MCE101A

Proportional Transmission Controller

BLN-95-8959-6 **Issued** June 1995

DESCRIPTION

The MCE101A Proportional Transmission Controller (PTC) is primarily used with a hydrostatic transmission driven by a diesel/gas engine or electric motor. The purpose is to match the engine and transmission operating characteristics in order to optimize power consumption or regulate vehicle performance. The control can be set to prevent internal combustion engine stall or electric motor overload by controlling the swashplate position of the hydrostatic pump through changes in voltage to the pump's Electrical Displacement Control (EDC).

In a typical application, the PTC (Forward-Acting) senses engine RPM and proportionally reduces voltage to the EDC valve on the hydrostatic pump to reduce the machine's forward speed. By automatically reducing the ground speed, engine stall is prevented and productivity is increased.

A common application of the PTC (Reverse-Acting) monitors electric motor current with a transducer and reduces the output to the EDC as setpoint is exceeded.

ORDERING INFORMATION (Forward-Acting Models)

DEVICE NUMBER	SUPPLY VOLTAGE (Vdc)	RATED OUTPUT VOLTAGE (Vdc)	RATED OUTPUT CURRENT (AMPS)	OUTPUT LIMIT RESISTANCE Ω	MINIMUM LOAD RESISTANCE (OHMS)	FREQUENCY RANGE (Hz)	PROPOR-TIONING BAND (%)	SPEED CONTROL SWITCH (Y/N)
MCE101A1008	12	10	1.00	-	10	135-600 400-1900	4 - 75	YES
MCE101A1016	24	10 (22 N.L.)	0.25	60	33	50-450	15 FIXED	NO
MCE101A1032	12	3 (10 N.L)	0.12	60	23	135-600 400-1900	4 - 75	YES
MCE101A1040	24	22	0.7	-	30	2150-9500	4 - 75	YES
MCE101A1057	12	10	1.00	-	10	135-600 400-1900	4 - 75	YES
MCE101A1065	24	22	0.7	-	30	135-600 400-1900	4 - 75	YES
MCE101A1073	24	22 N.L.	0.15	120	25	135-600 400-1900	4 - 75	NO
MCE101A1180	24	22	0.7	60-MAN	30	400-1900	3 – 45	YES
MCE101A1198	12	10	1.00	-	10	2000-9500	4 - 75	YES
MCE101A1214	24	22	0.7	-	30	400-1900	4 - 75	YES
MCE101A1222	12	10	1.00	-	10	DC 0 - 10 VOLT	20 - 100	YES
MCE101A1248	12	10	1.00	-	10	125-550 400-1800	20 – 50	YES
MCE101A1263	24	22	0.7	-	30	135-600 400-1900	4 - 75	YES Lo/Med Mod.
MCE101A1271	12	10	1.00	-	10	2-10 VDC	20 - 125	YES
MCE101B1007	24	22 N.L.	0.13	150	25	0-200	-	Aggressive

Maximum Output = + Supply -3 Vdc
Supply Current = Load Current + 0.1 amp

*Note: N.L. refers to no load.

ORDERING INFORMATION (Reverse-Acting Models)

DEVICE NUMBER	SUPPLY VOLTAGE (Vdc)	RATED OUTPUT VOLTAGE (Vdc)	RATED OUTPUT CURRENT (AMPS)	OUTPUT LIMIT RESISTANCE Ω	MINIMUM LOAD RESISTANCE (OHMS)	RANGE	PROPOR-TIONING BAND (%)	SPEED CONTROL SWITCH (Y/N)
MCE101A1081	24	22 N.L.	0.35	25	25	2-10 DC REV ACT	4 - 75	YES
MCE101A1107	12	10	1.00	-	10	2-10 DC REV ACT	4 - 75	YES
MCE101A1206	24	22	0.7	-	30	2-10 DC REV ACT	4 - 75	YES
MCE101A1230	24	10	0.5	150-MAN	20	.5-4 VDC REV ACT	1 – 30	YES
MCE101A1255	24	22	0.7	-	30	.5-4 VDC REV ACT	1 – 30	YES

Maximum Output = + Supply -3 Vdc
Supply Current = Load Current + 0.1 amp

*Note: N.L. refers to no load.

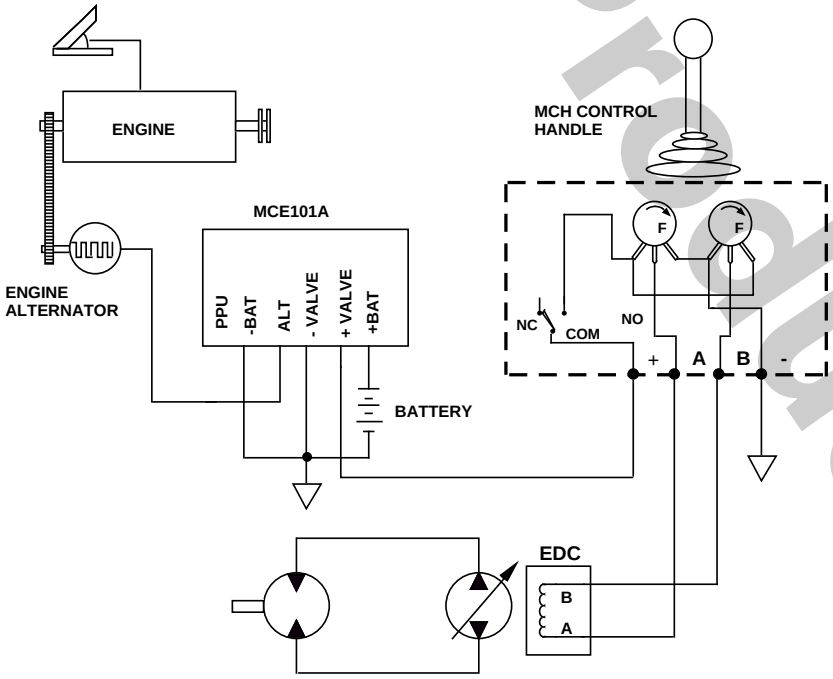
FEATURES

- Options suitable for interfacing with most engines
- Options for interfacing with Sauer-Danfoss pump controls or proportional solenoid valves
- Options to vary control parameters to tailor performance to vehicle needs
- Use with Sauer-Danfoss MCH Control Handles
- Rugged design suitable for off-highway equipment
- Easy installation in your vehicle's dashboard
- 12 and 24 volt models
- Electrically and environmentally hardened

