Software Radio Technology

Conformance Test Report for

AIS Transponder

Equipment Under Test	**Class B CSTDMA AIS Transponder**
Type	**SRT-MTB-OEM**
Applying Test Standards	**IEC 62287-1 Section 11**
Test Report No	LD2235
Applicant	Software Radio Technology Wireless House FirstAvenue Midsomer Norton Bath BA3 4BS United Kingdom

Authorised Signatory

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1. HISTORY

Issue	Date	Author	Review No.	Details
1.0	08/09/06	Phil Longhurst		First Issue for R&TTE Approval
2.0	19/09/06	Phil Longhurst		Minor updates after review by BSH
3.0	25/09/06	Phil Longhurst		Addition of authorised signatory

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3. GLOSSARY AND REFERENCES

1.	IEC 62287-1 Maritime navigation and radiocommunication equipment and systems Automatic Identification Systems. Class B shipborne equipment of the Universal Automatic Identification System (AIS) using CSTMA techniques

4. GENERAL INFORMATION

Applicant:	Software Radio Technology plc Wireless House First Avenue Westfield Industrial Estate Midsomer Norton Bath BA3 4BS UK
Equipment under test:	Marine AIS (Automatic Identification System) Class B Transponder
Type:	SRT-MTB-OEM
Manufacturer:	Software Radio Technology plc Wireless House First Avenue Westfield Industrial Estate Midsomer Norton Bath BA3 4BS UK
Place of test:	Software Radio Technology plc Wireless House First Avenue Westfield Industrial Estate Midsomer Norton Bath BA3 4BS UK
Start of test:	19th July 2006
End of test:	9th September 2006

Test standards[1]**:**

IEC 62287-1

Maritime navigation and radiocommunication equipment and systems-

Automatic Identification Systems

Class B shipborne equipment of the Universal Automatic Identification System (AIS) using CSTMA techniques

1 Numbers listed in the titles of the test sections of this report refer to the respective sections of IEC 62287 if not stated otherwise.

5. EQUIPMENT HISTORY

Type	AIS Class B Transponder
Delivery date	19.07.06
Part No	SRT-MTB-OEM
Serial number	0029

HW Version:	Delivery date	19.07.06	Version no	4
	Installation date	19.07.06		
SW Version:	Delivery date	19.07.06	Version no	9.3
	Installation date	19.07.06		
SW Version:	Delivery date		Version no	
	Installation date			
SW Version:	Delivery date		Version no	
	Installation date			
SW Version:	Delivery date		Version no	
	Installation date			

6. SUMMARY

Test No.	Reference	Section	Result
3	IEC 62287-1	11 Physical Tests	Passed

7. TEST ENVIRONMENT

This Test environment is completely equipped as described in Annex A. The calibration status of all items of test equipment is given and calibration certificates included where applicable.

Location	Software Radio Technology plc
Test engineer	Phil Longhurst
Location	002°27,9472 W 53° 16,7932 N

Equipment no	Start of test	End of test	Test Engineer
1	19.07.06	14.09.06	Phil Longhurst

8. PRODUCT FEATURES

Feature	Status
Display	Not available
DSC	Time sharing with TDMA Receiver
RF Band Coverage	Upper and Lower band can be used
Serial Interface	Available, RS232 and RS422 available
Sync signal for TDMA Transmitter testing	Available
Frequency coverage	156.025MHz to 162.025MHz

9. RESULT MARKING

PASS	The test case has passed successfully
NA	The test case is not applicable
FAIL	The test case has failed

10. TEST RESULTS

The sections below record the results of the tests covered by this report. The section numbering has been matched to that of the relevant specification to aid reading of this report.

11. Physical Tests

11.1. TDMA Transmitter

11.1.1. Frequency Error

11.1.1.1. Definition

The frequency error of the transmitter is the difference between the measured carrier frequency in the absence of modulation of the transmitter and its required frequency.

11.1.1.2. Method of measurement

a. The carrier frequency shall be measured in the absence of modulation.

b. Tests shall be performed on the lowest operating frequency on which the EUT can transmit according to the manufacturer's specification and AIS 2 (162.025MHz).

c. The measurement shall be made under normal and extreme test conditions.

11.1.1.3. Required results

The frequency error shall not exceed ±0,5 kHz under normal and ±1 kHz under extreme test conditions.

Test Results

These tests were completed using test setup 3.

Description	Supply Voltage (V)	Temperature (˚C)	Frequency (MHz)	Remark	Result
Frequency Error under normal conditions, low frequency	12	Ambient	156.025	See plots in Annex D	Pass
Frequency Error under normal conditions, high frequency	12	Ambient	162.025	See plots in Annex D	Pass
Frequency Error under extreme conditions (HTHV), low frequency	15.6	55	156.025	See plots in Annex D	Pass
Frequency Error under extreme conditions (HTHV), high frequency	15.6	55	162.025	See plots in Annex D	Pass
Frequency Error under extreme conditions (LTLV), low frequency	10.8	-25	156.025	See plots in Annex D	Pass
Frequency Error under extreme conditions (LTLV), high frequency	10.8	-25	162.025	See plots in Annex D	Pass

11.1.2. Carrier power

11.1.2.1. Definition

The power of a radio frequency signal (conducted) is defined as the mean power delivered to a 50 Ω load during a radio frequency cycle. The Carrier Power is defined as the average radio frequency power measured over the transmitter duration. The transmitter duration is defined in [1] §7.3.1.4.

11.1.2.2. Method of measurement

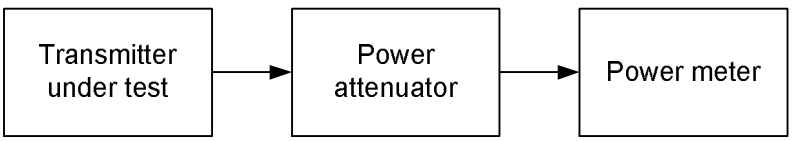


Figure 1 Measurement arrangement for carrier power

a) The transmitter shall generate test signal number 4.

b) The average power shall be measured over the transmitter duration. This power shall be further averaged over measurements from 200 transmissions. This value shall be corrected according to the transmitter duty cycle to indicate the carrier power.

c) Tests shall be performed on the lowest operating frequency on which the EUT can

d) transmit according to the manufacturer's specification and AIS 2 (162.025 MHz).

e) The measurement shall be carried out under normal and extreme test conditions.

11.1.2.3. Required results

At all test frequencies, the carrier power shall be 33 dBm ±1,5 dBm under normal test conditions.

At all test frequencies the carrier power shall be 33 dBm ±3 dBm under extreme test conditions.

Test Results

These tests were completed using test setup 3.

Description	Supply Voltage (V)	Temperature (˚C)	Frequency (MHz)	Remark	Result
Carrier Power under normal conditions, low frequency	12	Ambient	156.025	See plots in Annex E	Pass
Carrier Power under normal conditions, high frequency	12	Ambient	162.025	See plots in Annex E	Pass
Carrier Power under extreme conditions (HTHV), low frequency	15.6	55	156.025	See plots in Annex E	Pass
Carrier Power under extreme conditions (HTHV), high frequency	15.6	55	162.025	See plots in Annex E	Pass
Carrier Power under extreme conditions (LTLV), low frequency	10.8	-25	156.025	See plots in Annex E	Pass
Carrier Power under extreme conditions (LTLV), high frequency	10.8	-25	162.025	See plots in Annex E	Pass

11.1.3. Transmission spectrum

11.1.3.1. Definition

This test is to ensure that the modulation and transient sidebands produced by the transmitter under normal operating conditions fall within the allowable mask.

11.1.3.2. Method of measurement

a) The test shall use test signal number 4.

b) The EUT shall be connected to a spectrum analyser. A resolution bandwidth of 1 kHz, video bandwidth of 3 kHz or greater and positive peak detection (maximum hold) shall be used for this measurement. A sufficient number of sweeps shall be used and sufficient transmission packets measured to ensure that the emission profile is developed.

c) Tests shall be performed on the lowest operating frequency on which the EUT can transmit according to the manufacturer's specification and AIS 2 (162.025 MHz).

11.1.3.3. Required result

The spectrum for slotted transmission shall be within the emission mask as follows:

- in the region between the carrier and ±10 kHz removed from the carrier, the modulation and transient sidebands shall be below 0 dBc;
- at ±10 kHz removed from the carrier, the modulation and transient sidebands shall be below -25 dBc;
- at ±25 kHz to ±62.5 kHz removed from the carrier, the modulation and transient sidebands shall be below the lower value of –60 dBc or –30 dBm;
- in the region between ±10 kHz and ±25 kHz removed from the carrier, the modulation and transient sidebands shall be below a line specified between these two points.

The reference level for the measurement shall be the carrier power (conducted) recorded for the appropriate test frequency in 11.1.2.

Test Results

Description	Supply Voltage (V)	Temperature (˚C)	Frequency (MHz)	Remark	Result
Transmission Spectrum under normal conditions, low freq	12	Ambient	156.025	See Plots in Annex G	Pass
Transmission Spectrum under normal conditions, high freq	12	Ambient	162.025	See Plots in Annex G	Pass

11.1.4. Modulation accuracy

11.1.4.1. Definition

The modulation accuracy is the measurement of the peak frequency deviation of the transmitter modulation and the correct implementation of the GMSK BT filtering.

11.1.4.2. Method of measurement

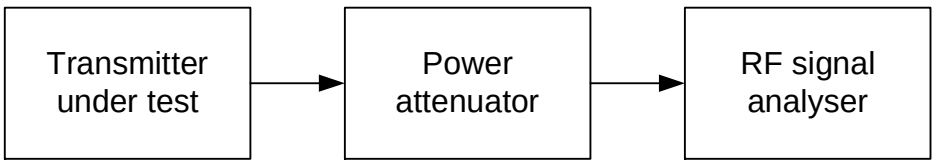


Figure 2 Measurement arrangement for modulation accuracy

The measurement procedure shall be as follows:

a) the equipment shall be connected as shown;

b) the transmitter shall be tuned to AIS 2 (162.025 MHz);

c) the transmitter shall be modulated with test signal number 2;

d) the deviation from the carrier frequency shall be measured as a function of time;

e) the transmitter shall be modulated with test signal number 3;

f) the deviation from the carrier frequency shall be measured as a function of time;

g) measurements shall be repeated at the lowest frequency on which the EUT can transmit, according to the manufacturer's specification;

h) testing shall be repeated under extreme test conditions.

11.1.4.3. Required results

Peak frequency deviation at various points within the data frame shall comply with [1] § 11.4.1.3, Table 22. These limits apply to both the positive and negative modulation peaks. Bit 0 is defined as the first bit of the training sequence.

Test Results

These tests were completed using test setup 3.

Description	Supply Voltage (V)	Temperature (˚C)	Frequency (MHz)	Remark	Result
Modulation Accuracy under normal conditions, Test Signal 2, low frequency	12	Normal	156.025	See plots in Annex F	Pass
Modulation Accuracy under normal conditions, Test Signal 2, high frequency	12	Normal	162.025	See plots in Annex F	Pass
Modulation Accuracy under normal conditions, Test Signal 3, low frequency	12	Normal	156.025	See plots in Annex F	Pass
Modulation Accuracy under normal conditions, Test Signal 3, high frequency	12	Normal	162.025	See plots in Annex F	Pass
Modulation Accuracy under extreme conditions (HTHV), Test Signal 2, low frequency	15.6	55	156.025	See plots in Annex F	Pass
Modulation Accuracy under extreme conditions (HTHV), Test Signal 2, high frequency	15.6	55	162.025	See plots in Annex F	Pass
Modulation Accuracy under extreme conditions (HTHV), Test Signal 3, low frequency	15.6	55	156.025	See plots in Annex F	Pass
Modulation Accuracy under extreme conditions (HTHV), Test Signal 3, high frequency	15.6	55	162.025	See plots in Annex F	Pass
Modulation Accuracy under extreme conditions (LTLV), Test Signal 2, low frequency	10.8	-25	156.025	See plots in Annex F	Pass
Modulation Accuracy under extreme conditions (LTLV), Test Signal 2, high frequency	10.8	-25	162.025	See plots in Annex F	Pass

Description	Supply Voltage (V)	Temperature (˚C)	Frequency (MHz)	Remark	Result
Modulation Accuracy under extreme conditions (LTLV), Test Signal 3, low frequency	10.8	-25	156.025	See plots in Annex F	Pass
Modulation Accuracy under extreme conditions (LTLV), Test Signal 3, high frequency	10.8	-25	162.025	See plots in Annex F	Pass

11.1.5. Transmitter output power versus time function

11.1.5.1. Definition

Transmitter output power versus time function is a combination of the transmitter delay, attacktime, release time and transmission duration (referring to Figure 3), where:

a) transmitter delay (TA) is the time between the start of the candidate transmission time period and the time when the transmission power exceeds –50 dBc;

b) transmitter attack time (TB – TA) is the time between the transmit power exceeding –50 dBc and the moment when the transmit power has reached a level 1 dB below the measured steady-state power (Pss) and maintains a level within +1,5/–1 dB from Pss thereafter;

c) transmitter release time (TF – TE) is the time between the end flag being transmitted and the moment when the transmitter output power has reduced to a level 50 dB below Pss and remains below this level thereafter;

d) transmission duration (TF – TA) is the time from when power exceeds –50 dBc to when the power returns to and stays below –50 dBc.

11.1.5.2. Method of measurement

a) The measurement shall be carried out by transmitting test signal number 2 (note that this test signal generates one additional stuffing bit within its CRC portion).

b) The EUT shall be connected to a spectrum analyser. A resolution bandwidth of 1 MHz, video bandwidth of 1 MHz and a sample detector shall be used for this measurement. The analyser shall be in zero-span mode for this measurement.

c) For the purposes of this test, the EUT shall be equipped with a test signal (SYNC) indicating the start of each time period that it intends to transmit into. This will be used as a trigger source for the spectrum analyser. The SYNC signal shall be aligned to the nominal start time (T0) of the transmission time period.

d) Tests shall be performed on the lowest operating frequency on which the EUT can transmit according to the manufacturer's specification and AIS 2 (162.025 MHz).

11.1.5.3. Required result

The transmitter power shall remain within the mask shown in

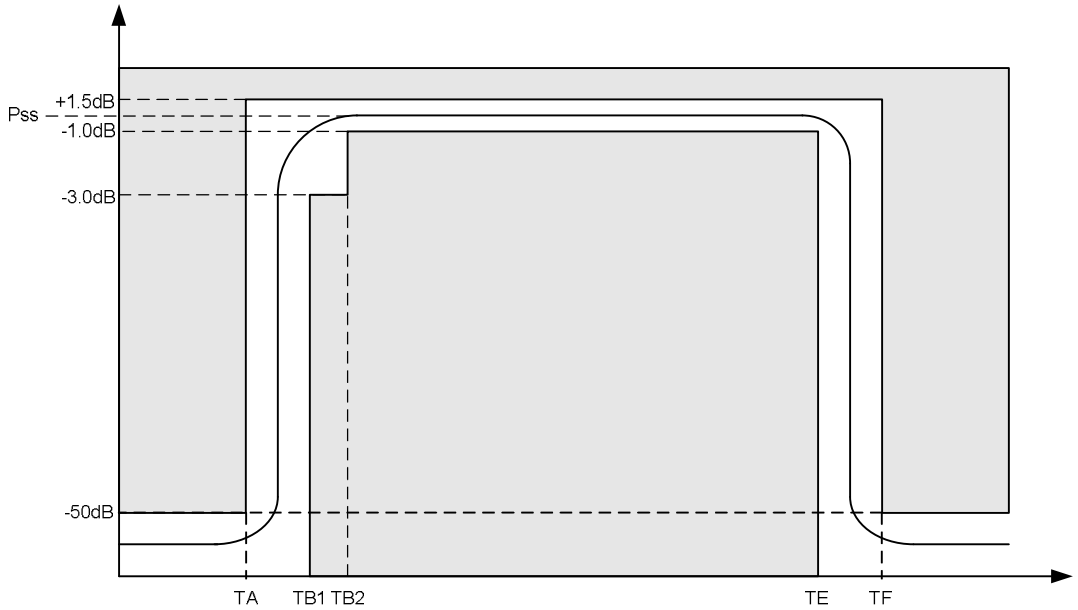


Figure 3 and associated timings given in Table 1.

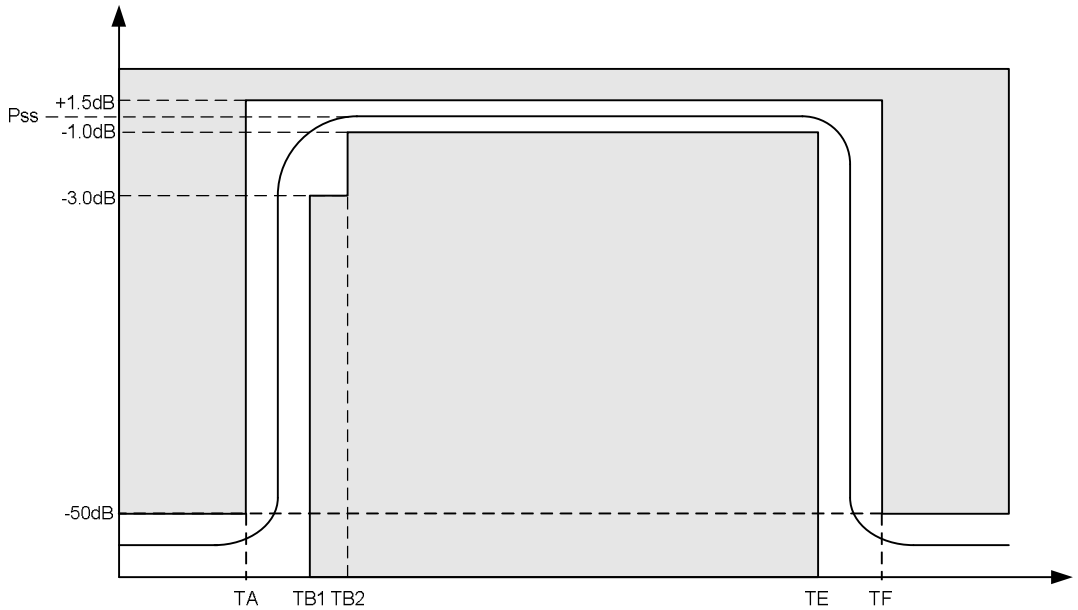


Figure 3 Power versus time mask

Reference		Bits	Time	Definition
T0		0	0ms	Start of candidate transmission time period
TA		20	2083ms	Power shall not exceed -50dB of Pss
TB	TB1	23	2396ms	Power shall reach within +1,5 dB or –3 dB of Pss
	TB2	25	2,604 ms	Power shall reach within +1,5 dB or –1 dB of Pss
TE (plus 1 stuffing bit)		248	25,833 ms	Power shall still remain within +1,5 dB or –1 dB of Pss
TF (plus 1 stuffing bit)		251	26146ms	Power shall reach –50 dB of Pss and stay below this

Table 1 Definition of timings for transmitter output power versus time

Test Results

Description	Supply Voltage (V)	Temperature (˚C)	Frequency (MHz)	Remark	Result
Transmission Power vs. Time under normal conditions, low freq	12	Ambient	156.025	See Plots in Annex H	Pass
Transmission Power vs. Time under normal conditions, high freq	12	Ambient	162.025	See Plots in Annex H	Pass

11.2. TDMA Receivers

11.2.1. Sensitivity

11.2.1.1. Definition

The maximum usable sensitivity is the minimum level of signal (dBm) at the receiver input, produced by a carrier at the nominal frequency of the receiver, modulated with the typical test signal (test signal 5), which will, without interference, produce after demodulation a data signal with a specified packet error rate (PER).

