USB 429/1553

aka

MIL-STD-1553B Tester Type 080507

Hardware Manual

1. INTRODUCTION

This document sets out details of the hardware of Airflair Limited's USB 429/1553 Multi-protocol databus tester. This equipment provides both ARINC 429 (transmit and receive) and MIL-STD-1553interfaces.

The 080509 connects to a standard PC (which provides the user interface) via a standard USB 1 interface. It provides a full dual redundant interface to one databus , on which it can operate simultaneously as a Bus Controller, Bus Monitor and Emulator of any combination of RTs and a bus monitor only interface to a second, dual redundant bus. In addition, it provides two ARINC 429 transmitter channels and three receivers.

The 080509 takes its power entirely from the PC to which it is connected, using either one or two USB interfaces. It is powered whenever the Host PC is powered and the primary USB cable is connected. (More details of power configurations are set out in Section 6 below.)

For brevity, the device will be referred to throughout the rest of this document as the USB 4291553 and the MIL-STD-1553 standard as `1553'.

2. PHYSICAL

The USB 429/1553 is supplied in two enclosure types, as follows:

A compact aluminium alloy enclosure, ideally suited to field use, measuring approximately 210 x 120 x 35mm.

A 1U high 19" rack mountable module. This in turn may be ordered with connectors located to best suit the application.

In either form the USB 429/1553 is provided with seven connectors:

A `density and a half 15 way Female D type connector for the ARINC 429 input and output signals

Two Trompeter Electronics BJ77 jacks, one for each half of the dual redundant `full' 1553 databus (which includes Bus Control and RT Emulation)

Two Trompeter Electronics BJ77 jacks, one for each half of the dual redundant `Bus Monitor only' 1553 databus

A standard USB connector for the link to the Host PC. This connector, centrally mounted in the rear panel of the unit, provides both the USB signal connections and the primary source of power to the unit.

A standard USB connector for an additional, secondary, link to the host PC. This connector carries power only; the signal lines are unused. The purpose of this secondary USB interface is to provide additional power when required (see Section 6).

