ESSE-2

ELECTRONIC SPEED SWITCH

INSTRUCTION MANUAL FEATURING:

- INSTALLATION
- OPERATION
- TROUBLE SHOOTING

Engine Management Systems & Controls
TABLE OF CONTENTS

INTRODUCTION 1
ELECTRICAL SPECIFICATIONS 2
MECHANICAL ENVIRONMENTAL 3
MOUNTING INSTRUCTIONS 3
MOUNTING DIMENSIONS 3
ESSE-2 ELECTRICAL OPERATION 4
RECOMMENDED WIRING PRACTICES 5
OUTPUT CIRCUIT PROTECTION 5
WIRING DIAGRAMS 6
SWITCH 1 AND 2 SETPOINT ADJUSTMENTS 7
ESSE-2 ENGINE VERIFICATION 9
SWITCH 1 SETPOINT VERIFICATION 9
SWITCH 2 SETPOINT VERIFICATION 10
TROUBLE SHOOTING PROCEDURE 10

INTRODUCTION

The ESSE-2 is a two channel reliable, rugged, flexible and cost effective Electronic Speed Switch with exceptional power transient protection. The unit is potted for protection against harsh environments.

In generator set applications, the two channels can be used for crank (starter motor) disconnect and overspeed protection, or for underspeed and overspeed warnings. In fact, most speed related switching functions on diesel and gas engines and other rotating machinery can be accommodated by the ESSE-2.

In addition to the standard features, options are available on the input voltage range of operation, setpoint range, reset of tripped setpoint switches, reverse relay logic control, and ignition signal input.

NOTICE

If you do not complete the installation of our product, please ensure that these instructions, and any other design information, literature or drawings relating to the installation of this product are given to the person who does do that installation.
## ESSE-2 Electrical Specifications

### Electrical Input Voltage Options

<table>
<thead>
<tr>
<th>Input Voltage Option</th>
<th>8 - 40 VDC</th>
<th>40 - 80 VDC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max Operating Current</td>
<td>AT 40V: 250 mA</td>
<td>AT 80V: 115 mA</td>
</tr>
<tr>
<td></td>
<td>24V: 220 mA</td>
<td>64V: 100 mA</td>
</tr>
<tr>
<td></td>
<td>12V: 200 mA</td>
<td>40V: 90 mA</td>
</tr>
<tr>
<td>Max Standby Current</td>
<td>AT 40V: 70 mA</td>
<td>AT 80V: 75 mA</td>
</tr>
<tr>
<td></td>
<td>24V: 45 mA</td>
<td>64V: 60 mA</td>
</tr>
<tr>
<td></td>
<td>12V: 30 mA</td>
<td>40V: 50 mA</td>
</tr>
<tr>
<td>Relay Contact Ratings</td>
<td>0.1 to 10 Amps - 28 VDC Resistive Load</td>
<td>0.1 to 4 Amps - 75 VDC Resistive Load</td>
</tr>
<tr>
<td></td>
<td>0.1 to 8 Amps - 28 VDC Inductive Load</td>
<td>0.1 to 3 Amps - 75 VDC Inductive Load</td>
</tr>
<tr>
<td>Power Supply Transient Protection</td>
<td>900 VDC for 100 microseconds Exponential Decay</td>
<td>900 VDC for 100 microseconds Exponential Decay</td>
</tr>
<tr>
<td></td>
<td>140 VDC for 1 millisecond</td>
<td>140 VDC for 1 millisecond</td>
</tr>
<tr>
<td></td>
<td>110 VDC for 0.45 seconds Exponential Decay</td>
<td>110 VDC for 0.45 seconds Exponential Decay</td>
</tr>
<tr>
<td>Reverse Polarity Protection</td>
<td>1000 VDC</td>
<td>1000 VDC</td>
</tr>
</tbody>
</table>

### ESSE-2 Specifications for All Options

- **Signal Input Min:** 1.2 VRMS
  - **Max:** 130 VRMS
- **Signal Input Impedance:** 33K ohms (Nominal)
- **Operating Temperature:** -40°C to 85°C (-40°F to 185°F)

### Setpoint Stability

For an input voltage of 9V to 40V and for a temperature range of -10°C to +85°C, the ESSE-2 shall typically be less than 1% or 8Hz, whichever is greater. The unit performs to -40°C.
OVERSPEED RESPONSE TIME: 75 MILLISECONDS TYPICAL

