SQTR-2 ADS-B Generator

ADS-B Squitter Generator for Synchronous and Asynchronous Interference Testing

Available with Mode S Squitters, UAT Messages, or Both

Wide Area Multilateration (WAM) Testing (Option)

The SQTR-2 is available in multiple configurations:
- SQTR-2 (Mode S ADS-B Squitters)
- SQTR-2U (Universal Access Transceiver Messages)
- SQTR-2B (Mode S squitters or UAT messages)

The SQTR-2 features 6 channels of Mode S (1090 MHz) squitters for compliance testing of receivers to RTCA DO-260A Minimum Operational Performance Standards for 1090 MHz Extended Squitter Automatic Dependent Surveillance – Broadcast (ADS-B) and Traffic Information Services – Broadcast (TIS-B). The SQTR-2U simulates UAT messages in an 8-channel configuration for compliance testing with DO-282A. The SQTR-2B features ADS-B testing capability that can be configured for Mode S squitters or UAT messages.

The SQTR-2 is available with an option for testing Wide Area Multilateration (WAM) receivers. The WAM option features:
- 400 independent, moving targets, each with settable RF level and frequency, on 5 channels for simulation of Time of Arrival information – Targets selectable as DF4, DF5, DF11, DF17, DF20, and DF21
- 1 channel of Asynchronous Interference targets
  - Up to 11,782 ATCRBS targets
  - Up to 2,092 Mode S targets selectable as Mode S Long or Short target replies

SQTR-2 ADS-B Squitter Generator

The SQTR-2 provides capability for verify de-garbling and re-triggering performance for an ADS-B Receiver. De-garbling and retriggering performance is tested by specific synchronous and asynchronous interference scenarios. Synchronous interference is ATCRBS or Mode S interference that aligns with the ADS-B message of interest. Asynchronous interference is random interference that occurs at predefined rates and power levels.

The SQTR-2 can be used to perform the following synchronous interference tests per RTCA DO-260A:

2.4.4.4.2.4 Combined Preamble and Data Block Tests with Mode A/C FRUIT
2.4.4.4.2.5 Data Block Tests with Mode S FRUIT
2.4.4.4.2.6 Re-Triggering Performance (Fixed Position and Varying Position)

The SQTR-2 consists of six independent RF modules, which are combined into a single RF port for connection to the unit-under-test (UUT). Each SQTR-2 channel has its own TCP/IP address. The Ethernet connection for each channel is connected to an Ethernet switch, which can be connected to a test computer using a single cable.

For the Synchronous Interference mode, a target is generated with up to five interference targets. Each interference target may be programmed to output either an ATCRBS or Mode S target (fruit) with its own RF level and programmable timing relative to the 'master'. The 'Master' channel will provide an output trigger to the 5 'slaves' for Synchronous Interference mode.

For the Asynchronous Interference mode, up to 250 targets may be generated on the 'master' channel with up to 58,910 ATCRBS interference targets and up to 10,460 Mode S targets may be generated on the other five channels.

In Asynchronous Interference mode, the 'slave' ignores the trigger from the 'master' and outputs ATCRBS and/or Mode S fruit. The user may program: 1) number of ATCRBS fruit per second, 2) number of Mode S fruit per second and 3) the RF level. The timing and data content of the fruit are selected randomly by the SQTR-2.

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ADS-B squitters can be setup via commands sent through the Ethernet port or via a graphical user interface (GUI). Typical GUI screens are described in following sections.

Synchronous Interference Test Setup Screen

The Synchronous Interference Test Setup screen provides control for saving or retrieving GUI or Scenario files. The SQTR-2 allows the test set operator to generate a specific test configuration. Data contained in the GUI file will be used to generate a scenario, which will have random target data. The test generated by the GUI can be selected to run ONCE or CONTINUSLY with a control for starting and stopping the test. The SQTR-2 allows the test set operator to compile a GUI file into a Scenario File. The SQTR-2 allows the test set operator to retrieve a specific Scenario File. The operator can select type of display for location (decimal or deg/min/sec). The test set operator can set the cable loss between the SQTR-2 and the UUT.

