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)

Skyworks Green™ products are compliant with all applicable legislation and are halogen-free. For additional information, refer to *Skyworks Definition of Green™*, document number SQ04–0074.


## 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.

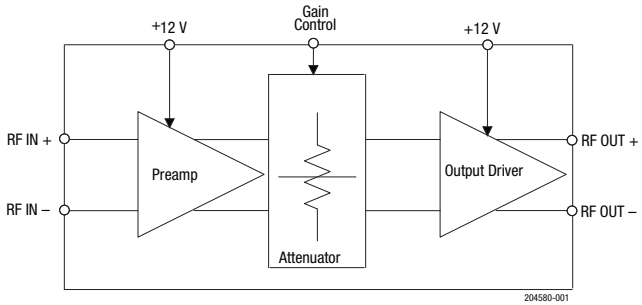



**Figure 1. ACA1240 Block Diagram**

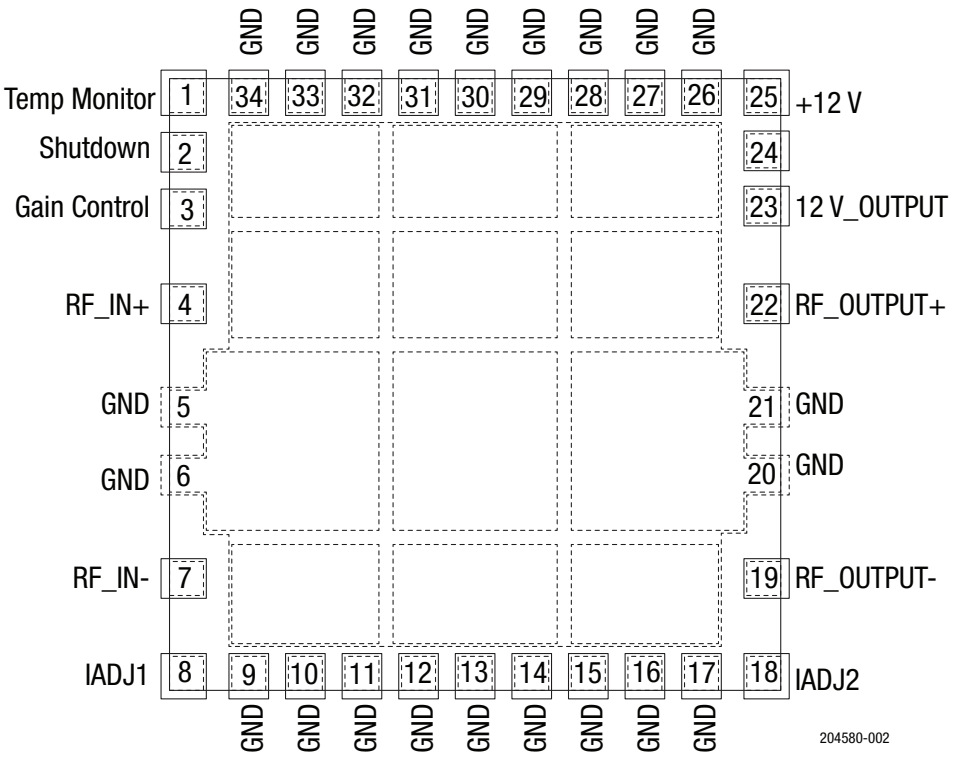



**Figure 2. ACA1240 Pinout**
**(Top View)**

**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:<br>θJC bottom heat slug<br>θJC top of package | | <br>3.9<br>27 | | <br>°C/W<br>°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<br>-16 | -25<br>-19 | | dB<br>dB | 50 MHz to 600 MHz<br>600 MHz to 1218 MHz |
| Output return loss (S22) | -16<br>-16 | -21<br>-20 | | dB<br>dB | 50 MHz to 600 MHz<br>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 |

