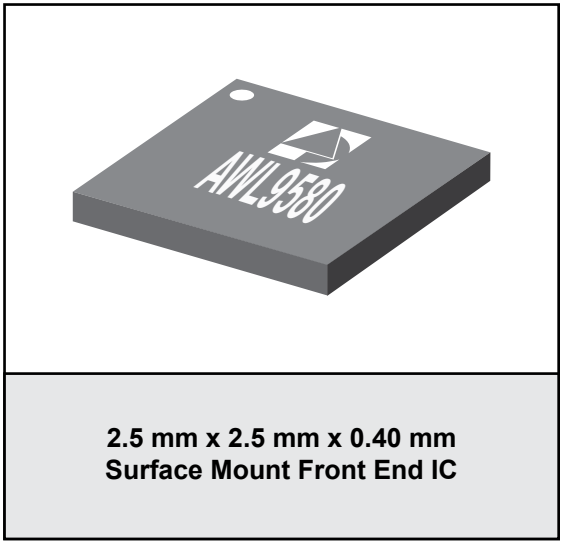
AWL9580

802.11a/n Power Amplifier, LNA and Tx/Rx Switch

DATA SHEET - Rev 2.1

FEATURES

- Fully integrated FEIC including 5GHz Power Amplifier, Low Noise Amplifier with Bypass mode and SP2T TX/RX Switch
- 2.5% Dynamic EVM @ Pout = +18 dBm with IEEE 802.11a 64 QAM OFDM at 54 Mbps
- 27 dB of Linear Power Gain
- Power Detector with High Accuracy over 3:1 VSWR
- 2.7dB RX Path Noise Figure with 12dB Gain LNA Mode
- Single 3.0 to 4.8 V Supply Voltage
- 50 Ω-Internally Matched RF Ports
- Leadfree and RoHS Compliant
- 2.5 x 2.5 x 0.40 mm QFN Package



2.5 mm x 2.5 mm x 0.40 mm
Surface Mount Front End IC

APPLICATIONS

- 802.11a/n WLAN for Fixed, Mobile and Handheld applications

PRODUCT DESCRIPTION

The ANADIGICS AWL9580 is a high performance InGaP HBT FEIC that incorporates a 5GHz Power Amplifier, Low Noise Amplifier, RF Switch and Power Detector. The FEIC is designed for WLAN transmit and receive applications in the 4.9 – 5.875GHz band. Matched to 50 Ohms and DC blocked at all RF inputs and outputs, the part requires no additional RF matching components off-chip.

The antenna port is switched between WLAN transmit and WLAN receive with low loss switches. The integrated detector circuit facilitates accurate power control under varying load conditions.

All circuits are biased by a single +3.6V supply and consume ultra low current in the OFF mode. The PA exhibits unparalleled linearity and efficiency for 802.11a/n WLAN systems under the toughest signal conditions within these standards.

The AWL9580 is manufactured using advanced InGaP HBT technology that offers state-of-the-art performance, reliability, temperature stability and ruggedness.

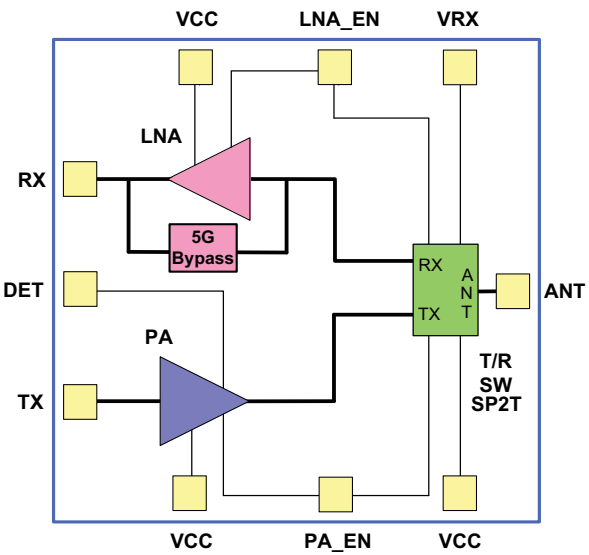


Figure 1: Block Diagram

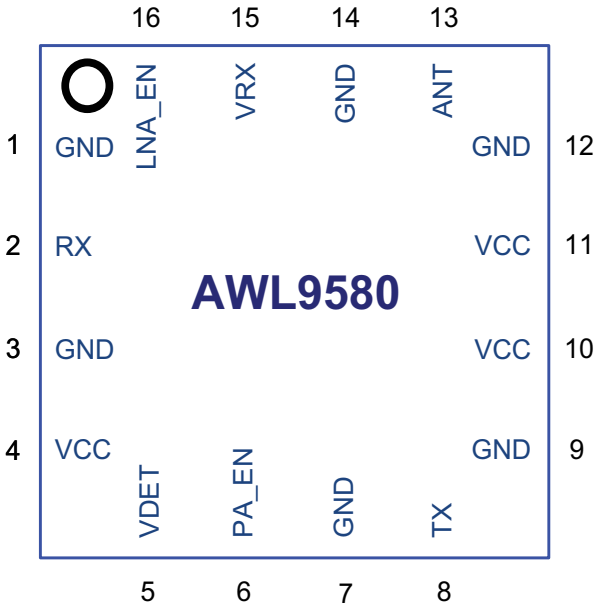


Figure 2: Pinout Diagram

Table 1: Pin Description Table

PIN	NAME	DESCRIPTION	PIN	NAME	DESCRIPTION
1	GND	Ground	9	GND	Ground
2	RX	5 GHz receive output port	10	VCC	Power Supply
3	GND	Ground	11	VCC	Power Supply
4	VCC	Power Supply	12	GND	Ground
5	VDET	Power detector output. DC coupled	13	ANT	Antenna port
6	PA_EN	Power Amplifier Enable. On/Off control for the Tx path power amplifier	14	GND	Ground
7	GND	Ground	15	VRX	Switch control receive path
8	TX	5 GHz RF transmit input port	16	LNA_EN	LNA Enable. On/Off control for the Rx path low noise amplifier

