Certification Test Report

For an

EVA Key Transmitter p/n 41-020285

Manufacturer:

Diebold, Inc.
5995 Mayfair Road
North Canton, Ohio 44720
United States of America

Testing Laboratory:

F-Squared Laboratories
16740 Peters Road
Middlefield, Ohio 44062
United States of America

The EVA Key Transmitter, p/n 41-020285, was tested and was found to comply with the requirements of the Federal Communications Commission outlined in the Federal Register CFR 47, Part 15.225.

The product was received on Sept. 12, 2008 and the testing was completed on Sept. 17, 2008.

Evaluation Conducted By:

Kenneth P. Klann
Senior EMC Engineer

Report Reviewed By:

Russell Beattie
EMC Technical Manager

Squared Laboratories
success thru compliance

F-Squared Laboratories
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Middlefield, Ohio 44062
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Table of Contents

1. ENGINEERING STATEMENT

This report has been prepared on behalf of Diebold, Inc. to provide documentation for the testing described herein. This equipment has been tested and found to comply with Part 15.225 of the FCC Rules using ANSI C63.4 2003 standards. The test results found in this test report relate only to the items tested.

1.1. Equipment Under Test:
EVA Key Transmitter
RFID Electronic Access Key

1.2. Trade Name:
EVA Key Transmitter

1.3. Model:
41-020285

1.4. Power Supply:
Battery – 3 AAA Ni-MH Rechargeable
Battery is charged by placing the Key Transmitter into the EVA Docking Station. The Transmitter is inoperable when placed in the Docking Station.

1.5. Applicable Rules:
CFR 47, Part 15.225, (a)-(e)

1.6. Equipment Category:
Radio Transmitter RF 1D
Signal Channel Operation
Frequency: 13.560 MHz

1.7. Antenna:
Internal multiple turn loop (printed circuit)

1.8. Measurement Location:
F-Squared Laboratories in Middlefield, Ohio. Site description and attenuation data are on file with the FCC's Sampling and Measurement Branch at the FCC Laboratory in Columbia, MD**.**

1.9. Measurement Procedure:

All measurements were performed according to the 2003 version of ANSI C63.4 and recommended FCC parts 15.31, 15.33 and 15.35. A list of the measurement equipment can be found in Section 2.

1.10. Uncertainty Budget:

Conducted Emissions – Combined uncertainly ±1.13 dB, expanded ±2.26 dB
Radiated Emissions – Combined Uncertainty ±2.24 dB; Expanded Uncertainty ±4.48 dB

2. LIST OF MEASUREMENT INFORMATION

Equipment Type	Manufacturer	Model	Serial Number	Calibration Due Date
Shield Room	Shielding Resources	3 Meter	001	May 14, 2009
Temp/Hum. Recorder	Extech	RH520	H005870	Nov. 20, 2008
OATS	Compliance Labs	N/A	001	Nov. 16, 2008
Receiver	Rohde & Schwarz	Display, EASI-0-804-8932-52; RF Unit, ESMI-RF 1032-5640-53	84982/015; 849152/005	Oct. 31, 2008
Antenna 1-Chamber	ETS/EMCO	3142B	9811-1330	June 29, 2009
Antenna 2-OATS	Sunol Sciences	JB1	A101101	June 29, 2009
Signal Generator	Hewlett Packard	8648A	3619U00447	Aug. 1, 2009
Active 18” Loop Antenna	A.H. Systems, Inc.	SAS-562B	241	Aug. 23, 2009
Environmental Chamber	Envirotronics	SH27	0501-5498-11214	Aug. 27, 2009

3. EQUIPMENT UNDER TEST (EUT) INFORMATION AND DATA

3.1 Test Item Condition:

The equipment to be tested was received in good condition.

3.2 Testing Algorithm:

The EVA Key Transmitter was provided with FCC test firmware to allow continuous modulated transmission.

3.3 Radiated Emission Testing on Open Area Test Site (OATS):

The EVA Key Transmitter was initially characterized in a semi-anechoic chamber over a frequency range of 1.7 to 1000 MHz. Magnetic field emissions were measured below 30 MHz and electric field emissions were examined above 30 MHz.

The final radiated emissions measurements were performed on an Open Air Test Site (OATS). The EVA Key Transmitter was tested at a tested at a distance of 10.0 meters at frequencies below 30 MHz and 3.0 meters above 30 MHz. At frequencies below 30 MHz, the emissions were maximized by rotating the Transmitter and the loop antenna on their axes. Additionally, the Transmitter was examined in three orthogonal positions to ensure maximization of emissions. At frequencies above 30 MHz, the emissions were maximized by rotating the Transmitter while raising/lowering the bilog antenna mounted on a 4.0 meter mast. Again, three orthogonal Transmitter positions were examined to ensure maximization of the emissions. Both horizontal and vertical field components were measured above 30 MHz. A resolution bandwidth of 9 kHz was used between 1.7 to 30 MHz, and 120 kHz was used between 30 to 1000 MHz. The detector function was set to quasi-peak mode for all measurements. The raw measurements were correlated to allow for antenna factor and cable loss. All measurements were performed with the Transmitter equipped with a fully charged battery.

3.4 Frequency Stability vs. Temperature Measurements

The Key Transmitter was placed in an environmental chamber and allowed to stabilize at 21ºC for 30 minutes. The initial frequency was recorded. Next, the chamber was ramped up to 50ºC and the Transmitter was allowed to stabilize for 30 minutes. Then, a series of frequency measurements were made at intervals of 0, 2, 5 and 10 minutes. The chamber was then set to ramp down to -20ºC and the Transmitter was allowed to stabilize for 30 minutes. Again, a series of frequency measurements were made at 0, 2, 5 and 10 minute intervals. Finally, the chamber was ramped back to 21ºC and the Transmitter was allowed to stabilize for 30 minutes before making a final frequency measurement.

The Transmitter, being battery operated, was fully charged at the start of testing. The Transmitter was continuously operating during the test sequence.

4. EUT CONFIGURATION AND CABLES

4.1. Equipment Under Test (EUT):

Device	Manufacturer	Model Number	Serial Number
EVA Key Transmitter	Diebold, Inc.	EVA/41-020285	None Specified

4.2. Accessories (Support Equipment):

Device	Manufacturer	Model Number	Serial Number
EVA Docking Station	Diebold, Inc.	EVA/41-020278	None Specified
Power Supply	MG Electronics	MG7535SP	None Specified

4.3. Cables:

None

5. PRODUCT DESCRPTION

The Diebold EVA Key Transmitter is based on a Texas Instruments 84DJ8XT controller clocked at 7.372 MHz coupled with a Texas Instruments TRF7961 RFID Low Power Single Chip Transmitter. The Transmitter generates a 13.56 MHz emission directly from a 13.56 MHz crystal. The RF output is coupled to an internal printed circuit loop antenna.

