DATA SHEET

ACA1240: CATV Infrastructure Amplifier 1.2 GHz CCAP/Edge QAM/CMTS Driver

Applications

- CATV head-end CCAP/EQAM/CMTS modulators
- MDU output device

Features

- 35 dB gain
- Meets DRFI specification +5 dB margin
- High-linearity, high-gain integrated amplifier with an adjustable linear attenuator
- Balanced inputs and outputs matched for a 75 Ω system
- 0 to 20 dB continuously adjustable attenuation using an external analog control signal
- Single 12 V supply with 6 W power consumption
- High-linearity GaAs process
- Unconditional stability (K factor > 1)

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Description

The ACA1240 is a GaAs based amplifier that contains highly linear amplification and attenuation stages for use in CATV CCAP/EQAM/CMTS modulators and networks. It incorporates a continuously adjustable linear attenuator that is controlled by an external analog voltage. This glitch-free attenuator provides a minimum of 20 dB of continuously variable attenuation and is preceded by a high-linearity pre-amplifier and followed by a high-gain output driver. Both input and output are matched to 75 Ω using balun transformers.

The ACA1240 operates from a single 12 V supply and is offered in an 11 mm x 11 mm surface-mount package.

A block diagram of the ACA1240 is shown in Figure 1. The device package and pinout are shown in Figure 2. Signal pin assignments and functional pin descriptions are described in Table 1.

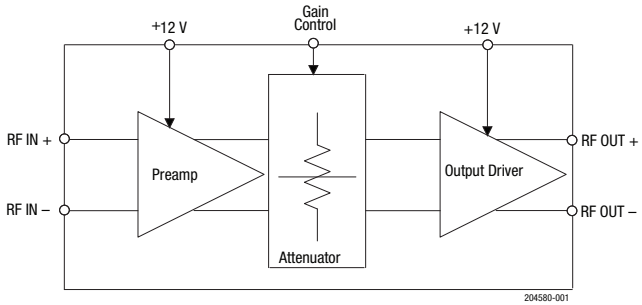


Figure 1. ACA1240 Block Diagram

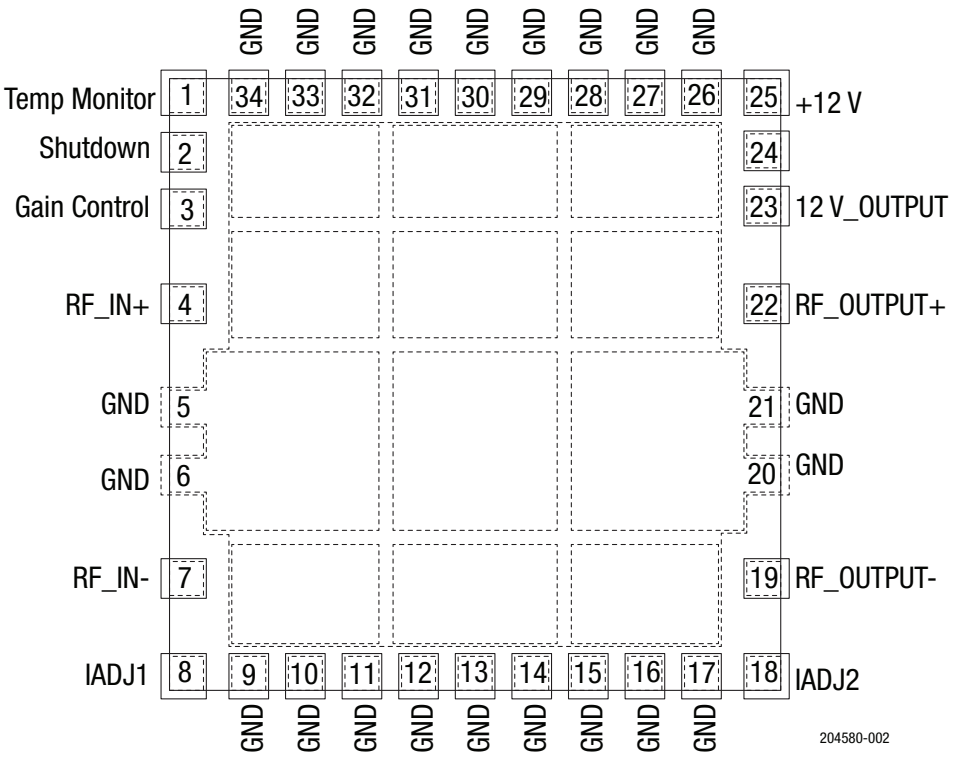


Figure 2. ACA1240 Pinout
(Top View)

Table 1. ACA1240 Signal Pin Descriptions[1]

Pin	Name	Description	Pin	Name	Description
1	TM	Device temperature monitor	18	IADJ2	Output amplifier current adjustment
2	PC_1	DC power shutdown	19	RF_OUT-	RF output
3	Gain control	0 to 12 V variable attenuator	20	GND	Ground
4	RF_IN+	RF input	21	GND	Ground
5	GND	Ground	22	RF_OUT+	RF output
6	GND	Ground	23	12V_OUT	+12 V output from device
7	RF_IN-	RF input	24	N/C	No connection
8	IADJ1	Input amplifier current adjustment	25	+12V	+12 supply voltage
9 to 17	GND	Ground	26 to 34	GND	Ground

[1] The ground pad between pins 5/6 and 20/21 must have a low inductance and low thermal resistance connection to the application's printed circuit board ground plane.