ELECTRICAL CHARACTERISTICS

Table 2: Absolute Minimum and Maximum Ratings

PARAMETER	MIN	MAX	UNIT	COMMENTS
DC Power Supply	-	+6.0	V	
RF Input Level, 5 GHz PA	-	+5	dBm	Modulated
Operating Ambient Temperature	-40	+85	°C	
Storage Temperature	-55	+125	°C	
Storage Humidity	-	60	%	
Junction Temperature	-	150	°C	
ESD Tolerance	1000	-	V	Human body model (HBM)
MSL Rating	MSL-1	-		

Functional operation to the specified performance is not implied under these conditions. Operation of any single parameter in excess of the absolute ratings may cause permanent damage. No damage occurs if one parameter is set at the limit while all other parameters are set within normal operating ranges.

Table 3: Operating Ranges

PARAMETER	MIN	TYP	MAX	UNIT	COMMENTS
Operating Frequency Ranges	4900	-	5875	MHz	802.11a/n
DC Power Supply Voltage (V_{CC})	+3.0	+3.6	+4.8	V	With RF applied
Control Pin Voltage (PA_EN, LNA_EN, VRX)	+2.8 0	+3.2 0	+4.8 +0.4	V	Logic High/On Logic Low/Off
Operating Temperature	-40	-	+85	°C	

The device may be operated safely over these conditions; however, parametric performance is guaranteed only over the conditions defined in the electrical specifications.

Table 4: Electrical Specifications - 5GHx TX Mode
(TC = +25°C, VCC = +3.6V, PA_EN = +3.2V, VRX = 0.0V, LNA_EN = 0.0V) 64 QAM OFDM 54 Mbps

PARAMETER	MIN	TYP	MAX	UNIT	COMMENTS
Operating Frequency	5150		5850	MHz	
Power Gain	25	27		dB	
Gain Flatness		+/-0.25		dB	
Error Vector Magnitude (EVM) (1)	-29	-32 180	225	dB mA	P_{OUT} = 18 dBm, Dyn Mode 54 Mbps data rate, Avg during packet
	-30	-33 155		dB mA	P_{OUT} = 16 dBm, Dyn Mode 54 Mbps data rate, Avg during packet
		-36 95		dB mA	P_{OUT} = 5 dBm, Dyn Mode 54 Mbps data rate, Avg during packet
Transmit Mask	Pass			N/A	OFDM, All rate, P_{OUT} = 18 dBm
PA Noise Figure		5		dB	
Input Return Loss		12		dB	
Output Return Loss		12		dB	
Output Spurious Levels - Harmonics 2 F0 3 F0 4 F0		 -30 -40 -60		 dBm/ MHz	 For Power levels up to 20 dBm OFDM 6 Mbps
Settling Time		0.5		uS	Within 0.5 dB of final value
Quiescent Current (Icq)		85	115	mA	

Notes:
(1) EVM includes system noise floor of 0.8% (-42 dB).

Table 5: Electrical Specifications - 5GHz TX Mode
(TC = +25°C, VCC = +3.6V, PA_EN = +3.2V, VRX = 0.0V, LNA_EN = 0.0V) 802.11n

PARAMETER	MIN	TYP	MAX	UNIT	COMMENTS
Operating Frequency	5150		5850	MHz	
Error Vector Magnitude (EVM)		-33 175		dB mA	P_{OUT} = 18 dBm, MCS7 - HT20
		-33 165		dB mA	P_{OUT} = 17 dBm, MCS7 - HT40
Transmit Mask	Pass			N/A	802.11n MCS7, HT20 - HT40 at respective power levels noted above

Table 6: Electrical Specifications - 5GHz TX Mode Power Detector
(TC = +25°C, VCC = +3.6V, PA_EN = +3.2V, VRX = 0.0V, LNA_EN = 0.0V)

PARAMETER	MIN	TYP	MAX	UNIT	COMMENTS
Detector Voltage	720 740 750	800 840 875	920 940 950	mV	P_{OUT} = +18 dBm, 54 Mbps, 5170 MHz P_{OUT} = +18 dBm, 54 Mbps, 5500 MHz P_{OUT} = +18 dBm, 54 Mbps, 5825 MHz
Total Internal Load Impedance		3.3		kΩ	
Load Accuracy		+/-0.5		dB	Output Power variation at 3:1 VSWR all phases
Detector Directivity		19		dB	Output Power variation at 3:1 VSWR all phases

Table 7: Electrical Specification - 5GHx RX LNA Mode
(TC = +25°C, VCC = +3.6V, LNA_EN = +3.2V, VRX = +3.2V, PA_EN = 0.0V)

