TT21 / TT22 Minor Change for Sailplanes

02 May 2011

Document Control	
Title:	TT21 / TT22 Minor Change for Sailplanes
Identifier:	SUP/TT2X/002
Issue:	Issue 4.0
Issue Date:	02 May 2011
Author:	Andy Campbell
Authority:	Andy Davis
CCB Category:	2
File Name:	SUP.TT2X.002 Iss 4.0 TT21, TT22 Minor Change for Sailplanes
Printed on:	27/05/2011 08:28:00

CONTENTS

THIS DOCUMENT IS CONFIDENTIAL AND CONTAINS COMMERCIALLY SENSITIVE INFORMATION TO TRIG AVIONICS LTD AND PARTNER COMPANIES. THE CONTENTS OF THIS DOCUMENT ARE TO BE KEPT CONFIDENTIAL AND ARE NOT TO BE DISCLOSED TO THIRD PARTIES WITHOUT THE PRIOR WRITTEN CONSENT OF TRIG AVIONICS LTD.

1. Preface

1.1 Purpose

To document the minor change to install a Trig Avionics TT21 or TT22 Mode S transponder.

1.2 Scope

This minor change applies to (CS-22) powered and non powered sailplanes with 12 Volt DC electrical systems. The applicable sailplanes are;

Schempp-Hirth Flugzeugbau GmbH Discus a	TCDS EASA.A.049
Schempp-Hirth Flugzeugbau GmbH Discus b	TCDS EASA.A.049
Schempp-Hirth Flugzeugbau GmbH Discus-2a	TCDS EASA.A.049
Schempp-Hirth Flugzeugbau GmbH Discus-2b	TCDS EASA.A.049
Schempp-Hirth Flugzeugbau GmbH Discus-2c	TCDS EASA.A.049
Schempp-Hirth Flugzeugbau GmbH Discus CS	TCDS EASA.A.049
Schempp-Hirth Flugzeugbau GmbH Discus-bT	TCDS EASA.A.050
Schempp-Hirth Flugzeugbau GmbH Discus-bM	TCDS EASA.A.050
Schempp-Hirth Flugzeugbau GmbH Discus-2cT	TCDS EASA.A.050
Schempp-Hirth Flugzeugbau GmbH Discus -2T	TCDS EASA.A.050
Schempp-Hirth Flugzeugbau GmbH Ventus a	TCDS LBA 349
Schempp-Hirth Flugzeugbau GmbH Ventus a/16.6	TCDS LBA 349
Schempp-Hirth Flugzeugbau GmbH Ventus b	TCDS LBA 349
Schempp-Hirth Flugzeugbau GmbH Ventus b/16.6	TCDS LBA 349
Schempp-Hirth Flugzeugbau GmbH Ventus c	TCDS LBA 349
Schempp-Hirth Flugzeugbau GmbH Ventus 2a	TCDS LBA 349
Schempp-Hirth Flugzeugbau GmbH Ventus 2b	TCDS LBA 349
Schempp-Hirth Flugzeugbau GmbH Ventus-2c	TCDS LBA 349
Schempp-Hirth Flugzeugbau GmbH Ventus bT	TCDS LBA 825
Schempp-Hirth Flugzeugbau GmbH Ventus cM	TCDS LBA 825
Schempp-Hirth Flugzeugbau GmbH Ventus cT	TCDS LBA 825
Schempp-Hirth Flugzeugbau GmbH Ventus-2cM	TCDS LBA 825
Schempp-Hirth Flugzeugbau GmbH Ventus-2T	TCDS LBA 825
Schempp-Hirth Flugzeugbau GmbH Cirrus	TCDS LBA 265
Schempp-Hirth Flugzeugbau GmbH Cirrus VTC	TCDS LBA 265
Schempp-Hirth Flugzeugbau GmbH Duo Discus	TCDS EASA.A.025
Schempp-Hirth Flugzeugbau GmbH Duo Discus C	TCDS EASA.A.025
Schempp-Hirth Flugzeugbau GmbH Duo Discus C	TCDS EASA.A.025

