



Constant Temperature Test – Mod State 0 and 1 Comparison

| Parameters to be Measured | Range of Specification | Units | Test Results | | Comments |
|--|------------------------|-----------|-----------------------|-----------------------|----------|
| | | | Tamb (MS0) (+21°C) | Tamb (MS1) (+21°C) | |
| 1. Power Output | | | | | |
| Model: S/N: 000005, TUV Ref: TSR005 and Modification State 0 (Ambient Only) | | | | | |
| Model: S/N: 000005, TUV Ref: TSR005 and Modification State 1 (Ambient Only) | | | | | |
| Transmitter power output (maximum) (minimum) | 35 - 39 | dBm | 36.43 36.39 | 36.63 36.49 | |
| Power output rise time (maximum) (minimum) | < 5 | ms | 0.43 0.42 | 0.45 0.41 | |
| Power output 1ms before burst (maximum) (minimum) | < -10 | dBm | -32.88 -33.26 | -31.47 -32.01 | |
| 2. Digital Message Coding | | | | | |
| Model: S/N: 000005, TUV Ref: TSR005 and Modification State 0 (Ambient Only) | | | | | |
| Model: S/N: 000005, TUV Ref: TSR005 and Modification State 1 (Ambient Only) | | | | | |
| Bit Sync | 1 - 15 | P / F | P | P | |
| Frame sync | 16 - 24 | P / F | P | P | |
| Format flag | 25 | bit value | 1 | 1 | |
| Protocol flag | 26 | bit value | 0 | 0 | |
| Identification / position data | 27 - 85 | P / F | P | P | |
| BCH code | 86 -106 | P / F | P | P | |
| Emerg. Code/nat. use/supplem. Data | 107 - 112 | bit value | 111000 | 111000 | |
| Additional data / BCH (if applicable) | 112 - 144 | P / F | P | P | |
| Position Error (if applicable) | | km | N/A | N/A | |
| Result: Pass | | | | | |



| Parameters to be Measured | Range of Specification | Units | Test Results | | Comments |
|---|---|----------|------------------|------------------|----------|
| | | | Tamb (MS0) | Tamb (MS1) | |
| | | | (+21°C) | (+21°C) | |
| 3. Digital Message Generator | | | | | |
| Model: S/N: 000005, TUV Ref: TSR005 and Modification State 0 (Ambient Only) | | | | | |
| Model: S/N: 000005, TUV Ref: TSR005 and Modification State 1 (Ambient Only) | | | | | |
| Repetition rate, T_R : | | | | | |
| Average T_R | $48.5 \leq T_{Ravg} \leq 51.5$ | seconds | 50.220 | 50.538 | |
| Minimum T_R | $47.5 \leq T_{Rmin} \leq 48.0$ | seconds | 47.518 | 48.000 | |
| Maximum T_R | $52.0 \leq T_{Rmax} \leq 52.5$ | seconds | 52.120 | 52.109 | |
| Standard deviation | $0.5 - 2.0$ | seconds | 1.48 | 1.33 | |
| Bit rate | | | | | |
| Minimum fb | ≥ 399.6 | bits/sec | 399.97 | 399.96 | |
| Maximum fb | ≤ 400.4 | bits/sec | 399.98 | 399.99 | |
| Total transmission time | | | | | |
| Short message | (maximum) (minimum) $435.6 - 444.4$ | ms | - - | - - | |
| Long message | (maximum) (minimum) $514.8 - 525.2$ | ms | 520.18 520.13 | 520.10 520.03 | |
| Unmodulated carrier | | | | | |
| Minimum T1 | ≥ 158.4 | ms | 160.74 | 160.68 | |
| Maximum T1 | ≤ 161.6 | ms | 160.81 | 160.76 | |
| First burst delay | ≥ 47.5 | seconds | 56 | 56 | |

