

## **Trakus Player Patch Peak Conducted Output Power**

The Peak Conducted Output Power for the Trakus Player Patch must be calculated. The antenna for the Player Patch is a microwave patch antenna that is located on the printed circuit board. No cable or external connection exists.

In order to calculate the peak conducted output power, the output power was measured and the Peak Conducted Output Power was calculated.

### **Output Power Test Method**

The output power of the player patch was measured. This was accomplished by making a free space measurement inside a shielded room. The Player Patch was placed one meter from a receiving antenna. The receiving antenna was attached to a spectrum analyzer and the peak of the signal was measured and recorded with a resolution bandwidth of 3MHz.

To calculate the peak output power the following equation is used:

**Output Power** = Measured Output Power + Antenna Factor + Cable Loss + Bandwidth Correction Factor

**Measured Power** = Peak output power measured at one meter by a H/P88566B Spectrum analyzer. See attached plot (Figure 1).

**Antenna Factor** = Antenna factor of receiving antenna at one meter. See attached antenna factor (Figure 2).

**Cable Loss** = Measured cable loss at 2.45GHz. (Figure 3)

**Bandwidth Correction Factor** = Correction factor due to measured bandwidth is smaller than bandwidth of emission. See Figure 4 for calculation and plot of bandwidth.

$$\text{Output Power} = -27.0\text{dBm} + 28\text{dB} + 8.7\text{dB} + 2.1\text{dB}$$

$$\text{Output Power} = 11.8\text{dBm}$$

### Peak Conducted Output Power Calculation

The Peak Conducted Output Power can be calculated by the following equation:

$$P = (E \times D)^2 / 30 \times G$$

P= Output Power mW

E= Electric Field Strength V/m

D= Distance from source m

G= Gain of Antenna dBi

$$E = 11.8 \text{ dBm} = 118.8 \text{ dBuV} = 0.875 \text{ V/m}$$

$$D = 1 \text{ m}$$

$$G = 4 \text{ dBi}$$

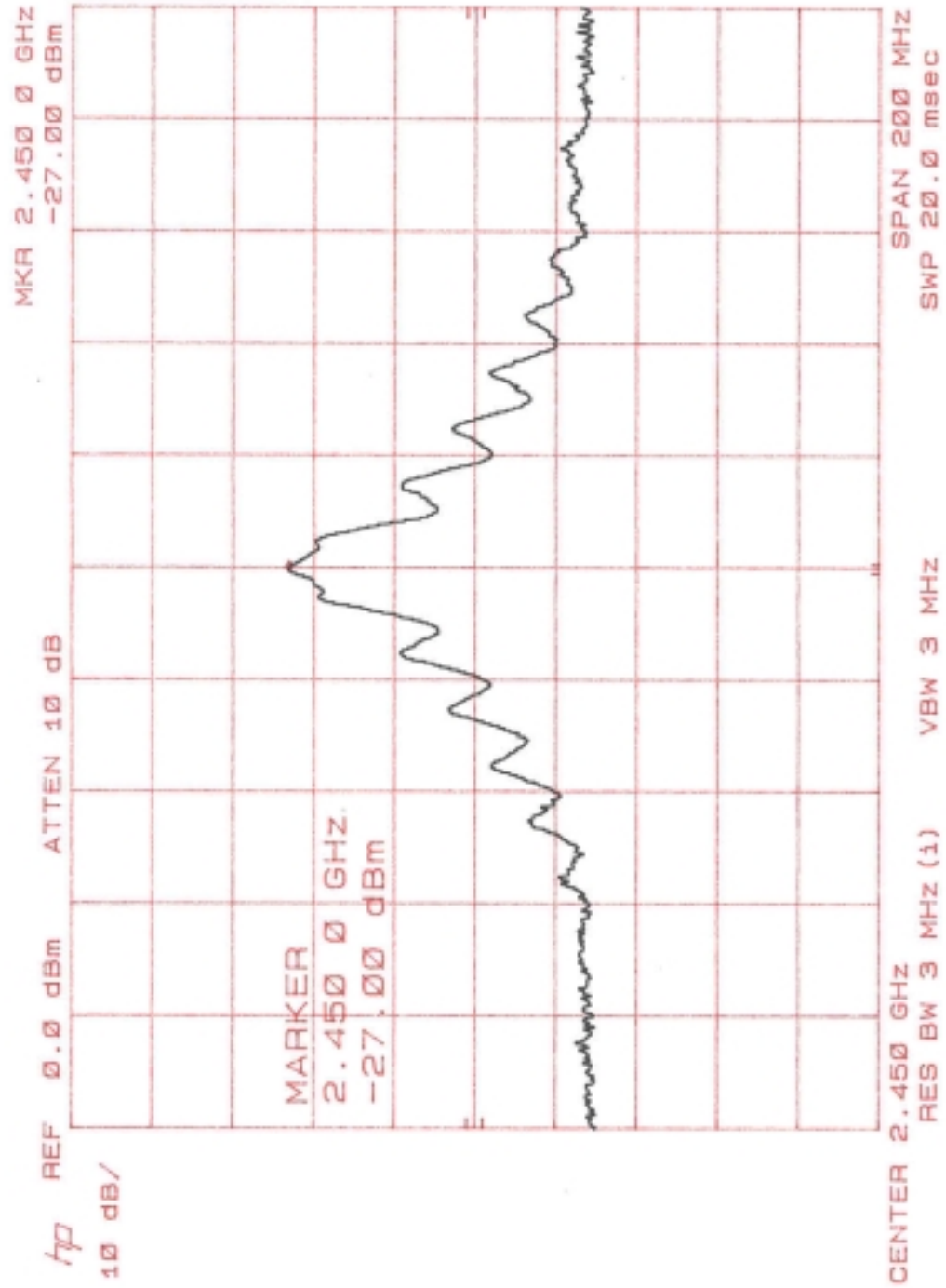
$$P = (0.875 \times 1)^2 / 30 \times 4$$

