Engineering and Testing for EMC and Safety Compliance

TYPE CERTIFICATION REPORT

ICOM Incorporated
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Osaka, Japan 547

MODEL: MR-570R

FCC ID: AFJMR-570R

May 29, 2001

STANDARDS REFERENCED FOR THIS REPORT	
PART 2: 1999	FREQUENCY ALLOCATIONS AND RADIO TREATY MATTERS; GENERAL RULES AND REGULATIONS
PART 80: 1998	STATIONS IN THE MARITIME SERVICES
PART 90: 1998	PRIVATE LAND MOBILE RADIO SERVICES
ANSI C63.4-1992	STANDARD FORMAT MEASUREMENT/TECHNICAL REPORT PERSONAL COMPUTER AND PERIPHERALS
ANSI/TIA/EIA 603- 1992	LAND MOBILE FM OR PM COMMUNICATIONS EQUIPMENT MEASUREMENT AND PERFORMANCE STANDARDS
ANSI/TIA/EIA 603-1-1998	ADDENDUM TO ANSI/TIA/EIA 603-1992
RSP-100	RADIO EQUIPMENT CERTIFICATION PROCEDURE

FCC Rules Parts	**Frequency Range**	**Output Power (W)**	**Freq. Tolerance**	**Emission Designator**
80 and 90	9380-9440 MHz	4000	9301.64- 9513.64 MHz	78M0P0N
Industry Canada Standard	**Frequency Range**	**Output Power (W)**	**Freq. Tolerance**	**Emission Designator**
RSP-100	9380-9440 MHz	4000	9301.64- 9513.64 MHz	78M0P0N

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1 CONFORMANCE STATEMENT

Standards Referenced for this Report	
Part 2: 1999	Frequency Allocations and Radio Treaty Matters; General Rules and Regulations
Part 80: 1998	Stations In The Maritime Services
Part 90: 1998	Private Land Mobile Radio Services
ANSI C63.4-1992	Standard Format Measurement/Technical Report Personal Computer and Peripherals
ANSI/TIA/EIA603- 1992	~~603:1992~~Land Mobile FM or PM Communications Equipment Measurement and Performance Standards
ANSI/TIA/EIA 603-1-1998	Addendum to ANSI/TIA/EIA 603-1992
RSP-100	Radio Equipment certification Procedure

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We, the undersigned, hereby declare that the equipment tested and referenced in this report conforms to the identified standard(s) as described in this attached test record. No modifications were made to the equipment during testing in order to achieve compliance with these standards.

Furthermore, there was no deviation from, additions to or exclusions from the above mentioned standards Certification methodology.

Signature: _______________ Date: May 29, 2001

Typed/Printed Name: Desmond A. Fraser

Position: President
(NVLAP Signatory)

NVLAP *Accredited by the National Voluntary Accreditation Program for the specific scope of accreditation under Lab Code 200061-0.*

Note: This report may not be used by the client to claim product endorsement by NVLAP or any agency of the U.S. Government.

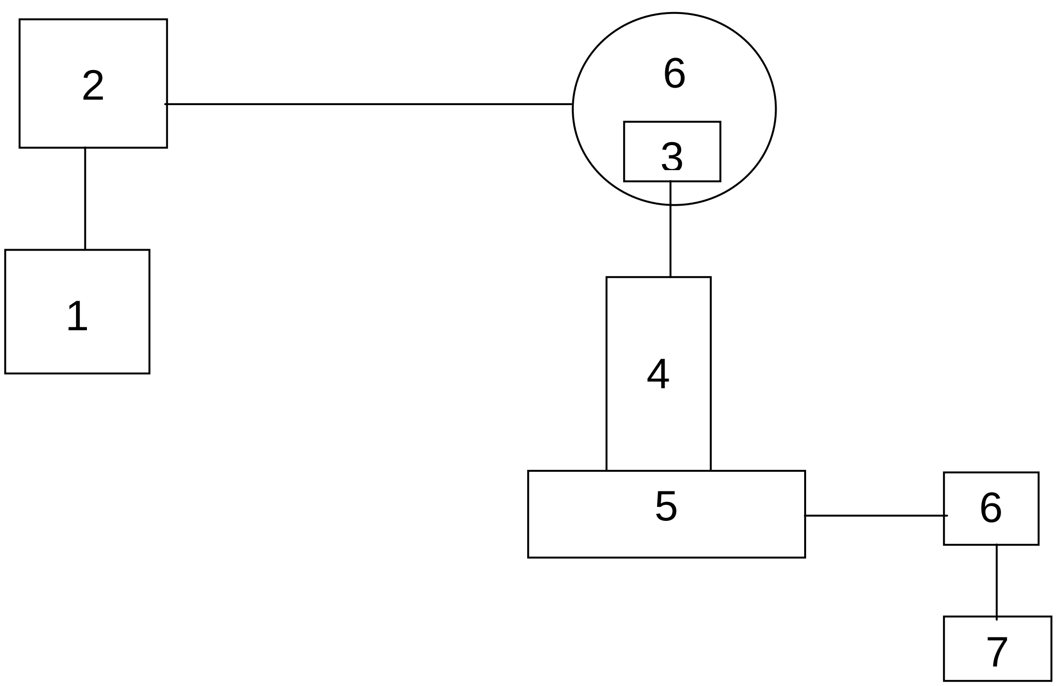
2 TESTED SYSTEM DETAILS

Listed below is the identifiers and descriptions of all equipment, cables, and internal devices used with the EUT for this test, as applicable.

TABLE 2-1: COMPONENTS USED IN TEST CONFIGURATION

Figure Item #	Part	Manufacturer	Model	Serial Number	FCC ID	Cable Description	RTL Bar Code
1	DC Power Supply	Alinco	DM-330MV	0001638		Unshielded	901124
2	Display Unit	ICOM	EX-2473	K35		Shielded	13108
3	Magnetron	ICOM	MAF1421B	N/A			N/A
4	NARDO	Directivity Coupler	1080	N/A			901151
5	HP	Wave Guide Adapter	X281A	N/A			90114
6	ICOM	Radar Unit	MR-570R	K35K1288	AFJMR-570R		N/A
7	HP	Crystal Detector	423B	N/A			901147

FIGURE 2-1: CONFIGURATION OF TESTED SYSTEM



3 FCC PART 2 §2.1046 (A): RF OUTPUT POWER

3.1 TEST PROCEDURE

The MR-570R RADAR transmitter output into a dummy load was measured with an NARDA directional coupler, a HP pad, and an Agilent E4416A power meter with E9327A thermocouple sensor. The power meter was corrected for the directional coupler attenuation, attenuating pad, and sensor calibration by setting the power meter offset to 45.3 dB. This value was obtained by performing a transmission line loss measurement with an HP 83752A synthesizer sweeper set to the operating frequency at 9.41GHz. The directional coupler, the wave-guide to BNC adapter, and the dummy load were part of the transmission line.

