

DERA

DEFENCE EVALUATION and RESEARCH AGENCY
FRASER
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PO4 9LJ

Restricted - Commercial

Report on Type Testing to RTCM SC110-STD
of

McMurdo Ltd 406 MHz EPIRB Type E3

DERA/SS/WI/RTCM/R-TT7/98-1.0

Cover + iii + 26 pages + Annex A to C

Issue 1.0 - Date: February 1999

Commissioned by;

McMurdo Ltd.
Rodney Road,
Portsmouth,
Hants, UK
PO4 8SG



TESTING
No. 1217

Authorisation

Position Held	Name	Signature	Date
Test Engineer	W T Harmer	W. T. Harmer	3 / 2 / 99
Quality Officer	R. Rogers		5 / 2 / 99
Head of Test	D. Parr		26 / 2 / 99

Issued by

Maritime Navigation Systems
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Issue	Date	Details of Change
1.0	Feb 1999	First issue

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1. Introduction

- 1.1. The McMurdo "E3" 406 MHz EPIRB was tested in accordance with the RTCM Recommended Standards for 406 MHz Satellite Emergency Position-Indicating Radio Beacons (EPIRBs) Version 2.0 February 5, 1997 (RTCM PAPER 4-97/SC110-STD) .
- 1.2. The McMurdo "E3" is a Class 1 EPIRB. It has no GPS and gives a short message only. This report covers Category 2 only (i.e. non-float free operation).
- 1.3. The test laboratories at DERA Fraser have been accredited by UKAS under their NAMAS scheme and is a UKAS accredited Testing Laboratory No. 1217.
- 1.4. Opinions and interpretations expressed herein are outside the scope of UKAS accreditation.

2. Equipment under test

- 2.1. For the duration of type testing McMurdo Ltd. supplied the following items on the 3rd September 1998.

<u>ITEM</u>	<u>Part Number</u>	<u>Serial Number</u>
EPIRB	E3	9D1E4932C2AE0D1
Lens Dome with 50 ohm connector	-	-
5 Battery Packs	82-140-1	-
Manual Release Bracket	-	-

3. Test Location

- 3.1. All but one of the tests were executed at DERA Fraser, Fort Cumberland Road, Portsmouth, Hants.
The Luminous Intensity measurements were performed by BSI Products Services, Maylands Avenue, Hemel Hempstead, Herts. HP2 4SQ at their premises. This test is not UKAS accredited.

4. Configuration of the EPIRB

- 4.1. The EPIRB was supplied with the homing device frequency set to the test frequency of 121.65 MHz.
- 4.2. For tests requiring the 50Ω output from the EPIRB, the dome and antenna had to be replaced with a dome which had a coaxial lead inserted in the antenna position. This lead was connected internally to the power amplifier output.
- 4.3. The changing of the domes was undertaken by McMurdo in the presence of DERA staff.

5. Conclusions and Recommendation

- 5.1. The McMurdo "E3" 406 MHz Class 1 EPIRB tested was found to meet the requirements of the RTCM Recommended Standards for 406 MHz Satellite Emergency Position-Indicating Radio Beacons (EPIRBs) Version 2.0 in all aspects as detailed in this report. It is therefore recommended for Type Approval.

Section 6.

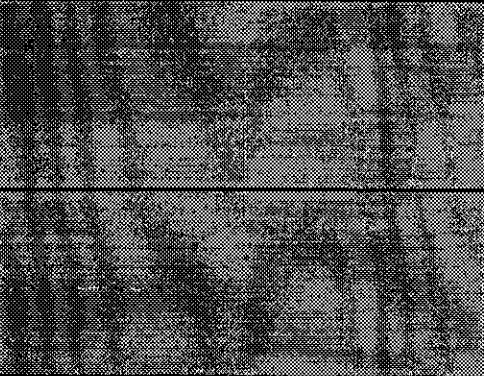
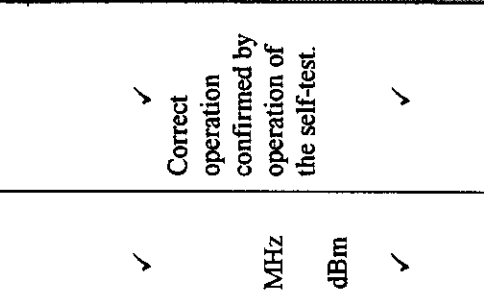
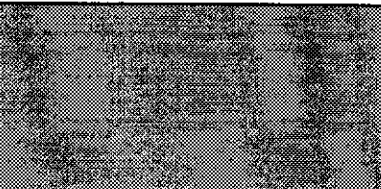
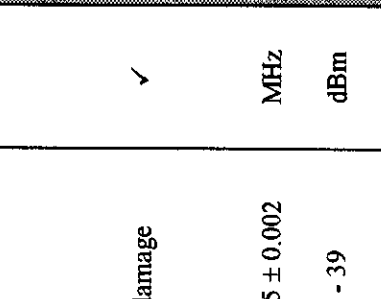
Summary of Test Results

SUMMARY OF TEST RESULTS

PARAMETERS TO BE MEASURED DURING TESTS	RANGE OF SPECIFICATION	UNITS	TEST RESULTS			COMMENTS
			T _{min.} (...°C)	T _{amb.} (+20 °C)	T _{max.} (+70 °C)	
1. INITIAL ALIVENESS TEST (A1.0)						
• Carrier Frequency	406.025 ± 0.002	MHz		406.025		
• Power Output	35 - 39	dBm		37.5		
2. DRY HEAT CYCLE (A3.0)						Soak at 70°C Measurement at 55°C
• Aliveness Test (during 2 hour period):						
- Carrier Frequency	406.025 ± 0.002	MHz			406.02521	
- Power Output	35 - 39	dBm			37.55	
• Aliveness Test (at end of 2 hour period):						
- Carrier Frequency	406.025 ± 0.002	MHz			406.02521	
- Power Output	35 - 39	dBm			37.32	

PARAMETERS TO BE MEASURED DURING TESTS	RANGE OF SPECIFICATION	UNITS	TEST RESULTS			COMMENTS
			T _{min.} (...°C)	T _{amb.} (+20 °C)	T _{max.} (+40 °C)	
3. DAMP HEAT CYCLE (A4.0)						
• Aliveness Test (during 2 hour period):						
- Carrier Frequency	406.025 ± 0.002	MHz			406.0251	
- Power Output	35 - 39	dBm			37.5	
• Aliveness Test (at end of 2 hour period):						
- Carrier Frequency	406.025 ± 0.002	MHz			406.0251	
- Power Output	35 - 39	dBm			37.5	
4. VIBRATION TEST (A5.0)						
• Exterior Mechanical Inspection	No damage	✓		✓		
• Aliveness Test:						
- Carrier Frequency	406.025 ± 0.002	MHz		406.0251		
- Power Output	35 - 39	dBm		37.5		
• Activation	No activation during test	✓		✓		

PARAMETERS TO BE MEASURED DURING TESTS	RANGE OF SPECIFICATION	UNITS	TEST RESULTS			COMMENTS
			T _{min.} (-40 °C)	T _{amb.} (+20 °C)	T _{max.} (+55 °C)	
5. BUMP TEST (A6.0)						
• Exterior Mechanical Inspection	No Damage	✓		✓		
• Aliveness Test:						
- Carrier Frequency	406.025 ± 0.002	MHz		406.0252		
- Power Output	35 - 39	dBm		37.65		
• Activation	No activation during test	✓		✓		
6. SALT FOG TEST (A7.0)				Not Tested		See Annex B for the manufacturers statement on materials
• Exterior Mechanical Inspection	No damage	✓				
• Aliveness test:						
- Carrier Frequency	406.025 ± 0.002	MHz				
- Power Output	35 - 39	dBm				