Schempp-Hirth Flugzeugbau GmbH Duo Discus T	TCDS EASA.A.074
Schempp-Hirth Flugzeugbau GmbH Janus	TCDS LBA 295
Schempp-Hirth Flugzeugbau GmbH Janus B	TCDS LBA 295
Schempp-Hirth Flugzeugbau GmbH Janus C	TCDS LBA 295
Schempp-Hirth Flugzeugbau GmbH Janus Ce	TCDS LBA 295
Schempp-Hirth Flugzeugbau GmbH Janus CM	TCDS LBA 809
Schempp-Hirth Flugzeugbau GmbH Janus CT	TCDS LBA 809
Schempp-Hirth Flugzeugbau GmbH Mini-Nimbus B	TCDS LBA 328
Schempp-Hirth Flugzeugbau GmbH Mini-Nimbus C	TCDS LBA 328
Schempp-Hirth Flugzeugbau GmbH Mini-Nimbus HS-7	TCDS LBA 328
Schempp-Hirth Flugzeugbau GmbH Nimbus 2M	TCDS LBA 798
Schempp-Hirth Flugzeugbau GmbH Nimbus 2	TCDS LBA 286
Schempp-Hirth Flugzeugbau GmbH Nimbus-2b	TCDS LBA 286
Schempp-Hirth Flugzeugbau GmbH Nimbus-2c	TCDS LBA 286
Schempp-Hirth Flugzeugbau GmbH Nimbus-3	TCDS LBA 286
Schempp-Hirth Flugzeugbau GmbH Nimbus-3/24,5	TCDS LBA 286
Schempp-Hirth Flugzeugbau GmbH Nimbus-3T	TCDS LBA 831
Schempp-Hirth Flugzeugbau GmbH Nimbus-3DM	TCDS LBA 847
Schempp-Hirth Flugzeugbau GmbH Nimbus-3DT	TCDS LBA 847
Schempp-Hirth Flugzeugbau GmbH Nimbus-3D	TCDS LBA 373
Schempp-Hirth Flugzeugbau GmbH Nimbus-4	TCDS LBA 380
Schempp-Hirth Flugzeugbau GmbH Nimbus-4D	TCDS LBA 380
Schempp-Hirth Flugzeugbau GmbH Nimbus-4DM	TCDS EASA.A.063
Schempp-Hirth Flugzeugbau GmbH Nimbus-4DT	TCDS EASA.A.063
Schempp-Hirth Flugzeugbau GmbH Nimbus-4M	TCDS EASA.A.063
Schempp-Hirth Flugzeugbau GmbH Nimbus-4T	TCDS EASA.A.063
Schempp-Hirth Flugzeugbau GmbH SHK-1	TCDS LBA 258
Schempp-Hirth Flugzeugbau GmbH Standard Austria	TCDS LBA 230
Schempp-Hirth Flugzeugbau GmbH Standard Austria-S	TCDS LBA 230
Schempp-Hirth Flugzeugbau GmbH Standard Austria-SH	TCDS LBA 230
Schempp-Hirth Flugzeugbau GmbH Standard Austria-SH-1	TCDS LBA 230
Schempp-Hirth Flugzeugbau GmbH Standard Cirrus	TCDS LBA 278
Schempp-Hirth Flugzeugbau GmbH Standard Cirrus B	TCDS LBA 278
Schempp-Hirth Flugzeugbau GmbH Standard Cirrus CS 11-75L	TCDS LBA 278
Schempp-Hirth Flugzeugbau GmbH Standard Cirrus G	TCDS LBA 278
Schempp-Hirth Flugzeugbau GmbH Standard Cirrus B TOP	TCDS LBA 865

Schempp-Hirth Flugzeugbau GmbH Standard Cirrus TOP	TCDS LBA 865
Schempp-Hirth Flugzeugbau GmbH VSO 10	TCDS EASA.A.442
H36 “Dimona”	TCDS EASA.A.065
HK36 “Super Dimona”	TCDS EASA.A.065
HK36 R “Super Dimona”	TCDS EASA.A.065
HK36 TS	TCDS EASA.A.065
HK36 TC	TCDS EASA.A.065
HK36 TTS	TCDS EASA.A.065
HK36 TTC	TCDS EASA.A.065
HK36 TTC-ECO	TCDS EASA.A.065

1.3 Changes from Previous Issue

The changes from Issue 3.0 to Issue 4.0 are as follows;

Section	Detail of Change
1.2	Aircraft types added
1.5.3	Approval traceability table added
3.1	Wording changed to apply to incorporate installation into new aircraft types
3.2	Wording changed to apply to incorporate installation into new aircraft types
3.3	Wording changed to clarify periodic maintenance requirements.
4.3.3	Wire type recommendation of tefzel hook-up wire added to paragraph
4.3.3.1	Extra picture added to illustrate a panel mounted controller
4.3.3.2	Wording changed and extra picture added to incorporate installation into new aircraft types
5. Section 12.2 of table	Wording changed to clarify periodic maintenance requirements.
6. Section 4 of table	Wording changed to clarify maintenance requirements.

1.4 Changes Forecast

None.

1.5 Document Cross-References

1.5.1 Internal Documents

00560-00	TT21/TT22 Installation Manual	Issue AI
DEV/TT21/008	TT21 Declaration of Design Performance	Issue 3.0
DEV/TT22/008	TT22 Declaration of Design Performance	Issue 2.0
DEV/TC20/005	TC20 Declaration of Design Performance	Issue 3.0

1.5.2 External Documents

CS-22 (Amdt 2)	Certification Specifications for sailplanes and powered sailplanes.	EASA
CAP747	Mandatory Requirements for Airworthiness	CAA
CAP766	Light Aircraft Maintenance Programme	CAA
ED-73B	MOPS for SSR Mode S Transponders	Eurocae
TGL 13 Rev 1	Certification of Mode S Transponder Systems for Elementary Surveillance	JAA

1.5.3 Approval Traceability

Document	Additional Aircraft	Document Changes	EASA Minor Change Approval
SUP/TT2x/002 Issue 1.0	Schempp Hirth	Original Document	N/A
SUP/TT2x/002 Issue 2.0	None	Internal changes	10029518
SUP/TT2x/002 Issue 3.0	Schempp Hirth additional models	Additional applicable aircraft	10030508
SUP/TT2x/002 Issue 4.0	Dimona HK36 series	Additional applicable aircraft	10035083

1.5.4 Abbreviation and Acronyms

The following abbreviations and acronyms are used in this document:

AFM	Aircraft Flight Manual
DC	Direct Current
DDP	Declaration of Design Performance
EASA	European Aviation Safety Agency
ETSO	European Technical Standards Order
MOPS	Minimum Operational Performance Standard
POH	Pilots Operating Handbook

2. Introduction

The TT21/TT22 Mode S transponder system is an ED-73B compliant Mode S level 2els datalink transponder, with support for ADS-B extended squitter, elementary surveillance and SI codes, which also meets the relevant environmental requirements of ED-14F. The TT21 has a nominal power output of 125 Watts, and meets the power output requirements for Class 2. The TT22 has a nominal power output of 250 watts, and meets the power output requirements for Class 1. The ADS-B function meets DO-260A class B0. The TT21/TT22 is certified to ETSO 2C112b and ETSO C166a.

The TT21/TT22 transponder is controlled using a separate front panel controller, called the TC20. This allows the transponder to be mounted separately from the instrument panel, and reduces the amount of panel space taken by the transponder. The TC20 includes an altitude encoder. The TC20 is certified to ETSO 2C112b and ETSO C88a.

