

## OPERATING INSTRUCTIONS ECON-F



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## 1.0 Introduction

- ECON- F is an Engine Control / Protection Unit for engines used for NON DG applications.
- The controller can measure signals from either MPU or charging alternator to calculate RPM.
- ECON provide choice of Variety of sensor selection from predefined selection chart.
- In critical operation it is possible to disable or debar tripping of engine via an external digital input.
- 128x64 pixel graphical display enhance convenience in configuration of controller.

## 2.0 Protection, Supervision Salient Features

### Protection

- Low Lube Oil Pressure(LLOP)
- High Water Temp. (HWT)
- Oil Temp.
- Emergency off
- Fuel level
- Charging Alternator Fail/V-Belt failure

### Display and Measurement

- Battery Voltage
- Engine Run Hour
- RPM
- Water Temp in degree centigrade
- Fuel level in %
- Oil Temp in degree centigrade
- Service Hour

## 3.0 Digital Output

Eight digital output (seven negative and one positive) are available, four output contacts programmable.

- Start/Crank (Battery Negative)
- Charging Alternator (Battery positive)
- Solenoid (Battery Negative)
- Annunciation 1 (Battery Negative)
- Annunciation 2 (Battery Negative)
- Annunciation 3 (Battery Negative)
- Annunciation 4 (Battery Negative)
- Hooter (Battery Negative)

## 4.0 Digital Input

ECON can measure / detect three Analog, seven digital and one pulse input. These inputs are as mentioned below.

1. **LLOP Sensor** : Resistive sensor can be connected to LUBE Oil PRESSURE terminal(2). Pre Programmed sensor value (Listed in TABLE 5.1) can be assigned to LLOP input.
2. **HWT Sensor** : Resistive sensor can be connected to Water Temperature terminal(3). Pre Programmed sensor value (Listed in TABLE 5.1) can be assigned to HWT input.
3. **Fuel / Oil Temp. sensor** : resistive sensor can be connected to Fuel / Oil Temp. sensor terminal (4).
4. **LLOP Switch** : Oil pressure switch can be connected to LLOP switch terminal (8) . The input is activated on connection of DC negative at terminal no. 8. on activation stop command is issued to the engine and the fault is indicated on front LED.
4. **Oil Temp. Switch** : Oil Temp. switch can be connected to oil temp. switch terminal (10) . The input is activated on connection of DC negative at terminal no. 10. on activation stop command is issued to the engine and the fault is indicated on front LED.
5. **HWT Switch** : Water Temperature switch can be connected to HWT switch terminal (9) . The input is activated on connection of DC negative at terminal no. 9. on activation stop command is issued to the engine and the fault is indicated on front LED.
6. **Emergency Off** :  
The input is activated on connection of DC negative at terminal no. 11. on activation stop command is issued to the engine and the fault is indicated on front LED.
7. **Protection Debar** : The input is activated on connection of DC negative at terminal no. 12. on activation ECON disable trip function on all the faults.
8. **Remote Start** : ECON issues start command to engine on receipt of DC negative at remote start terminal.
9. **Remote Stop** : ECON issues stop command to engine on receipt of DC negative at remote stop terminal.

## 5.0 Indication





Listed below are the two LED indication available on front of ECON-F

**Warning** : Blinks in case of sensor open or on low fuel warning.

**Fault** : Blinks on any fault which results in engine shutdown.

## 6.0 Front Panel Switch

ECON – F has four switch provided on its front panel. Switch can have more than one functions assigned to them. The table below describes the operation of these

| Switch Symbol   | Switch Function  | Description   |
|---|------------------|---|
|  | Increment /Start | <b>Programming Mode:</b> It is used to increment the value of the parameters under programming. & it is used to issue the crank/ start command to DG  |
|  | Decrement /Stop  | <b>Programming mode:</b> It is used to decrement the value of the parameter under programming &. It is used to issue the stop command to DG   |
|  | Next             | <b>Normal operation mode:</b> In this mode, it is used to change the parameters being displayed on LCD.<br><b>Programming Mode:</b> Next key is used to select the next parameter to be programmed. |
|  | Reset            | Either to reset the fault / Or press enter and reset together to select programming mode.   |

## 7.0 Setting Procedure / Menu

ECON is user/site configurable. User can view all parameters, fault history, events no. of start/stop and can also edit, system parameter (password protected), engine / generator parameter, annunciation setting, RS485 parameter clock and password. Following is the sequential procedure to edit. view all the menu and submenus

Press “R” & “Enter” switch simultaneously.

