

Velocity TC-3

One to Twelve channel thermocouple (EGT/CHT) indicator

Operating Manual – English 1.02



Introduction

The TC-3 thermocouple display unit is a 12 channel 3 1/8" instrument that contains all the features necessary to monitor EGT's and CHT's. The TC3 can be configured to display up to 12 thermocouples in an easy to read bargraph format.

The TC-3's high accuracy is due to it's built in thermocouple linearization curves and cold junction compensation techniques. Common J, K or E type thermocouple probes are supported.

In addition the TC3 has an individual programmable EGT and CHT alarm with an external output that can switch an external visual alarm indicator such as a lamp. Maximum temperature for each thermocouple is recorded in permanent memory and is also indicated by a solid line above that thermocouples bar graph.

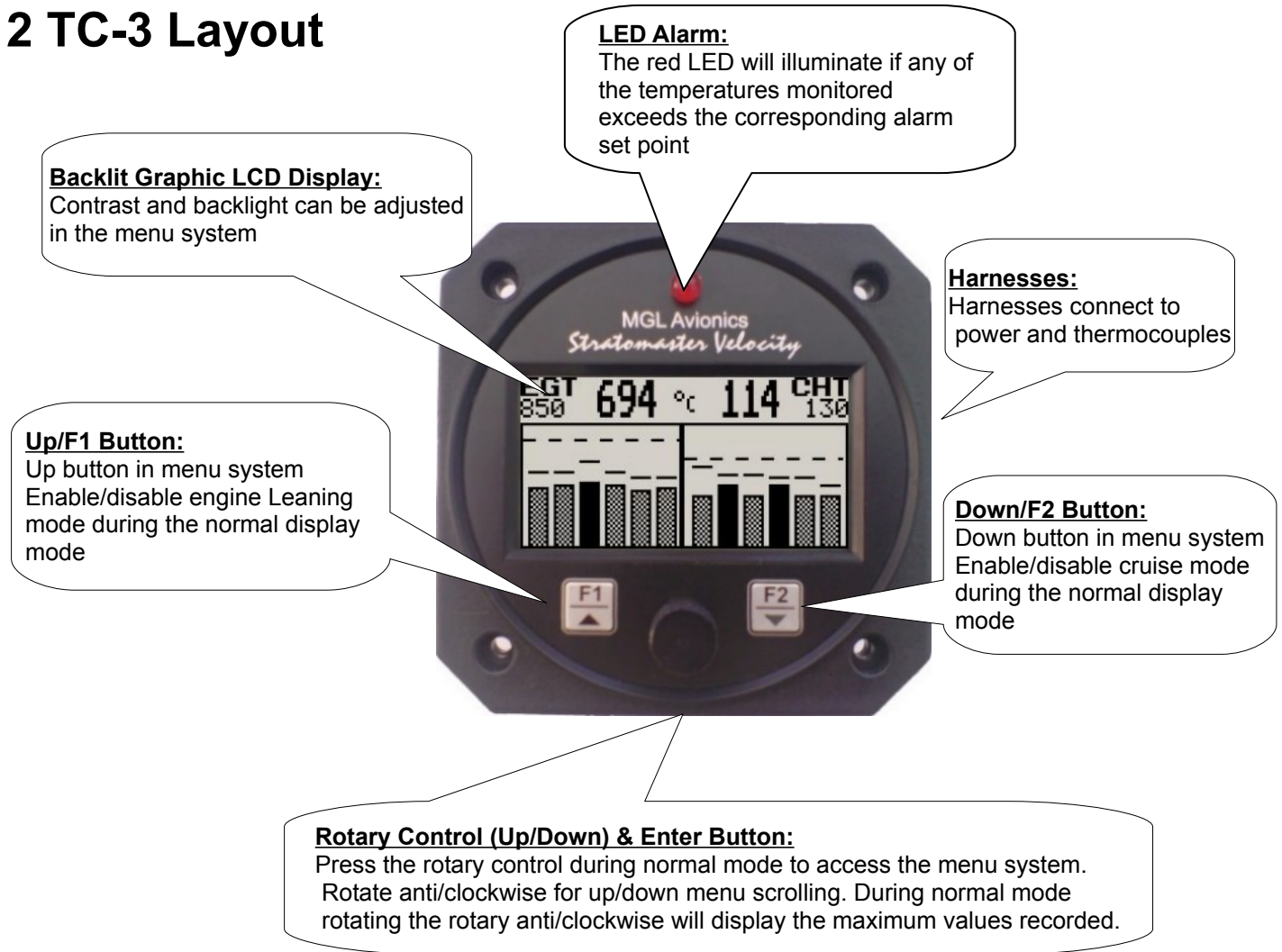
The TC3 also features a built in engine leaning facility which allows the pilot to optimize the fuel mixture according to peak EGT temperatures as well as a cruise mode facility to provide instant identification of changing EGT/CHT trends.