11.2.1.2. Method of measurement

The measurement procedure shall be as follows:

a) the signal generator shall be at the nominal frequency of the receiver and shall be modulated to generate test signal number 5;

b) the signal level at the input of the receiver shall be set to –107 dBm;

c) the message measuring test set shall be monitored and the packet error rate observed; The PER shall be derived by the following formula:

PER = (PTX – PRX)/PTX ×100 (%)

where:

PRX is the number of packets received without errors;

PTX is the number of transmitted packets.

d) the test shall be repeated at the nominal carrier frequency ±500 Hz and the level at the input to the receiver adjusted to –104 dBm under normal conditions;

e) the test shall be carried out on the lowest TDMA frequency declared by the manufacturer and AIS 2 (162.025 MHz);

f) repeat under extreme conditions, at the nominal carrier frequency only. The signal generator shall be adjusted so the level at the input to the receiver is –101 dBm.

11.2.1.3. Required results

The PER shall not exceed 20 %.

Test Results

Tests completed using Test Set-up 1 (See Annex A).

Description	Supply Voltage (V)	Temperature (˚C)	Frequency (MHz)	Remark	Result
AIS1 Sensitivity under normal conditions, Nominal Frequency, -107dBm	12	Ambient	159.025	20% PER was reached at an input level of -113.5dBm	Pass
AIS1 Sensitivity under normal conditions, Nominal Frequency ±500Hz, -104dBm	12	Ambient	159.025	20% PER was reached at an input level of -113dBm	Pass
AIS1 Sensitivity under normal conditions, Low Frequency, -107dBm	12	Ambient	156.025	20% PER was reached at an input level of -111dBm	Pass
AIS1 Sensitivity under normal conditions, High Frequency, -107dBm	12	Ambient	162.025	20% PER was reached at an input level of -113dBm	Pass
AIS1 Sensitivity under extreme conditions (HTHV), Nominal Frequency, -101dBm	15.6	55	159.025	20% PER was reached at an input level of -113.5dBm	Pass
AIS1 Sensitivity under extreme conditions (LTLV), Nominal Frequency, -101dBm	10.8	-25	162.025	20% PER was reached at an input level of -111.5dBm	Pass
AIS2 Sensitivity under normal conditions, Nominal Frequency, -107dBm	12	Ambient	159.025	20% PER was reached at an input level of -115.5dBm	Pass
AIS2 Sensitivity under normal conditions, Nominal Frequency ±500Hz, -104dBm	12	Ambient	159.025	20% PER was reached at an input level of -115dBm	Pass
AIS2 Sensitivity under normal conditions, Low Frequency, -107dBm	12	Ambient	156.025	20% PER was reached at an input level of -114dBm	Pass
AIS2 Sensitivity under normal conditions, High Frequency, -107dBm	12	Ambient	162.025	20% PER was reached at an input level of -115dBm	Pass
AIS2 Sensitivity under extreme conditions (HTHV), Nominal Frequency, -101dBm	15.6	55	159.025	20% PER was reached at an input level of -115.5dBm	Pass
AIS2 Sensitivity under extreme conditions (LTLV), Nominal Frequency, -101dBm	10.8	-25	159.025	20% PER was reached at an input level of -111.5dBm	Pass

11.2.2. Error behaviour at high input levels

11.2.2.1. Definition

The error behaviour (performance) at high input levels (noise free operation) is defined in the same manner as for the measurement of the maximum usable sensitivity when the level of the wanted signal is significantly above the maximum wanted sensitivity.

11.2.2.2. Method of measurement

The measurement configuration for receiver sensitivity (11.2.1) shall be used.

The signal generator shall be at the nominal frequency of the receiver and shall be modulated to generate test signal number 5. The test shall be carried out on the lowest TDMA frequency declared by the manufacturer and AIS 2 (162.025 MHz). The message measuring test set shall be monitored and the packet error rate observed.

a) The level of the input signal shall be adjusted to a level of –77dBm;

b) The level of the input signal shall be adjusted to a level of –7dBm.

11.2.2.3. Required results

The PER shall not exceed 2 % under a) and 10 % under b).

Test Results

Tests completed using Test Set-up 1 (See Annex A).

Description	Supply Voltage (V)	Temperature (˚C)	Frequency (MHz)	Remark	Result
AIS1 Error at high input level under normal conditions, low freq, -77dBm	12	Ambient	156.025	199 out of 200 Packets received	Pass
AIS1 Error at high input level under normal conditions, high freq, -77dBm	12	Ambient	162.025	199 out of 200 Packets received	Pass
AIS1 Error at high input level under normal conditions, low freq, -7dBm	12	Ambient	156.025	199 out of 200 Packets received	Pass
AIS1 Error at high input level under normal conditions, high freq, -7dBm	12	Ambient	162.025	199 out of 200 Packets received	Pass
AIS2 Error at high input level under normal conditions, low freq, -77dBm	12	Ambient	156.025	199 out of 200 Packets received	Pass
AIS2 Error at high input level under normal conditions, high freq, -77dBm	12	Ambient	162.025	199 out of 200 Packets received	Pass
AIS2 Error at high input level under normal conditions, low freq, -7dBm	12	Ambient	156.025	199 out of 200 Packets received	Pass
AIS2 Error at high input level under normal conditions, high freq, -7dBm	12	Ambient	162.025	199 out of 200 Packets received	Pass

11.2.3. Co-channel rejection

11.2.3.1. Definition

The co-channel rejection is a measure of the capability of the receiver to receive a wanted modulated signal without exceeding a given degradation due to the presence of an unwanted modulated signal, both signals being at the nominal frequency of the receiver.

11.2.3.2. Method of measurement

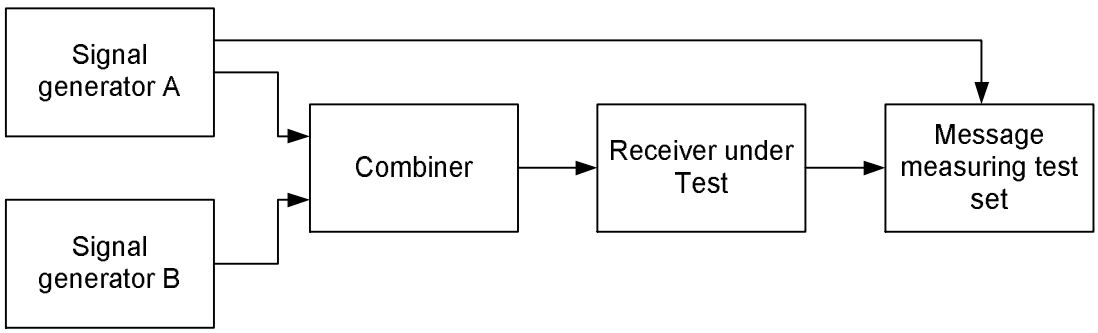


Figure 4 Measurement arrangement with two generators

The measurement procedure shall be as follows:

a) two generators A and B, shall be connected to the receiver via a combining network;

b) the wanted signal, provided by signal generator A, shall be at the nominal frequency of the receiver and shall be modulated to generate test signal number 5;

c) the unwanted signal, provided by generator B, shall also be at the nominal frequency of the receiver. Generator B shall be modulated to generate test signal number 4, either continuously or in the same time period as that used by generator A for test signal number 5. The content of the wanted and unwanted signals shall not be synchronised;

d) the level of the wanted signal from generator A shall be adjusted to –101dBm;

e) the level of the unwanted signal from generator B shall be adjusted to –111dBm;

f) the message measuring test set shall be monitored and the packet error rate (PER) observed;

g) the measurement shall be repeated for displacements of the unwanted signal of ±1 kHz from the nominal frequency of the receiver and the PER again observed;

h) the test shall be carried out on the lowest TDMA frequency declared by the manufacturer and AIS 2 (162,025 MHz).

11.2.3.3. Required result

The PER shall not exceed 20 %.

Test Results

Tests completed using Test Set-up 2. Another Class B transponder was used as a generator of continuous Test signal 4 as the Sine Qua Non PMG-1 generator is not capable of producing a continuous signal, only a bursted signal.

Description	Supply Voltage (V)	Temperature (˚C)	Frequency (MHz)	Remark	Result
AIS1 Co-Channel Rejection under normal conditions, low frequency	12	Ambient	156.025	187 out of 200 Packets received successfully (6.5%)	Pass
AIS1 Co-Channel Rejection under normal conditions, high frequency	12	Ambient	162.025	179 out of 200 Packets received successfully (10.5%)	Pass
AIS2 Co-Channel Rejection under normal conditions, low frequency	12	Ambient	156.025	184 out of 200 Packets received successfully (8%)	Pass
AIS2 Co-Channel Rejection under normal conditions, high frequency	12	Ambient	162.025	184 out of 200 Packets received successfully (8%)	Pass
AIS1 Co-Channel Rejection under normal conditions, low frequency ±1kHz	12	Ambient	156.025	180 out of 200 Packets received successfully (10%)	Pass
AIS1 Co-Channel Rejection under normal conditions, high frequency ±1kHz	12	Ambient	162.025	173 out of 200 Packets received successfully (13.5%)	Pass
AIS2 Co-Channel Rejection under normal conditions, low frequency ±1kHz	12	Ambient	156.025	190 out of 200 Packets received successfully (5%)	Pass
AIS2 Co-Channel Rejection under normal conditions, high frequency ±1kHz	12	Ambient	162.025	181 out of 200 Packets received successfully (9.5%)	Pass

11.2.4. 11.2.4 Adjacent channel selectivity

11.2.4.1. Definition

The adjacent channel selectivity is a measure of the capability of the receiver to receive a wanted modulated signal without exceeding a given degradation due to the presence of an unwanted signal which differs in frequency from the wanted signal by an amount equal to the adjacent channel separation for which the equipment is intended.

11.2.4.2. Method of measurement

The measurement procedure shall be as follows:

a) the measurement configuration for co-channel rejection (11.2.3) shall be used;

b) the wanted signal, provided by signal generator A, shall be at the nominal frequency of the receiver and shall be modulated to generate test signal number 5;

c) the unwanted signal, provided by generator B, shall be frequency modulated with a 400 Hz sine wave giving a deviation of ±3 kHz. Generator B shall be at a frequency 25 kHz above that of the wanted signal;

d) the level of the wanted signal from generator A shall be adjusted to a level of –101 dBm;
e) the level of the unwanted signal from generator B shall be adjusted to –31 dBm;
f) the message measuring test set shall be monitored and the packet error rate observed;
g) repeat the above measurement with the unwanted signal 25 kHz below the wanted signal;
h) the test shall be carried out on the lowest TDMA frequency declared by the manufacturer and AIS 2 (162,025 MHz).

11.2.4.3. Required results

The *PER* shall not exceed 20 %.

Test Results

This test was completed using test setup 1.

Description	Supply Voltage (V)	Temperature (˚C)	Frequency (MHz)	Remark	Result
AIS1 Adjacent Channel Selectivity under normal conditions, low freq (+25KHz)	12	Ambient	156.025	196 out of 200 Packets received successfully (2%)	Pass
AIS1 Adjacent Channel Selectivity under normal conditions, low freq (-25kHz)	12	Ambient	156.025	199 out of 200 Packets received successfully (0.5%)	Pass
AIS1 Adjacent Channel Selectivity under normal conditions, high freq (+25KHz)	12	Ambient	162.025	199 out of 200 Packets received successfully (0.5%)	Pass
AIS1 Adjacent Channel Selectivity under normal conditions, high freq (-25kHz)	12	Ambient	162.025	199 out of 200 Packets received successfully (0.5%)	Pass
AIS2 Adjacent Channel Selectivity under normal conditions, low freq (+25KHz)	12	Ambient	156.025	195 out of 200 Packets received successfully (2.5%)	Pass
AIS2 Adjacent Channel Selectivity under normal conditions, low freq (-25kHz)	12	Ambient	156.025	196 out of 200 Packets received successfully (2%)	Pass
AIS2 Adjacent Channel Selectivity under normal conditions, high freq (+25KHz)	12	Ambient	162.025	197 out of 200 Packets received successfully (1.5%)	Pass
AIS2 Adjacent Channel Selectivity under normal conditions, high freq (-25kHz)	12	Ambient	162.025	197 out of 200 Packets received successfully (1.5%)	Pass

11.2.5. 11.2.5 Spurious response rejection

11.2.5.1. Definition

The spurious response rejection is a measure of the capability of the receiver to receive a wanted modulated signal without exceeding a given degradation due to the presence of an unwanted modulated signal at any other frequency, at which a response is obtained.

11.2.5.2. Manufacturers' declarations

The manufacturer shall declare the following in order to calculate the "Limited Frequency Range" over which the initial part of the test will be performed:

- . list of intermediate frequencies: (IF1, IF2, ...IFN) in Hz;
- switching range of the receiver;
- frequency of the local oscillator at AIS 2 and at the lowest TDMA channel: (fLOH, fLOL).

11.2.5.3. Introduction to the method of measurement

The initial evaluation of the unit shall be performed over the “Limited Frequency Range” and shall then be performed at the frequencies identified from this test and at “Specific Frequencies of Interest” (as defined below).

To determine the frequencies at which spurious responses can occur the following calculations shall be made:

a) calculation of the "Limited Frequency Range":

b) the limits of the limited frequency range (LFR_{HI} LFR_{LO}) are determined from the following calculations:

$$LFR_{HI} = f_{LOH} + (IF_1 + IF_2 + \ldots + IF_N + sr/2)$$

$$LFR_{LO} = f_{LOL} - (IF_1 + IF_2 + \ldots + IF_N + sr/2)$$

b) calculation of Specific Frequencies of Interest (SFI) outside the limited frequency range:

these are determined by the following calculations:

$$SFI_1 = (K \cdot f_{LOH}) + IF_1$$

$$SFI_2 = (K \cdot f_{LOL}) - IF_1$$

where K is an integer from 2 to 4.

11.2.5.4. Method of measurement over the Limited Frequency Range

Two methods are available for the measurements over the Limited Frequency Range, one based on SINAD measurements (A) and the other based on PER measurements (B). Either method may be used, but in each case shall be followed by the method of measurement at identified frequencies.

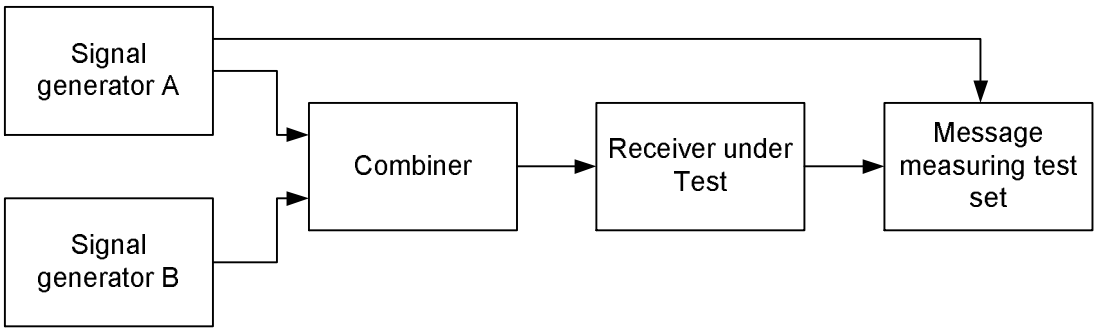


Figure 5 PER/BER measuring equipment

Method of search over the "Limited Frequency Range" using PER or BER measurement

a) Two generators A and B, shall be connected to the receiver via a combining network. The wanted signal, provided by generator A, shall be at the nominal frequency of the receiver and shall be modulated to generate test signal number 5. The unwanted signal, provided by generator B, shall be frequency modulated with a 400 Hz sine wave giving a deviation of ±3 kHz.

b) Initially, generator B (unwanted) shall be switched off (maintaining the output impedance). The signal level from generator A (wanted) shall be adjusted to –101 dBm at the receiver. The PER or BER shall be noted.

c) Signal generator B shall be switched on and adjusted to –27 dBm at the receiver.

d) The frequency of the unwanted signal shall be varied in steps of 5 kHz over the Limited Frequency Range (from LFR_{LO} to LFR_{HI})

e) The frequency of any spurious response detected (by an increase in either PER or BER)

f) during the search shall be recorded for use in the next measurements.

g) In the case where operation using a continuous packet stream is not possible a similar method may be used.

11.2.5.5. Method of measurement (at identified frequencies)

a) Two generators A and B, shall be connected to the receiver via a combining network. The wanted signal, provided by generator A, shall be at the nominal frequency of the receiver and shall be modulated to generate test signal number 5. The unwanted signal, provided by generator B, shall be frequency modulated with a 400 Hz sine wave giving a deviation of ± 3 kHz. Generator B shall be at the frequency of that spurious response being considered.

b) Initially, generator B (unwanted) shall be switched off (maintaining the output impedance). The signal level from generator A (wanted) shall be adjusted –101 dBm at the receiver.

c) Generator B shall be switched on, and the level of the unwanted signal set to –31 dBm.

d) For each frequency noted during the tests over the Limited Frequency Range and the Specific Frequencies of Interest (SFI_1 and SFI_2), transmit 200 packets to the EUT and note the PER.

11.2.5.6. Required results

At any frequency separated from the nominal frequency of the receiver by two channels or more, the spurious responses shall not result in a PER of greater than 20 %.

Test Results

This test was completed using test setup 1 in Annex A.

Manufacturer's declarations

The manufacturer declares that the intermediate frequencies are:

Receiver 1: 38.855MHz, 455kHz

Receiver 2: 26.055MHz, 455kHz

The manufacturer declares that the switching range of the receivers are:

156.025MHz to 162.025MHz (in 25KHz steps)

The manufacturer declares that the frequency ranges of local oscillators are:

Receiver 1: 117.17MHz – 123.17MHz

Receiver 2: 129.97MHz – 135.97MHz

The manufacturer declares that the limited frequency range of the receivers as defined in section 11.2.5.3 is:

Receiver 1: 74.86MHz – 165.48MHz

Receiver 2: 100.46MHz – 165.46MHz

The manufacturer declares that the specific frequencies of interest of the receivers as defined in section 11.2.5.3 are:

Receiver 1, SFI1: 285.195MHz, 408.385MHz, 531.535MHz

Receiver 1 SFI2: 195.485MHz, 312.655MHz, 429.825MHz

Receiver 2, SFI1: 297.995MHz, 433.965MHz, 569.935MHz

Receiver 2 SFI2: 233.885MHz, 363.655MHz, 493.825MHz

Description	Supply Voltage (V)	Temperature (˚C)	Frequency (MHz)	Remark	Result
AIS1 Spurious Response Rejection	12	Ambient	162.025	Maximum PER over SFIs and identified frequencies within the limited frequency is 1%	Pass
AIS2 Spurious Response Rejection	12	Ambient	162.025	Maximum PER over SFIs identified frequencies within the limited frequency is 2.5%	Pass

11.2.6. Intermodulation response rejection

11.2.6.1. Definition

The intermodulation response rejection is the capability of the receiver to receive a wanted modulated signal, without exceeding a given degradation due to the presence of two close spaced unwanted signals with a specific frequency relationship to the wanted signal frequency.

