ABA3130

50-1100 MHz Low Noise Amplifier/ Attenuator with Gain Control

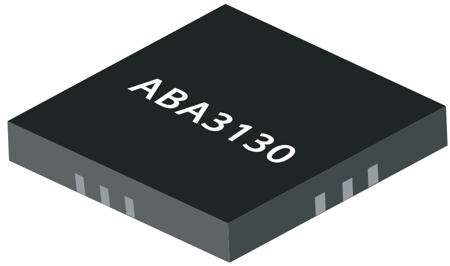
PRELIMINARY DATA SHEET

FEATURES

- -33 to +5 dB Gain (user adjustable)
- Accepts single-ended or differential inputs
- Differential output
- High Linearity, Low Distortion
- 37 dB of Gain Control Range
- Wideband Operation: to Above 1.1 GHz
- 4.5 dB Typical Noise Figure at 5 dB Gain
- Single +5 V Supply
- RoHS Compliant/Lead-Free Package
- 3 mm x 3 mm x 1 mm QFN Package

APPLICATIONS

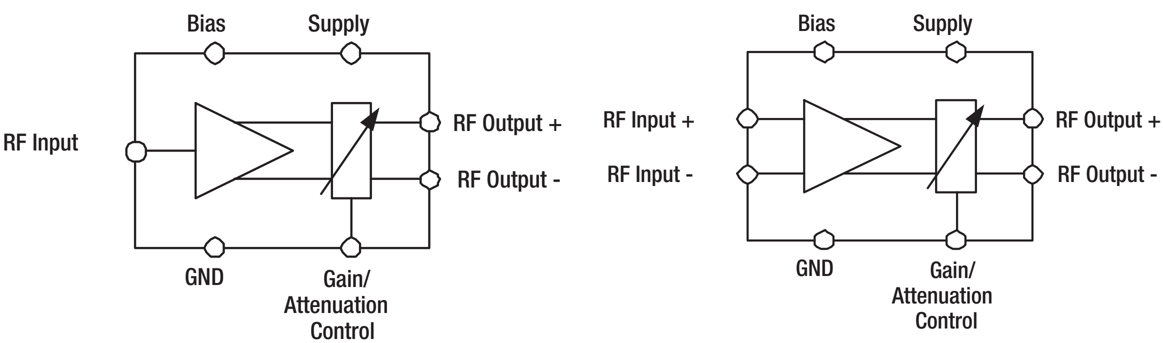
- CATV Digital Set Top Boxes
- Television Receiver Front-Ends
- Replacement for Passive Balun with Separate Gain Stage



S26 Package
12 Pin QFN
3 mm x 3 mm x 1 mm

PRODUCT DESCRIPTION

The ABA3130 is a low noise amplifier with gain control that accepts a single-ended or differential RF input in the 50 MHz to 1.1 GHz frequency range and provides a balanced RF output with minimal degradation in signal quality. This highly integrated device amplifies the input signal using a highly linear, low noise amplification stage. Alternately, it can be used as a signal attentuator using the appropriate gain/attenuation control voltage. The overall linearity is maintained across a wide gain control range, ensuring low distortion effects on the output signal. Requiring a single +5 V supply, the ABA3130 design is implemented using high-reliability GaAs MESFET process. The small, surface mount QFN packaging makes this device ideal for use in Cable TV set-top boxes, television receiver front-ends, and other low noise applications. The device is characterized for both 75 Ω and 50 Ω systems.



Single Ended Input (No balun required)

Differential Input

Figure 1: Functional Block Diagrams

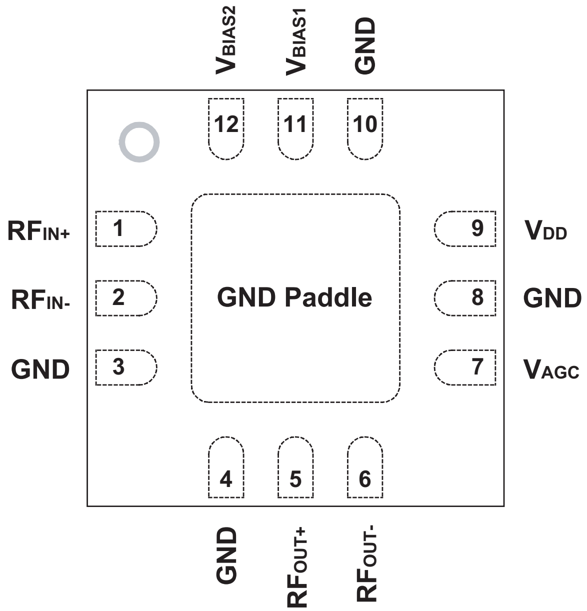


Figure 2: Pinout (X-ray Top View)