PARAMETERS TO BE MEASURED DURING TESTS	RANGE OF SPECIFICATION	UNITS	TEST RESULTS			COMMENTS
			T _{min.} (-40 °C)	T _{amb.} (+14 °C)	T _{max.} (. °C)	
7-A. DROP TEST (A8.1) On Hard Surface • Exterior Mechanical Inspection • Aliveness Test: - Carrier Frequency - Power Output • Activation	No damage 406.025 ± 0.002 35 - 39 No activation during test	✓ MHz dBm ✓	✓ Correct operation confirmed by operation of the self-test. ✓			It was not possible to measure the parameters directly as the unit was configured with the antenna connected, i.e. no 50Ω output.
7-B. DROP TEST (A8.2) In Water • Exterior Mechanical Inspection • Aliveness test: - Carrier frequency - Power Output	No damage 406.025 ± 0.002 35 - 39	✓ MHz dBm		✓ Correct operation confirmed by operation of the self-test.		It was not possible to measure the parameters directly as the unit was configured with the antenna connected, i.e. no 50Ω output.

PARAMETERS TO BE MEASURED DURING TESTS	RANGE OF SPECIFICATION	UNITS	TEST RESULTS			COMMENTS
			T _{min} (-40 °C)	T _{amb} (+20 °C)	T _{max} (+55 °C)	
8. LEAKAGE AND IMMERSION TEST (A8.2)						It was not possible to measure the parameters directly as the unit was configured with the antenna connected, i.e. no 50Ω output.
• Aliveness Test:						
- Carrier Frequency	406.025 ± 0.002	MHz		Correct operation confirmed by operation of the self-test.		
- Power Output	35 - 39	dBm		✓		
• Interior Inspection	No water	✓				
9. SPURIOUS EMISSIONS TEST (A10.0)						
• 406 MHz	Figure 2-1	✓ (attach graphs)	✓	✓	✓	Figures 1 to 6
• 121.5 MHz	Figure 2-6	✓ (attach graphs)	✓	✓	✓	Figures 7 to 9

PARAMETERS TO BE MEASURED DURING TESTS	RANGE OF SPECIFICATION	UNITS	TEST RESULTS			COMMENTS
			T _{min} (-50 °C)	T _{amb} (... °C)	T _{max} (+70 °C)	
10. THERMAL SHOCK (A11.0)						
• Self-activation in water	≤ 5	minutes	22 seconds		4 seconds	
• Aliveness Test:						
- Carrier Frequency	406.025 ± 0.002	MHz	406.02519		406.02518	
- Power Output	35 - 39	dBm	37.12		37.7	
• Frequency Stability						
- short term stability	≤ 0.002	parts/ million in 100ms	0.0000539		0.000026	
- medium term stability						
mean slope	≤ 0.001	parts/ million/ minute	0.000386		0.0000284	
residual frequency variation	≤ 0.001	parts/ million	0.000343		0.000085	
11. COSPAS-SARSAT TYPE APPROVAL TESTS (A12.0)	C - S Certificate (attach test report)	✓	(-40°C) ✓	✓	(+55°C) ✓	See Test Report of COSPAS/SARSAT Tests [1]

PARAMETERS TO BE MEASURED DURING TESTS	RANGE OF SPECIFICATION	UNITS	TEST RESULTS			COMMENTS
			T _{min} (-40 °C)	T _{amb} (... °C)	T _{max} (... °C)	
12. OPERATIONAL LIFE, STROBE LIGHT AND SELF TESTS (A13.0)						The EPIRB was operated for 8.3 hours prior to the test commencing. See Annex C for manufacturer's statement on battery self discharge.
Operational Life						
• Frequency						
• Nominal Carrier	406.025 ± 0.002	MHz	406.025186			
• Short term stability	≤ 0.002	parts/ million in 100ms	0.0000195			
• Medium-term stability						
- Mean slope	≤ 0.001	parts/ million/ minute	0.0000075			
- Residual variation	≤ 0.003	parts/ million	0.000048			
• RF output power	35 -39	dBm	36.45			
• Strobe flash rate	20 - 30	/min	22			
• Auxiliary radio-locating Peak envelope output power	14 - 20	dBm	19.2			

PARAMETERS TO BE MEASURED DURING TESTS	RANGE OF SPECIFICATION	UNITS	TEST RESULTS			COMMENTS
			T _{min.} (-40 °C)	T _{amb.} (+20 °C)	T _{max.} (+55 °C)	
13. STROBE LIGHT TEST (A13.2)						
• Flash rate	20 – 30	/min	22	22	22	
• Effective intensity	≥ 0.75	Cd	1.12	1.02	0.91	
• Pulse duration	10 ⁻⁶ to 10 ⁻²	s	48 × 10 ⁻⁶	46 × 10 ⁻⁶	43 × 10 ⁻⁶	
14. SELF TEST (A13.3)						
• RF pulse duration	≤ 0.444	✓	✓	✓	✓	
• Frame synchronization pattern	0 1101 0000	✓	✓	✓	✓	
• Number of RF bursts	1-burst	✓	✓	✓	✓	

PARAMETERS TO BE MEASURED DURING TESTS	RANGE OF SPECIFICATION	UNITS	TEST RESULTS			COMMENTS
			T _{min.} (... °C)	T _{amb.} (+20 °C)	T _{max.} (... °C)	
15. AUTOMATIC RELEASE MECHANISM TEST (A14.0)						
• Normal mounted orientation	Release and float free before 4 meters; automatic activation	✓		Not tested		
• Rolling 90° starboard		✓		This report covers manual release only.		
• Rolling 90° port		✓				
• Rolling 90° bow down		✓				
• Rolling 90° stern down		✓				
• Upside down		✓				
16. STABILITY AND BUOYANCY TEST (A15.0)						
• Time to upright	≤ 2	s		0.5		
• Reserve buoyancy	≥ 5	%		30.5		
• Float upright; Antenna base	> 4	cm		6		
17. INADVERTENT ACTIVATION TEST (A16.0)						
• Activation release	EUT should not release from bracket or automatically activate	✓		✓		

PARAMETERS TO BE MEASURED DURING TESTS	RANGE OF SPECIFICATION	UNITS	TEST RESULTS			COMMENTS
			T _{min.} (-40 °C)	T _{amb.} (+20 °C)	T _{max.} (+55 °C)	
18. AUXILIARY RADIO-LOCATING DEVICE TRANSMITTER TEST (A17.0)						
• Carrier frequency	121.5 ± 0.006 (see comment)	MHz	121.648	121.650	121.650	The transmitter frequency is offset therefore limits are 121.65 ± 0.006 MHz
• PERP	14 - 20	dBm	-	15.3	-	
• Duty Cycle	100	%	100	100	100	The percentage of power within ±30 Hz of carrier was measured as 31%
• Modulation						
- Frequency	≥ 700 Hz within range of 300 - 1600 Hz	Hz	353 - 1300	352 - 1282	355 - 1299	
- Direction	Upward	✓	✓	✓	✓	
- Duty cycle	33 - 55	%	42	38	35	
- Factor	0.85 - 1.0	#	0.96	0.96	0.94	
- Sweep repetition rate	2 - 4	Hz	3.1	3.1	3.1	
• Antenna						
- Pattern	Omnidirectional	✓		✓		
- Polarization	Vertical	✓		✓		
- VSWR	≤ 1.5:1	✓		Integral antenna		

PARAMETERS TO BE MEASURED DURING TESTS	RANGE OF SPECIFICATION	UNITS	TEST RESULTS			COMMENTS
			T _{min.} (...°C)	T _{amb.} (+20 °C)	T _{max.} (+40 °C)	
19. HUMIDITY TEST (A18.0)						
• Aliveness Test:						
- Carrier Frequency	406.025 ± 0.002	MHz			406.02519	
- Power Output	35 - 39	dBm			37.1	
20. ORIENTATION TEST (A19.0)						
VERTICAL						
• Aliveness Test:						
- Carrier Frequency	406.025 ± 0.002	MHz		406.02518		
- Power Output	35 - 39	dBm		37.5		
UPSIDE DOWN						
• Aliveness test:						
- Carrier frequency	406.025 ± 0.002	MHz		406.02518		
- Power Output	35 - 39	dBm		37.5		
HORIZONTAL						
• Aliveness test:						
- Carrier frequency	406.025 ± 0.002	MHz		406.02518		
- Power Output	35 - 39	dBm		37.5		

Section 7.

