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Approved By:

Robert Zigler  
James Lundberg

Mechanical Engineer, Wireless Products Group (Author)  
Engineering Manager, Wireless Products Group

Referenced forms, documents, and records:

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# Introduction

The purpose of this document is to provide Intermec Technologies Corp. personnel a tool that will enable them to better understand how the various Intermec antennas, cable assemblies, and accessories blend together. This guide is biased towards 2.4 GHz offerings. Future updates will include 900 MHz and UHF.

## Regulatory Concerns

**Note:** The information below will help you to understand some of the regulatory issues surrounding the use of antenna, antenna circuits, and radios. However, it is critical to remember that all antennas must be approved and certified before they can be used with radio (RF) equipment purchased from Intermec.

### FCC

FCC requirements limit the total output power of a wireless LAN system operating in the 900 MHz and 2.4 GHz frequency ranges to 4 Watts. This limit is expressed in EIRP, which stand for “Effective Isotropically Radiated Power.” This is the total power created by the transmitter and gain generated by the antenna, minus any loss due to cabling and connections. Given this 4W (4000 mW) maximum, the EIRP must not exceed 36dBi. The FCC has no stated EIRP maximums of UHF systems.

### ETSI

ETSI requirements limit the total output power of a 2.4 GHz wireless LAN system to 0.1 Watt (100 mW). Given this 100 mW maximum, the EIRP must not exceed 20dBm. 900 MHz systems are not allowed and UHF system maximum EIRPs vary from country to country. Most European countries such as France and Italy operate under a lower power directive, which limits them to a maximum output limit of 10 mW.

### Non-ETSI & Non-FCC Countries

Electromagnetic-transmission regulations are mandated by each country’s own governing body. Many countries follow the directives issued by ETSI or the FCC but others create their own regulations.

**Before adding radios or antennas to a RF system, please consult a certified Intermec Systems Consultant operating in the country where the system will be used.**

# Basic Antenna Concepts

## Antennas and Power

Antennas do not increase nor decrease the power applied to them. They can only transmit or receive the amount of power that is applied to them. It is possible to have some power loss before or after the signal leaves the antenna. An example of this is “line loss: which is a decrease in power due to imperfect connections and imperfect conductivity to cabling materials. It is, however, possible to increase the power output in a certain direction. But the total power emitted will always be the same as the amount applied to the antenna minus the amount lost due to line loss, ohmic loss, reflection loss etc...

### **dBi – (decibels relative to an isotropic {spherical} radiation pattern)**

An isotropic antenna is a theoretical antenna that radiates in the shape of a perfect sphere.

### **dBm – (decibels relative to one milliwatt)**

dBm is a commonly used unit of measurement in the RF industry that expresses radio frequency power relative to a 1 mW point of reference.

### **dBd – (decibels relative to a ½ wave dipole antenna)**

dBd is gain with respect to a ½ wave dipole antenna. Some commercial antenna companies use dBd to rate their antennas.

### **EIRP – (Effective isotropically radiated power)**

The mathematical product of (1) the power supplied to the antenna and (2) its gain.

## Gain

Gain is given in dB (decibels). If an “I” is added as in 3dBi, this rating is relative to an “isotropic” antenna. An isotropic antenna is a theoretical antenna that radiates in the shape of a perfect sphere. If a “d” is added as in 3dBd, this rating is relative to a “dipole” antenna. A dipole antenna with a rating of 2.14dB is equivalent to a 0dBd antenna.

## Line-of-sight

This refers to the fact that some electromagnetic wave frequencies require a clear line of sight between transmitter and receiver. This is largely because higher frequency electromagnetic waves, such as those in the 2.4 GHz range, do not bend around or penetrate objects as well as some lower frequency signals.

## Multipath, Reflection, or Physical Interference

Because of the electromagnetic properties of waves used to transmit data, large metal objects in the immediate transmission path of the antenna will likely cause distortion of the signal and should therefore be avoided.

## Omnidirectional

An omnidirectional antenna radiates evenly horizontally around the antenna in a plane parallel to the earth. These antennas do not always radiate evenly vertically around the antenna in a plane perpendicular to the earth. By giving up vertical coverage, above and or below the antenna and refocusing that signal around the antenna, it is possible to achieve gain with an omnidirectional antenna.