Table 1: Pin Description

PIN	NAME	DESCRIPTION
1	RF_{IN+}	RF Input (+)
2	RF_{IN-}	RF Input (-)
3	GND	Ground
4	GND	Ground
5	RF_{OUT+}	RF Output (+)
6	RF_{OUT-}	RF Output (-)
7	V_{AGC}	Gain/Attenuation Control
8	GND	Ground
9	V_{DD}	Supply Voltage
10	GND	Ground
11	V_{BIAS1}	Bias1 Voltage
12	V_{BIAS2}	Bias2 Voltage

ELECTRICAL CHARACTERISTICS

Table 2: Absolute Minimum and Maximum Ratings

PARAMETER	MIN	MAX	UNIT	COMMENTS
Supply Voltage (V_{CC})	0	+8	V	
AGC Input Voltage (V_{AGC})	0	+5	V	
RF Input Power (P_{IN})	-	+25	dBmV	

Stresses in excess of the absolute ratings may cause permanent damage. Functional operation is not implied under these conditions. Exposure to absolute ratings for extended periods of time may adversely affect reliability.

Table 3: Operating Ranges

PARAMETER	MIN	TYP	MAX	UNIT	COMMENTS
Operating Frequency (f)	50	-	1100	MHz	
Supply Voltage (V_{DD})	+3.3	+5.0	+5.5	V	
AGC Input Voltage (V_{AGC})	0	-	+5	V	
RF Input Power (P_{IN})	-15	-	+15	dBmV	
Case Temperature (T_C)	-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 - 75 Ω system
(T_C = +25 °C, V_{DD} = +5 V, I_{DD} = 80 mA)

PARAMETER	MIN	TYP	MAX	UNIT	COMMENTS
Gain at Maximum V_{AGC}	4	4.3	6	dB	at 55 MHz
Gain at Maximum V_{AGC}	2.8	-	-	dB	at 853 MHz
Gain at Minimum V_{AGC}	-41	-33	-30	dB	at 55 MHz
Gain Flatness	-	□1	-	dB	
AGC Input Voltage (V_{AGC})	0.3	-	3.0	V	Max. Gain at +3 V
Noise Figure at Maximum Gain	-	4.5	5	dB	V_{AGC} = +3 V
CTB (1)	-	-63	-50	dBc	
CSO (1)	-	-62	-48	dBc	
XMOD (1)	-	-63	-	dBc	
Reverse Isolation	-	-30	-	dB	
Input Return Loss	-13	-	-	dB	75 □ single-ended
Output Return Loss	-13	-	-	dB	75 □ differential
Supply Current (I_{DD})	50	80	100	mA	

Notes:
(1) 79 flat analog channels at +15 dBmV input power, plus 53 digital channels at +9 dBmV input power, and an output power of -7 dBmV.

Table 5: Electrical Specifications - 50 Ω system
(T_C = +25 °C, V_{DD} = +5 V, I_{DD} = 78 mA)

PARAMETER	MIN	TYP	MAX	UNIT	COMMENTS
Gain at Maximum V_{AGC}	-	4.2	-	dB	at 450 MHz
Gain at Minimum V_{AGC}	-	-34	-	dB	at 450 MHz
Gain Flatness	-	□1	-	dB	
AGC Input Voltage (V_{AGC})	0.3	-	3.0	V	Max. Gain at +3 V
Noise Figure at Maximum Gain	-	4.2	5.5	dB	V_{AGC} = +3.0 V
OIP3	- -	15.5 15.0	- -	dBm dBm	two tones: 510 and 511 MHz two tones: 860 and 861 MHz P_{OUT} per tone = -5 dBm
OIP2	- -	51.0 48.6	- -	dBm dBm	two tones: 222 and 228 MHz two tones: 427 and 433 MHz P_{OUT} per tone = -5 dBm
P1dB (Output power at 1dB compression)	-	8.3	-	dBm	at 450 MHz, V_{AGC} = 3.0 V

Notes:
(1) 50 Ω tests measured using Figure 18, but with C1= 0.5 pF and L3 = 5.6 nH.
(2) Tested with balun on output (see Figure 18).

