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Static Test Method

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For Applied Tag Performance Testing

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30 **Abstract**

31 This document defines the equipment and procedures that are used in testing
32 “Applied Tag Performance” (ATP) in static test scenarios.

33 **Status of this document**

34 This section describes the status of this document at the time of its publication.
35 Other documents may supersede this document. The latest status of this
36 document series is maintained at the EPCglobal Subscriber’s Website.

37 This is a Last Call Working Draft Test Method (LCWDTM) developed by the
38 legacy Applied Tag Performance WG. This LCWDTM is to be approved by the
39 TLRPP WG for review and approval by the Hardware Action Group.

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90

91 **1 Purpose**

92 This document represents consolidated requirements that have been developed
93 by the EPCglobal Retail Certification Working Group (FMCG BAG), UHF Gen 2
94 Working Group (HAG), UHF Gen2 Joint Working Group (BAG/HAG), FMCG
95 Workplan Working Group (BAG), and the Performance Test Center Council
96 (PTCC). These requirements are for the static testing of EPCglobal UHF RFID
97 tags on cases or pallets for their successful interrogation power based on 50%
98 read rates.

99 The purpose of this document is to ensure consistency of requirements by
100 consolidating them into a single resource.

101 This document may also be used as guideline to implement RFID technology.

102 Other standards may be produced by the Tag, Label, Printer Performance
103 (TLRPP) Working Group of EPCglobal for the purpose of testing tags by
104 themselves in free-space, on substrates and on items. This test method is
105 envisioned as a lower-cost alternative to such methods, with the purpose of
106 adding insight to Performance Test Centers (PTCs) on the behavior of RFID tags
107 in the dynamic environment, where RFID is normally used. Whereas the Tag
108 Performance Specification can be used in the selection of tags for a particular
109 application, the purpose of the Static Test Method is pre-dominantly to find the
110 best application of a particular tag on its respective item, case or pallet.

111 **2 Target Users**

112 This document is intended for use by Performance Test Center labs or end users
113 performing Static Testing of applied tags.

114 **3 Scope**

115 This document outlines an alternate test method to Dynamic Portal testing for
116 understanding the effect of tag placement on RFID read rates, when the subject
117 tag is placed on an item, filled case, or pallet. This document also defines the
118 methods for performing read-range static testing, based on 50% read rates.
119 These methods can be used for the comparison of tags on the same case, or the
120 same tag at different locations on the same item/case/pallet with regard to their
121 read-rates.

122 **4 Terms and Definitions**

123 **Case** Non-specific term for a transport packaging, often used
124 to refer to a box [ISO 21067:2004]

125 **Detection Rate** Calculated as equal to “successful reads” divided by
126 “read attempts”

| | | |
|-----|------------------------|--|
| 127 | Item | A packaged good or the packaged good within its |
| 128 | | wrapping, placed outside of its transport packaging, that |
| 129 | | contains an RFID tag. This could be any salable unit |
| 130 | | that contains an EPCglobal UHF Class-1 Generation-2 |
| 131 | | RFID tag. |
| 132 | FHSS | Frequency Hopping Spread Spectrum. A standard |
| 133 | | modulation mode used for RFID interrogators in some |
| 134 | | regions of the world and in certain frequency bands |
| 135 | | where the channel power does not remain at a fixed |
| 136 | | frequency. Instead, the interrogator “hops” between |
| 137 | | channels in a known way to enable broader use of RF |
| 138 | | spectrum and compliance with regional requirements. |
| 139 | | If an Open Area Range is used and the local |
| 140 | | regulations require the FHSS mode be turned on for the |
| 141 | | test interrogator, then it is the responsibility of the test |
| 142 | | lab to ensure that this mode is not violated. |
| 143 | Open Area Range | A test site, located either indoors or outdoors, that |
| 144 | | follows the design given in Section 5 for a radiated test |
| 145 | | range that contains no anechoic chamber. Strict |
| 146 | | adherence to the constraints of such a test site, |
| 147 | | including legal constraints, must be maintained for this |
| 148 | | test site to be used. |
| 149 | Pallet | Rigid horizontal platform of minimum height compatible |
| 150 | | with handling by pallet trucks, and/or fork-lift trucks and |
| 151 | | other appropriate handling equipment, used as a base |
| 152 | | for assembling, stacking, storing, handling or |
| 153 | | transporting goods and loads [ISO 445 1996]. |
| 154 | Path loss | The attenuation of the signal due to its distance |
| 155 | | traveled from transmission to reception. From the Friis |
| 156 | | Transmission formula, Path Loss (PL) is calculated as |
| 157 | | the power transmitted at the input of an antenna port |
| 158 | | minus the power received at the output of an antenna |
| 159 | | port, plus the gain of the transmit and receive antennas. |
| 160 | Pstandard | The maximum power setting for the interrogator/test |
| 161 | | system used to test the RFID tag. |
| 162 | RF | Radio frequency |
| 163 | UUT | “Unit Under Test”, an RFID tagged case, item or pallet. |
| 164 | | The tagged case is the normative application in this test |
| 165 | | method. |
| 166 | | |

167 **5 Static Test Range Definition**

168 Two methods are presented for possible test ranges. The first is the preferred
169 method of using an anechoic chamber. The second is an open area test range
170 with well-defined RF characteristics. These two types of test ranges will be
171 defined in this section.

