



# MCH Control Handle/EDC

Control Handles For  
Electrical Displacement Controls (EDC)

BLN 95-9007-0101

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## DESCRIPTION

The MCHXXX Control Handle is intended for use in open-loop systems controlling Danfoss hydrostatic pumps with an Electrical Displacement Control (EDC).

These Control Handles may also be used with an MCE101 Proportional Transmission Controller in pressure or horsepower limiting applications.

The Control Handle is designed to provide a remote man-machine interface. In addition to proportional operation of electrically controlled hydrostatics, switches may be incorporated to operate backup, alarm, brake, and neutral interlock circuits.



## FEATURES

- Choice of three mounting styles with or without water resistant case.
- Mechanical options include center lock, spring return, friction held, and center detents.
- High torque handle actuation gives a realistic force feel.
- Easy installation.
- Shock and vibration resistant.
- Environmental hardened components designed for off-road construction equipment.
- Optional switches in knobs.
- Optional cam operated switches.
- Optional electrical cable and connectors.

## ORDERING INFORMATION

The following tabulation is the list of current standard production Control Handle models for EDCs. Behind each circuit (as described in the Electrical Characteristics section of this bulletin) is the mounting, knob, and actuation which are available as production models. For example, for the B1039 circuit there is MCH12AB1039, MCH41AB1039, and MCH51AB1039 in production. Other combinations may be possible. Consult factory for availability.

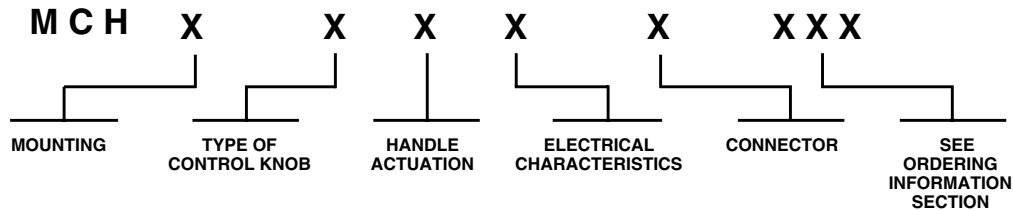
CIRCUIT NUMBER	MOUNTING, KNOB AND ACTUATION
<b>B1032</b>	11A 11B 12A 12B 13B 21A 21B 21C 22A 22B 23A 26A 26B 29A 29B 31A 32B 40A 41A 41B 42A 42B 47A 48B 51A 51B 58A
<b>B1035</b>	11C 21C 29C 31C 41C 43C 51C 59C
<b>B1039</b>	11A 12A 41A 51A
<b>B1042</b>	11A 11B 12A 12B 21A 22A 22B 23A 25A 29B 41A 41B 42A 43B 48A
<b>B3069</b>	12A 22B 32B 41A 42A
<b>B5087</b>	11B 22B 41B 42B
<b>B5093</b>	11A 12B 22A 22B 41A 51B
<b>C1033</b>	11A 11B 12A 12B 13A 21A 21B 22A 22B 23A 29A 32B 41A 41B 42A 42B 43A 51A 51B 52A 52B 53A

CIRCUIT NUMBER	MOUNTING, KNOB AND ACTUATION
<b>C1065</b>	22B
<b>C1067</b>	11A 12B 21A 22A 22B 32A 41B 42B
<b>C5168</b>	11A 22B 32A 42B
<b>D1029</b>	11B 22B 29B
<b>D1040</b>	19A 21A 22B 31B 42B
<b>D1043</b>	11A 11B 12B 13A 13B 16B 21A 22B 23A 26B 29A 29B 32A 41A 41B 42B 51B 52B
<b>D1058</b>	11A 11B 12A 12B 21B 22A 22B 23A 41B 42B 45B 48A 52B
<b>D1064</b>	11A 11B 12A 12B 22A 22B 29B 41A 41B 42B 48A

## ORDERING INFORMATION (continued)

CIRCUIT NUMBER	MOUNTING, KNOB AND ACTUATION	CIRCUIT NUMBER	MOUNTING, KNOB AND ACTUATION
D1073	11B 12B 21A 21B 22B 23B 31B 41B 51B 52B	M1068	11A 11B 12B 13A 21A 21B 22A 22B 28A 29B 41B 42A 42B 48A 51B 52A 58B 59A
D1077	21A 21B 22B 41B 51A 51B	M1083	11A 12B 19A 21A 22B 41A 51A 51B 52B
D1082	13A 21A 21B 22B 42B	M1101	11B 12B 21A 22A 22B 41B 42B
D1089	42B 51B	M1112	22B 31B 41B 52B
D2155	48A	M1122	21A 22B 41B 42B 48A
D3059	11B	M1167	21A 32B 42B 51B
D5129	11A 11B 22B 41A 41B	M1169	22B 41B 45B
L2171	11A 11B 12A 12B 19A 21A 22B 42B		

