

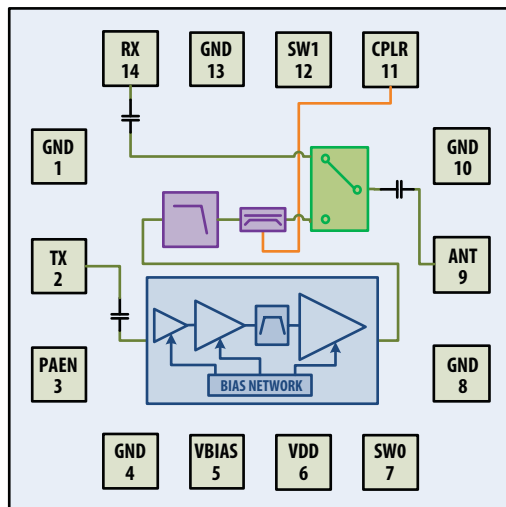
# Data Sheet

## Description

Avago Technologies AFEM-S105 WiFi FEM includes power amplifier, directional coupler, and SPDT antenna switch. It is designed for mobile and fixed wireless data applications in the 5.15 to 5.85 GHz frequency ranges. The PA is optimized for IEEE 802.11 a/n WiFi modulation. The PA exhibits flat gain and good match while providing linear power efficiency to meet stringent mask conditions. It utilizes Avago Technologies proprietary GaAs Enhancement-mode pHEMT technology for superior performance across voltage and temperature levels.

The AFEM-S105 is packaged in a 3.2 x 3.2 x 0.6 mm size for space-constrained applications.

## Functional Block Diagram (Top View)



**Attention: Observe precautions for handling electrostatic sensitive devices.**

ESD Machine Model = 50 V  
ESD Human Body Model = 450 V  
Refer to Avago Application Note A004R:  
*Electrostatic Discharge, Damage and Control.*

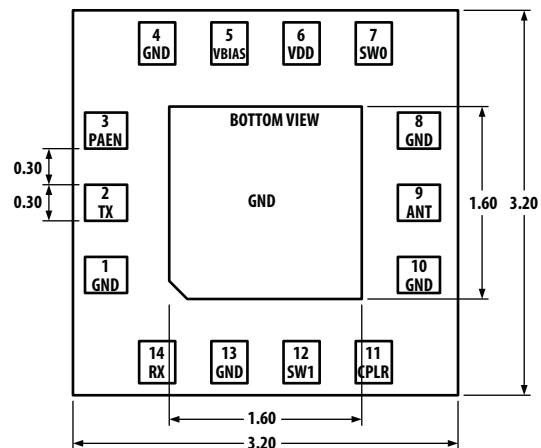
## Features

- 50 Ω all RF ports
- Integrated directional coupler, -17 dB coupling factor, > 14 dB directivity
- High Tx – Rx switch isolation
- 3 to 4.2 V supply
- Small size: 3.2 x 3.2 x 0.6 mm
- Stable under all loads or conditions
- Gain of 28 dB
- Meets 802.11a/n emission mask requirements @ 15 dBm
- Meets FCC 15.205 emission requirements @ 15 dBm
- EVM < -32.5 dB at 15dBm, < -35 dB at 12 dBm
- I<sub>dd</sub> < 105 mA @ 15 dBm P<sub>out</sub>
- PAE(PA) > 21% @ P<sub>out</sub> (ANT) = 15 dBm
- Only 1 external component required

## Applications

- Portable WiFi applications
- WiFi Access points

## Package Diagram (Bottom View)



## ELECTRICAL SPECIFICATIONS

### Absolute Minimum and Maximum Ratings

**Table 1. Minimum and Maximum Ratings**

Parameter		Specifications			Unit	Comments
Description	Pin	Min.	Max.			
Supply Voltage	VCC		5.5		V	
Bias Supply	VBIAS		5.5		V	
PA enable	PAEN		4.5		V	
Switch Control	SW0, SW1		4.5		V	
RF Input Power	RFIN		15		dBm	
Channel Temperature			150		°C	
Storage Temperature		-65	150		°C	

**Table 2. Operating Range**

Parameter		Specifications			Unit	Comments
Description	Pin	Min.	Typical	Max.		
Supply Voltage	VCC	3.0	3.3	4.2	V	
Bias Supply	VBIAS	3.0	3.3	4.2	V	
				16	mA	
PA enable	PAEN	2.7	2.9	3.3	V	
				2.0	mA	
Switch Control	SW0	2.7	2.9	3.6	V	RX Mode
				200	μA	
	SW1	2.7	2.9	3.6	V	TX Mode
				200	μA	
RF Output Power	ANT		15		dBm	
Frequency Range		5.15		5.85	GHz	
Thermal Resistance, $\theta_{jc}$			29.8		°C/W	Channel to board
Case Temperature		-30		+85	°C	

## Electrical Specifications

All data measured on an Avago demo board at  $V_{dd} = 3.3\text{ V}$ ,  $T_c = 25^\circ\text{ C}$ ,  $50\ \Omega$  at all ports. Unless otherwise specified, all data is taken at 54 Mbps 64QAM modulated signal per IEEE 802.11a with 20 MHz BW at 5.15 – 5.85 GHz. For TX mode  $PAEN = SW1 = 2.9\text{ V}$ ,  $SW0 = 0\text{ V}$ . For RX mode  $SW0 = 2.9\text{ V}$ ,  $PAEN = SW1 = 0\text{ V}$ .