$$P = 0.766 / 120$$

$$P = 0.006 \text{ W}$$

See attached Figure 5: the gain for the antenna.

FIGURE 1  
Measured Output Power



## FIGURE 2

### Antenna Factor

Date Printed On: Friday, February 02, 2001 8:39 AM

Customer Name: Chomerics, Inc.

Antenna Manufacturer: EMCO

Antenna Model: 3115

Antenna Serial No.: 2796

Temperature (Deg C): 22

Humidity (%): 31

Measurement Distance in Meters = 1

Antenna Polarization = HORZ

NOTES:

CAL CERT #: 2001012307

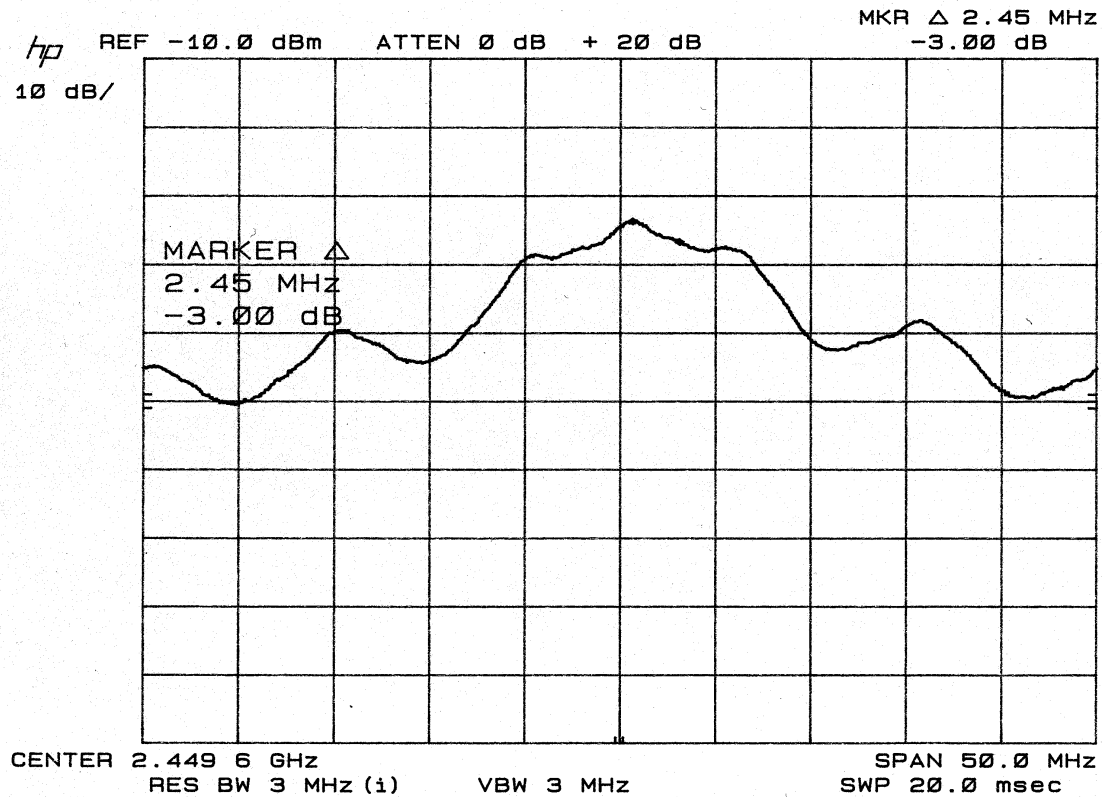
FREQ	ACF	Gain	NUM
MHz	dB/m	dB	Gain
1000.0000	22.9	7.3	5.37
1500.0000	24.6	9.1	8.11
2000.0000	27.2	9.0	7.98
2500.0000	28.0	10.1	10.28
3000.0000	30.1	9.7	9.27
3500.0000	31.4	9.7	9.29
4000.0000	32.7	9.5	8.94
4500.0000	32.4	10.9	12.29
5000.0000	33.1	11.1	12.82
5500.0000	34.6	10.4	11.06
6000.0000	34.7	11.0	12.66
6500.0000	34.4	12.0	15.95
7000.0000	36.3	10.8	12.11
7500.0000	37.3	10.4	10.97
8000.0000	36.8	11.4	13.91
8500.0000	37.4	11.4	13.86
9000.0000	37.8	11.5	13.98
9500.0000	37.3	12.5	17.72
10000.0000	38.0	12.2	16.44
10500.0000	38.5	12.1	16.31
11000.0000	38.5	12.5	17.77
11500.0000	39.8	11.6	14.40
12000.0000	40.5	11.2	13.32
12500.0000	39.7	12.5	17.69
13000.0000	40.0	12.5	17.70
14000.0000	41.0	12.1	16.30
14500.0000	40.0	13.5	22.22
15000.0000	39.3	14.5	27.87
15500.0000	37.6	16.4	44.02
16000.0000	37.7	16.6	45.21
16500.0000	40.8	13.7	23.55
17000.0000	41.4	13.4	22.07
17500.0000	44.8	10.2	10.55
18000.0000	45.5	9.8	9.56

