AEP Blue Cat
MIL-STD-188-125-1
Acceptance Shielding Effectiveness
Acceptance Test Plan and Procedures

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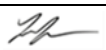
Luke Johnson	Engineer		07OCT2022
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LIST OF ACRONYMS AND SYMBOLS

A	Ampere
AC	Alternating Current
AON	Amplifier Off Noise
CC	Coupled Current
CP	Control Panel
CW	Continuous Wave
CWI	Continuous Wave Immersion
DAS	Data Acquisition System
dB	Decibel
dBi	Decibel level relative to an isotropic source
E Field	Electric Field
EM	Electromagnetic
EMP	Electromagnetic Pulse
ENSR	Energy Noise to Signal Ratio
EP	Entry Panel
ft	Imperial Feet
H Field	Magnetic Field
HEMP	High-Altitude Electromagnetic Pulse
HF	High Frequency
HM/HS	Hardness Maintenance/Hardness Surveillance
HPF	High-Pass Filter
Hz	Hertz
J-box	Junction Box
JEM	Jaxon Engineering and Maintenance
m	Metric Meter
MIL-STD	Military Standard
PCI	Pulsed Current Injection
PLC	Programmable Logic Control
PoE	Point-of-Entry
PPD	Point-of-Entry Protective Device
RF	Radio Frequency
RX	Receiver
SE	Shielding Effectiveness
Sec	Second
SN	Serial Number
SW	Software
TP	Transmit Position [of the CWI antenna]
TX	Transmitter
V/m	Volts per meter
WBC	Waveguide Below Cutoff

1. INTRODUCTION

This Test Plan and Procedures (TPP) document describes the MIL-STD-188-125-1 Acceptance Shielding Effectiveness (SE) testing to be performed by Jaxon Engineering and Maintenance (JEM) test plan for the HEMP-hardened Blue Cat 'Area C EM barrier at Shreveport, LA'.

1.1. PURPOSE

A Shielding Effectiveness (SE) test is one of two major components of an overall MIL-STD-188-125-1 Acceptance test program, the other being a Pulsed Current Injection (PCI) test.

The definition of a High-Altitude Electro-Magnetic Pulse (HEMP) acceptance test, as provided in MIL-STD-188-125-1, is as follows:

> **3.3.9** HEMP Acceptance Test: An acceptance test of a system, subsystem, or component performed to ensure that specified HEMP performance characteristics have been met. HEMP acceptance tests, conducted near the conclusion of a hardening construction or installation contract, are tests for the purpose of demonstrating that at least minimum performance requirements of the HEMP protective subsystem have been achieved before the subsystem is accepted by the Government from the contractor.

1.2. TEST OVERVIEW

The testing described in this plan is performed to characterize the shielding effectiveness performance of the site when tested in accordance with the methodology and guidance given in Appendix A of MIL-STD-188-125-1. The measured shielding effectiveness provided by the areas are compared against the applicable performance specifications given in MIL-STD-188-125-1 to verify that it provides the required level of shielding effectiveness. During the acceptance SE testing effort, faulty or defective Point-of-Entry Protective Device (PPDs) or installation practices will be identified so that that repairs and / or replacements can be made.

1.3. TEST SCHEDULE

The actual test will be scheduled following review and approval of this plan.

1.4. REFERENCE DOCUMENT(S)

The following specifications, standards, documents, and handbooks were used in the preparation of this test plan and are relevant to this MIL-STD-188-125-1 acceptance shielding effectiveness test effort.

Military Standards and/or Handbooks:

[1]. Department of Defense, "High-Altitude Electromagnetic Pulse (HEMP) Protection for Ground-Based C4I Facilities Performing Critical, Time-Urgent Missions Part 1 Fixed Facilities", MIL-STD-188-125-1, July 1998.
[2]. Department of Defense, "High-Altitude Electromagnetic Pulse (HEMP) Environment", MIL-STD-2169C, (document is classified SECRET).
[3]. Department of Defense, "High-Altitude Electromagnetic Pulse (HEMP) Protection for Fixed and Transportable Ground-Based Facilities, Volume I: Fixed Facilities", MIL-HDBK-423, May 1993.

Internal Jaxon Documents:

[4]. Jaxon Engineering and Maintenance, "Jaxon Safety Policy".

2. TEST ARTICLE DESCRIPTION

2.1. DESCRIPTION OF THE AREA C BLUE CAT

The Blue Cat Area C supports the HEMP and critical function for the AEP control building. The building consists of three areas (A, B and C) but only area C is HEMP shielded. The HEMP shield consists of Points-of-Entry (PoE) (WBC, filters, waveguides, and RF doors) and is shieled by 0.25-inch mild steel.

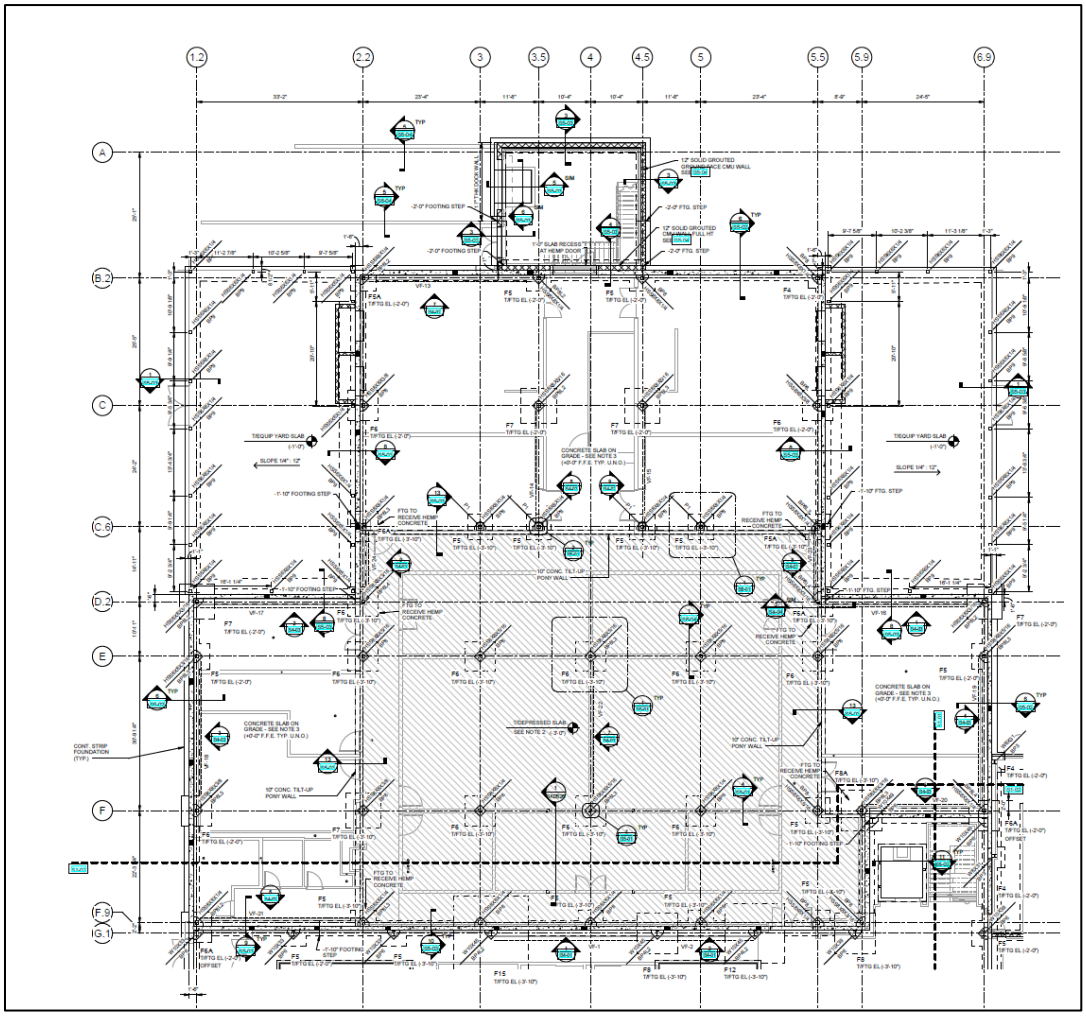

Figure 1. Blue Cat Area C Configuration

3. MIL-STD-188-125-1 SHIELDING EFFECTIVENESS TESTING

In general, a MIL-STD-188-125-1 acceptance Shielding Effectiveness (SE) test characterizes the SE performance of a topologically complete electromagnetic barrier including not only the shield itself, but also all associated electrical, mechanical, structural and aperture PoE protective devices (PPDs) or treatments.

3.1. ACCEPTANCE SE TESTING OVERVIEW

The acceptance shielding effectiveness test method defined in Appendix A of MIL-STD-188-125-1 is essentially a measurement of insertion loss which is performed at individual discrete frequencies. At each measurement frequency, the shielding effectiveness at a test point on an electromagnetic barrier is defined as the ratio, or difference when expressed in decibels, of the signal produced by a receive antenna (voltage or power) in the measurement configuration (shield present) to that produced by the same antenna when in the calibration configuration (shield absent), as shown in Figure 2 which is taken from Appendix A of MIL-STD-188-125-1. In practice, shielding effectiveness is a function of the type and nature of the illuminating electromagnetic field (near field versus far field, magnetic versus electric and plane wave, etc.).

Conceptually, the only difference between the calibration and measurement configurations is the insertion of the EM barrier or shield between the paired transmit and receive antennas. All other measurement parameters (such as antenna spacing and polarities) and equipment settings (such as transmit amplifier input power and gain), are kept the same for both the calibration and measurement configurations. Adjustable diagnostic equipment settings, such as receive signal path attenuation or gain, are properly accounted when comparing the signals provided by the receive antenna in the calibration and measurement configurations to determine the shielding effectiveness at the measurement location.

At each measurement point or location, a MIL-STD-188-125-1 Appendix A acceptance shielding effectiveness measurement is made across a wide frequency range using three different pairs of transmit and receive antennas, with one antenna in each pair serving as the transmit antenna and the other as receive. Over the “low frequency” range from 10 kHz to 20 MHz the measurement is that of near-field magnetic field shielding effectiveness and is made using loop antennas. Over the “mid frequency” range from 20 MHz to approximately 200 MHz biconical antennas are used; the SE measurement starts as one of near-field electric field shielding effectiveness, transitioning to plane wave shielding effectiveness at the upper end of the range. Finally, over the “high frequency” range from approximately 200 MHz to 1 GHz the measurement is mostly one of plane wave shielding effectiveness which is made using log periodic antennas.

