SQTR-3B ADS-B SQUITTER GENERATOR

Generates 1090 MHz DF17/18/19 Squitters
Generates UAT Messages
Generates 1030 MHz ATCRBS and Mode S Interrogations

The SQTR-3B provides capability for generating the following signals:

- Simulation of forty-five (45) Mode S Squitters (10 moving and 35 stationary) at 1090 MHz
- Simulation of up to ten (10) UAT message (moving or stationary) at 978 MHz
- Simulation of 1030 MHz Interrogations (Modes A, C, Mode A/Mode S All Call, Mode C/Mode S All Call, and Mode S)

The SQTR-3B provides capability for generating scenarios for airborne targets transmitting data via ADS-B, either UAT messages or Mode S Squitters (DF-17/18/19). The SQTR-3B replaces a previous product called the SQTR-3. The signals generated by the SQTR-3B are compliant with signal requirements of:

- RTCA DO-185A
- ICAO Annex 10 Volume 4
- RTCA DO-260 (with change 1)
- RTCA DO-260A (with changes 1&2)
- RTCA DO-282A (with change 1)
- RTCA DO-260B
- RTCA DO-282B

The Waypoint data for each target can be set. The GPS position (latitude and longitude) of each target can be set to occur at a selected time. The SQTR-3B will generate the moving GPS position between each waypoint. The scenario can be set to run for a specific time or the SQTR-3B will continue to simulate a moving target after passing the last selected waypoint (unless a scenario run-time length is set in the System Setup screen.

Each target can be configured for specific event-points in which various actions can be programmed to occur. The actions that can be configured include:

- Event Squitter Data – Event-driven squitters
- Surveillance Status
  - Special Position Identification (18 second)
  - Permanent Emergency Alert (Alert)
  - Temporary Alert (Squawk)
- RF Level Offset from RF Level selected in System Setup screen (0 to +31 dB)
- Change status (change or unchanged) of Squitter types (DF 11 Acquisition, DF 17/18 Surface Position, DF17/18, DF17/18 Airborne Position, DF 17/18 Airborne Velocity, or DF17/18 Identification and Category) selected in 1090 Target Setup screen
- Encode data in Type 23 (Test), Type 28 (Aircraft Status), Type 29 (Target State), or Type 31 (Aircraft Operational Status) Squitters

Product Description

The SQTR-3B consists of two transmit channels, one for either 1030 or 1090 MHz and the second for UAT messages. Each of the two transmitter channels is controlled using an Ethernet connection.

The SQTR-3B contains an internal GPS receiver to obtain a 1 PPS trigger source. The SQTR-3B is supplied with an external GPS antenna.

The SQTR-3B can be controlled using a graphical user interface that allows limited control of the SQTR-3B functions or through the use of manual user commands that allows control of all test set functions. The manual user commands can be sent to the SQTR-3B using a freeware program called Tera Term Pro.

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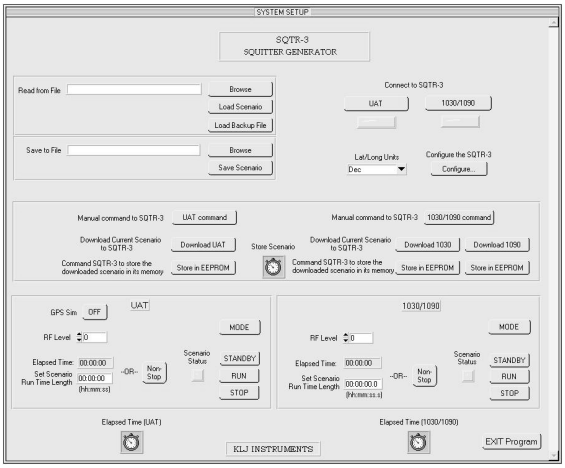
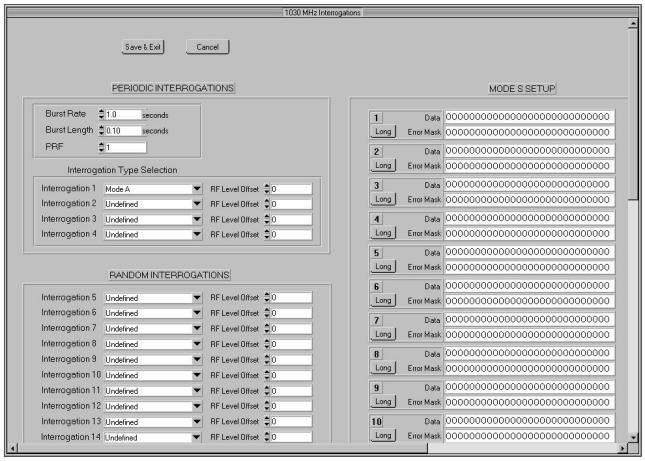
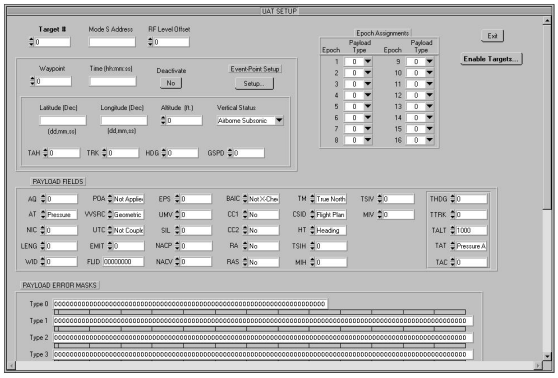




