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# NASA GLENN RESEARCH CENTER

## EMI TEST DATA REPORT

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Radio Frequency Mass Gauge (RFMG)  
Measurement System RF Emissions Test using  
1 Meter Composite and Aluminum Boxes

Prepared by: Michael D. Herlacher  
Michael D. Herlacher, Test Engineer  
Analex Corporation

Date: 28 Jan 10

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# Composite & Aluminum Box Emissions

## I. TEST DESCRIPTION

Equipment Under Test: 36" Composite Box, 1 meter Aluminum Box,  
10' Low loss RF transmission line,  
TNC bulkhead feed through with 5" rod antenna element,  
TNC-TNC bulkhead isolated adapter,  
TNC terminated 0.25" diameter coax formed into 4" rod  
with 1" lead-in.

Date of Test: 21 – 22 Jan 2010

Test Location: Power & Avionics Division,  
EMC Test Lab, Bldg. 332,  
24' X 32' Reflective Chamber

Test Plan: Comparative readings between box types, feed-through  
types, and box grounding status.

Test Specification(s): Instrument settings and emissions limit extracted from  
SSP-30237 and SSP-30238, (International Space Station).

Test Engineer(s): Michael Herlacher, Analex Corporation

## II. TEST NOTES

II.1 The purpose of this test session was to determine a developmental RFMG measurement system configuration that produced a minimized electric field radiated emission. Basic EMI instrument settings and the emission limit line (appearing red on the data graphics) were extracted from the International Space Station EMI test specifications: SSP-30237 and SSP-30238.

II.2 The EMI measurements were performed using a hybrid active electric field receive antenna coupled to an EMI receiver instrument. The EMI receiver was controlled using commercial Rhode & Schwarz ES-K1 EMI emissions software. Another function of the software was to develop the individual report pages contained in Section V. The measurements were executed in a 24' x 32' x 16' steel walled EMI chamber to reduce the internal RF background. The low background eliminated any outside environment RF contamination of these measurements.

II.3 The RFMG system was comprised of either the aluminum or composite box with 5" rod radiating antenna placed inside the box centered on one wall. The antenna was fed through a bulkhead connector and pair of transmission lines from a R&S ZVL vector network analyzer. The analyzer served as RF signal source to excite the box interior and would display box resonance frequencies. The ZVL was placed in an adjacent shielded chamber as to not electrically corrupt the measurement chamber containing the test boxes.

II.4 A measurement technical challenge existed when executing this test session. The ZVL analyzer sweeps through the selected frequency range of 100MHz to 500MHz in approximately 1 second. The EMI receiver is set to sweep through the same frequency range but at a much slower, obviously asynchronous rate. One receiver sweep would take approximately 2.5 minutes. This produced a measurement result where many ZVL sweeps occur for one EMI receiver sweep. At the point in the receiver sweep where the ZVL would cross the receiver band-pass, a spectral spike would be detected and displayed. This would occur many times (~150) during the one receiver sweep. Hence the receiver output plot contains many segregated spectral lines with apparent voids between. The apparent voids were actually the frequencies where the receiver and the ZVL sweeps do not coincide. There is actually energy at these voids but are undetectable with only one receiver sweep. Also, the measurement window of the receiver at any one frequency may not catch the absolute peak of the ZVL power because the resultant field level is not present long enough for the receiver filter to charge to the peak. If multiple receiver sweeps were performed where the peak reading was held from previous readings, the spectra would 'fill-in'. So, the plots in this report may be interpreted by drawing an imaginary line across the existing peak tops to determine complete spectrum field levels.

II.5 Prior to testing each box, a reference measurement was made where the ZVL driven transmitting antenna was placed outside the box. The EMI antenna was placed 3 meters away with direct line-of-sight to the transmitting antenna. This is considered an 'open-air' measurement and can be used to judge how much attenuation (energy containment) is provided by the various test box set-ups.

II.7 A sweep was performed on each box where a calibrated 'open' was used in place of the transmitting antenna. The calibrated open means the component possessed a 50 $\Omega$  characteristic impedance up to the point where the center conductor opens (or stops). The transmission line open would theoretically reflect the ZVL transmission power back to itself and not into the box or test chamber. This configuration helps determine if the electric field strength measured in the test chamber is a result of RF leakage from the transmission line or the box.

- II.6 Each box was tested separately varying the following conditions:
- Shield isolated **OR** non-isolated box feed through
  - Box on **OR** off chamber metal grounded floor
  - ZVL supplying **between** 0dBm and -40dBm RF power
  - Using a box internal antenna **OR** a calibrated 'open' termination
  - ZVL performing a full spectrum sweep **OR** single frequency generation
  - EMI test antenna at 1 meter **OR** 3 meter distance

II.7 The results of this test session showed evidence of the following conclusions:

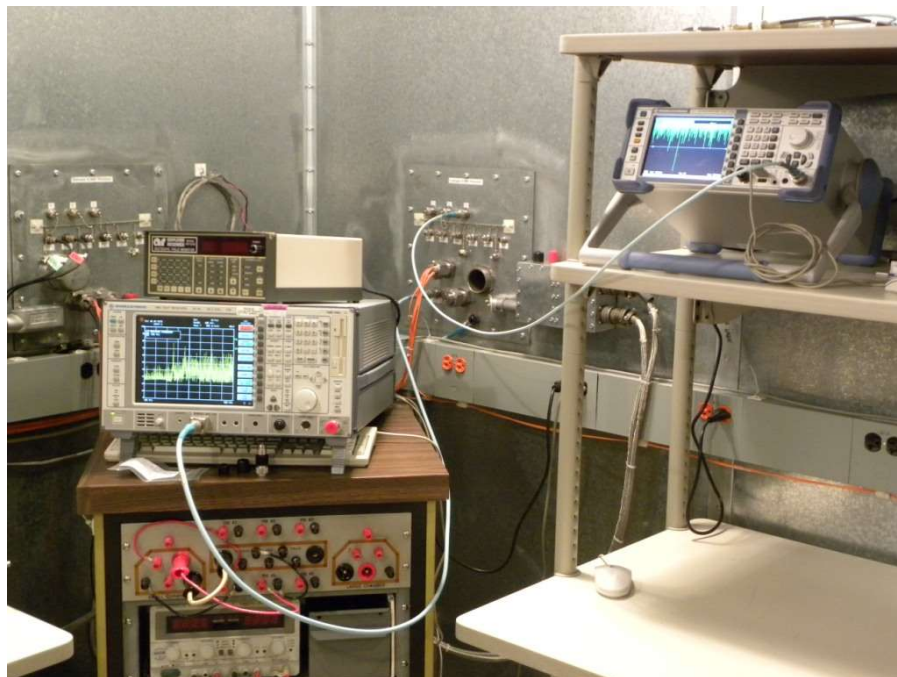
- The open air reference measurement was typically about 100dB $\mu$ V/m when the ZVL output power was set to 0dBm. The composite box best configuration at the same 0dBm power level saw 25 to 55dB lower field levels for an average reduction of 40dB. The aluminum box best configuration at the same 0dBm power level saw 40 to 80dB lower field levels for an average reduction of 60dB.
- The composite box leaks more of the internally generated electric field through its walls than the aluminum box. Measurements on the order of 5 to 25dB more field strength was seen leaking through the composite box verses the aluminum box.
- The shield isolated box feed through caused large RF field generation and would not be suitable for use in the RFMG measurement system. A non-isolated feed through should be used to minimize RF radiated emissions.
- The ZVL power level required to drive the composite box interior modes could be reduced from 0dBm to -30dBm without degrading the ZVL mode display. A -40dB drive level would produce about 2dB noise on the ZVL reference line which is considered undesirable.
- When a calibrated open was tested in place of the antenna for each box, the test chamber radiated electric field strength decreased dramatically. The levels decreased between 5 and 40dB for the aluminum box, and between 2 and 45dB for the composite box. This shows each box allows up to 45dB more radiated noise over what radiates off the transmission line alone.

- f. Either box grounded to or floating off the chamber floor produced no compelling evidence that either configuration produced less radiated emissions.
- g. The composite box construction with an inner metal frame was thought to possible have radiated emissions transmitting through the panel seams. So, copper tape with conductive adhesive was applied to all box seams. There was no compelling evidence that the copper taped configuration produced less radiated emissions.
- h. A combination of non-isolated box feed through and lower RF drive level could be used to satisfactorily gauge the composite box modes without serious RF radiated emissions as compared to the Space Station standard.

### III. GENERAL PHOTOGRAPHS



Typical test setup in EMI chamber



Test instrumentation in isolated adjacent chamber

#### IV. TEST EQUIPMENT

Instrument	Manufacturer Model # (s/n)	Test Type	Cal. Due	CALIBRATION SOURCE
Antenna, Wideband Active	ARA SAS-2A/M	Radiated emissions	24 Mar 10	Antenna Research
EMI Receiver	Rhode & Schwarz ESI26	Radiated emissions	29 Dec 10	World Cal. Inc.
Vector network analyzer	Rhode & Schwarz ZVL	RFMG system component		



## **V. TEST DATA**

### **V.1 ANTENNA IN OPEN AIR**

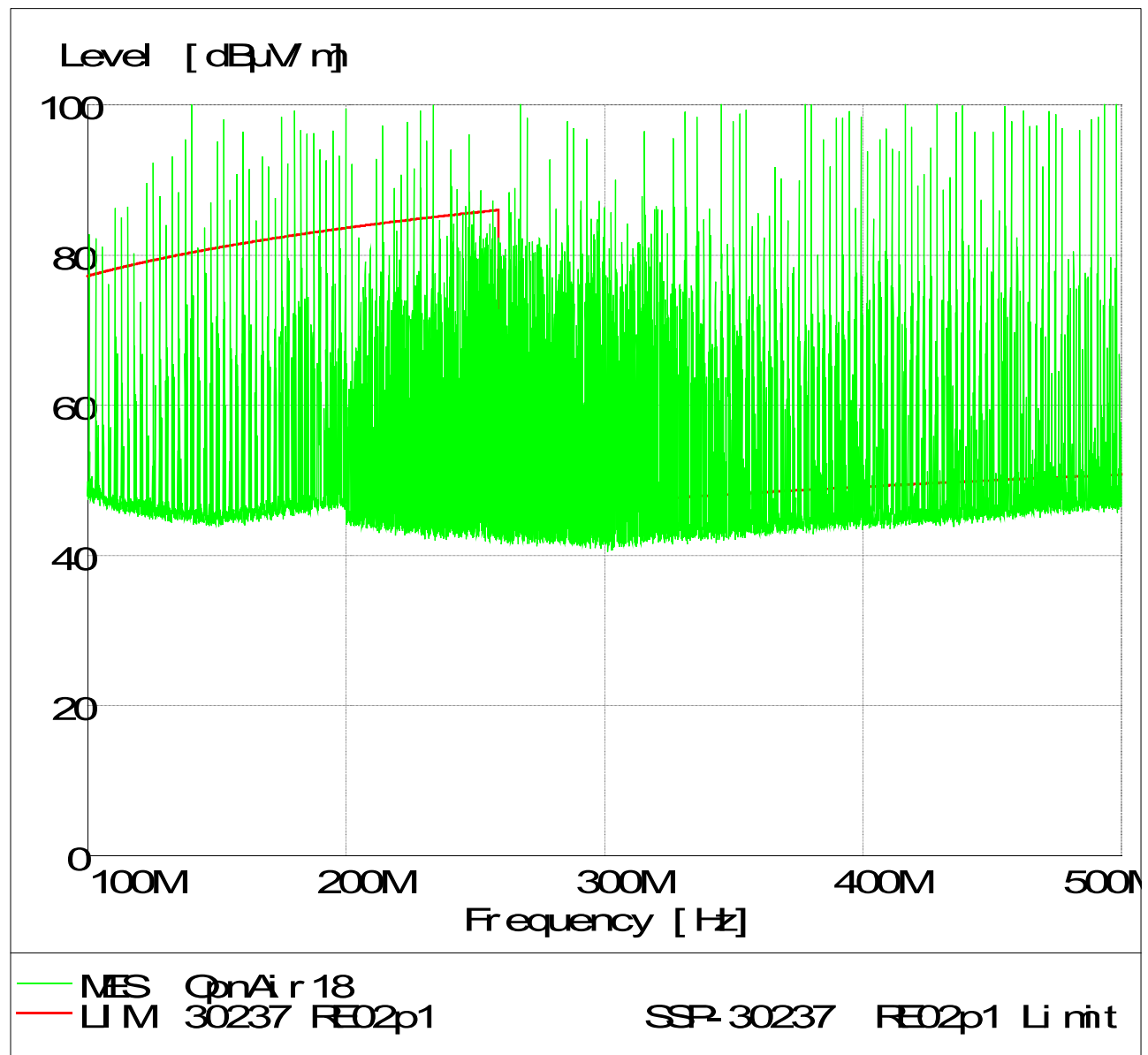
# NASA Glenn Research Center

## EMI Laboratory

EUT: Open Air, antenna to antenna  
EUT Engineer(s):  
Test Engineer(s): Mike Herlacher  
Operating Condition: 21 Jan 2010, 77F, 18%RH  
Test Site: 24' x 32' reverberant chamber  
Test Spec/Plan: SSP-30237, Space Station Radiated Electric Field Environment  
Comment: ZVL full spectrum, 0dBm, EMI antenna @ 3 meters.

## SCAN TABLE: "30237 RE02p1"

Short Description:			30237 RE02p1	In2DC		
Start	Stop	Step	Detector	Meas. Time	IF Bandw.	Transducer
Frequency	Frequency	Width				
100.0 MHz	500.0 MHz	50.0 kHz	MaxPeak	15.0 ms	100 kHz	AA SAS-2A/M (1052)



## **V.2 ALUMINUM BOX**

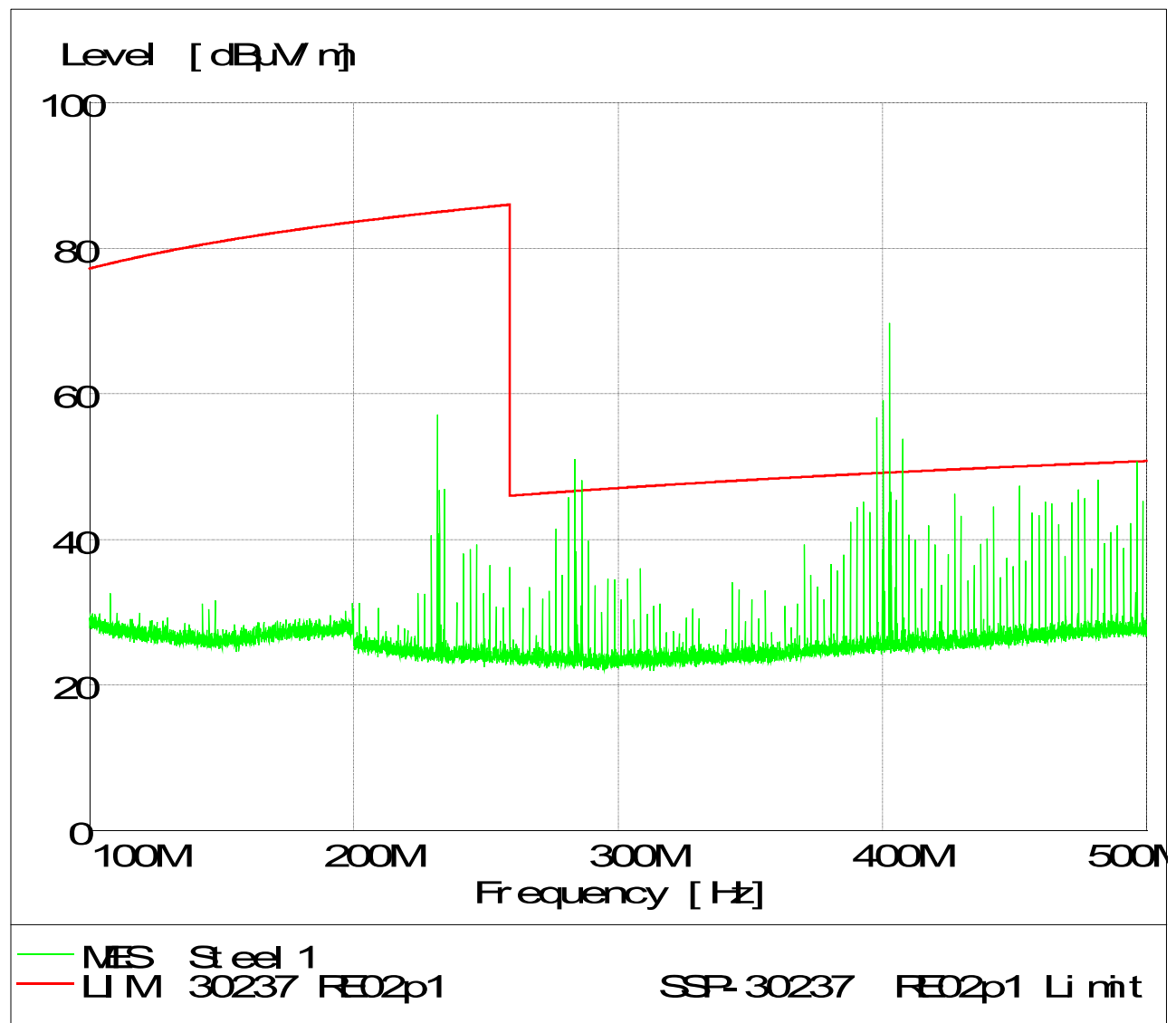
# NASA Glenn Research Center

## EMI Laboratory

EUT: Aluminum 1 meter square box  
EUT Engineer(s):  
Test Engineer(s): Mike Herlacher  
Operating Condition: 22 Jan 2010, 77F, 18%RH  
Test Site: 24' x 32' reverberant chamber  
Test Spec/Plan: SSP-30237, Space Station Radiated Electric Field Environment  
Comment: Box off grounded floor, non-isolated feed-thru, 5" rod.  
ZVL full sweep, 0dBm, EMI antenna @ 1 meter.