Electrical and Mechanical Specifications

The absolute maximum ratings of the ACA1240 are provided in Table 2. Recommended operating conditions are specified in Table 3.

Electrical specifications are provided in Tables 4 through 7. VTM vs case temperatue is shown in Figure 3. K factor vs case temperature plots for the ACA1240 are shown in Figures 4 through 10.

Table 2. ACA1240 Absolute Maximum Ratings[1]

Parameter	Min	Typ	Max	Units
Supply (VDD)		+12	+14	VDC
RF power at input pins (single channel)			+40	dBmV
Gain control voltage	0	+12	+14	VDC
Shutdown voltage	0	+3	+4	VDC

[1] Exposure to maximum rating conditions for extended periods may reduce device reliability. There is no damage to device with only one parameter set at the limit and all other parameters set at or below their nominal value. Exceeding any of the limits listed here may result in permanent damage to the device.

[2] Pins 4 and 7 should be AC-coupled. No external DC bias should be applied.

ESD HANDLING: *Although this device is designed to be as robust as possible, electrostatic discharge (ESD) can damage this device. This device must be protected at all times from ESD when handling or transporting. Static charges may easily produce potentials of several kilovolts on the human body or equipment, which can discharge without detection. Industry-standard ESD handling precautions should be used at all times.*

Table 3. ACA1240 General Specifications[1]

Parameter	Min	Typ	Max	Unit
VDD		+12		VDC
Operating frequency	50		1218	MHz
Storage temperature	-40		+100	°C
Assembly temperature (for 5 seconds max)			+250	°C
Thermal resistance: θJC bottom heat slug θJC top of package		 3.9 27		 °C/W °C/W
Operating temperature (measured at case)	-20		+100	°C

[1] 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 4. ACA1240 General RF Specifications
(Measured at V_{DD} = 12V, I_{DD} = 500 mA, Tcase = 25 °C, 75 Ω, Gain Control = 12 V, Measured in Application Circuit as Shown in Figure 11)

Parameter	Min	Typ	Max	Units	Comments
Gain @ 1.218 GHz		35		dB	
Gain flatness		±0.75		dB	
Gain slope		0		dB	Measured at 50 MHz to 1.218 GHz
Attenuator range	0	20		dB	
Input return loss (S11)	-18 -16	-25 -19		dB dB	50 MHz to 600 MHz 600 MHz to 1218 MHz
Output return loss (S22)	-16 -16	-21 -20		dB dB	50 MHz to 600 MHz 600 MHz to 1218 MHz
I_{DD}		500	530	mA	
Noise figure		4.5		dB	
Stability (K factor)	1.0				T_{CASE} = -40 °C to +100 °C
VTM		0.41		VDC	T_{CASE} = +25 °C

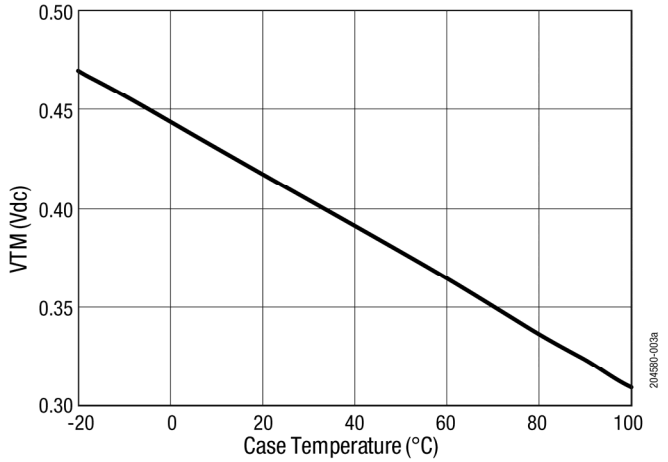


Figure 3. VTM vs Case Temperature

Table 5. ACA1240 Adjacent Channel Power Ratio (ACPR) [1]
(N = 8 Contiguous Channels, 256 QAM @ +63 dBmV Total Composite Power DRFI +5, 6 MHz Channels, Gain Control = 12 V)

Channel	Min	Typ	Max	Unit	Comments
Adjacent		-70	-58	dBc	Up to 750 kHz from channel block edge
Adjacent		-63	-60	dBc	750 kHz to 6 MHz from channel block edge
Next adjacent		-63	-62	dBc	6 MHz to 12 MHz from channel block edge
Third adjacent		-65	-64	dBc	12 MHz to 18 MHz from channel block edge