The System Setup screen allows user control of Ethernet connections for 1030 and 1090 board and UAT board, saving and recalling test setup, downloading of test parameters from the GUI, a data entry screen that allows manual entry of test parameters, and scenario controls.

The 1090 MHz Setup screen allows user control of target Mode S data, waypoint data, and error injection. Screen controls allow access to the Target Enable and the Event-Point Setup screens.



The UAT Setup screen provides user control of Target information including address, RF level offset, waypoint control, GPS position, Epoch assignments, payload fields, A/C intent, and error masks. User controls allow access to Target Enable and Event-Point Setup screens.

The 1030 MHz Interrogation screen provides user control of Interrogation type, burst rate, burst length, interrogation PRF, target data, and error masks.

Remote Commands

Scenarios can be created for each of the three functions using MS Notepad. After creating the scenario file, it can be downloaded to the SQTR-3B using Tera Term Pro Web.

The GUI is useful for learning the command format that is needed for creating a scenario file. Each time that a scenario is configured and downloaded from the GUI to the SQTR-3B (1030 MHz Interrogation, 1090 Squitters, or UAT messages); the SQTR-3B generates three files in the directory containing the SQTR-3B program. The three files (1030 commands, 1090 commands or UAT commands) can be used by a new user of the SQTR-3B to view an example of the structure of the commands used to generate a scenario. This is useful for learning how to manually program the SQTR-3B.

Specifications

1. **1030 MHz Interrogator Performance Characteristics**
   - 1.1. Compliance with DO-185A, ICAO Annex 10 Vol 4
   - 1.2. ATCRBS Interrogation Modes Supported - A, C, A/C All Call
   - 1.3. Mode S Interrogation UF types supported - 0-24
   - 1.4. RF pulse characteristics
     - 1.4.1. Carrier Frequency - 1030MHz +/-10KHz
     - 1.4.2. Carrier harmonic level - </= -50dBc @</= -3dBm
     - 1.4.3. Pulse Rise time - 50ns to 100ns
     - 1.4.4. Pulse Fall time - 50ns to 200ns
     - 1.4.5. P1, P2, P3 Pulse width – 800ns +/-100ns
     - 1.4.6. Pulse ON/OFF radio - >/= 50 dB
     - 1.4.7. Unwanted Output Power = < -83dBm at 1030MHz
     - 1.4.8. ATCRBS Mode P1 to P3 Spacing - 8 or 21us +/-200ns
     - 1.4.9. ATCRBS Mode P3 to P4 Spacing - 2us+/-50ns
     - 1.4.10. ATCRBS Mode P4 Pulse width – 0.8us or 1.6us +/-50ns
     - 1.4.11. Mode S P1 to P2 Spacing – 2us+/-50ns
     - 1.4.12. Mode S P2 to Sync Phase Reversal – 2.75us +/-50ns
     - 1.4.13. Mode S P6 to Sync Phase Reversal –1.25us +/-50ns
     - 1.4.14. Mode S Sync Phase Reversal to first data pulse – 500ns +/-20ns
     - 1.4.15. Mode S Data Chip duration – 250ns +/-20ns
     - 1.4.16. RF Output Amplitude Range - +13dBm to -73dBm in 1 dB steps
     - 1.4.17. RF Output accuracy - +/-0.5dB (@+25C +/-5 deg)
     - 1.4.18. Message Amplitude Variation - +/-1dB max from beginning of message
   - 1.5. Transmit capacity – 50 interrogations per second
   - 1.6. Minimum Transmit Interval – Minimum spacing between random interrogations is 200 microseconds. Periodic interrogations are spaced according to the PRF.
   - 1.7. Detected Modulation Accuracy - +/-5ns (referenced to a fixed delay from the 50% point on the leading edge of the output message)