This minor change describes the process of installing a TT21 or TT22 transponder system in a sailplane.

Although the TT21/TT22 Mode S transponder system adds support for ADS-B extended squitter, EASA AMC20-24 compliance cannot be claimed as a direct result of this minor change. EASA AMC20-24 compliance requires the installation of a certified GPS receiver and AFM change, neither of which is included in this minor change.

3. Change Details

3.1 Description of Change

This change involves mounting the TC20 controller in the instrument panel and the TT21/TT22 transponder unit in a separate location.

TheTC20 is mounted in a location that is visible and controllable by the pilot. The TT21/TT22 will be securely mounted somewhere within the airframe where access can be gained for maintenance and is not likely to be damaged from loose objects during flight. The hardware used to attach the TT21/TT22 will not penetrate the fuselage skin.

The TC20 controls the TT21/TT22 by an electrical control loom which is run from the back of the TC20 in the instrument panel to the TT21/TT22. It is cable tied and supported by wire clips to ensure it does not interfere with any other components or moving surfaces. The TT21/TT22 is powered from the aircraft batteries and the power supply circuit is protected by a 3 amp circuit breaker.

This change does not include installing an antenna. The installation of the antenna must be carried out in accordance with the aircraft manufacturer's instructions.

3.2 Mechanical Details

The TT21/TT22 uses a TC20 head unit to control the transponder, it has a combination of knobs and press buttons to set transponder codes and control the functions of the unit. The operating mode, squawk code and altitude are displayed on an LCD. The panel location should allow the screen to be visible to the pilot and have reasonable access to the knobs and buttons.

The location of the TT21/TT22 will be accessible for maintenance and protected from both physical and environmental damage i.e. loose objects during flight, knocked by persons entering/exiting the aircraft, water ingress. The TT21/TT22 should also be in a position where the interconnecting cable loom can be routed in such a way it also is protested from physical damage.

The TT21/TT22 is compatible with any TSO approved transponder antenna.

The TT21/TT22 combined with the TC20 has a total weight of 440 grams. The effect on weight and balance of the aircraft will be small due the low weight of the transponder equipment. After the installation, a weight and balance check should be calculated or performed in accordance with the manufactures instructions.

3.3 Continued Airworthiness Instructions

An approved aircraft maintenance program will normally include periodic functional checks of the transponder installation using a test set including frequency tolerance, side lobe suppression, and Mode C and Mode S performance. The Mode S checks should confirm that the aircraft assigned Mode S address is correct. Please refer to Appendix 1 for an example of Continued Airworthiness Instructions based on compliance with CS-22.

Other than for periodic functional checks required by the regulations, the TT21/TT22 Mode S transponder has been designed and manufactured to allow "on condition maintenance". This means that there are no periodic service requirements necessary to maintain continued airworthiness, and no maintenance is required until the equipment does not properly perform its intended function. When service is required, a complete performance test as detailed in section 4.4 of these instructions should be accomplished following any maintenance action.

3.4 Installed Equipment Suitability

3.4.1 ETSO

The TT21 is certified to ETSO 2C112b and ETSO C166a under ETSOA EASA.21O.1056, REV. A.

The TT22 is certified to ETSO 2C112b and ETSO C166a under ETSOA EASA.21O.1277.

The TC20 is certified to ETSO 2C112b and ETSO C88a under ETSOA EASA.21O.1112, REV. A

3.4.2 Deviations

The environmental standard tested against was RTCA DO-160F and not DO-160D as required by ETSO 2C11b, ETSO C166a and ETSO 88a.

3.4.3 Environmental

The environmental testing conducted for the TT21/TT22 and TC20 is appropriate for this installation. Key aspects of the TT21 and TT22 environmental qualification are summarised here:

DO-160F reference	Qualification	Applicability
Temperature & Altitude	Category A2 and C1	Equipment intended for installation in a partially controlled temperature but pressurised location and installed is a non-pressurised but controlled temperature location.
Loss of Cooling	+70C without cooling air	Forced air cooling not required.
Temperature Variation	Category C	Temperature controlled internal section of the aircraft.
Humidity	Category A	Standard humidity environment.
Operational Shock & Crash Safety	Category B type 5	Equipment generally installed in fixed-wing aircraft helicopters, VLA's and sailplanes tested for standard operational shock and crash safety.
Vibration	Aircraft zone 2; type 3, 4, 5 to category S level M, type 1	Single engine fixed wing reciprocating or turboprop. Multi engine less than 5700Kg. Helicopters, reciprocating and turbojet engines. Equipment fitted to instrument panel, console or equipment rack.
Magnetic Effect	Category Z	Equipment and/or its connecting cable harness may be mounted within 0.3m of magnetic compass.
Power Input	Category BX	DC equipment intended for use on aircraft electrical system supplied by engine driven alternator or generator, where a battery of significant capacity is on the DC bus at all times.
Voltage Spike	Category B	Installation where a lower standard of protection is acceptable.
Audio Susceptibility	Category B	DC equipment intended for use on aircraft electrical system supplied by engine drive alternator or generator, where a battery of significant capacity is on the DC bus at all times.

Induced Signal Susceptibility	Category AC	Equipment intended for operation where interference-free operation is desirable and installed on aircraft whose primary power is constant frequency or DC.
RF Susceptibility	Category TT	Specified in the HIRF rules; representative of the internal EMI environment from aircraft equipment.
RF Emission	Category B	Basic emission control.

