Antenna Design Specification
Embedded Antenna
For Mobicom Firefly

Ethertronics Project

Part Number: GZ04001

ethertronics
shaping antenna technology™

ANTENNA SPECIFICATION
Part Number: GZ04001
Rev. B

CONTENTS

1. Purpose and Scope

The purpose of this document is to establish a design specification for the antenna product that Ethertronics is developing for the Mobicom Firefly wireless handset. This specification is preliminary. Any changes or additions to this specification can affect schedule and/or cost or the product and should be negotiated between Ethertronics and Mobicom before being incorporated into the specification. Upon agreement of this specification, Ethertronics will make no changes without the written approval from Mobicom. Any changes requested by Mobicom will be given to Ethertronics with sufficient time to evaluate the cost impact and react as required. The development of the product at Ethertronics is conducted in accordance to the QSP-7.3.101.

2. Related Document

QSP-7.3.101 Product Design

3. Abbreviations and Definitions

AVG	Average
°	Degree
˚C	Celsius (degrees Centigrade)
cm	Centimeter
G	Gravitational Force
g	Grams
Hz	Hertz
In	Inches
MHz	Megahertz
m	Meter
mm	Millimeter
N	Newton
PCB	Printed Circuit Board
TX	Transmit Band
RH	Relative Humidity
RX	Receive Band
VSWR	Voltage Standing Wave Ratio
W	Watt

Design specification: A preliminary target specification to guide design process.
Product Specification: A final specification for the qualified product.

4. Description and Part Numbers

1.1. Description

This antenna is an embedded cellular type. The antenna is designed to be affixed to the rear housing enclosure by a heat stake process. Contact to the PCB is obtained through use of spring contacts.

1.2. Part Number

Ethertronics Part Number	Frequency Bands	
GZ04001	GSM 850	PCS
	824-894 MHz	1850-1990 MHz

1.3. Rating

Operating Temperature	-30˚ C to 90˚ C
Storage Temperature	5˚ C to 35˚ C – condition1 * -40˚ C to 90˚ C – condition 2 *
Input power	2 W max

***** See condition information in paragraph 10.1 2) a)

1.4. Antenna Dimension

Length	Width	Height
21.7mm	32.4 mm	7.3 mm

For more dimension details see attached part drawing GZ04001.

5. Electrical Specifications

1.5. Frequency Band

Mode	Frequency Band
GSM 850	824-894 MHz
US PCS	1850-1990 MHz

1.6. Electrical Characteristics

Center Frequencies in assembled phone	**6.**	**7. 1810 MHz**	**1.7. Impedance**	50 Ohm
Bandwidth (@ VSWR=4:1)	**8.**	**9. 120 MHz**	**Polarization**	**10.Linear**
Frequency at Minimum Return Loss on Test Fixture*	**11.**	**12.1670MHz**		**13.**

1.8. Matching Requirements

In order to assure the best performance of the antenna, the matching will be evaluated in free space and in talk position. The antenna will comply with the Electrical Specification requirements, as set out below, while mounted on the handset containing the PCB. The handset and PCB are to be provided by the customer and should be representative of the latest design version of all parts. Any modifications in the handset or PCB can affect the performance of the antenna and should be discussed with Ethertronics to determine the affect of such changes on the antenna performance and delivery requirements.

1.9. VSWR

13.1.1. Requirements in free space

Mode	TX	RX
GSM 850	8:1	8:1
US PCS	4:1	4:1

Transmit Band for antenna mounted on the phone (Herein designated TX) in MHz:

Mode	TX - start	TX - stop
GSM 850	824	849
US PCS	1850	1910

Receive Band for the antenna mounted on the phone (Herein designated RX) in MHz:

Mode	RX - start	RX - stop
GSM 850	869	894
US PCS	1930	1990

13.1.2. Test Method (Design Engineering)

The VSWR measurement of antennas heat staked to the enclosure and assembled into a fully operating Firefly phone handset is measured on the Network Analyzer. The handset is set up with a 50 Ohm coaxial cable connected to the 50 Ohm point. Calibration is done at the end of the 50 Ohm coaxial cable connection. The other end of the 50 Ohm coaxial cable is connected to a network analyzer. The handset is positioned on a non-conductive table for free space measurements.

Figure 1: Test of Antenna in Phone.

1.10. Gain

Plane		Gain (dBi)			
		GSM850 (860MHz)		PCS (1920 MHz)	
		AVG	PEAK	AVG	PEAK
	Phi = 0	-7.52dBi	-5.04 dBi	-7.59dBi	-4.02dBi
	Phi = 90	-5.37dBi	-4.04 dBi	-6.46dBi	-3.86dBi
	Theta = 90	-7.35 dBi	-3.73dBi	-7.59dBi	-5.10dBi

13.1.3. Gain Values

* Gain Measure Conditions
See figure below for mounting geometry
† All Measurements are performed at the center frequencies.

13.1.4. Test Methods

Antennas tested for Gain and Efficiency must be heat stake mounted to the enclosure and tested in the fully assembled and operating Firefly handset. The antenna is tested in free space in the 3D anechoic chamber. The radiation patterns are measured at the edges and center of the combined transmit and receive bands.

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Figure 2: Test of phone in Anechoic Chamber.

1.11. Power Rating

13.1.5. Requirements

Maximum value: 2 W

13.1.6. Test Method

The antenna is connected to the handset enclosure as described in 5.4.2. A power of 2 W is applied to the antenna for a period of 30 min. at room temperature (+20° +/- 3° C). The antenna shall satisfy electrical requirements in 5.4.1 after the test and have no visible deterioration.

14.Mechanical Specifications

1.12. Mechanical Configuration

The appearance of the antenna is according to the drawing GZ04001.
See GZ04001 customer part drawing.

1.13. Connection

14.1.1. Type

Spring contact.

14.1.2. Material

Phosphor Bronze – C52100 Spring Hard 0.2 mm thick, Gold plated with nickel undercoat.

1.14. Mechanical Test Methods

Ethertronics performs the following mechanical and reliability testing on antenna families (G series). Each part number is passed by design similarity to tested sample.

Item		Specification	Test Method
Vibration resistance	Visual	No evidence of mechanical damage	Antenna shall be measured after being applied vibration of 20G acceleration from 10-2,000Hz vibration frequency in 3 orthogonal directions for 30 minutes each (3, 10 minute sweeps).
	△ R/R	+/- 0.5% of the initial value	
Random drop	Visual	No evidence of mechanical damage	Drop height: 1.5 m Drop angle : 45 ˚/ 90 ˚ Drop cycle : each 5 times Weight : 150 g
	△ R/R	+/- 0.5% of the initial value	
Spring contact	Visual	No evidence of mechanical damage	Measure reaction force at 0.8 mm nominal deflection 10 times.
	Mechanical	Minimum 1 +/- 0.5 N of force required for deflection.	

* △ R/R is a shift ratio of the center frequency

14.1.3. Vibration Resistance Test

Place antennas mounted into the rear housing (enclosure) onto the vibration table. Vibration will be applied with 3, 10 minute sweeps, 10-2,000Hz 20 G at 0.06 in. double amplitude maximum displacement. Then remove antennas and housing together from the vibration table and for measurements.

Post Test Requirements: There will be no evidence of mechanical damage. Electrical characteristics should be within +/-0.5% of their initial value.