11.2.6.2. Method of test

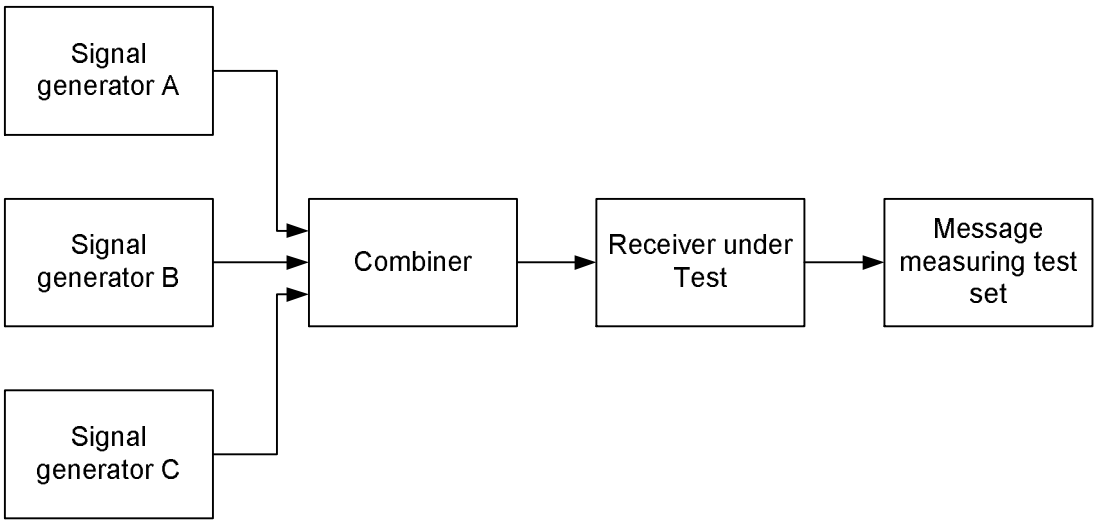


Figure 6 Measurement arrangement for intermodulation

The measurement procedure shall be as follows:

a) three signal generators shall be connected to the receiver via a combining network;

b) the wanted signal, provided by signal generator A, shall be at the nominal frequency of the receiver and shall be modulated to generate test signal number 5;

c) the unwanted signal from generator B shall be unmodulated;

d) the unwanted signal from generator C shall be frequency modulated with a 400 Hz sine wave giving a deviation of ±3 kHz;

e) the signal level from generator A (wanted) shall be set for –101 dBm at the receiver input;

f) the signal level from generators B and C shall be set for –36 dBm at the receiver input;

g) the frequencies of generators A, B, C shall be set as per test #1 of Table 23;

h) the message measuring test set shall be monitored and the packet error rate observed;

i) repeat the measurement with frequencies set as per tests #2, #3 and #4 of Table 23.

	Generator A Wanted AIS signal	Generator B Unmodulated (±50kHz)	Generator C Modulated (±100kHz)
Test #1	162.025MHz	162.075MHz	162.125MHz
Test #2	162.025MHz	161.975MHz	161.925MHz
Test #3	F_{TDMAlo}	F_{TDMAlo}+50kHz	F_{TDMAlo}+100kHz
Test #4	F_{TDMAlo}	F_{TDMAlo}-50kHz	F_{TDMAlo}-100kHz

Note: F_{TDMAlo} is the lowest frequency on which the EUT can operate according to the manufacturer's specification.

11.2.6.3. Required results

The *PER* shall not exceed 20 %.

Test Results

Description	Supply Voltage (V)	Temperature (°C)	Frequency (MHz)	Remark	Result
AIS1 Intermodulation Response Rejection	12	Ambient	162.025	Worst case PER for all intermodulation products is 3.5%	Pass
AIS2 Intermodulation Response Rejection	12	Ambient	162.025	Worst case PER for all intermodulation products is 4%	Pass

11.2.7. Blocking or desensitisation

11.2.7.1. Definition

Blocking is a measure of the capability of the receiver to receive a wanted modulated signal without exceeding a given degradation due to the presence of an unwanted input signal at any frequencies other than those of the spurious responses or the adjacent channels.

11.2.7.2. Method of measurement

The measurement procedure shall be as follows:

a) two generators A and B, shall be connected to the receiver via a combining network;

b) the wanted signal, provided by signal generator A, shall be at the nominal frequency of the receiver and shall be modulated to generate test signal number 5;

c) the unwanted signal from generator B shall be unmodulated and shall be at a frequency 0.5 MHz to 10 MHz away from the nominal frequency of the receiver. Measurements shall be carried out at frequencies of the unwanted signal at approximately ±500 kHz, ±1 MHz, ±2 MHz, ±5 MHz and ±10 MHz, avoiding those frequencies at which spurious responses could occur (see C.4.5);

d) initially, signal generator B (unwanted signal) shall be switched off (maintaining the output impedance). The level of the wanted signal from generator A shall be adjusted to –101 dBm at the receiver input;

e) the RF signal level for signal generator B (unwanted signal) shall be adjusted to –23 dBm when the frequency setting is less than ±5 MHz. For frequency settings of ±5 MHz or higher the RF level shall be adjusted to –15 dBm;

f) the test shall be repeated for all the frequencies defined in step c);

g) the test shall be carried out on the lowest frequency on which the EUT can operate according to the manufacturer's specification and AIS 2 (162,025 MHz).

11.2.7.3. Required results

The maximum packet error rate shall not exceed 20 %.

Test Results

This test was completed using test setup 1 in annex A.

Description	Supply Voltage (V)	Temperature (˚C)	Frequency (MHz)	Remark	Result
AIS1 Blocking under normal conditions, low freq	12	Ambient	156.025	Worst case PER for all blocking frequencies is 2.5%	Pass
AIS1 Blocking under normal conditions, high freq	12	Ambient	162.025	Worst case PER for all blocking frequencies is 2%	Pass
AIS2 Blocking under normal conditions, low freq	12	Ambient	156.025	Worst case PER for all blocking frequencies is 2.5%	Pass
AIS2 Blocking under normal conditions, high freq	12	Ambient	162.025	Worst case PER for all blocking frequencies is 3.5%	Pass

11.3. Conducted spurious emissions

11.3.1. Spurious emissions from the receiver

11.3.1.1. Definition

Spurious emissions from the receiver are components at any frequency, conducted to the antenna. The level of spurious emissions shall be measured as their power level in a specified load.

11.3.1.2. Method of measurement

The receiver shall be connected to a 50Ω attenuator. The output of the attenuator shall be connected to a spectrum analyser or selective voltmeter having an input impedance of 50Ω. If the detecting device is not calibrated in terms of power input, the level of any detected components shall be determined by a substitution method using a signal generator. The measurement shall extend over the frequency range 9 kHz to 4 GHz.

The receiver shall be switched on, and the measuring receiver shall be tuned over the frequency range 9 kHz to 4 GHz.

At each frequency at which a spurious component is detected, the power level shall be recorded as the spurious level delivered into the specified load.

11.3.1.3. Required results

The power of any spurious emission in the specified range at the antenna terminal shall not exceed –57dBm (2nW) in the frequency range 9 kHz to 1 GHz and –47dBm (20nW) in the frequency range 1 GHz to 4 GHz.

Test Results

This Test was completed using Test setup 3 in Annex A. Screen plots of the measurements are shown in Annex C.

Description	Supply Voltage (V)	Temperature (˚C)	Frequency (MHz)	Remark	Result
AIS1 Conducted Spurious	12	Ambient	N/A	See plots in Annex C	Pass
AIS2 Conducted Spurious	12	Ambient	N/A	See plots in Annex C	Pass

11.3.2. Spurious emissions from the transmitter

11.3.2.1. Definition

Conducted spurious emissions are emissions on a frequency or frequencies, which are outside the necessary bandwidth and the level of which may be reduced without affecting the corresponding transmission of information. Spurious emissions include harmonic emissions, parasitic emissions, intermodulation products and frequency conversion products, but exclude out-of-band emissions.

11.3.2.2. Method of measurement

The transmitter shall be connected to a 50Ω power attenuator. The output of the power attenuator shall be connected to a measuring receiver.

If possible, the measurement shall be made with the transmitter unmodulated. If this is not possible, the transmitter shall be modulated by test signal number 4. If possible the modulation should be continuous for the duration of the measurement.

The measurement shall be made over a frequency range from 9 kHz to 4 GHz, excluding the channel on which the transmitter is operating and its adjacent channels.

The resolution bandwidth of the measuring instrument shall be the smallest bandwidth available which is greater than the spectral width of the spurious component being measured. This shall be considered to be achieved when the next highest bandwidth causes less than 1 dB increase in amplitude. Positive peak detection (maximum hold) shall be selected on the spectrum analyser used for this measurement.

A sufficient number of sweeps shall be measured to ensure that the emission profile is developed. At each frequency at which a spurious component is detected, the power level shall be recorded as the conducted spurious emission level delivered into the specified load, except for the channel on which the transmitter is intended to operate and the adjacent channels. The conditions used in the relevant measurements shall be recorded in test reports

11.3.2.3. Required results

The power of any spurious emission on any discrete frequency shall not exceed 0,25 µW (–36 dBm) in the frequency range 9 kHz to 1 GHz and 1 µW (–30 dBm) in the frequency range 1 GHz to 4 GHz.

Test Results

This test was carried out by connecting a spectrum analyser directly to the receiver inputs to measure spurious emissions.

Description	Supply Voltage (V)	Temperature (˚C)	Frequency (MHz)	Remark	Result
Transmitter Conducted Spurious	12	Ambient	N/A	See plots in Annex J	Pass

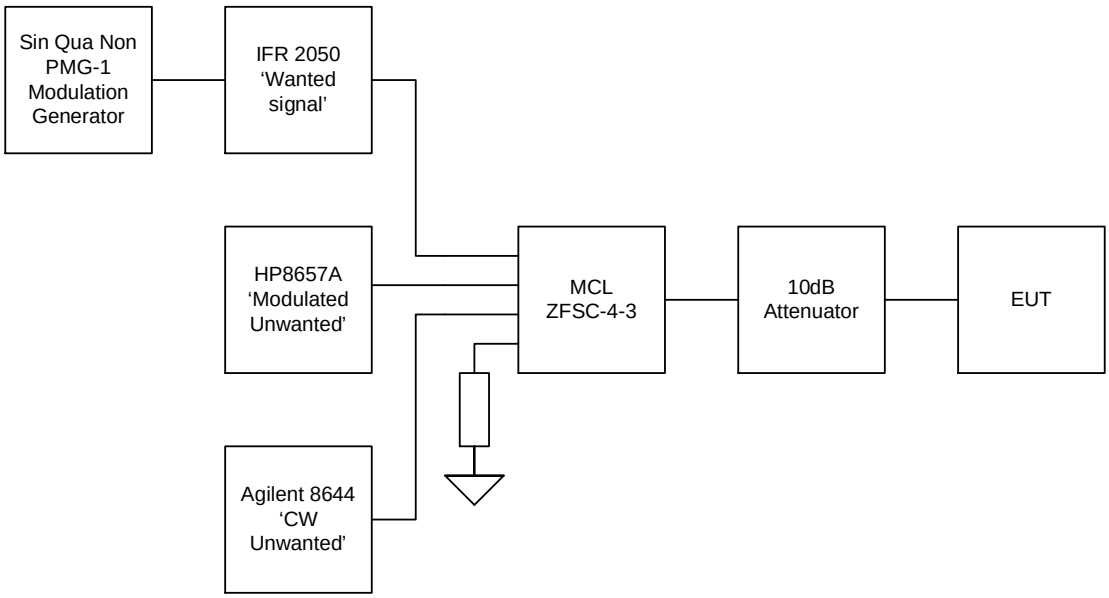
11. DSC TESTING AS PER ANNEX C.4 OF IEC 62287-1

It is declared within IEC62287-1 that if the DSC receiver is time shared with the DSC receiver that it is not necessary for these tests to be completed.

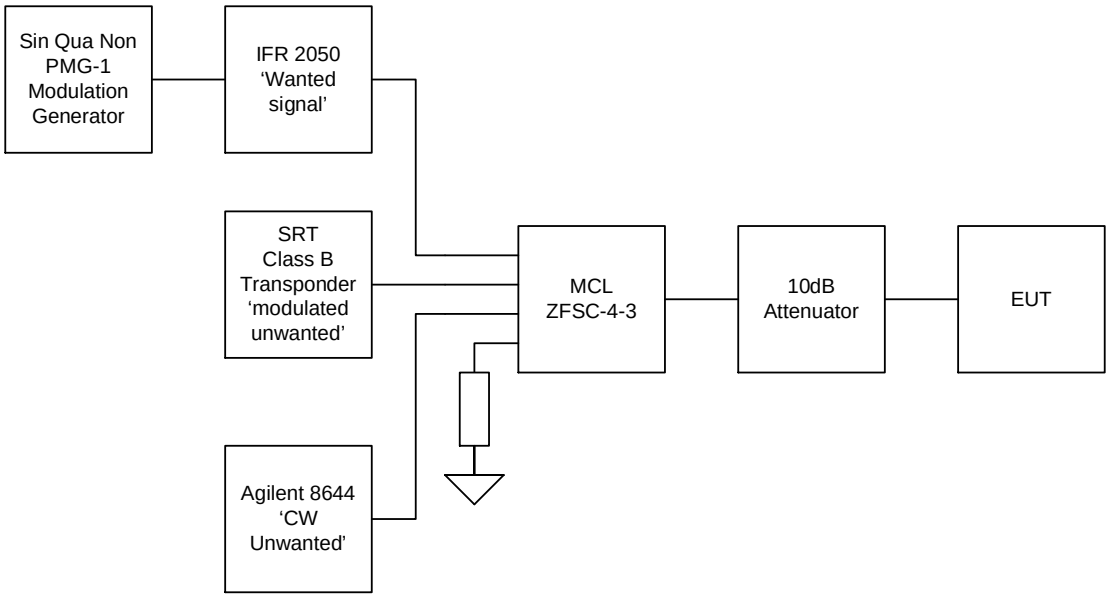
Software Radio Technology plc declares that the DSC receiver used within the SRT-MTB-OEM product is time shared with the AIS TDMA receiver and therefore the tests in Annex C.4 of IEC 62287-1 are not included in this report.

ANNEX A – TEST SETUP

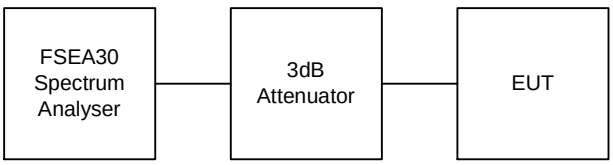
Test Setup 1



Test Setup 2



Test Setup 3



ANNEX B – RF TEST MODE

General Operation

Password commands for test mode are shown below. These include the checksums.

$PSRT,012,,,(--JeHoVah--)*60

$PSRT,007,,,%%TestMode Enable%%*26

Command and response format

Commands and parameters always consist of four hex characters representing 16-bit unsigned numbers, followed by <enter>. Apart from the repeat (space), auto-increment (+) and auto-decrement (-) characters, inputting a non-hex character, e.g. 'q', will cause the current input to be rejected. Any input string containing a number of characters not divisible by four will also be rejected. Spaces can optionally be included between groups of characters for readability.

Commands start with "#" and responses with "%". Optional parameters are shown [thus].

Some example commands:

Open the test interface: #0011 (response: %0011)

Set the transmitter to 156.025MHz, 25kHz AIS, low power: #0020 30c2 0000 0001

Command parameter decode

Channel: frequency in MHz * 80

Mode: 0 = AIS 25kHz, 1= AIS 12.5kHz, 2 = DSC.

TX power level (low"Power): zero = high, non-zero = low

Repeat previous parameter(s)

(Where supported) by entering "FFFF"

Missing parameters

Are treated as zero.

Repeat previous command

By pressing <SPACE>

Responses

TM_ACK (acknowledge) is "%0011"; TM_NAK (negative acknowledge) is "%0010".

Commands that request a response will generally echo the command number as the first response parameter e.g. TM_GET_ADC ("#0063 <ADC_channel>") generates a response "%0063 <ADC_channel> <reading>".

Auto-increment & -decrement

By pressing "+" or "-". See note 2 below command list.

Command List

General and interface commands

Command	Meaning	Cmd	Params	Response
TM_RESEND_LAST	Resend the previous test-mode response message.	0000 or <space>		(last response)
TM_NO_OP	Do nothing. May be used to verify that the interface is functioning.	0010		TM_ACK
TM_ENTER	Enable the T&D interface mode. Accept test mode commands.	0011		TM_ACK
TM_BERT	Start internal PER/BER test	0016	rx1packets, [rx2packets,] [rx3packets]	See 0 below.
TM_EXIT	Exit test mode; restore normal trasponder operation	001F		“Goodbye”.

Commands to set up RF hardware and read its status

NB : Channel number: frequency in MHz * 80 expressed as four hex digits, for example 156.525MHz = 12522_{10} = 30EA hex.

