DATASHEET

REV M: 11/17/21

SCD8663

3A LDO Adjustable Negative Voltage Regulator

VRG8663

Features

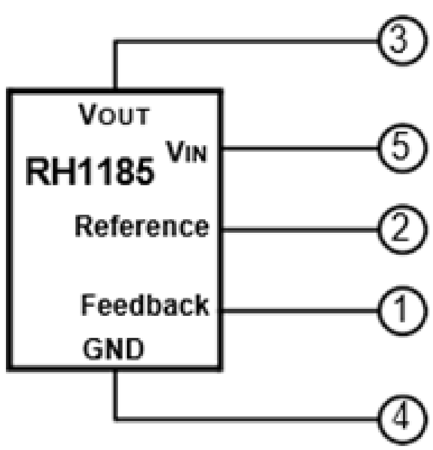
- Manufactured using Analog Devices Space Qualified RH1185 die
- Radiation performance
- Total dose: >100 krad(Si), Dose rate = 50-300 rad(Si)/s
- ELDRS: > 50 krad(Si), Dose rate = 0.01 rad(Si)/s
- Thermal shutdown
- Output voltage adjustable: -2.37 to -25V
- Dropout voltage: 1.05V at 3.0 Amps
- 5-Terminal
- Output current: 3A
- Voltage reference: -2.370V ±3%
- Load regulation: 0.8% max
- Line regulation: 0.02% max
- Ripple rejection: >60dB
- Packaging – Hermetic metal
  - Hermetic Surface Mount Power Package
  - 5 Pads, .545"L x .296"W x .120"Ht
  - Weight - 1.2 gm max
- Designed for aerospace and high reliability space applications
- Radiation Hardness Assurance Plan: DLA Certified to MIL-PRF-38534, Appendix G.

Description

The VRG8663 consists of a Negative Adjustable (RH1185) LDO voltage regulator capable of supplying 3.0 Amps over the output voltage range as defined under recommended operating conditions. The VRG8663 offers excellent line and load regulation specifications and ripple rejection. Dropout (VIN - VOUT) decreases at lower load currents.

The VRG8663 serves a wide variety of applications including High Efficiency Linear Regulators, Post Regulators for Switching Supplies, Constant Current Regulators, Battery Chargers and Microprocessor Supply.

The VRG8663 has been specifically designed to meet exposure to radiation environments and is configured for a SMD power package. It is guaranteed operational from -55°C to +125°C. Available screened to MIL-STD-883, the VRG8663 is ideal for demanding military and space applications.



BLOCK DIAGRAM / SCHEMATIC

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Absolute Maximum Ratings

PARAMETER	RANGE	UNITS
Input Voltage	-35	VDC
Lead temperature (soldering 10 Sec)	300	°C
Input Output Differential	30	VDC
Feedback & Reference Voltage	-7	VDC
Output Voltage	-30	VDC
ESD	2000 1/	V
Operating Junction Temperature Range	-55 to +150	°C
Storage Temperature Range	-65 to +150	°C

1/ Meets ESD testing per MIL-STD-883, method 3015, Class 1C.

NOTICE: Stresses above those listed under "Absolute Maximums Rating" may cause permanent damage to the device. These are stress rating only; functional operation beyond the "Operation Conditions" is not recommended and extended exposure beyond the "Operation Conditions" may effect device reliability.

Recommended Operating Conditions

PARAMETER	RANGE	UNITS
Output Voltage Range	-2.45 to -25	VDC
Input Output Differential	1 to 28	VDC
Case Operating Temperature Range	-55 to +125	°C

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Electrical Performance Characteristics

Unless otherwise specified, -55°C < Tc < +125°C.

