Generic TT31 Minor Modification for VLA

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1. Preface

1.1 Purpose

To document the minor modification to replace a Mode A/C transponder with a Trig Avionics TT31 Mode S transponder.

1.2 Scope

This minor modification applies to light (CS-VLA) single engine piston aeroplanes with fixed landing gear and 14 Volt or 28 Volt DC electrical systems, having an existing certified Mode A/C transponder installation, and an existing altitude encoder. It also applies to simpler retractable aircraft which lack switchgear required to derive an accurate "on the ground" indication, and which are therefore treated for the purposes of this installation as fixed gear aircraft. The applicable VLA types are:

Aquila AT01	TCDS EASA.A.527
Tecnam P2002 (JF and JR Variants)	TCDS.A.006
Diamond DA20-A1 and DA20-C1	TCDS.IM.A.223
Diamond DV20	TCDS EASA.A.439

1.3 Changes from Previous Issue

The changes from Issue 1.1 to Issue 2.0 are as follows;

SECTION	SUMMARY DETAILS
1.2	Added VLA types to Scope
1.5.2	Added reference to CAP 766
1.5.2	Clarified the issue status of CS.VLA to Amdt/1.
3.1	Clearly stated that the modification does not cover any new design or new part install to the antenna, wiring, altitude encoder and or circuit breakers.
3.3	Added CAP 766 as an example of a light aircraft maintenance program.
5	Clarified the issue status of CS.VLA to Amdt/1 and added the following compliance references; CS.VLA.1325 CS.VLA.1365 CS.VLA.1529

1.4 Changes Forecast

None.

1.5 Document Cross-References

1.5.1 Internal Documents

00455-00	TT31 Installation Manual	Issue AI
DEV/TT31/199	Declaration of Design Performance for TT31 Mode S	Issue 16.1

Transponder

1.5.2 External Documents

CS-VLA (Amdt/1)	Certification Specifications for Very Light Aeroplanes	EASA
CAP 747	Mandatory Requirements for Airworthiness	CAA
CAP 766	Light Aircraft Maintenance Programme – Aeroplanes	CAA
ED-73B	MOPS for SSR Mode S Transponders	Eurocae
TGL 13	Certification of Mode S Transponder Systems for Elementary Surveillance	JAA

1.6 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 TT31 Mode S panel mount transponder is an ED-73B Class 1 compliant Mode S level 2 datalink transponder, with support for extended squitter, which also meets the relevant environmental requirements of ED-14D. The TT31 meets the European requirements for Mode S Elementary Surveillance and is certified to ETSO 2C112b.

The TT31 is targeted at the light aircraft retrofit market, and is designed to be compatible with the existing wiring and installation provisions of current Mode A/C transponders. In addition to this general compatibility, the TT31 is physically directly compatible with the Bendix/King KT76A and KT78A Mode A/C transponder. Replacement of a KT76A or KT78A may therefore be able to reuse some or all of the existing mounting provisions. Replacement of other transponders is expected to re-use the existing antenna, altitude encoder, and circuit breaker, and may also use some or all of the existing wiring harness.

This minor modification describes the process of upgrading an existing Mode A/C transponder to a TT31.

3. Modification Details

3.1 Description of Modification

This modification involves removing a Mode A/C transponder, and replacing it with a Trig Avionics TT31 Mode S transponder.

The TT31 is designed to be plug compatible with the KT76A and KT78A; it fits in the same mounting tray and uses the same connectors and connector pin assignments. Both transponders use the same quick-release latch to hold them in the mounting tray, and therefore the physical upgrade can be as simple as unlatching the KT76A or KT78A, sliding it out of the tray, sliding in a TT31, and latching it into the tray.

If the existing transponder is another model (including the Bendix/King KT76) then the mounting tray and connectors will need to be replaced. This will involve fitting the new tray as described below, and rewiring the connectors to the transponder in accordance with the wiring diagram in section 3.5.

In all cases the existing antenna, altitude encoder, wiring and circuit breaker will be re-used. If the installer wishes to redesign or use a different type of antenna, altitude encoder, wiring and or circuit breaker, then a new EASA modification approval must be obtained.

The upgrade is predicated on the suitability of the existing installation, and the compatibility of the new transponder with the existing installation. The activities involved in the upgrade therefore include pre-testing of the installation; verification of the suitability of the existing mechanical arrangements; verification of the suitability of the existing power and signal wiring; transponder commissioning; and post-installation testing. These activities are described in detail in the Accomplishment Instructions in this document.