HYSTERESIS (RESET OF OVERSPEED/CRANK DISCONNECT SWITCHES)

° ELECTRICAL LATCHING - REMOVE POWER TO RESET
° MANUAL RESET - PRESS RESET BUTTON ON UNIT (OPTIONAL, EXTRA)
° AUTOMATIC RESET - 80 TO 90% OF SETPOINT (REMOVE JUMPERS, SEE PAGE 7)
° ADJUSTABLE RESET (VARIABLE AUTOMATIC) - 25 TO 95% OF SETPOINT (OPTIONAL, EXTRA)

MECHANICAL/ENVIRONMENTAL

° CASE: NICKEL PLATED TERMINALS
  HUMIDITY AND SALT SPRAY RESISTANT
  POTTED FOR ENVIRONMENTAL PROTECTION
° VIBRATION: 4.2 G'S FROM 20 TO 500 Hertz
° SHOCK: 4 FOOT DROP TEST

MOUNTING INSTRUCTIONS

FOUR MOUNTING HOLES ARE PROVIDED ON THE ESSE-2 CASE AS SHOWN
FIGURE 1. ALTHOUGH THE UNIT CAN WITHSTAND THE NORMAL VIBRATION
LEVELS AND TEMPERATURE EXCURSIONS ENCOUNTERED, IT IS A GOOD
PRACTICE TO MOUNT THE UNIT IN A LOCATION WHERE THESE EFFECTS
ARE MINIMIZED. THE UNIT SHOULD BE ATTACHED TO THE MOUNTING
PLATE WITH FOUR (4) 10-32 SCREWS.
The ESSE-2 is a two channel electronic speed switch, typically used in generator set applications. In these applications, the first and second switch are commonly used for crank disconnect and overspeed respectively.

The switches shown on the cover of the ESSE-2 and in Figures 2 and 3 are for the no power condition and also for the condition of power applied with no signal present. With input signal (Mini-Gen, etc.) and power applied, the two switches will close at frequencies determined by the two setpoint potentiometers (pots). When the engine reaches proper speed during cranking (starting), SW1 will close. Power will be removed from Terminal 10 and applied to Terminal 11 causing the cranking motor to be disconnected. (See Figure 2 or 3). When SW2 closes during an overspeed condition, power will be removed from Terminal 7 (fuel solenoid) and applied to Terminal 8 causing the engine not to operate. On an ESSE-2 with a switch having reverse relay logic, the switch will close when power is applied and open upon reaching the setpoint.

The TEST terminal, when connected to ground, will force SWITCH 2 to close at 67 ± 10% of the setpoint. This allows a test of SWITCH 2 without running the engine at overspeed conditions. The TACH terminal provides a connection point for a TACHOMETER. The electrical characteristics of the TACH signal are the same as the input signal. The TACH terminal has a 33,000 ohm isolation resistor to prevent loss of signal from a shorted TACH.

There are four (4) reset options available for resetting the speed switch: electrical latch, manual reset, automatic reset and adjustable (automatic) reset.

With the electrical latch option, the switch (after the setpoint has been reached) will close and remain closed even if the input signal frequency has been lowered to 0 Hertz. The only way to reset the unit is to remove power.

With the manual reset option, the ESSE-2 is supplied with a reset button. By depressing this button, the unit will be reset.

With automatic reset option, the switch will automatically reset if the frequency of the input signal is lowered to 85 ± 5% of the setpoint. (See the EXAMPLE for more details)

With the adjustable (automatic) reset option, the switch will automatically reset at the frequency determined by the setting of the supplied reset pot. By adjusting the pot, the reset can be selected anywhere between 25% and 95%.

EXAMPLE: The first setpoint is set to 1000 Hertz. With a 1500 Hertz signal applied, the switch will close. The unit will automatically reset (switch open) if the input frequency is lowered to 800 Hertz. The unit may reset anywhere between 800 and 900 Hertz for the automatic reset is specified between 80 and 90% of the setpoint.
RECOMMENDED WIRING PRACTICES

Good wiring practices should be applied whenever electronics is introduced into an engine control system. If poor wiring practices are used, the ESSE-2 may malfunction or operate erratically. The Wire Gauge Chart is provided to facilitate selection of wires for ESSE-2 terminals.