1 ACP specs are relaxed by 3 dB above 600 MHz.

Table 6. ACA1240 Distortion
(Gain Control = 12 V, 100 MHz CW tone at 66 dBmV)

Harmonic	Min	Typ	Max	Unit
2nd Order		-65	-63	dBc
3rd Order		-68	- 63	dBc

Table 7. Bias Control

	+12 V	Shutdown	Gain Control
Shutdown mode	N/A	0 V	N/A
Min gain mode	On	3 V	0 V
Max gain mode	On	3 V	12 V

ACA 1240 Typical K Factor vs Case Temperature

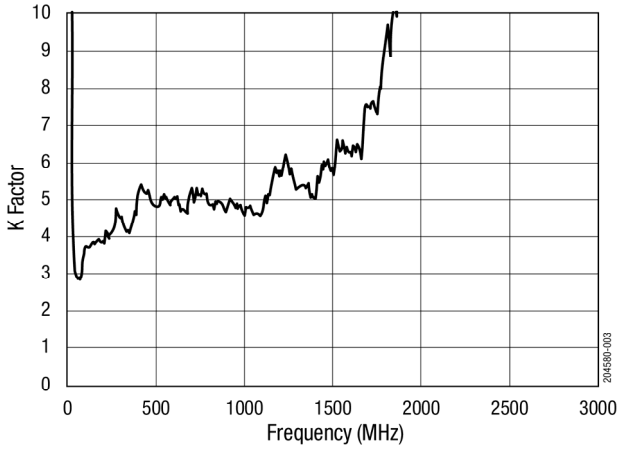


Figure 4. K vs Frequency (T_{CASE} = -40 °C) Gain Control= 12 VDC

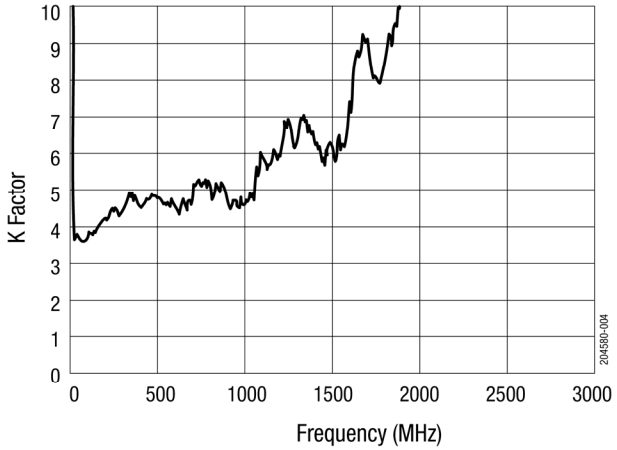


Figure 5. K vs Frequency (T_{CASE} = -20 °C) Gain Control= 12 VDC

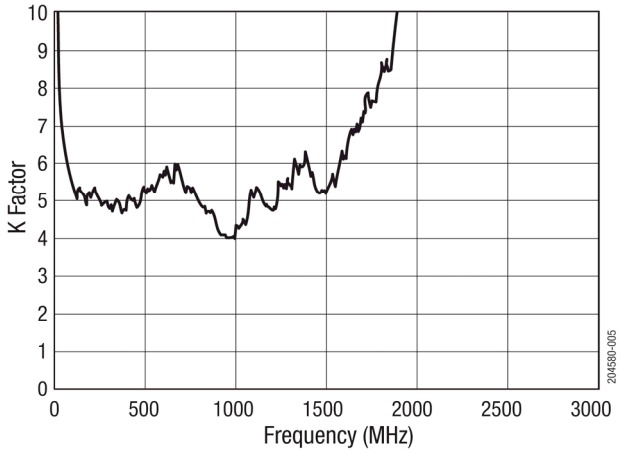


Figure 6. K vs Frequency (T_{CASE} = 0 °C) Gain Control= 12 VDC

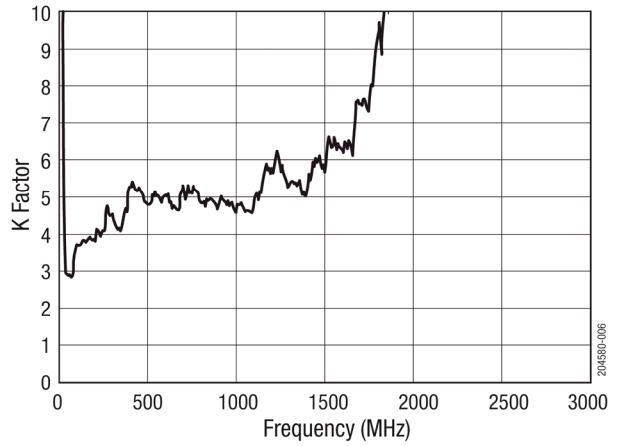


Figure 7. K vs Frequency (T_{CASE} = +25 °C) Gain Control= 12 VDC

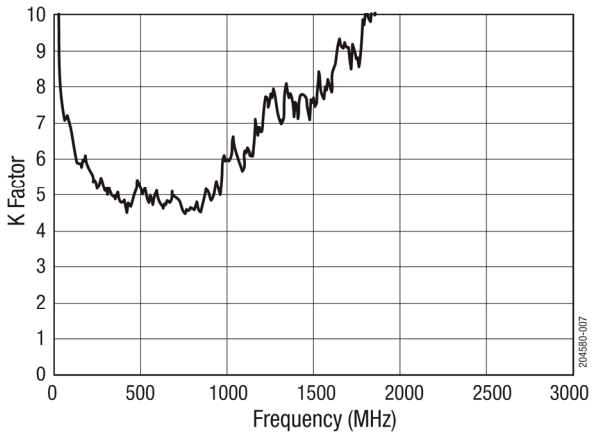


Figure 8. K vs Frequency (T_{CASE} = +45 °C) Gain Control= 12 VDC

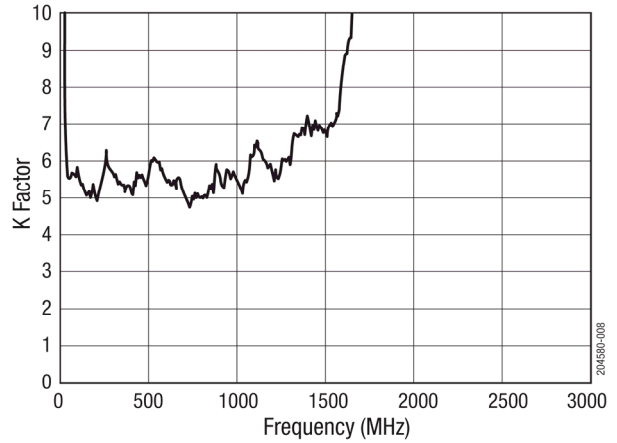


Figure 9. K vs Frequency (T_{CASE} = +85 °C) Gain Control= 12 VDC

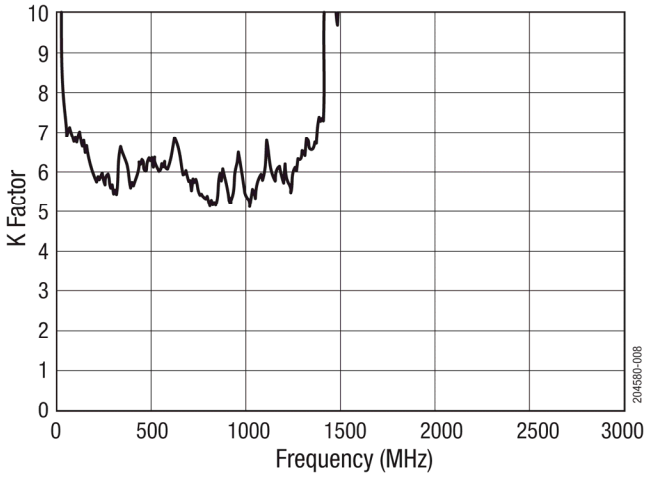


Figure 10. K vs Frequency (T_{CASE} = +100 °C) Gain Control= 12 VDC

Evaluation Board Description

The ACA1240 Evaluation Board is used to test the performance of the ACA1240 device. An Evaluation Board schematic is provided in Figure 11. Table 8 provides the Bill of Materials (BOM) list for Evaluation Board components.

Shutdown Mode

The power amplifier can be enabled by applying logic level high (3 V) to pin 2 (DC Power Shutdown) or placed in Power Shutdown by applying logic low level (0 V) to pin 2.

Amplifier Operation

Bias Current Adjustment

The input gain stage bias current and output gain stage bias current are set at the high end of their range by default by the internal circuitry of the amplifier. The bias currents can be adjusted for linearity optimization by placing resistors to ground on pin 7 (ladj1) and pin 8 (ladj2). Lowering the value of the resistances decreases the bias current in each gain stage. It is not recommended to apply a voltage to pin 7 or pin 8 to increase the bias current above the factory set value.

Gain Adjustment

The amplifier gain can be adjusted with a continuously variable analog control voltage applied to pin 3 (gain control). The range is 0 V to 12 V, with 0 V being the minimum gain and 12 V being the maximum gain setting.

The complete pin functions are shown in Table 9.

Evaluation Board Setup Procedure

1. Apply 12 V to pin 12.
2. Apply +3 V to pin 2 (to enable the PA).
3. Turn the RF ON.
4. Apply 0 to +12 V to pin 3 to adjust Gain.
5. Measure RF output power at pins 9 and 10.

