RFID Tech Insights

ERP and EIRP

Abbreviations

- ERP stands for

  Effective Radiated Power

- EIRP stands for

  Effective Isotropic Radiated Power

Definitions

ERP:

ERP is the total power radiated by an antenna relative to a half wave-length dipole antenna. Half wave-length dipole antennas' gain is 2.15 dBi theoretically.

EIRP:

EIRP is the total power radiated by an isotropic antenna in a single direction. An isotropic antenna is a hypothetical antenna that radiates evenly in all directions with 0 dBi gain.

What is ERP and EIRP in simple terms?

- The radiated power from a reader antenna is measured in two different scales, namely ERP and EIRP.
- Just like we have kilometres and miles to measure distances, we have ERP and EIRP units to measure the radiated power of an antenna.
- As antennas are passive devices; its radiated power measurement is dependent on the antenna's gain, amount of power fed into it and the cable losses associated between the antenna and an RFID reader.

What is the relation between ERP and EIRP

- Similar to miles and kilometres, we have a mathematical formula to convert ERP into EIRP and vice-versa.
- As the power can be expressed in Watts (W) or in dBm (in log scale); we have two formulae to express the relation.

$$EIRP\ (dBm) = ERP\ (dBm) + 2.15$$

$$EIRP\ (W) = 1.64 \times ERP\ (W)$$

What is the significance of ERP and EIRP in RAIN RFID?

- Each Government has country-specific regulations that prescribe the permitted maximum radiated power in ERP or EIRP.
- An RFID system is deemed to breach the laws when it exceeds this limit.
- These limits are set by regulatory authorities to ensure that an RFID system does not cause any unwanted interference with other IoT and telecommunication systems and to ensure safety around personnel RF radiation effects.

How do I calculate EIRP and ERP?

$EIRP\ (dBm) = P_R\ (dBm) - L_C\ (dB) + G_A\ (dBi)$

P_R = reader power setting in dBm,

L_C = cable losses involved in dB, and

G_A = antenna's linear gain in dBi

$ERP\ (dBm) = EIRP\ (dBm) - 2.15$

To convert dBm to Watts: $\frac{10^{\frac{Power\ in\ dBm}{10}}}{1000}$

To convert Watts to dBm: $10\ X\ Log_{10}\ (Power\ in\ Watts)$

Is there a calculator for ERP and EIRP calculations ?

Yes, the following online calculators can be used;

- EIRP: EIRP calculator
- ERP: It can be calculated from EIRP by subtracting 2.15

- Converting Watts to dBm and vice-versa

dBm to Watts conversion

Watts to dBm conversion

Where do I find radiated power limits for different countries ?

- Country-specific radiated power limits can be found in their respective standards such as FCC for the USA region, AS/NZS for Australia and New Zealand region, ETSI for the European region, etc.
- As RAIN RFID follows the GS1 standards as well; this information has been consolidated and listed in GS1 website also.
- Country-specific regulations posted by GS1: https://www.gs1.org/docs/epc/uhf_regulations.pdf

Example

Scenario:

Bob wants to deploy an RFID system using A5060 and A5020 antennas in the US region. He is planning to use 8m long LMR-240 cables to connect the antenna with the reader.

- Radiation limit in the USA is 4 W EIRP (36 dBm).
- 8m LMR-240 cable has approximately 1.5 dB losses.
- A5060 and A5020 antenna's gain is 10.5 dBiC (7.5 dBi) and 5.5 dBiC (2.5 dBi), respectively.
- To maintain safe limits in the US; the reader power settings should not exceed 30 dBm for the A5060 antenna but can go as high as 33 dBm for A5020 antennas.

Calculation:

EIRP = reader power – cable loss + antenna gain

- 30 dBm (reader power) - 1.5 dB (cable loss) + 7.5 dBi (A5060 is a 10.5 dBiC antenna)
- Which translates to 7.5 dBi, (subtract 3 dB to convert C to i)
- 7.5 dBi = 36 dBm
- 36 dBm = 4W EIRP limit for USA