



Constant Temperature Test – Mod State 0 and 1 Comparison

Parameters to be Measured	Range of Specification	Units	Test Results		Comments
			Tamb (MS0)	Tamb (MS1)	
			(+21°C)	(+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) 35 - 39 (minimum)	dBm	36.43 36.39	36.63 36.49	
Power output rise time	(maximum) < 5 (minimum)	ms	0.43 0.42	0.45 0.41	
	(maximum) < -10 (minimum)	dBm	-32.88 -33.26	-31.47 -32.01	
Result: Pass					
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	15 bits "1"	P / F	P	P
Frame sync	16 - 24	"000101111"	P / F	P	P
Format flag	25	1 bit	bit value	1	1
Protocol flag	26	1 bit	bit value	0	0
Identification / position data	27 - 85	59 bits	P / F	P	P
	86 -106	21 bits	P / F	P	P
BCH code					
Emerg. Code/nat. use/supplem. Data	107 - 112	6 bits	111000	111000	111000
Additional data / BCH (if applicable)	112 - 144	32 bits	P / F	P	P
		< 5	km	N/A	N/A
Position Error (if applicable)					
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 ≤ T _{Ravg} ≤ 51.5	seconds	50.220	50.538	
Minimum T _R	47.5 ≤ T _{Rmin} ≤ 48.0	seconds	47.518	48.000	
Maximum T _R	52.0 ≤ T _{Rmax} ≤ 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)	(+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	P	
Rise time	(maximum)	50 - 250	206.4	198.3	
	(minimum)	50 - 250	179.3	178.3	
Fall time	(maximum)	50 - 250	223.6	216.6	
	(minimum)	50 - 250	198.7	197.7	
Phase deviation: positive	(maximum)	+(1.0 to 1.2)	1.1487	1.1541	
	(minimum)	+(1.0 to 1.2)	1.0315	1.0286	
Phase deviation: negative	(maximum)	-(1.0 to 1.2)	-1.1625	-1.1579	
	(minimum)	-(1.0 to 1.2)	-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) (minimum)	C/S T.001	MHz	406.0310506 406.0310501	406.0310726 406.0310721
Short-term stability	(maximum) (minimum)	≤ 2x10 ⁻⁹	/100ms	47.308E-11 43.790E-11	45.392E-11 43.211E-11
Medium-term stability – Slope	(maximum) (minimum)	(-1 to +1)x10 ⁻⁹	/minutes	45.534E-12 -19.716E-11	26.376E-12 -15.906E-11
Medium-term stability – Residual frequency variation	(maximum) (minimum)	≤ 3x10 ⁻⁹		68.044E-11 35.530E-11	73.917E-11 42.224E-11
Result: Pass					

Battery Current Measurement Comparison – Mod State 0 to Mod State 1

RLS

Operating Mode	Modification State 0	Modification State 1	% Difference
	Average Current (mA)	Average Current (mA)	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	Modification State 1	% Difference
	Average Current (mA)	Average Current (mA)	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) (minimum)	35 - 39	36.63 36.49	36.37 36.32	36.57 36.44	
Power output rise time	(maximum) (minimum)	< 5	0.45 0.41	0.36 0.35	0.34 0.33	
Power output 1ms before burst	(maximum) (minimum)	< -10	-31.47 -32.01	-28.01 -31.76	-26.85 -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	15 bits "1"	P	P	P	
Frame sync	16 - 24	"000101111"	P	P	P	
Format flag	25	1 bit	1	1	1	
Protocol flag	26	1 bit	0	0	0	
Identification / position data	27 - 85	59 bits	P	P	P	
BCH code	86 -106	21 bits	P	P	P	
Emerg. Code/nat. use/supplem. Data	107 - 112	6 bits	111000	111000	111000	
Additional data / BCH (if applicable)	112 - 144	32 bits	P	P	P	
Position Error (if applicable)		< 5	N/A	N/A	N/A	
Result: Pass						



Parameters to be Measured	Range of Specification	Units	Test Results			Comments
			Tamb (MS1)	Tamb (MS2)	Tamb (MS3)	
			(+21°C)	(+21°C)	(+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 ≤ T _{Rawg} ≤ 51.5	seconds	50.54	50.51	50.48	
Minimum T _R	47.5 ≤ T _{Rmin} ≤ 48.0	seconds	48.00	48.00	47.99	
Maximum T _R	52.0 ≤ T _{Rmax} ≤ 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)	-	-	-	-	
	(minimum)	-	-	-	-	
Long message	(maximum)	ms	520.18	520.25	519.63	
	(minimum)	ms	520.13	520.17	519.61	
Unmodulated carrier						
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)	Tamb (MS2)	Tamb (MS3)	
			(+21°C)	(+21°C)	(+21°C)	
4. Modulation						Result: Pass
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	198.3	200.4	195.1	
	(minimum)	50 - 250	178.3	178.3	162.3	
Fall time	(maximum)	50 - 250	216.6	217.6	210.1	
	(minimum)	50 - 250	197.7	196.6	183.4	
Phase deviation: positive	(maximum)	+(1.0 to 1.2)	1.1541	1.1661	1.138	
	(minimum)	+(1.0 to 1.2)	1.0286	1.0270	1.034	
Phase deviation: negative	(maximum)	-(1.0 to 1.2)	-1.1579	-1.1692	-1.161	
	(minimum)	-(1.0 to 1.2)	-1.0242	-1.0393	-1.048	
Symmetry measurement		≤ 0.05	0.0266	0.0266	0.0224	
5. 406 MHz Transmitted Frequency						Result: Pass
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	(maximum) (minimum)	C/S T.001	406.0310726 406.0310721	406.0310720 406.0310711	406.0310776 406.0310760	
Short-term stability	(maximum) (minimum)	≤ 2x10 ⁻⁹ /100ms	45.392E-11 43.211E-11	40.067E-11 36.491E-11	5.83E-10 5.49E-10	
Medium-term stability – Slope	(maximum) (minimum)	(-1 to +1)x10 ⁻⁹ /minutes	26.376E-12 -15.906E-11	17.519E-12 -24.155E-11	-1.66E-10 -3.33E-10	
Medium-term stability – Residual frequency variation	(maximum) (minimum)	≤ 3x10 ⁻⁹	73.917E-11 42.224E-11	71.899E-11 43.371E-11	7.69E-10 3.62E-10	



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

Operating Mode	Modification State 0	Modification State 1	Modification State 2	Modification State 3	% Difference
RLS	Average Current (mA)	Average Current (mA)	Average Current (mA)	Average Current (mA)	Max value to Min value
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.