The Diebold EVA Key Transmitter is battery operated, using 3 AAA Ni-MH rechargeable batteries. The Transmitter is designed to operate only on battery power and does not transmit when charging using the EVA Docking Station.

During normal operation, the RFID transmission has intended transmission range of a couple inches.

6. FCC PART 15.225(a)-(d) – RADIATED EMISSIONS

6.1. Requirements:

The field strength of emissions of the Transmitter operating to FCC Part 15.225 shall not exceed:

(a) In the band 13.553-13.567 MHz, 15848µV/m (84 dBµV/m) at 30m
(b) In the bands 13.410-13.553 and 13.567-13.710 MHz, 334 µV/m (50.5 dBµV/m) at 30m
(c) In the bands 13.110-13.410 MHz and 13.710-14.010 MHz, 106 µV/m (40.5 dBµV/m) at 30m
(d) Any emissions outside the 13.110-14.010 MHz band shall not exceed the FCC 15.209(a) limits.

The radiated emissions measurements were initially performed in a semi-anechoic chamber to profile the emissions characteristics of the Diebold EVA Key Transmitter. These measurements were performed at a 1.5 meter distance. The test setups used in the chamber are shown in Pictorials 1 and 2.

The final compliance measurements were performed on the OATs at a 10 meter distance for frequencies below 30 MHz and at 3 meters above 30 MHz. The test setup used on the OATS are showed in Pictorials 3-7.

6.2. Results:

The Spectral Plots of the characterization measurements performed in the semi-anechoic chamber are organized as follows:

Figure 1	1.7 MHz to 30 MHz	H-Field Loop Antenna
Figure 2	30 MHz to 1000 MHz	E-Field Vertical Bilog Antenna
Figure 3	30 MHZ to 1000 MHz	E-Field Horizontal Bilog Antenna

The compliance measurements performed on the OATs are organized as follows, and are found on pages 10-11 of this Test Report:

Table 1	EVA Key Transmitter Emissions below 30 MHz
Table 2	EVA Key Transmitter Emissions 30 MHz to 1000 MHz

The band-edge analysis performed on the OATS (10m distance) used the EUT orthogonal position, turntable and antenna placement that maximizes the field strength of the fundamental (13.56 MHz). With the Transmitter operating the resultant spectrum was recorded over the 13.061-14.061 MHz range.

The band-edge characteristic Spectral Plot is shown in Figure 4. Reviewing the plot, note that the field strength of the fundamental emission at 13.56 MHz is below both the FCC Part 15.225 and 15.209(a) limits. The only emissions detected near the limits are ambient shortwave broadcast stations.

Reviewing the OATS data, it is evident that the Diebold EVA Key Transmitter meets FCC Part 15.225(a)-(d) requirements for radiated emissions.

Table-1
Diebold EVA Key RFID Transmitter (battery operated) 13.560 MHz
Emissions below 30 MHz measured with Vertical Active Loop Antenna.

Frequency (MHz)	Antenna Polarization	Reading[1] (dBuV)	Correction[2] Factor (dB)	Emissions Level (dBuV/m)	Measurement Distance (m)	Emission[3] Extrapolation Factor 10 to 30m (dB)	Emissions Level at 30 meters (dBuV/m)	Limit at 30m (dBuV/m)	Margin (dB)	Orthogonal Position Maximizing Emissions	Emisssion Type
13.56	V	25.1	7.9	33.0	10.0	9.5	42.5	84.0	-41.5	1	Fundamental

Notes:
[1]Detector function set to Quasi-Peak. Checks made with detector function set to peak mode yielded levels with 0.3 dB of that found with Quasi-Peak detector.
[2]Correction Factor is the summation of antenna factor and coax factor.
[3]Linear extrapolation (20 dB/decade)

Table-2
Diebold EVA Key RFID Transmitter (battery operated) 13.560 MHz
Emissions above 30-1000 MHz measured with BiLog Antenna.

Frequency (MHz)	Antenna Polarization	Reading[1] (dBuV)	Correction[2] Factor (dB)	Emissions Level (dBuV/m)	Measurement Distance (m)	Emissions Level at 3m (dBuV/m)	Limit at 3m (dBuV/m)	Margin (dB)	Orthogonal Position Maximizing Emissions	Emisssion Type
189.83	H	9.1	14.3	23.4	3.0	23.4	43.5	-20.1	1	Harmonic
203.39	H	15.9	14.6	30.5	3.0	30.5	43.5	-13.0	1	Harmonic
216.95	V	12.9	14.0	26.9	3.0	26.9	46.0	-19.1	1	Harmonic
230.51	H	11.0	14.8	25.8	3.0	25.8	46.0	-20.2	1	Harmonic
298.31	H	9.6	17.3	26.9	3.0	26.9	46.0	-19.1	3	Harmonic
311.87	H	8.4	17.7	26.1	3.0	26.1	46.0	-19.9	2	Harmonic
325.43	V	11.0	17.6	28.6	3.0	28.6	46.0	-17.4	3	Harmonic
338.99	H	16.2	18.2	34.4	3.0	34.4	46.0	-11.6	2	Harmonic
352.55	H	21.8	19.0	40.8	3.0	40.8	46.0	-5.2	1	Harmonic
366.12	H	12.3	19.3	31.6	3.0	31.6	46.0	-14.4	2	Harmonic
379.68	V	11.8	19.2	31.0	3.0	31.0	46.0	-15.0	3	Harmonic
393.23	H	10.6	19.7	30.3	3.0	30.3	46.0	-15.7	2	Harmonic
555.96	H	11.4	23.5	34.9	3.0	34.9	46.0	-11.1	3	Harmonic
569.52	H	18.5	23.9	42.4	3.0	42.4	46.0	-3.6	3	Harmonic
583.07	H	11.7	24.0	35.7	3.0	35.7	46.0	-10.3	2	Harmonic
596.64	H	15.9	24.1	40.0	3.0	40.0	46.0	-6.0	2	Harmonic
623.76	H	15.8	24.8	40.6	3.0	40.6	46.0	-5.4	3	Harmonic
637.32	H	15.5	25.3	40.8	3.0	40.8	46.0	-5.2	3	Harmonic
650.88	H	11.4	25.3	36.7	3.0	36.7	46.0	-9.3	2	Harmonic
664.44	H	12.4	25.4	37.8	3.0	37.8	46.0	-8.2	3	Harmonic
678.00	H	9.4	25.5	34.9	3.0	34.9	46.0	-11.1	2	Harmonic
691.56	H	17.2	25.7	42.9	3.0	42.9	46.0	-3.1	3	Harmonic
705.12	H	6.5	26.0	32.5	3.0	32.5	46.0	-13.5	2	Harmonic
800.04	H	12.7	27.7	40.4	3.0	40.4	46.0	-5.6	2	Harmonic
813.60	H	9.1	27.7	36.8	3.0	36.8	46.0	-9.2	2	Harmonic
827.16	H	16.0	28.2	44.2	3.0	44.2	46.0	-1.8	2	Harmonic
840.72	V	14.4	27.7	42.1	3.0	42.1	46.0	-3.9	1	Harmonic
854.28	H	16.1	28.2	44.3	3.0	44.3	46.0	-1.7	2	Harmonic
867.84	V	14.5	28.2	42.7	3.0	42.7	46.0	-3.3	1	Harmonic
894.96	H	16.3	28.9	45.2	3.0	45.2	46.0	-0.8	2	Harmonic
908.52	H	11.0	29.0	40.0	3.0	40.0	46.0	-6.0	2	Harmonic
922.08	H	12.6	29.1	41.7	3.0	41.7	46.0	-4.3	2	Harmonic
935.64	H	11.1	29.4	40.5	3.0	40.5	46.0	-5.5	2	Harmonic
949.20	H	13.3	29.7	43.0	3.0	43.0	46.0	-3.0	2	Harmonic
962.76	H	7.0	29.8	36.8	3.0	36.8	54.0	-17.2	2	Harmonic