3.2 Mechanical Details

The TT31 is directly compatible with any approved antenna used with a Mode A/C transponder and subject to this being correctly sited and in good condition the same antenna will be used.

The TT31 chassis is mechanically identical to the KT76A and KT78A, and fits into the same instrument panel mounting tray. The TT31 is slightly lighter (by about 100g) than earlier models of KT76A, but is slightly heavier (also by about 100g) than later models. The difference in weight has no material effect on the mechanical mounting.

For replacement of other models of transponder the mounting tray must be replaced. The TT31 mounting tray complies with the “Mark width” de facto industry standard and the existing tray mounting position will be appropriate for the TT31 tray. Note however that it is unlikely that the existing screw holes for the old tray will be in the correct location, and new mounting provisions may be required.

The TT31 uses 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. It is important that the knobs and buttons be reasonably accessible to the pilot, and that the screen be visible, although the transponder is obviously not a primary flight control or instrument. Since the switch positions and display location are very similar to the legacy Mode A/C transponders, a panel location that was appropriate to the Mode A/C transponder will also be appropriate to the TT31.

The knobs on the TT31 protrude slightly further than some older transponders (up to 5mm). This is not a significant factor in conventional panel mount radio locations.

3.3 Continued Airworthiness Instructions

The system described here is a Mode S transponder installation utilising a Gilham code altitude input,

and therefore EASA AD 2006-0265 will apply. The initial test described in section 4.5.3.2 of this document satisfies the requirements of the AD. Subsequent functional checks shall be carried out at intervals of not more than 24 months.

An approved aircraft maintenance program, for example UK CAA CAP 766, 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.

Other than for periodic functional checks required by the regulations, the TT31 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 4.5 of these instructions should be accomplished following any maintenance action.

3.4 Installed Equipment Suitability

3.4.1 ETSO

The TT31 is certified by EASA to ETSO 2C112b under ETSOA EASA.21O.643 Rev A and ETSO C166A under ETSOA EASA.21O.906.

3.4.2 Deviations

For units with software identifier Version 2.1 or lower a single deviation is noted on the DDP for the TT31 which affects the behaviour of the transponder when recovering from All-Call interrogations which have been locked out. This deviation has negligible effect on this installation.

3.4.3 Environmental

The environmental testing conducted for the TT31 is appropriate for this installation. Key aspects of the environmental qualification are summarised here:

DO-160E reference	Qualification	Applicability
Temperature & Altitude	Category C1	Equipment intended for installation in 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	Equipment generally installed in fixed-wing aircraft or helicopters, tested for standard operational shock and crash safety.
Vibration	Aircraft zone 2; type 5 to category S level M	Single engine fixed wing reciprocating or turboprop, fitted to instrument panel, console or equipment rack.
Magnetic Effect	Category Z	Equipment may be mounted as close as 0.3m from the magnetic compass.
Power Input	Category B	DC equipment intended for use on aircraft electrical system supplied by engine driven