PARAMETER	SYM	CONDITIONS (P ≤ PMAX)	MIN	MAX	UNITS
Reference Voltage (At pin 1) 2/ 7/	VREF	5mA ≤ IOUT ≤ 3A, VIN - VOUT = 1.2V to 28V, VOUT = -5V	-2.29	-2.45	V
Dropout Voltage 2/ 4/	VDROP	IOUT = 0.5A, VOUT = -5V	-	0.425	V
		IOUT = 3A, VOUT = -5V	-	1.05	V
Line Regulation 2/ 8/	ΔVOUT / ΔVIN	1.0V ≤ VIN - VOUT ≤ 20V, VOUT = -5V, ILOAD = 5mA	-	0.02	%/V
Load Regulation 2/ 8/	ΔVOUT / ΔIOUT	5mA ≤ IOUT ≤ 3A, VIN - VOUT = 1.5V to 10V, VOUT = -5V	-	0.8	%
Minimum Input Voltage 2/ 5/	VIN MIN	IOUT = 3A , VOUT = VREF	-	-4.5	V
Internal Current Limit (See Figure 4) 2/ 11/	ICL	1.5V ≤ VIN - VOUT ≤ 10V	3.3	4.55	A
		VIN - VOUT = 15V	2.0	4.5	A
		VIN - VOUT = 20V	1.0	3.1	A
		VIN - VOUT = 28V 3/	0.2	1.6	A
External Current Limit 2/	ILIM	RLIM = 15KΩ 10/	2.7	3.7	A
		RLIM = 5KΩ 10/	0.9	1.75	A
Quiescent Supply Current 2/ 6/	IQ	IOUT = 5mA, VOUT = VREF, -4V ≤ VIN ≤ -25V	-	3.5	mA

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Electrical Performance Characteristics

Unless otherwise specified, -55°C < Tc < +125°C.

PARAMETER	SYM	CONDITIONS (P < PMAX)	MIN	MAX	UNITS
Supply Current Change with Load 2/	IQΔ	VIN – VOUT = VSAT 9/	-	35	mA/A
		VIN – VOUT Š 2V	-	21	mA/A
Ripple Rejection	-	IOUT = 1.0A, VIN - VOUT = 3V, f = 120Hz,	60	-	dB
Thermal Regulation (See application info LT1185) 3/	-	VIN – VOUT = 10V, IOUT = 5mA to 2A, TC = +25°C	-	0.014	%/W
Thermal Resistance (Junction to Case)	ΘJC		-	3	°C/W

Notes:

1) Meets ESD testing per MIL-STD-883, method 3015, Class 2.
2) Specifications derated to reflect Total Dose exposure to 100 krad(Si) @ +25°C.
3) Not tested. Shall be guaranteed by design, characterization, or correlation to other tested parameters.
4) Dropout voltage is tested by reducing input voltage until the output drops 1% below its nominal value. Tests are done at 0.5A and 3A. The power transistor looks basically like a pure resistance in this range so that minimum differential at any intermediate current can be calculated by interpolation; VDROPOUT = 0.25V + (0.25Ω x IOUT). For load current less than 0.5A, see Figure 3.
5) "Minimum input voltage" is limited by base emitter voltage drive of the power transistor section, not saturation as measured in Note 4. For output voltages below 4V, "minimum input voltage" specification may limit dropout voltage before transistor saturation limitation.
6) Supply current is measured on the ground pin, and does not include load current, RLIM, or output divider current.
7) The 25W power level is guaranteed for an input-output voltage of 8.3V to 17V. At lower voltages the 3Amp limit applies, and at higher voltages the internal power limiting may restrict regulator power below 25W.
8) Line and load regulation are measured on a pulse basis with a pulse width of 2ms, to minimize heating. DC regulation will be affected by thermal regulation and temperature coefficient of the reference.
9) VSAT is the maximum specified dropout voltage: 0.25V + (0.25 x IOUT).
10) Current limit is programmed with a resistor from REF pin to GND. RLIM = 15k Ω/ILIM.
11) Pulsed @<10% duty cycle @25°C.