PERFORMANCE DATA - 75 Ω System

Figure 3: Gain (S21) vs. Frequency (T_C = +25 °C, V_{DD} = +5 V)

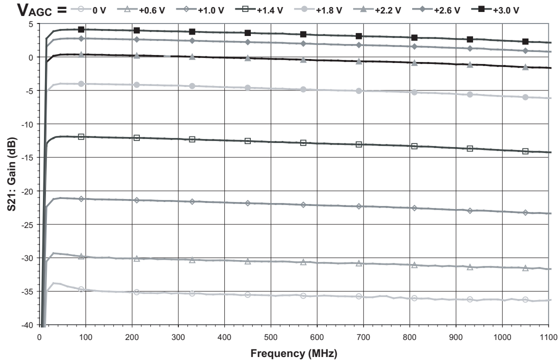


Figure 4: Input Return Loss (S11) vs. Frequency (T_C = +25 °C, V_{DD} = +5 V)

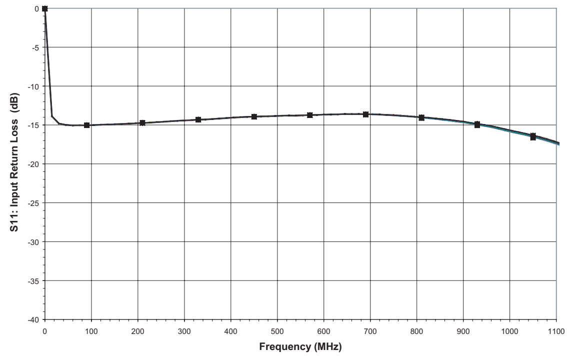


Figure 5: Reverse Isolation (S12) vs. Frequency (T_C = +25 °C, V_{DD} = +5 V, V_{AGC} = +3 V)

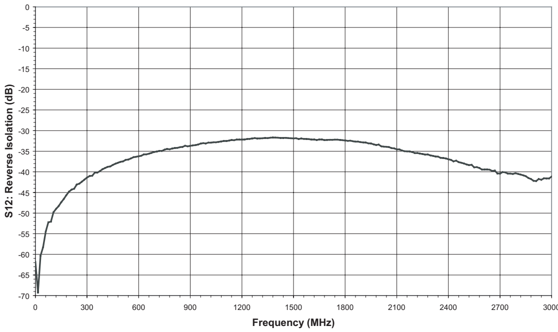


Figure 6: Output Return Loss (S22) vs. Frequency (T_C = +25 °C, V_{DD} = +5 V)

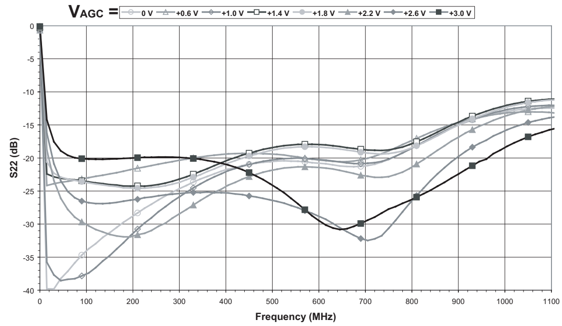


Figure 7: Noise Figure vs. Frequency (T_C = +25 °C, V_{DD} = +5 V, V_{AGC} = +3 V)

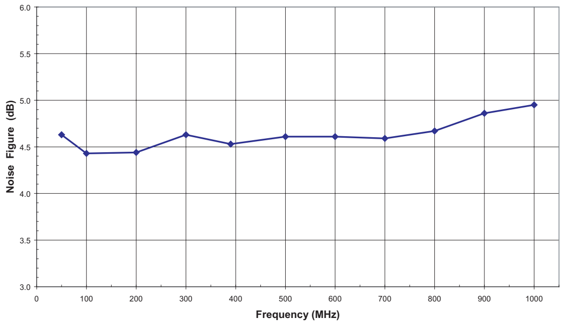


Figure 8: Gain vs. AGC Voltage (T_C = +25 °C, V_{DD} = +5 V, at 495 MHz)