PARAMETER	MIN	TYP	MAX	UNIT	COMMENTS
Operating Frequency	5150		5850	MHz	
Gain - LNA Mode	10	12		dB	
Gain Flatness		+/-0.25		dB	Across any 40 MHz band
Rx Noise Figure		2.7		dB	
Input Return Loss		8		dB	
Output Return Loss		12		dB	
IIP3		0		dBm	
Settling Time		0.7		uS	Within 0.5 dB of final value
Rx Current		9	14	mA	

Table 8: Electrical Specification - 5GHx RX Bypass Mode
(TC = +25°C, VCC = +3.6V, VRX = +3.2V, LNA_EN = 0.0V, PA_EN = 0.0V)

PARAMETER	MIN	TYP	MAX	UNIT	COMMENTS
Operating Frequency	5150		5850	MHz	
Gain - RX Bypass Mode		-5		dB	
Gain Flatness		+/-0.25		dB	Across any 40 MHz band
Input Return Loss		15		dB	
Output Return Loss		8		dB	
IIP3		+20		dBm	
Settling Time		0.5		uS	Within 0.5 dB of final value

Table 9: Electrical Specifications - Switch and Control Pin
(TC = +25°C, VCC = +3.6V, Vcontrol High = +3.2V, Vcontrol Low = 0.0V)

PARAMETER	MIN	TYP	MAX	UNIT	COMMENTS
Control Pin Steady State Input Current (PA_EN)		10 0.5		uA uA	Logic Hi/On Logic Low/OFF
Control Pin Steady State Input Current (VRX)		10 0.5		uA uA	Logic Hi/On Logic Low/OFF
Control Pin Steady State Input Current (LNA_EN)		630 0.5		uA uA	Logic Hi/On Logic Low/OFF
Leakage Current		6	14	uA	Total from all bias Pins, Controls in OFF mode Vcc = 3.6V
TX-RX Isolation		20		dB	

Table 10: Switch Modes of Operation

Mode of Operation	PA_EN	LNA_EN	VRX
TX Mode	**HIGH**	LOW	LOW
RX LNA Mode	LOW	**HIGH**	**HIGH**
RX Bypass Mode	LOW	LOW	**HIGH**
Power on Reset	LOW	LOW	LOW

V_{CC} = +3.0 V to +4.8 V; Logic State LOW = 0 V to +0.5 V;
Logic State HIGH = +2.8 V to +4.8 V

54 Mbps PERFORMANCE DATA

Figure 3: EVM and Icc vs. Output Power Across Frequency (Vcc = +3.3V, Tc = +25°C)

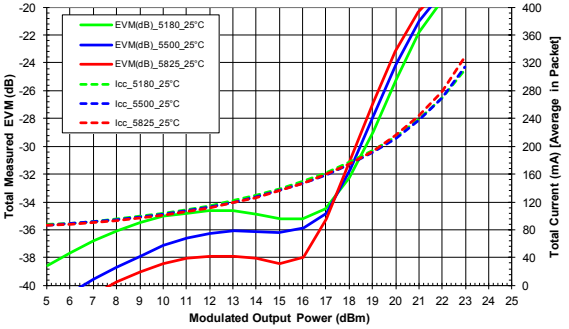


Figure 4: EVM and Icc vs. Output Power Across Frequency (Vcc = +3.6V, Tc = +25°C)

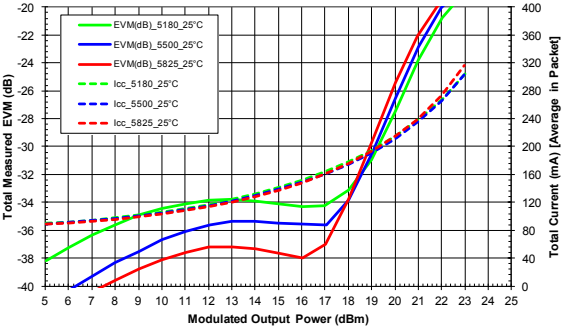


Figure 5: EVM and Icc vs. Output Power Across Temp (Frequency = 5.5 GHz, Vcc = +3.6V)

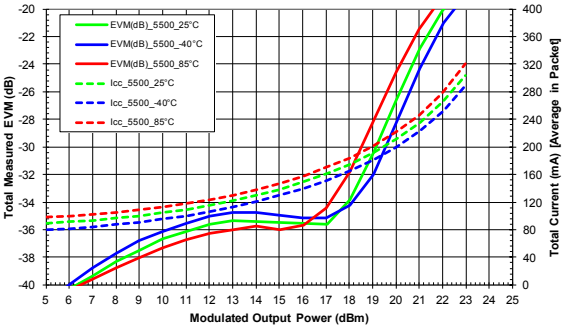


Figure 6: Gain vs. Output Power Across Frequency (Vcc = +3.6V, Tc = +25°C)

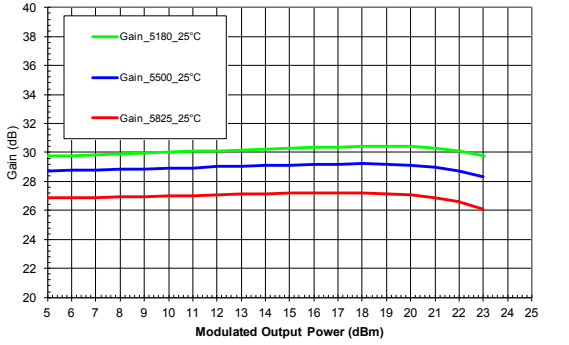


Figure 7: Gain vs. Output Power Across Voltage (Frequency = 5.18 GHz, Tc = +25°C)

