RDAC X

Technical installation document

Models:

A – 4TC channels
B – 12TC channels
C – 4TC channels plus Manifold pressure sender
D – 12TC channels plus Manifold pressure sender

RDAC X – general

The RDAC X consists of two parts:

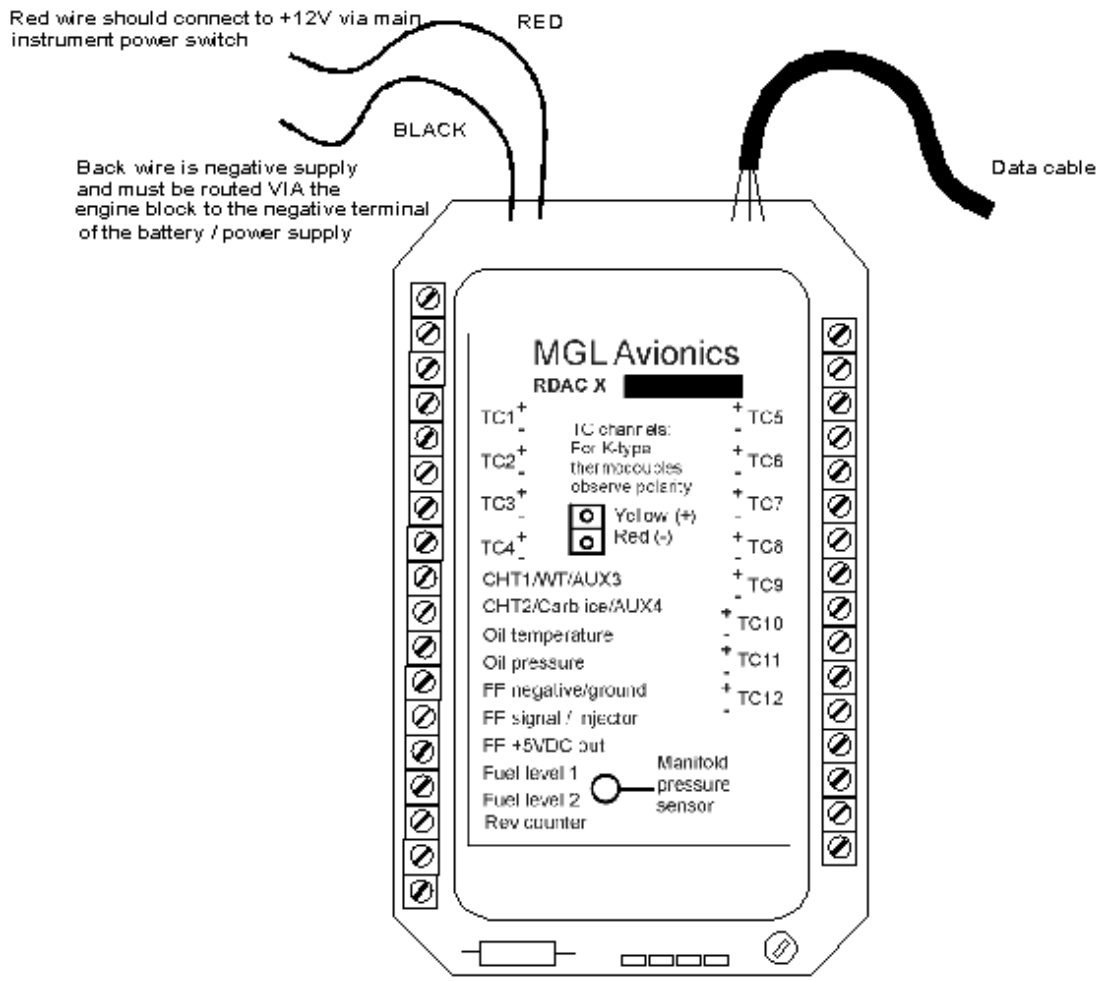
The baseboard. This board contains one or two rows of friction lock screw terminal connectors.
This part is intended to be installed on an aircraft firewall (engine compartment side).

Models A and C contain one row of connectors.
Models B and D contain two rows of connectors.

The RDAC module. This module plugs into the baseboard and is held in place using nylon straps or bonding material. In the event of a failure, the module is quick and easy to replace.