TECHNICAL DATA

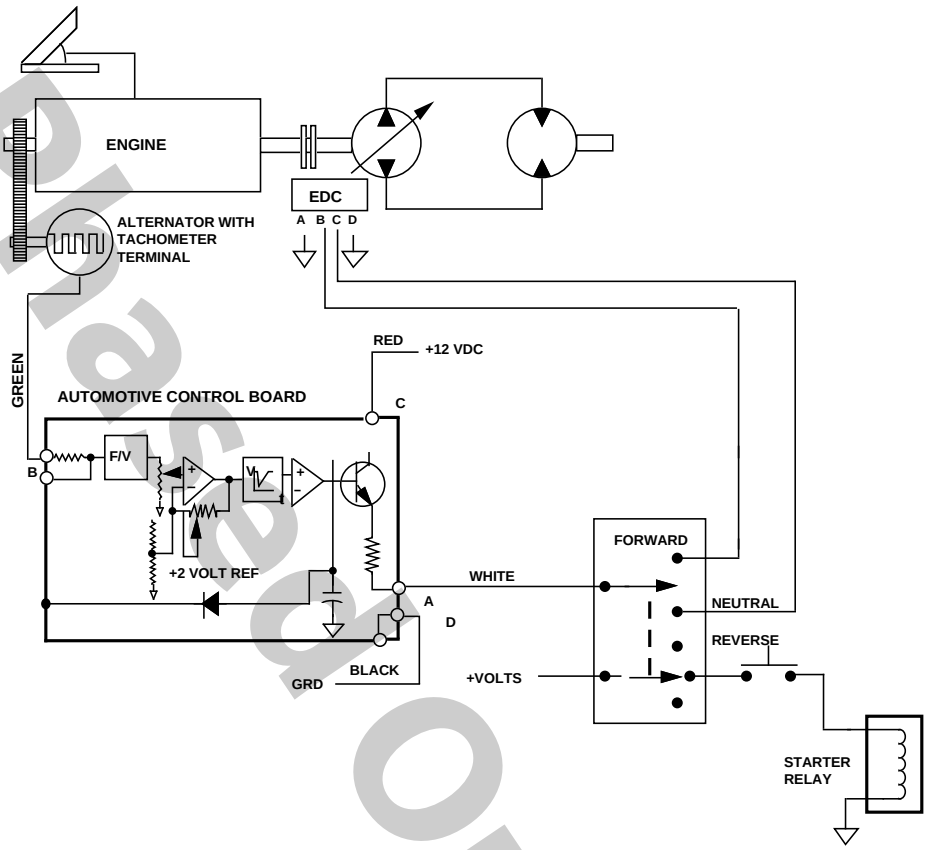
Variations in electrical specifications for devices are reflected in table under Ordering Information. Controllers with specifications different from those in this table may be available. Check with factory.

CONNECTION DIAGRAM -Anti Stall (Typical)



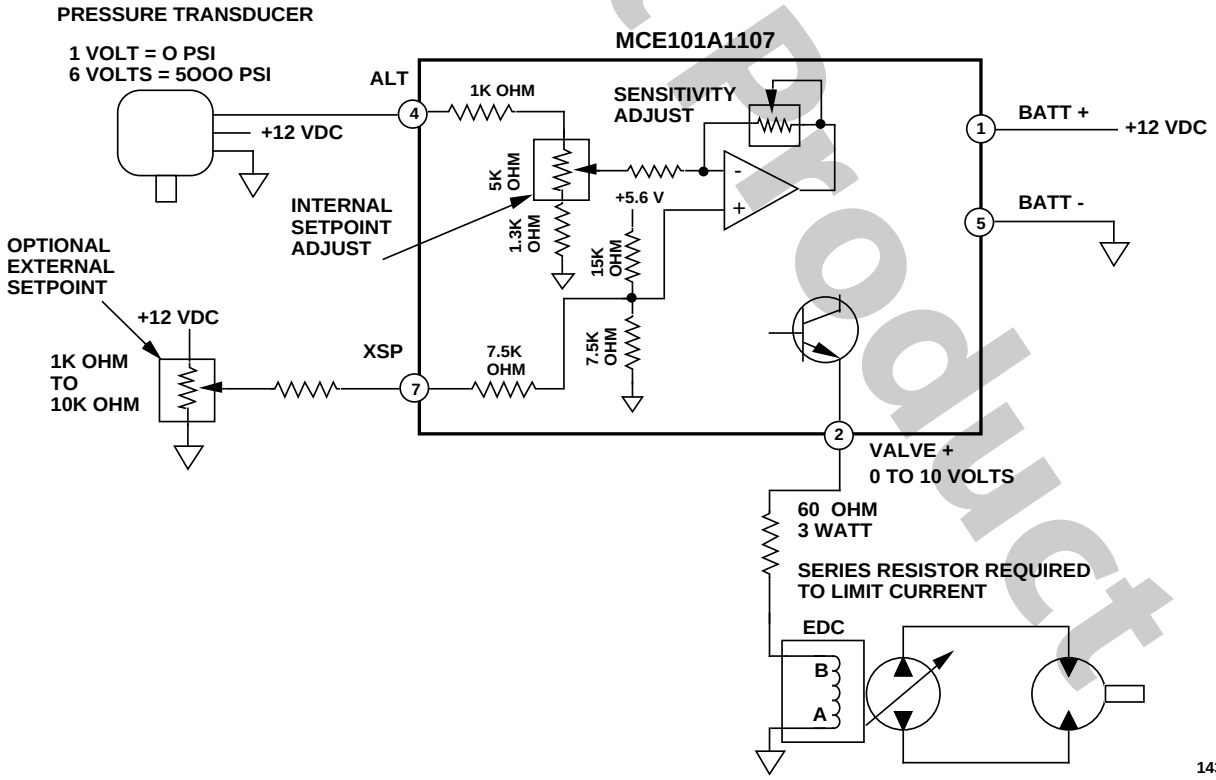
Proportional Transmission Controller Used in a Typical Drive System.

