

RAD1419 Analog-to-Digital Converter

Data Sheet

April, 2012

www.aeroflex.com/AtoD



FEATURES

- ❑ 800 kSPS sample rate
- ❑ 150mW power dissipation
- ❑ Typical performance: 81.5dB S/(N + D) and 93dB THD
- ❑ No pipeline delays or missing codes
- ❑ Nap and shutdown modes
- ❑ Operates with 2.5V internal 15ppm/°C reference or external reference
- ❑ True differential inputs reject common mode noise
- ❑ 20MHz full-power bandwidth sampling
- ❑ Bipolar input range: $\pm 2.5V$
- ❑ Operational Environment; total dose irradiation testing to MIL-STD-883 Method 1019
 - Total-dose: 100 krad(Si)
 - Latchup immune ($LET \leq 55 \text{ MeV-cm}^2/\text{mg}$)
- ❑ Packaging options:
 - 28-lead hermetic ceramic flatpack
- ❑ Class S A-to-D Converter built to your custom flow

INTRODUCTION

Aeroflex RAD's RAD1419 Analog-to-Digital Converter (ADC) is a 1 μ s, 800kSPS, 14-bit sampling A/D converter that draws only 150mW from $\pm 5V$ supplies. This easy-to-use device includes a high dynamic range sample-and-hold and a precision reference.

Two digitally selectable power shutdown modes provide flexibility for low power systems.

The RAD1419 has a full-scale input range of $\pm 2.5V$. Outstanding AC performance includes 81.5dB S/(N + D) and 93dB THD with a 100kHz input; 80dB S/(N + D) and 86dB THD at the Nyquist input frequency of 400kHz.

The unique differential input sample-and-hold can acquire single-ended or differential input signals up to its 20MHz bandwidth. The 60dB common mode rejection allows users to eliminate ground loops and common mode noise by measuring signals differentially from the source.

The ADC has a μ P compatible, 14-bit parallel output port. There is no pipeline delay in the conversion results. A separate convert start input and data ready signal (BUSY) ease connections to FIFOs, DPSs and microprocessors.