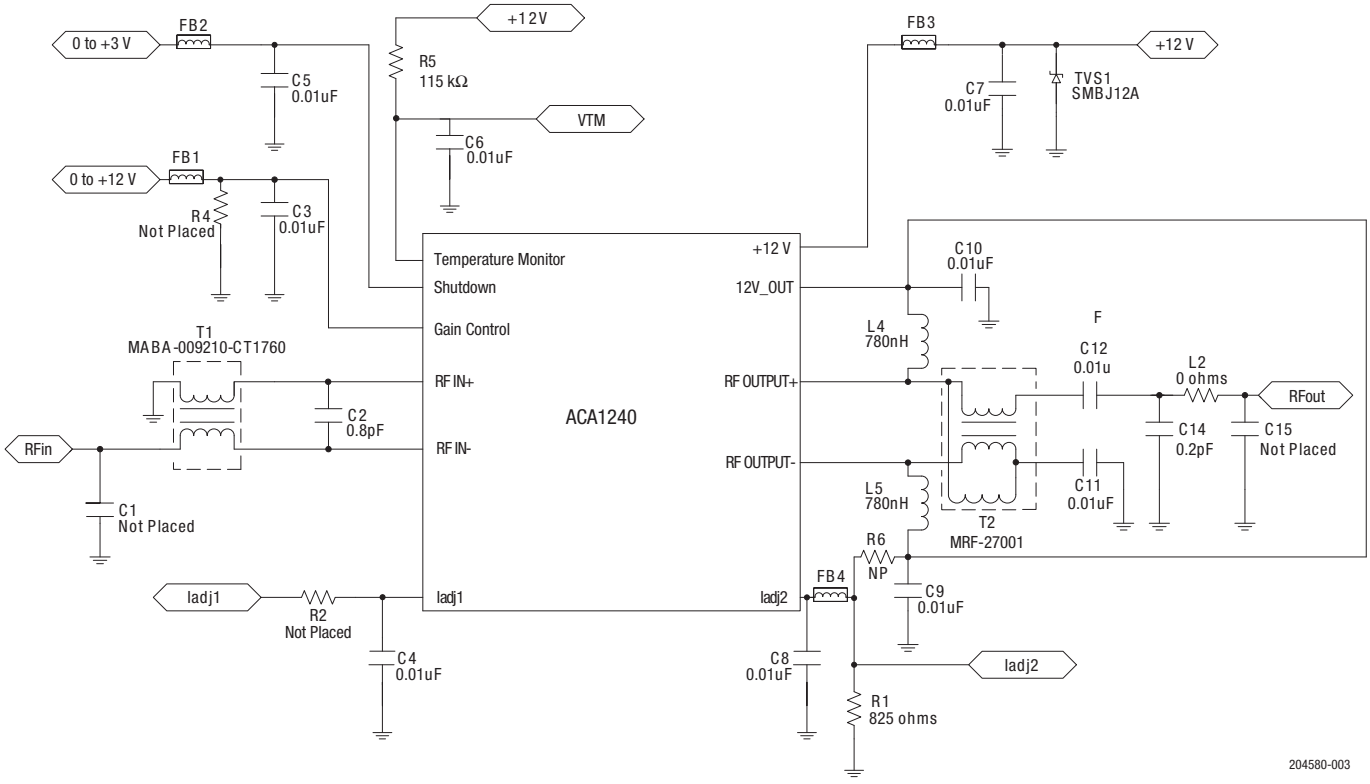


Figure 11. ACA1240 Evaluation Board Schematic

Table 8. ACA1240 Evaluation Board Bill of Materials (BOM)

Component	Mfr Part Number	Manufacturer	Size	Description
C1, C15	NP		0402	NP
C2	04025U0R8BAT2A	AVX	0402	0.8 pF
C3 ,C4, C5, C6, C7, C8, C9, C10, C11, C12	GRM155R71H103K	Murata	0402 size	0.01 uF capacitor (0402)
C14	GRM1555C1HR20BA01D	Murata	0402	0.2 pF
CON1-2	PE4504	Pasternack	or similar type	75 Ω N bulkhead
FB1, FB2, FB4	BLM15HG601SN1	Murata	0402	Ferrite chip bead
FB3	BLM15EG121SN1D	Murata	0402	Ferrite chip bead
L2*	CRCW-04020000Z0EDHP	Vishay	0402	Changed to 0 Ω resistor
L4, L5	LS03-R78J-RC	Allied	0603	780 nH
R1	ERJ-2RKF8250X	Panasonic	0402	825 Ω
R2, R4			0402	NP
T1	MABA- 009210-CT1760	Macom		1:1 transmission line balun
T2	MRF-27001	Minntronix		2:1 transmission line balun
TVS1	SMBJ12CA	Little fuse	DO-214AA	12V TVS DIODE
U1	ACA1240	Skyworks	11 mm	Edge QAM amplifier
R5	ERJ-2RKF1153X	Panasonic	0402	115 k Ω resistor

Table 9. ACA1240 Signal Pin Functions

Pin	Name	Description	Pin	Name	Description
1	TM	Device temperature monitor	18	IADJ2	Output amplifier current adjustment
2	PC_1	DC power shutdown: 0 V = off, +3 V = on (normal operation)	19	RF_OUT	RF output (+12 V through bias inductor)
3	Gain control	0 V = min gain 12 V = max gain	20	GND	Ground
4	RF_IN+	RF input (DC block)	21	GND	Ground
5	GND	Ground	22	RF_OUT+	RF output (+12 V through bias inductor)
6	GND	Ground	23	12V_OUT	+12 V output from device
7	RF_IN-	RF input (DC block)	24	N/C	No connection
8	IADJ1	Input amplifier current adjustment	25	+12V	+12 supply voltage (supplies +12 V bias to the device)
9 to 17	GND	Ground	26 to 34	GND	Ground

Package Dimensions

The ACA1240 typical part marking is shown in Figure 12. The PCB layout footprint drawing for the ACA1240 is shown in Figure 13. The package dimensions for the ACA1240 are shown in Figure 14. The tape and reel dimensions are provided in Figure 15.