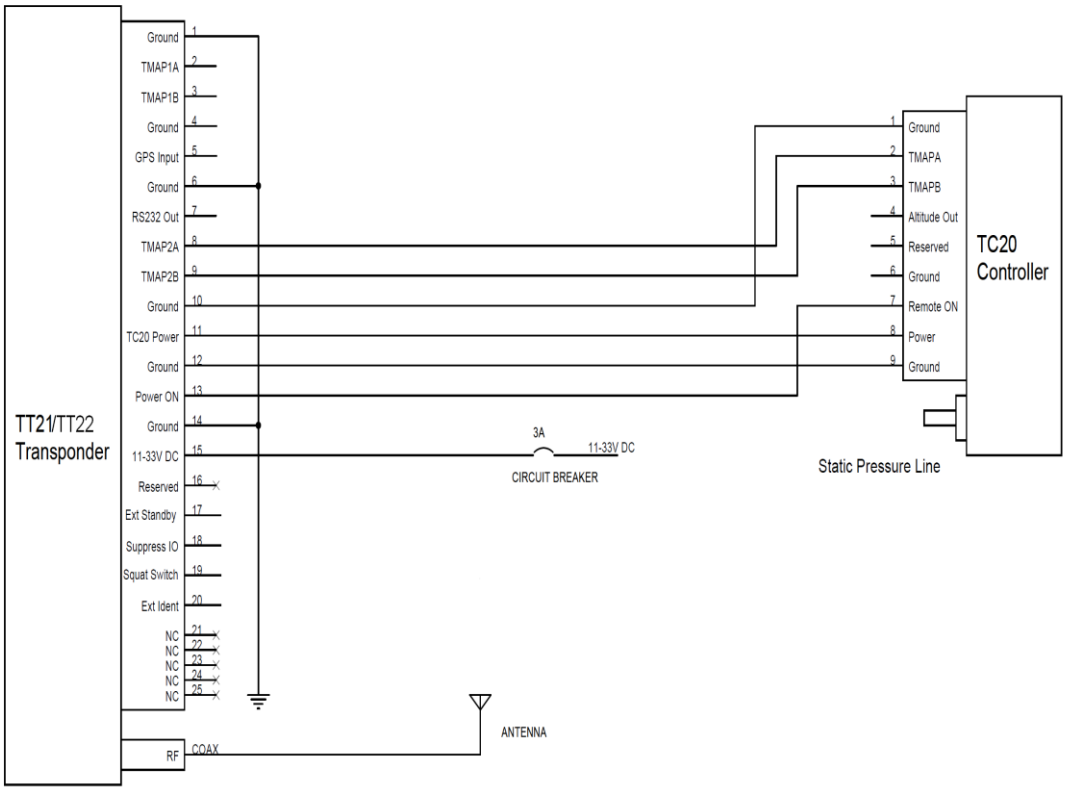
Key aspects of the TC20 environmental qualification are summarised here:

DO-160F reference	Qualification	Applicability
Temperature & Altitude	Category A4 and C2	Equipment intended for installation in a controlled temperature and pressurized location. Equipment intended for installation in non-pressurised and non- controlled temperature location.
Loss of Cooling	+70C without cooling air	Forced air cooling not required.
Temperature Variation	Category A	Equipment external to the aircraft or internal to the aircraft.
Humidity	Category A	Standard humidity environment.
Operational Shock & Crash Safety	Category B type 5	Equipment generally installed in fixed-wing aircraft helicopters, VLA's and sailplanes tested for standard operational shock and crash safety.
Vibration	Aircraft zone 2; type 3, 4, 5 to category S level M, type 1 (Helicopters) to category U level G	Single engine fixed wing reciprocating or turboprop. Multi engine less than 5700Kg. Helicopters, reciprocating and turbojet engines. Equipment fitted to instrument panel, console or equipment rack.
Magnetic Effect	Category Z	Equipment and/or its connecting cable harness may be mounted within 0.3m of magnetic compass.
Power Input	Category X	Equipment identified as Category X – no test required
Voltage Spike	Category X	Equipment identified as Category X – no test required
Audio Susceptibility	Category X	Equipment identified as Category X – no test required
Induced Signal Susceptibility	Category BC	Equipment intended for operation in systems where interference would be controlled to a tolerable level and is installed on aircraft whose primary power is constant frequency or DC.
RF Susceptibility	Category TT	Specified in the HIRF rules; representative of the internal EMI environment from aircraft equipment.
RF Emission	Category B	Equipment and interconnected wiring located in areas where apertures are electro-magnetically significant and not directly in view of radio receivers antenna.

In each case the environmental qualification is appropriate to the installation in the instrument panel of a sailplane with a DC electrical system.

3.5 Wiring Diagram

3.5.1 General Wiring Arrangement



Note 1: Suppress I/O is only required in aircraft with DME, and is shown here not connected.

Note 2: External Ident is optional and not present on most aircraft, it is shown not connected.

Note 3: The squat switch is not connected.