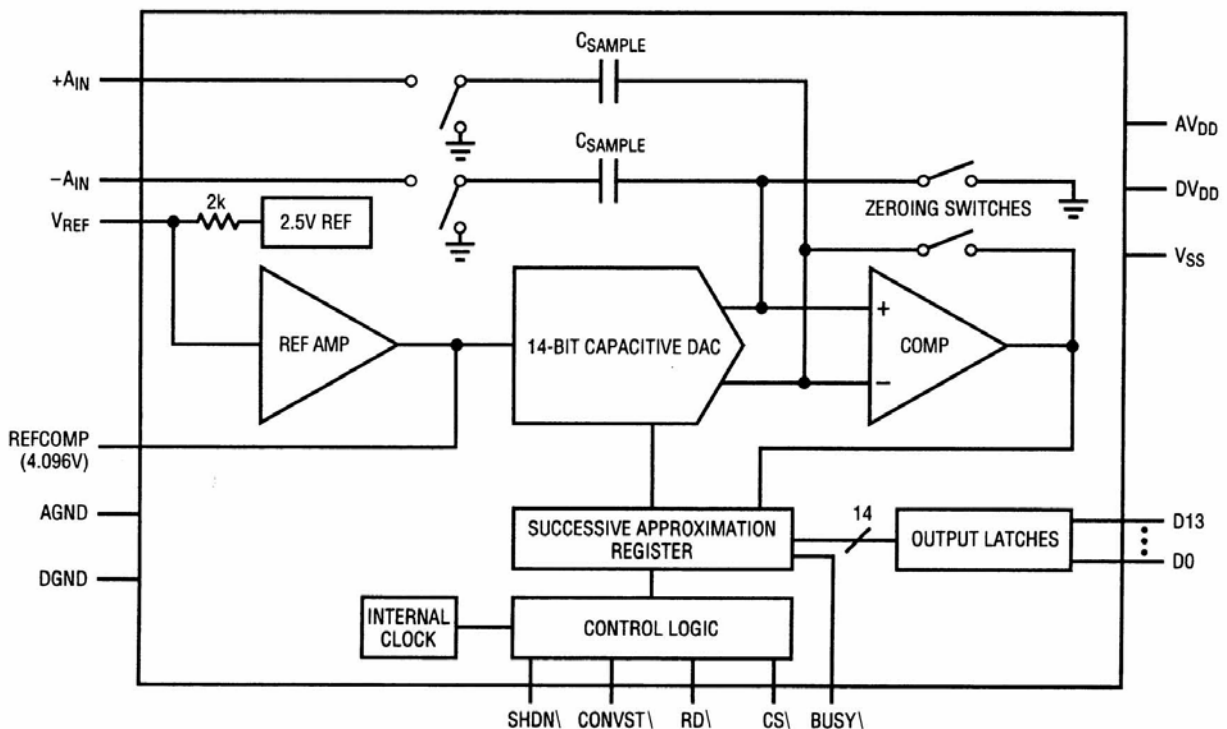


Figure 1. RAD1419 Block Diagram

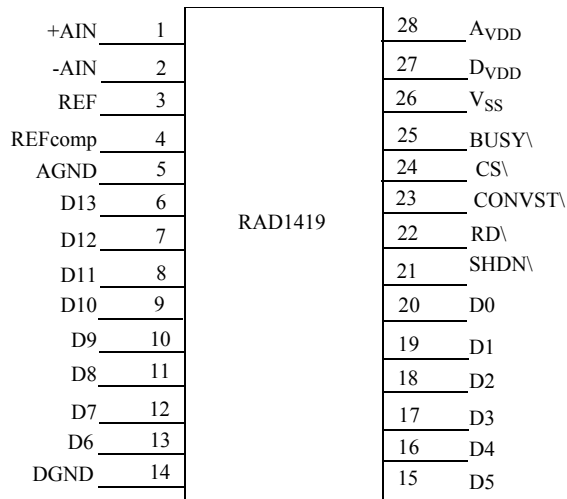


Figure 2. RAD1419 Pinout

PIN DESCRIPTION

Pin Name	No.	Description
+AIN	1	$\pm 2.5V$ Positive analog input
-AIN	2	$\pm 2.5V$ Negative analog input
VREF	3	2.5V Reference output. Bypass to AGND with 1 μF .
REFcomp	4	4.06V Reference output. Bypass to AGND with 10 μF tantalum in parallel with 0.1 μF or 10 μF ceramic.
AGND	5	Analog ground
D13 to D6	6-13	Three-state data outputs. The output format is 2's complement.
DGND	14	Digital ground for internal logic. Tie to AGND.
D5 to D0	0-5	Three-state data outputs. The output format is 2's complement.
SHDN\	21	Power shutdown input. Low selects shutdown. Shutdown mode selected by CS\, CS\ = 0 nap mode and CS\ = 1 for sleep mode.
RD\	22	Read input. This enables the output drivers when CS\ is low.
CONVST\	23	Conversion start signal. This active low signal starts a conversion on its falling edge.
CS\	24	Chip select. The input must be low for the ADC to recognize CONVST\ and RD\ inputs. CS\ also sets the shutdown mode when SHDN\ goes low. CS\ and SHDN\ low select the quick wake-up nap mode. CS\ high and SHDN\ low select sleep mode.
BUSY\	25	The BUSY\ output shows the converter status. It is low when a conversion is in progress. Data valid on the rising edge of BUSY\.
VSS	26	5V Negative supply. Bypass to AGND with 10 μF tantalum in parallel with 0.1 μF or 10 μF ceramic.
DVDD	27	5V Positive supply. Short to Pin 28.
AVDD	28	5V Positive Supply. Bypass to AGND with 10 μF tantalum in parallel with 0.1 μF or 10 μF ceramic.