Each of the three pairs of antennas (loops, bicones, and log periodics) are calibrated at the start of the overall baseline SE test effort. The resultant calibration sweep is combined with the measurements made each test point to provide the actual SE result for each frequency range. Finally, for each test point and antenna polarity the individual results from each frequency range are combined into a single combined shielding effectiveness result which covers the entire 10 kHz

to 1 GHz frequency range. This combined SE result can then easily be compared to the MIL-STD-188-125-1 acceptance SE performance requirement.

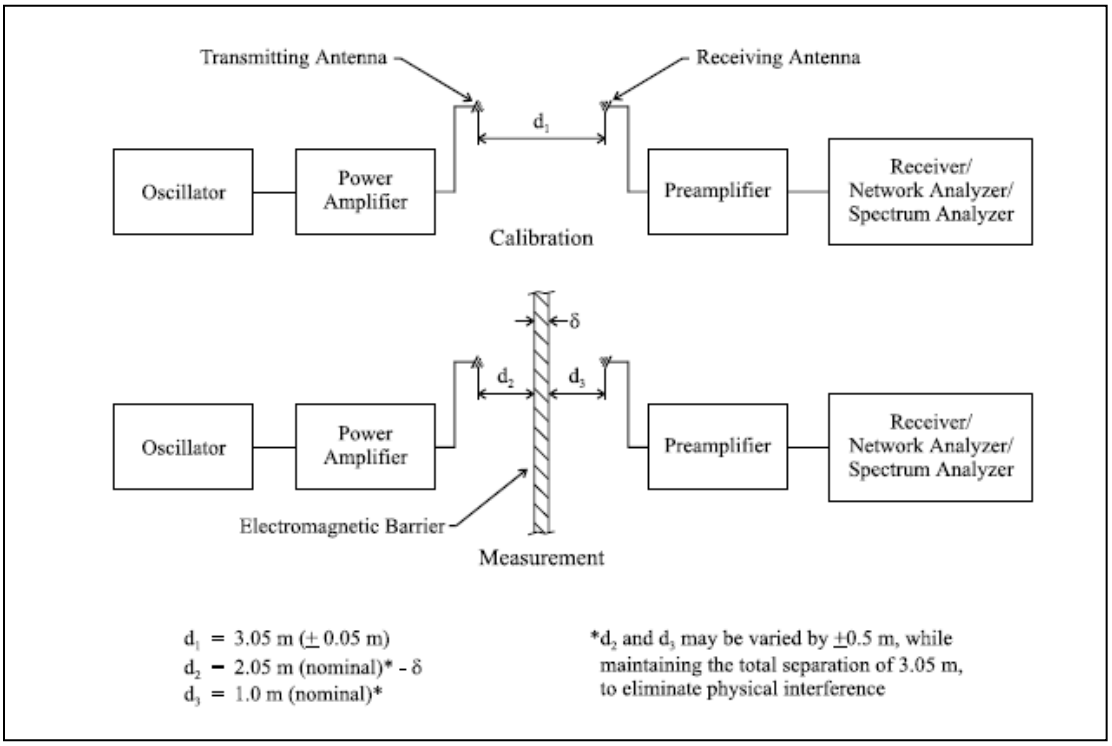

Figure 2. MIL-STD-188-125-1 Acceptance SE Calibration and Measurement Configurations

3.2. ACCEPTANCE SE PERFORMANCE REQUIREMENT

The acceptance shielding effectiveness requirement levied by MIL-STD-188-125-1 is shown in Figure 3. Note that Appendix A of MIL-STD-188-125-1 requires that acceptance SE measurements start at 10 kHz and end at 1 GHz.

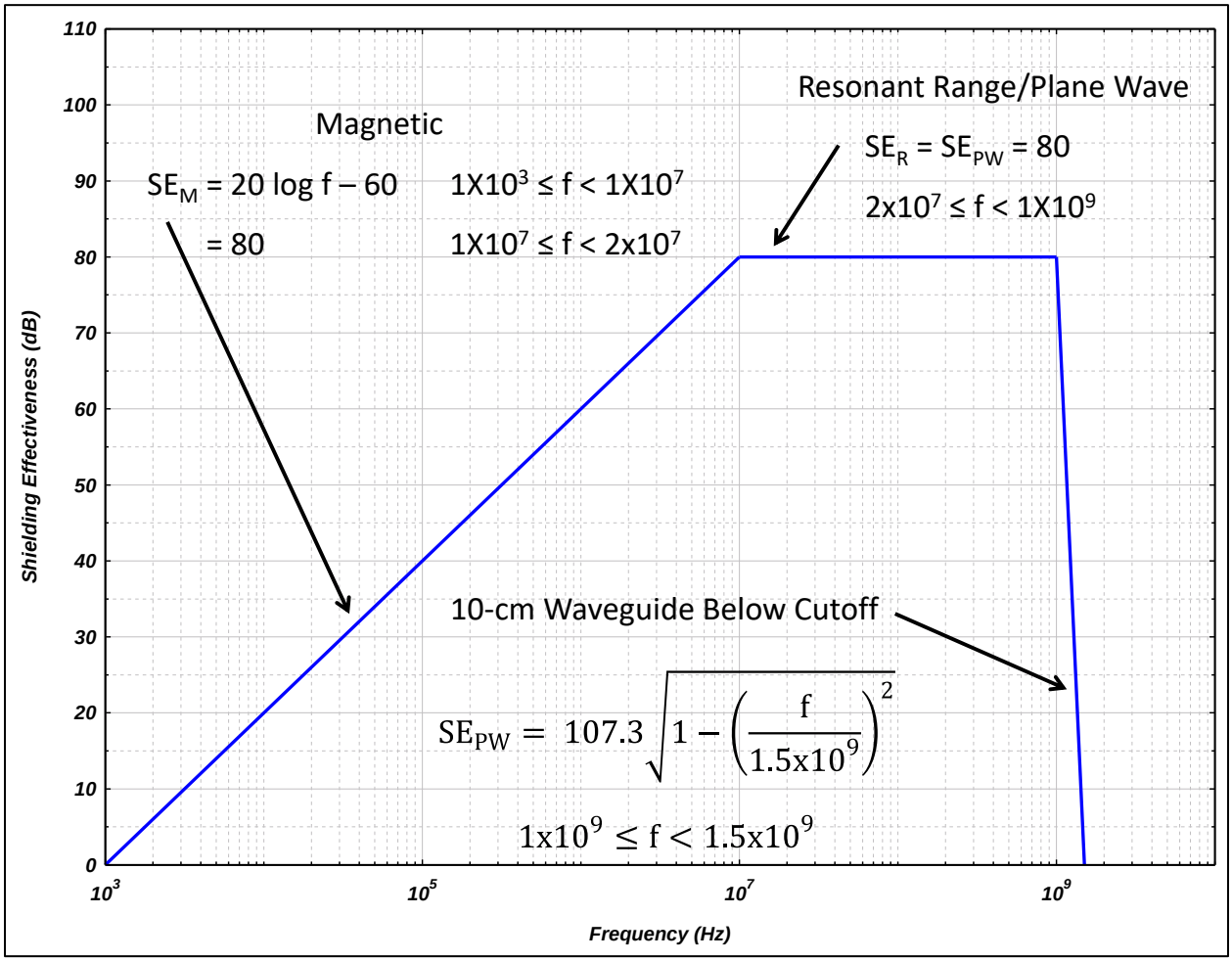

Figure 3. Nominal MIL-STD-188-125-1 Acceptance SE Performance Requirement

3.3. ACCEPTANCE SE MEASUREMENT REQUIREMENTS

MIL-STD-188-125-1 provides details of the required acceptance SE measurement system and measurement procedures, including measurement frequencies, antenna types, minimum measurement system sensitivity, test point selection, and so forth. These requirements are summarized in the following sections of this TPP document. Included are details of the Jaxon acceptance SE measurement system which meets all MIL-STD-188-125-1 requirements.

3.3.1. TEST FREQUENCIES AND DENSITY

As defined in MIL-STD-188-125-1, shielding effectiveness measurements are to be performed over the frequency range of 10 kHz to 1 GHz. Measurements at a minimum total of 380 discrete frequencies are required. Within each decade, MIL-STD-188-125-1 further provides the minimum number of measurement frequencies that are to be spaced approximately logarithmically. This is detailed in Table 1 which also includes the type of field to be generated, and thus the type of antenna to be used, within each frequency decade.

The Jaxon MIL-STD-188-125-1 acceptance SE measurement system can be programmed with any desired set of measurement frequencies. This allows any individual frequency or frequency ranges to be avoided as required by the site frequency authorization. Prior to any specific MIL-STD-188-125-1 acceptance SE or baseline SE test effort an overall test "frequency list" in the form of three Excel spreadsheets, one each for the low, medium, and high frequency ranges, will be generated. Each sheet is composed of a list of the specific test frequencies within the respective range that have been allocated for the test. In this manner the Jaxon MIL-STD-188-125-1 acceptance SE measurement system can accommodate any arbitrary list of test frequencies.

Table 1. Acceptance SE measurement field type and frequency density by decade.

Frequency Range		Field Type	MIL-STD-188-125-1 Minimum
LOW	HIGH		Number of Test Frequencies
10 kHz	100 kHz	magnetic	20
100 kHz	1 MHz	magnetic	20
1 MHz	10 MHz	magnetic	40
10 MHz	100 MHz	electric	150
100 MHz	1 GHz	electric / plane wave	150

For reference, tables giving specific frequencies forming a (possible) "default" set of MIL-STD-188-125-1 acceptance SE testing frequencies are provided in Table 2, 0, 0, and 0 for the low, medium (two tables) and high frequency ranges, respectively. The specific frequencies given in these tables are based on the guidance given in Table 1, namely the required minimum number of frequencies in each decade which are spaced equally in log10 (frequency) space (i.e., a constant ratio between adjacent frequency points). However, for each range the total number of frequencies provided greatly exceeds that required by MIL-STD-188-125-1. Specifically, for the low frequency range (10 kHz to 20 MHz) Table 2 contains a total of 202 frequencies; for the mid frequency range (20 MHz to 300 MHz) 0 (part 1) and 0 (part 2) contain a total of 402 frequencies; and for the high frequency (200 MHz to 1 GHz) 0 contains a total of 202 frequencies. This default set of acceptance SE test frequencies has in the past been used extensively by Jaxon and provides a very thorough characterization of shielding effectiveness, especially over the mid and high frequency ranges.