SPECTRUM MASK PLOTS

Figure 1	RF Spectrum Mask (-40°C)	406 MHz to 406.05MHz
Figure 2	RF Spectrum Mask (-40°C)	406.05 MHz to 406.1MHz
Figure 3	RF Spectrum Mask (+20°C)	406 MHz to 406.05MHz
Figure 4	RF Spectrum Mask (+20°C)	406.05 MHz to 406.1MHz
Figure 5	RF Spectrum Mask (+55°C)	406 MHz to 406.05MHz
Figure 6	RF Spectrum Mask (+55°C)	406.05 MHz to 406.1MHz
Figure 7	RF Spectrum Mask of Auxiliary Radio-Locating Device (-40°C)	
Figure 8	RF Spectrum Mask of Auxiliary Radio-Locating Device (+20°C)	
Figure 9	RF Spectrum Mask of Auxiliary Radio-Locating Device (+55°C)	

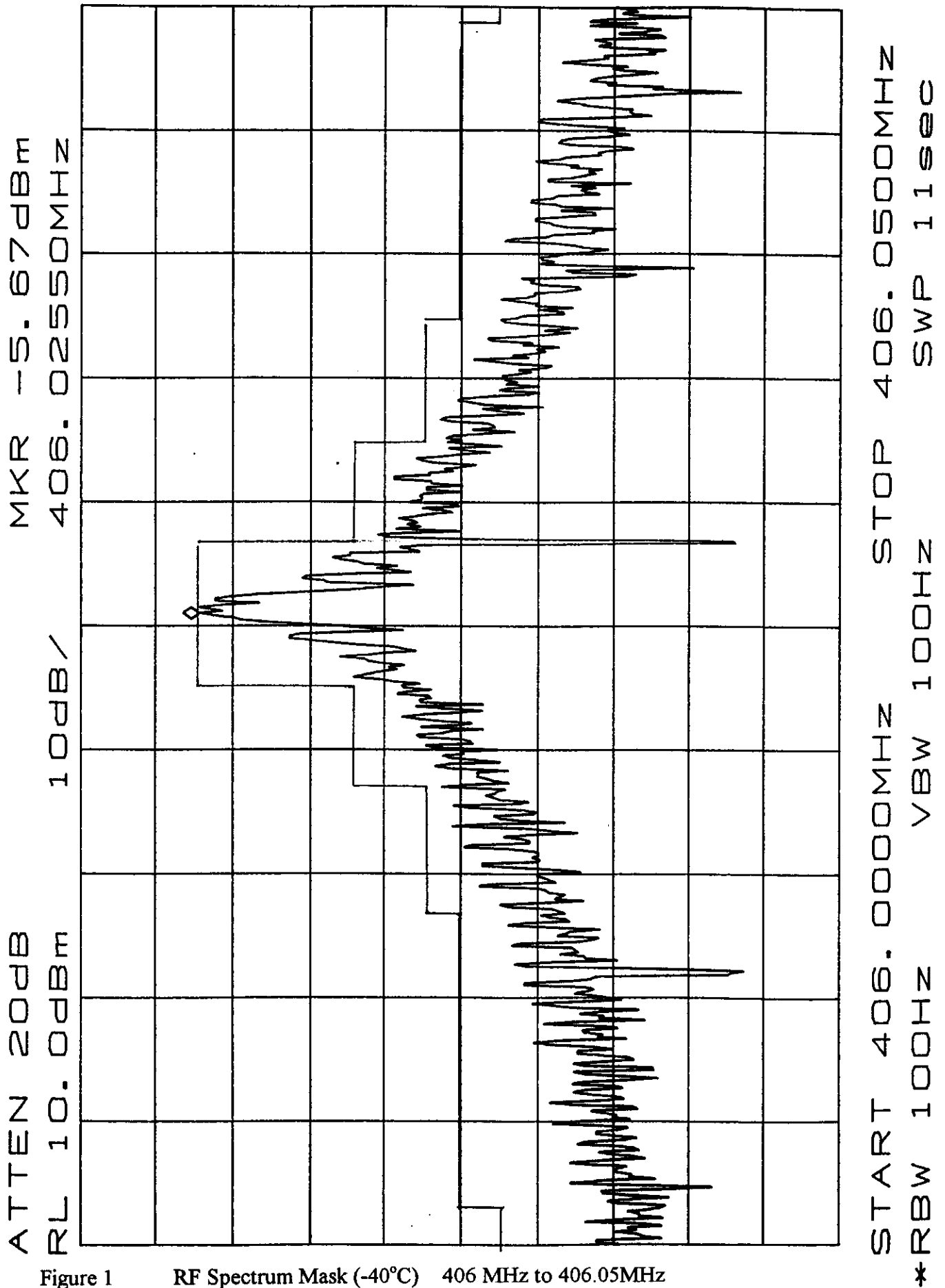


Figure 1 RF Spectrum Mask (-40°C) 406 MHz to 406.05MHz

1/11/78 low temperature