Notes:
[1]Detector function set to Quasi-Peak.
[2]Correction Factor is the summation of antenna factor and coax factor.

7 FCC PART 15.225(e) – FREQUENCY STABILITY VS. TEMPERATURE

7.1. Requirements:

The frequency tolerance of the carrier shall be maintained within ±0.01% of the operating frequency over a temperature variation of -20ºC to 50ºC at a normal supply voltage (FCC Part 15.225(e). The Diebold Key Transmitter, being battery operated, was tested using a fully charged battery. Since the Key Transmitter oprated at 13.56 MHz, the ±0.01% frequency tolerance allows a maximum departure from the carrier frequency of +1356 Hz or remain within the window of 13.558644-13.561356 MHz.

The Diebold Key Transmitter in operating mode was placed into the Envirotronics Environmental Chamber as shown in Pictorial 8. A pickup loop antenna was positioned adjacent to the Transmitter to sample the generated RF carrier. The RF output of the loop antenna was coupled into the HP8591E spectrum analyzer operating in frequency count mode. The analyzer frequency reference was connected to an external 10 MHz reference provided by a HP8648A equipped with option 1E5 (high stability frequency reference). The measurement equipment arrangement is shown in Pictorial 9.

With the Key Transmitter operating, the chamber temperature was set to 21ºC and allowed to stabilize 30 minutes and an initial frequency measurement was made. Next, the chamber was set to ramp to 50ºC and the EUT was allowed to stabilize for 30 minutes. However, the Transmitter shut down at two minutes into the stabilization period. The Transmitter batter pack protective thermal cutoff (PTC) opened, deactivating the EUT. To restore operation, the chamber temperature was reduced to 40ºC, the EUT operation returned after six minutes and the test commenced at 40ºC. The EUT was allowed to stabilize to 30 minutes at 40ºC and a series of frequency measurements were made at 2, 5 and 10 minute intervals. Now the chamber was set to -20ºC and allowed to stabilize 30 minutes. Again, a series of frequency measurements were made at 2, 5 and 10 minute intervals. Finally, the chamber was set to 21ºC and the EUT was allowed to stabilize for 30 minutes and a final frequency measurement was performed.

7.2. Results:

Test Date:	Sept. 17, 2008	**Test Engineer:**	K. Klann
Standard:	FCC 15.225(e)	**Air Temperature:**	22.5ºC
Test Method:	ANSI C63.4 2003	**Relative Humidity:**	48%

Time (H:M:SEC)	Frequency (MHz)	Comments
0:00:00	13.560280	EUT in chamber 30m @ 21ºC
0:00:10		Chamber set to ramp up to 50ºC
0:22:00		Chamber internal temp at 50ºC
0:22:10	13.560235	Start 30m EUT stabilization period
0:25:10		EUT ceased operating – battery pack protective thermal cutout (PTC) opened
0:26:00		Chamber set to 40ºC
0:33:54	13.560245	EUT operation restored
0:37:00		Chamber internal temp at 40ºC
0:37:01	13.560245	Start 30m EUT stabilization period
1:07:00	13.560240	Frequency at 0 minute interval
1:09:00	13.560240	Frequency at 2 minute interval
1:12:00	13.560240	Frequency at 5 minute interval
1:18:00	13.560235	Frequency at 10 minute interval
1:18:00	13.560240	Chamber set to ramp down to -20ºC
1:40:00		Chamber internal temp at -20ºC
1:40:01	13.560375	Start 30m EUT stabilization period
2:10:00	13.560385	Frequency at 0 minute interval
2:12:00	13.560385	Frequency at 2 minute interval
2:15:00	13.560385	Frequency at 5 minute interval
2:20:00	13.560390	Frequency at 10 minute interval
2:21:00	13.560390	Chamber set to ramp up to 21ºC
2:35:00		Chamber internal temp at 21ºC
2:35:01	13.560340	Start 30m EUT stabilization period
3:05:00	13.560290	End of 30m stabilization period

Based on these measurements, the Diebold EVA Key Transmitter meets FCC Part 15.225(e) requirements for frequency stability vs. temperature. The Transmitter frequency remains between 13.560235-13.560390 MHz which is within the ±0.01% window for an operating frequency of 13.56 MHz.

