

14. FREQUENCY STABILITY / VARIATION OF AMBIENT TEMPERATURE

14.1 PROVISIONS APPLICABLE

14.1.1 For Hand carried battery powered equipment

Frequency stability testing is performed in accordance with the guidelines of ANSI/TIA-603-E-2016. The frequency stability of the transmitter is measured by:

- a.) Temperature: The temperature is varied from -30°C to +50°C in 10°C increments using an environmental chamber.
- b.) Primary Supply Voltage: The primary supply voltage is varied from 85% to 115% of the nominal value for non hand-carried battery and AC powered equipment. For hand-carried, battery-powered equipment, primary supply voltage is reduced to the battery operating end point which shall be specified by the manufacturer.

For Part 22, the frequency stability of the transmitter shall be maintained within $\pm 0.00025\%$ (± 2.5 ppm) of the center frequency. For Part 24 and Part 27, the frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block.

14.1.2 For equipment powered by primary supply voltage

- 1 The carrier frequency of the transmitter is measured at room temperature (20°C to provide a
- 2 reference).
- 3 The equipment is turned on in a “standby” condition for fifteen minutes before applying power to
- 4 the transmitter. Measurement of the carrier frequency of the transmitter is made within one minute after applying power to the transmitter.
- 5 Frequency measurements are made at 10°C intervals ranging from -30°C to +50°C. A period of at
- 6 least one half-hour is provided to allow stabilization of the equipment at each temperature level.

14.2 MEASUREMENT METHOD

In order to measure the carrier frequency under the condition of AFC lock, it is necessary to make measurements with the EUT in a “call mode”. This is accomplished with the use of R&S CMW500 DIGITAL RADIO COMMUNICATION TESTER.

- 7 Measure the carrier frequency at room temperature.
- 8 Subject the EUT to overnight soak at -20°C. With the EUT, powered via nominal voltage, connected to the CMW500 and in a simulated call on channel 20175 for LTE band 4 measure the carrier frequency. These measurements should be made within 2 minutes of Powering up the EUT, to prevent significant self-warming.
- 9 Repeat the above measurements at 10°C increments from -20°C to +50°C. Allow at least 1 1/2 hours at each temperature, unpowered, before making measurements.
- 10 Re-measure carrier frequency at room temperature with nominal voltage. Vary supply voltage from

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minimum voltage to maximum voltage, in 0.1Volt increments re-measuring carrier frequency at each voltage. Pause at nominal voltage for 1 1/2 hours unpowered, to allow any self-heating to stabilize, before continuing.

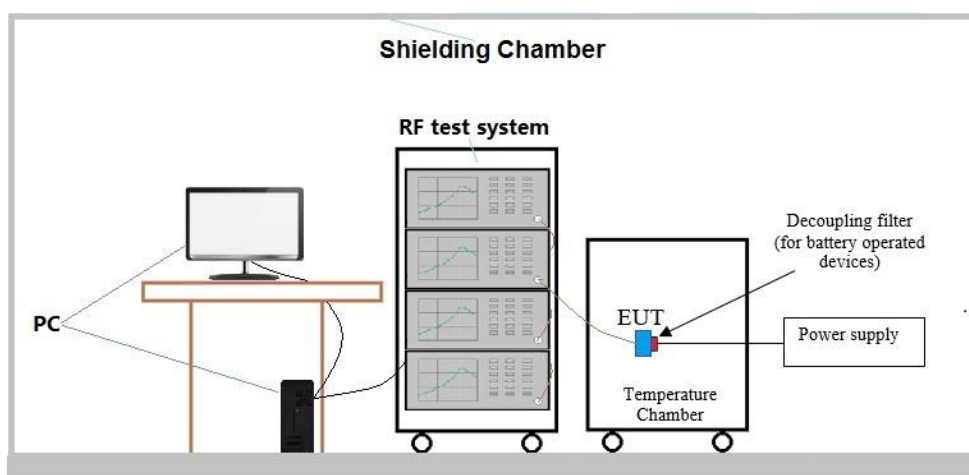
11 Subject the EUT to overnight soak at +50°C.

12 With the EUT, powered via nominal voltage, connected to the CMW500 and in a simulated call on the centre channel, measure the carrier frequency. These measurements should be made within 2 minutes of Powering up the EUT, to prevent significant self-warming.

13 Repeat the above measurements at 10°C increments from +50°C to -30°C. Allow at least 1 1/2 hours at each temperature, unpowered, before making measurements.