172

173 *WARNING: It is the responsibility of the testing lab to ensure that local*
174 *regulations are met for the intentional radiation of interrogator antennas for*
175 *static testing. If a shielded anechoic chamber is not used, then testing*
176 *MUST be performed with the following constraints:*

- 177 • *The FHSS mode shall not be inhibited unless local regulations permit*
178 *its inhibition. The testing mode used shall be included in the final*
179 *report.*
- 180 • *Static testing will be performed ONLY in the frequency band*
181 *permitted by local regulations. The testing region shall be included*
182 *in the final report.*
- 183 • *A site evaluation shall be performed both once per year, and a brief*
184 *evaluation of ambient noise and RF reflectivity shall be performed*
185 *before each test.*

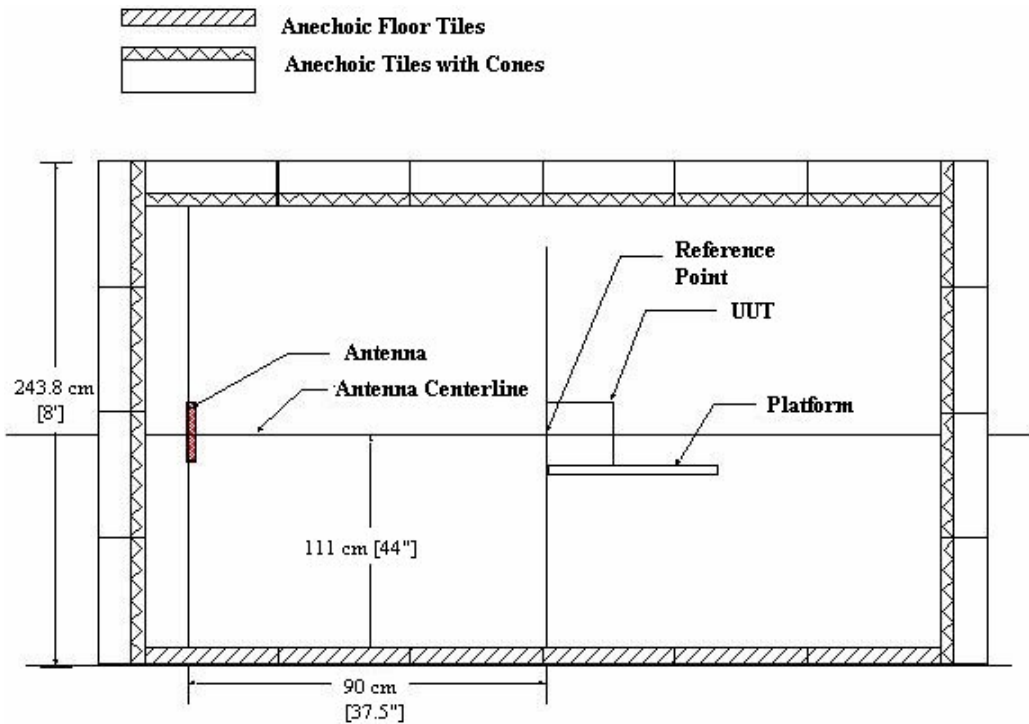
186 **5.1 Anechoic Chamber Range**

187 The preferred method for carrying out the Static Test Method is to do so in an
188 anechoic chamber. This kind of closed system is lined with materials that will
189 absorb and suppress reflections. This effectively eliminates any interference
190 caused by reflections of materials in the environment surrounding the reader and
191 the tag.

192 Recommended dimensions of the anechoic chamber and test set-up in an
193 anechoic chamber are shown in Figure 1.

194

195
196



197

Figure 1 Test Range Schematic

198

199

- 200 Absorber material lines the interior of the range (see Figure 1).
- 201 Shield material (non ferro-magnetic, and at least 0.1 mm thick) surrounds
- 202 exterior of the range (see Figure 1).
- 203 Adjust antenna centerline to midpoint of the test range.

204

205 Table 1 gives the specifications for shielding and absorbing material that is
206 should be designed into the anechoic chamber. These specifications are
207 described in further detail in section 5.3.