The LCD shall display, “System Parameter”

### 1. System Parameter

- System parameter are password protected.
- To enter “system parameter” press “Enter”.
- ECON will request for password, LCD will display “ Enter Password”
- System parameter can be edited by entering correct password or else can be viewed by entering “0” as password.

### 2. Engine / Generator Parameter

- To go to next menu after system parameter, press “Increment”.
- The LCD shall display “Generator Parameter”.
- Generator parameter can be modified / viewed by pressing “Enter”.  
(for setting details pls refer table 5.1)

### **3. Annunciation Setting**

- To go to next menu after generator parameter, press “Increment”.
- The LCD shall display “annunciation setting”.
- Annunciation settings can modified / viewed by pressing “Enter”.  
(for setting details pls refer table 5.1).

### **4. Comm RS-485 Parameter**

- To go to next menu after Annunciation parameter, press “Increment”.
- The LCD shall display “Comm RS-485 parameter setting”.
- Comm RS-485 parameter settings can modified / viewed by pressing “Enter”. (for setting details pls refer table 5.1).

### **5. Display History**

- To go to next menu after annunciation press “Increment”.
- The LCD shall display “Display History”.
- Trip record / history can be viewed by pressing “Enter”.
- ECON keep a record of last 32 tripping with date and time stamp.
- Tripping records are updated on first in first out basis

### **6. Display Event**

- To go to next menu after history press “Increment”.
- The LCD shall display “Display Event”.
- Display Event can be viewed by pressing “Enter”.
- ECON keep a record of last 32 event with date and time stamp.
- Event record is updated on first in first out basis.

### **7. Display Start Stop**

- To go to next menu after event press “Increment”.
- The LCD shall display “Display Start / Stop”.
- Start Stop can viewed by pressing “Enter”.
- ECON keep a record of last 64 start and stop event with date and time stamp.
- Start/ stop record is updated on first in first out basis.

### **8. Reset Service Alarm**

- To go to next menu after Start-Stop press “Increment”.
- The LCD shall display “Reset Service Alarm”.
- Service due hour can be reset by pressing start button after entering in to this menu.

### **9. Adjust Clock**

- To go to next menu after Service Alarm press “Increment”.
- The LCD shall display “Adjust Clock”.
- Time can be modified / viewed by pressing “Enter”.

## 9. Reset Password

- To go to next menu after annunciation press “Increment”.
- The LCD shall display “Reset Password”.
- Password can be modified by pressing “Enter”
- ECON will request for the present password, after feeding correct password change password will be requested and the password will be replaced by new password on pressing start button..


### Parameter Mode





| Parameter | Options/Limits | Description | Default Setting |
|-----------|----------------|-------------|-----------------|
|-----------|----------------|-------------|-----------------|

#### A. System Parameter




System parameters are the parameters which are programmed once during initial installation and does not require frequent changes. As these are critical parameter and hence are password protected. It is possible to view system parameter without knowing the password but editing is possible only after entering correct password

All system parameters are listed below along with their default value and minimum / maximum variation range. Values can be increased or decreased by pressing up/start and down/stop button respectively . Next parameter can be selected by pressing next button

|   |                                     |  |              |
|---|-------------------------------------|--|--------------|
| Solenoid Type<br> | 1: Pull to Start<br>2: Pull to Stop | <p><b>Pull To Start</b><br/>           In this mode fuel solenoid contact changes from Open to Close at the time of cranking and remains close till the genset is running. For stopping the generator this contact opens.</p> <p><b>Pull To Stop</b><br/>           In this mode fuel solenoid contact remains open at the time of cranking and till the genset is running. For stopping the generator this contact closes for a user programmed time.</p> | Pull to Stop |
|---|-------------------------------------|--|--------------|







