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| <b>CLASSIFICATION</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <b>PAGE</b>                                                                                                                                      |
| <b>TRANSMITTER EQUIPMENT CHARACTERISTICS</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                  |
| <b>1. NOMENCLATURE, MANUFACTURER'S MODEL NO.</b><br>Radio, E-band, 71-76 GHz Transmit, Full Duplex<br>1000391701                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <b>2. MANUFACTURER'S NAME</b><br>L-3 Communications, CSW                                                                                         |
| <b>3. TRANSMITTER INSTALLATION</b><br>1) SHADOW UAV underwing, 2) Fixed ground site                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <b>4. TRANSMITTER TYPE</b><br>PSK Data Communications                                                                                            |
| <b>5. TUNING RANGE</b><br>71-76 GHz                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <b>6. METHOD OF TUNING</b><br>Crystal Controlled PLL Synthesizer                                                                                 |
| <b>7. RF CHANNELING CAPABILITY</b><br>71.81 GHz, 1.7 GHz increments, 3 channels                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <b>8. EMISSION DESIGNATOR(S)</b><br>760MG1D<br>75M9G1D<br>15M2G1D<br>1M52G1D                                                                     |
| <b>9. FREQUENCY TOLERANCE</b><br>10 ppm                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                  |
| <b>10. FILTER EMPLOYED (X one)</b><br><input checked="" type="checkbox"/> a. YES <input type="checkbox"/> b. NO                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                  |
| <b>11. SPREAD SPECTRUM (X one)</b><br><input type="checkbox"/> a. YES <input checked="" type="checkbox"/> b. NO                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <b>12. EMISSION BANDWIDTH (X and complete as applicable)</b><br><input checked="" type="checkbox"/> CALCULATED <input type="checkbox"/> MEASURED |
| <b>13. MAXIMUM BIT RATE</b><br>1.14 Gbps (after coding)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | a. -3 dB See Remarks<br>b. -20 dB See Remarks<br>c. -40 dB See Remarks<br>d. -60 dB See Remarks<br>e. OC-BW See Remarks                          |
| <b>14. MODULATION TECHNIQUES AND CODING</b><br>S-OQPSK for 1 Gbps and 100 Mbps, 7/8 LDPC<br>DPSK for 10 Mbps and 1 Mbps, 7/8 LDPC<br>Root Raised Cosine, alpha = .33                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>15. MAXIMUM MODULATION FREQUENCY</b><br>285MHz (baseband single-sided -3dB point)                                                             |
| <b>16. PRE-EMPHASIS (X one)</b><br><input type="checkbox"/> a. YES <input checked="" type="checkbox"/> b. NO                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <b>17. DEVIATION RATIO</b><br>NA                                                                                                                 |
| <b>19. POWER</b><br>a. MEAN 17 W<br>b. PEP 17 W                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <b>18. PULSE CHARACTERISTICS</b><br>a. RATE NA<br>b. WIDTH NA<br>c. RISE TIME NA<br>d. FALL TIME NA<br>e. COMP RATIO NA                          |
| <b>20. OUTPUT DEVICE</b><br>GaN solid state power amplifier                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <b>21. HARMONIC LEVEL</b><br>a. 2ND Not measurable<br>b. 3RD Not measurable<br>c. OTHER Not measurable                                           |
| <b>22. SPURIOUS LEVEL</b><br>-20 dBc                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                  |
| <b>23. FCC TYPE ACCEPTANCE NO.</b><br>NA                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                  |
| <b>24. REMARKS</b><br>8. Necessary BW calculated from Annex J as $BW = 2RK/\log_2(S)$ with $R_b$ =coded bit rate, $K=0.665$ (due to Root Raised Cosine)<br>$R_b = 1.14\text{Gbps}, 114.2\text{Mbps}, 11.42\text{Mbps}, 1.14\text{Mbps}$<br><br>12. Emission BW shown is for single sided and includes model for saturated power amplifier.<br>-60dB point is diplexer skirt due to wideband power amplifier response.<br><div style="margin-left: 40px;">           1Gbps   100Mbps   10Mbps   1Mbps<br/>           12a -3dB    285      28.5      5.7      0.571   MHz<br/>           12b -20dB   410      41        8.2      0.82    MHz<br/>           12c -40dB   975      97.5     19.5     1.95    MHz<br/>           12d -60dB   4500     4500    4500    4500    MHz<br/>           12e OC-BW   385      38.5     7.7      0.77    MHz         </div> |                                                                                                                                                  |
| <b>CLASSIFICATION</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                  |