Command	Meaning	Cmd	Params	Response
TM_SET_TX	Sets transmitter parameters (‘FFFF’ in any parameter field means ‘re-use previous setting’).	0020	Channel num; Mode: 0 = AIS 25kHz, 1 = AIS 12.5, 2 = DSC; Power: 0 = high, 1 = low.	TM_ACK
TM_SET_RX1	Sets receiver parameters for Rx 1. (‘FFFF’ in any parameter field means ‘re-use previous setting’).	0021	Channel num; Mode: 0 = AIS 25kHz, 1 = AIS 12.5. 2 = DSC (Class B only)	TM_ACK
TM_SET_RX2	Sets receiver parameters for Rx 2. (‘FFFF’ in any parameter field means ‘re-use previous setting’).	0022	- as above.	TM_ACK
TM_SET_RX3 (Class A)	Sets receiver parameters for Rx 3. (‘FFFF’ in any parameter field means ‘re-use previous setting’).	0023	Channel num; Mode 2 = DSC	TM_ACK

Command	Meaning	Cmd	Params	Response
TM_GET_ERRORS	Read error flags	0030		Error flags: bit0: TX bit1: RX1 bit2: RX2 bit3: RX70 bit4: VSWR bit5: MON 12V bit6: MON 5V bit7: TX LOCKED OUT
TM_CLEAR_ERRORS	Clear error flags	0031		TM_ACK
TM_GET_RT_RX1	Read realtime status of RX1	0032		RSSI; 0000(FFE)
TM_GET_RT_RX2	Read realtime status of RX2	0033		RSSI; 0000(FFE)
TM_GET_RT_RX3	Read realtime status of RX3	0034		RSSI; channel_ occupied
TM_GET_TX	Read the Tx status.	0039		channel; mode; lowPower
TM_GET_RX1	Read the status of Rx1. B0: Bandwidth 0=25KHz 1=12.5KHz B1: AIS/DSC 0==AIS, 1==DSC B2: timeshare DSC 0==off, 1==on	003A		channel; mode
TM_GET_RX2	Read the status of Rx2. Mode as Rx1.	003B		channel; mode
TM_GET_RX3	Read the status of Rx3. Mode as Rx1.	003C		channel; mode
TM_SET_DAC	Set DAC. Write to a DAC channel. Channels are: 0 – TX power 1 - Spare 2 – Ref osc trim 3 – DAC to ADC loopback (for testing)	0062	DAC channel; Data value (0 -> 0xFF).	TM_ACK
TM_GET_ADC	Read ADC. Read an ADC channel. Channels are: 0 - RSSI_RX1 1 - RSSI_RX2 2 - RSSI_RX3 3 - TX_FWD_PWR	0063	ADC channel.	ADC channel; reading

Command	Meaning	Cmd	Params	Response
	4 - TX_REV_PWR 5 - MON_12V 6 - MON_5V 7 - DAC_LOOPBK			

Commands for transmitter testing

Command	Meaning	Cmd	Params	Response
TM_KEY	Start a transmitter test. **data** is: 0 continuous high (mark) 1 continuous low (space) 2 alternating 1010... sequence 3 alternating 1100... sequence 4 random PR data 5 fixed test message from memory **mode** is: 0 – AIS 25kHz 1 - AIS 12.5kHz 2 - DSC 3 – Unmodulated carrier 4 – Not used (reserved) **run** is: 0 – Repeated indefinite bursts tied to slot clock(*) 1 – Continuous transmission(*) 2 – A fixed number of bursts as set by the TM_SET_TX_BURSTS command 3 – A fixed number of alternate burst / quiet cycles tied to slot clock (for TX/RX turnaround test) (*) (*) Stop these tests by sending the TM_DEKEY command.	0060	data; mode; run.	TM_ACK
TM_DEKEY	De-key transmitter. Stops the current TX test.	0061		TM_ACK
TM_SRT_WITH_HW_CONT	1 for true continuious mode operation 0 – normal mode	006C	Mode of operation.	TM_ACK
TM_SET_TX_ BURSTS	Sets number of TX test bursts to be sent when **run** (above) is 2 or 3. Default = 1 burst.	0064	Number of bursts.	TM_ACK
TM_GET_VSWR	Display most recent TX fwd and rev power readings; VSWR value is calculated from these readings and also displayed.	0080		Fwd power; reverse power; VSWR * 256.

E2PROM commands

Important note: The E2PROM checksums should be updated using TM_SET_EE_CHK after any write (_SET command) to the E2PROM. Otherwise, at start-up, the transponder software will assume that the E2PROM is corrupted and attempt to restore default values.

Command	Meaning	Cmd	Params	Response
TM_TX_GET_DEV	Read current TX deviation setting from EEPROM	0070		
TM_TX_SET_DEV	Set TX deviation setting and store in EEPROM (note 1)	0071	New deviation value (note 2)	
TM_TX_ GET_OFFSET	Read current TX frequency offset from EEPROM	0072		
TM_TX_ SET_OFFSET	Set TX frequency offset and store in EEPROM (note 1)	0073	New frequency offset value (note 2)	
TM_TX_ GET_POWER	Read current TX power setting from EEPROM	0074		
TM_TX_ SET_POWER	Set TX power setting and store in EEPROM (note 1)	0075	New power value (note 2)	
TM_TX_ GET_REF_OSC	Read current ref osc trim setting from EEPROM	0076		
TM_TX_ SET_REF_OSC	Set ref osc trim and store in EEPROM (note 1)	0077	New ref osc trim value (note 2)	
TM_SET_EE	Write to EEPROM. Writes a byte or a word (16 bits) to the EEPROM. Addresses above 0x0ff are treated as 16-bits, otherwise 8 bits. All addresses are in bytes; address LSB is ignored for 16-bit accesses.	0065	EE address; New value	TM_ACK
TM_GET_EE	Read from EEPROM. Reads one byte or word (16 bits) from the EEPROM (See TM_SET_EE).	0066	EE address.	Address; E2 data; RAM image data.
TM_SET_EE_CHK	Sets the EEPROM checksum locations	0067		TM_ACK
TM_GET_EE_CHK	Checks the EEPROM contents against the check locations.	0068		b0 means checksum wrong; b1 means inverse-checksum wrong; b2 means eeprom is corrupt.

note 1: Supports auto-increment and decrement. Press '+' to repeat the command with the given value incremented, and '-' to repeat with the value decremented.

note 2: If the **value** parameter is omitted, the command will automatically read the current value and display it. The command can then be repeated with auto-increment or decrement (see **note 1** above) to alter the value.

DSP memory and I/O commands

Command	Meaning	Cmd	Params	Response
TM_POKE	Pokes a word into the DSPs I/O or ram space. 'map ' = 0 for I/O space; 1 for RAM space. Address31:16 ignored for I/O space. .	00A7	Map; Address31:16; Address15:0; Value.	TM_ACK
TM_PEEK	Peeks a word from the DSPs I/O or RAM space. - Details as above.	00A8	Map; Address31:16; Address15:0;	Same as TM_POKE command

Serial port loopback

Command	Meaning	Cmd	Params	Response
TM_SER_LOOP	Sends an LPB (loopback) message from port P1 to port P2. If sending port is 0, then msg sent on all ports; if dest port is 0, then msg is to be received on all ports. .	0069	Port which sends the LPB msg; Port to receive the LPB.	TM_ACK
TM_SET_LOOPRES	Gets the result of the loopback test.	006A	none;	TM_ACK (pass) or TM_NAK (fail)

Miscellaneous commands

Command	Meaning	Cmd	Params	Response
TM_SET_RSSI	Sets the –77dB or –108dB RSSI level or use the initial default values.	0036	Receiver (1,2); dB (004D, 006C); RSSI (0 to 255)	TM_ACK
TM_GET_RSSI	Gets the –77dB & –108dB RSSI level in use.	0037	Receiver (1,2)	Command; RSSI at -77dB; RSSI at –108dB
TM_SET_SERIALNO	Set Serial Number max 9999999 where top 3 digits in param 1 and bottom 4 digits in param 2	0081	Top 3 digits in BCD; Bottom 4 digits in BCD	TM_ACK
TM_GET_SERIALNO	Get Serial Number max 9999999	0082		Command; Top 3 digits in BCD; Bottom 4 digits in BCD
TM_GET_VERS	returns FPGA and Software Version	0083		fpga version; Software major & Minor Version
TM_FLAST_LEDS	Turns all LEDS ON or OFF	008A	Paramerer1 (LEDs) 0001 = ON 0000 = OFF	TM_ACK

Command	Meaning	Cmd	Params	Response
TM_SET_CONTROL_GAIN	Special Testmode commands to enable otherwise constant parameters to be adjusted while seeking the ultimate value	008B	Parameter1 in range 0 to 1F	Parameter1
TM_GET_UPRAMP		008C		Return 10 Parameter that make-up this array
TM_SET_UPRAMP		008D	10 Parameter that make-up this array	TM_ACK
TM_GET_UPRAMP_ANT_EN		008E		Parameter
TM_SET_UPRAMP_ANT_EN		008F	Parameter	TM_ACK
TM_GET_UPRAMP_PA_EN		0090		Parameter
TM_SET_UPRAMP_PA_EN		0091	Parameter	TM_ACK
TM_GET_UPRAMP_START_DAC		0092		Parameter
TM_SET_UPRAMP_START_DAC		0093	Parameter	TM_ACK
TM_GET_UPRAMP_END_DAC		0094		Parameter
TM_SET_UPRAMP_END_DAC		0095	Parameter	TM_ACK
TM_GET_DOWNRAMP		0096		Return 10 Parameter that make-up this array
TM_SET_DOWNRAMP		0097	10 Parameter that make-up this array	TM_ACK
TM_GET_DOWNRAMP_ANT_DIS		0098		Parameter
TM_SET_DOWNRAMP_ANT_DIS		0099	Parameter	TM_ACK
TM_GET_DOWNRAMP_PA_DIS		009A		Parameter
TM_SET_DOWNRAMP_PA_DIS		009B	Parameter	TM_ACK
TM_GET_DOWNRAMP_VCO_DIS		009C		Parameter
TM_SET_DOWNRAMP_VCO_DIS		009D	Parameter	TM_ACK
TM_SCALE	Test mode commands to vary and interrogate the operation of the demodulator.	00B0		Parameter
TM_MASK		00B1	(Parameter)	Parameter
TM_MASK2		00B2	(Parameter)	Parameter
TM_GET_MATCH_COUNTS		00B3		Parameters
TM_GET_MIN_MAX		00B4		Parameters
TM_EXTEND_INFO		00B5	(Parameter)	Parameter
TM_DISABLE_WATCHDOG	Setting parameter stops the operation of the watchdog.	00B8	(Parameter)	Parameter

BER and PER testing

Test mode allows BER and PER testing of the AIS and DSC receivers. The AIS receivers perform PER measurements and the DSC RX performs BER measurements. The error rate testing is performed internally within the receivers, so that no external testing equipment is required, and the results are output in real time on the serial link.

PER vs. BER

To measure PER (AIS only), the receivers calculate the CRC of each received block (burst) and report its validity. To measure BER (DSC), the receivers count bit errors by comparing the received data with a built-in PRBS pattern; this relies on the RF test source transmitting the appropriate data expected by the receiver. There is currently no capability to determine if a burst was expected but was not detected (a “missed burst detector”).

Automatic BER measurement

The TM_IBERT_AUTO command allows PER/BER data from one or more receivers to be streamed out of the T&D port. The BER test code maintains counts of:

- The number of blocks of data received (for AIS, where a start flag and training sequence combination was received, followed by an end flag within a timeout; for DSC, where a valid dot pattern and DX/RX sequence was received)
- On the AIS RXs the number of blocks received with a good CRC, or on the DSC RX the number of blocks received with a no bit errors since the BER test was started
- On the DSC RX, bit errors in the last block
- On the DSC RX, total bit errors in all blocks since the BER test was started
- On the DSC RX, the error rate as a reciprocal (“1 in x”) since the BER test was started

A new line is output on the T&D port for each received block, in the following formats:

AIS RXs: **(see table below)**

"RXn <TP> <GC> <CC>"

Use the #0021 and #0022 commands to set the receivers up in the normal way, however the frequency will need to be set to 156.525MHz and the mode to 2 (DSC).

E.g. #0021 30EA 0002

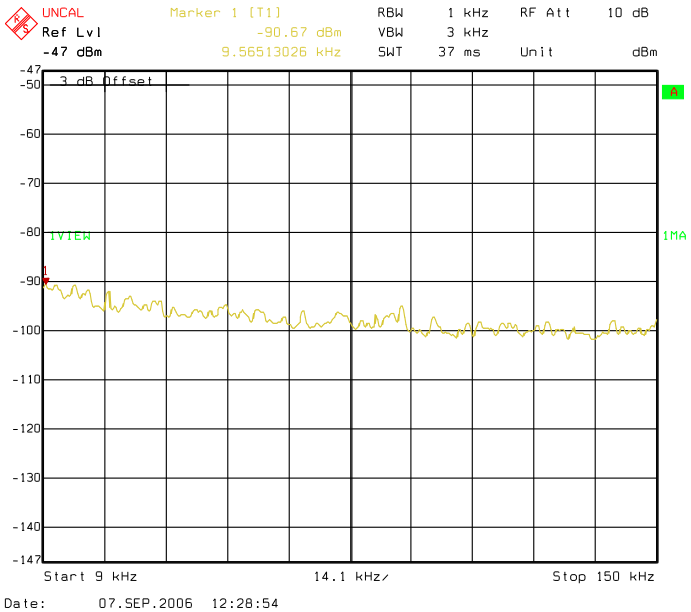
To change to test on RX 2, first RX1 must be set back to a default AIS frequency and then set RX2 to DSC. The same applies when changing DSC receiver from RX2 to RX1.

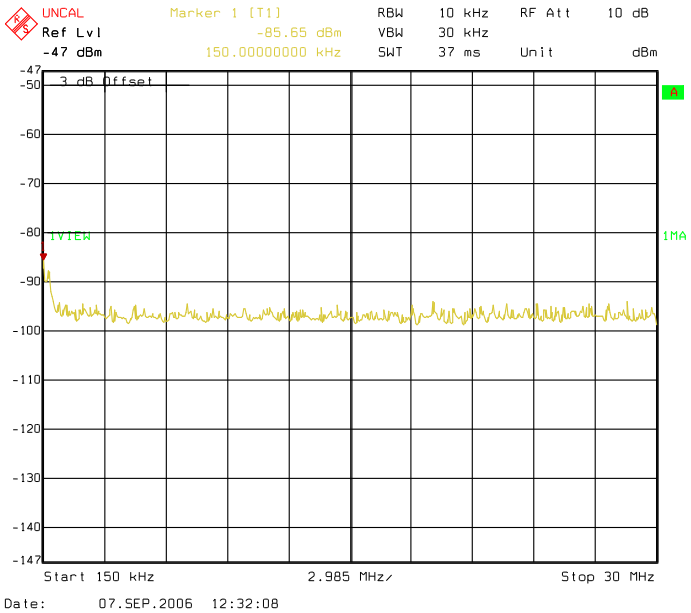
E.g. #0021 329E (RX1 back to AIS)

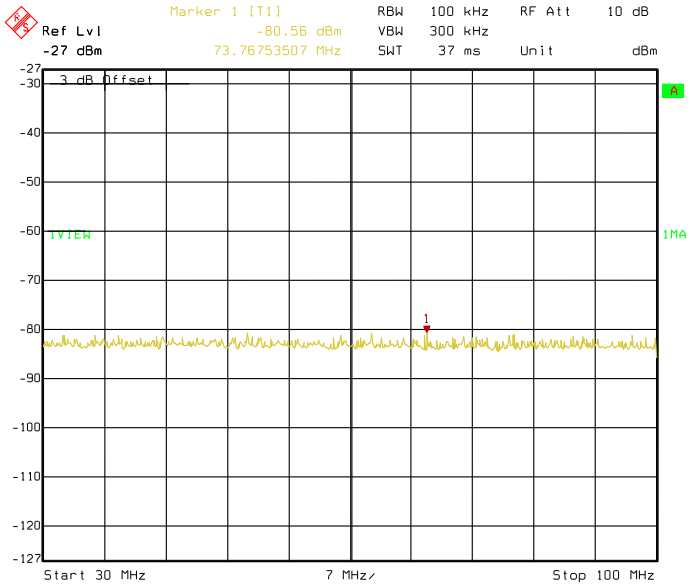
#0022 30EA 0002 (RX2 to DSC)

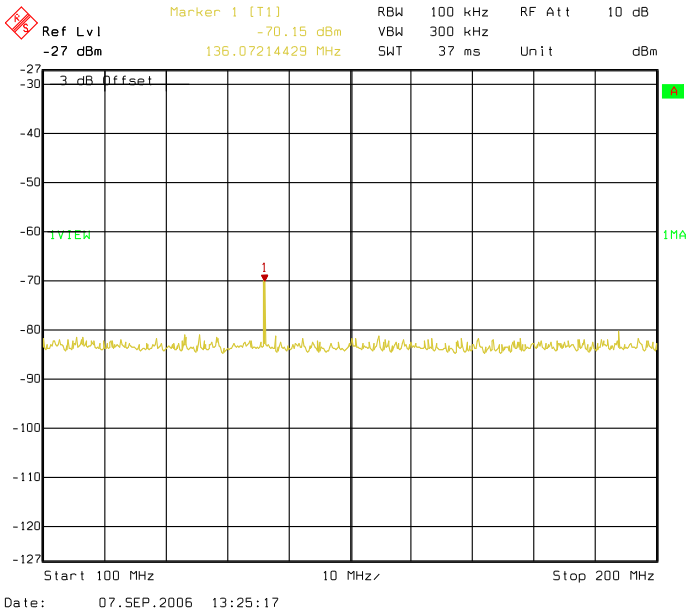
Field code	Field name	Explanation
N	AIS RX number	1 or 2
TP	Total packet count	A number which increments each time a packet is received.
GC	Good-CRC packet count	Number of packets received with a good CRC
CC	Current CRC status	Shows this packet's CRC status: "good" or "bad".
EF	Error-free packet count	Number of packets received with no bit errors.
CP	Current packet bit errors	Number of bit errors in this packet.
TE	Total bit errors	Sum of the bit errors in all packets.
ER	Error rate	Either "No errors" or a ratio "1 in x" for the current BER test.
DS	Decode Status	0 = No valid message could be decoded 1 = Message DX was good without error correction 2 = Message RX was good without error correction 3 = A valid composite msg was assembled from DX and RX