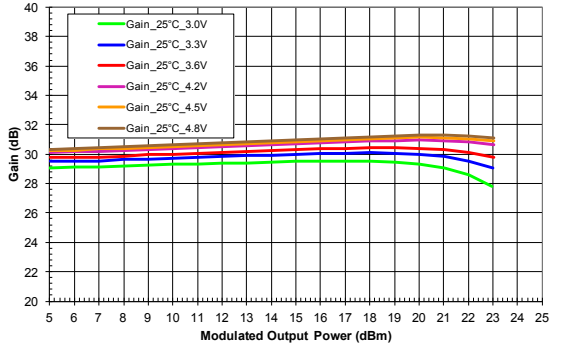


Figure 8: Gain vs. Output Power Across Voltage (Frequency = 5.5 GHz, Tc = +25°C)

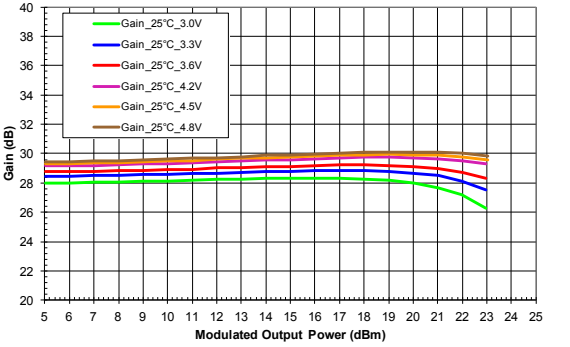


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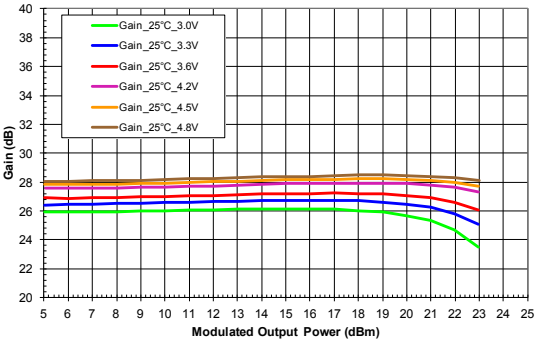
Figure 9: Gain vs. Output Power Across Voltage (Frequency = 5.825 GHz, Tc = +25°C)



MCS7-HT20 PERFORMANCE DATA

Figure 10: EVM and Icc vs. Output Power Across Frequency (Vcc = +3.3V, Tc = +25°C)

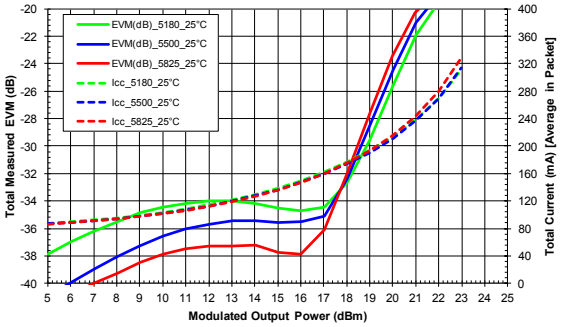


Figure 11: EVM and Icc vs. Output Power Across Frequency (Vcc = +3.6V, Tc = +25°C)

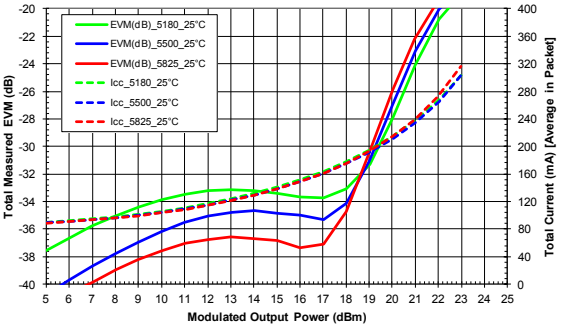


Figure 12: EVM and Icc vs. Output Power Across Temp (Frequency = 5.51 GHz, Vcc = +3.6V)

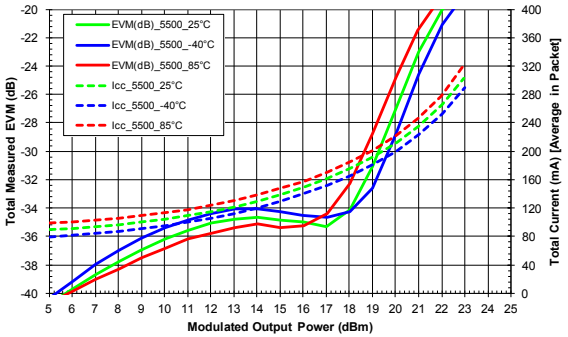


Figure 13: Gain vs. Output Power Across Frequency (Vcc = +3.6V, Tc = +25°C)

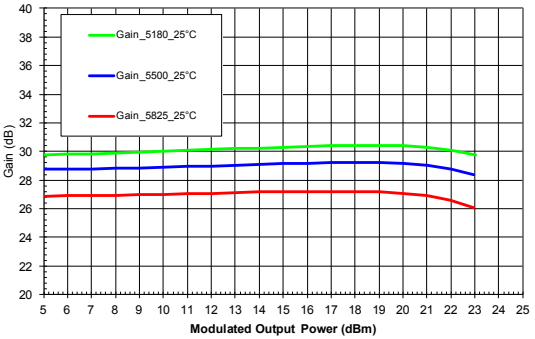


Figure 14: Gain vs. Output Power Across Voltage (Frequency = 5.18 GHz, Tc = +25°C)