OPERATIONAL ENVIRONMENT

PARAMETER	LIMIT	UNITS
Total Ionizing Dose (TID)	1.0E5	rad(Si)
Single Event Latchup (SEL)	≤ 55	MeV-cm ² /mg
Neutron Fluence ¹	1.0E13	n/cm ²

Notes:

1. Guaranteed but not tested.

ABSOLUTE MAXIMUM RATINGS¹

(Referenced to V_{SS})

SYMBOL	PARAMETER	LIMITS
V_{DD}	Supply voltage	6.0V
V_{SS}	Negative supply voltage	-6.0V
V_{DD} to V_{SS}	Total supply voltage	12.0V
T_{STG}	Storage temperature	-65 to +150°C
P_D	Maximum power dissipation	500mW
T_J	Maximum junction temperature	TBD
Θ_{JC}	Thermal resistance, junction-to-case ²	TBD

Notes:

- Stresses outside the listed absolute maximum ratings may cause permanent damage to the device. This is a stress rating only, and functional operation of the device at these or any other conditions beyond limits indicated in the operational sections of this specification is not recommended. Exposure to absolute maximum rating conditions for extended periods may affect device reliability and performance.
- Test per MIL-STD-883, Method 1012.

RECOMMENDED OPERATING CONDITIONS

SYMBOL	PARAMETER	LIMITS
V_{SS} to V_{DD}	Input/output voltage	-0.5V to +0.5V
T_C	Case temperature range	-55 to +125°C

ELECTRICAL CHARACTERISTICS

CONVERTER CHARACTERISTICS

*Denotes specifications which apply over the full operating temperature range, otherwise specifications are TA = +25°C. With Internal Reference.^{5,6}

SYMBOL	PARAMETER	CONDITIONS	GROUP A SUBGROUPS	MIN	TYP	MAX	UNITS
	Resolution	(No Missing Codes)	1	14			Bits
			2				
			3				
INL	Integral Linearity Error	Note 7	1		±0.8	±2	LSB
			2				
			3				
DNL	Differential Linearity Error		1		±0.7	±1.5	LSB
			2				
			3		±0.7	±2	LSB
	Offset Error	Note 8	1		±5	±20	LSB
			2				
			3				
	Full scale Error Internal Reference		1		±10	±60	LSB
	Full scale Error External Reference	2.5V			±5		LSB
	Full Scale Tempco	I _{OUT} (REF) = 0			±15		ppm/°C

ANALOG INPUT

*Denotes specifications which apply over the full operating temperature range, otherwise specifications are TA = +25°C.⁵

SYMBOL	PARAMETER	CONDITIONS	GROUP A SUBGROUPS	MIN	TYP	MAX	UNITS
V _{IN}	Analog Input Range	4.75V ≤ V _{DD} ≤ 5.25V, -5.25V ≤ V _{SS} ≤ -4.75V *			±2.5		V
I _{IN}	Analog Input Leakage Current	CS\ = HIGH	1			±1	μA
			2				
			3				
C _{IN}	Analog Input Capacitance	Between Conversions			15		pF
C _{IN}	Analog Input Capacitance	During Conversions			5		pF
t _{ACQ}	Sample-and-Hold Acquisition Time	Note 9			90	300	ns
t _{AP}	Sample-and-Hold Aperture Delay Time				-1.5		ns
t _{JITTER}	Sample-and-Hold Aperture Delay Time Jitter				2		psRMS
CMRR	Analog Input Common Mode Rejection Ratio	-2.5V < (-AIN = AIN) < 2.5V			60		dB

DYNAMIC ACCURACY

*Denotes specifications which apply over the full operating temperature range, otherwise specifications are TA = +25°C.⁵

SYMBOL	PARAMETER	CONDITIONS	GROUP A SUBGROUPS	MIN	TYP	MAX	UNITS
S/(N + D)	Signal-to (Noise + Distortion) Ratio	100 KHz Input Signal *	4	78	81.5		dB
S/(N + D)	Signal-to (Noise + Distortion) Ratio	390 KHz Input Signal *			80.0		dB
THD	Total Harmonic Distortion	100 KHz Input Signal, First 5 Harmonics *	4		-93	-86	dB
THD	Total Harmonic Distortion	390 KHz Input Signal, First 5 Harmonics *			-86		dB
SFDR	Spurious Free Dynamic Range	100 KHz Input Signal *	4		-95	-86	dB
IMD	Intermodulation Distortion	f _{IN1} = 29.37 KHz, f _{IN2} = 32.446 KHz			-86		dB
	Full-Power Bandwidth				20		MHz
	Full-Linear Bandwidth	S/(N + D) ≥ 77dB			1		MHz