**Table 3. RF Electrical Characteristics**

Parameter	Performance			Unit	Comments
	Min.	Typical	Max.		
Input Return Loss		-15		dB	TX and RX ports
Antenna Switch Switching Time		100		nS	
<b>WiFi TX Path</b>					
Gain	25	28		dB	
Gain Variation over any 20 MHz		$\pm 0.25$		dB	
Mask compliant OFDM output power	15			dBm	.11a 64QAM
EVM		-32.5	-31.0	dB	Pout = 15 dBm
		-35			Pout = 12 dBm
Total DC Current		105	120	mA	Pout = 15 dBm
		85			Pout = 12 dBm
PAE @ PA output		21		%	Pout = 15 dBm
		14			Pout = 12 dBm
Harmonics		-43		dBm/MHz	Pout = 15 dBm
Coupler coupling factor		-17		dB	@ 5850 MHz
Coupler directivity		14		dB	
PA Turn-On Time		125		nS	
<b>WiFi Rx Path</b>					
Insertion Loss (In-Band)		1.3		dB	
Isolation ANT/RX in WiFi TX mode		28		dB	

**Table 4. Control Logic Truth Table**

Mode	SW0	SW1	PAEN
RX	1	0	0
TX	0	1	1
FEM OFF	0	0	0

## Selected Performance Plots

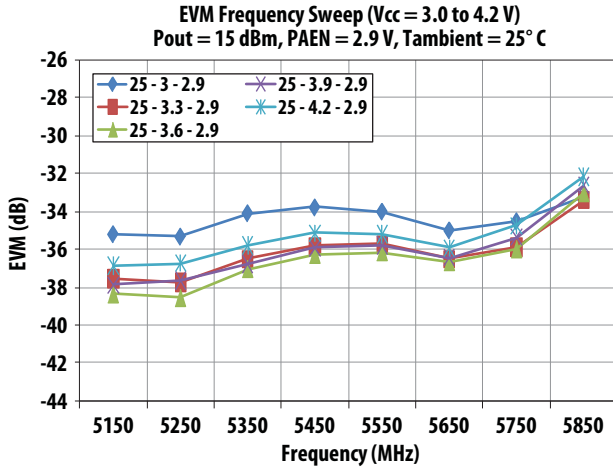


Figure 1. EVM Frequency Sweep at  $25^\circ$  C and  $P_{out} = 15$  dBm over  $V_{cc}$

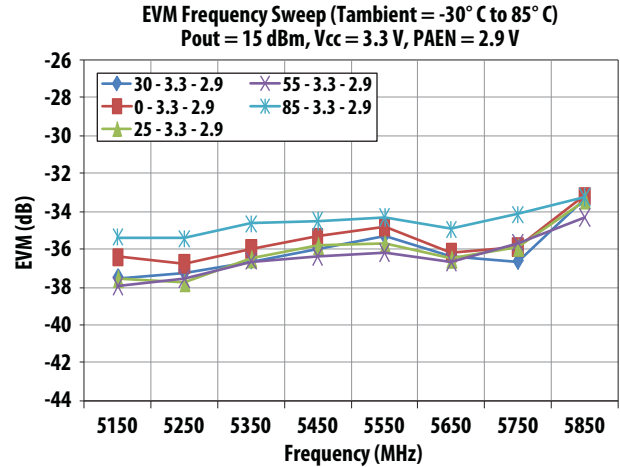


Figure 2. EVM Frequency Sweep at  $V_{cc} = 3.3$  V and  $P_{out} = 15$  dBm over  $T_{ambien}$

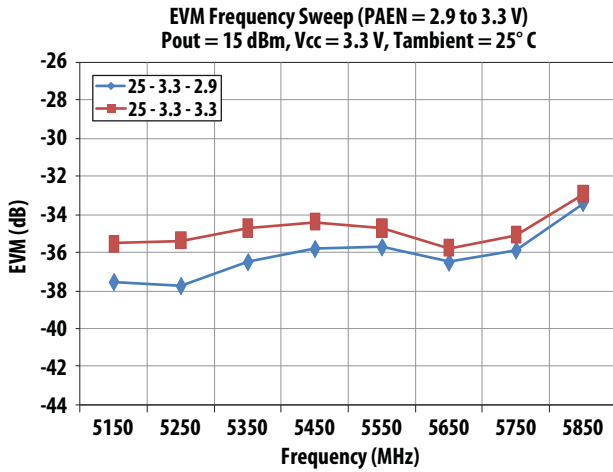


Figure 3. EVM Frequency Sweep at  $V_{cc} = 3.3$  V and  $P_{out} = 15$  dBm over  $PAEN$