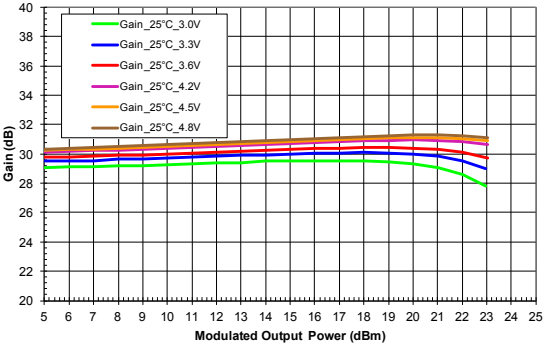
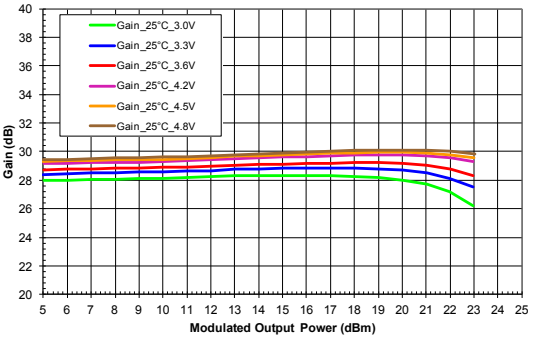
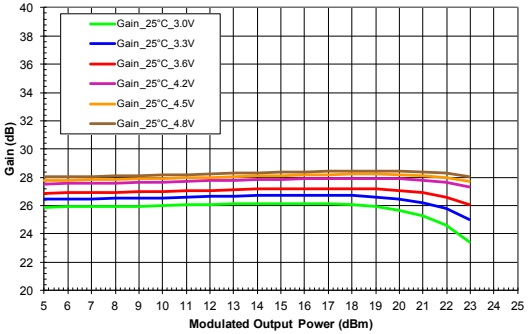


Figure 15: Gain vs. Output Power Across Voltage (Frequency = 5.5 GHz, Tc = +25°C)



MCS7-HT20 PERFORMANCE DATA

Figure 16: Gain vs. Output Power Across Voltage (Frequency = 5.825 GHz, Tc = +25°C)



MCS7-HT40 PERFORMANCE DATA

Figure 17: EVM and Icc vs. Output Power Across Frequency (Vcc = +3.3V, Tc = +25°C)

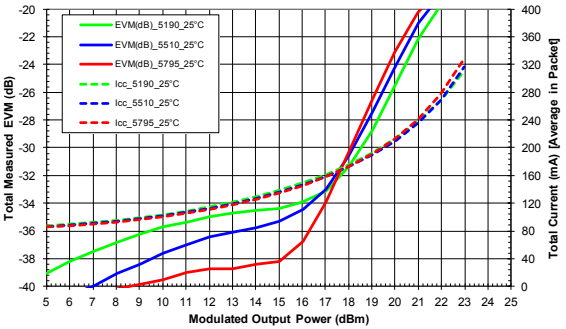


Figure 18: EVM and Icc vs. Output Power Across Frequency (Vcc = +3.6V, Tc = +25°C)

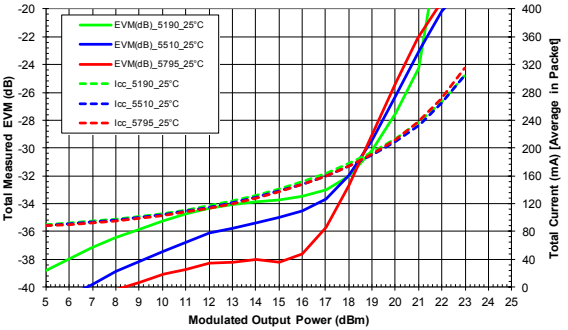


Figure 19: EVM and Icc vs. Output Power Across Temp (Frequency = 5.51 GHz, Vcc = +3.6V)

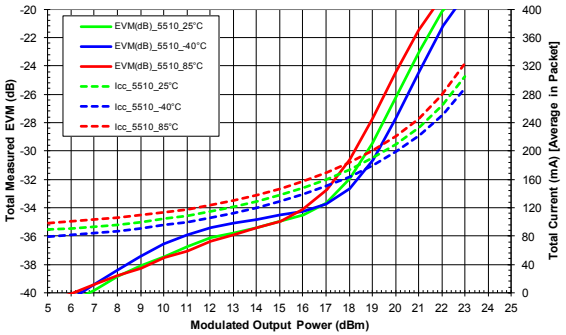


Figure 20: Gain vs. Output Power Across Frequency (Vcc = +3.6V, Tc = +25°C)