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| <b>CLASSIFICATION</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | <b>PAGE</b>                                                                                                                                      |          |      |       |     |       |     |           |     |    |     |      |     |           |     |      |      |      |     |           |      |      |      |      |     |           |     |      |     |      |     |
| <b>TRANSMITTER EQUIPMENT CHARACTERISTICS</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                  |          |      |       |     |       |     |           |     |    |     |      |     |           |     |      |      |      |     |           |      |      |      |      |     |           |     |      |     |      |     |
| <b>1. NOMENCLATURE, MANUFACTURER'S MODEL NO.</b><br>Radio, E-band, 81-86GHz Transmit, Full Duplex<br>1000391702                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <b>2. MANUFACTURER'S NAME</b><br>L-3 Communications, CSW                                                                                         |          |      |       |     |       |     |           |     |    |     |      |     |           |     |      |      |      |     |           |      |      |      |      |     |           |     |      |     |      |     |
| <b>3. TRANSMITTER INSTALLATION</b><br>1) SHADOW UAV underwing, 2) Fixed ground site                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <b>4. TRANSMITTER TYPE</b><br>PSK Data Communications                                                                                            |          |      |       |     |       |     |           |     |    |     |      |     |           |     |      |      |      |     |           |      |      |      |      |     |           |     |      |     |      |     |
| <b>5. TUNING RANGE</b><br>81-86 GHz                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <b>6. METHOD OF TUNING</b><br>Synthesizer                                                                                                        |          |      |       |     |       |     |           |     |    |     |      |     |           |     |      |      |      |     |           |      |      |      |      |     |           |     |      |     |      |     |
| <b>7. RF CHANNELING CAPABILITY</b><br>81.81 GHz, 1.7 GHz increments, 3 channels                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <b>8. EMISSION DESIGNATOR(S)</b><br>760MG1D<br>75M9G1D<br>15M2G1D<br>1M52G1D                                                                     |          |      |       |     |       |     |           |     |    |     |      |     |           |     |      |      |      |     |           |      |      |      |      |     |           |     |      |     |      |     |
| <b>9. FREQUENCY TOLERANCE</b><br>10 ppm                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                  |          |      |       |     |       |     |           |     |    |     |      |     |           |     |      |      |      |     |           |      |      |      |      |     |           |     |      |     |      |     |
| <b>10. FILTER EMPLOYED (X one)</b><br><input checked="" type="checkbox"/> a. YES <input type="checkbox"/> b. NO                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                  |          |      |       |     |       |     |           |     |    |     |      |     |           |     |      |      |      |     |           |      |      |      |      |     |           |     |      |     |      |     |
| <b>11. SPREAD SPECTRUM (X one)</b><br><input type="checkbox"/> a. YES <input checked="" type="checkbox"/> b. NO                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <b>12. EMISSION BANDWIDTH (X and complete as applicable)</b><br><input checked="" type="checkbox"/> CALCULATED <input type="checkbox"/> MEASURED |          |      |       |     |       |     |           |     |    |     |      |     |           |     |      |      |      |     |           |      |      |      |      |     |           |     |      |     |      |     |
| <b>13. MAXIMUM BIT RATE</b><br>1.14 Gbps                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | a. -3 dB See Remarks<br>b. -20 dB See Remarks<br>c. -40 dB See Remarks<br>d. -60 dB See Remarks<br>e. OC-BW See Remarks                          |          |      |       |     |       |     |           |     |    |     |      |     |           |     |      |      |      |     |           |      |      |      |      |     |           |     |      |     |      |     |
| <b>14. MODULATION TECHNIQUES AND CODING</b><br>S-OQPSK for 1 Gbps and 100 Mbps, 7/8 LDPC<br>DPSK for 10 Mbps and 1 Mbps, 7/8 LDPC<br>Root Raised Cosine, alpha = .33                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | <b>15. MAXIMUM MODULATION FREQUENCY</b><br>285MHz (baseband single-sided -3dB point)                                                             |          |      |       |     |       |     |           |     |    |     |      |     |           |     |      |      |      |     |           |      |      |      |      |     |           |     |      |     |      |     |
| <b>16. PRE-EMPHASIS (X one)</b><br><input type="checkbox"/> a. YES <input checked="" type="checkbox"/> b. NO                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <b>17. DEVIATION RATIO</b><br>NA                                                                                                                 |          |      |       |     |       |     |           |     |    |     |      |     |           |     |      |      |      |     |           |      |      |      |      |     |           |     |      |     |      |     |
| <b>19. POWER</b><br>a. MEAN 17 W<br>b. PEP 17 W                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <b>18. PULSE CHARACTERISTICS</b><br>a. RATE NA<br>b. WIDTH NA<br>c. RISE TIME NA<br>d. FALL TIME NA<br>e. COMP RATIO NA                          |          |      |       |     |       |     |           |     |    |     |      |     |           |     |      |      |      |     |           |      |      |      |      |     |           |     |      |     |      |     |
| <b>20. OUTPUT DEVICE</b><br>GaN solid state power amplifier                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | <b>21. HARMONIC LEVEL</b><br>a. 2ND Not measurable<br>b. 3RD Not measurable<br>c. OTHER Not measurable                                           |          |      |       |     |       |     |           |     |    |     |      |     |           |     |      |      |      |     |           |      |      |      |      |     |           |     |      |     |      |     |
| <b>22. SPURIOUS LEVEL</b><br>-20 dBc                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                  |          |      |       |     |       |     |           |     |    |     |      |     |           |     |      |      |      |     |           |      |      |      |      |     |           |     |      |     |      |     |
| <b>23. FCC TYPE ACCEPTANCE NO.</b><br>NA                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                  |          |      |       |     |       |     |           |     |    |     |      |     |           |     |      |      |      |     |           |      |      |      |      |     |           |     |      |     |      |     |
| <b>24. REMARKS</b><br>8. Necessary BW calculated from Annex J as $BW = 2RK/\log_2(S)$ with $R_b$ =coded bit rate, $K=0.665$ (due to Root Raised Cosine)<br>$R_b = 1.14\text{Gbps}, 114.2\text{Mbps}, 11.42\text{Mbps}, 1.14\text{Mbps}$<br><br>12. Emission BW shown is for single sided and includes model for saturated power amplifier.<br>-60dB point is diplexer skirt due to wideband power amplifier response.<br><div style="display: flex; justify-content: space-around; margin-top: 5px;"> <span>1Gbps</span> <span>100Mbps</span> <span>10Mbps</span> <span>1Mbps</span> </div> <table style="width: 100%; border-collapse: collapse; margin-top: 5px;"> <tr> <td style="width: 10%;">12a -3dB</td> <td style="width: 15%;">285</td> <td style="width: 15%;">28.5</td> <td style="width: 15%;">5.7</td> <td style="width: 15%;">0.571</td> <td style="width: 20%;">MHz</td> </tr> <tr> <td>12b -20dB</td> <td>410</td> <td>41</td> <td>8.2</td> <td>0.82</td> <td>MHz</td> </tr> <tr> <td>12c -40dB</td> <td>975</td> <td>97.5</td> <td>19.5</td> <td>1.95</td> <td>MHz</td> </tr> <tr> <td>12d -60dB</td> <td>4500</td> <td>4500</td> <td>4500</td> <td>4500</td> <td>MHz</td> </tr> <tr> <td>12e OC-BW</td> <td>385</td> <td>38.5</td> <td>7.7</td> <td>0.77</td> <td>MHz</td> </tr> </table> |                                                                                                                                                  | 12a -3dB | 285  | 28.5  | 5.7 | 0.571 | MHz | 12b -20dB | 410 | 41 | 8.2 | 0.82 | MHz | 12c -40dB | 975 | 97.5 | 19.5 | 1.95 | MHz | 12d -60dB | 4500 | 4500 | 4500 | 4500 | MHz | 12e OC-BW | 385 | 38.5 | 7.7 | 0.77 | MHz |
| 12a -3dB                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 285                                                                                                                                              | 28.5     | 5.7  | 0.571 | MHz |       |     |           |     |    |     |      |     |           |     |      |      |      |     |           |      |      |      |      |     |           |     |      |     |      |     |
| 12b -20dB                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 410                                                                                                                                              | 41       | 8.2  | 0.82  | MHz |       |     |           |     |    |     |      |     |           |     |      |      |      |     |           |      |      |      |      |     |           |     |      |     |      |     |
| 12c -40dB                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 975                                                                                                                                              | 97.5     | 19.5 | 1.95  | MHz |       |     |           |     |    |     |      |     |           |     |      |      |      |     |           |      |      |      |      |     |           |     |      |     |      |     |
| 12d -60dB                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 4500                                                                                                                                             | 4500     | 4500 | 4500  | MHz |       |     |           |     |    |     |      |     |           |     |      |      |      |     |           |      |      |      |      |     |           |     |      |     |      |     |
| 12e OC-BW                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 385                                                                                                                                              | 38.5     | 7.7  | 0.77  | MHz |       |     |           |     |    |     |      |     |           |     |      |      |      |     |           |      |      |      |      |     |           |     |      |     |      |     |
| <b>CLASSIFICATION</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                  |          |      |       |     |       |     |           |     |    |     |      |     |           |     |      |      |      |     |           |      |      |      |      |     |           |     |      |     |      |     |