These lists are provided as a starting point for the frequency authorization process. Frequencies can be moved, deleted, or added to accommodate local restrictions as required. The objective, however, is to maintain—to the extent possible—the minimum number of approximately equally spaced measurement frequencies over each decade as detailed in Table 1.

Table 2. Generic MIL-STD-188-125-1 Acceptance SE Testing Frequency List, LF Range

PNT	FREQUENCY	PNT	FREQUENCY	PNT	FREQUENCY	PNT	FREQUENCY	PNT	FREQUENCY	PNT	FREQUENCY
1	1.000000E+04	35	3.617289E+04	69	1.308478E+05	103	4.733142E+05	137	1.712114E+06	171	6.193212E+06
2	1.038540E+04	36	3.756697E+04	70	1.358906E+05	104	4.915555E+05	138	1.778098E+06	172	6.431895E+06
3	1.078564E+04	37	3.901479E+04	71	1.411278E+05	105	5.104999E+05	139	1.846625E+06	173	6.679777E+06
4	1.120132E+04	38	4.051840E+04	72	1.465668E+05	106	5.301743E+05	140	1.917793E+06	174	6.937213E+06
5	1.163301E+04	39	4.207996E+04	73	1.522154E+05	107	5.506070E+05	141	1.991704E+06	175	7.204570E+06
6	1.208134E+04	40	4.370170E+04	74	1.580817E+05	108	5.718271E+05	142	2.068464E+06	176	7.482231E+06
7	1.254695E+04	41	4.538595E+04	75	1.641741E+05	109	5.938650E+05	143	2.148181E+06	177	7.770592E+06
8	1.303050E+04	42	4.713510E+04	76	1.705013E+05	110	6.167523E+05	144	2.230971E+06	178	8.070067E+06
9	1.353269E+04	43	4.895166E+04	77	1.770723E+05	111	6.405217E+05	145	2.316952E+06	179	8.381084E+06
10	1.405424E+04	44	5.083824E+04	78	1.838966E+05	112	6.652071E+05	146	2.406246E+06	180	8.704087E+06
11	1.459588E+04	45	5.279752E+04	79	1.909839E+05	113	6.908439E+05	147	2.498982E+06	181	9.039539E+06
12	1.515840E+04	46	5.483231E+04	80	1.983443E+05	114	7.174687E+05	148	2.595291E+06	182	9.387918E+06
13	1.574260E+04	47	5.694552E+04	81	2.059884E+05	115	7.451196E+05	149	2.695313E+06	183	9.749724E+06
14	1.634931E+04	48	5.914018E+04	82	2.139271E+05	116	7.738361E+05	150	2.799189E+06	184	1.012547E+07
15	1.697941E+04	49	6.141941E+04	83	2.221718E+05	117	8.036594E+05	151	2.907068E+06	185	1.051571E+07
16	1.763378E+04	50	6.378649E+04	84	2.307342E+05	118	8.346321E+05	152	3.019105E+06	186	1.092098E+07
17	1.831338E+04	51	6.624479E+04	85	2.396265E+05	119	8.667984E+05	153	3.135460E+06	187	1.134186E+07
18	1.901917E+04	52	6.879784E+04	86	2.488616E+05	120	9.002044E+05	154	3.256299E+06	188	1.177898E+07
19	1.975216E+04	53	7.144927E+04	87	2.584527E+05	121	9.348979E+05	155	3.381796E+06	189	1.223293E+07
20	2.051340E+04	54	7.420289E+04	88	2.684133E+05	122	9.709284E+05	156	3.512128E+06	190	1.270438E+07
21	2.130398E+04	55	7.706264E+04	89	2.787578E+05	123	1.008348E+06	157	3.647484E+06	191	1.319400E+07
22	2.212502E+04	56	8.003260E+04	90	2.895010E+05	124	1.047209E+06	158	3.788057E+06	192	1.370249E+07
23	2.297771E+04	57	8.311702E+04	91	3.006583E+05	125	1.087568E+06	159	3.934047E+06	193	1.423058E+07
24	2.386326E+04	58	8.632031E+04	92	3.122455E+05	126	1.129482E+06	160	4.085663E+06	194	1.477902E+07
25	2.478294E+04	59	8.964705E+04	93	3.242793E+05	127	1.173012E+06	161	4.243122E+06	195	1.534860E+07
26	2.573806E+04	60	9.310201E+04	94	3.367769E+05	128	1.218219E+06	162	4.406650E+06	196	1.594013E+07
27	2.673000E+04	61	9.669012E+04	95	3.497561E+05	129	1.265169E+06	163	4.576481E+06	197	1.655445E+07
28	2.776016E+04	62	1.004165E+05	96	3.632355E+05	130	1.313928E+06	164	4.752856E+06	198	1.719245E+07
29	2.883002E+04	63	1.042865E+05	97	3.772344E+05	131	1.364566E+06	165	4.936029E+06	199	1.785504E+07
30	2.994112E+04	64	1.083057E+05	98	3.917729E+05	132	1.417156E+06	166	5.126261E+06	200	1.854317E+07
31	3.109503E+04	65	1.124797E+05	99	4.068716E+05	133	1.471772E+06	167	5.323825E+06	201	1.925781E+07
32	3.229342E+04	66	1.168146E+05	100	4.225523E+05	134	1.528494E+06	168	5.529003E+06	202	2.000000E+07
33	3.353800E+04	67	1.213166E+05	101	4.388372E+05	135	1.587401E+06	169	5.742088E+06		
34	3.483054E+04	68	1.259921E+05	102	4.557498E+05	136	1.648579E+06	170	5.963385E+06		

Table 3. Generic MIL-STD-188-125-1 Acceptance SE testing Frequency List, MF Range (1/2)

PNT	FREQUENCY	PNT	FREQUENCY	PNT	FREQUENCY	PNT	FREQUENCY	PNT	FREQUENCY	PNT	FREQUENCY
1	2.000000E+07	35	2.431185E+07	69	2.955330E+07	103	3.592478E+07	137	4.366989E+07	171	5.308480E+07
2	2.011517E+07	36	2.445185E+07	70	2.972349E+07	104	3.613165E+07	138	4.392137E+07	172	5.339049E+07
3	2.023101E+07	37	2.459266E+07	71	2.989466E+07	105	3.633972E+07	139	4.417430E+07	173	5.369795E+07
4	2.034751E+07	38	2.473428E+07	72	3.006681E+07	106	3.654899E+07	140	4.442868E+07	174	5.400717E+07
5	2.046468E+07	39	2.487672E+07	73	3.023995E+07	107	3.675946E+07	141	4.468453E+07	175	5.431818E+07
6	2.058253E+07	40	2.501997E+07	74	3.041409E+07	108	3.697115E+07	142	4.494185E+07	176	5.463098E+07
7	2.070106E+07	41	2.516405E+07	75	3.058924E+07	109	3.718405E+07	143	4.520065E+07	177	5.494558E+07
8	2.082027E+07	42	2.530896E+07	76	3.076539E+07	110	3.739818E+07	144	4.546095E+07	178	5.526199E+07
9	2.094017E+07	43	2.545471E+07	77	3.094256E+07	111	3.761354E+07	145	4.572274E+07	179	5.558022E+07
10	2.106075E+07	44	2.560129E+07	78	3.112074E+07	112	3.783014E+07	146	4.598604E+07	180	5.590029E+07
11	2.118203E+07	45	2.574872E+07	79	3.129995E+07	113	3.804799E+07	147	4.625086E+07	181	5.622220E+07
12	2.130401E+07	46	2.589700E+07	80	3.148020E+07	114	3.826710E+07	148	4.651720E+07	182	5.654596E+07
13	2.142669E+07	47	2.604613E+07	81	3.166148E+07	115	3.848746E+07	149	4.678507E+07	183	5.687159E+07
14	2.155008E+07	48	2.619612E+07	82	3.184381E+07	116	3.870910E+07	150	4.705449E+07	184	5.719909E+07
15	2.167418E+07	49	2.634697E+07	83	3.202719E+07	117	3.893201E+07	151	4.732546E+07	185	5.752848E+07
16	2.179900E+07	50	2.649870E+07	84	3.221162E+07	118	3.915620E+07	152	4.759799E+07	186	5.785976E+07
17	2.192453E+07	51	2.665129E+07	85	3.239711E+07	119	3.938169E+07	153	4.787209E+07	187	5.819295E+07
18	2.205078E+07	52	2.680477E+07	86	3.258368E+07	120	3.960847E+07	154	4.814776E+07	188	5.852806E+07
19	2.217776E+07	53	2.695913E+07	87	3.277131E+07	121	3.983656E+07	155	4.842503E+07	189	5.886511E+07
20	2.230548E+07	54	2.711437E+07	88	3.296003E+07	122	4.006597E+07	156	4.870389E+07	190	5.920409E+07
21	2.243393E+07	55	2.727051E+07	89	3.314983E+07	123	4.029669E+07	157	4.898436E+07	191	5.954502E+07
22	2.256312E+07	56	2.742756E+07	90	3.334073E+07	124	4.052875E+07	158	4.926644E+07	192	5.988792E+07
23	2.269305E+07	57	2.758550E+07	91	3.353273E+07	125	4.076214E+07	159	4.955015E+07	193	6.023279E+07
24	2.282373E+07	58	2.774436E+07	92	3.372583E+07	126	4.099687E+07	160	4.983549E+07	194	6.057965E+07
25	2.295516E+07	59	2.790412E+07	93	3.392005E+07	127	4.123295E+07	161	5.012247E+07	195	6.092850E+07
26	2.308735E+07	60	2.806481E+07	94	3.411538E+07	128	4.147040E+07	162	5.041111E+07	196	6.127937E+07
27	2.322030E+07	61	2.822643E+07	95	3.431184E+07	129	4.170921E+07	163	5.070141E+07	197	6.163225E+07
28	2.335402E+07	62	2.838897E+07	96	3.450943E+07	130	4.194940E+07	164	5.099338E+07	198	6.198717E+07
29	2.348851E+07	63	2.855246E+07	97	3.470815E+07	131	4.219097E+07	165	5.128703E+07	199	6.234413E+07
30	2.362377E+07	64	2.871688E+07	98	3.490802E+07	132	4.243393E+07	166	5.158237E+07	200	6.270315E+07
31	2.375981E+07	65	2.888225E+07	99	3.510905E+07	133	4.267829E+07	167	5.187942E+07	201	6.306423E+07
32	2.389663E+07	66	2.904857E+07	100	3.531123E+07	134	4.292406E+07	168	5.217817E+07	202	6.342740E+07
33	2.403425E+07	67	2.921585E+07	101	3.551457E+07	135	4.317125E+07	169	5.247865E+07	203	6.379265E+07
34	2.417265E+07	68	2.938409E+07	102	3.571908E+07	136	4.341985E+07	170	5.278085E+07	204	6.416001E+07