Temperatures can be displayed in degrees Celsius or degrees Fahrenheit from -100°C to 1200°C (-148°F to 2192°F).

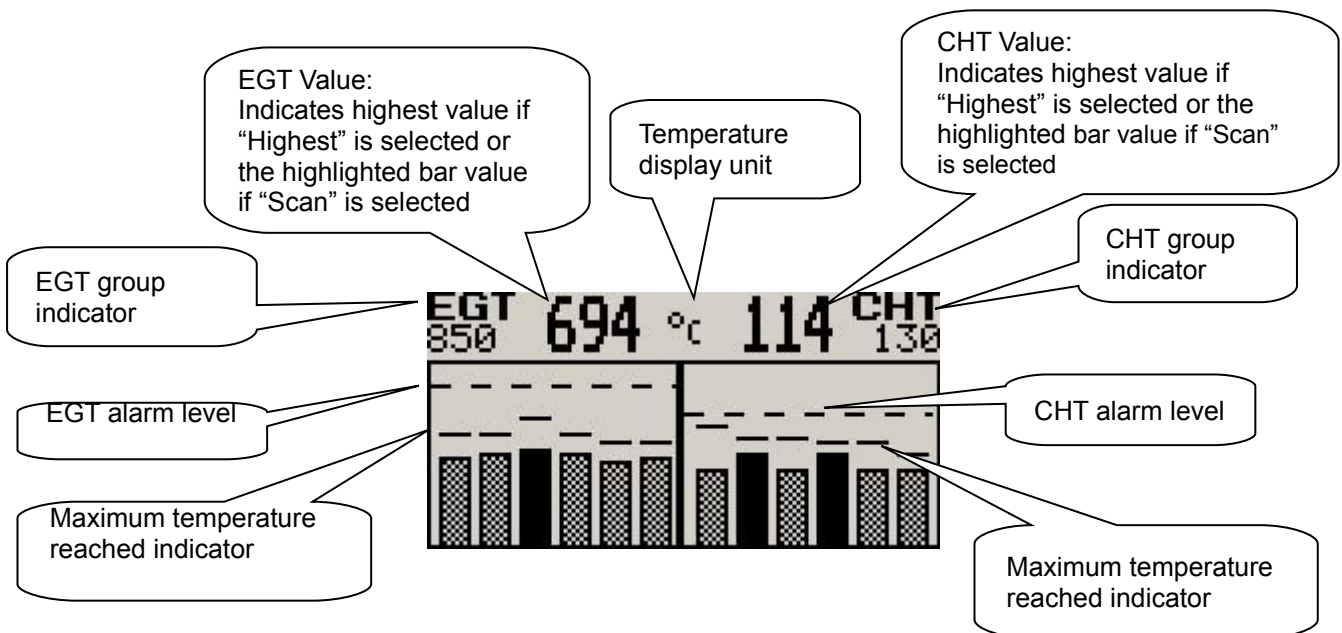
1 Features

- 12 Channel thermocouple display unit
- Supports J, K and E thermocouple probes
- Temperatures can be displayed in degrees Celsius or degrees Fahrenheit from -100°C to 1200°C (-148°F to 2192°F)
- High accuracy: Built in thermocouple linearization curves and cold junction compensated
- Maximum temperature for each thermocouple is recorded in permanent memory and indicated by a solid line above the thermocouples bar graph
- Engine leaning function according to peak EGT temperatures
- Engine cruise mode to instantly identify changing EGT/CHT trends
- Standard 3 1/8" aircraft enclosure (can be front or rear mounted)
- Rotary control plus 2 independent buttons for easy menu navigation and user input
- External alarm output as well as a red LED illuminates when the programmable alarm has been activated
- Large backlit graphic LCD with adjustable contrast
- Wide input supply voltage range of 8 to 30V DC with built in voltage reversal and over voltage protection for harsh electrical environments
- Light weight design

2 TC-3 Layout



3 Main Display



3.1 Permanent maximum values display

This display can be accessed by rotating the rotary control either clockwise or anticlockwise. Pressing the F1 key will reset the permanent maximum values to the current temperature values. Pressing any other key will return the TC-3 to the normal display mode.



Note: The permanent maximum values are stored in non-volatile memory and are recalled on power-up.

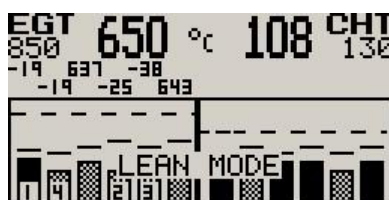
3.2 Engine leaning mode