Package and Handling Information

Since the device package is sensitive to moisture absorption, it is baked and vacuum packed before shipping. Instructions on the shipping container label regarding exposure to moisture after the container seal is broken must be followed. Otherwise, problems related to moisture absorption may occur when the part is subjected to high temperature during solder assembly.

The ACA1240 is rated to Moisture Sensitivity Level 3 (MSL3) at 250 °C. It can be used for lead or lead-free soldering. For additional information, refer to the Skyworks Application Note, *Solder Reflow Information*, document number 200164.

Care must be taken when attaching this product, whether it is done manually or in a production solder reflow environment. Production quantities of this product are shipped in a standard tape and reel format.

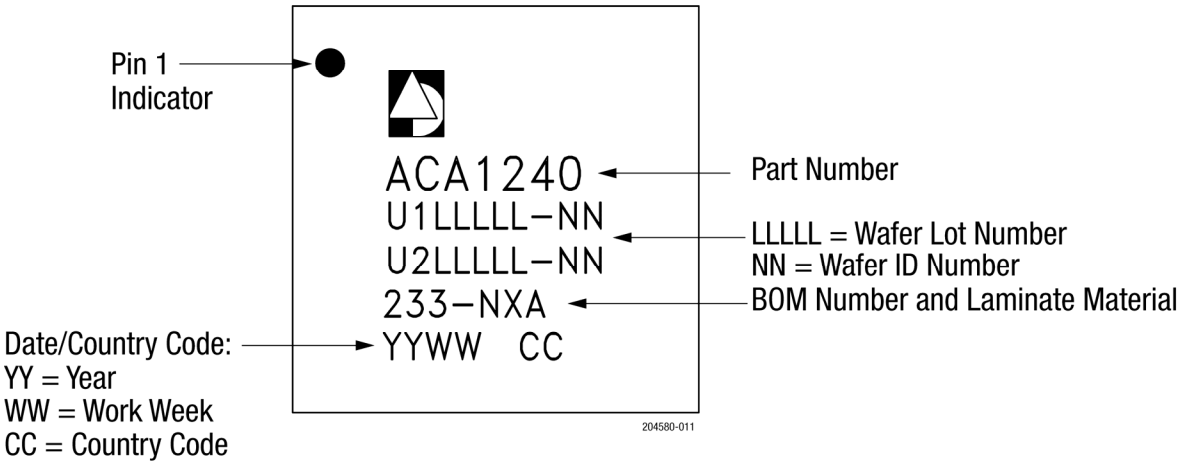
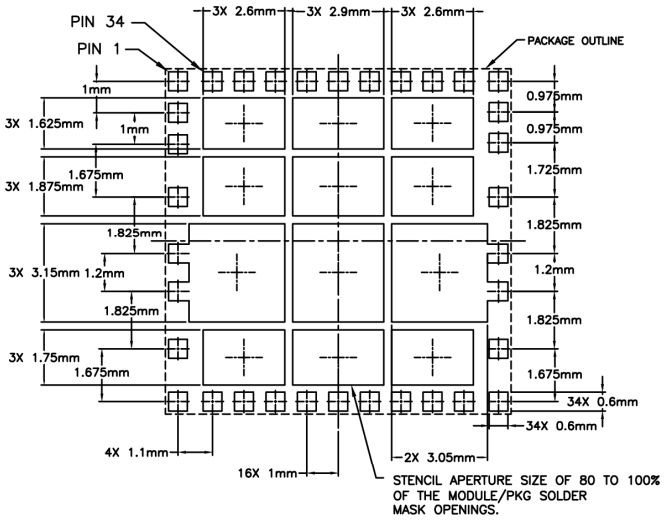
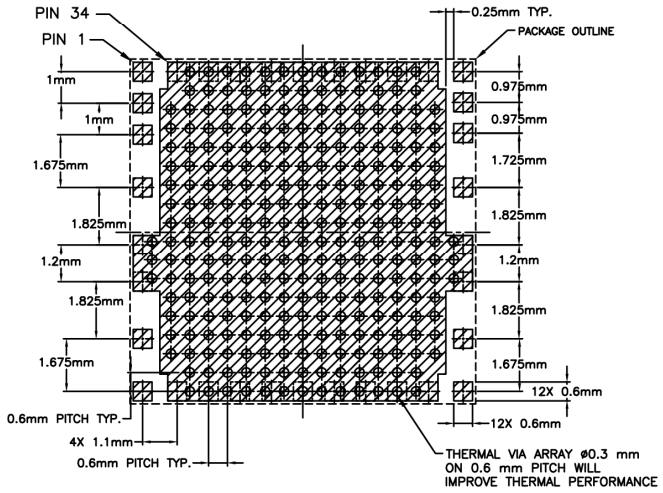