Table 4. Generic MIL-STD-188-125-1 Acceptance SE Testing Frequency List, MF Range (2/2)

PNT	FREQUENCY	PNT	FREQUENCY	PNT	FREQUENCY	PNT	FREQUENCY	PNT	FREQUENCY	PNT	FREQUENCY
205	6.452948E+07	239	7.844156E+07	273	9.535297E+07	307	1.159104E+08	341	1.408998E+08	375	1.712767E+08
206	6.490108E+07	240	7.889327E+07	274	9.590207E+07	308	1.165778E+08	342	1.417112E+08	376	1.722630E+08
207	6.527482E+07	241	7.934759E+07	275	9.645434E+07	309	1.172492E+08	343	1.425272E+08	377	1.732550E+08
208	6.565072E+07	242	7.980452E+07	276	9.700978E+07	310	1.179244E+08	344	1.433480E+08	378	1.742527E+08
209	6.602877E+07	243	8.026409E+07	277	9.756843E+07	311	1.186035E+08	345	1.441735E+08	379	1.752562E+08
210	6.640901E+07	244	8.072630E+07	278	9.813029E+07	312	1.192864E+08	346	1.450037E+08	380	1.762654E+08
211	6.679143E+07	245	8.119117E+07	279	9.869538E+07	313	1.199734E+08	347	1.458387E+08	381	1.772805E+08
212	6.717606E+07	246	8.165872E+07	280	9.926373E+07	314	1.206643E+08	348	1.466786E+08	382	1.783014E+08
213	6.756290E+07	247	8.212896E+07	281	9.983535E+07	315	1.213591E+08	349	1.475232E+08	383	1.793281E+08
214	6.795197E+07	248	8.260191E+07	282	1.004103E+08	316	1.220580E+08	350	1.483728E+08	384	1.803608E+08
215	6.834328E+07	249	8.307758E+07	283	1.009885E+08	317	1.227609E+08	351	1.492272E+08	385	1.813995E+08
216	6.873685E+07	250	8.355600E+07	284	1.015700E+08	318	1.234678E+08	352	1.500865E+08	386	1.824441E+08
217	6.913268E+07	251	8.403716E+07	285	1.021550E+08	319	1.241788E+08	353	1.509508E+08	387	1.834947E+08
218	6.953078E+07	252	8.452110E+07	286	1.027432E+08	320	1.248939E+08	354	1.518201E+08	388	1.845514E+08
219	6.993119E+07	253	8.500783E+07	287	1.033349E+08	321	1.256131E+08	355	1.526944E+08	389	1.856141E+08
220	7.033389E+07	254	8.549736E+07	288	1.039300E+08	322	1.263365E+08	356	1.535737E+08	390	1.866830E+08
221	7.073892E+07	255	8.598970E+07	289	1.045284E+08	323	1.270640E+08	357	1.544580E+08	391	1.877581E+08
222	7.114628E+07	256	8.648489E+07	290	1.051304E+08	324	1.277957E+08	358	1.553475E+08	392	1.888393E+08
223	7.155598E+07	257	8.698292E+07	291	1.057358E+08	325	1.285316E+08	359	1.562421E+08	393	1.899267E+08
224	7.196805E+07	258	8.748382E+07	292	1.063447E+08	326	1.292718E+08	360	1.571418E+08	394	1.910205E+08
225	7.238248E+07	259	8.798761E+07	293	1.069571E+08	327	1.300162E+08	361	1.580468E+08	395	1.921205E+08
226	7.279931E+07	260	8.849430E+07	294	1.075730E+08	328	1.307649E+08	362	1.589569E+08	396	1.932268E+08
227	7.321853E+07	261	8.900390E+07	295	1.081925E+08	329	1.315180E+08	363	1.598723E+08	397	1.943395E+08
228	7.364017E+07	262	8.951644E+07	296	1.088155E+08	330	1.322753E+08	364	1.607929E+08	398	1.954587E+08
229	7.406424E+07	263	9.003193E+07	297	1.094421E+08	331	1.330371E+08	365	1.617189E+08	399	1.965842E+08
230	7.449074E+07	264	9.055039E+07	298	1.100724E+08	332	1.338032E+08	366	1.626501E+08	400	1.977163E+08
231	7.491971E+07	265	9.107184E+07	299	1.107063E+08	333	1.345737E+08	367	1.635868E+08	401	1.988549E+08
232	7.535114E+07	266	9.159629E+07	300	1.113438E+08	334	1.353487E+08	368	1.645288E+08	402	2.000000E+08
233	7.578506E+07	267	9.212376E+07	301	1.119850E+08	335	1.361281E+08	369	1.654763E+08		
234	7.622148E+07	268	9.265426E+07	302	1.126298E+08	336	1.369120E+08	370	1.664292E+08		
235	7.666041E+07	269	9.318782E+07	303	1.132784E+08	337	1.377004E+08	371	1.673876E+08		
236	7.710187E+07	270	9.372446E+07	304	1.139308E+08	338	1.384934E+08	372	1.683515E+08		
237	7.754587E+07	271	9.426418E+07	305	1.145868E+08	339	1.392909E+08	373	1.693210E+08		
238	7.799243E+07	272	9.480701E+07	306	1.152467E+08	340	1.400930E+08	374	1.702960E+08		

Table 5. Generic MIL-STD-188-125-1 Acceptance SE Testing Frequency List, HF Range

PNT	FREQUENCY	PNT	FREQUENCY	PNT	FREQUENCY	PNT	FREQUENCY	PNT	FREQUENCY	PNT	FREQUENCY
1	2.000000E+08	35	2.625813E+08	69	3.447446E+08	103	4.526173E+08	137	5.942442E+08	171	7.801869E+08
2	2.016079E+08	36	2.646922E+08	70	3.475161E+08	104	4.562561E+08	138	5.990215E+08	172	7.864591E+08
3	2.032286E+08	37	2.668202E+08	71	3.503099E+08	105	4.599240E+08	139	6.038372E+08	173	7.927816E+08
4	2.048625E+08	38	2.689652E+08	72	3.531261E+08	106	4.636215E+08	140	6.086916E+08	174	7.991550E+08
5	2.065094E+08	39	2.711275E+08	73	3.559650E+08	107	4.673487E+08	141	6.135851E+08	175	8.055797E+08
6	2.081696E+08	40	2.733072E+08	74	3.588267E+08	108	4.711059E+08	142	6.185178E+08	176	8.120560E+08
7	2.098431E+08	41	2.755044E+08	75	3.617114E+08	109	4.748932E+08	143	6.234903E+08	177	8.185843E+08
8	2.115301E+08	42	2.777192E+08	76	3.646193E+08	110	4.787110E+08	144	6.285027E+08	178	8.251652E+08
9	2.132307E+08	43	2.799519E+08	77	3.675506E+08	111	4.825595E+08	145	6.335554E+08	179	8.317989E+08
10	2.149449E+08	44	2.822025E+08	78	3.705055E+08	112	4.864390E+08	146	6.386488E+08	180	8.384860E+08
11	2.166729E+08	45	2.844712E+08	79	3.734841E+08	113	4.903496E+08	147	6.437831E+08	181	8.452268E+08
12	2.184148E+08	46	2.867582E+08	80	3.764866E+08	114	4.942917E+08	148	6.489586E+08	182	8.520219E+08
13	2.201707E+08	47	2.890635E+08	81	3.795133E+08	115	4.982654E+08	149	6.541758E+08	183	8.588715E+08
14	2.219407E+08	48	2.913874E+08	82	3.825643E+08	116	5.022711E+08	150	6.594349E+08	184	8.657763E+08
15	2.237250E+08	49	2.937299E+08	83	3.856399E+08	117	5.063090E+08	151	6.647363E+08	185	8.727365E+08
16	2.255236E+08	50	2.960913E+08	84	3.887402E+08	118	5.103794E+08	152	6.700803E+08	186	8.797527E+08
17	2.273366E+08	51	2.984717E+08	85	3.918653E+08	119	5.144825E+08	153	6.754673E+08	187	8.868253E+08
18	2.291642E+08	52	3.008712E+08	86	3.950157E+08	120	5.186186E+08	154	6.808976E+08	188	8.939547E+08
19	2.310066E+08	53	3.032900E+08	87	3.981913E+08	121	5.227879E+08	155	6.863715E+08	189	9.011415E+08
20	2.328637E+08	54	3.057282E+08	88	4.013925E+08	122	5.269907E+08	156	6.918895E+08	190	9.083860E+08
21	2.347358E+08	55	3.081861E+08	89	4.046194E+08	123	5.312274E+08	157	6.974518E+08	191	9.156888E+08
22	2.366229E+08	56	3.106637E+08	90	4.078723E+08	124	5.354981E+08	158	7.030588E+08	192	9.230503E+08
23	2.385251E+08	57	3.131612E+08	91	4.111513E+08	125	5.398031E+08	159	7.087109E+08	193	9.304710E+08
24	2.404427E+08	58	3.156788E+08	92	4.144566E+08	126	5.441427E+08	160	7.144084E+08	194	9.379513E+08
25	2.423757E+08	59	3.182166E+08	93	4.177886E+08	127	5.485173E+08	161	7.201518E+08	195	9.454918E+08
26	2.443242E+08	60	3.207748E+08	94	4.211473E+08	128	5.529270E+08	162	7.259413E+08	196	9.530929E+08
27	2.462884E+08	61	3.233536E+08	95	4.245330E+08	129	5.573721E+08	163	7.317773E+08	197	9.607551E+08
28	2.482684E+08	62	3.259532E+08	96	4.279460E+08	130	5.618530E+08	164	7.376603E+08	198	9.684789E+08
29	2.502643E+08	63	3.285736E+08	97	4.313864E+08	131	5.663699E+08	165	7.435906E+08	199	9.762648E+08
30	2.522763E+08	64	3.312151E+08	98	4.348544E+08	132	5.709231E+08	166	7.495685E+08	200	9.841132E+08
31	2.543044E+08	65	3.338779E+08	99	4.383503E+08	133	5.755129E+08	167	7.555945E+08	201	9.920248E+08
32	2.563488E+08	66	3.365620E+08	100	4.418744E+08	134	5.801396E+08	168	7.616690E+08	202	1.000000E+09
33	2.584097E+08	67	3.392677E+08	101	4.454267E+08	135	5.848035E+08	169	7.677923E+08		
34	2.604871E+08	68	3.419952E+08	102	4.490076E+08	136	5.895050E+08	170	7.739648E+08		

3.3.2. ACCEPTANCE SE MEASUREMENT ANTENNAS

MIL-STD-188-125-1 details the precise types of transmit and receive antenna pairs which must be used to perform an acceptance SE or baseline SE test, as well as the frequency ranges over which these antennas are to be used. These antenna pairs are detailed in Table 6 for the "low," "mid," and "high" frequency ranges. Also provided is the approximate minimum number of test frequencies required by MIL-STD-188-125-1 for the frequency ranges over which each antenna (or field) type is typically used.