208

209 **Table 1: Placement of Absorber Materials**

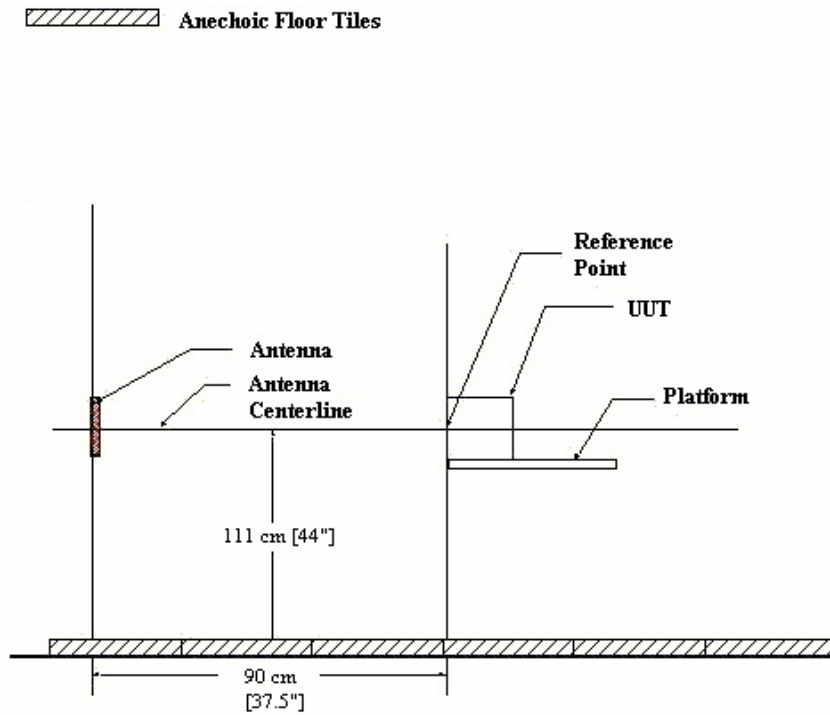
| | |
|--------------------------------|---|
| <p>1. RF absorber material</p> | <p>The test range will be lined with RF absorber tiles to prevent reflections that can disrupt the measurement. The tile's (ceiling and walls) minimum reflected path loss, as measured at the position of the UUT, at normal incidence shall be at least 30 dB in the 1-3 GHz range.</p> <p>The floor of the range will be covered with anti-reflective floor tiles whose minimum reflection path loss at normal incidence shall be at least 10 dB in the 1-3 GHz range.</p> |
| <p>2. RF shield material</p> | <p>The test range must be shielded on the exterior with aluminum or copper sheet material. This is due to the high conductivity of these materials. Seams may be sealed using aluminum or copper adhesive tape.</p> <p>Aluminum foil bonded to insulating foam, or sheet aluminum are examples material for this shielding.</p> |

210

211 **5.2 Open Area Range**

212 If an anechoic chamber is not available and testing must be carried out in an
 213 open area, then this section prescribes how that test set-up should be arranged,
 214 including materials to should be used.

215 The ideal open-range test set-up is shown in Figure 2.
216



217
218
219

Figure 2: Open Area Range Schematic

- 220 □ Recommended dimensions of the test range: 244 x 244 x 366 cm (8 x 8 x 12
- 221 feet) or larger.
- 222 □ Absorber material covering a metal (non ferro-magnetic, and at least 0.1 mm
- 223 thick) sheet lines the floor of the range. This material should extend at least 1
- 224 meter beyond the boundary area of the antenna and the UUT.

225
226
227
228
229

The required absorbing material characteristics for an Open Area test range are given in Table 2. Requirements for the range site evaluation are given in Section 5.3.

230 **Table 2 Absorber Material for Open-Area Range Testing**

| | |
|----------------------|---|
| RF absorber material | <p>The test range floor will be lined with RF anti-reflective floor tiles to prevent reflections that can disrupt the measurement.</p> <p>The floor's reflection path loss at normal incidence shall be at least 10 dB in the 1-3 GHz range.</p> <p>The minimum reflected path loss, as measured from the position of the UUT and at normal incidence to the axis that runs between the antenna and the UUT, shall be at least 0 dB in the 1-3 GHz range.</p> |
|----------------------|---|

231

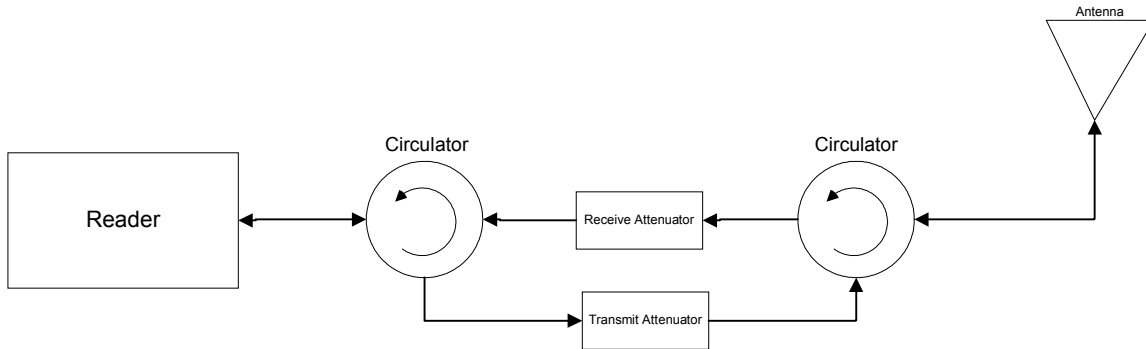
232 **5.3 Test Range Requirements for Both Types of Ranges**