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| <b>CLASSIFICATION</b>                                                                                                           |                                     |            |                                                                                                                                                                                                                                                                                                                                      | <b>PAGE</b>                                       |  |            |
| <b>RECEIVER EQUIPMENT CHARACTERISTICS</b>                                                                                       |                                     |            |                                                                                                                                                                                                                                                                                                                                      |                                                   |  |            |
| <b>1. NOMENCLATURE, MANUFACTURER'S MODEL NO.</b><br>Radio, E-band, 71-76 GHz Transmit, Full Duplex<br>1000391701                |                                     |            | <b>2. MANUFACTURER'S NAME</b><br>L-3 Communications, CSW                                                                                                                                                                                                                                                                             |                                                   |  |            |
| <b>3. RECEIVER INSTALLATION</b><br>1) SHADOW UAV underwing(airborne), 2) Fixed ground site                                      |                                     |            | <b>4. RECEIVER TYPE</b><br>Homodyne Receiver                                                                                                                                                                                                                                                                                         |                                                   |  |            |
| <b>5. TUNING RANGE</b><br>71-76 GHz                                                                                             |                                     |            | <b>6. METHOD OF TUNING</b><br>Crystal Controlled PLL Synthesizer                                                                                                                                                                                                                                                                     |                                                   |  |            |
| <b>7. RF CHANNELING CAPABILITY</b><br>71.81 GHz, 1.7 GHz increments, 3 channels                                                 |                                     |            | <b>8. EMISSION DESIGNATOR(S)</b><br>760MG1D, 75M9G1D, 15M2G1D, 1M52G1D                                                                                                                                                                                                                                                               |                                                   |  |            |
| <b>9. FREQUENCY TOLERANCE</b><br>10 ppm                                                                                         |                                     |            | <b>11. RF SELECTIVITY</b> ( <i>X and complete as applicable</i> )<br><input checked="" type="checkbox"/> CALCULATED <input type="checkbox"/> MEASURED<br>a. -3 dB 6.9 GHz<br>b. -20 dB 7.9 GHz<br>c. -60 dB 11.8 GHz<br>d. PRESELECTION TYPE<br>Cavity Filter                                                                        |                                                   |  |            |
| <b>10. IF SELECTIVITY</b>                                                                                                       | <b>1ST</b>                          | <b>2ND</b> |                                                                                                                                                                                                                                                                                                                                      |                                                   |  | <b>3RD</b> |
| a. -3 dB                                                                                                                        |                                     |            |                                                                                                                                                                                                                                                                                                                                      |                                                   |  |            |
| b. -20 dB                                                                                                                       |                                     |            |                                                                                                                                                                                                                                                                                                                                      |                                                   |  |            |
| c. -60 dB                                                                                                                       |                                     |            |                                                                                                                                                                                                                                                                                                                                      |                                                   |  |            |
| <b>12. IF FREQUENCY</b><br>a. 1ST NA<br>b. 2ND NA<br>c. 3RD NA                                                                  |                                     |            |                                                                                                                                                                                                                                                                                                                                      | <b>13. MAXIMUM POST DETECTION FREQUENCY</b><br>NA |  |            |
| <b>15. OSCILLATOR TUNED</b><br>a. ABOVE TUNED FREQUENCY<br>b. BELOW TUNED FREQUENCY<br>c. EITHER ABOVE OR BELOW TUNED FREQUENCY |                                     |            |                                                                                                                                                                                                                                                                                                                                      | <b>14. MINIMUM POST DETECTION FREQUENCY</b><br>NA |  |            |
| <b>1ST</b>                                                                                                                      | <b>2ND</b>                          | <b>3RD</b> | <b>16. MAXIMUM BIT RATE</b><br>1.14 Gb                                                                                                                                                                                                                                                                                               |                                                   |  |            |
| <input checked="" type="checkbox"/>                                                                                             | <input checked="" type="checkbox"/> |            | <b>17. SENSITIVITY</b><br>a. SENSITIVITY      See Remarks      dBm<br>b. CRITERIA      4.1dB Eb/No @ BER 1E10-8<br>c. NOISE FIG      3.7      dB<br>d. NOISE TEMP      Kelvin                                                                                                                                                        |                                                   |  |            |
| <b>18. DE-EMPHASIS</b> ( <i>X one</i> )<br><input type="checkbox"/> a. YES <input checked="" type="checkbox"/> b. NO            |                                     |            | <b>19. IMAGE REJECTION</b><br>15 dB                                                                                                                                                                                                                                                                                                  |                                                   |  |            |
| <b>20. SPURIOUS REJECTION</b><br>42 dB                                                                                          |                                     |            | <b>21. REMARKS</b><br>8. Necessary BW calculated from Annex J as $BW = 2RK/\log_2(S)$ with $R_b$ =coded bit rate, $K=0.665$ (due to Root Raised Cosine)<br>$R_b = 1.14\text{Gbps}, 114.2\text{Mbps}, 11.42\text{Mbps}, 1.14\text{Mbps}$<br><br>Block 17a. -72dBm @ 1 Gbps, -82 dBm @ 100 Mbps, -91 dBm @ 10 Mbps, -101 dBm @ 1 Mbps. |                                                   |  |            |
| <b>CLASSIFICATION</b>                                                                                                           |                                     |            |                                                                                                                                                                                                                                                                                                                                      |                                                   |  |            |

