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Data Critical Corporation
FCC Part 95 Application
Model DR-10100

December 5, 2002

MEASUREMENT/TECHNICAL REPORT

COMPANY NAME: **Data Critical Corporation**

MODEL: **DR-10100**

FCC ID: **BQI02DR-10100**

DATE: **December 5, 2002**

This report concerns (check one): Original grant__X___
Class II change ____

Equipment type: **Low Power Transmitter (for Biomedical Applications)**

Deferred grant requested per 47 CFR 0.457(d)(1)(ii)? yes_____ No_X_

If yes, defer until:_____
date

__N.A.__ agrees to notify the Commission by__N.A.____
date
of the intended date of announcement of the product so that the grant can be issued on that date.

Report prepared by:

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Alpharetta, GA 30004

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GENERAL INFORMATION

Product Description

The Equipment Under Test (EUT) is a Data Critical Corporation, DR-10100. The DR-10100 is a wireless Access Point (AP) designed for use in medical monitoring applications. The DR-10100 receives patient monitoring data from similar radios (FCC ID: BQI00DT-4500) attached to the patients in that hospital. The DR-10100 is linked to other DR-10100's or DR-10000's through a 10Base-T Ethernet backbone. This backbone allows the AP's to pass patient data back to the end user of the system - a nurses monitoring station. The DR-10100 is composed of a 608-614 MHz wireless transceiver and Ethernet conversion circuitry that passes data from the transceiver to the Ethernet backbone.

The DR-10100 may operate with two different types of antennas: a 0 dBi monopole to provide omni-directional coverage and a +2 dBi patch antenna to provide unidirectional coverage. The unit requires external DC power but has its own internal voltage regulation. The DR-10100 is self contained in a plastic package and is designed to be installed on the ceiling of a hospital hallway.

Related Submittal(s)/Grant(s)

Additionally, the EUT will be used with other transceivers (already submitted and approved under FCC ID: BQIOODT-4500).

SECTION 2

TESTS AND MEASUREMENTS

TESTS AND MEASUREMENTS

Configuration of Tested System

The sample was tested per ANSI C63.4, Methods of Measurement from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz (1992). Conducted and radiated emissions data were taken with the test receiver or spectrum analyzer's resolution bandwidth adjusted to 9 kHz and 120 kHz, respectively. All measurements are peak unless stated otherwise. The video filter associated with the spectrum analyzer was off throughout the evaluation process. Interconnecting cables were manipulated as necessary to maximize emissions. A block diagram of the tested system is shown in Figure 1. Test configuration photographs for spurious and fundamental emissions are shown in Figure 2.

Test Facility

Testing was performed at US Tech's measurement facility at 3505 Francis Circle, Alpharetta, GA. This site has been fully described and submitted to the FCC, and accepted in their letter marked 31040/SIT. Additionally this site has also been fully described and submitted to Industry Canada (IC), and has been approved under file number IC2982.

Modifications

To bring the EUT into compliance with FCC Part 95 limits for the transmitter portion of the EUT and the Part 15 Digital Device Requirements, the following modifications were made:

1) A ferrite was placed on the Ethernet Cable (Steward Part Number 28A2024-0A0).

The following changes were made to the digital device board.
2) Changed R32 to 330 ohm.
3) Added a 0.01 uF to the VCC pin of Y1.
4) Added a 330 ohm resistor in series with output of Y1.
5) Added a shunt 56 pF capacitor to ground at "cold" side of the 330 ohm
6) Resistor added in series with Y1.
7) Inserted series Z-Beads in line with pins numbers 4, 5 and 7 of JP6.
8) Part number of bead is ETC1608-221.
9) Added 0.01 uF cap between pins 7 and 8 of JP6.
10)Added 0.01 uF cap between pins 7 and 8 of JP5.
11) Increased R64 to 330 ohms.
12) Added a 0.01 uF to ground from pin 14 of U4.
13) Added a 0.01 uF to ground from pin 14 of U7.
14) Added a termination consisting of two 50 ohm resistors and one 0.01 uF
15) Capacitor to pins 15 and 16 of U4.
16) Added a termination consisting of two 50 ohm resistors and one 0.01 uF
17) Added a capacitor to pins 15 and 16 of U7.

Test Equipment

Table 2 describes test equipment used to evaluate this product.

FIGURE 1

TEST CONFIGURATION

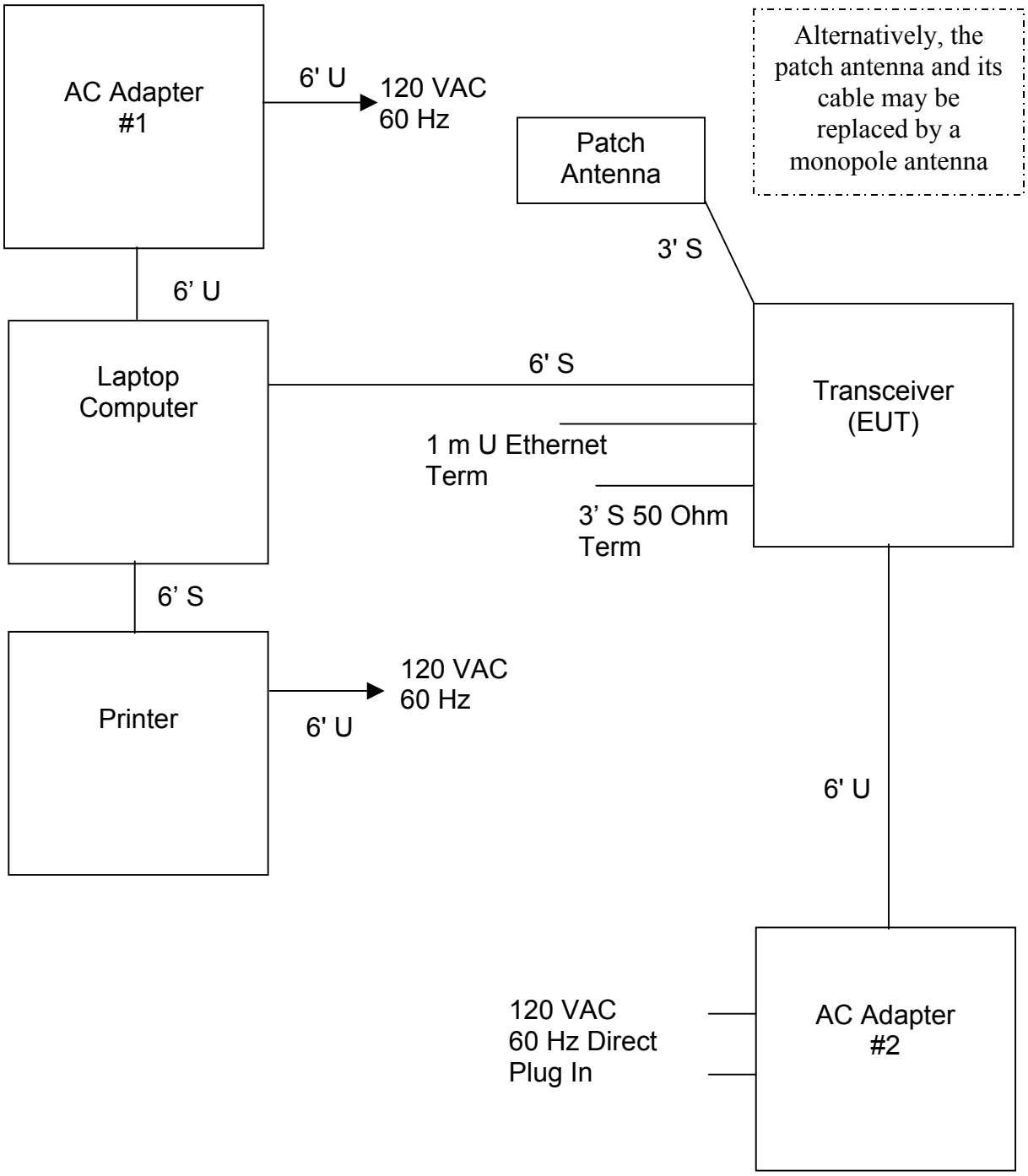


FIGURE 2a

Photograph(s) for Fundamental, Spurious and Digital Devices Emissions
Dipole Configuration