3.2 TEST DATA

TABLE 3-1: RF OUTPUT POWER

PULSE SETTING	PULSE LENGTH µSEC	PRF	CORRECTED AV POWER (W)	PEAK POWER (KW)
SHORT	0.11	2183	0.820	3.41
MEDIUM SHORT	0.29	2183	2.087	3.30
MEDIUM LONG	0.36	2183	2.736	3.48
LONG	0.91	725	2.640	4.00

Note:
Duty cycle = PRF x Pulse Length; Peak Power = Av Power / Duty Cycle

3.3 TEST EQUIPMENT

Spectrum Analyzer HP8596EM

4 FCC PART 2 §2.1047 (C) (1): MODULATION CHARACTERISTICS

The MR-570R magnetron pulse input was measured with a Tektronix TDS 560 digital oscilloscope and a high voltage probe. The oscilloscope display for each pulse width of 0.11, 0.29, 0.36, and 0.91 microseconds respectively are included.
Occupied bandwidth for nominal pulse widths of 0.11, 0.29, 0.36, and 0.91 microseconds are included respectively. These plots were made with an HP 8564E spectrum analyzer and an HP 7550 plotter.

4.1 TEST PROCEDURE

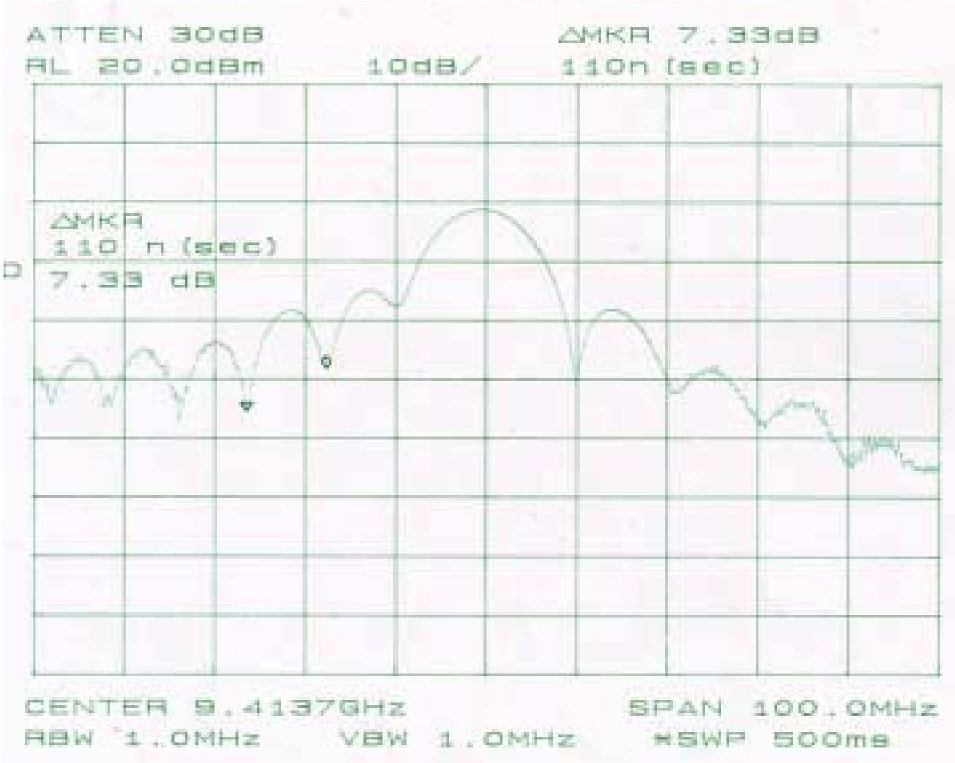
ANSI/TIA/EIA-603-1992, section 2.2.11

Device with digital modulation: operation to its maximum extent

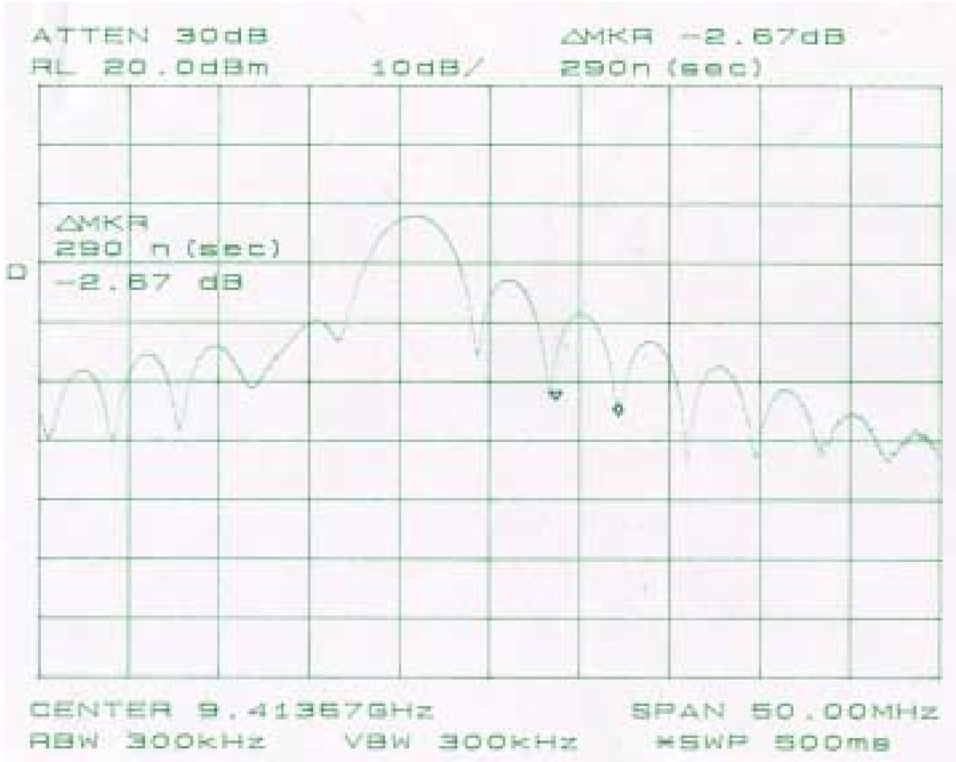
4.2 TEST EQUIPMENT

Spectrum Analyzer HP8564E s/n 3943A01719

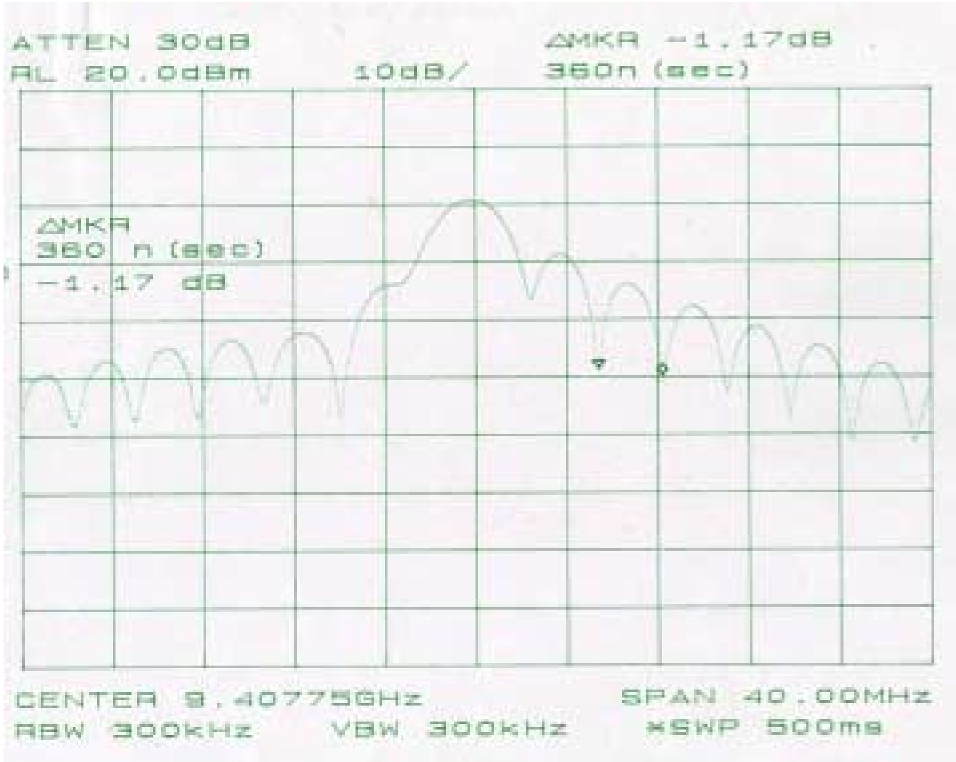
4.3 TEST DATA



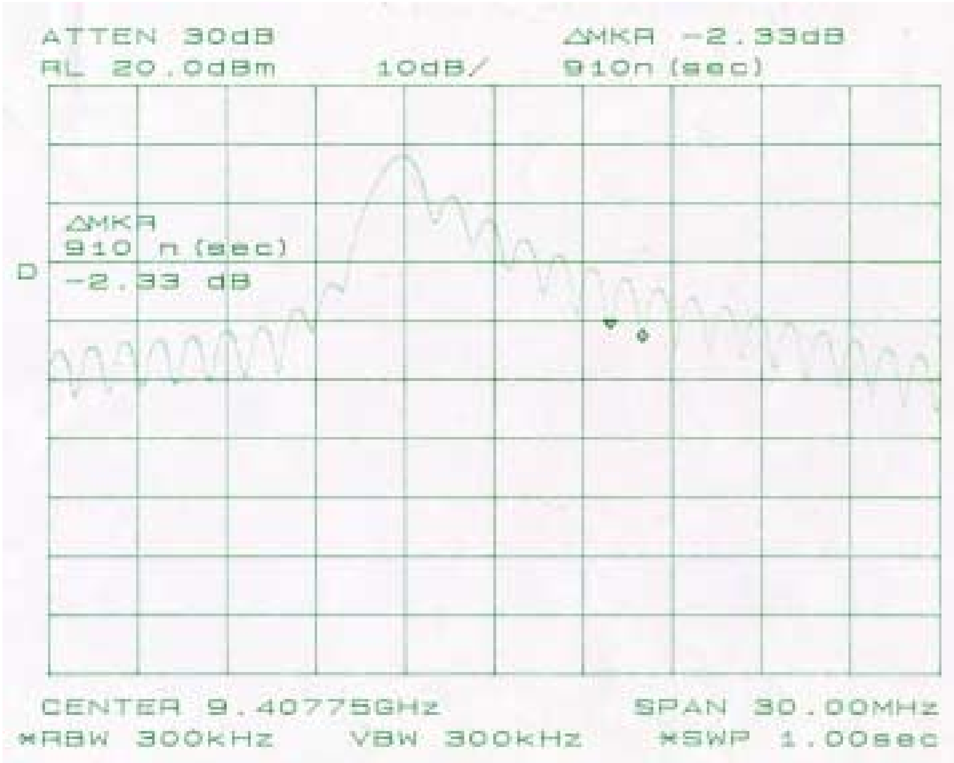
PLOT 1: PULSE LENGTH (0.11 MICROSECONDS)



PLOT 2: PULSE LENGTH (0.29 MICROSECONDS)



PLOT 3 PULSE LENGTH (0.36 MICROSECONDS)



PLOT 4: PULSE LENGTH (0.91 MICROSECONDS)

5 FCC PART 2 §2.1049 (C) (1): OCCUPIED BANDWIDTH

OCCUPIED BANDWIDTH (99% POWER BANDWIDTH) - COMPLIANCE WITH THE FCC RULES.