14.1.4. Drop Test

The antenna will be attached to a dummy weighted radio (150 g). It should be dropped from a height of 1.5 m. The drop will be done at two different angle, 5 drops at ~45°, and 5 drops from ~90°. The antenna shall satisfy the electrical specifications 5.4.1 after the test. The antenna should function mechanically after the test. Temperature of the environment will be+24°C +/- 3°C.
Post Test Requirements: There will be no evidence of mechanical damage. Electrical characteristics should be within +/-0.5% of their initial value.

14.1.5. Spring Contact Test

Measure reaction force of the antenna spring contacts at 0.8 mm nominal deflection 10 times.

Post Test Requirements: There will be no evidence of mechanical damage. Minimum 1 +/- 0.5 N of force required for deflection.

1.15. Environmental Specification

Item		Specification	Test Method
Heat resistance	Visual	No evidence of mechanical damage	Dwell in 90 +/- 2° C chamber for 96 hours then stabilize at room temperature for measurement.
	△ R/R	+/- 0.5% of the initial value	
Temperature cycle	Visual	No evidence of mechanical damage	Perform 10 cycles as follows: -40 +/- 2° C for 30 minutes 90 +/- 2° C for 30 minutes
	△ R/R	+/- 0.5% of the initial value	
Moisture resistance	Visual	No evidence of mechanical damage	Dwell in test chamber at +65° C and 90 to 95% RH for 96 hours and then stabilize at room temperature for measurement.
	△ R/R	Minimum 1 +/- 0.5 N of force required for deflection.	
Corrosion (IEC 68-2-11)	Visual	No evidence of mechanical damage	Exposed to 5% sodium atmosphere at +35° C for 96 hours.
	△ R/R	Minimum 1 +/- 0.5 N of force required for deflection.	

△ R/R is a shift ratio of the center frequency

1.16. 7.1 Heat Resistance Test

Place the antennas in an environmental chamber at +90°C +/- 2°C for 96 hours. Then remove antennas from chamber and all to stabilize at room temperature before measurement.

Post Test Requirements: There will be no evidence of mechanical damage. Electrical characteristics should be within +/-0.5% of their initial value.

1.17. Temperature Cycling Test

Place the antennas in an environmental chamber. Set temperature cycles between -40˚C +/- 2˚C for 30 minutes and +90˚C +/-2˚C for 30 minutes. Complete this cycle 10 times. Then remove antennas from chamber and all to stabilize at room temperature before measurement.

Post Test Requirements: There will be no evidence of mechanical damage. Electrical characteristics should be within +/-0.5% of their initial value.

1.18. Moisture Resistance Test

Place the antennas in an environmental chamber set at +65˚C and 90% RH for 96 hours. Then remove antennas from chamber and all to stabilize at room temperature before measurement.

Post Test Requirements: There will be no evidence of mechanical damage. Electrical characteristics should be within +/-0.5% of their initial value.

1.19. Corrosion (Salt Spray) Test

Place the antennas into the Corrosion (Salt Spray) environmental chamber with 5% sodium atmosphere at 35˚C for 96 hours. Then remove antennas from chamber and all to stabilize at room temperature before measurement.

Post Test Requirements: There will be no evidence of mechanical damage. Electrical characteristics should be within +/-0.5% of their initial value.

15. Qualification

The mechanical and environmental tests mentioned above are performed according to Property Verification Flow chart shown in Figure 1 below. The entire testing procedure will be conducted according to PQS- 003. A summary report of the results of the tests will be sent to the customer. Ethertronics will not start mass production until the customer grant the product a qualified status.

16.Packaging

The antennas will be packed in compartmentalized vacuum formed trays. The trays are packed in a corrugated cardboard box. The box will be labeled for shipping according to the standards outlined in EIA-STD-556 (See attached packaging specification)

The label should provide the following information:

- Supplier Address
- Customer Address
- Packing Count
- Packing Weight
- Ship Date
- Ship Number
- Sales Order Number
- Vendor's Part Number
- Packing Identification (Bar Code)
- Special (Bar Code)
- Transaction Identification (Bar Code)
- Customer Product Identification (Bar Code)

17.Caution for Use

1.20. 10.1 Storage

1) Please keep the product away from high temperature and high humidity.

2) Please keep product away from corrosive gases such as hydrogen sulfide, sulfurous acid, chlorine, ammonia, etc…. The acid could cause the metal antenna to corrode degrading antenna performance.

a) <u>Storage condition 1</u>
Temperature: 5 to 35˚C
Humidity: 45 to 75% RH
Period: 6 months from date of packaging

b) <u>Storage Condition 2</u>
Temperature: -40 to 90˚C
Humidity: 96% RH max
Period: 96 hours

1.21. Handling

1) Since the antenna has a spring contact it is important not to bend or push on the spring as it will degrade the spring response and could cause poor contact.
2) It is important to handle the antenna carefully and bending or dents made into the metal will cause the antenna to detune and could cause performance issues.
3) Please do not touch product directly with bare hands. This will put fingerprints on the antennas and the acids in the hand will cause the antenna to discolor. While this will not have a performance effect it does have a cosmetic effect on the part.

1.22. Production Site

Volume production manufacturing of the product is provided by Xianduan Precision Ltd. in Shenzhen, China. The manufacturer is ISO 9002 registered and has been audited and qualified by Ethertronics.