Table 6. SE Measurement Antenna Types and Frequency Ranges

FREQUENCY RANGE	FIELD TYPE	ANTENNA TYPE	MIL-STD-188-125 FREQUENCIES	TEST SYSTEM FREQUENCIES	APPROX NUMBER OF TEST FREQUENCIES
LOW	Magnetic	Loop	10 kHz – 20 MHz	10 kHz – 10 MHz	80
MID	Electric, Plane Wave	Biconic	20 MHz – 100 MHz	10 MHz – 200 MHz	195
HIGH	Plane Wave	Log Periodic	100 MHz – 1 GHz	200 MHz – 1 GHz	105

MIL-STD-188-125-1 requires that magnetic field SE measurements (versus electric field measurements) be made at the lowest measurement frequencies; this measurement is one near field magnetic shielding effectiveness. Electrostatically shielded loop antennas are required to be used for this measurement over the frequency range of 10 kHz to 20 MHz.

In addition, MIL-STD-188-125-1-STD-188-125-1 suggests the use of biconical and log periodic antennas in the resonant and plane wave frequency regime, which is defined as frequencies from 10 MHz to 1 GHz. Guidance is also provided in footnote 2 to Table A-1 in MIL-STD-188-125-1 which addresses specific antenna types and frequency ranges of operation for SE measurements in the 20 MHz to 1 GHz range. However, practical considerations often dictate a slightly different implementation. For example, log periodic antennas that are rated for operation down to 100 MHz are very large, unwieldy and can be difficult to use for acceptance SE measurements which are often performed in congested areas. For this reason, log periodic antennas rated for operation down to 200 MHz are typically used, in combination with biconical antennas that operate up to this frequency for the mid-frequency SE measurement range. This adjustment does not adversely impact the SE measurement in terms of the type of field produced, on the sensitivity of the SE measurement system (i.e., its measurement range), or the measurement results thus obtained.

Likewise, other types of linear antennas can also be used for SE measurements in the mid and high frequency range without loss of measurement fidelity. For example, hybrid combinations of a mid-frequency antenna structure with a high frequency log periodic antenna can also be used to perform the MIL-STD-188-125-1 acceptance SE measurement.

The specific set of antennas which Jaxon uses to perform MIL-STD-188-125-1 acceptance SE measurements can vary; a typical set is shown in Figure 4 and consists of shielded loops, bicones, and log periodic from ETS-Lindgren or Electrometrics. Other types of antennas, such as hybrid broadband antennas from Sunol (combining the mid and high frequency ranges) can also be used.

Regardless of the specific antenna types utilized, the MIL-STD-188-125-1 acceptance SE measurement procedure by its design will accommodate different types of TX / RX antenna pairs, as long as they radiate and receive the appropriate type of field and can provide the required measurement range. That is, because a shielding effectiveness measurement is defined as the relative difference between received signal strength in the calibration and measurement configurations, specific antenna details are largely inconsequential as long as the antennas generate / receive the required electromagnetic field. Caution should be exercised when using antennas with higher gains (or tighter patterns) than the recommended antennas as the spatial area of the EM barrier being illuminated might suffer; it is for this reason that linear antennas are specified, versus (for example) aperture antennas.

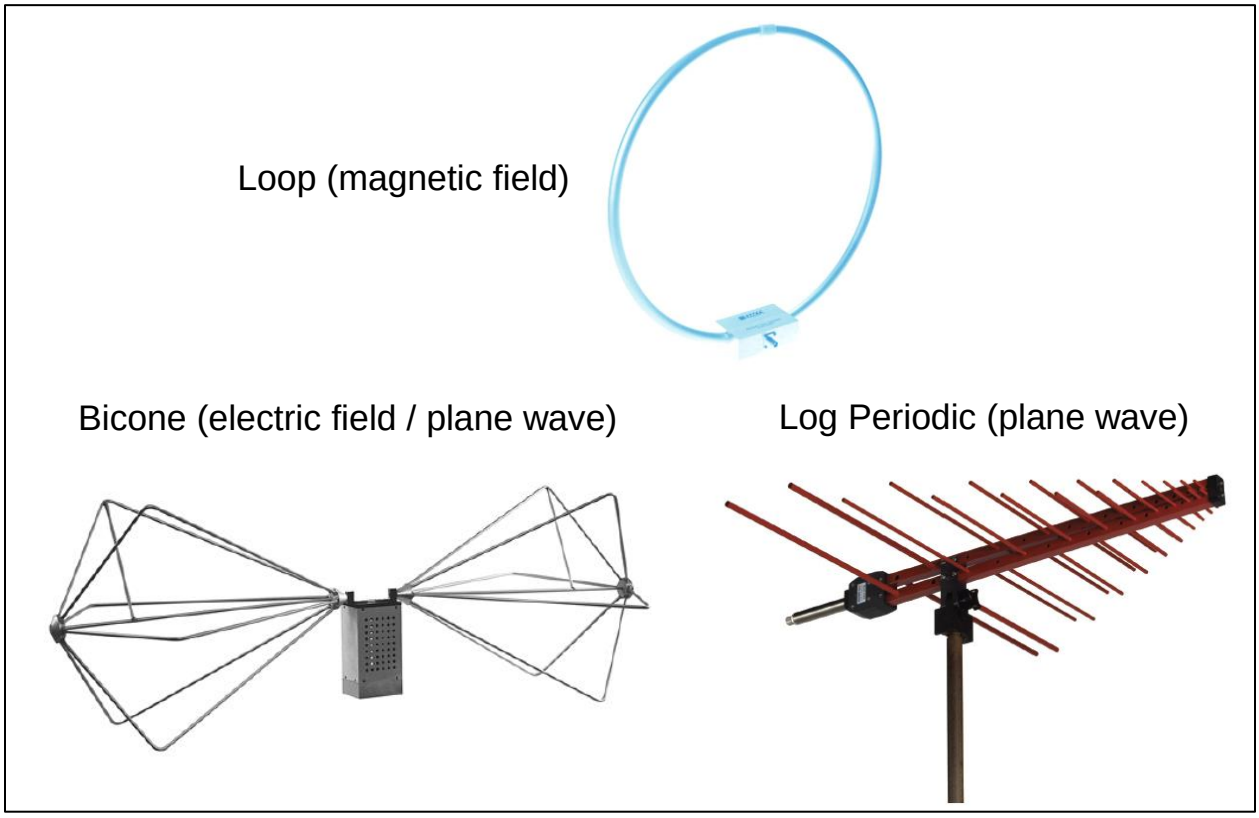

Figure 4. Typical set of MIL-STD-188-125-1 Acceptance SE Measurement Antennas.

3.3.3. MEASUREMENT SENSITIVITY

MIL-STD-188-125-1 requires that an SE measurement system be capable of measuring an SE value 20 dB greater than that shown in Figure 3. The Jaxon SE measurement system is extremely sensitive and capable of measuring SE values well in excess of this requirement, especially across the mid and high frequency ranges. The light blue curve labeled "FTN" (for "Fiber Terminated Noise") or "RTN" (Receiver Terminated Noise") in Figure 5 shows the typical measurement range of the Jaxon MIL-STD-188-125-1 acceptance SE testing system where "measurement range" is defined as the maximum value of SE that can be measured at each test frequency. As the FTN trace shows, the Jaxon SE measurement system can easily provide a measurement margin of 20 dB above the nominal MIL-STD-188-125-1 SE requirement (the purple curve).

Note that the measurement range of an SE measurement system cannot be arbitrarily increased. To increase the measurement range at the low (magnetic field) frequencies (or for any frequency, for that matter) would require a higher TX power level which is not recommended or required to meet the objectives of the testing described in this TPP document. In addition, frequency authorization is contingent upon using the least amount of RF TX power to accomplish the test objectives, in addition to being a careful user of the authorized spectrum.

The sensitivity of the Jaxon SE measurement system has been carefully optimized by using RF fiber optic links on both the transmit and receive sides of the measurement, the later link possessing

a wide adjustable gain range (from 50 dB of gain to 55 dB of attenuation). Even when combined with a relatively low transmit power level (less than 50 W), this results in a very large shielding effectiveness measurement range, in excess of 150 dB for most of the mid and high frequency ranges, as the "RTN" (Receiver Terminated Noise) and "AON" (Amplifier Off Noise) curve in the plot presented as Figure 5 shows.

