MGL Avionics
Garrecht VT-0102 mode-s transponder
Interface installation manual

Document date: September 2012

This document should be read in conjunction with the Garrecht VT-0102 installation manual

General

This document details the installation of the Garrecht VT-0102-070 and VT0102-125 mode-S transponder to an MGL Odyssey/Voyager G2 and iEFIS system.

The Garrecht VT-0102 transponder

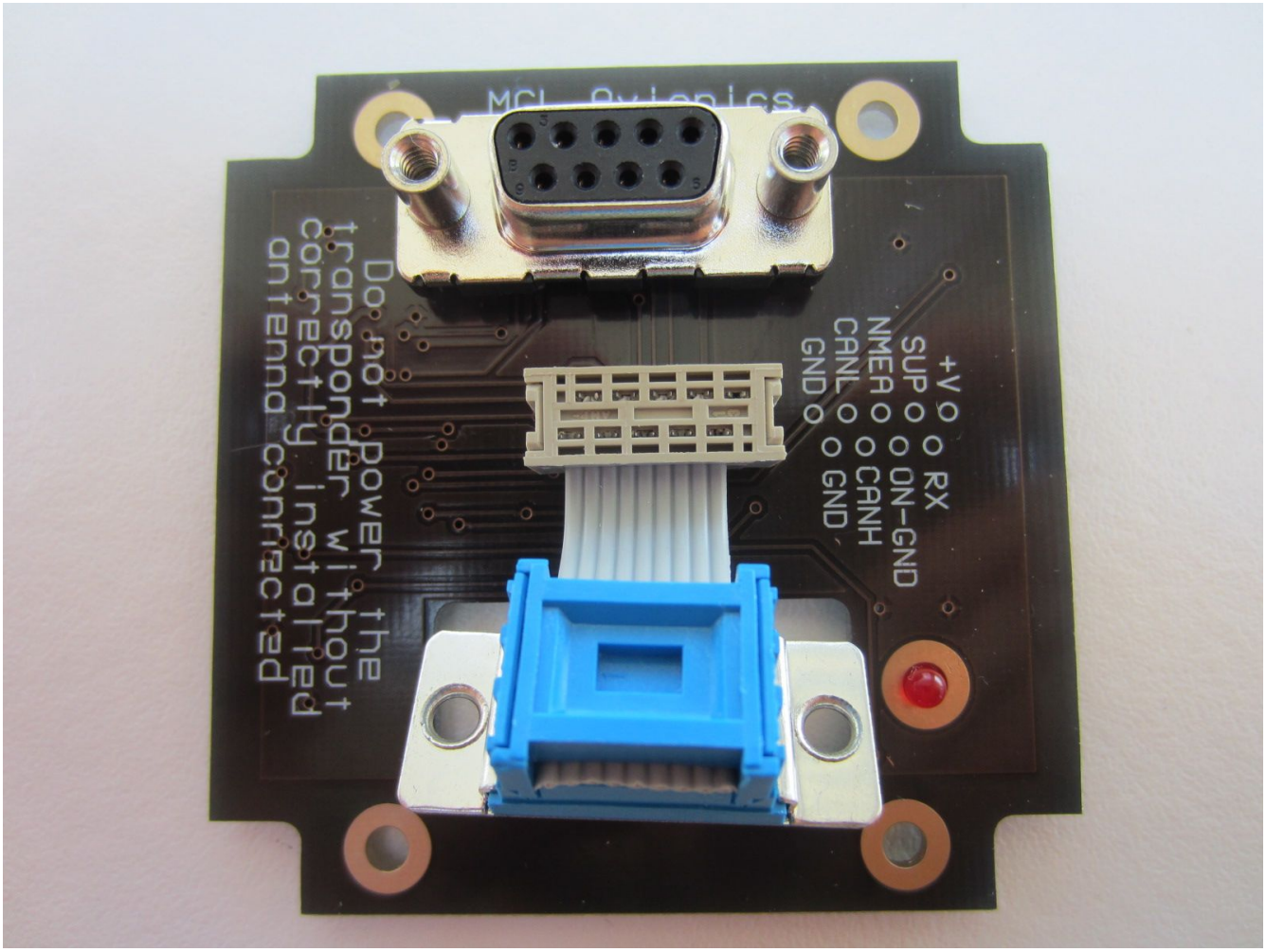
The Garrecht VT-0102 transponder is available in two versions identified by suffix 070 (Class-2) and 125 (Class-1).