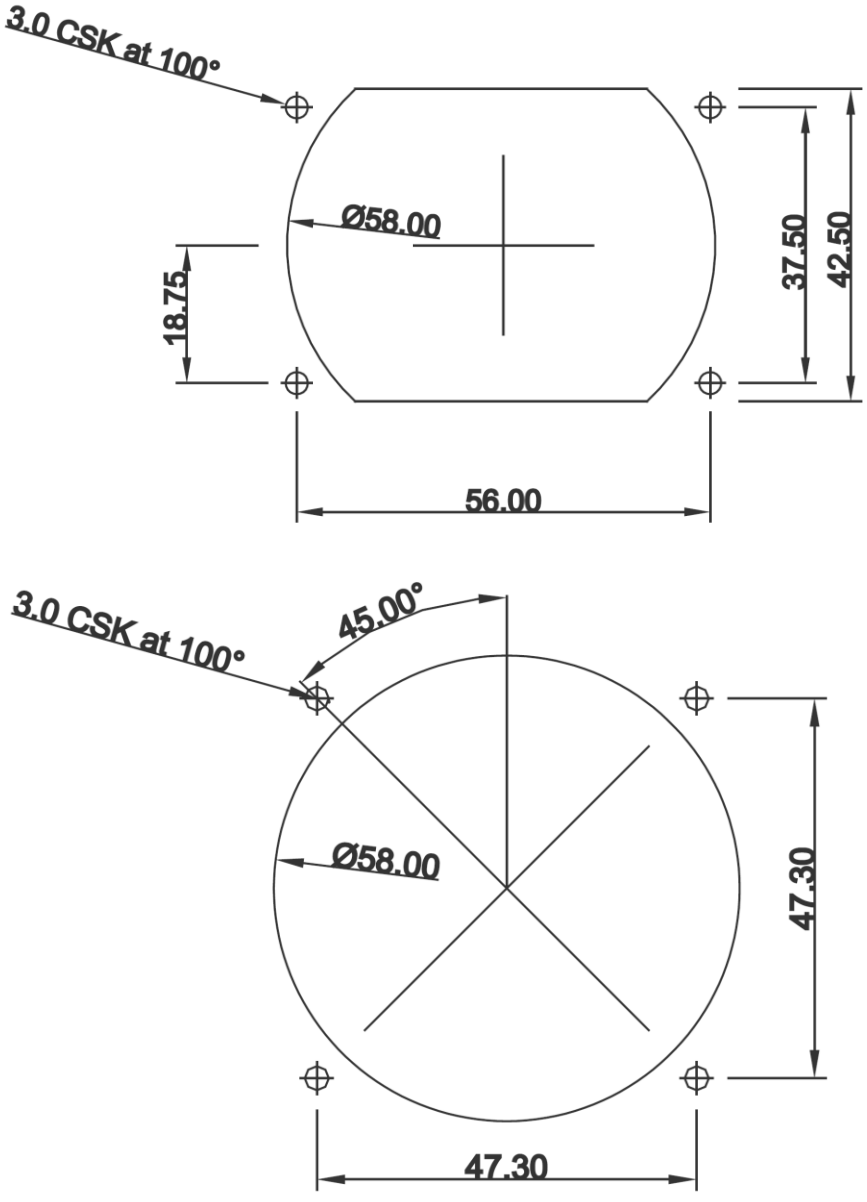
Note 4: The GPS Input is not required as part of this minor change, and is shown here not connected.

Note 5: The Altitude Out from the TC20 Controller is not required as part of this minor change, and is shown here not connected.

3.6 Drawings

3.6.1 Front Panel Cut-out

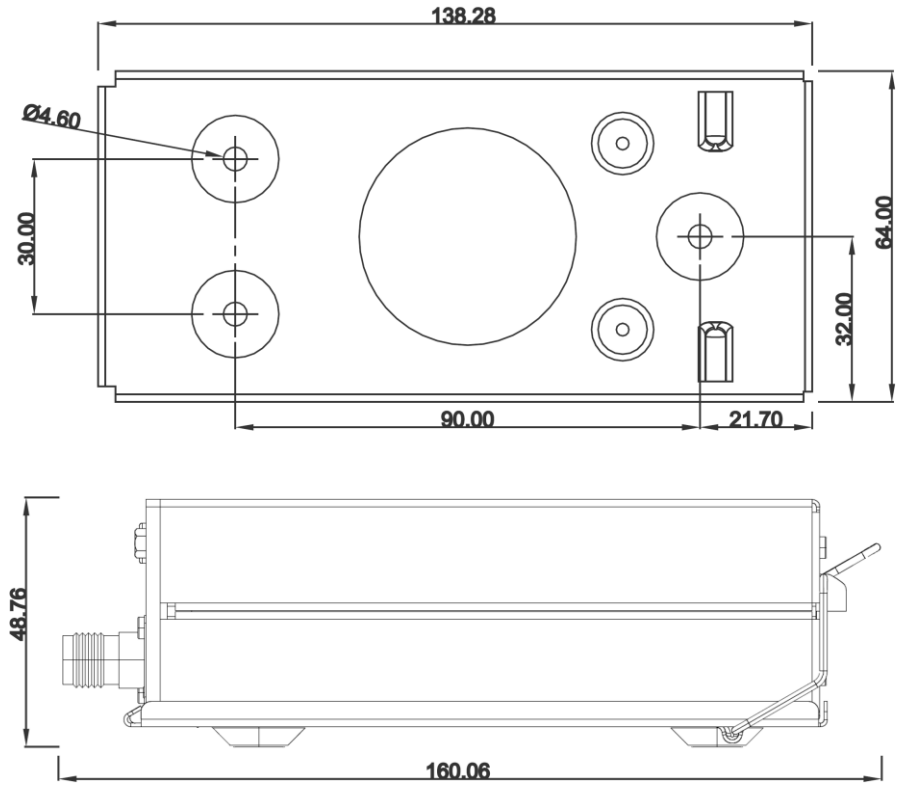
The front panel controller can be fitted to either the compact mounting hole or a conventional 57mm (2¼ inch) instrument cut-out. The compact mounting is a truncated 58 mm opening; please note that the mounting screws are NOT in the same location for the two options.



All dimensions in millimetres. The drawing is not to scale.

Drawing A

3.6.2 Mounting tray fixing and overall dimensions



All dimensions in millimetres. The drawing is not to scale.

Drawing B

3.7 Electrical Load Analysis

The TT21 draws typically 0.13 Amp from a 12VDC power supply on standby, with currents of around 0.32 Amp during high activity.

The TT22 draws typically 0.15 Amp from a 12VDC power supply on standby, with currents of around 0.45 Amp during high activity.