8 FIGURES – SPECTRAL DATA PLOTS

Figure 1: Radiated Emissions Characterization – 1.7MHz to 30 MHz
H-Field Loop Antenna, 1.5m Distance, Peak Reading

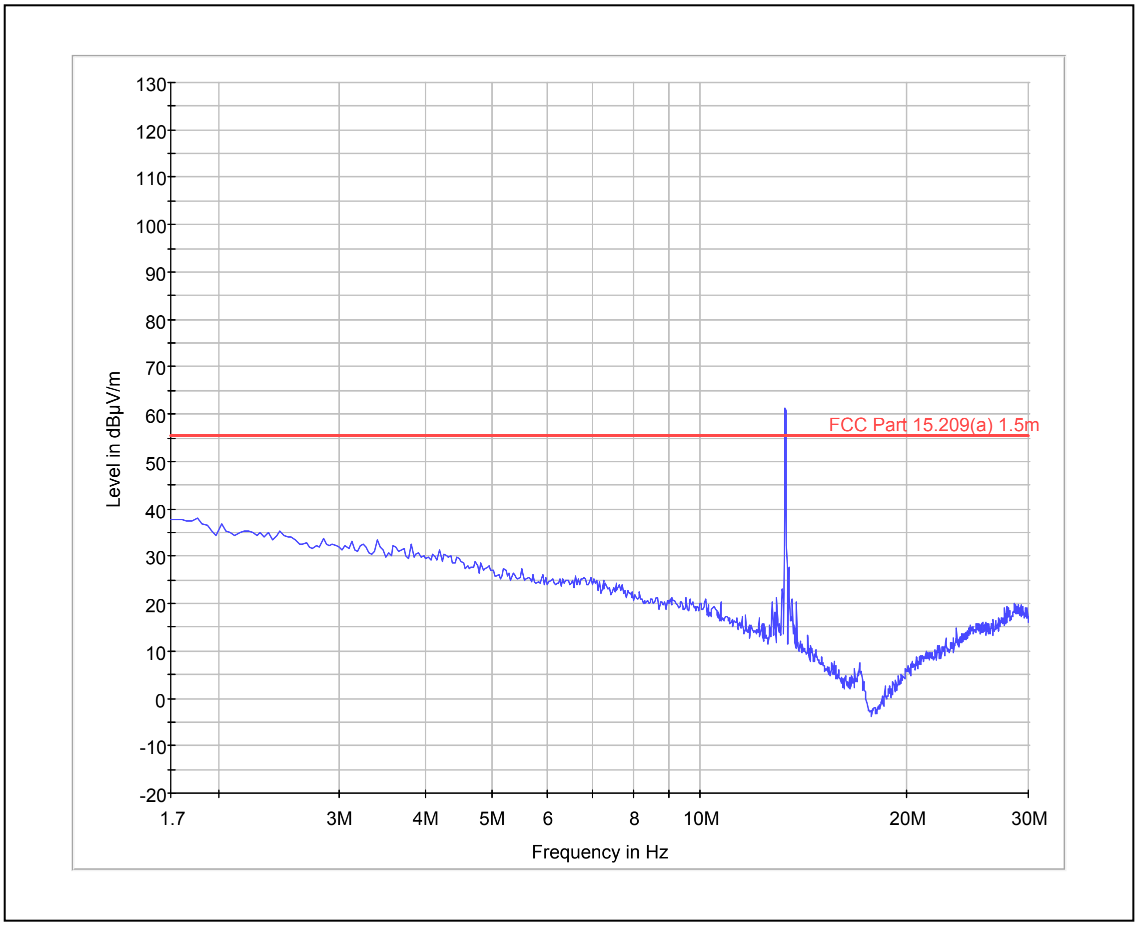


Figure 2: Radiated Emissions Characterization – 30 MHz to 1000 MHz
E-Field Vertical Bilog Antenna, 1.5m Distance, Peak Reading

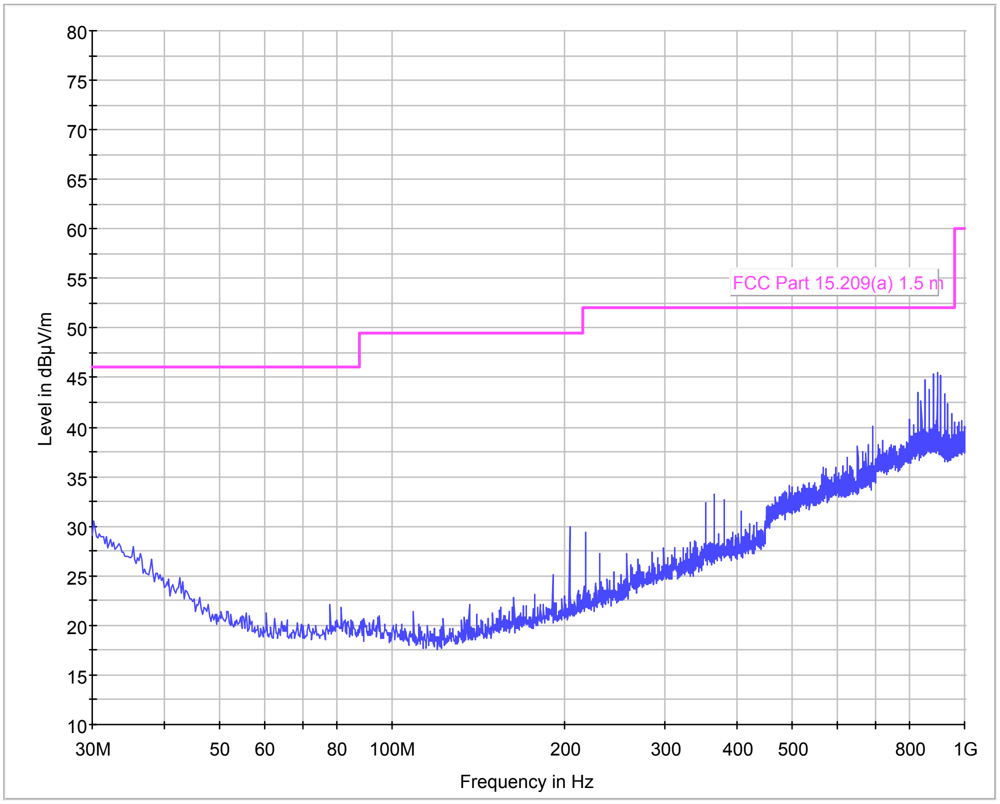


Figure 3: Radiated Emissions Characterization – 30 MHz to 1000 MHz
E-Field Horizontal Bilog Antenna, 1.5m Distance, Peak Reading

