MOV Backseat Relay
P/N 201602

User's Manual

1. INTRODUCTION

This device is used to remotely backseat motor operated valves (MOV) to stop packing leaks in locations where the valve cannot be easily accessed. It is connected at the motor control center to bypass the open limit switch. Three clamp-on current sensors are used to measure three phase current to the valve motor. By sensing an increase in current, it detects the valve at the backseat and opens a contact to remove power from the valve motor.

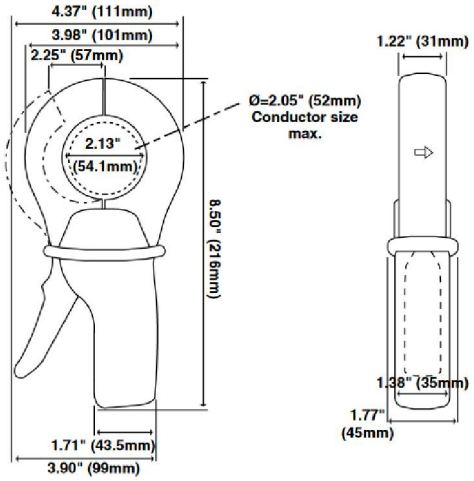
2. SPECIFICATIONS

Inputs:	Three phase AC, 60 Hz, from split transformer 1000:1 ratio AC current probes
Input Range:	0 to 1A (RMS) from current probes, corresponding to 0 to 1000 Amps sensed by the 1000:1 probes. Auto scaling is used to measure current in ranges of approximately 20, 150, and greater amps.
Accuracy:	5% absolute RMS current, 10 bit (1/1024) sensor resolution
Output:	MOSFET solid state relays rated for 400 volts AC, 2 amps continuous duty, shutoff delay of < 0.1 millisecond. Dual MOSFET relays are used in series for the output contact, along with an independent permit logic circuit controlled by the panel buttons, to reduce the possibility of a single failure keeping the motor running.
Connectors:	4mm safety banana jacks
Response Time:	< 8 milliseconds trip current sensing
Display:	2 lines x 20 characters LCD, backlit
Indications:	LEDs, green (contact open) and red (contact closed)
Controls:	POWER — turn on or turn off the unit OPERATE MOV — close contact and begin a test sequence STOP — stop a test sequence and open contact SETUP — view and change settings [+], [-] — change a setting
Power:	6 volts DC from four AA alkaline (supplied) or lithium batteries, 46 mA, good for up to 50 hours of operation.
Auto Shutoff:	After 30 minutes with no key press
Size:	195mm x 101mm x 44mm
Weight:	0.5 kg

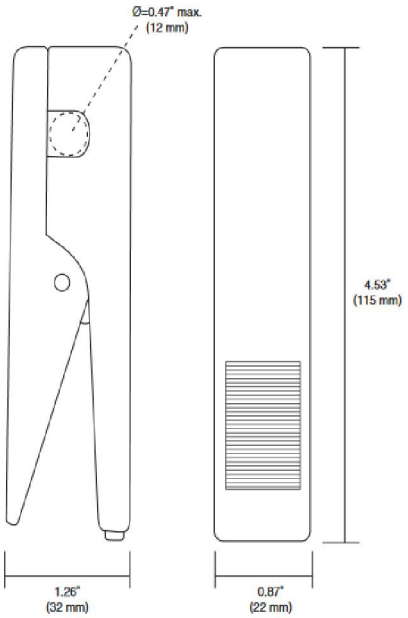
3. CURRENT PROBES

AC current probes are passive clip-on transformer types having a current ratio of 1000:1. Probes from any manufacturer meeting this spec may be used. The following probes made by AEMC Instruments have been evaluated as suitable for this application.

AEMC Model SR601 has a nominal current range of 1000 Amps RMS. It is supplied with banana jacks for use with longer leads to give a safe distance from an open MCC. It is suitable for the full range of the MOV relay.



AEMC Model MN106 has a nominal current range of 150 Amps RMS. It is a mini probe for tight areas and has six foot leads.



Refer to AEMC Instruments web site https://www.aemc.com/ for other probes.