The current draw of the transponder needs to be taken into account and the electrical load analysis of the aircraft recalculated.

3.8 Testing Details

The test procedure is based on the installation test guidelines in ED-73B, the MOPS for SSR Mode S Transponders.

3.9 Flight manual/POH Amendments

No AFM amendments are required as part of this minor change. A pilot's operating booklet is provided (reference 00559-00) with the TT21/TT22 and this should be made available to the flight crew.

3.10 Radio Station Licence

Installation of this transponder may require a new or updated aircraft radio licence. The relevant national authority should be contacted in each case.

3.11 Mode S Address

Installation of the TT21/TT22 transponder requires allocation of an Airframe Address from the national authority of aircraft registration for the aircraft.

In the case of UK aircraft, Mode S addresses have been allocated to all aircraft, and can be obtained directly from the CAA web site G-INFO database.

4. Accomplishment Instructions

4.1 Equipment and tools required

You will need a Mode S transponder ramp test set, a pitot/static system test set, the TT21/TT22 install kit and standard avionics workshop tooling.

4.2 Preparation

During the installation you will need to program the unique Mode S airframe address into the transponder. Allocation of Mode S addresses comes from the appropriate national authority of aircraft registration; ensure that you have applied for and been issued with a Mode S address before you start.

4.3 Process

4.3.1 Install a Three Amp Circuit Breaker

If not already fitted, install a 3 amp circuit breaker in the AMP plug board as detailed in the Glider Maintenance Manual. A typical example is shown:

The circuit breaker should be installed in accordance with the manufactures instructions and a placard added in close proximity on the instrument panel, clearly showing that it is the transponder circuit breaker. An example is shown above.

4.3.2 Verify Antenna Status

Verify the transponder antenna has been installed in accordance with the aircraft manufacturer's instructions. The transponder antenna will be a small stub or blade antenna on the bottom of the aircraft, or in some cases an internal dipole antenna in the aircraft fuselage.

4.3.3 Install the Wiring loom

Manufacture a wiring loom in accordance with the wiring diagram in section 3.

Aircraft standard wire should be used for the installation. For example, wire that meets MIL-W-22759/1 to 23, 32 to 35 specifications would be acceptable for this installation. Common wire types include MIL-W-22759/34 or Raychem 55 wire.

Care must be taken to ensure surface damage does not occur to the wires during installation and that all wire looms are appropriately secured to prevent damage during its installed life. Ensure the loom does not chafe on any parts of the aircraft or interfere with any moving parts especially if you are using thin

walled insulated wire to save on weight, such as MIL-22759/16, 17, 18 or 19.

The power wires should be AWG 22 or heavier; the other signal wires carry only light currents and may be any gauge appropriate to the mechanical environment.

4.3.3.1 Installing the TC20 controller

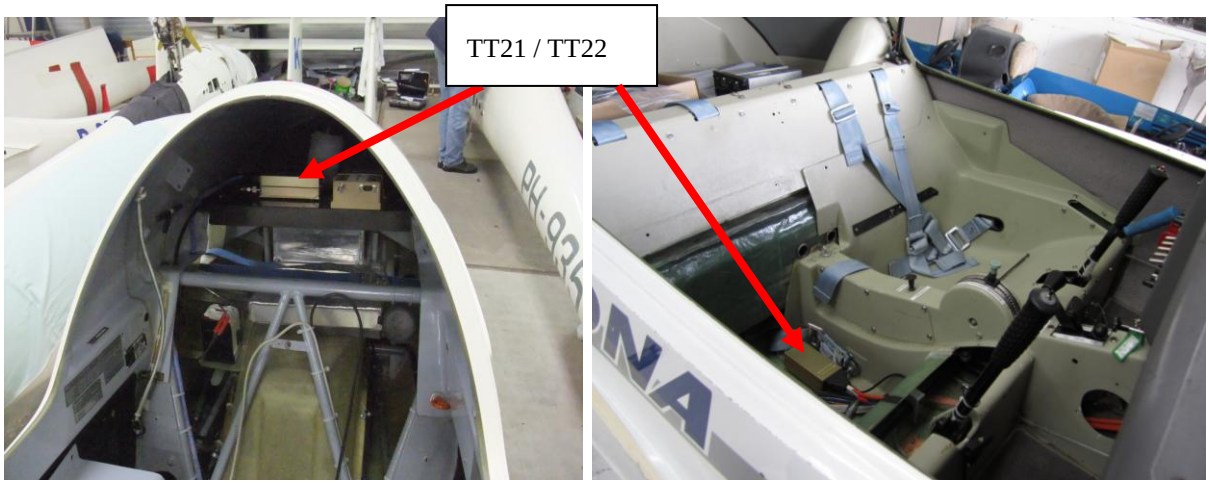
Mount the TC20 in a position where the pilot is able to see the screen and operate the unit. The TC20 can be mounted in the ultra compact mounting hole (as shown below) or in a conventional 57mm (2 ¼ inch) instrument cut out; refer to drawing A in section 3.6.

Connect to the existing static pressure system by choosing a point in the static pressure line that is as close as practical to the TC20 mounting location. Cut the static pressure line and use the supplied T fitting and a length of 5mm EPDM rubber tubing from the installation kit to connect to the static pressure port on the rear of the TC20 as shown below.

Ensure the tubing does not chafe against parts of the aircraft and that there are no excessive bends. Before completing the installation in the instrument panel connect, the 9 way D type connector to the rear of the TC20.

4.3.3.2 TT21/TT22 Transponder Main Unit

Mount the TT21/TT22 to a secure and accessible location where it will be protected from physical and environmental damage.



Secure the mounting tray to the aircraft using the 3 mounting holes in the tray and ensure the tray is supported by the three dimples as well as the three mounting points. Install the transponder in accordance with the installation manual.