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| <b>CLASSIFICATION</b>                                                                                                                                                                                                                                                                                                                |                                     |            |                                                                        | <b>PAGE</b>                                                                                                                                           |  |
| <b>RECEIVER EQUIPMENT CHARACTERISTICS</b>                                                                                                                                                                                                                                                                                            |                                     |            |                                                                        |                                                                                                                                                       |  |
| <b>1. NOMENCLATURE, MANUFACTURER'S MODEL NO.</b><br>Radio, E-band, 81-86 GHz Transmit, Full Duplex<br>1000391702                                                                                                                                                                                                                     |                                     |            | <b>2. MANUFACTURER'S NAME</b><br>L-3 Communications, CSW               |                                                                                                                                                       |  |
| <b>3. RECEIVER INSTALLATION</b><br>1) SHADOW UAV underwing(airborne), 2) Fixed ground site                                                                                                                                                                                                                                           |                                     |            | <b>4. RECEIVER TYPE</b><br>Homodyne Receiver                           |                                                                                                                                                       |  |
| <b>5. TUNING RANGE</b><br>81-86 GHz                                                                                                                                                                                                                                                                                                  |                                     |            | <b>6. METHOD OF TUNING</b><br>Synthesizer                              |                                                                                                                                                       |  |
| <b>7. RF CHANNELING CAPABILITY</b><br>81.81 GHz, 1.7 GHz increments, 3 channels                                                                                                                                                                                                                                                      |                                     |            | <b>8. EMISSION DESIGNATOR(S)</b><br>760MG1D, 75M9G1D, 15M2G1D, 1M52G1D |                                                                                                                                                       |  |
| <b>9. FREQUENCY TOLERANCE</b><br>10 ppm                                                                                                                                                                                                                                                                                              |                                     |            |                                                                        |                                                                                                                                                       |  |
| <b>10. IF SELECTIVITY</b>                                                                                                                                                                                                                                                                                                            | <b>1ST</b>                          | <b>2ND</b> | <b>3RD</b>                                                             | <b>11. RF SELECTIVITY</b> ( <i>X and complete as applicable</i> )<br><input checked="" type="checkbox"/> CALCULATED <input type="checkbox"/> MEASURED |  |
| a. -3 dB                                                                                                                                                                                                                                                                                                                             |                                     |            |                                                                        | a. -3 dB 7.9 GHz                                                                                                                                      |  |
| b. -20 dB                                                                                                                                                                                                                                                                                                                            |                                     |            |                                                                        | b. -20 dB 10.4 GHz                                                                                                                                    |  |
| c. -60 dB                                                                                                                                                                                                                                                                                                                            |                                     |            |                                                                        | c. -60 dB 13 GHz                                                                                                                                      |  |
| <b>12. IF FREQUENCY</b>                                                                                                                                                                                                                                                                                                              |                                     |            |                                                                        | d. PRESELECTION TYPE                                                                                                                                  |  |
| a. 1ST NA                                                                                                                                                                                                                                                                                                                            |                                     |            |                                                                        | Cavity Filter                                                                                                                                         |  |
| b. 2ND NA                                                                                                                                                                                                                                                                                                                            |                                     |            |                                                                        | <b>13. MAXIMUM POST DETECTION FREQUENCY</b>                                                                                                           |  |
| c. 3RD NA                                                                                                                                                                                                                                                                                                                            |                                     |            |                                                                        | NA                                                                                                                                                    |  |
| <b>15. OSCILLATOR TUNED</b>                                                                                                                                                                                                                                                                                                          |                                     |            |                                                                        | <b>16. MAXIMUM BIT RATE</b>                                                                                                                           |  |
| a. ABOVE TUNED FREQUENCY                                                                                                                                                                                                                                                                                                             | 1ST                                 | 2ND        | 3RD                                                                    | 1.14 Gb                                                                                                                                               |  |
| b. BELOW TUNED FREQUENCY                                                                                                                                                                                                                                                                                                             | <input checked="" type="checkbox"/> |            |                                                                        | <b>17. SENSITIVITY</b>                                                                                                                                |  |
| c. EITHER ABOVE OR BELOW TUNED FREQUENCY                                                                                                                                                                                                                                                                                             |                                     |            |                                                                        | a. SENSITIVITY      See Remarks      dBm                                                                                                              |  |
| <b>18. DE-EMPHASIS</b> ( <i>X one</i> )                                                                                                                                                                                                                                                                                              |                                     |            |                                                                        | b. CRITERIA      4.1dB Eb/No @ BER 1E10-8                                                                                                             |  |
| <input type="checkbox"/> a. YES <input checked="" type="checkbox"/> b. NO                                                                                                                                                                                                                                                            |                                     |            |                                                                        | c. NOISE FIG      3.6      dB                                                                                                                         |  |
| <b>19. IMAGE REJECTION</b>                                                                                                                                                                                                                                                                                                           |                                     |            |                                                                        | d. NOISE TEMP      Kelvin                                                                                                                             |  |
| 15 dB                                                                                                                                                                                                                                                                                                                                |                                     |            |                                                                        | <b>20. SPURIOUS REJECTION</b>                                                                                                                         |  |
|                                                                                                                                                                                                                                                                                                                                      |                                     |            |                                                                        | 42 dB                                                                                                                                                 |  |
| <b>21. REMARKS</b><br>8. Necessary BW calculated from Annex J as $BW = 2RK/\log_2(S)$ with $R_b$ =coded bit rate, $K=0.665$ (due to Root Raised Cosine)<br>$R_b = 1.14\text{Gbps}, 114.2\text{Mbps}, 11.42\text{Mbps}, 1.14\text{Mbps}$<br><br>Block 17a. -72dBm @ 1 Gbps, -82 dBm @ 100 Mbps, -91 dBm @ 10 Mbps, -101 dBm @ 1 Mbps. |                                     |            |                                                                        |                                                                                                                                                       |  |
| <b>CLASSIFICATION</b>                                                                                                                                                                                                                                                                                                                |                                     |            |                                                                        |                                                                                                                                                       |  |