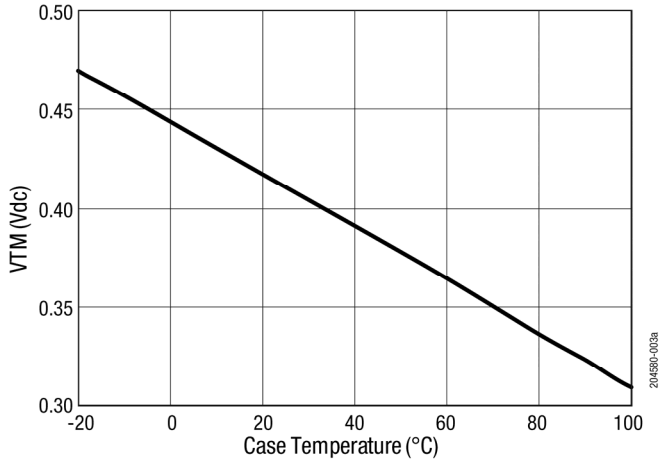



**Figure 3. VTM vs Case Temperature**

**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

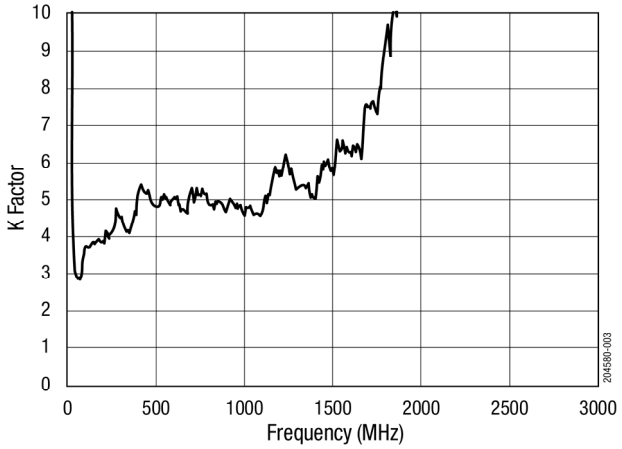



**Figure 4. K vs Frequency ($T_{CASE}$ = -40 °C) Gain Control= 12 VDC**

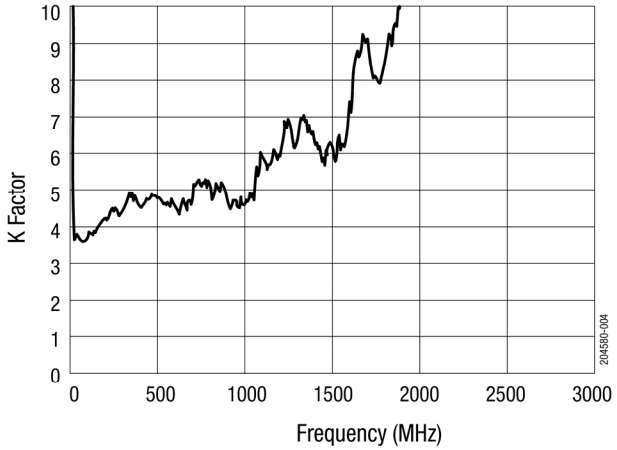



**Figure 5. K vs Frequency ($T_{CASE}$ = -20 °C) Gain Control= 12 VDC**

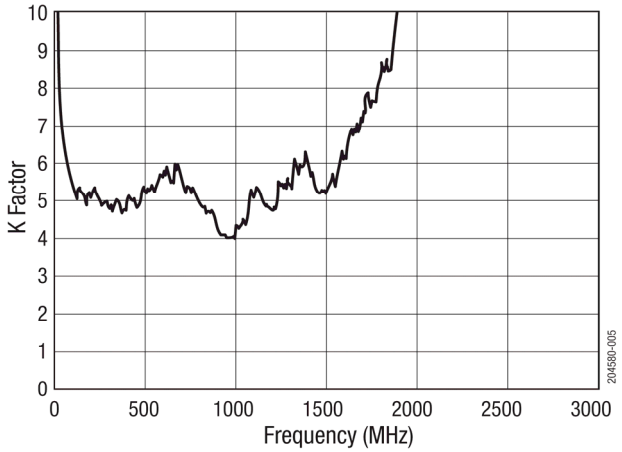