1.23. Property Verification Test Flowchart

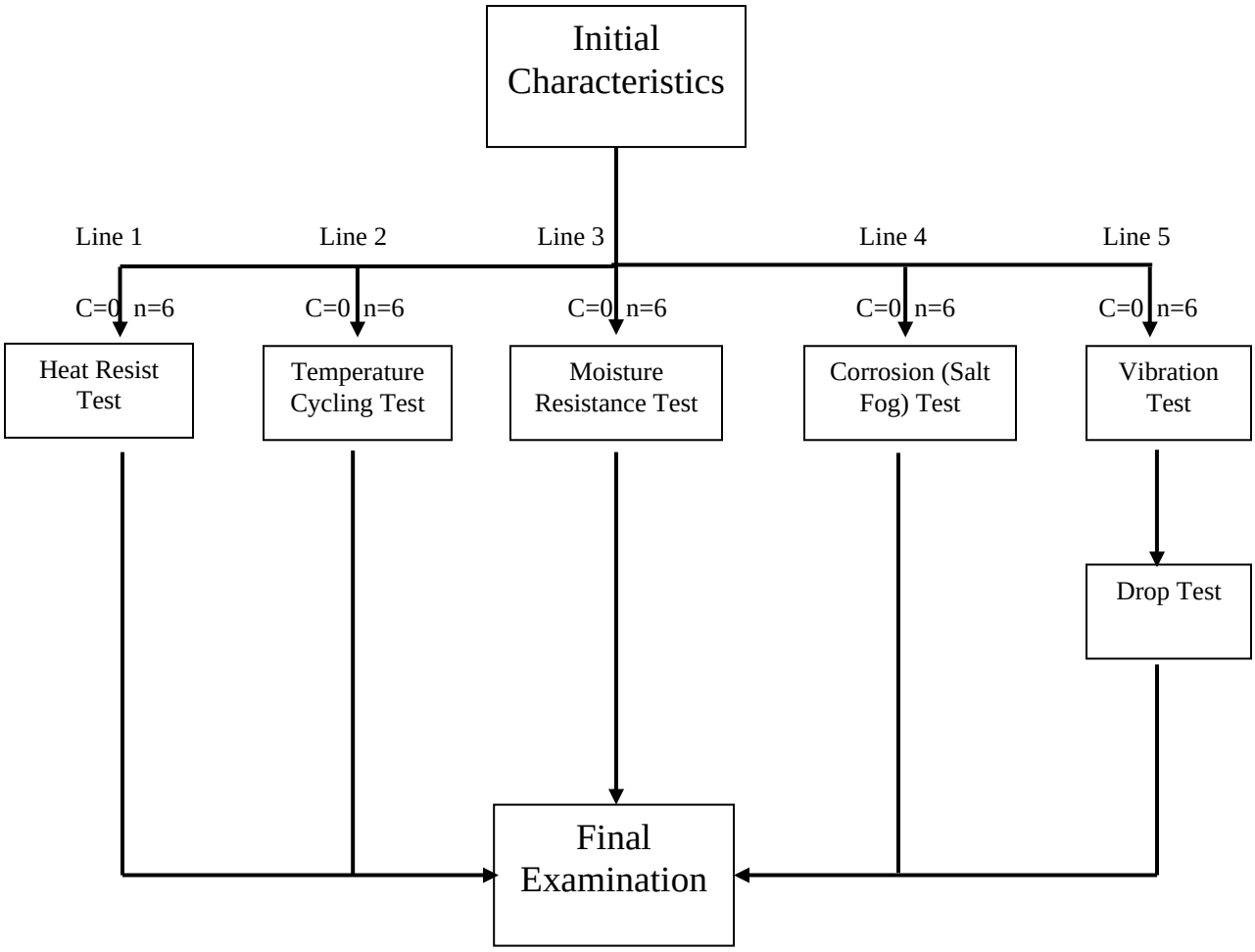
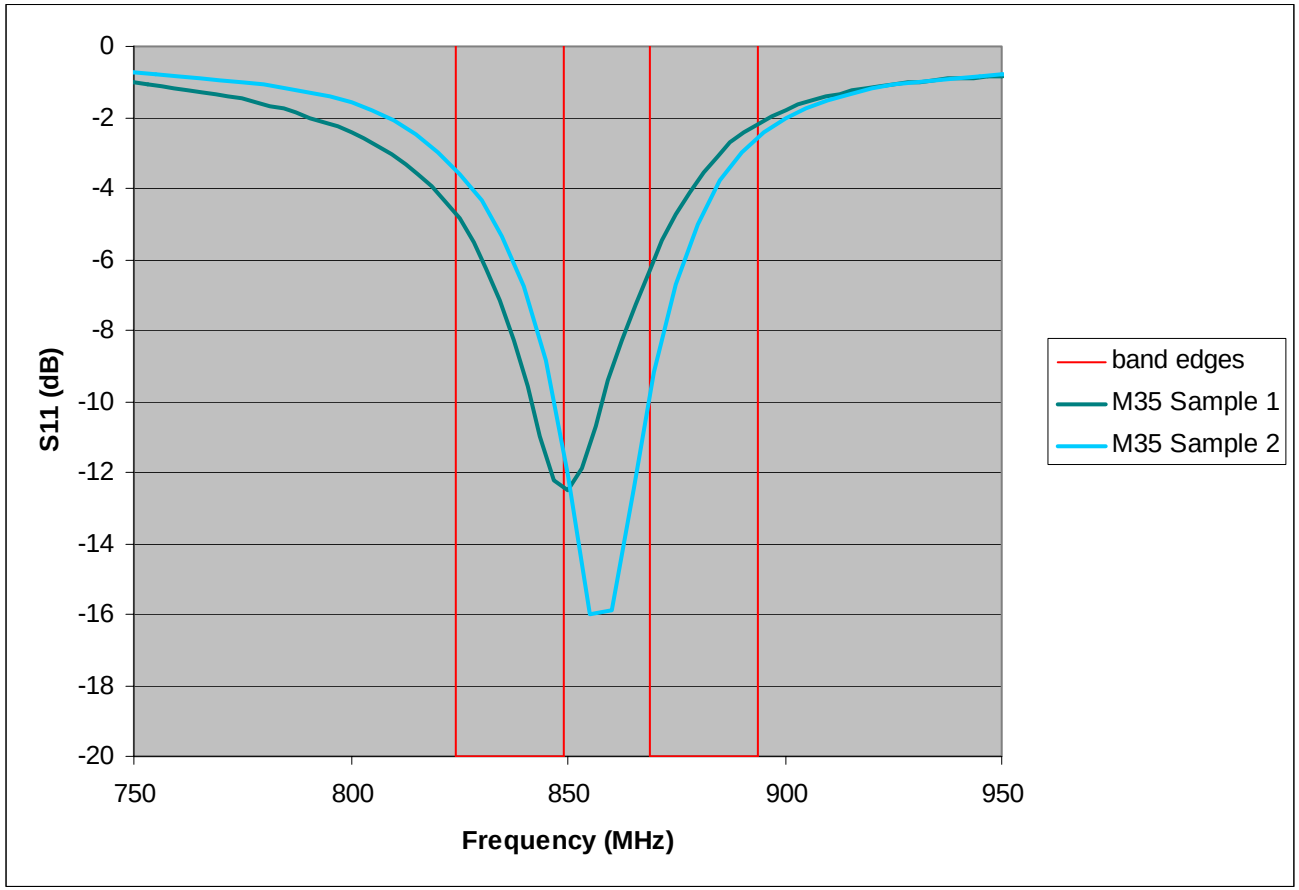