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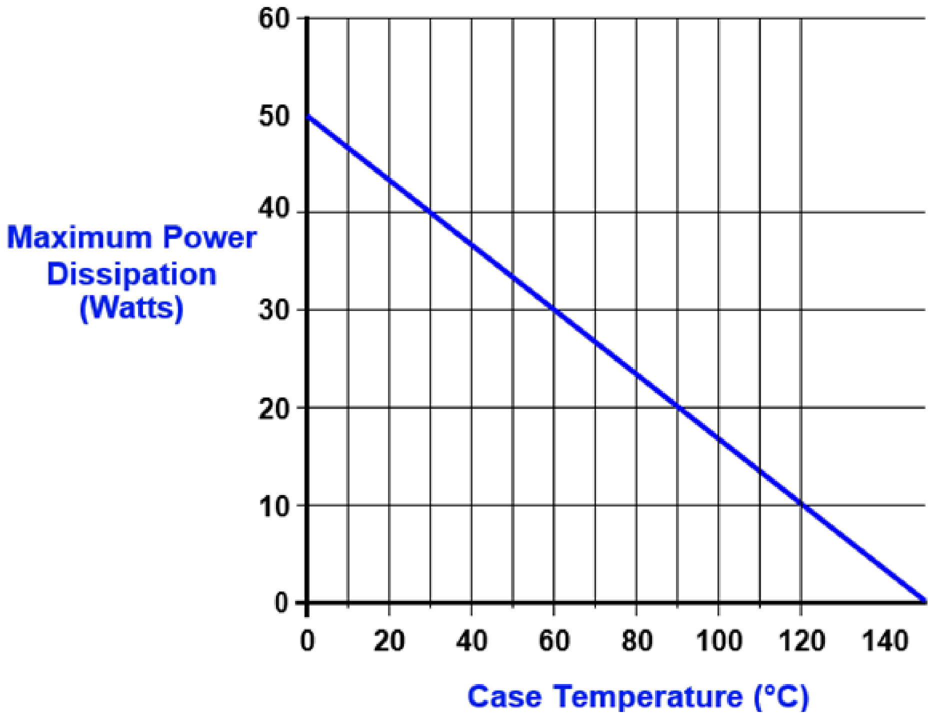
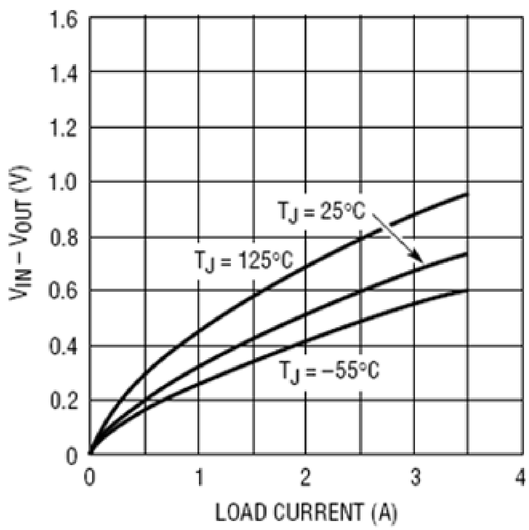
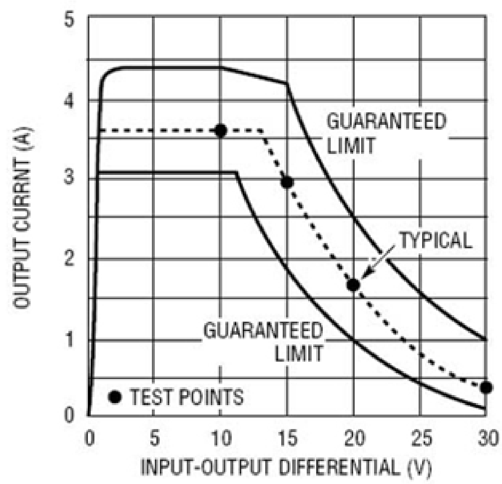


MAXIMUM POWER vs CASE TEMPERATURE

The maximum Power dissipation is limited by the thermal shutdown function of the regulator chip in the VRG8663. The graph above represents the achievable power before the chip shuts down. The line in the graph represents the maximum power dissipation of the VRG8663 This graph is based on the maximum junction temperature of 150°C and a thermal resistance (ΘJC) of 3°C/W.



RH1185 DROPOUT VOLTAGE
TYPICAL CURVE



RH1185 INTERNAL CURRENT LIMIT

The RH1185 output voltage is set by two external resistors. Internal reference voltage is trimmed to 2.37V so that a standard 1% 2.37k resistor (R1) can be used to set divider current at1mA. R2 is then selected from:

$$R2 = \frac{(V_{OUT} - 2.37)\,R1}{VREF}$$

for R1 = 2.37k and VREF = 2.37V, this reduces to:

$$R2 = \frac{V_{OUT} - 2.37}{10^{-3}}$$

suggested values of 1% resistors are shown.