233

- 234 □ At least once per year, a Range Site Evaluation (RSE) shall be performed.
- 235 This RSE shall include the following:
- 236 ○ RF ambient noise shall be measured in order to evaluate the
 - 237 "background noise" of the test site. If no other internationally
 - 238 recognized method is used for this evaluation, the RF ambient
 - 239 noise shall be measured in the range of 0.5-3 GHz for a period of at
 - 240 least 1 hour minimum. The RF ambient noise shall be below -60
 - 241 dBm, as measured by a 10 kHz resolution bandwidth.
 - 242 ○ RF reflection shall be measured in order to test the multipath
 - 243 reflection of the site. This is done according to the methods
 - 244 mentioned for each range and with the limits given for each range.
- 245 □ If an open area range is used, the site must be evaluated at least once per
- 246 hour of use for the following characteristics:
- 247 ○ RF ambient noise shall be measured. If no other internationally
 - 248 recognized method is used for this evaluation, the RF ambient
 - 249 noise shall be measured in the range of 0.5-3 GHz for a period of at
 - 250 least 1 continuous sweep of the power-frequency analyzer. The
 - 251 maximum RF ambient noise shall be below -60 dBm, as measured
 - 252 by a 10 kHz resolution bandwidth. This is typically done with the
 - 253 power-frequency analyzer in its "peak hold" feature.
- 254 □ If the range is found to be out of tolerance for either the annual evaluation or
- 255 the hourly evaluation, the data shall not be used in the final report, and
- 256 erroneous data reported prior to the incident shall be remedied according to
- 257 the quality policy of the laboratory.

258

259 Figures 3 and 4 give recommended configurations for the single and dual
260 antenna cases respectively. Therefore, the type of the selected antenna and
261 capabilities of the reader are the primary factors affecting selection of a
262 configuration. The circulators in Figure 3 act as passive elements to isolate the
263 ports from each other and to enable receiver and transmitter attenuation for a
264 single port reader. This setup will be further explained later on in the document.

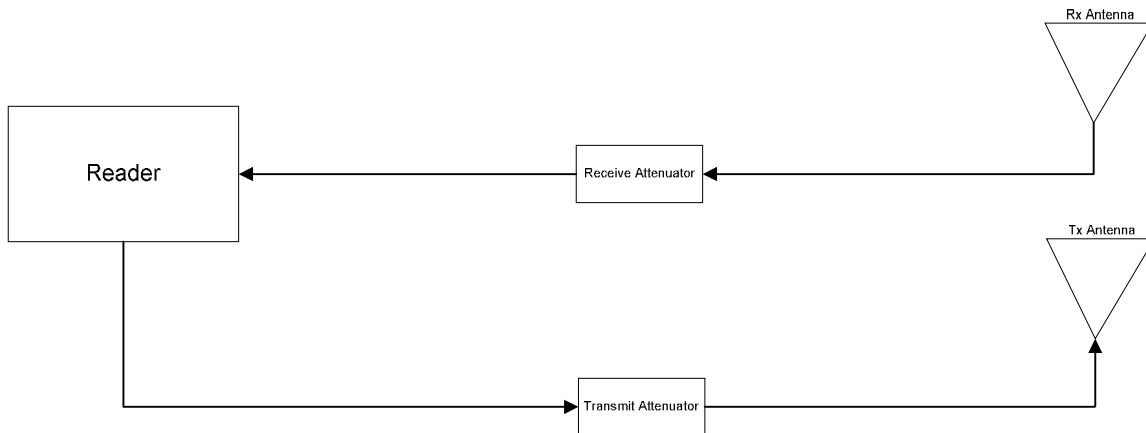


265

266 **Figure 3 Interrogator and Attenuator Configuration – Single Antenna**

267

268



269

270

Figure 4 Interrogator and Attenuator Configuration – Dual Antenna

271 The static test range will be composed of the following elements (see Table 3):

272 Table 3: Test Range Elements

| Element | Description |
|-----------------------------|---|
| 1. RFID Interrogator device | Any EPC certified interrogator device or a test system that supports the EPCglobal Class 1, Gen 2 protocol. |
| 2. Transmit attenuator | The interrogator may provide this attenuation function via its radio controls, or the attenuation may be provided by an external attenuator. The attenuator must have at least 1 dB resolution. |
| 3. Receive attenuator | The attenuator must have at least 1 dB resolution. In the case of a single antenna system, the attenuator must be used in conjunction with RF circulators as shown in Figure 2. |
| 4. Antenna(s) | Circularly polarized antenna(s) with a maximum axial ratio of 1 dB. Separate receive and transmit antennas may be used. |
| 5. Target platform | This platform will hold the tagged case during test, and will allow the tagged case to be tested in multiple positions while maintaining a fixed distance from the transmit /receive antenna plane to the RFID tag. The platform will also be adjustable in height to assure that the RFID tag is on center with the antenna beam. The platform shall be constructed of "RF transparent" materials. These materials shall have a relative permittivity of between 1 and 2.3. PVC piping is an example of a suitable material. |
| 6. Reference Point | The RFID tag will always be located at this point in the test range, for all case orientations. The reference point will be located 0.9 meters from the face of the antenna(s). |

273

274 The following accessories are required for the test range (see Table 4):

275

276 **Table 4: Test Range Accessories**

| | |
|--------------------------------------|--|
| RF power meter or spectrum analyzer. | Used to verify power level at the reference point. If a power meter is used, it shall be capable for tuning to the frequency band for each region tested in order to not measure extraneous noise. |
| Dipole Antenna | Used to measure the transmit power at the reference point A.H. Systems, Inc Model FCC-4 Tuned Dipole Antenna (or Equivalent) |

277

278 **6 Static Test Range: Temperature and Humidity**
 279 **Conditions**

280 The required temperature and humidity conditions are described in Table 5.

281 **Table 5: Temperature and humidity conditions**

| Parameter | Specification |
|---------------------|-------------------------------|
| Ambient Temperature | 25 degrees C +/- 5 degrees C. |
| Ambient Humidity | Up to 75 % RH +/- 1% |

282

283 **7 Static Test Procedure**

284 **7.1 Range Power Correction**

285 ***Caution: this test must be run in compliance with applicable radio***
 286 ***communications regulations at the test range location.***

287 The range setup for generating the Power Adjustment Factor, which is used in
 288 tagged test item calculations of minimum sensitivity, is shown in Figure 5.
 289 Although an anechoic test range is shown, this test can also be performed on an
 290 open area range.