|  |  |  |                   |
|--|--|--|-------------------|
| <p>LLOP Sensor</p>       | <p>1: Type A<br/>2: Type B<br/>3: M&amp;M<br/>4: MNEPL<br/>5: VE<br/>6: TMTL<br/>7: HUAFANG<br/>8: TATA<br/>9: GC(VDO)<br/>10: GC(Murphy)<br/>11: MVD<br/>12: 4-20 mA10bar<br/>13: 4-20 mA16bar<br/>14: Disabled</p> | <p>Select the installed sensors. If no sensor is installed select "Disabled"</p> | <p>GC(VDO)</p>    |
| <p>Fuel Sensor</p>       | <p>1: Type A<br/>2: Sam 0<br/>3: Sam 1<br/>4: Disabled</p>   | <p>Select the installed sensors. If no sensor is installed select "Disabled"</p> | <p>Type A</p>     |
| <p>Oil Temp. Sensor</p>  | <p>1: Type A<br/>2: Type B<br/>3: M&amp;M<br/>4: MNEPL<br/>5: VE<br/>6: TMTL AIR<br/>7: TMTL WATER<br/>8: HUAFANG<br/>9: TATA<br/>10: GC(VDO)<br/>11:GC(Murphy)<br/>12: Disabled</p>                                 | <p>Select the installed sensors. If no sensor is installed select "Disabled"</p> | <p>TMTL Water</p> |
| <p>HWT Sensor</p>      | <p>1: Type A<br/>2: Type B<br/>3: M&amp;M<br/>4: MNEPL<br/>5: VE<br/>6: TMTL AIR<br/>7: TMTL WATER<br/>8: HUAFANG<br/>9: TATA<br/>10: GC(VDO)<br/>11:GC(Murphy)<br/>12: Disabled</p>                                 | <p>Select the installed sensors. If no sensor is installed select "Disabled"</p> | <p>TMTL Water</p> |














|   |                                       |  |               |
|---|---------------------------------------|--|---------------|
| Sensor Open<br>       | 1: Warning<br>2: Fault<br>3: Disabled | The action to be taken if the sensor is found to be open.  | Warning       |
| Pulses/Revolution<br> | 1-300                                 | No of pulses, from Magnetic Pickup unit or W point of charging alternator, in one revolution of the engine. This shall be used to calculate the RPM.   | 134           |
| Start Stop Config<br> | 1: Separate keys<br>2: Only Start key | This parameter decides as to how the remote start and stop shall be done. Option 1: Separate keys is selected than a single pulse on remote start shall the engine and another pulse on remote stop shall stop the engine. The duration of these pulses shall be more than 200msec. Option 2: In this option the engine shall be started and kept working till Remote start is pulled low. As soon as the pin is released the engine shall stop. To attempt a new start cycle, after the engine fails to start, the remote start pin must be released for some time and again pulled low.<br>* Option 2 should not be selected if the start and stop functions are to be executed from front keys. | Separate keys |






**B. Engine/Generator Parameter**






All the Engine programmable parameters are listed below along with their default value and minimum / maximum variation range. Values can be increased or decreased by pressing up/start and down/stop button respectively . Next parameter can be selected by pressing next button.

|   |  |   |         |
|---|--|---|---------|
| Maximum RPM<br>       | 600-4000   | Maximum allowed RPM of Engine. Engine running at speed above this is treated as over speeding and a fault is registered and engine stopped.   | 1600    |
| Minimum RPM<br>       | 600-4000   | Minimum allowed RPM of Engine. running at speed below this is treated as over speeding and a fault is registered and engine Stopped.  | 600     |
| RPM Delay<br>         | 1-999 Sec  | Duration for which engine is allowed to operated outside the set RPM limits. If it continues to operate beyond the limits for more than the set time a fault condition is registered and engine stopped.  | 3       |
| Action Over RPM<br>   | <ol style="list-style-type: none"> <li>1. No action</li> <li>2. Warning</li> <li>3. Engine Shutdown</li> </ol> | The action to be taken if the Over RPM fault occur <ol style="list-style-type: none"> <li>1. The fault is neglect.</li> <li>2. This generate warning, fault with annunciation and log to history.</li> <li>3. This stop the engine, fault with annunciation and log to history.</li> </ol>  | Warning |
| Action Under RPM<br> | <ol style="list-style-type: none"> <li>1. No action</li> <li>2. Warning</li> <li>3. Engine Shutdown</li> </ol> | The action to be taken if the Under RPM fault occur <ol style="list-style-type: none"> <li>1. The fault is neglect.</li> <li>2. This generate warning, fault with annunciation and log to history.</li> <li>3. This stop the engine, fault with annunciation and log to history.</li> </ol> | Warning |
| Pick Up RPM<br>     | 80-1000  | The engine stalling RPM. This parameter defines the RPM above which the engine will not stall and hence can be treated as running. This is used to detect the engine running condition after crank.   | 300     |