CONNECTION DIAGRAM -Automotive Control (Typical)



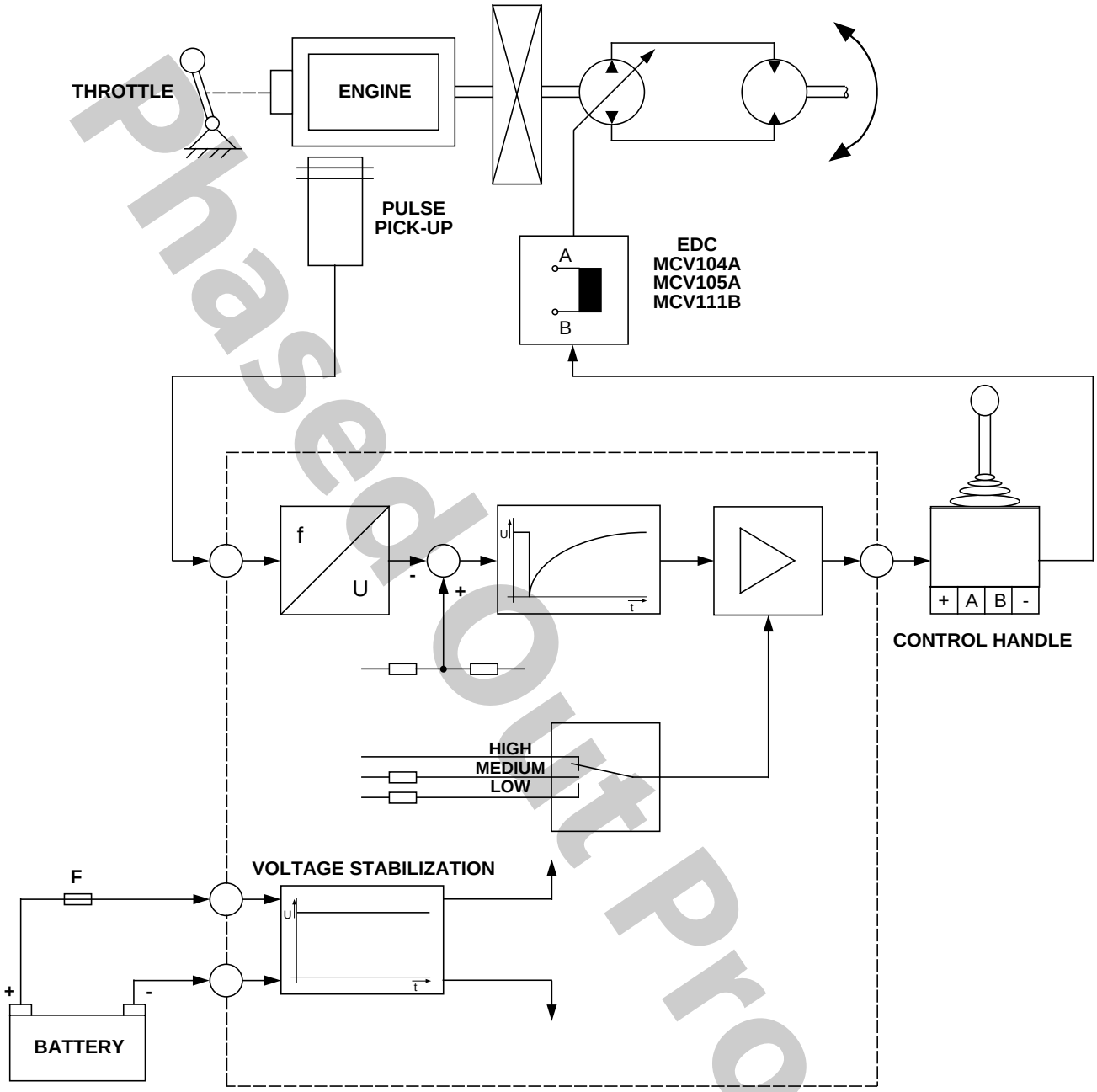
Proportional Transmission Controller Used as an Automotive Control.

CONNECTION DIAGRAM -Reverse Acting (Typical)

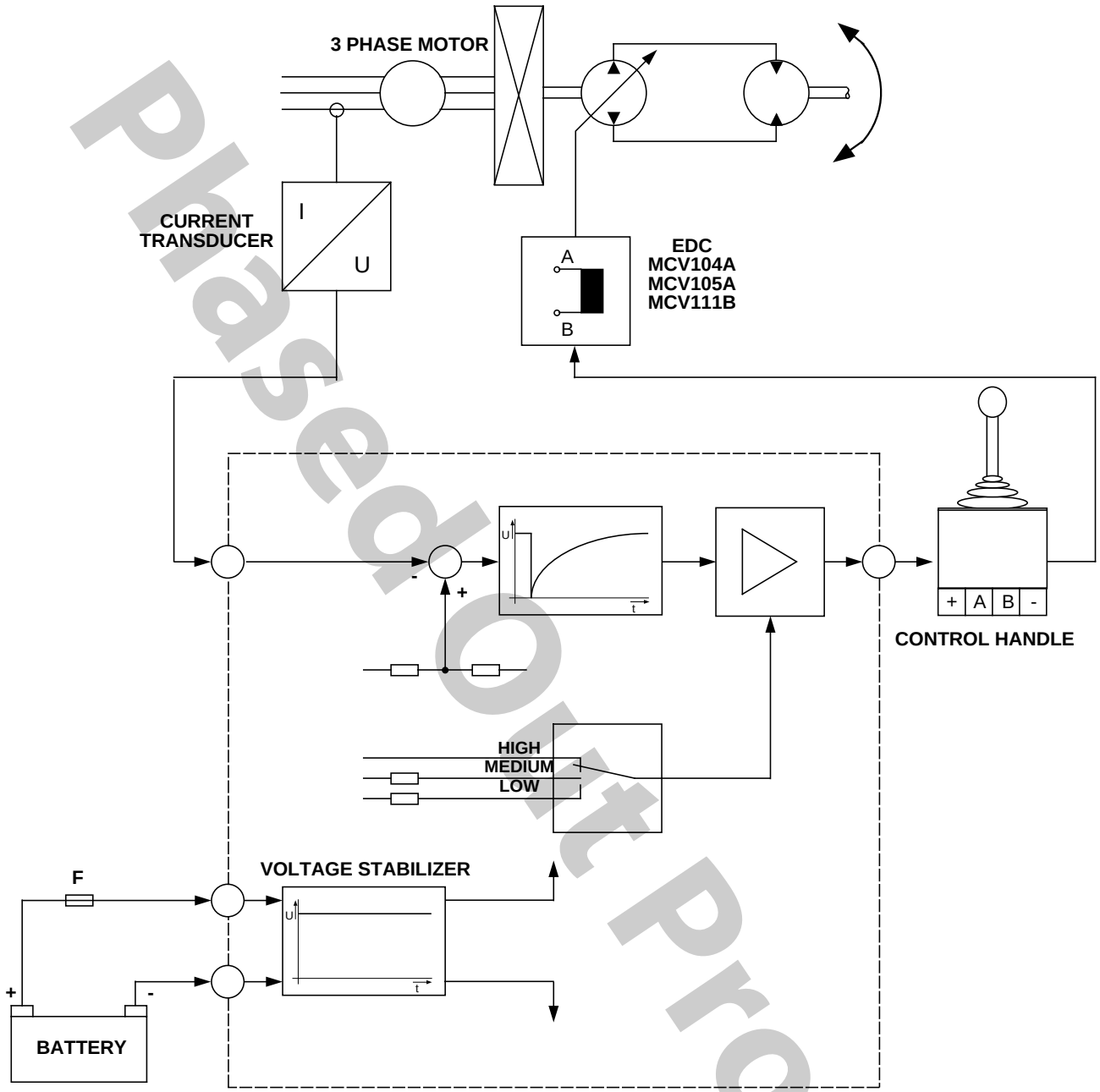


Proportional Transmission Controller (Reverse-Acting) Used as a Pressure Override Control.