EGT information is also very useful for fuel mixture control. As the fuel mixture is leaned, so the exhaust gasses get hotter. This rise in temperature is a sign of increased combustion efficiency as the optimum mixture setting is approached. If the leaning progresses past a certain point however, the temperature will begin to drop. This temperature drop is the result of reduced energy output from the diminished fuel flow. The best operating mixture for aircraft engines is in the vicinity of this peak EGT reading. The TC-3 has a special Leaning mode, which easily identifies the peak EGT condition allowing you to adjust your fuel mixture for best performance.



Fuel mixture should be adjusted once you have decided on a suitable cruise power setting (typically 70%). Press the Up/F1 key at the main display to enable the leaning mode. The "LEAN MODE" label is displayed at the bottom of the main display to clearly differentiate it from the normal operating mode.



As the fuel mixture is slowly leaned past the point at which the temperature begins to drop (by more than 10°C/15°F), the absolute EGT temperatures will change to show the EGT reading relative to this peak. The sequential order as each cylinder peaks is also shown.

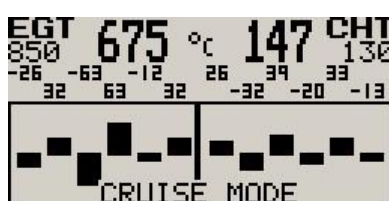
Leaning mode can be cancelled by pressing the Up/F1 key.

3.3 Engine cruise mode



Once in the cruise, pressing the Down/F2 key will immediately enable Cruise Mode. The "CRUISE MODE" label is displayed at the bottom of the main display to clearly differentiate it from the normal operating mode. All EGT and CHT readings are immediately sampled as reference temperatures for the cruise.

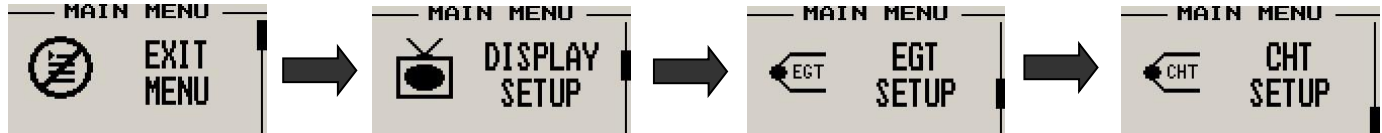
The display then shows EGT and CHT values relative to this reference temperature.