|   |   |  |         |
|---|---|--|---------|
| Service Due Hour<br>    | 10-999Hrs                                 | Service due warning is generated after the engine has logged these many hours.   | 500     |
| pump pre<br>           | Disable<br>1-999                          | Start with cranking and remains there until it gets the stopping command   | 2       |
| Fuel warn Level<br>     | Disable<br>11-80                          | Monitoring value for the fuel level below which fuel level warning is generated  | 24%     |
| Fuel warn delay<br>     | 1-999 Sec                                 | Monitoring time for the fuel level below which fuel level warning is generated.  | 10      |
| Fuel Trip Level<br>     | 5-80                                      | Monitoring time for the fuel level below which fuel trip warning is generated.   | 15      |
| Fuel Trip delay<br>     | 1-999 Sec                                 | Monitoring time for the fuel level below which fuel trip warning is generated.   | 10      |
| Action Fuel Fault<br> | 1. No action<br>2. Warning<br>3. Disabled | The action to be taken if the fuel fault occur<br>1. The fault is neglect.<br>2. This generate warning, fault with annunciation and log to history.<br>3. Disabled | disable |

|   |  |   |                       |
|---|--|---|-----------------------|
| Oil temp Trip Level<br>   | 40-250oC   | The maximum OIL temperature up to which the engine is allowed to operate.   | 115°C                 |
| Oil temp trip delay<br>   | 1-999Sec   | Monitoring time for the Oil temp level to avoid false tripping of the engine.   | 3                     |
| Action Oil temp Fault<br> | 1. No action<br>2. Warning<br>3. Engine Shutdown | The action to be taken if the Oil temp fault occur<br>1. The fault is neglect.<br>2. This generate warning, fault with annunciation and log to history.<br>3. This stop the engine, fault with annunciation and log to history. | Warning               |
| LLOP Trip Level<br>       | 0.4-8.5Kg/cm <sup>2</sup>                        | The minimum lubricant oil pressure on which the engine is allowed to operate. A drop of pressure below the set limit shall trigger a fault condition thereby stopping the engine  | 1.5Kg/cm <sup>2</sup> |

|   |  |   |         |
|---|--|---|---------|
| LLOP Trip Delay<br>   | 1-999 Sec  | Duration for which the low lubricant oil pressure can be tolerated.   | 3       |
| Action LLOP Fault<br> | 1. No action<br>2. Warning<br>3. Engine Shutdown | The action to be taken if the LLOP fault occur<br>1. The fault is neglect.<br>2. This generate warning, fault with annunciation and log to history.<br>3. This stop the engine, fault with annunciation and log to history. | Warning |
| HWT trip level<br>    | 40-250°C   | The maximum coolant temperature up to which the engine is allowed to operate.   | 96°C    |
| HWT Trip delay<br>    | 1-999 Sec  | The duration for which the engine is allowed to operate at temperature higher than the above set maximum temperature  | 3       |
| Action HWT Fault<br>  | 1. No action<br>2. Warning<br>3. Engine Shutdown | The action to be taken if the HWT fault occur<br>1. The fault is neglect.<br>2. This generate warning, fault with annunciation and log to history.<br>3. This stop the engine, fault with annunciation and log to history.  | Warning |





|   |  |   |         |
|---|--|---|---------|
| <p>ChgAlt-Vbelt</p>               | 1-999Sec   | While the engine is running and the Charging alternator pin is not pulled low for this duration it is assumed that either the charging alternator or V-Belt has failed thereby generating a fault condition and stopping the engine.  | 10      |
| <p>Action ChgAlt-Vbelt Fault</p>  | <ol style="list-style-type: none"> <li>1. No action</li> <li>2. Warning</li> <li>3. Engine Shutdown</li> </ol> | <p>The action to be taken if the ChgAlt-Vbelt fault occur</p> <ol style="list-style-type: none"> <li>1. The fault is neglect.</li> <li>2. This generate warning, fault with annunciation and log to history.</li> <li>3. This stop the engine, fault with annunciation and log to history.</li> </ol> | Warning |
| <p>Crank On Time</p>              | 1-10 Sec   | The maximum duration for which the engine can be cranked continuously. In case engine fails to start another attempt to start shall be attempted after some time.   | 3       |
| <p>Solenoid On Time</p>           | 1-60 Sec   | The duration for which the Pull solenoid can be continuously energized while trying to stop the engine.   | 20      |
| <p>Auto Scroll</p>               | <ol style="list-style-type: none"> <li>1: Enabled</li> <li>2: Disabled</li> </ol>                              | Can be used to stop/start the automatic scrolling of the display parameters.  | Enabled |
| <p>Hooter On Time</p>   | 1-999 Sec  | Duration for which the hooter shall be . This setting is only available if the hooter is assigned to an DO.   | 15      |

**C. Annunciation Setting**

It is possible to freely assign digital outputs to different fault. There are four (ANN1 , ANN2, ANN3 and ANN4) field programmable output.

