

# LEO, RHF, RHR, N, ST, JAN, BYW, STPS, STTH, STRH, ACT, VCXH, HC, AC

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# Rad-hard products

## Introduction

A comprehensive ecosystem of products and services for traditional and new space.

For over 40 years at STMicroelectronics, we have been developing a wide portfolio of radiation hardened products qualified to ESCC, QML-V, and JANS standards. We are recognized for our product quality and reliability, our flexible service options, and our longevity commitment for the supply of legacy products.

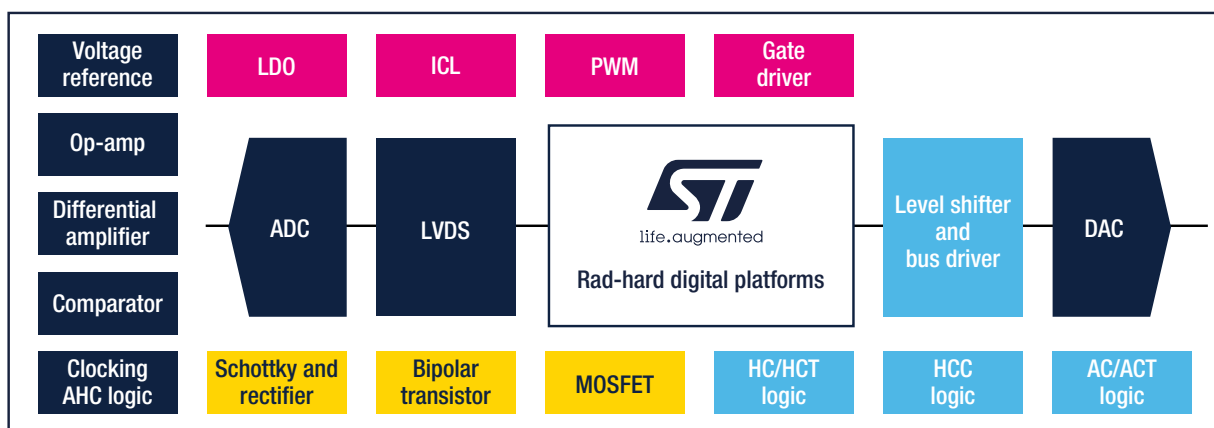
From our earliest involvement in space, our semiconductor and package technologies have flown in the majority of space crafts and missions, including the James Webb Space Telescope and Artemis moon exploration program.

Recent upgrades to our ESCC and DLA Space certified assembly facility ensure the highest process quality, sophistication, and capacity for our traditional range of space discrete, logic, interface, analog, and power management products.

Regarding new space, ST is currently releasing a new series of rad-hard companion chips in plastic packages for LEO constellations and enabling a new generation of GEO VHTS software-defined communications satellites through technologies and extended foundry services that draw from our space and hardening expertise, our most advanced differentiated mixed signal and RF technologies, and major experience in other high-performance industries such as automotive.

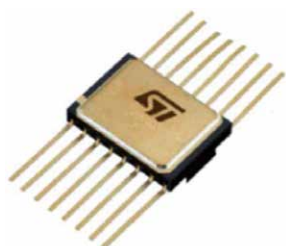
ST completes its foundry services with a fully European supply chain for ASIC customers or fabless companies, offering the most recent packaging technologies covering high-pin-count wire-bonded or flip-chip packages on ceramic or organic substrates from our upgraded space assembly facility.

### A PORTFOLIO OF PRODUCTS AND TECHNOLOGIES

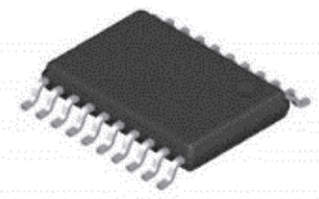


Legend: □ Asic and foundry    ■ Power    ■ Analog    ■ Logic and interfaces    ■ Discretes

QML-V, ESCC, and JANS products



Rad-hard plastic for LEO and New Space

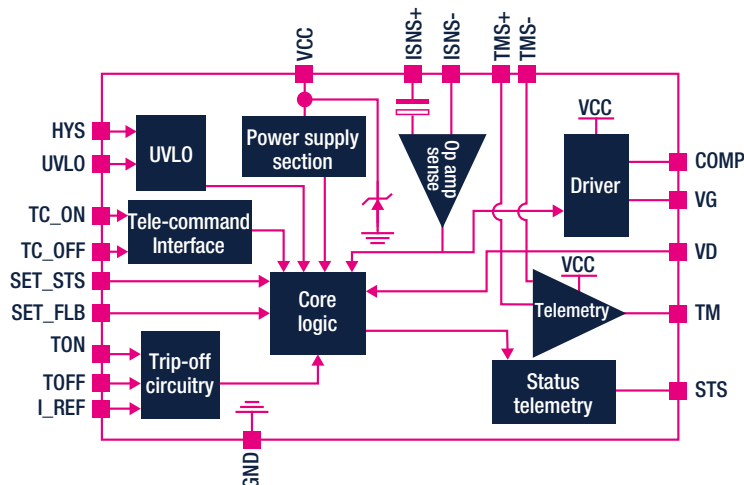


# Power management

## RHRPMICL1A RAD-HARD INTEGRATED CURRENT LIMITER SOC SMD: 5962R17211

### KEY FEATURES

- Qualified for wide supply voltage range: 8.5-52 V
- Configurable for operation over 52 V
- Retriggerable, latched, and fold-back modes
- Current limitation and undervoltage protection
- Configurable trip-off and recovery times
- Floating ground
- Repetitive overload handling
- Telemetry I/Os

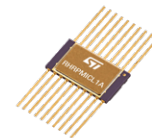


### TYPICAL APPLICATION

- Load protection
- Electronic fuse
- Current limitation

### RADIATION PERFORMANCE

- RHA guaranteed at 100 krad(Si) ELDRS free
- SEL & SEU free up to 125 MeV.cm<sup>2</sup>/mg
- SET characterized

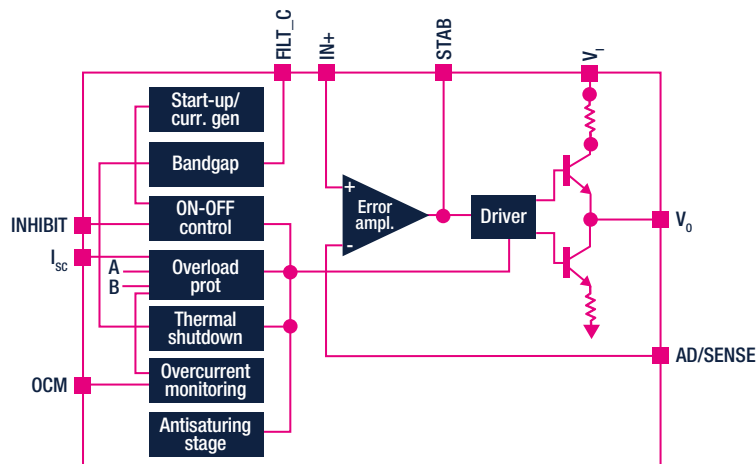


Flat-20

## RHFL6000L RAD-HARD VERY LOW VOLTAGE LDO SMD: 5962F15216

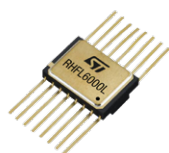
### KEY FEATURES

- Extended operating Vin range: 3.0 to 12 V
- Vout min: 0.6 V
- Iout: 2 A max
- Low drop: 0.35 V typ @ 0.4 A
- Current sink capable for fast power down
- Overtemperature & overcurrent protection



### RADIATION PERFORMANCE

- RHA guaranteed at 300 krad(Si) ELDRS
- SEL & SEU free up to 68 MeV.cm<sup>2</sup>/mg
- Fully characterized SET



Flat-16P

## QML-V linear voltage regulators

Enhanced low dose rate sensitivity free  
 Full protection set: overvoltage, overtemperature, and overcurrent  
 Inhibit pin  
 Temperature range: -55 to +125°C

Part number	Description	TID RHA <sup>(1)</sup> [krad(Si)]	SEL/SET threshold <sup>(2)</sup> [MeV.cm <sup>2</sup> /mg]	QML-V SMD#	V <sub>cc</sub> range [V]	V <sub>out</sub> min. [V]	I <sub>out</sub> max. [A]	Package
RHFL6000A	Adjustable positive	300	120/120 <sup>(3)</sup>	5962F15216	2.5 to 12	1.23	2.0	Flat-16P
RHFL6000L <sup>(4)</sup>	Adjustable positive			5962F15216		0.6		
RHFL4913A	Adjustable positive		120/86	5962F02524	3 to 12	1.23	3.0	Flat-16P <sup>(5)</sup> , SMD5C
RHFL4913XX15	1.5V fixed positive			5962F15215		1.46		
RHFL4913XX25	2.5V fixed positive			5962F02534		2.45		
RHFL4913XX33	3.3V fixed positive			5962F02535	3.23			
RHFL4913XX50	5.0V fixed positive			5962F02536	4.9			
RHFL7913A	Adjustable negative			5962F02532	-12 to -3	-9.5		

- (1) All products integrate CMOS and bipolar structures. They are therefore tested at high and low dose rates.  
 (2) See details in the datasheet; the complete characterization data, tested configuration, Weibull parameters, and actual impact is provided in the radiation report (available on request).  
 (3) One configuration with less than 3.3% V<sub>out</sub> variation @ 120 MeV. See radiation report for other configurations.  
 (4) Under development.  
 (5) I<sub>out</sub> = 2 A max.