5.1 `TEST PROCEDURE

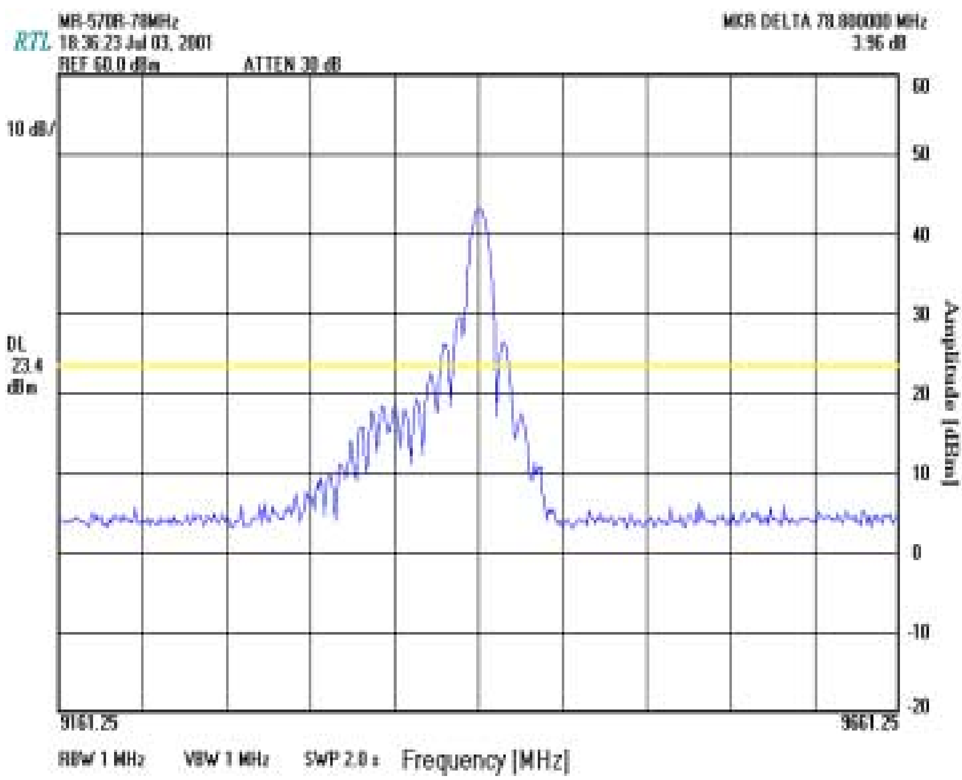
ANSI/TIA/EIA-603-1992, section 2.2.11

The 99% occupied bandwidth was measured using the HP8596EM 99% power bandwidth soft key. The carrier was centered on the spectrum analyzer before applying the analyzer's soft key. The measurement was verified by comparing the measured bandwidth to the –20dBc bandwidth measurement.