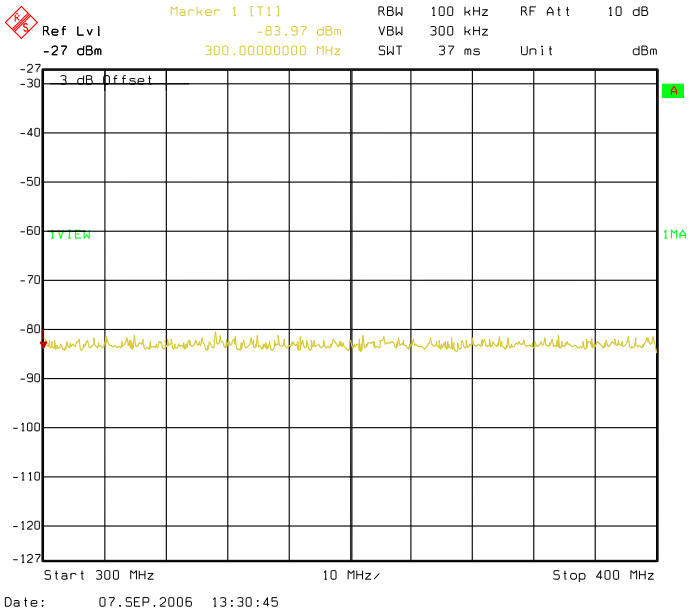
ANNEX C - SCREEN PLOTS FOR RECEIVER SPURIOUS EMISSIONS

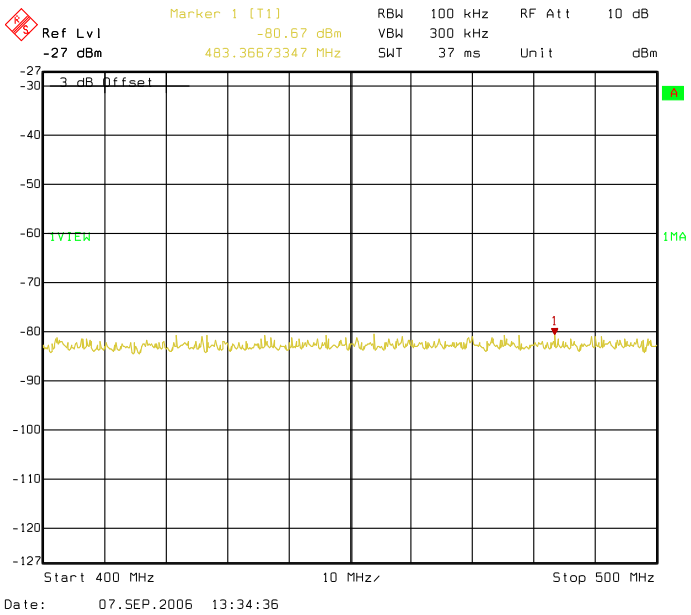


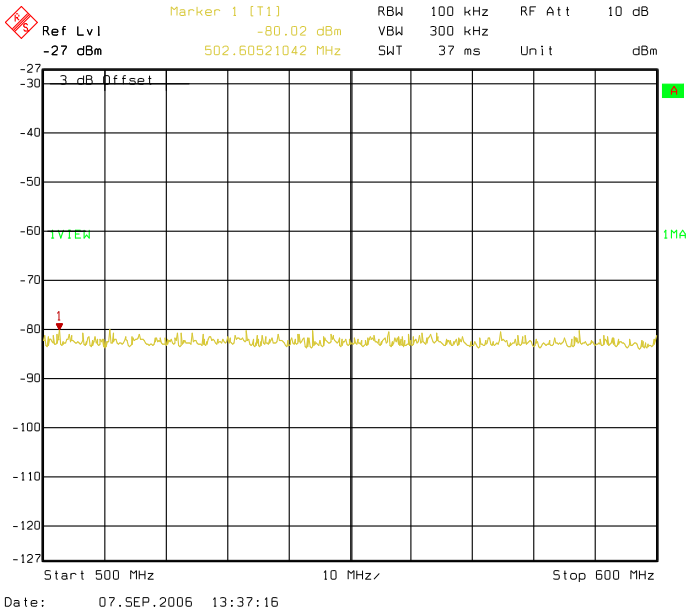


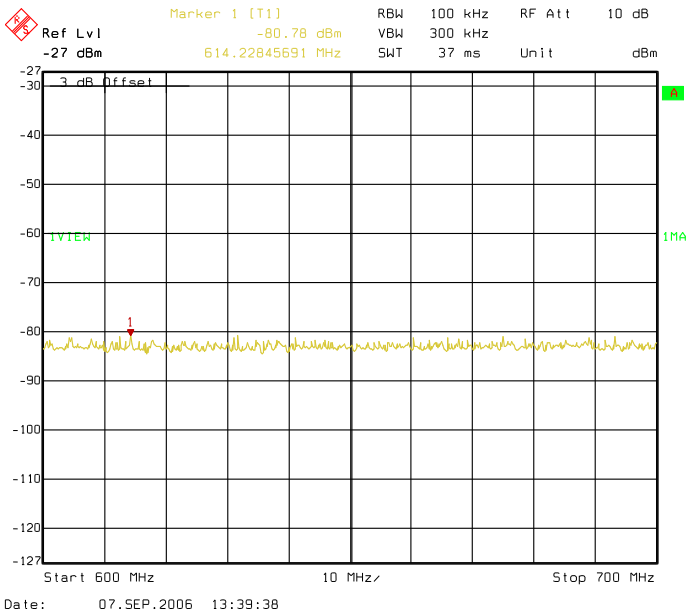


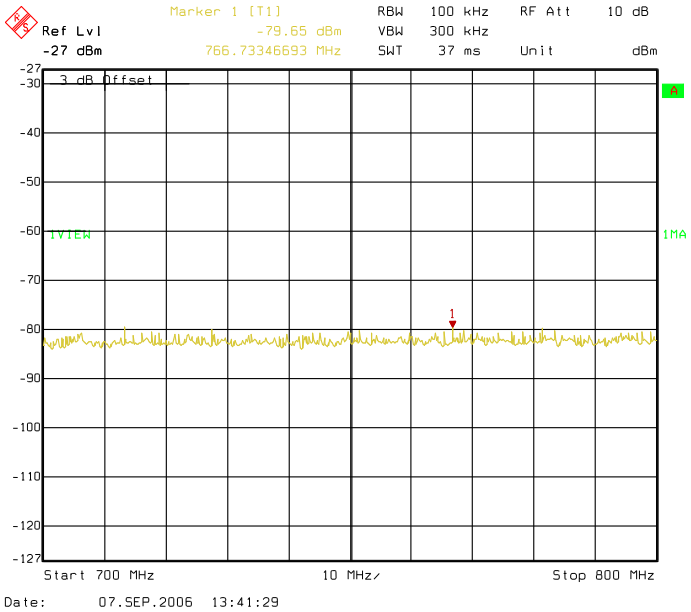


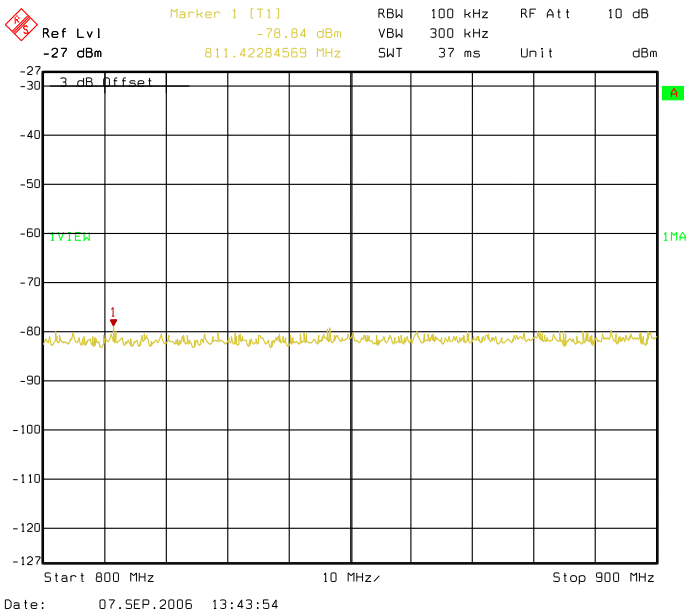


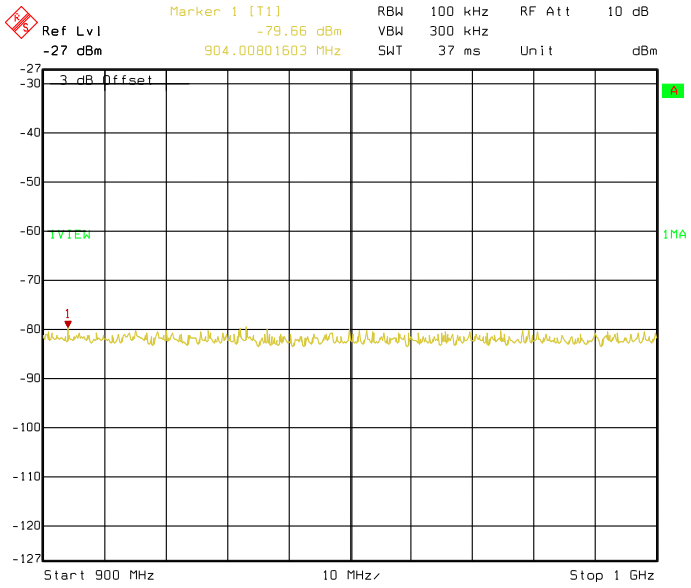


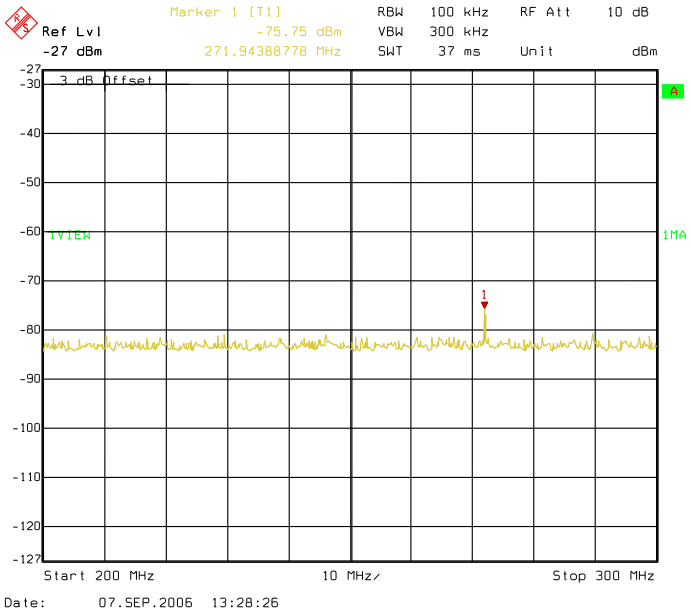


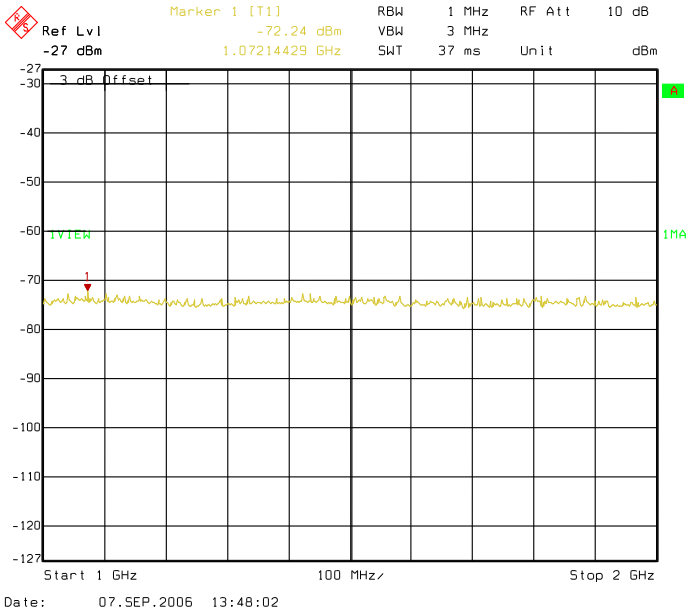


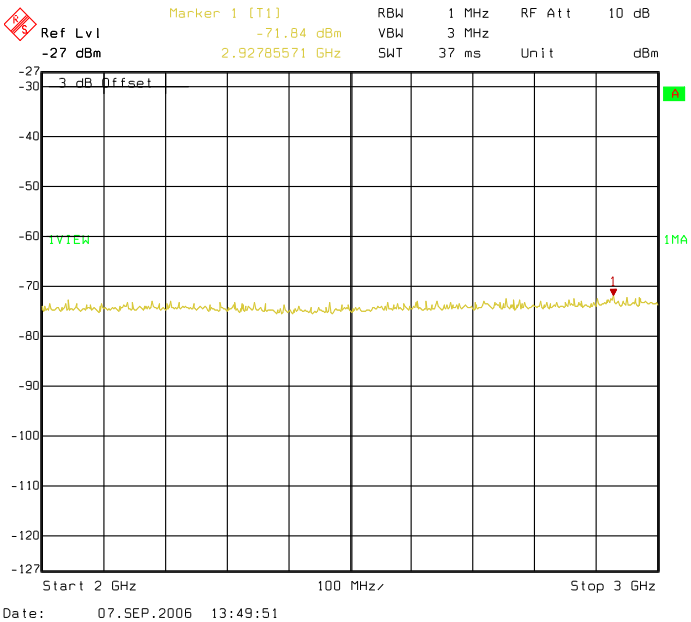


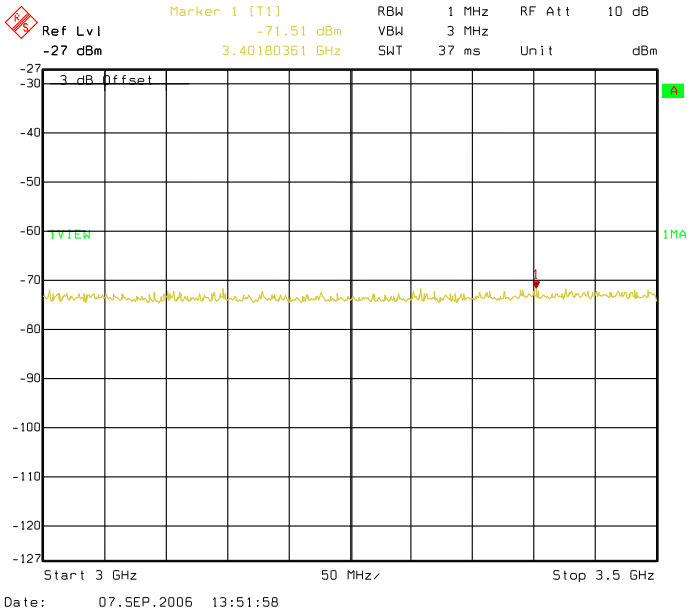






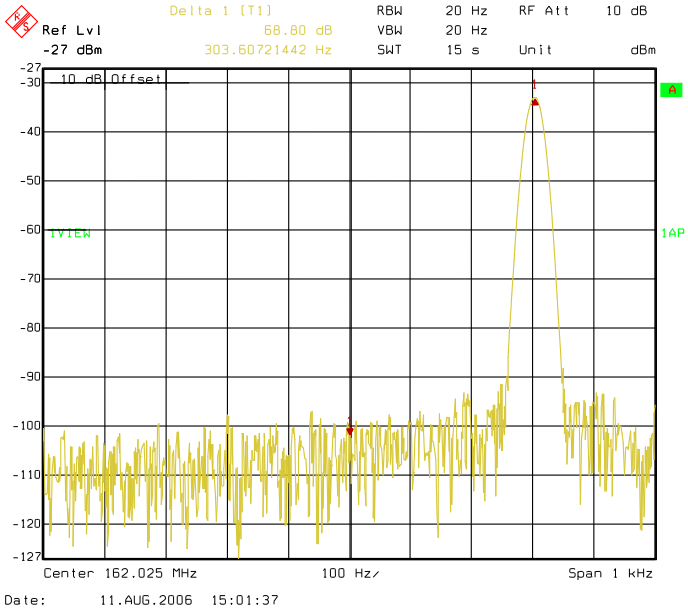




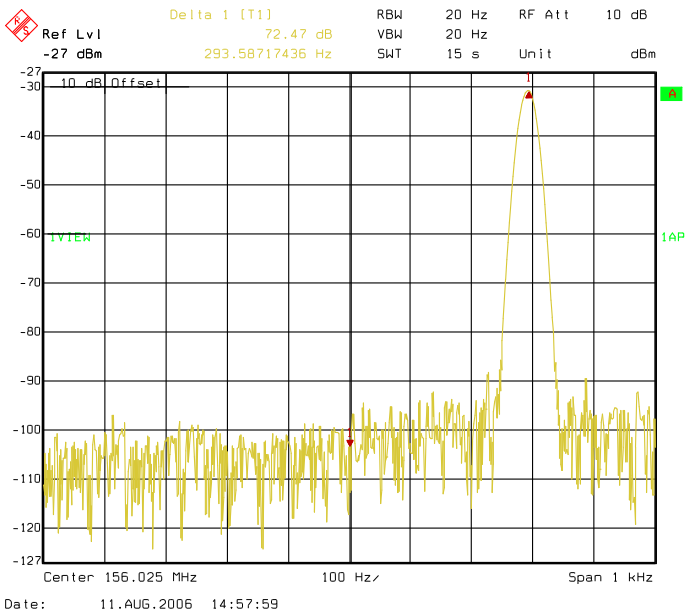


ANNEX D – TEST PLOTS FOR TRANSMITTER FREQUENCY ERROR

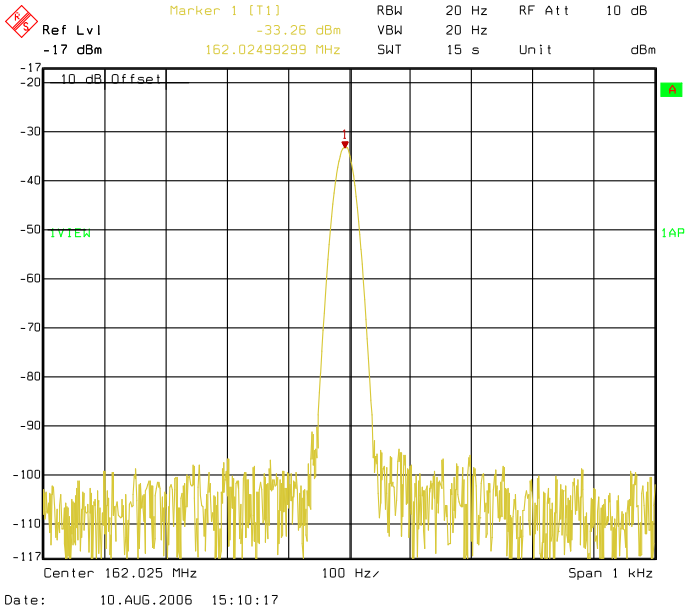
-25°C Ambient Temperature High Frequency



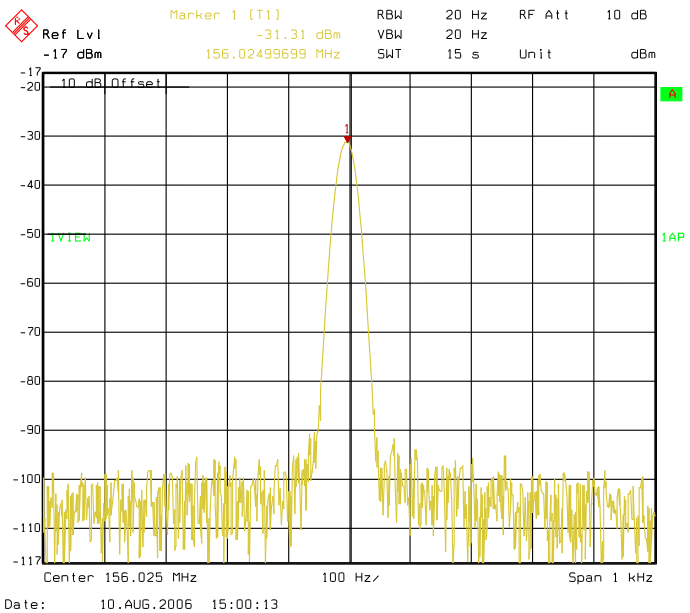
-25°C Ambient Temperature Low Frequency



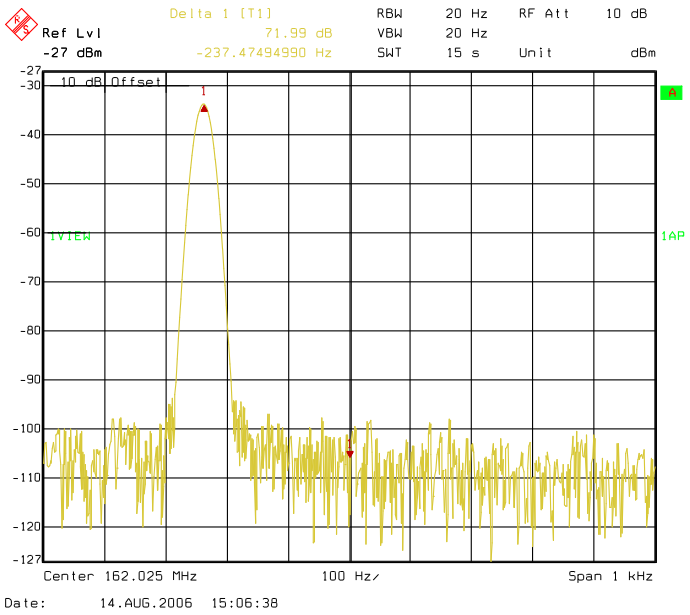
+25°C Ambient Temperature High Frequency