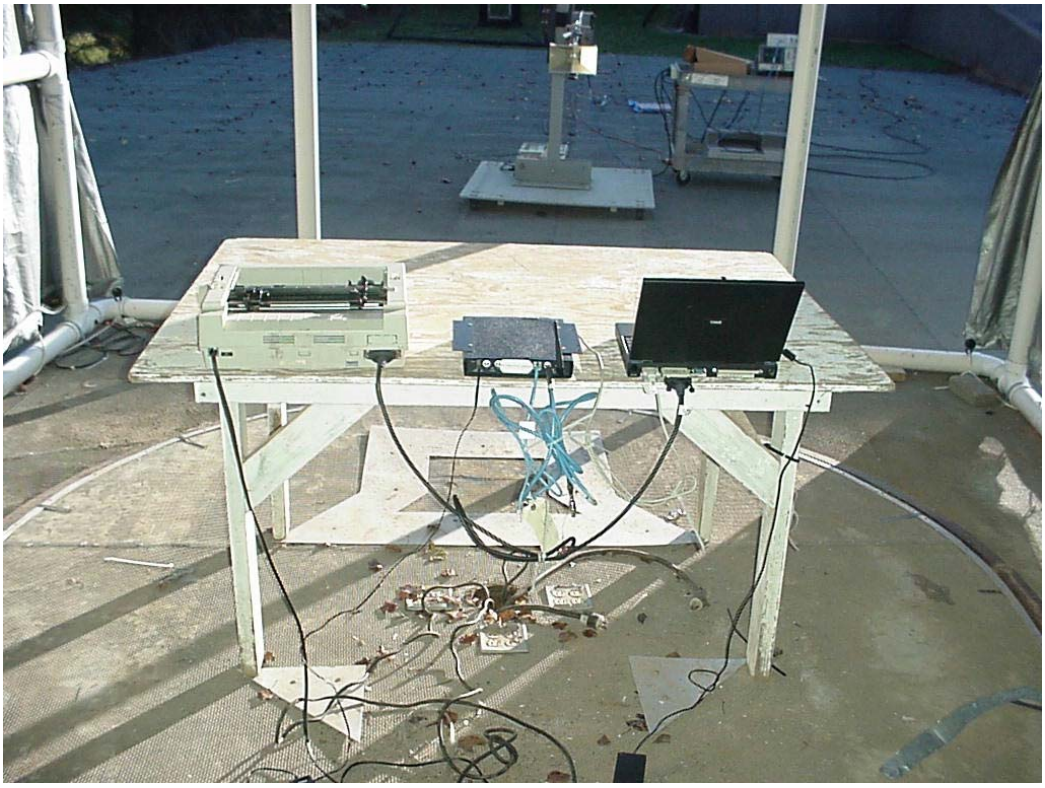


FIGURE 2b

Photograph(s) for Fundamental, Spurious and Digital Devices Emissions Patch Configuration