## Omnigain

Wavelength and operating frequency determine the size of the antenna. By using a longer antenna, you do not achieve greater overall coverage, but you can achieve greater distance in a focused direction. For example, omnidirectional antennas with gain achieve some measure of gain in the horizontal plane.

IF4, IF5, IV7

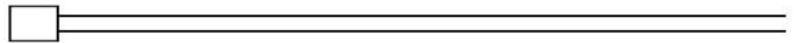
<div><div>915MHz IF4 IF5 IV7</div><div></div></div>	<div><div>345-004-001 - Terminator, 50 ohm, SMA RP</div><div></div><div>203-720-001 - Kit, Cable, SMA RP Plug/N RP Plug - 12 feet</div><div>203-720-002 - Kit, Cable, SMA RP Plug/N RP Plug - 20 feet (Customer trims cable and terminates N plug)</div><div></div><div>236-021-001 - Cable, SMA RP Plug/SMA RP Receptacle - 13 feet</div><div>321-574-001 - Cable, SMA RP Plug/SMA RP Receptacle - 6 feet</div><div>321-574-002 - Cable, SMA RP Plug/SMA RP Receptacle - 10 feet</div><div></div><div>063247 - Cable, SMA RP Plug/N RP Receptacle - 12 inch</div><div>Use with Extension Cables:</div><div>064616 - Cable N RP Plug/N RP Plug - 30 inches</div><div>063245 - Cable N RP Plug/N RP Plug - 5 feet</div><div>063246 - Cable N RP Plug/N RP Plug - 20 feet</div><div>071179 - Cable N RP Plug/N RP Plug - 30 feet</div></div>	<div><div></div><div></div></div> <div>203-655-001 - Antenna, 5 dBi - SMA RP Plug (Includes 236-021-001 Cable</div> <div>805-609-001 - Antenna, 7 dBi - SMA RP Plug, 13 feet</div> <div>805-610-001 - Antenna, 6 dBi - N RP Receptacle, 5 feet</div> <div>805-619-001 - Antenna, 5 dBi - SMA RP Plug, 13 feet</div> <div>805-622-002 - Antenna, 9 dBi - N RP Receptacle</div> <div>805-623-002 - Antenna, 8 dBi - N RP Receptacle</div> <div>805-626-001 - Antenna, 6 dBi - N RP Receptacle</div> <div>805-628-002 - Antenna, 10.5 dBi - N RP Receptacle</div>
<div><div>865/869MHz IF4 IF5 IV7</div><div></div></div>	<div><div>345-005-001 - Terminator, 50 ohm, SMA</div><div></div><div>236-044-001 - Cable, SMA Plug/N Plug- 10 Feet (305 cm)</div><div>236-045-001 - Cable, SMA Plug/N Plug - 22.5 Feet (686 cm)</div><div>236-046-001 - Cable, SMA Plug/N Plug - 28.5 Feet (869 cm)</div><div></div><div>203-719-001 - Kit, Cable, SMA Plug/N Plug - 12 feet</div><div>203-720-002 - Kit, Cable, SMA Plug/N Plug - 20 feet (Customer trims cable and terminates N plug)</div></div>	<div><div></div><div></div></div> <div>805-622-001 - Antenna, 9 dBi - N Receptacle</div> <div>805-623-001 - Antenna, 8 dBi - N Receptacle</div> <div>805-626-002 - Antenna, 6 dBi - N Receptacle</div> <div>805-628-001 - Antenna, 10.5 dBi - N Receptacle</div>

## IV7



075128 - Cable, RS232, 8 position/9 position dsub socket - 36 inches

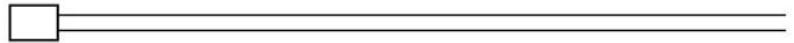
075513 - Cable, RS232, 8 position/9 position dsub socket - 9 feet



075511 - Cable, RS232, 8 position - 9 feet

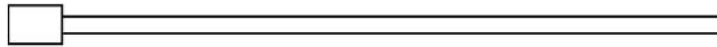


075512 - Cable, RS232, 9 position dsub socket - 6 feet



203-713-001 - Kit, Power Cable  
(includes fuse, fuse-holder, cable ties,  
terminals, shrink tubing, cord clips)

## IF6/IV6



236-040-001 - Cable, I/O  
(Does not include connector  
for terminal)



203-714-001 - Kit, Combination Power and I/O Cable  
(includes fuse, fuse-holder, cable ties, cord clips,  
shrink tubing, and 2-position circular plug for  
connecting to Intermec fork lift power conditioner.  
Does not include connector for terminal.)