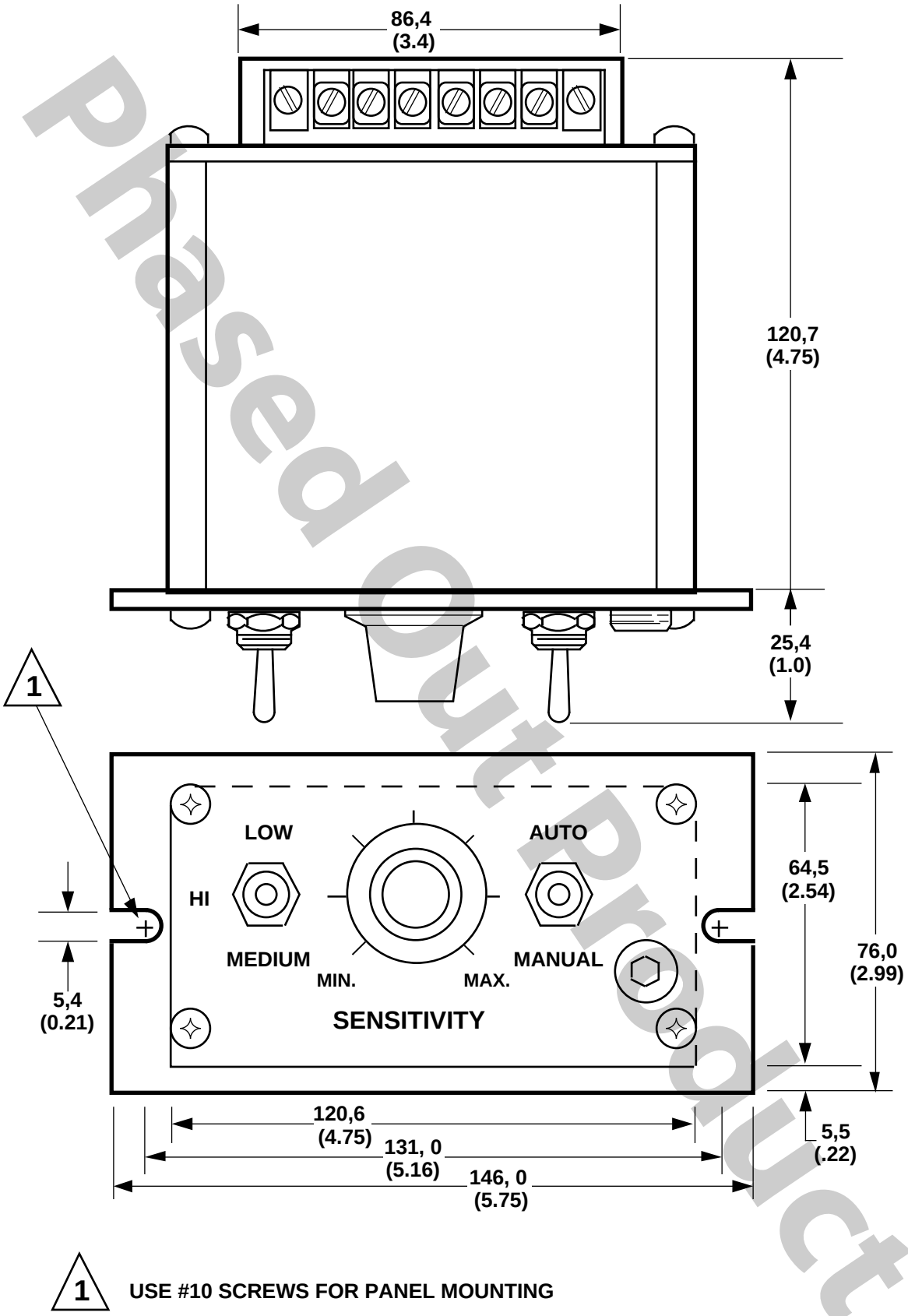
BLOCK DIAGRAM 1 - Gasoline Engine



BLOCK DIAGRAM 2 - Electric Motors



DIMENSIONS



Dimensions of the MCE101A in Millimeters (Inches).
Sensitivity and High/Medium/Low Switch Not Used on Some Models.

THEORY OF OPERATION

The MCE101A Proportional Transmission Controller (PTC) is used to control the power requested from a system under conditions which would otherwise overload the system. The work function being controlled may be the ground speed of a ditcher, chain velocity of a wood chipper or other applications in which engine speed must be kept at an optimum horsepower.

The work function is generally accomplished through the use of a hydrostatic transmission (or a proportional valve/bleed valve/hydraulic motor arrangement) whose prime mover is the vehicle's engine. The engine is set at its most efficient RPM. When the hydrostatic transmission encounters resistance during its work cycle, it transmits the information back as a torque opposing the engine, which lugs the engine below the desired operating point. Either a pulse pick-up or the vehicle alternator senses engine speed, in the form of a frequency, to the PTC, where it undergoes a frequency-to-voltage conversion. The voltage is then compared against a reference voltage from the adjustable RPM setpoint potentiometer. As the engine governor acts, it performs the necessary corrective action within a given band around the throttle setting. But when engine droop is great enough (i.e., input voltage crosses the setpoint), the output voltage from the Controller is cut back. See Performance Curve. This reduces the signal to the Electrical Displacement Control (EDC) valve on the hydrostatic transmission, which in turn sheds load. As commanded work speed is reduced, the opposing torque on the engine is proportionally diminished and engine speed rises towards setpoint. With heavy loads, engine speed will reach an equilibrium point somewhere on the RPM-output voltage curve. If a control handle is used to control the EDC valve, the effect is the same except that the operator has full control of hydrostatic transmission speed until engine droop crosses the RPM setpoint.

