

MGA-445940-02 4.4 – 5.9 GHz 10 W High Efficiency Linear Power Amplifier

Features:

- 14 dB Gain
- 40 dBm P_{-3dB}
- 34 dBm Linear Pout @ 2.5 % EVM (802.11 64-QAM)
- 25 % Efficiency at 33 dBm Linear Output Power
- Fully Matched Input and Output for Easy Cascade
- + 28 V Bias Voltage
- Surface Mount Package with RoHS Compliance
- MTTF > 100 years @ 85 °C ambient temperature

Applications:

- 802.16d/e WiMax
- 802.11a WLAN
- Point-To-Point Radio Applications

Description:

The MGA-445940-02 is a power amplifier with the State-of-the-Art linear power-added-efficiency between 4.4 GHz and 5.9 GHz frequency band. Based on advanced robust GaN device technology, the power-added-efficiency of this power amplifier is as high as 25 % when it outputs 2 watt linear burst power with 2.5 % EVM under the 802.16d/e 64QAM modulation schemes. The high efficiency linear power amplifier also has excellent reliability. Ideal applications include the driver and the output power stage of WLAN infrastructures and access points. It also can be used for PTP (Point-To-Point) radio applications for this band.

Absolute Maximum Ratings: ($T_a = 25\text{ °C}$)*

SYMBOL	PARAMETERS	UNITS	ABSOLUTE MAXIMUM
V _{ds}	Drain-Source Voltage	V	50
I _d	Drain Current	mA	1000
I _g	Gate Current	mA	100
P _{diss}	DC Power Dissipation	W	50
Pin max	RF Input Power	dBm	+33
T _{ch}	Channel Temperature	°C	175
T _{stg}	Storage Temperature	°C	-55 to 150

*Operation of this device above any one of these parameters may cause permanent damage.

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Typical RF Performance: $V_{ds} = 28\text{ V}$, $I_{cq} = 80\text{ mA}$, $T_a = 25\text{ }^{\circ}\text{C}$, $Z_0 = 50\text{ ohm}$

Parameter	Units	Min	Typical
Frequency Range	MHz		4400 - 5900
Gain (Typ / Min)	dB		14 / 13
Gain Flatness (Typ / Max)	+/- dB		0.6 / 1.0
Input Return Loss	dB	6	
Output Return Loss	dB	3	
Output P3dB	dBm		40
Pout @ 2.5 % EVM	dBm		34
Operating Current Range	mA		100 - 1200
Thermal Resistance	$^{\circ}\text{C} / \text{W}$		5

ESD Caution

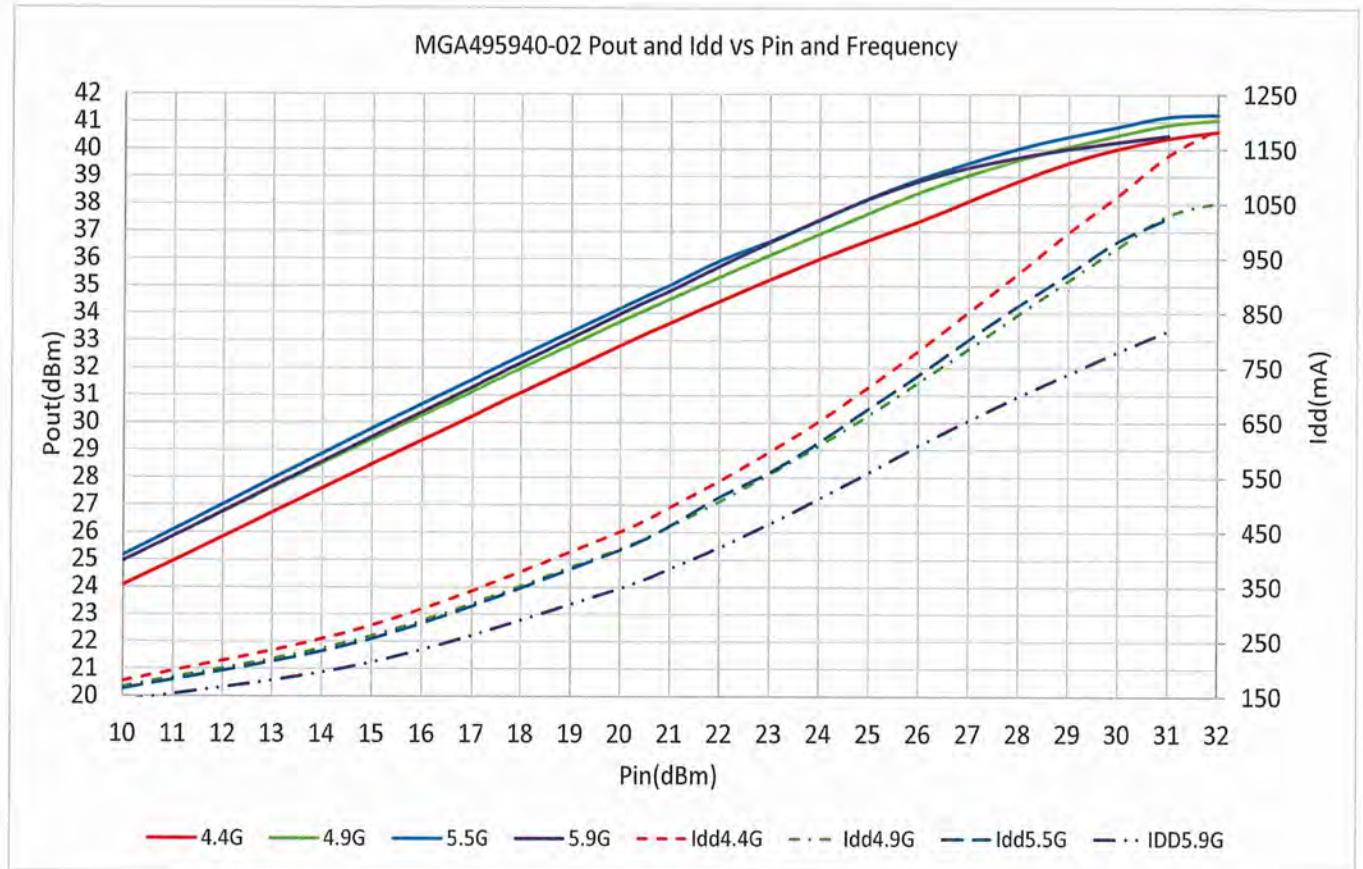
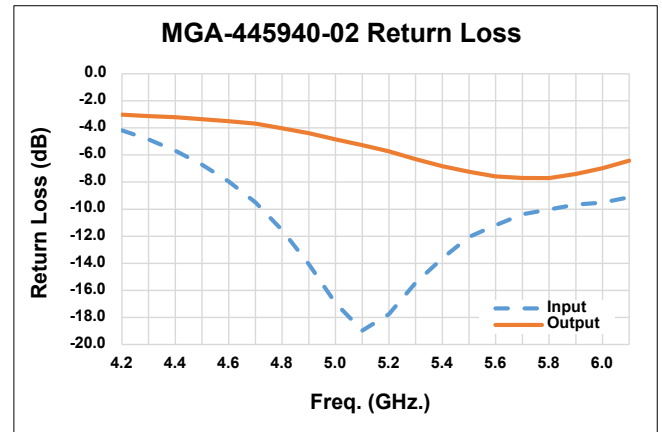
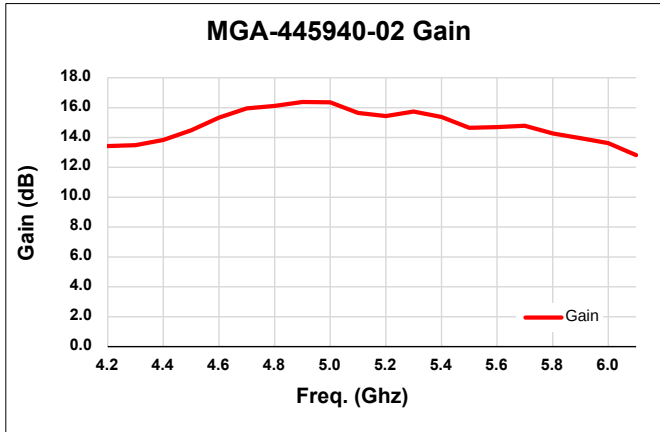