VOUT	R2 WHEN R1 = 2.37k
2.5V	130^
3..3V	930^
5V	2.67k
12V	9.76k
15V	12.7k

SETTING OUTPUT VOLTAGE

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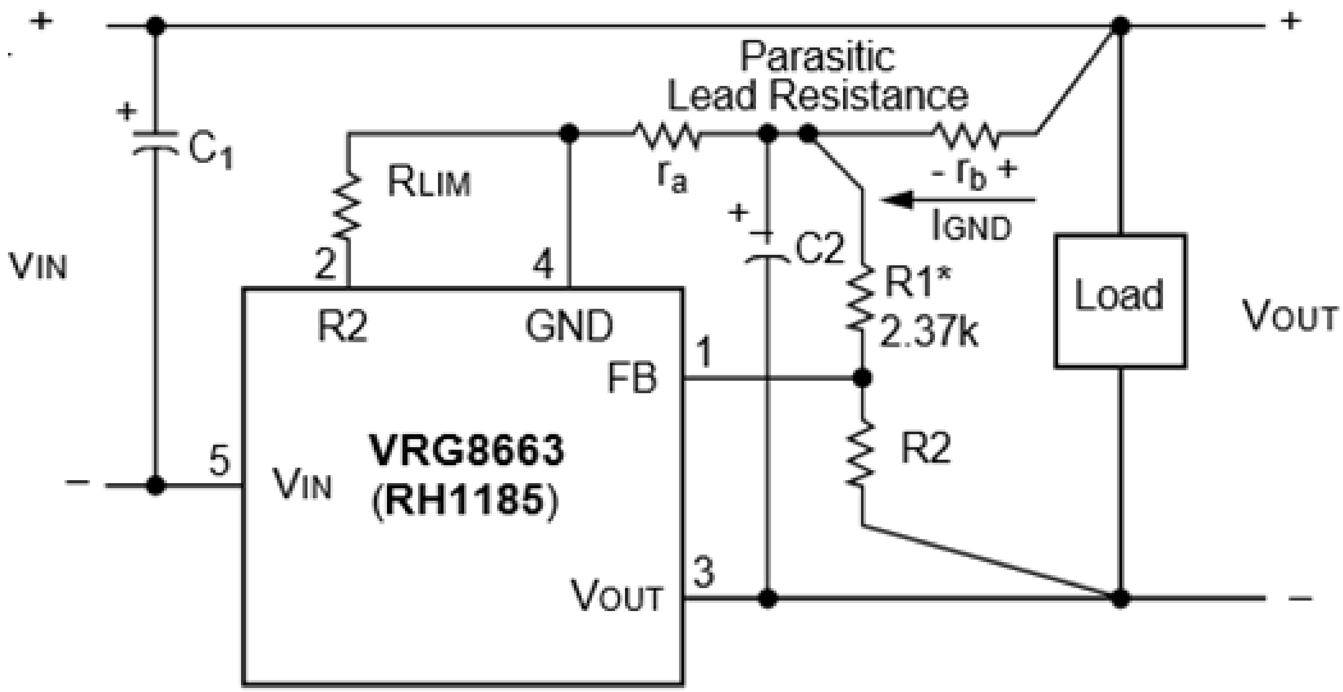

BASIC VRG8663 ADJUSTABLE REGULATOR APPLICATION
R1 & R2 LOCATION & PROPER CONNECTION OF POSITIVE SENSE LEAD

*R1 should be connected directly to ground lead, not to the load, so that ra=0Ω. This limits the output voltage error to (IGND)(rb). Errors created by ra are multiplied by (1 + R2/R1). Note that VOUT increases with increasing ground pin current. R2 should be connected directly to load for remote sensing. C1 = C2 > 2µF Tantalum.