**Figure 6. K vs Frequency ($T_{CASE}$ = 0 °C) Gain Control= 12 VDC**

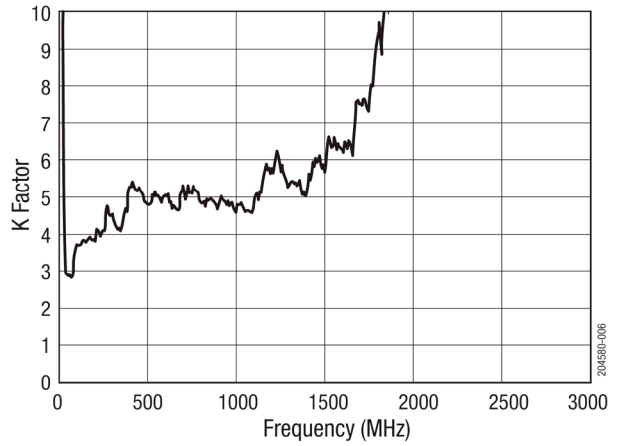



**Figure 7. K vs Frequency ($T_{CASE}$ = +25 °C) Gain Control= 12 VDC**

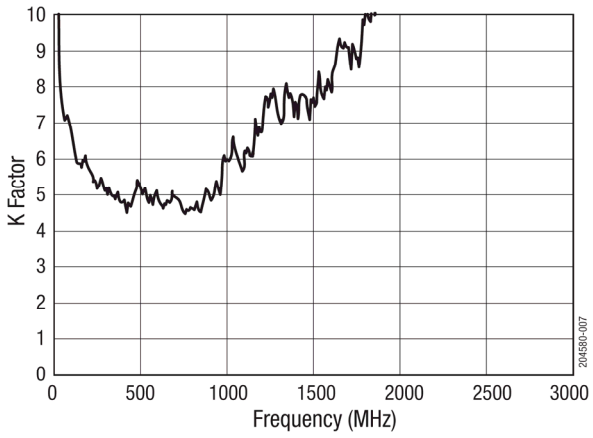



**Figure 8. K vs Frequency ($T_{CASE}$ = +45 °C) Gain Control= 12 VDC**

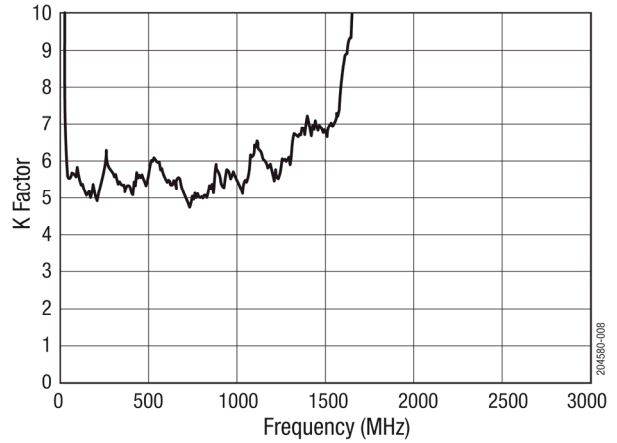



**Figure 9. K vs Frequency ($T_{CASE}$ = +85 °C) Gain Control= 12 VDC**

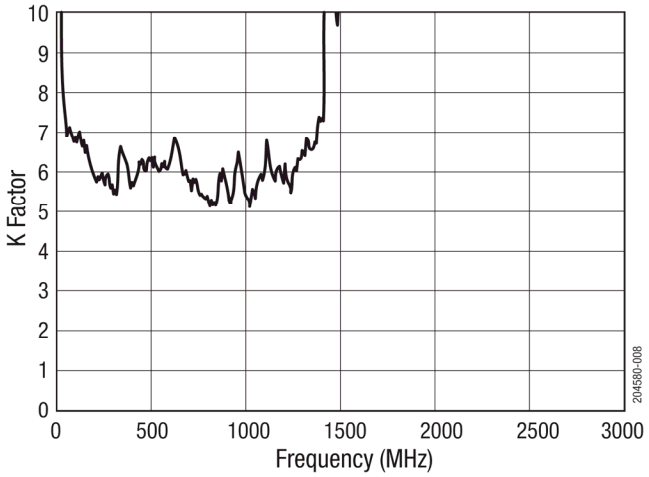