High-performance RF integrated circuits are highly sensitive to electrostatic discharge (ESD) and may contain unprotected inputs and outputs. Handling and assembly should be conducted in an ESD-controlled environment. It is recommended that ESD precautions and protocols are adopted to minimise the risk of electrostatic discharge and protect product integrity.

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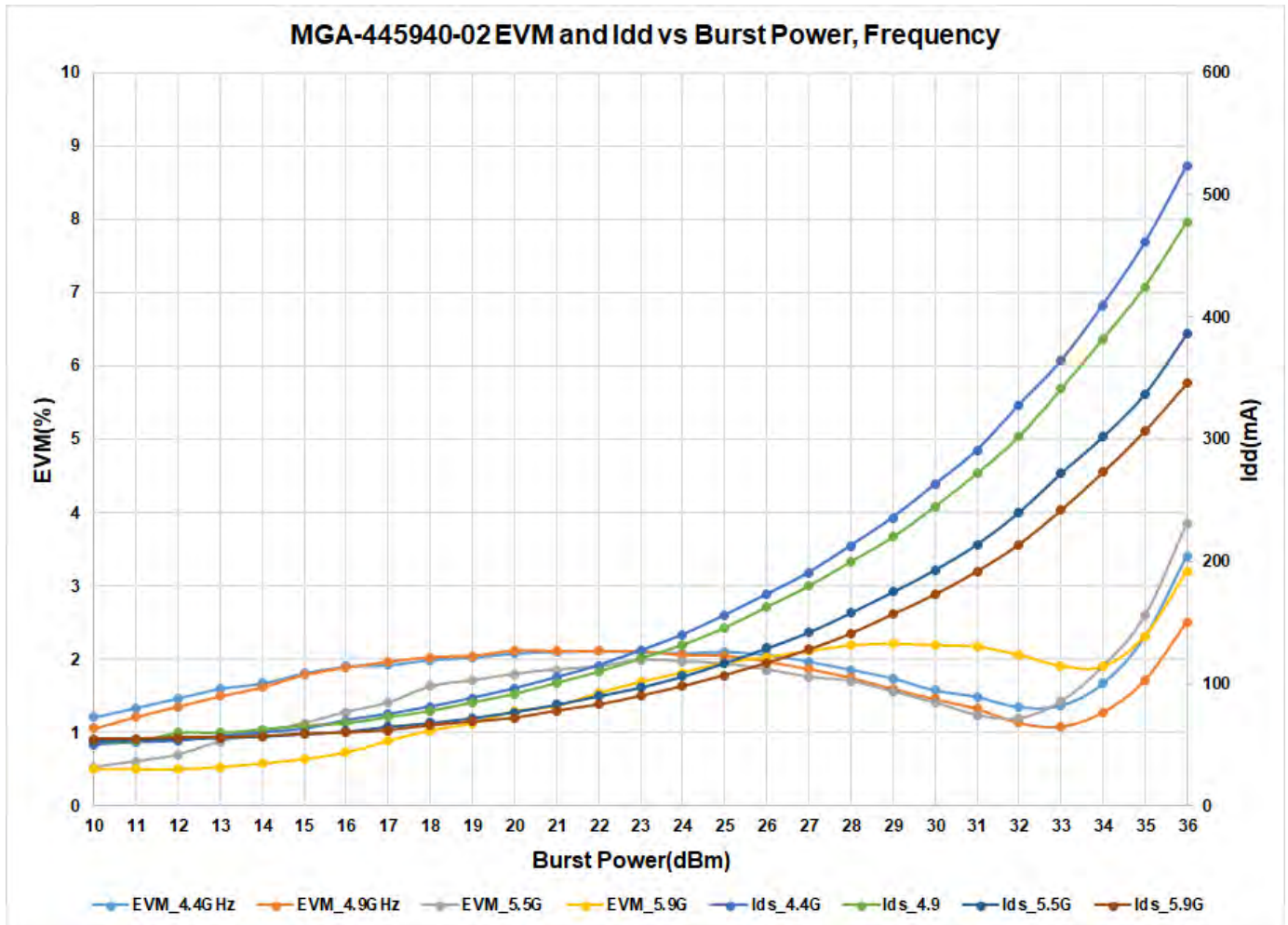
Typical RF Performance: $V_{ds} = 28.0\text{ V}$, $I_{cq} = 80\text{ mA}$, $Z_0 = 50\ \Omega$, $T_a = 25\text{ }^\circ\text{C}$