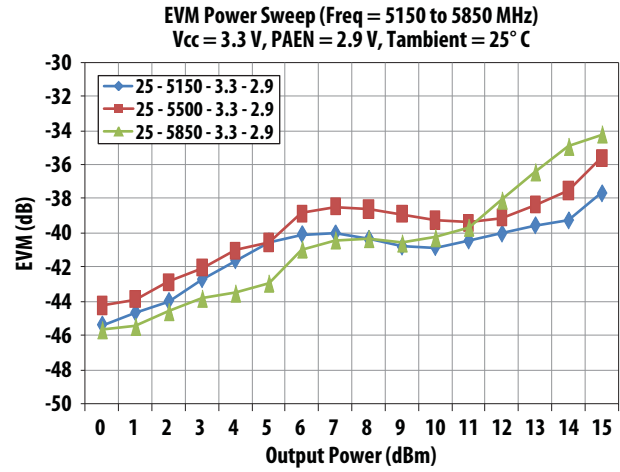


Figure 4. EVM Power Sweep at  $V_{cc} = 3.3$  V and  $25^\circ$  C over Frequency

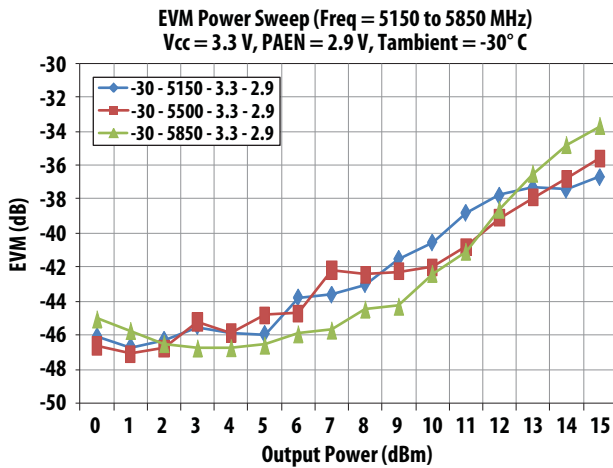


Figure 5. EVM Power Sweep at  $V_{cc} = 3.3$  V and  $-30^\circ$  C over Frequency

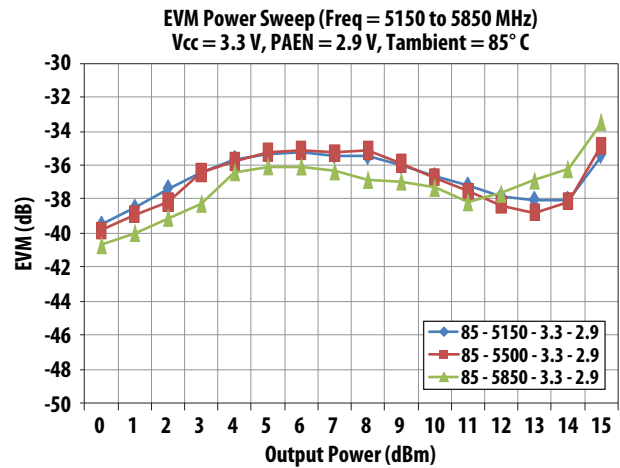


Figure 6. EVM Power Sweep at  $V_{cc} = 3.3$  V and  $85^\circ$  C over Frequency

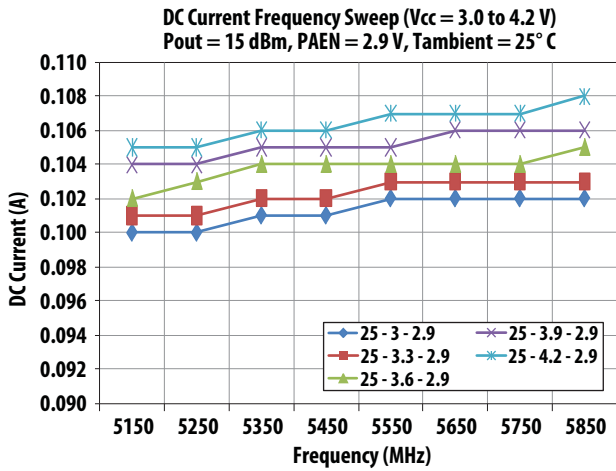


Figure 7. DC Current Frequency Sweep at 25° C and Pout = 15 dBm over Vcc

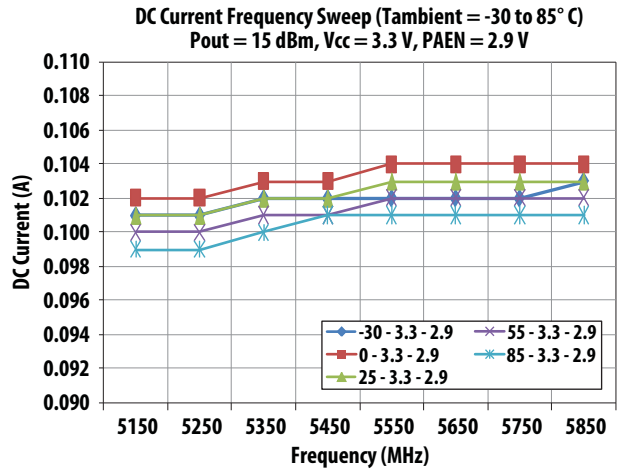


Figure 8. DC Current Frequency Sweep at Vcc = 3.3 V and Pout = 15 dBm over Tambient