It is also possible to assign same digital output to more than one fault( e.g. ANN1 can be assigned to fuel fault and HWT fault both, in this case ANN1 will activate on both the faults.

|                    |  |  |                 |
|--------------------|--|--|-----------------|
| Ann fuel fault     | 1: No Annunciation<br>2:On DO Ann1<br>3:On DO Ann2<br>4:On DO Ann3<br>5:On DO Ann4 | If desired, the oil temp fault can be announced at one of the annunciation Digital Output.               | No Annunciation |
| Ann Oil Temp Fault | 1: No Annunciation<br>2:On DO Ann1<br>3:On DO Ann2<br>4:On DO Ann3<br>5:On DO Ann4 | If desired, the oil temp fault can be announced at one of the annunciation Digital Output.               | No Annunciation |
| Ann HWT Fault      | 1: No Annunciation<br>2:On DO Ann1<br>3:On DO Ann2<br>4:On DO Ann3<br>5:On DO Ann4 | If desired, the High water temperature fault can be announced at one of the annunciation Digital Output. | No Annunciation |
| Ann LLOP Fault     | 1: No Annunciation<br>2:On DO Ann1<br>3:On DO Ann2<br>4:On DO Ann3<br>5:On DO Ann4 | If desired, the LLOP fault can be announced at one of the annunciation Digital Output.                   | No Annunciation |
| Ann RPM Fault      | 1: No Annunciation<br>2:On DO Ann1<br>3:On DO Ann2<br>4:On DO Ann3<br>5:On DO Ann4 | If desired, the Over/Under speed fault can be announced at one of the annunciation Digital Output.       | No Annunciation |
| Announce Unit OK   | 1: No Annunciation<br>2:On DO Ann1<br>3:On DO Ann2<br>4:On DO Ann3<br>5:On DO Ann4 | If desired, the healthiness of the controller can be announced at one of the annunciation Digital Output | No Annunciation |

| <b>D</b>  |                                  |   |                                       |
|---|----------------------------------|---|---------------------------------------|
| Device Id<br> | Modbus device ID                 | 1   | 1-247                                 |
| Baud Rate<br> | RS 485 Communication Baudrate    | 9600  | 1200<br>2400<br>4800<br>9600<br>19200 |
| Parity<br>    | RS 485 Communication Parity Bits | None  | Even<br>Odd<br>None                   |
| Stop Bit<br>  | RS 485 Communication Stop Bits   | 1   | 1<br>2                                |
| <b>E Reset Service Alarm</b>  |                                  |   |                                       |
|   |                                  | Press INC to Reset<br>Press DEC to esc  |                                       |
| <b>F Adjust Clock</b>   |                                  |   |                                       |
|   | 00.00<br>DD/MM/YY<br>YY          | Automatic real time based DG Start & Stop (Manual Controller Configuration) RTC Time and Date can be easily entered | 00.00                                 |
| <b>G Reset Password</b>   |                                  |   |                                       |
|   |                                  | Three digit password protection for system settings<br>Password can be change easily.                               |                                       |



## 8.0 Technical Specification

|                      |   |
|----------------------|---|
| AC voltage withstand | 330 VAC, Continuously, (Phase to neutral) |
| Frequency Range      | 40-70 Hz                                  |
| Measurement Accuracy |   |
| Voltage & Current    | ± 2%                                      |
| Frequency            | ± 0. 05 Hz.                               |
| Surge 1.2/50Usec     | 2.5KV                                     |
| Auxiliary Voltage    | 8-35V/DC OR 50-300 V AC/DC                |
| Contact Rating       | 230 VAC, 5A                               |
| Humidity             | 95 %                                      |