4.3.4 Commission Transponder

4.3.4.1 Installation Setup Process

Apply power. The TC20 controller should light up and – assuming this is the first installation – will automatically start the installation setup process.

Continue with the setup process by entering the Mode S address and other parameters in accordance with the TT21/TT22 Installation Manual.

4.3.4.2 Altitude Encoder Calibration

Using a pitot-static system test set, check and if necessary calibrate the TC20 built in altitude encoder to correspond to the primary altimeter in accordance with the Installation Manual.

4.4 Post-installation Test

4.4.1 Equipment Function

Verify that the proper mechanical and electrical connections have been made. Operate each of the controls and verify that each performs the intended function.

4.4.2 Interference Effects

With the transponder powered on, operate each of the other electrically operated aircraft systems to determine that no significant interference effects are present.

4.4.3 Leak Test

To ensure that the installation of the TC20 Controller as not had an adverse effect on the primary altimeter or existing static system, an aircraft pitot/static system sense and leak test must be carried out.

4.4.4 Ramp Test

Using the transponder ramp test set, verify the following parameters. Note that actual procedures may vary according to the test set specific operating instructions; many test sets will execute the tests listed here in a semi-automated sequence, and will report the answers directly or as a Pass/Fail indication.

4.4.4.1 Reply Frequency

Verify that the reply frequency is 1090 ± 1 MHz.

4.4.4.2 Pressure Altitude Transmission

Verify using the pitot/static system test set that altitudes are correctly reported by the transponder. Use at least 10 test points and verify that the altitude reported is within ± 125 feet of the supplied altitude.

NOTE: Precautions must be taken during altitude reporting tests to prevent nuisance ACAS Traffic Advisories and ACAS resolution advisories to aircraft flying in the area.

4.4.4.3 Receiver Sensitivity

Verify that for Mode A/C interrogations the receiver sensitivity of the transponder at the antenna is -73 dBm ± 4 dB.

Verify that for Mode S interrogations the sensitivity of the transponder at the antenna is -74 dBm, ±3dB.

4.4.4.4 Transmitter Power Output

Verify that the TT22 transponder has a peak pulse power at the antenna of at least +21 dBW (125 Watts). Verify that the TT21 transponder has a peak pulse power at the antenna of at least +18.5 dBW (71 Watts).

4.4.4.5 Received Reply

Interrogate the transponder with UF=11 (Mode S Only All-Call) and record the announced address in the reply. Verify that the address matches the assigned address for this airframe.

4.4.4.6 Airspeed Fixed Field

Interrogate the transponder to confirm the maximum airspeed reported is correctly set.

4.4.4.7 Aircraft Identification

Interrogate the transponder with UF=4 or 5, and correct address, with RR=18. Verify that the equipment correctly reports the aircraft call sign in the MB field of the reply.

5. Compliance Statement

CS 22 (Amdt/2) Para	Requirement	Compliance	References
CS-22.1301 (a) (1)	Installed equipment to be of a design appropriate to its intended function.	TT21/TT22 is approved under ETSO 2c112b. Review of certification basis in DDP completed.	TT21 DDP. TT22 DDP. TC20 DDP.
CS-22.1301 (a) (2)	Be labeled as to its identification, function or operating limitations.	All controls are adequately labeled. No limitations are recorded. ETSO compliance is shown on the product identification label.	TT21/TT22 Installation Manual.
CS-22.1301 (a) (3)	Be installed according to specified limitations	Review of environmental testing, deviations and limitations in DDP completed.	TT21 DPP. TT22 DDP. TC20 DDP.
CS-22.1301 (a) (4)	Function properly when installed.	System tested by ground tests on completion.	Section 4.4 of accomplishment instructions
CS-22.1301 (b)	Instruments and any other equipment may not in themselves, or by their effect upon the sailplane, constitute a hazard to safe operation.	Post installation checks include a Leak Test and EMI Testing to ensure no adverse effects.	Section 4.4 of accomplishment instructions
CS-22.1325 (a)	Static Pressure System	The TC20 is a sealed system.	TC20 DDP.
CS-22.1325 (b)(1)(2)(3)	Static Pressure System; Positive drainage is provided, chaffing of the tubing and excessive bends in the tubing are avoided and the materials used are durable suitable for the purpose intended and protected against corrosion.	TC20 installation is adequately described and the materials provided are suitable.	Section 4.3.3.1 accomplishment instructions. TT21/TT22 Installation Manual
CS-22.1327 (a)	Magnetic Direction Indicator	Equipment or the interconnecting wiring harness may be mounted as close as 0.3m from the magnetic compass.	Section 3.4.3, Environmental.

CS-22.1365 (a)	Electric Connecting Cable	The power wires should be AWG 22 or heavier; the other signal wires carry only light currents and may be any gauge appropriate to the mechanical environment.	Section 4.3.3 of accomplishment instructions
CS-22.1365 (b)	Circuit Protective Devices	Three amp circuit breaker installed.	Section 4.3.1 of accomplishment instructions.
CS-22.1431(a)	The equipment may neither in itself or by its mode of operation or by its effect upon the operating characteristics of the sailplane and its equipment constitutes a hazard to safe operation.	The system does not interface with any other system. Installation is physically separate from other systems. EMI tests carried out post-installation.	Section 3.5, Wiring Diagram. Section 4.4.2 of accomplishment instructions.
CS-22.1431(b)	The equipment and its control and monitoring devices must be arranged so as to be easily controllable. Their installation must be such that they are sufficiently ventilated to prevent overheating.	The equipment is designed to be mounted in the aircraft instrument panel. The TT21/TT22 does not require additional ventilation or forced air cooling.	Section 4.3 of accomplishment instructions. TT21 DPP. TT22 DDP. TC20 DDP.
CS-22.1529(n)	Maintenance Manual. Airworthiness Limitations	Other than for periodic functional checks required by the maintenance program, the TT21/TT22 Mode S transponder has been designed and manufactured to allow “on condition maintenance”. This means that there are no periodic service requirements necessary to maintain continued airworthiness, and no maintenance is required until the equipment does not properly perform its intended function.	Section 3.3 Continued Airworthiness Instructions

A transponder installation carried out in accordance with this minor change will meet the requirements of TGL 13 Rev 1 – Certification of Mode S Transponder Systems for Elementary Surveillance.