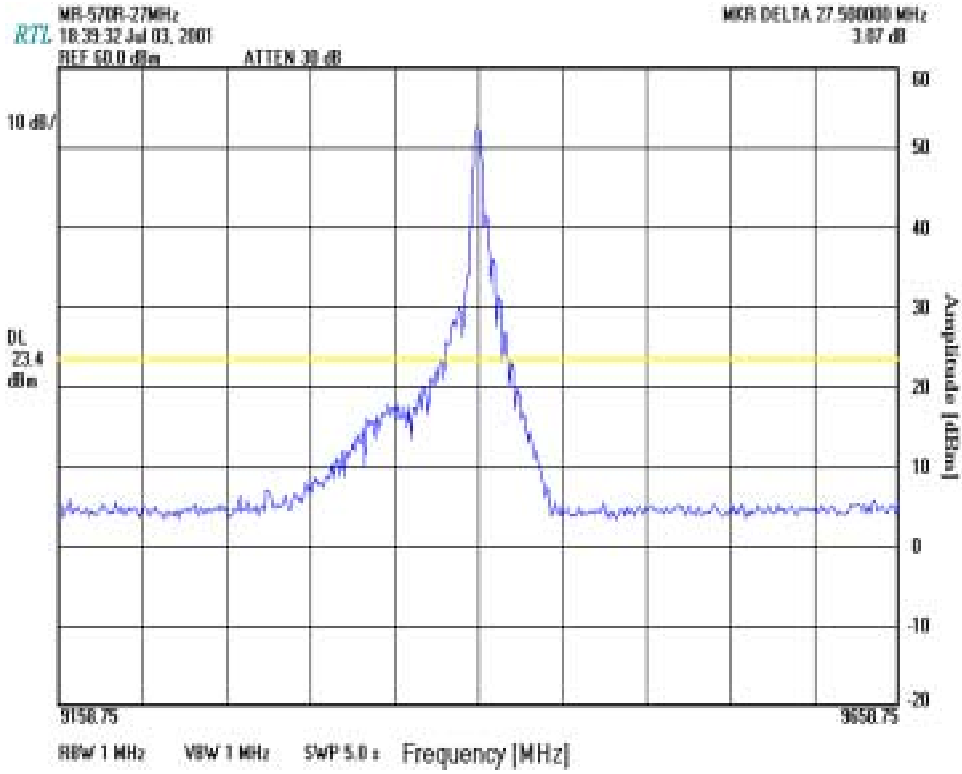
5.2 TEST EQUIPMENT

Spectrum Analyzer HP8596EM s/n 3943A01719

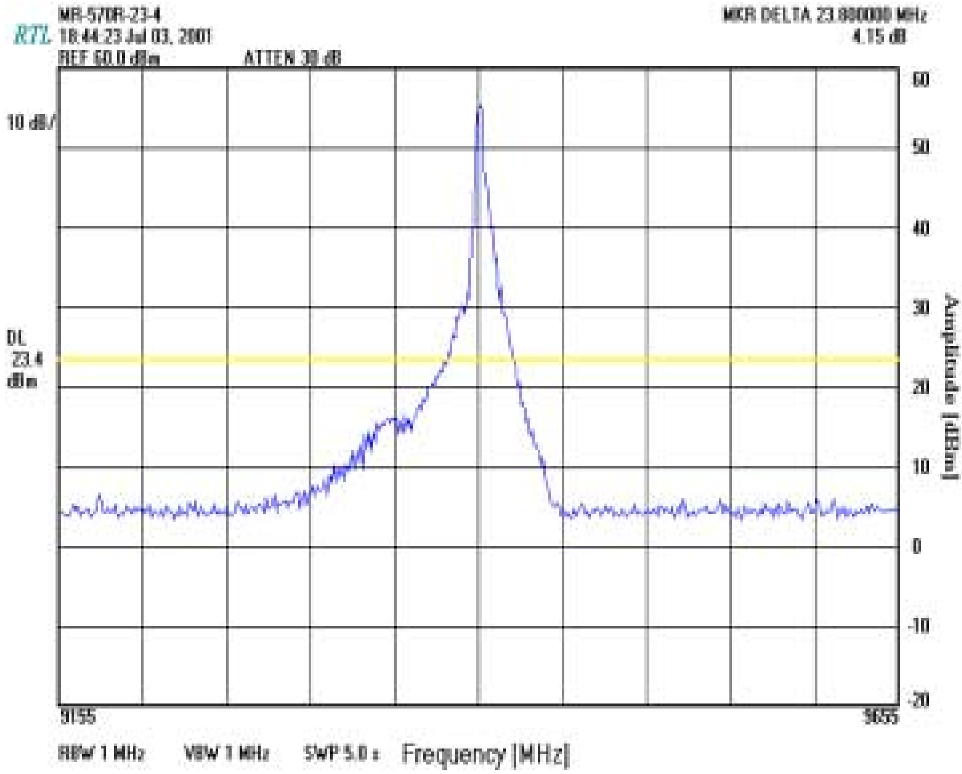
5.3 TEST DATA



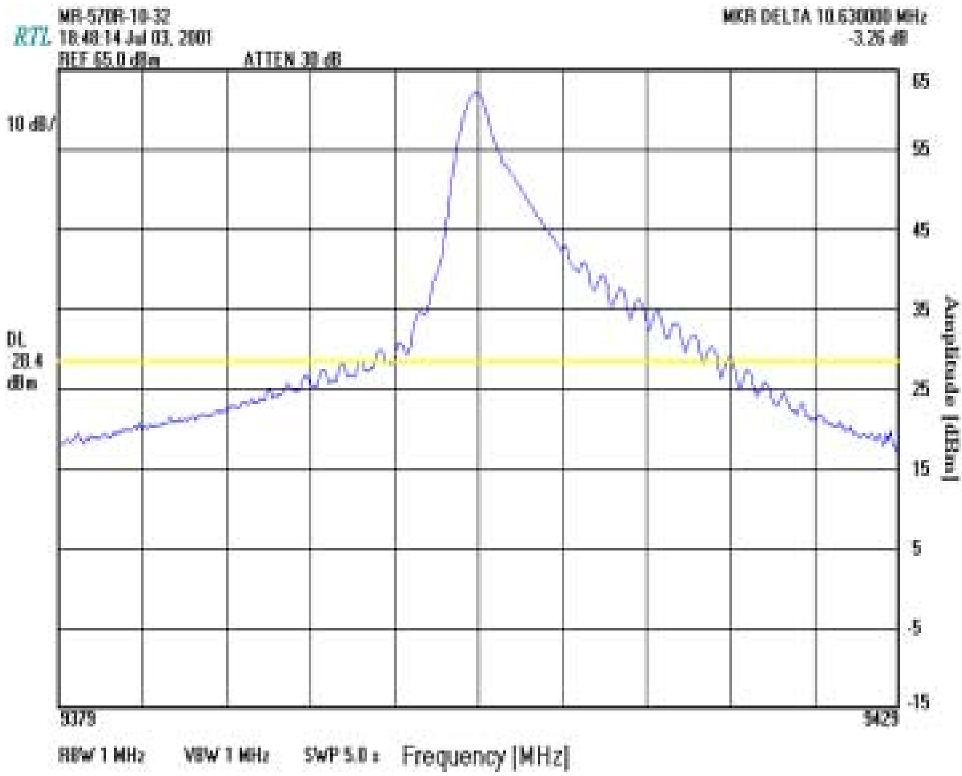
PLOT 5: BANDWIDTH 78.8 MHZ (0.11 MICROSECONDS PULSE LENGTH)



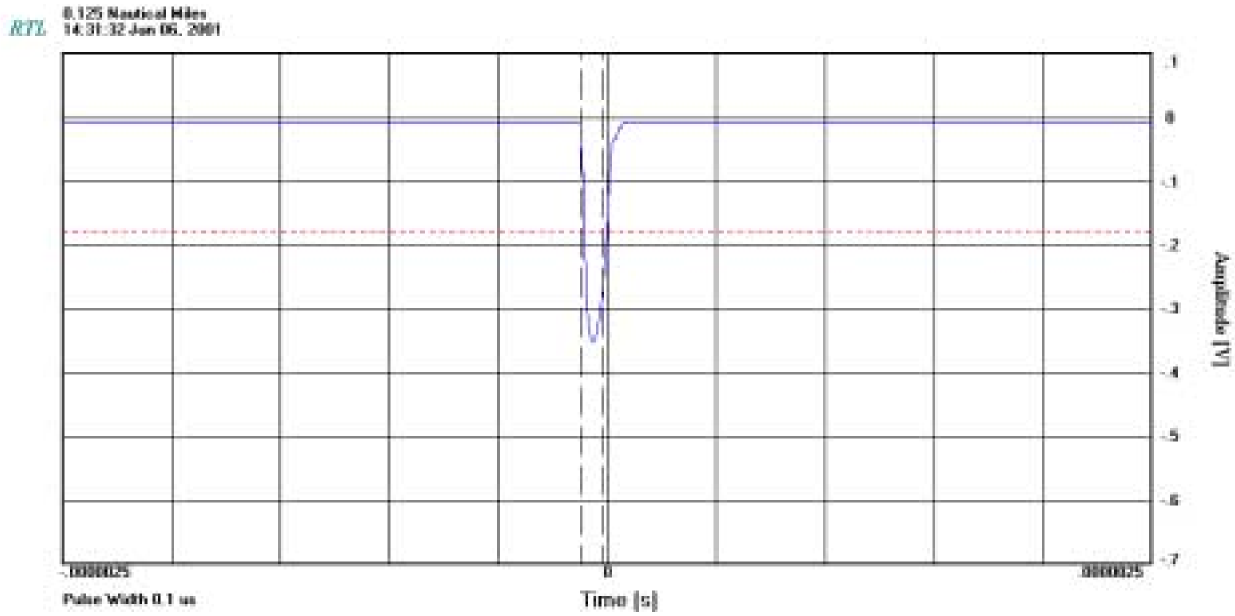
PLOT 6: BANDWIDTH 27.5 MHZ (0.29 MICROSECONDS PULSE LENGTH)