## QML-V current limiter

Enhanced low dose rate sensitivity free  
 Highly configurable: current limit, timings, protection voltages  
 Floating ground  
 Temperature range: -55 to +125°C

Part number	Description	TID RHA <sup>(1)</sup> [krad(Si)]	SEL/SEB/SET threshold <sup>(2)</sup> [MeV.cm <sup>2</sup> /mg]	QML-V SMD#	V <sub>cc</sub> range [V]	Other features	Package
RHRPMICL1A	Integrated current limiter	100	120/120/9	5962R17211	8.5 to 52	3 operating modes <sup>(3)</sup>	Flat-20

- (1) The product integrates CMOS and bipolar structures. It is therefore tested at high and low dose rates.  
 (2) See datasheet for details on the test conditions and Weibull parameters. The radiation report (available on request) provides the complete characterization including descriptions of the actual impacts.  
 (3) Retriggerable, latched, and foldback

## QML-V gate drivers

Enhanced low dose rate sensitivity free  
 Parallel driving capable  
 110 ns typical propagation time  
 Matched propagation time  
 Temperature range: -55 to +125°C

Part number	Description	TID RHA <sup>(1)</sup> [krad(Si)]	SEL/SEB/SET threshold <sup>(2)</sup> [MeV.cm <sup>2</sup> /mg]	QML-V SMD#	V <sub>cc</sub> range [V]	I <sub>SOURCE</sub> / I <sub>SINK</sub> peak per gate typ. [A]	Package
RHRPM4423	Dual low-side inverting	100	70/70/18	5962R99511	4.65 to 16	4.5	Flat-10, Flat-16P
RHRPM4424	Dual low-side noninverting			5962R99560			

- (1) The products integrate CMOS and bipolar structures. They are tested at high and low dose rates.  
 (2) See datasheet for details on the test conditions and Weibull parameters. The radiation report (available on request) provides the complete characterization including descriptions of the actual impacts.

## ESCC PWM

Oscillator frequency up to 250 kHz  
 High current totem pole outputs  
 Temperature range: -55 to +150°C

Part number	Description	TID RHA <sup>(1)</sup> [krad(Si)]	SEE threshold [MeV.cm <sup>2</sup> /mg]	ESCC detail specification	V <sub>cc</sub> range [V]	Duty cycle max. [%]	Package
ST1843	Current mode PWM controller	50	120	9108/020	7.6 to 30	100	Flat-8
ST1845		100		9108/021		50	

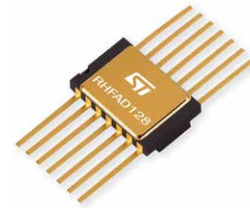
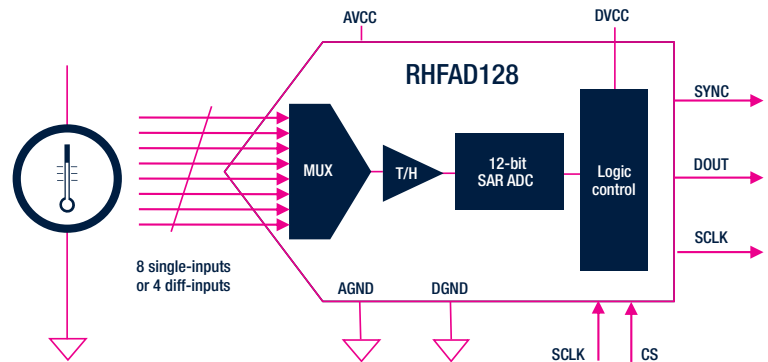
- (1) The products include only bipolar structures. They are therefore only tested at low dose rates.

# Analog

## RHFAD128 RAD-HARD, 12-BIT ANALOG-TO-DIGITAL CONVERTER SMD: 5962F18204

### KEY FEATURES

- SAR architecture
- Industry standard pinout
- 50 ksp/s–1 Msp/s conversion rate
- 8-to-1-channel single input MUX
- 4-to-1-channel differential input MUX
- SPI output
- 2.7–3.6 V operating supply, 4.8 V AMR
- Very low consumption: 1.65 mA typ. @ 3.6 V
- Power-down with high Z-out



Flat-16 with grounded lid

### RADIATION PERFORMANCE

- RHA guaranteed at 300 krad(Si)
- SEL & SEU free up to 125 MeV.cm<sup>2</sup>/mg
- SET characterized

### QML-V A/D converter

Demo board available  
Temperature range: -55 to +125°C

Part number	Description	TID RHA [krad(Si)]	SEL/SEU/SEFI threshold <sup>(1)</sup> [MeV.cm <sup>2</sup> /mg]	QML-V SMD#	V <sub>cc</sub> range [V]	INL/DNL <sup>(2)</sup> [LSB]	Input/output	Power typ. <sup>(5)</sup> [mW]	Package
RHFAD128	12-bit, 1 Msp/s, 8-channel, SAR <sup>(3)</sup>	300	135/32/62	5962F18204	2.7 to 3.6	±1.1/±0.9	Differential/SPI	6	Flat-16 <sup>(4)</sup>
RHF1201	12-bit, 50 Msp/s, pipeline		120/120/120	5962F05217	2.5 to 3.3	±2/±0.5	Differential/parallel	100	S0-48
RHF1401	14-bit 20 Msp/s, pipeline		120/120/120	5962F06260	2.5 to 3.3	±2/±1		85	S0-48

(1) See datasheet for details on the test conditions and Weibull parameters. The radiation report (available on request) provides the complete characterization including descriptions of the actual impacts.

(2) Integral nonlinearity/differential nonlinearity

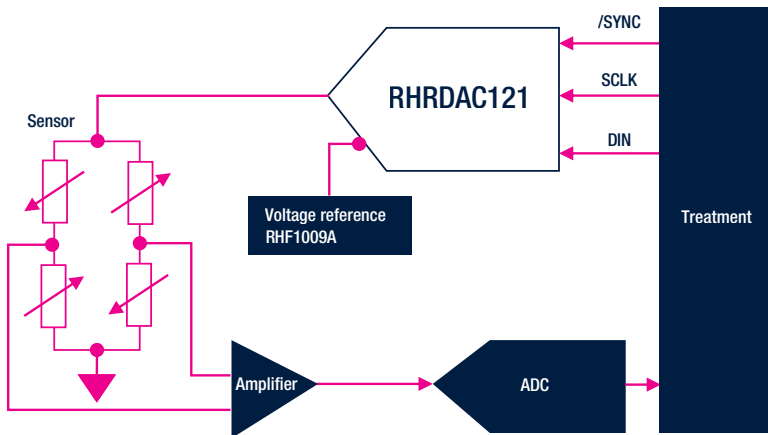
(3) Successive approximation registers

(4) Grounded metallic lid

(5) At nominal sampling rate

# RHRDAC121 RAD-HARD, 12-BIT DIGITAL-TO-ANALOG CONVERTER

## SMD: 5962F21208



### KEY FEATURES

- 12-bit architecture, serial input
- Industry standard pinout
- SPI compatible
- SYNC interrupt capability
- Clocked up to 20 MHz
- Rail to rail voltage output
- Power-on reset to zero volt output
- Internal voltage reference
- Vcc 2.3–3.6 V with 4.8 V absolute max
- 2.5 and 3.3 V logic compatible
- Power-down with high Z-out



Flat-10 with grounded lid

### RADIATION PERFORMANCE

- RHA guaranteed at 100 krad(Si)
- SEL free up to 120 MeV.cm<sup>2</sup>/mg @ 125°C
- SEE report available on request

### QML-V qualified D/A converters

Grounded metallic lid versions  
 Demo board available  
 Temperature range: -55 to +125°C

Part number	Description	TID RHA [krad(Si)]	SEL threshold <sup>(1)</sup> [MeV.cm <sup>2</sup> /mg]	QML-V SMD#	F <sub>clock</sub> [MHz]	V <sub>cc</sub> range [V]	INL/DNL <sup>(2)</sup> [LSB]	Package
RHRDAC121	12-bit, differential in, SPI out	100	125	5962R21208	20	1.8 to 3.6	±4/±0.7	Flat-10
RHRDAC1612	16-bit, sigma-delta, differential in, parallel out			5962F16211	0.012	2.3 to 3.6	±4.5/±0.3	Flat-24

(1) See datasheet for details on the test conditions and Weibull parameters. The radiation report (available on request) provides the complete characterization including descriptions of the actual impacts.  
 (2) Integral nonlinearity/differential nonlinearity

## QML-V operational amplifiers

Temperature range: -55 to +125°C

Demo boards available

Part number	Description	TID RHA [krad(Si)]	SEL threshold <sup>(1)</sup> [MeV.cm <sup>2</sup> /mg]	QML-V SMD#	V <sub>cc</sub> range [V]	I <sub>cc</sub> max/operator [mA]	Slew rate typ.(V/μs)	Rail to rail in/out	Package
RHF310A	120MHz high-speed single CFA <sup>(2)</sup>	300	110	5962F07233	4.5 to 5.5	0.4	115	No/No	Flat-8
RHF330A	1GHz low noise single CFA <sup>(2)</sup>			5962F07231		16.6	1800		
RHF350A	550MHz low noise single CFA <sup>(2)</sup>			5962F07232		4.1	700		
RHF43B	8MHz precision single VFA <sup>(3)</sup>			5962F06237	3.0 to 16	2.2	3	No/Yes	Flat-8
RHF484	8MHz precision quad VFA <sup>(3)</sup>	5962F08222	4.0 to 14	2.2	3	Flat-14W			
RHR61	0.7MHz low power single VFA <sup>(3)</sup>	100	120	5962F16204	1.5 to 5.5	0.06	0.3		Flat-8
RHR64	0.7MHz power quad VFA <sup>(3)</sup>			5962F16205		0.06	30		Flat-14

(1) See datasheet for details on the test conditions and Weibull parameters. The radiation report (available on request) provides complete characterization including descriptions of actual impacts.

