C, CSA C22.2, No. 14
(For CE Mark):
EN61010-1 (EU Low Voltage Directive) and
EN61326 (EU EMC Directive)

WARRANTY

Use only MASTERFLEX precision tubing with MASTERFLEX pumps to ensure optimum performance. Use of other tubing may void applicable warranties.

This product is warranted against defects in material or workmanship, and at the option of the manufacturer or distributor, any defective product will be repaired or replaced at no charge, or the purchase price will be refunded to the purchaser, provided that: (a) the warranty claim is made in writing within the period of time specified on this warranty card, (b) proof of purchase by bill of sale or receipted invoice is submitted concurrently with the claim and shows that the product is within the applicable warranty period, and (c) the purchaser complies with procedures for returns set forth in the general terms and conditions contained in the manufacturer's or distributor's most recent catalog.

This warranty shall not apply to: (a) defects or damage resulting from: (i) misuse of the product, (ii) use of the product in other than its normal and customary manner, (iii) accident or neglect, (iv) improper testing, operation, maintenance, service, repair, installation, or storage, (v) unauthorized alteration or modification, or (b) post-expiration dated materials.

THIS WARRANTY IS THE EXCLUSIVE REMEDY OF THE PURCHASER, AND THE MANUFACTURER AND DISTRIBUTOR DISCLAIM ALL OTHER WARRANTIES, WHETHER EXPRESS, IMPLIED, OR STATUTORY, INCLUDING WITHOUT LIMITATION, WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. NO EMPLOYEE, AGENT, OR REPRESENTATIVE OF THE MANUFACTURER OR DISTRIBUTOR IS AUTHORIZED TO BIND THE MANUFACTURER OR DISTRIBUTOR TO ANY OTHER WARRANTY. IN NO EVENT SHALL THE MANUFACTURER OR DISTRIBUTOR BE LIABLE FOR INCIDENTAL, INDIRECT, SPECIAL OR CONSEQUENTIAL DAMAGES.

The warranty period for this product is two (2) years from date of purchase.

PRODUCT RETURN

To limit charges and delays, contact the seller or Manufacturer for authorization and shipping instructions before returning the product, either within or outside of the warranty period. When returning the product, please state the reason for the return. For your protection, pack the product carefully and insure it against possible damage or loss. Any damages resulting from improper packaging are your responsibility.

TECHNICAL ASSISTANCE

If you have any questions about the use of this product, contact the Manufacturer or authorized seller.

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