## MCHXX ORDERING SPECIFICATION CHART



### MOUNTING

- 1 Base (surface) mount aluminum case
- 2 Top mount (drop-in) with plastic case
- 3 Top mount (drop-in) without plastic case
- 4 Panel mount with plastic case
- 5 Panel mount without plastic case

### TYPE OF CONTROL KNOB

- 1 Non-locking
- 2 Center lock
- 3 Push button in knob
- 4 Tron maintained rocker switch (obsoleted)
- 5 Non-locking, no knob
- 6 3-position maintained rocker switch in knob
- 7 Tron momentary rocker switch (obsoleted)
- 8 Special (no handle or knob)
- 9 3-position momentary rocker switch in knob
- C Maintained rocker and trigger switch
- D Momentary rocker and lever switch
- E Momentary rocker and trigger switch

### HANDLE ACTUATION

- A Spring-return, bi-directional
- B Friction held, bi-directional
- C Friction held, uni-directional
- D Special (friction held, center detent only, no brake)
- E Spring return, uni-directional (one direction blocked, 30° movement)

### ELECTRICAL CHARACTERISTICS

- A Proportional, no switches
- B Proportional, 12 Vdc center-off switch
- C Proportional, 24 Vdc center-off switch
- D Proportional, center-off and auxiliary switch
- L Electronic PWM auxiliary switching
- M 3-switches
- N 4-switches
- P 5-switches
- R 2-switches
- X Special
- Y Special
- Z Special

### CONNECTOR

- 1 Terminal strip internal
- 2 Pigtail 60 inch with no connector
- 3 Pigtail with unsealed Packard connector
- 4 Pigtail with both halves of unsealed Packard connector
- 5 Sealed Packard connector with mating half
- 6 Sealed Packard connector 4-pin male and female
- 7 Pigtail with sealed Packard connector
- 8 Pigtail sealed Deutsch connector
- 9 No connector / terminal strip

## TECHNICAL DATA

### ELECTRICAL SPECIFICATIONS

#### OPERATING VOLTAGE RANGE

11-15 Vdc	(12 Volt models)
10 Vdc	(12 Volt proportional transmission controller models)
22-30 Vdc	(24 Volt models)
20 Vdc	(24 Volt proportional transmission controller models)

#### LOAD RESISTANCE

15-30  $\Omega$   
Danfoss single and dual-coil Electrical Displacement Controls.

#### AUXILIARY SWITCH CURRENT CAPABILITY

V3L Microswitch (cam actuated)  
3-amp, inductive at 28 Vdc

SM Microswitch (cam actuated)  
2.5-amp, inductive at 28 Vdc

Rocker Switch (in knob)  
2-amp, inductive at 28 Vdc

Push button Switch (in knob)  
5-amp, inductive at 28 Vdc

### MECHANICAL SPECIFICATIONS

#### HANDLE STROKE:

$\pm 30^\circ$   
60° total travel

#### SPRING TORQUE

11  $\pm$  4-in./lb. (1.2  $\pm$  0.4-N-m) at center break away  
18  $\pm$  6-in./lb. (2.0  $\pm$  0.7-N-m) at full stroke

#### DETENTE TORQUE (over & above friction drag):

10-in./lb. (1.1-N-m)

#### FRICITION DRAG:

13.5  $\pm$  3-in./lb. (1.5  $\pm$  0.3-N-m)

Friction is adjusted at brake assembly with a 5/32 English Allen wrench and 3/8 open-ended wrench.

## MOUNTING, TYPE OF KNOB, HANDLE ACTUATION

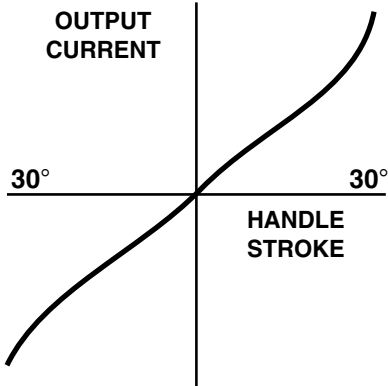
A wide range of options to the basic Control Handle allows it be custom-tailored to each application. See Ordering Specification chart in Ordering Information.