## SCAN TABLE: "30237 RE02p1"

Short Description:			30237 RE02p1	In2DC		
Start	Stop	Step	Detector	Meas. Time	IF Bandw.	Transducer
Frequency	Frequency	Width				
100.0 MHz	500.0 MHz	50.0 kHz	MaxPeak	15.0 ms	100 kHz	AA SAS-2A/M (1052)



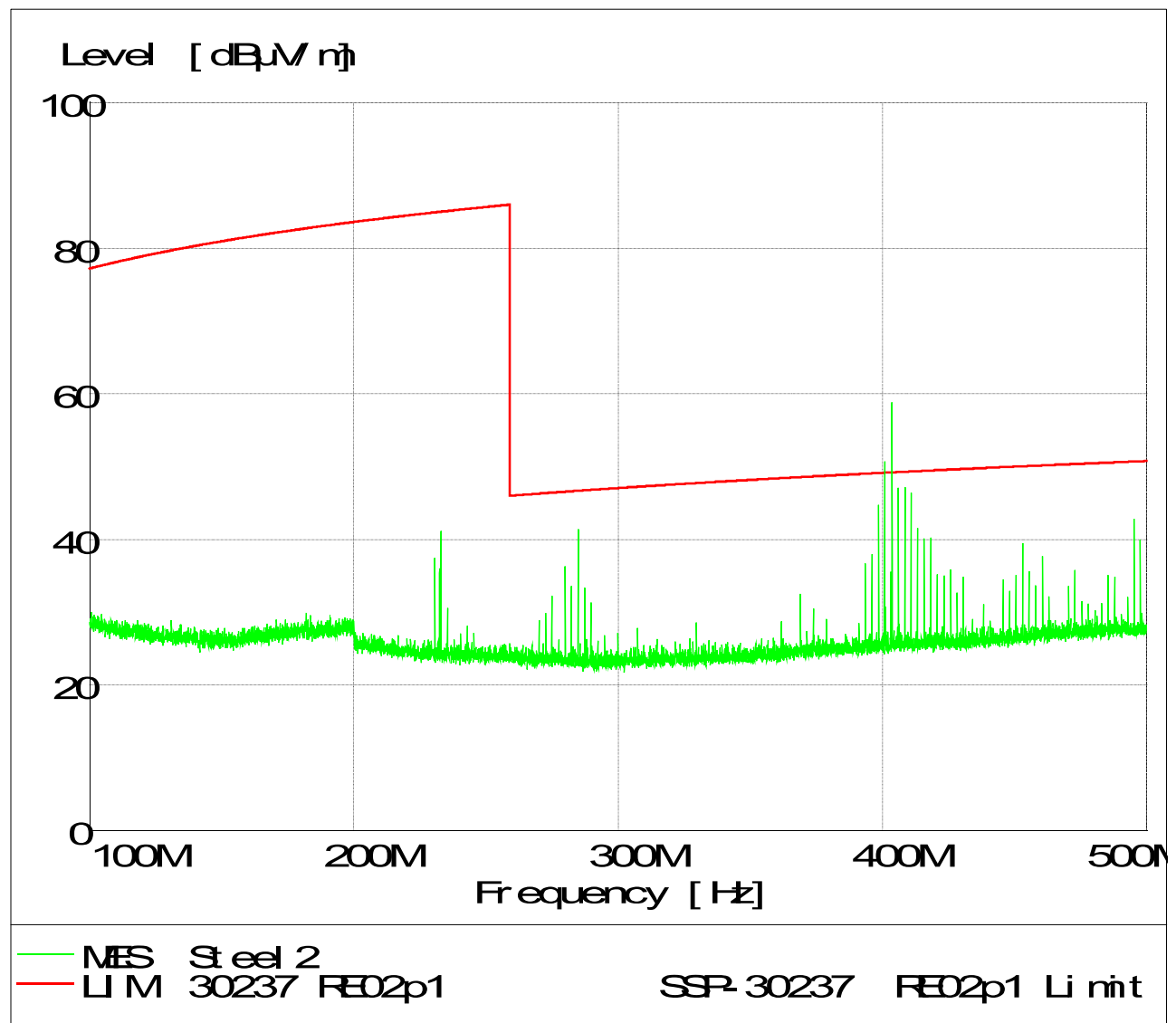
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## EMI Laboratory

EUT: Aluminum 1 meter square box  
EUT Engineer(s):  
Test Engineer(s): Mike Herlacher  
Operating Condition: 22 Jan 2010, 77F, 18%RH  
Test Site: 24' x 32' reverberant chamber  
Test Spec/Plan: SSP-30237, Space Station Radiated Electric Field Environment  
Comment: Box off grounded floor, non-isolated feed-thru, 5" rod.  
ZVL full sweep, -10dBm, EMI antenna @ 1 meter.

## SCAN TABLE: "30237 RE02p1"

Short Description:			30237 RE02p1	In2DC		
Start	Stop	Step	Detector	Meas.	IF	Transducer
Frequency	Frequency	Width		Time	Bandw.	
100.0 MHz	500.0 MHz	50.0 kHz	MaxPeak	15.0 ms	100 kHz	AA SAS-2A/M (1052)



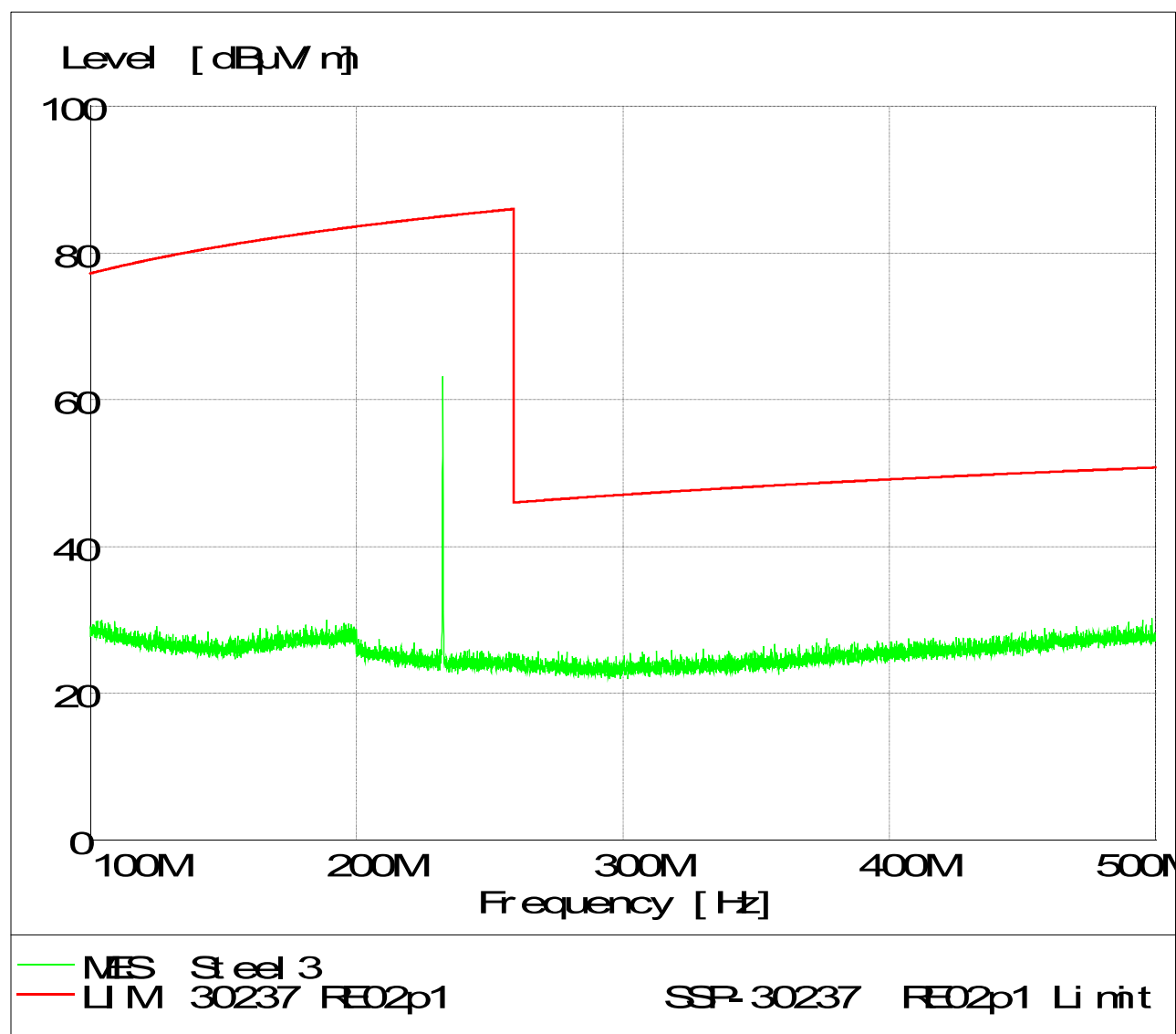
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EUT: Aluminum 1 meter square box  
EUT Engineer(s):  
Test Engineer(s): Mike Herlacher  
Operating Condition: 22 Jan 2010, 77F, 18%RH  
Test Site: 24' x 32' reverberant chamber  
Test Spec/Plan: SSP-30237, Space Station Radiated Electric Field Environment  
Comment: Box off grounded floor, non-isolated feed-thru, 5" rod.  
ZVL @ 232MHz, -10dBm, EMI antenna @ 1 meter.

## SCAN TABLE: "30237 RE02p1"

Short Description:			30237 RE02p1	In2DC		
Start	Stop	Step	Detector	Meas. Time	IF Bandw.	Transducer
Frequency	Frequency	Width				
100.0 MHz	500.0 MHz	50.0 kHz	MaxPeak	15.0 ms	100 kHz	AA SAS-2A/M (1052)



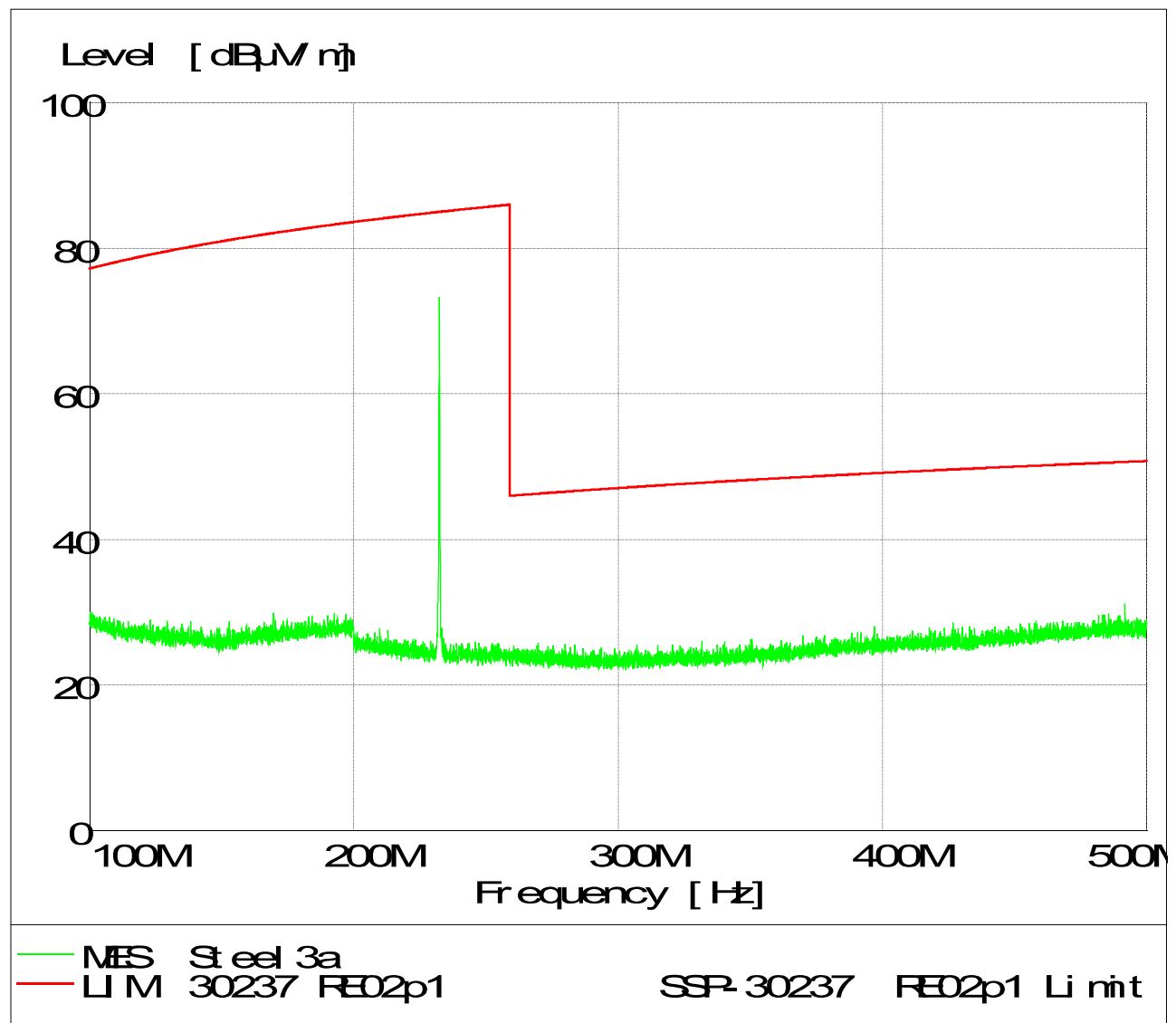
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## EMI Laboratory

EUT: Aluminum 1 meter square box  
EUT Engineer(s):  
Test Engineer(s): Mike Herlacher  
Operating Condition: 22 Jan 2010, 77F, 18%RH  
Test Site: 24' x 32' reverberant chamber  
Test Spec/Plan: SSP-30237, Space Station Radiated Electric Field Environment  
Comment: Box off grounded floor, non-isolated feed-thru, 5" rod.  
ZVL @ 232MHz, 0dBm, EMI antenna @ 1 meter.

## SCAN TABLE: "30237 RE02p1"

Short Description:			30237 RE02p1	In2DC		
Start	Stop	Step	Detector	Meas. Time	IF Bandw.	Transducer
Frequency	Frequency	Width				
100.0 MHz	500.0 MHz	50.0 kHz	MaxPeak	15.0 ms	100 kHz	AA SAS-2A/M (1052)



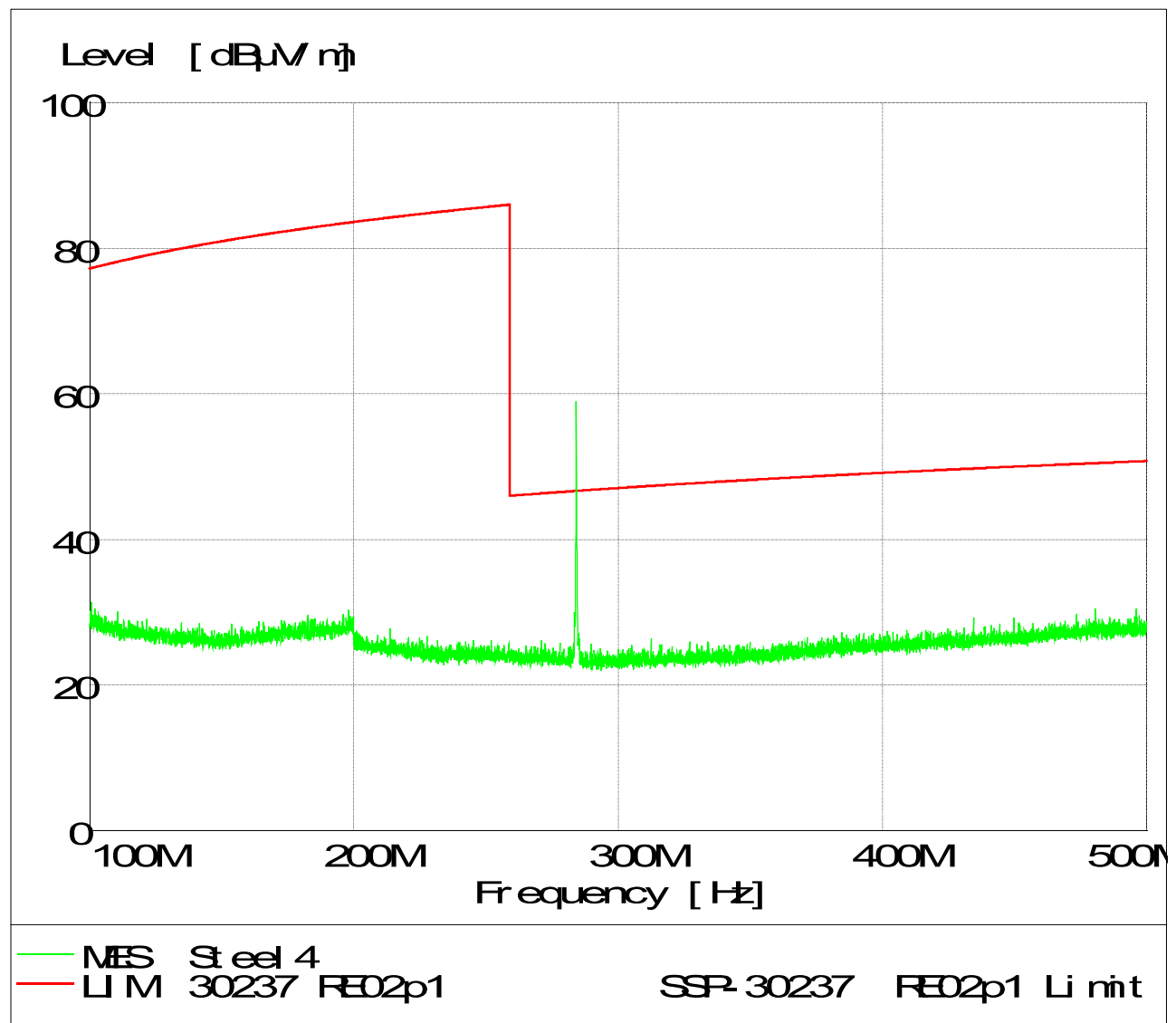
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## EMI Laboratory

EUT: Aluminum 1 meter square box  
EUT Engineer(s):  
Test Engineer(s): Mike Herlacher  
Operating Condition: 22 Jan 2010, 77F, 18%RH  
Test Site: 24' x 32' reverberant chamber  
Test Spec/Plan: SSP-30237, Space Station Radiated Electric Field Environment  
Comment: Box off grounded floor, non-isolated feed-thru, 5" rod.  
ZVL @ 284MHz, 0dBm, EMI antenna @ 1 meter.