4. DESCRIPTION OF OPERATION

4.1. The purpose of the relay is to sense the increased current drawn by the valve motor when the load increases as the valve backseats against the packing. The relay contact is connected into the Motor Control Center (MCC) and is closed to start operation of the motor. Upon sensing increased current, the relay contact is tripped opened, thereby removing power from the valve motor.

4.2. Current from each probe is passed through a one ohm resistor to produce a voltage. The absolute value of each AC phase voltage is calculated and the three voltages are added together to obtain the measured current. A digital filter is applied to reduce susceptibility to noise.

4.3. When the relay contact is closed, there will be a current inrush surge as the motor starts up. An inrush delay is specified to prevent tripping during this surge.

4.4. The input amplifiers have three gain settings, with the gain selected automatically to keep the inrush surge in range. This improves current resolution for smaller motors.

4.5. At the end of the inrush delay, current is measured and a trip setpoint is established as a percentage (typically 110%) of this current. The motor will continue to run at a constant current until the backseat is reached and motor current increases. When the current increases above the setpoint, the relay opens to stop the motor.

4.6. A second maximum current setpoint is specified as a safety backup in case the valve is already against the backseat. It is established as a percentage (typically 50%) of the maximum current detected during the inrush surge. If the current exceeds this setpoint after the inrush delay, the relay opens to stop the motor.

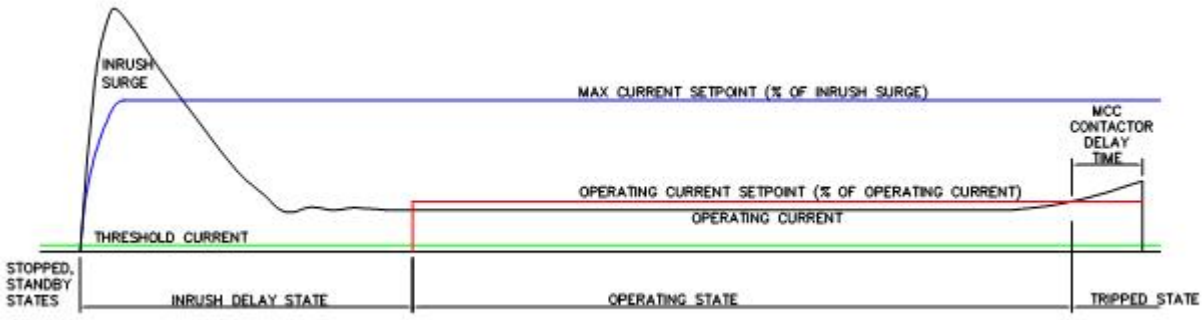


Figure 1: Typical Test Sequence

4.7. Figure 1 shows a hypothetical current trace for a test. The relay progresses through various states according to the sensed current.

4.8. In the STOPPED state, the relay contact is open and the current sensed must be zero. During this time, a self-calibration of the zero current level is performed for use in later calculations. If current is detected or excessive noise is present, an error message will display.

4.9. When OPERATE MOV is pressed, the STANDBY state is entered. The relay contact is closed and the inputs are compared to a current threshold. When input exceeds threshold, the INRUSH DELAY state is entered.

4.10. The maximum current setpoint is initialized and continuously recalculated as the specified percentage of the measured current during the delay. It is always lower than the current during the delay state and follows the current, but only increasing.

4.11. The operating trip, maximum trip, and lost phase trip are not enabled during the delay state.

4.12. OPERATING state is entered when the inrush delay setting time expires.

4.13. If a phase shows continued zero current at the end of the delay, a LOST PHASE TRIP will occur.

4.14. The initial operating current setpoint is determined by multiplying the measured current at start of operating state by the specified setpoint percentage.

4.15. The actual inrush surge time is determined by scanning the readings taken during the delay and determining the time at which the current drops to a level below the operating current setpoint.

4.16. The operating current trip setpoint will continue to follow the current down, but not up.

4.17. In the operating state, the operating trip, maximum trip, and lost phase trip will all be enabled.

4.18. Should the motor be stalled or if the delay is specified too small, current will be above the maximum current setpoint when operating state is entered. The program will jump to the MAX CURRENT TRIP state.