2. **1090 MHz Squitter Generator Performance Characteristics**
   - 2.1. Compliant with RTCA DO-260 (chg 1), DO-260A (chg 1&2), DO-282B, DO-181D
   - 2.2. ADS-B message types supported – 0, 1, and 2
   - 2.3. Downlink Formats supported – DF11, DF17, DF18, DF19 (AF=0 only)
     - 2.3.1. version 0 – type codes 0-22 automatically generated using scripts(all other type codes generated via script command)
     - 2.3.2. version 1 - type codes 0-23, 28, 29, 31 automatically generated using scripts(all other type codes generated via script command)
     - 2.3.3. Version 2 - type codes 0-23, 28, 29, 31 automatically generated using scripts (all other type codes generated via script command)
     - 2.3.4. 1090 Version 1 Targets shall use the NIC, NICA, AT, and VS fields to automatically generate the position ME Type code
     - 2.3.5. 1090 Version 2 Targets shall use the NIC, NICA, NICB, NICC, AT, and VS fields to automatically generate the position ME Type code
   - 2.4. RF pulse characteristics
     - 2.4.1. Carrier Frequency - 1090MHz +/-10KHz
     - 2.4.2. Carrier harmonic level - </= -50dBc @</= -3dBm
     - 2.4.3. Pulse Rise time - 50ns to 100ns
     - 2.4.4. Pulse Fall time - 50ns to 200ns
     - 2.4.5. Pulse width – 0.5us or 1.0us +/-50ns
     - 2.4.6. Pulse ON/OFF radio - >/= 50 dB
     - 2.4.7. Unwanted Output Power = < -101dBm at 1090MHz
     - 2.4.8. Four Preamble Pulse Spacing - 1.0us, 3.5us, 4.5us +/-50ns
     - 2.4.9. First Preamble Pulse to First Data Pulse Spacing – 8us +/-50ns
     - 2.4.10. Message Pulse Spacing – Multiples of 500ns +/-50ns referenced to first Data Pulse
     - 2.4.11. RF Output Amplitude Range - 0dBm to -91dBm in 1 dB steps
     - 2.4.12. RF Output accuracy - +/-0.5dB (@+25C +/-5 deg)
     - 2.4.13. Message Amplitude Variation - +/-1dB max from beginning of message
   - 2.5. Transmit capacity – 10 targets per second (54 messages per second)
   - 2.6. Minimum Transmit Interval - 5ms
   - 2.7. Detected Modulation Accuracy - +/-5ns (referenced to a fixed delay from the 50% point on the leading edge of the output message)

3. **UAT ADS-B Generator Performance Characteristics**
   - 3.1. Compliant with DO-282A change 1 and DO-282B
   - 3.2. ADS-B Payload types supported – 0-31 (Payload types 0-6 are automatically populated with Element content per MOPS and non-waypoint and waypoint script commands)
   - 3.3. RF pulse characteristics
     - 3.3.1. Carrier Frequency - 978MHz +/-10KHz
     - 3.3.2. Carrier harmonic level - </= -50dBc @</= -3dBm
     - 3.3.3. Modulation – CPFSK with Modulation Index = 0.6 (This modulation format is simulated using a piece-wise frequency lookup table.)
     - 3.3.4. Frequency Deviation - +/-280KHz min, +/-345Kz max
     - 3.3.5. Message Envelope at 6bits before or after message - </= -20dBc
     - 3.3.6. Message Envelope at 8bits before or after message - </= -50dBc
     - 3.3.7. Unwanted Output Power = < -111dBm at 978MHz
     - 3.3.8. RF Output Range - 0 to -101dBm in 1 dB steps
     - 3.3.9. RF Output accuracy - +/-0.5dB (@+25C +/-5 deg)
     - 3.3.10. Message Amplitude Variation - +/-1dB max from beginning of message
   - 3.4. Transmission scheduling – GPS coupled UTC timing to within +/-500ns
   - 3.5. Transmit Capacity – 10 targets per second
   - 3.6. 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.
   - 3.7. Detected Modulation Accuracy - +/-5ns (referenced to a fixed delay from the 50% point on the leading edge of the output message)