## SCAN TABLE: "30237 RE02p1"

Short Description:			30237 RE02p1	In2DC		
Start	Stop	Step	Detector	Meas. Time	IF Bandw.	Transducer
Frequency	Frequency	Width				
100.0 MHz	500.0 MHz	50.0 kHz	MaxPeak	15.0 ms	100 kHz	AA SAS-2A/M (1052)





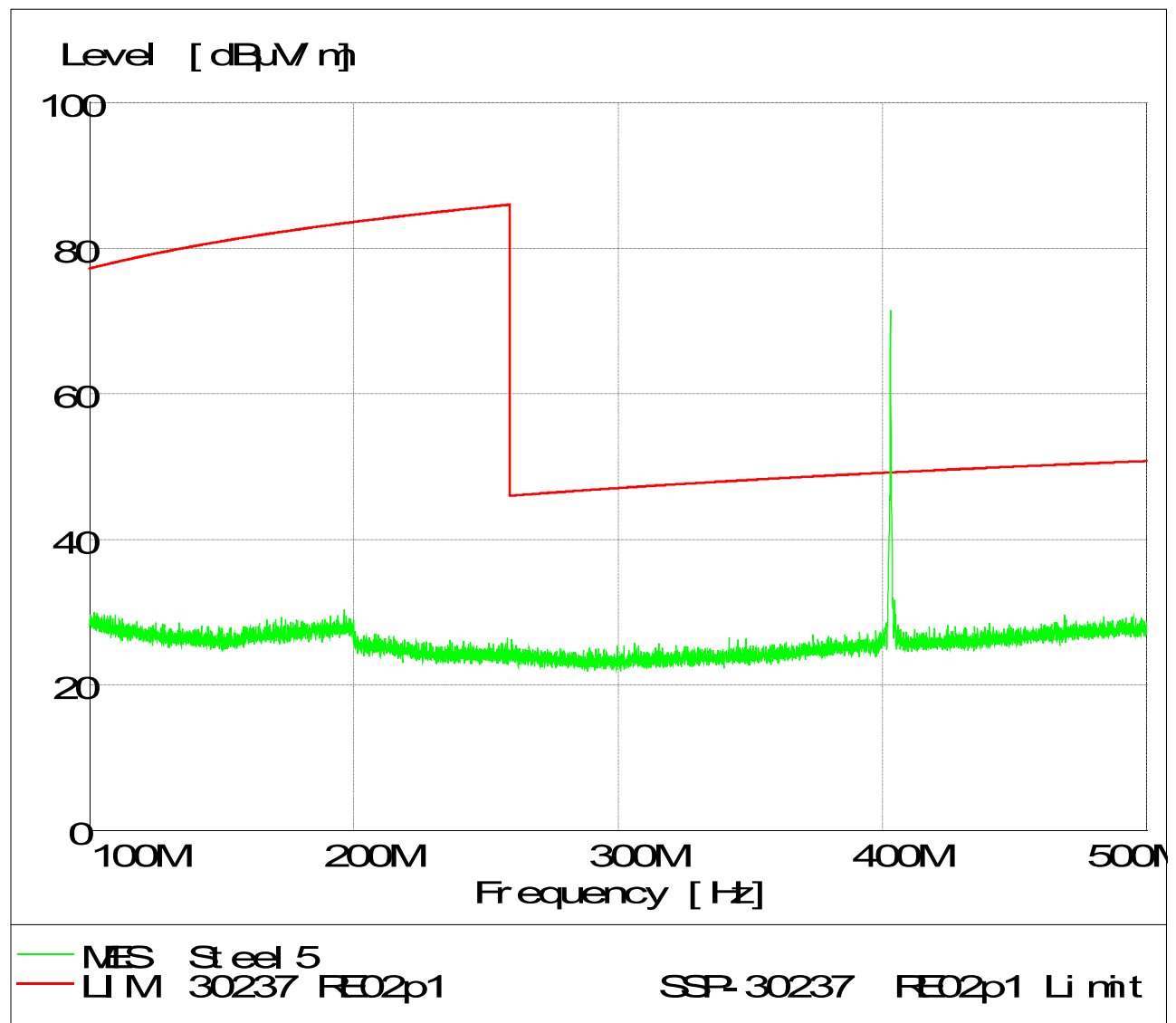
# NASA Glenn Research Center

## EMI Laboratory

EUT: Aluminum 1 meter square box  
EUT Engineer(s):  
Test Engineer(s): Mike Herlacher  
Operating Condition: 22 Jan 2010, 77F, 18%RH  
Test Site: 24' x 32' reverberant chamber  
Test Spec/Plan: SSP-30237, Space Station Radiated Electric Field Environment  
Comment: Box off grounded floor, non-isolated feed-thru, 5" rod.  
ZVL @ 403MHz, 0dBm, EMI antenna @ 1 meter.

## SCAN TABLE: "30237 RE02p1"

Short Description:			30237 RE02p1	In2DC		
Start	Stop	Step	Detector	Meas. Time	IF Bandw.	Transducer
Frequency	Frequency	Width				
100.0 MHz	500.0 MHz	50.0 kHz	MaxPeak	15.0 ms	100 kHz	AA SAS-2A/M (1052)



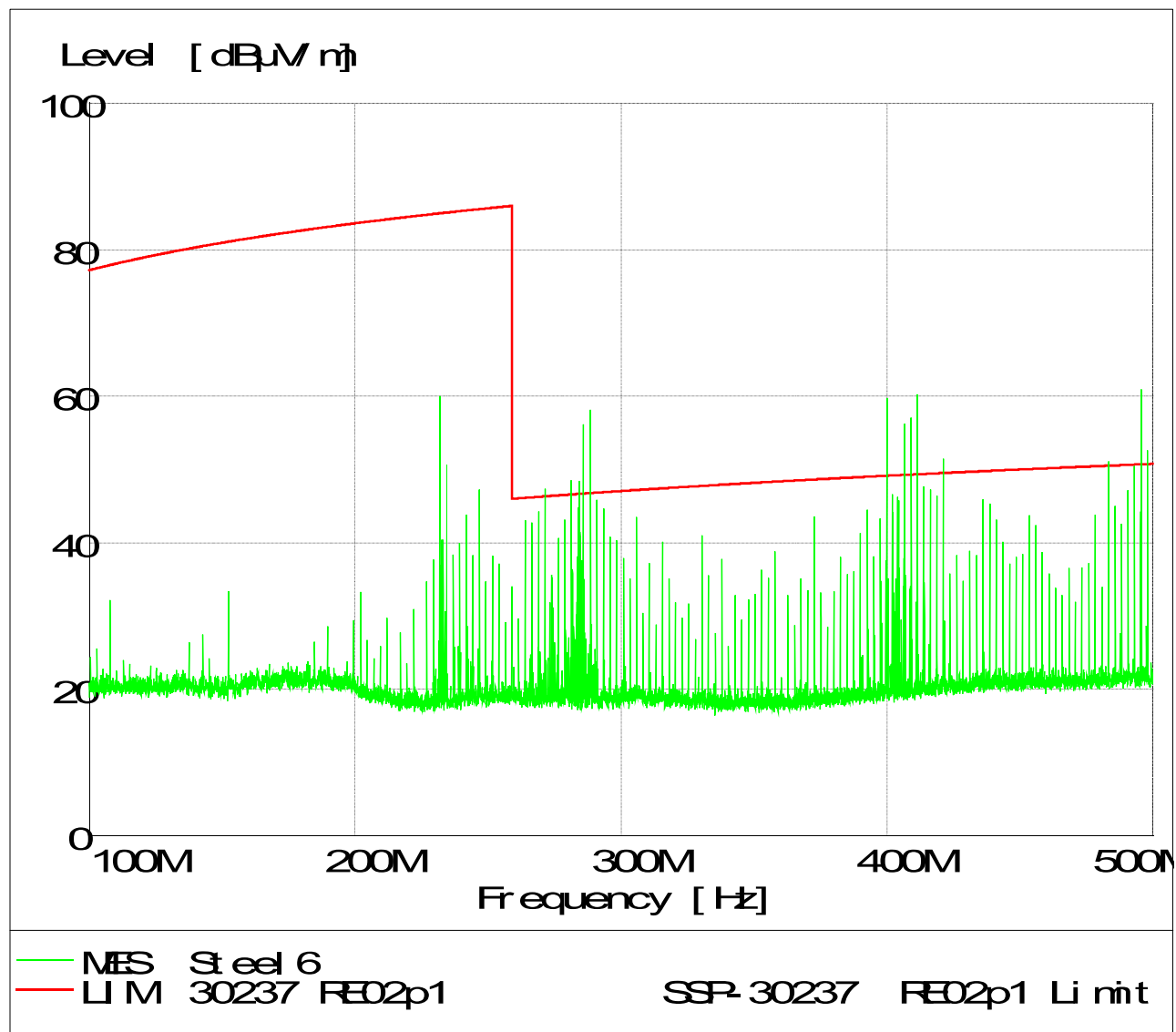
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## EMI Laboratory

EUT: Aluminum 1 meter square box  
EUT Engineer(s):  
Test Engineer(s): Mike Herlacher  
Operating Condition: 22 Jan 2010, 77F, 18%RH  
Test Site: 24' x 32' reverberant chamber  
Test Spec/Plan: SSP-30237, Space Station Radiated Electric Field Environment  
Comment: Box on grounded floor, non-isolated feed-thru, 5" rod.  
ZVL full spectrum, 0dBm, EMI antenna @ 1 meter.

## SCAN TABLE: "30237 RE02p1"

Short Description:			30237 RE02p1	In2DC		
Start	Stop	Step	Detector	Meas. Time	IF Bandw.	Transducer
Frequency	Frequency	Width				
100.0 MHz	500.0 MHz	50.0 kHz	MaxPeak	15.0 ms	100 kHz	AA SAS-2A/M (1052)



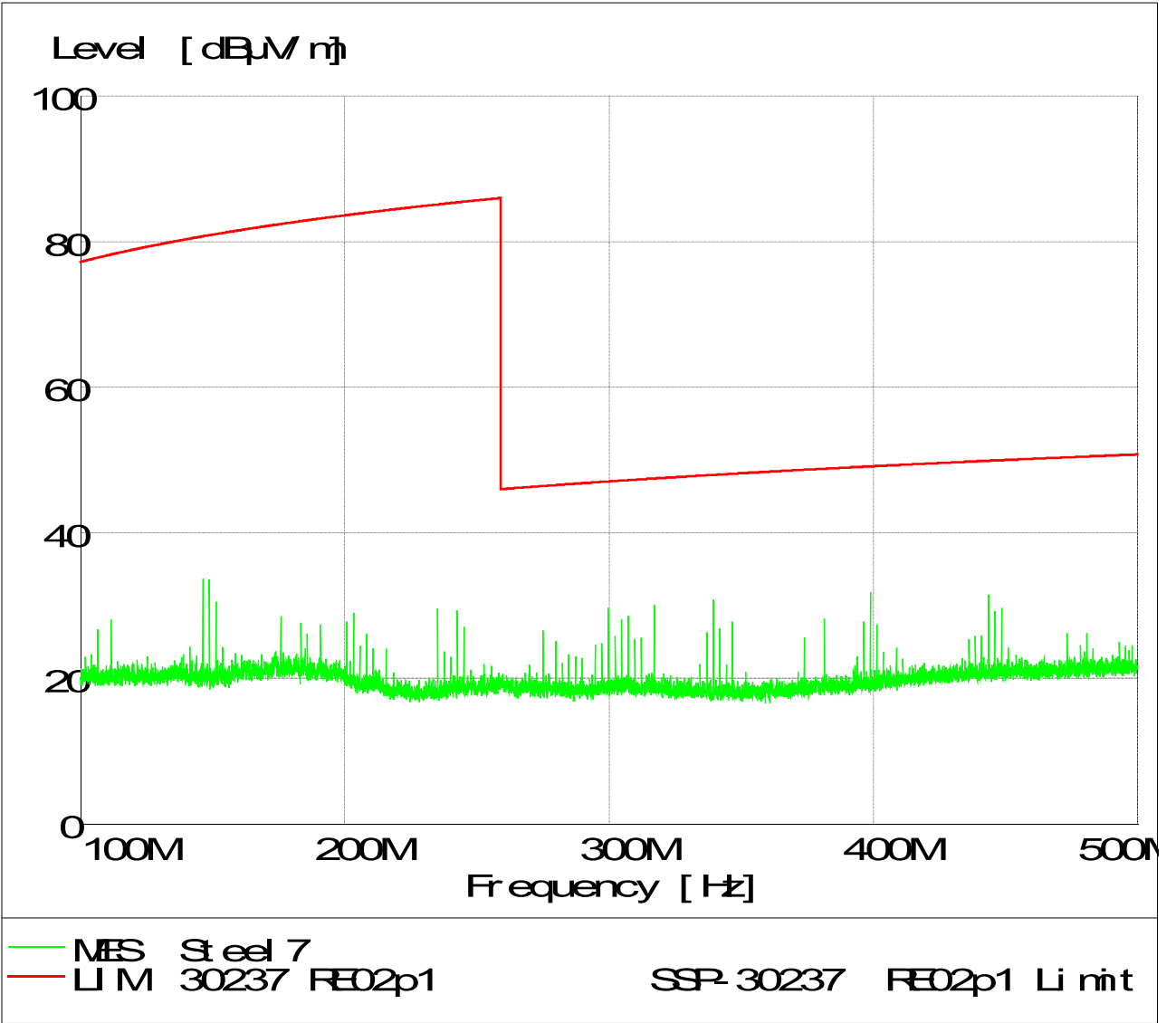
NASA Glenn Research Center

EMI Laboratory

EUT: Aluminum 1 meter square box  
EUT Engineer(s):  
Test Engineer(s): Mike Herlacher  
Operating Condition: 22 Jan 2010, 77F, 18%RH  
Test Site: 24' x 32' reverberant chamber  
Test Spec/Plan: SSP-30237, Space Station Radiated Electric Field Environment  
Comment: Box on grounded floor, non-isolated feed-thru,  
Calibrated open-no antenna.  
ZVL full spectrum, 0dBm, EMI antenna @ 1 meter.

SCAN TABLE: "30237 RE02p1"

Short Description:			30237 RE02p1	In2DC		
Start	Stop	Step	Detector	Meas.	IF	Transducer
Frequency	Frequency	Width		Time	Bandw.	
100.0 MHz	500.0 MHz	50.0 kHz	MaxPeak	15.0 ms	100 kHz	AA SAS-2A/M (1052)



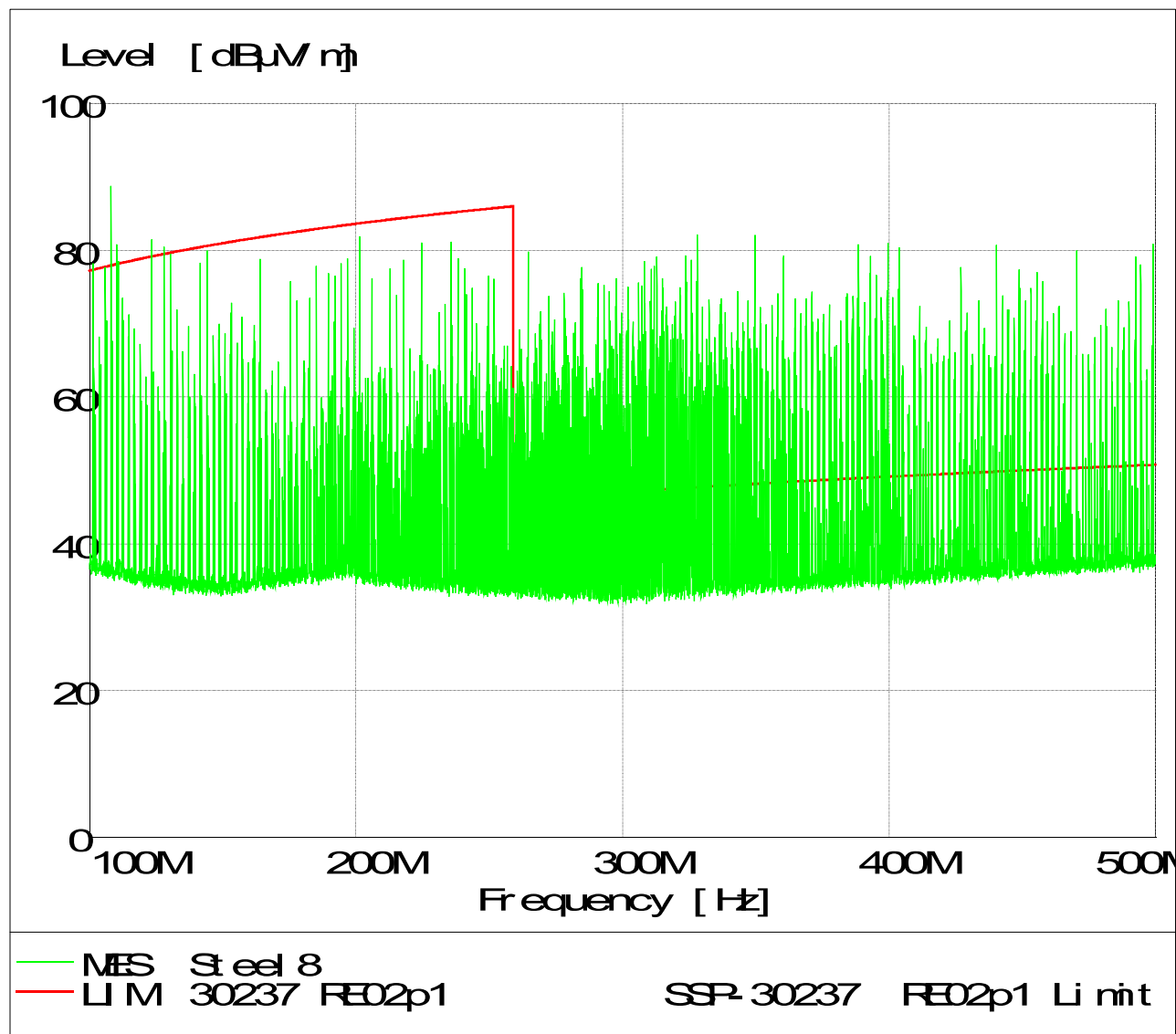
# NASA Glenn Research Center

## EMI Laboratory

EUT: Aluminum 1 meter square box  
EUT Engineer(s):  
Test Engineer(s): Mike Herlacher  
Operating Condition: 22 Jan 2010, 77F, 18%RH  
Test Site: 24' x 32' reverberant chamber  
Test Spec/Plan: SSP-30237, Space Station Radiated Electric Field Environment  
Comment: Box on grounded floor, isolated feed-thru, 5" rod.  
ZVL full spectrum, 0dBm, EMI antenna @ 1 meter.