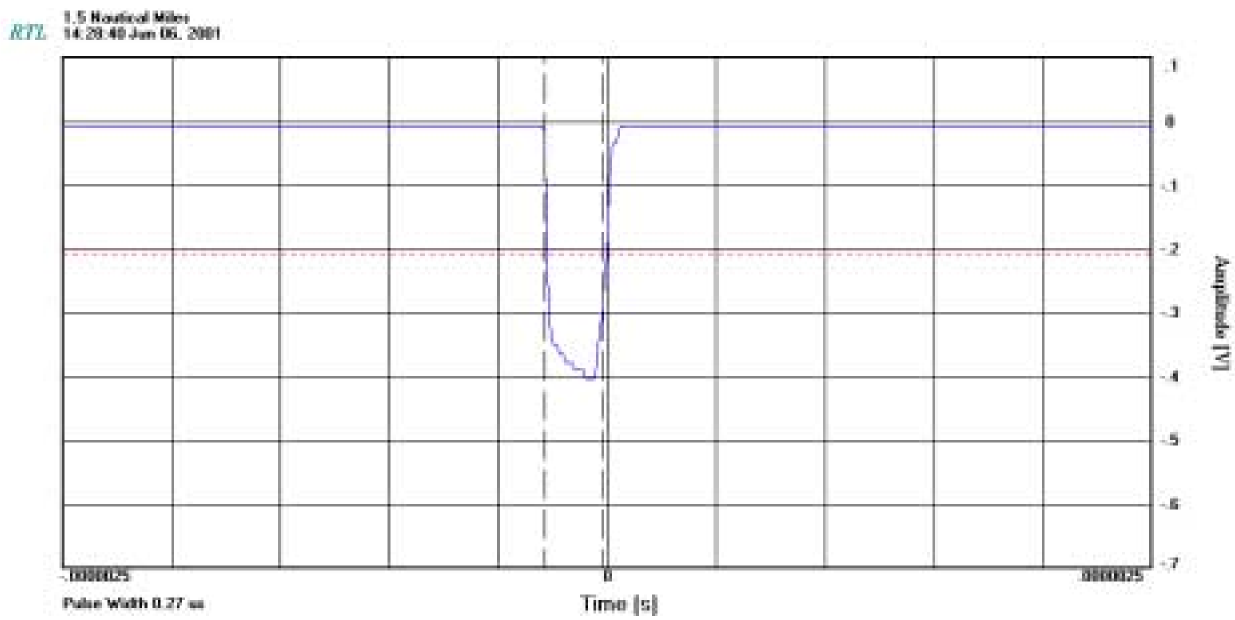
PLOT 7: BANDWIDTH 23.8 MHZ (0.36 MICROSECONDS PULSE LENGTH)



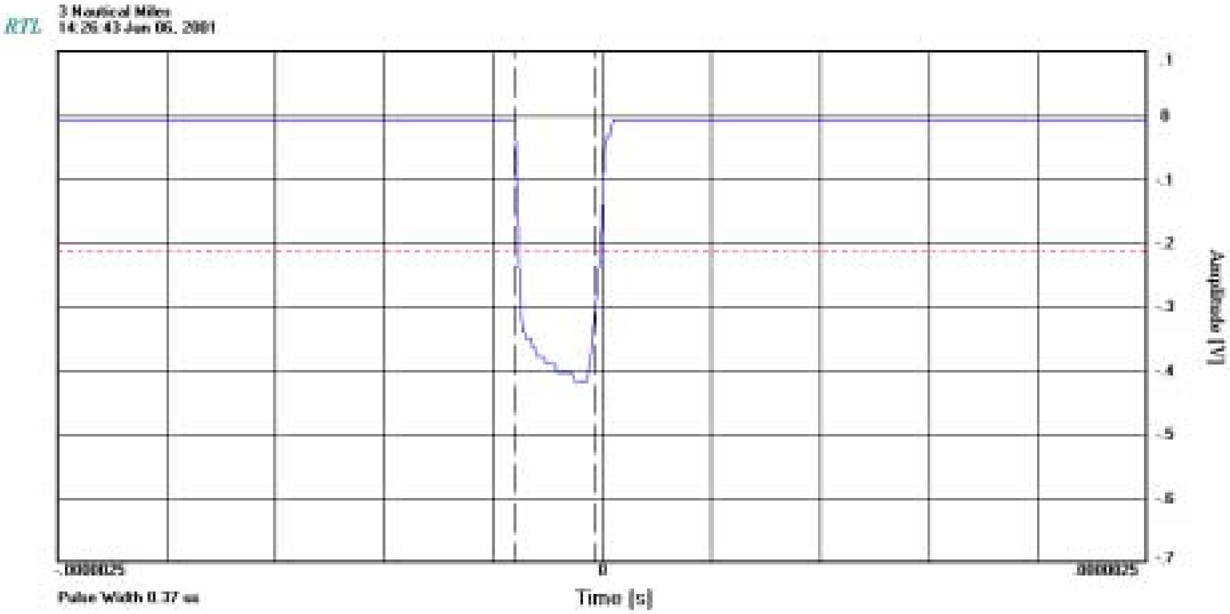
PLOT 8: BANDWIDTH 10.63 MHZ (0.36 MICROSECONDS PULSE LENGTH)