**Figure 10. K vs Frequency ($T_{CASE}$ = +100 °C) Gain Control= 12 VDC**

## 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.

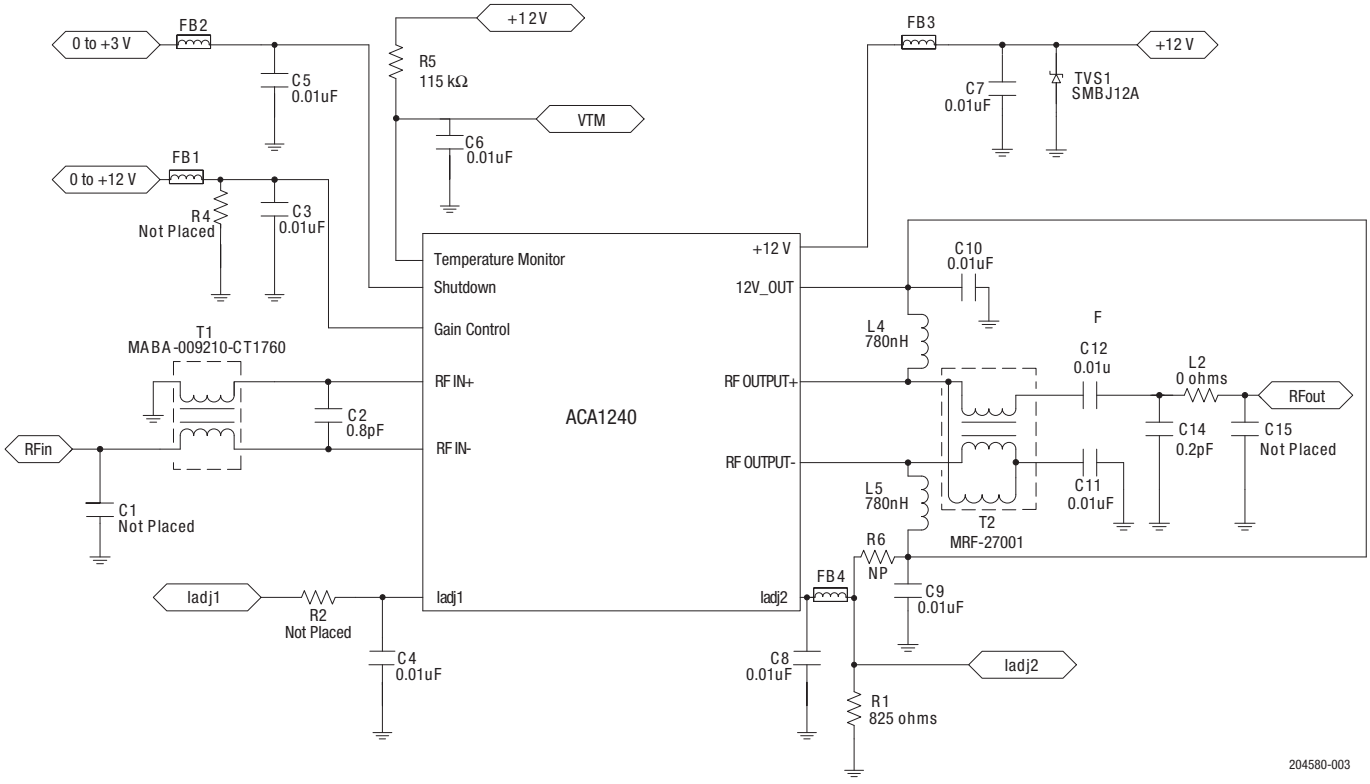



**Figure 11. ACA1240 Evaluation Board Schematic**

**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:<br>0 V = off,<br>+3 V = on (normal operation) | 19 | RF_OUT | RF output (+12 V through bias inductor) |
| 3 | Gain control | 0 V = min gain<br>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.