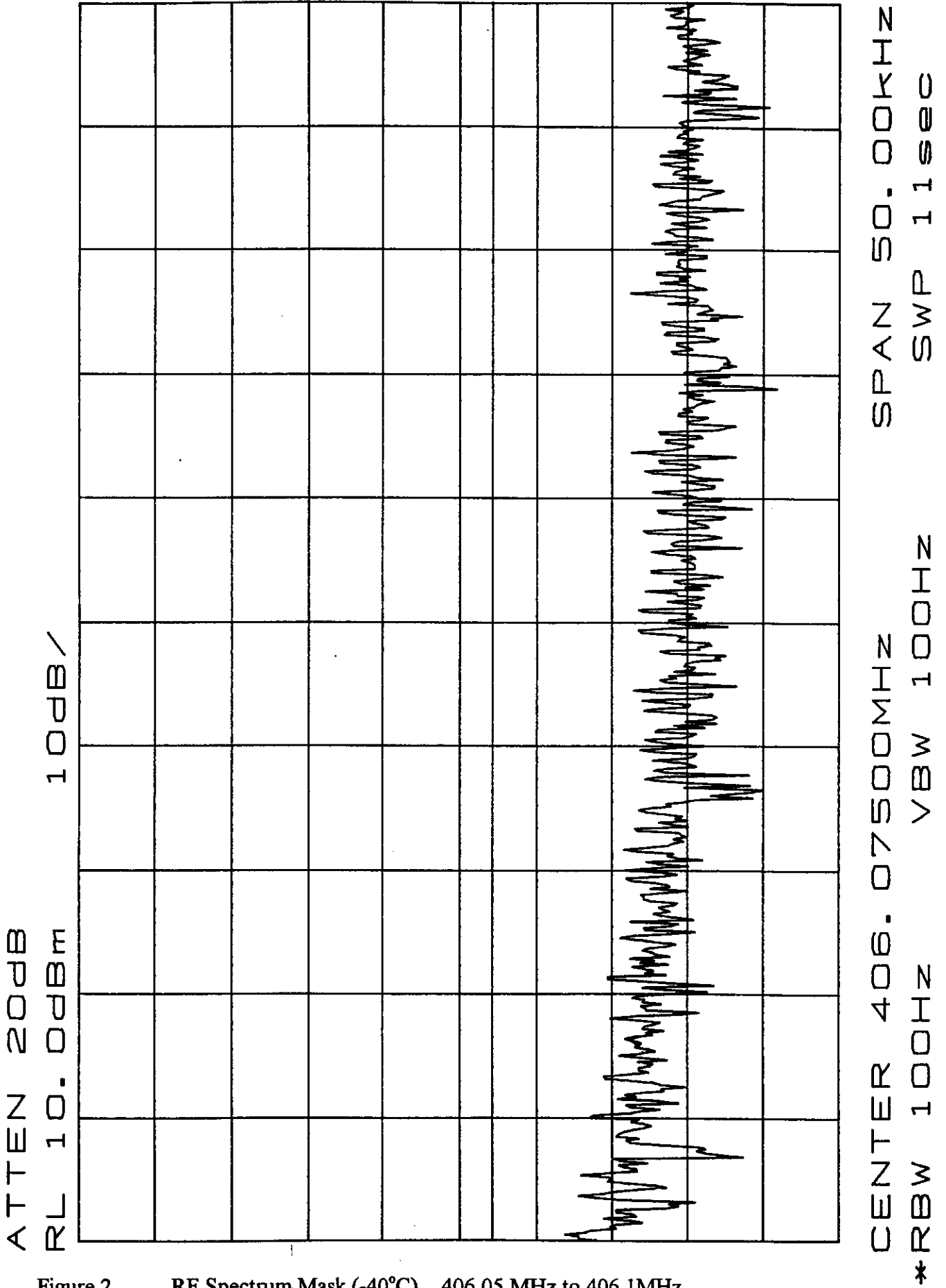


Figure 2 RF Spectrum Mask (-40°C) 406.05 MHz to 406.1MHz

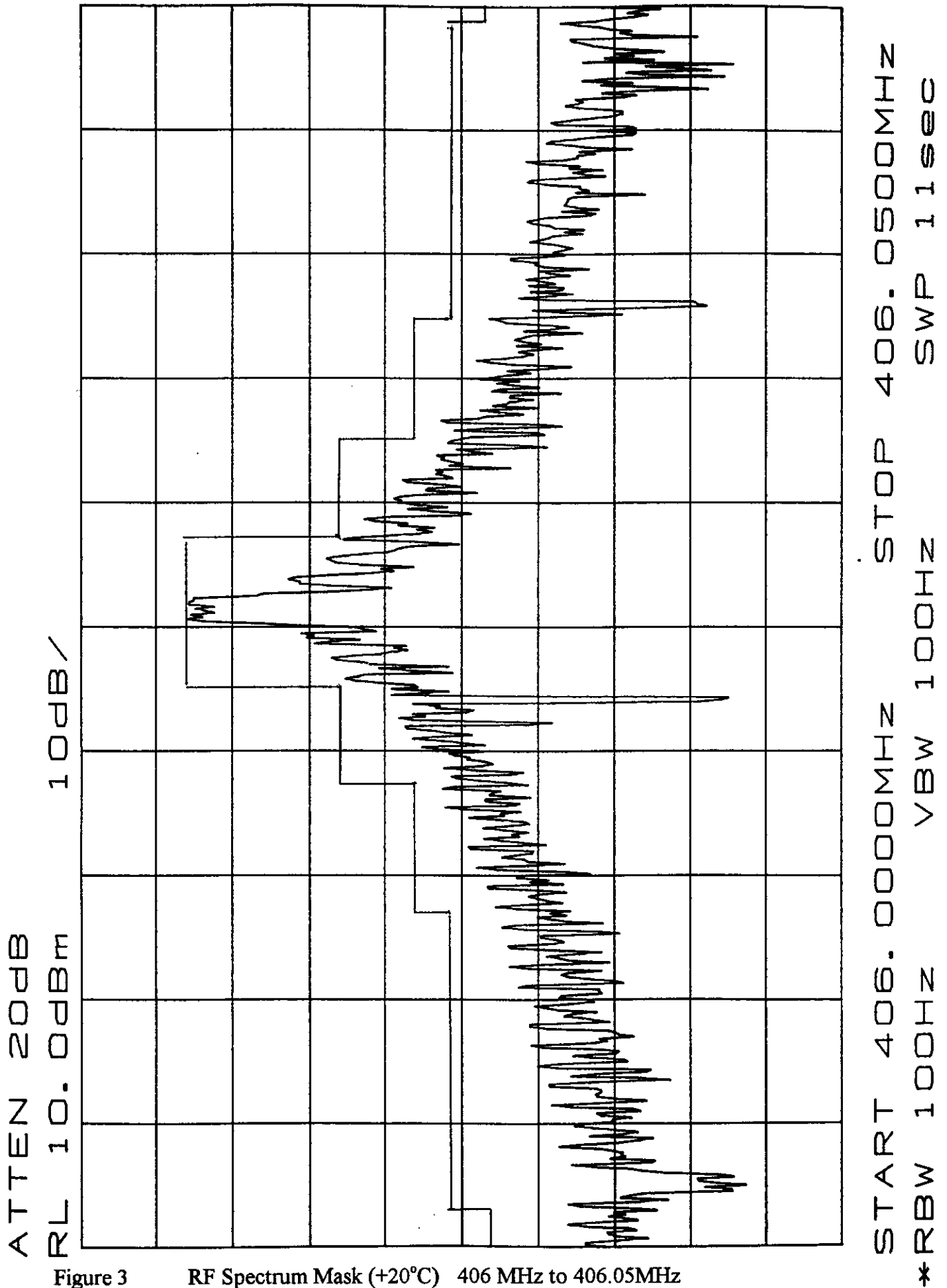


Figure 3 RF Spectrum Mask (+20°C) 406 MHz to 406.05MHz

E3 Normal Temp WTH

ATTEN 20dB
RL 10.00dBm
10dB/

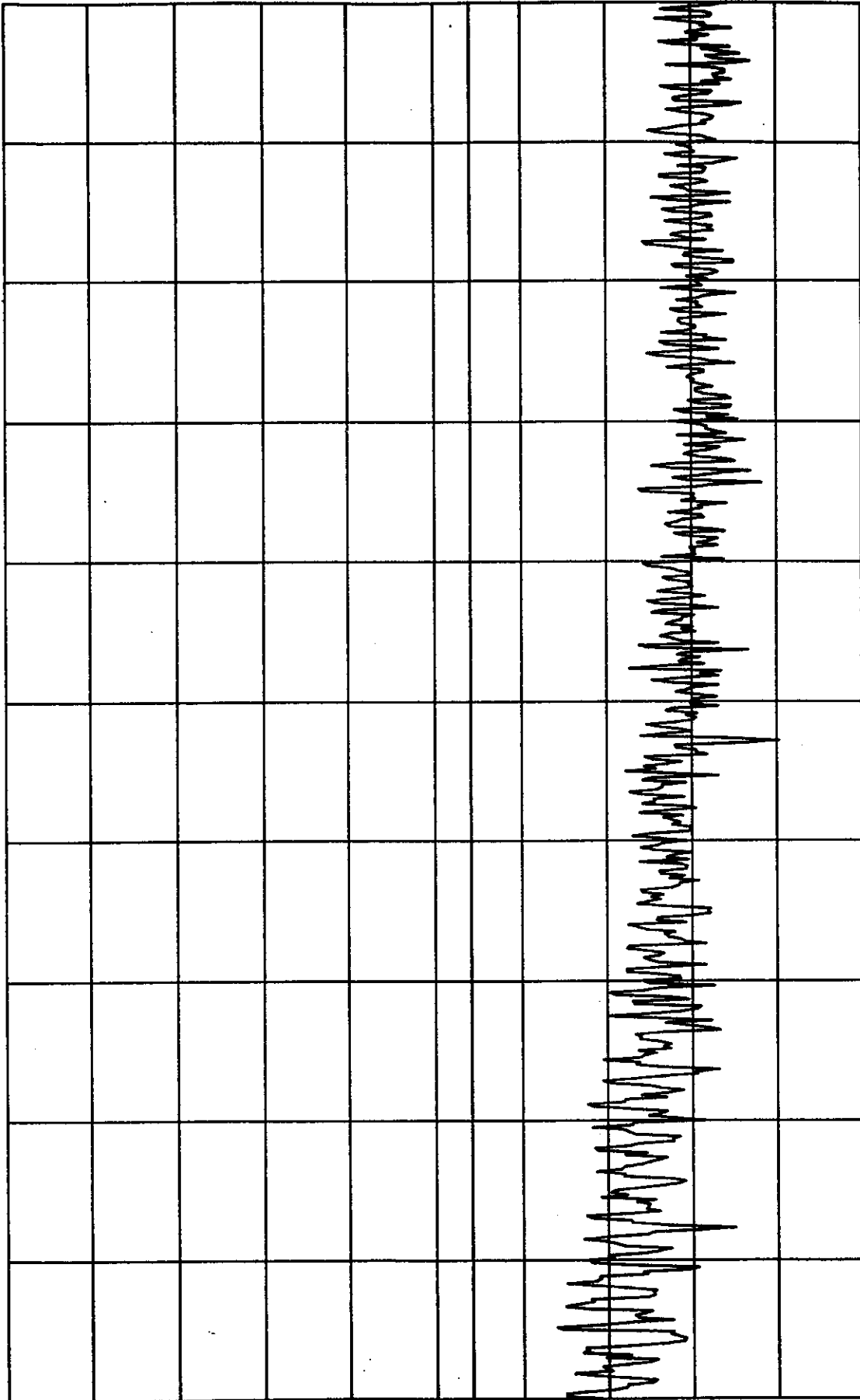


Figure 4 RF Spectrum Mask (+20°C) 406.05 MHz to 406.1MHz

START 406.0500MHz STOP 406.1000MHz