(2) Current feedback amplifier

(3) Voltage feedback amplifier

## QML-V differential amplifier

Temperature range: -55 to +125°C

Part number	Description	TID RHA [krad(Si)]	SEL threshold <sup>(1)</sup> [MeV.cm <sup>2</sup> /mg]	QML-V SMD#	V <sub>cc</sub> range [V]	I <sub>cc</sub> max/operator [mA]	Rail to rail in/out	Package
RHF200	420MHz noninverting, high impedance in	300	110	5962F17210	4.5 to 5.5	27	No/Yes	Flat-16

(1) See datasheet for details on the test conditions and Weibull parameters. The radiation report (available on request) provides complete characterization including descriptions of actual impacts.

## QML-V ultrafast comparator

Temperature range: -55 to +125°C

Part number	Description	TID RHA [krad(Si)]	SEL threshold <sup>(1)</sup> [MeV.cm <sup>2</sup> /mg]	QML-V SMD#	V <sub>cc</sub> range [V]	I <sub>cc</sub> max/operator [mA]	Rail to rail in/out	Package
RHR801	7 ns, push-pull output	100	120	5962R10215	2.5 to 5.5	1.4	Yes	Flat-16

(1) See datasheet for details on the test conditions and Weibull parameters. The radiation report (available on request) provides complete characterization including descriptions of actual impacts.

## QML-V voltage references

Temperature range: -55 to +125°C

Demo boards available

Part number	Description	TID RHA [krad(Si)]	SEL threshold <sup>(1)</sup> [MeV.cm <sup>2</sup> /mg]	QML-V SMD#	V <sub>KA</sub> [V]	I <sub>k</sub> range [mA]	Package
RHF1009A	Adjustable shunt, 0.15% 30ppm/°C	300	120	5962F14222	2.5 to 5.5	0.06 to 12	Flat-10
RHF100	Fixed shunt, 0.15% 15ppm/°C			5962F14225	1.2		

(1) See datasheet for details on the test conditions and Weibull parameters. The radiation report (available on request) provides complete characterization including descriptions of actual impacts.

# Interfaces

## QML-V QUALIFIED 3.3 V LVDS DRIVER, RECEIVER, AND MULTIPLEXER

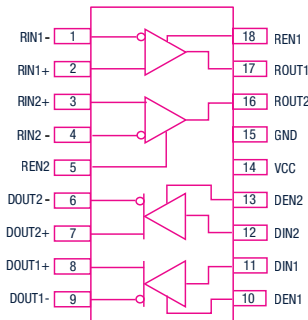
### KEY FEATURES

- Industry standard pinout
- 400 Mbps (200 MHz)
- Large common mode: -4 to +5 V
- V<sub>cc</sub>: 3 to 3.6 V operating, 4.8 V AMR
- 8 kV ESD on LVDS pins
- Cold spare and fail safe
- Grounded lid flat packages

### RADIATION HARDNESS

- RHA guaranteed at 300 krad(Si)
- SEL free up to 125 MeV.cm<sup>2</sup>/mg @ 125°C
- SET-free up to 67 MeV.cm<sup>2</sup>/mg

### SMD: 5962F060202

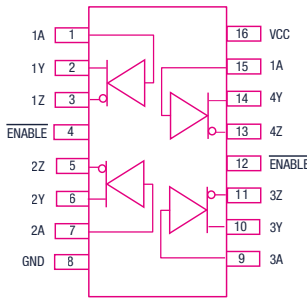


RHFLVDSR2D2 dual driver/receiver



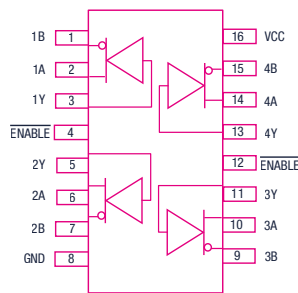
Flat package with grounded lid

### SMD: 5962F98651



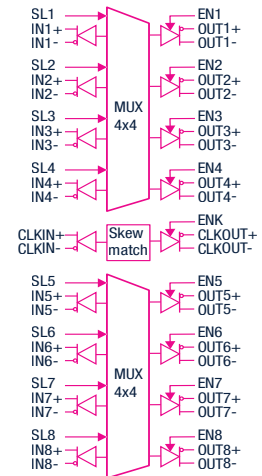
RHFLVDS31A quad driver

### SMD: 5962F98652



RHFLVDS32A quad receiver

### SMD: 5962F01537



RHFLVDS2281 dual 4x4 crosspoint switch

## QML-V 400 Mbps LVDS

Cold spare on all pins

Fail-safe

Grounded metallic lid versions on all parts

Temperature range: -55 to +125°C

Part number	Description	TID RHA [krad(Si)]	SEL/SET/SEU threshold <sup>(1)</sup> [MeV.cm <sup>2</sup> /mg]	QML-V SMD#	V <sub>cc</sub> range [V]	Data rate max. [Mbps]	V <sub>ICM</sub> <sup>(2)</sup> [V]	Package
RHFLVDS31A	High speed quad driver	300	135/67/67	5962F98651	3.0 to 3.6	400	-	Flat-16
RHFLVDS32A	High speed quad receiver		135/32/32	5962F98652	3.0 to 3.6		-4 to +5 V	Flat-16
RHFLVDS315	Quad driver		135/67/67	5962F98651	3.0 to 3.6		-	Flat-16
RHFLVDS325	Quad receiver		135/32/32	5962F98652	3.0 to 3.6		-4 to +5 V	Flat-16
RHFLVDSR2D2	Dual transceiver		120/32/32	5962F06202	3.0 to 3.6		-4 to +5 V	Flat-18
RHFLVDS2281	Dual 4x4 crosspoint switch		135/22/32	5962F01537	3.0 to 3.6		-4 to +5 V	Flat-64

(1) See datasheet for details on the test conditions and Weibull parameters. The radiation report (available on request) provides complete characterization including descriptions of the actual impacts.

(2) Input common mode voltage

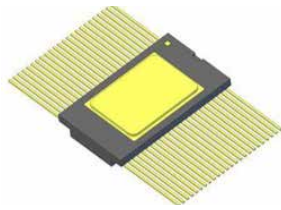


# RHFXH163245 1.8 TO 3.3 V 16-BIT LEVEL SHIFTER

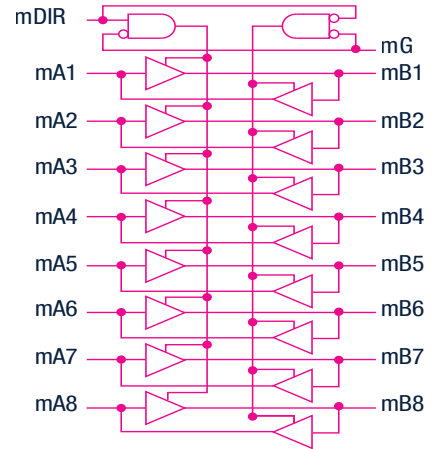
## SMD: 5962F11207

### KEY FEATURES

- Dual supply bidirectional level shifter
- Cold spare inputs and outputs
- Bus hold for floating redundant inputs (fail-safe)
- Port dedicated enable pin
- Very high speed: 7.5 max data propagation time



Flat-48 with grounded lid



### RADIATION HARDNESS

- RHA guaranteed at 300 krad(Si)
- SEL free up to 125 MeV.cm<sup>2</sup>/mg @ 125°C
- SET free @ 125 MeV.cm<sup>2</sup>/mg @ 125°C

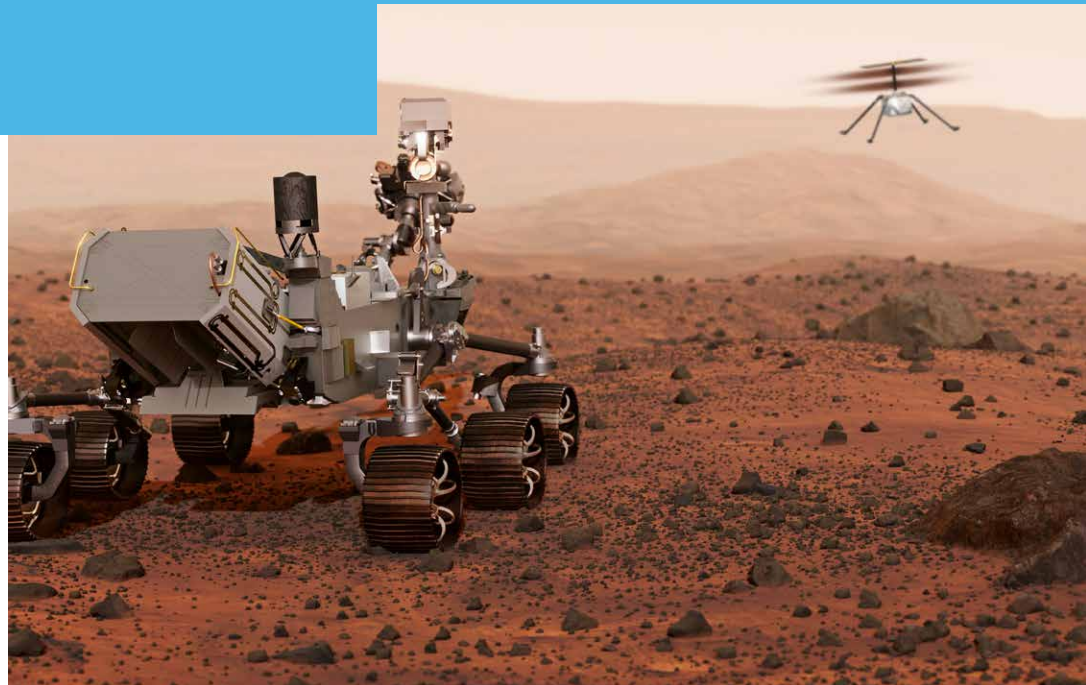
### QML-V qualified transceivers

Cold spare  
Grounded metallic lid versions on all parts  
Temperature range: -55 to +125°C