TGL 13 Rev 1 Ref	Requirement	Compliance
Section 7, and Table 1.	Provide Aircraft Identification, Capability Report, Pressure Altitude and Flight Status	**COMPLIANT** All these (including for the avoidance of doubt, the Flight Status requirement) are provided by the TT21/TT22 transponder. Reference; TT21 DPP. TT22 DDP. TC20 DDP.
8.1	Mode S Address	**COMPLIANT** Satisfied by assignment from National Authority of Aircraft Registration.
8.2	Aircraft >5,700kgs or TAS >250kts must operate with transponder antenna diversity	**COMPLIANT** Aircraft MTOW less than 5,700kgs and TAS less than 250kts. Antenna diversity is not required.
8.3	Transponder peak pulse power to be ICAO Annex 10, Volume IV, Amendment 77 compliant.	**COMPLIANT** The TT21 output power is in excess of 18.5 dBW and less than 27.0 dBW. The TT22 output power is in excess of 21.0 dBW and less than 27.0 dBW
8.4	Transponder and ACAS antenna location need to satisfy physical separation limits	**COMPLIANT** Not applicable to this change.
8.5	Pressure altitude source to be obtained from a monitored air data sensor in either databus or synchro format, ideally the same source as the pilot's cockpit display.	**COMPLIANT** The TC20 controller has a built in Altitude Encoder fed from the same static source as the pilot's altimeter. Encoded altitude readout is available on Transponder display.
8.6	Where Gilliam is used a detection of source/encoding failure must be provided.	**COMPLIANT** Gillham code is not used.
8.7	Transponder must indicate the correct altitude resolution according to the altitude source.	**COMPLIANT** The TT21/TT22 correctly reports that the TC20 is a 25 foot encoder.
8.8	Simultaneous operation of both transponders must be prevented.	**COMPLIANT** Only a single transponder is installed in this Minor Change.
9.1	Transponder will meet the minimum requirements for Elementary Surveillance (ELS)	**COMPLIANT** This is a single transponder installation. The

		TT21/TT22 transponder is ELS compliant.
9.2	Certification standard for transponder is JTSO-2C112a including SI functionality as required by ICAO Annex 10 Amendment 77.	**COMPLIANT** The TT21 and TT22 are certified to ETSO 2C112b, which adopts ED-73B as a Minimum Operational Performance Specification and includes compliance to Annex 10 amendment 77.
9.3	The applicant shall submit: (a) a TGL 13 Rev 1 compliance statement. (b) a statement showing compliance with airworthiness requirements for installation. (c) safety analysis of transponder data source interfaces.	**COMPLIANT** (a) this document (b) refer to the airworthiness compliance matrix for this Minor Change (c) refer to 22.1431(a) statement in the compliance matrix for this Minor Change
9.4	Following Mode S System functionality must be demonstrated: System operation ICAO 24-bit address in transmitted response Data in transmitted response Function of system fault detectors	**COMPLIANT** Ground testing is described in section 4.4 of this minor change.
12.1	Maintenance of altitude reporting transponders should be suitably screened.	**COMPLIANT** Testing detailed in section 4.4.4.2 recommends appropriate precautions to avoid interference.
12.2	Maintenance should include a periodic check of aircraft derived data including 24-bit address or in the event of a change of registration of the aircraft.	**COMPLIANT** Please refer to your national approved aircraft maintenance program for any periodic functional checks that need to be carried out on the transponder system. The TT21/22 does not interface with any external equipment to operate as a mode S transponder. The 24-bit address is setup during installation and cannot be readily changed during normal operation. Therefore, there are no periodic maintenance requirements necessary to maintain continued airworthiness other than the periodic functional checks required by the regulations.
12.4	Testing of Gillham code data should be based on the transition points as defined in Annex 2 of TGL13	**COMPLIANT** Gillham code is not used.

6. Appendix 1

TT21/TT22 Instructions for Continued Airworthiness

1. Description

This document describes the necessary maintenance requirements and instructions necessary to ensure the continued airworthiness of the aircraft following the embodiment of the Minor Change to add the TT21/TT22 Transponder system.

2. Operation

Operating instructions for the Trig Avionics TT21/TT22 Mode S Transponder are detailed in the following documents;

- 00559-00 Operating Manual
- 00560-00 Installation Manual section Normal Operation

3. Servicing

There are no periodic service requirements necessary to maintain continued airworthiness of the TT21/TT22 Transponder.

4. Maintenance Instructions

Please refer to your national approved aircraft maintenance program for any periodic functional checks that must be carried out on the transponder system.

Other than for periodic functional checks required by the regulations, there are no periodic maintenance requirements necessary to maintain continued airworthiness.

If a service is required, a complete performance test as detailed in section 4.4 of these instructions should be accomplished following any maintenance action.

5. Install and Removal Instructions

Please refer to Trig Avionics TT21/TT22 Installation Manual;

- 00560-00 Installation Manual section Installation

6. Required Tools and Test Equipment

- Mode S Transponder Test Set
- Pitot-Static Test Set

7. Airworthiness Limitations

There are no Airworthiness Limitations applicable to the Trig Avionics Minor Change to install a TT21/TT22 Mode S Transponder.