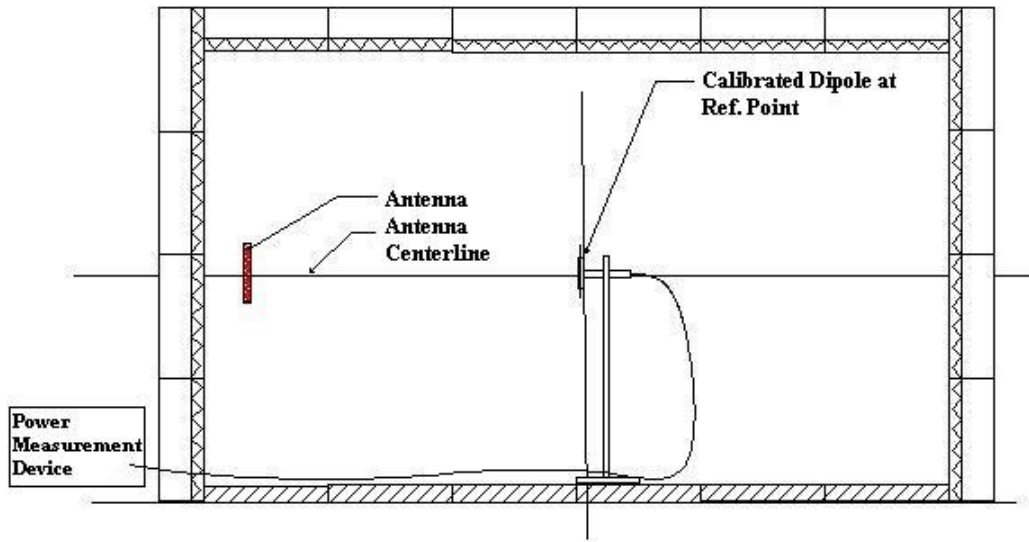


Figure 5 Range setup for setting Standard Power

291
292

7.1.1 Range Correction Procedure.

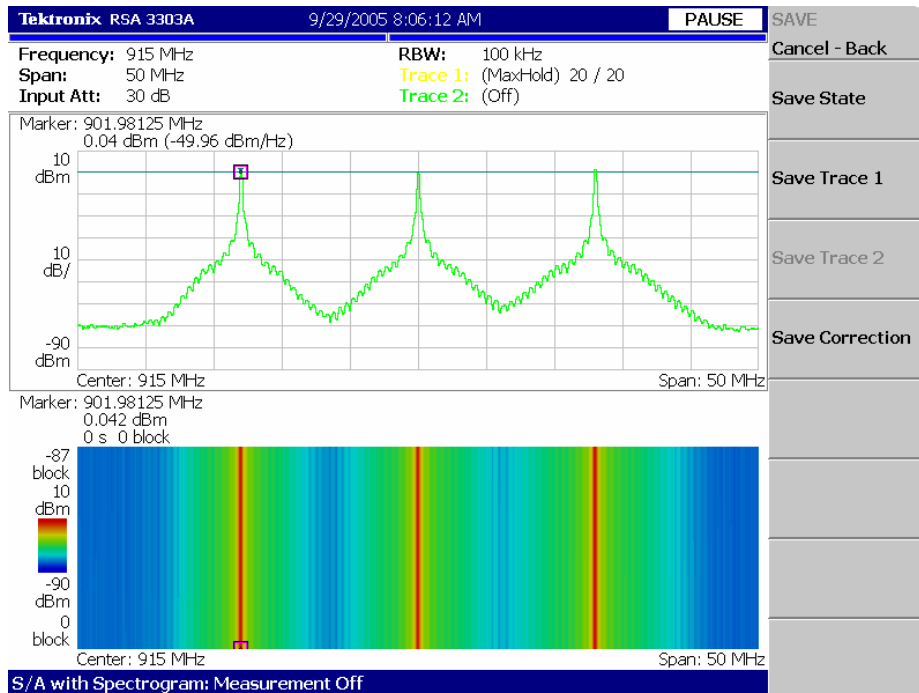
- 294 □ Set interrogator to standard transmit power:
 - 295 ○ Set transmit and receive attenuation to zero.
 - 296 ○ Set the interrogator power setting to **32 dBm or the maximum**
 - 297 **interrogator power.**
- 298 □ Turn on continuous reading of the target RFID tag.
- 299 □ If possible, inhibit frequency hopping to correct for specific channels in the
- 300 band. If the frequency band being tested is greater than 10 MHz wide, set the
- 301 frequency to the low, middle and high frequency of interest within the band
- 302 center of the band being tested (902 MHz, 915 Mhz, and 928 MHz, for
- 303 example).
- 304 □ Place the RF probe antenna at the reference point in the test range. Orient
- 305 the dipole antennas vertically. The power measurement instrument should be
- 306 placed outside of the test range.
- 307 □ If using a spectrum analyzer, set the display for maximum hold and peak
- 308 detector, and measure for at least 2 minutes while the interrogator is actively
- 309 reading. The peak readings should stabilize as time goes by.