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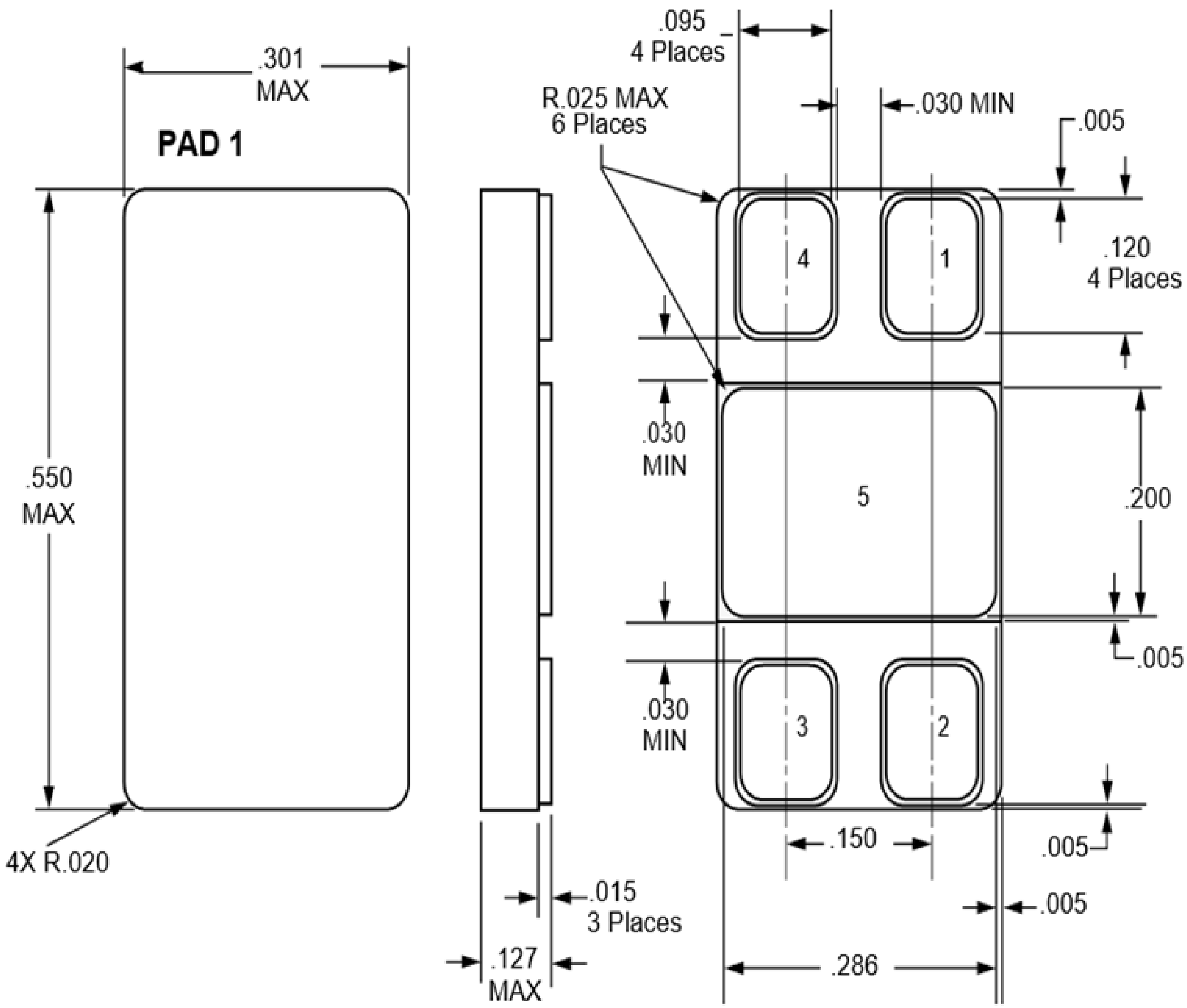

PACKAGE OUTLINE — SURFACE MOUNT

Notes:

1) Package & Lid are electrically isolated from signal pads.

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Ordering Information

MODEL	DLA SMD #	SCREENING	PACKAGE
VRG8663 - 7	-	Commercial Flow, +25°C testing only	SMD Power Pkg
VRG8663 - S	-	Military Temperature, -55°C to +125°C Screened in accordance with the individual Test Methods of MIL-STD-883 for Space Applications	
VRG8663- 201-1S	5962-0920702KYC	In accordance with DLA SMD	
VRG8663- 201-2S	5962-0920702KYA		
VRG8663- 901-1S	5962R0920702KYC		
VRG8663- 901-1S	5962R0920702KYC	In accordance with DLA Certified RHA Program Plan to RHA Level "R", 100 krad(Si)	

Revision History

Rev	ECN Description	DATE
F	REVISED PER ECN 8663-14	12/06/11
G	REVISED PER ECN 8663-16	06/20/12
H	REVISED PER ECN 8663-18	04/21/16
J	REVISED PER ECN 8663-21	10/23/16
K	REVISED PER ECN 23408	12/11/20
L	REVISED PER ECN 23925	11/09/21
M	REVISED PER ECN 23939	11/17/21

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Datasheet Definition

Datasheet	Definition
Advanced Datasheet	Product In Development
Preliminary Datasheet	Shipping Prototype
Datasheet	Shipping QML & Reduced Hi - Rel

For detailed performance characteristic curves, applications information and typical applications, see the latest Analog Devices datasheet for their RH1185, which is available on-line at www.Analog.com.

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