The RDAC module comes in two versions: One version has a manifold pressure sensor with stovepipe connector, the other does not have such a sensor.

The RDAC X power supply and data cable connection



RDAC X Power supply

The RDAC X requires supply from a 12V DC source. Voltages such as found in typical 12V nicad or lead-acid battery based installations are acceptable. The RDAC X is designed to operate from 8VDC to 18VDC. Should your aircraft have a 24/28V system, you need to provide a 12V preregulator.

In order to achieve maximum accuracy, it is important to route the power supply wiring correctly.
It is important that the black wire is routed in as sort as possible manner to the engine block. The engine block should have a connection to the negative of the battery. Normally this connection is provided in the form of a heavy duty cable to allow for the considerable currents of an electric starter motor. Should your installation not have electric start, you will still need to provide this connection.

Do not route the black wire directly to the battery minus. This can lead to false readings on some senders. The black wire must be routed to the engine block. You must have a connection from the engine block to the battery minus.

The red wire is to be connected to +12VDC. This connection would normally be provided via your aircrafts master switch or instrument power supply switch. This cable should not be connected to the battery positive terminal directly without a power switch as this would result in your battery being drained when the system is not in use.

RDAC X function indicator

The RDAC X has a red LED that will flash in an approximate 0.5-1 second interval if power has been supplied and the RDAC is functioning.

RDAC X communications link

The RDAC X has a serial data communications link that is optically isolated, i.e. it has no electrical connection to the RDAC electronics itself.
This prevents any form of electrical current flowing in this cable in case of an electrical wiring fault in your aircraft, in particular ground faults.
Connect the wire as indicated by color code on the rear of your instrument.
You have three connections:
Braid – electrically connected to ground by your instrument.
Blue – the data line. Inverse polarity compared to RS232.
Red – connected to +12V by the instrument. Used to power a pull-up resistor on the blue wire.

RDAC X jumpers

The RDAC X provides several jumpers to allow you to configure your rev counter. In the current release, two jumpers are provided while a further two are permanently closed.

The jumper marked “ballast” switches a 220 ohm resistor into you rev counter line to ground (12V negative rail). This ballast may be required for some engines in particular Rotax engines. You should first try without the ballast (jumper removed). If you find the RPM display unstable insert the ballast by placing the link on the ballast terminals.
The jumper marked “DC” will route the rev counter signal to the RDAC with a direct current connection. Removing the link will activate an AC connection. The AC connection can provide better signal detection in case your signal has a DC offset voltage.
The best setting (link removed or not) is best found by experimentation.

Installation of the RDAC X

The RDAC X must be installed with the following requirements met:

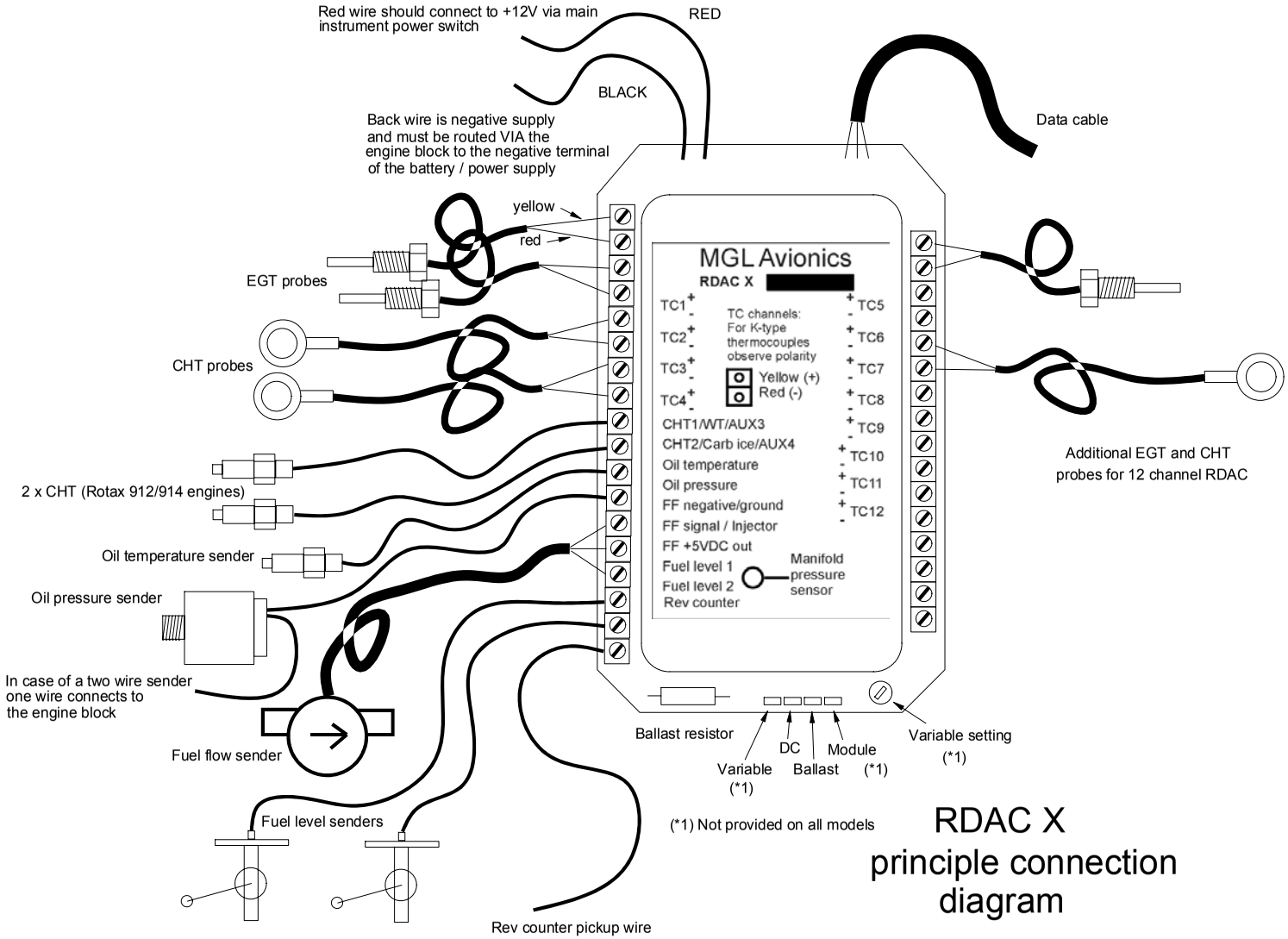
a) The RDAC must not be exposed to direct engine vibrations. Never mount the RDAC on the engine itself. The baseboard is intended to be mounted on the aircrafts firewall or similar suitable structure.
b) The RDAC must be installed so extreme heat from the engine cannot damage it.
c) The RDAC must be mounted in a position where it is protected from any engine oils or other engine fluids including water.
d) If required the RDAC should be mounted inside a protected enclosure if it is otherwise not possible to protect it from environmental exposure such as rain.
e) All wires to the baseboard must be secured such that it is not possible for any wire to be damaged due to chafing or that any wire can loosen itself from its connection terminal.
f) If the RDAC is operated in conditions that may lead to corrosion of exposed electrical metal parts, suitable protection is a mandatory requirement.
g) The RDAC includes very good protection against voltage transients on the power supply. However, in cases where severe transients containing a large amount of energy are expected, additional, external protection may be required.
h) All signal connections that terminate in any of the RDAC terminals must never be allowed to contain dangerous high voltages such as can be created by ignition systems or inductive devices. In particular never route such cables alongside HT ignition leads.

RDAC X principle wiring diagram

The following diagram shows a basic connection sample for various sensors. The actual connection of sensors depends on your application and setup in the display unit (instrument).
Normally, in cases of multiple EGT/CHT thermocouple sensors, EGT sensors start from TC channel 1 while the CHT channels follow.
The starting channel for CHT channels depends on your instruments setup.

CHT1/WTAUX3 is used for either a NTC type water temperature sender or the CHT probe of a Rotax 912/914 engine.