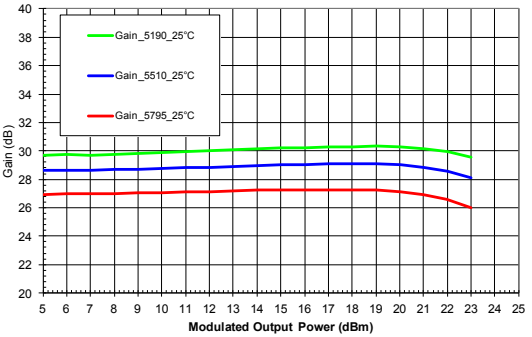


Figure 21: Gain vs. Output Power Across Voltage (Frequency = 5.19 GHz, Tc = +25°C)

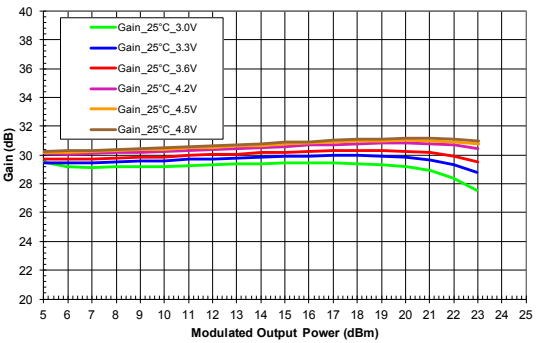


Figure 22: Gain vs. Output Power Across Voltage (Frequency = 5.51 GHz, Tc = +25°C)

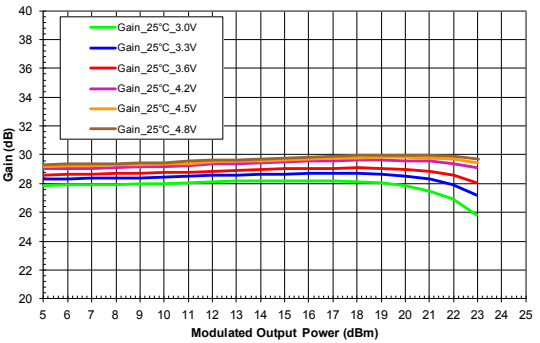


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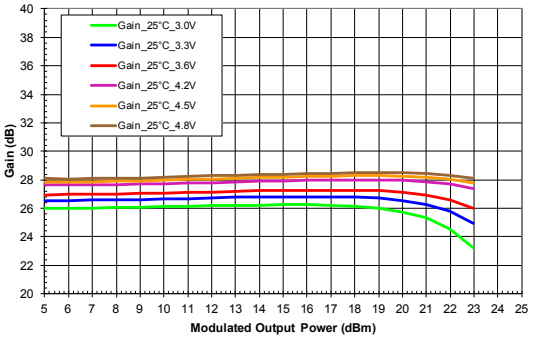
Figure 23: Gain vs. Output Power Across Voltage (Frequency = 5.795 GHz, Tc = +25°C)



RX PERFORMANCE DATA

Figure 24: LNA Gain vs. Frequency Across Voltage (Temp = +25°C)

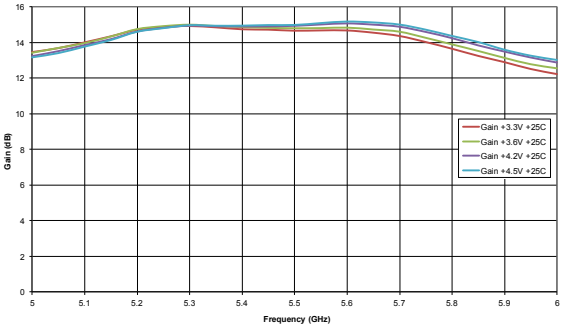
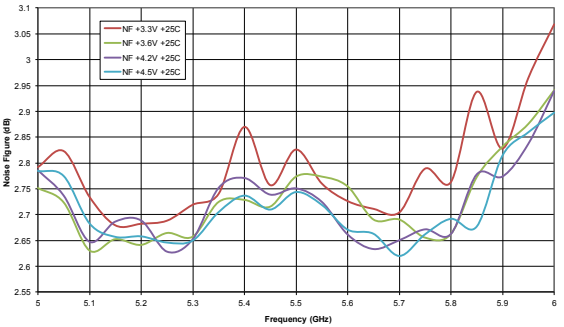


Figure 25: LNA NF vs. Frequency Across Voltage (Temp = +25°C)



APPLICATION Schematic

Although not shown in the schematic, a large value capacitor (~ 10 uF) should be connected to the voltage supply lines for low frequency decoupling.