The transponder is available as modular system consisting of the transponder body and a panel mount control head. The control head may also be fitted directly to the transponder.

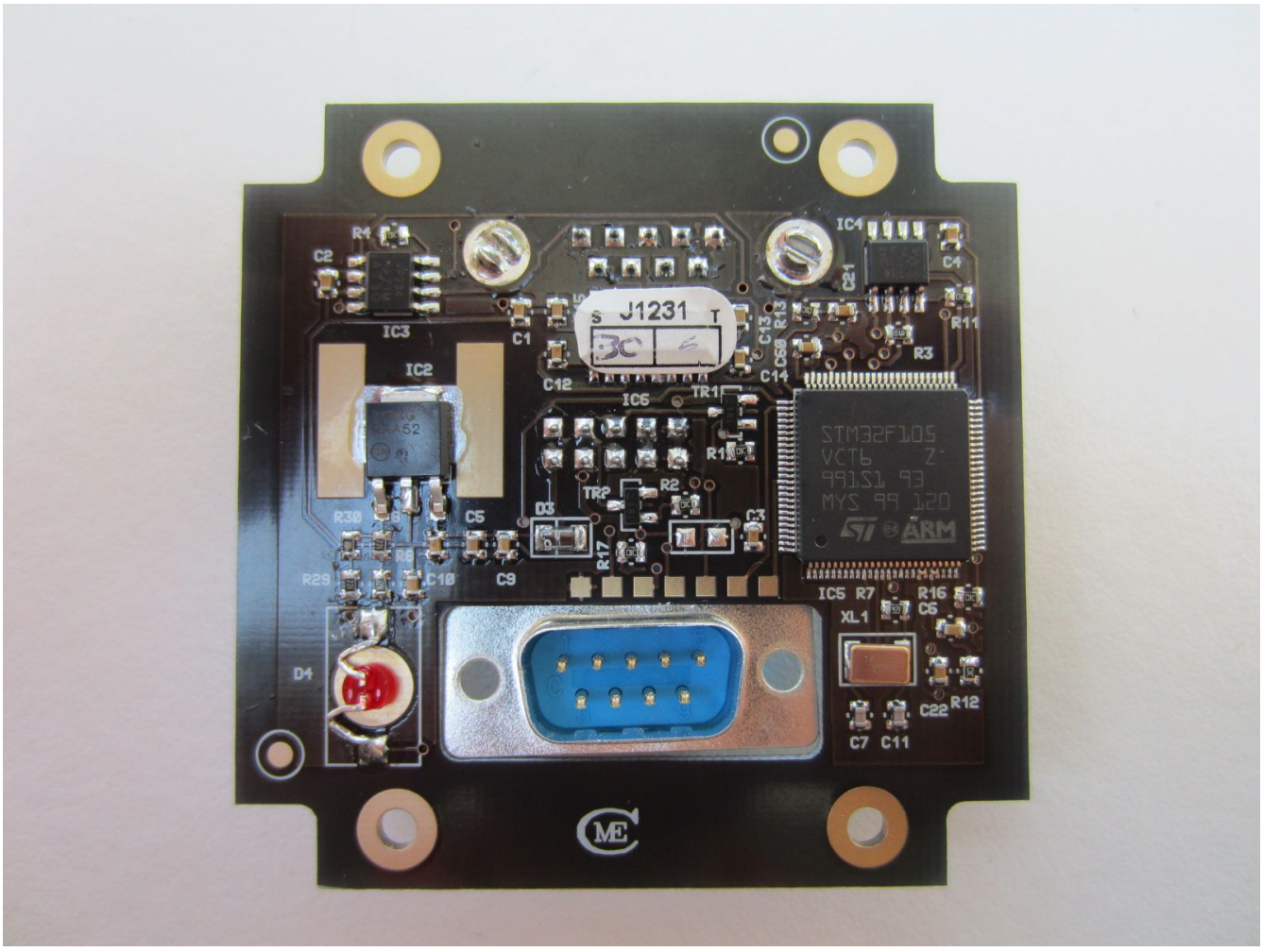
For MGL Avionics direct EFIS control installations the Garrecht control head is not used. A separate control head available from MGL may be used in installations requiring redundant operation using both a panel mount control head as well as the EFIS system.