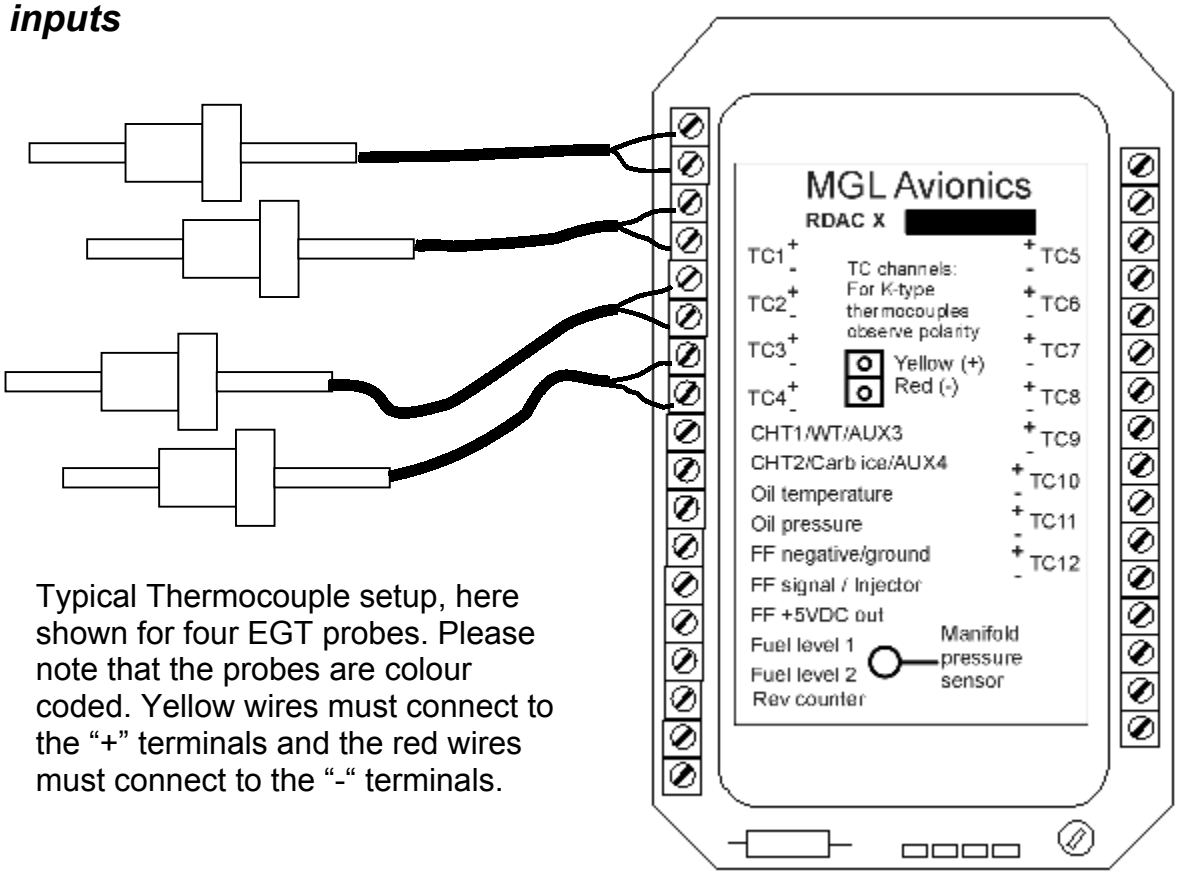
CHT2/CarbIce/AUX4 is used for a LM335 based ice waring sensor or the second CHT probe of a Rotax 912/914 engine.



(*1) Not provided on all models

RDAC X principle connection diagram

RDAC EMS unit thermocouple inputs



Typical Thermocouple setup, here shown for four EGT probes. Please note that the probes are colour coded. Yellow wires must connect to the "+" terminals and the red wires must connect to the "-" terminals.

Thermocouple inputs – details

The RDAC X EMS provides for up to twelve thermocouple inputs for use with EGT and CHT probes. Both K as well as J type probes can be used. K types are used for EGT probes while most CHT probes are also K types. Some makes of CHT probes are J type.
Probe types are selected in the sender setup menu of your instrument.
Important: Incorrect selection will lead to incorrect temperature display.

The RDAC X EMS 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 RDAC X (Black wire).
Probe usage depends on your setup and kind of your instrument.
Usage of thermocouple inputs with various display units:

<u>E2, Ultra L</u>
The first four thermocouple inputs are supported. These can be freely configured in the relevant setup menus. Normaly, thermocouple inputs from TC1 upwards are used for EGT probes, followed by CHT probes. For

example, a popular setup would be TC1 and TC2 are EGT, TC3 and TC4 are CHT. Channels TC5 to TC12 cannot be used with these instruments.