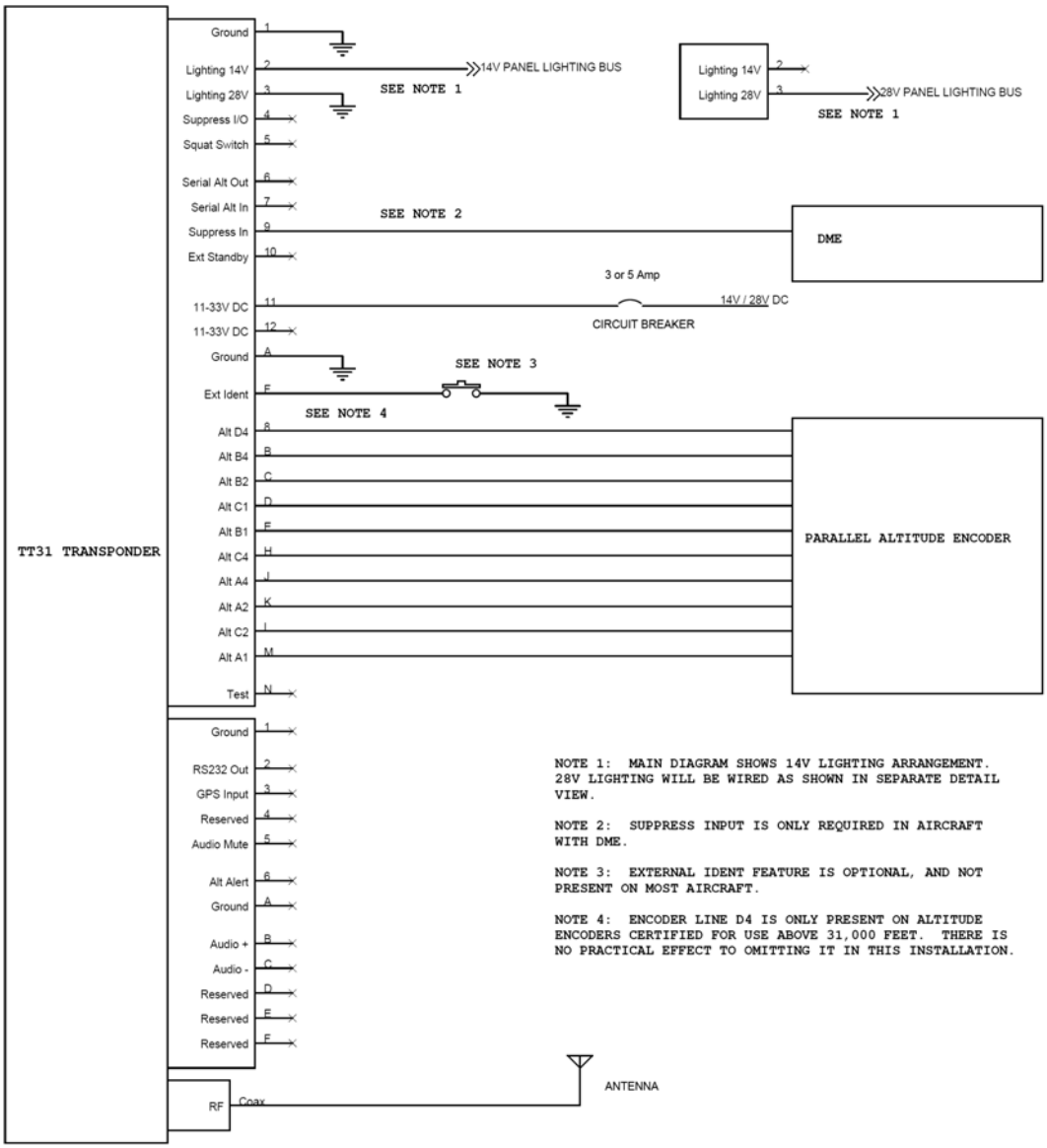
		alternator or generator, where a battery of significant capacity is on the DC bus at all times.
Voltage Spike	Category B	Installation where a lower standard of protection is acceptable.
Audio Susceptibility	Category B	DC equipment intended for use on aircraft electrical system supplied by engine drive alternator or generator, where a battery of significant capacity is on the DC bus at all times.
Induced Signal Susceptibility	Category A	Equipment intended for operation where interference-free operation is desirable.
RF Susceptibility	Category T	Specified in the HIRF rules; representative of the internal EMI environment from aircraft equipment.
RF Emission	Category B	Basic emission control.

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

3.5 Wiring Diagram

3.5.1 General Wiring Arrangement

The wiring diagram is the same in 14V and 28V aircraft, with the exception of the lighting bus input.



3.5.2 Voltage Conversion in 28 Volt Aircraft

Some existing Mode A/C transponders, including the KT76A and KT78A, are 14 Volt only devices. When installed in a 28 Volt aircraft, these transponders will be fitted with a voltage converter. This is typically a passive resistive dropper, but may be an active voltage regulator such as the KA39. The TT31 will NOT meet the certification low voltage requirements when installed with the dropper resistor in place, and the resistor should therefore be removed or bypassed. Active voltage regulators need not be removed.

Although not required for correct operation of this minor modification, if the modification identified and removed a resistive dropper on a 28 Volt aircraft with a KT76A it is good practice to replace the KT76A tray with a Trig TT31 tray, and install a connector – even if it is empty – in the TT31 tray secondary connector position. This makes it impossible to put a KT76A back into the tray.

In aircraft with other models of transponder the tray will be changed anyway, so avoiding this problem.

3.6 Electrical Load Analysis

Existing Mode A/C transponders draw typically 1.1 Amp from the DC power supply, with currents of up to 1.9 Amp during high activity.

The TT31 draws typically 0.25 Amp from a 14V DC power supply on standby, with currents of around 0.45 Amp during high activity. On 28V supplies the currents are lower.

Since the current taken by the TT31 is less than half that of the transponder it is replacing, any systems that were properly sized to support an existing transponder will be adequate to support the TT31.