4.19. When the valve reaches the limit of travel, current will increase until the operation trip setpoint is reached. The OPER CURRENT TRIP state will be entered.

4.20. After the relay contact opens, current may continue to increase until the motor controller mechanical contacts have opened. This is normally a few milliseconds. This is recorded as post trip current.

4.21. In any tripped state, the relay contact opens and the display shows the cause of trip and the current level at time of trip. The [+] and [-] buttons may be pressed to show recorded readings of trip current, post trip current, inrush peak current, inrush time, and run time.

4.22. These recorded readings are no longer available after the Stop button is pressed.

5. TEST PROCEDURE

5.1. Using test leads, connect the output contact in parallel with the limit switches in the motor control cabinet. Typical connection points are shown in Figure 2. Option A gives full control to the relay. With option B, the relay just bypasses the limit switches.

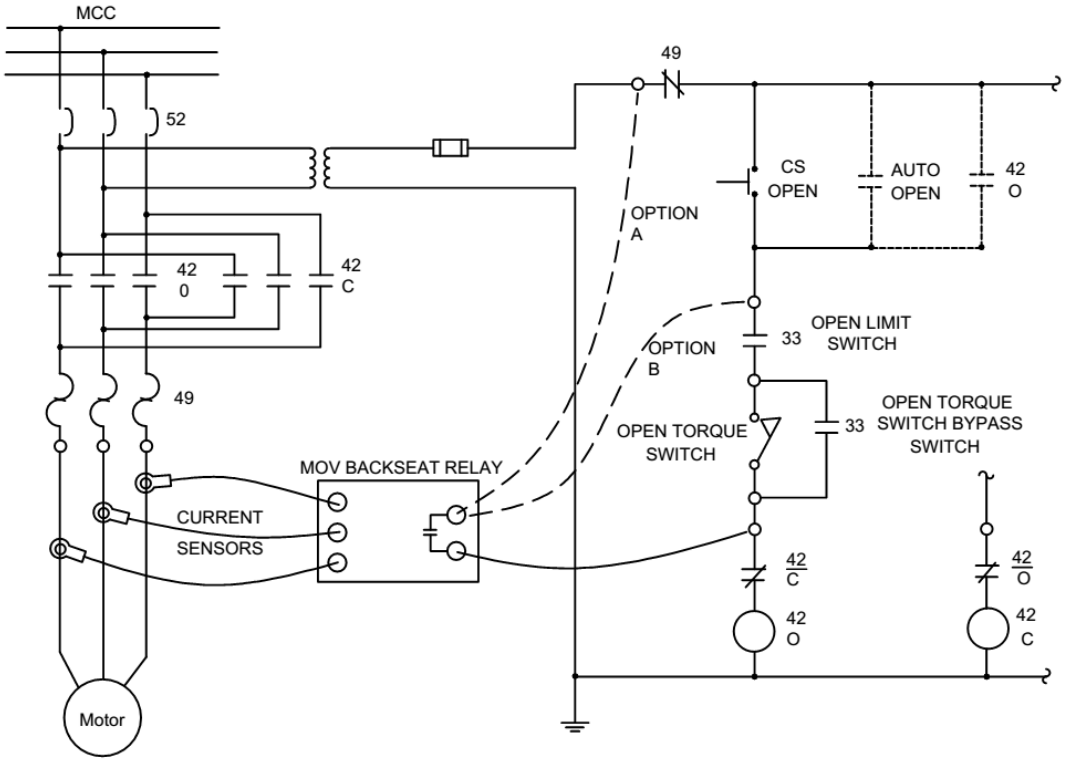


Figure 2: Typical Connection Diagram

5.2. Clip the current sensors across the wires to the motor. Phase sequence and sensor orientation do not matter.

5.3. Press POWER to turn on device. The display will show PREREQ to prompt you to press the SETUP button and verify settings are appropriate for the motor and valve.