Ultra X, UltraH

These instruments support up to eight thermocouple inputs. You would thus use TC1 to TC8.
With these instruments, EGT and CHT monitoring is configured in blocks. For example a popular configuration would be four EGT and four CHT probes. The EGT channels would start at TC1 and the CHT in this case at TC5. Channels TC9 to TC12 cannot be used with these instruments.

Enigma

All versions of Enigma supplied with engine monitor can support channels TC1 to TC12. Usage of these channels depends on how you configure the visual thermocouple monitors. We suggest that you use inputs TC1 and upwards for EGT probes and follow this with CHT probes. For example, for a six cylinder engine you might choose TC1 to TC6 as EGT and TC7 to TC12 as CHT.

RDAX X thermoucouple guidelines

The thermocouple amplifier is a precision device providing full cold junction compensation and bow voltage correction. 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 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.

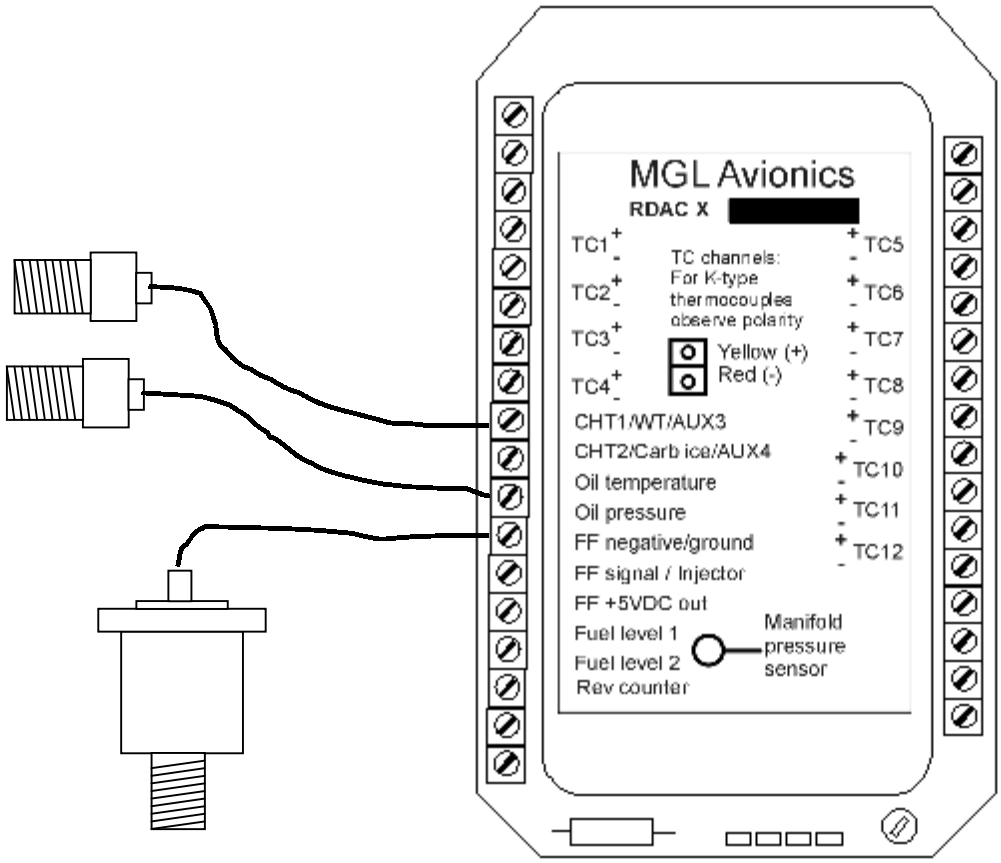
Warning: Four stroke engines produce much hotter exhaust gases compared to two stroke engines. Do not use EGT probes made from lower grade stainless steel (for example 310), these probes will not withstand the high temperatures and can fail as the metal gets very soft at 800 degrees C. Many

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 plain 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.

Connecting coolant temperature, oil temperature and oil pressure senders.