**Standard N Receptacle**  
(For use in Europe with 865 MHz  
and 869 MHz Systems)



**Reverse Polarity N Receptacle**  
(For use in United States and  
Canada with 915 MHz Systems)





**203-655-001**  
**Antenna – 5dBd – SMA RP Plug**  
**(includes 236-021-001 Cable)**



**Frequency Range: 800 – 1000 MHz**  
**Gain: 5 dbd**  
**VSWR: 50ohms maximum - 1.5:1**  
**Polarization: Vertical**  
**Pattern Direction: Directional**  
**Horizontal Beam Width: 90 degrees**  
**Vertical Beam Width: 60 degrees**  
**Average Power Input: 50 Watts maximum**  
**Front to Back Ratio: 25 dB**  
  
**Cable Length: 156 inches**

**805-609-001**  
**Antenna – 7dBi – SMA RP Plug**



**Frequency Range: 902 – 928 MHz**  
**Gain: 7 dBi**  
**Front to Back Ratio: 18 dB**  
**3 dB Horizontal Beam Width: 65 degrees**  
**3 dB Vertical Beam Width: 65 degrees**  
**VSWR: 1.5:1**  
**Power Rating: 1 Watt maximum**  
**Polarization: Right Hand Circular**  
**Impedance: 50 Ohms**

**Size: 10.2 x 10.2 x 1.5 inches**  
**Weight: 1.25 lbs**

**Cable Length: 156 inches**

**805-610-001**  
**Antenna – 6dBi – N RP Receptacle**



**Frequency Range: 890 – 945 MHz**

**Gain: 6 dBd**

**Front to Back Ratio: 15 dB**

**3dB Horizontal Beam Width: 70 degrees**

**3dB Vertical Beam Width: 60 degrees**

**VSWR: less than 1.5:1**

**Power: 50 Watts maximum**

**Radiation Pattern: Directional**

**Polarization: Vertical, Linear**

**Impedance: 50 Ohms**

**Size: Width - 8.6 inches, Height – 7.8 inches, Depth – 2.25 inches**

**Weight: 1.0 lbs**

**Cable Length: 5 feet**

**805-619-001**  
**Antenna – 5 dBi – SMA RP Plug**



**Frequency Range: 824 – 896 MHz**  
**Gain: 5 dBi**  
**Polarization: Elliptical**  
**Coverage: Hemispherical**  
**Azimuth and Elevation: 360 degrees and 120 degrees respectively**  
**Front to Back Ratio: 15dB**  
**VSWR: 1.2:1**  
**Impedance: 50 Ohms**  
**Power: 50 Watts**