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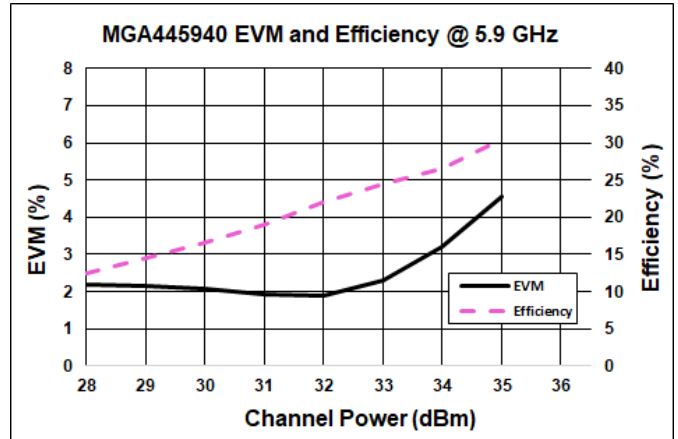
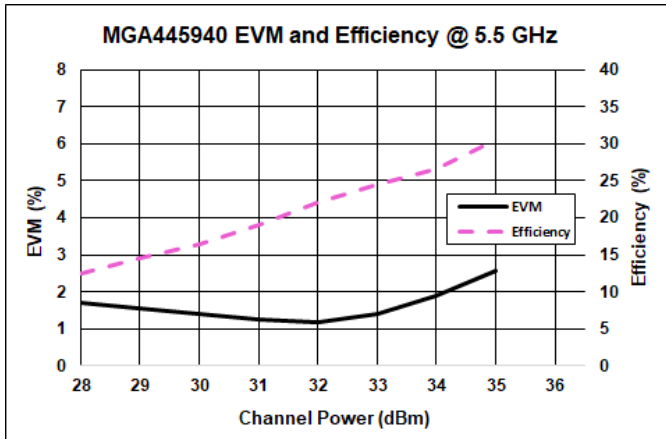
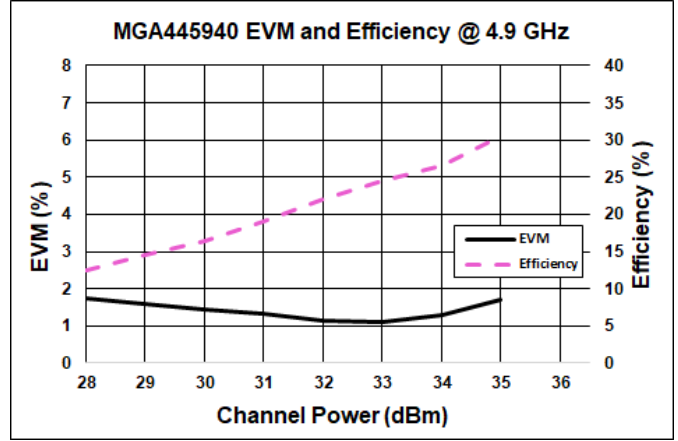
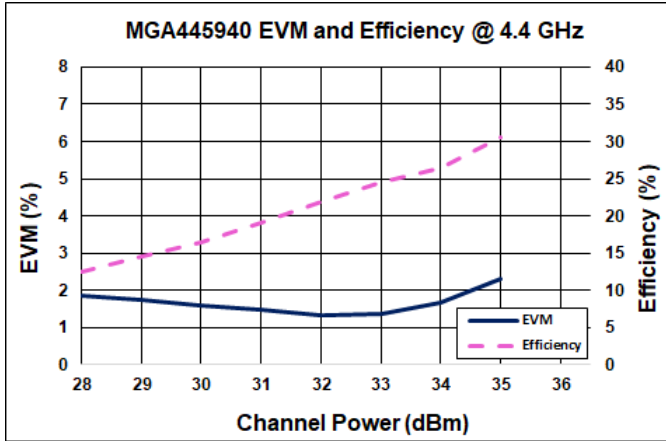
Typical RF Performance (Cont): $V_{ds} = 28.0\text{ V}$, $I_{dq} = 46\text{ mA}$, $Z_0 = 50\ \Omega$, $T_a = 25\text{ }^\circ\text{C}$



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Typical RF Performance (Cont): $V_{ds} = 28.0\text{ V}$, $I_{dq} = 80\text{ mA}$, $Z_0 = 50\ \Omega$, $T_a = 25\text{ }^\circ\text{C}$



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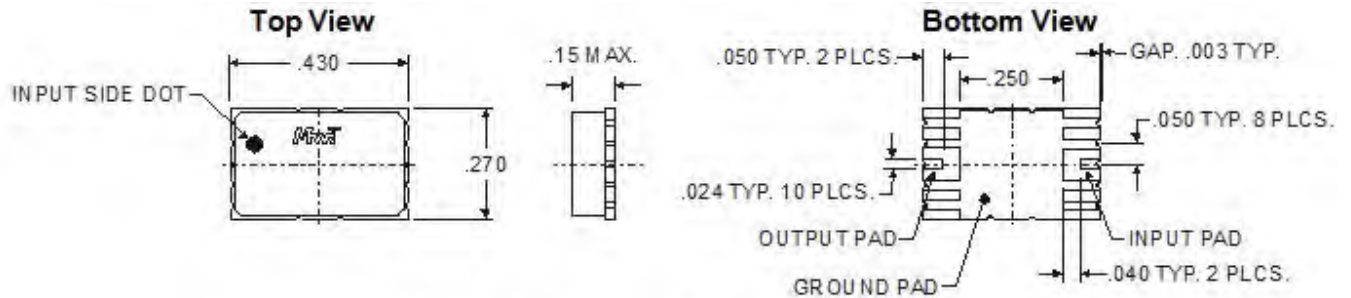
Typical Scattering Parameters: $V_{ds} = 28\text{ V}$, $I_{cq} = 80\text{ mA}$, $Z_0 = 50\ \Omega$, $T_a = 25\text{ }^\circ\text{C}$