This drawings shows the connection of a coolant temperature probe, a oil temperature probe and a oil pressure sender.
Note that all of these probes require a good electrical ground connection to the engine block so they should never be installed using sealant or PTFE sealant tapes. The RDAC X black supply cable connection should also be wired to the engine block.
The RDAC X supports various types of temperature senders and well as oil pressure senders. These are selected in the relevant sender setup menus of your instrument.

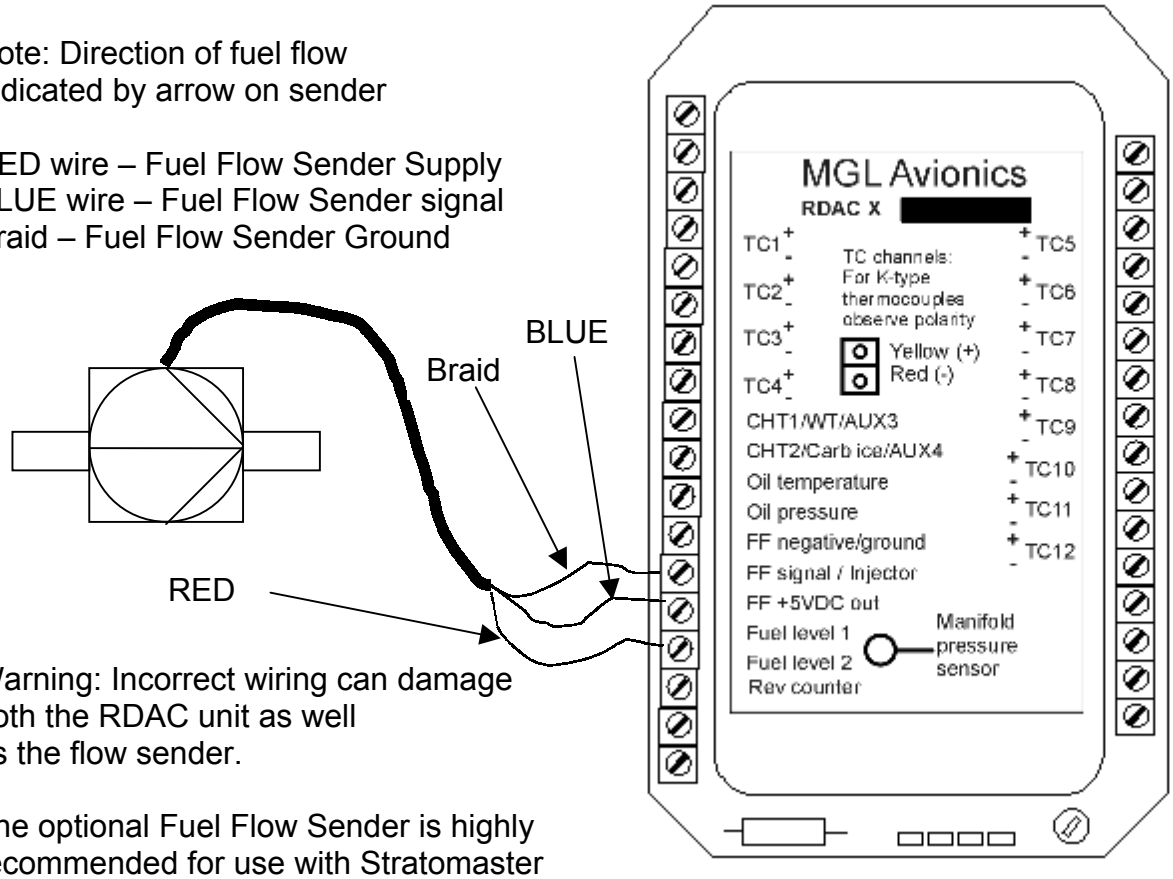
Please note that the CHT1 and CHT2 terminals are used in case of a Rotax 912 or 914 engine to interface to the two built in CHT senders. These senders are standard VDO oil temperarature senders.

Coolant and oil temperature senders are mostly NTC resistors. These are resistors that vary their resistance with temperature. These senders come in a wide variety so ensure that the sender you are using is compatible with the instrument and that you have selected the correct probe type in the relevant setup menu.