## SCAN TABLE: "30237 RE02p1"

Short Description:			30237 RE02p1	In2DC		
Start	Stop	Step	Detector	Meas. Time	IF Bandw.	Transducer
Frequency	Frequency	Width				
100.0 MHz	500.0 MHz	50.0 kHz	MaxPeak	15.0 ms	100 kHz	AA SAS-2A/M (1052)



## **V.3 COMPOSITE BOX**

### **V.3.1 EMI ANTENNA @ 3 METERS**

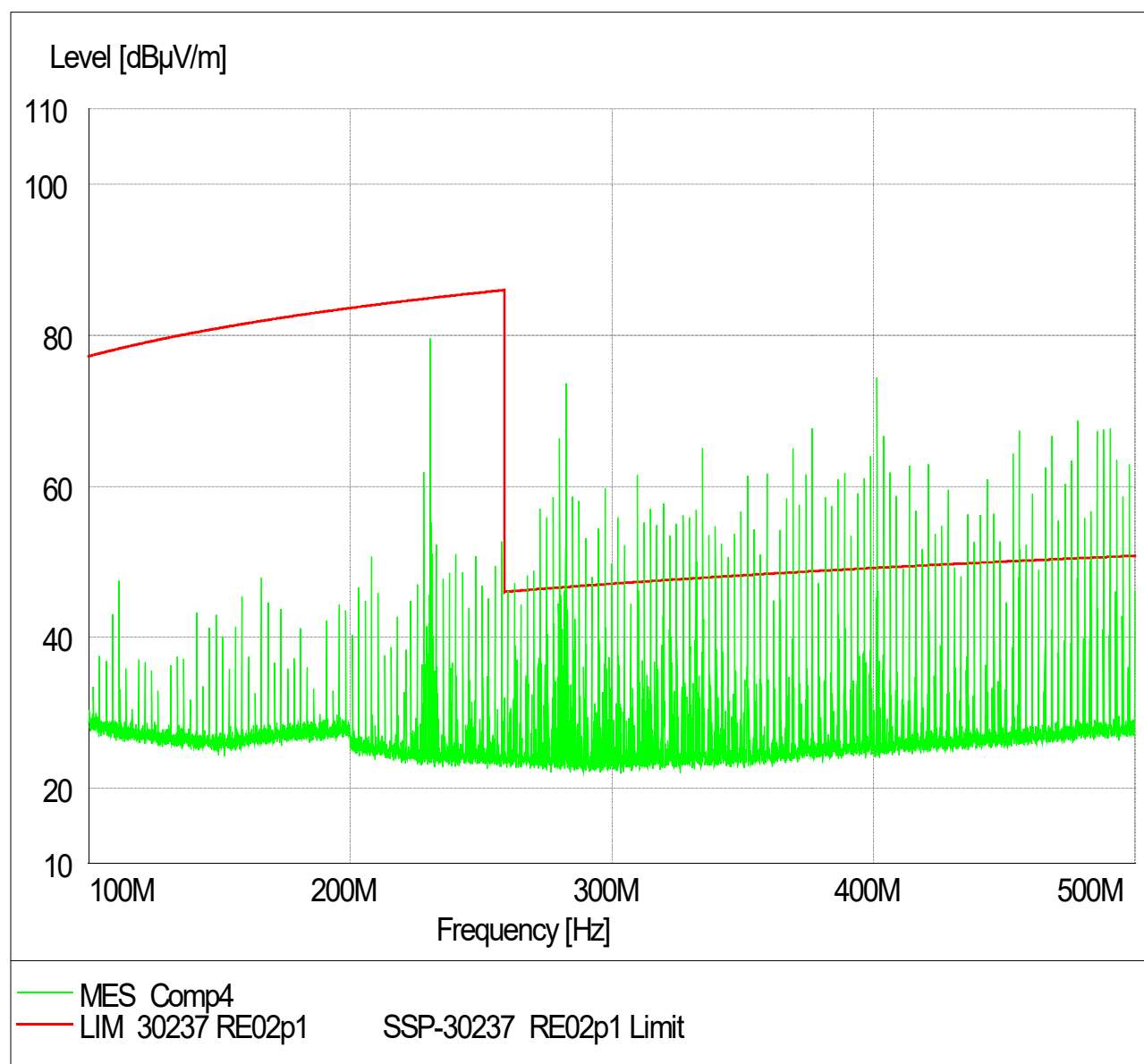
# NASA Glenn Research Center

## EMI Laboratory

EUT: Composite 1 meter square box  
EUT Engineer(s):  
Test Engineer(s): Mike Herlacher  
Operating Condition: 21 Jan 2010, 77F, 18%RH  
Test Site: 24' x 32' reverberant chamber  
Test Spec/Plan: SSP-30237, Space Station Radiated Electric Field Environment  
Comment: Box off grounded floor, non-isolated feed-thru, 5" rod.  
ZVL full spectrum sweep, 0dBm level, EMI antenna @3 meters.

## SCAN TABLE: "30237 RE02p1"

Short Description:			30237 RE02p1	In2DC		
Start	Stop	Step	Detector	Meas. Time	IF Bandw.	Transducer
Frequency	Frequency	Width				
100.0 MHz	500.0 MHz	50.0 kHz	MaxPeak	15.0 ms	100 kHz	AA SAS-2A/M (1052)



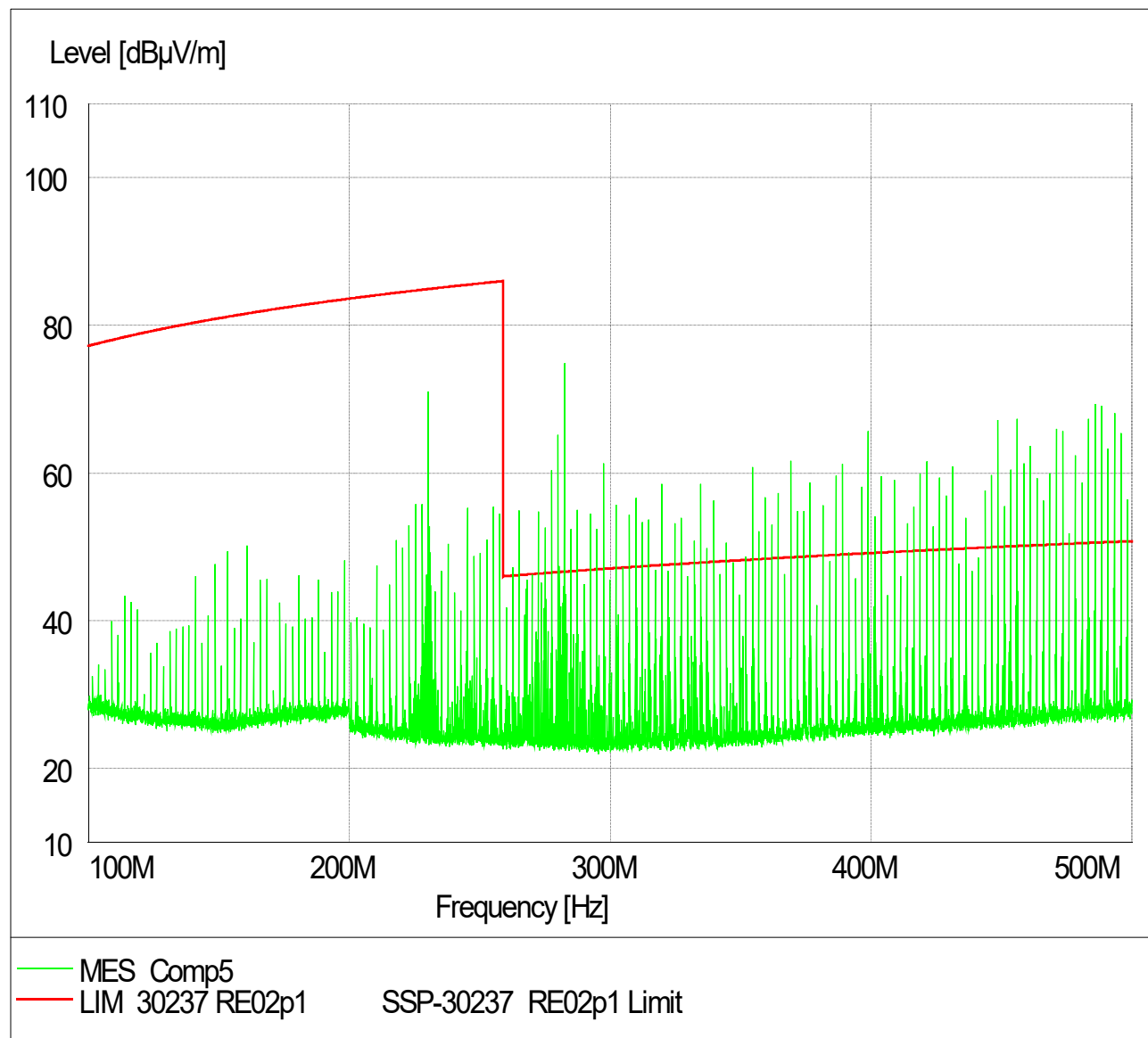
# NASA Glenn Research Center

## EMI Laboratory

EUT: Composite 1 meter square box  
EUT Engineer(s):  
Test Engineer(s): Mike Herlacher  
Operating Condition: 21 Jan 2010, 77F, 18%RH  
Test Site: 24' x 32' reverberant chamber  
Test Spec/Plan: SSP-30237, Space Station Radiated Electric Field Environment  
Comment: Box off grounded floor, non-isolated feed-thru, 5" rod.  
ZVL full sweep, 0dBm level. Box seams copper taped.  
EMI antenna @3 meters.

## SCAN TABLE: "30237 RE02p1"

Short Description:			30237 RE02p1	In2DC		
Start	Stop	Step	Detector	Meas. Time	IF Bandw.	Transducer
Frequency	Frequency	Width				
100.0 MHz	500.0 MHz	50.0 kHz	MaxPeak	15.0 ms	100 kHz	AA SAS-2A/M (1052)



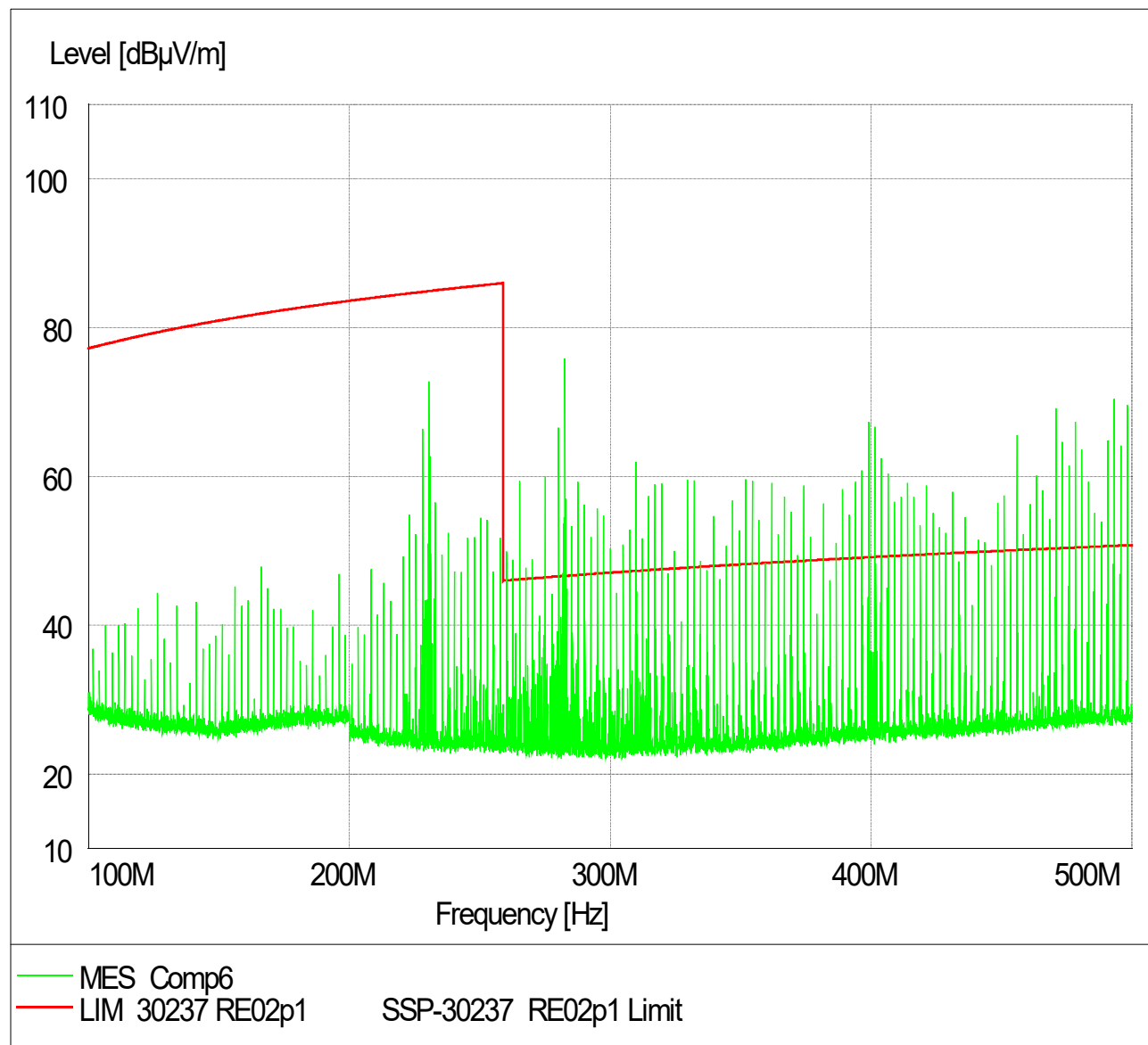
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EMI antenna @3 meters.

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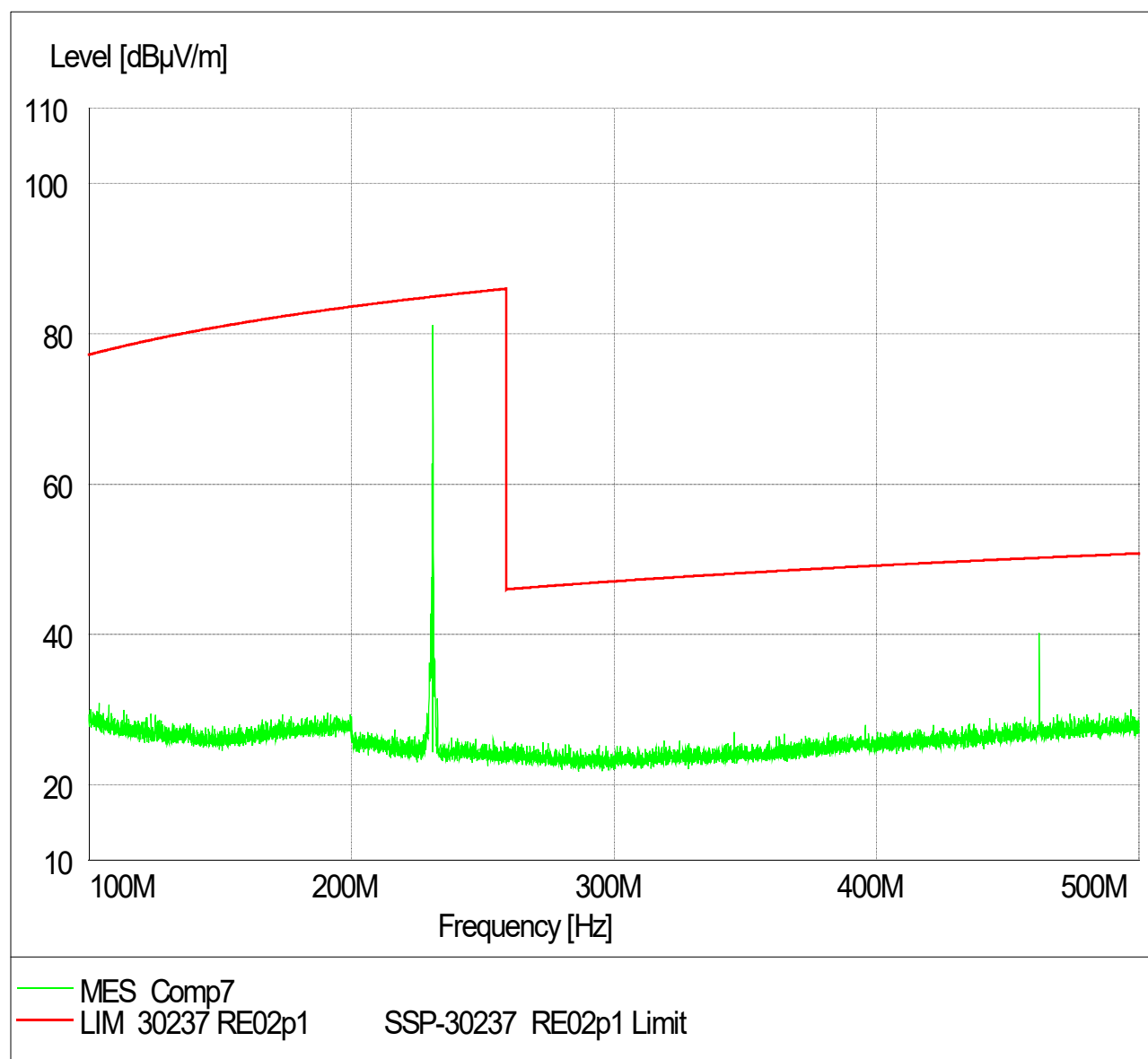
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## EMI Laboratory

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EUT Engineer(s):  
Test Engineer(s): Mike Herlacher  
Operating Condition: 21 Jan 2010, 77F, 18%RH  
Test Site: 24' x 32' reverberant chamber  
Test Spec/Plan: SSP-30237, Space Station Radiated Electric Field Environment  
Comment: Box on grounded metal floor, non-isolated feed-thru, 5" rod.  
ZVL @230MHz only, 0dBm power level. Box seams taped.  
EMI antenna @3 meters.