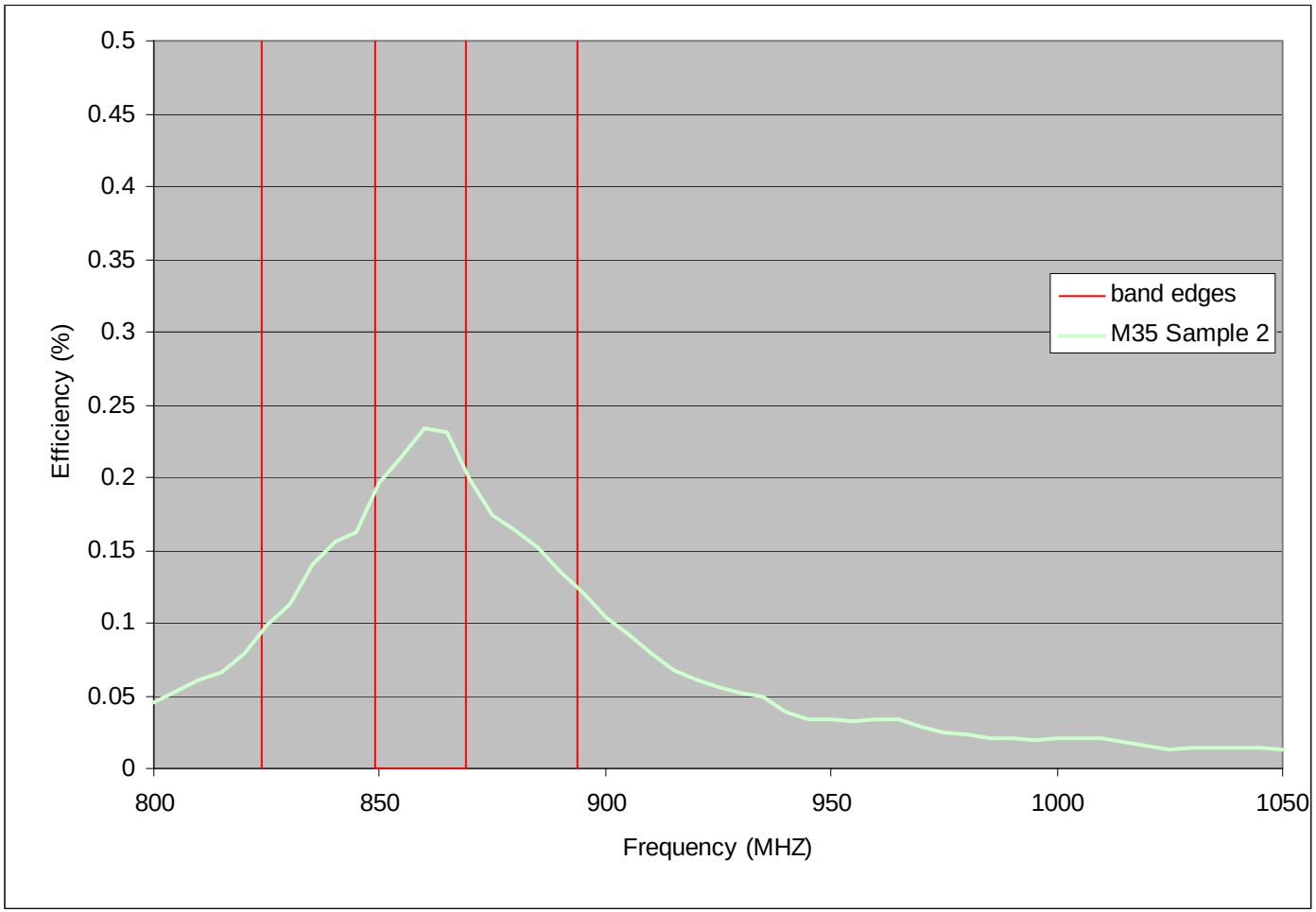
Figure 3: Property Verification Test Flow Chart

Allowed amount of failures after every test line c=0; Sample size n=6

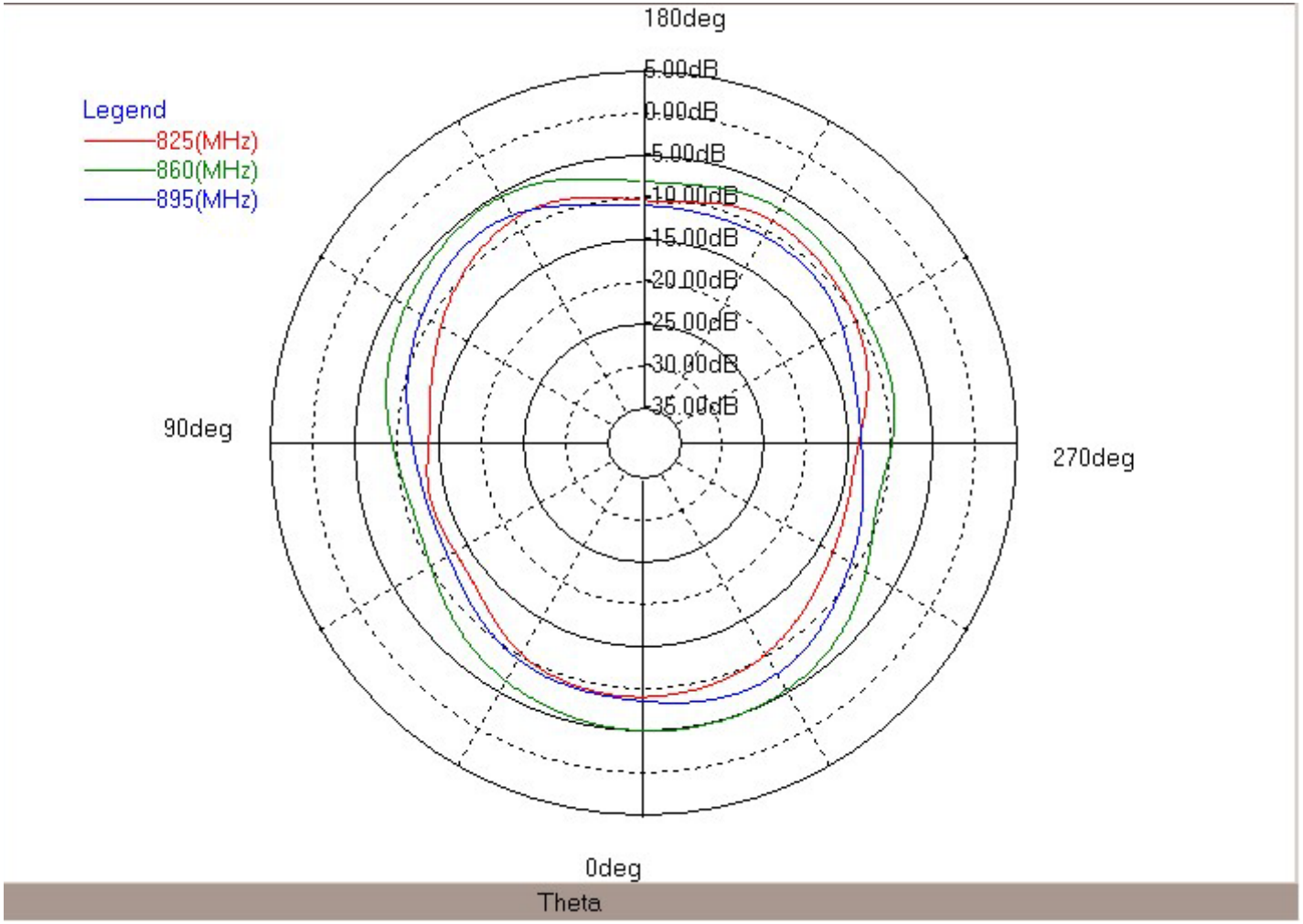
Test Performed: Return Loss measurement Low Band
Test Condition: Antenna mounted in MOBICOM Firefly phone free space