RDAC Fuel flow sender installation

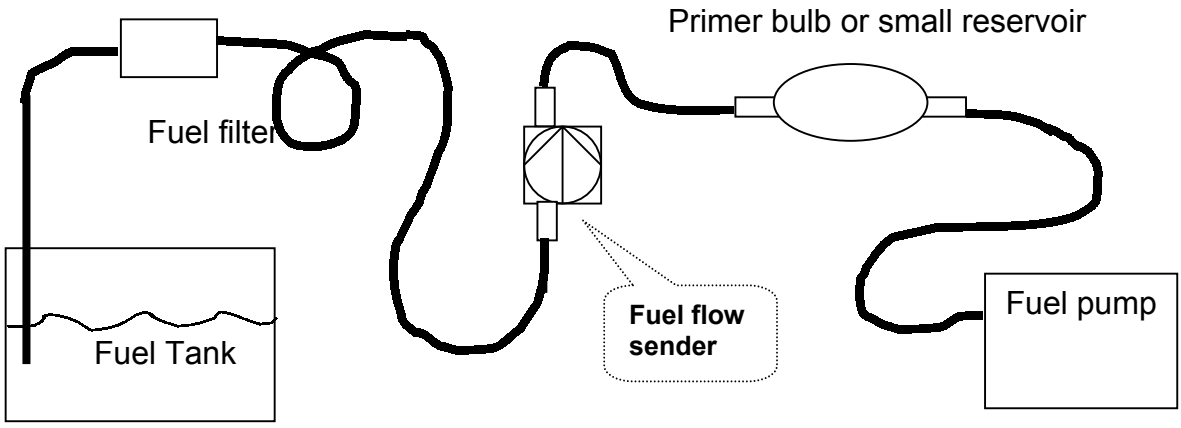
Note: Direction of fuel flow
Indicated by arrow on sender

RED wire – Fuel Flow Sender Supply
BLUE wire – Fuel Flow Sender signal
Braid – Fuel Flow Sender Ground



Warning: Incorrect wiring can damage both the RDAC unit as well as the flow sender.

The optional Fuel Flow Sender is highly recommended for use with Stratomaster instruments. It provides instantaneous readouts of hourly fuel usage, and both time and distance estimates on remaining fuel in flight. You can also verify the performance of your fuel pump during the pre-takeoff engine run up – a very valuable check !
Further, it is possible to set up the instruments to calculate Fuel remaining by subtracting fuel used from a value entered when you filled your tank(s).
In this case you may omit the installation of the optional fuel level sender.
Please note that the installation of the Fuel Flow sender should be done in such a fashion that dirt or debris from the fuel tank cannot lodge inside the flow sender. These will not block you fuel flow but may lead to the impeller inside the sender jamming. It is usually sufficient to mount the Flow sender **AFTER** the fuel filter but before the fuel pump. It is a good idea to provide a small reservoir such as a primer bulb between the flow sender and the fuel pump.



As indicated in the recommended fuel flow sender installation drawing, it can be of advantage to install the flow sender in such a fashion that the inlet points slightly down and the outlet points slightly up. This prevents vapor from forming a bubble inside the flow sender.
We strongly recommend to mount the flow sender in such a fashion that the impreller rests on only one bearing. This is achieved if you mount the sender such that the surface with the arrow faces upwards.
Mounting the sender like this results in the best performance at low flow rates as only very little friction is present.

The flow sender is delivered with a small jet that can be installed in the flow sender inlet. Installation of this jet is recommended for engines with fuel flow rates lower than about 30 liters per hour. This would apply to most small two and four stroke engines.
Stratomaster instruments are shipped with the Fuel sender calibration set for the jet installed. In a good installation you can expect about +/- 3% maximum flow reading error with this factor.
You can calibrate the flow sender yourself to a higher degree of accuracy if you so desire.

Recommended procedure to calibrate the fuel flow sender:
Note: You must disable the Fuel Level sender if you have one installed first.
Fill your tank exactly to a known level (for example 50 liters).
Set your fuel level to 50 liters using the Main Menu. If required you may have to disable the fuel level sender first using the Mode Menu.
Fly your aircraft for a period that you know will use approximately 20 liters of fuel. The exact fuel burn is not important, just burn about 20 liters of your fuel.
At the end of your flight the instrument should give you a reading of how much fuel you have left – the reading should be about 30 liters left.
Now place your aircraft in exactly the same position that you used when you first filled the tank and refill the tank to 50 liters using a measuring jug. You should find that you need 20 liters of fuel to refill to 50 liters.
If you find that the instrument under or over reads the fuel used, you should perform a simple adjustment of the Fuel Flow sender calibration factor. This is outlined in the Owners Manual.