### MOUNTING (See Dimension Drawing)

- BASE OR SURFACE MOUNT**  
Connection is via four screws to the flanges on the bottom of the metal case.
- TOP MOUNT WITH CASE**  
Connection is via two screws to an enlarged mounting plate. Top mounting allows the entire handle to be removed from above the panel. The case is made of black nylon plastic.
- TOP MOUNT WITHOUT CASE**  
Same as 2, but without case.
- PANEL MOUNT WITH CASE**  
Connection is via four screws to the top plate that holds the boot in place. The case is made of black nylon plastic.
- PANEL MOUNT WITHOUT CASE**  
Same as 4, but without case.

### TYPE OF CONTROL KNOB (See Dimension Drawing)

- NON-LOCKING**  
The non-locking handle has a standard ball knob. The friction-held handle detents with a spring-loaded ball to indicate null, while the spring-return handle has a spring-preload indicating null.
- CENTER-LOCK**  
The center-lock handle has a cylindrical knob and provides a positive center-lock that unlatches when the operator pulls up on the knob.
- NON-LOCKING, AUXILIARY SWITCH**  
This knob is teardrop shaped, with an auxiliary momentary push button switch on top. The switch is wired through the handle shaft to the body with three wires (common, normally open and normally closed).
- NON-LOCKING, NO KNOB**  
The customer provides his own customized knob.
- THREE POSITION MAINTAINED ROCKER SWITCH IN KNOB**  
The cylindrical knob has a boot covering the three position switch in the knob. The switch, wired through the handle, is used for auxiliary functions.
- THREE POSITION MOMENTARY ROCKER SWITCH IN KNOB**  
This is the same as 6, but the switch returns to the center position when released.

HANDLE ACTUATION ( <i>continued</i> )	PERFORMANCE CURVE
<p><b>HANDLE ACTUATION</b></p> <p>A. <b>SPRING-RETURN, BI-DIRECTIONAL</b> This handle uses a torsion spring to return to the mechanical center position, and has 30 degrees of handle throw on either side of center.</p> <p>B. <b>FRICTION-HELD, BI-DIRECTIONAL</b> This handle has an adjustable drag set with a clamp-type brake, that holds the handle at the set position, and has 30 degrees of handle throw on either side of the center detent.</p> <p>C. <b>FRICTION-HELD, UNI-DIRECTIONAL</b> This handle has a high-resolution 60 degrees of handle throw, rotating on only one side of mechanical null, which is at full stroke. It has no detent mechanism.</p>	 <p style="text-align: right;">1139</p> <p><b>Proportional Control Handle Output Current vs. Control Handle Travel.</b></p>

ELECTRICAL CHARACTERISTICS	
<p><b>A. <u>PROPORTIONAL, NO SWITCHES, 12 Vdc, BI-POLAR</u></b> Not recommended for Control Handles driving an Electrical Displacement Control. To be used only as setpoint. See Performance Curve.</p> <p><b>B. <u>PROPORTIONAL, CENTER-OFF SWITCH, 12 Vdc, BI-POLAR</u></b> These handles have a center-off switch wired to ensure zero output when the handle is within <math>\pm 3^\circ</math> of mechanical center.</p> <p>CIRCUIT NUMBERS FOR USE WITH A FIXED POWER SUPPLY B1032 - Single pot, terminal strip B2095 - Single pot, pigtail no connector B3069 - Single pot, unsealed Packard connector B5093 - Single pot, sealed Packard connector</p> <p>CIRCUIT NUMBERS FOR USE WITH THE MCE101 PROPORTIONAL TRANSMISSION CONTROLLER B1042 - Dual pot, terminal strip B3086 - Dual pot, unsealed Packard connector B5087 - Dual pot, sealed Packard connector</p> <p>CIRCUIT FOR OPERATING TWO EDCs IN SERIES B1039 - Dual pot, terminal strip</p> <p><b>C. <u>PROPORTIONAL, CENTER-OFF SWITCH, 24 Vdc, BI-POLAR</u></b> These handles have a center-off switch wired to ensure zero output when the handle is within <math>\pm 3^\circ</math> of mechanical center.</p> <p>CIRCUIT NUMBERS FOR USE WITH A FIXED POWER SUPPLY C1033 - Single pot, terminal strip C3076 - Single pot, unsealed Packard connector C5168 - Single pot, sealed Packard connector</p>	<p>CIRCUIT NUMBERS FOR USE WITH THE MCE101 PROPORTIONAL TRANSMISSION CONTROLLER C1067 - Dual pot, terminal strip</p> <p>CIRCUIT FOR OPERATING TWO EDCs IN SERIES C1065 - Dual pot, terminal strip</p> <p><b>D. <u>PROPORTIONAL, CENTER-OFF SWITCH, UNWIRED AUXILIARY SWITCH, 12 OR 24 Vdc, BI-POLAR</u></b></p> <p>CIRCUIT NUMBERS FOR USE WITH FIXED 12 Vdc POWER SUPPLY D1043 - Single pot, reverse switch, terminal strip D1058 - Single pot, neutral start switch, terminal strip D2163 - Single pot, neutral start switch, 60" pigtail D3059 - Single pot, reverse switch, unsealed Packard connector</p> <p>CIRCUIT NUMBERS FOR USE WITH FIXED 24 Vdc POWER SUPPLY D1040 - Single pot, reverse switch, terminal strip D1082 - Single pot, neutral start switch, terminal strip</p> <p>CIRCUIT NUMBERS FOR USE WITH 12 Vdc MCE101 PROPORTIONAL TRANSMISSION CONTROLLER D1029 - Dual pot, reverse switch, terminal strip D1064 - Dual pot, neutral start switch, terminal strip D2155 - Dual pot, neutral start switch, 60" pigtail D5129 - Dual pot, neutral start switch, sealed Packard connector</p> <p>CIRCUIT NUMBERS FOR USE WITH 24 Vdc MCE101 PROPORTIONAL TRANSMISSION CONTROLLER D1077 - Dual pot, neutral start switch, terminal strip</p> <p>CIRCUIT FOR OPERATING TWO EDCs IN SERIES D1073 - 12 Vdc, dual pot, neutral start switch, terminal strip D1089 - 24 Vdc, dual pot, reverse switch, terminal strip D1138 - 24 Vdc, dual pot, neutral start switch</p>