Result: Pass



| Parameters to be Measured | Range of Specification | Units | Test Results | | Comments |
|--|-----------------------------|----------|--------------|-------------|----------|
| | | | Tamb (MS0) | Tamb (MS1) | |
| | | | (+21°C) | | |
| 4. Modulation | | | | | |
| Model: S/N: 000005, TUV Ref: TSR005 and Modification State 0 (Ambient Only) | | | | | |
| Model: S/N: 000005, TUV Ref: TSR005 and Modification State 1 (Ambient Only) | | | | | |
| Biphase-L | P / F | P / F | P | P | |
| Rise time (maximum) | 50 - 250 | µs | 206.4 | 198.3 | |
| Rise time (minimum) | 50 - 250 | µs | 179.3 | 178.3 | |
| Fall time (maximum) | 50 - 250 | µs | 223.6 | 216.6 | |
| Fall time (minimum) | 50 - 250 | µs | 198.7 | 197.7 | |
| Phase deviation: positive (maximum) | +(1.0 to 1.2) | radians | 1.1487 | 1.1541 | |
| Phase deviation: positive (minimum) | +(1.0 to 1.2) | radians | 1.0315 | 1.0286 | |
| Phase deviation: negative (maximum) | -(1.0 to 1.2) | radians | -1.1625 | -1.1579 | |
| Phase deviation: negative (minimum) | -(1.0 to 1.2) | radians | -1.0397 | -1.0242 | |
| Symmetry measurement | ≤ 0.05 | | 0.0266 | 0.0270 | |
| 5. 406 MHz Transmitted Frequency | | | | | |
| Model: S/N: 000005, TUV Ref: TSR005 and Modification State 0 (Ambient Only) | | | | | |
| Model: S/N: 000005, TUV Ref: TSR005 and Modification State 1 (Ambient Only) | | | | | |
| Nominal Value (maximum) | C/S T.001 | MHz | 406.0310506 | 406.0310726 | |
| Nominal Value (minimum) | | | 406.0310501 | 406.0310721 | |
| Short-term stability (maximum) | ≤ 2x10 ⁻⁹ | /100ms | 47.308E-11 | 45.392E-11 | |
| Short-term stability (minimum) | | | 43.790E-11 | 43.211E-11 | |
| Medium-term stability – Slope (maximum) | (-1 to +1)x10 ⁻⁹ | /minutes | 45.534E-12 | 26.376E-12 | |
| Medium-term stability – Slope (minimum) | | | -19.716E-11 | -15.906E-11 | |
| Medium-term stability – Residual frequency variation (maximum) | ≤ 3x10 ⁻⁹ | | 68.044E-11 | 73.917E-11 | |
| Medium-term stability – Residual frequency variation (minimum) | | | 35.530E-11 | 42.224E-11 | |
| Result: Pass | | | | | |



Battery Current Measurement Comparison – Mod_State 0 to Mod_State 1

RLS

| Operating Mode | Modification State 0 Average Current (mA) | Modification State 1 Average Current (mA) | % Difference Mod State 0 to 1 |
|------------------------------|--|--|----------------------------------|
| A2, On at Main, GNSS Average | 52.55 | 52.18 | -0.70 |
| A3, On at Main, GNSS Sleep | 43.61 | 42.87 | -1.70 |
| A4, On at Main, GNSS Search | 54.83 | 54.47 | -0.66 |
| A7, Self-test | 77.9 | 78.24 | 0.44 |

SLP

| Operating Mode | Modification State 0 Average Current (mA) | Modification State 1 Average Current (mA) | % Difference Mod State 0 to 1 |
|------------------------------|--|--|----------------------------------|
| A2, On at Main, GNSS Average | 52 | 51.32 | -1.31 |
| A3, On at Main, GNSS Sleep | 40.85 | 40.2 | -1.59 |
| A4, On at Main, GNSS Search | 54.3 | 54.04 | -0.48 |
| A5, Self-test | 76.63 | 77.2 | 0.74 |

Summary

The measurements above demonstrate that the changes to the modification states do not significantly affect the operational life of the EUT.