## SCAN TABLE: "30237 RE02p1"

Short Description:			30237 RE02p1	In2DC		
Start	Stop	Step	Detector	Meas. Time	IF Bandw.	Transducer
Frequency	Frequency	Width				
100.0 MHz	500.0 MHz	50.0 kHz	MaxPeak	15.0 ms	100 kHz	AA SAS-2A/M (1052)



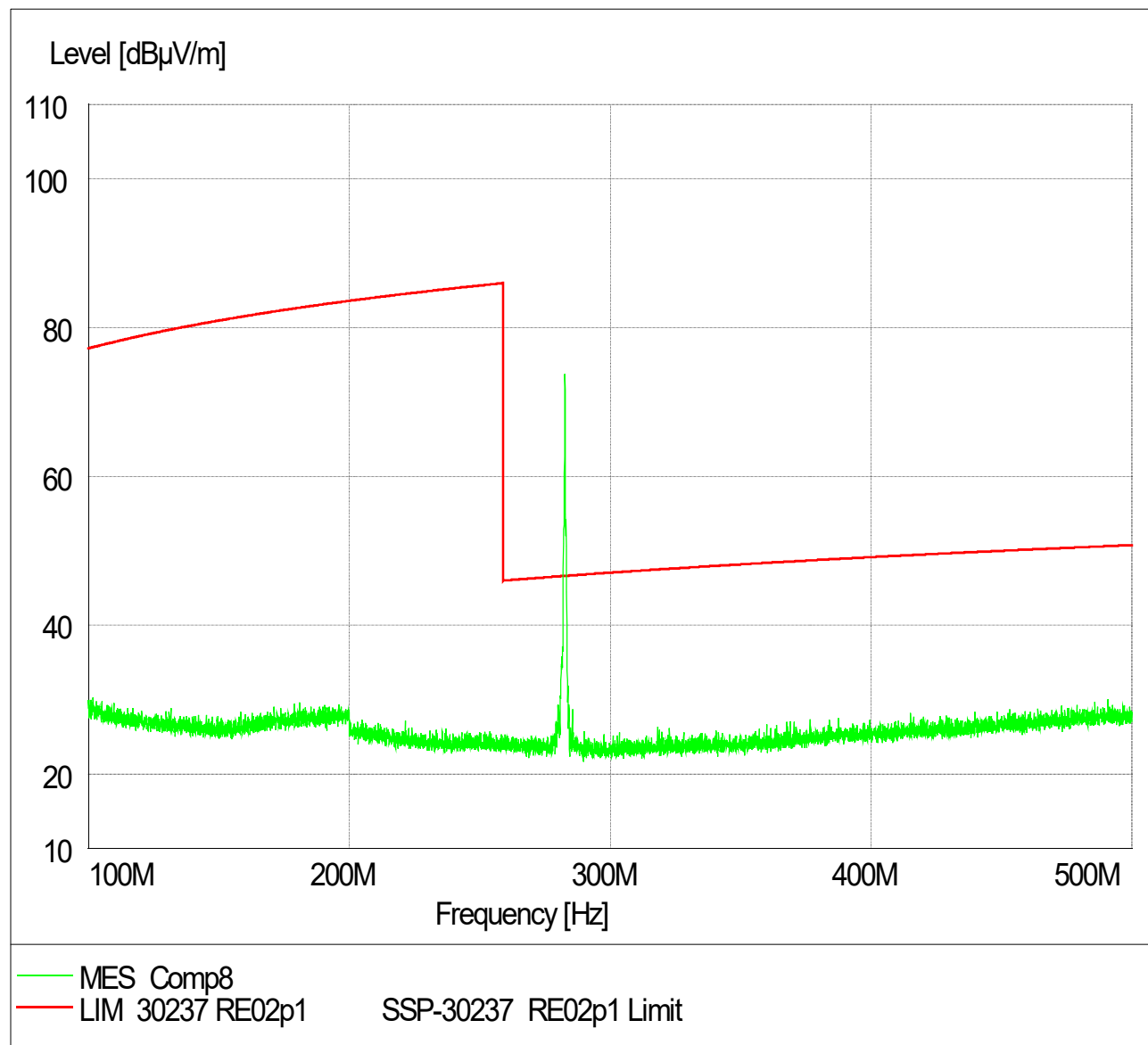
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Test Engineer(s): Mike Herlacher  
Operating Condition: 21 Jan 2010, 77F, 18%RH  
Test Site: 24' x 32' reverberant chamber  
Test Spec/Plan: SSP-30237, Space Station Radiated Electric Field Environment  
Comment: Box on grounded metal floor, non-isolated feed-thru, 5" rod.  
ZVL @282MHz only, 0dBm level. Box seams taped.  
EMI antenna @3 meters.

## SCAN TABLE: "30237 RE02p1"

Short Description:			30237 RE02p1	In2DC		
Start	Stop	Step	Detector	Meas. Time	IF Bandw.	Transducer
Frequency	Frequency	Width				
100.0 MHz	500.0 MHz	50.0 kHz	MaxPeak	15.0 ms	100 kHz	AA SAS-2A/M (1052)



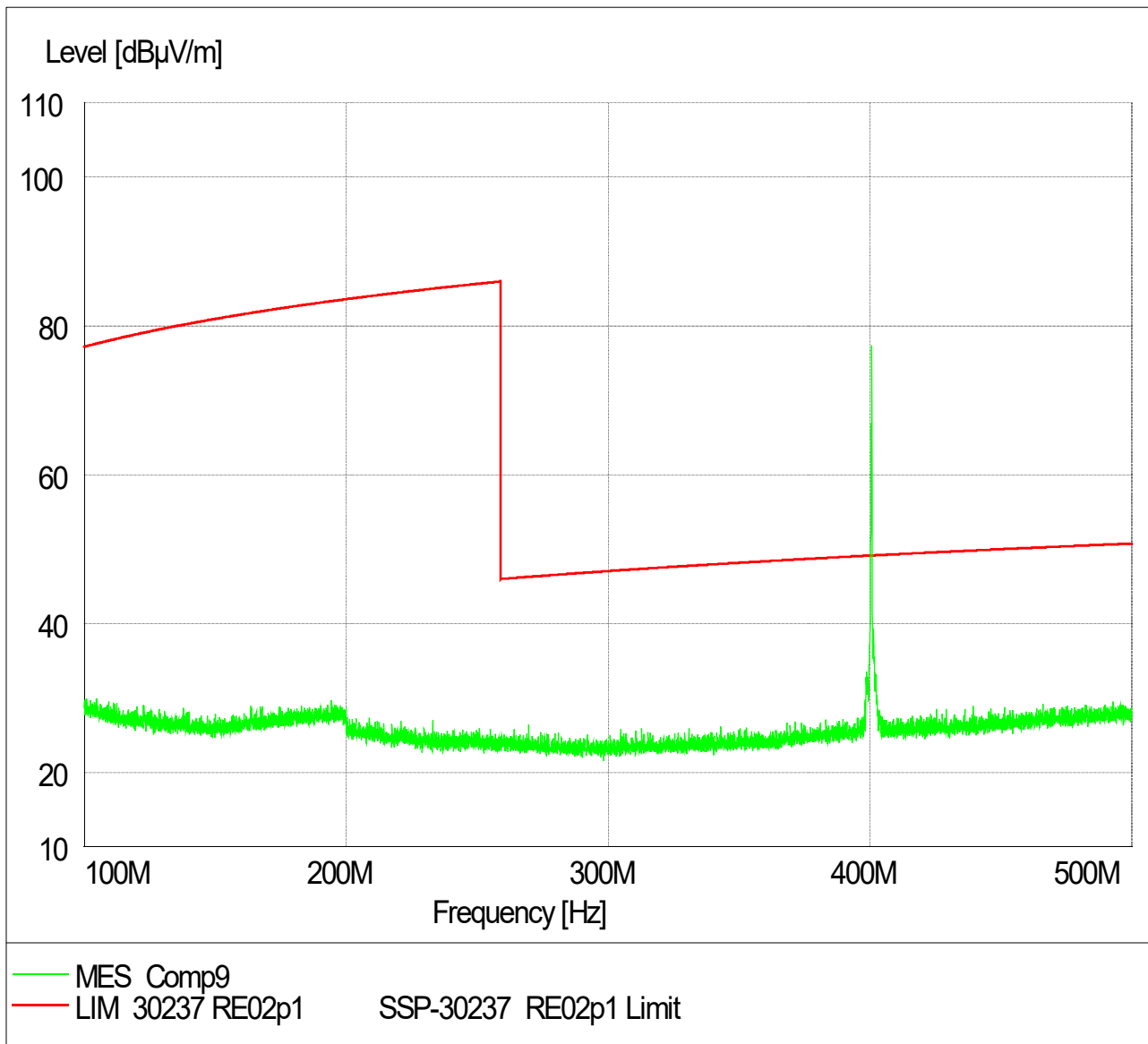
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## EMI Laboratory

EUT: Composite 1 meter square box  
EUT Engineer(s):  
Test Engineer(s): Mike Herlacher  
Operating Condition: 21 Jan 2010, 77F, 18%RH  
Test Site: 24' x 32' reverberant chamber  
Test Spec/Plan: SSP-30237, Space Station Radiated Electric Field Environment  
Comment: Box on grounded metal floor, non-isolated feed-thru, 5" rod.  
ZVL @401MHz only, 0dBm level. Box seams taped.  
EMI antenna @3 meters.

## SCAN TABLE: "30237 RE02p1"

Short Description:			30237 RE02p1	In2DC		
Start	Stop	Step	Detector	Meas. Time	IF Bandw.	Transducer
Frequency	Frequency	Width				
100.0 MHz	500.0 MHz	50.0 kHz	MaxPeak	15.0 ms	100 kHz	AA SAS-2A/M (1052)



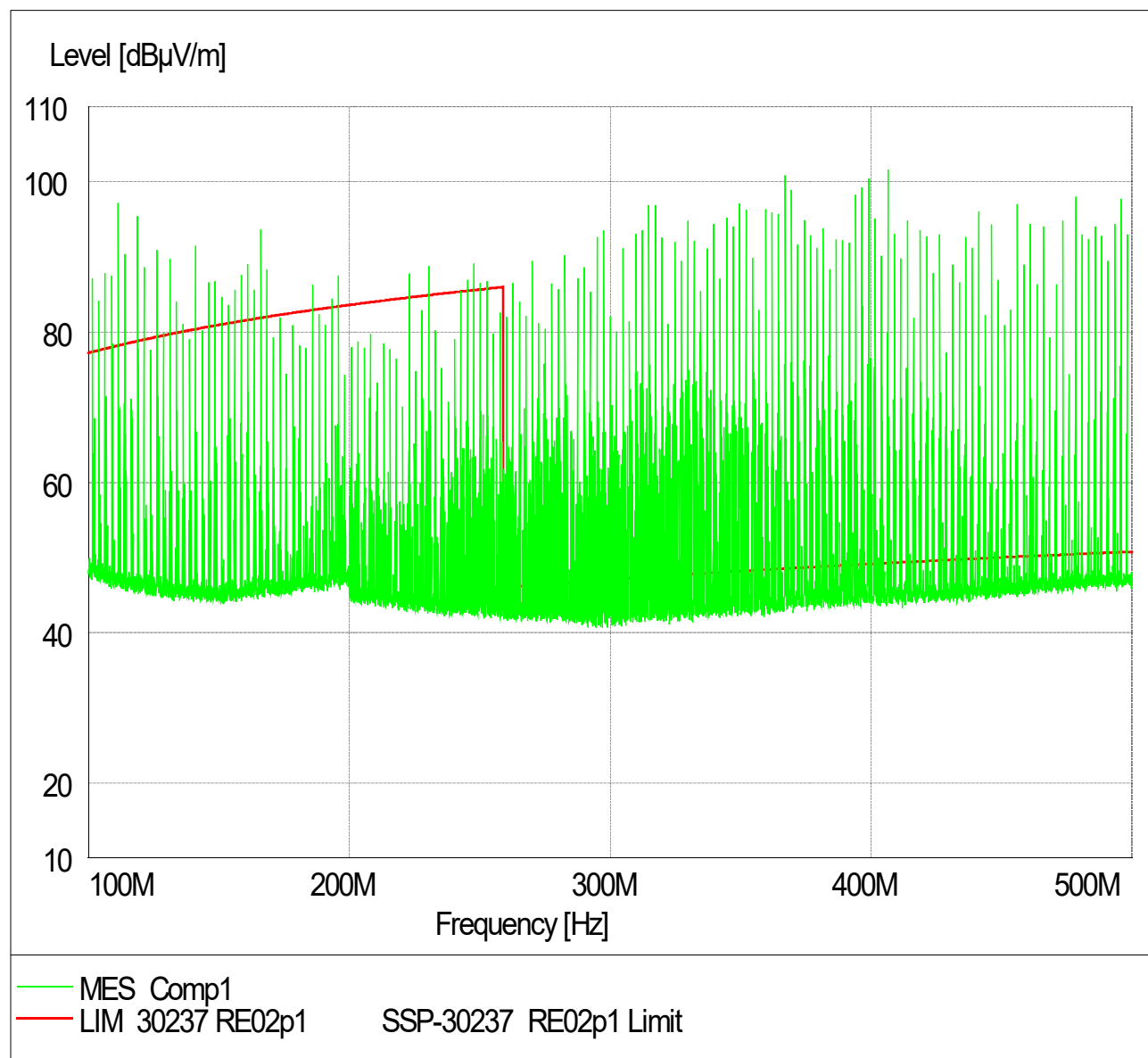
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Test Spec/Plan: SSP-30237, Space Station Radiated Electric Field Environment  
Comment: Box on grounded metal floor, isolated feed-thru, 5" rod.  
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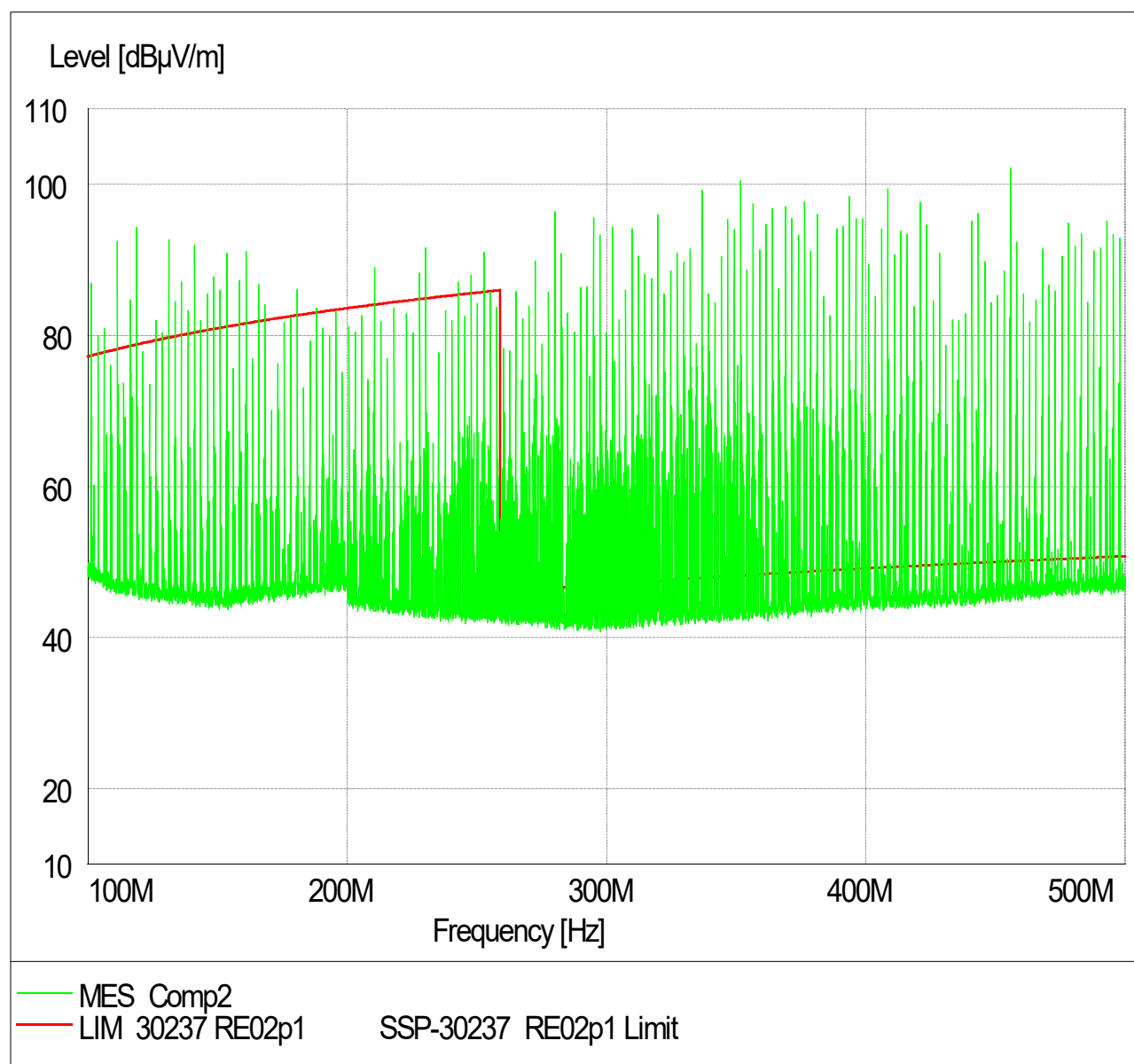
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### **V.3 COMPOSITE BOX (Cont.)**

#### **V.3.2 EMI ANTENNA @ 1 METER**

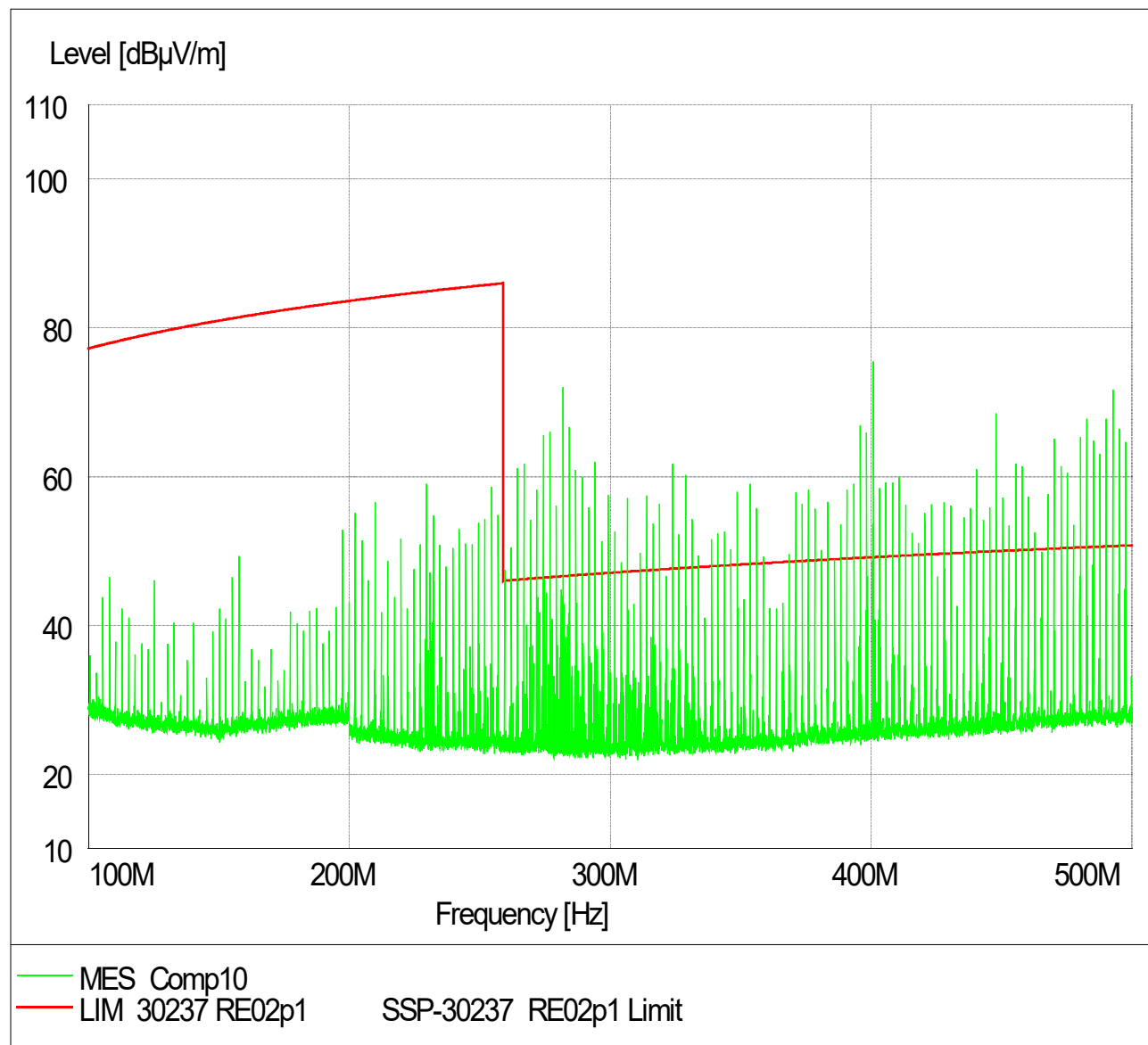
# NASA Glenn Research Center

## EMI Laboratory

EUT: Composite 1 meter square box  
EUT Engineer(s):  
Test Engineer(s): Mike Herlacher  
Operating Condition: 21 Jan 2010, 77F, 18%RH  
Test Site: 24' x 32' reverberant chamber  
Test Spec/Plan: SSP-30237, Space Station Radiated Electric Field Environment  
Comment: Box on grounded metal floor, non-isolated feed-thru, 5" rod.  
ZVL full sweep, 0dBm. Box taped. EMI antenna @ 1 meter.