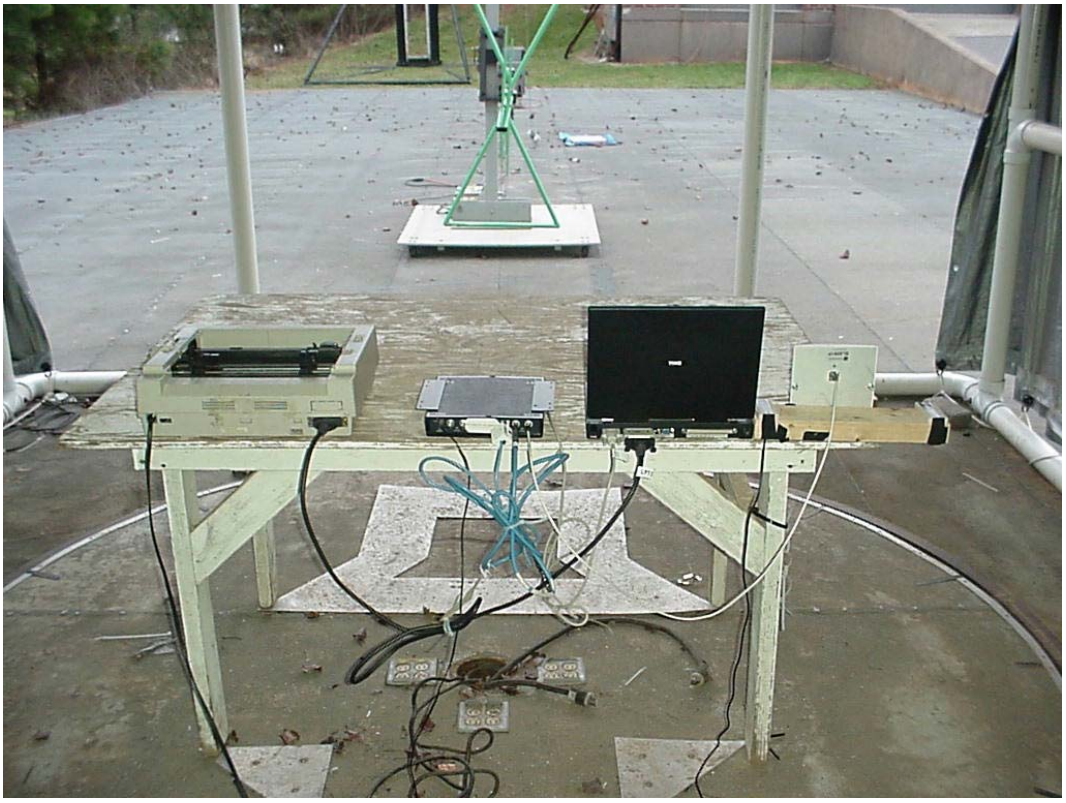


FIGURE 2c

Photograph(s) for Conducted Emissions

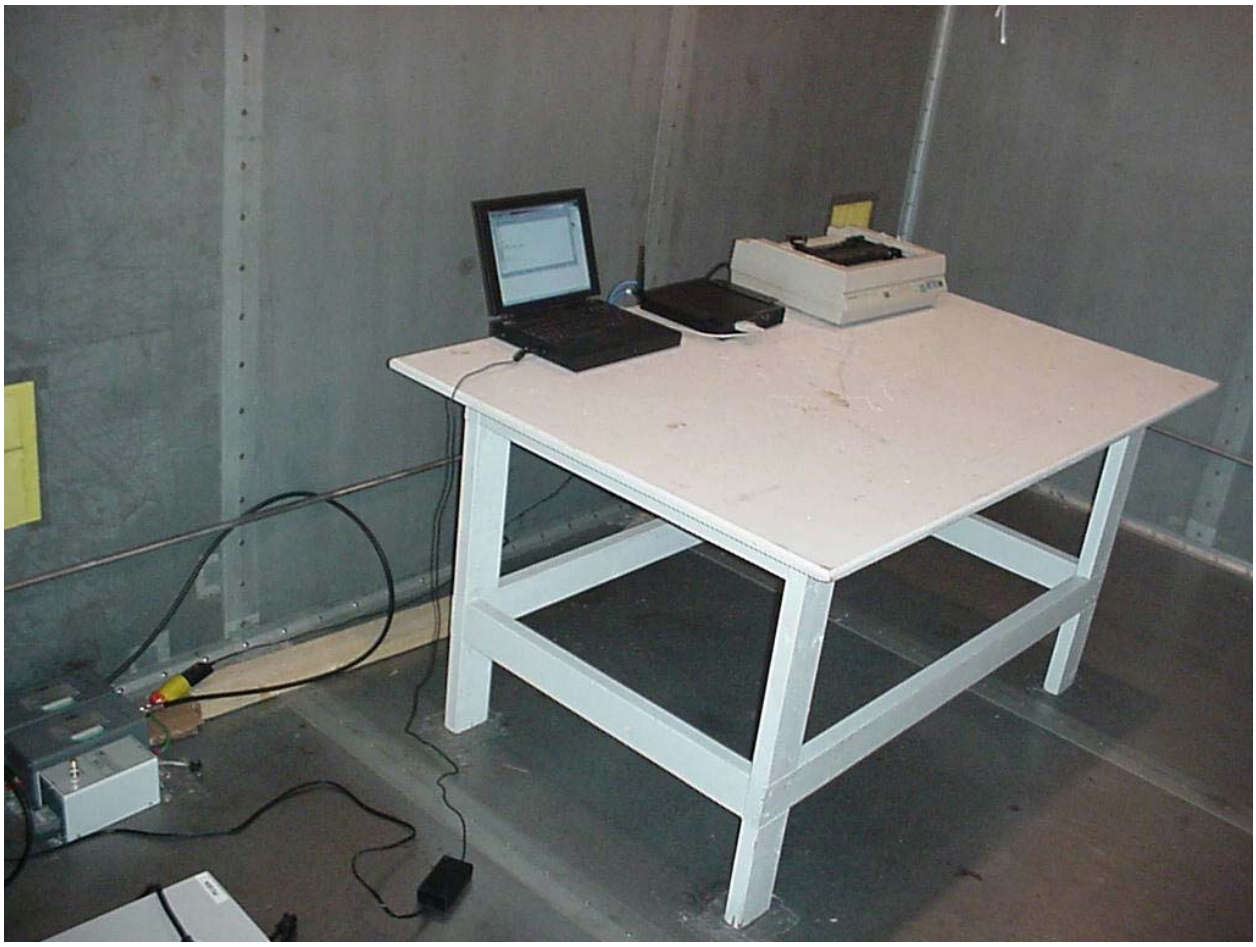


TABLE 1

EUT and Peripherals

PERIPHERAL MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	FCC ID:	CABLES P/D
Transmitter Data Critical Corporation (EUT)	DR-10100	None	BQI00DR-10100 (Pending)	6' S 3' S 50 Ohm Term. 1 m U, Ethernet Term
Antenna Cushcraft	SL6081 (Patch, +2 dBi)	None	None	3' S each
Antenna Nearson, Inc.	P-24A48G (Monopole, 0 dBi)	None	None	None
AC Adapter #1 Dell	55522	P38312318777	N/A	6' U Power Cord
AC Adapter #2 Volgen	SPU10R-2	None	N/A	6’U Direct Plug In
Computer Dell	Inspiron 3200	TS3043	IIRTS30HT	6' U
Printer Panasonic	KX-P1180	1CKARQ99923	ACJ326KX-P1180	6' S 6’ U Power Cord

TABLE 2

TEST INSTRUMENTS

TYPE	MANUFACTURER	MODEL	SN.
SPECTRUM ANALYZER	HEWLETT-PACKARD	8593E	3205A00124
SPECTRUM ANALYZER	HEWLETT-PACKARD	8558B	2010A09206
S A DISPLAY	HEWLETT-PACKARD	853A	2404A02387
COMB GENERATOR	HEWLETT-PACKARD	8406A	1632A01519
RF PREAMP	HEWLETT-PACKARD	8447D	1937A03355
RF PREAMP	HEWLETT-PACKARD	8449B	3008A00480
HORN ANTENNA	EMCO	3115	3723
BILOG	EMCO	CBL6112B	2584
LISN	SOLAR ELE.	8028	910495 & 910494

Antenna Descriptions

The Model DR-10100 may be used with the following antennas.

MANUFACTURER	MODEL	TYPE	CONNECTOR	GAIN dBi
Cushcraft	SL6081P48SMM	Patch	SMA	+2
Nearson Inc.	P-24A48G	Monopole*	SMA	0

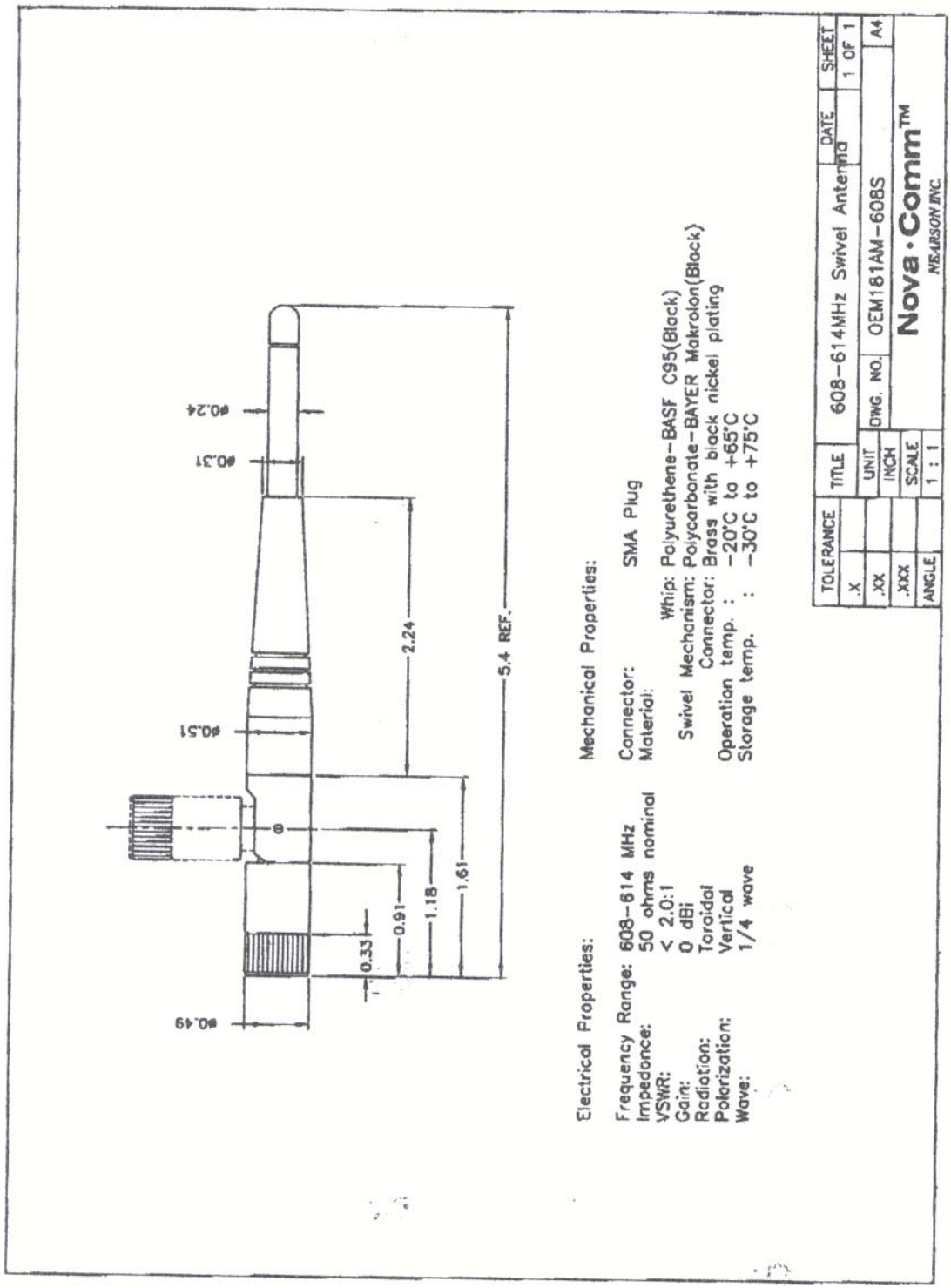
*For antenna specifications, please see the following pages.

The EUT and antenna incorporate standard SMA connectors. Due to the type of installation, this unit will only be professionally installed.