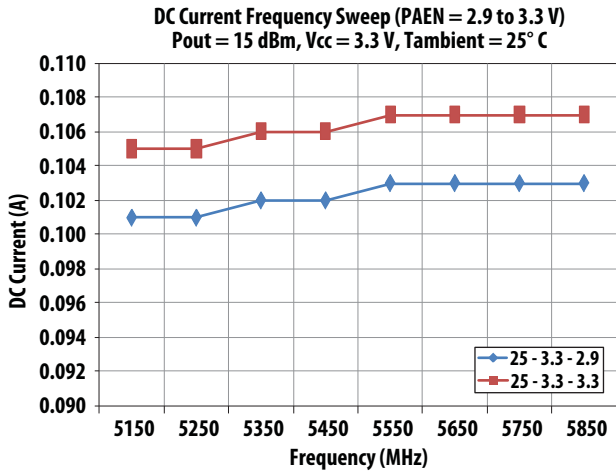


Figure 9. DC Current Frequency Sweep at Vcc = 3.3 V and Pout = 15 dBm over PAEN

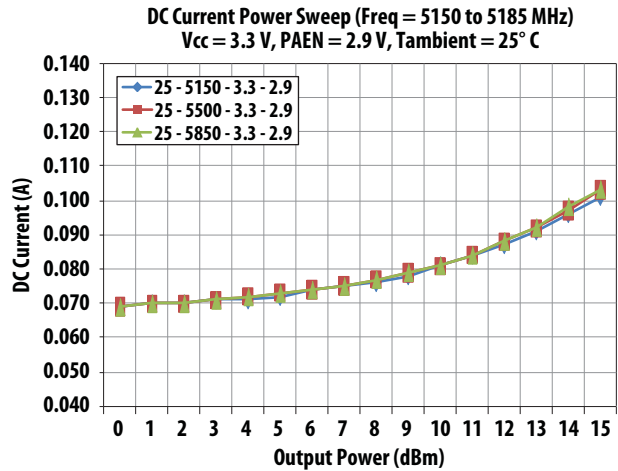


Figure 10. DC Current Power Sweep at Vcc = 3.3 V and 25° C over Frequency

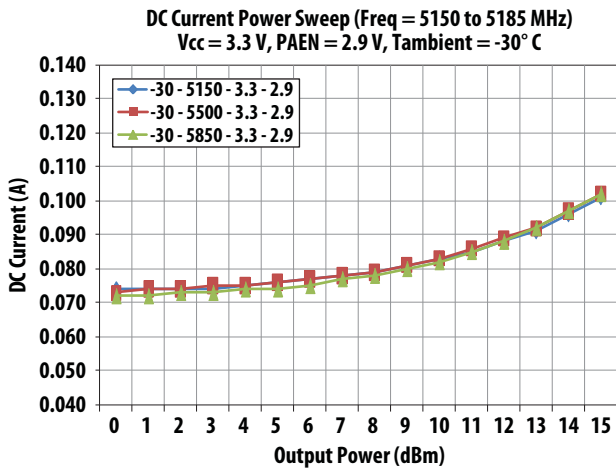


Figure 11. DC Current Power Sweep at Vcc = 3.3 V and -30° C over Frequency

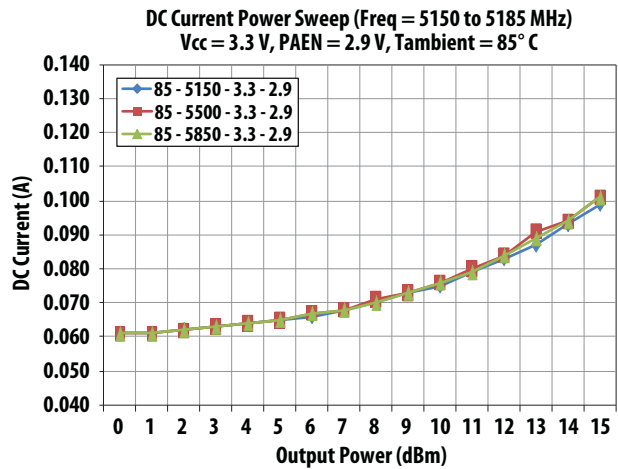


Figure 12. DC Current Power Sweep at Vcc = 3.3 V and 85° C over Frequency

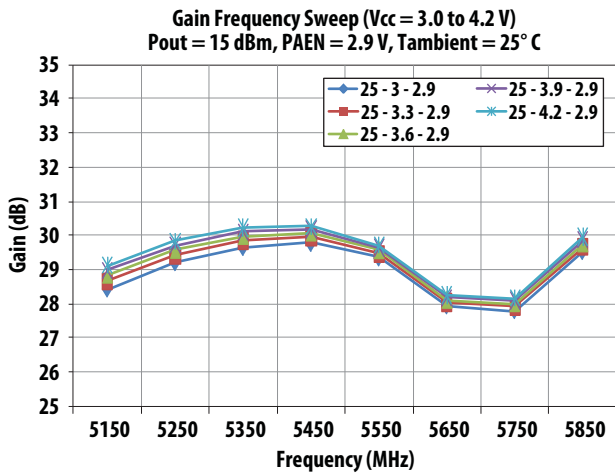


Figure 13. Gain Frequency Sweep at 25° C and  $P_{out} = 15$  dBm over  $V_{cc}$

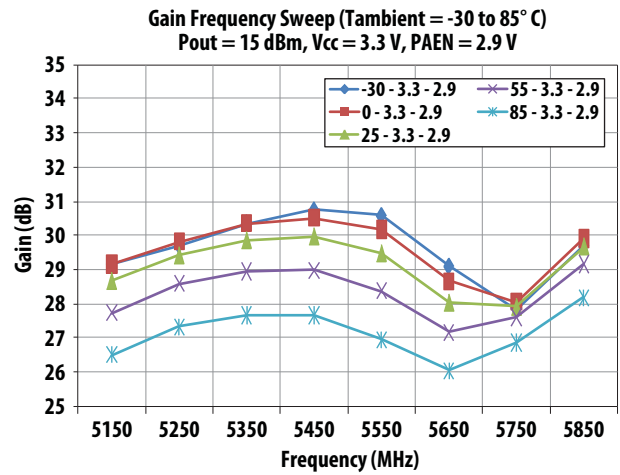


Figure 14. Gain Frequency Sweep at  $V_{cc} = 3.3$  V and  $P_{out} = 15$  dBm over Tambient

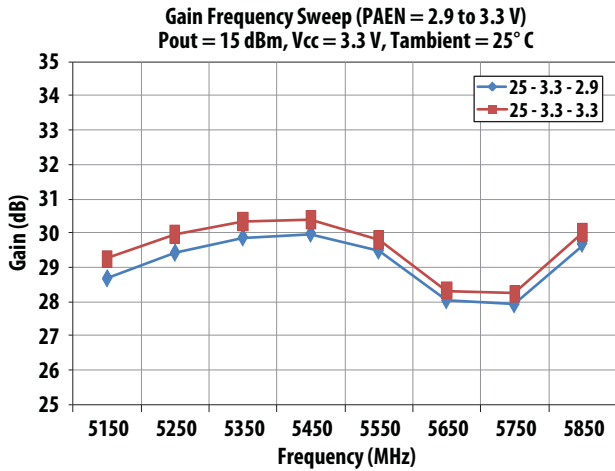


Figure 15. Gain Frequency Sweep at  $V_{cc} = 3.3$  V and  $P_{out} = 15$  dBm over PAEN