## SCAN TABLE: "30237 RE02p1"

Short Description:			30237 RE02p1	In2DC		
Start	Stop	Step	Detector	Meas. Time	IF Bandw.	Transducer
Frequency	Frequency	Width				
100.0 MHz	500.0 MHz	50.0 kHz	MaxPeak	15.0 ms	100 kHz	AA SAS-2A/M (1052)



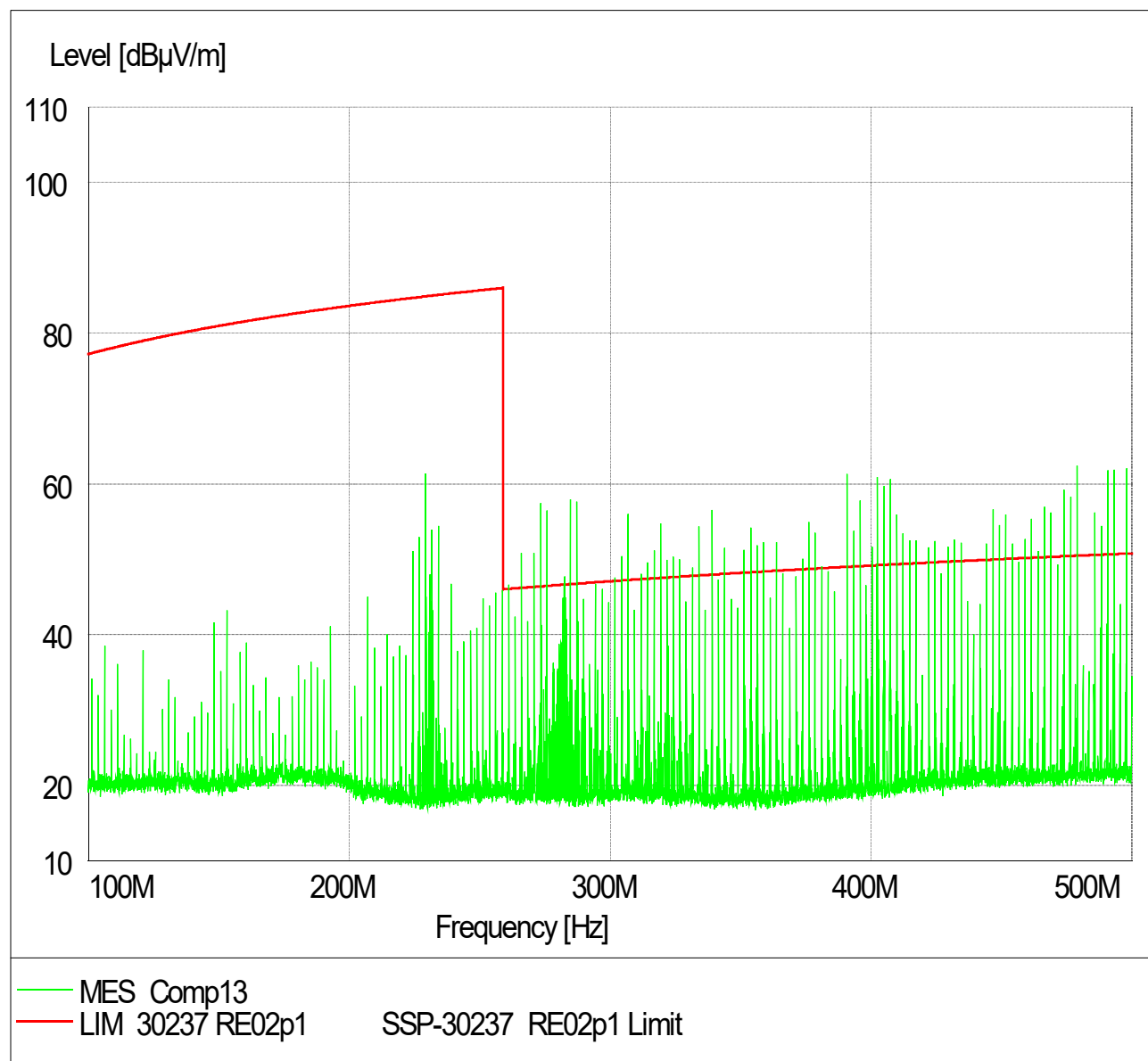
# NASA Glenn Research Center

## EMI Laboratory

EUT: Composite 1 meter square box  
EUT Engineer(s):  
Test Engineer(s): Mike Herlacher  
Operating Condition: 22 Jan 2010, 77F, 18%RH  
Test Site: 24' x 32' reverberant chamber  
Test Spec/Plan: SSP-30237, Space Station Radiated Electric Field Environment  
Comment: Box on grounded floor, non-isolated feed-thru, 5" rod  
ZVL full sweep, 0dBm. Box taped, EMI ant @ 1 meter.

## SCAN TABLE: "30237 RE02p1"

Short Description:			30237 RE02p1	In2DC		
Start	Stop	Step	Detector	Meas. Time	IF Bandw.	Transducer
Frequency	Frequency	Width				
100.0 MHz	500.0 MHz	50.0 kHz	MaxPeak	15.0 ms	100 kHz	AA SAS-2A/M (1052)





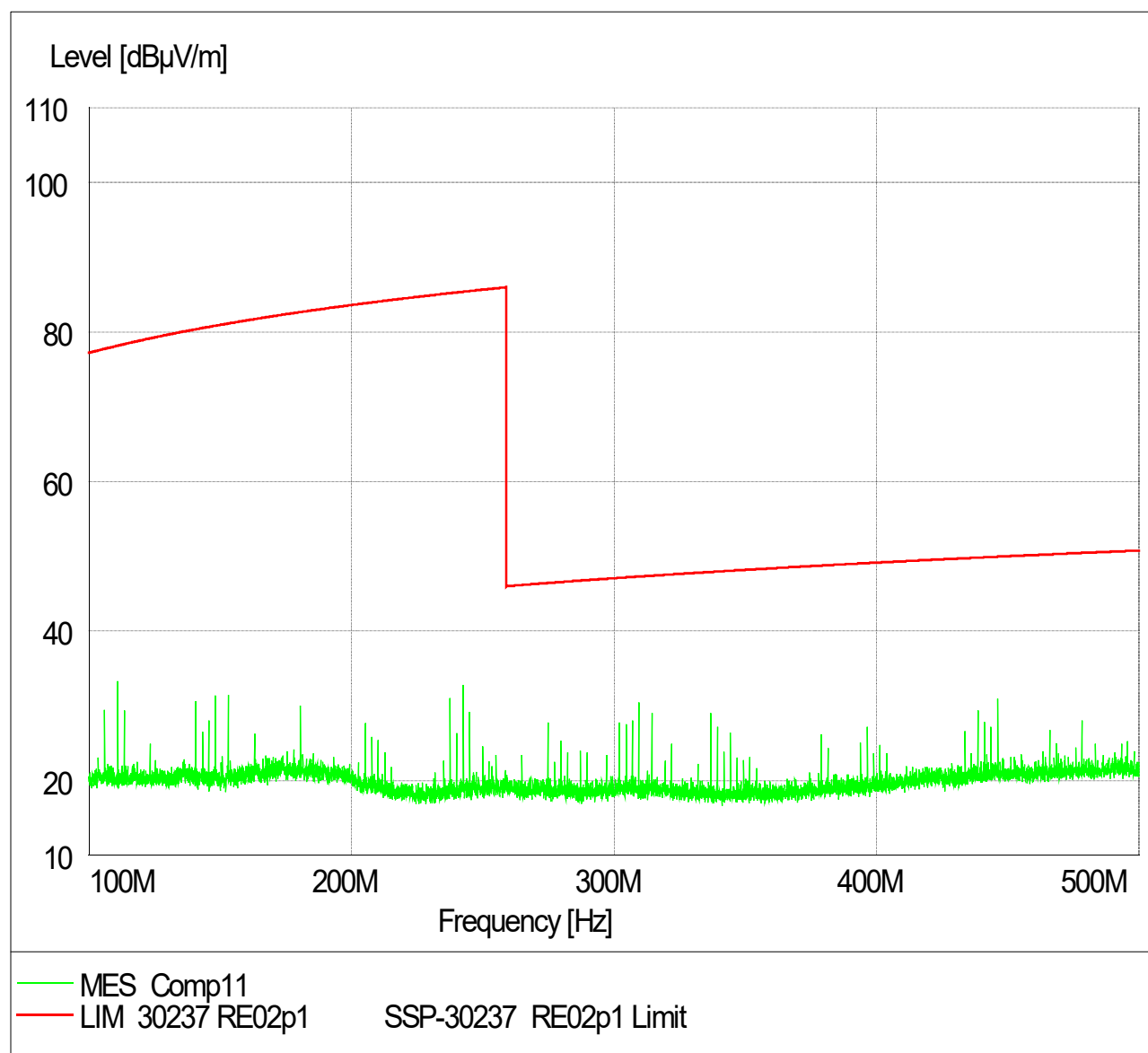
# NASA Glenn Research Center

## EMI Laboratory

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EUT Engineer(s):  
Test Engineer(s): Mike Herlacher  
Operating Condition: 22 Jan 2010, 77F, 18%RH  
Test Site: 24' x 32' reverberant chamber  
Test Spec/Plan: SSP-30237, Space Station Radiated Electric Field Environment  
Comment: Box on grounded metal floor, non-isolated feed-thru, calibrated open-no antenna.  
ZVL full sweep, 0dBm. Box taped, EMI antenna @ 1 meter.

## SCAN TABLE: "30237 RE02p1"

Short Description:			30237 RE02p1	In2DC		
Start	Stop	Step	Detector	Meas. Time	IF Bandw.	Transducer
Frequency	Frequency	Width				
100.0 MHz	500.0 MHz	50.0 kHz	MaxPeak	15.0 ms	100 kHz	AA SAS-2A/M (1052)



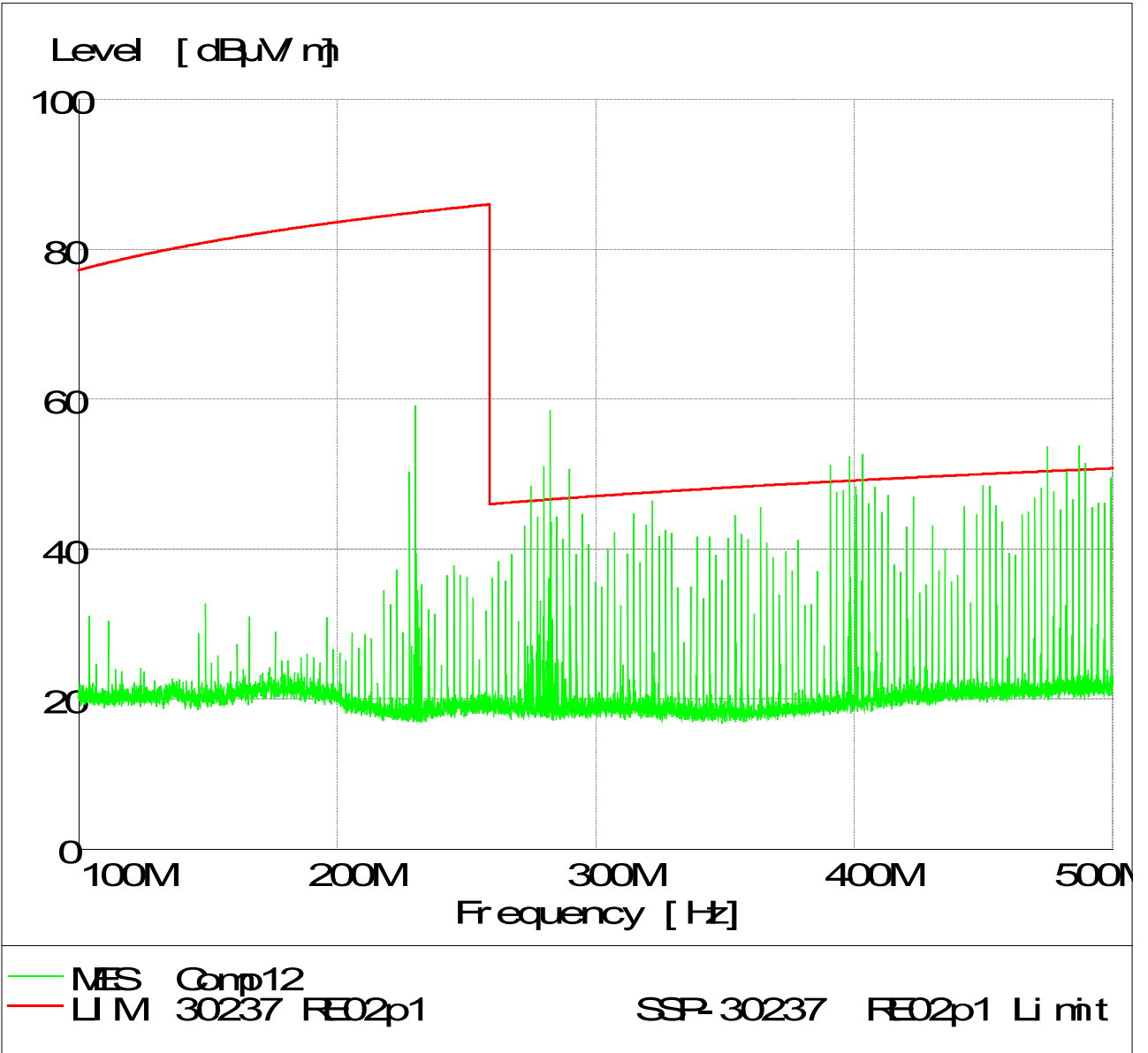
NASA Glenn Research Center

EMI Laboratory

EUT: Composite 1 meter square box  
EUT Engineer(s):  
Test Engineer(s): Mike Herlacher  
Operating Condition: 22 Jan 2010, 77F, 18%RH  
Test Site: 24' x 32' reverberant chamber  
Test Spec/Plan: SSP-30237, Space Station Radiated Electric Field Environment  
Comment: Box on grounded floor, non-isolated feed-thru, 5" rod.  
ZVL full sweep, -10dBm, EMI antenna @ 1 meter.

SCAN TABLE: "30237 RE02p1"

Short Description:			30237 RE02p1		In2DC		
Start	Stop	Step	Detector	Meas.	IF	Transducer	
Frequency	Frequency	Width		Time	Bandw.		
100.0 MHz	500.0 MHz	50.0 kHz	MaxPeak	15.0 ms	100 kHz	AA SAS-2A/M (1052)	



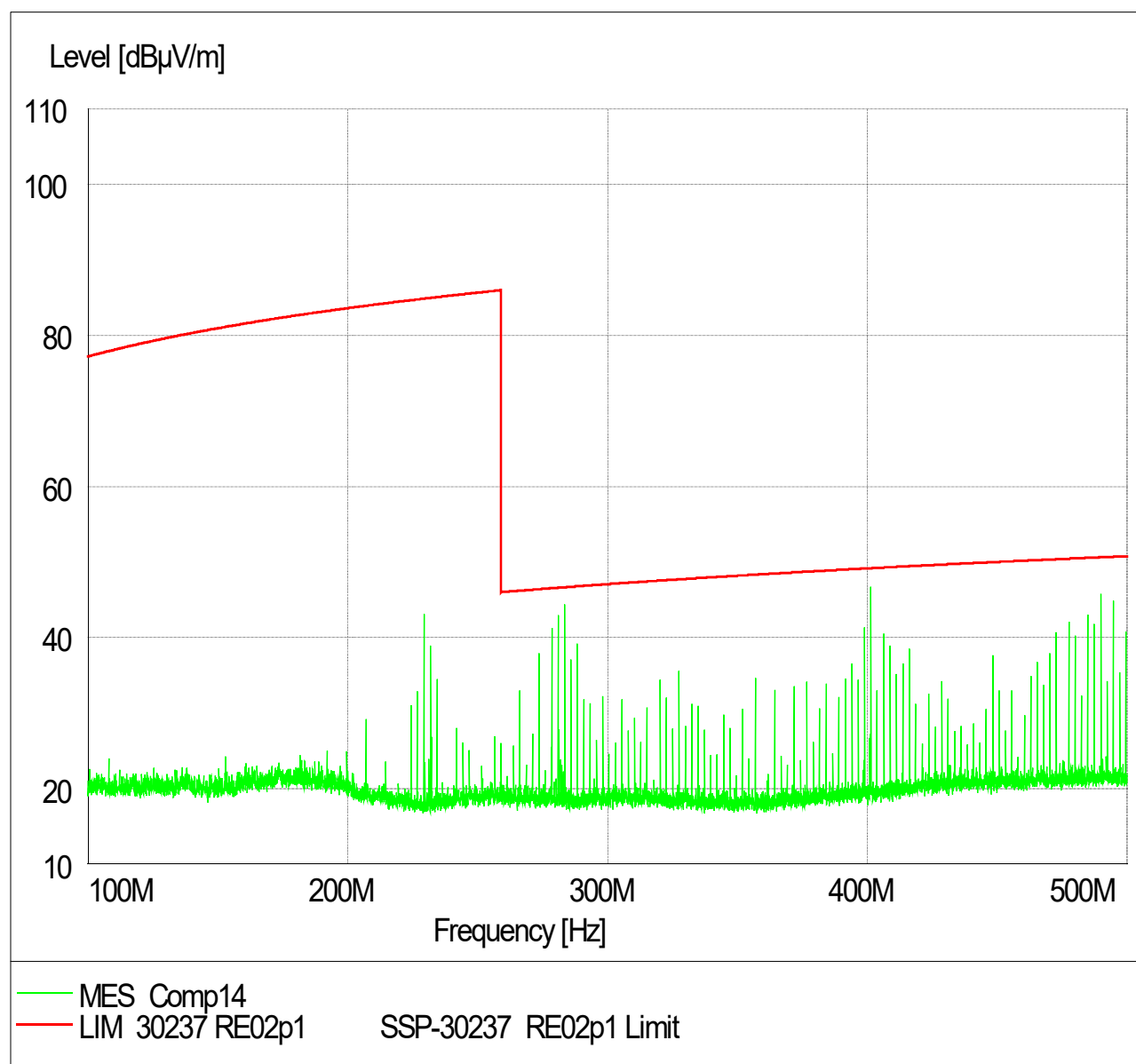
# NASA Glenn Research Center

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Test Engineer(s): Mike Herlacher  
Operating Condition: 22 Jan 2010, 77F, 18%RH  
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Test Spec/Plan: SSP-30237, Space Station Radiated Electric Field Environment  
Comment: Box on grounded floor, non-isolated feed-thru, 5" rod  
ZVL full sweep, -20dBm. Box taped. EMI antenna @ 1 meter.