The DR-10100 has been designed exclusively for Data Critical Corporation Data Critical Corporation designs and markets medical monitoring equipment to be used in hospital environments and is the only marketer of this product and is the sole installer. The units will not be marketed to the general public.

The DR-10100 are to be installed in the hallway ceilings of hospitals. These units will receive monitoring data from similar radios (FCC ID: BQI OODT-4500) that are attached to patients in the hospital. The system is very complicated and expensive (generally greater than $100k for a complete installation) and relies on professional installation and upkeep. Trained Data Critical Corporation personnel will be installing these units and will be solely responsible for their operation.

FCC ID: BQI02DR-10100



Electrical Properties:

Frequency Range:	608–614 MHz
Impedance:	50 ohms nominal
VSWR:	< 2.0:1
Gain:	0 dBi
Radiation:	Toroidal
Polarization:	Vertical
Wave:	1/4 wave

Mechanical Properties:

Connector:	SMA Plug
Material:	
Whip:	Polyurethene–BASF C95(Black)
Swivel Mechanism:	Polycarbonate–BAYER Makrolon(Black)
Connector:	Brass with black nickel plating
Operation temp. :	–20°C to +65°C
Storage temp. :	–30°C to +75°C

TOLERANCE		TITLE	608–614MHz Swivel Antenna	DATE	SHEET
.X					1 OF 1
.XX		UNIT	DWG. NO. OEM1181AM–608S		A4
.XXX		INCH			
ANGLE		SCALE	Nova·Comm™		
		1 : 1	NEARSON INC.		

Frequency Range of Fundamental(s) (47 CFR 95.630 & 95.1115(d))

The EUT may operate in the frequency bands specified below:

608-614 MHz
1395-1400 MHz
1429-1432 MHz

The EUT is designed to operate on the following frequency list:

608.6656
608.802133
608.938667
609.0752
609.211733
609.348267
609.4848
609.621333
609.757867
609.8944
610.030933
610.167467
610.304
610.440533
610.577067
610.7136
610.850133
610.986667
611.1232
611.259733
611.396267
611.5328
611.669333
611.805867
611.9424
612.078933
612.215467
612.352
612.488533
612.625067
612.7616
612.898133

Frequency Range of Fundamental(s) (47 CFR 95.1115(d)(2))

In the 608-614 MHz band, wireless medical telemetry devices utilizing broadband technologies such as spread spectrum shall be capable of operating within one or more of the following channels of 1.5 MHz each, up to a maximum of 6 MHz, and shall operate on the minimum number of channels necessary to avoid harmful interference to any other wireless medical telemetry devices.

608.0 – 609.5 MHz
609.5 – 611. 0 MHz
611.0 – 612.5 MHz
612.5 – 614.0 MHz

The device operates on the frequencies given on the previous page. Alternatively the radio may be operated on one of 4 sub-bands, consisting of 8 channels:

Sub-band 1	Sub-band 2	Sub-band 3	Subband 4
608.6656	609.757867	610.850133	611.9424
608.802133	609.8944	610.986667	612.078933
608.938667	610.030933	611.1232	612.215467
609.0752	610.167467	611.259733	612.352
609.211733	610.304	611.396267	612.488533
609.348267	610.440533	611.5328	612.625067
609.4848	610.577067	611.669333	612.7616
609.621333	610.7136	611.805867	612.898133

Sub-band 2 meets with the requirements specified above.

Field Strength of Fundamental Emission (47 CFR 95.639(g) & 95.1115(a))

Measurements were made using a peak detector. Field strength of the peak fundamental emission is shown in Tables 3a through 3c. The radio was checked with both antennas and for a typical low, middle, and high channel with the radio hop-stopped and transmitting continuously on a single channel. Only the worse case results are shown for each low, middle, and high transmit channel which all occurred with while using the monopole antenna.

TABLE 3a

FIELD STRENGTH OF FUNDAMENTAL EMISSION

Test Date: December 4, 2002
UST Project: 02-0396
Customer: Data Critical Corporation
Model: DR-10100

QP Measurement (Low Channel-Monopole)
Highest Emission measured from Radio

FREQ. (MHz)	TEST DATA (Dbm) @ 3m	ANTENNA FACTOR + CABLE ATTENUATION	RESULTS (uV/m) @ 3m	QP FCC LIMITS (uV/m) @ 3m
608.695	-26.65*	25.1	186,672	200,000

*** - Quasi-Peak Measurement**

SAMPLE CALCULATIONS:

RESULTS uV/m @ 3m = Antilog ((-26.65 + 25.1 + 107)/20) = 186,672
CONVERSION FROM dBm TO dBuV = 107 dB

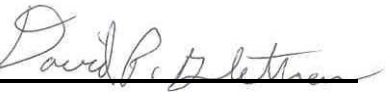
Test Results
Reviewed By:  **Name: David Blethen**

TABLE 3b

FIELD STRENGTH OF FUNDAMENTAL EMISSION

Test Date: December 4, 2002
UST Project: 02-0396
Customer: Data Critical Corporation
Model: DR-10100

QP Measurement (Middle Channel-Monopole)
Highest Emission measured from Radio

FREQ. (MHz)	TEST DATA (dBm) @ 3m*	ANTENNA FACTOR + CABLE ATTENUATION	RESULTS (uV/m) @ 3m	QP FCC LIMITS (uV/m) @ 3m
610.745	-27.74*	25.1	165,645	200,000

*** - Quasi-Peak Measurement**

SAMPLE CALCULATIONS:

RESULTS uV/m @ 3m = Antilog ((-27.74 + 25.1 + 107)/20) = 165,645
CONVERSION FROM dBm TO dBuV = 107 dB

Test Results
Reviewed By:  **Name:** David Blethen

TABLE 3c

FIELD STRENGTH OF FUNDAMENTAL EMISSION

Test Date: December 4, 2002
UST Project: 02-0396
Customer: Data Critical Corporation
Model: DR-10100

QP Measurement (High Channel-Monopole)
Highest Emission measured from Radio

FREQ. (MHz)	TEST DATA (dBm) @ 3m*	ANTENNA FACTOR + CABLE ATTENUATION	RESULTS (uV/m) @ 3m	QP FCC LIMITS (uV/m) @ 3m
612.805	-29.42*	25.2	137,025	200,000

*** - Quasi-Peak Measurement**

SAMPLE CALCULATIONS:

RESULTS uV/m @ 3m = Antilog ((-29.42 + 25.2 + 107)/20) = 137,025
CONVERSION FROM dBm TO dBuV = 107 dB

Test Results
Reviewed By: _____ **Name:** David Blethen

Field Strength Of Spurious Emissions (47 CFR 95.1115(b))

Measurements were made using a peak detector. Field strength of Spurious Emissions are shown in Tables 4a through 4b and Figure 3. For comparison to the average limits, duty cycle corrections were made as shown below.

Preliminary measurements were made with two different antennas (patch and monopole). The results from each radio were similar, but preliminary data showed that the Radio with the patch antennas transmitting on the high channel to be worse case. Therefore all results shown are shown for the radio configured with the patch antenna (high channel).

Duty Cycle Correction During 100 msec:

The system is designed that the system hops at 35 msec per channel. The system will only be on one channel in any 100 msec period of time. During this 35 msec per channel, each transmitter is allotted only a small duration of this period (5 msec max).