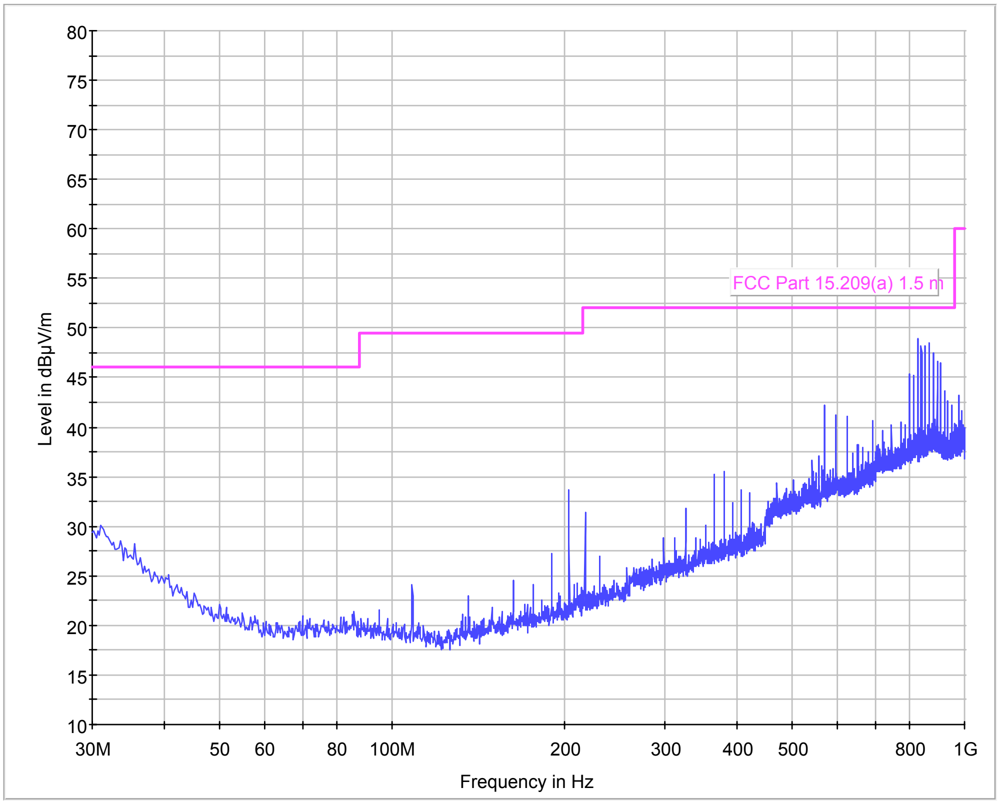
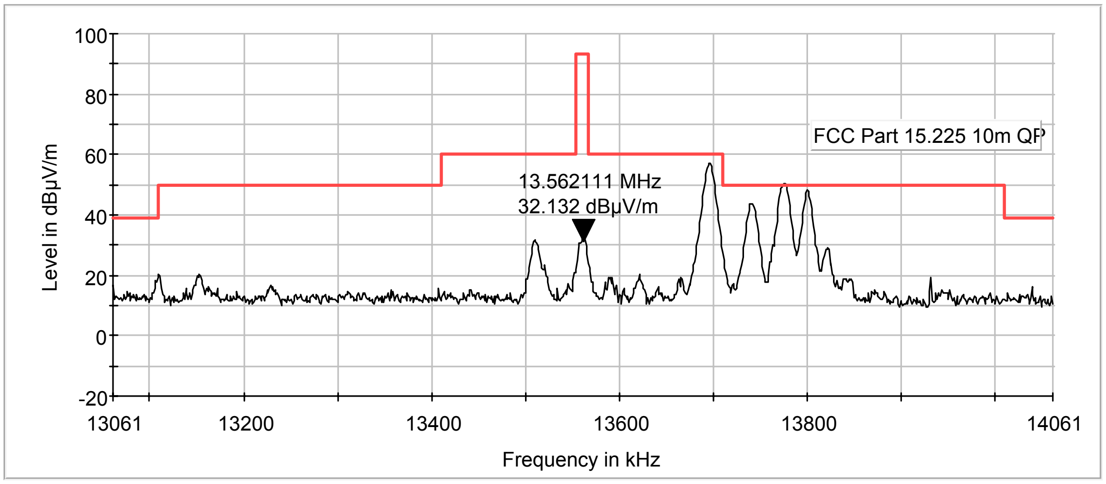


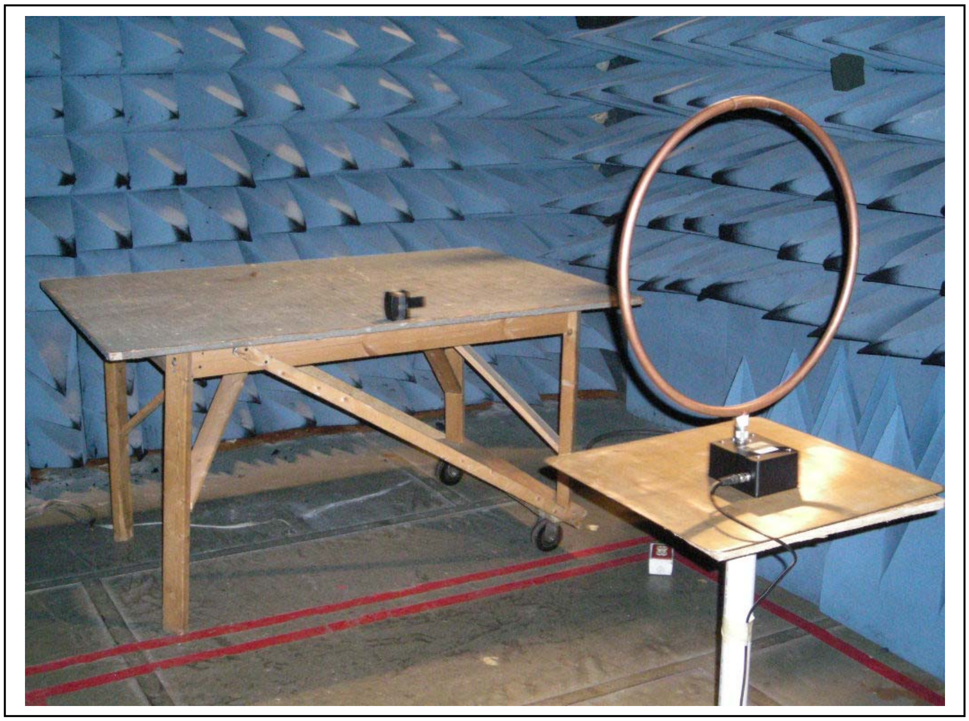
Figure 4: Band-Edge Characterization
10m OATS at Maximum Field Strength Orientation