Freq (GHz)	dB(S11)	Ang(S11)	dB(S21)	Ang(S21)	dB(S12)	Ang(S12)	dB(S22)	Ang(S22)
3.0	-1.40	107.7	9.70	-24.2	-36.82	-84.6	-3.02	149.9
3.1	-1.43	104.0	9.45	-31.6	-36.75	-84.2	-2.99	146.5
3.2	-1.55	99.8	10.04	-34.2	-37.57	-88.8	-2.96	143.4
3.3	-1.59	95.4	9.97	-34.0	-37.18	-86.1	-2.92	140.0
3.4	-1.71	91.0	9.64	-38.5	-37.18	-90.2	-2.92	136.7
3.5	-1.85	85.9	10.18	-45.5	-36.27	-87.9	-2.91	133.1
3.6	-2.04	80.7	11.12	-50.2	-36.47	-87.3	-2.90	129.3
3.7	-2.24	75.1	11.94	-53.5	-35.91	-89.4	-2.91	125.5
3.8	-2.49	69.3	12.26	-56.4	-34.67	-97.1	-2.92	121.5
3.9	-2.82	63.0	12.08	-63.6	-32.84	-97.0	-2.93	117.2
4.0	-3.18	56.4	12.41	-74.4	-33.08	-103.9	-2.94	113.0
4.1	-3.59	49.4	13.13	-81.4	-31.18	-114.5	-2.97	108.4
4.2	-4.18	41.6	13.42	-86.5	-31.10	-122.3	-3.02	103.3
4.3	-4.85	32.9	13.49	-94.0	-30.28	-134.3	-3.12	98.1
4.4	-5.68	24.1	13.83	-103.1	-30.10	-144.0	-3.21	92.4
4.5	-6.71	13.8	14.49	-111.6	-30.12	-153.3	-3.35	86.2
4.6	-7.96	2.5	15.33	-119.4	-30.22	-162.3	-3.50	79.6
4.7	-9.50	-10.7	15.95	-128.3	-29.87	-168.1	-3.69	72.4
4.8	-11.54	-25.8	16.12	-140.4	-30.30	-173.8	-4.03	64.6
4.9	-14.07	-46.0	16.38	-153.6	-29.78	178.5	-4.39	56.3
5.0	-16.94	-73.0	16.36	-164.7	-29.39	172.8	-4.84	47.7
5.1	-18.97	-116.4	15.65	-176.5	-28.97	163.6	-5.28	38.4
5.2	-17.76	-159.7	15.43	169.5	-28.28	153.9	-5.73	28.6
5.3	-15.45	169.9	15.73	160.5	-28.17	145.1	-6.30	17.5
5.4	-13.63	148.1	15.38	155.0	-28.12	131.1	-6.83	5.0
5.5	-12.06	129.5	14.65	143.8	-27.83	124.6	-7.24	-8.3
5.6	-11.18	113.0	14.70	130.0	-28.76	113.2	-7.58	-22.1
5.7	-10.38	96.2	14.78	118.7	-28.35	104.0	-7.69	-36.8
5.8	-10.03	79.6	14.27	107.6	-29.12	99.2	-7.71	-51.7
5.9	-9.67	60.7	13.95	94.8	-28.90	88.3	-7.40	-66.9
6.0	-9.51	40.8	13.63	85.9	-28.53	84.1	-6.97	-81.1
6.1	-9.12	19.1	12.82	76.7	-28.38	75.2	-6.42	-94.4
6.2	-8.72	-4.0	12.43	60.7	-28.16	65.2	-5.80	-107.2
6.3	-7.99	-28.1	12.88	43.7	-28.44	48.7	-5.20	-119.3
6.4	-7.18	-51.0	12.68	29.5	-28.52	36.0	-4.67	-130.2
6.5	-6.10	-71.2	11.16	14.0	-30.40	25.9	-4.14	-139.7
6.6	-5.19	-89.6	9.25	-1.9	-31.76	11.3	-3.70	-148.7
6.7	-4.25	-106.4	6.72	-15.1	-32.64	8.9	-3.35	-157.1
6.8	-3.58	-121.0	4.30	-29.2	-34.21	7.5	-3.04	-164.8
6.9	-2.94	-134.2	3.36	-33.6	-35.34	2.6	-2.79	-171.7
7.0	-2.49	-145.6	1.77	-24.0	-35.68	5.7	-2.58	-177.8

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Mechanical Information: *This Package is RoHS compliant*



All dimensions are in inches

Pin Designation (Top View)			
Pin 1 (DOT Top Left)	GND	Pin 10	GND
Pin 2	GND	Pin 9	GND
Pin 3	RF In/Vg	Pin 8	RF Out/Vdd
Pin 4	GND	Pin 7	GND
Pin 5	GND	Pin 6	GND

Application Notes:

The evaluation board, shown in Figure 3, is fabricated with Rogers's 4003 material, 20 mil thick, 2 oz copper weight. The MGA-445940-02 shown in the center of board is a 10 watt amplifier with high gain and high linearity. For best thermal performance, the PCB requires via holes with a diameter of 20 mils placed uniformly over the center pad for thermal relief and RF ground as shown in Figure 4. The via holes underneath the package are filled with conductive epoxy as shown in Figure 4. The choice of capacitor bypassing near the amplifier should have a short circuit resonance at the frequency of operation. A small capacitor 3.9 pF 0603 from AVX has a series resonance at 5.5 GHz and will make a good choice for the first bypass capacitor.