## ELECTRICAL CHARACTERISTICS (continued)

### L. ELECTRONIC, PULSE WIDTH MODULATED, ADJUSTABLE OUTPUT, 12 Vdc, BI-POLAR

CIRCUIT NUMBERS FOR USE WITH AN ELECTRICAL DISPLACEMENT CONTROL

L2171 - Center off and output phasing switch, suitable for fixed or variable power supplies.

### M. PROPORTIONAL, THREE SWITCHES, 12 OR 24-VOLT

The three switches include a wired center-off switch and two unwired auxiliary switches.

CIRCUIT NUMBERS FOR USE WITH 12 Vdc FIXED POWER SUPPLY

M1068 - Single pot, forward & reverse switches, terminal strip  
M1101 - Single pot, forward & neutral start switches, terminal strip

CIRCUIT NUMBERS FOR USE WITH 24 Vdc FIXED POWER SUPPLY

M1083 - Single pot, forward & reverse switches, terminal strip

CIRCUIT NUMBERS FOR USE WITH 12 Vdc MCE101 PROPORTIONAL TRANSMISSION CONTROLLER

M1122 - Dual pot, forward & neutral start switches, terminal strip  
M1167 - Dual pot, forward & reverse switches, terminal strip  
M2151 - Dual pot, forward & neutral start switches, 60" pigtail

CIRCUIT NUMBERS FOR USE WITH 24 Vdc MCE101 PROPORTIONAL TRANSMISSION CONTROLLER

M1169 - Dual pot, forward & reverse switches, terminal strip

CIRCUIT NUMBERS FOR OPERATING TWO EDCs IN SERIES

M1091 - Dual pot, 12 Vdc, forward & reverse switches, terminal strip  
M1112 - Dual pot, 24 Vdc, forward & reverse switches, terminal strip

## CONNECTORS

### TERMINAL STRIP

Electrical connectors are made to a set of four internal screw terminals.

### PIGTAIL WITHOUT A CONNECTOR

60 inch lead wire, total length.

### PIGTAIL WITH UNSEALED PACKARD CONNECTOR

12 inch lead wire with unsealed Packard connector. Unsealed connectors are generally used inside a sealed panel.

### PIGTAIL WITH UNSEALED PACKARD CONNECTOR

Halves of the connector are included.