|                                                                                                                                                     |  |                                                                                                                  |  |
|-----------------------------------------------------------------------------------------------------------------------------------------------------|--|------------------------------------------------------------------------------------------------------------------|--|
| CLASSIFICATION                                                                                                                                      |  | PAGE                                                                                                             |  |
| <b>ANTENNA EQUIPMENT CHARACTERISTICS</b>                                                                                                            |  |                                                                                                                  |  |
| 1. <input type="checkbox"/> a. TRANSMITTING <input type="checkbox"/> b. RECEIVING <input checked="" type="checkbox"/> c. TRANSMITTING AND RECEIVING |  |                                                                                                                  |  |
| <b>2. NOMENCLATURE, MANUFACTURER'S MODEL NO.</b><br>9051237301<br>E-band Axially Displaced Ellipse Antenna                                          |  | <b>3. MANUFACTURER'S NAME</b><br>Millitech (Smiths Microwave)                                                    |  |
| <b>4. FREQUENCY RANGE</b><br>71- 86 GHz                                                                                                             |  | <b>5. TYPE</b><br>Axially Displaced Ellipse                                                                      |  |
| <b>6. POLARIZATION</b><br>Right Hand Circular                                                                                                       |  | <b>7. SCAN CHARACTERISTICS</b>                                                                                   |  |
| <b>8. GAIN</b>                                                                                                                                      |  | <b>a. TYPE</b> Vertical and Horizontal                                                                           |  |
| <b>a. MAIN BEAM</b><br>41dBi @ 86 GHz                                                                                                               |  | <b>b. VERTICAL SCAN</b>                                                                                          |  |
| <b>b. 1ST MAJOR SIDE LOBE</b><br>31dBi, 2 degrees                                                                                                   |  | <b>(1) MAX ELEV</b><br>+10 degrees                                                                               |  |
|                                                                                                                                                     |  | <b>(2) MIN ELEV</b><br>-100 degrees                                                                              |  |
|                                                                                                                                                     |  | <b>(3) SCAN RATE</b><br>60 degrees/sec                                                                           |  |
| <b>9. BEAMWIDTH</b>                                                                                                                                 |  | <b>c. HORIZONTAL SCAN</b>                                                                                        |  |
| <b>a. HORIZONTAL</b><br>1.6 degrees                                                                                                                 |  | <b>(1) SECTOR SCANNED</b><br>+110 degrees/-110 degrees                                                           |  |
| <b>b. VERTICAL</b><br>1.6 degrees                                                                                                                   |  | <b>(2) SCAN RATE</b><br>60 degrees/sec                                                                           |  |
|                                                                                                                                                     |  | <b>d. SECTOR BLANKING (X one)</b><br><input type="checkbox"/> (1) YES <input checked="" type="checkbox"/> (2) NO |  |
| <b>10. REMARKS</b>                                                                                                                                  |  |                                                                                                                  |  |
| CLASSIFICATION                                                                                                                                      |  |                                                                                                                  |  |