## SCAN TABLE: "30237 RE02p1"

Short Description:			30237 RE02p1	In2DC		
Start	Stop	Step	Detector	Meas. Time	IF Bandw.	Transducer
Frequency	Frequency	Width				
100.0 MHz	500.0 MHz	50.0 kHz	MaxPeak	15.0 ms	100 kHz	AA SAS-2A/M (1052)



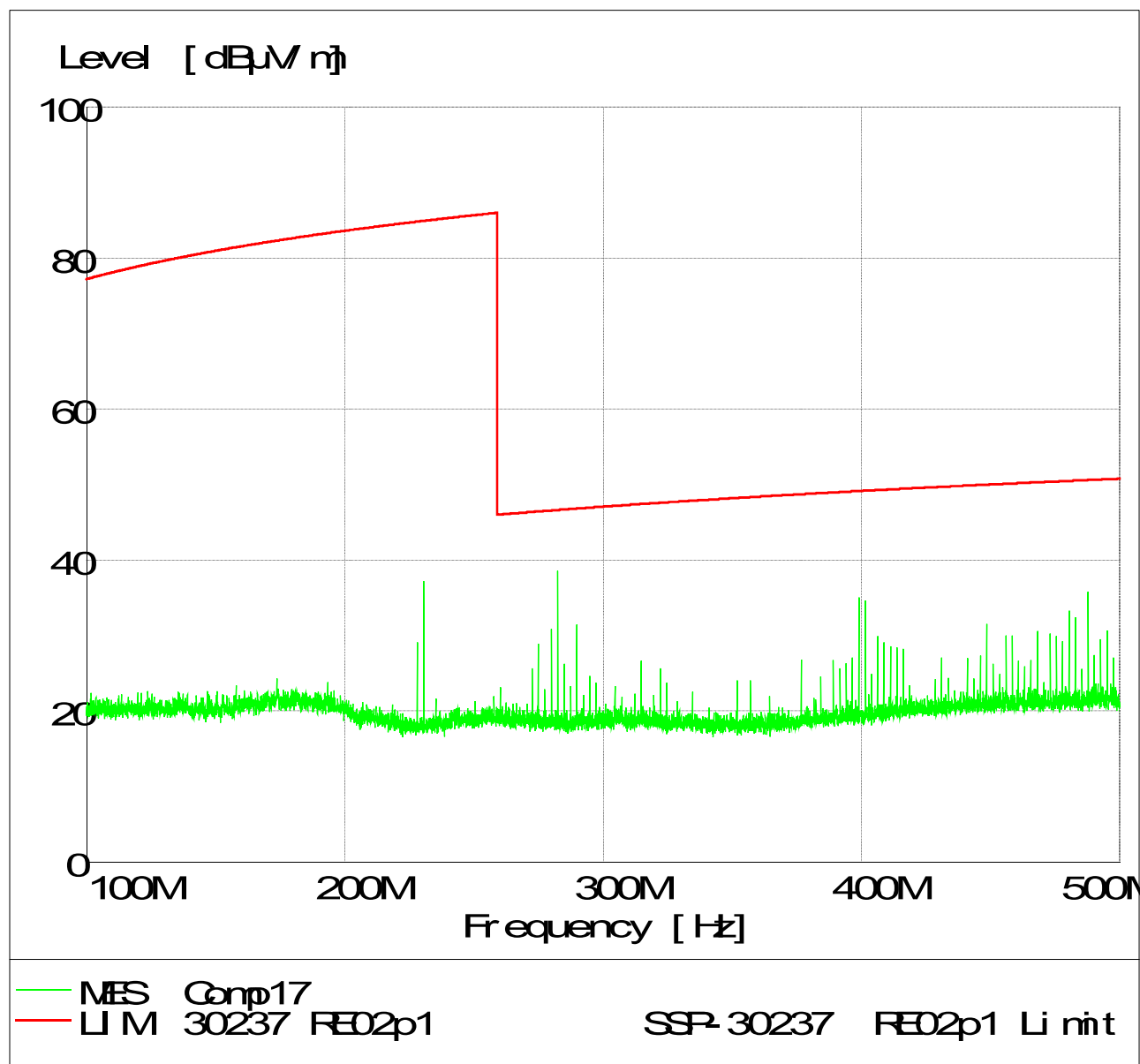
# NASA Glenn Research Center

## EMI Laboratory

EUT: Composite 1 meter square box  
EUT Engineer(s):  
Test Engineer(s): Mike Herlacher  
Operating Condition: 22 Jan 2010, 77F, 18%RH  
Test Site: 24' x 32' reverberant chamber  
Test Spec/Plan: SSP-30237, Space Station Radiated Electric Field Environment  
Comment: Box on grounded floor, non-isolated feed-thru, 5" rod.  
ZVL full sweep, -30dBm, EMI antenna @ 1 meter.

## SCAN TABLE: "30237 RE02p1"

Short Description:			30237 RE02p1	In2DC		
Start	Stop	Step	Detector	Meas.	IF	Transducer
Frequency	Frequency	Width		Time	Bandw.	
100.0 MHz	500.0 MHz	50.0 kHz	MaxPeak	15.0 ms	100 kHz	AA SAS-2A/M (1052)



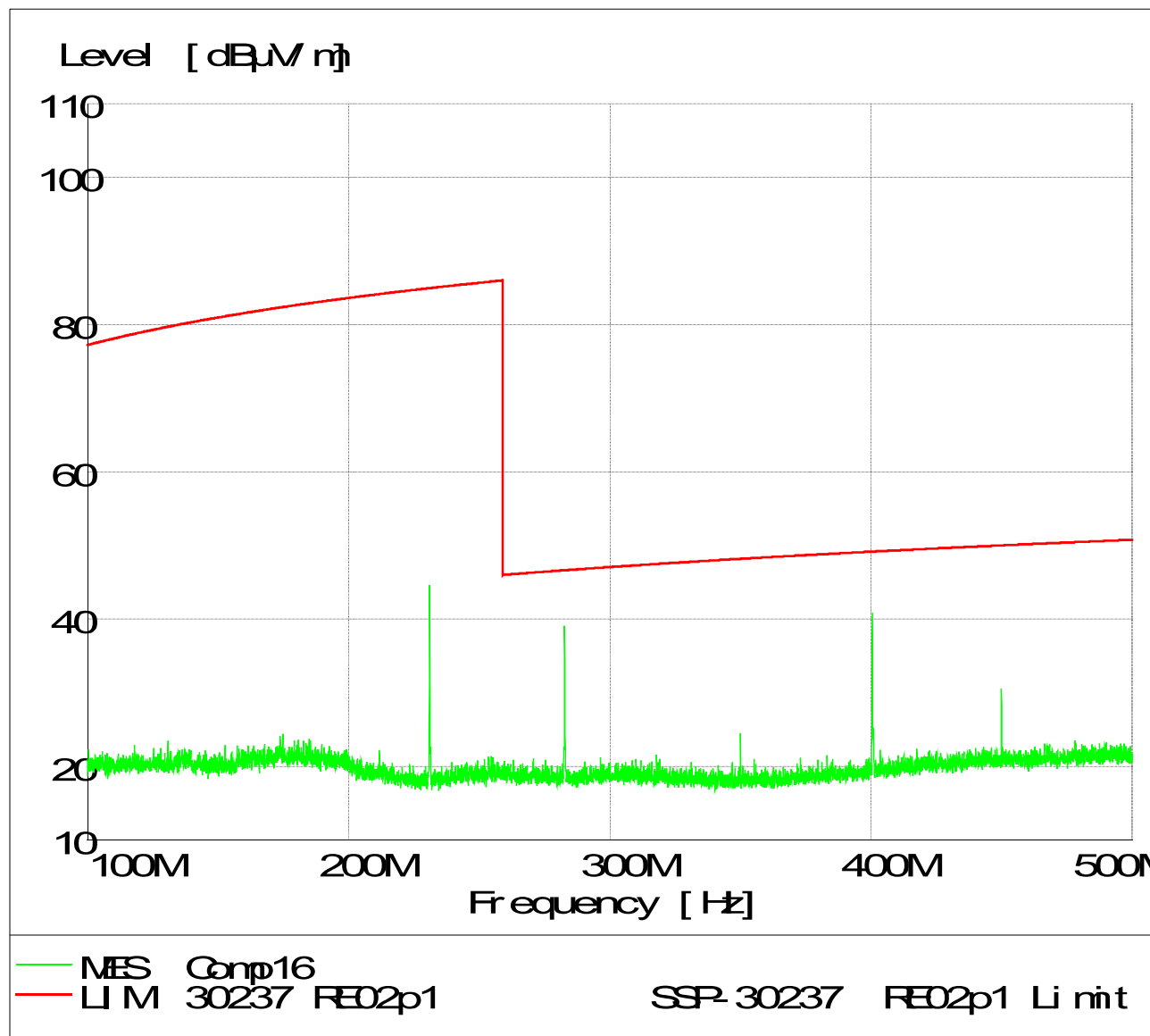
# NASA Glenn Research Center

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 Test Engineer(s): Mike Herlacher  
 Operating Condition: 22 Jan 2010, 77F, 18%RH  
 Test Site: 24' x 32' reverberant chamber  
 Test Spec/Plan: SSP-30237, Space Station Radiated Electric Field Environment  
 Comment: Box on grounded floor, non-isolated feed-thru, 5" rod.  
 ZVL @ 7 Frequencies, -30dBm. Box taped.  
 EMI antenna @ 1 meter.

## SCAN TABLE: "30237 RE02p1"

Short Description:			30237 RE02p1	In2DC		
Start	Stop	Step	Detector	Meas. Time	IF Bandw.	Transducer
Frequency	Frequency	Width				
100.0 MHz	500.0 MHz	50.0 kHz	MaxPeak	15.0 ms	100 kHz	AA SAS-2A/M (1052)



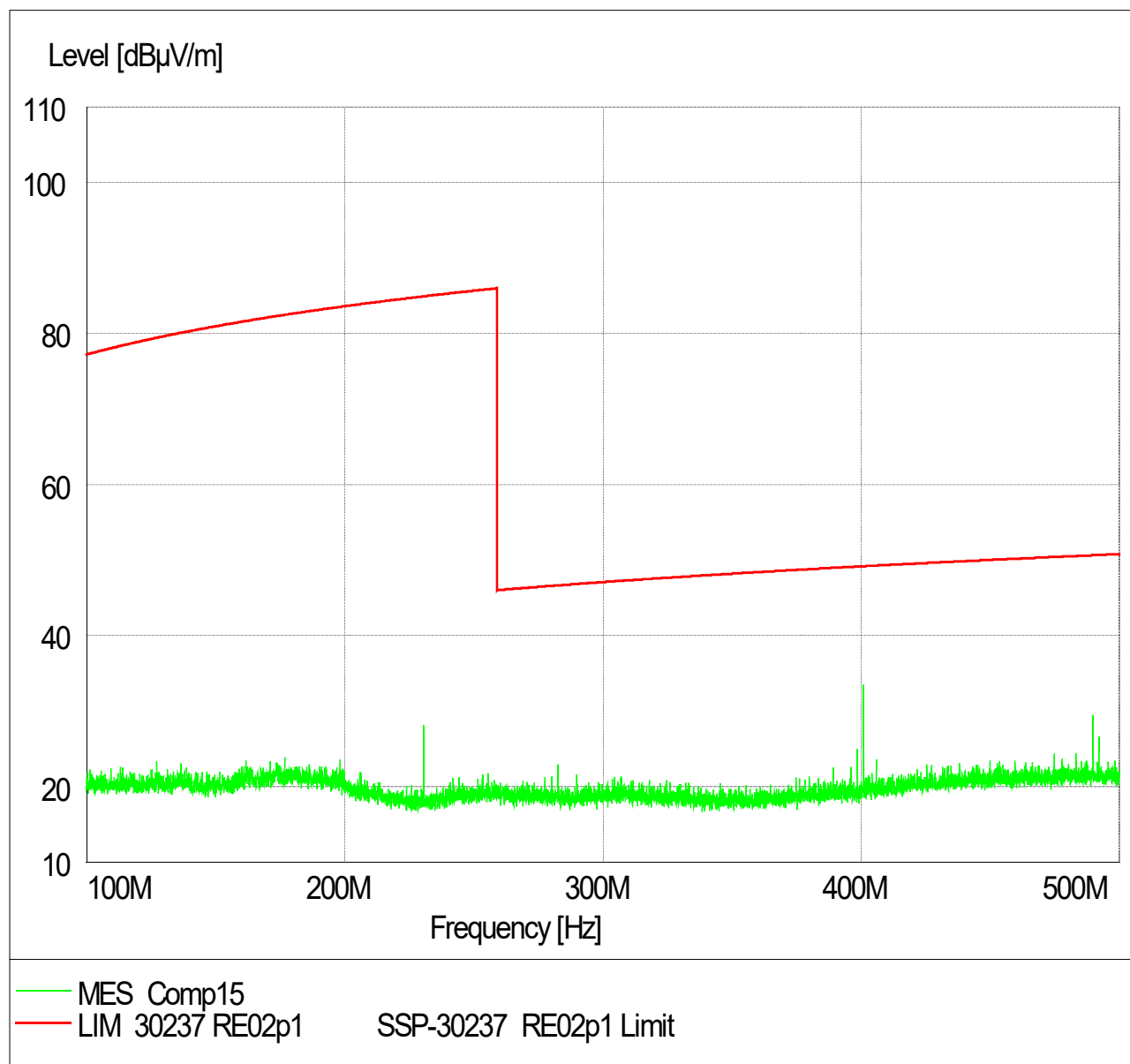
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Operating Condition: 22 Jan 2010, 77F, 18%RH  
Test Site: 24' x 32' reverberant chamber  
Test Spec/Plan: SSP-30237, Space Station Radiated Electric Field Environment  
Comment: Box on grounded floor, non-isolated feed-thru, 5" rod  
ZVL full sweep, -40dBm. Box taped. EMI antenna @ 1 meter.

### SCAN TABLE: "30237 RE02p1"

Short Description:			30237 RE02p1	In2DC		
Start	Stop	Step	Detector	Meas. Time	IF Bandw.	Transducer
Frequency	Frequency	Width				
100.0 MHz	500.0 MHz	50.0 kHz	MaxPeak	15.0 ms	100 kHz	AA SAS-2A/M (1052)



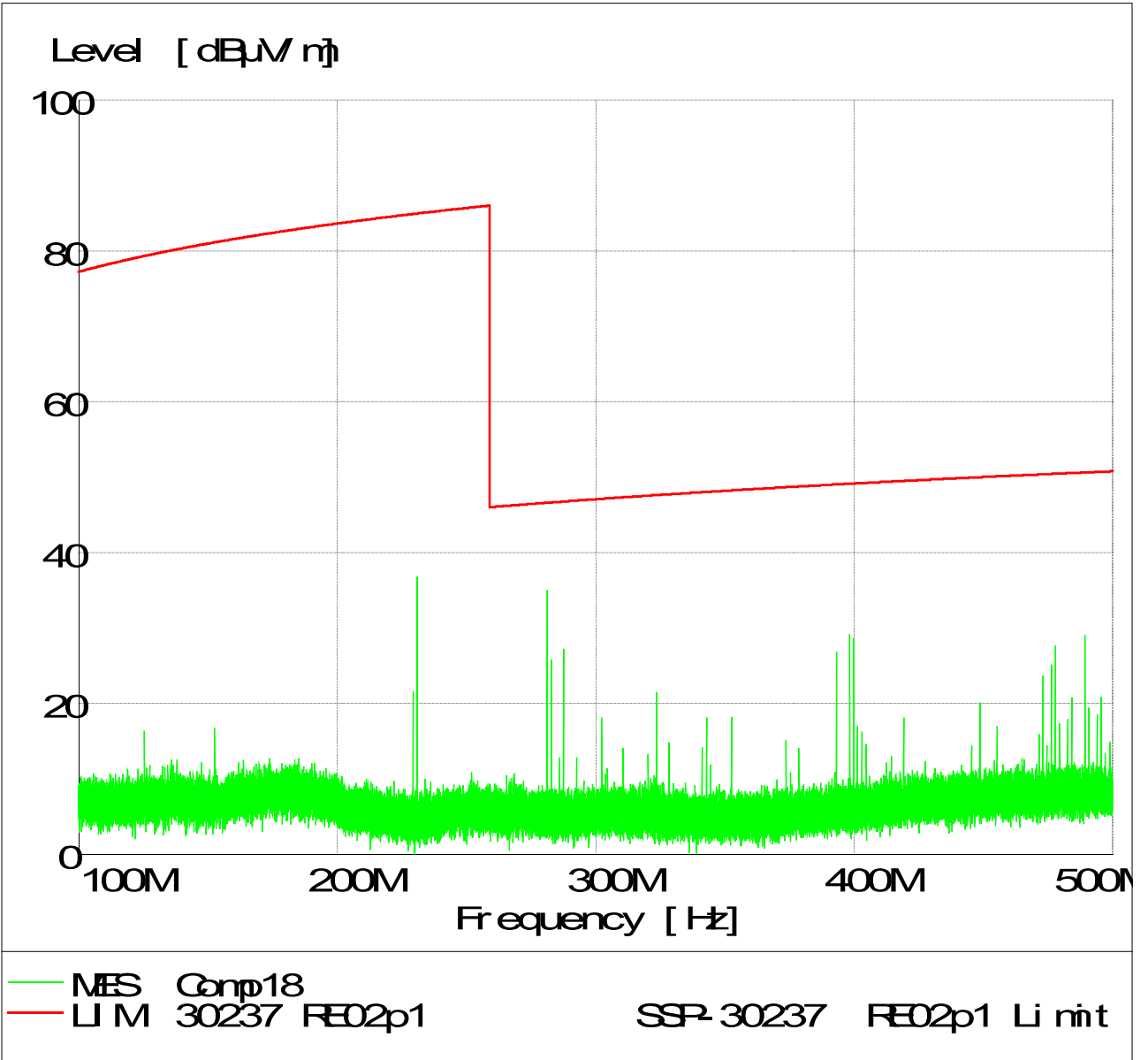
NASA Glenn Research Center

EMI Laboratory

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Test Engineer(s): Mike Herlacher  
Operating Condition: 22 Jan 2010, 77F, 18%RH  
Test Site: 24' x 32' reverberant chamber  
Test Spec/Plan: SSP-30237, Space Station Radiated Electric Field Environment  
Comment: Box on grounded floor, non-isolated feed-thru, 5" rod.  
ZVL full sweep, -30dBm, EMI antenna @ 1 meter.