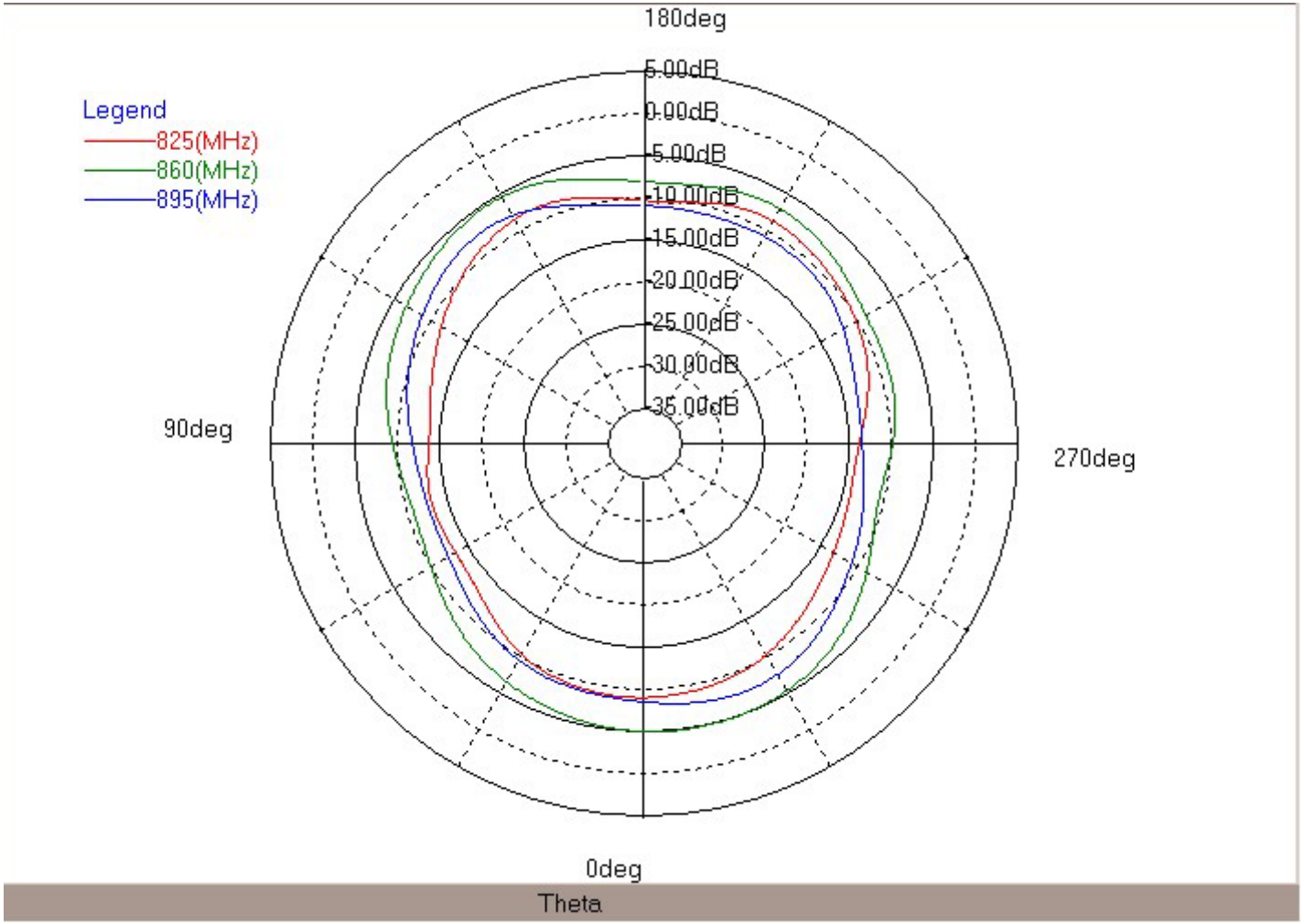
Test Performed: Efficiency in Free Space.
Test Condition: Antenna mounted in MOBICOM Firefly phone: Low band



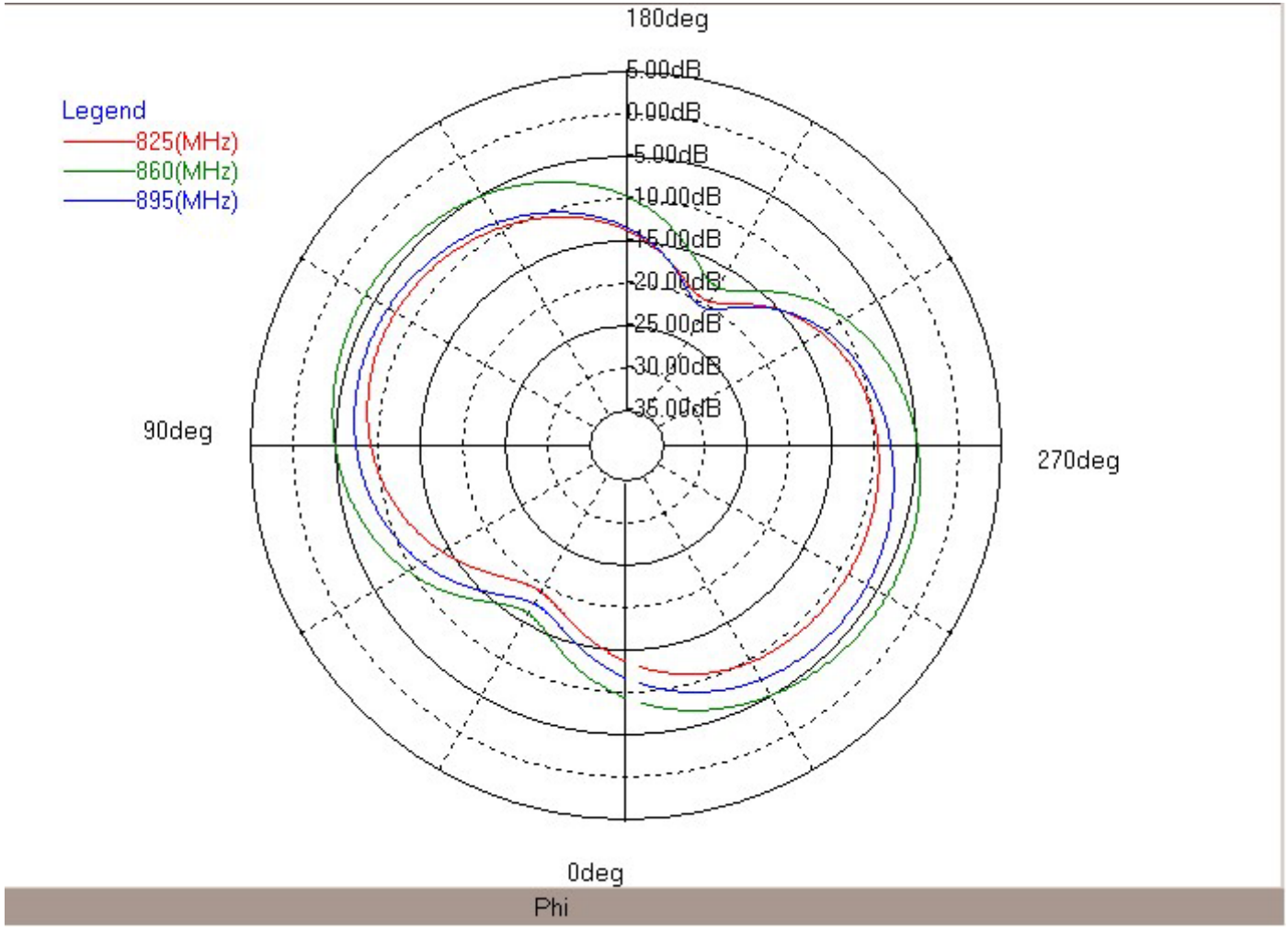
Test Performed: Radiation Pattern in Free Space.
Test Condition: Antenna mounted on MOBICOM Firefly phone: Low Band
Phi = 0 Plane