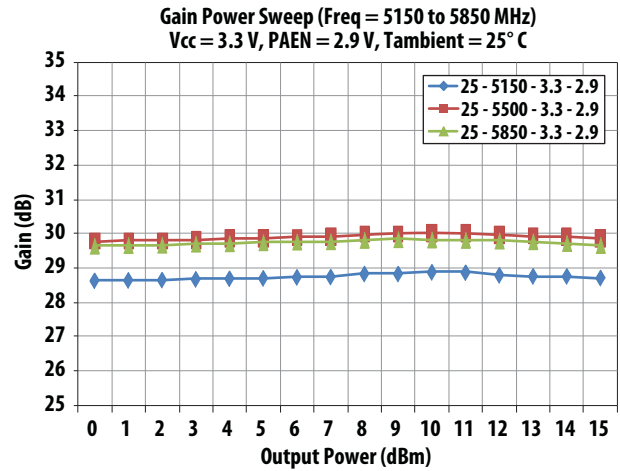


Figure 16. Gain Power Sweep at  $V_{cc} = 3.3$  V and 25° C over Frequency

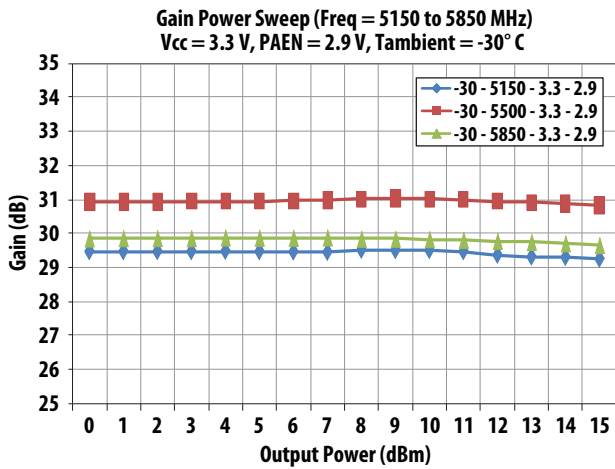


Figure 17. Gain Power Sweep at  $V_{cc} = 3.3$  V and -30° C over Frequency

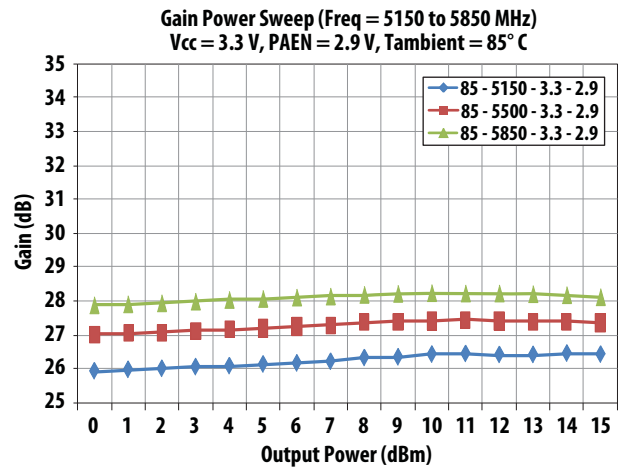


Figure 18. Gain Power Sweep at  $V_{cc} = 3.3$  V and 85° C over Frequency

## Evaluation Board Description

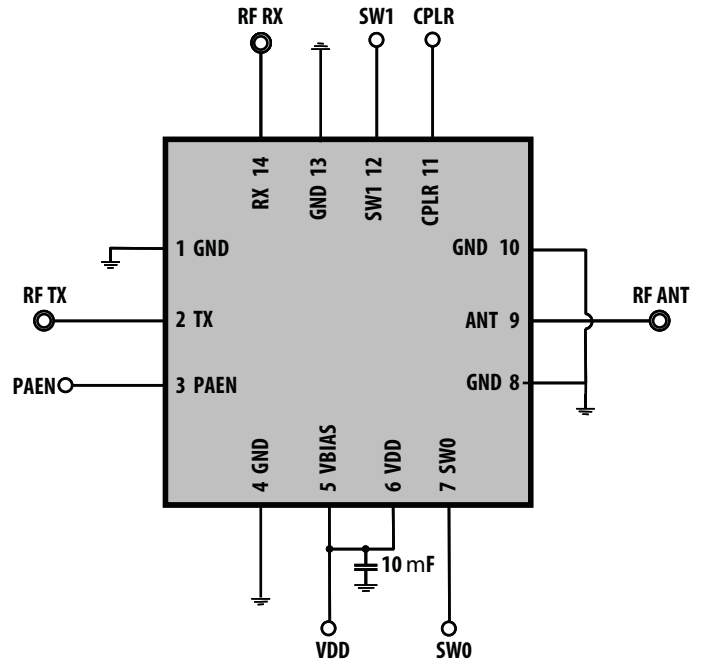
**Table 5. Pin Description:**

Top Pin No.	Function	Bottom Pin No.	Function
1	VDD	2	GND
3	VBIAS	4	GND
5	VREF	6	GND
7	PAEN	8	GND
9	SW0	10	GND
11	SW2	12	GND