**FIGURE 3**  
**Measured Cable Loss**

Cable Loss of 20ft of N-Type cable at 2.45GHz = 8.7dB

**FIGURE 4**  
**Bandwidth Correction Factor**

**6dB Bandwidth**



$$\begin{aligned} \text{Bandwidth Correction Factor} &= \\ 10\log (6\text{dB Bandwidth}/ \text{Resolution Band Width}) \\ &= 10\log (3.9/3) \quad 10\log(1.6)=2.1\text{MHz} \end{aligned}$$

Note: Maximum bandwidth of HP8566B Spectrum Analyzer is 3MHz

**FIGURE 5**  
**Listed Gain for antenna**



## 2.4 GHz Patch Antenna for ISM Band

**ANP-C-116**

V3.00

### Features

- Hemispherical/Omnidirectional
- Flat Configuration
- Rugged/Durable
- Low VSWR
- Circular Polarization Minimizes Multipath Effects
- Various Types of Input Connectors Available
- Variety of ISM Applications

### Description

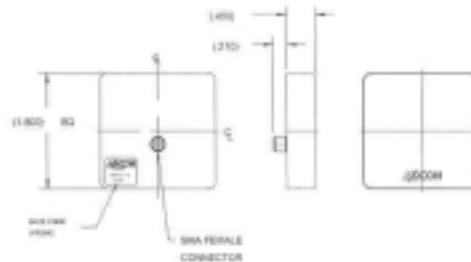
The ANP-C-116 patch antenna is a hemispherical/omnidirectional antenna. It is circularly polarized to maximize immunity to fading in high multipath environments.

This durable antenna has a flat configuration that makes it suitable for surface mount applications. It can be used for a variety of ISM applications such as bar code scanning, auto toll collection, wireless LAN and medical monitoring devices.



### Specifications

Frequency Range	2400-2485 MHz
Peak Gain	+4 dBic Min
Polarization	Right Hand Circular
Nominal Impedance	50 Ohms
VSWR	2.0:1 Max
R. F. Power Handling	1 W Avg. Max 3 W Peak Max
Connector Type	SMA Female
Weight	1.5 oz Max



Specifications Subject to Change Without Notice

M/A-COM Inc.

North America: Tel. (800) 366-2266  
Fax (800) 618-8883

Asia/Pacific: Tel. +85 2 2111 8088  
Fax +85 2 2111 8087

Europe: Tel. +44 (1344) 869-595  
Fax +44 (1344) 300-020