The interface

Frontal view of the interface PCB



Rear view of the interface PCB



The interface PCB is mounted on the face of the transponder body. It connects to the transponder using a DB-9 connector. All power and control signals are routed via this connector. The only additional connection required for the transponder itself is the transponder antenna.

The only external connection to the interface consists of a DC power supply and a CAN bus connection to the EFIS system.

An optional RS232 NMEA output is provided that may be used to supply GPS NMEA data at 4800 baud to external equipment.

Note: This output is connected to the transponder and is required for correct operation of the mode-s extended squitter and must not be electrically disturbed by a incorrect wiring. Connection should be performed by qualified personnel only.

All data and status information required for operation of the mode-s transponder is supplied by the EFIS via the CAN interface:

a) Transponder squawk code
b) Transponder operation mode (including ground mode and ident)
c) Aircraft call sign

d) ICAO identifier
e) Aircraft speed
f) Aircraft category
g) Aircraft length
h) Aircraft Width
I) GPS position
j) GPS ground speed
k) GPS track
l) GPS status information including ADSB-IN flag
j) UTC GPS time stamp
k) GPS altitude and height of Geoid
l) Pressure altitude (Mode-S, high resolution, Mode-C 100 ft resolution)

Ground/Airborne mode detect (squat switch)

The transponder interface provides this signal to the transponder via the CAN interface. The signal is sourced from the EFIS flight detect status.

The ON-GND status signal is provided on the DB-9 connector.

An external ON-GND squat switch may be connected to this line. This switch must be voltage free and must consist of a switch to ground that is closed when the aircraft is on the ground.

The external ON-GND signal is “wire-or'ed” with the internal signal. Both signals must be in “airborne” state for the transponder to detect “airborne” state.

Note: The external ON-GND signal is not normally wired and is provided for special applications only.

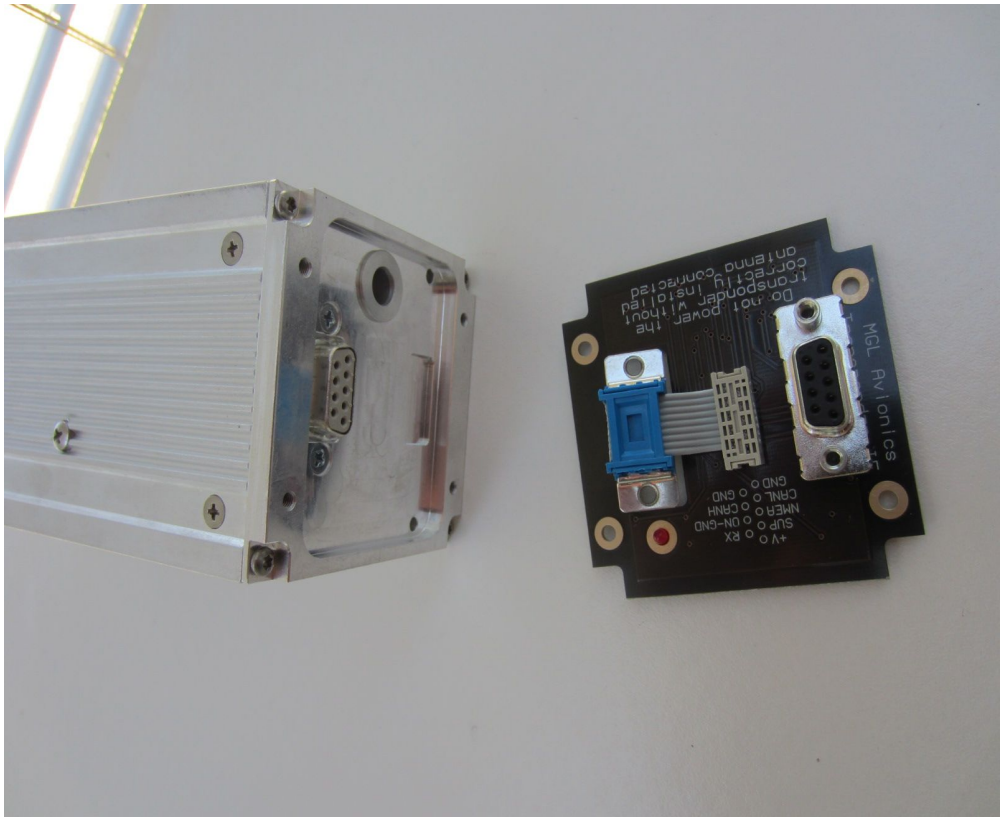
Note: The transponder does not reply to interrogations in ground mode.