Constant Temperature Test – Mod State 1, 2 and 3 Comparison

| Parameters to be Measured | Range of Specification | Units | Test Results | | | Comments |
|--|-----------------------------------|-----------|-----------------------|-----------------------|-----------------------|----------|
| | | | Tamb (MS1) (+21°C) | Tamb (MS2) (+21°C) | Tamb (MS3) (+21°C) | |
| 1. Power Output | | | | | | |
| Model: S/N: 000005, TUV Ref: TSR005 and Modification State 1 (Ambient Only) | | | | | | |
| Model: S/N: 000005, TUV Ref: TSR005 and Modification State 2 (Ambient Only) | | | | | | |
| Model: S/N: 000005, TUV Ref: TSR005 and Modification State 3 (Ambient Only) | | | | | | |
| Transmitter power output | (maximum) 35 - 39 (minimum) | dBm | 36.63 | 36.37 | 36.57 | |
| | | | 36.49 | 36.32 | 36.44 | |
| Power output rise time | (maximum) < 5 (minimum) | ms | 0.45 | 0.36 | 0.34 | |
| | | | 0.41 | 0.35 | 0.33 | |
| Power output 1ms before burst | (maximum) < -10 (minimum) | dBm | -31.47 | -28.01 | -26.85 | |
| | | | -32.01 | -31.76 | -41.93 | |
| 2. Digital Message Coding | | | | | | |
| Model: S/N: 000005, TUV Ref: TSR005 and Modification State 1 (Ambient Only) | | | | | | |
| Model: S/N: 000005, TUV Ref: TSR005 and Modification State 2 (Ambient Only) | | | | | | |
| Model: S/N: 000005, TUV Ref: TSR005 and Modification State 3 (Ambient Only) | | | | | | |
| Bit Sync | 1 - 15 | P / F | P | P | P | |
| Frame sync | 16 - 24 | P / F | P | P | P | |
| Format flag | 25 | bit value | 1 | 1 | 1 | |
| Protocol flag | 26 | bit value | 0 | 0 | 0 | |
| Identification / position data | 27 - 85 | P / F | P | P | P | |
| BCH code | 86 - 106 | P / F | P | P | P | |
| Emerg. Code/nat. use/supplem. Data | 107 - 112 | bit value | 11000 | 11000 | 11000 | |
| Additional data / BCH (if applicable) | 112 - 144 | P / F | P | P | P | |
| Position Error (if applicable) | < 5 | km | N/A | N/A | N/A | |
| Result: Pass | | | | | | |



| Parameters to be Measured | Range of Specification | Units | Test Results | | | Comments |
|--|---|----------|-----------------------|-----------------------|-----------------------|----------|
| | | | Tamb (MS1) (+21°C) | Tamb (MS2) (+21°C) | Tamb (MS3) (+21°C) | |
| 3. Digital Message Generator | | | | | | |
| Model: S/N: 000005, TUV Ref: TSR005 and Modification State 1 (Ambient Only) | | | | | | |
| Model: S/N: 000005, TUV Ref: TSR005 and Modification State 2 (Ambient Only) | | | | | | |
| Model: S/N: 000005, TUV Ref: TSR005 and Modification State 3 (Ambient Only) | | | | | | |
| Repetition rate, T_R : | | | | | | |
| Average T_R | $48.5 \leq T_{Ravg} \leq 51.5$ | seconds | 50.54 | 50.51 | 50.48 | |
| Minimum T_R | $47.5 \leq T_{Rmin} \leq 48.0$ | seconds | 48.00 | 48.00 | 47.99 | |
| Maximum T_R | $52.0 \leq T_{Rmax} \leq 52.5$ | seconds | 52.11 | 52.28 | 52.11 | |
| Standard deviation | $0.5 - 2.0$ | seconds | 1.33 | 1.44 | 1.40 | |
| Bit rate | | | | | | |
| Minimum fb | ≥ 399.6 | bits/sec | 399.96 | 399.96 | 399.91 | |
| Maximum fb | ≤ 400.4 | bits/sec | 399.99 | 399.98 | 400.00 | |
| Total transmission time | | | | | | |
| Short message | (maximum) $435.6 - 444.4$ (minimum) | - | - | - | - | |
| Long message | (maximum) $514.8 - 525.2$ (minimum) | ms | 520.18 | 520.25 | 519.63 | |
| Unmodulated carrier | | ms | 520.13 | 520.17 | 519.61 | |
| Minimum T1 | ≥ 158.4 | ms | 160.68 | 160.76 | 160.41 | |
| Maximum T1 | ≤ 161.6 | ms | 160.76 | 160.82 | 160.43 | |
| First burst delay | ≥ 47.5 | seconds | 56 | 56 | 56 | |