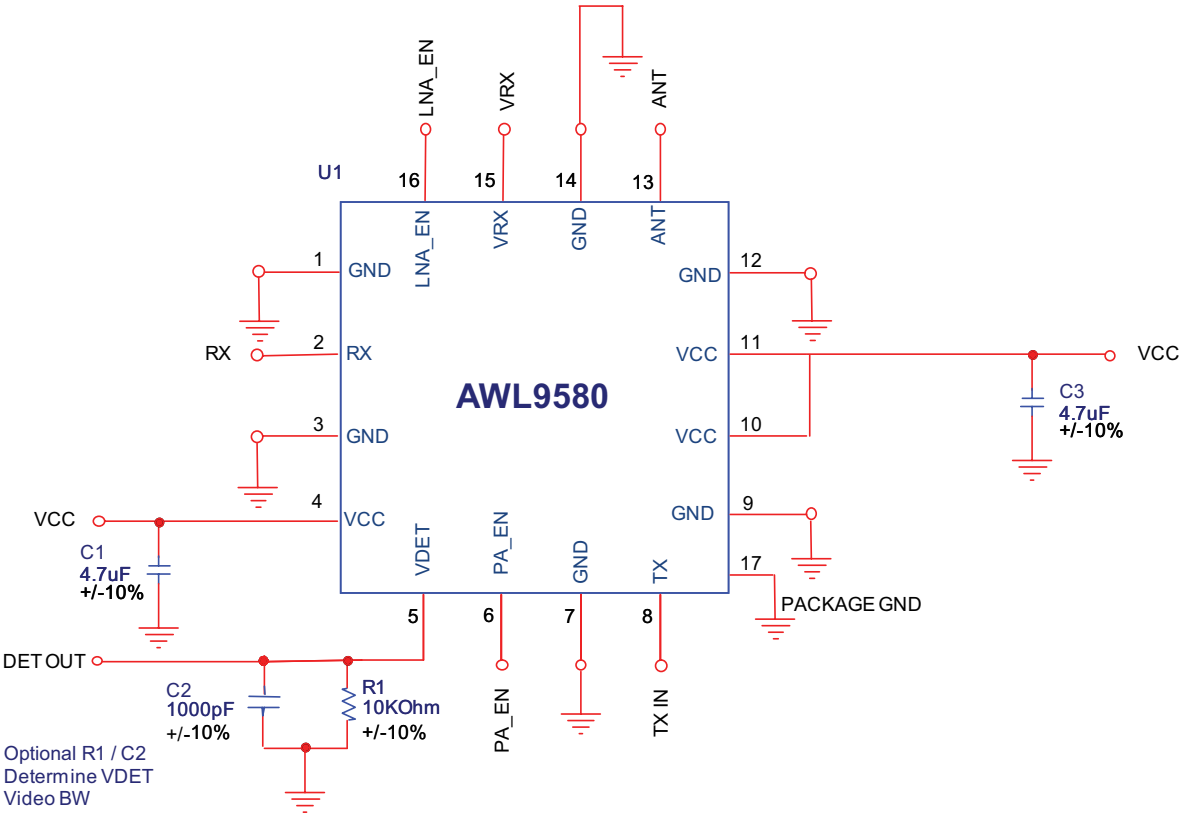
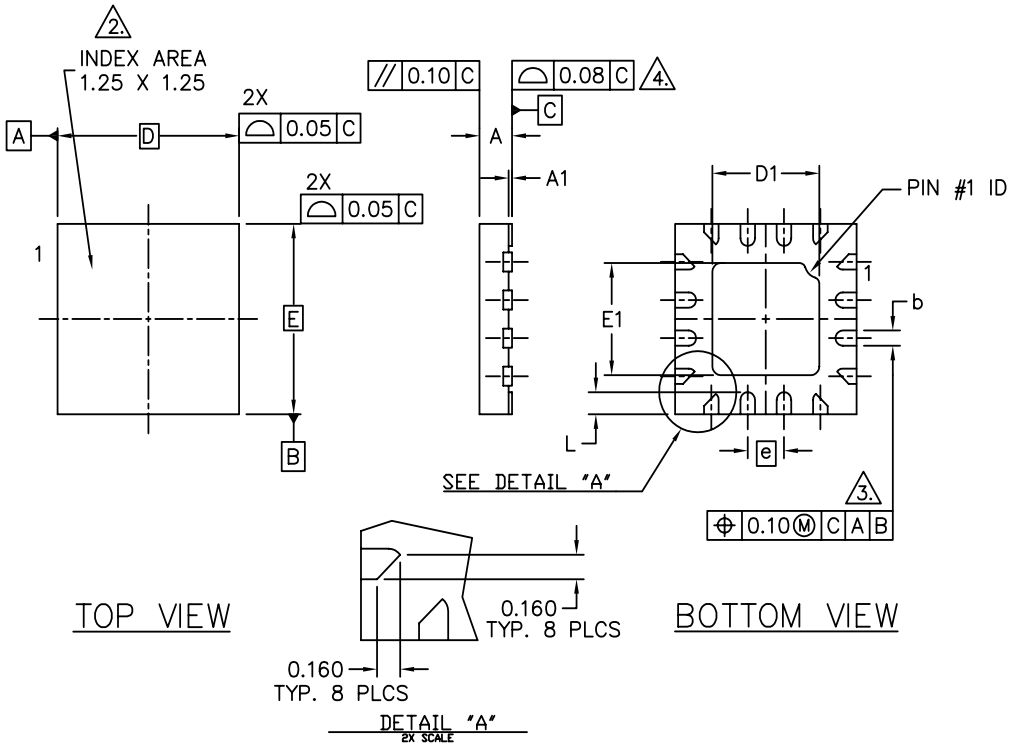


Figure 26: Recommended Application Schematic



SYMBOL	DIMENSIONS–MM MIN.	NOM.	MAX.	NOTE	SYMBOL	DIMENSIONS–INCHES MIN.	NOM.	MAX.	NOTE
A	–	–	0.40		A			0.016	
A1	0.00	0.02	0.05		A1	0.000	0.001	0.002	
b	0.15	0.20	0.25		b	0.006	0.008	0.010	
D		2.50 BSC			D		0.098 BSC		
D1	1.32	1.47	1.57		D1	0.052	0.058	0.062	
E		2.50 BSC			E		0.098 BSC		
E1	1.32	1.47	1.57		E1	0.052	0.058	0.062	
e		0.50 BSC			e		0.020 BSC		
L	0.19	0.29	0.39		L	0.0075	0.011	0.015	

NOTES :

1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. TERMINAL #1 IDENTIFIER AND PAD NUMBERING CONVENTION SHALL CONFORM TO JESD 95–1 SPP–012.
3. DIMENSION b APPLIES TO METALLIZED TERMINAL AND IS MEASURED BETWEEN 0.10 AND 0.15mm FROM TERMINAL TIP.
4. BILATERAL COPLANARITY ZONE APPLIES TO THE EXPOSED PAD AS WELL AS THE TERMINALS.