On the same basis, it can be concluded that the 30 minute battery requirement of CAP 747 GR6 will also be satisfied.

3.7 Testing Details

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

3.8 Flight manual/POH Amendments

No AFM amendments are required as part of this minor modification.

A pilots operating booklet is provided with the TT31 and this should be made available to the flight crew.

3.9 Radio Station Licence

No change is required to the radio station licence for the aircraft, since the TT31 operates in the same band at similar nominal power levels as the transponder being replaced, but there may be a requirement to notify the licence issuing authority of the change in equipment.

3.10 Mode S Address

Installation of the TT31 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, an inspection lamp or torch, and a 3/32nd inch Allen key. Depending on the accessibility of the mounting tray and rear connector wiring, you may also need screwdrivers – including a long screwdriver – to inspect the mounting brackets and connectors.

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 Pre-test Existing Installation

This step is optional, but may assist in fault finding if a problem is found later in the process. Pre-testing will not be possible if the reason you are replacing the Mode A/C transponder is because the transponder itself is faulty.

The pre-test activities involve testing the existing installation and noting in particular:

- Transponder receiver sensitivity – Minimum Triggering Level or MTL. The existing transponder MTL should have an MTL between -71 dBm and -77 dBm. Sensitivity below this range may indicate a problem with the antenna or antenna cable, although could also be an indication of a fault in the existing transponder.
- Transponder transmitted power. The existing transponder should provide not less than 125 Watts (Class 1) or 70 Watts (Class 2) at the antenna. Power levels below this may also indicate a problem with the antenna or antenna cable, although could also be an indication of a fault in the existing transponder.
- Altitude reporting. Test the altitude reporting system, ideally over the service ceiling of the aircraft. A problem with the altitude reporting may indicate a fault in the altitude encoder or wiring between the encoder and the transponder tray, although could also be an indication of a fault in the existing transponder.

If a fault is identified in the pre-testing, you will need to trace the fault cause. If the fault is in the transponder to be replaced, then the upgrade process described here would clear the fault. If the fault is in the existing installation however, upgrading the transponder will not fix it.

4.4 Process

4.4.1 Verify Circuit Breaker Status

Trace and identify the existing transponder circuit breaker. Verify that the circuit breaker is in satisfactory condition and is of the correct type and rating. The circuit breaker for the TT31 should rated between 3 Amps and 5 Amps.

4.4.2 Verify Antenna Status

Trace and identify the existing transponder antenna. The transponder antenna will be a small stub or blade antenna on the bottom of the aircraft. Note that on an aircraft with DME the antenna for the DME will look similar to the transponder antenna; ensure you are looking at the right one. Check the

condition of the antenna, including the attachment to the airframe. It is important that the ground plane of the antenna is correctly bonded to the aircraft skin. The antenna should be in a vertical orientation, as clear as possible from other antennae and from airframe obstacles and protrusions, such as landing gear.

4.4.3 Remove Existing Transponder

Using the Allen key, remove the existing transponder. Turning the locking screw should initially turn the camlock and then jack the transponder out of the tray. Check the transponder for mechanical damage that may indicate the existing tray is inadequately fitted.

4.4.4 Inspect Wiring

Inspect the wiring to the interface connector, check general condition and gauge. 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.

4.4.5 Remove Voltage Converter (28V Only)

If this is a 28 Volt aircraft with a 14 Volt transponder, such as the KT76A, trace the power wire from the transponder connector to determine the method used for voltage conversion. The voltage reduction typically uses a resistive dropper attached to the firewall or other metal aircraft structure. Remove or bypass the resistive dropper; the power supply to the TT31 must come directly from the 28V aircraft supply.

Consider replacing the transponder mounting tray as discussed in section 3.5.2.

4.4.6 KT76A Style Replacement

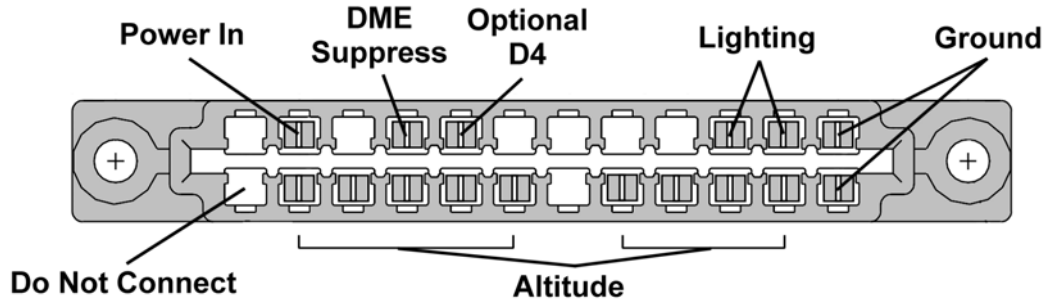
4.4.6.1 Inspect/Replace Mounting Tray

Check the security and integrity of the mounting tray. The tray should be securely mounted with the four screws at the front of the tray and two at the rear.