14 At all temperature levels hold the temperature to +/- 0.5°C during the measurement procedure.

14.3 MEASUREMENT SETUP



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13.4 MEASUREMENT RESULT

Frequency Error vs. Voltage:

Test Band	Test Mode	Test Channel	Test Temp.	Test Volt.(V)	Freq.Error (Hz)	Freq.vs.rated (ppm)	Limit (ppm)	Verdict
GSM850	GSM	LCH	TN	VL	-12.66	-0.015360	±2.5	PASS
			TN	VN	-11.43	-0.013868	±2.5	PASS
			TN	VH	-14.92	-0.018102	±2.5	PASS
		MCH	TN	VL	-12.46	-0.014894	±2.5	PASS
			TN	VN	-13.37	-0.015981	±2.5	PASS
			TN	VH	-13.30	-0.015898	±2.5	PASS
		HCH	TN	VL	-15.82	-0.018638	±2.5	PASS
			TN	VN	-20.47	-0.024116	±2.5	PASS
			TN	VH	-20.99	-0.024729	±2.5	PASS

Test Band	Test Mode	Test Channel	Test Temp.	Test Volt.(V)	Freq.Error (Hz)	Freq.vs.rated (ppm)	Limit (ppm)	Verdict
GSM850	GPRS	LCH	TN	VL	-0.90	-0.001092	±2.5	PASS
			TN	VN	-3.68	-0.004465	±2.5	PASS
			TN	VH	-4.13	-0.005011	±2.5	PASS
		MCH	TN	VL	-14.33	-0.017129	±2.5	PASS
			TN	VN	-16.27	-0.019448	±2.5	PASS
			TN	VH	-14.85	-0.017750	±2.5	PASS
		HCH	TN	VL	-12.91	-0.015210	±2.5	PASS
			TN	VN	-10.59	-0.012476	±2.5	PASS
			TN	VH	-8.59	-0.010120	±2.5	PASS

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Test Band	Test Mode	Test Channel	Test Temp.	Test Volt. (V)	Freq.Error (Hz)	Freq.vs.rated (ppm)	Verdict
PCS1900	GSM	LCH	TN	VL	-15.95	-0.008621	PASS
			TN	VN	-13.04	-0.007048	PASS
			TN	VH	-12.01	-0.006491	PASS
		MCH	TN	VL	-13.04	-0.006936	PASS
			TN	VN	-14.08	-0.007489	PASS
			TN	VH	-12.66	-0.006734	PASS
		HCH	TN	VL	4.33	0.002267	PASS
			TN	VN	5.10	0.002670	PASS
			TN	VH	5.62	0.002943	PASS

Test Band	Test Mode	Test Channel	Test Temp.	Test Volt. (V)	Freq.Error (Hz)	Freq.vs.rated (ppm)	Verdict
PCS1900	GPRS	LCH	TN	VL	-17.43	-0.009421	PASS
			TN	VN	-9.36	-0.005059	PASS
			TN	VH	-9.30	-0.005026	PASS
		MCH	TN	VL	-0.65	-0.000346	PASS
			TN	VN	-10.01	-0.005324	PASS
			TN	VH	-4.52	-0.002404	PASS
		HCH	TN	VL	0.90	0.000471	PASS
			TN	VN	3.94	0.002063	PASS
			TN	VH	6.52	0.003414	PASS

Note: Based on the results of the frequency stability test at the center channel the frequency deviation results measured are very small. As such it is determined that channels at the band edge would remain in-band when the maximum measured frequency deviation noted during the frequency stability tests is applied. Therefore the device is determined to remain operating in band over the temperature and voltage range as tested.

Frequency Error vs. Temperature:

Test Band	Test Mode	Test Channel	Test Volt.	Test Tem. (°C)	Freq.Error (Hz)	Freq.vs.rated (ppm)	Limit (ppm)	Verdict
GSM850	GSM	LCH	VN	-10	-13.30	-0.016137	±2.5	PASS
			VN	0	-12.46	-0.015118	±2.5	PASS
			VN	10	-14.85	-0.018017	±2.5	PASS
			VN	20	-15.05	-0.018260	±2.5	PASS
			VN	30	-15.17	-0.018406	±2.5	PASS
			VN	40	-14.85	-0.018017	±2.5	PASS
GSM850	GSM	MCH	VN	-10	-16.85	-0.020444	±2.5	PASS
			VN	0	-16.14	-0.019583	±2.5	PASS
			VN	10	-17.18	-0.020844	±2.5	PASS
			VN	20	-14.53	-0.017368	±2.5	PASS
			VN	30	-14.21	-0.016985	±2.5	PASS
			VN	40	-16.47	-0.019687	±2.5	PASS
GSM850	GSM	HCH	VN	-10	-16.66	-0.019914	±2.5	PASS
			VN	0	-14.14	-0.016902	±2.5	PASS
			VN	10	-14.14	-0.016902	±2.5	PASS
			VN	20	-15.69	-0.018754	±2.5	PASS
			VN	30	-16.21	-0.019376	±2.5	PASS
			VN	40	-17.31	-0.020691	±2.5	PASS

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GSM850	GPRS	LCH	VN	-30	-3.55	-0.004307	±2.5	PASS
			VN	-20	-1.36	-0.001650	±2.5	PASS
			VN	-10	-4.39	-0.005326	±2.5	PASS
			VN	0	-1.81	-0.002196	±2.5	PASS
			VN	10	-1.94	-0.002354	±2.5	PASS
			VN	20	-3.68	-0.004465	±2.5	PASS
			VN	30	-1.49	-0.001808	±2.5	PASS
			VN	40	-6.01	-0.007292	±2.5	PASS
			VN	50	-4.26	-0.005169	±2.5	PASS
GSM850	GPRS	MCH	VN	-30	-13.69	-0.016364	±2.5	PASS
			VN	-20	-14.33	-0.017129	±2.5	PASS
			VN	-10	-12.27	-0.014667	±2.5	PASS
			VN	0	-14.53	-0.017368	±2.5	PASS
			VN	10	-16.79	-0.020069	±2.5	PASS
			VN	20	-15.05	-0.017989	±2.5	PASS
			VN	30	-16.59	-0.019830	±2.5	PASS
			VN	40	-14.08	-0.016830	±2.5	PASS
			VN	50	-13.37	-0.015981	±2.5	PASS
GSM850	GPRS	HCH	VN	-30	-19.50	-0.022974	±2.5	PASS
			VN	-20	-19.31	-0.022750	±2.5	PASS
			VN	-10	-17.43	-0.020535	±2.5	PASS
			VN	0	-20.79	-0.024493	±2.5	PASS
			VN	10	-19.18	-0.022597	±2.5	PASS
			VN	20	-18.85	-0.022208	±2.5	PASS
			VN	30	-18.85	-0.022208	±2.5	PASS
			VN	40	-17.63	-0.020770	±2.5	PASS
			VN	50	-15.50	-0.018261	±2.5	PASS

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GSM1900	GSM	LCH	VN	-30	-10.91	-0.005897	±2.5	PASS
			VN	-20	-10.65	-0.005756	±2.5	PASS
			VN	-10	-10.01	-0.005410	±2.5	PASS
			VN	0	-10.07	-0.005443	±2.5	PASS
			VN	10	-9.75	-0.005270	±2.5	PASS
			VN	20	-10.65	-0.005756	±2.5	PASS
			VN	30	-11.43	-0.006178	±2.5	PASS
			VN	40	-12.53	-0.006772	±2.5	PASS
			VN	50	-15.24	-0.008237	±2.5	PASS
GSM1900	GSM	MCH	VN	-30	-11.24	-0.005979	±2.5	PASS
			VN	-20	-10.65	-0.005665	±2.5	PASS
			VN	-10	-10.07	-0.005356	±2.5	PASS
			VN	0	-9.62	-0.005117	±2.5	PASS
			VN	10	-11.11	-0.005910	±2.5	PASS
			VN	20	-8.78	-0.004670	±2.5	PASS
			VN	30	-5.75	-0.003059	±2.5	PASS
			VN	40	-4.97	-0.002644	±2.5	PASS
			VN	50	-5.23	-0.002782	±2.5	PASS
GSM1900	GSM	HCH	VN	-30	7.94	0.004158	±2.5	PASS
			VN	-20	10.33	0.005409	±2.5	PASS
			VN	-10	8.98	0.004702	±2.5	PASS
			VN	0	-0.84	-0.000440	±2.5	PASS
			VN	10	-0.65	-0.000340	±2.5	PASS
			VN	20	-1.81	-0.000948	±2.5	PASS
			VN	30	-1.16	-0.000607	±2.5	PASS
			VN	40	0.39	0.000204	±2.5	PASS
			VN	50	-1.87	-0.000979	±2.5	PASS