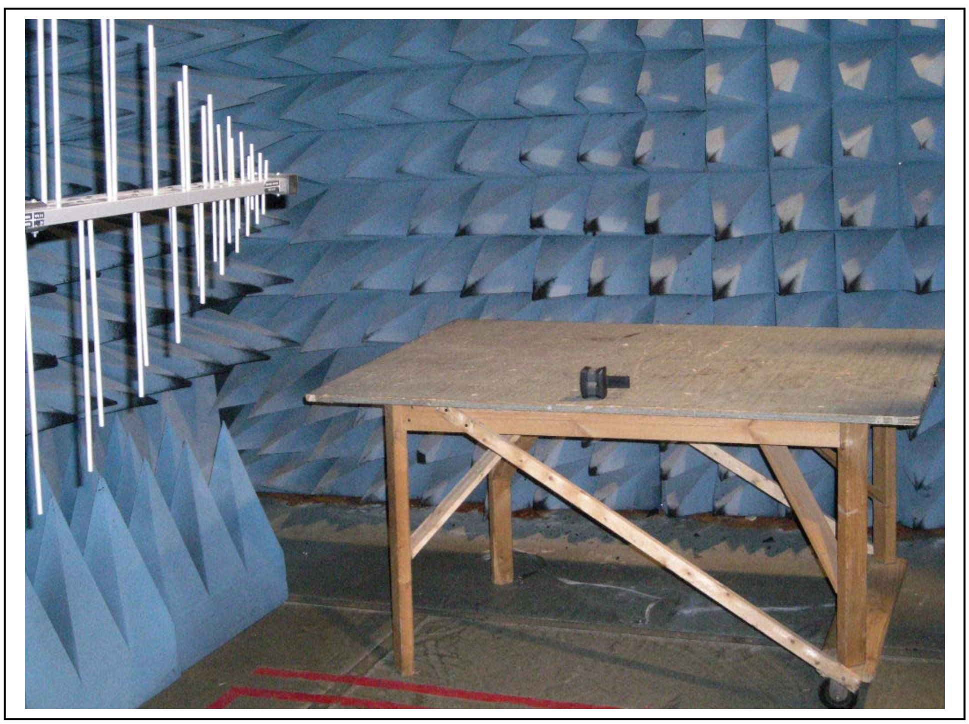
Band Edge Characteristic
Spectum Display Corrected for Antenna/Coax Factors
Note: all spurious emissions beyond the 13.56 MHz fundamental signal are ambient shortwave transmission
Peak Reading, 9 kHz RBW, 30 kHz VBW

9 PICTORIALS – TEST SETUP

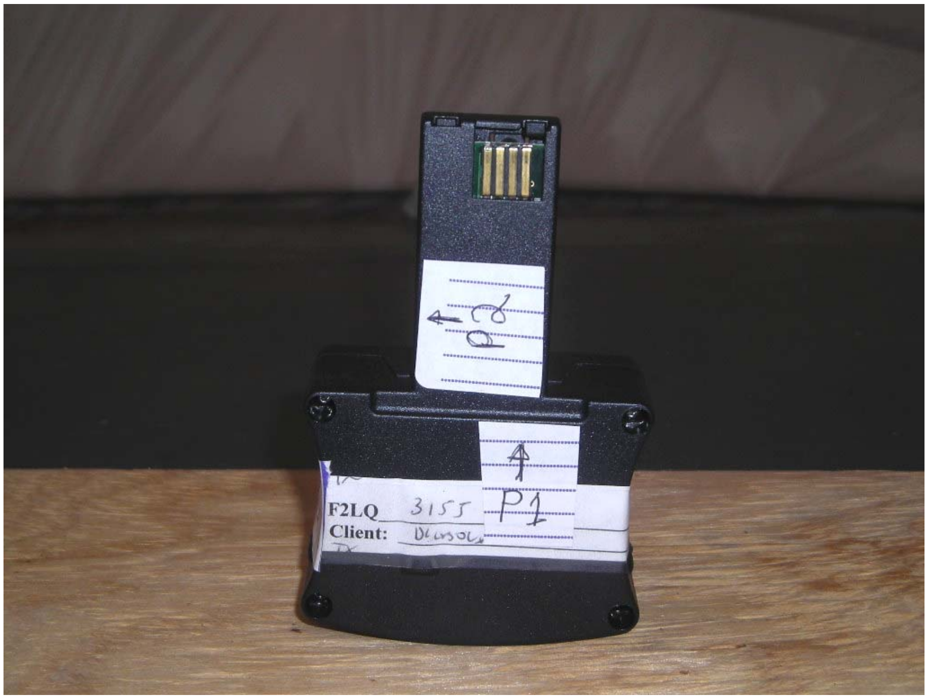
Pictorial 1: Radiated Emissions Test Setup – Chamber
H-Field Loop Antenna, 1.5m Distance



Pictorial 2: Radiated Emissions Test Setup – Chamber
E-Field Bilog Antenna, 1.5m Distance



**Pictorial 3: Radiated Emissions Test Setup – OATS
Orthogonal Position 1**



**Pictorial 4: Radiated Emissions Test Setup – OATS
Orthogonal Position 2**

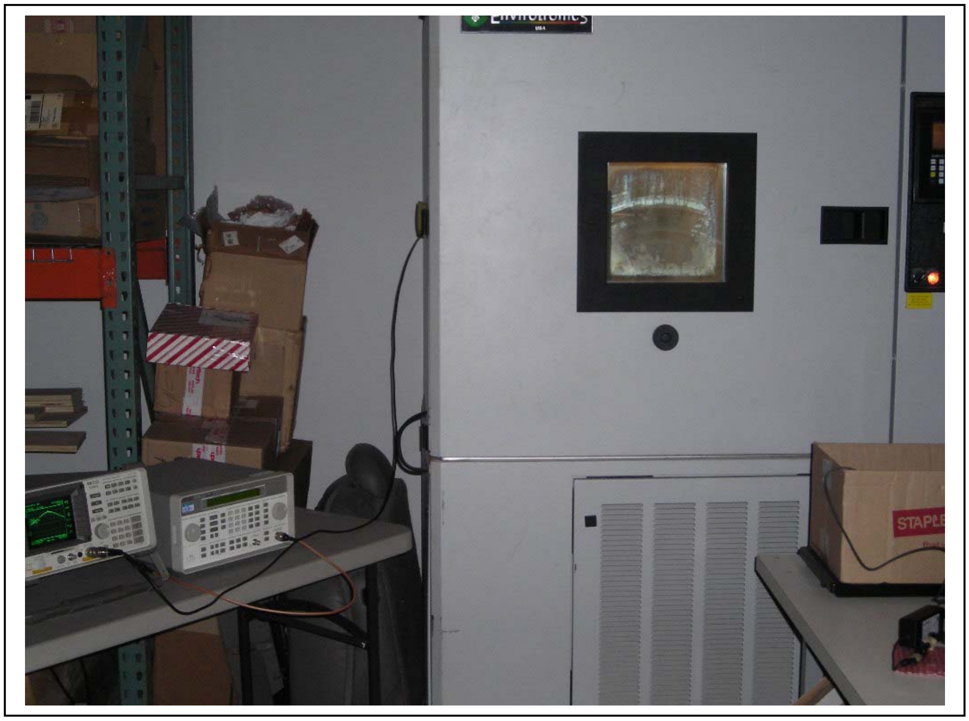
Pictorial 5: Radiated Emissions Test Setup – OATS
Orthogonal Position 3