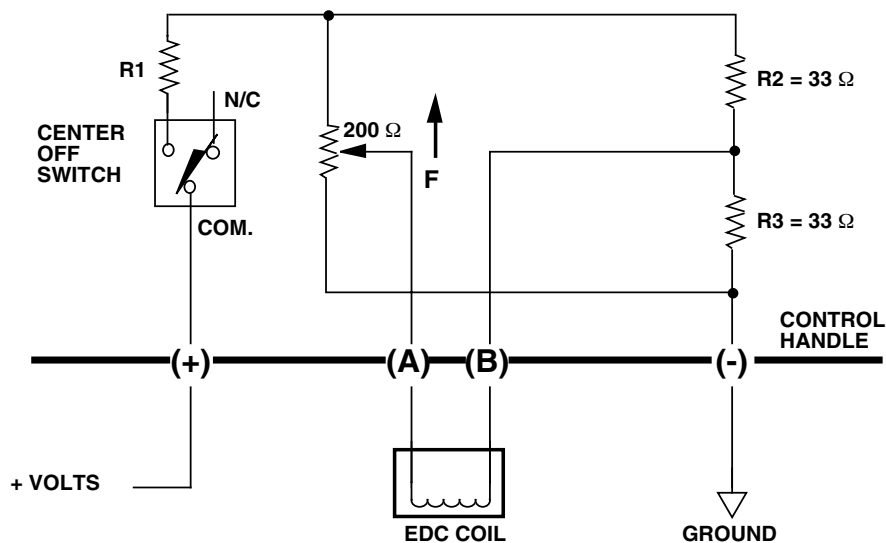
### SEALED PACKARD CONNECTOR WITH MATING HALF

A weather-sealed Packard connector and unassembled mate.

### SEALED PACKARD CONNECTORS

(4-pin male & female) These are two separate connectors, each connected to a separate potentiometer bridge.

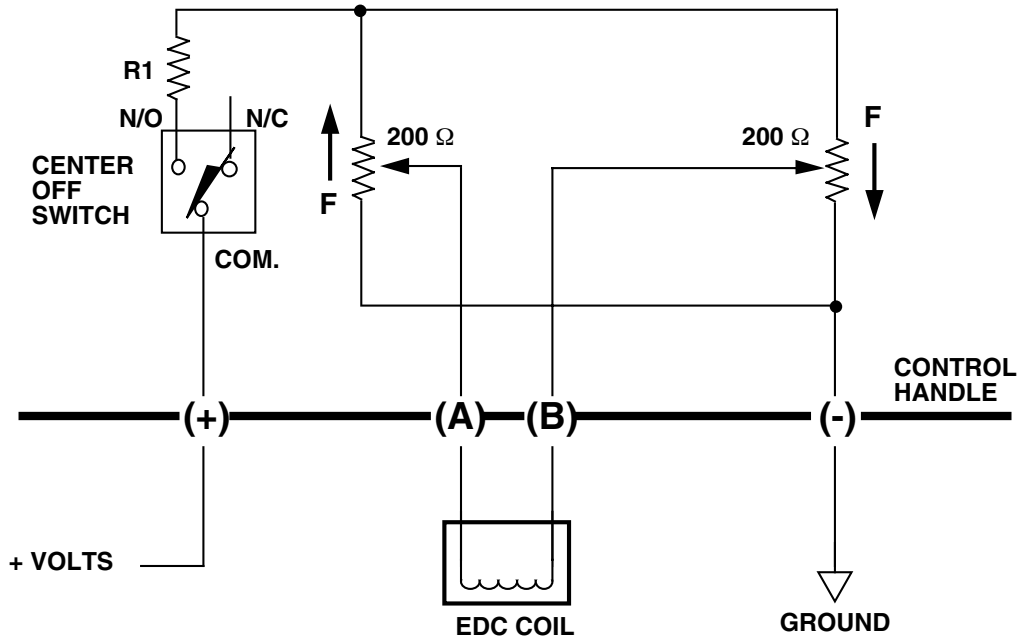
## BLOCK DIAGRAM 1



Single Potentiometer Control Handle Circuit (Bi-Directional Output).