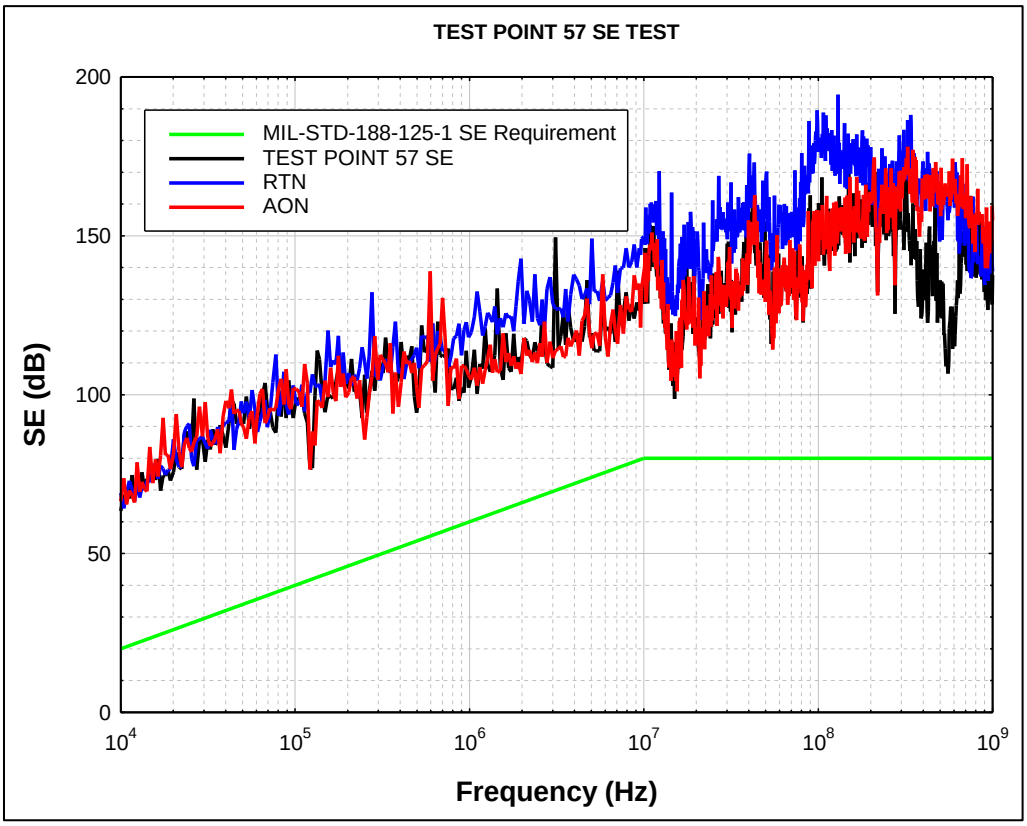

Figure 5. Typical Measurement Range for the Jaxon SE Measurement System.

3.3.4. TEST POINTS

For this SE test effort, the test areas will be 10'x10' around the perimeter of the shielded rooms. Additional test points are typically located at penetration treatments for architectural, mechanical, and electrical PoEs if not adequately covered by the test areas. Preliminary test point locations for the site are shown in Figure 6 for the walls and Figure 7 for the ceiling.

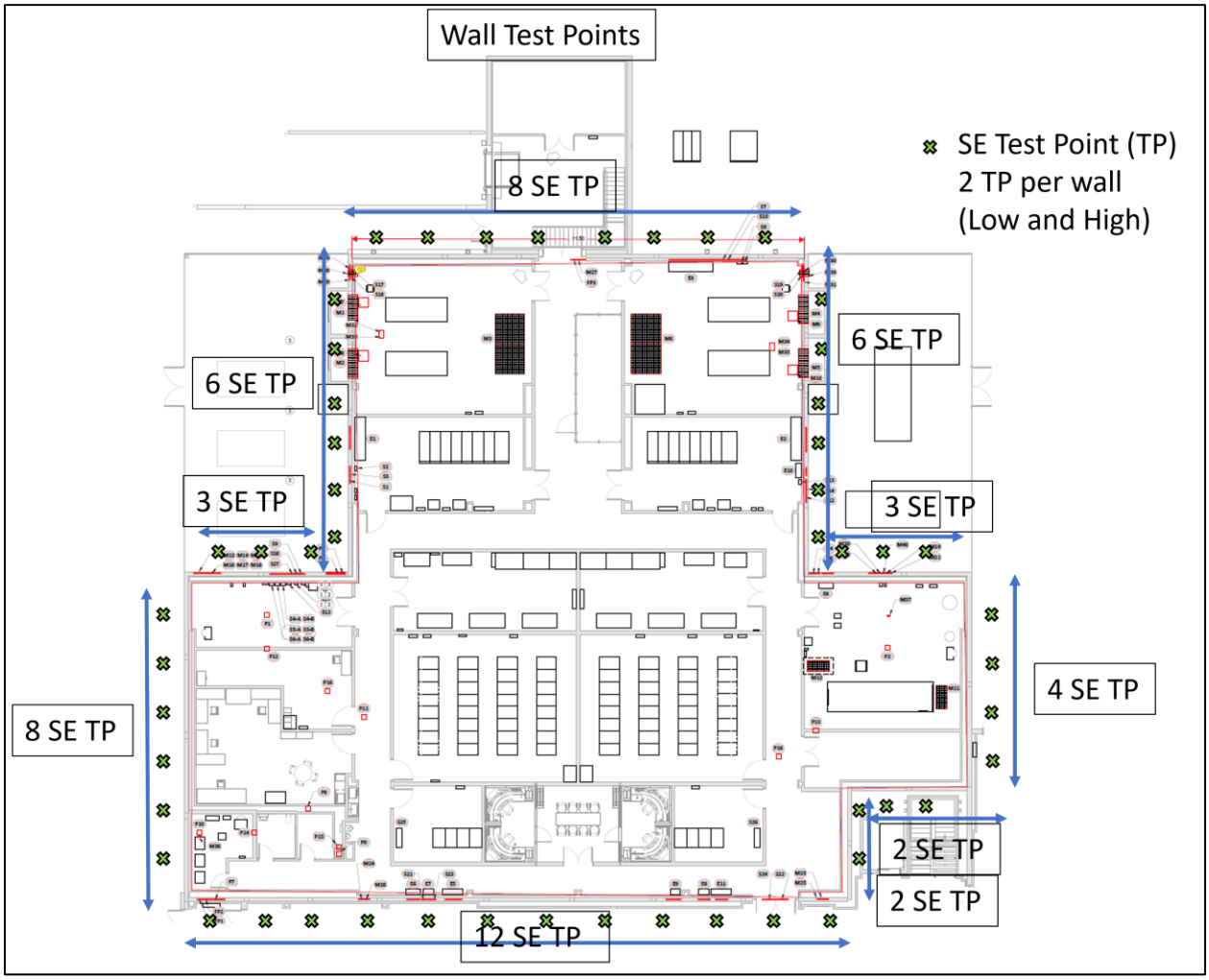

Figure 6. Wall Test Point Locations

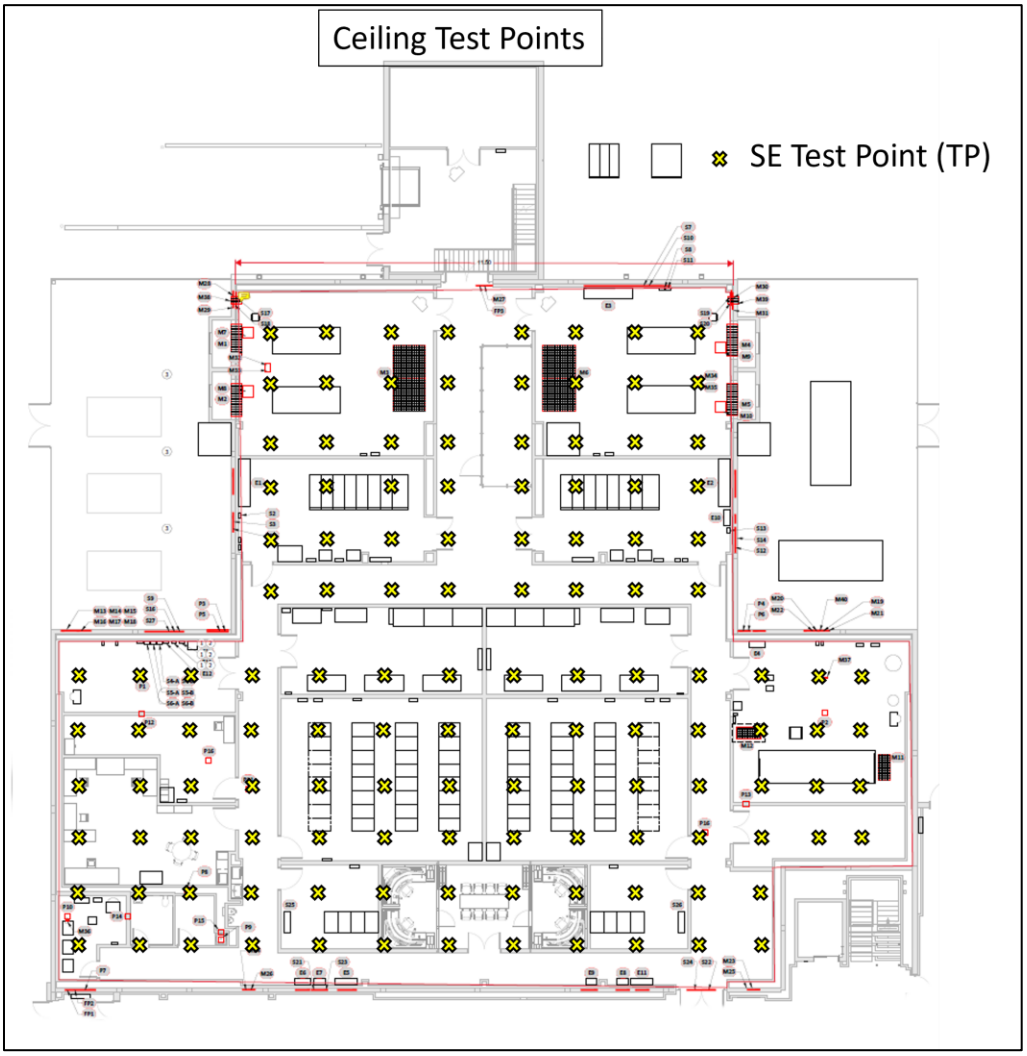

Figure 7. Ceiling Test Point Locations

The green stars represent vertical wall test points; as the shield height is >10 feet, there will be two vertical points at each wall test location. For the walls there is a total of 108 test points. Yellow stars represent ceiling test points. There is a total of 120 ceiling test points.

Test points locations can be altered, added, or subtracted to avoid internal/external obstructions and obstacles as well as time and weather constraints. Likewise, the separation distance between either the transmit or receive antenna and the shield can be varied by up to 0.5 m to avoid physical interference, if the 3.05m TX to RX antenna separation can be maintained. Any required deviations from the nominal TX and RX antenna placements will be documented for inclusion in the final test report.