On 28 Volt aircraft, even where the tray is compatible, consider replacing the mounting tray as discussed in section 3.5.2.

4.4.6.2 Inspect/Replace Interface Connector

Using an inspection light, examine the interface connector at the rear of the tray. The connector should be securely fitted with two screws. The connector is numbered on the rear, but since this inspection is conducted looking into the tray from the front of the tray, the orientation is open to confusion. For the avoidance of doubt, the contacts populated should be as follows when viewed from the FRONT:



Not all of these contacts need be present. In aircraft flown below 30,000 feet, the D4 signal from the altitude encoder is not used, and need not be connected. The DME suppress contact may not be

present in an aircraft without DME. It is also not strictly necessary to connect the lighting bus, and the previous installation may have omitted these contacts.

The only required contacts for basic functionality are the power contact, the two ground contacts, and the 9 lower altitude encoder inputs.

Pin N – the lower left pin when viewed from the front – is not normally used in a KT76A or KT78A installation and should be empty. Pin N is used for bench testing of the TT31 and MUST NOT be connected in the aircraft – it is marked "Do Not Connect" in the diagram above. Confirm that there is no connection to pin N before continuing with the installation.

4.4.6.3 Inspect Antenna Connector

Using the inspection light, examine the coaxial connector at the rear of the tray. Check that the connector is secure and that all the leaf contacts on the outer surface are intact.

4.4.7 Non KT76A Replacement

4.4.7.1 Replace Interface Connector

Before rewiring the connector, establish the relationship between pin positions on the transponder being removed and the TT31, referring to the wiring diagram in section 3.5.

Rewire the crimp connector in accordance with the TT31 installation manual.

4.4.7.2 Inspect/Replace Antenna Connector

Inspect the antenna connector removed from the previous transponder tray. Although most transponders use compatible blind-mate BNC connectors it may be necessary to replace the existing antenna connector if it is damaged or incompatible with the TT31.

4.4.7.3 Replace Mounting Tray

Fit the connectors to the TT31 mounting tray and install the tray in accordance with the TT31 installation manual.

4.4.8 Install TT31

Install the TT31 transponder. Check that the camlock is in the correct orientation before inserting the TT31 in the tray; tighten with the Allen key. Do not over tighten.

4.4.9 Commission Transponder

Apply power. The TT31 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 TT31 Installation Manual.

4.5 Post-installation Test

The following post-installation test procedure shall be followed.

4.5.1 Equipment Function

Verify that the proper mechanical and electrical connections have been made. Exercise the setup and test software to confirm correct operation of the aircraft lighting bus input (where fitted).

Operate each of the controls and verify that each performs the intended function.

4.5.2 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.

4.5.3 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.

4.5.3.1 Reply Frequency

Verify that the reply frequency is 1090 ± 1 MHz.

4.5.3.2 Pressure Altitude Transmission

Verify using the pitot/static system test set that altitudes are correctly reported by the transponder. Tests for each code segment of the encoder (1000, 2300, 2500, 3800, 4100, 4300, 4800, 6800 and 14800 feet) are sufficient to ensure proper operation of each altitude code input. 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.

4.5.3.3 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.

4.5.3.4 Transmitter Power Output

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

4.5.3.5 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.

4.5.3.6 Airspeed Fixed Field

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

4.5.3.7 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

This statement is made in accordance with EASA Certification Specifications for Very Light Aeroplanes, ref CS-VLA (Amdt/1) as effective on 5th March 2009.