1437

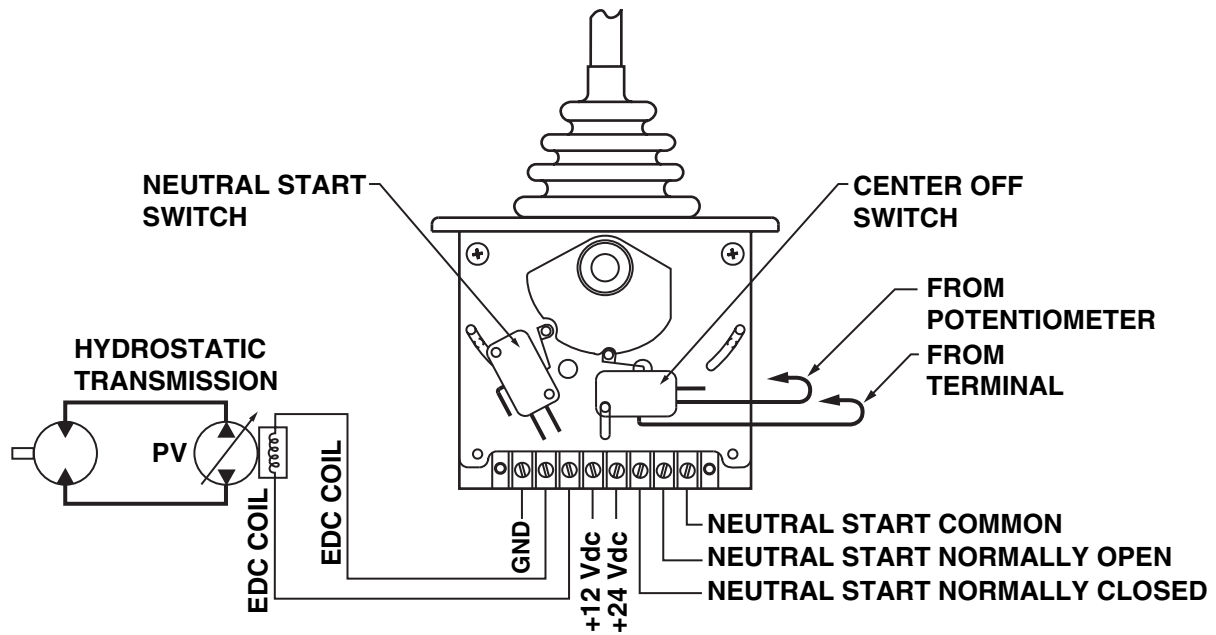
## BLOCK DIAGRAM 2



1438

Dual Potentiometer Control Handle Circuit (Bi-Directional Output).

## CONNECTION DIAGRAM

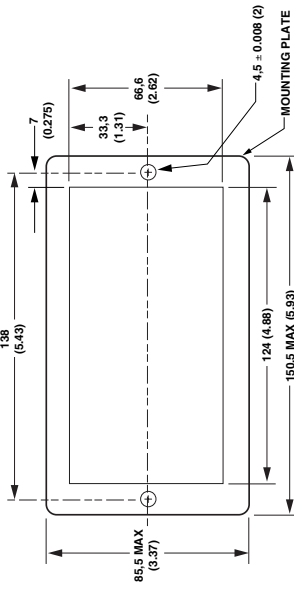


1439

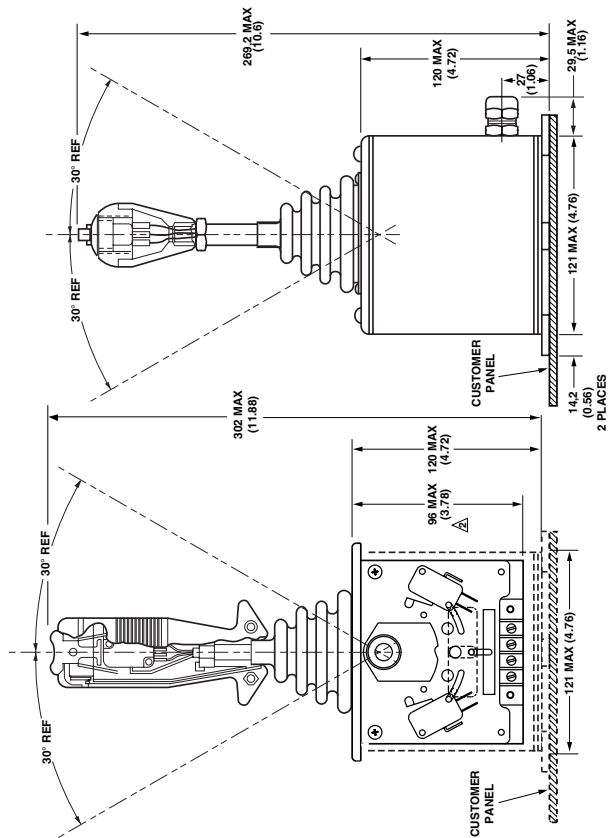
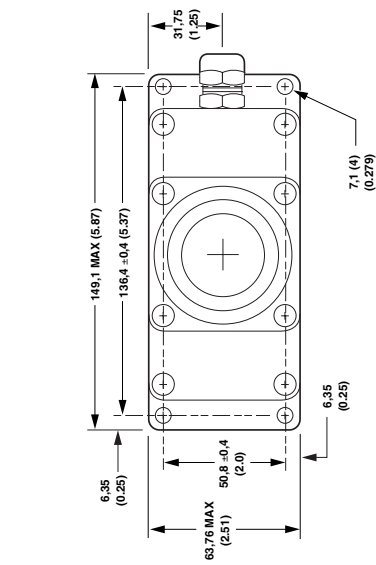
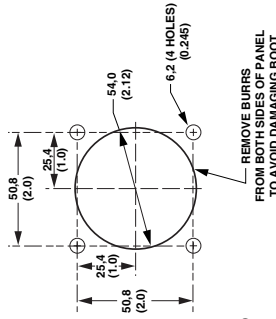
Typical Connection Diagram.