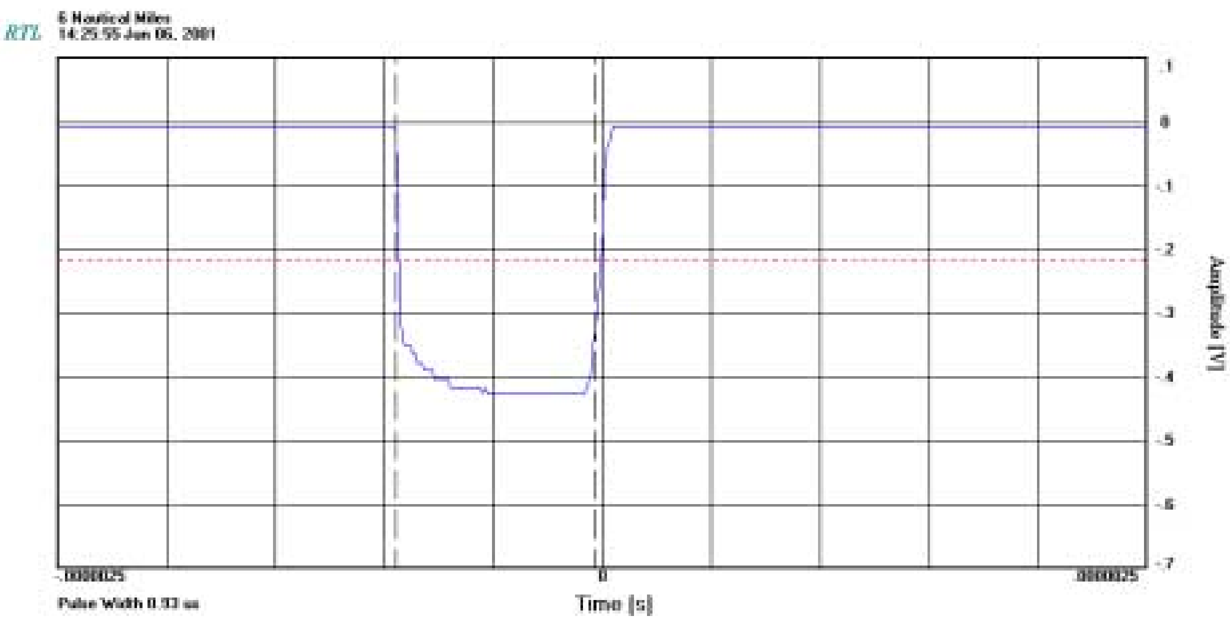
PLOT 9: MAGNETRON CONTROL PULSE 0.1µS



PLOT 10: MAGNETRON CONTROL PULSE 0.26µS



PLOT 11: MAGNETRON CONTROL PULSE 0.36µS



PLOT 12: MAGNETRON CONTROL PULSE 0.91µS

6 FCC PART 2 §2.1051 (A): SPURIOUS EMISSIONS AT THE ANTENNA TERMINAL

6.1 TEST PROCEDURE

The MR-570R RADAR transmitter was tested for spurious emissions while the equipment was modulated with nominal pulse widths of 0.11, 0.29, 0.36, and 0.91 microseconds. Measurements were made with an HP 8546E Spectrum Analyzer coupled to the transmitter output waveguide through a directional coupler. During the tests, the MDR-570R was terminated in a 50 Ohm dummy X-band load. The supply voltage was maintained at 24VDC through out the test. Spurious emissions were measured from 9KHz to 40GHz. Emissions that were between the required attenuation and the noise floor of the spectrum Analyzer were recorded.

6.2 TEST DATA

	dBC for each nominal Pulse Width			
	0.11µs	0.29µs	0.36µs	0.91µs
Frequency 9KHz to 40 GHz	NF	NF	NF	NF
Average Power (W)	1.6	4.45	6.6	6.3
Required Attenuation 43 + 10logP (dB)	45.0	49.5	51.2	51.0

NF=Noise Floor (There were no signals observed above the Analyzer noise floors). The Spectrum analyzer settings were RBW/VBW = 100 kHz. The data below reflects the analyzer noise floor.

9KHz – 2 GHz = -96dBm
2GHz – 5 GHz = -89dBm
5GHz – 10 GHz = -88dBm
10GHz – 15GHz = -88dBm
15GHz – 20GHz = -86dBm
20GHz – 25GHz = -76dBm
30GHz – 35GHz = -67dBm
35GHz – 40GHz = -66dBm

7 FCC PART 2 §2.1053 (A): FIELD STRENGTH OF SPURIOUS RADIATION

7.1 TEST PROCEDURE

Substitution Method: ERP:

The EUT was setup at an antenna to EUT distance of 3 meters on an open area test site with the transmitter connected to the dummy load. The EUT was placed on a nonconductive turntable approximately 0.8 meters above the ground plane.

The physical arrangement of the EUT and associated cabling was varied in order to determine the effect on the EUT's emissions in amplitude, direction and frequency. At each frequency, the EUT was rotated 360 degrees, and the antenna was raised and lowered from one to four meters in order to determine the maximum emission levels. Measurements were taken using both horizontal and vertical antenna polarizations.

The worst-case, maximum radiated emission was recorded and used as reference for the ERP measurement.

The EUT was then replaced by a ½ wave dipole antenna and polarized in accordance with the EUT's antenna polarization. The ½ wave dipole antenna was connected to a RF signal generator with a coaxial cable.

The search antenna height, and search antenna polarity was set to levels that produced the maximum reading obtained in step 3. The signal generator was adjusted to a level that produced the radiated emission level obtained in step 3.

The signal generator level was recorded and corrected by the power loss in the cable between the generator and the antenna and further corrected for the gain of the substitution antenna used relative to an ideal ½ wave dipole antenna. The signal generator corrected level is the ERP level

CALCULATION METHOD: EIRP

$$P_{Watt} = \frac{E_{v/m}{}^{2} \times d_{m}{}^{2}}{30}$$

7.1.1 TEST EQUIPMENT

Amplifier: HP8449B s/n 3008A00505
Spectrum analyzer: HP8564E s/n 3943A01719
Antenna BiLog Chase 6112L, EMCO Horn 2-4 GHz, EMCO horn 4-8 GHz, EMCO horn 8 – 12 GHz
RF Signal Generator HP8648C s/n 3537A01741
Synthesized Sweeper HP83752A s/n 3610A00846

7.1.2 TEST DATA

There were no spurious emissions observed.