4. **Physical Interface definition** (All connectors are on the front panel)
   - 4.1. Ethernet Ports
     - 4.1.1. 1030/1090 Control - One CAT-5 Ethernet connector
     - 4.1.2. UAT Control - One CAT-5 Ethernet connector

4.2. RF Output Ports
- 4.2.1. Combined 1030MHz and 1090MHz output
  - 4.2.1.1. Type N female connector
  - 4.2.1.2. Output Impedance – 50 Ohms nominal
  - 4.2.1.3. Maximum input for no damage - +23dBm
- 4.2.2. UAT (978MHz) Output
  - 4.2.2.1. Type N female connector
  - 4.2.2.2. Output Impedance – 50 Ohms nominal
  - 4.2.2.3. Maximum input for no damage - +23dBm
- 4.2.3. GPS Input
  - 4.2.3.1. Type N female connector
  - 4.2.3.2. Input Impedance – 50 Ohms nominal
  - 4.2.3.3. Max signal required for GPS Acquisition – </= -135dBm
  - 4.2.3.4. Max signal level required to maintain GPS lock - </= -140dBm
  - 4.2.3.5. DC Bias on center conductor - +3.3VDC +/- 0.3VDC
  - 4.2.3.6. DC Bias source current @3.3VDC - >/= 55mA

4.3. Video Ports (Detected amplitude modulation of RF output used to verify transmission)
- 4.3.1. 1030/1090 Video Port
  - 4.3.1.1. BNC female connector
  - 4.3.1.2. Voltage Range - 1.5 to 3.5 Vpp when RF Level >/=-75dBm, 0.1 to 0.4 Vpp when RF Level < -75dBm
  - 4.3.1.3. Output Impedance - 10KOhms
- 4.3.2. UAT Video Port (Analog detected AM of transmit envelope - does not demodulate FSK data)
  - 4.3.2.1. BNC female connector
  - 4.3.2.2. Voltage Range - 1.5 to 3.5 Vpp when RF Level >/=-75dBm, 0.1 to 0.4 Vpp when RF Level < -75dBm
  - 4.3.2.3. Output Impedance - 10KOhms

4.4. Scope Sync Ports (One microsecond pulse synchronized to leading edge of first pulse for 1030/1090ES, and middle of first sync bit for UAT. This output is used to measure events related to the RF modulation to within +/-5ns)
- 4.4.1. 1030/1090 Scope Sync Port
  - 4.4.1.1. BNC female connector
  - 4.4.1.2. Voltage Range - 2.0 V to 3.0 Vpp into 50 Ohms
  - 4.4.1.3. Output Impedance - 50 Ohms
- 4.4.2. UAT Scope Sync Port
  - 4.4.2.1. BNC female connector
  - 4.4.2.2. Voltage Range - 2.0 V to 3.0 Vpp into 50 Ohms
  - 4.4.2.3. Output Impedance - 50 Ohms

4.5. DC Power Port
- 4.5.1. Connector Type 2.1mm ID/5.5mm OD, center positive
- 4.5.2. Input Voltage - 115 VAC, 50/60 Hz
- 4.5.3. Power Consumption - 15 Watts max

4.6. Front Panel LEDs
- 4.6.1. 1030/1090 RPLY - lights when a 1090ES Squitter output is commanded
- 4.6.2. 1030/1090 INTR - lights when controlled 1030 interrogation is commanded
- 4.6.3. UAT RPLY - lights when a UAT ADS-B Message output is commanded