If problem areas are identified during testing, additional investigation test points will be added as necessary and as time permits.

4. TESTING EQUIPMENT AND PROCEDURES

4.1. JAXON MIL-STD-188-125-1 ACCEPTANCE SE TEST EQUIPMENT

The typical list of equipment used in the Jaxon MIL-STD-188-125-1 acceptance SE measurement system is provided in Table 7.

Table 7. Jaxon Acceptance SE Test System Parts List

Item	Description	Manufacturer	Part Number	Quantity
1	Network Analyzer	Agilent	E5061B	1
2	Broadband RF - Variable Gain Fiber Link (RX)	Fiore	ODR-22	1
3	Broadband RF - Fixed Gain Fiber Link (TX)	Optical Zonu	OZ600	1
4	RF Broadband Power Amplifier	AR	25U100	1
5	Loop Antennas	ETS-Lindgren	6512	2
6	Bicone Antennas	ETS-Lindgren, Electro-Metrics	3109	2
7	Log Periodic Antennas	ETS-Lindgren, Com-Power	31488	2
8	Sniffers	Jaxon EM	N/A	1
9	DAS Computer(s)	Dell	Latitude E6420	As Req
10	FO Ethernet	COTS	N/A	As Req
11	Data Acquisition Software	Jaxon EM	N/A	1
12	Data Reduction Software	Jaxon EM, Easy Plot	N/A	1
13	Coaxial Cables and Connectors	Various	N/A	As Req
14	FO Communications	OWL	Hoots	As Req
15	Screen Box (for Network Analyzer & EG&G FO RX)	Jaxon EM	N/A	1

The Jaxon MIL-STD-188-125-1 acceptance SE measurement system is driven by a network analyzer (NA) which functions both as the RF signal generator and receiver. At each discrete measurement frequency (the collection of which is called a “sweep”) the NA generates an RF signal which is sent, using an RF fiber optic link, to the transmit antenna. Simultaneously, the receive antenna samples the RF environment (field) which is returned to the NA using a high-performance RF fiber optic link, closing the measurement loop. The NA then calculates the ratio of the power present at the receive port to that provided to the transmit port; this ratio (difference for powers expressed logarithmically) which is presented as the measurement result.

The only element of the Jaxon MIL-STD-188-125-1 acceptance SE measurement system which requires calibration is the network analyzer. Jaxon uses both company-owned and rental network analyzers as part of its MIL-STD-188-125-1 acceptance SE measurement system. However, regardless of ownership, the calibration of the specific network analyzer used for this MIL-STD-188-125-1 acceptance SE test will be current. The calibration certificate will be included with the test report.

4.2. MIL-STD-188-125-1 ACCEPTANCE SE MEASUREMENT SET-UP

The typical diagnostic equipment set-up and configuration for MIL-STD-188-125-1 acceptance SE measurements made using the Jaxon SE measurement system is shown in Figure 8. This implementation uses an RF fiber optic link on both the transmit and receive sides of the measurement, as well as an RF screen box to house the diagnostic equipment (RX side FO receiver, TX side FO transmitter, network analyzer) to provide maximum measurement flexibility as well as RF isolation from both the fields generated by transmit antenna and from any ambient RF signals that may be present.

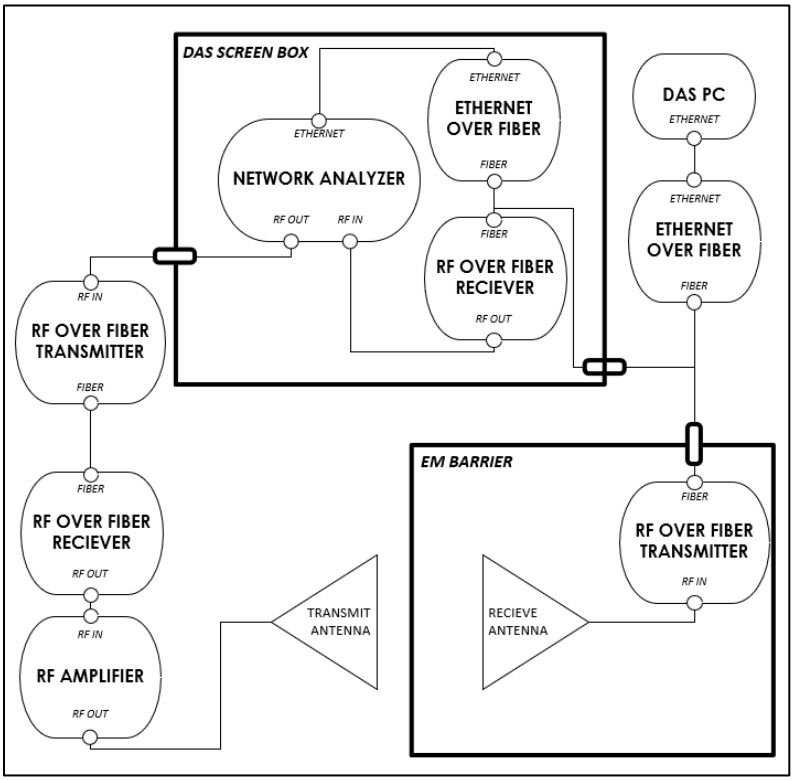

Figure 8. Jaxon MIL-STD-188-125-1 Acceptance SE Test Set-up

4.3. SE MEASUREMENT PROCEDURE

The generic SE measurement procedure that will be employed during this SE measurement test effort is as follows

- For all measurements the diagnostic screen box housing the network analyzer, transmit side FO TX unit and receive side FO RX unit should be located away from the TX amplifier and antenna (minimum 10m separation distance).

- Perform antenna calibration measurements in a relatively clear area for each of the three antenna pairs (loops, bicones, and log periodics). For each antenna pair the TX – RX antenna spacing (between antenna reference points) is 3.05m.

- Move antennas to first test point.
- Perform high frequency measurements using the log periodic antennas in both horizontal and vertical antenna polarities.
- Perform the mid frequency measurements using the biconical antennas in both horizontal and vertical orientations.
- Perform the low frequency measurements using the loop antennas in both horizontal and vertical orientations.
- Repeat for remaining test points.
- Periodically throughout the measurement process perform noise measurements (transmit side of the system disabled) to characterize the ambient noise environment at each test point.
- Periodically throughout the measurement process, perform measurements with the EM barrier of the host shelter intentionally degraded or defeated in some manner to ensure that the SE measurement system is functioning properly. Typical degradations include opening a door or inserting a conductive wire through a WBC penetration (pipe, conduit, or vent).

The detailed SE measurement procedure to be followed during this SE testing effort is as follows:

1. Conduct daily coordination and safety briefing. Lead engineer or test director will conduct a daily coordination and safety briefing for appropriate personnel (site leads and testing contractors).
2. Although the transmit power is low and presents no RF hazard, all non-test personnel should stay a minimum of 10’ from the TX antenna in order to avoid interference with testing operations.
3. At the start of the test perform SE antenna pair free-field calibrations:
    a. Place the log periodic transmit and receive antennas in the calibration configuration (in a clear area, 3.05m separation between antenna reference points). Configure the JEM RF Measurement SW (software) and select the appropriate spreadsheet containing the list of (high frequency) test frequencies. Using the SW, perform a measurement sweep on the network analyzer and save the resultant calibration curve. Do so for both horizontal and vertical antenna polarizations. Record sweep information in engineering logbook.
    b. Place the biconical transmit and receive antennas in the calibration configuration (in a clear area, 3.05m separation between antenna reference points). Configure the

JEM RF Measurement SW and select the appropriate spreadsheet containing the list of (medium frequency) test frequencies. Using the SW, perform a measurement sweep on the network analyzer and save the resultant calibration curve. Do so for both horizontal and vertical antenna polarizations. Record sweep information in engineering logbook.

c. Place the loop transmit and receive antennas in the calibration configuration (in a clear area, 3.05m separation between antenna reference points). Configure the JEM RF Measurement SW and select the appropriate spreadsheet containing the list of (low frequency) test frequencies. Using the SW, perform a measurement sweep on the network analyzer and save the resultant calibration curve. Do so for both horizontal and vertical antenna polarizations. Record sweep information in engineering logbook.

4. Relocate test equipment to first test point.

5. Perform a complete set of SE measurements to characterize SE performance:

   a. Place the log periodic transmit and receive antennas in the measurement configuration (TX antenna 2.0m from outside of RF door, RX antenna 1.0m from inside of RF door). Configure the JEM RF Measurement SW and select the appropriate spreadsheet containing the list of (high frequency) test frequencies. Using the SW, perform a measurement sweep on the network analyzer and save the resultant calibration curve. Do so for both horizontal and vertical antenna polarizations. Record sweep information in engineering logbook.

   b. Place the biconical transmit and receive antennas in the measurement configuration (TX antenna 2.0m from outside of RF door, RX antenna 1.0m from inside of RF door). Configure the JEM RF Measurement SW and select the appropriate spreadsheet containing the list of (medium frequency) test frequencies. Using the SW, perform a measurement sweep on the network analyzer and save the resultant calibration curve. Do so for both horizontal and vertical antenna polarizations. Record sweep information in engineering logbook.

   c. Place the loop transmit and receive antennas in the measurement configuration (TX antenna 2.0m from outside of RF door, RX antenna 1.0m from inside of RF door). Configure the JEM RF Measurement SW and select the appropriate spreadsheet containing the list of (low frequency) test frequencies. Using the SW, perform a measurement sweep on the network analyzer and save the resultant calibration curve. Do so for both horizontal and vertical antenna polarizations. Record sweep information in engineering logbook.

6. Process the SE measurement data from the test point.

7. Repeat for next test point

8. During all measurements, if significant leakage is detected investigate as required to isolate and localize the leak. Record data and document in engineering logbook.

5. DATA ACQUISITION, PROCESSING AND TEST RESULTS

The Jaxon MIL-STD-188-125-1 acceptance SE measurement system uses several codes during the overall process of acquiring raw sweep data from the network analyzer, reducing the raw measurement sweeps, and preparing the final SE results for presentation and reporting.