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GSM1900	GPRS	LCH	VN	-30	-0.06	-0.000032	±2.5	PASS
			VN	-20	-16.01	-0.008653	±2.5	PASS
			VN	-10	-6.97	-0.003767	±2.5	PASS
			VN	0	-16.53	-0.008934	±2.5	PASS
			VN	10	-10.33	-0.005583	±2.5	PASS
			VN	20	-12.27	-0.006632	±2.5	PASS
			VN	30	-4.52	-0.002443	±2.5	PASS
			VN	40	-19.76	-0.010680	±2.5	PASS
			VN	50	-13.56	-0.007329	±2.5	PASS
GSM1900	GPRS	MCH	VN	-30	2.84	0.001511	±2.5	PASS
			VN	-20	5.10	0.002713	±2.5	PASS
			VN	-10	-6.26	-0.003330	±2.5	PASS
			VN	0	-5.17	-0.002750	±2.5	PASS
			VN	10	1.55	0.000824	±2.5	PASS
			VN	20	-4.46	-0.002372	±2.5	PASS
			VN	30	-0.58	-0.000309	±2.5	PASS
			VN	40	-2.07	-0.001101	±2.5	PASS
			VN	50	-5.10	-0.002713	±2.5	PASS
GSM1900	GPRS	HCH	VN	-30	7.94	0.004158	±2.5	PASS
			VN	-20	-3.36	-0.001759	±2.5	PASS
			VN	-10	-1.74	-0.000911	±2.5	PASS
			VN	0	-4.20	-0.002199	±2.5	PASS
			VN	10	-4.78	-0.002503	±2.5	PASS
			VN	20	3.29	0.001723	±2.5	PASS
			VN	30	2.20	0.001152	±2.5	PASS
			VN	40	10.78	0.005645	±2.5	PASS
			VN	50	7.04	0.003686	±2.5	PASS

Note: Based on the results of the frequency stability test at the center channel the frequency deviation results measured are very small. As such it is determined that channels at the band edge would remain in-band when the maximum measured frequency deviation noted during the frequency stability tests is applied. Therefore the device is determined to remain operating in band over the temperature and voltage range as tested.

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Frequency Error vs. Voltage:

Test Band	Test Mode	Test Channel	Test Temp.	Test Volt.(V)	Freq.Error (Hz)	Freq.vs.rated (ppm)	Limit (ppm)	Verdict
WCDMA850	UMTS	LCH	TN	VL	-1.85	-0.002239	±2.5	PASS
			TN	VN	2.03	0.002456	±2.5	PASS
			TN	VH	1.37	0.001658	±2.5	PASS
		MCH	TN	VL	4.03	0.004818	±2.5	PASS
			TN	VN	4.53	0.005416	±2.5	PASS
			TN	VH	2.93	0.003503	±2.5	PASS
		HCH	TN	VL	1.27	0.001500	±2.5	PASS
			TN	VN	2.29	0.002705	±2.5	PASS
			TN	VH	7.28	0.008599	±2.5	PASS

Note: Based on the results of the frequency stability test at the center channel the frequency deviation results measured are very small. As such it is determined that channels at the band edge would remain in-band when the maximum measured frequency deviation noted during the frequency stability tests is applied. Therefore the device is determined to remain operating in band over the temperature and voltage range as tested.

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WCDMA1900	UMTS	LCH	TN	VL	-7.51	-0.004054	PASS
			TN	VN	4.59	0.002478	PASS
			TN	VH	3.98	0.002149	PASS
		MCH	TN	VL	3.66	0.001947	PASS
			TN	VN	-1.24	-0.000660	PASS
			TN	VH	3.10	0.001649	PASS
		HCH	TN	VL	-1.17	-0.000613	PASS
			TN	VN	-11.00	-0.005766	PASS
			TN	VH	2.01	0.001054	PASS

Note: Based on the results of the frequency stability test at the center channel the frequency deviation results measured are very small. As such it is determined that channels at the band edge would remain in-band when the maximum measured frequency deviation noted during the frequency stability tests is applied. Therefore the device is determined to remain operating in band over the temperature and voltage range as tested.