INTERNAL REFERENCE CHARACTERISTICS⁵

SYMBOL	PARAMETER	CONDITIONS	GROUP A SUBGROUPS	MIN	TYP	MAX	UNITS
V _{REF}	Output Voltage	I _{OUT} = 0	1	2.480	2.500	2.520	V
			2				
			3				
V _{REF}	Output Tempco	I _{OUT} = 0			±15		ppm/°C
V _{REF}	Line Regulation	4.75V < V _{DD} < 5.25V, -5.25V < V _{SS} < -4.75V			0.05		LSB/V
V _{REF}	Output Resistance	-0.1mA < I _{OUT} < 0.1mA			2		kΩ
REFCOMP	Output Voltage	I _{OUT} = 0			4.06		V

DIGITAL INPUTS AND DIGITAL OUTPUTS

*Denotes specifications which apply over the full operating temperature range, otherwise specifications are TA = +25°C.⁵

SYMBOL	TEST	TEST CONDITION	GROUP A SUBGROUPS	MIN	TYP	MAX	UNITS
V _{IH}	High Level Input Voltage	V _{DD} = 5.25V * Note 12	1	2.4			V
			2				
			3				
V _{IL}	Low Level Input Voltage	V _{DD} = 4.75V * Note 12	1			0.8	V
			2				
			3				
I _{IN}	Digital Input Current	V _{IN} = 0V to V _{DD} *	1			±10	μA
			2				
			3				
C _{IN}	Digital Input Capacitance				5		pF
V _{OH}	High Level Output Voltage	V _{DD} = 4.75V IO = -10μA*			4.5		V
V _{OH}	High Level Output Voltage	V _{DD} = 4.75V IO = -200μA	1	4.0			V
			2				
			3				
V _{OL}	Low Level Output Voltage	V _{DD} = 4.75V IO = 160μA			0.05		V
V _{OL}	Low Level Output Voltage	V _{DD} = 4.75V IO = 1.6mA *	1		0.10	0.4	V
			2				
			3				
I _{OZ}	High-Z Output Leakage D13 to D0	V _{OUT} = 0V to V _{DD} , CS\ High *	1			±10	μA
			2				
			3				
C _{OZ}	High-Z Output Capacitance D13 to D0	CS\ High, Note 9 *				15	pF
I _{SOURCE}	Output Source Current	V _{OUT} = 0V			-10		mA
I _{SINK}	Output Sink Current	V _{OUT} = V _{DD}			10		mA

POWER REQUIREMENTS

*Denotes specifications which apply over the full operating temperature range, otherwise specifications are TA = +25°C.⁵

SYMBOL	PARAMETER	CONDITIONS	GROUP A SUBGROUPS	MIN	TYP	MAX	UNITS
V _{DD}	Positive Supply Voltage	Note 10		4.75		5.25	V
V _{SS}	Negative Supply Voltage	Note 10		-4.75		-5.25	V
I _{DD}	Positive Supply Current		1		11	20	mA
			2				
			3				
I _{DD}	Positive Supply Current	Nap Mode: SHDN\ = 0V, CS\ = 0V			1.5		mA
I _{DD}	Positive Supply Current	Sleep Mode: SHDN\ = 0V, CS\ = 5V			250		μA
I _{SS}	Negative Supply Current		1		19	30	mA
			2				
			3				
I _{SS}	Negative Supply Current	Nap Mode: SHDN\ = 0V, CS\ = 0V			100		μA
I _{SS}	Negative Supply Current	Sleep Mode: SHDN\ = 0V, CS\ = 5V			1		μA
P _{DIS}	Power Dissipation		1		150	240	mW
			2				
			3				
P _{DIS}	Power Dissipation	Nap Mode: SHDN\ = 0V, CS\ = 0V	1		7.5	1.2	mW
			2				
			3				
P _{DIS}	Power Dissipation	Sleep Mode: SHDN\ = 0V, CS\ = 5V			1.2		mW