5.4. Press SETUP to cycle through various settings. Press the [+] or [-] button to make adjustments to settings.

- Operating Trip - the operating trip setpoint is set as a percent of the operating current, with 100% being the minimum steady state motor operating current. Thus, a 150% setting for a 2 amp current will give a trip at 3 amps. Allowable values are 101% to 200%. Recommended is 110%.
- Inrush Delay Time - this time, in milliseconds, is the delay to allow for the inrush current spike to settle out before determining the operating current. Allowable values are 33 to 1000 milliseconds. Recommended is at least 125% of measured inrush time.
- Max Current Trip – the maximum trip setpoint is set as a percentage of the inrush current during the delay. It is set to less than 100% with 100% being the peak inrush current detected during the delay. Allowable values are 10% to 95%. Recommended is 50%.

5.5. After the setup pages have been reviewed, you will enter the STOPPED state.

5.6. Press OPERATE MOV to close the relay contacts.

NOTE: MOV will start immediately if the MCC breaker is closed and power is being supplied to the control circuit.

NOTE: STOP may be pressed at any time to halt the test and open relay contacts.

5.7. If connection option B is used, initiate valve operation using the control panel OPEN switch.

5.8. If control circuit power is being supplied by a secondary device (such as a variable AC unit), initiate opening of the valve from this secondary device.

5.9. When the motor current reaches a trip condition, the relay contact will open and the display will show the type of trip:

- OPER CURRENT TRIP will occur when current exceeds the operating trip setpoint (operating state only).
- MAX CURRENT TRIP will occur if current exceeds the maximum trip setpoint (operating state only), possibly caused by motor stall or insufficient inrush delay time.
- LOST PHASE TRIP will occur if any phase is not detecting current (operating state only).

5.10. With the tripped display showing, press (+) or (-) to review various measurements taken during the test. These are useful for establishing setup values for a given valve.

- Trip current
- Operating current
- Post trip current (maximum current due to motor contactor delay)
- Inrush peak current
- Inrush time (peak width)
- Run time (inrush + operating)
- Lost phase identification (if applicable)

5.11. Press STOP to reset the test.

6. ADVANCED SETTINGS

These settings are hidden during the normal SETUP sequence. Should it be necessary to adjust, enable the display option as follows:

6.1. Turn on power so that the PREREQ screen is displayed.

6.2. Press [+] exactly one time.

6.3. Press [-] exactly three times.

6.4. Press SETUP. Additional options will appear after the normal trip settings:

6.5. Sample Filter - This numerical value defines a noise filter applied to the incoming signals. A larger value will give better noise filtering at the expense of slower response. Default value is 10.

6.6. Restore Defaults? – This gives the option of restoring all the settings to factory default.

6.7. For both the normal and advance settings, any changes will be stored in non-volatile memory and retained when power is turned off or batteries removed.

7. MAINTENANCE

No calibration is required. Trip setpoints are specified as a percentage of current. As such, the actual current does not matter to meet the intent. Current readings are provided for information.

A battery icon displays on the STOPPED screen. LOW BATTERY will display when battery drops below 4 volts. No operations are possible under low battery condition.

To replace batteries, remove panel at top rear of case.

8. TROUBLESHOOTING

The programming relies on balanced phases to properly calculate current. If phases are unbalanced or if there is a problem with a probe, you are likely to get a premature operating current trip.

Likewise, a clean sine wave is required for proper operation. Electronic inverters may not provide this.

The operating current trip is proportional to the minimum current measured during the valve stroke. So if friction varies, this could affect the trip point.

Small valves with low operating current, typically less than 1 amp, may require a higher operating trip % to prevent premature trip.

9. CONTACT INFORMATION

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10. WARRANTY

Camp Creek Technologies warrants that the product is free from defects in materials and workmanship for a period of one year from date of purchase. If product proves defective during this warranty period, Camp Creek Technologies, at its option, will either repair the defective product without charge for parts or labor, or will provide a replacement in exchange for the defective product.

Revisions

Rev 0, 12/26/2016
Original Issue
Rev 1, 5/26/2017
For prototype firmware version 1.4
Rev 2, 3/3/2018
For production hardware and firmware version 2.0
Rev 3, 3/15/2018
Revised Figure 2 and text to show connection options