|                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                  |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>CLASSIFICATION</b>                                                                                                                                                                                                                                                                                                                                                                                | <b>PAGE</b>                                                                                                                                      |
| <b>TRANSMITTER EQUIPMENT CHARACTERISTICS</b>                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                  |
| <b>1. NOMENCLATURE, MANUFACTURER'S MODEL NO.</b><br>DARPA Mobile Hotspots Long Term Evolution (LTE Radio), P020712                                                                                                                                                                                                                                                                                   | <b>2. MANUFACTURER'S NAME</b><br>Athena Wireless Communications, Inc.                                                                            |
| <b>3. TRANSMITTER INSTALLATION</b><br>1) SHADOW UAV underwing(airborne), 2) Fixed ground site                                                                                                                                                                                                                                                                                                        | <b>4. TRANSMITTER TYPE</b><br>LTE MIMO-OFDMA Base Station                                                                                        |
| <b>5. TUNING RANGE</b><br>2620 - 2690 MHz                                                                                                                                                                                                                                                                                                                                                            | <b>6. METHOD OF TUNING</b><br>Direct Homodyne Conversion with PLL                                                                                |
| <b>7. RF CHANNELING CAPABILITY</b><br>1st channel at 2625 MHz, 100 KHz increments                                                                                                                                                                                                                                                                                                                    | <b>8. EMISSION DESIGNATOR(S)</b><br>9M26D1D                                                                                                      |
| <b>9. FREQUENCY TOLERANCE</b><br>0.26 ppm                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                  |
| <b>10. FILTER EMPLOYED (X one)</b><br><input checked="" type="checkbox"/> a. YES <input type="checkbox"/> b. NO                                                                                                                                                                                                                                                                                      |                                                                                                                                                  |
| <b>11. SPREAD SPECTRUM (X one)</b><br><input type="checkbox"/> a. YES <input checked="" type="checkbox"/> b. NO                                                                                                                                                                                                                                                                                      | <b>12. EMISSION BANDWIDTH (X and complete as applicable)</b><br><input type="checkbox"/> CALCULATED <input checked="" type="checkbox"/> MEASURED |
| <b>13. MAXIMUM BIT RATE</b><br>40 Mbps                                                                                                                                                                                                                                                                                                                                                               | a. -3 dB 8.99 MHz<br>b. -20 dB 9.32 MHz                                                                                                          |
| <b>14. MODULATION TECHNIQUES AND CODING</b><br>QPSK, 16-QAM, 5/6 Turbo coding, root raised cosine alpha = 0.1                                                                                                                                                                                                                                                                                        | c. -40 dB 9.66 MHz<br>d. -60 dB 10.488 MHz<br>e. OC-BW 9.98 MHz                                                                                  |
| <b>16. PRE-EMPHASIS (X one)</b><br><input type="checkbox"/> a. YES <input checked="" type="checkbox"/> b. NO                                                                                                                                                                                                                                                                                         | <b>15. MAXIMUM MODULATION FREQUENCY</b><br>10 MHz                                                                                                |
|                                                                                                                                                                                                                                                                                                                                                                                                      | <b>17. DEVIATION RATIO</b><br>N/A                                                                                                                |
| <b>19. POWER</b><br>a. MEAN 1 W<br>b. PEP 1 W                                                                                                                                                                                                                                                                                                                                                        | <b>18. PULSE CHARACTERISTICS</b><br>a. RATE N/A<br>b. WIDTH N/A<br>c. RISE TIME N/A<br>d. FALL TIME N/A<br>e. COMP RATIO N/A                     |
| <b>20. OUTPUT DEVICE</b><br>Transistor, Vendor Avago, P/N MGA43728                                                                                                                                                                                                                                                                                                                                   | <b>21. HARMONIC LEVEL</b><br>a. 2ND 36 dBc<br>b. 3RD 72 dBc<br>c. OTHER                                                                          |
| <b>22. SPURIOUS LEVEL</b><br>45.5 dBc                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                  |
| <b>23. FCC TYPE ACCEPTANCE NO.</b><br>N/A                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                  |
| <b>24. REMARKS</b><br>Block 3. The proposed usage includes LTE radios, operating concurrently, 1) is airborne based, and 2) is ground based. Reference associated Line Diagram.<br><br>Block 8. FEC and modulation is adaptive to channel conditions, user throughput will be adjusted to maintain 10 MHz occupied bandwidth.<br><br>Block 10. Band pass filter, Vendor: EPCOS, P/N B39272B5122U410. |                                                                                                                                                  |
| <b>CLASSIFICATION</b>                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                  |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |            |            |                                                                       |                                                                                                                                                       |  |
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| <b>CLASSIFICATION</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |            |            |                                                                       | <b>PAGE</b>                                                                                                                                           |  |
| <b>RECEIVER EQUIPMENT CHARACTERISTICS</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |            |            |                                                                       |                                                                                                                                                       |  |
| <b>1. NOMENCLATURE, MANUFACTURER'S MODEL NO.</b><br>DARPA Mobile Hotspots Long Term Evolution (LTE Radio), P020712                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |            |            | <b>2. MANUFACTURER'S NAME</b><br>Athena Wireless Communications, Inc. |                                                                                                                                                       |  |
| <b>3. RECEIVER INSTALLATION</b><br>1) SHADOW UAV underwing(airborne), 2) Fixed ground site                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |            |            | <b>4. RECEIVER TYPE</b><br>LTE MIMO SC-FDMA Base Station              |                                                                                                                                                       |  |
| <b>5. TUNING RANGE</b><br>2500 - 2570 MHz                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |            |            | <b>6. METHOD OF TUNING</b><br>Direct Homodyne Conversion with PLL     |                                                                                                                                                       |  |
| <b>7. RF CHANNELING CAPABILITY</b><br>1st channel 2505 MHz, 100 KHz increments                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |            |            | <b>8. EMISSION DESIGNATOR(S)</b><br>9M26D1D                           |                                                                                                                                                       |  |
| <b>9. FREQUENCY TOLERANCE</b><br>0.27 ppm                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |            |            |                                                                       |                                                                                                                                                       |  |
| <b>10. IF SELECTIVITY</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | <b>1ST</b> | <b>2ND</b> | <b>3RD</b>                                                            | <b>11. RF SELECTIVITY</b> ( <i>X and complete as applicable</i> )<br><input checked="" type="checkbox"/> CALCULATED <input type="checkbox"/> MEASURED |  |
| a. -3 dB                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | N/A*       |            |                                                                       | a. -3 dB 118 Mhz                                                                                                                                      |  |
| b. -20 dB                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | N/A        |            |                                                                       | b. -20 dB 282 Mhz                                                                                                                                     |  |
| c. -60 dB                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | N/A        |            |                                                                       | c. -60 dB See Remark                                                                                                                                  |  |
| <b>12. IF FREQUENCY</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |            |            |                                                                       | d. PRESELECTION TYPE                                                                                                                                  |  |
| a. 1ST N/A*                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |            |            |                                                                       | SAW filter                                                                                                                                            |  |
| b. 2ND                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |            |            |                                                                       | <b>13. MAXIMUM POST DETECTION FREQUENCY</b>                                                                                                           |  |
| c. 3RD                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |            |            |                                                                       | N/A                                                                                                                                                   |  |
| <b>15. OSCILLATOR TUNED</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |            |            |                                                                       | <b>16. MAXIMUM BIT RATE</b>                                                                                                                           |  |
| a. ABOVE TUNED FREQUENCY                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |            |            |                                                                       | 40 Mbps                                                                                                                                               |  |
| b. BELOW TUNED FREQUENCY                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |            |            |                                                                       | <b>17. SENSITIVITY</b>                                                                                                                                |  |
| c. EITHER ABOVE OR BELOW TUNED FREQUENCY                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |            |            |                                                                       | a. SENSITIVITY                                                                                                                                        |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |            |            |                                                                       | -96 dBm                                                                                                                                               |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |            |            |                                                                       | b. CRITERIA                                                                                                                                           |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |            |            |                                                                       | 1 x 10-E-6                                                                                                                                            |  |
| <b>18. DE-EMPHASIS</b> ( <i>X one</i> )                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |            |            |                                                                       | c. NOISE FIG                                                                                                                                          |  |
| <input type="checkbox"/> a. YES <input checked="" type="checkbox"/> b. NO                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |            |            |                                                                       | 4dB dB                                                                                                                                                |  |
| <b>19. IMAGE REJECTION</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |            |            |                                                                       | d. NOISE TEMP                                                                                                                                         |  |
| N/A (Direct Conversion)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |            |            |                                                                       | 438.4 Kelvin                                                                                                                                          |  |
| <b>20. SPURIOUS REJECTION</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |            |            |                                                                       | See Remark                                                                                                                                            |  |
| <b>21. REMARKS</b><br>Block 3. The proposed usage includes LTE radios, operating concurrently, 1) is airborne based, and 2) is ground based. Reference Figure 2<br><br>Block 8. FEC and modulation vary with user throughput, to keep occupied bandwidth at 10 MHz<br><br>Block 10, 12, 15 Direct conversion to baseband, no IF stage<br><br>Block 11. Use EPCOS B5115 filter, which does not support selectivity at or below -60 dB<br><br>Block 20. Max input spurious level Pin = -15 dBm absolute power. Product complies to 3GPP TS 36.104 version 9.13 release 9 Table 7.6.1.1-1a.<br><a href="http://www.etsi.org/deliver/etsi_ts/136100_136199/136104/09.13.00_60/ts_136104v091300p.pdf">http://www.etsi.org/deliver/etsi_ts/136100_136199/136104/09.13.00_60/ts_136104v091300p.pdf</a> |            |            |                                                                       |                                                                                                                                                       |  |
| <b>CLASSIFICATION</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |            |            |                                                                       |                                                                                                                                                       |  |

## FULL RECORD PRINT FOR Receiver

**RECEIVER MM2-EX Family**

**Nomenclature** : (U) MM2-EX Family  
**Other Nomenclature** : (U) MM2-EX-P  
**Other Nomenclature** : (U) MM2-EX-T  
**Manufacturer** : (U) FREEWAVE INC  
  
**RxType** : (U) Spread Spectrum Frequency Hopping  
**NTIA Approval Status** : (U) Unapproved  
**Coordination ID** : J/F 12  
**Date of Import** : 4/9/2015 4:14:55 PM (GMT)  
**Date/Time Last Mod.** : 4/7/2015 2:21:16 PM (GMT)  
**Freq. Stability** : (U) 1.5ppm  
**Image Reject** : (U) 70.0 dB  
**Oscillator Tuned** : (U) Above  
**Tuning Method** : (U) Digital Synthesizer  
**Maximum Bit Rate** : (U) 0.154 Mbps