Part number	Description	TID RHA [krad(Si)]	SEL/SET/SEU threshold <sup>(1)</sup> [MeV.cm <sup>2</sup> /mg]	QML-V SMD#	V <sub>cc</sub> range [V]	Prop. time max [ns]	I <sub>cc</sub> max [A]	Package <sup>(2)</sup>
<b>Level shifters</b>								
54VCXH163245	16-bit bidirectional 1.8 to 3.3 V level shifter	300	110/110/-	5962F11207	1.65 to 3.6	3.4	20	Flat-48
54AC164245	16-bit bidirectional 3.3 to 5.0 V level shifter	100	120/21/-	5962R98580	2.3 to 6.0	8	100	
<b>Bus transceivers</b>								
54VCXH162244	16-bit bus buffer, resistance on bus A	300	110/110/-	5962F05210	1.8 to 3.3	3.4	20	Flat-48
54VCXH162245	16-bit bidirectional bus buffer, resistance on bus A			5962F05208				
54VCXHR162245	16-bit bidirectional bus buffer, resistance on bus A & B			5962F05213				
54AC16244	16-bit bus buffer		125/8/60	5962F04210	2.0 to 6.0	10	4	
54ACT16244	16-bit TTL bus buffer			5962F92022	4.5 to 5.5		40	
54AC16245	16-bit bidirectional bus buffer			5962R98580	2.0 to 6.0		4	
54ACT16245	16-bit TTL bidirectional bus buffer			5962F92023	4.5 to 5.5		40	

(1) See datasheet for details on the test conditions and Weibull parameters. The radiation report (available on request) provides the complete characterization.

# Logic



## Rad-hard logic series overview

ESCC	ESCC	QML-V	QML-V	QML-V
<b>HCC4000</b>	<b>54HC - HCT</b>	<b>54AC – ACT</b>	<b>VCX</b>	<b>AHC</b>
100 krad(Si) SEL free @ 120 MeV.cm <sup>2</sup> /mg SEU characterized	50 / 100 krad(Si) <sup>(1)</sup> SEL free @ 110 MeV.cm <sup>2</sup> /mg SEU characterized	300 krad(Si) SEL free @ 110MeV.cm <sup>2</sup> /mg SEU characterized		
<ul style="list-style-type: none"> <li>• 75 types</li> <li>• 3 to 15 V</li> </ul>	<ul style="list-style-type: none"> <li>• 75 types</li> <li>• 2 to 6 V</li> </ul>	<ul style="list-style-type: none"> <li>• 62 types</li> <li>• 2 to 6 V/4.5 to 5.5 V</li> <li>• High Speed: 70 MHz typ.                             <ul style="list-style-type: none"> <li>• Prop delay: 9ns @ 3 V</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• 6 types</li> <li>• 1.65 to 3.6 V</li> <li>• Prop delay: 3.6 ns @ 3V</li> <li>• Cold spare</li> </ul>	<ul style="list-style-type: none"> <li>• 2 types</li> <li>• 2.3 to 3.6 V</li> <li>• 150MHz+                             <ul style="list-style-type: none"> <li>• Prop delay: 3ns @ 3 V</li> </ul> </li> </ul>
HCC4051 analog mux	M54HC4051 analog mux	Grounded lid versions for all Flat packaged FM		
		AC2525 clock driver AC/ACT16xxx 16-bit bus interfaces Level shifter 2.3 to 5 V	Level shifter 1.65 to 3.6 V	AHC00 RHFOSC04

(1) See TN1292 for specific information about 100 krad(Si) versions

Mux/demux	Transceivers	PLLs	Oscillators
Buffers	Gates	Flip-flops	Latches
Decoders	Counters	Adders	

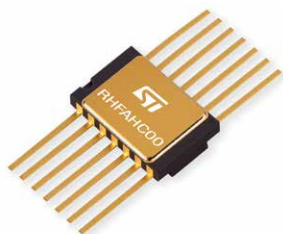
## RHFAC14A LOW POWER HEX SCHMIDT TRIGGER SMD: 5962F20207

### KEY FEATURES

- Static supply current between  $V_{ih}$  and  $V_{in}$ : 7.5 mA max
  - not specified in the standard version
- Same SMD as standard version (dedicated variant)
- Grounded lid versions

### KEY BENEFITS

- Reduced consumption in fast/waveform cleaning applications
- Pin to pin compatible with standard version (variant 01)
- Single BOM change for reduced power and grounded lid

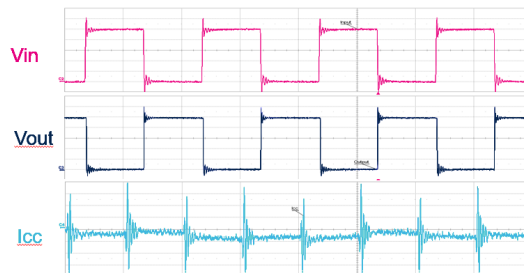


Flat-14 with grounded lid

### RADIATION HARDNESS

- RHA guaranteed at 300 krad(Si)
- SEL free up to 125 MeV.cm<sup>2</sup>/mg @ 125°C
- SET free up to 125 MeV.cm<sup>2</sup>/mg

### Typical waveforms at 1 MHz @ $V_{cc} = 5.0 V$

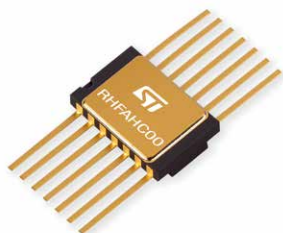


Icc peak: 9.7 mA, Icc avg: 1.72 mA

## RHFAHC00 RAD-HARD, HIGH-SPEED QUAD NAND GATE SMD: 5962F20207

### KEY FEATURES

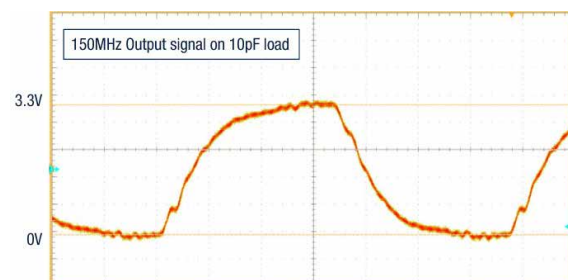
- 1.65 to 3.6 V operating supply (4.8 V absolute max. rating)
- Ultralow power: 50  $\mu A$  quiescent current @no load
- Very high speed: characterized up to 200 MHz
- propagation delay 3 ns max.
- Space proven 130 nm CMOS technology



Flat-14 with grounded lid

### RADIATION HARDNESS

- RHA guaranteed at 300 krad(Si)
- SEL free up to 125 MeV.cm<sup>2</sup>/mg @ 125°C
- SET free up to 62.5 MeV.cm<sup>2</sup>/mg



## QML-V 150MHz+ AHC Logic series

Grounded metallic lid versions on all parts  
Temperature range: -55 to +150°C

Part number	Description	TID RHA [krad(Si)]	SEL/SET/SEU threshold <sup>(1)</sup> [MeV.cm <sup>2</sup> /mg]	QML-V SMD	V <sub>cc</sub> range [V]	Frequency max. [MHz]	Tr/Tf <sup>(2)</sup> typ. [ns]	Package
RHFOSC04	Crystal oscillator driver and divider	300	125/125/125	5962F20207	2.3 to 3.6	120	1.6	Flat-10
RHFAHC00	Quad high speed NAND gate		125/62/125	5962F18202	1.65 to 3.6	150	1.3	Flat-14

(1) See datasheet for details on the test conditions and Weibull parameters. The radiation report (available on request) provides the complete characterization.