## 9.0 Model selection

| Model      | Analog Channel          | RS-485 Comm |
|------------|-------------------------|-------------|
| ECON-F-311 | 3(OIL TEMP., HWT, LLOP) | X           |
| ECON-F-312 | 3(OIL TEMP., HWT, LLOP) | ✓           |
| ECON-F-321 | 3(FUEL, HWT, LLOP)      | X           |
| ECON-F-322 | 3(FUEL, HWT, LLOP)      | ✓           |

## 10.1 High Water Temperature Sensors Data :

| Temp. | Resistance in ohms |        |      |       |      |         |        |          |             |            |
|-------|--------------------|--------|------|-------|------|---------|--------|----------|-------------|------------|
| In °C | Type A             | Type B | M&M  | MNEPL | VE   | Huafang | TATA   | GC (VDO) | GC (Murphy) | TMTL Water |
| 0     | 3282               | 1525   | 3282 | 3282  | 2363 | 2900    | 3192.6 | 3417     | 10613       | 3512       |
| 5     | 2765               | 1319   | 2765 | 2765  | 1873 | 2199    | 2461.1 | 2609     | 7764        | 2707       |
| 10    | 2247               | 1112   | 2247 | 2247  | 1383 | 1684    | 1914.6 | 2011     | 5743        | 2106       |
| 15    | 1730               | 906    | 1730 | 1730  | 1111 | 1301    | 1502.7 | 1564     | 4292        | 1653       |
| 20    | 1212               | 700    | 1212 | 1212  | 839  | 1015    | 1189.2 | 1227     | 3240        | 1308       |
| 25    | 1036               | 570    | 1036 | 1036  | 683  | 798     | 948.4  | 970      | 2469        | 1043       |
| 30    | 860                | 440    | 860  | 860   | 527  | 632     | 762.1  | 773      | 1898        | 838        |
| 35    | 684                | 365    | 684  | 684   | 434  | 505     | 616.7  | 621      | 1472        | 678        |
| 40    | 508                | 287    | 508  | 508   | 340  | 406     | 502.5  | 520      | 1050        | 552        |
| 45    | 426                | 260    | 426  | 426   | 283  | 327     | 412    | 438      | 885         | 453        |
| 50    | 343                | 232    | 343  | 343   | 226  | 247     | 340    | 356      | 720         | 374        |
| 55    | 291                | 205    | 291  | 291   | 190  | 214     | 282.1  | 288      | 560         | 310        |
| 60    | 238                | 178    | 238  | 238   | 154  | 187     | 235.5  | 220      | 410         | 259        |
| 65    | 203                | 151    | 203  | 203   | 131  | 154     | 197.6  | 183      | 360         | 217        |
| 70    | 167                | 123    | 167  | 167   | 107  | 120     | 166.6  | 145      | 300         | 183        |
| 75    | 144                | 96     | 144  | 144   | 92   | 101     | 141.2  | 128      | 240         | 155        |
| 80    | 120                | 69     | 120  | 120   | 76   | 85      | 120.2  | 110      | 193         | 132        |
| 85    | 104                | 62     | 104  | 104   | 66   | 74      | 102.8  | 95       | 160         | 113        |
| 90    | 88                 | 54     | 88   | 88    | 55   | 62      | 88.3   | 80       | 145         | 97         |
| 95    | 77                 | 46     | 77   | 77    | 48   | 55      | 76.2   | 71       | 120         | 83         |
| 100   | 66                 | 38     | 66   | 66    | 41   | 47      | 66     | 61       | 100         | 72         |
| 105   | 58                 | 35     | 58   | 58    | 36   | 41      | 57.4   | 52       | 90          | 63         |
| 110   | 50                 | 31     | 50   | 50    | 30   | 36      | 43.8   | 45       | 80          | 55         |
| 115   | 45                 | 27     | 45   | 45    | 27   | 31      | 38.5   | 40       | 70          | 48         |
| 120   | 39                 | 23     | 39   | 39    | 23   | 27      | 33.9   | 34       | 55          | 42         |
| 125   | 34                 | 19     | 34   | 34    | 21   | 24      | 30     | 30       | 45          | 37         |
| 130   | 30                 | 15     | 30   | 30    | 18   | 21      | 26.6   | 27       | 38          | 33         |
| 135   | 27                 | 11     | 27   | 27    | 16   | 18      | 23.7   | 23       | 33          | 29         |
| 140   | 25                 | 0      | 25   | 25    | 14   | 15      | 21.1   | 21       | 29          | 26         |
| 145   | 23                 | 0      | 23   | 23    | 12   | 12      | 18.9   | 18       | 25          | 23         |
| 150   | 21                 | 0      | 21   | 21    | 10   | 10      |        | 16       | 22          | 20         |