The Connection Diagrams show three possible load control applications. The Connection Diagram for Anti-Stall shows a typical control loop used on a trencher or scraper auger system. The Connection Diagram for Automotive Control is a coordinated transmission control system used on front-end loaders, motorgraders and fork lift trucks. It offers automatic hydrostatic ratio control from no output at low engine speed to high output at higher engine speed. The hydrostatic transmission and therefore ground speed, is controlled by the vehicle foot pedal through the engine. The Connection Diagram for Reverse Acting is an electronic pressure override system, differing from the systems above in that power outputs do not lug the engine. When line pressure crosses a pre-set limit, the PTC reduces the signal to the control valve, reducing the pressure. In this scheme, the PTC is Reverse-Acting: increased input (from the transducer) causes decreased output (to the valve). Other transducers like electric motor "current to voltage" can be used to reduce the hydrostatic transmission as motor load increases above a chosen setpoint.

CONTROL FEATURES

AUTO/MANUAL SWITCH

AUTO: Controller in

MANUAL: Controller out

SPEED CONTROL SWITCH

(Maximum output when unloaded)

HIGH Position: 100% supply less 3 volts

MEDIUM (or Plow) Position: 55% of HIGH Position

LOW (or Trench) Position: 30% of HIGH Position

(Speed control switch works in AUTO on all models, and on MANUAL with some models.)

SENSITIVITY CONTROL

Adjusted according to load conditions. The adjustment widens or narrows the proportioning band as a percentage of the RPM setpoint. As proportioning band is adjusted, the start of "turndown" is kept at the selected RPM. See Performance Curve.

RPM SETPOINT

A 25 turn, infinite adjustment control. An LED (on some models) on the output transistor becomes brighter as engine RPM droops below setpoint. External setpoint signals can be supplied.

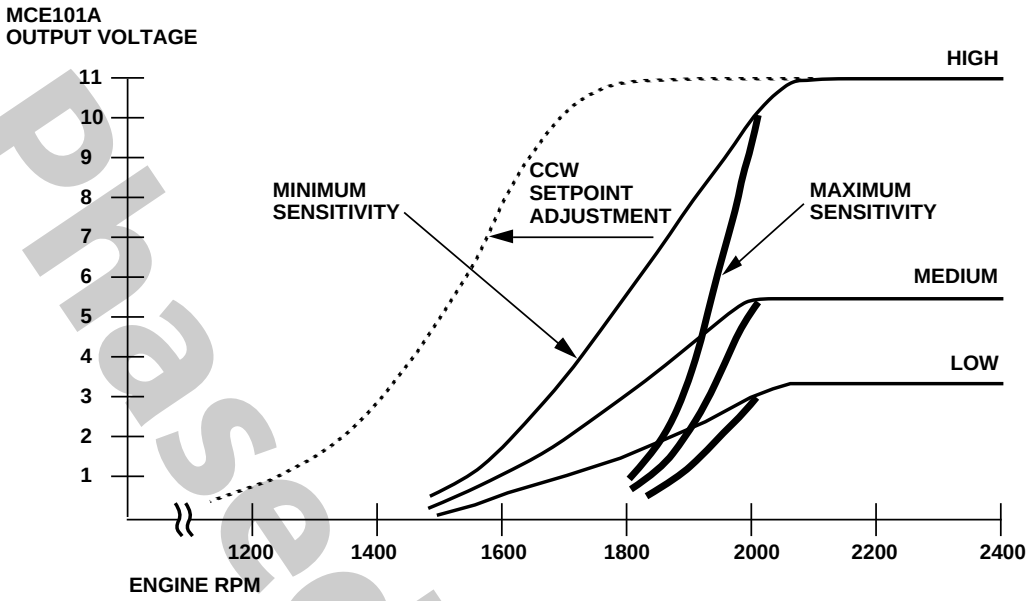
FEEDBACK FREQUENCY INPUT RANGE

Controllers are shipped with high and low frequency ranges. High range is selected by breaking a connection in the device. The table found under Ordering Information shows the full frequency span.

DYNAMIC COMPENSATION

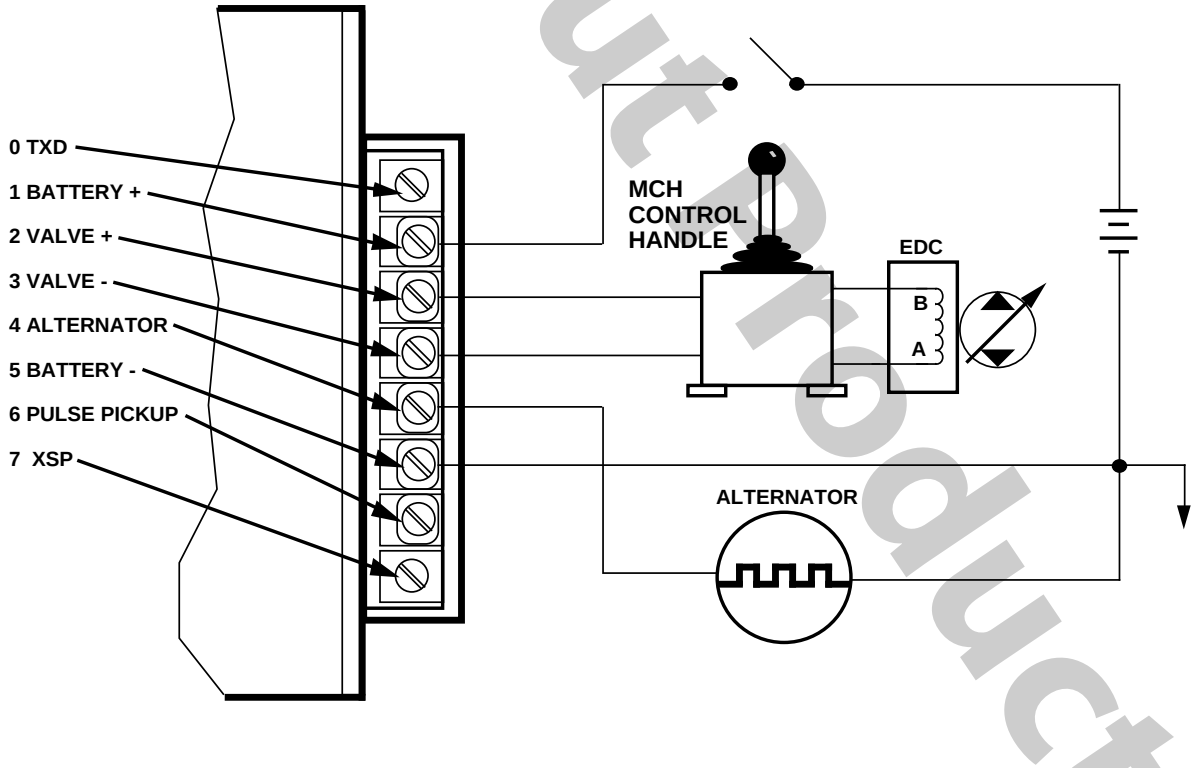
The response time from encountering the load to reducing the commanded power is approximately one half second. Once load is shed, the Controller automatically begins increasing output voltage. If the load encountered is instantaneous - for instance, if a rock is struck and removed immediately while trenching - the "ramp up" is five seconds from maximum reduction to full output. This "quick dump/slow recover" feature avoids unstable oscillations in the loop, giving the operator greater control of his machines.

