AFE10004 4-Channel Power-Amplifier Precision Analog Front End With Integrated EEPROM and Gate Bias Switches

1 Features

- Local and remote diode temperature sensor
  - ±2.5°C accuracy, maximum
  - 0.0625°C resolution
- Internal EEPROM for autonomous operation
  - Four independent transfer functions storage
  - Device configuration storage
  - Open space for user storage
- Four analog outputs
  - Four monotonic DACs: 1.22-mV resolution
  - Automatically configured output ranges:
    - Positive output voltage: 5.5 V, maximum
    - Negative output voltage: –10 V, minimum
  - High current drive capability:
    - Source up to 100 mA
    - Sink up to 20 mA
  - High capacitive load tolerant: up to 15 µF
- Gate bias on and off control switches
  - Two programmable off voltages
    - Two auxiliary DACs: 1.22-mV resolution
  - Fast switching time: 50 ns, typical
  - Low resistance: 3 Ω, maximum
- Built-in sequencing control
- Internal 2.5-V reference
- SPI and I^2C interfaces: 1.7-V to 3.6-V operation
  - SPI: 4-wire Interface
  - I^2C: Eight selectable slave addresses
- Specified temperature range: –40°C to +125°C
- Operating temperature range –40°C to +150°C

2 Applications

- Radar
- Electronic warfare
- Communications payload
- Defense radio
- Active antenna system mMIMO (AAS)
- Outdoor backhaul unit

3 Description

The AFE10004 is a highly integrated, autonomous, power-amplifier (PA) precision analog front end (AFE) that includes four temperature compensation digital-to-analog converters (DACs), integrated EEPROM, and gate bias switches. The four DACs are programmed by four, independent, user-defined, temperature-to-voltage transfer functions stored in the internal EEPROM, allowing any temperature effects to be corrected without additional external circuitry. After start up, the device operates without intervention from a system controller to provide a complete system for setting and compensating bias voltages in control applications.

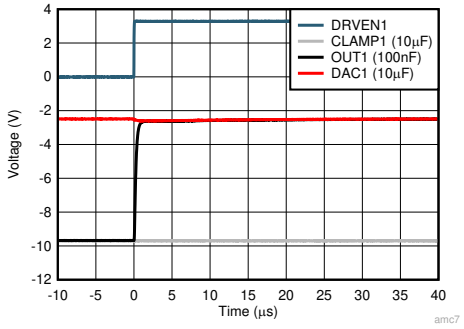
The AFE10004 has four gate bias outputs that are switched on and off through dedicated control pins. The gate bias switches are designed for fast response. In combination with the device PA_ON pin, this fast response enables correct power sequencing and protection of depletion-mode transistors, such as GaAs and GaN.

The function integration and wide operating temperature range make the AFE10004 an excellent choice as an all-in-one, autonomous bias control circuit for the power amplifiers found in RF systems. The flexible DAC output ranges and built-in sequencing features let the device be used as a biasing controller for a large variety of transistor technologies, such as LDMOS, GaAs, and GaN. Contact TI sales for the full data sheet.

Device Information

PART NUMBER	PACKAGE(1)	BODY SIZE
AFE10004	QFN (24)	4.00 mm x 4.00 mm

(1) For all available packages, see the package option addendum at the end of the data sheet.



Gate Bias Switch Response

4 Device and Documentation Support

4.1 Documentation Support

4.1.1 Related Documentation

For related documentation see the following:

- Texas Instruments, AFE10004EVM user's guide

4.2 Receiving Notification of Documentation Updates

To receive notification of documentation updates, navigate to the device product folder on ti.com. Click on *Subscribe to updates* to register and receive a weekly digest of any product information that has changed. For change details, review the revision history included in any revised document.

4.3 Support Resources

TI E2E™ support forums are an engineer's go-to source for fast, verified answers and design help — straight from the experts. Search existing answers or ask your own question to get the quick design help you need.

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4.4 Trademarks

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4.5 Electrostatic Discharge Caution

This integrated circuit can be damaged by ESD. Texas Instruments recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

4.6 Glossary

TI Glossary This glossary lists and explains terms, acronyms, and definitions.

5 Mechanical, Packaging, and Orderable Information

The following pages include mechanical, packaging, and orderable information. This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the left-hand navigation.

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead finish/ Ball material (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
AFE10004RGER	ACTIVE	VQFN	RGE	24	3000	RoHS & Green	NIPDAU	Level-3-260C-168 HR	-40 to 125	AFE 10004	Samples
AFE10004RGET	ACTIVE	VQFN	RGE	24	250	RoHS & Green	NIPDAU	Level-3-260C-168 HR	-40 to 125	AFE 10004	Samples

(1) The marketing status values are defined as follows:
ACTIVE: Product device recommended for new designs.
LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.
NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.
PREVIEW: Device has been announced but is not in production. Samples may or may not be available.
OBSOLETE: TI has discontinued the production of the device.