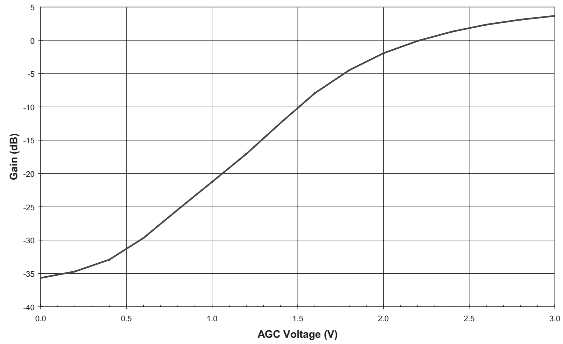


Figure 9: CTB vs. Frequency (T_C = +25 °C, V_{DD} = +5 V, 132 channels, +15 dBmV input, +6dBmV output)

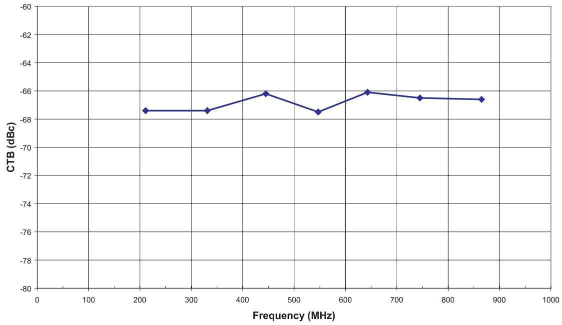


Figure 10 CSO vs. Frequency (T_C = +25 °C, V_{DD} = +5 V, 132 channels, +15 dBmV input, +6dBmV output)

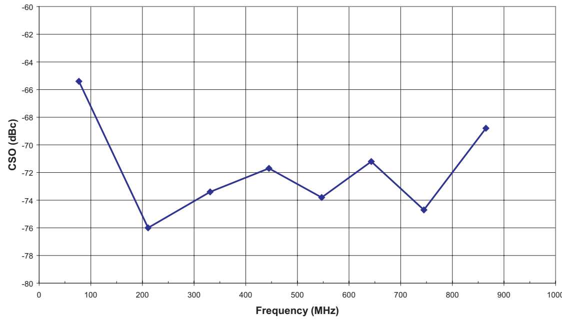


Figure 11: Gain Flatness at V_{AGC} = 0 V (T_C = +25 °C, V_{CC} = +5 V)

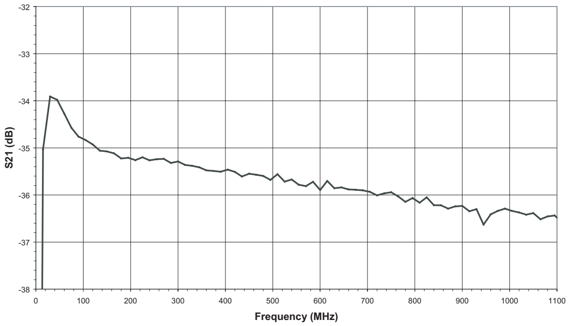
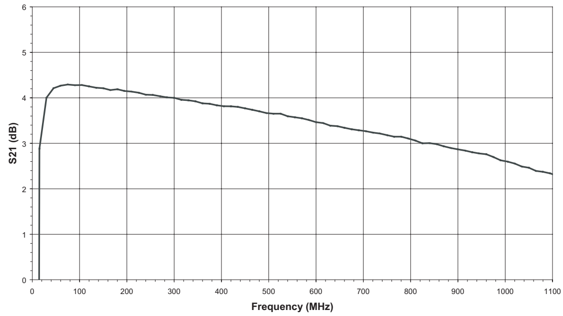


Figure 12: Gain Flatness at V_{AGC} = +3 V (T_C = +25 °C, V_{DD} = +5 V)



PERFORMANCE DATA - 50 Ω System

Figure 13: Gain (S21) vs. Frequency (T_C = +25 °C, V_{DD} = +5 V)

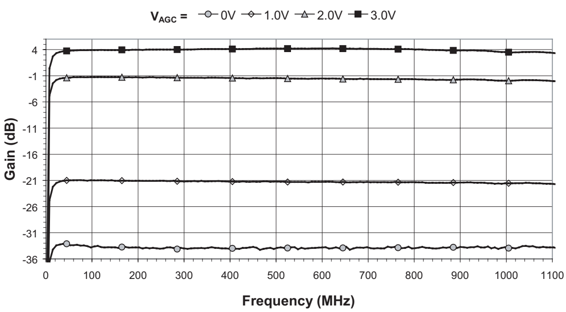


Figure 14: Input Return Loss (S11) vs. Frequency (T_C = +25 °C, V_{DD} = +5 V)