CS.VLA (Amdt/1) Para	Requirement	Compliance	References
CS-VLA.1301 (a)	Installed equipment to be of a design appropriate to its intended function.	TT31 is approved under ETSO 2c112b. Review of certification basis in DDP completed.	TT31 DDP.
CS-VLA.1301 (b)	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.	TT31 installation manual.
CS-VLA.1301 (c)	Be installed according to specified limitations	Review of environmental testing, deviations and limitations in DDP completed.	TT31 DDP.
CS-VLA.1301 (d)	Function properly when installed.	System tested by ground tests on completion.	Section 4.5 of accomplishment instructions
CS-VLA.1309	The equipment, systems, and installations must be designed to minimise hazards to the aeroplane in the event of a probable malfunction or failure	The system does not interface with any other system except dedicated altitude encoder. Installation is physically separate from other systems. EMI tests carried out post-installation.	Section 3.5, Wiring Diagram. Section 4.5.2 of accomplishment instructions.
CS-VLA.1325 (a)	Static Pressure System	The system interfaces with the static pressure system via the existing altitude encoder. The modification does not cover change to the altitude encoder to static pressure connection.	Not applicable
CS-VLA.1351(a)	Electrical system capacity	Existing 3 A circuit breaker used supplying nominal 0.45A load. Wire gauge 20 appropriate. New equipment replaces load of 1.1A with load of 0.45A. Battery endurance increased as a result.	TT31 Installation Manual.

CS-VLA.1357	Circuit Protective Devices	Existing circuit breaker used - inspected as part of modification.	Section 4.4.1 of accomplishment instructions.
CS-VLA.1365	Electric Connecting Cable	Existing electric connecting cabling used – inspected as part of modification.	Section 4.4.4 of accomplishment instructions
CS-VLA.1431	Electronic equipment and installations must be free from hazards in themselves, in their method of operation, and in their effects on other components.	The system does not interface with any other system except dedicated altitude encoder. Installation is physically separate from other systems. EMI tests carried out post-installation.	Section 3.5, Wiring Diagram. Section 4.5.2 of accomplishment instructions.
CS-VLA.1529	Instructions for Continued Airworthiness	Other than for periodic functional checks required by the maintenance program, the TT31 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. An approved maintenance program, for example UK CAA CAP 766, will normally include periodic functional checks of the transponder installation.	Section 3.3 Continued Airworthiness Instructions
CAP 747, GR6	Battery duration not less than 30 minutes	New equipment replaces load of 1.1A with load of 0.45A. Battery endurance increased as a result.	TT31 Installation Manual.

A transponder installation carried out in accordance with this Minor Modification will meet the requirements of TGL 13 Rev 1 – Certification of Mode S Transponder Systems for Elementary Surveillance. This compliance is dependent on the performance of the existing altitude encoder, which must meet the requirements of ICAO Annex 10, Vol IV, 3.1.1.7.12.2.4.

TGL 13 Ref	Requirement	Compliance
Section 7, and Table 1.	Provide Aircraft Identification, Capability Report, Pressure Altitude and Flight Status	**COMPLIANT** With the exception of Pressure Altitude all these (including for the avoidance of doubt, the Flight Status requirement) are provided directly by the TT31 transponder.

		Pressure Altitude compliance depends on the performance of the altitude encoder.
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 T31 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 modification.
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 Altitude Encoder is fed from the same static source as the pilot's altimeter. Encoded altitude readout is available on Transponder display.
8.6	Where Gillham is used a detection of source/encoding failure must be provided.	**COMPLIANT – ALTERNATE MEANS** Only a single Gillham encoded altitude source is provided by this installation, so a comparator function is not available. Provision is made in the Instructions for Continued Airworthiness (see section 3.3) of this Minor Change to ensure periodic checking of the integrity of the Gillham interface as required by EASA AD 2006-0265. Encoded altitude is displayed to the pilot by the TT31. Complete failure of the altitude source is flagged by the transponder. Erroneous indications can be identified by the pilot.
8.7	Transponder must indicate the correct altitude resolution according to the altitude source.	**COMPLIANT** This modification uses a parallel altitude source and therefore only 100 foot resolution is available. The TT31 correctly displays and transmits this data.
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 TT31 transponder is ELS compliant.
9.2	Certification standard for transponder is JTSO-2C112a including SI functionality as required by ICAO	**COMPLIANT** The TT31 is certified to ETSO 2C112b, which adopts

	Annex 10 Amendment 77.	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 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 VLA.1309 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 4.5 above.
12.1	Maintenance of altitude reporting transponders should be suitably screened.	**COMPLIANT** Testing detailed in section 4.5.3.2 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** Testing detailed in Instructions for Continued Airworthiness (see 3.3) requires testing, which includes 24-bit address and aircraft derived data, every 24 months.
12.4	Testing of Gillham code data should be based on the transition points as defined in Annex 2 of TGL13	**COMPLIANT** Encoder testing detailed in Instructions for Continued Airworthiness (section 3.3) and section 4.5.3.2 complies with Annex 2.