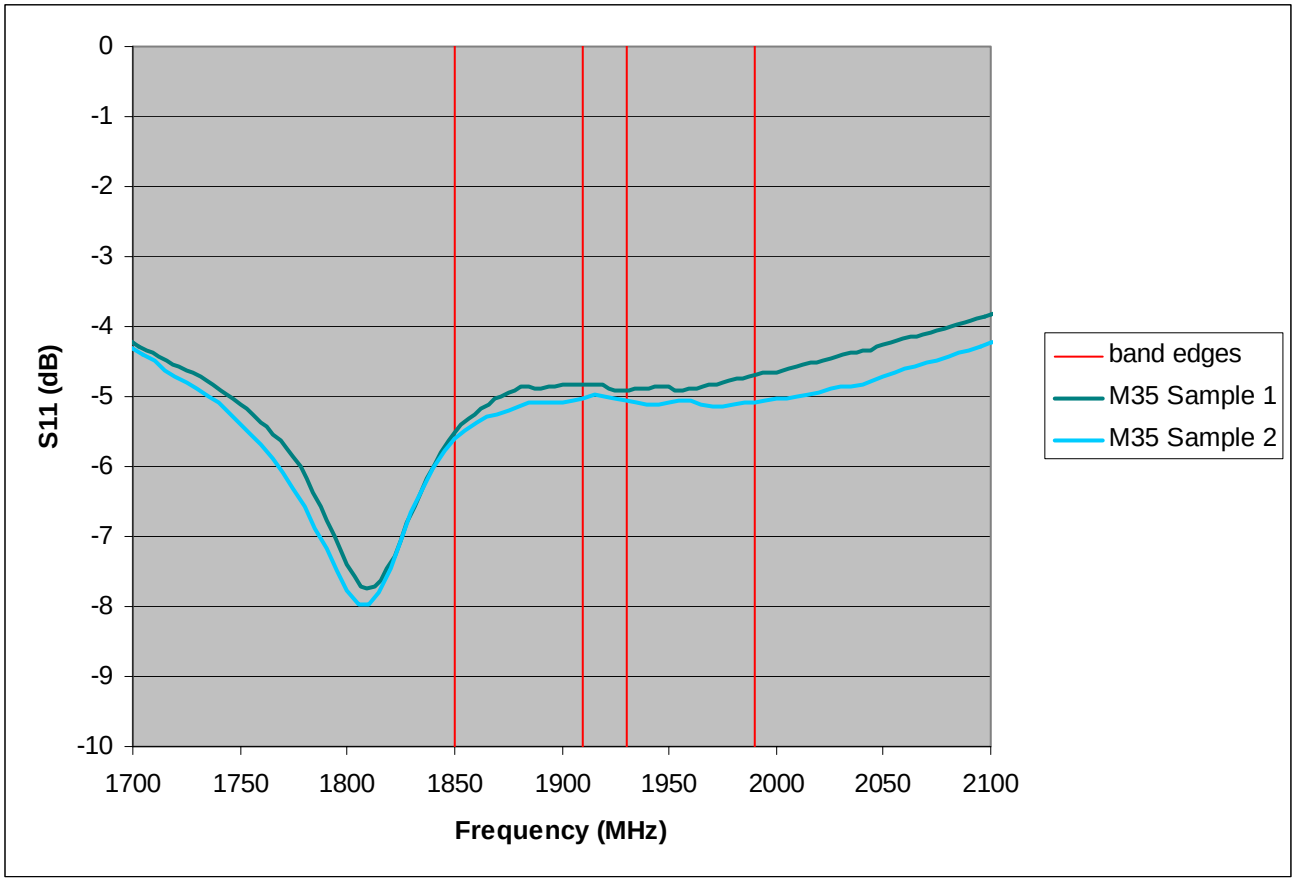
Test Performed: Radiation Pattern in Free Space.
Test Condition: Antenna mounted on MOBICOM Firefly phone: Low Band
Phi = 0 Plane



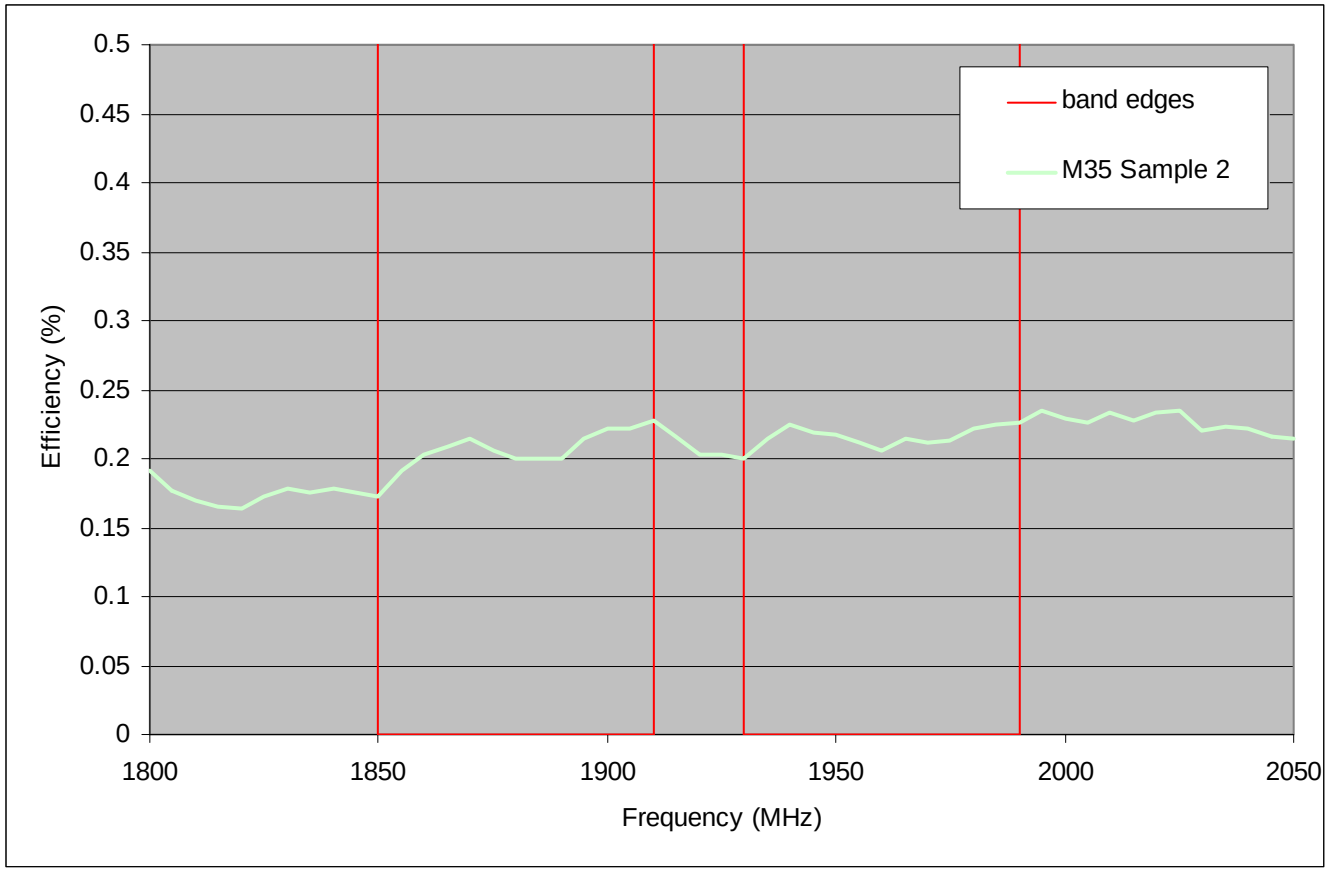
Test Performed: Radiation Pattern in Free Space.
Test Condition: Antenna mounted on MOBICOM Firefly phone: Low Band
Theta = 90 Plane