<table>
<thead>
<tr>
<th>CURRENT</th>
<th>TERMINALS</th>
<th>AWG</th>
</tr>
</thead>
<tbody>
<tr>
<td>UNDER 5 AMPS</td>
<td>1-2, 7-12</td>
<td>16 AWG</td>
</tr>
<tr>
<td>5-10 AMPS</td>
<td>1-2, 7-12</td>
<td>14 AWG</td>
</tr>
<tr>
<td>-</td>
<td>3-6</td>
<td>18-20 AWG</td>
</tr>
</tbody>
</table>

Two conductor shielded cable should be used when connecting the signal source (Mini-Gen, mag pickup) to the ESSE-2. Single conductor shielded cable is recommended for alternator or ignition signal sources. The shield should be connected to ground only at one end. The shield must be connected to Terminal 2 of the ESSE-2 for the Mini-Gen or mag pickup connection and to Terminal 5 for the alternator connection.

**CAUTION:** DO NOT CONNECT A VOLTAGE BETWEEN TERMINALS 2 AND 5 OF THE ESSE-2. THIS CAN DAMAGE THE PRINTED CIRCUITRY AND VOID THE MANUFACTURER'S WARRANTY.

OUTPUT CIRCUIT PROTECTION

**CAUTION:** PULLING CONTINUOUS CURRENTS GREATER THAN 10 AMPS THROUGH THE ESSE-2'S SWITCH CONTACTS CAN DAMAGE THE PRINTED CIRCUITRY AND VOID THE MANUFACTURER'S WARRANTY.

Fuses or circuit breakers should be connected in series with the load to protect the ESSE-2 and your warranty. The fuse should be a 10 Amp slow blow. The circuit breaker should be rated at 10 Amps.

If load currents in excess of 10 Amps are expected, interface relays should be used (see Figures 2 and 3).
CONNECTION DIAGRAM FOR ESSE-2

FIGURE 2

CONNECTION DIAGRAM FOR ESSE-2 IGNITION INPUT OPTION

FIGURE 3
SWITCH 1 AND SWITCH 2 SETPOINT ADJUSTMENTS

1. To determine desired setpoint frequency in Hertz:
   A. For a Mini-Gen Signal Generator Signal Source
      Setpoint Frequency in Hertz = \(1/2 \times \text{Mini-Gen RPM Setpoint}\)
   B. For a Magnetic Pickup Signal Source
      Setpoint Frequency in Hertz = \(\frac{\text{No. of Gear Teeth} \times \text{Engine RPM Setpoint}}{60}\)
   C. For Alternator Signal Source
      Setpoint Frequency in Hertz = \(\frac{\text{Pulley Ratio} \times \text{No. of Poles} \times \text{Engine RPM Setpoint}}{120}\)
   D. For Ignition Signal Source (SPECIAL OPTION)
      Setpoint Frequency in Hertz = \(\frac{\text{No. of Cylinders} \times \text{Engine RPM Setpoint}}{120}\)

2. To select the range and automatic reset (this is normally done at the factory):
   A. Remove cover by removing four corner screws to expose jumpers. See Figure 4.
   B. Refer to SWITCH 1 and SWITCH 2 setpoints determined in Step 1.
      Refer to the table below to determine if the J1 jumper is to be removed.
      The setpoints for both switches must be in the same range.

<table>
<thead>
<tr>
<th>Setpoint Hertz</th>
<th>Remove Jumper</th>
<th>Approx. Pot Hertz Adj. Per. Turn</th>
</tr>
</thead>
<tbody>
<tr>
<td>RANGE 1 80 to 2,500</td>
<td>J1</td>
<td>120</td>
</tr>
<tr>
<td>RANGE 2 325 to 10,000</td>
<td>-</td>
<td>400</td>
</tr>
</tbody>
</table>

C. With J2 and J3 in place, both switches are latching.
   If Automatic Reset is required on SWITCH 1, cut J2.
   If Automatic Reset is required on SWITCH 2, cut J3.

D. Replace Cover and Screws.

\[\text{FIGURE 4}\]
3. Potentiometer Adjustments - Bench Adjustment Procedure

A. Connect signal generator, frequency counter and power to ESSE-2 as shown in Figure 5.

B. Connect ohmmeter to SWITCH 1 Terminals 10 and 12.

C. Turn SWITCH 1 setpoint potentiometer adjustment 20 turns clockwise or until a clicking noise is heard.

D. Turn power supply, signal generator and frequency counter on. Adjust the input frequency for SWITCH 1 to the setpoint determined in Step 1 and set generator output level to 1 VAC or greater.