(2) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".
RoHS Exempt: TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.
Green: TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

(3) MSL, Peak Temp. - The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

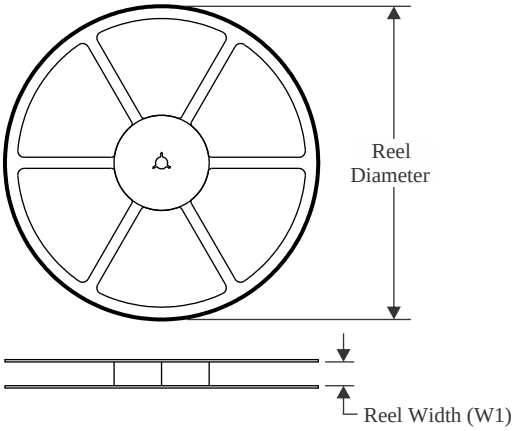
(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

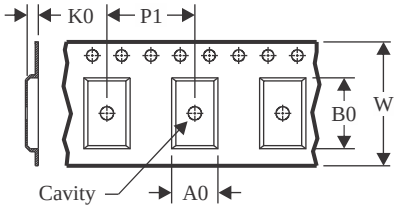
(6) Lead finish/Ball material - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

TAPE AND REEL INFORMATION

REEL DIMENSIONS

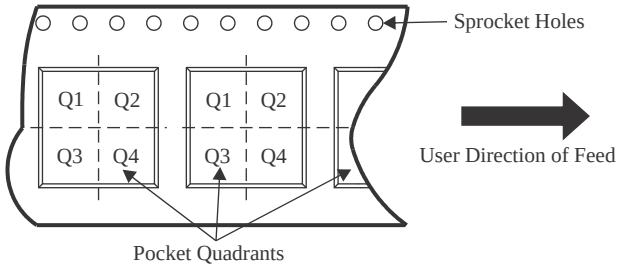


TAPE DIMENSIONS



A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

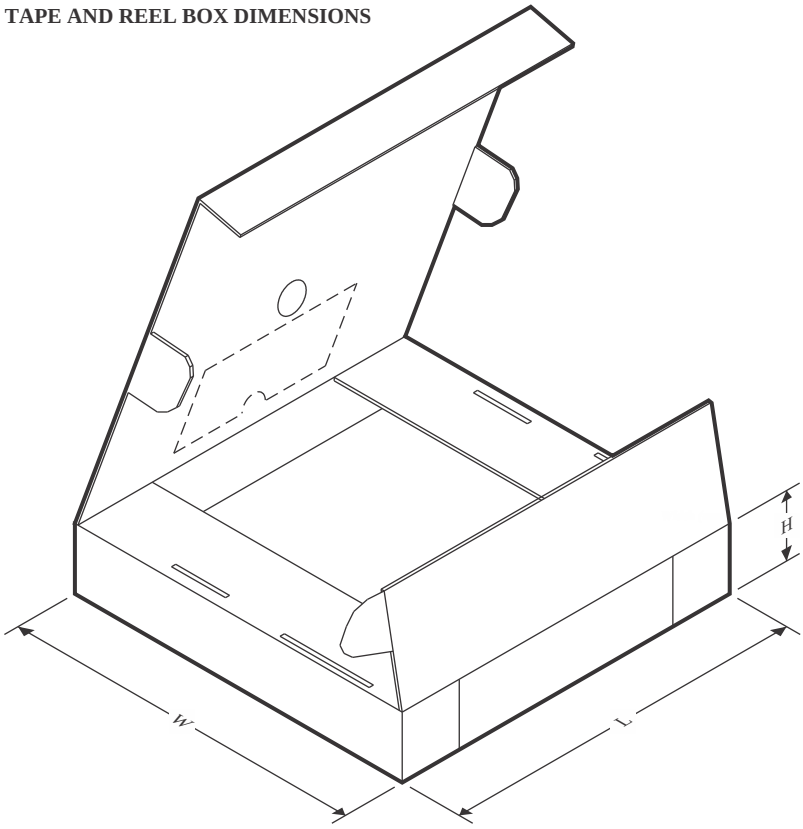
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
AFE10004RGER	VQFN	RGE	24	3000	330.0	12.4	4.35	4.35	1.1	8.0	12.0	Q2
AFE10004RGET	VQFN	RGE	24	250	180.0	12.5	4.35	4.35	1.1	8.0	12.0	Q2

TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
AFE10004RGER	VQFN	RGE	24	3000	338.0	355.0	50.0
AFE10004RGET	VQFN	RGE	24	250	205.0	200.0	33.0

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