(2) Tr: output rise time; Tf: output fall time

## QML-V AC Logic series

All parts have grounded lid versions  
Temperature range: -55 to 150°C

Part number	Description	TID RHA [krad(Si)]	SEL/SET/SEU threshold <sup>(1)</sup> [MeV.cm <sup>2</sup> /mg]	QML-V SMD	V <sub>cc</sub> min. [V]	V <sub>cc</sub> max. [A]	Temperature range [°C]	Package
<b>AC Logic</b>								
54AC00	Quad 2-input NAND gate	300	125/17 <sup>(2)</sup> /33 <sup>(2)</sup>	5962F87549	2.0	6.0	-55 to 150	Flat-14, DIL-14
54AC02	Quad 2-input NOR gate		125/17 <sup>(2)</sup> /33 <sup>(2)</sup>	5962F87612				Flat-14, DIL-14
54AC04	Hex inverter		125/17 <sup>(2)</sup> /33 <sup>(2)</sup>	5962F87609				Flat-14, DIL-14
54AC08	Quad 2-input AND gate		125/17 <sup>(2)</sup> /33 <sup>(2)</sup>	5962F87615				Flat-14, DIL-14
54AC10	Triple 3-input NAND gate		125/17 <sup>(2)</sup> /33 <sup>(2)</sup>	5962F87610				Flat-14, DIL-14
54AC11	Triple 3-input AND gate		125/17 <sup>(2)</sup> /33 <sup>(2)</sup>	5962F87611				Flat-14, DIL-14
54AC14	Hex Schmitt inverter		125/17 <sup>(2)</sup> /33 <sup>(2)</sup>	5962F87624				Flat-14, DIL-14
54AC14A	Hex Schmitt inverter low power		125/17 <sup>(2)</sup> /33 <sup>(2)</sup>	5962F87624				Flat-14
54AC32	Quad 2-input OR gate		125/17 <sup>(2)</sup> /33 <sup>(2)</sup>	5962F87614				Flat-14, DIL-14
54AC74	Dual D-type flip-flop with preset & clear		125/8/8	5962F88520				Flat-14, DIL-14
54AC86	Quad exclusive OR		125/17 <sup>(2)</sup> /33 <sup>(2)</sup>	5962F89550				Flat-14, DIL-14
54AC138	3-to-8 line decoder inverter		125/17 <sup>(2)</sup> /33 <sup>(2)</sup>	5962F87622				Flat-16, DIL-16
54AC139	Dual 2-to-4 line decoder/demultiplexer		125/17 <sup>(2)</sup> /33 <sup>(2)</sup>	5962F87623				Flat-16
54AC151	8-channel multiplexer		125/17 <sup>(2)</sup> /33 <sup>(2)</sup>	5962F87691				Flat-16
54AC157	Quad 2-channel multiplexer		125/17 <sup>(2)</sup> /33 <sup>(2)</sup>	5962F89539				Flat-16, DIL-16
54AC161	Synchronous binary counter with asynchronous clear		125/8/8	5962F89561				Flat-16, DIL-16
54AC174	Hex D-type flip-flop with clear		125/8/8	5962F87626				Flat-16
54AC191	4 bit synchronous binary up/down counter		125/8/8	5962F89749				Flat-16, DIL-16
54AC240	Octal bus buffer 3-state inverter		125/33 <sup>(3)</sup> /33 <sup>(3)</sup>	5962F87550				Flat-20
54AC244	Octal bus buffer 3-state with OE by nimble		125/33 <sup>(3)</sup> /33 <sup>(3)</sup>	5962F87552				Flat-20
54AC245	Octal bus transceiver 3-state with OE and T/R		125/33 <sup>(3)</sup> /33 <sup>(3)</sup>	5962F87758				Flat-20
54AC273	Octal D-type flip-flop with clear		125/8/8	5962F87756				Flat-20
54AC373	Octal D-type latch 3-state		125/17 <sup>(2)</sup> /8 <sup>(2)</sup>	5962F87555				Flat-20
54AC374	Octal D-type flip-flop 3-state		125/17 <sup>(2)</sup> /8 <sup>(2)</sup>	5962F87694				Flat-20
54AC521	8-bit comparator with enable		125/17 <sup>(2)</sup> /33 <sup>(2)</sup>	5962F90985				Flat-20
54AC540	Octal buffer/line driver 3-State		125/33 <sup>(3)</sup> /33 <sup>(3)</sup>	5962F87695				Flat-20

Part number	Description	TID RHA [krad(Si)]	SEL/SET/SEU threshold <sup>(1)</sup> [MeV.cm <sup>2</sup> /mg]	QML-V SMD	V <sub>cc</sub> min. [V]	V <sub>cc</sub> max [A]	Temperature range [°C]	Package
54AC541	Octal bus buffer 3-state	300	125/33 <sup>(3)</sup> /33 <sup>(3)</sup>	5962F88706	2.0	6.0	-55 to 150	Flat-20
54AC574	Octal D-type flip-flop 3-state		125/17 <sup>(2)</sup> /8 <sup>(2)</sup>	5962F96773				Flat-20
54AC2525	1-to-8 skew clock driver		125/17 <sup>(2)</sup> /33 <sup>(2)</sup>	5962F92174				Flat-14
54AC16244	16-bit buffer 3-state with OE by nimble		125/33 <sup>(3)</sup> /33 <sup>(3)</sup>	5962F04210				Flat-48
54AC16245	16-bit transceiver 3-state with OE and DIR by byte		125/33 <sup>(3)</sup> /33 <sup>(3)</sup>	5962F04211				Flat-48
54AC16373	16-bit D-type latch 3-state		125/17 <sup>(2)</sup> /8 <sup>(2)</sup>	5962F04212				Flat-48
54AC16374	16-bit D-type flip-flop 3-state		125/17 <sup>(2)</sup> /8 <sup>(2)</sup>	5962F04213				Flat-48
54AC164245	16-bit 3 to 5 V level shifter transceiver 3-state	100	120/21/-	5962R98580	2.3		Flat-48	
<b>ACT Logic</b>								
54ACT00	Quad 2-input NAND gate	300	125/17 <sup>(2)</sup> /33 <sup>(2)</sup>	5962F87699	4.5	5.5	-55 to 150	Flat-14, DIL-14
54ACT02	Quad 2-input NOR gate		125/17 <sup>(2)</sup> /33 <sup>(2)</sup>	5962F89791				Flat-14
54ACT04	Hex inverter		125/17 <sup>(2)</sup> /33 <sup>(2)</sup>	5962F89734				Flat-14, DIL-14
54ACT08	Quad 2-input AND gate		125/17 <sup>(2)</sup> /33 <sup>(2)</sup>	5962F89547				Flat-14, DIL-14
54ACT10	Triple 3-input NAND gate		125/17 <sup>(2)</sup> /33 <sup>(2)</sup>	5962F92182				Flat-14
54ACT11	Triple 3-input AND gate		125/17 <sup>(2)</sup> /33 <sup>(2)</sup>	5962F90772				Flat-14
54ACT14	Hex Schmitt inverter		125/17 <sup>(2)</sup> /33 <sup>(2)</sup>	5962F96813				Flat-14
54ACT32	Quad 2-input OR gate		125/17 <sup>(2)</sup> /33 <sup>(2)</sup>	5962F89736				Flat-14, DIL-14
54ACT74	Dual D-type flip-flop with preset & clear		125/8/8	5962F87525				Flat-14, DIL-14
54ACT86	Quad exclusive OR		125/17 <sup>(2)</sup> /33 <sup>(2)</sup>	5962F90687				Flat-14
54ACT138	3-to-8 line decoder inverter		125/17 <sup>(2)</sup> /33 <sup>(2)</sup>	5962F87554				Flat-16
54ACT139	Dual 2-to-4 line decoder/demultiplexer		125/17 <sup>(2)</sup> /33 <sup>(2)</sup>	5962F87553				Flat-16, DIL-16
54ACT151	8-channel multiplexer		125/17 <sup>(2)</sup> /33 <sup>(2)</sup>	5962F88756				Flat-16
54ACT157	Quad 2-channel multiplexer		125/17 <sup>(2)</sup> /33 <sup>(2)</sup>	5962F89688				Flat-16, DIL-16
54ACT161	Synchronous binary counter with asynchronous clear		125/8/8	5962F91722				Flat-16
54ACT174	Hex D-type flip-flop with clear		125/8/8	5962F87757				Flat-16
54ACT191	4-bit synchronous binary up/down counter		125/8/8	5962F04228				Flat-16
54ACT240	Octal bus buffer 3-state inverter		125/33 <sup>(3)</sup> /33 <sup>(3)</sup>	5962F87759				Flat-20
54ACT244	Octal bus buffer 3-state with OE by nimble		125/33 <sup>(3)</sup> /33 <sup>(3)</sup>	5962F87760				Flat-20
54ACT245	Octal bus transceiver 3-state with OE and T/R		125/33 <sup>(3)</sup> /33 <sup>(3)</sup>	5962F87663				Flat-20
54ACT273	Octal D-type flip-flop with clear		125/8/8	5962F01527				Flat-20
54ACT373	Octal D-type latch 3-state		125/17 <sup>(2)</sup> /8 <sup>(2)</sup>	5962F87556				Flat-20
54ACT374	Octal D-type flip-flop 3-state		125/17 <sup>(2)</sup> /8 <sup>(2)</sup>	5962F87631				Flat-20
54ACT541	Octal bus buffer 3-state		125/33 <sup>(3)</sup> /33 <sup>(3)</sup>	5962F89795				Flat-20
54ACT574	Octal D-type flip-flop 3-state		125/17 <sup>(2)</sup> /8 <sup>(2)</sup>	5962F89601				Flat-20
54ACT16244	16-bit buffer 3-state with OE by nimble		125/33 <sup>(3)</sup> /33 <sup>(3)</sup>	5962F92022				Flat-48
54ACT16245	16-bit transceiver 3-state with OE and DIR by byte		125/33 <sup>(3)</sup> /33 <sup>(3)</sup>	5962F92023				Flat-48
54ACT16373	16-bit D-type latch 3-state		125/17 <sup>(2)</sup> /8 <sup>(2)</sup>	5962F92024				Flat-48
54ACT16374	16-bit D-type flip-flop 3-state		125/17 <sup>(2)</sup> /8 <sup>(2)</sup>	5962F92025				Flat-48

(1) See datasheet for details on the test conditions and Weibull parameters. The radiation report (available on request) provides the complete characterization.

(2) At 3.0 V

(3) At 4.5 V, outputs activated

## ESCC HC Logic series

100 krad versions on most parts (see TN1292)  
 Optional screening similar to Class S (see TN0985)  
 Temperature range: -55 to +125°C