PERFORMANCE CURVE



MCE101A Proportional Transmission Controller Curves Showing Output Voltage as a Function of Engine Droop. The Setpoint Illustrated is 2000 RPM. Setpoint, Sensitivity and Maximum Output Voltage are Selectable.

CONNECTION DIAGRAM



Typical Wiring Schematic for the MCE101A Proportional Transmission Controller Used with Hydrostatic Transmissions.

ENVIRONMENTAL

OPERATING TEMPERATURE
-20° to 65° C (-4° to 149° F)

STORAGE TEMPERATURE
-30° to 65° C (-22° to 149° F)

SUPPLY VOLTAGES ACCEPTED
12 volt rated: 11-15 Vdc
24 volt rated: 22-30 Vdc

HUMIDITY
Controlled atmosphere of 95% humidity at 40° C for 10 days.

RAIN
Suitable for dash board mounting.

VIBRATION
Withstands a vibration test designed for mobile equipment controls consisting of two parts:
1. Cycling from 5 to 2000 Hz
2. Resonance dwell for one million cycles

Run from 1 to 8 g's. Acceleration level varies with frequency.

SHOCK
50 Gs for 11 milliseconds.

REVERSE POLARITY PROTECTION
50 Vdc maximum

SHORT CIRCUIT PROTECTION
Auto only.

DIMENSIONS
See Dimension drawing.

WIRING

Wiring connections are made with spade lugs to an eight-screw terminal strip on the back of the case. Each terminal is labeled. See Connection Diagram.

Engine input to the Controller must be an AC voltage. Frequency is measured typically by connecting to a single-phase tap when using the alternator.

MOUNTING

The controllers listed in the Ordering Information table are panel-mounted models. Surface-mounted versions are also available. See Dimension drawing for mounting information.

A pair of mounting brackets is included with surface-mounted units. They are put into the channels on either side of the case and tightened down with 1/4-28 screws.

GENERAL CALIBRATION INSTRUCTIONS

There are five control parameters that must be adjusted: AUTO/MANUAL, speed control, sensitivity, RPM setpoint and frequency range. See Performance Curve.

1. AUTO/MANUAL
   The Proportional Transmission Controller will be in AUTO during normal machine use but may be overridden in MANUAL. Work to be done while machine is in idle must be done on MANUAL.

2. SPEED CONTROL
   The speed control switch has three settings: HIGH, MEDIUM and LOW. On HIGH, maximum output from the Controller is supply less three volts in the unloaded condition. MEDIUM and LOW are 55 and 30 percent of HIGH, respectively. Mode selection will depend on work conditions; when the load is heavy enough so that the engine would be continuously lugged below setpoint on HIGH, one of the two lower settings would be preferable. This gives the control handle better resolution (since full throw gives a lower output voltage) and gives the operator better feathering control.

3. SENSITIVITY
   The sensitivity potentiometer is infinitely variable from minimum to maximum setting. With a given RPM setpoint adjustment, the maximum sensitivity will cause the rated output voltage to be linearly cut back to 20% by the time the engine lugs 4% below the RPM setpoint. At minimum sensitivity, output voltage is reduced to 20% when the engine is 75% below setpoint. For instance, on HIGH setting, maximum sensitivity and 2000 RPM setpoint, voltage from the Controller will be reduced from the rated output to 20% of rated output by the time the engine reaches 1920 RPM.

   To set sensitivity, turn the front panel knob to maximum. For normal loads, this setting will probably be too high: the loop may oscillate as evidenced by a lurching action in the power output. Reduce sensitivity until stability is achieved.

4. RPM SETPOINT
   The RPM setpoint is varied through a 25-turn potentiometer. The potentiometer is accessed through a hole in the Controller's front panel, covered with a plug that must be unscrewed.

   To adjust the RPM setpoint, first set the vehicle throttle to the RPM at which the operator wants the Controller to begin shedding load. The operator chooses this point based on criteria of productivity or engine wear. Next, place a volt-ohmmeter across the two output ("valve") terminals and set the speed control on HIGH. Use an instrument-type screwdriver to adjust the setpoint potentiometer. If the VOM reading is above the rated output, turn the setpoint clockwise until the reading reduces to the rated output. If the VOM reading is less than the rated output, turn the setpoint counterclockwise until it increases to the rated output.

   If a VOM is not available, the operator may use the LED (light emitting diode) on the output transistor. Again, turn the potentiometer clockwise until the LED begins to glow. Then turn back one turn counterclockwise to compensate for overshoot. If the VOM reading stays above the rated output, after the full 25-turn (or if the LED remains off) the frequency range must be changed as described below.

5. FREQUENCY RANGE
   In order to span all RPM setpoints, the Proportional Transmission Controller comes in both a HIGH and LOW alternator-frequency/engine-speed range. The choice of high or low range is determined while setting the 25-turn RPM potentiometer.

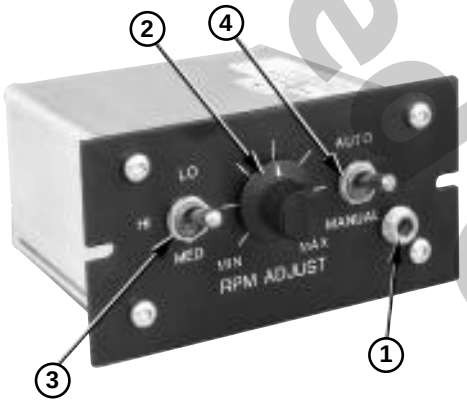
   The Proportional Transmission Controller is factory shipped in the low frequency range. If after the full clockwise travel of the setpoint the output voltage is still above the rated output, clip or break out resistor 37 (the PCB component closest to the terminal strip) to switch to HIGH frequency. *Be certain that the Controller is in the AUTO mode.* Since the setpoint potentiometer will be fully clockwise, clipping R37 will put the Controller at the high end of the high frequency range and the output voltage will be low. Turn the setpoint back counterclockwise until the rated output is reached. Some overlap of the two ranges is provided to ensure that all frequencies are provided for.