Figure 27: Package Outline - 16 Pin, 2.5 x 2.5 x 0.40 mm QFN

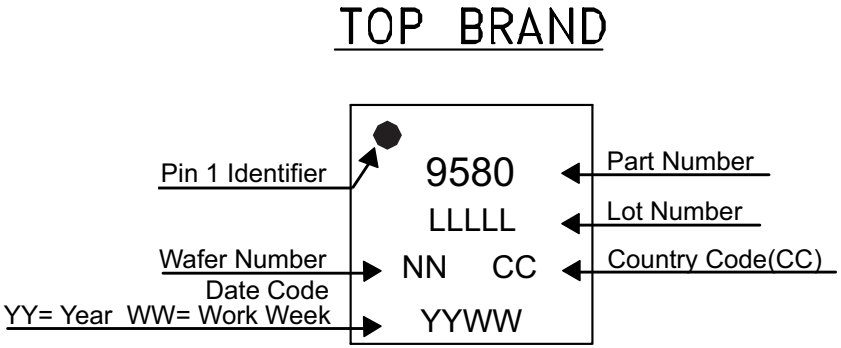
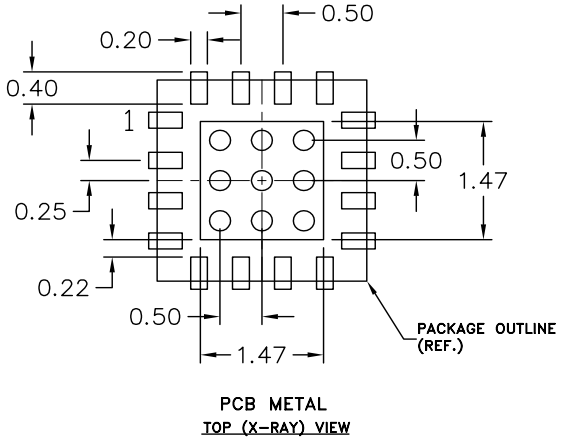


Figure 28: Branding Specification



PCB METAL
TOP (X-RAY) VIEW

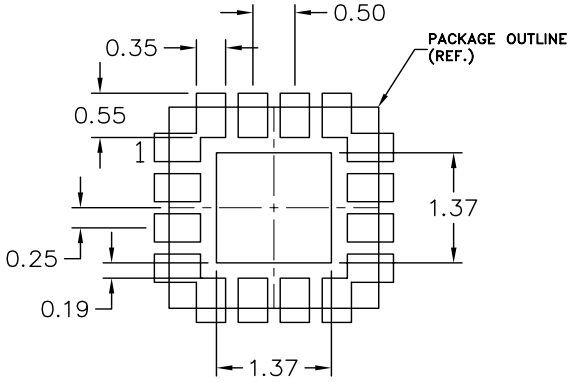
NOTES:
(1) OUTLINE DRAWING REFERENCE: P8002535

(2) UNLESS SPECIFIED DIMENSIONS ARE SYMMETRICAL ABOUT CENTER LINES SHOWN.

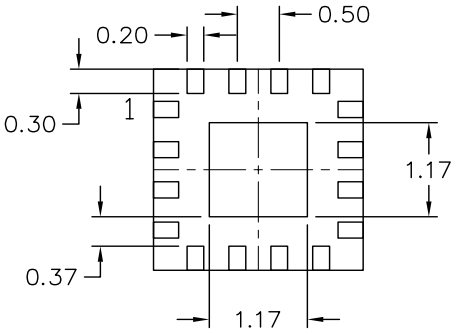
(3) DIMENSIONS IN MILLIMETERS.

(4) VIAS SHOWN IN PCB METAL VIEW ARE FOR REFERENCE ONLY. NUMBER & SIZE OF THERMAL VIAS REQUIRED DEPENDENT ON HEAT DISSIPATION REQUIREMENT AND THE PCB PROCESS CAPABILITY.

(5) RECOMMENDED STENCIL THICKNESS: APPROX. 0.125mm (5 Mils)



PCB SOLDER MASK
TOP (X-RAY) VIEW



STENCIL APERTURE
TOP (X-RAY) VIEW

Figure 29: Recommended PCB Layout

ORDERING INFORMATION

ORDER NUMBER	TEMPERATURE RANGE	PACKAGE DESCRIPTION	COMPONENT PACKAGING
AWL9580P7	-40 °C to +85 °C	16 pin, 2.5 x 2.5 x 0.40 mm Surface Mount Module	Bags
AWL9580P9	-40 °C to +85 °C	16 pin, 2.5 x 2.5 x 0.40 mm Surface Mount Module	Partial Reel
AWL9580Q7	-40 °C to +85 °C	16 pin, 2.5 x 2.5 x 0.40 mm Surface Mount Module	2500 piece T/R
EVB9580	-40 °C to +85 °C	Evaluation Board	Evaluation Board

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