Part number	Description	TID [krad(Si)]	SEL/SET/SEU threshold <sup>(1)</sup> [MeV.cm <sup>2</sup> /mg]	ESCC detail specification	V <sub>cc</sub> min. [V]	V <sub>cc</sub> max. [A]	Package
<b>HC Logic</b>							
M54HC00	Quad 2-input NAND gate	50	125/15/-	9201/105	2	6.0	Flat-14E; DIL-14
M54HC02	Quad 2-input NOR gate		125/15/-	9201/113			Flat-14E; DIL-14
M54HC03	Quad 2-input NAND open drain		125/15/-	9201/114			Flat-14E; DIL-14
M54HC04	Hex inverter		125/15/-	9401/033			Flat-14E; DIL-14
M54HC08	Quad 2-input AND gate		125/15/-	9201/106	2.4		Flat-14E; DIL-14
M54HC10	Triple 3-input NAND gate		125/15/-	9201/107	2.0		Flat-14E; DIL-14
M54HC11	Triple 3-input AND gate		125/15/-	9201/117			Flat-14E; DIL-14
M54HC14	Hex Schmitt inverter		125/18/-	9409/007			Flat-14E; DIL-14
M54HC20 <sup>(2)</sup>	Dual 4-input NAND gate		125/15/-	9201/118			Flat-14E
M54HC21 <sup>(2)</sup>	Dual 4-input AND gate		125/15/-	9201/108			Flat-14E; DIL-14
M54HC27	Triple 3-input NOR gate		125/15/-	9201/109			Flat-14E; DIL-14
M54HC30 <sup>(2)</sup>	8-input NAND gate		125/15/-	9201/110			Flat-14E; DIL-14
M54HC32	Quad 2-input OR gate		125/15/-	9201/111			Flat-14E; DIL-14
M54HC74	Dual D-type flip-flop with preset & clear		125/18/-	9203/050			Flat-14E; DIL-14
M54HC85	4-bit magnitude comparator		125/15/-	9209/004			Flat-16E; DIL-16
M54HC86	Quad exclusive OR gate		125/15/-	9201/119			Flat-14E; DIL-14
M54HC109	Dual J-K flip-flop with preset & clear		125/18/-	9306/048			Flat-16E; DIL-16
M54HC123	Dual retriggerable monostable multivibrator with clear		125/18/-	9207/006			Flat-16E; DIL-16
M54HC125	Quad bus buffer 3-state		125/14/-	9401/039			Flat-14E; DIL-14
M54HC132	Quad 2-input Schmitt NAND gate		125/18/-	9201/120			Flat-14E; DIL-14
M54HC137 <sup>(2)</sup>	3-to-8 line decoder latch inverter		125/15/-	9205/013			Flat-16E
M54HC138	3-to-8 line decoder inverter		125/15/-	9408/046			Flat-16E; DIL-16
M54HC139	Dual 2-to-4 line decoder/demultiplexer		125/15/-	9205/017			Flat-16E; DIL-16
M54HC148	8-to-3 line priority encoder		125/15/-	9410/017			Flat-16E; DIL-16
M54HC151	8-channel multiplexer		125/15/-	9408/054			Flat-16E; DIL-16
M54HC153	Dual 4-channel multiplexer		125/15/-	9408/038			Flat-16E; DIL-16
M54HC154	4-to-16 line decoder/demultiplexer		125/15/-	9205/023			DIL-24N, Flat-24
M54HC157	Quad 2-channel multiplexer		125/15/-	9408/057			Flat-16E; DIL-16
M54HC158 <sup>(2)</sup>	Quad 2-channel multiplexer inverter		125/15/-	9408/059			Flat-16E; DIL-16
M54HC160	Synchronous decade counter with async. clear		125/18/-	9205/062			Flat-16E; DIL-16
M54HC161	Synchronous binary counter with async. clear		125/18/-	9204/059			Flat-16E; DIL-16
M54HC164	8-bit SIPO shift register		125/18/-	9306/041			Flat-14E; DIL-14
M54HC165	8-bit PISO shift register	125/18/-	9306/042	Flat-16E; DIL-16			
M54HC166	8-bit PISO shift register with clear	125/18/-	9306/043	Flat-16E; DIL-16			



Part number	Description	TID [krad(Si)]	SEL/SET/SEU threshold <sup>(1)</sup> [MeV.cm <sup>2</sup> /mg]	ESCC detail specification	V <sub>cc</sub> min. [V]	V <sub>cc</sub> max. [A]	Package
M54HC174	Hex D-type flip-flop with clear	50	125/18/–	9306/052	2.0	6.0	Flat-16E; DIL-16
M54HC175	Quad D-type flip-flop with clear		125/18/–	9203/052			Flat-16E; DIL-16
M54HC191	4-bit synchronous binary up/down counter		125/18/–	9204/066			Flat-16E; DIL-16
M54HC193	Synchronous up/down binary counter		125/18/–	9204/065			Flat-16E; DIL-16
M54HC194 <sup>(2)</sup>	4-bit PIP0 shift register		125/18/–	9306/047			Flat-16E; DIL-16
M54HC237	3-to-8 line decoder latch		125/15/–	9205/021			Flat-16E; DIL-16
M54HC240	Octal bus buffer 3-state inverter		125/14/–	9401/034			Flat-20E; DIL-20
M54HC244	Octal bus buffer 3-state		125/14/–	9401/048			Flat-20E; DIL-20
M54HC245	Octal bus transceiver 3-state		125/14/–	9405/013			Flat-20E; DIL-20
M54HC251	8-channel multiplexer 3-state		125/14/–	9408/048			Flat-16E; DIL-16
M54HC257	Quad 2-channel multiplexer 3-state		125/14/–	9408/047			Flat-16E
M54HC259	8-bit addressable latch		125/18/–	9203/073			Flat-16E
M54HC273	Octal D-type flip-flop with clear		125/18/–	9203/053			Flat-20E; DIL-20
M54HC283 <sup>(2)</sup>	4-bit binary full adder		125/15/–	9202/075			Flat-16E; DIL-16
M54HC367 <sup>(2)</sup>	Hex bus buffer 3-state		125/14/–	9401/044			Flat-16E
M54HC373	Octal D-type latch 3-state		125/18/–	9203/059			Flat-20E; DIL-20
M54HC374	Octal D-type flip-flop 3-state		125/18/–	9203/060			Flat-20E; DIL-20
M54HC393	Dual binary counter		125/18/–	9204/074			Flat-14E; DIL-14
M54HC540	Octal bus buffer 3-state inverter		125/14/–	9401/049			Flat-20E
M54HC541	Octal bus buffer 3-state		125/14/–	9401/047			Flat-20E; DIL-20
M54HC573	Octal D-type latch 3-state		125/18/–	9202/072			Flat-20E; DIL-20
M54HC574	Octal D-type flip-flop 3-state		125/18/–	9203/054			Flat-20E; DIL-20
M54HC590 <sup>(2)</sup>	8-bit binary counter register 3-state		125/18/–	9204/071			Flat-16E; DIL-16
M54HC595	8-bit shift register output latch 3-state		125/18/–	9306/051			Flat-16E; DIL-16
M54HC597	8-bit latch/shift register		125/18/–	9306/054			Flat-16E; DIL-16
M54HC688	8-bit equality comparator		125/15/–	9209/005			Flat-20E; DIL-20
M54HC4020	14-stage binary counter		125/18/–	9204/070			Flat-16E; DIL-16
M54HC4040	12-stage binary counter		125/18/–	9204/069			Flat-16E; DIL-16
M54HC4049	Hex buffer/converter inverter		125/15/–	9401/037			Flat-16E; DIL-16
M54HC4050	Hex buffer/converter		125/15/–	9401/038			Flat-16E; DIL-16
M54HC4051	Single 8-channel analog mux/demux		125/15/–	9408/064			Flat-16E; DIL-16
M54HC4053	Triple 2-channel analog mux/demux		125/15/–	9408/065			Flat-16E; DIL-16
M54HC4060	14-stage binary counter/oscillator		125/18/–	9204/076			Flat-16E; DIL-16
M54HC4066	Quad bilateral switch		125/15/–	9408/052			Flat-14E; DIL-14
M54HC4078 <sup>(2)</sup>	8-input NOR/OR gate		125/15/–	9201/123			Flat-14E; DIL-14
M54HC4094	8-bit SIPO shift register 3-state		125/18/–	9306/050			Flat-16E; DIL-16
M54HC4514	4-to-16 line decoder latch		125/18/–	9205/019			Flat-24; DIL24N

Part number	Description	TID [krad(Si)]	SEL/SET/SEU threshold <sup>(1)</sup> [MeV.cm <sup>2</sup> /mg]	ESCC detail specification	V <sub>cc</sub> min. [V]	V <sub>cc</sub> max. [A]	Package
HCT Logic							
M54HCT74	Dual D-type flip-flop with preset & clear	50	125/18/–	9203/070	4.5	5.5	DIL-20,Flat-20E
M54HCT244	Octal bus buffer 3-state		125/14/–	9402/009			DIL-20,Flat-20E
M54HCT245	Octal bus transceiver 3-state		125/14/–	9405/014			DIL-20,Flat-20E
M54HCT373 <sup>(2)</sup>	Octal D-type latch 3-state		125/18/–	9203/064			DIL-20,Flat-20E

(1) See datasheet for details on the test conditions and Weibull parameters. The radiation report (available on request) provides the complete characterization.

(2) Product termination planned

## ESCC CMOS4000B series

V<sub>cc</sub> absolute max. rating 18 V

Transferred to 6" wafer fab for renewed lifetime

Optional screening similar to Class S (see TN0985)