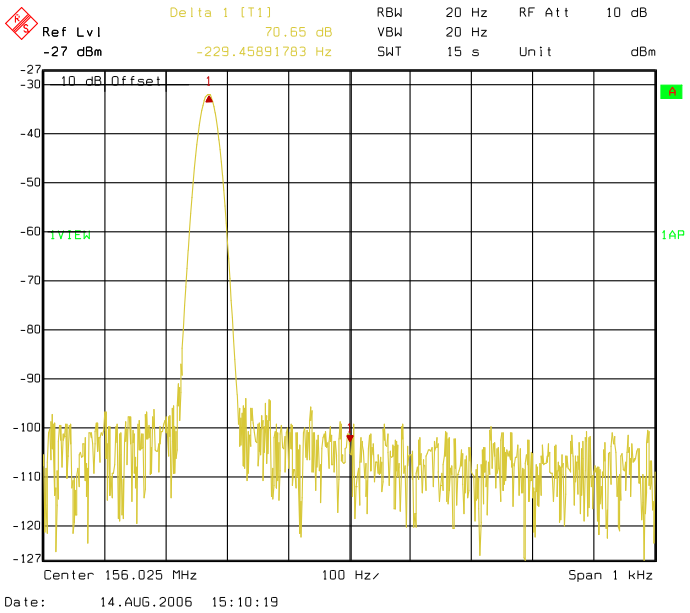
+25°C Ambient Temperature Low Frequency



+55°C Ambient Temperature High Frequency

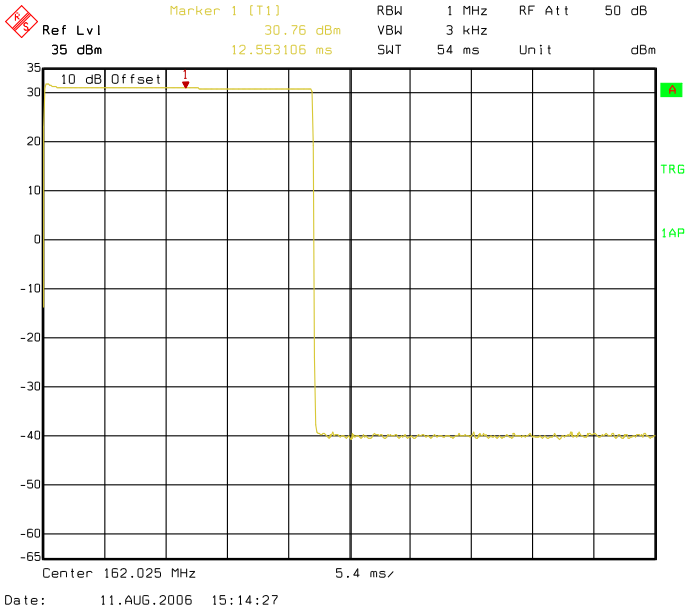


+55°C Ambient Temperature Low Frequency

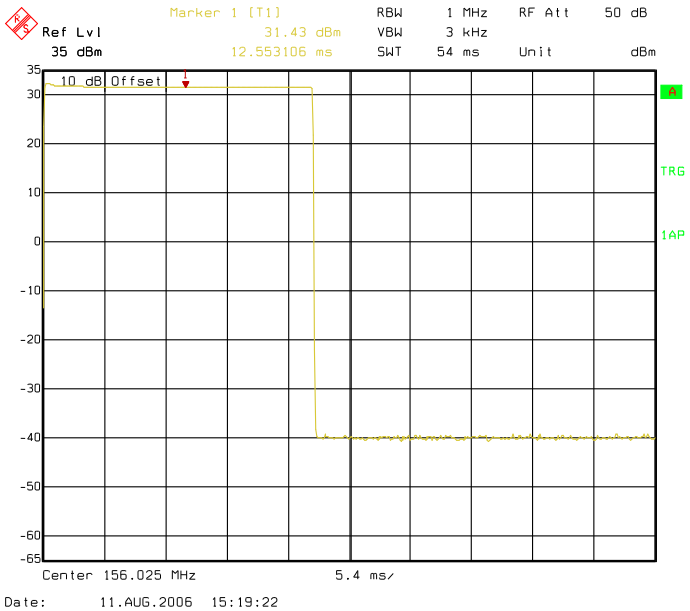


ANNEX E – TEST PLOTS FOR CARRIER POWER

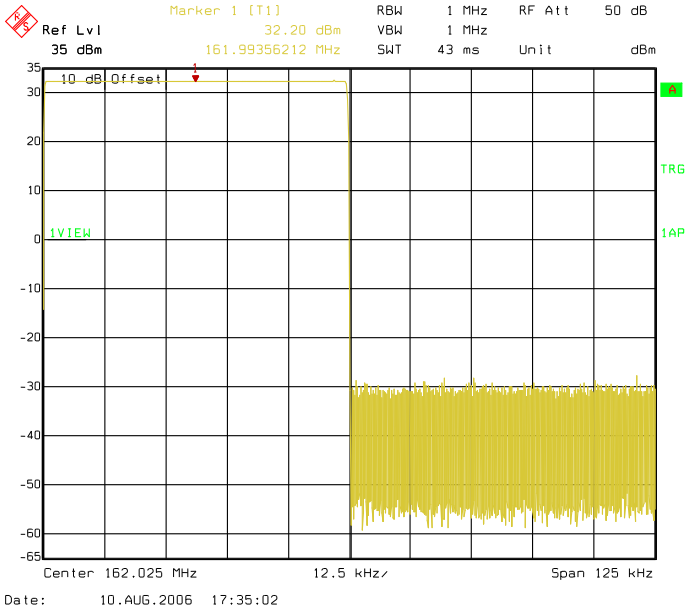
-25°C Ambient Temperature High Frequency



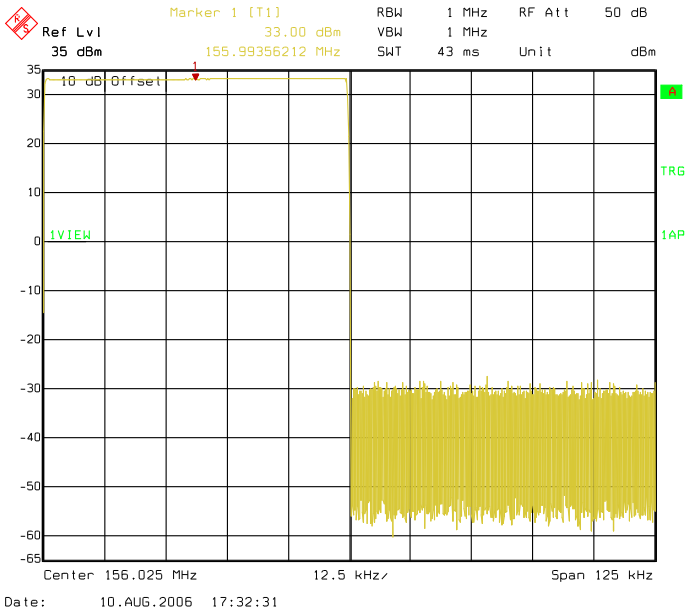
-25°C Ambient Temperature Low Frequency



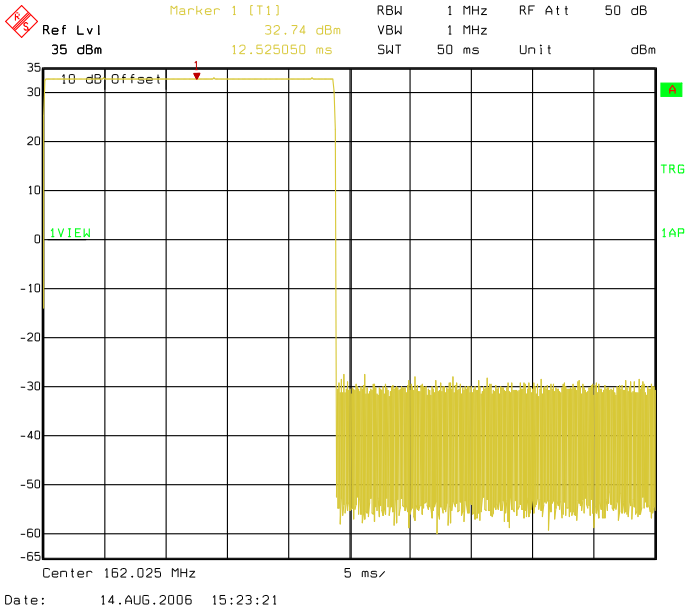
+25°C Ambient Temperature High Frequency