**Frequencies**

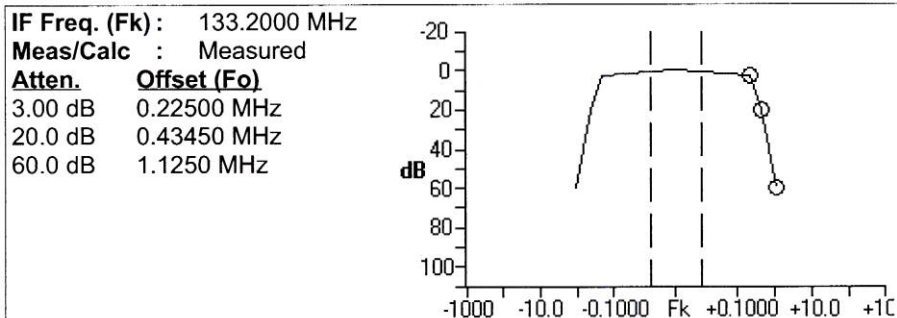
**Tuned Frequency:** (U) 902.2464 MHz - 927.8208 MHz

**Tuning Increment:** (U) 230.40 kHz

**Sensitivities**

**Em. Designator** : (U) 220KF1D  
**Necessary BW** : (U) 0.22000 MHz  
**Perf. Crit.** : (U) BER - Bit Error Rate

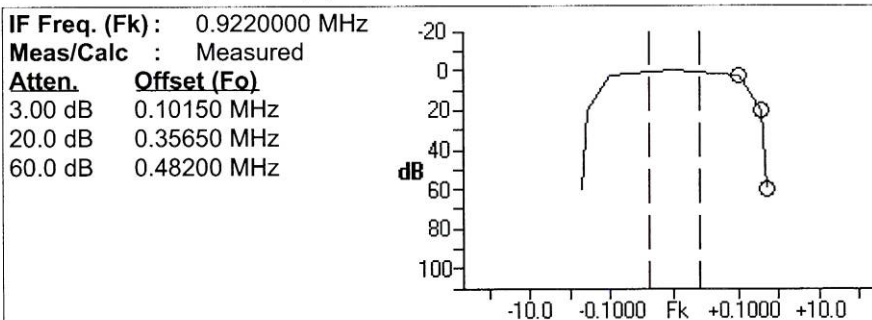
**Perf. Value** : (U) 0.0001  
**Sensitivity** : (U) -103 dBm  
**Noise Fig.** : (U) 3.39 dB  
**Noise Temp.** : (U) 344 K  
**Spur. Reject** : (U) 60.0 dB

**Figure 1 - IF Selectivity Curve (U)**

(UNCLASSIFIED)

## FULL RECORD PRINT FOR Receiver

Figure 2 - IF Selectivity Curve (U)



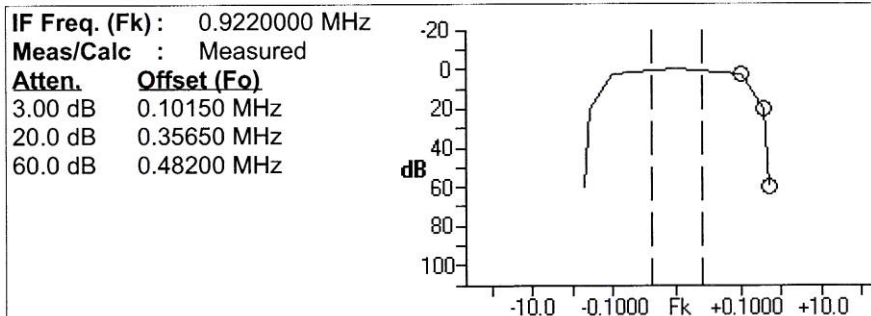
(UNCLASSIFIED)

Sensitivities

Em. Designator : (U) 210KF1D  
Necessary BW : (U) 0.21000 MHz  
Perf. Crit. : (U) BER - Bit Error Rate

Perf. Value : (U) 0.0001  
Sensitivity : (U) -108 dBm  
Noise Fig. : (U) 3.39 dB  
Noise Temp. : (U) 344 K  
Spur. Reject : (U) 60.0 dB

Figure 3 - IF Selectivity Curve (U)

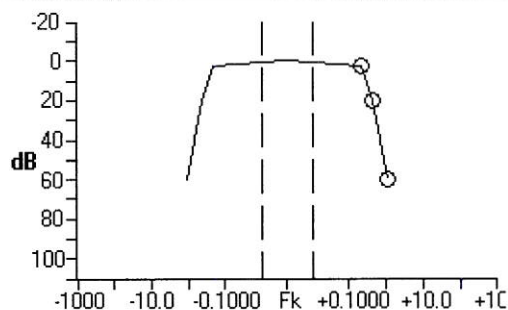


(UNCLASSIFIED)

## FULL RECORD PRINT FOR Receiver

Figure 4 - IF Selectivity Curve (U)

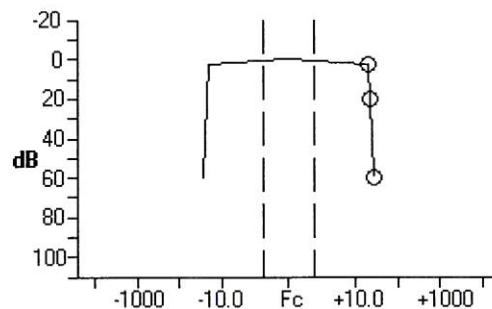
IF Freq. (Fk): 133.2000 MHz  
Meas/Calc : Measured  
**Atten.**    **Offset (Fo)**  
3.00 dB    0.22500 MHz  
20.0 dB    0.43450 MHz  
60.0 dB    1.1250 MHz



(UNCLASSIFIED)

Figure 5 - RF Selectivity Curve (U)

Meas/Calc : Measured  
**Atten.**    **Offset (Fo)**  
3.00 dB    19.800 MHz  
20.0 dB    22.400 MHz  
60.0 dB    26.450 MHz



(UNCLASSIFIED)

**Remark(s)** (U)

- (U) 1. General - The RF rate is selectable and affects the emissions and sensitivity so emission designators are include for both.
- (U) 2. Item 10 - Additional match and baseband filtering is applied to the demodulation.