13	SW1	14	GND

**Table 6. Typical Test Conditions:**

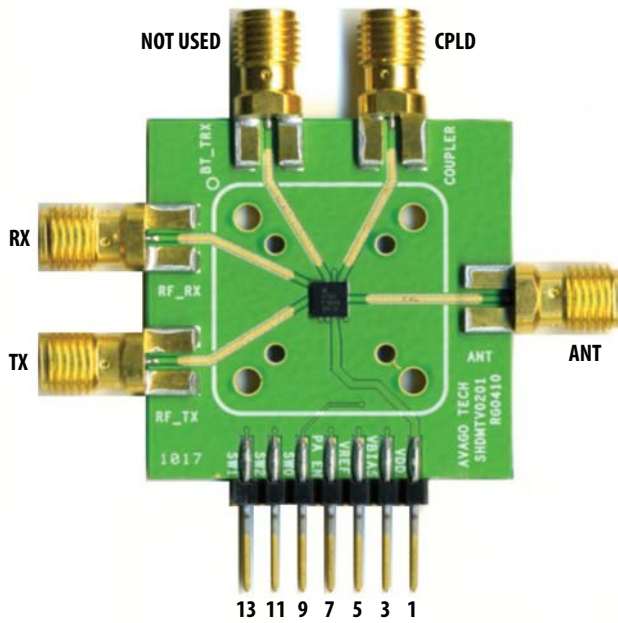
PIN	TX	RX	Description
VDD	3.3 V	3.3 V	Supply Voltage
VBIAS	3.3 V	3.3 V	Bias Supply
VREF	NA	NA	NOT USED
PAEN	2.9 V	0 V	PA Enable
SW0	0 V	2.9 V	Switch Control
SW2	2.9 V	0 V	Switch Control
SW1	NA	NA	NOT USED

## Application Circuit

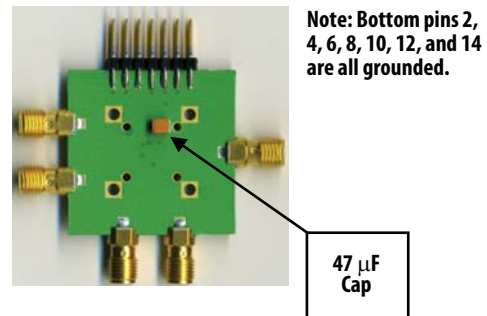


**Note: Only one bypass cap on VDD is required**

## Demoboard Top Pins



## Demoboard Bottom Pins



## Ordering Information

Part Number	No. of Devices	Container
AFEM-S105-TR1G	3000	13" Reel
AFEM-S105-BLKG	100	Antistatic Bag