A Jaxon-developed RF Measurement SW package running on a "Data Acquisition and Control" (DAS) laptop PC is used to control the acceptance SE measurement process. Under user direction, the code sends a list of measurement frequencies to the network analyzer, commands the analyzer to perform a measurement sweep, and when the sweep is complete extracts the raw sweep data from the network analyzer. Each raw sweep is saved on the DAS PC and is automatically processed by the code (subtracted from the appropriate calibration sweep) to obtain, save, and then present the shielding effectiveness result in real time for user inspection.

During post-test data reduction, an additional code is used to append the low, mid, and high frequency SE results at each test point and for each antenna polarity, generating a combined SE result spanning the entire SE measurement frequency range. The combined results are then plotted using EasyPlot, a commercial data plotting package. Standard Microsoft Office products (Word, PowerPoint) are used to generate test reports and briefing documents incorporating the SE result plots.

A sample EasyPlot graphic presenting a typical MIL-STD-188-125-1 acceptance SE test result is provided in Figure 9. The green trace is the nominal MIL-STD-188-125-1 acceptance SE requirement.

The black trace in the plot presented as TEST POINT 57 SE is the actual shielding effectiveness results from the article under test; the trace is a combination of the reduced SE measurements over the three frequency ranges (low, mid, high) corresponding to the three antenna pairs (loops, bicones, log periodics). Individual SE results are obtained by subtracting a raw measurement sweep from the appropriate calibration sweep, with proper accounting of differing diagnostic system settings (such as the gain or attenuation of the RF fiber optic link on the receive side of the measurement).

As required periodically through the SE testing process, measurements of the "ambient" RF noise environment captured by the receive antenna are acquired. This is accomplished by turning off the transmit RF amplifier and taking a normal measurement sweep. These "amp off noise" (AON) raw sweeps are processed in the same manner as normal measurement sweeps to obtain a "measurement range" result which represents the maximum shielding effectiveness that the system can measure, in the presence of the "ambient" noise environment, at the specific test point location.

The red "Amplifier Off Noise" ("AON") curve in Figure 8 represents the maximum SE that could be characterized by the system during this particular test. In this case and for this test point the ambient RF fields at the RX were insignificant and thus the measurement range (MR) at this test point was quite good. This conclusion is confirmed by the light blue curve which represents the best-case SE that the system could measure during this particular test if the ambient RF noise were to be completely eliminated. Elimination of the ambient RF is achieved by disconnecting the RX

antenna and performing a measurement sweep; in practice this is accomplished by switching the FO input port connected to the RX antenna into an internal 50Ω termination, hence the "Receiver Terminated Noise" ("RTN") label. However, because the TX amplifier is placed in its normal operating mode, the RTN sweep will show if the field radiated by the TX antenna is limiting the measurement range.

Additionally, during a MIL-STD-188-125-1 acceptance SE test it is necessary to verify that the measurement system is functioning properly, especially for a TA which does not exhibit any significant RF leakage. This verification is accomplished by periodically performing a measurement sweep with the EM barrier temporarily and intentionally violated in some manner such as opening an RF door ("door open" or DO) or inserting a wire through a WBC ("wire through wave guide" or WTWG). The violation generally must be located some distance from the test point in order not to overwhelm the receive side of the diagnostic system.

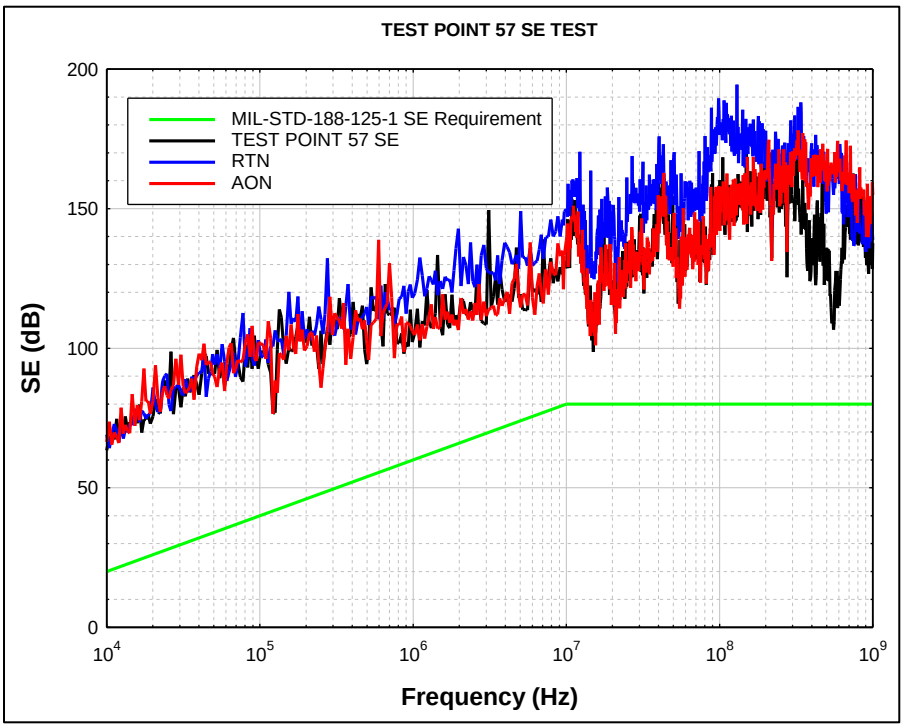

Figure 9. Sample SE Test Point Plot

6. TEST REPORTING

As detailed in Section A.4.8 “Test Report Requirements” of MIL-STD-188-125-1 Appendix A, the report for this MIL-STD-188-125-1 SE test effort will contain the following information:

- Executive summary of the test effort and results
- Reference to the test plan (i.e., this document)
- Test article description (including photographs, as permitted)
- A description and discussion of any deviations from the test plan or the requirements provided in MIL-STD-188-125-1, including the underlying rationale
- A narrative describing the overall test effort and any notable or unexpected events impacting test execution
- Test results in the form of plots providing measured shielding effectiveness as a function of frequency
- Pass / fail conclusions
- If applicable, lessons learned

7. LOGISTICS AND SUPPORT REQUIREMENTS

NOTE: The information provided in this section is primarily applicable to MIL-STD-188-125-1 acceptance SE testing performed at a remote site (i.e., not within the Jaxon H-FET facility) and is provided for reference purposes only.

7.1. COORDINATION AND SAFETY

A daily coordination and safety briefing shall be conducted by the lead test engineer to ensure that proper procedures are in place and that the plan for the day is communicated to all stakeholders.

In addition to site-specific safety requirements, all test team members have completed training in the following topics:

- OSHA 10-hour work card safety course
- First aid, CPR, and AED certification
- High voltage electrical safety training (OSHA standard)
- Lock out tag out (OSHA standard)
- Power tool safety
- Fire safety
- PPE safety
- Lift and Rope Training

The transmit power level used by the Jaxon MIL-STD-188-125-1 acceptance SE measurement system is low and presents no RF hazards. However, all non-test personnel will be kept a minimum of 10’ from the TX antenna to avoid interference with testing operations. A similar restriction will be enforced near the RX antenna.

In addition, the Jaxon acceptance SE measurement system uses several fiber optic cables; one runs from the diagnostic screen box to the transmit antenna amplifier; one runs from the receive antenna to the diagnostic screen box, and two are used for communication between the test engineer and the technicians moving each (transmit and receive) antenna. These cables, as well as the various coaxial cables which are also used, are fragile and can be broken if stepped on (or driven over). Jaxon will mark all FO cable runs with cones and caution tape. However, restricting access to the active test area is important to avoid cable damage and to keep the testing moving forward in an efficient and timely manner.

7.2. SECURITY

The local site security officer shall brief the Jaxon test personnel on any site-specific security requirements, procedures, restrictions, and processes. Note that all Jaxon test personnel will have a, at a minimum, a DoD SECRET level clearance. The Jaxon Security manager will complete a visit request (through JPAS or alternate method) as required for all Jaxon test personnel.

Jaxon will provide any necessary information to the local site security personnel in order to bring the MIL-STD-188-125-1 acceptance SE test equipment into the area. Note that this system includes a laptop PC and an Agilent network analyzer, both of which contain hard disks and USB ports. If possible, Jaxon requests permission to photograph the test set-ups and configurations for documentation purposes. Jaxon will provide a camera for this purpose (details to be provided); alternatively, the use of a site-provided camera or photographer is also acceptable.

All raw test data acquired during this effort as well as test logbooks, test set-up photographs and other related material, is considered to be unclassified. It is anticipated that the final processed MIL-STD-188-125-1 acceptance test results will NOT be classified. In general, results of a MIL-STD-188-125-1 acceptance SE (or PCI) test which demonstrate compliance with the requirements of the standard are not classified.

Raw test data files will not be stored or associated with schedules, plans, photographs, or other document which infer or identify the facility at which the data was collected. Contractor understands that ANY association of data revealing a vulnerability to Survivable Nuclear Command, Control and Communications (NC3) system must be controlled as US SECRET information in accordance with EO, and DoD directives.

Therefore, unless otherwise directed, any test results briefings (in-progress or final Quick-Look) and the final test report documenting the results this baseline SE test effort will be marked “FOR OFFICIAL USE ONLY.”

Note that, if for any reason the final processed test results and report are to be classified, the Jaxon main office located in Colorado Springs, CO is approved to both generate and store classified information at up to the SECRET level. Jaxon has been provided with a current DD-254.

7.3. SITE SUPPORT AND ACCESS REQUIREMENTS

Jaxon recommends that all operational fire system sensors and detectors in areas near (within 10m) of the transmit TX antenna location be disabled or inhibited during the actual testing. While unlikely, it is possible that the signal from the transmit antenna could inadvertently cause these sensors or detectors to indicate an alarm.

Unimpeded access to both the interior and exterior periphery of the structure under test is required to complete the MIL-STD-188-125-1 acceptance SE measurements. The EM barrier of the room under test must be complete; all RF doors must be closed. Any temporary conductors (such as for construction power) entering the room that are not filtered must be removed.

Normal antenna placements as required by MIL-STD-188-125-1 are with the TX antenna positioned 2m from the external EM barrier surface, with the RX antenna positioned 1m from the internal surface. At each test point a free area with depth of approximately 10’ is required outside the shield for placement of the TX antenna and approximately 6’ inside the shield for placement of the RX antenna. Access to the exterior of the ceiling shielding is also required.

7.4. FREQUENCY AUTHORIZATION

A frequency authorization is necessary for this activity.