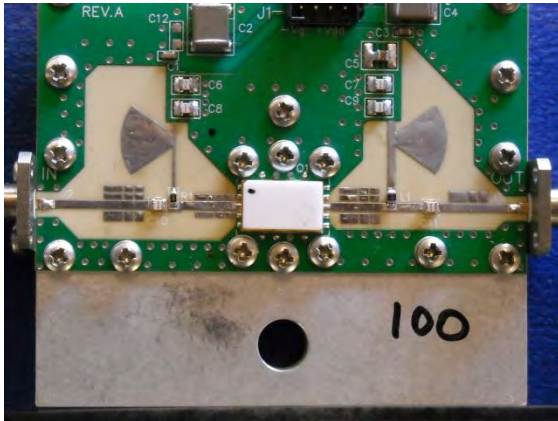


Figure 3 Evaluation board

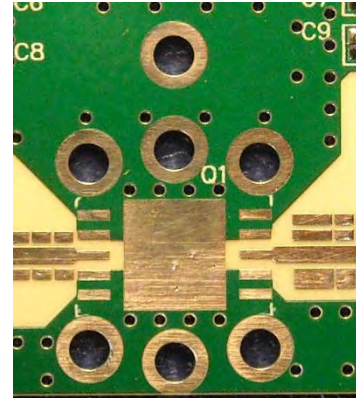


Figure 4 Hole Pattern

Followed up with larger value capacitors 100pF, 1000pF and 2.2 μ F can be used to maintain voltage stability under peak current conditions. The DC ground via holes should be laid out to minimized inductive returns associated with ground loops. Use of stitch ground vias holes can help control the return current and also maintain ground continuity between the top and bottom ground layers. Biasing with quarter-wave stubs at the gate and drain are shown in Figure 3. A 56 Ω resistor is added in series to the gate bias and a 2.2 nH choke is added in series to the drain bias. The effective impedance is increased which reduces the risk of low frequency oscillations.

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Application Notes (cont):

Typical constellation response for 802.16 Pavg = 32.5 dBm @ 2.5 % EVM, 4.4 GHz

IEEE 802.16-2004 OFDM *						
Frequency: 4.4 GHz		Signal Level Setting: 17.8 dBm		Ref. Level / Ext. Att: 27.8 dBm / 18 dB		
Sweep Mode: Continuous		Trigger Mode: Free Run		Trigger Offset: -10 μs		
Burst Type: OFDM DL Burst 1 (1)		Modulation: 64QAM3/4		No Of Data Symbols: 1/2425		
CONTINUOUS		TRG : FREE RUN		RF		
Result Summary						
No. of Bursts	1					
	Min	Mean	Limit	Max	Limit	Unit
EVM All Carriers	2.50	2.50	2.82	2.50	2.82	%
EVM Data Carriers	2.51	2.51		2.51		%
EVM Pilot Carriers	2.44	2.44		2.44		%
IQ Offset	0.26	0.26	17.78	0.26	17.78	%
Gain Imbalance	0.06	0.06		0.06		%
Quadrature Error	0.015	0.015		0.015		°
Center Frequency Error	32.23	32.23	± 35200	32.23	± 35200	Hz
Clock Error	- 0.02	- 0.02	± 8	- 0.02	± 8	ppm
Burst Power	33.85	33.85		33.85		dBm
Crest Factor	9.56	9.56		9.56		dB
RSSI	36.91	36.91		36.91		dBm
RSSI Standard Deviation		- 2.12				dB
CINR	15.56	15.56		15.56		dB
CINR Standard Deviation		- 1.83				dB

Measurement Aborted

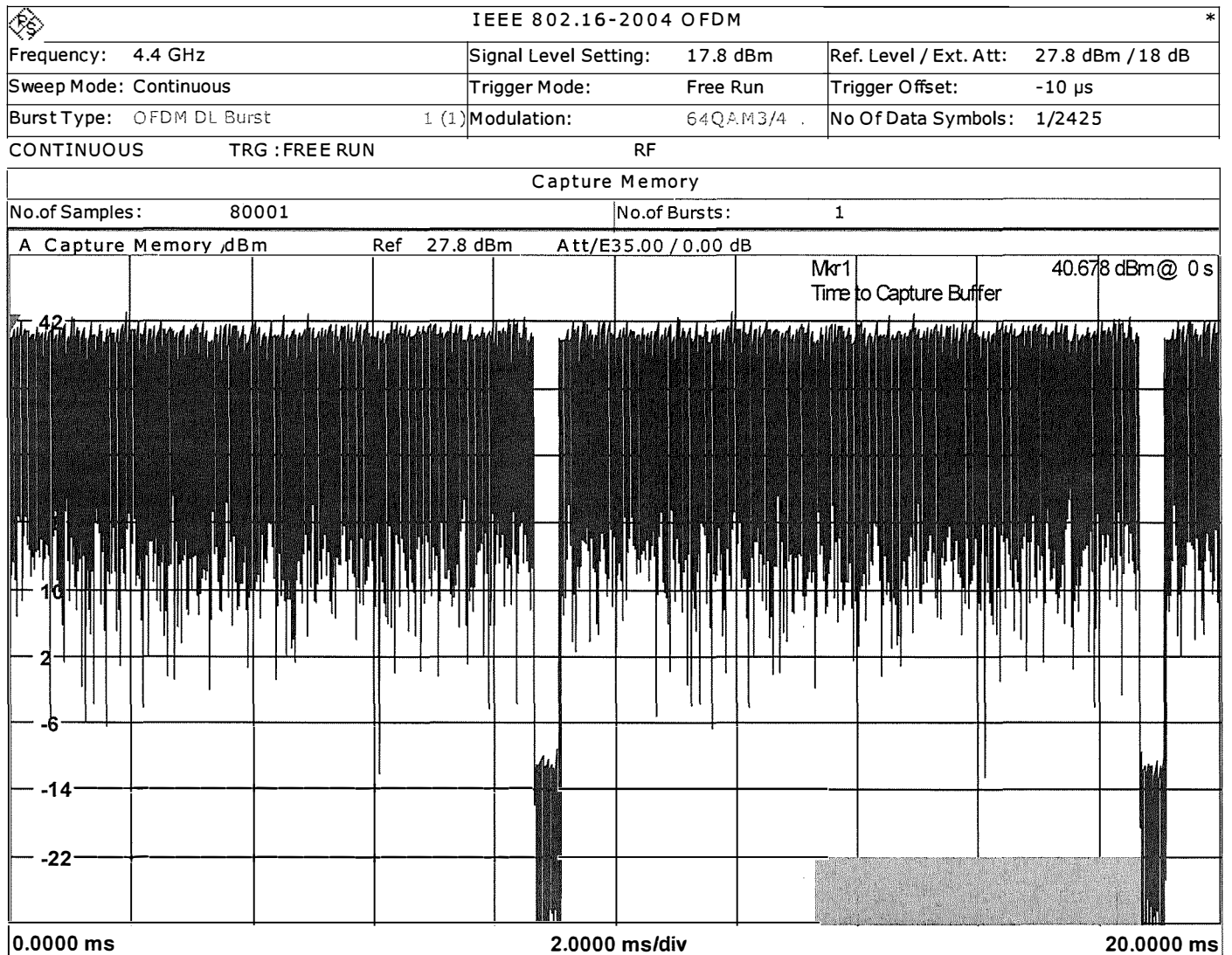
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Application Notes (cont):