## FULL RECORD PRINT FOR Transmitter

**TRANSMITTER MM2-EX Family**

**Nomenclature** : (U) MM2-EX Family  
**Other Nomenclature** : (U) MM2-EX-P  
**Other Nomenclature** : (U) MM2-EX-T  
**Manufacturer** : (U) FREEWAVE INC  
  
**Tx Type** : (U) Spread Spectrum Frequency Hopping  
**NTIA Approval Status** : (U) Unapproved  
**Coordination ID** : J/F 12  
**Date of Import** : 4/9/2015 4:15:16 PM (GMT)  
**Date/Time Last Mod.** : 10/16/2014 3:17:50 PM (GMT)  
**Filter Type** : (U) Gaussian Low Pass Filter

**Freq. Stability** : (U) 1.5ppm  
**Output Device** : (U) Field Effect Transistor  
**Tuning Method** : (U) Digital Synthesizer  
**Radar/Comm** : (U) Communications  
**Supp. of Harmonics** : (U) No

**Powers**

**Power Type** : Peak Envelope  
**Lower Limit** : (U) 0.00500 W  
**Upper Limit** : (U) 1.50 W

**Frequencies**

**Tuned Frequency** : (U) 902.2464 MHz - 927.8208 MHz  
**Tuning Increment** : (U) 230.40 kHz  
**Number Freq. Required** : (U) 50  
**Min. Separation** : (U) 0.2304000 MHz  
**Freq. Blocking Indicator** : (U) No  
**Lowest Usable Channel** : (U) 902.2464 MHz  
**Em. Designator** : (U) 210KF1D  
**Necessary BW** : (U) 0.21000 MHz

**Modulation - 210KF1D**

**Occupied Bandwidth** : (U) 0.21762 MHz  
**Measured/Calculated** : (U) Measured  
**Radar/Communications** : (U) Communications  
**Modulation Type** : (U) Digital Modulation  
**Max. Modulation Frequency** : (U) 0.057600 MHz  
**Low Freq. Hop** : (U) 902.2462 MHz  
**High Frequency Hop** : (U) 927.8202 MHz  
**Spread Spectrum** : Yes  
**Spread Spectrum Type** : (U) Frequency Hopped  
**SS Processing Gain** : (U) 20.4 dB  
**Dig. Modulation Type** : (U) GFSK - Gaussian Frequency Shift Keying

**Number of Digital States** : (U) 2  
**Digital Bit Rate** : (U) 0.115 Mbps  
**Deviation Ratio** : (U) 0.803  
**Digital Peak Deviation** : (U) 0.046253 MHz  
**Number Freq. Hop Sets** : (U) 7  
**Number Freq. Per Hop** : (U) 112  
**Number of Freq. Hop** :  
**Pulses Per Dwell** : (U) 16  
**Lowest Frequency in Hop** : (U) 902.2462 MHz

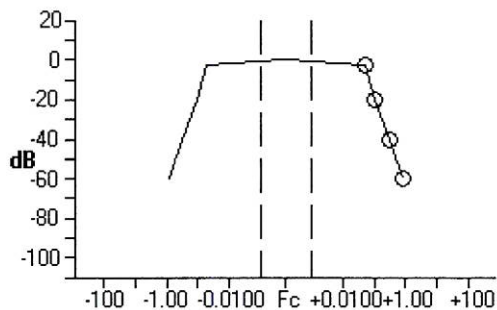
## FULL RECORD PRINT FOR Transmitter

Highest Frequency in Hop : (U) 927.8202 MHz  
 Frequency Hop Rate : (U) 47.0 /sec  
 Frequency Hop Dwell Time : (U) 6.00 ms

Figure 1 - Fundamental Curve (U)

Meas/Calc : Measured  
 Level Offset (Fo)

-3.00 dB 0.055000 MHz  
 -20.0 dB 0.110000 MHz  
 -40.0 dB 0.310000 MHz  
 -60.0 dB 0.785000 MHz



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Em. Designator : (U) 220KF1D  
 Necessary BW : (U) 0.22000 MHz

Modulation - 220KF1D

Occupied Bandwidth : (U) 0.22300 MHz  
 Measured/Calculated : (U) Measured  
 Radar/Communications : (U) Communications  
 Modulation Type : (U) Digital Modulation  
 Max. Modulation Frequency : (U) 0.076800 MHz  
 Low Freq. Hop : (U) 902.2464 MHz  
 High Frequency Hop : (U) 927.8202 MHz  
 Spread Spectrum : Yes  
 Spread Spectrum Type : (U) Frequency Hopped  
 SS Processing Gain : (U) 20.4 dB  
 Dig. Modulation Type : (U) GFSK - Gaussian Frequency Shift Keying

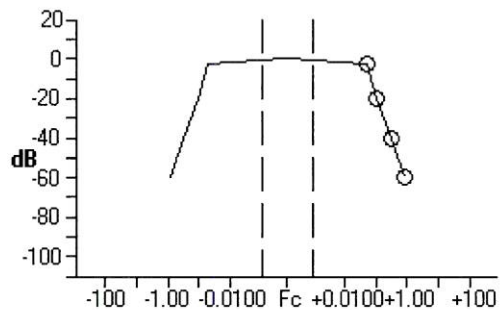
Number of Digital States : (U) 2  
 Digital Bit Rate : (U) 0.154 Mbps  
 Deviation Ratio : (U) 0.603  
 Digital Peak Deviation : (U) 0.046310 MHz  
 Number Freq. Hop Sets : (U) 7  
 Number Freq. Per Hop : (U) 112  
 Number of Freq. Hop Pulses Per Dwell : (U) 16  
 Lowest Frequency in Hop : (U) 902.2464 MHz  
 Highest Frequency in Hop : (U) 927.8202 MHz  
 Frequency Hop Rate : (U) 47.0 /sec  
 Frequency Hop Dwell Time : (U) 6.00 ms

## FULL RECORD PRINT FOR Transmitter

Figure 2 - Fundamental Curve (U)

Meas/Calc : Measured  
 Level Offset (Fo)

|          |              |
|----------|--------------|
| -3.00 dB | 0.055000 MHz |
| -20.0 dB | 0.11000 MHz  |
| -40.0 dB | 0.31000 MHz  |
| -60.0 dB | 0.78500 MHz  |



(UNCLASSIFIED)

**Remark(s)** (U)

- (U) 1. The RF rate is selectable which affects the transmission bit rate so an emissions designator is included for both.
- (U) 2. The configuration of the radio affects various frequency hopping parameters.
- (U) 2a. The number of frequencies within the hop set is user selectable from 50 to 112.
- (U) 2b. The hop rate varies between 47 to 167 hops per second depending on the configuration.
- (U) 2c. The hop dwell time varies from 6 to 21 milliseconds depending on the configuration.
- (U) 2d. The hop pulses per dwell varies from 16 to 317 milliseconds depending on the configuration.