Installation of the interface

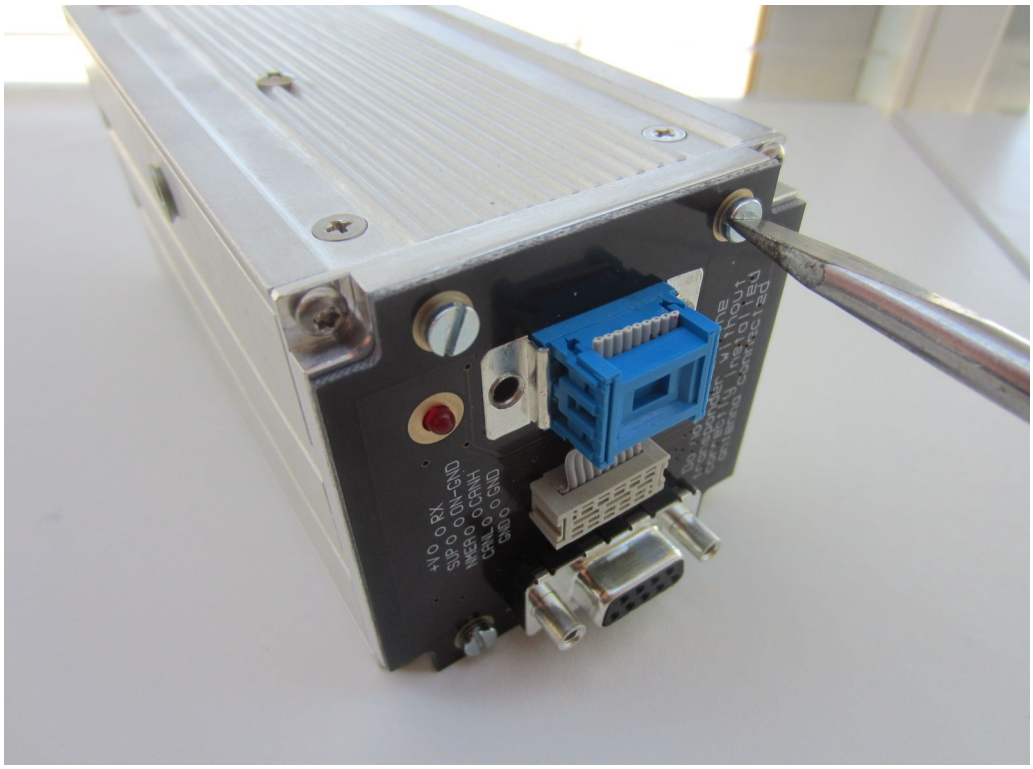
For transponders shipped by MGL Avionics, the interface is installed and the transponder tested for correct operation using a MGL EFIS and an Aeroflex IFR 6000 mode-A/C/S test set.

For transponders supplied from other sources, the interface only is supplied tested. The interface is installed by the distributor of the transponder.