*RBW 100Hz VBW 100Hz SWP 11sec

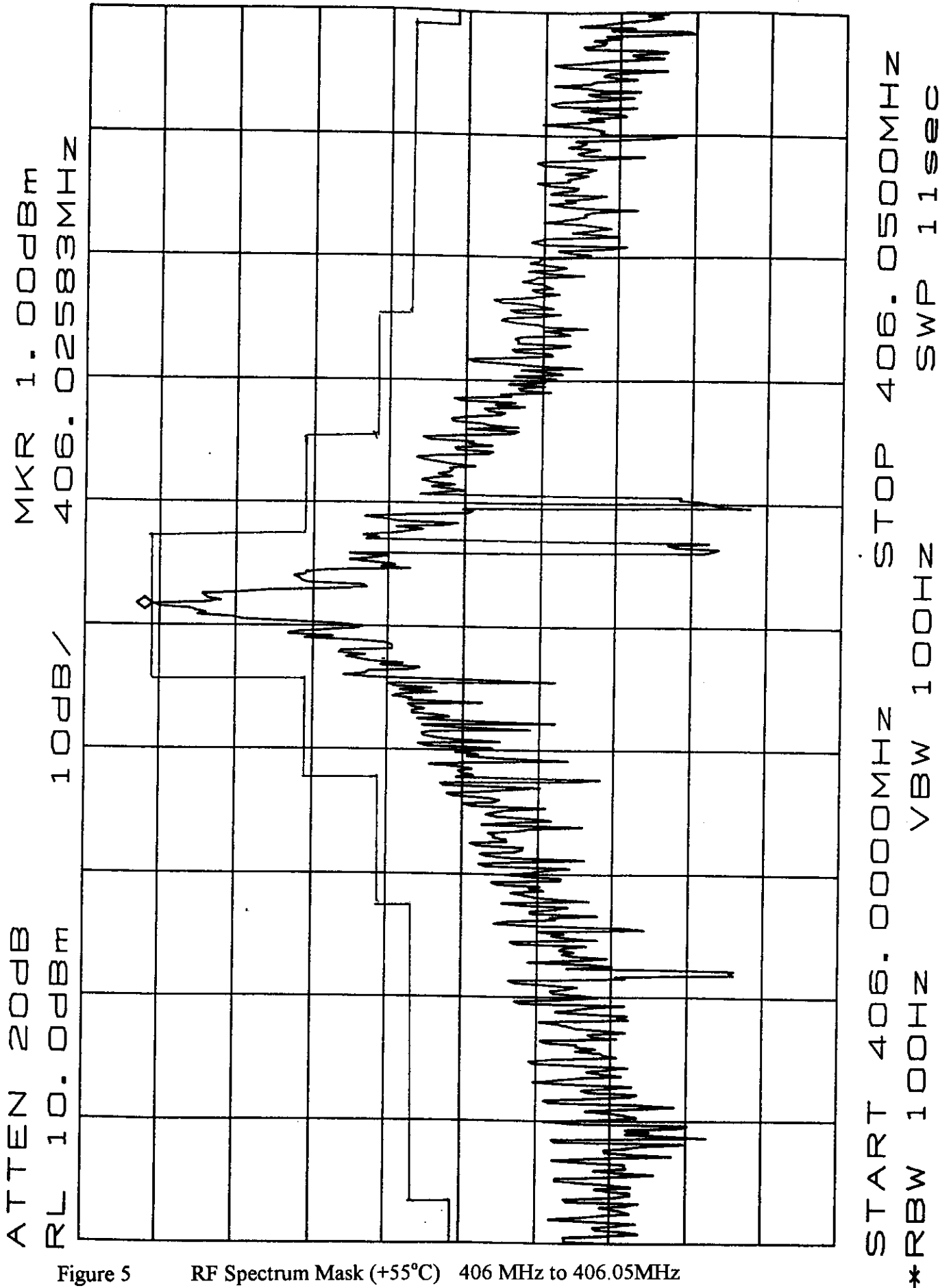


Figure 5 RF Spectrum Mask (+55°C) 406 MHz to 406.05MHz

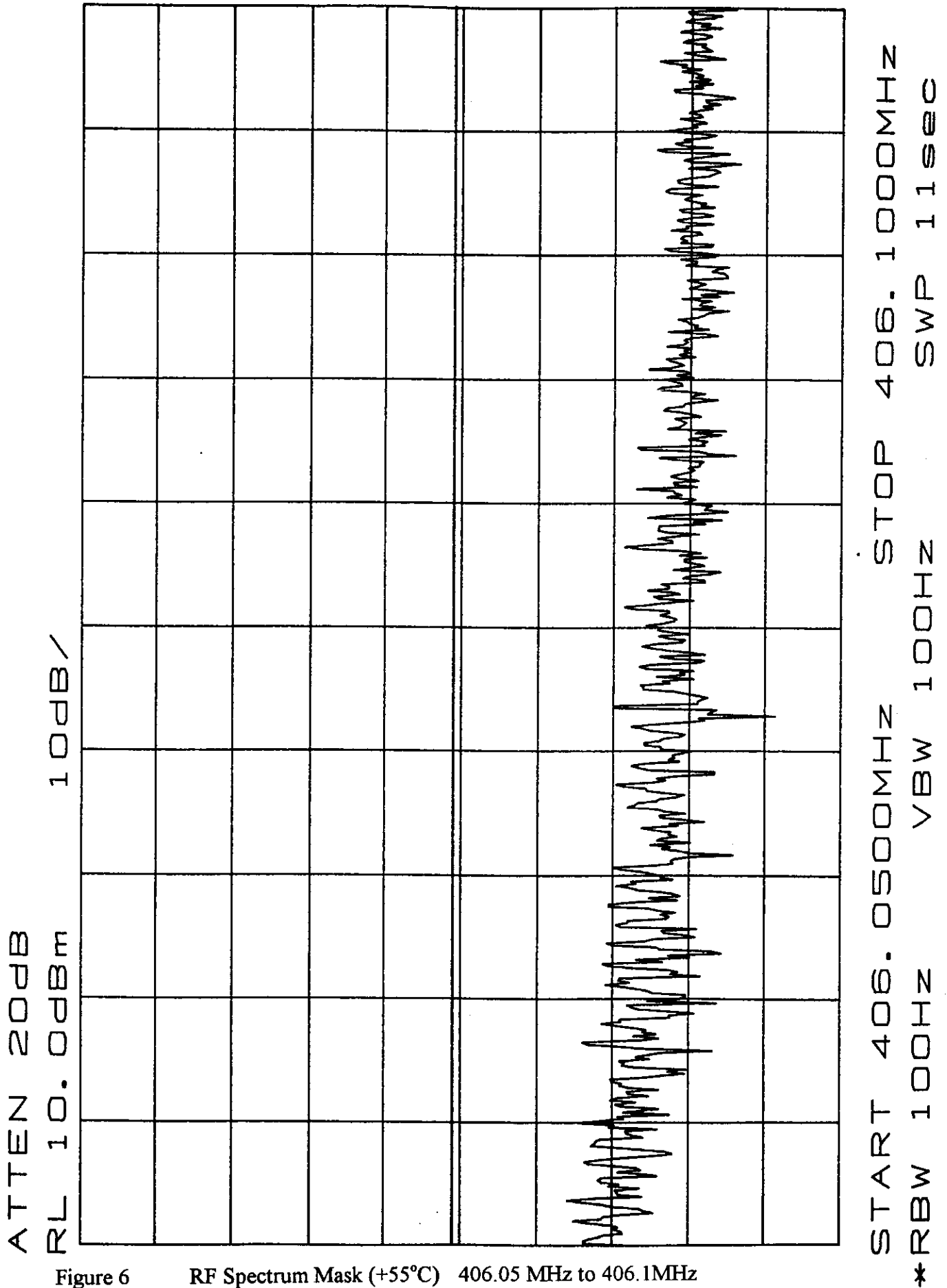


Figure 6 RF Spectrum Mask (+55°C) 406.05 MHz to 406.1MHz

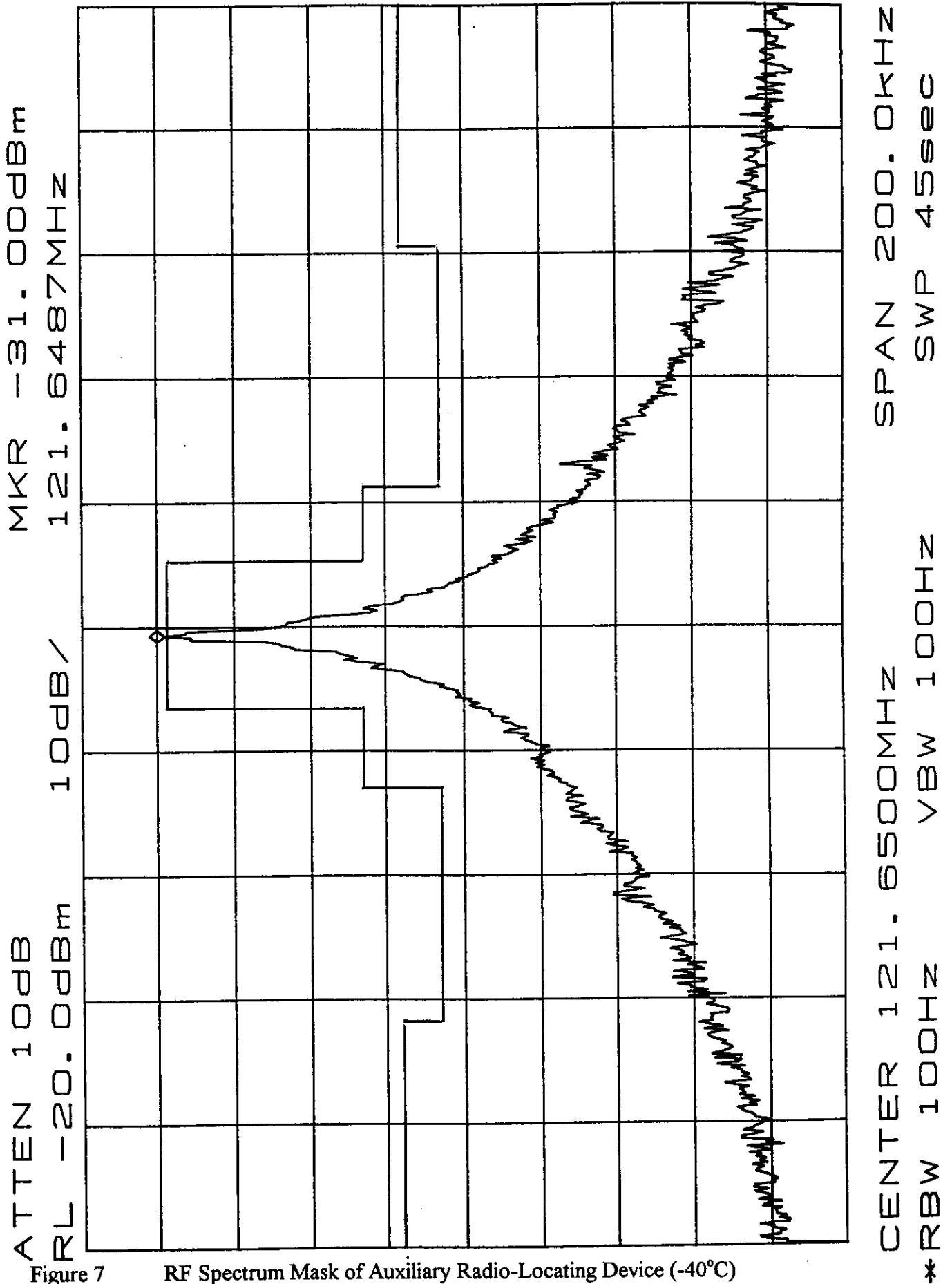


Figure 7 RF Spectrum Mask of Auxiliary Radio-Locating Device (-40°C)