**Size: 7.0 x 7.0 x 5.2 inches**  
**Weight: 1 lb**

**Cable Length: 13 feet**

**805-622-002**  
**Antenna – 9 dBi – N RP Receptacle**



**Frequency Range: 868-956 MHz**

**Gain: 9 dBi**

**Front to Back Ratio: >23 dB**

**H-plane Beam Width: 80 degrees (half power)**

**E-plane Beam Width: 30 degrees (half power)**

**VSWR: 1.8:1 over full frequency range**  
**1.4:1 over 902 – 956 MHz frequency range**

**Power: 100 Watts maximum**

**Polarization: Right Hand Circular**

**Impedance: 50 Ohms**

**Size: Width – 6.1 inches, Length – 25.5 inches (including mounting brackets),**  
**Height – 2.25 inches**

**Weight: 5.2 lbs**

**805-623-002**  
**Antenna – 8 dBi – N RP Receptacle**



**Frequency Range: 865 – 928 MHz**

**Gain: 8 dBi**

**Axial Ratio: 3 dB over entire half power beam  
<1dB at boresight**

**Front to Back Ratio: >20 dB**

**H-plane Beam Width: 60 degrees (half power)**

**E-plane Beam Width: 60 degrees (half power)**

**VSWR: 1.3:1 over full frequency range**

**Power: 100 Watts maximum**

**Polarization: LH Circular**

**Impedance: 50 Ohms**

**Size: Width - 10.3 inches, Length – 15.4 inches (including mounting brackets),  
Height – 2.4 inches**

**Weight: 3.8 lbs**

**805-626-001**  
**Antenna – 6 dBi – N RP Receptacle**



**Frequency Range: 865 – 928 MHz**

**Gain: 6 dBi**

**Front to Back Ratio: >20 dB**

**H-plane Beam Width: 90 degrees (half power)**

**E-plane Beam Width: 70 degrees (half power)**

**VSWR: 1.5:1 over full frequency range**

**Power: 100 Watts maximum**

**Polarization: Vertical**

**Impedance: 50 Ohms**

**Size: Width – 6.1 inches, Length – 13.4 inches (including mounting brackets),  
Height – 1.9 inches**

**Weight: 3.3 lbs**

**805-622-001**  
**Antenna – 9 dBi – N Receptacle**



**Frequency Range: 868 – 956 MHz**

**Gain: 9 dBi**

**Front to Back Ratio: >23 dB**

**H-plane Beam Width: 80 degrees (half power)**

**E-plane Beam Width: 30 degrees (half power)**

**VSWR: 1.8:1 over full frequency range**  
**1.4:1 over 902 – 956 MHz frequency range**

**Power: 100 Watts maximum**

**Polarization: Right Hand Circular**

**Size: Width – 155 mm (6.1 inches), Length – 648 mm (25.5 inches) (including mounting brackets), Height – 57 mm (2.25 inches)**

**Weight: 2.35 kg (5.2 lbs)**



**805-623-001**  
**Antenna – 8 dBi – N Receptacle**



**Frequency Range: 865 – 928 MHz**

**Gain: 8 dBi**

**Front to Back Ratio: >20dB**

**H-plane Beam Width: 60 degrees (half power)**

**E-plane Beam Width: 60 degrees (half power)**

**VSWR: 1.3:1 over full frequency range**

**Power: 100 Watts maximum**

**Polarization: Left Hand Circular**

**Impedance: 50 Ohms**

**Size: Width – 262 mm (10.3 inches), Length – 390 mm (15.4 inches) (including mounting brackets), Height – 59 mm (2.4 inches)**

**Weight: 1.7 kg (3.8 lbs)**

**805-626-002**  
**Antenna – 6 dBi – N Receptacle**



**Frequency Range: 865 – 928 MHz**

**Gain: 6 dBi**

**Front to Back Ratio: >20 dB**

**H-plane Beam Width: 90 degrees (half power)**

**E-plane Beam Width: 70 degrees (half power)**

**VSWR: 1.5:1 over full frequency range**

**Power: 100 Watts maximum**

**Polarization: Vertical**

**Impedance: 50 Ohms**

**Size: Width – 155 mm (6.1 inches), Length – 340 mm (13.4 inches) (including mounting brackets), Height – 49 mm (1.9 inches)**

**Weight: 1.5 kg (3.3 lbs)**

**805-628-001**  
**Antenna – 10.5 dBi – N Receptacle**



**Frequency Range: 865 – 870 MHz**  
**Gain: 10.5 dBi**  
**Axial Ratio: <3 dB over entire half power beam**  
**Front to Back Ratio: >20 dB**  
**H-plane Beam Width: 70 degrees (half power)**  
**E-plane Beam Width: 30 degrees (half power)**  
**VSWR: 1.3:1 over full frequency range**  
**Power: 100 Watts maximum**  
**Polarization: Left Hand Circular**  
**Impedance: 50 Ohms**

**Size: Width – 262 mm (10.3 inches), Length – 635 mm (25 inches) (including mounting brackets), Height – 59 mm (2.3 inches)**

**Weight: 3.62 kg (8 lbs)**

**592030-001**

**Adapter, SMA RP Plug/ TNC RP Receptacle**  
(Used to convert Readers from TNC RP Receptacles to SMA RP Plugs. This allows existing antenna /cable Infrastructure to operate with IF4 and IF5 Readers.)

**592154-001**

**Tool, Crimp, SMA N, RG58**  
(Used to crimp N connectors to RG58 Coaxial cable in Kits 203-719-001, 203-719-002, 203-720-001, and 203-720-002)



**345-004-001**  
**Terminator, 50 ohm, SMA RP Plug**





**345-005-001**  
**Terminator, 50 ohm, SMA Plug**