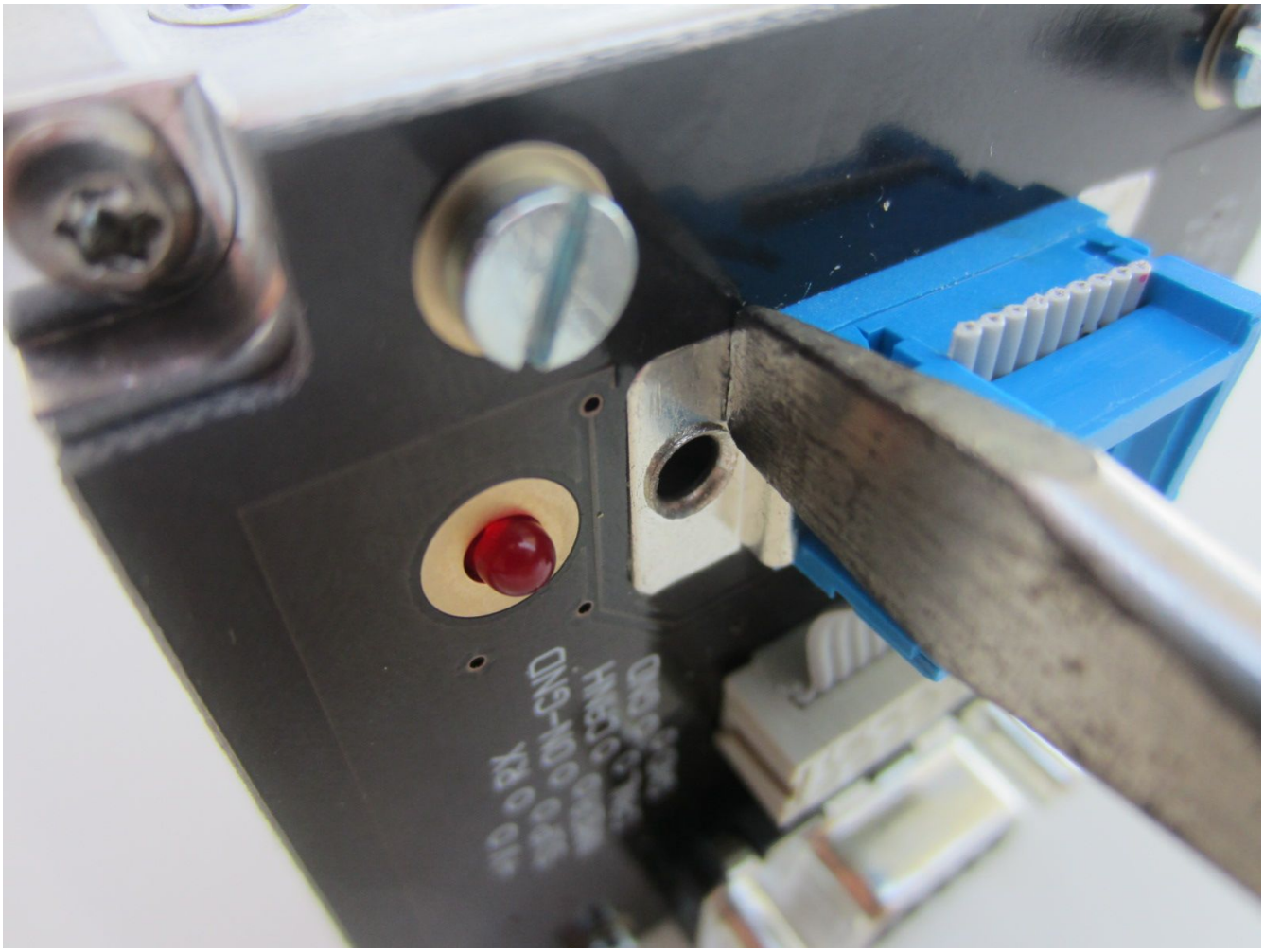
Correct operation of the transponder must be verified before first flight using relevant procedures applicable by the aviation authorities in the country of operation. This must be entered into the aircraft's airframe logbook.