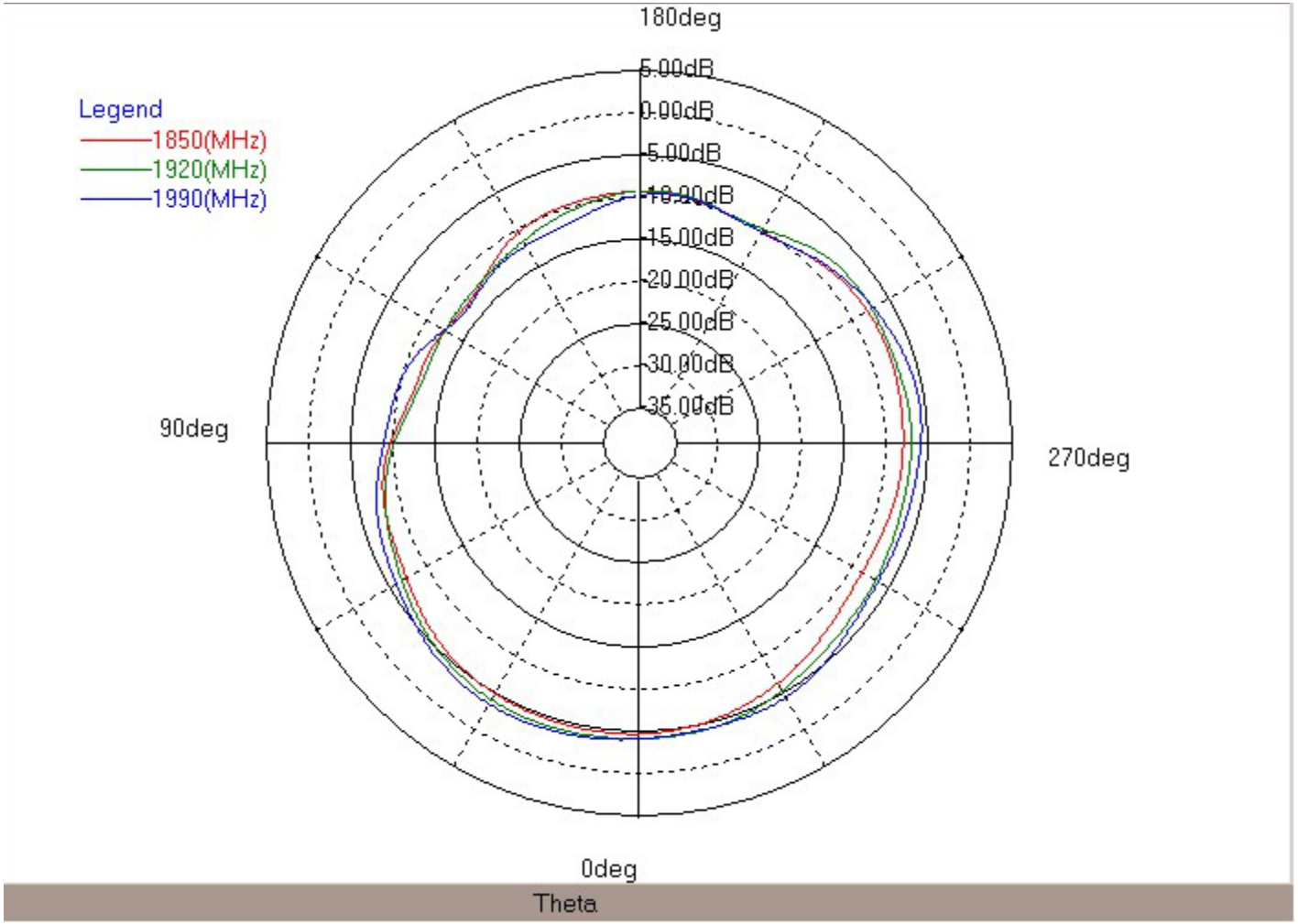
Test Performed: Return Loss measurement High Band
Test Condition: Antenna mounted in MOBICOM Firefly phone free space



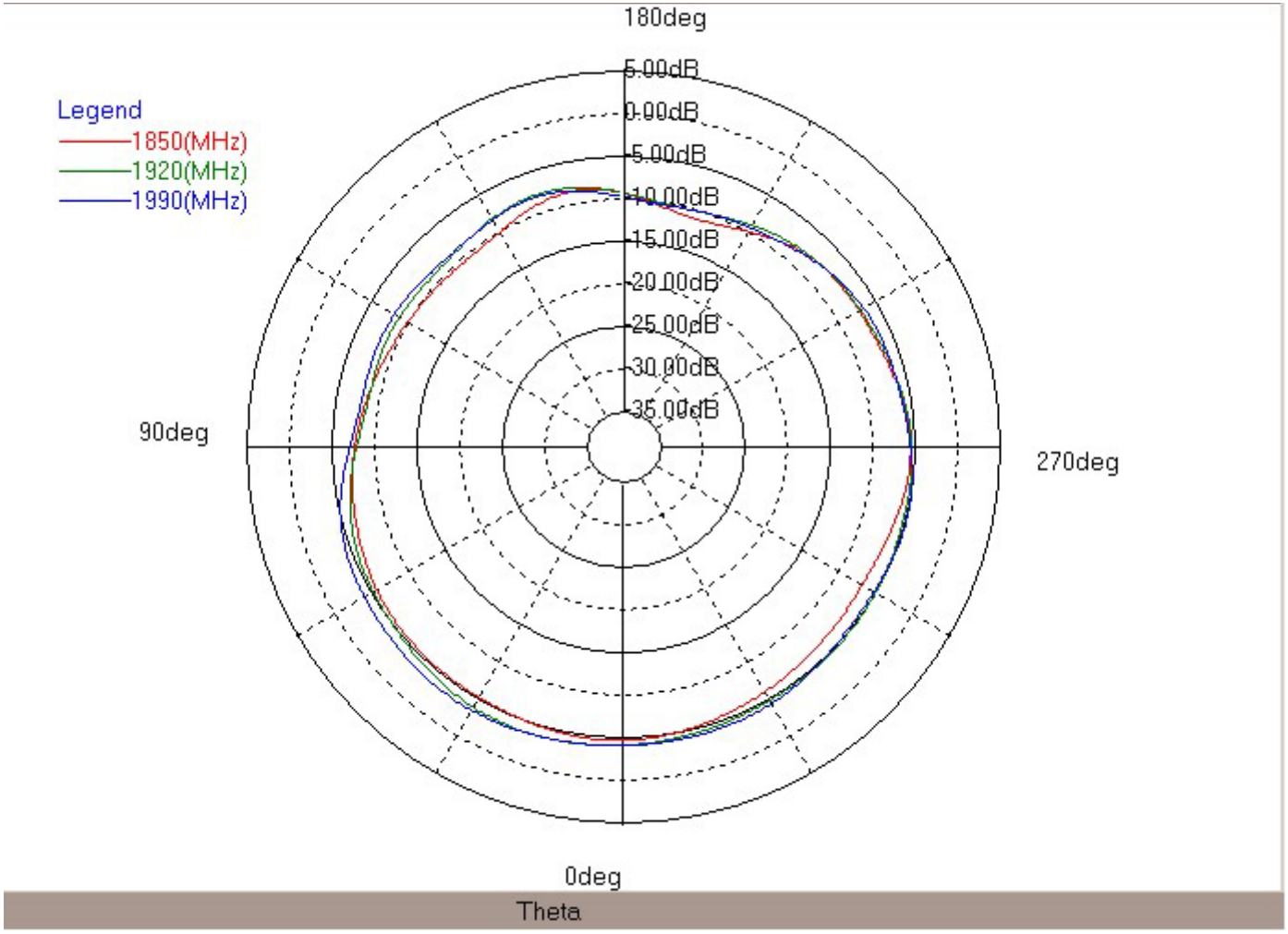
Test Performed: Efficiency in Free Space.
Test Condition: Antenna mounted in MOBICOM Firefly phone: High band