Therefore the worse case duty cycle is:

Duty Cycle Correction = 20 log (0.05) = -26.0 dB

TABLE 4a

FIELD STRENGTH OF SPURIOUS EMISSIONS

Test Date: December 6, 2002
UST Project: 02-0396
Customer: Data Critical Corporation
Model: DR-10100

Peak Measurements (High Channel, Patch Antenna)

FREQ. (GHz.)	TEST DATA (dBm) @ 3m	ANTENNA FACTOR + CABLE ATTENUATION - AMP GAIN	RESULTS (uV/m) @ 3m	PEAK FCC LIMITS (uV/m) @ 3m
1.226	-31.98	-6.2	2743.1	5000
1.838	-42.01	-2.8	1285.0	5000

SAMPLE CALCULATIONS:

RESULTS uV/m @ 3m = Antilog ((-31.98 – 6.2 + 107)/20) = 2743.1
CONVERSION FROM dBm TO dBuV = 107 dB

Test Results
Signature:  **Name: David Blethen**

TABLE 4b

FIELD STRENGTH OF SPURIOUS EMISSIONS

Test Date: December 6, 2002
UST Project: 02-0396
Customer: Data Critical Corporation
Model: DR-10100

Average Measurements (High Channel, Patch Antenna)

FREQ. (GHz.)	TEST DATA (dBm) @ 3m*	ANTENNA FACTOR + CABLE ATTENUATION - AMP GAIN	RESULTS (uV/m) @ 3m	AVERAGE FCC LIMITS (uV/m) @ 3m
1.226	-57.98	-6.2	137.5	500
1.838	-68.01	-2.8	64.4	500

*** - Readings adjusted by duty cycle = 20 log (0.05) = -26.0 dB**

SAMPLE CALCULATIONS:

RESULTS uV/m @ 3m = Antilog ((-57.98 - 6.2 + 107)/20) = 137.5
CONVERSION FROM dBm TO dBuV = 107 dB

Test Results Signature: _____ **Name:** David Blethen

FIGURE 3

SPURIOUS EMISSIONS 15.242(c)

Plots Not Available

Radiated Digital Device Emissions (47 CFR 15.109a)

Radiated emissions were evaluated from 30 MHz to 6.5 GHz with the EUT set to a receive mode of operation. Measurements were made with the analyzer's bandwidth set to 120 kHz for measurements below 1 GHz and 1 MHz for measurements above greater than or equal to 1 GHz. Results of these emissions are shown in Tables 5a and 5b.

TABLE 5a

CLASS B
RADIATED EMISSIONS

Test Date: November 27, 2002
UST Project: 02-0396
Customer: Data Critical Corporation
Model: DR-10100

Measurements 30 MHz – 1 GHz

FREQ. (MHz)	TEST DATA (dBm) @ 3m	ANTENNA FACTOR + CABLE ATTEN.	RESULTS (uV/m) @ 3m	LIMITS (uV/m) @ 3m	MARGIN BELOW LIMIT (dB)
120	-96.0	14.9	19.7	150.0	17.6
320	-80.0	18.5	187.9	200.0	0.5
340	-80.5	19.1	191.0	200.0	0.4
355	-84.0	19.5	133.7	200.0	3.5
440	-84.0	22.1	179.9	200.0	0.9
500	-86.0	23.5	167.9	200.0	1.5

Note: All measurements above are Quasi-Peak measurements. All data is listed for the worse case configurations with the monopole.

SAMPLE CALCULATIONS:

RESULTS uV/m @ 3m =
Antilog ((-96.0 + 14.9 + 107)/20) = 19.7
CONVERSION FROM dBm TO dBuV = 107 dB

Test Results
Signature:  **Name: David Blethen**

TABLE 5b

CLASS B
RADIATED EMISSIONS

Test Date: November 27, 2002
UST Project: 02-0396
Customer: Data Critical Corporation
Model: DR-10100

Peak Measurements >1 GHz

FREQ. (GHz)	TEST DATA (dBm) @ 3m	AMP GAIN (dB)	ANT. FACTOR (dB)	CABLE LOSS (dB)	RESULTS (uV/m) @ 3m	FCC LIMITS (uV/m) @ 3m	MARGIN BELOW LIMIT (dB)
1.25015	-52.9	35.3	26.3	2.8	249.0	5000	26.1

Note: Since the peak measurements met with average limits (500 uV/m), average measurements were not performed.

SAMPLE CALCULATIONS:

RESULTS uV/m @ 3m =
Antilog ((-52.9 - 35.3 + 26.3 + 2.8 + 107)/20) = 249.0
CONVERSION FROM dBm TO dBuV = 107 dB

Test Results
Signature:  **Name: David Blethen**

Power Line Conducted Emissions for Digital Device, Transmitter, and Receiver (FCC Section 15.207 & 15.107)

The conducted voltage measurements have been carried out in accordance with FCC Section 15.207/15.107, with a spectrum analyzer connected to a LISN and the EUT placed into an continuous transmit or a continuous mode of receive. Since no difference was noted due to transmit or receive operation, only one set of results is shown. The results are given in Tables 6a - 6b.

TABLE 6a

CONDUCTED EMISSIONS DATA

CLASS B

UST Project: 02-0396
Customer: Data Critical Corporation
Model: DR-10100

PHASE MEASUREMENT (Peak/QP versus Average Limits)

FREQ. (MHz)	TEST DATA (dBuV) PHASE	LISN LOSS (dB) PHASE	CABLE FACTOR (dB)	RESULTS (dBuV) PHASE	EN55022 CLASS B LIMITS (uV)	MARGIN BELOW LIMIT (dB) PHASE
0.20	46.0	0.2	0.1	46.3	53.7	7.4
9.49	36.6	0.1	0.5	37.2	50.0	12.8
11.17	33.8	0.1	0.5	34.5	50.0	15.5
11.27	34.4	0.1	0.5	35.1	50.0	14.9
11.45	34.0	0.1	0.5	34.6	50.0	15.4
27.22	36.4	0.1	0.8	37.3	50.0	12.7

*** - Note: CISPR limits have been applied since they are deemed worse case**

SAMPLE CALCULATIONS:
RESULTS dBuV = Antilog ((46.0 + 0.2 + 0.1) = 46.3

Test Date: December 6, 2002

Tested Results
Signature: David R. Blethen **Name: David Blethen**

TABLE 6b

CONDUCTED EMISSIONS DATA

CLASS B

UST Project: 02-0396
Customer: Data Critical Corporation
Model: DR-10100

NEUTRAL MEASUREMENT (Peak/QP versus Average Limits

FREQ. (MHz)	TEST DATA (dBuV) PHASE	LISN LOSS (dB) PHASE	CABLE FACTOR (dB)	RESULTS (dBuV) PHASE	EN55022 CLASS B LIMITS (uV)	MARGIN BELOW LIMIT (dB) PHASE
0.20	45.0	0.2	0.1	45.3	53.6	8.3
4.05	34.3	0.1	0.3	34.7	46.0	11.3
4.15	34.3	0.1	0.3	34.7	46.0	11.3
4.74	34.5	0.1	0.4	34.9	46.0	11.1
11.45	31.6	0.1	0.5	32.3	50.0	17.7
26.97	37.5	0.1	0.8	38.4	50.0	11.6

*** - Note: CISPR limits have been applied since they are deemed worse case**

SAMPLE CALCULATIONS:
RESULTS dBuV = Antilog ((45.0 + 0.2 + 0.1) = 45.3

Test Date: December 6, 2002

Tested Results
Signature: David R. Blethen **Name: David Blethen**

Emissions Type (47 CFR Section 95.631(i), 95.1115(c), and 95.1117)

A wireless medical telemetry device may transmit any emission type appropriate for communications in this service, except for video and voice. Waveforms such as electrocardiograms (ECG's) are not considered video.

Basic Description of Transmitter Emissions
The EUT utilizes spread spectrum (frequency hopping) type technology and GFSK (Gaussian filtered, Frequency Shift Keying) as its modulation approach.