TIMING CHARACTERISTICS

*Denotes specifications which apply over the full operating temperature range, otherwise specifications are TA = +25°C.⁵

SYMBOL	PARAMETER	CONDITIONS	GROUP A SUBGROUPS	MIN	TYP	MAX	UNITS
f _{SAMPLE} (MAX)	Maximum Sampling Frequency	Note 9 *	9	800			kHz
			10				
			11				
t _{CONV}	Conversion Time		9		950	1150	ns
			10				
			11				
t _{ACQ}	Acquisition Time	Note 9 *	9		90	300	ns
			10				
			11				
t _{ACQ} + CONV	Acquisition + Conversion Time	Note 9 *	9		1040	1250	ns
			10				
			11				
t ₁	CS\ to RD\ Setup Time	Note 9 *		0			ns
t ₂	CS\ to CONVST\ Setup Time	Note 9 *		40			ns
t ₃	CS\ to SHDN\ Setup Time	Note 9		40			ns
t ₄	SHDN\ to CONVST\ Wake-up Time	Note 10			400		ns
t ₅	CONVST\ Low Time	Notes 9, 11 *	9	40			ns
			10				
			11				
t ₆	CONVST\ to BUSY\ Delay	CL = 25pF	9		20		ns
t ₆	CONVST\ to BUSY\ Delay	CL = 25pF	9			50	ns
			10				
			11				
t ₇	Data Ready Before BUSY\		9	20	50		ns
t ₇	Data Ready Before BUSY\	Note 9	9	15			ns
			10				
			11				
t ₈	Delay Between Conversions	Note 9 *	9	40			ns
			10				
			11				
t ₉	Wait Time RD\ After BUSY\	Note 9 *		-5			ns
t ₁₀	Data Access Time After RD\	CL = 25pF	9		15	25	ns
t ₁₀	Data Access Time After RD\	CL = 25pF, Note 9	9			35	ns
			10				
			11				
t ₁₀	Data Access Time After RD\	CL = 100pF, Note 9	9		20	35	ns
t ₁₀	Data Access Time After RD\	CL = 100pF, Note 9	9			50	ns
			10				
			11				
t ₁₁	Bus Relinquish Time	Note 9	9		10	20	ns

TIMING CHARACTERISTICS (Cont'd)

*Denotes specifications which apply over the full operating temperature range, otherwise specifications are TA = +25°C.⁵

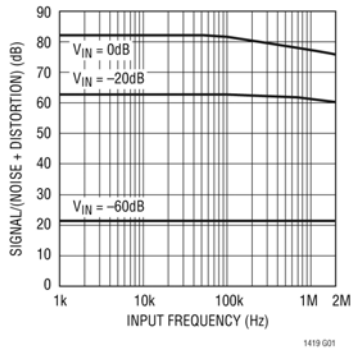
SYMBOL	PARAMETER	CONDITIONS	GROUP A SUBGROUPS	MIN	TYP	MAX	UNITS
t ₁₁	Bus Relinquish Time		9			35	ns
			10				
RD\ Low Time	t ₁₂	Note 9 *	9	10			ns
			10				
			11				
CONVST\ High Time	t ₁₃	Note 9 *	9	40			ns
			10				
			11				
			11				

Notes:

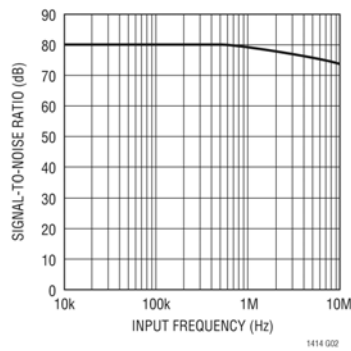
Parameters listed only as "Typical" are not tested in production.