310 Figure 6 shows an example output of a spectrum analyzer showing the peak hold

311 readings at each frequency for UHF Class-1 Generation-2 at 902, 915 and 928

312 MHz.:

313



314

315 **Figure 6 Spectrum Analyzer Readings Under Peak Hold for the Power Adjustment Factor**

316

- 317 □ Take the analyzer readings at each frequency, and calculate conversion
- 318 factors that will translate the interrogator power setting to power at the
- 319 reference point. See Section 7.1.2 for more information on how to perform
- 320 the calculations.

321

322 **7.1.2 Example Calculations for accounting for the cable loss and antenna**

323 **factor**

324 In order to obtain accurate measurements, calculations must be made to account

325 for cable loss and antenna gain. The example given in Table 6 assumes 50 Ohm

326 cabling, connections, and instruments.

327

328 **Table 6: Calculations for Antenna Factor and Cable Loss**

| Step | Calculation | Comment |
|--|------------------------------------|--|
| 1. Start with the reading of the peak power at the receiver (spectrum analyzer or power meter) | 0.38 dBm | The Interrogator is set to 32 dBm. The analyzer (attached to the probe antenna) has captured the peak reading. In this example, the reading is 0.38 dBm. |
| 2. Subtract the antenna gain from the datasheet provided with the calibrated dipole antenna. (dBi) | 0.38 dBm – 1.24 dBi = -0.86 dBm | In this example, the antenna gain is 1.24.dBi |
| 4. Add the cable and connector loss | -0.86 dBm+ 4.63 dB = 3.77 dBm | In this example, a long cable is used, and the loss of this cable is 4.63 dB. The result is the power at the Reference point, when the interrogator is set to 32 dBm. |

329

330 Record the Power at the reference point for each of the frequencies (see Table
 331 7). It is important to remember that the numbers recorded in Column B
 332 (Measured Power at Ref Point) are power levels **after** performing the calculations
 333 for antenna factor and cable loss in this section.

334 **Table 7: Power Level Adjustments**

| Freq (MHz) | (A) Interrogator Power Setting (dBm) | (B) Measured Power at Ref Point (dBm) | (B-A) Power Adjustment Factor (dB) |
|------------|---|--|---|
| 902 | 32 | 3.77 | - 28.23 |
| 915 | 32 | | |
| 928 | 32 | | |
| 865 | 32 | | |
| 866.5 | 32 | | |
| 868 | 32 | | |
| 950 | 32 | | |
| 953 | 32 | | |
| 956 | 32 | | |

335

336 **7.2 Determine Range Capability**

337 In this section, a determination will be made as to whether the transmit path or
 338 the receive path “fails” first. If the receive path maximum attenuation is greater
 339 than the forward path maximum attenuation, then the range and range test
 340 equipment should not be used. This indication is a sure sign that there is a
 341 problem with the range or test equipment used.

342 **7.2.1 Measure Minimum tag turn on power**

- 343 Select an RFID Tag selected from the population of Tags that will be used
 344 with the Unit Under Test (UUT).
- 345 Place the Tag at the reference point in the test range, parallel to the receive
 346 and transmit antenna(s). The tag should be oriented in the same orientation
 347 that it will be applied to the UUT.
- 348 Adjust Receive attenuation to zero (no attenuation)
- 349 Set up a read trial in which the tag ID is read (a read attempt) 30 times. A
 350 successful read is one that receives all the backscattered commands of UHF
 351 Class-1 Generation-2 standard. This includes the RN16 and then a
 352 PC+EPC+CRC16 after the ACK command of the Interrogator. Record the
 353 number of successful reads of the tag ID as a Detection Rate (see Section 4
 354 Terms and Definitions).

- 355 □ Adjust transmit attenuation and repeat the read trial until the tag detection
356 rate falls to 50%. Record this attenuation value as P_{TurnOn} .
- 357 □ The transmit power must be turned off for at least 500 ms between
358 attenuation levels to allow the stored energy of the tag to return to minimal
359 level.

360 **7.2.2 Measure receive path sensitivity**

- 361 □ Adjust Receive attenuation to zero.
- 362 □ Adjust Transmit attenuation to $P_{Standard}$.
- 363 □ Turn on continuous reading of the target RFID tag.
- 364 □ Increase receive attenuation until the tag detection rate falls to 50%. Record
365 this value as $RX_{AttenuationMax}$.

366 **7.2.3 Evaluate Capability**

367 The test range is capable of static test measurements if it meets the following
368 criterion:

369 $RX_{AttenuationMax} > (P_{Standard} - P_{TurnOn})$

370

371 **7.3 Tagged Case Test**

372 This section describes the procedure for using the static test method when
373 testing tags applied on cases containing items.