Continues on Next Page

## 10.2 High Water Temperature Sensors Data :

| S.No | Temperature in °C | Resistance in ohms |            |
|------|-------------------|--------------------|------------|
|      |                   | TMTL AIR3C         | TMTL AIR1C |
| 1    | 80                | 300                | 300        |
| 2    | 85                | 279.3              | 273.1      |
| 3    | 90                | 258.5              | 246.2      |
| 4    | 95                | 237.8              | 223.8      |
| 5    | 100               | 217                | 208.5      |
| 6    | 105               | 201.3              | 193.1      |
| 7    | 110               | 185.5              | 177.7      |
| 8    | 115               | 169.8              | 162.3      |
| 9    | 120               | 154                | 146.9      |
| 10   | 125               | 138.3              | 131.5      |
| 11   | 130               | 122.5              | 116.2      |
| 12   | 135               | 106.8              | 100.8      |
| 13   | 140               | 91                 | 85.4       |
| 14   | 145               | 76.3               | 70         |
| 15   | 150               | 61.5               | 57.3       |
| 16   | 155               | 46.8               | 44.7       |
| 17   | 160               | 32                 | 32         |
| 18   | 165               | 30.3               | 30.3       |
| 19   | 170               | 28.5               | 28.7       |
| 20   | 175               | 26.8               | 27         |
| 21   | 180               | 25                 | 23.6       |
| 22   | 185               | 22.3               | 20.2       |
| 23   | 190               | 19.5               | 16.8       |
| 24   | 195               | 16.8               | 13.4       |
| 25   | 200               | 14                 | 10         |
| 26   | 205               | 13                 |            |
| 27   | 210               | 12                 |            |
| 28   | 215               | 11                 |            |
| 29   | 220               | 10                 |            |

### 10.3 Low Lube Oil Pressure Sensors Data

| Pressure              | Resistance In Ohms |        |       |       |       |       |         |      |          |             |
|-----------------------|--------------------|--------|-------|-------|-------|-------|---------|------|----------|-------------|
| In Kg/cm <sup>2</sup> | Type A             | Type B | M&M   | MNEPL | Volvo | TMTL  | Huafang | TATA | GC (VDO) | GC (Murphy) |
| 0                     | 10                 | 10     | 10    | 10    | 15    | 10    | 10      | 10   | 10       | 240         |
| 0.5                   | 16.5               | 20     | 16.5  | 20.5  | 19.5  | 21    | 20      | 20.5 | 20       | 214         |
| 1                     | 23.5               | 30     | 23.5  | 31    | 24    | 32    | 30      | 31   | 30       | 189         |
| 1.5                   | 30.2               | 40     | 30.2  | 41.5  | 28.5  | 43    | 40      | 41.5 | 41       | 166         |
| 2                     | 37                 | 50     | 37    | 52    | 33    | 54    | 50      | 52   | 52       | 147         |
| 2.5                   | 49.5               | 58.7   | 49.5  | 70    | 40.5  | 62.7  | 58.7    | 61   | 61       | 129         |
| 3                     | 62                 | 67.5   | 62    | 88    | 48    | 71.5  | 67.5    | 70   | 70       | 115         |
| 3.5                   | 74.5               | 76.2   | 74.5  | 106   | 54.5  | 80.2  | 76.2    | 79   | 79       | 102         |
| 4                     | 87                 | 85     | 87    | 124   | 61    | 89    | 85      | 88   | 88       | 91          |
| 4.5                   | 96                 | 93.5   | 96    | 142   | 63.5  | 97.7  | 93.5    | 97   | 97       | 81          |
| 5                     | 105                | 102    | 105   | 160   | 66    | 106.5 | 102     | 106  | 106      | 71          |
| 5.5                   | 114                | 110.5  | 114   | 178   | 72.5  | 115.2 | 110.5   | 115  | 115      | 61          |
| 6                     | 123                | 119    | 123   | 196   | 79    | 124   | 119     | 124  | 124      | 51          |
| 6.5                   | 133.5              | 127.2  | 133.5 | 214   | 82    | 132.7 | 127.2   | 132  | 132      | 41          |
| 7                     | 143                | 135.5  | 143   | 232   | 85    | 141.5 | 135.5   | 140  | 139      | 31          |
| 7.5                   | 152.5              | 143.7  | 152.5 | 250   | 87.5  | 150.2 | 143.7   | 148  | 146      | 24          |
| 8                     | 162                | 152    | 162   | 268   | 90    | 159   | 152     | 156  | 152      | 20          |
| 8.5                   | 171.5              | 159    | 171.5 | 286   | 95    | 167.7 | 159     | 164  | 159      | 16          |