Temperature range: -55 to +125°C

Part number	Description	TID [krad(Si)]	SEL/SET/SEU threshold <sup>(1)</sup> [MeV.cm <sup>2</sup> /mg]	ESCC detail specification	V <sub>cc</sub> min. [V]	V <sub>cc</sub> max. [A]	Package
HCC4001B	Quad 2-input NOR gate	100	120/120/120	9201/041	3	15	Flat-14E, DIL-14
HCC4002B	Dual 4-input NOR gate		120/120/120	9201/042			Flat-14E, DIL-14
HCC4008B <sup>(2)</sup>	4-bit full adder		120/120/120	9202/039			Flat-16E, DIL-16
HCC4011B	Quad 2-input NAND gate		120/120/120	9201/043			Flat-14E, DIL-14
HCC4013B	Dual D flip-flop		120/120/120	9203/023			Flat-14E, DIL-14
HCC4014B	8-stage Static synchronous shift register		120/120/60	9306/014			Flat-16E, DIL-16
HCC4015B	Dual 4-stage Static shift register		120/120/60	9306/015			Flat-16E, DIL-16
HCC4017B	Decade counter/divider		120/120/120	9204/020			Flat-16E, DIL-16
HCC4018B	Presetable divide-By N counter		120/120/120	9204/021			Flat-16E, DIL-16
HCC4019B	Quad AND/OR select gate		120/120/120	9202/051			Flat-16E, DIL-16
HCC4020B	14-stage binary/ripple counter		120/120/36	9204/022			Flat-16E, DIL-16
HCC4021B	8-stage Static shift register		120/120/60	9306/016			Flat-16E, DIL-16
HCC4022B	Divide-By-8 counter/divider		120/120/120	9204/023			Flat-16E, DIL-16
HCC4024B	7-stage binary/ripple counter		120/120/36	9204/024			Flat-14E, DIL-14
HCC4027B	Dual J-K master-slave flip-flop		120/120/120	9203/022			Flat-16E, DIL-16
HCC4028B	BCD-to-decimal decoder		120/120/120	9205/010			Flat-16E, DIL-16
HCC4029B	Presetable up/down counter		120/120/120	9204/025			Flat-16E, DIL-16
HCC4030B	Quad exclusive OR gate		120/120/120	9201/047			Flat-14E, DIL-14
HCC4040B	12-stage binary/ripple counter		120/120/36	9204/026			Flat-16E, DIL-16
HCC4041UB	Quad true complement buffer		120/120/120	9202/040			Flat-14E, DIL-14
HCC4043B	Quad 3-state NOR R/S latch		120/120/120	9202/042			Flat-16E, DIL-16
HCC4044B <sup>(2)</sup>	Quad 3-state NAND R/S latch		120/120/120	9202/043			Flat-16E, DIL-16
HCC4046B	Micropower phase locker Loop		120/120/120	9202/044			Flat-16E, DIL-16
HCC4047B	Monostable/astable multivibrator		120/120/120	9207/003			Flat-14E, DIL-14
HCC4049UB	Hex inverting buffer/converter		120/120/120	9202/045			Flat-16E, DIL-16
HCC4050B	Hex non-inverting buffer/converter		120/120/120	9202/046			Flat-16E, DIL-16



Part number	Description	TID [krad(Si)]	SEL/SET/SEU threshold <sup>(1)</sup> [MeV.cm <sup>2</sup> /mg]	ESCC detail specification	V <sub>cc</sub> min. [V]	V <sub>cc</sub> max. [A]	Package
HCC4051B	Single 8-channel analog mux/demux	100	120/120/120	9202/047	3	15	Flat-16E, DIL-16
HCC4052B	Differential 4-channel analog mux/demux		120/120/120	9202/048			Flat-16E, DIL-16
HCC4053B	Triple 2-channel analog mux/demux		120/120/120	9202/049			Flat-16E, DIL-16
HCC4060B	14-stage counter/divider AND oscillator		120/120/120	9204/052			Flat-16E, DIL-16
HCC4063B	4-bit magnitude comparator		120/120/120	9209/001			Flat-16E, DIL-16
HCC4066B	Quad bilateral switch		120/120/120	9408/005			Flat-14E, DIL-14
HCC4067B	Single 16-channel analog mux/demux		120/120/120	9408/009			Flat-24E, DIL-24
HCC4068B	8-input NAND/AND gate		120/120/120	9201/061			Flat-14E, DIL-14
HCC4069UB	Hex inverter		120/120/120	9401/010			Flat-14E, DIL-14
HCC4070B	Quad exclusive OR gate		120/120/120	9201/048			Flat-14E, DIL-14
HCC4071B	Quad 2-input OR gate		120/120/120	9201/063			Flat-14E, DIL-14
HCC4072B	Dual 4-input OR gate		120/120/120	9201/082			Flat-14E, DIL-14
HCC4073B	Triple 3-input AND gate		120/120/120	9201/064			Flat-14E, DIL-14
HCC4075B	Triple 3-input OR gate		120/120/120	9201/065			Flat-14E, DIL-14
HCC4076B <sup>(2)</sup>	4-bit D-type register		120/120/60	9306/022			Flat-16E, DIL-16
HCC4077B	Quad exclusive NOR gate		120/120/120	9201/055			Flat-14E, DIL-14
HCC4081B	Quad 2-input AND gate		120/120/120	9201/052			Flat-14E, DIL-14
HCC4093B	Quad 2-input NAND Schmitt trigger		120/120/120	9409/002			Flat-14E, DIL-14
HCC4094B	8-stage shift-and-store bus register		120/120/60	9306/026			Flat-16E, DIL-16
HCC4098B	Dual monostable multivibrator		120/120/120	9206/003			Flat-16E, DIL-16
HCC40103B	Presetable 8-bit binary down counter		120/120/120	9204/036			Flat-16E, DIL-16
HCC40106B	Hex Schmitt trigger		120/120/120	9409/005			Flat-14E, DIL-14
HCC40107B <sup>(2)</sup>	Dual 2-input nand buffer/driver		120/120/120	9401/013			Flat-14E, DIL-14
HCC40109B	Quad low-to-high voltage level shifter		120/120/120	9407/003			Flat-16E, DIL-16
HCC40161B <sup>(2)</sup>	Binary counter with asynchronous clear		120/120/120	9204/054			Flat-16E, DIL-16
HCC40174B	Hex D flip-flop		120/120/120	9203/038			Flat-16E, DIL-16
HCC40193B <sup>(2)</sup>	Presetable 4-bit binary up-down counter		120/120/120	9204/041			Flat-16E, DIL-16
HCC4503B	Hex buffer 3-state noninverter		120/120/120	9401/030			Flat-16E, DIL-16
HCC4512B	8-channel data selec. with 3-state output		120/120/120	9408/006			Flat-16E, DIL-16
HCC4514B	4-bit latch/4-to-16 line decoder output high		120/120/120	9408/012			Flat-24E, DIL-24
HCC4515B <sup>(2)</sup>	8-input priority encoder		120/120/120	9205/011			Flat-24E, DIL-24
HCC4516B	Presetable 4-bit binary up/down counter		120/120/120	9204/045			Flat-16E, DIL-16
HCC4520B	Dual binary up-down counter		120/120/120	9204/028			Flat-16E, DIL-16
HCC4532B <sup>(2)</sup>	8-input priority encoder		120/120/120	9202/065			Flat-16E, DIL-16
HCC4538B	Dual precision monostable multivibrator		120/120/120	9207/007			Flat-16E, DIL-16
HCC4555B	Dual 1-of-4 decoder/demux output high		120/120/120	9408/011			Flat-16E, DIL-16
HCC4556B	Dual 1-of-4 decoder/demux output low	120/120/120	9408/025	Flat-16E, DIL-16			

(1) See datasheet for test conditions and Weibull parameters. The radiation report provides complete characterization (available on request).

(2) Product termination notice released. Last order entry Sept 30, 2022

# Discretes

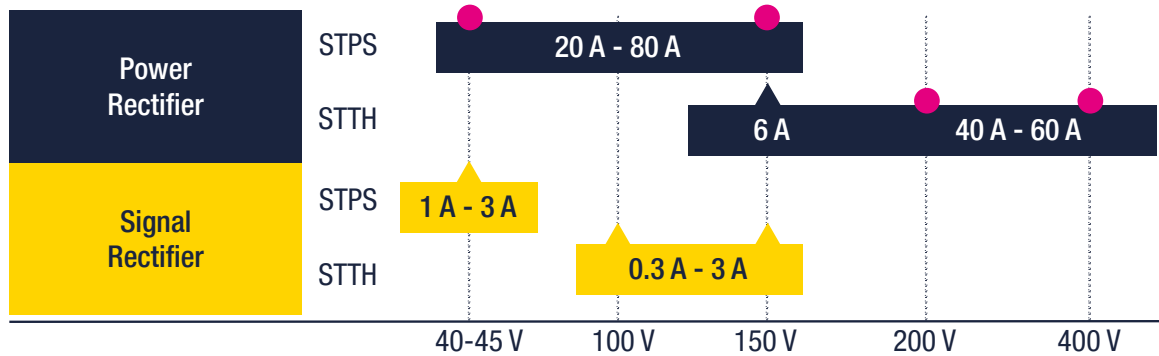
## NEW POWER RECTIFIER SERIES UP TO 80 A AND 400 V

### KEY FEATURES & BENEFITS

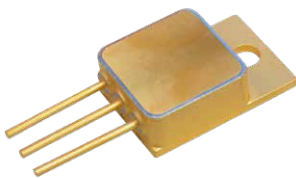
- Junction temperature range: -65 to 175°C
- $V_f$  guaranteed at multiple  $T_j$  and  $I_f$  values
- Schottky diodes:  $dV/dt$  specified at 10 V/ns

### RADIATION PERFORMANCE

- TID immune up to 3 Mrad (Si)
- Schottky SEE tested up to 60 MeV.cm<sup>2</sup>/mg



Legend: ● New power generation



TO-254AA



SMD.5



LCC-2A, LCC-2B, LCC-2D

## ESCC Schottky and ultrafast rectifiers

Junction temperature range: -65 to 175°C

Max. dV/dt specified (new power Schottky)