Cruise mode can be cancelled by pressing the Down/F2 key.

4 Menu System

The TC-3 will enter the menu system by pressing the rotary control button during the normal display mode. Use the up/down keys or the rotary control to navigate through the menu system



4.1 Exit Menu

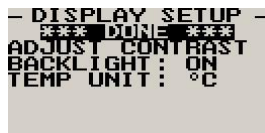


Press the rotary control on this menu item to exit the menu system. All changes made during navigation of the menu system will be saved in non-volatile memory on exiting the menu system. If you remove power before exiting the menu the instrument will not save any changes.

4.2 Display Setup



Move the highlight over this menu item and press the rotary button to return to the main menu



Select this menu option to adjust the display contrast

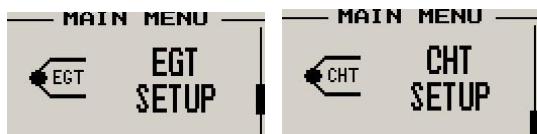


Select this menu option to turn the backlight on and off



Select whether you want the temperature to be displayed in degrees Celsius (°C) or degrees Fahrenheit (°F).

4.3 EGT / CHT Setup



Only “EGT SETUP” is shown below, follow the same steps for CHT setup

```

EGT SETUP
*** DONE ***
CHANNELS: 6
SPAN: 900°C
TOPSCALE: ON
ALARM: 850
ALARM ON/OFF: ON
PROBE: K-TYPE
  
```

Move the highlight over this menu option and press the rotary button to return to the “TC Setup” menu.

```

EGT SETUP
*** DONE ***
CHANNELS: 6
SPAN: 900°C
TOPSCALE: ON
ALARM: 850
ALARM ON/OFF: ON
PROBE: K-TYPE
  
```

Select the number of EGT or CHT channels you want to use. Choices are from 1 to 12. The temperature display will configure itself to make best possible use of the available display size. Please note that the minimum number of EGT & CHT channels that can be displayed is 1 and the maximum number of EGT and CHT channels that can be displayed is 12.

Note: Always install EGT probes starting on Channel 1 followed by the CHT probes without skipping any channels in between.

```

EGT SETUP
*** DONE ***
CHANNELS: 6
SPAN: 900°C
TOPSCALE: ON
ALARM: 850
ALARM ON/OFF: ON
PROBE: K-TYPE
  
```

This function sets the top end of your temperature bar graph. It has no effect on the actual temperature range that can be displayed in the digital temperature readout. Select the range to be just higher than the highest temperature you expect to measure using this channel.

```

EGT SETUP
*** DONE ***
CHANNELS: 6
SPAN: 900°C
TOPSCALE: ON
ALARM: 850
ALARM ON/OFF: ON
PROBE: K-TYPE
  
```

Select this function to “ON” if you want the bar graph display to show the upper half of the temperature range only. This results in a higher resolution of the temperature range you may be interested in. For engine temperature measurements we recommend that you set this to “ON”.

```

EGT SETUP
*** DONE ***
CHANNELS: 6
SPAN: 900°C
TOPSCALE: ON
ALARM: 850
ALARM ON/OFF: ON
PROBE: K-TYPE
  
```

Adjust the temperature that you would like to use as an alarm limit. Any temperature above this limit will activate the alarm. Active alarms will flash the affected channel and also activate the alarm contact that you can use to switch a lamp on.

```

EGT SETUP
*** DONE ***
CHANNELS: 6
SPAN: 900°C
TOPSCALE: ON
ALARM: 850
ALARM ON/OFF: ON
PROBE: K-TYPE
  