Synchronous Target Setup

The Target Setup screen allows control of the test target parameters including:
- Target Mode S data - MS Address, Control Field for DF18, Aircraft Category, Flight ID, Weight on Wheels Capability, Inhibit Capability, COMM A/B Capability
- Target RF level and frequency.
- Target squitter control (Jitter or PRF)
- Scenario control
- Target position information – Lat/Long, Altitude, Heading, Ground Speed

Synchronous Interference Setup

The Interference Setup Screen allows control of parameters for interference targets including:
- Channel ON/OFF control
- Interference timing, frequency, and RF level
- Interference target type – ATCRBS, Mode S Long, or Mode S short
- Average number of pulses for all interference targets

Asynchronous Interference Test Setup

The Asynchronous Interference Test Setup screen provides control for saving or retrieving GUI or Scenario files. The SQTR-2 allows the test set operator to generate a specific test configuration. Data contained in the GUI file will be used to generate a scenario, which will have random target data. The test generated by the GUI can be selected to run ONCE or CONTINUSLY with a control for starting and stopping the test. The SQTR-2 allows the test set operator to compile a GUI file into a Scenario File. The SQTR-2 allows the test set operator to retrieve a specific Scenario File. The operator can select type of display for location (decimal or deg/min/sec). The test set operator can set the cable loss between the SQTR-2 and the UUT.

Asynchronous Target Setup

The Target Setup screen allows control of the test target parameters including:
- Target Mode S data - MS Address, Control Field for DF18, Aircraft Category, Flight ID, Weight on Wheels Capability, Inhibit Capability, COMM A/B Capability
- Target RF level and frequency.
- Target squitter control (Jitter or PRF)
- Scenario control
- Target position information – Lat/Long, Altitude, Heading, Ground Speed
- Selection of Mode S Reply and Squitter types

Asynchronous Interference Setup

The Interference Setup Screen allows control of parameters for interference targets including:
- Channel ON/OFF control
- Frequency minimum and maximum value for each channel
- Number of ATCRBS, Mode S Long, or Mode S Short interference targets
- Average number of pulses for all interference targets

Asynchronous Target Enable

The Target Enable screen allows user to enable up to 250 targets.

Asynchronous Event-Point Setup

The Event-Point Setup screen allows the user to program various events at specific times including:

- Event squitter data
- Ident, SQUAWK, and Alert events
- Turn Squitter Types ON or OFF
- Configure data for Squitter Types 23, 28, 29, and 31

SQTR-2 Wide Area Multilateration Simulator (Option)

In addition to the synchronous and asynchronous interference capability of the SQTR-2, an optional capability is available for testing Wide Area Multilateration (WAM) systems. WAM systems locate aircraft by measuring the time of arrival (TOA) of transmissions at multiple points in space and calculating the time difference of arrival (TDOA) between receiver pairs. The WAM option allows simulation of RF transmissions from aircraft received at multiple points in space.

The SQTR-2 simulates transmissions received at 5 independent WAM receivers. The SQTR-2 automatically transmits messages at the correct TOA based on the three dimensional location of the targets and receivers. The timing accuracy between the true TOA calculated from the target's true position and receiver locations do not exceed +/- 10 ns.

The SQTR-2 can generate transmissions from 400 independent, moving targets. Each target can be configured to transmit Mode S DF 4, DF 5, DF 11, DF 17, DF 20, DF21 messages at a configurable rate. The SQTR-2 allows the test set operator to define 6 geographical waypoints for each tar-

get scenario and apply each waypoint to each target independently.

The SQTR-2 can be configured for output power from 0 to -70 dBm and frequency over 1090 +/- 3 MHz for each scenario.

The SQTR-2 can generate asynchronous interference on one RF channel. The asynchronous interference can be combined with the other five RF channels.

The SQTR-2 allows the test set operator to compile a GUI file into a Scenario File. The SQTR-2 allows the test set operator to retrieve a specific Scenario File. The operator can select type of display for location (decimal or deg/min/sec). The test set operator can set the cable loss between the SQTR-2 and the UUT.

WAM Target Setup

The Target Setup screen allows control of the test target parameters including:
- Target Mode S data - MS Address, Control Field for DF18, Aircraft Category, Flight ID, Weight on Wheels Capability, Inhibit Capability, COMM A/B Capability
- Target RF level and frequency.
- Target squitter control (Jitter or PRF)
- Scenario control
- Target position information – Lat/Long, Altitude, Heading, Ground Speed

WAM Target Enable

The Target Enable screen allows user to enable up to 400 targets.