Pictorial 6: Radiated Emissions Test Setup – OATS
H-Field Loop Antenna, 10m Distance

Pictorial 7: Radiated Emissions Test Setup – OATS
E-Field Bilog Antenna, 3m Distance

Pictorial 8: Environmental Chamber Test Setup
EUT With Pickup Loop in Temperature Chamber

Pictorial 9: Environmental Test Setup
Frequency Measuring Equipment



10 PICTORIALS – EUT

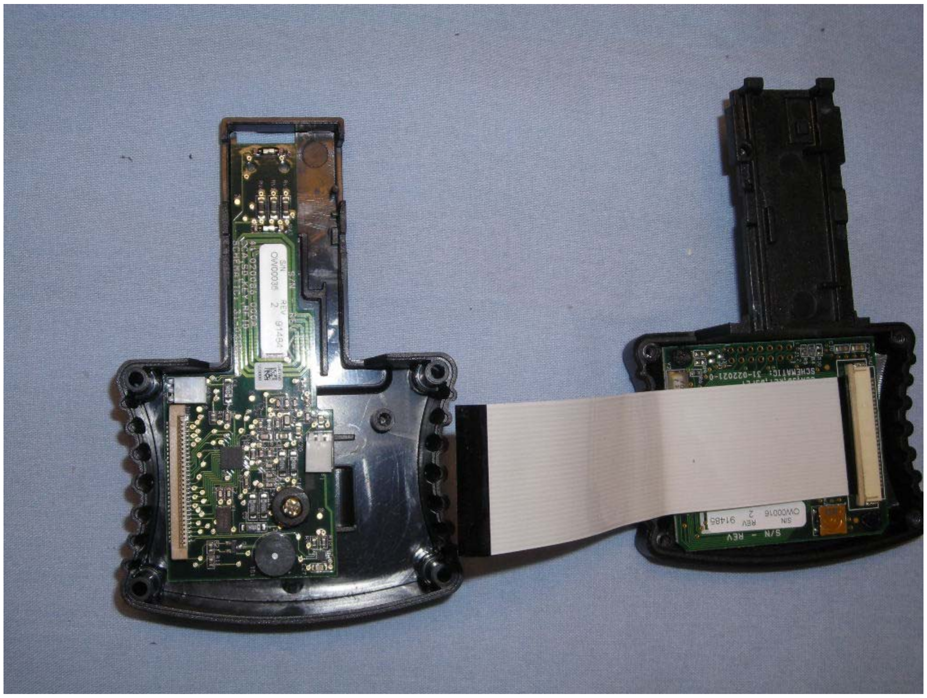
External View of Diebold EVA Key Transmitter
Front View

External View of Diebold EVA Key Transmitter
Rear View

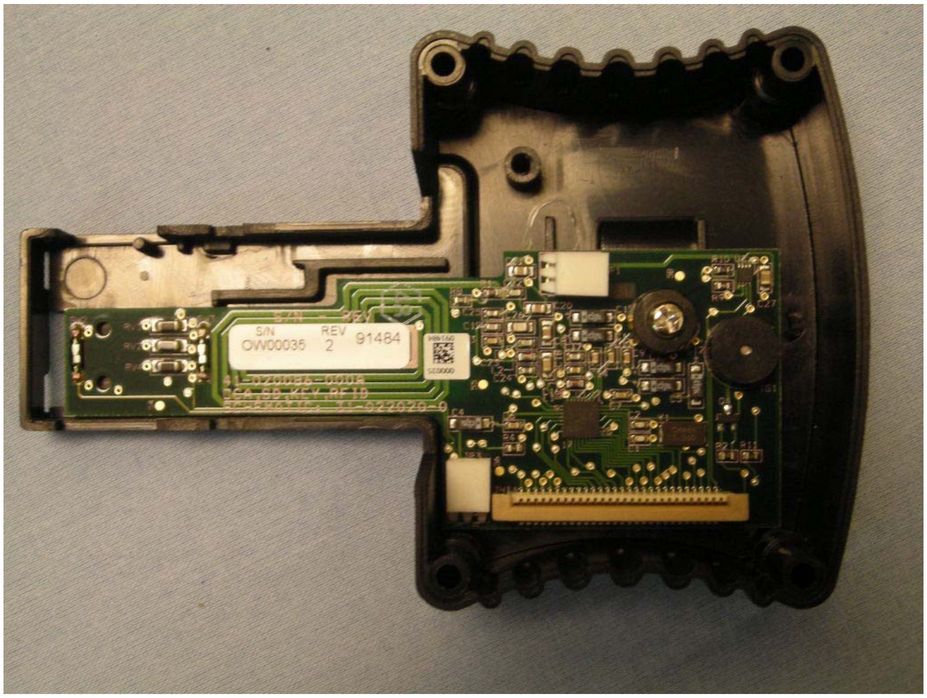
Internal View of Diebold EVA Key Transmitter