```

Select whether you want to turn the alarm on or off. To avoid false activation of the alarms, the alarm function is only activated 10 seconds after the instrument has powered up.

```

EGT SETUP
*** DONE ***
CHANNELS: 6
SPAN: 900°C
TOPSCALE: ON
ALARM: 850
ALARM ON/OFF: ON
PROBE: K-TYPE
  
```

Select if you are using a K-type, J-type or E-type thermocouple probe for this channel. All probes supplied by MGL Avionics are K-Type. J-types are sometimes used with American made CHT probes. All EGT probes are K-type. E-type probes are seldom used.

```

EGT SETUP
CHANNELS: 6
SPAN: 900°C
TOPSCALE: ON
ALARM: 850
ALARM ON/OFF: ON
PROBE: K-TYPE
MODE: SCANNING
  
```

A selection between “HIGHEST” or “SCANNING” can be selected. If “HIGHEST” is selected then the current highest thermocouple temperature is displayed. If “SCANNING” is selected then the unit will cycle through each thermocouple at the time specified in “SCAN TIME”.

```

EGT SETUP
SPAN: 900°C
TOPSCALE: ON
ALARM: 850
ALARM ON/OFF: ON
PROBE: K-TYPE
MODE: SCANNING
SCAN TIME: 33
  
```

Specify the time that each of the channels must be displayed for. This menu option is only shown if “SCANNING” is selected for the display mode.

5 Loading factory default settings

**LOADING
DEFAULT
SETTINGS**

Pressing and holding the F1 and F2 keys simultaneously during power up will cause the TC-3 to load preprogrammed factory default settings. The following screen will be displayed:

6 Operating the alarms

If the alarm is activated, the corresponding item on the display will flash. At the same time the externally available alarm switch will close. The switch will remain closed until any button is pressed to acknowledge the alarm or until the condition(s) that activated the alarm no longer exist. The alarm output can be used to switch an external alarm indicator. The external alarm switch is an open collector transistor switch to ground with a maximum rating of 0.5A DC. It is possible to wire the alarm contacts of several Stratomaster instruments in parallel should this be desired. To avoid false activation of the alarms, the alarm function is only active 10 seconds after the instrument has powered up.

7 Cleaning

The unit should not be cleaned with any abrasive substances. The screen is very sensitive to certain cleaning materials and should only be cleaned using a clean, damp cloth.

Warning: The TC-3 is not waterproof, serious damage could occur if the unit is exposed to water and/or spray jets.

8 TC-3 Specifications

Operating Temperature Range	-10°C to 50°C (14°F to 122°F)
Storage Temperature Range	-20°C to 80°C (-4°F to 176°F)
Humidity	<85% non-condensing
Power Supply	8 to 30Vdc SMPS (switch mode power supply) with built in 33V over voltage and reverse voltage protection
Current Consumption	Approx. 45mA @ 13.8V (backlight on) 15mA @13.8V (backlight off)
Display	128x64 graphic LCD display. Contrast and backlight is user configurable, green/yellow backlight
ADC	12bit over sampled successive approximation
Dimensions	see Velocity series dimensional drawing
Enclosure	3 1/8" ABS, black in color, front or rear mounting
Weight	Approx. 214 grams
Non-volatile memory storage	100000 write cycles
Thermocouples	K-type, J-type or E-type
Channels	1 to 12 independent channels
Measurement range	J-Type/K-Type: -100°C to 1200°C (-148°F to 2192°F) E-Type: -100°C to 900°C (-148°F to 1652°F)
Technology	Fully cold junction compensated using precision internal temperature reference, built in thermocouple linearization tables
Measurement accuracy	+/- 5 degrees typical over full temperature range, subject to quality of probe used. We recommend MGL Avionics EGT and CHT probes
Inputs	Differential, can use grounded and isolated probes
Common mode voltage range	-2V to +3V

9 Installation

The TC-3 provides for up to 12 thermocouple inputs for use with EGT and CHT probes. K, J as well as E-type probes can be used. K types are used for EGT probes while CHT probes can either be J or K type. E-type probes are seldom used. Probe types are selected under the “EGT SETUP” or “CHT SETUP” menus of the TC-3

Important: Incorrect selection of probe type will lead to an incorrect temperature display.