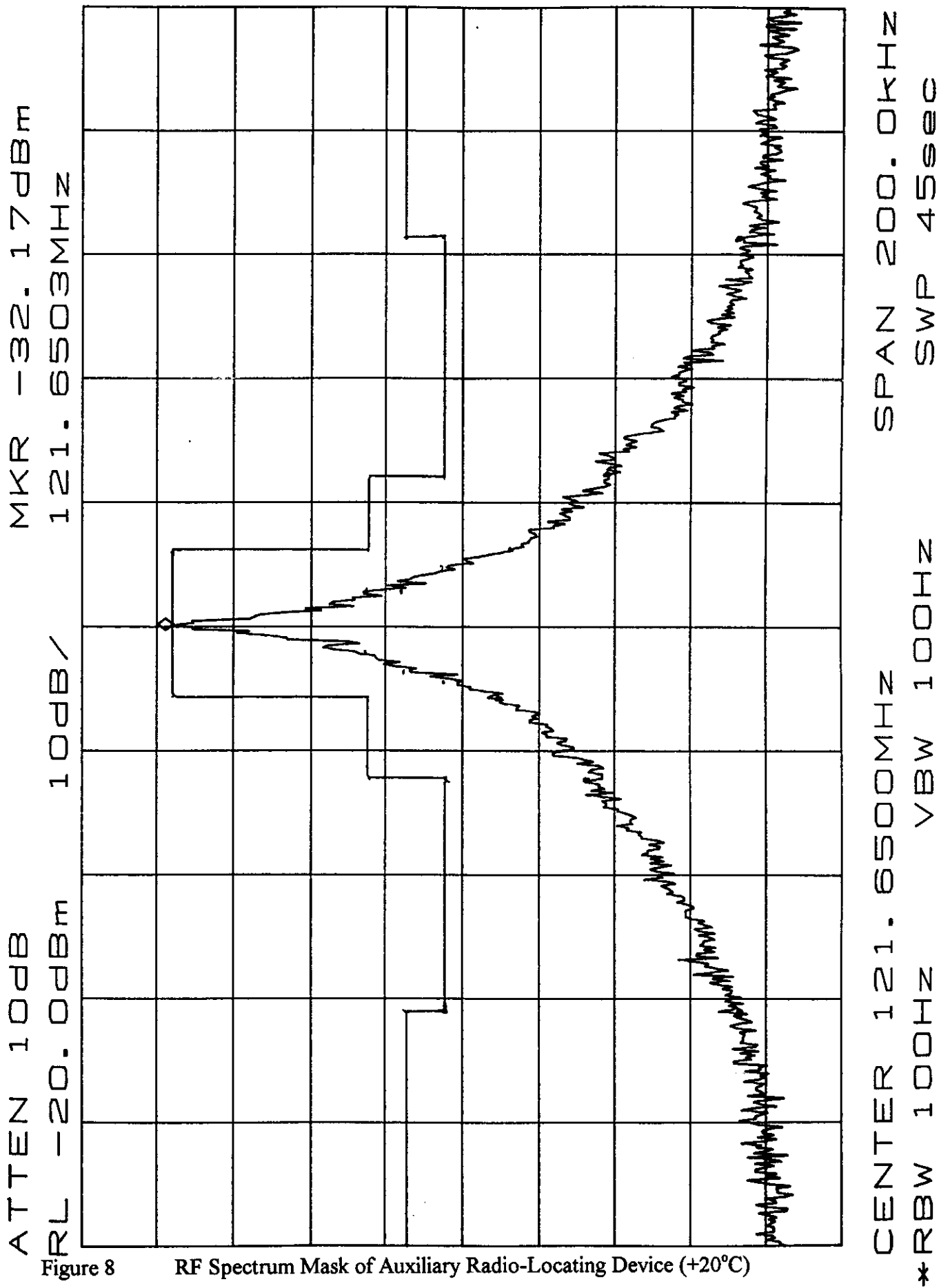


Figure 8 RF Spectrum Mask of Auxiliary Radio-Locating Device (+20°C)

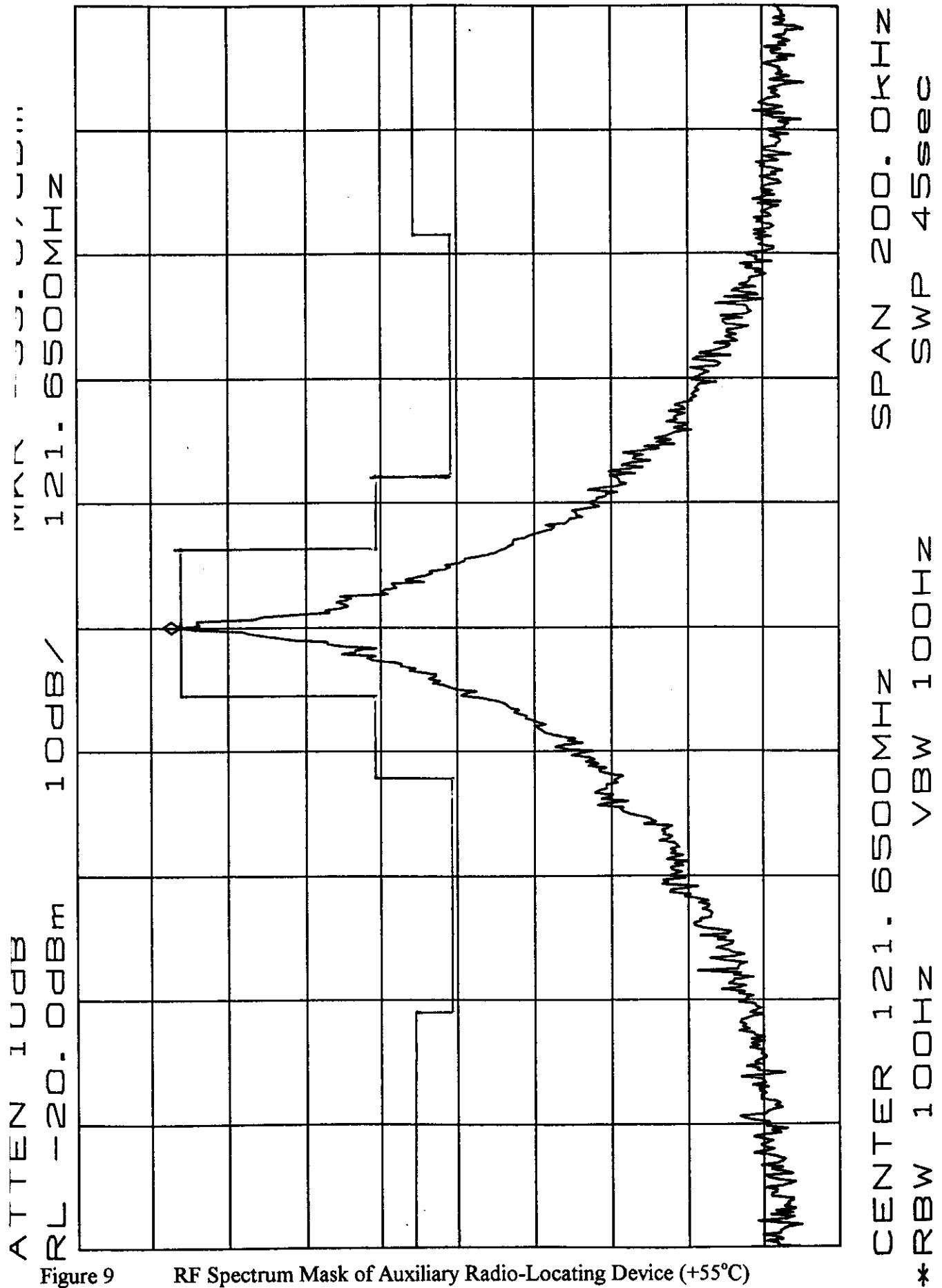


Figure 9 RF Spectrum Mask of Auxiliary Radio-Locating Device (+55°C)

8. References

- 1 *Report on Type Testing of McMurdo Ltd 406 MHz EPIRB Type E3.*
DERA/SS/WI/R-TT7/98-1.0, January 1999.

Distribution List

Copy No	Recipient	Location
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3/4	John Norrish	McMurdo Ltd Rodney Road, Portsmouth, PO4 8SG
Master	File TT 7/98	DERA Fraser, Portsmouth.