374

375 Place the tagged case in the test range with the RFID tag at the reference point.

376 **7.3.1 Measure Minimum tag turn on power – Tagged Case**

- 377 □ Place the UUT (the tagged case) at the reference point in the test range
- 378 □ Adjust Receive attenuation to zero (no attenuation)
- 379 □ Set up a read trial in which the tag ID is read (a read attempt) 30 times.
380 Record the number of successful reads of the tag ID as its Detection Rate.
- 381 □ Adjust transmit attenuation (or interrogator power setting) and repeat the read
382 trial until the tag detection rate falls to 0.50.
- 383 □ Record the Interrogator power setting, and transmit attenuation level (if any).
- 384 □ Calculate the tag turn-on power level for the tagged case ($P_{TurnOnC}$).

385

386 Table 8 shows a sample calculation for Tag turn-on power:

387

388 **Table 8: Minimum Tag Turn-On Power Sample Calculation**

| Step | Calculation | Comment |
|---|-------------------------------------|--|
| 1. Start with the interrogator power setting where the tag turned on (detection rate = 50%) | 20 dBm | In this example, the interrogator was set at 20 dBm. This is the point at which the detection rate fell to 50% |
| 2. Subtract the transmit attenuation level, if any. | 20 dBm – 0 dB = 20 dBm | In this example, the interrogator is capable of attenuating the transmit level, so an external attenuator was not implemented, the transmit attenuation value is zero. |
| 3. Add the Power Adjustment Factor for the frequency being measured. (See Table 7) | (20 dBm) – 28.23 dB = -8.23 dBm | In this example, the adjustment factor was measured at – 28.23 dBi. |
| 4. Record $P_{TurnOnC}$ | $P_{TurnOnC} = -8.23$ dBm | This is the final result. |

389 **NOTE:** The transmit power must be turned off for at least 500 ms between attenuation levels to
 390 allow the tag's stored energy to return to minimal level. Implement this delay in a software driven
 391 measurement system.

392

393 **7.3.2 Record $P_{TurnOnC}$ at designated frequencies.**

- 394 Perform step 7.3.1
- 395 Record $P_{TurnOnC}$ at each of the frequencies described in Table 9:

396

397 **Table 9 Test Frequencies for their respective frequency bands**

| Band | Description |
|------------------------|------------------------|
| 902-928 MHz (USA) | 902.25, 915.25, 927.75 |
| 865-868 MHz (Europe) | 866.5 |
| 950MHz – 956MHz (Asia) | 953 |

398

399 Table 10 shows a sample data table for $P_{TurnOnC}$ measurements:

400 **Table 10 Sample Data Table**

| Freq (MHz) | (A) Interrogator Power Setting at 50% detection (dBm) | (B) Transmit Attenuation (If any) (dB) | (C) Power Adjustment Factor @ Frequency (dB) | (A-B)+C $P_{TurnOnC}$ (dBm) |
|------------|--|---|---|--------------------------------|
| 902 | 20 | 0 | -28.23 | -8.23 |
| 915 | | | | |
| 928 | | | | |
| 865 | | | | |
| 866.5 | | | | |
| 868 | | | | |
| 950 | | | | |
| 953 | | | | |
| 956 | | | | |

401

402 **7.3.3 Repeat measurement at specified orientations.**

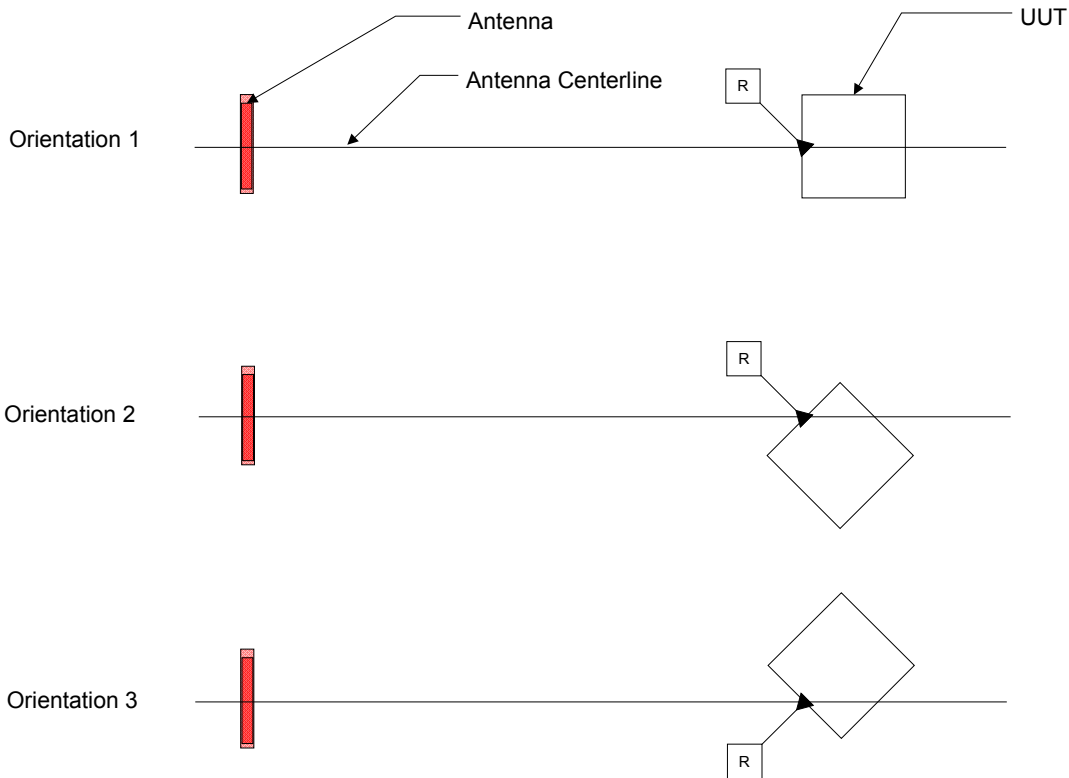
403 Repeat the Minimum Tag Turn On Power measurement for each of the following
404 orientations of the case (see Table 11). These orientations are measured in
405 order to gain an azimuthal plot of the tagged case sensitivity for 360° around the
406 case.