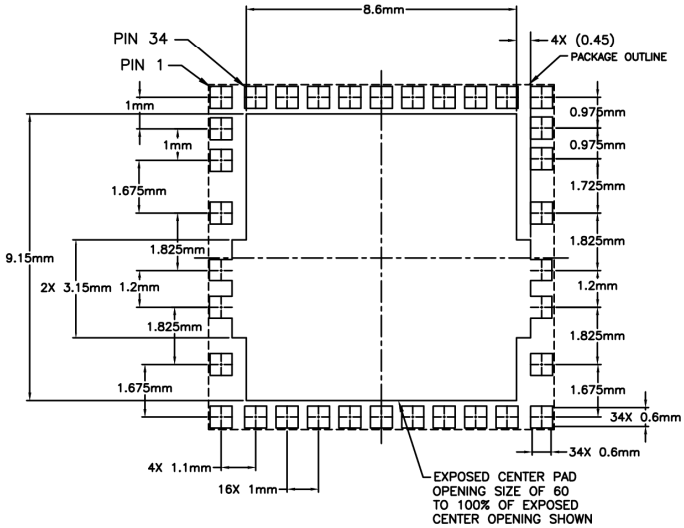
Figure 12. Typical Part Marking



STENCIL APERTURE
TOP VIEW



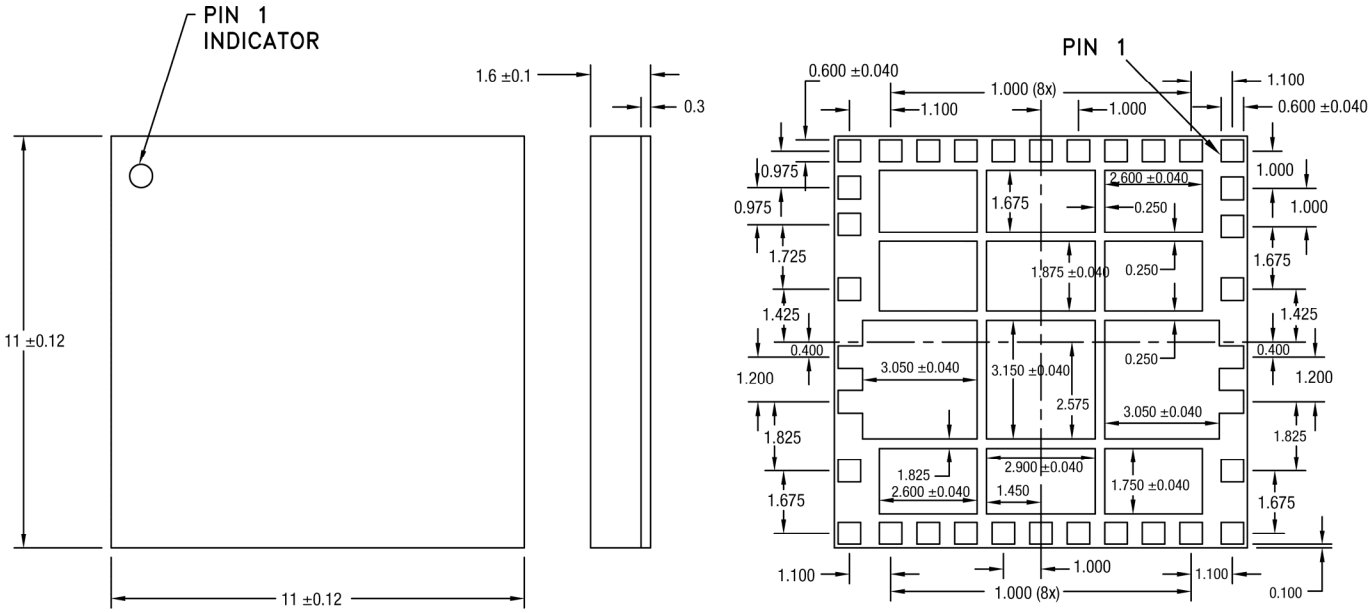
METALLIZATION
TOP VIEW



SOLDER MASK OPENING
TOP VIEW

NOTE: THERMAL VIAS SHOULD BE RESIN FILLED AND CAPPED IN ACCORDANCE WITH IPC–4761 TYPE VII VIAS. 30–35UM Cu THICKNESS IS RECOMMENDED.