Frequency Stability (47 CFR Section 95.1115(e))

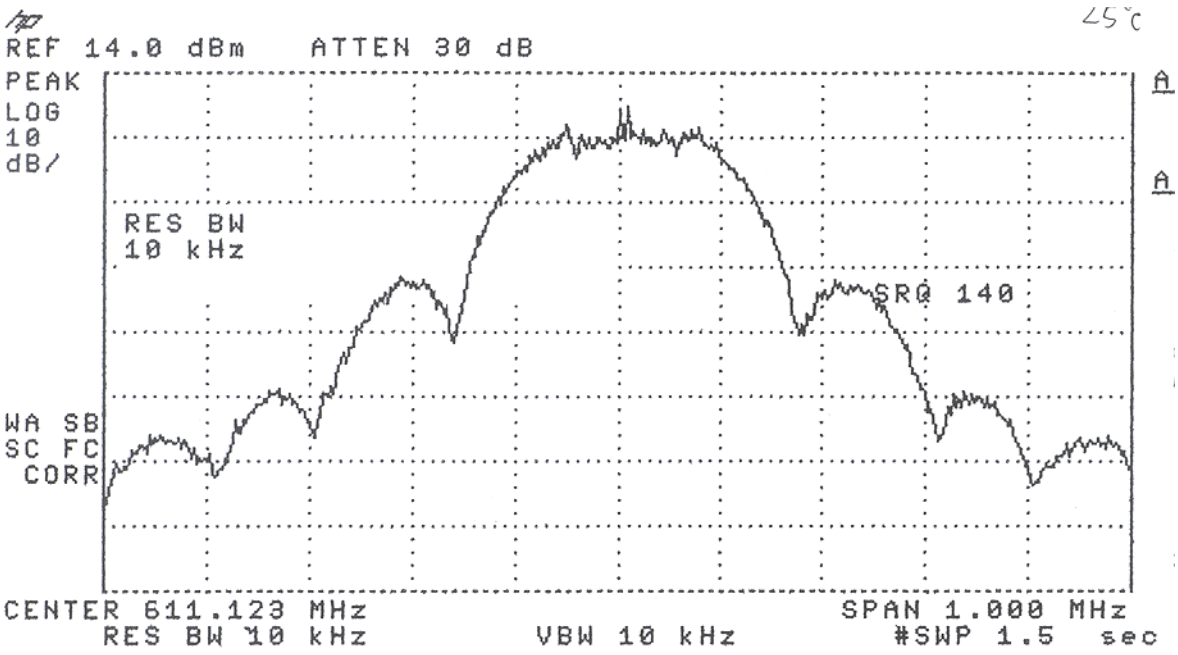
Manufacturers of wireless medical telemetry devices are responsible for ensuring frequency stability such that an emission is maintained within the band of operation under all of the manufacturer's specified conditions.

According to the manufacturer, the frequency drift of the transmitter is +/- 30 ppm over a temperature range of –20 to + 70 degrees C. This value was determined by the crystal used (manufacturers data) to stabilize the frequency synthesizer. The +/- 30 ppm corresponds to an actual frequency drift of +/- 18.33 kHz.

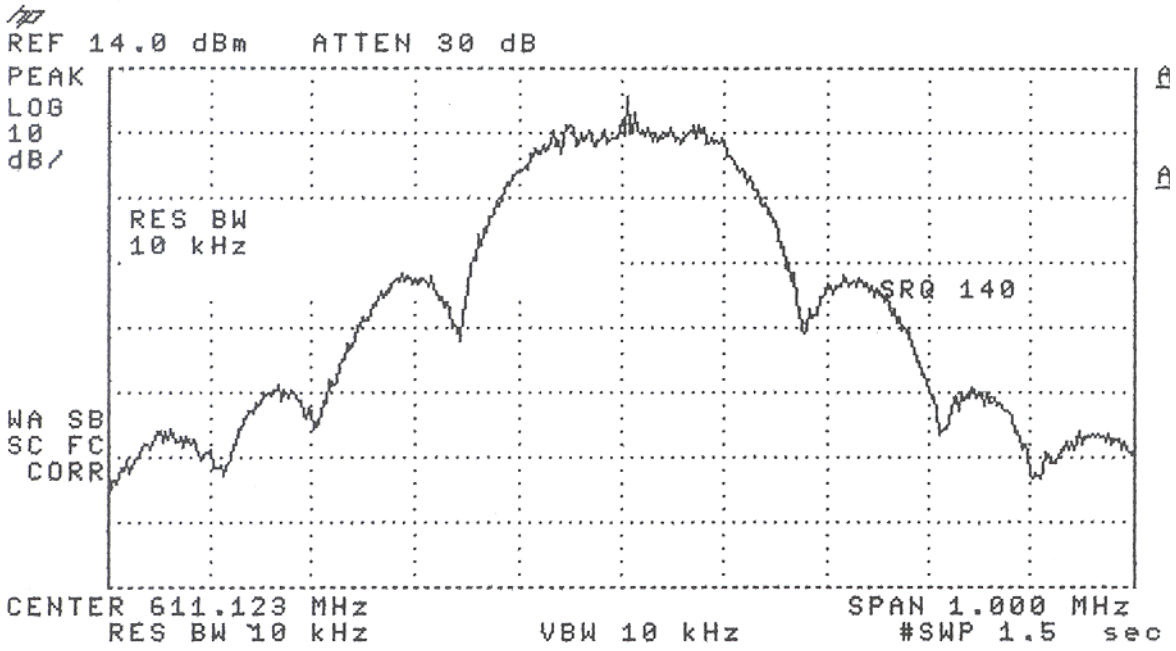
The following plots were provided by the manufacturer to show the fundamental under various conditions.

1) 25 degrees C temperature with supply voltage set to 85% of nominal
2) 25 degrees C temperatore with supply voltage set to 115% of nominal
3) nominal supply voltage and –20 degrees C
4) nominal supply voltage and –10 degrees C
5) nominal supply voltage and 0 degrees C
6) nominal supply voltage and 10 degrees C
7) nominal supply voltage and 20 degrees C
8) nominal supply voltage and 30 degrees C
9) nominal supply voltage and 40 degrees C
10) nominal supply voltage and 50 degrees C

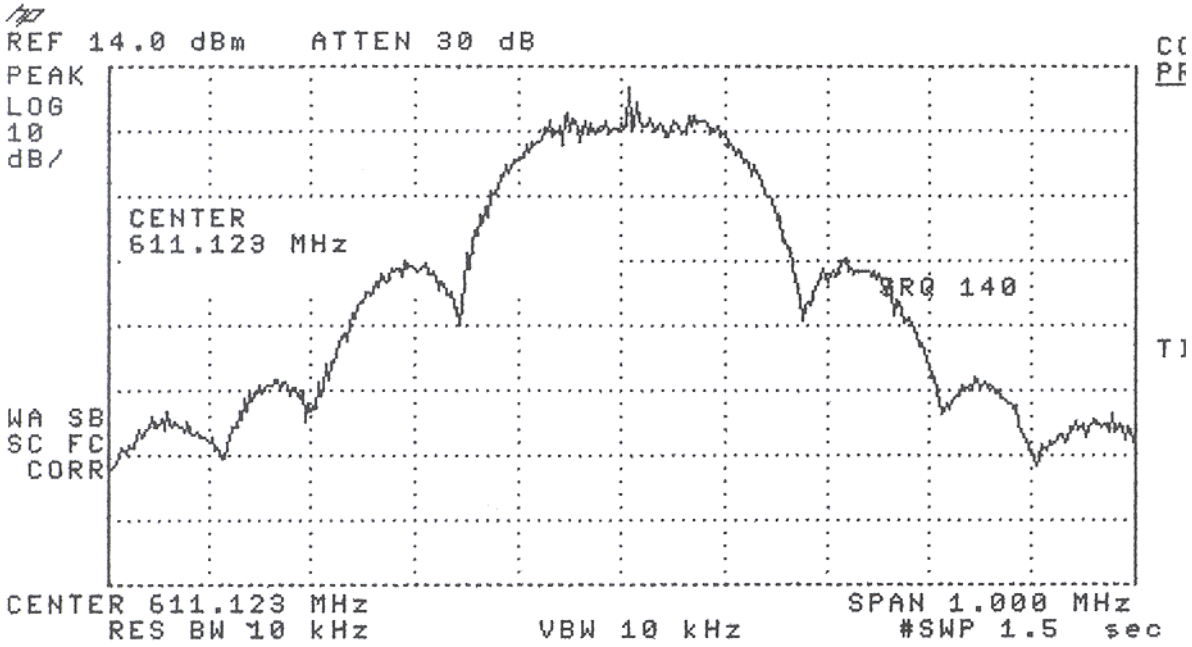
PLOT 1
(25 degrees C temperature with supply voltage set to 85% of nominal)