The TC-3 will accept both grounded and isolated thermocouple probes. Your only consideration in case of the more common grounded configurations is that you need to ensure that the thermocouple mounting position (exhaust flange, etc.) is at the same electrical potential as the negative supply line of the TC-3.

The thermocouple amplifier is a precision device providing full cold junction compensation. In addition the amplifier measures and corrects for its own errors. This results in very accurate measurements providing you install high quality probes. Here are some guidelines:

EGT Probes: Select probes that are made from 316 stainless steel and that use glass-fiber insulated conductors. Teflon insulated conductors as found in many cheap probes introduce errors as the insulation melts moving the measuring point towards the mounting bolt which transfers a lot of heat to the exhaust material. This results in under reading probes. Stay away from probes that use simple plastic heat shrink sleeving – it does not last. Choose probes that use a generous amount of stainless steel spring as strain relief. The bolt itself should be stainless steel as well or it will rust very quickly.

CHT Probes: These are made from washers to fit spark-plug bases. Temperatures are considerably lower so most thermocouple cables will work without problems. The biggest area of concern should be the connection of the thermocouple cable to the washer. This often breaks after the spark plug has been changed a few times. Choose a probe that is suitably reinforced at this point for a long and trouble free life.

EGT and CHT probes supplied by MGL Avionics are of highest quality. We recommend that you consider using our probes if at all possible.

Warning: Four stroke engines produce much hotter exhaust gases compared to two stroke engines. Do not use EGT probes made from lower grade stainless steel (for example 310), these probes will not withstand the high temperatures and can fail as the metal gets very soft at 800 degrees C. Many four strokes (such as the Rotax 912) will produce exhaust gases of up to 850 degrees C.

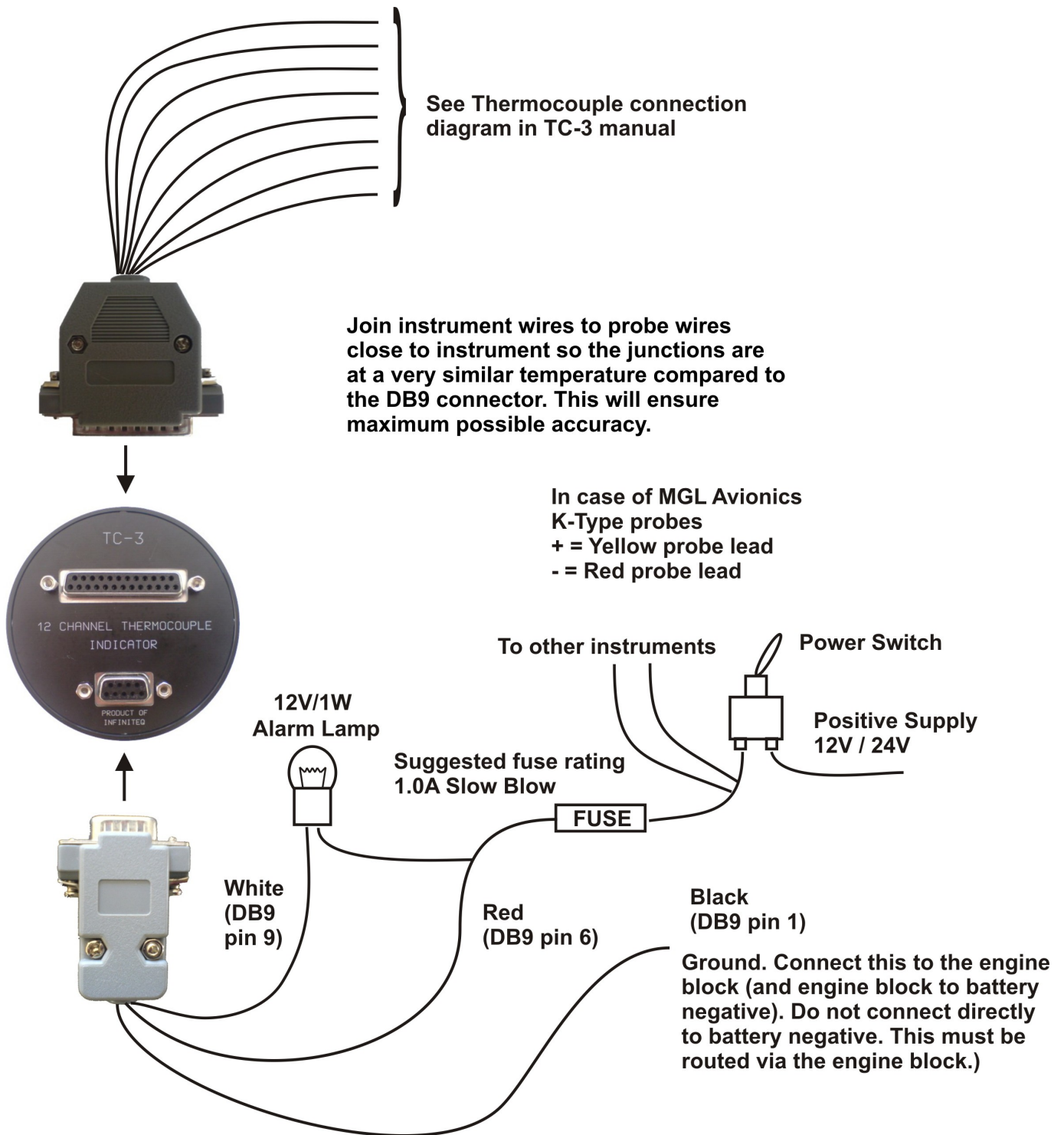
Important installation note:

EGT and CHT probes use wire made from iron and other basic metals. As a result these probes are not able to withstand much flexing of the wires due to engine vibrations. Avoid making nice looking coils or similar constructions that will result in excessive vibration or flexing of the wire. Route the cables from the probe points tightly along suitable engine mounting points eliminating any chance of unnecessary wire flexing during engine operation.

Note: Connect the ground to the engine block (and engine block to battery negative). Do not connect the TC-3 ground directly to battery negative. This must be routed via the engine block.

Note: Always install EGT probes starting on Channel 1 followed by the CHT probes without skipping any channels in between.

9.1 Connection Diagram



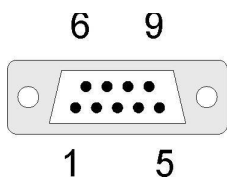
The use of an external 1A fuse is recommended. Connect the supply terminals to your aircrafts power supply. The TC-3 can be used on both 12V and 24V without the use of any pre-regulators. Ensure that the supply voltage will not drop below 8V during operation as this may result in incorrect readings.

9.2 Extending leads of thermocouple probes

Thermocouple leads as used with the EGT and CHT probes can be extended either with ordinary copper cable or with special K-Type extension cable. The choice of either depends on your desired accuracy. If it is possible in your installation to ensure that both ends of a copper extension cable will be at the same temperature (or very close), then it is quite possible to use the copper cable. In most open-air installations this will be the case. Should this not be possible or you require best possible accuracy at all times, you can obtain a special K-type extension cable. This cable is made from the same metals as your probes cable and uses ordinary plastic sleeving as insulation. In either case, ensure that the cable is not routed close to sources of electromagnetic interference of any kind. The voltages present in this cable are very small and are subject to changes applied by external fields. This can lead to false temperature indications. You can check your installation by using a hand-held transmitter, such as an air band radio. If you transmit a signal, no change in temperature reading should occur.