# DIMENSIONS

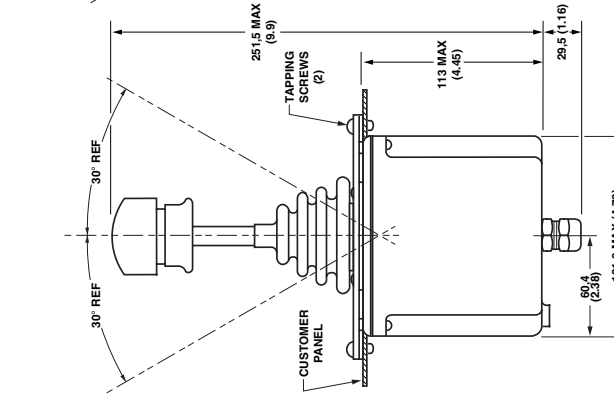
## PANEL CUTOUT AND MOUNTING PLATE



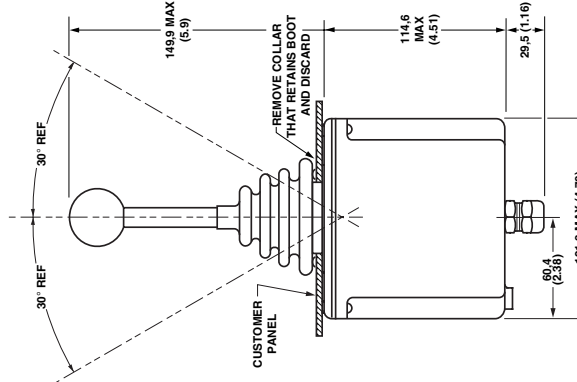
## MOUNTING PLATE



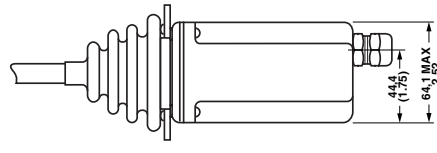
## SURFACE MOUNT



## TOP (DROP IN) MOUNT



## PANEL MOUNT



## SIDE VIEW OF ALL PANEL MOUNT

Dimensions of the MCHXXX Control Handle in Millimeters (Inches).

1135C

## THEORY OF OPERATION (Single Potentiometer)

The single potentiometer Control Handles are generally used with a fixed output power supply. The power supply may be either an automotive type battery for mobile equipment or an AC to DC convertor for industrial applications. There are Control Handle models designed for both 12 and 24 Volt power supply.

The single pot Control Handles have two advantages: simplified electrical circuit and lower cost. The only disadvantage is the limited output power makes it unsuitable for applications with the MCE101 or driving more than one EDC simultaneously.

A single coil or one coil of a dual coil EDC is connected as shown in the Block Diagram 1. The coil terminal connected to the common point of R2 and R3 ("B" terminal) will all remain at or near half the supply (with R1 = 0- $\Omega$ ) voltage as measured with respect to ground. The other side of the valve coil is connected to the potentiometer wiper ("A" terminal), with the handle centered it will also be at or near half the supply voltage.

With the Control Handle centered, the voltage on each EDC terminal is the same and there is no current flow through the valve coil. Since it is current flow which causes the pump output flow to change, the pump will be at zero stroke.

When the Control Handle is moved forward (as indicated by the forward arrow in Block Diagram 1), the voltage at the "A" terminal increases proportionally with distance travelled.

The Control Handle is moved, at full handle stroke, the voltage at terminal "A" will be approximately 8.6 Volts with respect to ground. The "B" terminal remains at half supply, thus a 2.6 Volt differential will result (for 12 Volt system and single coil valves). This differential voltage is sufficient to fully stroke any Danfoss pump.

When the Control Handle is moved in the reverse direction, the voltage at the "A" terminal decreases to approximately 3.4 Volts, the "B" terminal becomes more positive so current flows through the coil in the opposite direction resulting in flow out the other pump port.

Although useful for understanding how the single potentiometer Control Handle functions, it is not normally necessary to measure the voltages with respect to ground. The voltage measured across the "A" and "B" terminals is more useful since this is the actual differential voltage applied to the valve coil. The difference between 12 and 24 Volt version is a resistor (R1) installed to limit the current through the bridge circuit. The value for R1 used in most 24 Vdc Control Handles is 40  $\Omega$ , 25 W.