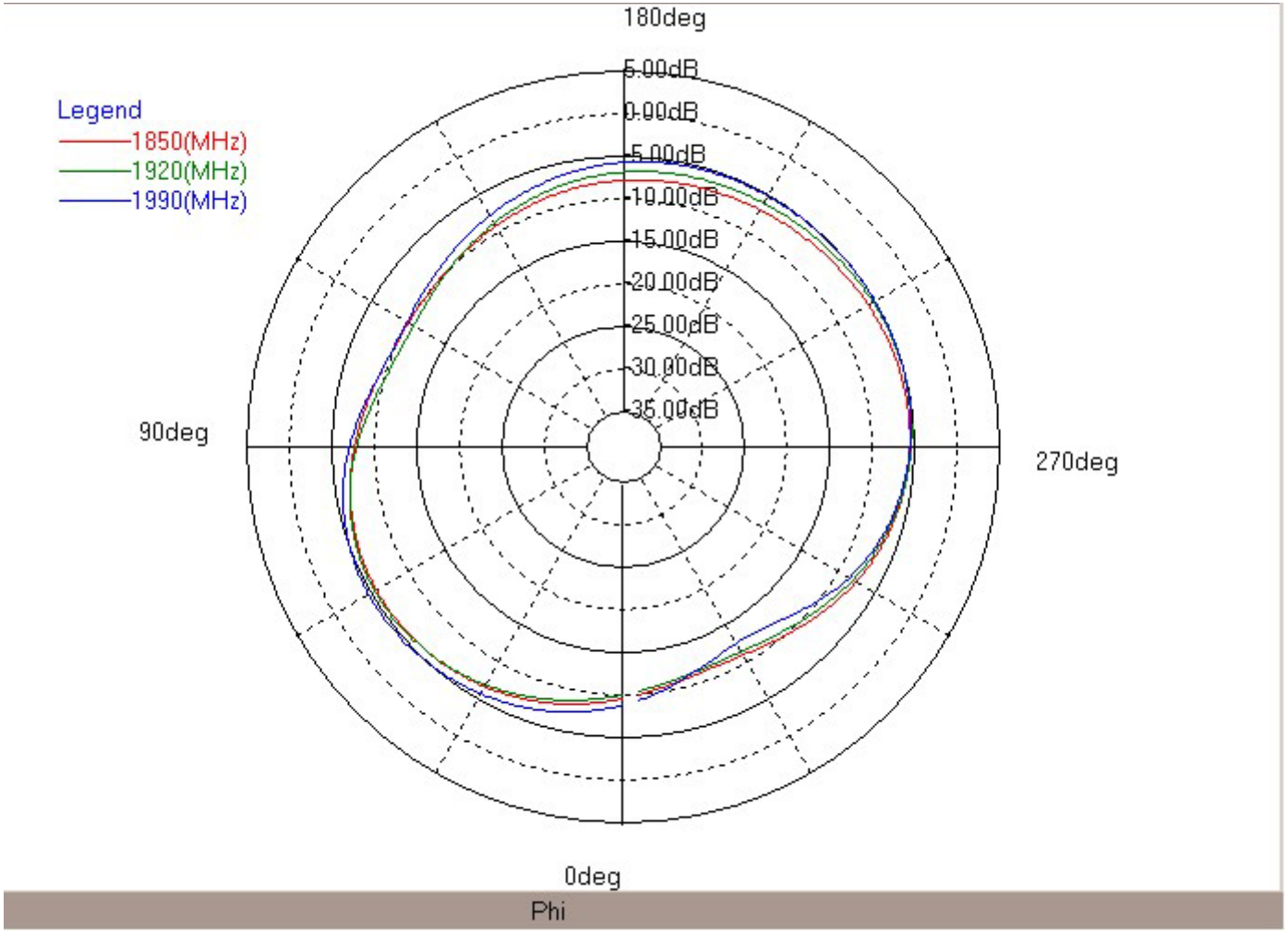
Test Performed: Radiation Pattern in Free Space.
Test Condition: Antenna mounted in MOBICOM Firefly phone: High Band
Phi = 0 Plane



Test Performed: Radiation Pattern in Free Space.
Test Condition: Antenna mounted in MOBICOM Firefly phone: High Band
Phi = 90 Plane



Test Performed: Radiation Pattern in Free Space.
Test Condition: Antenna mounted in MOBICOM Firefly phone: High Band
Theta = 90 Plane



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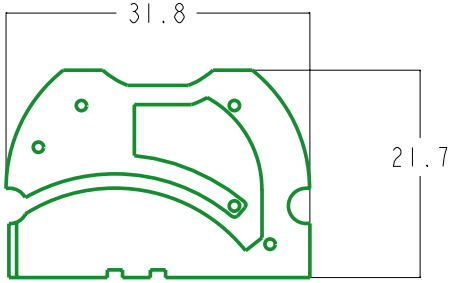
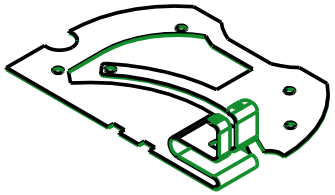
	.		





NOTES:
1. All dimensions are per 3D CAD data GZ04001-M35
2. Base material and temper are as per title block, or equivalent.
3. The following mechanical material properties are for reference only:
   Hardness: 230-270 Hv
   Tensile strength: 730-820 MPa
   0.2% Yield strength: 655-790 MPa
4. Material Thickness: 0.2mm +/-0.013.
5. No loose burrs on any edge. Maximum attached burr height is 0.05 mm
6. The plating on the contact points is:
   Underlayer of selective Ni: 0.2 - 1.0 um thickness.
   Covered by selective Au: 0.15 -0.30 um thickness, per ASTM-B-488, Type I, Hardness grade C.
7. Units are free of grease or foreign materials that cannot be removed by air jet.
8. Water spots or discoloration are permissible except for the plated areas.
9. Units are packaged in static free plastic trays for shipping.
10. TOLERANCES UNLESS OTHERWISE SPECIFIED:
    X.X: +/- 0.5 mm
    X.XX: +/- 0.5 mm
    Bend angles: +/-1 degrees
11. (ST) Cpk Value of 1.33 will be maintained.

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN MILIMETERS IN ACCORDANCE WITH ASME Y14.5M	**ETHERTRONICS**		**9605 SCRANTON ROAD SAN DIEGO, CA 92121-1788**
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SPEC: JIS	ORIGINATOR: Mark Krier	DATE: 11-29-2004	TITLE: GZ04001_M35
FINISH: AS ROLLED	R&D DIRECTOR	DATE	
THIRD ANGLE PROJECTION	QC ENGINEER	DATE	DWG #: GZ04001_M35
	VP OPS	DATE	SIZE: A3 / SCALE: 2.000 / NUMBER OF SHEETS / REV