Typical constellation response for 802.16 Pavg = 32.5dBm @ 2.5% EVM, 4.4 GHz



Measurement Aborted

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Application Notes (cont):

Typical constellation response for 802.16 Pavg = 32.5dBm @ 2.5 % EVM, 4.9 GHz

PS

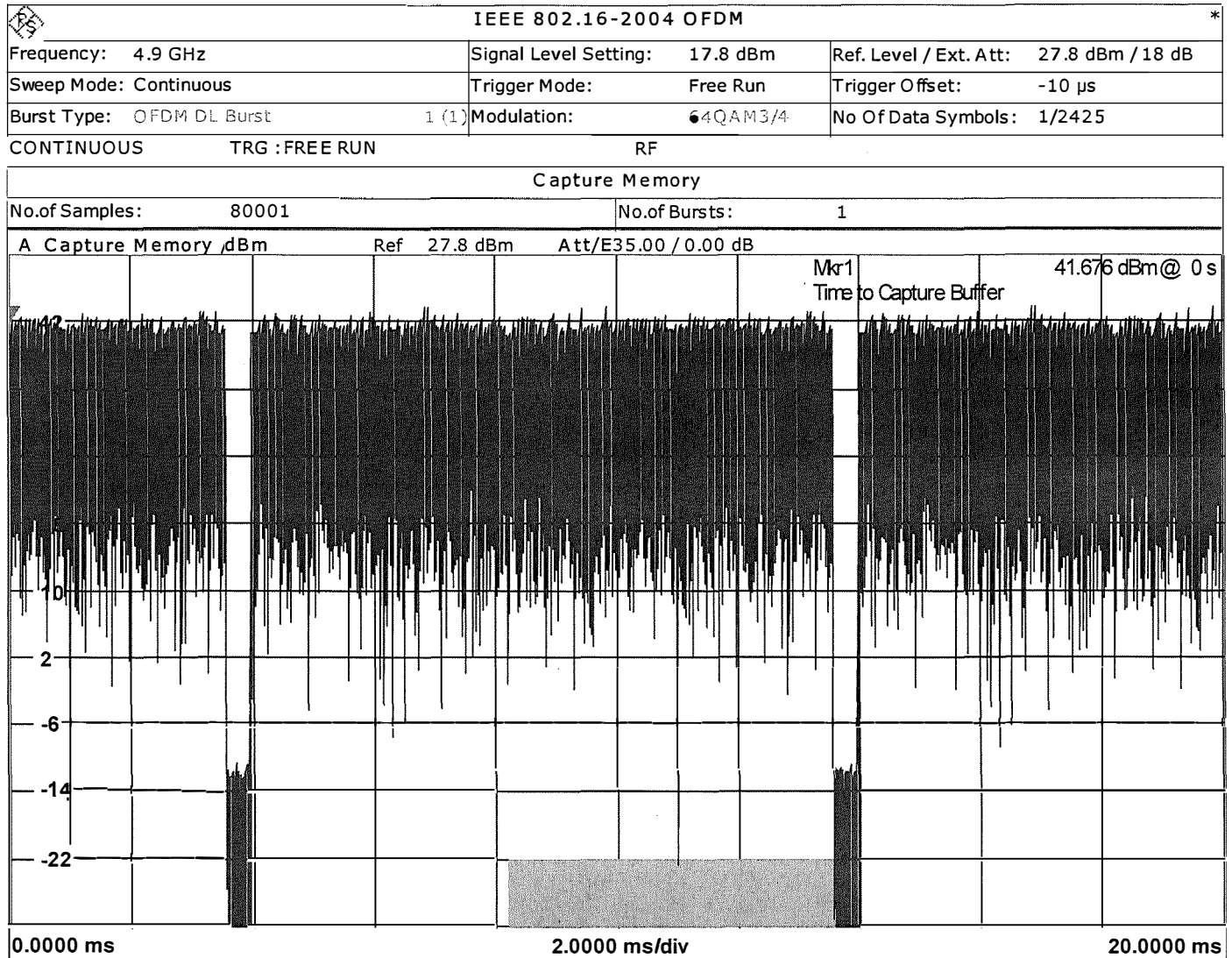
IEEE 802.16-2004 OFDM							*
Frequency: 4.9 GHz		Signal Level Setting: 17.8 dBm		Ref. Level / Ext. Att: 27.8 dBm / 18 dB			
Sweep Mode: Continuous		Trigger Mode: Free Run		Trigger Offset: -10 μs			
Burst Type: OFDM DL Burst		1 (1)	Modulation: 64QAM3/4		No Of Data Symbols: 1/2425		
CONTINUOUS		TRG : FREE RUN		RF			
Result Summary							
No. of Bursts		1					
	Min	Mean	Limit	Max	Limit	Unit	
EVM All Carriers	2.49	2.49	2.82	2.49	2.82	%	
EVM Data Carriers	2.49	2.49		2.49		%	
EVM Pilot Carriers	2.42	2.42		2.42		%	
IQ Offset	0.19	0.19	17.78	0.19	17.78	%	
Gain Imbalance	0.10	0.10		0.10		%	
Quadrature Error	0.013	0.013		0.013		°	
Center Frequency Error	35.30	35.30	± 39200	35.30	± 39200	Hz	
Clock Error	- 0.02	- 0.02	± 8	- 0.02	± 8	ppm	
Burst Power	34.62	34.62		34.62		dBm	
Crest Factor	9.55	9.55		9.55		dB	
RSSI	37.64	37.64		37.64		dBm	
RSSI Standard Deviation		- 1.09				dB	
CINR	15.68	15.68		15.68		dB	
CINR Standard Deviation		- 1.53				dB	