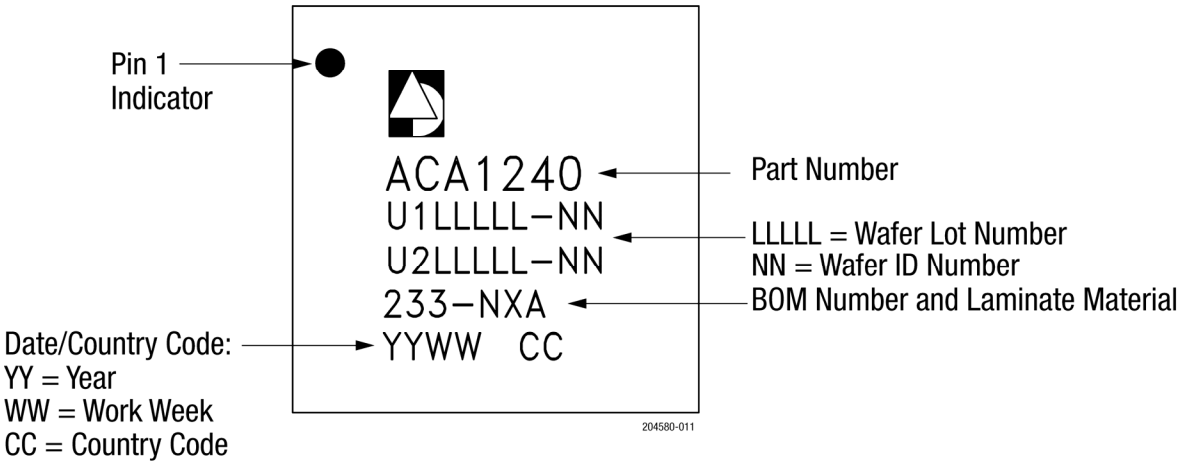
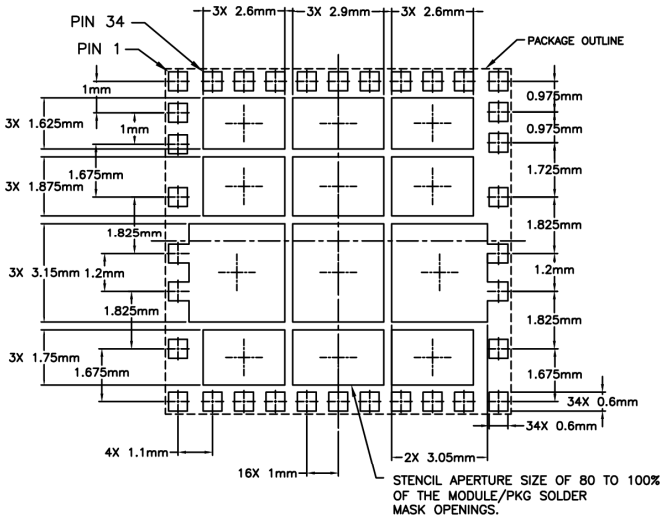
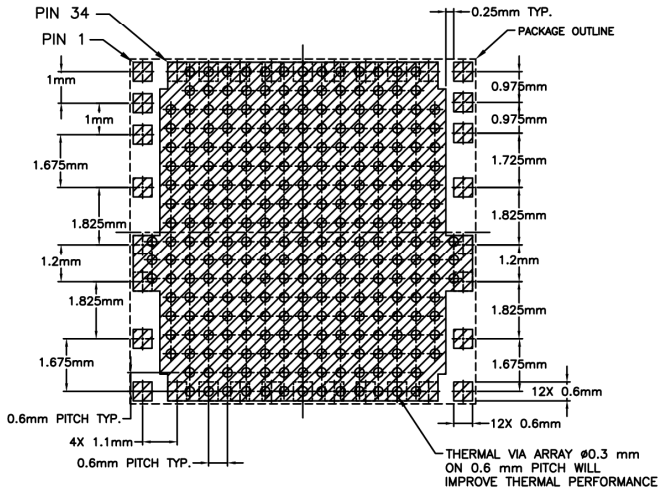