3. CONNECTORS AND PIN ALLOCATIONS
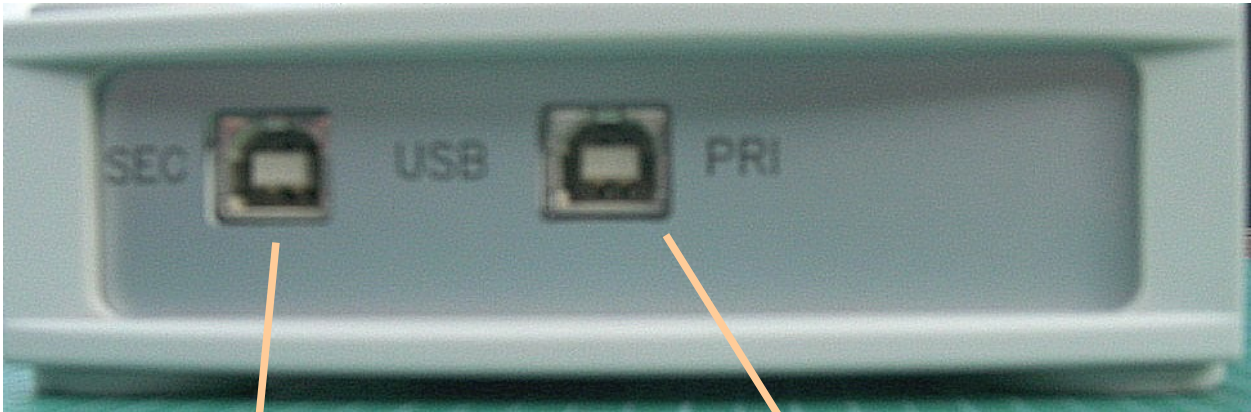
3.1 Identifying the Connectors

Please refer to the illustrations below to assist with the identification of the various connectors.
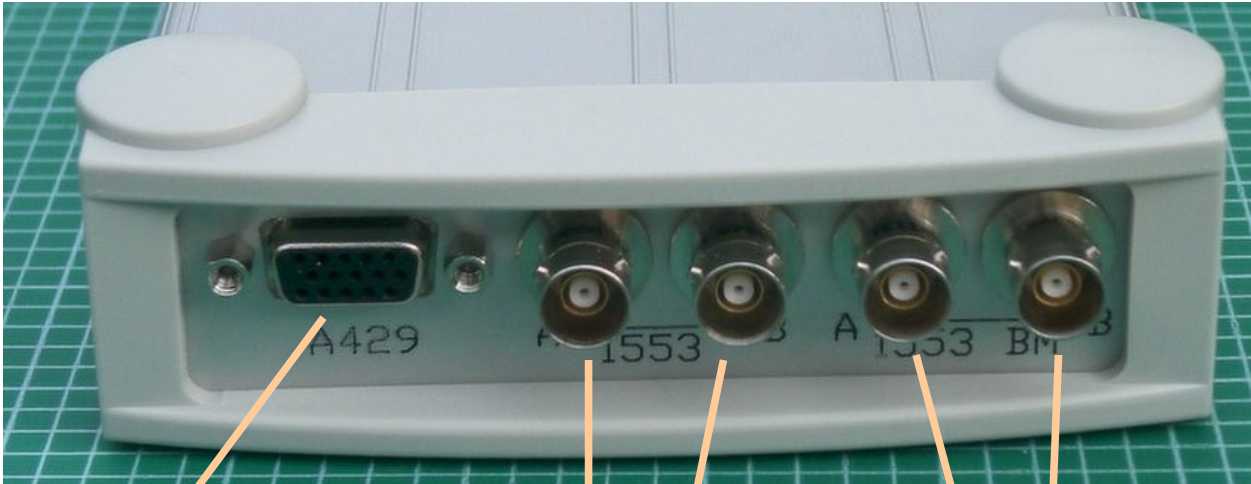
ARINC 429 Connector (Density and a Half D15)

Full 1553 Databus (BJ77 Jacks)

Bus Monitor only 1553 Databus (BJ77 Jacks)

Secondary USB Connector
Used only to provide power to the 1553 transceiver O/P drivers

Primary USB Connector
Provides the signal interface to the host PC and power for most of the USB 429/1553 unit (all of it when commanded so to do by software)

3.2 USB Connectors

The USB connectors are industry standard items, for use with the supplied USB cables or with equivalent cables sourced separately.

3.3 BJ77 jacks (1553 Signals)

The BJ77 connectors are wired, in accordance with standard practice, as follows:

Inner	1553 Data Hi
Outer	1553 Data Lo
Shell	Screen

3.4 Density and a Half 15 Way Female D-Type (ARINC 429 Signals)

ARINC 429. The ARINC 429 signals are connected via a 15 way `density and a half' D Type socket. The pin allocations are:

Pin	Used for
1	Rx2A
2	Rx2B
3	0v
4	Rx1A
5	Rx1B
6	Rx3B
7	0v
8	0v
9	0v
10	Rx3A
11	Tx1B
12	Tx1A
13	0v
14	Tx2A
15	Tx2B

4. INTERFACES TO THE 1553 DATA BUSES

The interface to each 1553 databus may be configured for operation with either transformer or directly coupled stubs. The standard `as shipped' setting is for transformer coupling.

To change the settings for use with direct coupled stubs, proceed as follows:

*** CAUTION *** Anti-static protection procedures MUST be observed during the work described below.

*** CAUTION *** This procedure involves the removal of screws which fit in threads formed in the extruded aluminium case. When re-assembling the unit take care not to over-tighten the screws as it is possible to strip the threads if too much force is used.

Prise off the bottom parts of the two `feet' at the front of the case, exposing the two screws which secure the end cap. Remove these two screws.