SCAN TABLE: "30237 RE02p1"

Short Description:			30237 RE02p1		In2DC	
Start	Stop	Step	Detector	Meas.	IF	Transducer
Frequency	Frequency	Width		Time	Bandw.	
100.0 MHz	500.0 MHz	5.0 kHz	MaxPeak	2.0 ms	10 kHz	AA SAS-2A/M (1052)



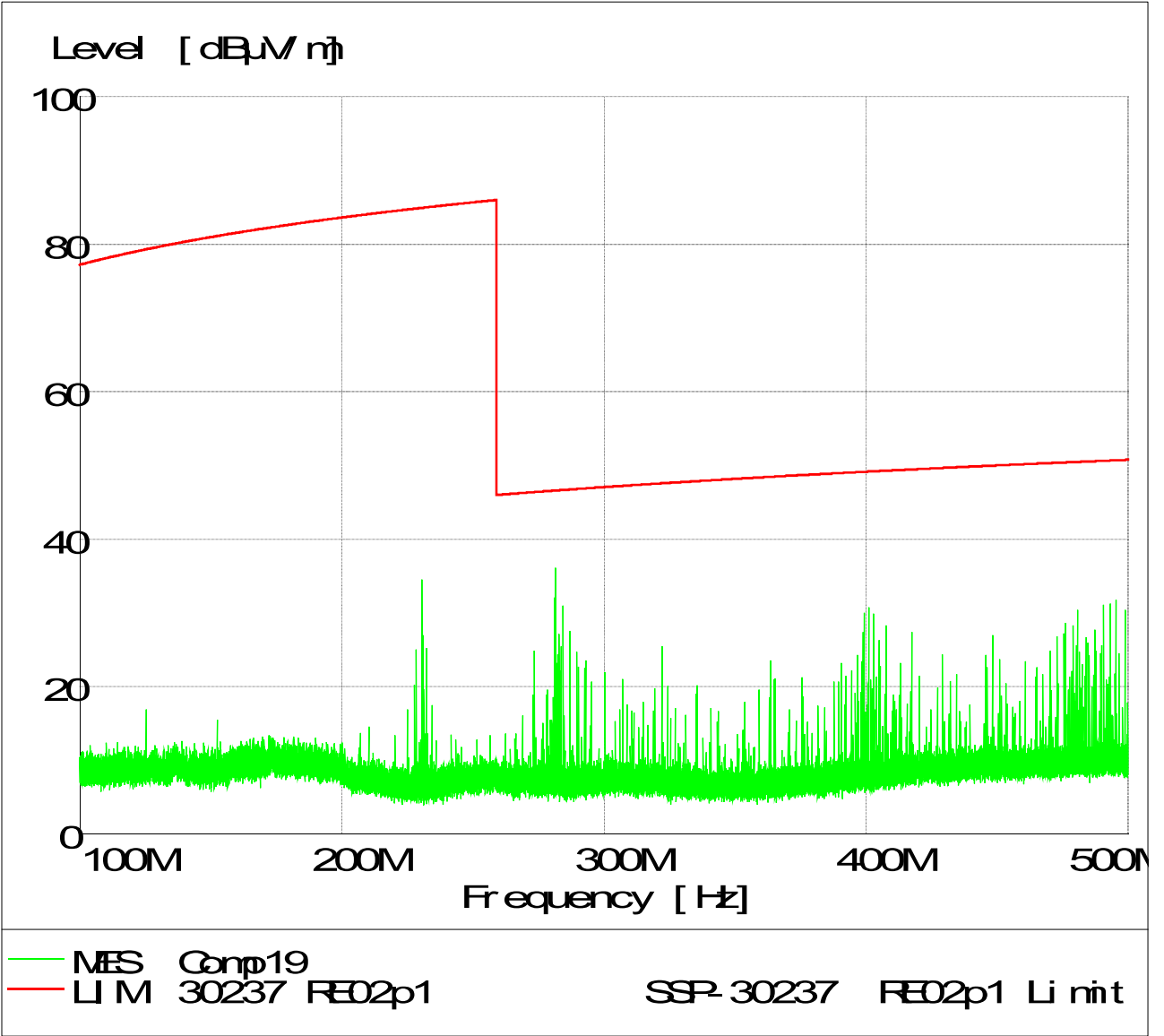
NASA Glenn Research Center

EMI Laboratory

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Test Engineer(s): Mike Herlacher  
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Test Site: 24' x 32' reverberant chamber  
Test Spec/Plan: SSP-30237, Space Station Radiated Electric Field Environment  
Comment: Box on grounded floor, non-isolated feed-thru, 5" rod  
ZVL full sweep, -30dBm. Box taped. EMI antenna @ 1 meter.

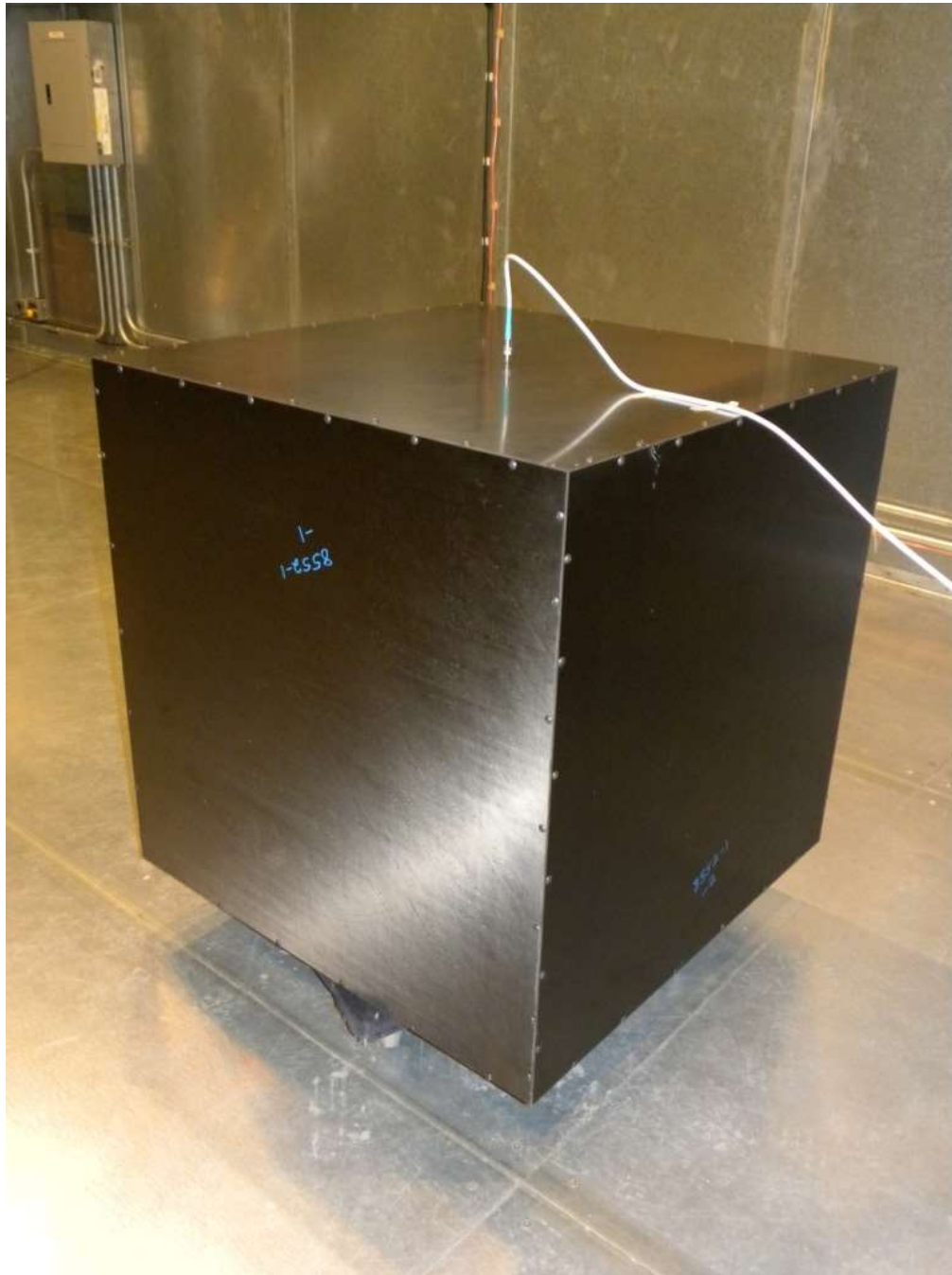
SCAN TABLE: "30237 RE02p1"

Short Description:			30237 RE02p1		In2DC	
Start	Stop	Step	Detector	Meas.	IF	Transducer
Frequency	Frequency	Width		Time	Bandw.	
100.0 MHz	500.0 MHz	5.0 kHz	MaxPeak	15.0 ms	10 kHz	AA SAS-2A/M (1052)





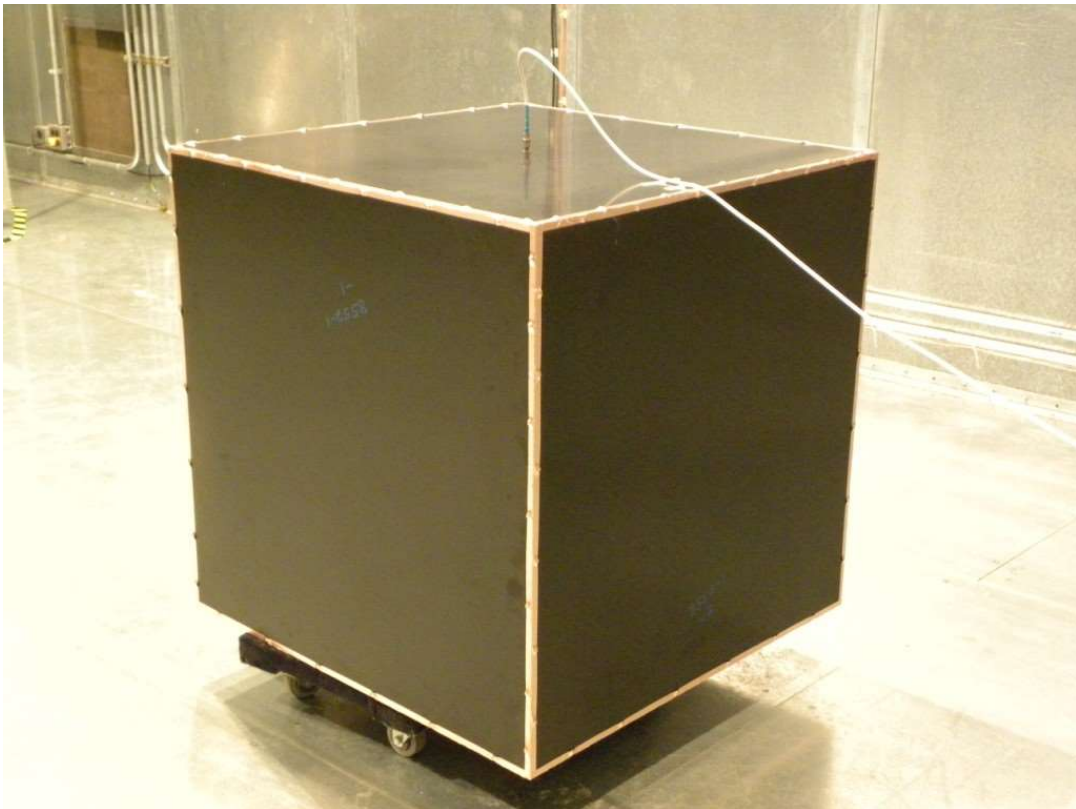
## VI. PHOTOGRAPH LIBRARY



Composite box close-up view



Composite box isolated from metal floor, EMI antenna @ 3 meters distance



Composite box isolated from metal floor, All box seams copper taped

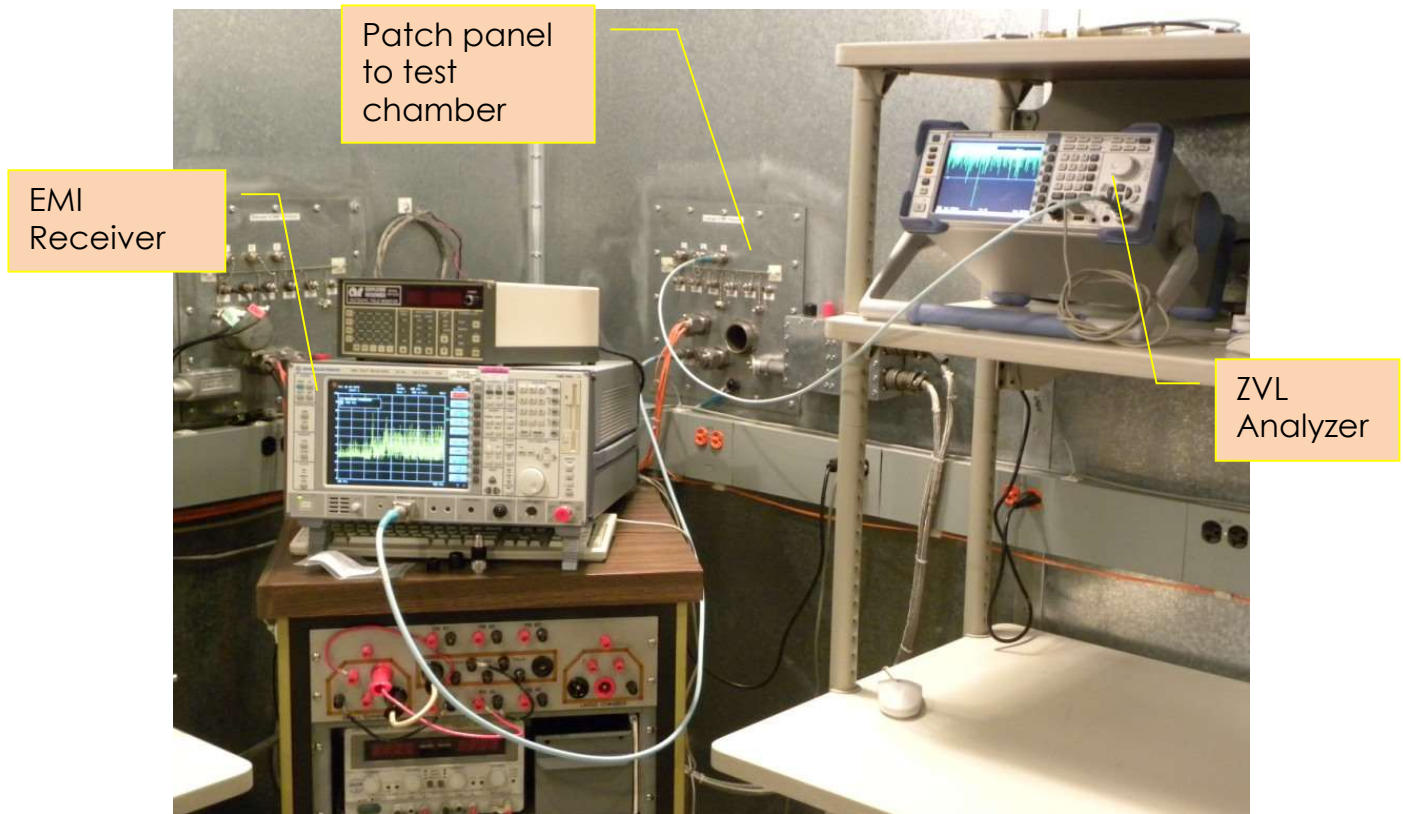


Taped composite box on metal floor, EMI antenna @ 1 meter distance

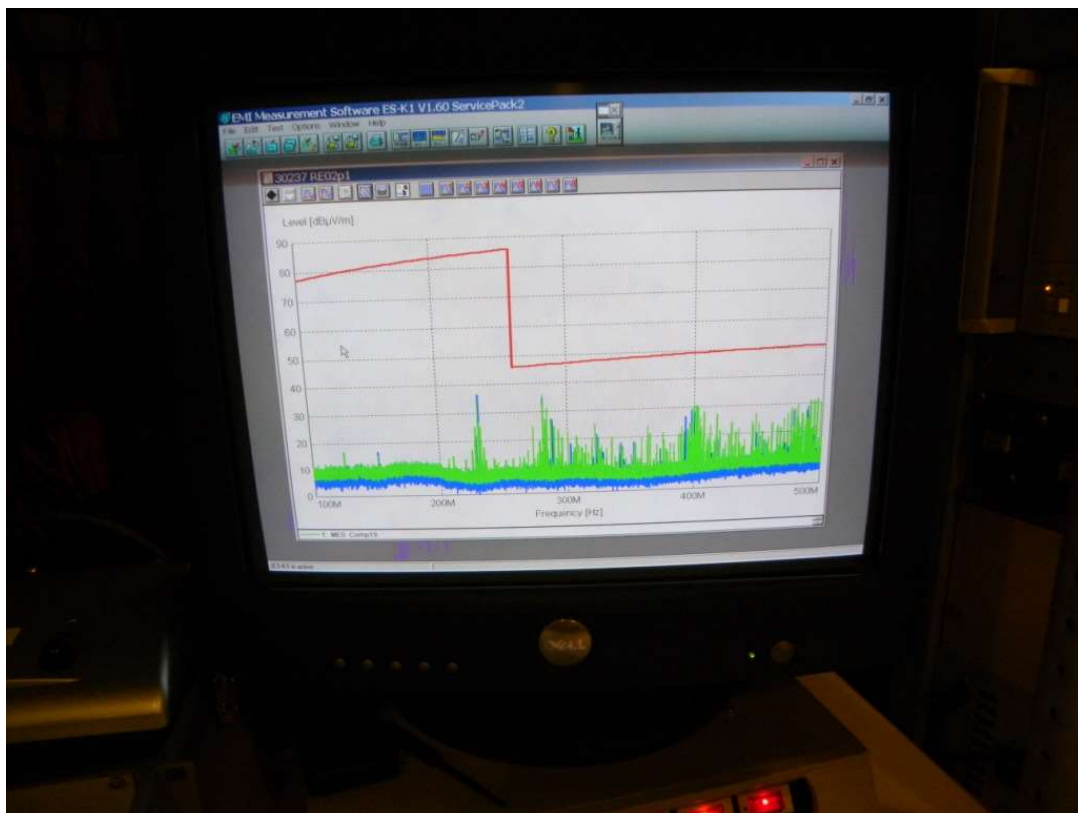


Aluminum box on metal floor, EMI antenna @ 1 meter distance





Test Instruments in isolated adjacent chamber



EMI Receiver controller computer monitor typical screen shot