1. Absolute Maximum Ratings are those values beyond which the life of a device may be impaired.
2. All voltage values are with respect to ground with D_{GND} and A_{GND} wired together unless otherwise noted.
3. When these pin voltages are taken below V_{SS} or above V_{DD}, they will be clamped by internal diodes. This product can handle input currents greater than 100mA below V_{SS} or above V_{DD} without latch up.
4. When these pin voltages are taken below V_{SS}, they will be clamped by internal diodes. This product can handle input currents greater than 100mA below V_{SS} without latch up. These pins are not clamped to V_{DD}.
5. V_{DD} = 5V, V_{SS} = -5V, f_{SAMPLE} = 800kHz, tr = tf = 5ns unless otherwise specified.
6. Linearity, offset and full-scale specifications apply for a single ended +A_{IN} input with - A_{IN} grounded.
7. Integral nonlinearity is defined as the deviation of a code from a straight line passing through the actual endpoints of the transfer curve. The deviation is measured from the center of the quantization band.
8. Bipolar offset is the offset voltage measured from -0.5LSB when the output code flickers between 0000 0000 0000 00 and 1111 1111 1111 11.
9. Guaranteed by design or characterization, not subject to test in production.
10. Recommended operating conditions.
11. The falling edge of CONVST\ starts a conversion. If CONVST\ returns high at a critical point during the conversion it can create small errors. For best performance ensure that CONVST\ returns high either within 650ns after the start of the conversion or after BUSY rises.
12. V_{IH} and V_{IL} will be guaranteed by testing V_{OH} and V_{OL} at the appropriate levels.

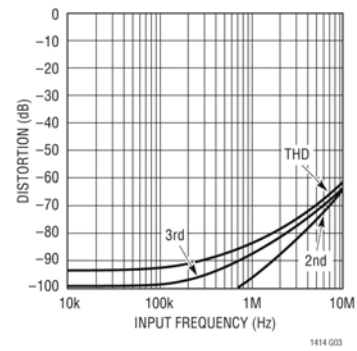
S/(N+D) vs Input Frequency and Amplitude



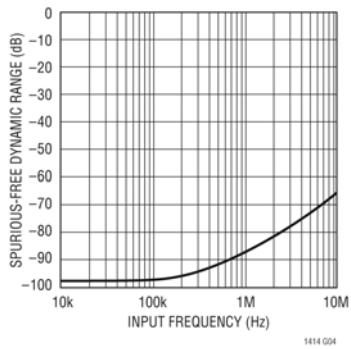
Signal-to-Noise Ratio



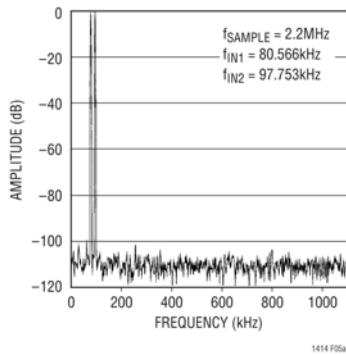
Distortion vs Input Frequency



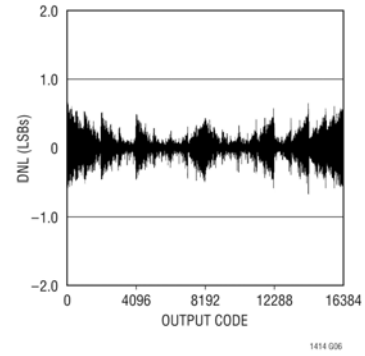
Spurious-Free Dynamic Range vs Input Frequency



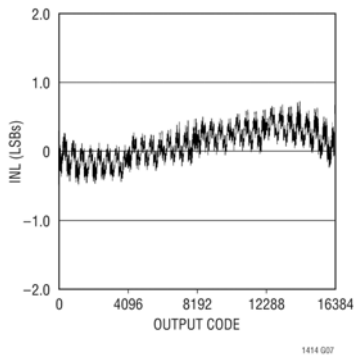
Intermodulation Distortion Plot



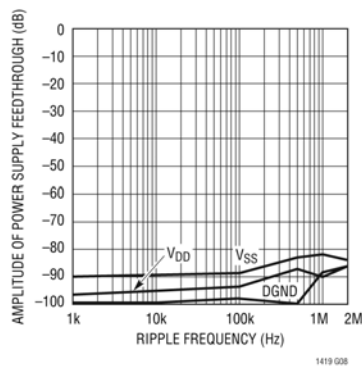
Differential Nonlinearity vs Output Code