#### 10.4 Low Fuel Sensors Data :

| S.No. | Fuel in % | Resistance in ohms |       |       |
|-------|-----------|--------------------|-------|-------|
|       |           | Type A             | Sam_0 | Sam_1 |
| 1     | 0         | 0                  | 14    | 10    |
| 2     | 5         | 5                  | 18    | 18.5  |
| 3     | 10        | 10                 | 22    | 27    |
| 4     | 17        | 17                 | 29.5  | 35.5. |
| 5     | 20        | 34                 | 37    | 44    |
| 6     | 25        | 51                 | 55.5  | 52.5  |
| 7     | 30        | 68                 | 74    | 61    |
| 8     | 35        | 85                 | 92    | 69.5  |
| 9     | 40        | 102                | 110   | 78    |
| 10    | 45        | 110.5              | 124.5 | 86.5  |
| 11    | 50        | 119                | 139   | 95    |
| 12    | 55        | 127.5              | 149   | 103.5 |
| 13    | 60        | 136                | 159   | 112   |
| 14    | 65        | 144.5              | 165   | 120.5 |
| 15    | 70        | 153                | 171   | 129   |
| 16    | 75        | 157.7              | 172.5 | 137.5 |
| 17    | 80        | 162.3              | 174   | 146   |
| 18    | 85        | 167                | 176   | 154.5 |
| 19    | 90        | 171.7              | 178   | 163   |
| 20    | 95        | 176.3              | 181   | 171.5 |
| 21    | 100       | 180                | 184   | 180   |

## 11.0 Wiring Diagram

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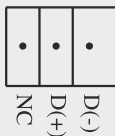
[www.mrmprocom.com](http://www.mrmprocom.com)

ECON - F

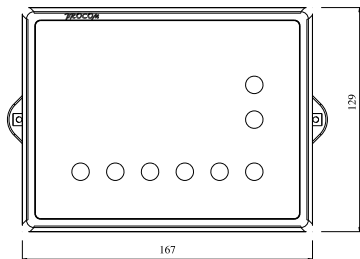
|    |                  |
|----|------------------|
| 5  | NC               |
| 6  | NC               |
| 7  | MPU / W-Point    |
| 8  | LLOP Switch      |
| 9  | HWT Switch       |
| 10 | Oil Temp Switch  |
| 11 | Emergency        |
| 12 | Protection Debar |
| 13 | Remote Start     |
| 14 | Remote Stop      |

|                       |   |
|-----------------------|---|
| NC                    | 1 |
| LLOP Sensor           | 2 |
| HWT Sensor            | 3 |
| Fuel/Oil Temp. Sensor | 4 |

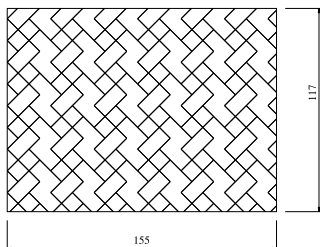
|    |                       |
|----|-----------------------|
| 15 | NC                    |
| 16 | Hooter                |
| 17 | Ann. 1 (-ve)          |
| 18 | Ann. 2 (-ve)          |
| 19 | Ann. 3 (-ve)          |
| 20 | Ann. 4 (-ve)          |
| 21 | Solenoid              |
| 22 | Crank                 |
| 23 | Chargine Alt. Contact |
| 24 | Battery(+)(8-35V DC)  |
| 25 | Battery(-)            |
| 26 | Sensor (-ve)          |



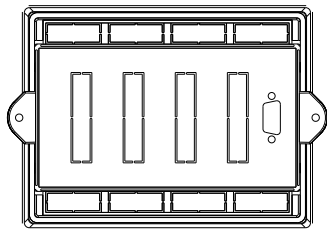
## 12.0 Dimensional Detail



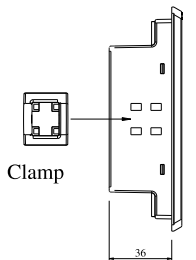
Front View



Cut Out



Rear View



Side View

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