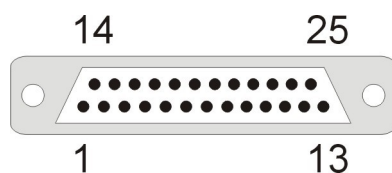
9.3 TC-3 Cable connections

Main connector (Bottom DB9 connector)



DB 9 Pin	Color	Function
1	Black	Ground. Connect the ground to the engine block (and engine block to battery negative). Do not connect the TC-3 ground directly to battery negative. This must be routed via the engine block.
4	NC	Airtalk communication (Not connected) Used for firmware upgrading
6	Red	8-30Vdc power via power switch / circuit breaker and fuse if required
9	White	Alarm Output

Thermocouple (EGT/CHT) input connector (Top DB25 connector)



In case of MGL Avionics K-Type probes + = Yellow probe lead, - = Red probe lead

DB 25 Pin	Function	DB 25 Pin	Function
1	TC Channel 1 +	14	TC Channel 1 -
2	TC Channel 2 +	15	TC Channel 2 -
3	TC Channel 3 +	16	TC Channel 3 -
4	TC Channel 4 +	17	TC Channel 4 -
5	TC Channel 5 +	18	TC Channel 5 -
6	TC Channel 6 +	19	TC Channel 6 -
7	TC Channel 7 +	20	TC Channel 7 -
8	TC Channel 8 +	21	TC Channel 8 -
9	TC Channel 9 +	22	TC Channel 9 -
10	TC Channel 10 +	23	TC Channel 10 -
11	TC Channel 11 +	24	TC Channel 11 -
12	TC Channel 12 +	25	TC Channel 12 -

10 Warranty

This product carries a warranty for a period of one year from date of purchase against faulty workmanship or defective materials, provided there is no evidence that the unit has been mishandled or misused. Warranty is limited to the replacement of faulty components and includes the cost of labor. Shipping costs are for the account of the purchaser.

Note: Product warranty excludes damages caused by unprotected, unsuitable or incorrectly wired electrical supplies and or sensors, and damage caused by inductive loads.

11 Disclaimer

Operation of this instrument is the sole responsibility of the purchaser of the unit. The user must make themselves familiar with the operation of this instrument and the effect of any possible failure or malfunction.

This instrument is not certified by the FAA. Fitting of this instrument to certified aircraft is subject to the rules and conditions pertaining to such in your country. Please check with your local aviation authorities if in doubt. This instrument is intended for ultralight, microlight, homebuilt and experimental aircraft. Operation of this instrument is the sole responsibility of the pilot in command (PIC) of the aircraft. This person must be proficient and carry a valid and relevant pilot's license. This person has to make themselves familiar with the operation of this instrument and the effect of any possible failure or malfunction. Under no circumstances does the manufacturer condone usage of this instrument for IFR flights.

The manufacturer reserves the right to alter any specification without notice.

Other instruments in the *Stratomaster Velocity* series

ALT-3	Encoding aviation altimeter and Vertical speed indicator (VSI)
ALT-4	Encoding aviation altimeter with Serial RS232 & Parallel Gillham code output
ASI-3	Airspeed indicator (ASI) with automatic flight log
ASX-2	Encoding aviation altimeter and Airspeed indicator (ASI)
AV-2	Artificial horizon and magnetic compass indicator
E-1	Universal engine monitor
FLIGHT-2	Primary Flight instrument
FF-3	Fuel Computer (single or dual fuel tanks)
GF-2	+/-10G tilt compensated dual range G-force meter
MAP-2	Manifold pressure and RPM Indicator
ROTOR-1	Dual Rotor / Engine tachometer
RTC-1	Aviation real time clock (RTC), outside air temperature (OAT) and Voltage display
RV-3	Universal engine / Rotor RPM Indicator
TC-2	4-Channel thermocouple (EGT/CHT) indicator
TC-3	12-Channel thermocouple (EGT/CHT) indicator
TP-2	Universal temperature and pressure gauge