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.

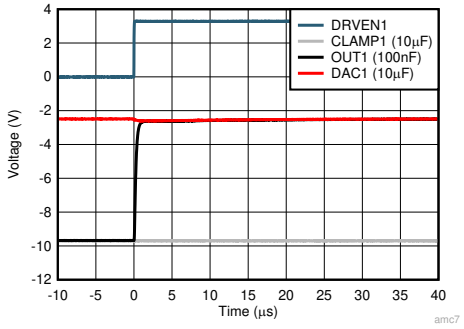
The AFE10004 has four gate bias outputs that are switched on and off through dedicated control pins. The gate bias switches are designed for fast response. In combination with the device PA_ON pin, this fast response enables correct power sequencing and protection of depletion-mode transistors, such 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 part number	Status (1)	Material type (2)	Package | Pins	Package qty | Carrier	RoHS (3)	Lead finish/ Ball material (4)	MSL rating/ Peak reflow (5)	Op temp (°C)	Part marking (6)
AFE10004RGER	Active	Production	VQFN (RGE) | 24	3000 | LARGE T&R	Yes	NIPDAU	Level-3-260C-168 HR	-40 to 125	AFE 10004
AFE10004RGER.A	Active	Production	VQFN (RGE) | 24	3000 | LARGE T&R	Yes	NIPDAU	Level-3-260C-168 HR	-40 to 125	AFE 10004
AFE10004RGER.B	Active	Production	VQFN (RGE) | 24	3000 | LARGE T&R	-	Call TI	Call TI	-40 to 125	
AFE10004RGET	Active	Production	VQFN (RGE) | 24	250 | SMALL T&R	Yes	NIPDAU	Level-3-260C-168 HR	-40 to 125	AFE 10004
AFE10004RGET.A	Active	Production	VQFN (RGE) | 24	250 | SMALL T&R	Yes	NIPDAU	Level-3-260C-168 HR	-40 to 125	AFE 10004
AFE10004RGET.B	Active	Production	VQFN (RGE) | 24	250 | SMALL T&R	-	Call TI	Call TI	-40 to 125	

(1) **Status:** For more details on status, see our product life cycle.

(2) **Material type:** When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.

(3) **RoHS values:** Yes, No, RoHS Exempt. See the TI RoHS Statement for additional information and value definition.

(4) **Lead finish/Ball material:** Parts 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.

(5) **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.

(6) **Part marking:** There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

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OTHER QUALIFIED VERSIONS OF AFE10004 :

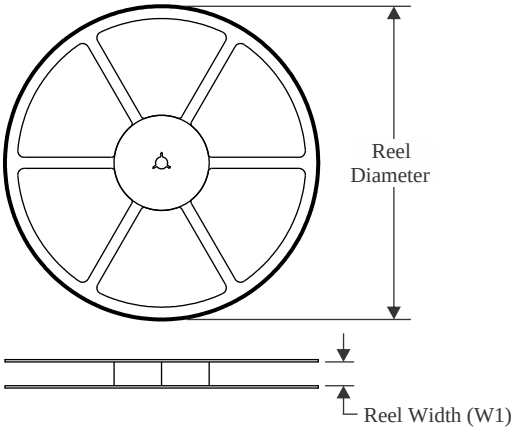
- Enhanced Product : AFE10004-EP

NOTE: Qualified Version Definitions:

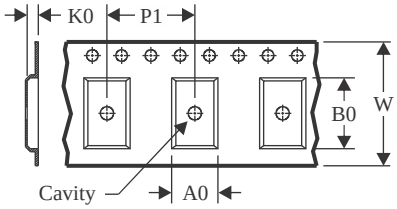
- Enhanced Product - Supports Defense, Aerospace and Medical Applications

TAPE AND REEL INFORMATION

REEL DIMENSIONS

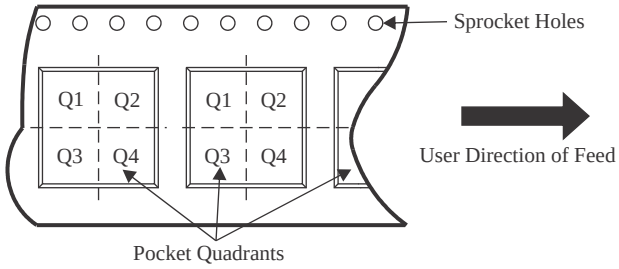


TAPE DIMENSIONS



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

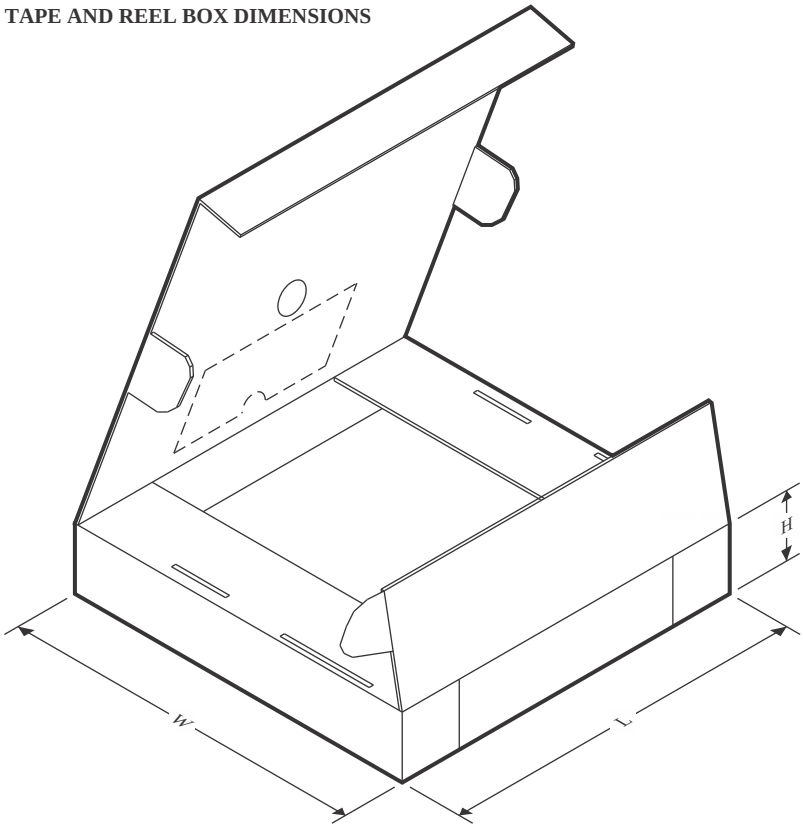
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*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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