The transponder and interface PCB

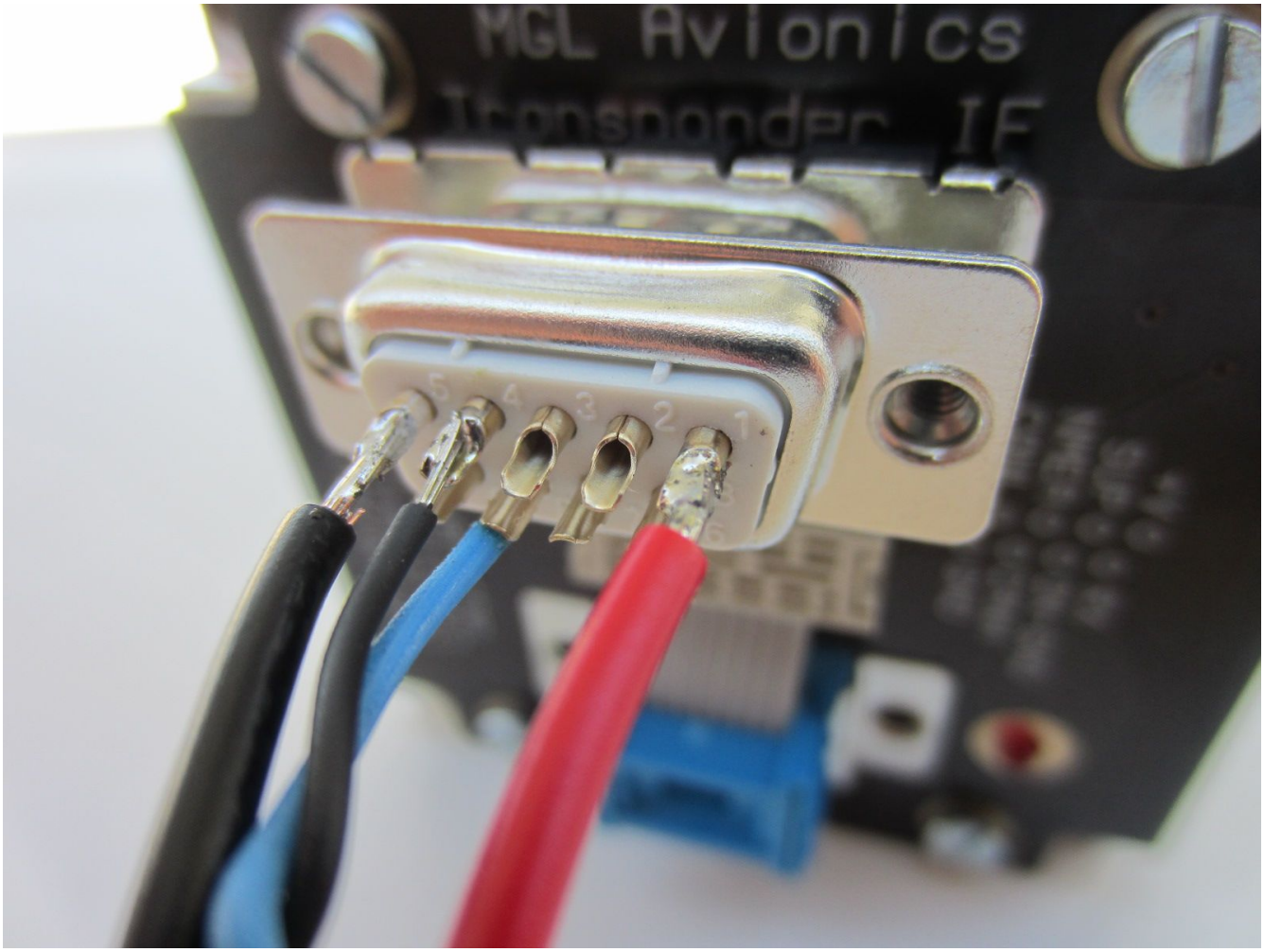


Mount the interface PCB onto the transponder using 4 M3x6 screws. Plug in the blue DB-9 connector into the transponders socket. Notice the plug has a tight fit.



Using a screw driver or suitable object, carefully press-fit the blue connector into the PCB slot. The surface of the plug metal part should be level with the surface of the PCB as shown in the above image. This provides a firm fit preventing the connector from being able to release itself.

External interface connections



This image shows the minimum connections required:

Thick red: +12VDC

Thick black: Ground

Thin black (twisted pair): CANL

Thin blue (twisted pair): CANH

Connector pinout:

PIN	Usage
1	+12V (please refer to Garrecht installation manual for allowable voltage range and current draw).
2	Supression. Wired to “suppression” input of transponder. Please refer to Garrecht installation manual for usage of this connection.

PIN	Usage
3	NMEA output RS232 levels (connected to transponder NMEA input)
4	CANL connection to EFIS
5	Ground. Power supply ground
6	RX. RS232 RX line. Used for firmware updates only.
7	ON-GND. Normally left unconnected, can be used for an external ON-GND switch with ability to override internal “airborne” state
8	CANH connection to EFIS
9	Ground. Power supply ground (same as pin 5, one of these may be left unconnected)

The status LED

The transponder interface has a red status LED.