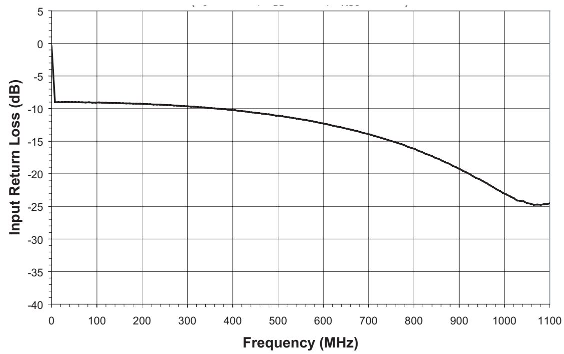


Figure 15: Reverse Isolation (S12) vs. Frequency (T_C = +25 °C, V_{DD} = +5 V, V_{AGC} = +3 V)

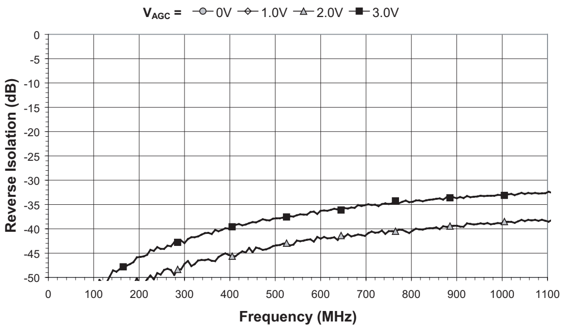


Figure 16: Output Return Loss (S22) vs. Frequency (T_C = +25 °C, V_{DD} = +5 V)

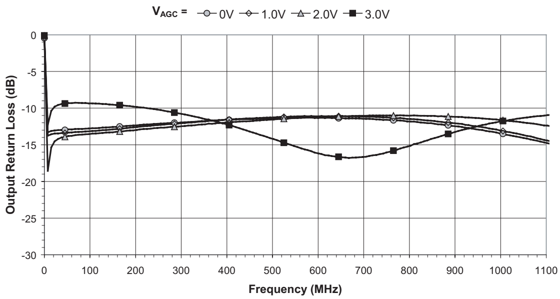
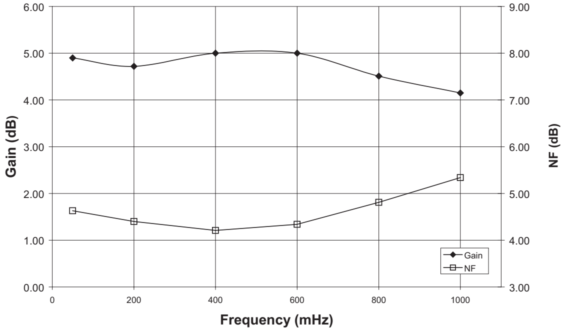
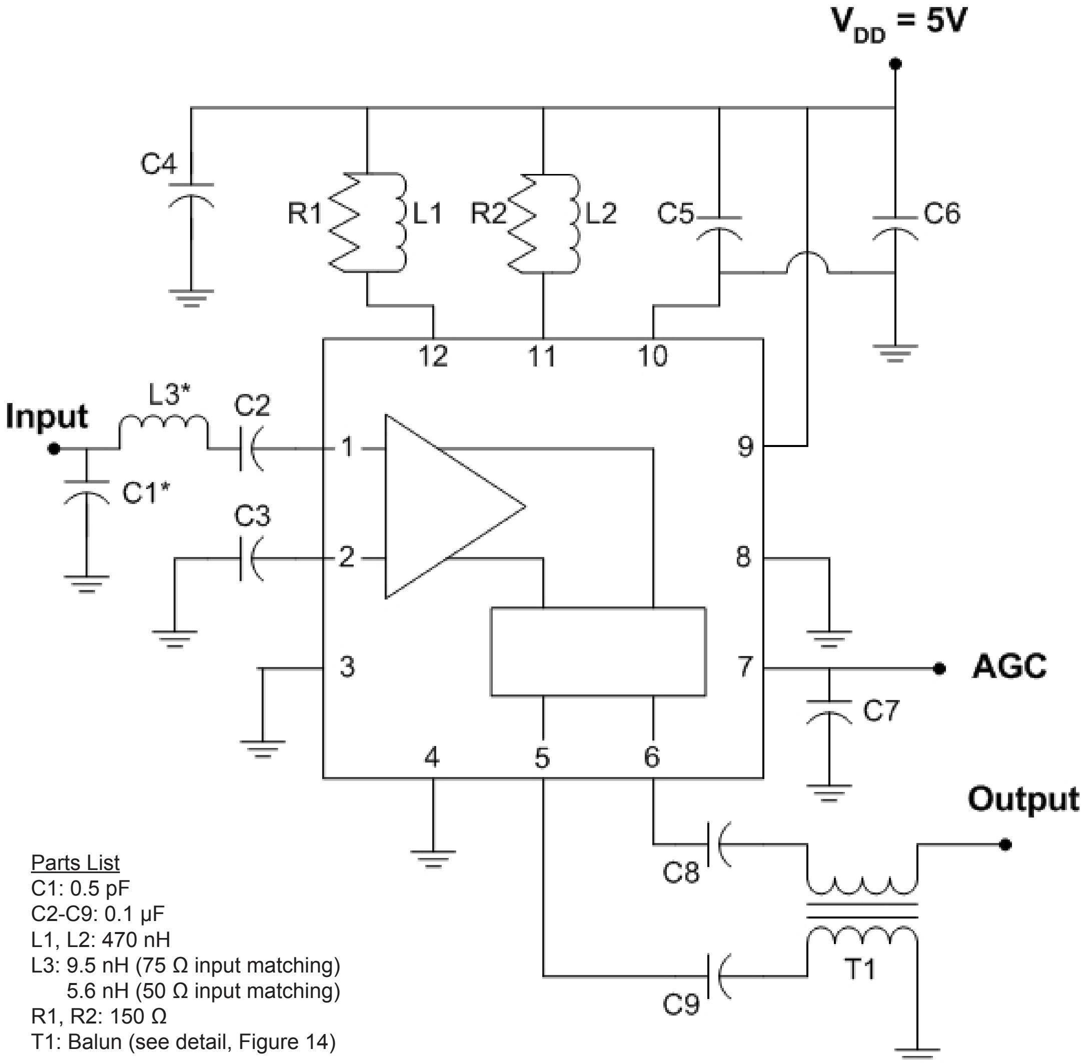