Internal View of Diebold EVA Key Transmitter
With Battery Pack Removed

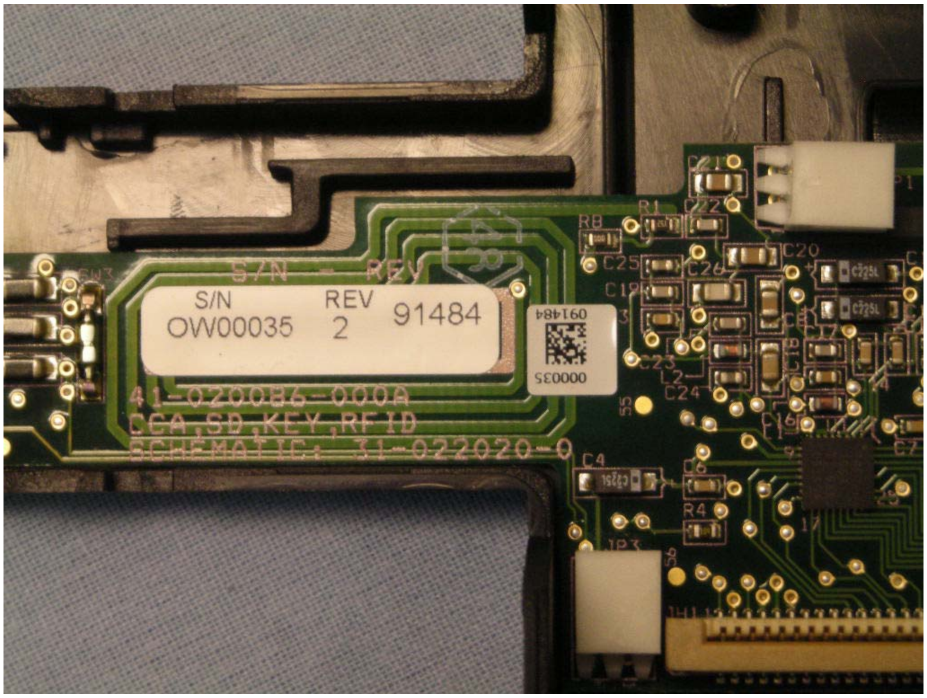
Internal View of Diebold EVA Key Transmitter
From Transmitter Board



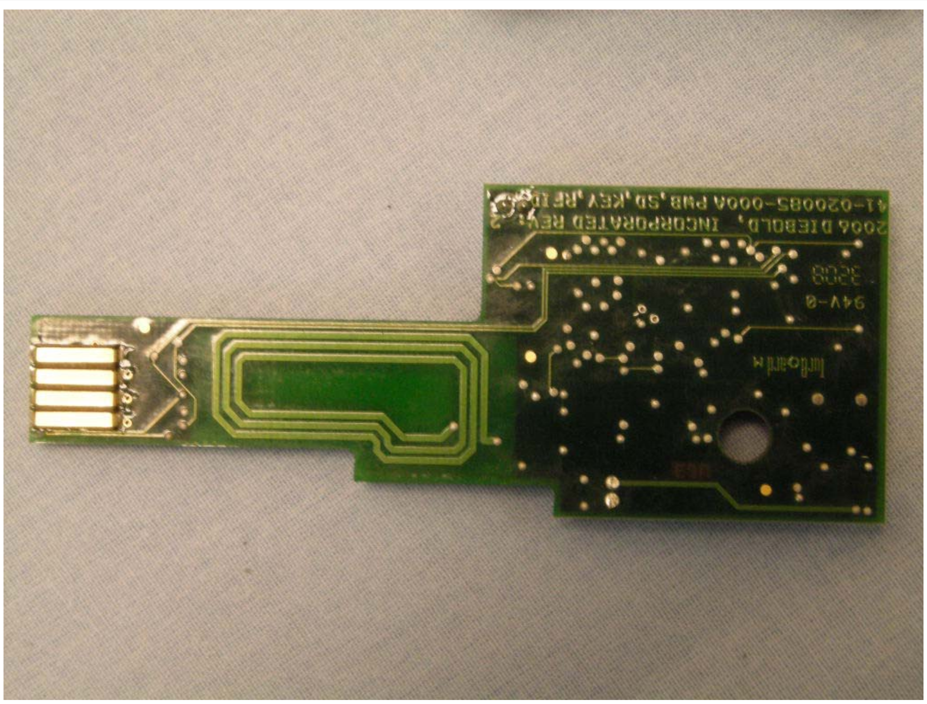
Internal View of Diebold EVA Key Transmitter
Close-up of Transmitter Board – Component Side



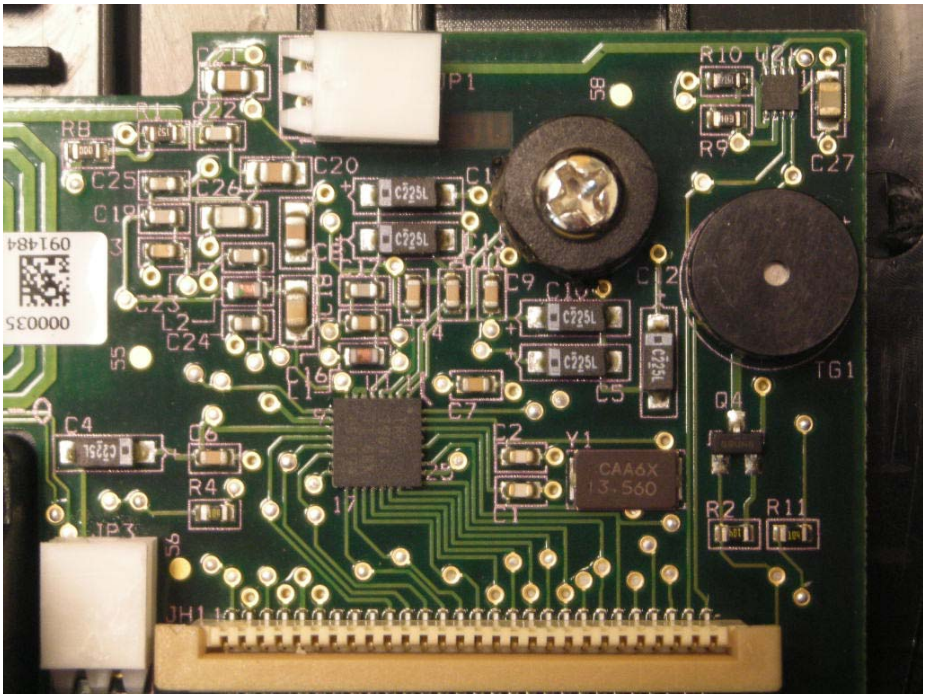
Internal View of Diebold EVA Key Transmitter
Close-up of Transmitter Board – Loop Antenna (Component Side)



Internal View of Diebold EVA Key Transmitter
Close-up of Transmitter Board – Loop Antenna (Resist Side)



Internal View of Diebold EVA Key Transmitter
Close-up of Transmitter Board – RF Circuitry



Internal View of Diebold EVA Key Transmitter
Close-up of Controller/Display Board