Annex A

Photographs of McMurdo E3 EPIRB

The dimensions of the EPIRB are: -

Height excluding antenna	210 mm
Width	111 mm
Depth	109 mm

Description	Figure
Front View (Configured with 50 Ω test lead)	A1
Rear View	A2
EPIRB (with test lead) alongside Antenna & Battery	A3
View with Dome Removed	A4
Under side of circuit board	A5
View showing both circuit boards.	A6

Annex B

Manufacturers Statement on Materials

McMurdo

McMurdo Ltd, Rodney Road, Portsmouth, Hampshire, United Kingdom

E3 MATERIALS DECLARATION

A list of materials used on the E3 is attached to this declaration. These materials are in contact with the marine environment and would normally, during type approval, be tested for immunity to...

Salt fog	(RTCM SC110 part A7.0)
Corrosion	(ETS 300-066 part 6.5)
Solar radiation	(ETS 300-066 part 6.11)
Oil resistance	(ETS 300-066 part 6.12)

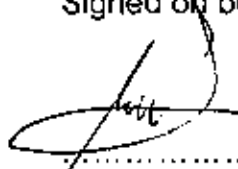
McMurdo believe this testing is unnecessary for one or more of the following reasons...

- 1) The materials have a proven history of service in a marine environment. Either from use in McMurdo's existing approved marine equipment range, or by implication from a long established history of exposure without effect (e.g. stainless steel).
- 2) The material manufacturer has conducted equivalent testing and has declared the product as being immune to these effects in the relevant material data sheet.
- 3) McMurdo in-house testing has proven the materials to be immune to the cause of degradation (eg Oil resistance).

DECLARATION

McMurdo Ltd hereby declares that the materials used on the E3 are not affected by the degrading agents listed above.

Signed on behalf of McMurdo Ltd



John Norrish BSc (Eng)
Product Manager - Electronics

Date 11/11/98

E3 MATERIALS LIST

The materials listed below are in contact with the marine environment.

EPIRB	Material
Body section	
Moulding	Cycoloy C1200 UV stabilised. Polycarbonate / ABS blend
Identity label	Polyester UV stabilised. Printed to rear. Adhesive 3M type 467
Front label	Polyester. Litho printed then laminated. Adhesive 3M type 467
Switch	
Button overlay	Polyester UV stabilised. Printed to rear. Adhesive 3M type 467
Slider & rim	Pulse A35/110 UV stabilised. Polycarbonate / ABS blend
Label	Polyester. Litho printed then laminated. Adhesive 3M type 467
Main seal	
Gasket	Sarlink. Polypropylene / ABS blended thermo-elastomer
Screws	Stainless steel
O-rings on screws	Nitrile rubber
Lens dome	
Moulding	Polycarbonate UV stabilised
Reflective tape	3M Solas approved retro-reflective tape
Expiry label	Fascal 940 all weather PVC vinyl
Antenna	
Conductor	Stainless steel wire rope
Fixing stud	Black Zinc plating over Nickel plated brass
O-ring seal	EPDM
Sleeving	Polyolefin heat shrink tube
Top cap	PVC fixed with cyano-acrylate adhesive
Lanyard	
Former	Pulse A35/110 UV stabilised. Polycarbonate / ABS blend
Cord	Woven polypropylene

BRACKET	Material
Moulding	Pulse A35/110 UV stabilised. Polycarbonate / ABS blend.
Clamping pad	Sarlink. Polypropylene / ABS blended thermo-elastomer
Spring	Stainless steel
Magnet potting	Flexible epoxy resin. 3M type DP105
Mounting screws	Stainless steel
Label instruction	Fascal 940 all weather PVC vinyl

ENCLOSURE	Material
Base & cover	Acrylic capped ASA (Acrylate Styrene Arylonitrile)
Test window	Silicone rubber sheet. Primed and glued with specialist Bostik Adhesive
Spring	Stainless steel
Metalwork	All stainless steel
Circular weight	Nickel plated brass
Fixings	All stainless steel
Breakable rod	Acetal Copolymer
Magnet holder	Acetal Copolymer
Magnet potting	Flexible epoxy resin. 3M type DP105
Foam pads	High density Polyethylene foam
Labels	Fascal 940 all weather PVC vinyl

Annex C

Manufacturers Statement on Battery Shelf Life

McMurdo

McMurdo Ltd, Rodney Road, Portsmouth, Hampshire, United Kingdom

McMurdo E3 EPIRB

Battery self-discharge statement

This statement details the discharge regime that must be applied to a fresh E3 battery pack to compensate for self discharge effects. It is based upon the following specifications...

ETS 300 066 para 4.13.1

RTCM SC110 Version2 para 2.3.1.5

McMurdo wish to quote a 6 year shelf life, which implies a 12 year self-discharge regime.

Self discharge at +20C

A statement from the battery manufacturer SAFT is attached. This is based on actual measured data. It states that over a 12 year period at +20C the average self-discharge is 0.766% per annum. Which equates to $0.766\% \times 12 \text{ yrs} = 9.19\%$ loss in total. During battery discharge testing McMurdo have measured the SAFT (3xLO26SX) battery 6.8Ah nominal capacity under true PCB loading. Hence the self discharge loss is $6.8 \times 0.0919 = 0.625 \text{ Ah}$.

Self test

The E3 self-test regime lasts for 6 seconds and consists of a frame inverted 406MHz transmission plus 3 sweeps of 121.5MHz. The current profile for this is as follows
 $0.2\text{A} \times 6\text{s} + 1.8\text{A} \times 0.44\text{s} = 2\text{As} = 0.00055 \text{ Ah}$. Based on user testing once per week for 12 years this becomes $0.00055 \times 52 \times 12 = 0.347 \text{ Ah}$.

Standby loads

The E3 uses a CMOS 4001 chip which is permanently powered. The worst case +20C supply current for this device is 0.24uA. Over 12 years this is $12 \times 365 \times 24 \times 0.24\text{uA} = 0.025 \text{ Ah}$.

Total losses come to $0.625 + 0.347 + 0.025 = 0.997 \text{ Ah}$. This can either be extracted from a fresh battery prior to life test (ETS 300 066) or it can be included as an overtest to **56.3 hours** (RTCM), where the overtest factor $F = [48 + (0.997\text{Ah}/0.12\text{A})] / 48 = 1.173$.



John Norrish
Product Manager - Electronics
7.9.98

Attachments : SAFT letter on self-discharge

▼
S A F T

McMurdo Ltd.,
Rodney Road,
Fratton, Portsmouth,
Hants.
PO4 8SG

28 October 1998

Ref 281098 / 1

For the attention of Mr J Norrish

Dear John.

SAFT 3LO26SX E3 EPIRB BATTERY PACK

Self discharge characteristics of LO26SX Cells in storage at
+20 degs C

Annual Rates of Self Discharge at +20 degs C					
Yr 1	Yr 2	Yrs 3 to 6	Yrs 7 to 10	Yrs 11 to 12	
3 %	3 %	0.5 %	<0.2 %	<0.2 %	

Average Rate of Self Discharge as	Yr 1	= 1 x 3.0 %
% of the nominal capacity	Yr 2	= 1 x 3.0 %
	Yr 3 - 6	= 4 x 0.5 %
	Yr 7 - 10	= 4 x 0.2 %
	Yr 11 - 12	= 2 x 0.2 %

Total Predicted % Capacity Loss (12 Years)	9.2 %
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Average rate of Capacity Loss : 0.766 % p.a.

Yours faithfully,

Malcolm W Ewing
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SAFT Ltd

c.c. Mr R A Gracie - SAFT Ltd

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