Figure 17: Gain and Noise Figure vs. Frequency (V_{DD} = +5 V, V_{AGC} = +3 V, I_{DD} = 75mA)



Note:
50 Ω characterization is for reference only. Part is not tested at 50 Ω in production.

APPLICATION INFORMATION



<u>Parts List</u>
C1: 0.5 pF
C2-C9: 0.1 µF
L1, L2: 470 nH
L3: 9.5 nH (75 Ω input matching)
    5.6 nH (50 Ω input matching)
R1, R2: 150 Ω
T1: Balun (see detail, Figure 14)

Figure 18: Test Circuit

**Note: C1 & L3 are required for matching to a 75 Ω low cost F connector at the RF Input. Higher quality connectors may not require such matching.*

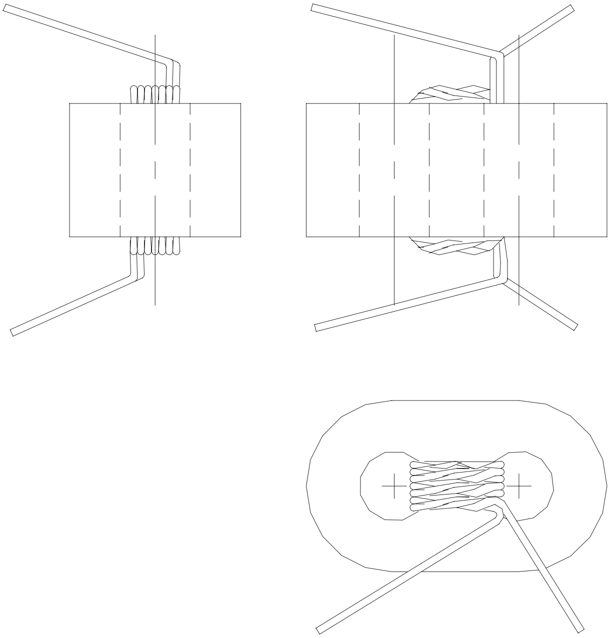
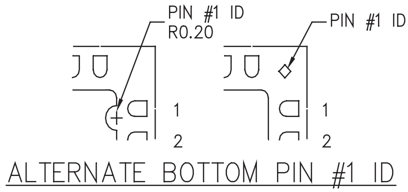
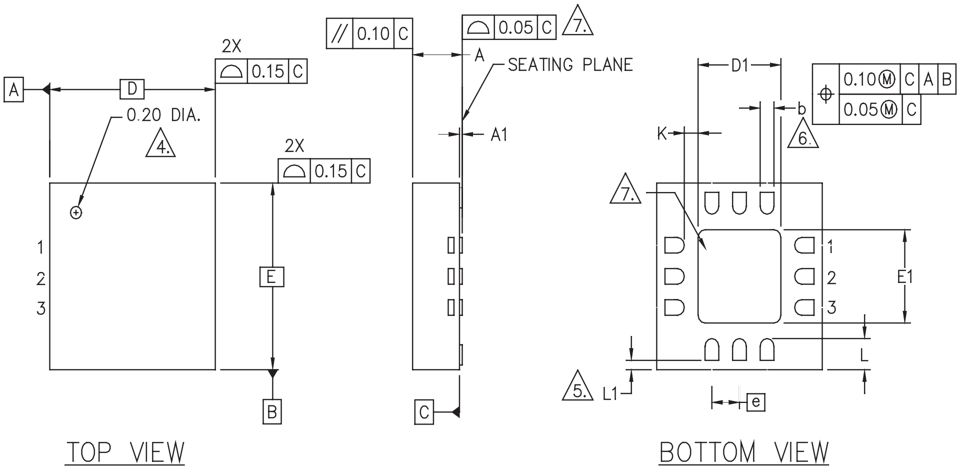


Figure 19: Balun Detail - 3.5 turn (P8002458)

Notes:
Ferrite core: FAIR-RITE #2843002702
Wire: MWS WIRE IND. #T-2361429-20
Balun Winding - 3 1/2 turns through core

PACKAGE OUTLINE





SYMBOL	DIMENSIONS–MM MIN.	DIMENSIONS–MM MAX.	NOTE	SYMBOL	DIMENSIONS–INCHES MIN.	DIMENSIONS–INCHES MAX.	NOTE
A	0.80	1.00		A	0.031	0.039	
A1	0.00	0.05		A1	0.000	0.001	
b	0.18	0.30		b	0.007	0.011	
D	3.00 BSC			D	0.118 BSC		
D1	1.30	1.70		D1	0.051	0.067	
E	3.00 BSC			E	0.118 BSC		
E1	1.30	1.70		E1	0.051	0.067	