Result: Pass



| Parameters to be Measured | Range of Specification | Units | Test Results | | | Comments |
|--|-------------------------------|----------|-----------------------|-----------------------|-----------------------|----------|
| | | | Tamb (MS1) (+21°C) | Tamb (MS2) (+21°C) | Tamb (MS3) (+21°C) | |
| 4. Modulation | | | | | | |
| Model: S/N: 000005, TUV Ref: TSR005 and Modification State 1 (Ambient Only) | | | | | | |
| Model: S/N: 000005, TUV Ref: TSR005 and Modification State 2 (Ambient Only) | | | | | | |
| Model: S/N: 000005, TUV Ref: TSR005 and Modification State 3 (Ambient Only) | | | | | | |
| Biphase-L | P / F | P / F | P | P | P | |
| Rise time | (maximum) 50 - 250 | µs | 198.3 | 200.4 | 195.1 | |
| | (minimum) 50 - 250 | µs | 178.3 | 178.3 | 162.3 | |
| Fall time | (maximum) 50 - 250 | µs | 216.6 | 217.6 | 210.1 | |
| | (minimum) 50 - 250 | µs | 197.7 | 196.6 | 183.4 | |
| Phase deviation: positive | (maximum) +(1.0 to 1.2) | radians | 1.1541 | 1.1661 | 1.138 | |
| | (minimum) +(1.0 to 1.2) | radians | 1.0286 | 1.0270 | 1.034 | |
| Phase deviation: negative | (maximum) -(1.0 to 1.2) | radians | -1.1579 | -1.1692 | -1.161 | |
| | (minimum) -(1.0 to 1.2) | radians | -1.0242 | -1.0393 | -1.048 | |
| Symmetry measurement | ≤ 0.05 | | 0.0266 | 0.0266 | 0.0224 | |
| 5. 406 MHz Transmitted Frequency | | | | | | |
| Model: S/N: 000005, TUV Ref: TSR005 and Modification State 1 (Ambient Only) | | | | | | |
| Model: S/N: 000005, TUV Ref: TSR005 and Modification State 2 (Ambient Only) | | | | | | |
| Model: S/N: 000005, TUV Ref: TSR005 and Modification State 3 (Ambient Only) | | | | | | |
| Nominal Value | C/S T.001 | MHz | 406.0310726 | 406.0310720 | 406.0310776 | |
| | (maximum) (minimum) | | 406.0310721 | 406.0310711 | 406.0310760 | |
| Short-term stability | ≤ 2x10 ⁻⁹ | /100ms | 45.392E-11 | 40.067E-11 | 5.83E-10 | |
| | (maximum) (minimum) | | 43.211E-11 | 36.491E-11 | 5.49E-10 | |
| Medium-term stability – Slope | (-1 to +1) x 10 ⁻⁹ | /minutes | 26.376E-12 | 17.519E-12 | -1.66E-10 | |
| | (maximum) (minimum) | | -15.906E-11 | -24.155E-11 | -3.33E-10 | |
| Medium-term stability – Residual frequency variation | ≤ 3x10 ⁻⁹ | | 73.917E-11 | 71.899E-11 | 7.69E-10 | |
| | (maximum) (minimum) | | 42.224E-11 | 43.371E-11 | 3.62E-10 | |
| Result: Pass | | | | | | |



Battery Current Measurement Comparison – Mod States 0, 1, 2 and 3

| Operating Mode | Modification State 0 Average Current (mA) | Modification State 1 Average Current (mA) | Modification State 2 Average Current (mA) | Modification State 3 Average Current (mA) | % Difference Max value to Min value |
|------------------------------|--|--|--|--|--|
| RLS | | | | | |
| A2, On at Main, GNSS Average | 52.18 | 52.18 | 50.77 | 51.07 | 2.77 |
| A3, On at Main, GNSS Sleep | 42.87 | 42.87 | 41.73 | 42.56 | 2.73 |
| A4, On at Main, GNSS Search | 54.47 | 54.47 | 53.65 | 53.44 | 1.92 |
| A7, Self-test | 78.24 | 78.24 | 77.65 | 78.09 | 0.75 |
| A8, GNSS Self-Test (Burst) | 34.73 | - | - | 34.07 | 1.93 |
| A9, GNSS Self-Test (Timeout) | 30.5 | - | - | 28.85 | 5.71 |

The percentage difference of operating mode A9 is due to Modification State 3 having a slightly longer GNSS Self-Test. This is because the measurement that was performed in Modification State 0 had a lower amount of GNSS Self-Tests remaining so the EUTs indications didn't display the maximum amount. If the A9 operating mode, performed in Modification State 3, was measured over the same duration then the average current is comparable.

Summary

The measurements above demonstrate that the changes to the modification states do not significantly affect the operational life of the EUT.