Integral Nonlinearity vs Output Code



Power Supply Feedthrough vs Ripple Frequency



Input Common Mode Rejection vs Input Frequency

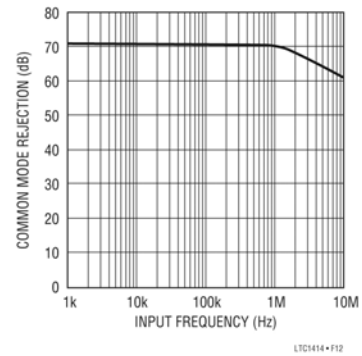


Figure 2. Typical Performance Characteristics

ELECTRICAL REQUIREMENTS

TEST REQUIREMENTS	SUBGROUPS
Pre Burn-in electrical parameters	1,4,9
Interim electrical parameters	1,4,9
Final electrical test parameters	1,2,3,4,9,10,11
Post seal electrical test parameters	1
Group A electrical test parameters	1,2,3,4,9,10,11
Group B electrical test parameters	1,4,9
Group C electrical test parameters	1,4,9
Group D electrical test parameters	1,4,9

SUBGROUP	Definitions
1	Static characteristics 25°C
2	Static characteristics 125°C
3	Static characteristics -55°C
4	Dynamic characteristics 25°C
5	Dynamic characteristics 125°C
6	Dynamic characteristics -55°C
9	Switching characteristics 25°C
10	Switching characteristics 125°C
11	Switching characteristics -55°C