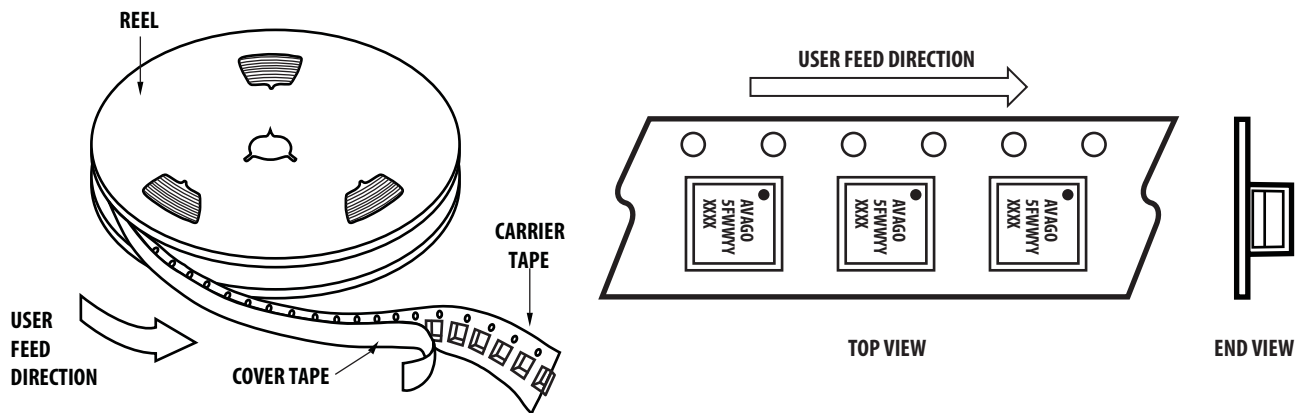
## Marking Specification



Note: Package marking provides Orientation and Identification

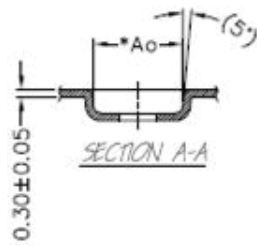
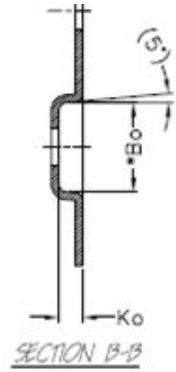
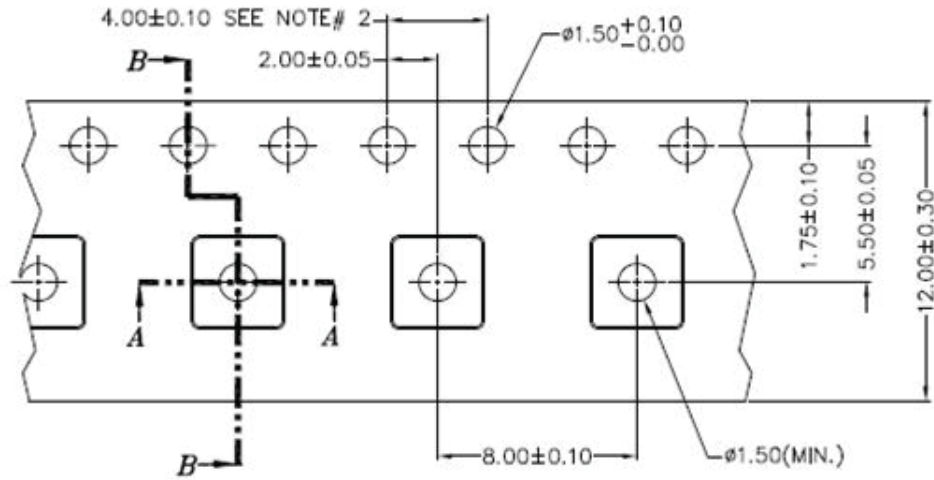
- "5" = Device Code
- "F" = Manufacturing code
- "WW" = Build of Work Week
- "YY" = Build of Year
- "XXXX" = Last 4 Digits of Assembly Lot Number