A center-off switch is recommended for all single potentiometer type Control Handles. If one of the wires between the Control Handle and the pump control becomes shorted to ground (i.e., worn insulation or broken wire), there would be sufficient electrical signal to fully stroke the pump. The center-off switch cuts the electrical power to the bridge circuit when the handle is in mechanical center of travel.

## THEORY OF OPERATION (Dual Potentiometer)

The operation of the dual potentiometer circuit is similar to single potentiometer circuit. When the Control Handle is in mechanical center both of the terminals are at half the supply voltage with respect to ground. As the handle is moved in the forward direction (as indicated by arrow in Block Diagram 2). The voltage on terminal "A" will increase (to approximately 9 Volts with a 12 Volt supply), as the pot wiper moves toward the plus terminal. The voltage on terminal "B" will decrease (to approximately 3 Volts with a 12 Volt supply), as the pot wiper moves toward the ground terminal. This results in a 6 Volt differential across the load. This differential voltage is

large enough to drive two pumps with an EDC coil connected in series to full stroke, or operate a variable pump, variable motor combination.

The dual potentiometer Control Handle circuit can be operated with an MCE101 Proportional Transmission Controller. It is necessary to utilize the larger available voltage differential in the dual pot circuit, because the MCE101A acts as a variable power supply starting at approximately 3 Volts less than the battery terminal voltage.

## PERFORMANCE

### NULL CURRENT

$\pm 5$  mA maximum if Control Handle is centered and center-off switch is closed (12 Vdc models).  
 $\pm 8$  mA maximum if Control Handle is centered and center-off switch is closed (24 Vdc models).

### CENTER DEAD ZONE

$\pm 3^\circ$  nominal. Handle travel required to actuate center-off switch.

### FULL STROKE OUTPUT CURRENT

120 mA into 22  $\Omega$  load (factory test current) other full stroke current optional.

### STEP CURRENT

Generally not applicable to Control Handles for EDCs but may be custom designed for special applications.



## ENVIRONMENTAL

### TEMPERATURE

-40°F to 170°F (-40°C to 77°C) operating  
-30°F to 150°F (-34°C to 66°C) storage

### HUMIDITY

After being placed in a controlled atmosphere of 95% humidity at 100°F (38°C) for 10 days, the Control Handle will perform within specification limits.

### RAIN

NEMA 4 for units with aluminum case only. After being showered from all directions by a high-pressure hose-down, the Control Handle will perform within specification limits.

### VIBRATION

Withstands a vibration test designed for mobile equipment control consisting of two parts:

1. Cycling from 5 to 2000 Hz in each of the 3 axes.
2. Resonance dwell for one million cycles for each resonance point in each of the 3 axes.

### SHOCK

50 g's for 11 milliseconds. Three shocks in both directions of the 3 mutually perpendicular axes for a total of 18 shocks.

### LIFE

Greater than 1,000,000 cycles.

### DIMENSIONS AND MOUNTING

See Dimension drawing.

## WIRING

For most Control Handles, access to power, ground, and the output is gained through the barrier terminal strip inside the handle case (see Connection diagram). A cable should run from the terminal strip through the connector/strain relief on the side or bottom of the case. For most applications, #18 AWG wire should be used.

Auxiliary switches are not factory wired. The switch terminals are 3/16" quick-connected for Control Handles with one

or two switches. For Control Handles with three switches, the terminals are 1/4 quick-connected. Generally a clockwise handle movement causes a current flow from terminal "B" to "A" when the terminal strip is facing you. Consult the factory for units with pigtail or connectors.

In order to avoid damaging the Control Handle, a 1-amp fuse wired in series with the power wire is recommended.

## ACCESSORIES

### ELECTRICAL DISPLACEMENT CONTROL MATING CONNECTORS

K03383 Single-coil Packard 2-wire  
K03384 Dual-coil Packard 4-wire  
K08106 MS connector

## CUSTOMER SERVICE

### NORTH AMERICA

#### ORDER FROM

Danfoss (US) Company  
Customer Service Department  
3500 Annapolis Lane North  
Minneapolis, Minnesota 55447  
Phone: (612) 509-2084  
Fax: (612) 559-0108

#### DEVICE REPAIR

For devices in need of repair, include a description of the problem, a copy of the purchase order and your name, address and telephone number.

#### RETURN TO

Danfoss (US) Company Return  
Goods Department 3500  
Annapolis Lane North  
Minneapolis, Minnesota 55447

### EUROPE

#### ORDER FROM

Danfoss (Neumünster) GmbH & Co. Order  
Entry Department  
Krokamp 35  
Postfach 2460  
D-24531 Neumünster  
Germany  
Phone: +49 4321 871-0  
Fax: +49 4321 871-284