SELECTING RFID ANTENNAS

By
Reuven Drori

MTI Wireless Edge Ltd.

Table of Contents

Selecting RFID Antennas 1
Table of Contents 2
Introduction 3
RFID antennas include the following main types 3
Linear Vs Circular 3
Bistatic Vs Monostatic 3
Beam-width, Size & Gain 4
Side Lobes & Cross polarization 4
Choosing the antenna polarization 5
Axial Ratio 6
VSWR 6
Isolation 6
About MTI Wireless Edge Ltd 7

11 Hamelacha St. Afek Industrial Park. Rosh Ha'ayin 48091, Israel.
Tel: 972-3-9025050. Fax: 972-3-9025051
http://www.mtiwe.com/

Introduction

RFID – Radio Frequency Identification is the common name for variety of systems that are used for people and assets tracking.

RFID systems include portals, dock doors conveyer belts, Hand Held readers, Near Field shelves antennas and other system configurations.

This article discusses the main considerations need to be taken for choosing the right **reader antenna** for RFID systems that can be mounted on dock doors, conveyer belts and portals.

RFID systems use several frequencies such as 450MHz, UHF & 2.4GHz and the systems are divided into active, passive and semi passive RFID systems.

RFID antennas include the following main types

Linear

Monostatic Circular

Bistatic Circular (2xRH, 2xLH & RH+LH)

All these models are available with variety of gain levels.

Linear Vs Circular

Linear antennas – Linear antennas operate best when the tag orientation is known and fixed. The tag antenna and the reader antenna have to be matched in polarization.

Circular polarized antennas are used when the tag orientation is unknown – because the tag polarization is linear we loose at least 3 dB (compare to matched polarized linear antenna).

To summarize: circular antennas are designed to receive equally well for many different tag orientations, with a trade-off of loosing 3 dB compared to linear antennas.

Bistatic Vs Monostatic

The mono-static antenna is the most common antenna and has single port (connector).

The transmitted and received signals are operated through a common port (connector)

The bi-static antenna is actually two antennas under the same radome with two ports (connectors).

The transmitted signal is being transmitted through one port (connector) and the received signal with the other port.

The decision whether to use monstatic or bistatic antenna is dictated by the reader type.

Beam-width, Size & Gain

The antenna size and gain are proportional. **The higher the gain the larger the antenna.**

The antenna gain and the beam width are mutually dependent; the higher the gain (the larger the size) the narrower the beams. For antennas where the Azimuth beam and the Elevation beam are not identical, the wider side controls the narrower beam.

Example: The antenna MT-263020/NRH (beams of 60°/ 30°) is a rectangle of 630x 320mm

To achieve 30° inspection site in the horizontal plane (AZ), the wider side of the antenna need to be put with in the horizontal plane.

Choosing the antenna Beam-width:

The sectoral coverage for the horizontal axis (Azimuth) and vertical axis (Elevation) is defined as 3dB beam-width. This means that the sectoral coverage beam width is the angle where the antenna gain is 3dB below the maximum gain

Narrowing the beam width prevents undesired readings outside the inspection area.

For illustration we compare the difference between the

MT-262006/NRH - 9dBic and the MT-263007/NRH - 10 dBic antennas:

9 dBic antennas beam widths are 63 EL & 63 AZ (deg) While the 10 dBic is narrower 63x45 deg. in one plane.

Note that the 9dBic is 1 sq ft only while 10dBic is 50% larger – 1.5 sq ft

Side Lobes & Cross polarization

Because an antenna's radiation pattern is a Fourier Transform of its aperture distribution, most antennas will generally have side lobes. Larger antennas have narrower main beams, as well as narrower side lobes. Hence, in order to avoid reading tags out of the beam width (by the side lobes) low side lobes antennas are superior.

When using circular antennas the cross polarization needs to be as low as possible outside the antenna sectoral coverage in order to avoid reading tags outside the beam width.

In portal applications we need to read only the passing tags and not those that stand nearby. So, we would like the EL beam to be wide enough to cover the height of the passing pallets. The AZ beam need to be narrow in order not to read the nearby pallets.

Choosing the antenna polarization

In portal application

This paragraph is applicable for applications where the antennas are facing each other and transmit/receive simultaneously like portals.

Choosing same polarization will cause mutual interferences.

Since the tag is linear there is no difference which antenna polarization combination is used but choosing the right polarization combination within the portal will reduce the mutual interference between the antennas.

For monostatic antennas it is relatively simple since our antennas can have either same or opposite polarization.

The recommended configuration is having opposite polarization so that when we transmits/receive LH on one side and transmits/receive RH on the other side.

Less interference will be caused on the opposite antenna in this case.

With bistatic antenna it is a bit more complicated. As discussed the Bi-static antenna is actually two antennas under the same radome with two ports (connectors), i.e. we can choose that either same polarization for both antennas (dual Right or dual Left hand) or inversed polarization- (one RH and the other LH).

The recommended combination is installing dual RH+LH antennas on each side.

The transmit signals should have RH polarization and the received signals should have LH polarization.

By doing so, less interference will be generated between the transmit and the receive signals.

Axial Ratio	Axial ratio defines the circular polarization of the antenna. The Axial ratio is actually the difference between the max & min linear gain. Since FCC limits the max transmitted power for RFID applications and the system need to be calibrated to this power limit (so that the EIRP complies to FCC), using low axial ratio antennas enables more tags can be read with the same output power level (compared to antenna with worse axial ratio & same gain). For RFID application, the lower the axial ratio, the better the antenna.
VSWR	The voltage standing wave ratio is a measure of how well a load is **impedance-matched** to a source in other words VSWR is the antenna transmission efficiency (measured at antenna the connector). The lower the value the better the antenna For example 1.3:1 means 98.3% of the power will be transmitted and for 1.2:1 99.2%
Isolation	Port to Port isolation is the isolation between the two ports of the bistatic antennas. This parameter is important for bistatic antennas when one port is transmitting and the other one is receiving.

About MTI Wireless Edge Ltd

MTI Wireless Edge is the world leader in the development, production and marketing of high quality, low cost, flat panel antennas for Fixed Wireless and RFID applications. MTI has more than 30 years experience in supplying antennas for both military and commercial applications from 100 KHz to 40 GHz. MTI flat panel antenna range for FBWA includes both base station and subscriber antennas for various broad and narrow band fixed wireless applications in Point-to-Point (PTP) and Point-to-Multipoint (PMP) schemes such in both licensed and unlicensed bands. MTI Military products include a wide range of broadband, tactical and specialized communications antennas, antenna systems and DF arrays installed on numerous airborne, ground and naval, including submarine, platforms worldwide. MTI's ISO 9001 and ISO 14001 certified development and production plant, based in Israel, produces small, low profile antennas with superior performance, and gain. In house test facilities include antenna test ranges, varying in length from 8 meters to 300 meters. We Are Taking Wireless Technology To The Edge. Visit us at www.mtiwe.com

Contact: **Reuven Drori**

MTI Wireless Edge Ltd

Tel: +972 3 9008900 ext.331
E-mail: reuvend_d@mti-group.co.il