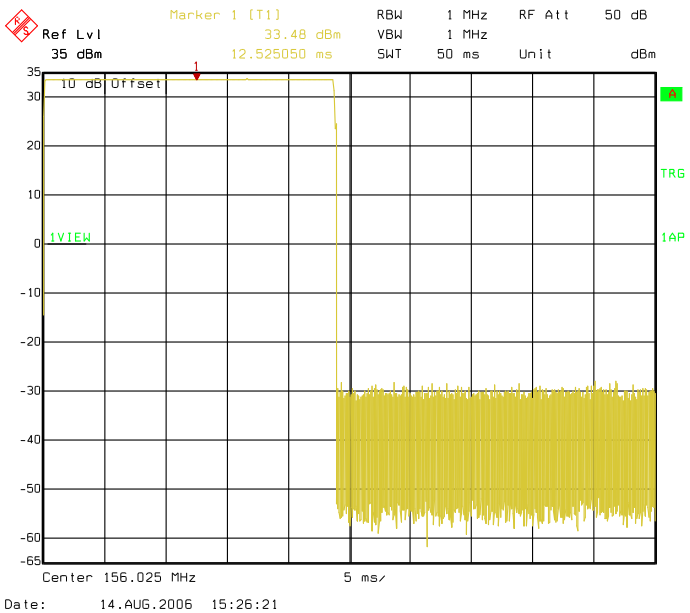
+25°C Ambient Temperature Low Frequency



+55°C Ambient Temperature High Frequency

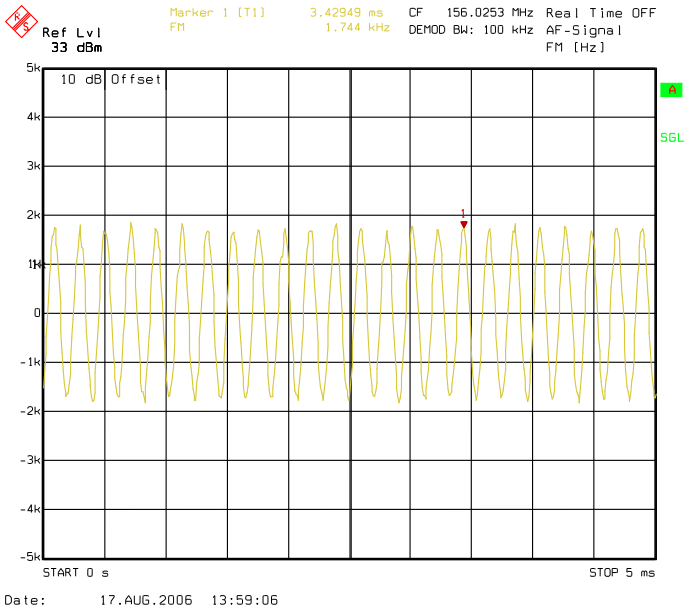


+55°C Ambient Temperature Low Frequency



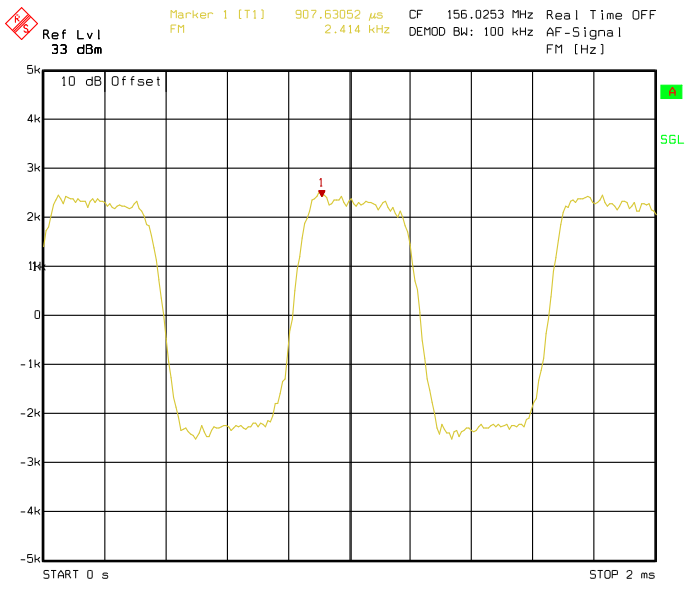
ANNEX F TEST PLOTS TRANSMITTER CARRIER POWER

-25°C, Test Signal 2, Low Frequency



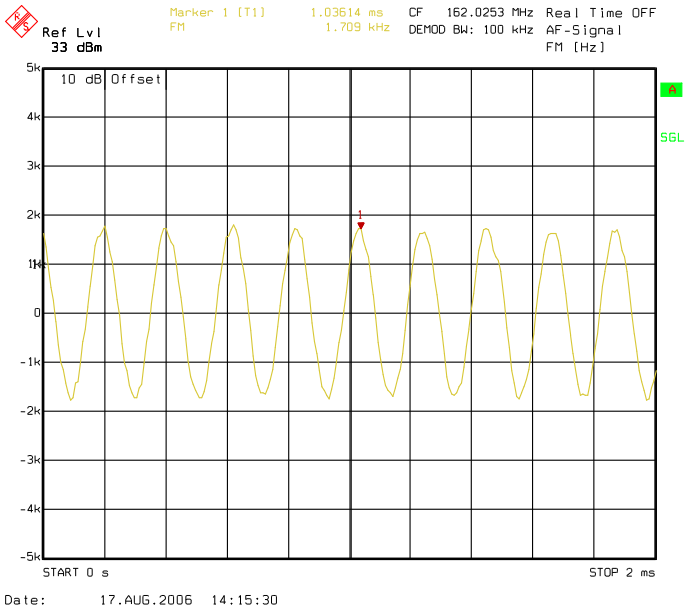
Date: 17.AUG.2006 13:59:06

-25°C, Test Signal 3, Low Frequency

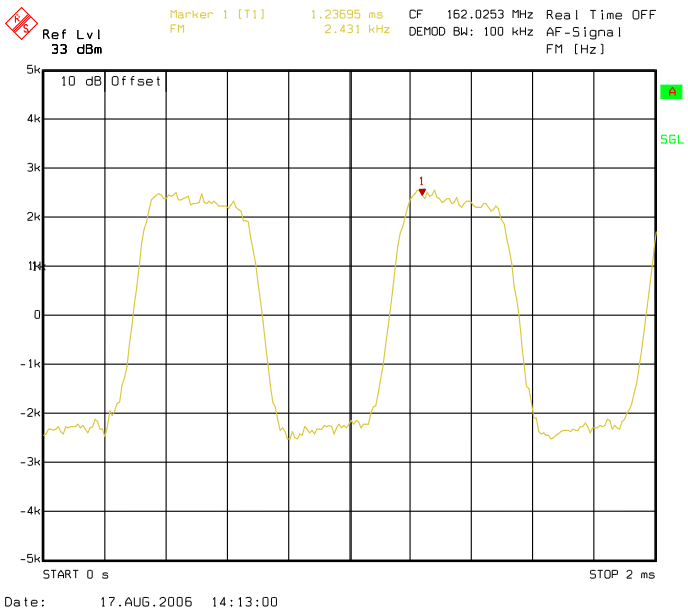


Date: 17.AUG.2006 14:06:09

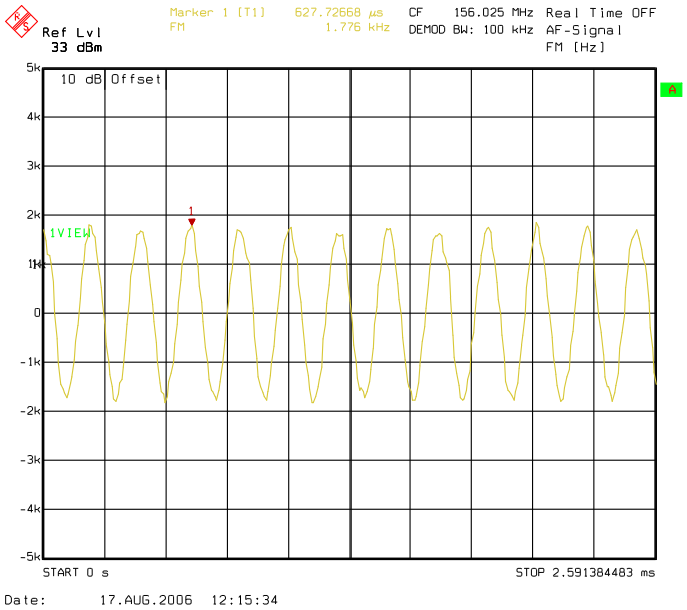
-25°C, Test Signal 2, High Frequency



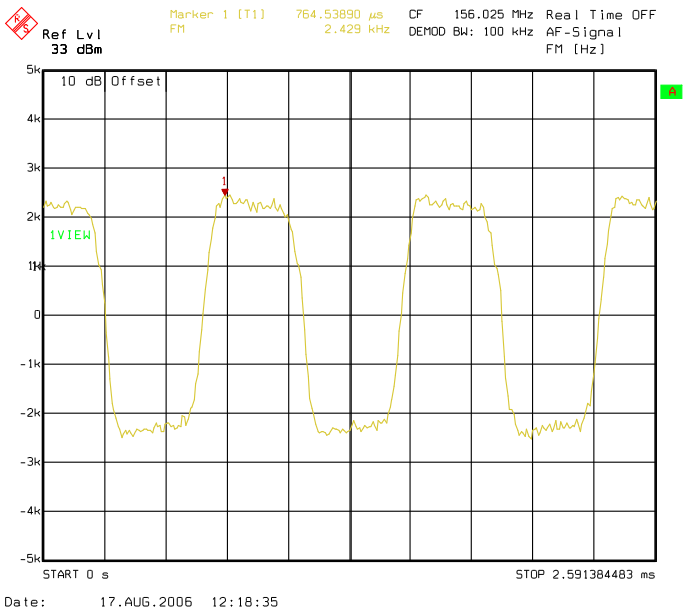
-25°C, Test Signal 3, High Frequency



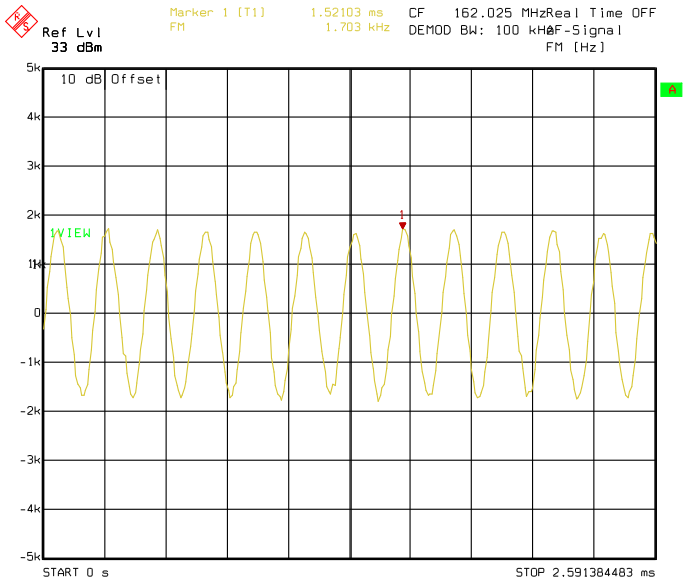
+25°C, Test Signal 2, Low Frequency



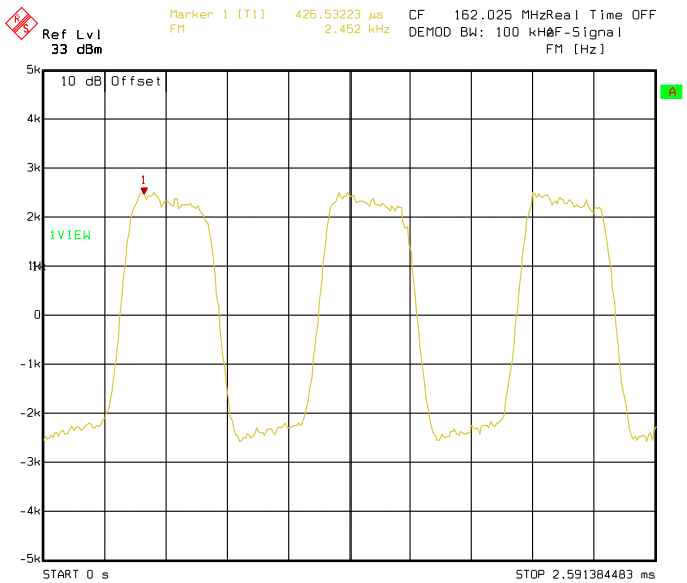
+25°C, Test Signal 3, Low Frequency



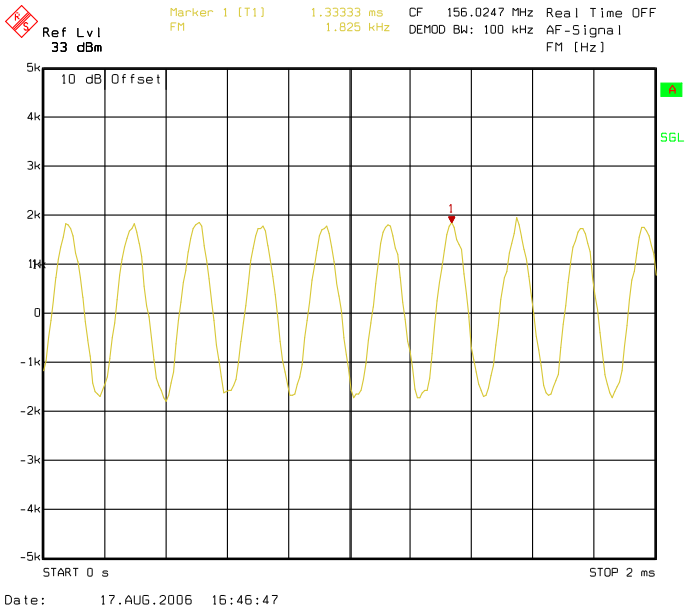
+25°C, Test Signal 2, High Frequency



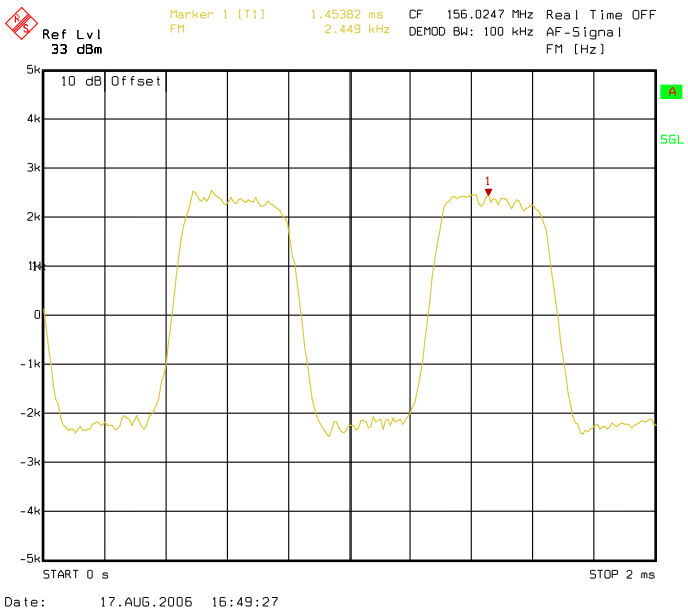
+25°C, Test Signal 3, High Frequency



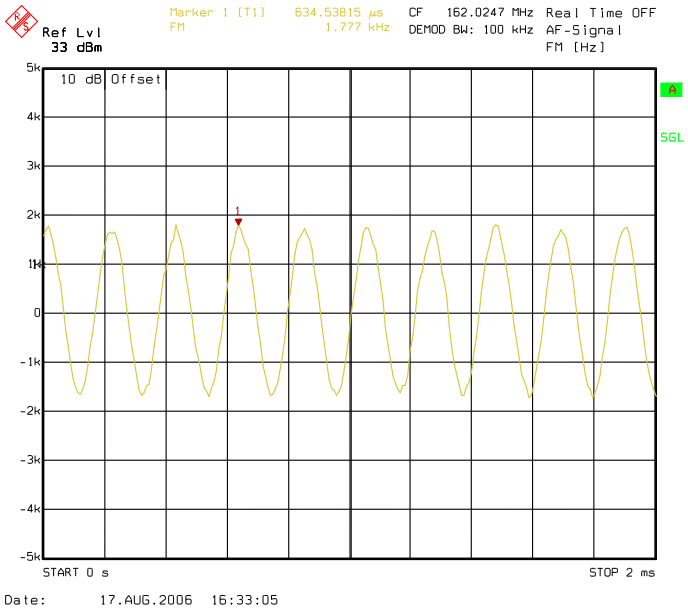
+55°C, Test Signal 2, Low Frequency



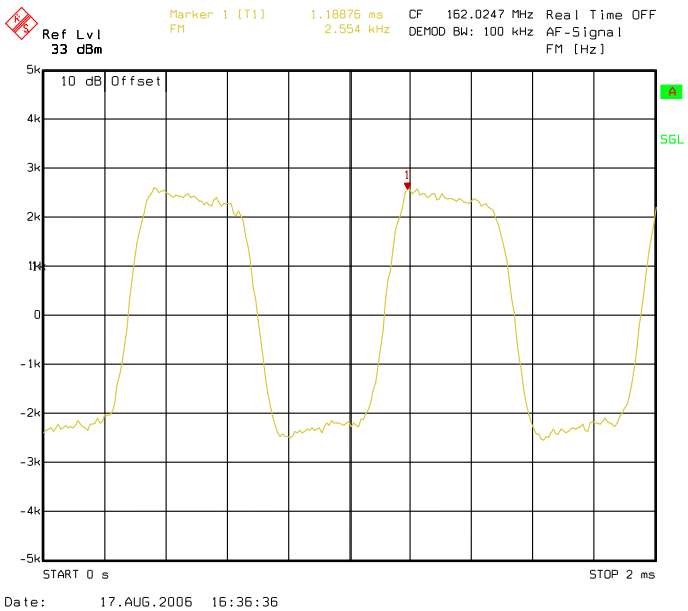
+55°C, Test Signal 3, Low Frequency



+55°C, Test Signal 2, High Frequency

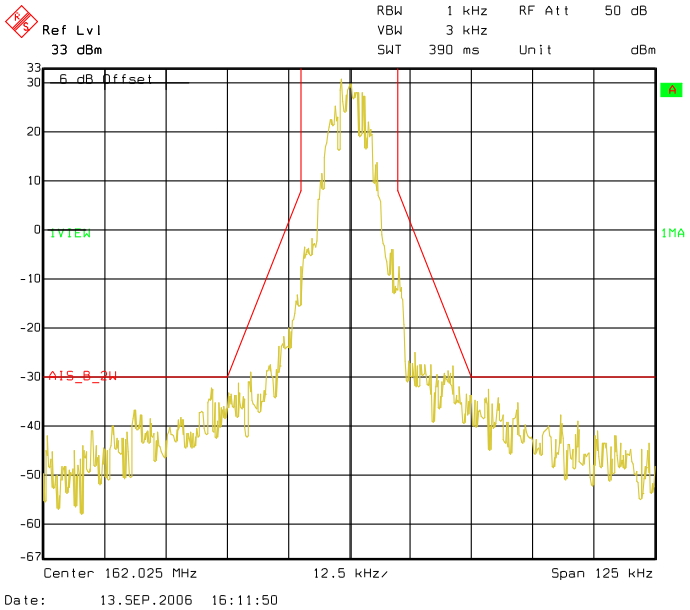


+55°C, Test Signal 3, High Frequency

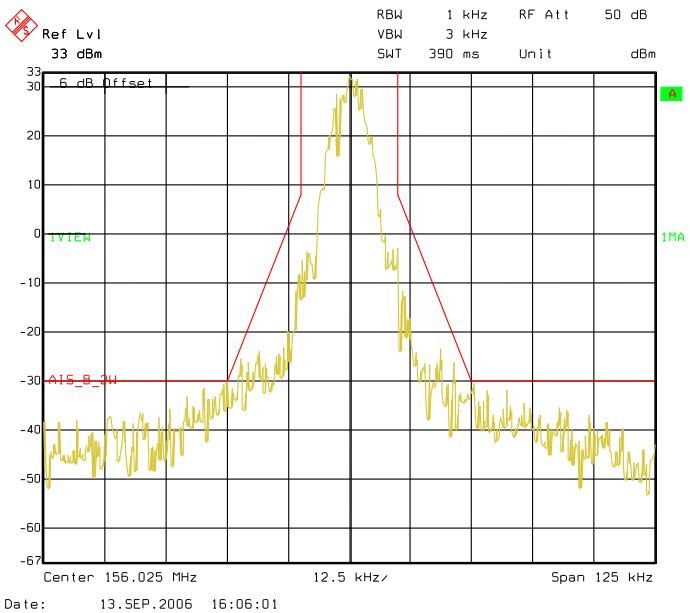


ANNEX G – PLOTS FOR TRANSMISSION SPECTRUM

+25°C, High Frequency

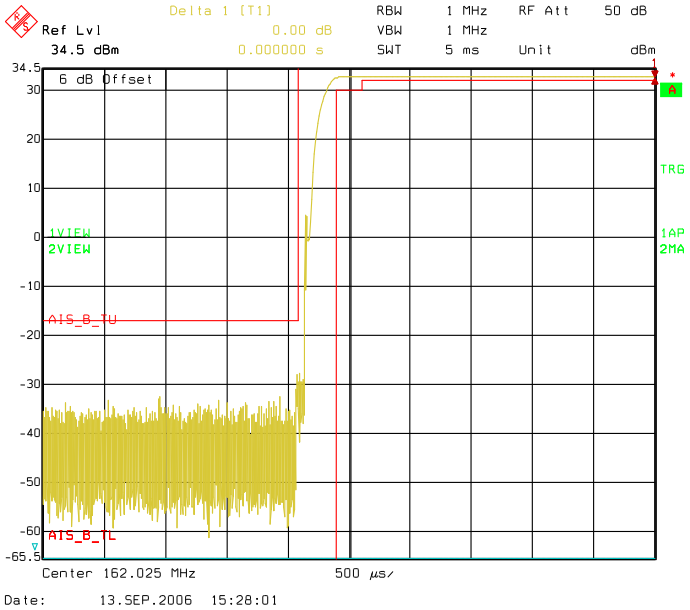


+25°C, Low Frequency

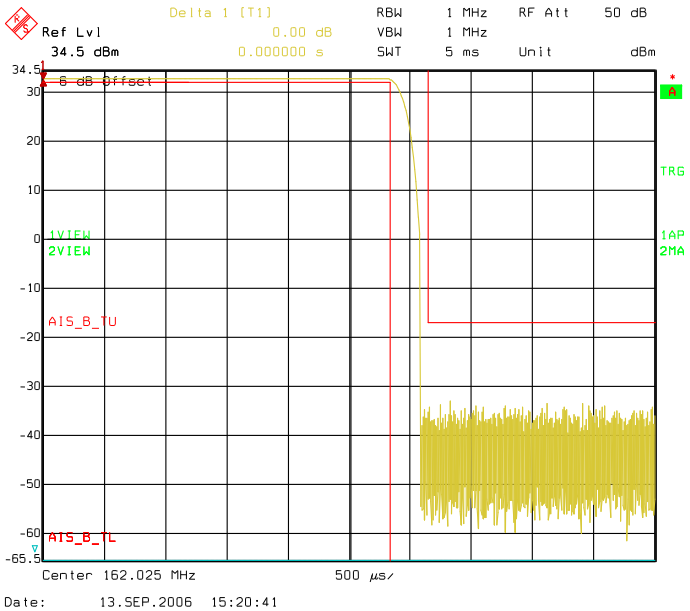


ANNEX H – TRANSMITTER POWER VS TIME PLOTS

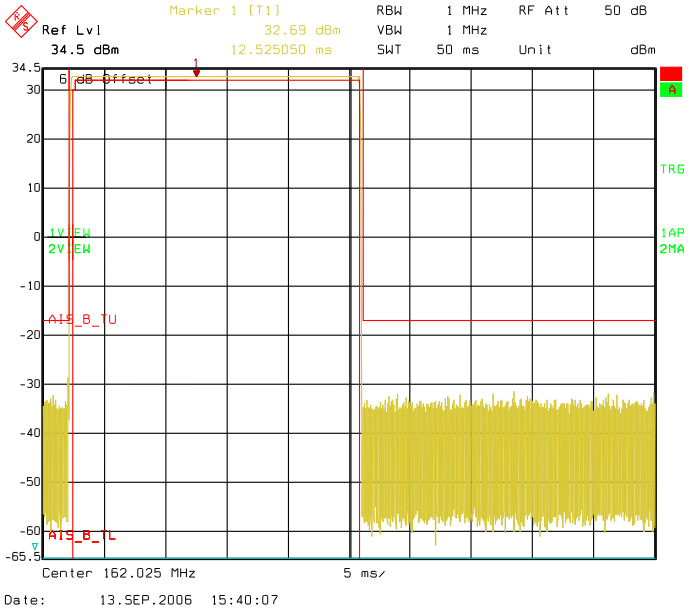
+25°C, High Frequency, Up-ramp



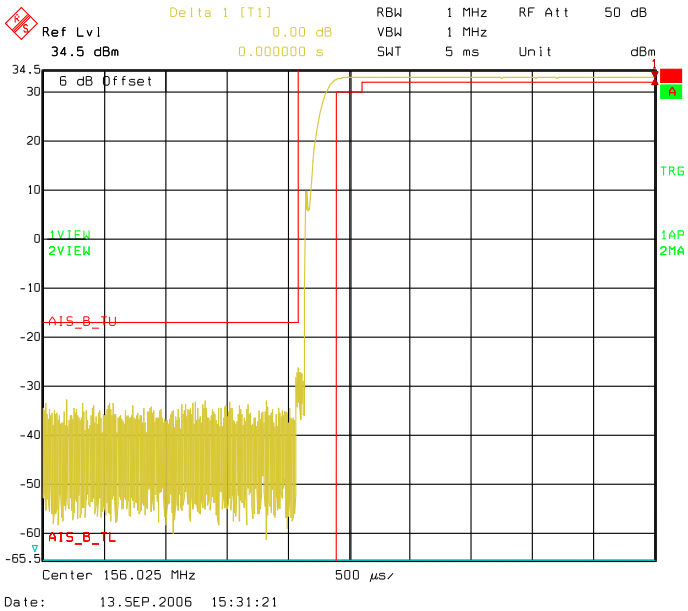
+25°C, High Frequency, Down-ramp



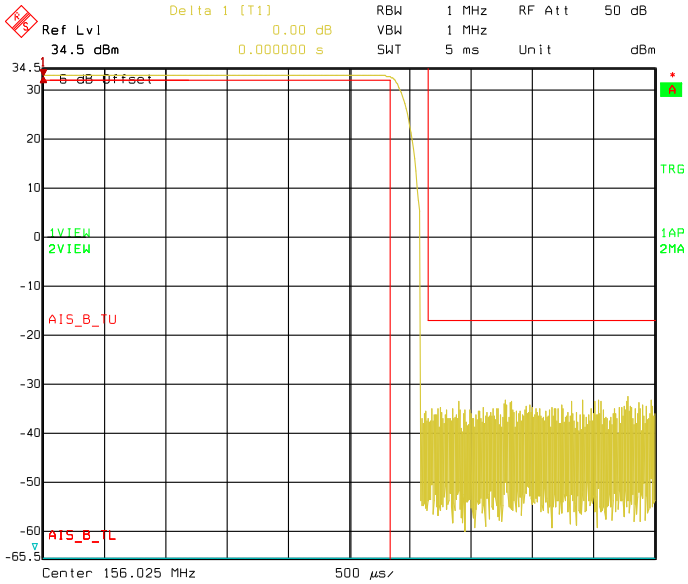
+25°C, High Frequency, Full Burst



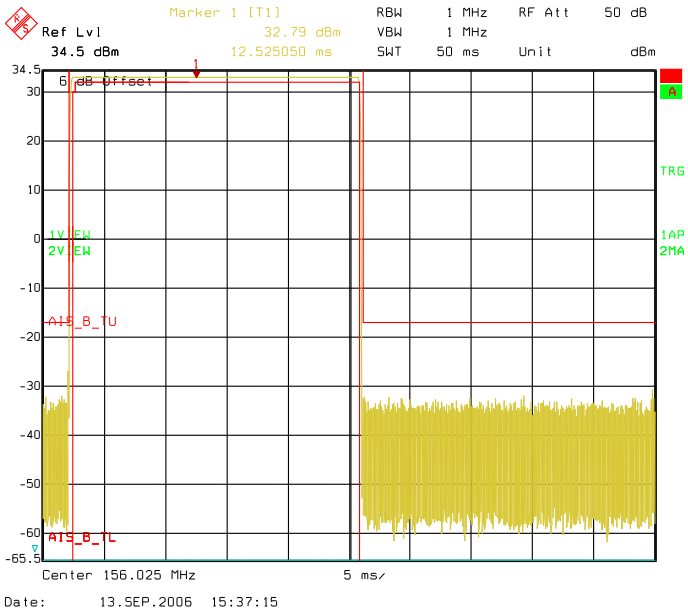
+25°C, Low Frequency, Up-ramp



+25°C, Low Frequency, Down-ramp

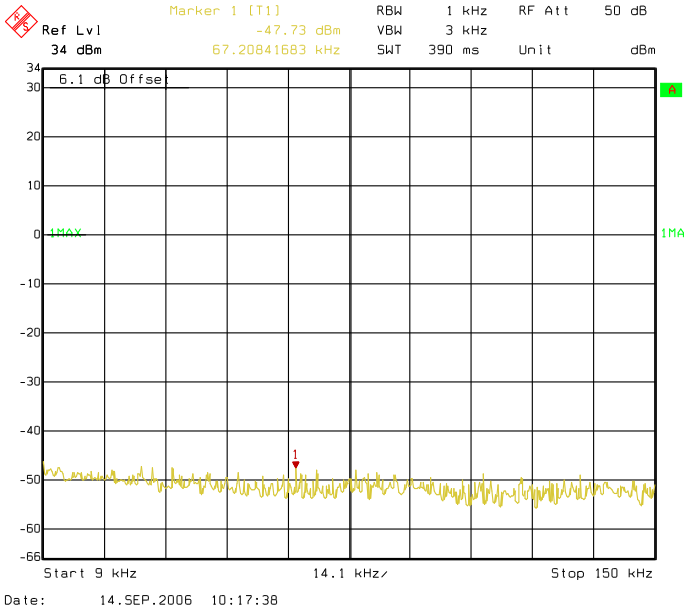


+25°C, Low Frequency, Full burst

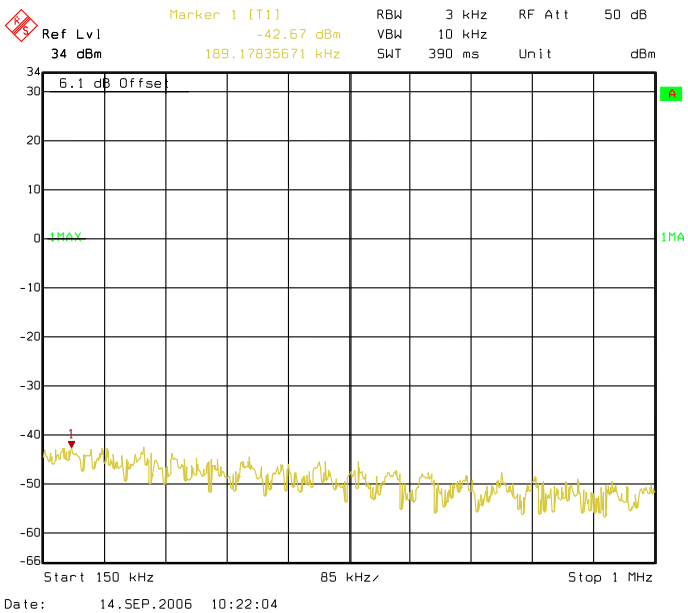


ANNEX J – CONDUCTED SPURIOUS EMISSIONS PLOTS

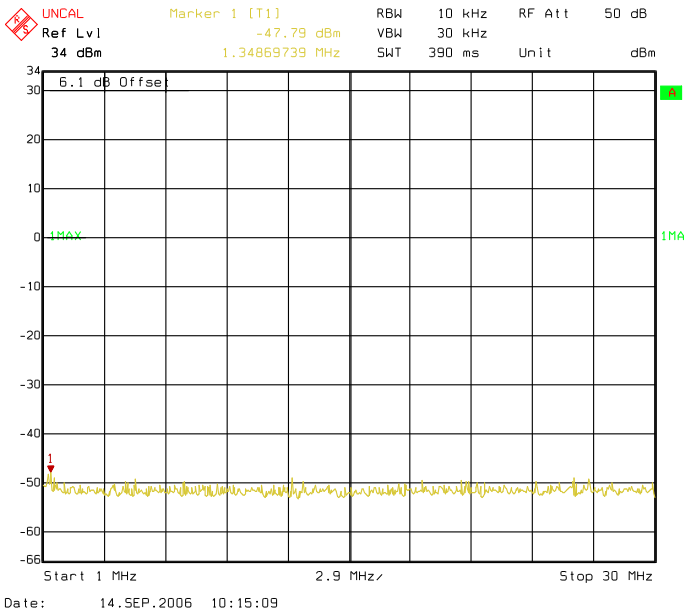
9kHz to 150kHz



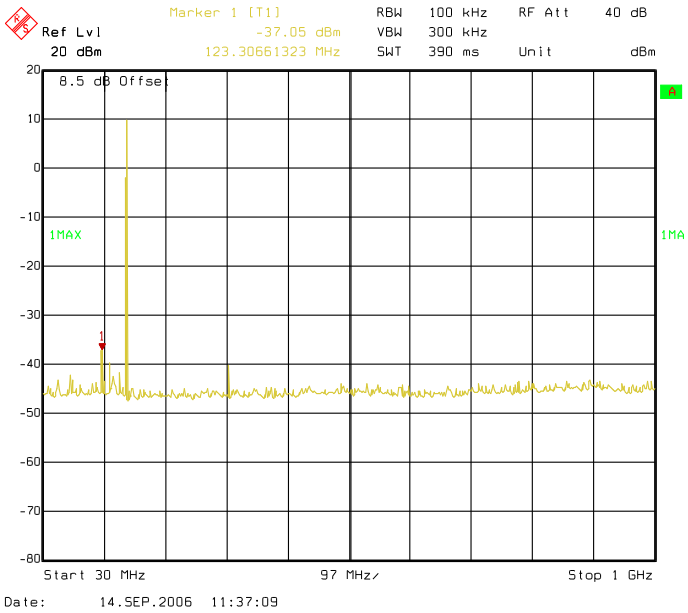
150kHz to 1MHz



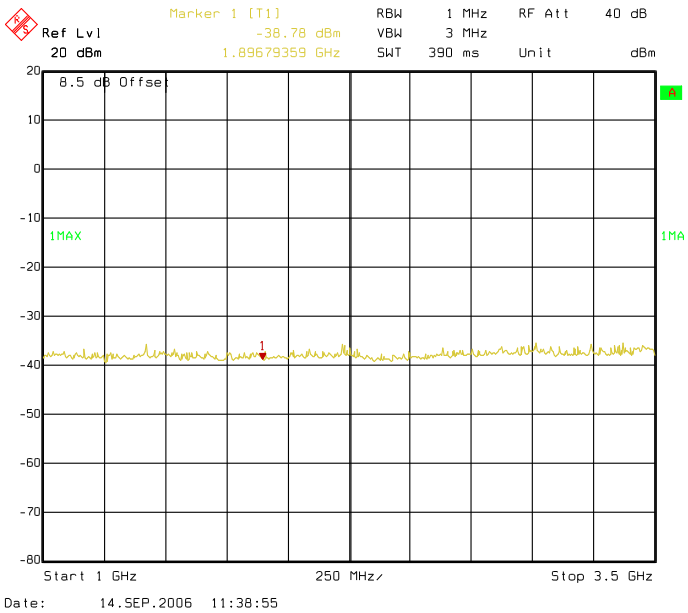
1MHz to 30MHz



30MHz to 1GHz



1GHz to 4GHz*



(* Equipment available only to 3.5GHz, no failures between 3.5GHz and 4GHz are expected)

ANNEX K – CALIBRATION CERTIFICATES

Where available, calibration certificates for the equipment used in this testing have been included in this annex.

Agilent Technologies AGILENT TECHNOLOGIES INTERNAL ASSESSMENT PROGRAM : AQ-SSU-12/95	Agilent Technologies UK Ltd Eskdale Road, Winnersh Triangle Wokingham, BERKSHIRE RG41 5DZ Tel +44(0)7004 666666 Fax: 07004 444555

Certificate of Calibration

Agilent Industry Calibration
Certificate No. : 2-230355339-1

Manufacturer:	Hewlett-Packard Co.	**Description:**	3.5 digit handheld multimeter, math fun
Model No:	E2377A	**Options installed:**	
Serial No:	3047J11159	**Customer asset No:**	
Customer:		**Location of calibration:**	
Software Radio Technology UK Ltd Wireless House Westfield Industrial Estate Midsomer Norton BATH BA3 4BS United Kingdom		Agilent Technologies UK Ltd Eskdale Road, Winnersh Triangle Wokingham, BERKSHIRE RG41 5DZ Tel +44(0)7004 666666 Fax: 07004 444555	
Procedure:	REFER-TO-RESULTS		
Date of calibration:	7 Mar 2006	**Customer PO No.:**	8016
Temperature:	(23 +/-3) °C	**Humidity:**	<70% RH

This calibration certificate documents that the instrument was calibrated for it's basic specifications employing a procedure defined by Agilent Technologies, using a Quality System certified compliant with the requirements of ISO 9001:2000. This calibration was performed as an Industry Calibration which contains tests and measurement points that are applicable to general industry applications.

As received conditions:
Initial testing found the equipment to be IN-SPECIFICATION at the points tested.

As shipped conditions:
At the completion of the calibration, measured values were IN-SPECIFICATION at the points tested.

Remarks or special requirements:

Our calibration procedures are designed to provide measurement uncertainty of less than or equal to one quarter of the specification of the unit under test, where possible, with a coverage factor of 2.

The test limits stated in the report correspond to the published specifications of the equipment, at the points tested.

This certificate is composed of 2 pages containing a summary of calibration information.

Based on the manufacturer recommended or user requested calibration interval, the next calibration is due on 7 Mar 2007 . The User should determine the suitability of this instrument for its intended use.

D Trotman

Issue date: 7 Mar 2006 — Dave Trotman - European Support Manager

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Agilent Technologies AGILENT TECHNOLOGIES INTERNAL ASSESSMENT PROGRAM : AQ-SSU-12/95	Agilent Technologies UK Ltd Eskdale Road, Winnersh Triangle Wokingham, BERKSHIRE RG41 5DZ Tel +44(0)7004 666666 Fax: 07004 444555

Certificate of Calibration

Agilent Industry Calibration

Certificate No. : 2-230288817-1

Manufacturer:	Hewlett-Packard Co.	**Description:**	RF Scalar Network Analyzer, 1.3 GHz
Model No:	8711B	**Options installed:**	
Serial No:	US34400206	**Customer asset No:**	
Customer:	Software Radio Technology UK Ltd Wireless House Westfield Industrial Estate Midsomer Norton BATH BA3 4BS United Kingdom	**Location of calibration:**	Agilent Technologies UK Ltd Eskdale Road, Winnersh Triangle Wokingham, BERKSHIRE RG41 5DZ Tel +44(0)7004 666666 Fax: 07004 444555
Procedure:	5011-2873		
Date of calibration:	8 Mar 2006	**Customer PO No.:**	8016
Temperature:	(23 +/-3) °C	**Humidity:**	<70% RH

This calibration certificate documents that the instrument was calibrated for it's basic specifications employing a procedure defined by Agilent Technologies, using a Quality System certified compliant with the requirements of ISO 9001:2000. This calibration was performed as an Industry Calibration which contains tests and measurement points that are applicable to general industry applications.

As received conditions:
Initial testing found the equipment to be **OUT-OF-SPECIFICATION** at one or more points tested. Adjustment and/or Repair was **NOT REQUESTED** for this instrument.

As shipped conditions:
At completion of the calibration, measured values were **IN-SPECIFICATION** for the parameters tested. At the customer's request this **CONDITIONAL CERTIFICATE** was issued. Refer to the measurement report associated with this certificate for details of IN-SPECIFICATION parameters.

Remarks or special requirements:

Our calibration procedures are designed to provide measurement uncertainty of less than or equal to one quarter of the specification of the unit under test, where possible, with a coverage factor of 2.

The test limits stated in the report correspond to the published specifications of the equipment, at the points tested.

This certificate is composed of 2 pages containing a summary of calibration information.

Based on the manufacturer recommended or user requested calibration interval, the next calibration is due on 8 Mar 2007 . The User should determine the suitability of this instrument for its intended use.