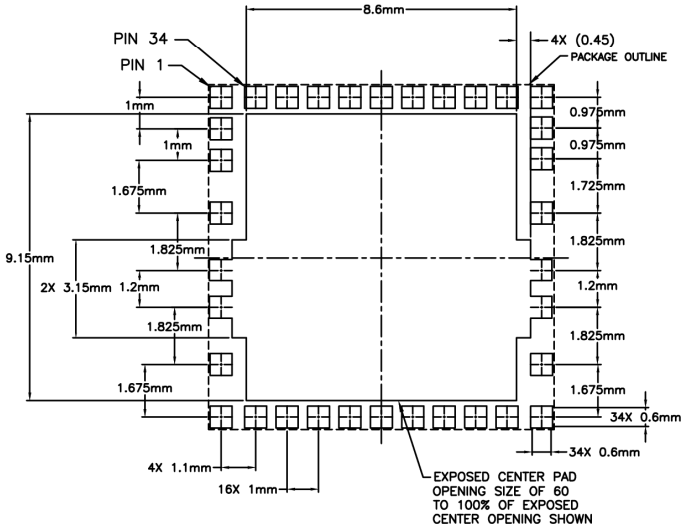

**Figure 12. Typical Part Marking**




STENCIL APERTURE
TOP VIEW



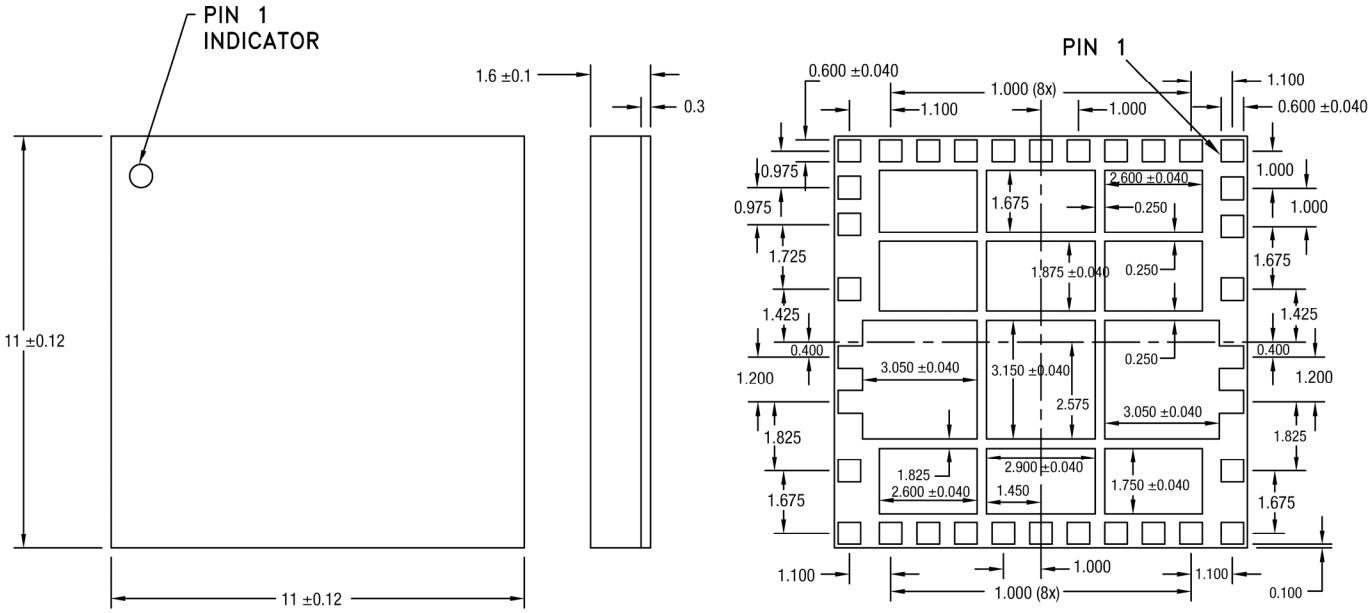

METALLIZATION
TOP VIEW




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**

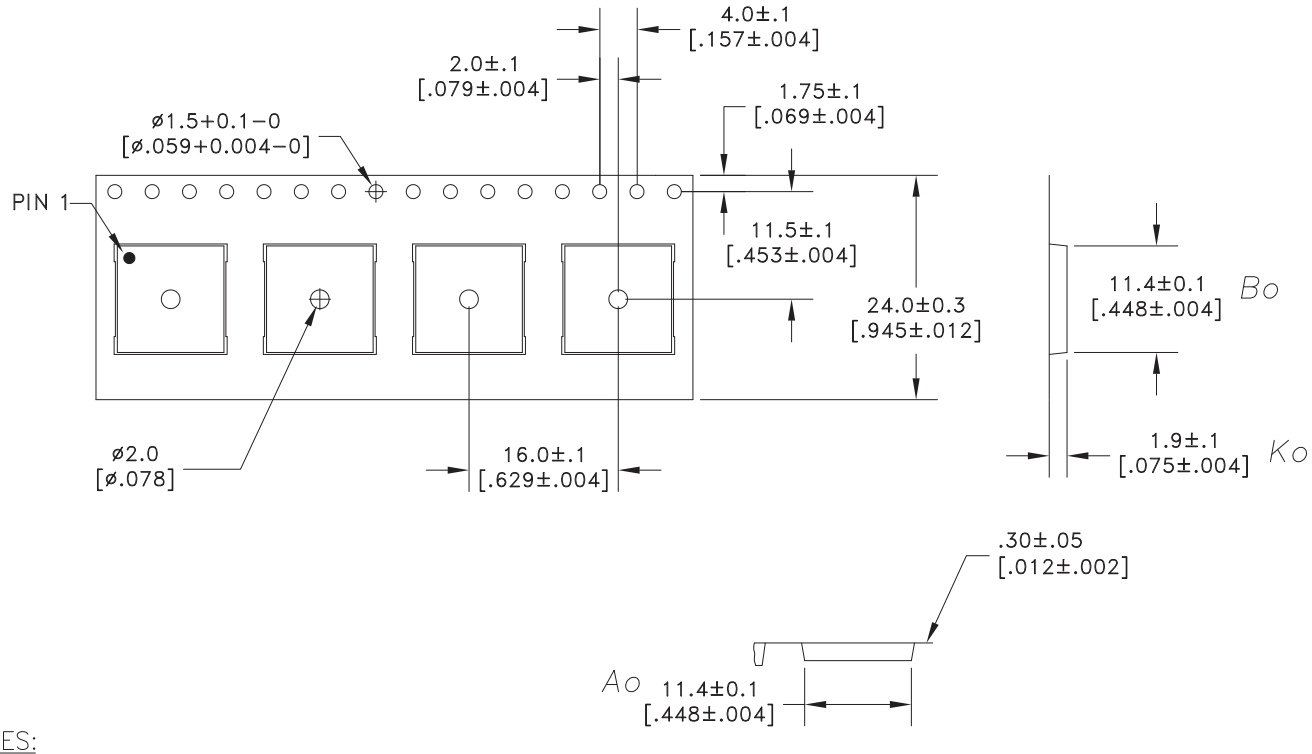



NOTES:

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 |

# X-ON Electronics

Largest Supplier of Electrical and Electronic Components

***Click to view similar products for*** RF Amplifier ***category:***

***Click to view products by*** Skyworks ***manufacturer:***

Other Similar products are found below :

A82-1 BGA622H6820XTSA1 BGA 728L7 E6327 BGB719N7ESDE6327XTMA1 HMC397-SX HMC405 HMC561-SX HMC8120-SX HMC8121-SX HMC-ALH382-SX HMC-ALH476-SX SE2433T-R SMA3101-TL-E SMA39 A66-1 A66-3 A67-1 A81-2 LX5535LQ LX5540LL MAAM02350 HMC3653LP3BETR HMC549MS8GETR HMC-ALH435-SX SMA101 SMA32 SMA411 SMA531 SST12LP19E-QX6E WPM0510A HMC5929LS6TR HMC5879LS7TR HMC1126 HMC1087F10 HMC1086 HMC1016 SMA1212 MAX2689EWS+T MAAMSS0041TR MAAM37000-A1G LTC6430AIUF-15#PBF SMA70-2 SMA4011 A231 HMC-AUH232 LX5511LQ LX5511LQ-TR HMC7441-SX HMC-ALH310 XD1001-BD-000V