Example:

Actual fuel used: 21.5 liters, Stratomaster fuel burn calculated 29.7 liters left in tank. This means the Stratomaster measured 50-29.7 = 20.3 liters. We are under reading by 1.2 liters.

Default calibration factor in Fuel Flow setup (Basic device setup menu) = 7000.

Let the corrected calibration factor be X.

X = (21.5 * 7000) / 20.3

X = 7413.79

The closest setting you can enter as factor is 7414. Enter it into the unit and you are done !
Repeat the above procedure to verify that your flow sender is now reading correctly.

Please note:

Before you calibrate the flow sender ensure there are no problems with your installation. We find the senders are very accurate if everything is installed and working properly. If your fuel burn indication is out by a large amount you have a problem that you should not attempt to fix by fiddling with the calibration factor !

Please ensure that no fuel vapor can be trapped inside the sender housing in the form of bubbles. Due to the low fuel flow rates the bubbles will prevent the tiny impeller from turning freely, You can verify the turning of the impeller. You should notice three dark spots that are just visible in the inside of the fuel flow sender. These are small magnets that are attached to the impeller. With fuel flowing you should see the magnets turning.

The best defense against vapor bubbles is to install the flow sender in such a way that the bubbles can escape. The easiest way is to point the outlet slightly upwards and the inlet (with the jet) slightly downwards.

Another possible problem is the fuel sender jet. When you install it, do not damage it. Use a drill bit of suitable diameter to push the jet all the way the opening of the jet must be just in front of the impeller.
YOU NEED TO APPLY SOME FORCE TO INSERT THE JET ALL THE WAY. THE JET MUST BE LOCATED RIGHT IN FRONT OF THE IMPELLOR. YOU CANNOT PUSH THE JET TOO FAR.

(Fuel flow sender – continued from previous page)

Using other Flow Senders

It is quite possible to use Flow Senders other than the Stratomaster device. In this case ensure that the Sender outputs a 5V TTL square wave or a similar signal. The Stratomaster interface electronics will adapt to a variety of different voltages and pulse shapes as it contains a schmidt-trigger input stage. The calibration factor can be entered in a wide range making the unit particulary suited to other Flow senders.
The supply output terminal for the Sender provides a positive, regulated 5 volt output. This may be used to power the Flow Sender provided the Sender will not draw more than 40 mA of current. Should your sender require a higher voltage or more current, then you must supply the sender from a different power source. Exceeding the rating on the Stratomaster Flow sender supply terminal can affect the operation on the unit negatively or even damage it.

Recommended Calibration Factors for the MGL Avionics dual range flow sender:

With jet installed = 7000. Recommended with flow rates below 30 liters/hour maximum.
Without jet installed = 1330. Recommended with flow rates above 30 liters/hour.

Please refer to the leaflet included with the Flow Sender for information on pressure drop vs. flow rate, wetted materials etc.

It is your responsibility to ensure that the flow sender used is compatible with the fuels you intend using. We have found the MGL Avionics sender to be very compatible with automotive fuels used in South Africa, many of which contain methanol. 100LL AVGAS also appears not to harm the sender in any way. We have exposed a sender continuously to our automotive fuels for a duration of two years without any noticeable ill effect on the sender.
However, despite this MGL Avionics or its appointed agents cannot assume responsibility for any incident or damage, even loss of life by whatsoever cause connected with the fuel flow sender or the Stratomaster Flight Instrument. Usage of this or other senders is your own sole responsibility.
If you do not agree with the above statement you must not use the fuel flow sender.

Note to Pilots: (Even though this is the installation manual)

You must always have a visual indication of the fuel level available, either by means of a sight glass, direct tank observation or a known, reliable secondary fuel level gauge. Fuel level indication by means of calculated fuel burn is subject to errors both by entering incorrect starting fuel levels as well as