TABLE 7-1: PART 2 §2.1053 (A): FIELD STRENGTH OF SPURIOUS RADIATION

Frequency (M Hz)	Emission Level* (dBuV)	Site Factor (dB/m)	Emission Level (dBuV/m)	Calculated ERP (mW)	Calculated EIRP (mW)	Comments

*Measurement accuracy is +/- 1.5 dB

8 FCC PART 2 §2.1055: FREQUENCY STABILITY

8.1 TEST PROCEDURE

ANSI/TIA/EIA-603-1992, section 2.2.2

The carrier frequency stability is the ability of the transmitter to maintain an assigned carrier frequency.

The EUT was evaluated over the temperature range -30°C to +50°C.

The temperature was initially set to -30°C and a 2-hour period was observed for stabilization of the EUT.
The frequency stability was measured within one minute after application of primary power to the transmitter. The temperature was raised at intervals of 10 degrees centigrade through the range. A ½ an hour period was observed to stabilize the EUT at each measurement step and the frequency stability was measured within one minute after application of primary power to the transmitter. Additionally, the power supply voltage of the EUT was varied from 85% to 115% of the nominal 24VDC voltage.

8.1.1 FCC § 80.209(b)

The frequency at which maximum emission occurs must be within the authorized bandwidth and must not be closer that 1.5/T MHz to the upper and lower limits of the authorized bandwidth, where T is the pulse duration in microseconds.

1) Center frequency (f_0):

Authorized bandwidth (AUBW): 9300 MHZ to 9500 MHz

Upper limit of authorized band = 9500 - 1.5/T
Lower limit of authorized band = 9300 + 1.5/T

TABLE 8-1: FREQUENCY STABILITY

FREQUENCY TOLERANCE		
PULSE WIDTH (µSEC)	**LOWER LIMITS (MHz)**	**UPPER LIMITS (MHz)**
0.11	9313.64	9513.64
0.29	9305.17	9505.17
0.36	9304.15	9504.17
0.91	9301.65	9501.64

Note:
From examining the frequency data from variation of frequency with voltage and variation of frequency with temperature results pages, it can be see that the transmitter is within the calculated specification.

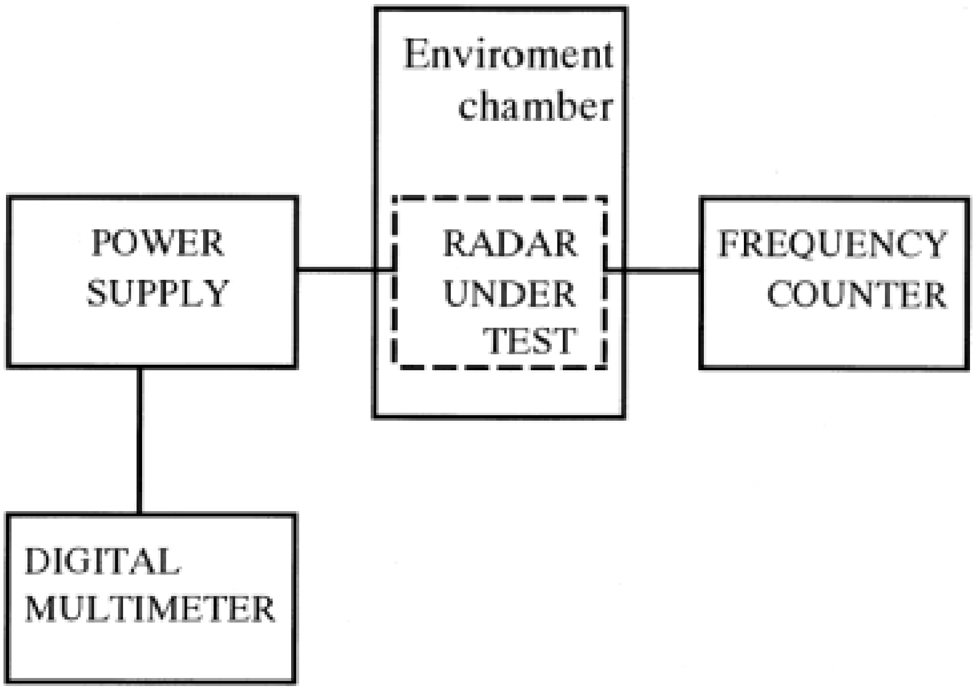


FIGURE 8-1: FREQUENCY STABILITY TEST SETUP

The worst-case test data are shown in tables below.

8.2 TEST EQUIPMENT

Temperature Chamber Tenney TH65 s/n 11380

Frequency Counter HP8901A (Frequency Mode) s/n 2545A04102

8.3 TEST DATA

TABLE 8-2: FREQUENCY STABILITY/TEMPERATURE VARIATION 0.11µS PULSE LENGTH

TEMPERATURE ºC	MEASURED FREQUENCY MHZ
-20	9428.6
-10	9424.2
0	9422.5
10	9421.0
20	9419.4
30	9417.9
40	9415.9
50	9414.2

TABLE 8-3 FREQUENCY STABILITY/TEMPERATURE VARIATION 0.91µS PULSE LENGTH

TEMPERATURE ºC	MEASURED FREQUENCY MHZ
-20	9424.3
-10	9420.6
0	9419.4
10	9417.3
20	9414.7
30	9414.5
40	9412.8
50	9411.1

TABLE 8-4 FREQUENCY STABILITY/VOLTAGE VARIATION 0.11µS PULSE LENGTH

% OF NOMINAL VOLTS	VOLTS (dc)	MEASURED FREQUENCY
100%10.2	10.2	9419.4
85% of 24.0	20.4	9419.4
115% 0f 24.0	27.6	9419.4
100%42.0	42.0	9419.4

TABLE 8-5 FREQUENCY STABILITY/VOLTAGE VARIATION 0.91µS PULSE LENGTH

% OF NOMINAL VOLTS	VOLTS (dc)	MEASURED FREQUENCY
100%10.2	10.2	9414.6
85% of 24.0	20.4	9414.6
115% 0f 24.0	27.6	9414.6
100%42.0	42.0	9414.6

The EUT can operate from 10.2 VDC to 42 VDC. Therefore the testing was performed at %85 and %115 of the nominal voltage including at the lowest and the highest operating voltages 10.2 VDCand 42 VDC.