System status is indicated by means of LED flash sequences, repeated every second.

Double flash: No connection to EFIS data feed, no data received from transponder.

Interpretation: Interface board has power, not connected to EFIS or transponder.

Short, single flash: No connection to EFIS data feed, data received from transponder.

Interpretation: EFIS not connected or not operational.

Long, single flash: EFIS data feed OK, no response from transponder.

Interpretation: Transponder not connected or faulty.

Regular flash – on/off at ½ second interval: EFIS data feed OK, response from transponder OK.

Interpretation: System operating normally. No problems.

Environmental compliance of the transponder interface

DO-160 compliance statement based on Do-160D

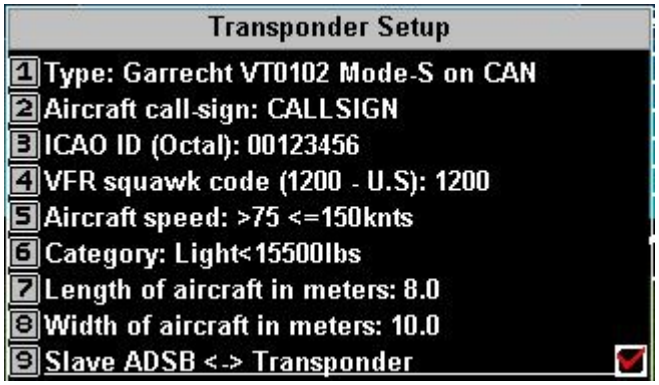
Note: This equipment extends to existing compliance of the VT-0102 Garrecht transponder. No environmental compiance of the existing transponder equipment is compromised by the fitment of this interface board.

Temperature and Altitude	4.0	Equipment intended for use with categories A4, C4
Low temperature ground survival (declared)	4.5.1	-55°C
Low temperature operating (declared)	4.5.1	-20°C
High temperature operating (declared)	4.5.3	+55°C
High temperature short-time operating (declared)	4.5.2	+70°C
High temperature ground survival (declared)	4.5.2	+85°C

Loss of Cooling	4.5.4	No cooling required
Altitude	4.6.1	No restriction
Decompression	4.6.2	No restriction
Overpressure	4.6.3	No restriction
Temperature Variation	5.0	Equipment complies with Category C
Humidity	6.0	Equipment complies with Category A
Operational Shocks	7.2	Equipment complies with Category B
Crash Safety	7.3	Equipment complies with Category A Note: tested separate from transponder equipment.
Vibration	8.0	Compiles with Categories S, R
Explosion	9.0	Not applicable
Waterproofing	10.0	Not applicable
Fluids Susceptibility	11.0	Not applicable
Sand and Dust	12.0	Not applicable
Fungus	13.0	Not applicable
Salt Spray	14.0	Not applicable
Magnetic Effect	15.0	Not applicable
Power Input	16.0	Equipment complies with Category B
Voltage Spike	17.0	Equipment complies with Category B
Audio frequency conducted susceptibility	18.0	Equipment complies with Category B
Induced signal susceptibility	19.0	Equipment complies with Category AC
Radio frequency susceptibility	20.0	Equipment complies with Category T
Radio frequency emission	21.0	Equipment complies with Category B
Lightning induced transient susceptibility	22.0	Not applicable
Lightning direct effects	23.0	Not applicable
Icing	24.0	Not applicable
Electrostatic Discharge	25.0	Not applicable

Transponder setup in EFIS

Transponder setup between various EFIS systems is similar. This example is based on the Odyssey/Voyager G2



Please enter all relevant setups as required. Note that the ICAO code must be entered as an Octal number (each digit has a value from 0 to 7).

Testing the transponder using the EFIS

With the Odyssey/Voyager G2 you control the transponder via the Radio Stack. You need to enable the transponder in the Radio Stack setup and your screen design(s) require a radio stack component.

With the IEFIS you need to enable the transponder in “Equipment Enables” and also select a screen design that has the transponder item visible.

In both cases, with the transponder connected and powered, the transponder screen item should not have a red cross. If it has a red cross, then the EFIS is not communicating with the transponder. Please check your wiring.

Transponder item from an iEFIS system.