407 **Table 11: Tag Orientation**

| Orientation | Description |
|-------------|--|
| 1 | Tag is normal to antenna centerline, case and contents are downrange. |
| 2 | Tag is at +30 degrees to antenna centerline, case and contents are downrange. |
| 3 | Tag is at -30 degrees to antenna centerline, case and contents are downrange. |
| 4 | Repeat this test for 9 more test orientations, with an orientation angle step size of 30 degrees for each orientation. If some of those orientations do not attain a 50 % read rate, record the lowest tag power measured and mark that data point for its percentage read rate in the final report. |

408 Note: The tag is always located at the reference point.

409 The test results from different case orientation will provide valuable information
 410 on tagged case performance in different orientations. This data may be affect the
 411 tag selection, tag placement or how cases are loaded on pallets.



412

413 **Figure 7 UUT orientations showing a top view of the test range. "R" indicates the location**
 414 **of the RFID tag.**

415 **7.4 Recording of Data**

416

417 The following data need to be recorded for each iteration:

- 418 • read percentage (exact percentage)
- 419 • corresponding power level transmitted
- 420 • corrected tag turn-on power
- 421 • region tested (EU, NA, and JP)
- 422 • orientation tested

423

424 **8 Reporting Requirements**

425 The final report should include, at minimum, all information previously requested
426 along with the following:

- 427 • A brief explanation of the purpose of the test and what the results mean,
- 428 • The completed tables provided in this specification.
- 429 • Temperature, humidity,
- 430 • power adjustment factor,
- 431 • cable loss
 - 432 ○ between the interrogator and transceiving antenna,
 - 433 ○ between the characterization dipole and the power-frequency
 - 434 analyzer,
- 435 • antenna gain,
- 436 • date and time of test,
- 437 • Calibration info for the antenna, power & frequency analyzer, anechoic
- 438 chamber, and temperature/humidity sensor should be recorded.

439 **9 References**

- 440 EPCglobal™: *EPC™ Radio-Frequency Identity Protocols Class-1 Generation-2*
441 *UHF RFID Protocol for Communications at 860 MHz-960 MHz Standards*
442 *(Normative)*
- 443 EPCglobal™ *Tag Performance Parameters and Test Methods, Version 1.1.2*
444 *(Normative)*
- 445 ANSI C63.4-2003: *American National Standard for Methods of Measurement of*
446 *Radio- Noise Emissions from Low-Voltage Electrical and Electronic Equipment in*
447 *the Range of 9 kHz to 40 GHz. (Informative)*
- 448 ISO 445-1996: *Pallets for Material Handling, Vocabulary (Informative)*
- 449 ISO 21067-2004: *Packaging- Vocabulary (Informative)*

450 **10 REVISIONS**

| Rev | Date | Description |
|-------|-----------|---|
| 1.0 | 6/1/2005 | Initial straw man proposal for Static Test. Based on sub committee discussions lead by Bud Klein (Paxar) prior to 6/1/2005 M. Alexis, Tyco Safety Products. |
| 1.1 | 8/2/2005 | Revised based on initial measurements and further discussion in sub committee lead by Bud Klein (Paxar) prior to 8/2/2005 M. Alexis, - Tyco Safety Products |
| 1.2 | 8/10/2005 | Revised based further feedback, and for clarification. Requirement for floor absorber added, three case orientations described. Diagram for power measurement at Ref point added. To be resolved: - Circular or linear antenna(s)? - Add fourth orientation with case contents between antenna and tag? M. Alexis, Tyco Safety Products |
| 1.3 | 10/5/2005 | Clarifications and enhancements after first pass tests in Round Robin Test. - Measuring field strength and using antenna factors - Adjusting power settings of the interrogator to actual power seen by the tagged case. M. Alexis, Tyco Safety Products |
| 1.9 | 12/28/07 | Enhanced test methods from PTCC comments. Made major revisions. J. Hazen, MET Laboratories |
| 1.9.2 | 2/2008 | Received comments from the GM subgroup of TLRPP WG and made changes from those comments. J. Hazen, MET Laboratories |
| 1.9.4 | 5/2008 | Technical and editorial corrections. J. Hazen, MET Laboratories |

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