PACKAGING

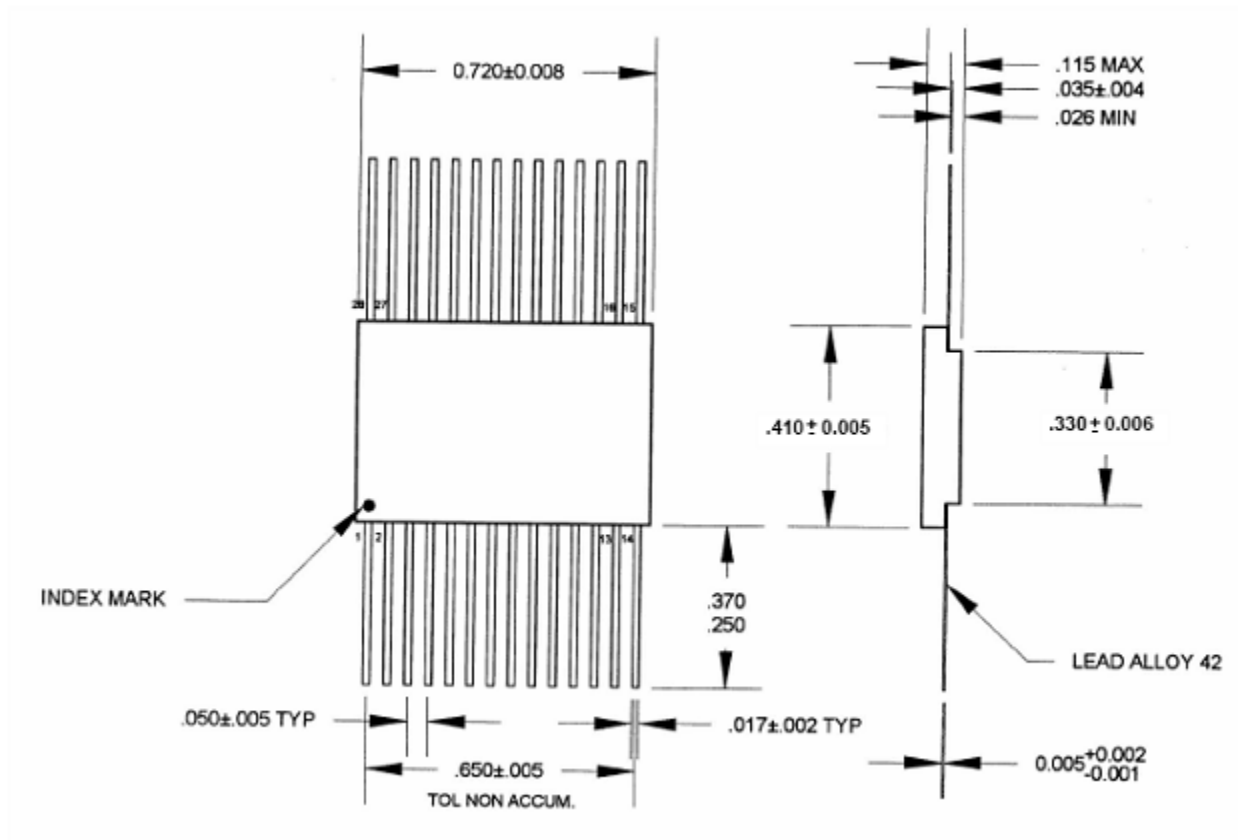
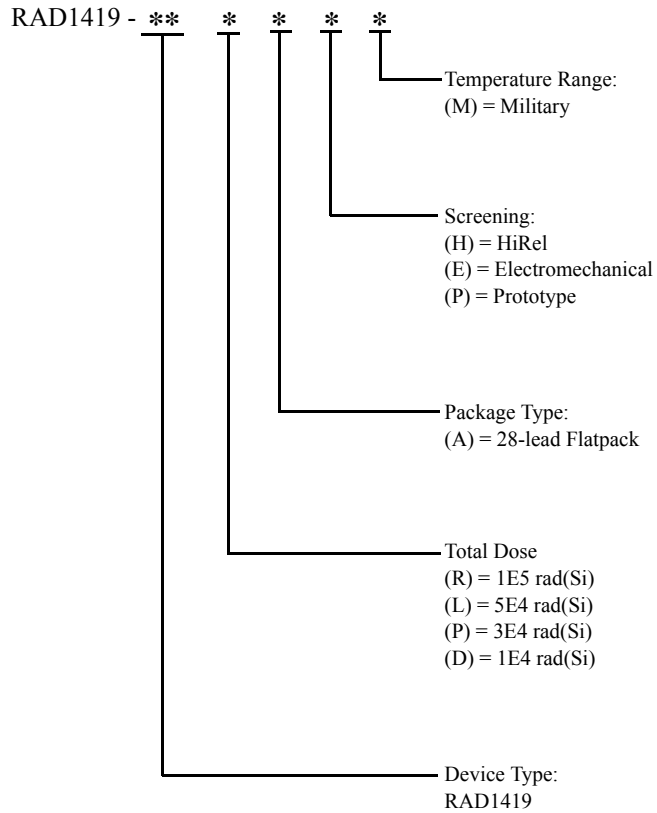


Figure 4. 28-Lead Hermetic Ceramic Flatpack

ORDERING INFORMATION

RAD1419:



Notes:

1. Military temperature range: -55°C to 125°C .
2. Prototype devices are tested at 25°C only, in a production package.
3. Electromechanical devices are tri-temp tested (-55°C , 25°C , 125°C), post-assembly screening: fine and gross leak, burn-in a production package.

Aeroflex RAD- Datasheet Definition

Datasheet - Class S Compliant

COLORADO

Toll Free: 800-645-8862
Fax: 719-594-8468

INTERNATIONAL

Tel: 805-778-9229
Fax: 805-778-1980

NORTHEAST

Tel: 603-888-3975
Fax: 603-888-4585

SE AND MID-ATLANTIC

Tel: 321-951-4164
Fax: 321-951-4254

WEST COAST

Tel: 949-362-2260
Fax: 949-362-2266

CENTRAL

Tel: 719-594-8017
Fax: 719-594-8468

www.aeroflex.com info-ams@aeroflex.com

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