## Device Orientation & Pin 1 Location In Tape





## Tape Dimensions

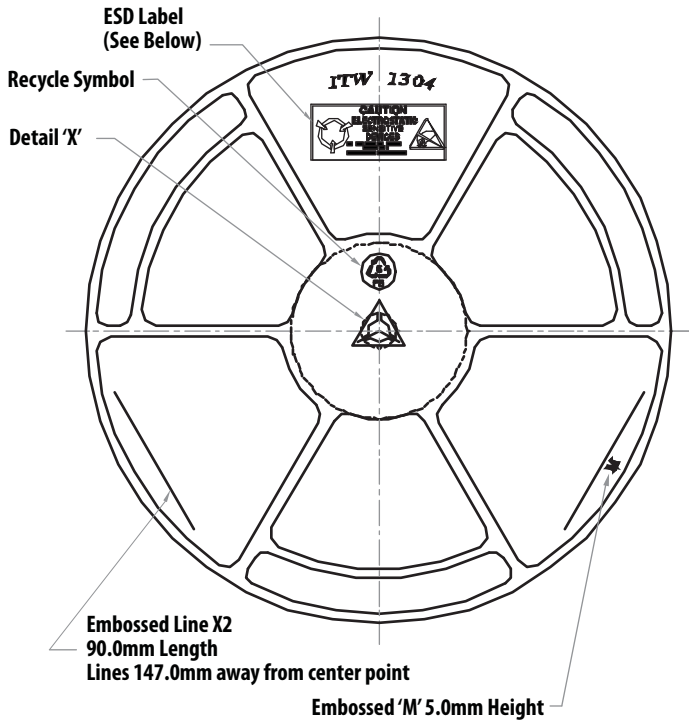


Ao:	3.60
Bo:	3.60
Ko:	0.95
Pitch:	8.00
Width:	12.00

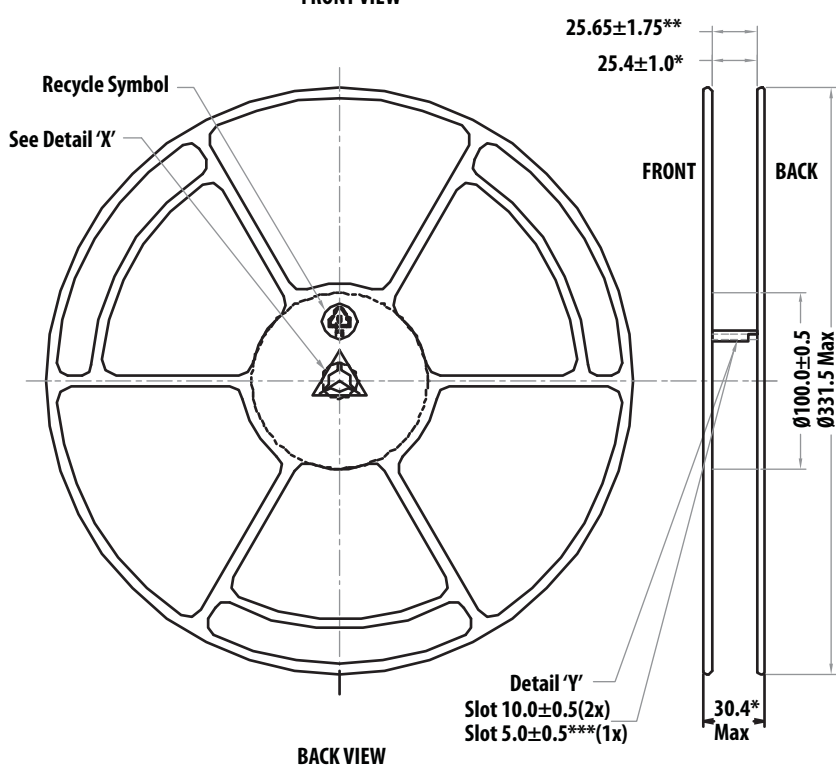
### Notes:

1. Ao & Bo measured at 0.3 mm above base of pocket.
2. 10 pitches cumulative tol. ±0.2 mm.
3. ( ) Reference dimensions only.

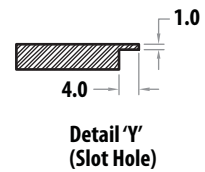
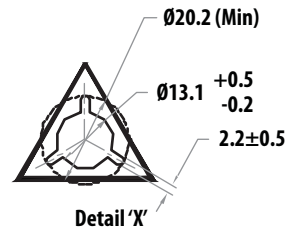
# Reel Dimensions (13 inch)



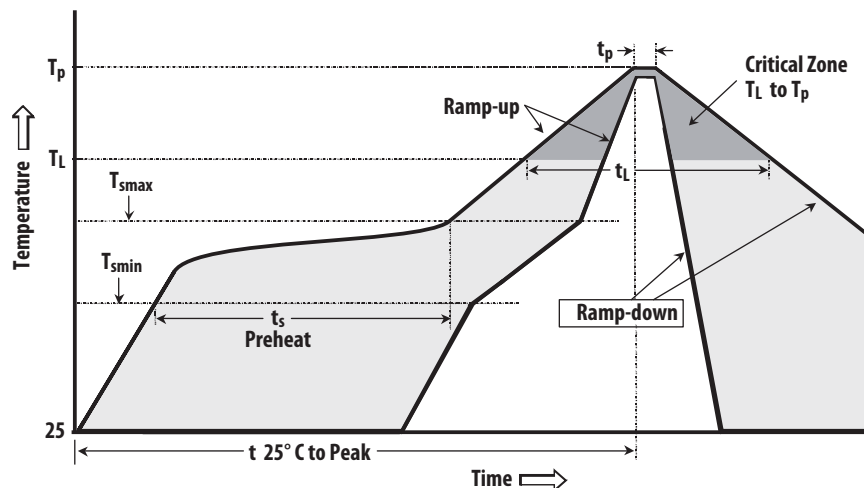
FRONT VIEW



BACK VIEW



## Reflow Profile Recommendations



### Typical SMT Reflow Profile for Maximum Temperature = $260 \pm 5^\circ \text{C}$

Profile Feature	Sn-Pb Solder	Pb-Free Solder
Average ramp-up rate (TL to TP)	3°C/sec max	3°C/sec max
Preheat		
– Temperature Min ( $T_{smin}$ )	100° C	150° C
– Temperature Max ( $T_{smax}$ )	150° C	200° C
– Time (min to max) ( $t_s$ )	60-120 sec	60-120 sec
$T_{smax}$ to TL		
– Ramp-up Rate		3°C/sec max
Time maintained above:		
– Temperature (TL)	183° C	217° C
– Time (TL)	60-150 sec	60-150 sec
Peak temperature ( $T_p$ )	240 $\pm 5^\circ \text{C}$	260 $\pm 5^\circ \text{C}$
Time within 5° C of actual Peak Temperature ( $t_p$ )	10-30 sec	20-40 sec
Ramp-down Rate	6°C/sec max	6°C/sec max
Time 25° C to Peak Temperature	6 min max.	8 min max.

For product information and a complete list of distributors, please go to our web site: [www.avagotech.com](http://www.avagotech.com)

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