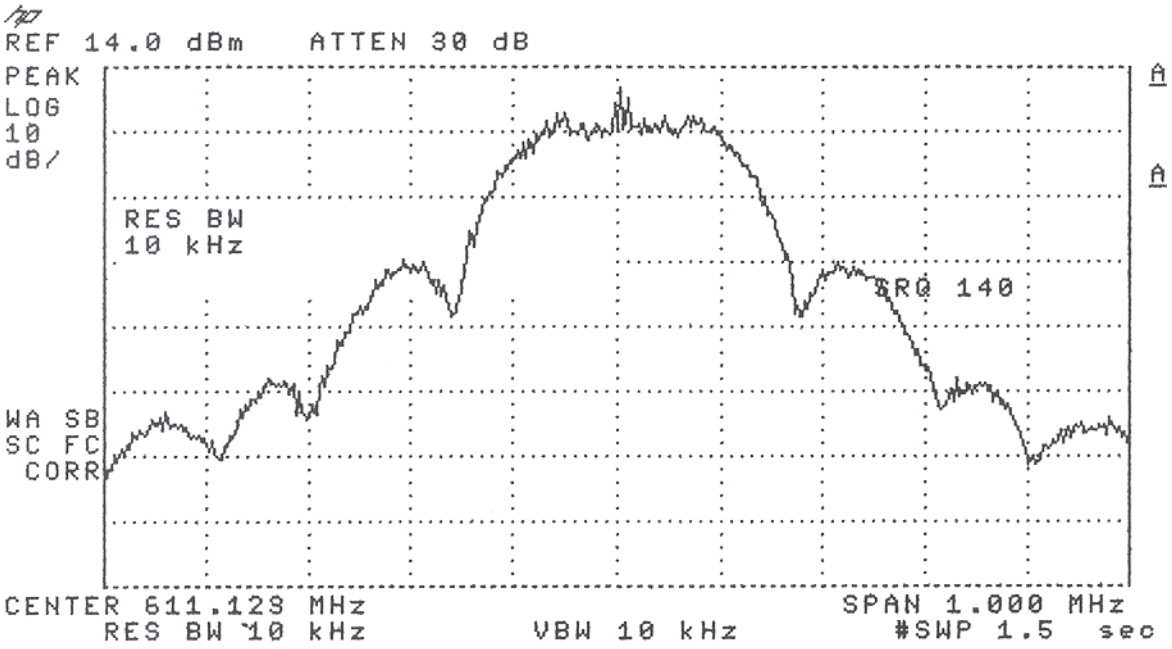
PLOT 2
(25 degrees C temperatore with supply voltage set to 115% of nominal)



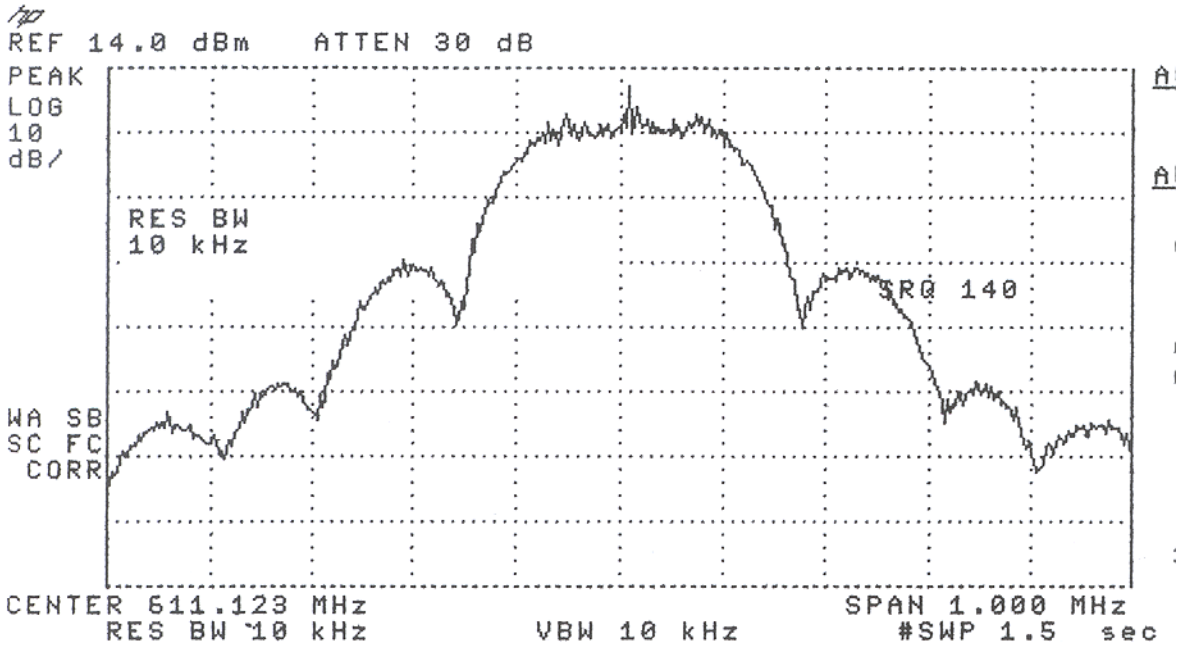
PLOT 3
(nominal supply voltage and –20 degrees C)



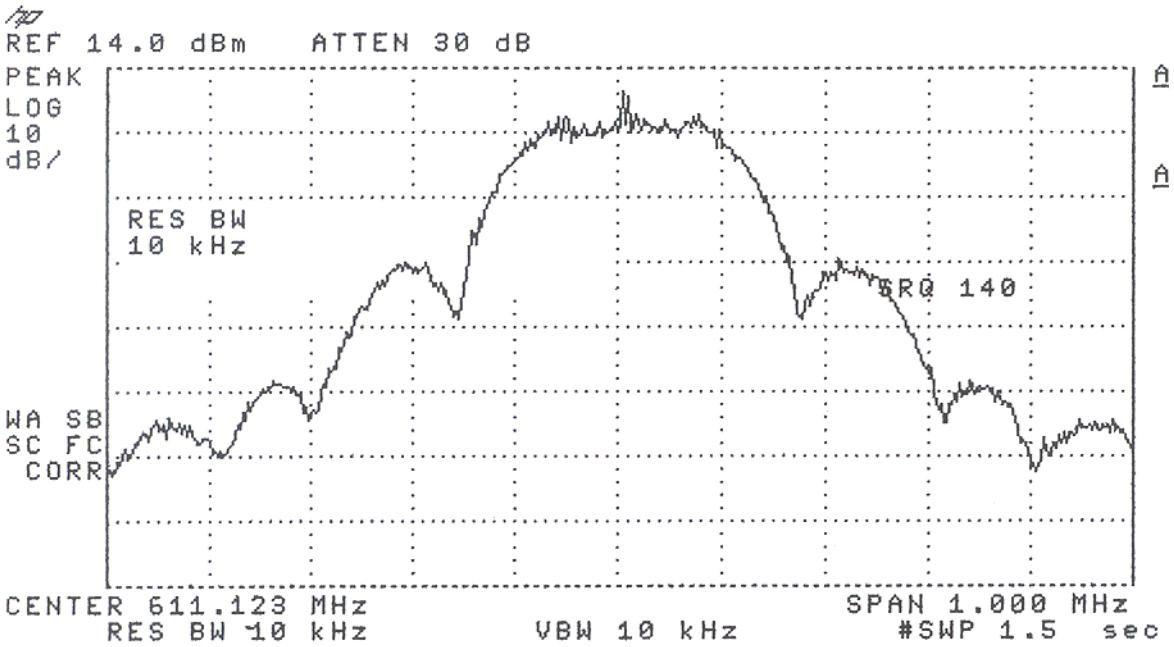
PLOT 4
(nominal supply voltage and –10 degrees C)