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Test Band	Test Mode	Test Channel	Test Volt.	Test Temp.	Freq.Error (Hz)	Freq.vs.rated (ppm)	Limit (ppm)	Verdict
WCDMA850	UMTS	LCH	VN	-30	3.37	0.004078	±2.5	PASS
			VN	-20	0.66	0.000799	±2.5	PASS
			VN	-10	3.98	0.004816	±2.5	PASS
			VN	0	2.52	0.003049	±2.5	PASS
			VN	10	0.63	0.000762	±2.5	PASS
			VN	20	1.85	0.002239	±2.5	PASS
			VN	30	2.66	0.003219	±2.5	PASS
			VN	40	2.73	0.003303	±2.5	PASS
			VN	50	2.14	0.002590	±2.5	PASS
WCDMA850	UMTS	MCH	VN	-30	2.37	0.002868	±2.5	PASS
			VN	-20	3.30	0.003993	±2.5	PASS
			VN	-10	5.13	0.006133	±2.5	PASS
			VN	0	0.06	0.000072	±2.5	PASS
			VN	10	3.25	0.003886	±2.5	PASS
			VN	20	0.41	0.000490	±2.5	PASS
			VN	30	5.45	0.006516	±2.5	PASS
			VN	40	3.78	0.004519	±2.5	PASS
			VN	50	2.84	0.003396	±2.5	PASS
WCDMA850	UMTS	HCH	VN	-30	-2.15	-0.002571	±2.5	PASS
			VN	-20	-0.82	-0.000969	±2.5	PASS
			VN	-10	1.51	0.001784	±2.5	PASS
			VN	0	-2.81	-0.003319	±2.5	PASS
			VN	10	1.37	0.001618	±2.5	PASS
			VN	20	1.45	0.001713	±2.5	PASS
			VN	30	5.22	0.006166	±2.5	PASS
			VN	40	-0.08	-0.000094	±2.5	PASS
			VN	50	-0.03	-0.000035	±2.5	PASS

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WCDMA1900	UMTS	LCH	VN	-30	5.40	0.002915	±2.5	PASS
			VN	-20	2.11	0.001139	±2.5	PASS
			VN	-10	1.42	0.000767	±2.5	PASS
			VN	0	-9.03	-0.004875	±2.5	PASS
			VN	10	4.47	0.002413	±2.5	PASS
			VN	20	-4.55	-0.002456	±2.5	PASS
			VN	30	7.08	0.003822	±2.5	PASS
			VN	40	-2.30	-0.001242	±2.5	PASS
			VN	50	-6.13	-0.003309	±2.5	PASS
WCDMA1900	UMTS	MCH	VN	-30	-9.05	-0.004886	±2.5	PASS
			VN	-20	-7.52	-0.004060	±2.5	PASS
			VN	-10	-9.86	-0.005245	±2.5	PASS
			VN	0	-5.26	-0.002798	±2.5	PASS
			VN	10	8.71	0.004633	±2.5	PASS
			VN	20	-2.55	-0.001356	±2.5	PASS
			VN	30	-7.19	-0.003824	±2.5	PASS
			VN	40	0.15	0.000080	±2.5	PASS
			VN	50	-2.64	-0.001404	±2.5	PASS
WCDMA1900	UMTS	HCH	VN	-30	-4.39	-0.002335	±2.5	PASS
			VN	-20	-3.54	-0.001883	±2.5	PASS
			VN	-10	0.27	0.000142	±2.5	PASS
			VN	0	0.81	0.000425	±2.5	PASS
			VN	10	-7.10	-0.003722	±2.5	PASS
			VN	20	4.07	0.002134	±2.5	PASS
			VN	30	-8.15	-0.004272	±2.5	PASS
			VN	40	5.98	0.003135	±2.5	PASS
			VN	50	-4.26	-0.002233	±2.5	PASS

Note: Based on the results of the frequency stability test at the center channel the frequency deviation results measured are very small. As such it is determined that channels at the band edge would remain in-band when the maximum measured frequency deviation noted during the frequency stability tests is applied. Therefore the device is determined to remain operating in band over the temperature and voltage range as tested.

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APPENDIX A: PHOTOGRAPHS OF TEST SETUP

Refer to the Report No.: AGC13369220301AP01

APPENDIX B: PHOTOGRAPHS OF EUT

Refer to the Report No.: AGC13369220301AP02

----END OF REPORT----



Conditions of Issuance of Test Reports

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3. The Company shall not be called or be liable to be called to give evidence or testimony on the Report in a court of law without its prior written consent, unless required by the relevant governmental authorities, laws or court orders.
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