   Before breaking R37, make certain that the setpoint is not within the low range. If the resistor is broken and it becomes necessary to reenter the low range, a jumper wire may be soldered across the PCB pads - no resistor is necessary.

CALIBRATION INSTRUCTIONS (Forward-Acting)

PROPORTIONAL TRANSMISSION CONTROLLER WITH RPM - ADJUST KNOB

1. Remove the socket head plug #1 from the front of the panel. See photo below for location.
2. Remove the PTC from the dash.
3. Turn the RPM-ADJUST knob #2 fully clockwise.
4. Place the range switch #3 in high range (HIGH).
5. Place the mode switch #4 in automatic mode (AUTO).



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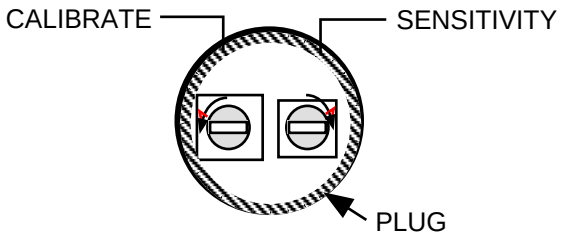
Faceplate of MCE101A1248



1411

Plug Diagram.

6. Attach the leads of a voltmeter to the Valve (+) and Valve (-) terminals.
7. Start the engine using the normal starting procedure.

WARNING

The machine will probably move during this adjustment phase. Keep everyone away. Be sure there is ample room for machine travel. Do not leave the controls unattended while the engine is operating.

8. Locate the machine where ample space is available for machine travel. Move the ground drive speed/directional control lever(s) until ground drive pump pressure just begins to build.
9. Increase engine RPM to the setting specified for your machine (2100 RPM, 2600 RPM, etc).
10. Adjust the Valve (+) voltage to 10 volts by turning the calibrate screw through the hole on the front of the control box. Turn the screw clockwise to reduce the voltage, counter-clockwise to increase the voltage.
11. Decrease engine RPM to the setting specified for your machine (1750 RPM, 2200 RPM, etc).
12. Adjust the voltage to 4 - 5 volts by turning the sensitivity screw. Turn the screw clockwise to reduce the voltage, counterclockwise to increase voltage.
13. Repeat steps 9 - 12 until you obtain both voltages at the specified engine RPM.
14. Follow the normal shutdown procedure.
15. Remove the voltmeter. Install the PTC in the dash.

The adjustment is now complete. The RPM-ADJUST knob will be used when you are trenching to select the operating RPM. When in automatic, the system will vary the travel speed to maintain the engine in the RPM you select.

If the engine RPM varies too much while trenching, rotate the sensitivity screw clockwise to decrease the RPM range.

CALIBRATION INSTRUCTIONS (Reverse-Acting)

REVERSE-ACTING PROPORTIONAL TRANSMISSION CONTROLLERS

When maintaining a constant load on hydrostatically driven transmission's, a pressure transducer on the high side of the loop or a current transducer on an electric motor can be used to provide a signal to the Sauer-Danfoss Proportional Transmission Controller (PTC). The Controller provides a proportional signal for use in modulating either a propel or flow rate. This keeps a constant load on the primary drive. The transducer should have a DC voltage output in a range less than 10 volt for full scale.

Adjusting voltage output and rate is necessary for proper operation of this control system. First, the PTC will decrease its output voltage toward zero when the set point is exceeded for pressure or current. Secondly, adjusting the sensitivity or gain determines the rate at which the output will be reduced. An additional external set point may be added to the system. This can vary the set point pressures to less than the maximum set by the internal set point adjustment.

NOTE: Transducer ground connection must be at the same electrical potential as the MCE101A Proportional Transmission Controller. Wire the transducer ground to terminal 5 on the MCE101A.

When using the optional setpoint potentiometer it must be in the MAX position (highest voltage at the wiper) during the calibration procedure.

Calibration Instructions:

1. Set the Range switch to the HIGH position.
2. Set the AUTO/MANUAL switch to the AUTO position.
3. Set the Sensitivity potentiometer to the 12 o'clock position.
4. Connect a voltmeter across the Valve (+) and the Valve (-) terminals of the MCE101A
5. Remove the pipe plug below the AUTO/MANUAL switch, this will access the 25-turn setpoint potentiometer. Make sure the 25-turn setpoint potentiometer is turned to clockwise position before you begin.
6. Select the voltage for turn down by simulating a transducer.

Transducer Scale Factor = $\frac{\text{Full Scale Output Voltage}}{\text{Transducer Range}}$

Example: 1 Vdc at 0 psi and 6 Vdc at rated psi

Specific Pressure Voltage = (Voltage at 0 psi) + $\left[\frac{\text{Desired Pressure)}}{\text{Scale factor}}\right]$

7. To set voltage for simulating a pressure for the start of turndown

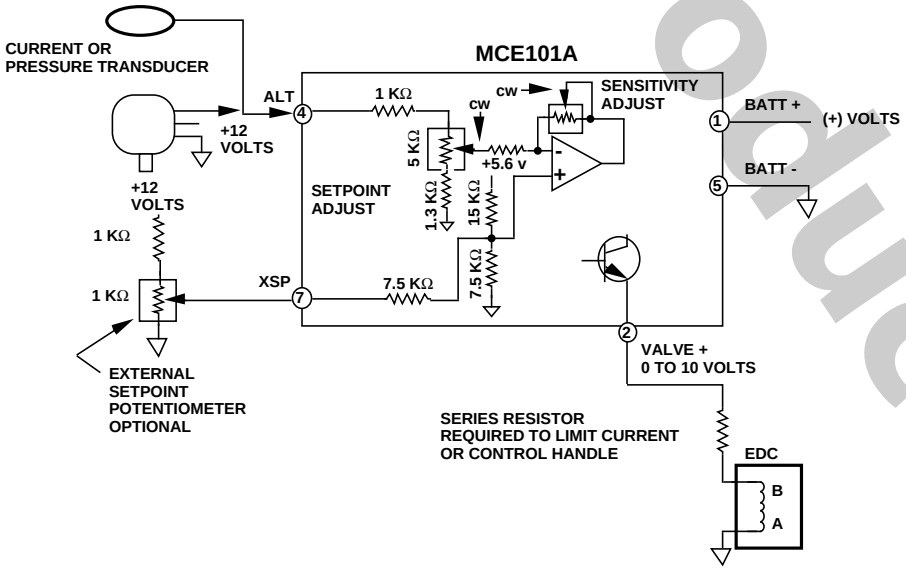
Example: If 1 Vdc = 0 psi and 7500 psi = 6 Vdc