e	0.50 BSC			e	0.019 BSC		
K	0.20 MIN.			K	0.007 MIN.		
L	0.35	0.55		L	0.014	0.022	
L1		0.15 MAX.		L1		0.006 MAX.	

NOTES :

1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. MAX. PACKAGE WARPAGE IS 0.05 mm.
3. MAXIMUM ALLOWABLE BURRS IS 0.076 mm IN ALL DIRECTIONS.
4. PIN #1 ID ON TOP WILL BE LASER MARKED.
5. A MAXIMUM 0.15mm PULL BACK (L1) MAYBE PRESENT. L MINUS L1 TO BE EQUAL TO OR GREATER THAN 0.30mm.
6. DIMENSION b APPLIES TO METALLIZED TERMINAL AND IS MEASURED BETWEEN 0.15 AND 0.30mm FROM TERMINAL TIP. IF THE TERMINAL HAS THE OPTIONAL RADIUS ON THE OTHER END OF THE TERMINAL, THE DIMENSION b SHOULD NOT BE MEASURED IN THAT RADIUS AREA.
7. BILATERAL COPLANARITY ZONE APPLIES TO THE EXPOSED HEAT SINK SLUG AS WELL AS THE TERMINALS.
8. REFERENCE JEDEC OUTLINE MO-220.

Figure 15: S26 Package Outline - 12 Pin 3 mm x 3 mm x 1 mm QFN

ORDERING INFORMATION

ORDER NUMBER	TEMPERATURE RANGE	PACKAGE DESCRIPTION	COMPONENT PACKAGING
ABA3130RS26Q1	-40 °C to +85 °C	RoHS Compliant 12 Pin 3 mm x 3 mm x 1 mm QFN Package	Tape and Reel, 1000 pieces per Reel

NOTES

Skyworks Solutions, Inc.
Phone [781] 376-3000 • Fax [781] 376-3100 • sales@skyworksinc.com • www.skyworksinc.com