D Trotman

Issue date: 9 Mar 2006

Dave Trotman - European Support Manager

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Agilent Technologies AGILENT TECHNOLOGIES INTERNAL ASSESSMENT PROGRAM : AQ-SSU-12/95	Agilent Technologies UK Ltd Eskdale Road, Winnersh Triangle Wokingham, BERKSHIRE RG41 5DZ Tel +44(0)7004 666666 Fax: 07004 444555

Certificate of Calibration

Agilent Industry Calibration

Certificate No. : 2-230288469-1

Manufacturer: Hewlett-Packard Co.
Model No: 8644A
Serial No: 3045A01373
Customer:
Software Radio Technology UK Ltd
Wireless House
Westfield Industrial Estate
Midsomer Norton
BATH BA3 4BS United Kingdom

Description: Synthesized Signal Generator 0.25-1030
Options installed: 1,2,4,7,10
Customer asset No:
Location of calibration:
Agilent Technologies UK Ltd
Eskdale Road, Winnersh Triangle
Wokingham, BERKSHIRE RG41 5DZ
Tel +44(0)7004 666666 Fax: 07004 444555

Procedure: STE-50110284-A.02.03
Date of calibration: 14 Mar 2006
Temperature: (23 +/-3) °C

Customer PO No.: 8016
Humidity: <70% RH

This calibration certificate documents that the instrument was calibrated for it's basic specifications employing a procedure defined by Agilent Technologies, using a Quality System certified compliant with the requirements of ISO 9001:2000. This calibration was performed as an Industry Calibration which contains tests and measurement points that are applicable to general industry applications.

As received conditions:
Initial testing found the equipment to be **OUT-OF-SPECIFICATION** at one or more points tested. Adjustment and/or Repair was **NOT REQUESTED** for this instrument.

As shipped conditions:
At completion of the calibration, measured values were **IN-SPECIFICATION** for the parameters tested. At the customer's request this **CONDITIONAL CERTIFICATE** was issued. Refer to the measurement report associated with this certificate for details of IN-SPECIFICATION parameters.

Remarks or special requirements:

Our calibration procedures are designed to provide measurement uncertainty of less than or equal to one quarter of the specification of the unit under test, where possible, with a coverage factor of 2.

The test limits stated in the report correspond to the published specifications of the equipment, at the points tested.

This certificate is composed of 2 pages containing a summary of calibration information.

Based on the manufacturer recommended or user requested calibration interval, the next calibration is due on 14 Mar 2007 . The User should determine the suitability of this instrument for its intended use.

Issue date: 14 Mar 2006

D Trotman

Dave Trotman - European Support Manager

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Agilent Technologies AGILENT TECHNOLOGIES INTERNAL ASSESSMENT PROGRAM : AQ-SSU-12/95	Agilent Technologies UK Ltd Eskdale Road, Winnersh Triangle Wokingham, BERKSHIRE RG41 5DZ Tel +44(0)7004 666666 Fax: 07004 444555

Certificate of Calibration

Agilent Calibration

Certificate No. : 2-230305498-1

Manufacturer:	Fluke Corp.	**Description:**	THERMOMETER
Model No:	52	**Options installed:**	
Serial No:	5610124	**Customer asset No:**	
Customer:		**Location of calibration:**	
Software Radio Technology UK Ltd Wireless House Westfield Industrial Estate Midsomer Norton BATH BA3 4BS United Kingdom		Agilent Technologies UK Ltd Eskdale Road, Winnersh Triangle Wokingham, BERKSHIRE RG41 5DZ Tel +44(0)7004 666666 Fax: 07004 444555	
Procedure:	$REVISION:-1.2-$		
Date of calibration:	8 Mar 2006	**Customer PO No.:**	
Temperature:	(23 +/-3) °C	**Humidity:**	<70% RH

This certifies that the above product was calibrated in compliance with a quality system registered to ISO9001:2000 using applicable Agilent Technologies procedures.

As received conditions:
Initial testing found the equipment to be IN-SPECIFICATION at the points tested.

As shipped conditions:
At the completion of the calibration, measured values were IN-SPECIFICATION at the points tested.

Remarks or special requirements:

Our calibration procedures are designed to provide measurement uncertainty of less than or equal to one quarter of the specification of the unit under test, where possible, with a coverage factor of 2.

The test limits stated in the report correspond to the published specifications of the equipment, at the points tested.

This certificate is composed of 2 pages containing a summary of calibration information.

Based on the manufacturer recommended or user requested calibration interval, the next calibration is due on 8 Mar 2007 . The User should determine the suitability of this instrument for its intended use.

D Trotman

Issue date: 9 Mar 2006

Dave Trotman - European Support Manager

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Agilent Technologies AGILENT TECHNOLOGIES INTERNAL ASSESSMENT PROGRAM : AQ-SSU-12/95	Agilent Technologies UK Ltd Eskdale Road, Winnersh Triangle Wokingham, BERKSHIRE RG41 5DZ Tel +44(0)7004 666666 Fax: 07004 444555

Certificate of Calibration

Agilent Industry Calibration

Certificate No. : 2-232616003-1

Manufacturer:	Agilent Technologies, Inc.	**Description:**	Synth. signal generator, 0.1 to 1040 MHz
Model No:	8657A	**Options installed:**	
Serial No:	3034A02539	**Customer asset No:**	
Customer:	Software Radio Technology UK Ltd Wireless House Westfield Industrial Estate Midsomer Norton BATH BA3 4BS United Kingdom	**Location of calibration:**	Agilent Technologies UK Ltd Eskdale Road, Winnersh Triangle Wokingham, BERKSHIRE RG41 5DZ Tel +44(0)7004 666666 Fax: 07004 444555
Procedure:	STE-50109100-B.05.02		
Date of calibration:	13 Mar 2006	**Customer PO No.:**	8016
Temperature:	(23 +/-3) °C	**Humidity:**	<70% RH

This calibration certificate documents that the instrument was calibrated for it's basic specifications employing a procedure defined by Agilent Technologies, using a Quality System certified compliant with the requirements of ISO 9001:2000. This calibration was performed as an Industry Calibration which contains tests and measurement points that are applicable to general industry applications.

As received conditions:
Initial testing found the equipment to be IN-SPECIFICATION at the points tested.

As shipped conditions:
At the completion of the calibration, measured values were IN-SPECIFICATION at the points tested.

Remarks or special requirements:

Our calibration procedures are designed to provide measurement uncertainty of less than or equal to one quarter of the specification of the unit under test, where possible, with a coverage factor of 2.

The test limits stated in the report correspond to the published specifications of the equipment, at the points tested.

This certificate is composed of 2 pages containing a summary of calibration information.

Based on the manufacturer recommended or user requested calibration interval, the next calibration is due on 13 Mar 2007 . The User should determine the suitability of this instrument for its intended use.

D Trotman

Issue date: 14 Mar 2006

Dave Trotman - European Support Manager

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