Transducer Output at 5000 psi =1 Vdc + (5000/1500)
= 1.0 +3.33 = 4.33 Vdc

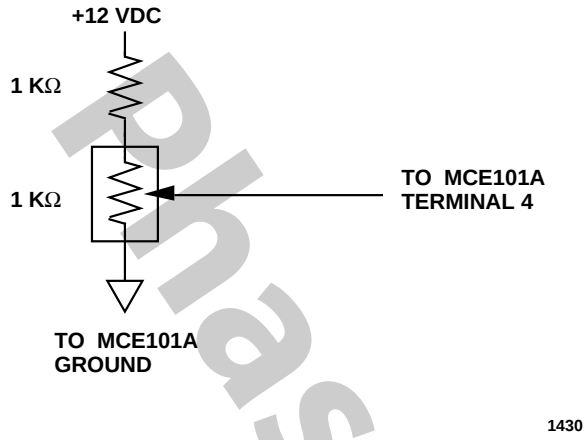
8. With 4.33 volts on Terminal 4 (ALT) and the external setpoint at MAX, adjust the 25-turn potentiometer until the voltage at Valve (+) with respect to ground reaches its minimum value at approximately .2 volts. Turning the potentiometer counterclockwise increases the PTC's setpoint.

9. If 6000 psi is the desired pressure for rated turndown, the voltage into terminal 4 should be 5 volts or 1 + 6000/1500. This produces a low output on the positive valve. For 12 Vdc controllers the voltage should be 2 volts. Adjust the Sensitivity knob on the front panel. There may be a small interaction in the calibration for Step 8, so steps 8 and 9 may need to be repeated.

CONNECTION DIAGRAM (Reverse-Acting)

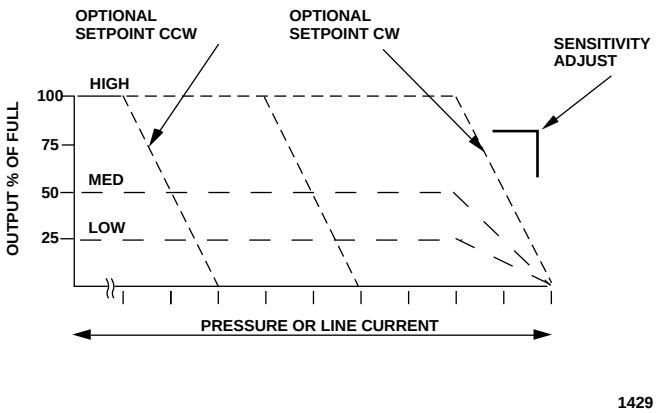


CALIBRATION CIRCUIT



DC Input Calibration Circuit.

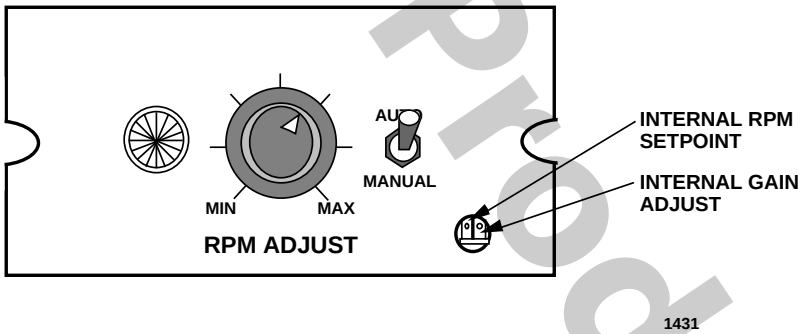
PERFORMANCE CURVE (Reverse-Acting)



Reverse-Acting Control.

CALIBRATION INSTRUCTIONS

1. AUTO/MANUAL switch allows the operator to override the load control function. The output voltage from terminal Valve (+) is high, approximately 10.5 volts when the switch is in the MANUAL position. In the AUTO position the output of the Valve (+) terminal varies with engine RPM's and throttle position.
2. RPM Adjust allows the operator to limit the maximum output of the Proportional Transmission Controller in either the AUTO or MANUAL Position.
3. Lamp is lit when the control is in the AUTO mode.
4. Internal RPM setpoint adjusts the RPM (frequency) where the output of the PTC reaches its maximum voltage. Clockwise increases the frequency Setpoint. This adjustment would be set by machine start up or by a service technician.
5. Internal Gain adjusts the rate at which the load decreases with changes in feedback frequency. Counterclockwise decreases the gain. This adjustment would be set by machine start up or by a service technician.



MCE101A1289 Faceplate.

TROUBLESHOOTING

The MCE101A should give years of trouble-free service. If the hydrostatic transmission fails to operate after having previously run properly, any one of the system components could be the problem source. All Proportional Transmission Controller tests should be run on HIGH output setting. Check the system as follows:

1. With all power connections made, put the PTC on MANUAL. This should power the next stage (control handle or control valve) regardless of engine RPM. Attach a VOM across the valve terminals of the Controller. If it reads less than the rated output, the problem is in the electrical power supply.

2. If normal electrical output shows, handle, valve and transmission should function properly. If not, one of them is the problem source.

3. If the voltage across MCE101A output is full in MANUAL but low in AUTO, unscrew the front panel plug for the RPM setpoint and observe the setpoint LED. In the unloaded (HIGH RPM) conditions the light should be out.

4. If the LED is on, put the VOM (on DC voltage scale) across the alternator connection. It should read approximately 7 Vdc, indicating that the alternator is actually connected.

5. If the alternator voltage is low, check the alternator belt. A loose or broken belt should be replaced.

6. If the above problems have been ruled out, the PTC is not field-repairable and will have to be returned to the factory. See Customer Service section for information on returning to factory for repair.

CUSTOMER SERVICE

NORTH AMERICA

ORDER FROM

Sauer-Danfoss (US) Company
Customer Service Department
3500 Annapolis Lane North
Minneapolis, Minnesota 55447
Telephone: (763) 509-2084
Fax: (763) 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

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

EUROPE

ORDER FROM

Sauer-Danfoss (Neumünster) GMBH & Co.
Customer Service Department
Krokamp 35
Postfach 2460
D-24531 Neumünster
Germany
Telephone: 49-4321-8710
Telex: (299) 708
Fax: 49-4321-871-284