Figure 13. ACA1240 PCB Layout Footprint Dimensions

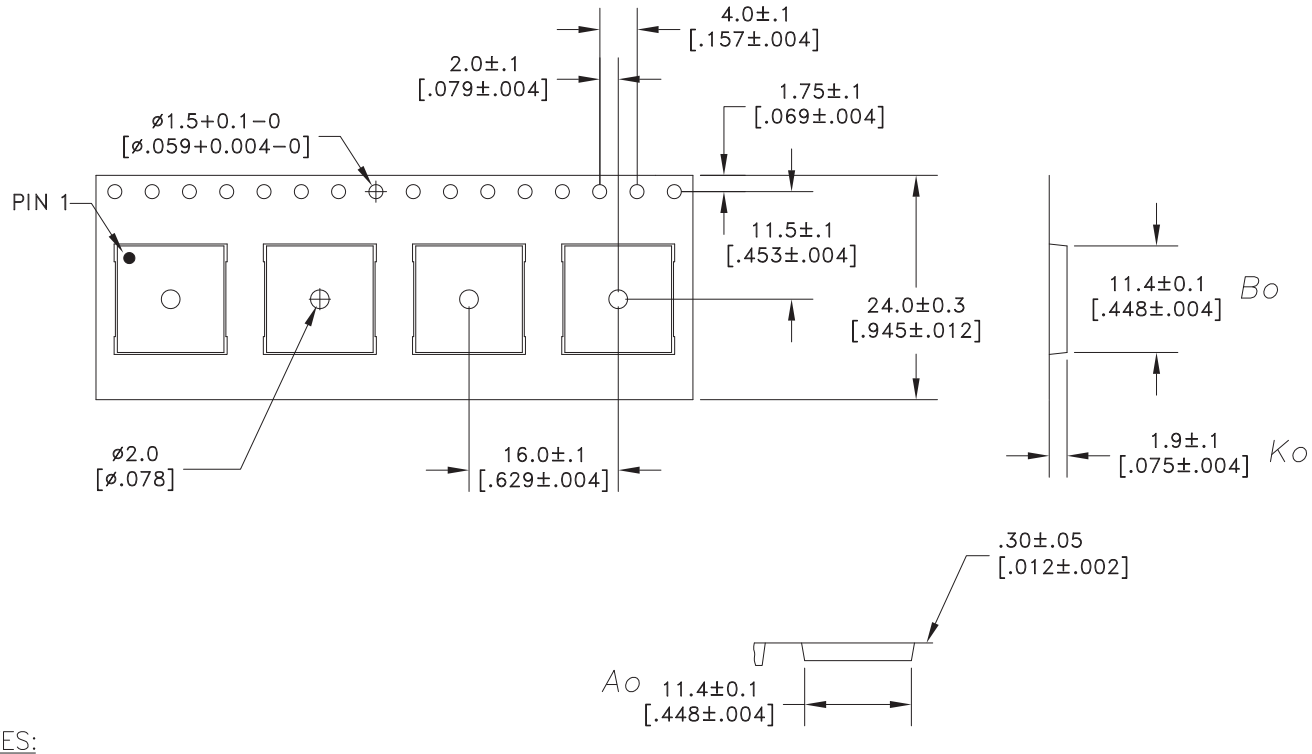


NOTES:

1. CONTROLLING DIMENSIONS IN MILLIMETERS.
2. UNLESS SPECIFIED, TOLERANCE=±0.076[0.003].
3. SIGNAL PADS SHOWN UNIFORM SIZE FOR REFERENCE ONLY.
   ACTUAL SIZE AND LOCATION WILL VARY WITHIN MIN. AND MAX. DIMENSIONS ACCORDING TO THE PRODUCT DESIGN.
4. GROUND PADS SHOWN UNIFORM SIZE FOR REFERENCE ONLY. ACTUAL SIZE AND LOCATION ARE REFERENCE ONLY.
5. PITCH MEASUREMENTS TAKE CENTERLINE TO CENTERLINE OF SOLDERMASK OPENINGS.
6. UNLESS SPECIFIED DIMENSIONS ARE SYMMETRICAL ABOUT CENTER LINES SHOWN.

204580-013

Figure 14. ACA1240 Package Dimensions



NOTES:

1. MATERIAL: CONDUCTIVE POLYSTYRENE.
2. DIMENSIONS ARE IN MILLIMETERS [INCHES]
3. 10 SPROCKET HOLE PITCH CUMULATIVE TOLERANCE ±0.2
4. CAMBER NOT TO EXCEED 1 MM IN 100 MM.
5. POCKET POSITION RELATIVE TO SPROCKET HOLE MEASURED. AS TRUE POSITION OF POCKET, NOT POCKET HOLE.
6. (S.R. OHM/SQ.) MEANS SURFACE ELECTRIC RESISTIVITY OF THE CARRIER TAPE.

DIMENSIONING AND TOLERANCING PER ASME Y14.5M−1994

204580-006

Figure 15. ACA1240 Tape and Reel Dimensions

Ordering Information

Part Number	Product Description	Component Packaging
ACA1240P8	CATV Infrastructure Amplifier 1.2 GHz CCAP/Edge QAM/CMTS Driver	1500-piece tape and reel
EVB1240		Evaluation Board part number

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