E. The ohmmeter should read "Zero".

---

**FIGURE 5**
F. Turn SWITCH 1 setpoint potentiometer counter clockwise slowly until the ohmmeter indicates an open circuit.

G. If desired, recheck setpoint adjustment for SWITCH 1 by lowering frequency setting on SIGNAL GENERATOR, remove and reapply power and slowly increase frequency until switch trips. Repeat Steps D, E, and F if necessary.

H. Connect ohmmeter to SWITCH 2 Terminals 7 and 9. Repeat Steps C, D, E, and F by substituting SWITCH 2 for SWITCH 1.

I. To recheck adjustments, follow Step G by substituting SWITCH 2 for SWITCH 1.

**ESSE-2/ENGINE VERIFICATION (NOTE 1)**

This procedure may be used to verify the ESSE-2 performance of SWITCH 1 and SWITCH 2 setpoints after bench adjustment (Paragraph 3) with the unit integrated with an engine.

**1.0 SWITCH 1 SETPOINT VERIFICATION**

To verify the function of SWITCH 1 (which is energized during cranking RPM), the following procedure can be utilized:

A. Connect a DC voltmeter between Terminal 2 (or negative terminal of battery) and 10 as shown in Figure 2 or 3.

B. Apply power to ESSE-2 unit and start the engine.

C. The DC voltmeter should indicate zero volts at engine idle speed. If this does not occur and the battery voltage is indicated on the DC voltmeter, shut off engine power.

D. Review the adjustment section to determine if SWITCH 1 setpoint is correct and if SWITCH 1 functions properly. Check the wiring. If everything appears OK, remove ESSE unit and readjust SWITCH 1 using procedure 3A to 3G.

**NOTE 1:** This section is for the standard relay logic model as shown on the cover of the ESSE-2 (see Page 3). If a switch is ordered with reverse logic (see THEORY OF OPERATION), battery voltage and zero voltage must be interchanged for the given switch in the text.
2.0 SWITCH 2 SETPOINT VERIFICATION

To verify the function of SW 2 (which is energized when the engine overspeeds) the following procedure can be utilized.

A. Connect a temporary jumper between Terminals 2 and 3. (Terminal 3 is the test terminal for the 0.67X (SETPOINT) test.)

B. Convert the frequency setpoint of SW2 to RPM by using conversion formula and multiply by 0.67. (RPM X 0.67 = TEST SETPOINT)

C. Apply power to the ESSE unit.

D. Connect a DC voltmeter between Terminals 2 (or battery negative terminal) and 7. Negative lead of voltmeter goes to Terminal 2 (or battery negative).

E. Start the engine. Monitor the TACH and slowly increase engine RPM to the TEST SETPOINT reading. Observe the DC voltmeter. It should indicate the battery voltage before the setpoint is activated and the relay trips. When the relay trips, at the TEST SETPOINT ± 6% RPM, the DC voltmeter will indicate zero volts. (Remove jumper from Terminals 2 and 3 and reset SWITCH 2)

TROUBLE SHOOTING PROCEDURE (NOTE 1)

The following checkpoints can be used to determine if the ESSE is operating properly. Refer to Figure 2. All AC voltage readings are in RMS.

A. Check for battery voltage and proper polarity on Terminals 1 and 2.

B. Check input signal on Terminals 5 and 6 with an AC Voltmeter. When the engine is running, the input voltage signal must be greater than 0.7 VAC.

C. Connect negative lead of DC Voltmeter to negative side of battery or Terminal 2.

D. With power switch "ON", the DC Voltmeter must indicate battery voltage on Terminals 9 and 12.

E. The DC Voltmeter must indicate battery voltage on Terminal 7 if an overspeed condition did not occur. If the voltmeter does not indicate battery voltage, review adjustments section to determine if the SWITCH 2 setpoint is correct and if SWITCH 2 functions.

F. The DC Voltmeter must indicate battery voltage on Terminal 10 during cranking and zero voltage when the engine is running. If the voltmeter indicates battery voltage on Terminal 10 when the engine is running, switch the power switch to the "OFF" position and review the adjustments section to determine if the SWITCH 1 setpoint is correct and if SWITCH 1 functions.