Remove the four screws securing the `front' panel to the unit (i.e. the panel which carries the D15 and BJ77 connectors).

Carefully withdraw the unit from its enclosure by gripping the ends of the aluminium panel and pulling it steadily away from the case.

With the I/O signal connectors on the left, locate the four link blocks close to the 1553 transformers (The square black shiny things!). Each of these has six pins and is fitted with two removable links. The top two link blocks control the configuration for the `full' 1553 bus and the bottom two the configuration for the `Bus Monitor only' bus. The positioning of the links determines the transformer/direct coupling selection, as follows:
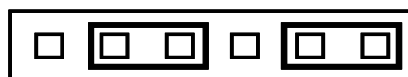
Transformer Coupled (as shipped)
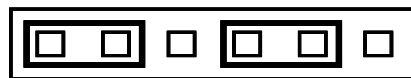
Direct Coupled

Position the two links on each of the two jumper blocks as required.

Carefully refit the unit in its case. Ensure that the edges of the circuit board engage in the correct `slots' in the case extrusion (the ones nearest the bottom of the case) and that the USB connectors fit correctly in the holes provided for them in the other end panel. (If not, then you are trying to fit the board into the case upside down.)

Refit the front panel screws, the end cap and the `feet', keeping in mind the need to exercise restraint when tightening the screws.

5. DATABUS CONFIGURATION

The USB 429/1553 is designed (as is all 1553 equipment) for use with correctly terminated data buses. At a minimum (for a transformer coupled arrangement) this will involve the use of a two port coupler and two termination resistors, making up a `mini bus' suitable for test purposes.

The USB 429/1553 is **not** designed for use without a databus attached, or when wired directly to another piece of 1553 equipment. Use of the USB 429/1553 in either of these configurations will result in significant distortion of the 1553 signals, which will disturb its operation (and, most probably, the operation of any attached equipment). Similar effects will occur if a `proper' databus is used but it is not correctly terminated.

Please contact Airflair (see contact details below) if you have any queries relating to the configuration of the 1553 physical network.

6. USB POWER CONSIDERATIONS

The USB 429/1553 is a USB bus powered device, as are all Airflair's USB connected databus testers. Having said that, the nature of the this particular device is such that there are some special considerations and requirements.

The USB specification calls for bus powered devices to draw no more than 500mA from the 5 volt supply which is included in the USB interface. This is not a lot of power, especially in connection with MIL-STD-1553 databus interfaces. As an example, Airflair's USB 1553 device, working as close as can practically be realised to 100% bus loading and acting as both BC and multiple RTs (in other words, providing all the signals on the bus) draws just short of the permitted 500ma. Clearly, adding five ARINC 429 channels and a (much less power hungry, its true) 1553 Bus Monitor has the potential to push the power drain beyond the permitted maximum.

It is, of course, considered to be less than perfect design to run a 1553 bus at 100% loading. Such loadings are legitimate within the definition set out in the standard, though, and may in any case occur for short periods in quite conservatively designed systems. In much the same way, while it may be unusual to have the test equipment standing in place of both the Bus Controller and all the RTs in the system there may be times when this is exactly what's wanted. (Testing a Bus Monitor system is the best example which comes to mind.) So, we need to make sure that the equipment will cope with these worst cases.

We also feel it is important to avoid external power bricks/wall worts and the like – and this is obviously the case for portable use in conjunction with a Notebook PC. So, additional power (when its required, see later) is taken from a second USB connection. Its important to understand what this does, and how it does it. In summary:

The secondary USB connection provides power only, the signal lines are not used.

The secondary USB connection powers only the transceiver output circuitry on 1553 Bus 1 (the `full' 1553 bus).

In the absence of the secondary USB connection the transceiver outputs are, along with everything else, powered from the power delivered via the primary USB interface. The changeover from one power source to the other is automatic. It is not `seamless', though, so you should connect the secondary USB cable before running a test.