Operation of the transponder is similar between EFIS systems. On the iEFIS touch screen, tap the transponder to bring up the larger transponder user interface.

For the Odyssey/Voyager there will be an “RF” button on the left keypad if the screen design has a radio stack component. If the transponder is the only radio stack item, pressing the RF button will activate the transponder user interface directly, otherwise all enabled items will be shown and you need to select which one you would like to control.

Ground test of the transponder

Before usage, the transponder must pass a ground test according to the requirements of your

local aviation authorities. Typically this is done using a dedicated transponder test set by your AMO. The transponder test set will transmit to your transponder antenna and expect correct replies.

The Garrecht transponder will only respond to interrogations in in airborne mode. This can be forced in the EFIS. Select your EFIS into “manual flight detect mode” in your “Operations setup”. You can now control the “in-flight” status using Menu 1 (G2) or the “Action menu” (iEFIS). Place the transponder into “airborne” using the in-flight status and select the transponder operating mode to “ALT” with the required squawk code entered.

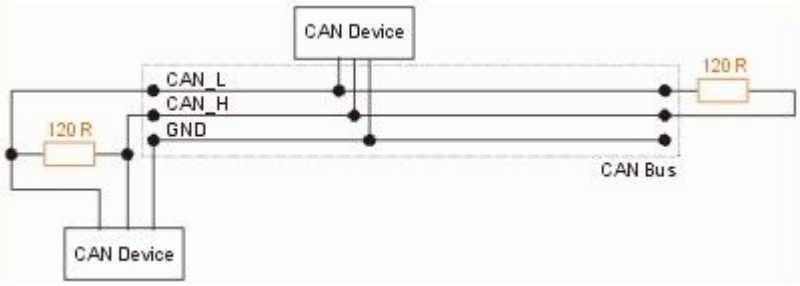
Verify that the transponder test set is receiving replies and that all replies contain the correct information as entered in your transponder setup menu. Verify correct altitude readout and squawk code. Press the Ident button and verify that the ident is active on the reply for 18 seconds.

Depending on your local regulations the transponder may require retesting at intervals (typically every two years in most countries).

Note: Full test of the mode-s extended squitter requires that your EFIS has a valid GPS fix.

CAN bus primer

The CAN bus (Controller Area Networking) was defined in the late 1980 by Bosch, initially for use in automotive applications.
It has been found to be very useful in a wide variety distributed industrial systems and is becoming popular in avionics applications due its robustness and ease of use.



The connection uses two wires which are twisted around each other. This forms a “balanced transmission line”. It helps to reduce emissions and also makes the link more robust against external interferences.

The CAN bus is always implemented as a single cable allowing only short stubs to connect to equipment along the route. Never implement a CAN bus as a “star” or other wiring topology.

The CAN bus requires termination resistors at each end of the bus. These are to be 120 ohm resistors. 1/4W or 1/8W resistors are usually used here. The resistors must be installed at each end of the bus, not in the center or anywhere else.

For short CAN runs (less than three meters) it is possible to install a single resistor of lesser value (not less than 60 ohms) at any location in the cable run.

The two wires are referred to “CAN High” and “CAN Low”. These must connect to the corresponding lines at the devices. Never swap these connections (I.e. Never connect CAN H to CAN L at any device) as the CAN bus will not be able to function.

Never run the CAN bus connection inside a wire harness next to sensitive connection such as audio or signal wires. Never run the CAN bus next to RF cables.

Making twisted wire

It is very easy to make your own twisted wire. Simply take two equally long wires (for example 5 meters) in parallel and tie one end (both wires) to a fixture (a door handle works well). Insert the other end (both wires) into a drill. Stretch the wires so they are straight. Run the drill for a few short bursts at slow speed and you have a created a perfect twisted pair !

Shielded, twisted wires

It is possible to purchase shielded, twisted wire. This can be used in applications where there may be electrical noise issues. In this case we advise to connect the shield to ground AT A SINGLE LOCATION ONLY. This prevents creating a “ground loop” which can cause EMI issues.

Basic wiring checks

You can use a volt meter to perform basic checks on a CAN connection.

With at least one device connected and powered you should be able to measure voltages of around 1.0 – 3.0 volts on each cable with respect to ground. The voltage should appear very similar on each connection.