Measurement Aborted

Date: 12.APR.2023 16:46:03

Application Notes (cont):

Typical constellation response for 802.16 Pavg = 32.5 dBm @ 2.5 % EVM, 4.9 GHz



Measurement Aborted

Date: 12.APR.2023 16:46:52

Application Notes (cont):

Typical constellation response for 802.16 Pavg = 32.5 dBm @ 2.5 % EVM, 5.4 GHz

IEEE 802.16-2004 OFDM							*
Frequency: 5.4 GHz		Signal Level Setting: 17.8 dBm		Ref. Level / Ext. Att: 27.8 dBm / 18 dB			
Sweep Mode: Continuous		Trigger Mode: Free Run		Trigger Offset: -10 μs			
Burst Type: ●FDM DL Burst 1 (1)		Modulation: 64QAM3/4		No Of Data Symbols: 1/2425			
CONTINUOUS		TRG : FREE RUN		RF			
Result Summary							
No. of Bursts		1					
	Min	Mean	Limit	Max	Limit	Unit	
EVM All Carriers	2.50	2.50	2.82	2.50	2.82	%	
EVM Data Carriers	2.51	2.51		2.51		%	
EVM Pilot Carriers	2.36	2.36		2.36		%	
IQ Offset	0.11	0.11	17.78	0.11	17.78	%	
Gain Imbalance	0.12	0.12		0.12		%	
Quadrature Error	0.007	0.007		0.007		°	
Center Frequency Error	38.20	38.20	± 43200	38.20	± 43200	Hz	
Clock Error	- 0.06	- 0.06	± 8	- 0.06	± 8	ppm	
Burst Power	34.83	34.83		34.83		dBm	
Crest Factor	9.49	9.49		9.49		dB	
RSSI	37.86	37.86		37.86		dBm	
RSSI Standard Deviation		- 0.97				dB	
CINR	15.76	15.76		15.76		dB	
CINR Standard Deviation		0.65				dB	

Measurement Aborted

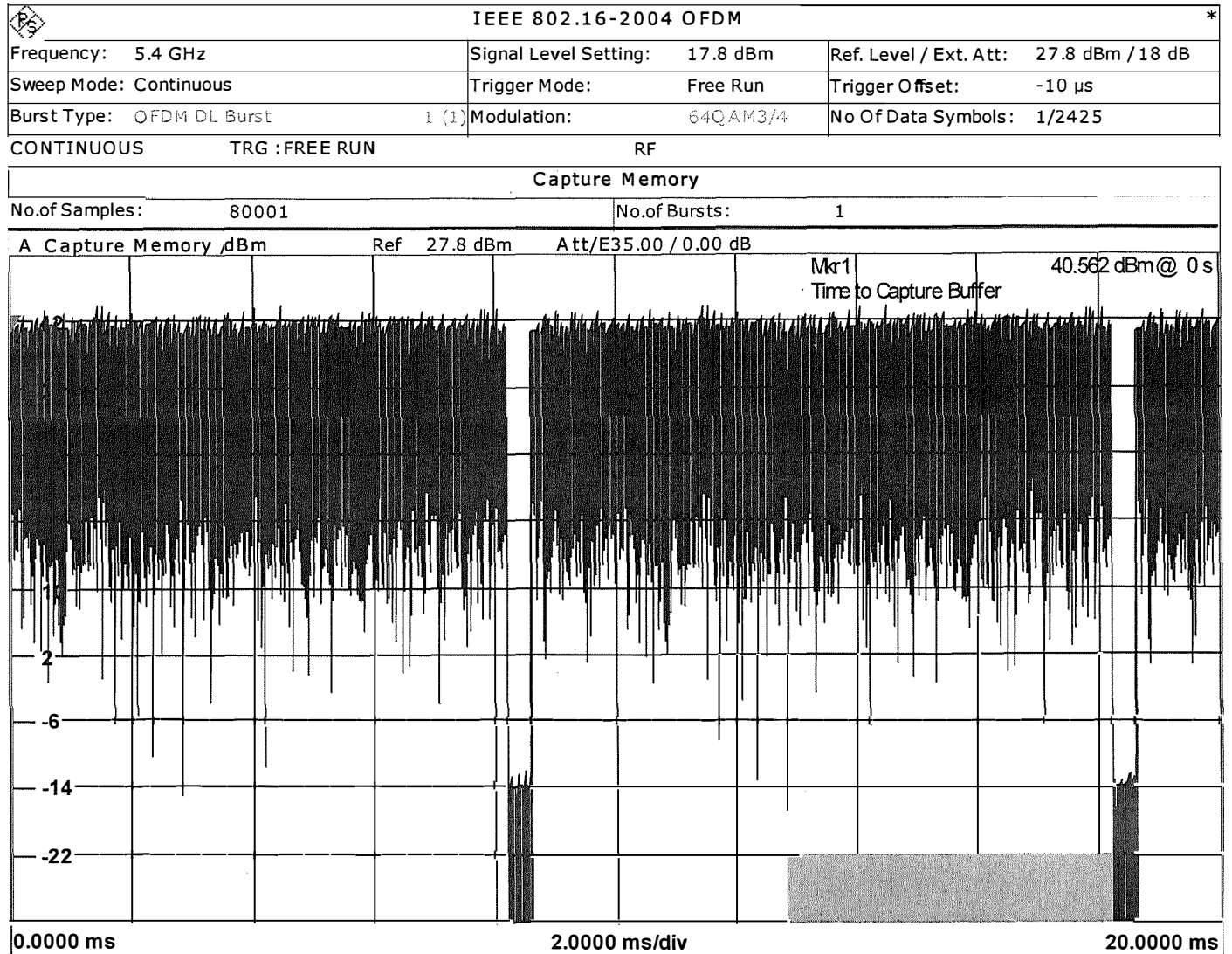
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Linear Power Amplifier