In the absence of a connection to the secondary USB interface the unit inhibits outputs from the 1553 transceiver – unless this safeguard is specifically overridden by a command from the PC. This should prevent any inadvertent overload of the primary USB power. *(Note: Calls for the use of BC or RT Emulation outputs with the transceiver inhibited in this way will not be rejected. But, no data relating to these outputs will be returned to the PC, so the signals will appear to you, as well as to the databus itself, not to be present.)*

The effects of this characteristics are, in operational terms:

You can, without qualification, use any combination of ARINC 429 interfaces and 1553 bus monitors.

You can, without qualification, use the `full' 1553 bus if no other interfaces are being used.

You can, without qualification, use any combination of databus interfaces provided that the secondary USB connection is made.

You can, with care, use combinations of any or all interfaces provided that output loadings (principally, those on the `full' 1553 bus) are low. It is very difficult to draw up hard and fast rules here, and in general we would not recommend this mode. It may well be entirely satisfactory, though, (and save the inconvenience of the secondary USB connection) for modest requirements such as emulating short messages from a single RT.

You can, without qualification, use any combination of databus interfaces with only the primary USB connection in use, provided that the PC to which is connected has been **confirmed** to be capable of providing the required power. Again, this is an area where it is not possible to set out general rules. Certainly, some PCs will restrict the current to the USB port in such a way that any attempt to exceed the specified 500mA maximum will cause the 5 volt supply to the USB 429/1553 unit to drop out, re-setting the on-board processor and stopping the test as a result. Some, on the other hand, are far more tolerant – although the manufacturers do not in general advertise this characteristic. We do, though, know of one excellent (albeit expensive) ruggedised Notebook PC which is specified by its manufacturer to be capable of supplying up to 1A (more than enough) from each of its USB ports and which is therefore ideal for field use with the USB 429/1553.

7. ARINC 429 OPTIONS

In addition to the normal ARINC 429 facilities, the USB 429/1553 provides a 50 KHz speed option on Tx2 and Rx3. This option is intended for use on certain Russian aircraft systems, which use the 50 KHz frequency.

50 KHz operation is selected by a command from the Host PC. Please see the *ZEUS* or API documentation, as appropriate, for details. When invoked, the 50 KHz operation takes the place of the normal 100KHz high speed mode. (The fine control over speed is still available on Tx2, all rates are simply divided by two.)

8. OPERATION

The operation of the USB 429/1553 is controlled entirely by the software running on the PC to which it is connected. The unit is powered up when connected to the PC.

Details of software operation, both for *ZEUS for Windows* (Airflair's turnkey test suite) and user code using the supplied API, are provided elsewhere.

The following general points regarding use are worth noting:

Power saving on many PCs can disable the USB ports. Recovery from this condition may cause the attached equipment to malfunction. We recommend that power saving be disabled on PCs running this equipment.

The two 1553 interfaces provided by the USB 429/1553 for each of the two dual redundant data buses are designed strictly for use on dual redundant systems. They should **NOT** be connected to entirely independent databuses (unless it is certain that only one of these will be active at any time).

Since the full 1553 bus interface of the USB 429/1553 can operate as both (or either) Bus Controller and RT Emulator(s) it is important to ensure that it is not `standing in for' any equipment which really exists, and is active, on the bus. Any such operation will give rise to bus clashes, resulting in unpredictable (but almost certainly incorrect) bus operation. (The resulting `battle of the transceivers' is also very unkind to these devices in both the USB 429/1553 and the `other' equipment). **Make sure that Bus Control and RT Emulation are only active when no other equipment is performing the associated functions.**

9. SUPPORT

For technical support please contact Airflair Limited or your local supplier.

Support contact details for Airflair are:

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Please also visit our website (www.airflair.co.uk) for more product information and to visit the `downloads' section, which makes enhancements and (a few :-) bug fixes available for free download.

We have extensive experience of putting our equipment to work in all sorts of ways and will be only too pleased to help you get the very best from it.