WAM Event-Point Setup
The Event-Point Setup screen allows the user to program various events at specific times including:

- Event squitter data
- Ident, SQUAWK, and Alert events
- Turn Squitter Types ON or OFF
- Configure data for Squitter Types 23, 28, 29, and 31
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WAM Interference Setup

The Interference Setup Screen allows control of parameters for interference targets including:
- Channel ON/OFF control
- Frequency minimum and maximum value for each channel
- Number of ATCRBS, Mode S Long, or Mode S Short interference targets
- Average number of pulses for all interference target

SQTR-2 Specifications
Channel 0 Targets

Target Capacity
Synchronous Mode 0 to 1

Asynchronous Mode 0 to 250

RF Level[1]
Range	0 to -70 dBm
Resolution	1 dB
Accuracy	0.5 dB

Cable Loss
Range	0 to 3 dB
Resolution	0.1 dB
Accuracy	0.15 dB

RF Frequency[2]
Range	1090 ±3 MHz
Resolution	0.1 MHz
Accuracy	10 KHz

Pulse Timing
Rise Time	50 to 100 ns
Fall Time	50 to 200 ns
Width	500 ± 50 ns

Channel 1-5 Fruit

Fruit Capacity
Synchronous Mode	1 per channel, ATCRBS or Mode S
Asynchronous Mode	
ATCRBS	0 to 58,000 /s
Mode S	0 to 10,500 /s

RF Level[1]
Range	0 to -70 dBm per fruit
Resolution	1 dB
Accuracy	0.5 dB

Cable Loss
Range	0 to 3 dB
Resolution	0.1 dB
Accuracy	0.15 dB

RF Frequency[2]
Range	1090 ±3MHz per fruit
Resolution	0.1 MHz
Accuracy	10 KHz

Pulse Timing
ATCRBS
Rise Time	50 to 100 ns
Fall Time	50 to 200 ns
Width	450 ± 50 ns

Mode S
Rise Time	50 to 100 ns
Fall Time	50 to 200 ns
Width	500 ± 50 ns

Timing – Relative to Channel 0 in Synchronous Mode
Range	±120 µs
Resolution	1 µs
Accuracy	0.1 µs

Timing – Relative to Channel 0 in Asynchronous Mode

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Randomly generated to produce the programmed average fruit rate

External Inputs
Two Type N connectors - 1090 MHz signals applied to these connectors are combined with the internally generated signals and output the front panel RF Output connector.

WAM Option
RF Level, Cable Loss, RF Frequency, Pulse Timing same as above

Target Capacity   400 Moving Targets
        6 geographical waypoints per target

Differential TOA
  Number of signals   1 to 5[3]
  Range   0 to 2 ms
  Resolution   0.25 ns

Power Requirements – 110/220 VAC, 50 to 60 Hz, 100 W Max

1. Custom RF Level specifications are available by request
2. Custom RF Frequency specifications are available by request
3. Custom Number of Signals are available by request

SQTR-2U ADS-B Squitter Generator

The SQTR-2U provides capabilities and user control similar to SQTR-2 for performing interference testing of a UAT receiver. UAT targets can be setup via commands sent through the Ethernet port or via a graphical user interface (GUI).

The SQTR-2U performance specifications are as follows:

Standard Signals

Compliant with DO-282A change 1, DO-282B

ADS-B Payload types supported: 0-31 (Payload types 0, 1 automatically generated using GUI

RF pulse characteristics
  Carrier Frequency: 968 to 988 MHz ±10KHz
  Carrier harmonic level: ≤ -50dBc @≤ -3dBm
  Modulation: CPFSK with Modulation Index = 0.6 (This modulation format is simulated using a piece-wise frequency lookup table.)
  Frequency Deviation: ±280KHz min, ±345Kz max
  Message Envelope at 6bits before or after message: ≤ -20dBc

Message Envelope at 8bits before or after message: ≤ -50dBc
Unwanted Output Power: ≤-111dBm at 978MHz
RF Output Amplitude Range: 0dbm to -101 dBm in 1 dB steps
RF Output accuracy: ±0.5dB (@+25C ±5 deg)
Message Amplitude Variation: ±1dB max from beginning of message
Transmission scheduling: GPS coupled UTC timing to within ±500ns
Transmit Capacity: see 1.2.1, 1.2.2 and 1.2.3
Minimum Transmit Interval: UAT squitter times are calculated per the MOPS. For squitters that are scheduled to be transmitted in adjacent MSOs, the second squitter is delayed until the preceding squitter is transmitted.

Qualification Test Features

Capacity for Successful Message Reception
  Target Transmit capacity: 800 unique stationary targets per second
  Random mix of 20% Basic and 80% Long
  10 ms 'peak' interval with start time increasing by 100 ms

Synchronous Interference Transmit Capacity
  5 non-coherent channels
  Programmable Timing - ±120 us
  Programmable RF Level 0 dBm to -101 dBm
  Selectable Interference Type – Basic or Long

Asynchronous Interference Transmit Capacity
  5 non-coherent channels
  Up to 3,000 randomly placed interferers

SQTR-2B ADS-B Squitter Generator

The SQTR-2B provides same testing capabilities as SQTR-2 and SQTR-2U in the same test set.

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