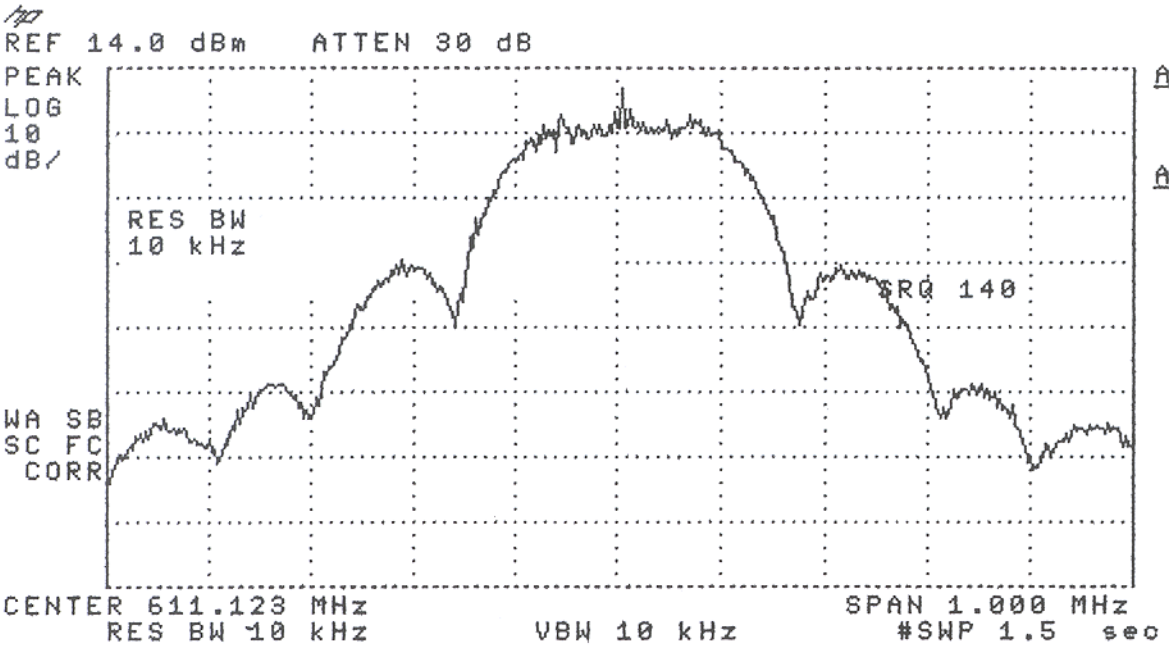
PLOT 5
(nominal supply voltage and 0 degrees C)



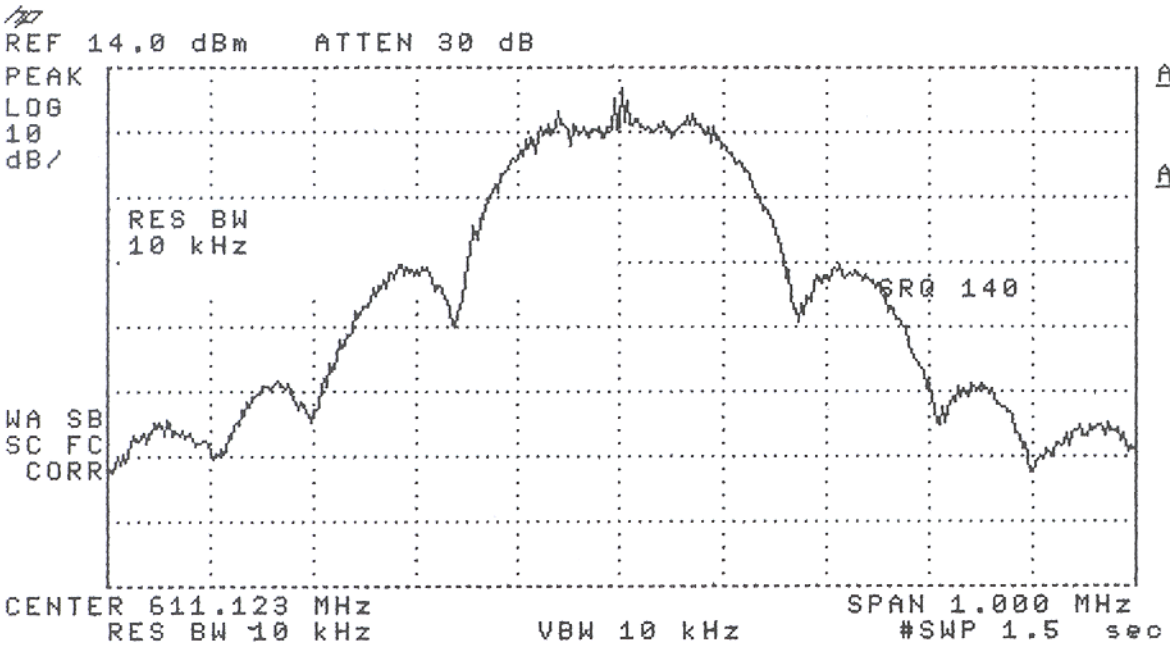
PLOT 6
(nominal supply voltage and 10 degrees C)



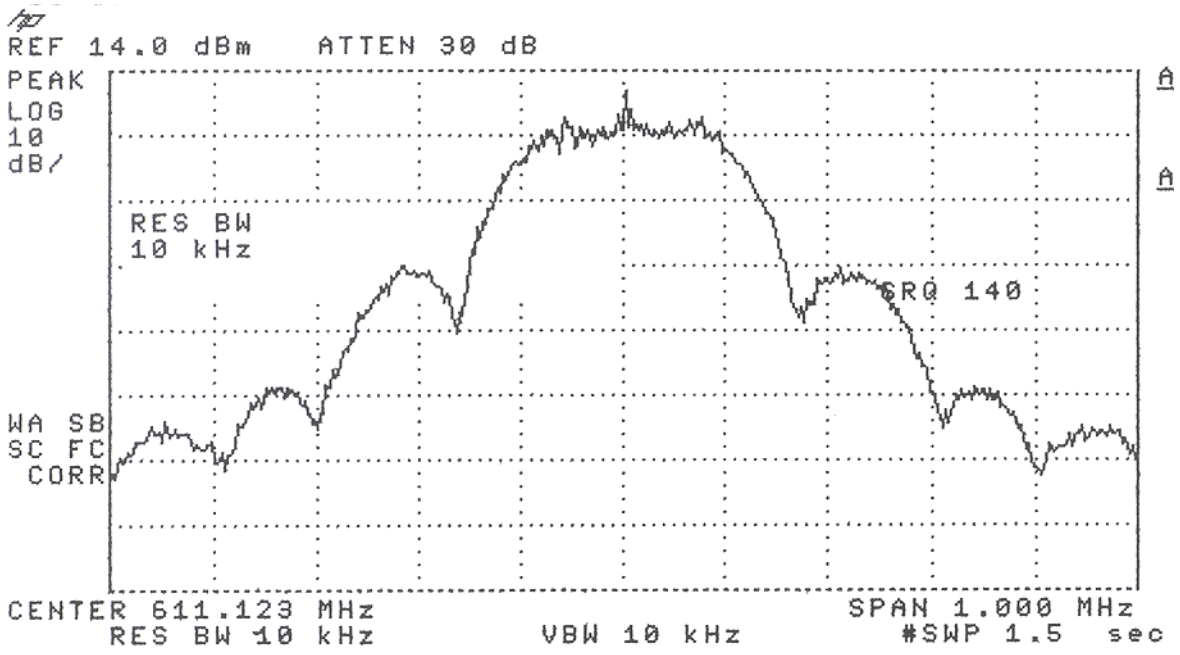
PLOT 7
(nominal supply voltage and 20 degrees C)



PLOT 8
(nominal supply voltage and 30 degrees C)



PLOT 9
(nominal supply voltage and 40 degrees C)



PLOT 10
(nominal supply voltage and 50 degrees C)