Application Notes (cont):

Typical constellation response for 802.16 Pavg = 32.5 dBm @ 2.5 % EVM, 5.4 GHz



Measurement Aborted

Date: 12.APR.2023 16:48:47

Application Notes (Cont):

Typical constellation response for 802.16 Pavg = 32.5 dBm @ 2.5 % EVM, 5.9 GHz

IEEE 802.16-2004 OFDM							*
Frequency: 5.9 GHz			Signal Level Setting: 17.1 dBm		Ref. Level / Ext. Att: 27.1 dBm / 18 dB		
Sweep Mode: Continuous			Trigger Mode: Free Run		Trigger Offset: -10 μs		
Burst Type: OFDM DL Burst 1 (1)			Modulation: 64QAM3/4		No Of Data Symbols: 1/2425		
CONTINUOUS			TRG : FREE RUN		RF		
Result Summary							
No. of Bursts		1					
	Min	Mean	Limit	Max	Limit	Unit	
EVM All Carriers	2.51	2.51	2.82	2.51	2.82	%	
EVM Data Carriers	2.51	2.51		2.51		%	
EVM Pilot Carriers	2.36	2.36		2.36		%	
IQ Offset	0.16	0.16	17.78	0.16	17.78	%	
Gain Imbalance	0.16	0.16		0.16		%	
Quadrature Error	- 0.005	- 0.005		- 0.005		°	
Center Frequency Error	41.47	41.47	± 47200	41.47	± 47200	Hz	
Clock Error	- 0.03	- 0.03	± 8	- 0.03	± 8	ppm	
Burst Power	33.30	33.30		33.30		dBm	
Crest Factor	9.42	9.42		9.42		dB	
RSSI	36.35	36.35		36.35		dBm	
RSSI Standard Deviation		- 3.28				dB	
CINR	15.83	15.83		15.83		dB	
CINR Standard Deviation		- 2.11				dB	

Measurement Aborted

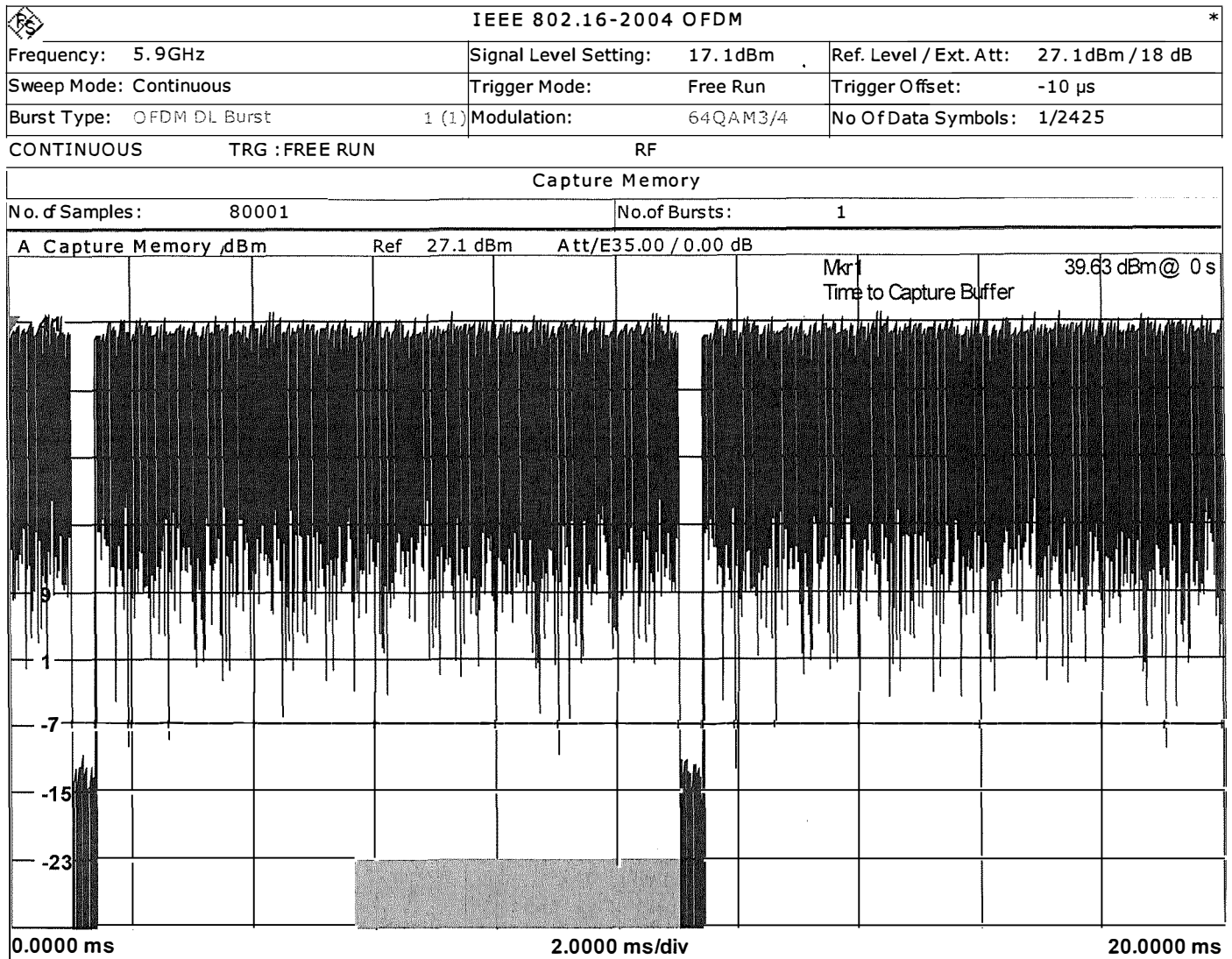
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Linear Power Amplifier

Application Notes (cont):

Typical constellation response for 802.16 Pavg = 32.5 dBm @ 2.5 % EVM, 5.9 GHz



Measurement Aborted

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RoHS Compliance



CML Micro certifies, to the best of our knowledge, that its products comply with RoHS directive (2011/65/EU), as amended by Directive (EU) 2015/863.

REACH Compliance



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