New Schottky rectifiers SEE tested up to 60 MeV.cm<sup>2</sup>/mg

V<sub>F</sub> guaranteed at 3 temperatures and up to 4 I<sub>F</sub> values

Part number	Description	TID [Mrad(Si)]	SEE threshold <sup>(1)</sup> [MeV.cm <sup>2</sup> /mg]	ESCC detailed specification	V <sub>RRM</sub> <sup>(2)</sup> max [V]	I <sub>F</sub> <sup>(3)</sup> max [A]	V <sub>F</sub> <sup>(4)</sup> @ 125°C max [V]	t <sub>RR</sub> <sup>(5)</sup> max [ns]	T <sub>J</sub> range <sup>(6)</sup> [°C]	Package	
<b>Schottky rectifiers</b>											
1N5822U	Single	3	–	5106/020	40	3	0.485	–	-65 to 175	LCC-2B	
1N5819U	Single	3	–	5106/021	45	1	0.45	–	-65 to 150	LCC-2B	
STPS1045HR <sup>(7)</sup>	Dual CC <sup>(8)</sup>	–	–	5106/017		20	0.88	–	-65 to 175	SMD.5	
STPS40A45CHR	Dual CC <sup>(8)</sup>	3	No SEB @ 60	5106/024		40	0.61	–	-65 to 175	TO-254AA	
STPS6045HR	Dual CC <sup>(8)</sup>	–	–	5106/018		40	0.75	–	-65 to 175	TO-254	
STPS80A45CHR	Dual CC <sup>(8)</sup>	3	No SEB @ 60	5106/024		80	0.74	–	-65 to 175	SMD.5	
STPS20100HR <sup>(7)</sup>	Single/dual CC <sup>(8)</sup>	–	–	5106/016		100	20/40	0.90	–	-65 to 175	SMD.5/ TO-254
STPS40100HR <sup>(7)</sup>	Dual CC <sup>(8)</sup>	–	–	5106/019			40	0.90	–	-65 to 175	TO-254AA
STPS40A150CHR	Dual CC <sup>(8)</sup>	3	No SEB @ 60	5106/023		150	40	0.79	–	-65 to 175	TO-254AA
STPS60A150CHR	Dual CC <sup>(8)</sup>	3	No SEB @ 60	5106/023			60	0.83	–	-65 to 175	SMD.5
STPS80A150CHR	Dual CC <sup>(8)</sup>	3	No SEB @ 60 <sup>(9)</sup>	5106/023			80	0.88	–	-65 to 175	SMD.5
<b>Ultrafast rectifiers</b>											
1N6640U	Single	3	Immune	5101/027	75	0.3	1.06	9	-65 to 175	LCC-2D	
1N6642U	Single	3		5101/026	100	0.3	1.2	9	-65 to 175	LCC-2D	
1N5806U	Single	3		5101/014	150	2.5	1	30	-65 to 175	LCC-2A	
1N5811U	Single	3		5101/013	150	6	0.955	35	-65 to 175	LCC-2B	
BYW81HR	Single	–		5103/029	200	15	1.15	40	-55 to 150	SMD.5	
STTH40200CHR	Dual CC <sup>(8)</sup>	3		5103/033	200	40	1.02	60	-65 to 175	TO-254AA	
STTH60200CHR	Dual CC <sup>(8)</sup>	3		5103/033	200	60	0.95	60	-65 to 175	SMD1	
STTH60400HR	Single	3		5103/032	400	60	1.15	80	-65 to 175	SMD1	

(1) See datasheet for details on the test conditions and Weibull parameters. The radiation report (available on request) provides the complete characterization.

(2) Repetitive peak reverse voltage

(3) Average forward current

(4) Forward voltage

(5) Reverse recovery time

(6) Junction temperature

(7) Product termination planned

(8) Common cathode

(9) @ 85% VRRM max

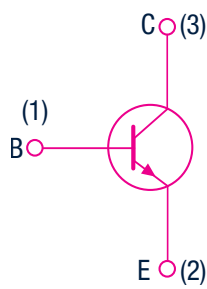
## 2ST15300 RAD-HARD 300 V, 5 A NPN BIPOLAR TRANSISTOR ESCC: 5201/020

**KEY FEATURES**

- Linear gain characteristics
- Inductive load ruggedness

**TYPICAL APPLICATIONS**

- Electrical propulsion
- Inductive load switches
- Linear amplifiers



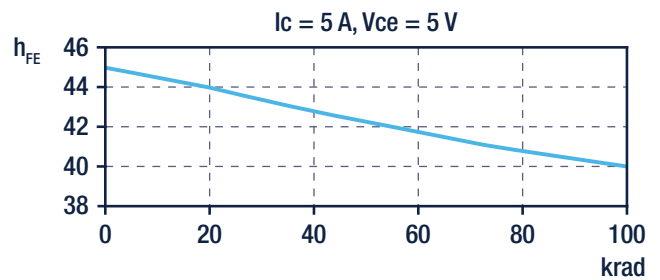
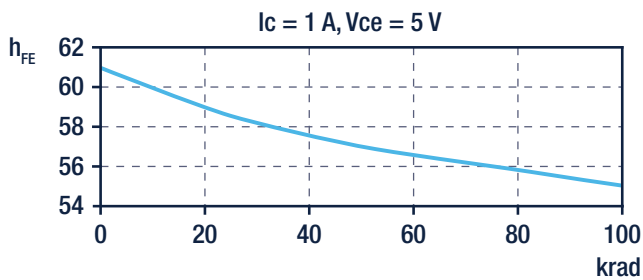
### RADIATION PERFORMANCE

- 100 krad(Si)



SMD.5

### $h_{FE}$ vs low dose rate total ionizing dose



## STRHMF16N20 RAD-HARD 200 V, 16 A, 100 KRAD N-CHANNEL POWER MOSFET ESCC: 5205/034

**KEY FEATURES**

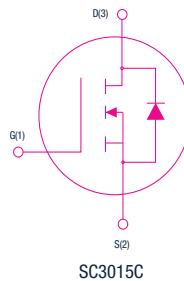
- Low  $R_{DS(on)}$  and superior dynamic performance
- Superior stability in extended reliability test
- Very low drift under total ionised dose exposure

**TYPICAL APPLICATIONS**

- Power conversion
- Motor control
- Power switch circuits

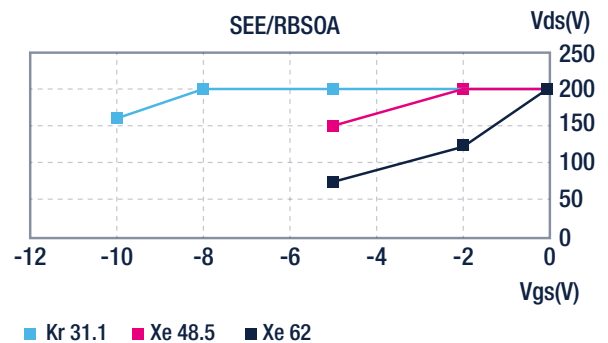
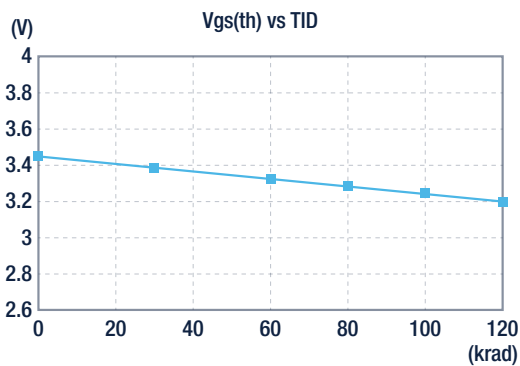
### RADIATION PERFORMANCE

- 100 krad(Si)
- No SEE up to 62 MeV/(mg/cm<sup>2</sup>)



SMD.5

### Radiation performance



## ESCC and DLA bipolar transistors

Temperature range -65 to 200°C

Part number	Description	TID [krad(Si)]	Agency qualification	Agency specification	$V_{CB0}^{(1)}$ max [V]	$I_c^{(2)}$ max [A]	$h_{FE}^{(3)}$ min	Package	
<b>NPN transistor</b>									
2N2222AHR	50 V, 0.8 A	100	ESCC	5201/002	75	0.8	100	LCC-3, UB	
JANS2N2222AUB			DLA	19500/255				UB	
2N3700HR	80 V, 1 A		ESCC	5201/004	140	1	100	LCC-3, UB	
JANS2N3700			DLA	19500/391				UB	
2N5551HR	160V, 0.5 A		ESCC	5201/019	180	0.5	80	LCC-3, UB	
JANS2N5551UB			DLA	19500/767				UB	
2N5154HR	80 V, 5 A		ESCC	5203/010	100	5	70	TO-257AA, SMD.5	
2ST15300	300 V, 5 A		ESCC	5201/020	300	5	55	SMD.5	
2N2484HR	60 V, 0.5 A	-	ESCC	5201/001	60	0.5	250	LCC-3	
<b>NPN dual matched bipolar transistors</b>									
2N2920AHR	60 V, 0.03 A	-	ESCC	5207/002	60	0.03	300	Flat-8, LCC-6	
<b>PNP transistor</b>									
2N2907AHR	60 V, 0.6 A	100	ESCC	5202/001	60	0.6	100	LCC-3, UB	
JANS2N2907AUB			DLA	19500/291				UB	
2N5401HR	150 V, 0.5 A		ESCC	5202/014	160	0.5	60	LCC-3, UB	
JANS2N5401UB			DLA	19500/766				UB	
2N5153HR	80 V, 5 A		ESCC	5204/002	100	5	70	TO-257AA, SMD.5	
<b>PNP dual matched bipolar transistors</b>									
2N3810HR	60 V, 0.05 A		100	ESCC	5207/005	60	0.05	125	Flat-8, LCC-6
<b>NPN and PNP complementary pair</b>									
2ST3360K	60 V, 0.8 A	100	ESCC	5207/009	60	0.8	160	Flat-8	
JANS2ST3360K			DLA	M19500/773					

(1) Collector-base voltage

(2) Collector current

(3) DC current gain

## ESCC rad-hard MOSFETs

Temperature range -55 to +150°C

Part number	Description	TID [krad(Si)]	SEB and SEGR threshold [MeV.cm <sup>2</sup> /mg]	ESCC detail specification	$V_{BDS}^{(1)}$ [V]	$I_D^{(2)}$ [A]	$R_{DS(on)}^{(3)}$ max [mΩ]	$Qg^{(4)}$ max [nC]	Package
<b>N-channel</b>									
STRH40N6	60 V, 30 A	50	60	5205/024	60	30	45	52	SMD.5
STRH100N6	60 V, 40 A			5205/022		40	13.5	160	TO-254AA
STRH8N10	100 V, 6 A			5205/023	100	6	300	22	SMD.5
STRH100N10	100 V, 48 A			5205/021		48	35	162	TO-254AA
STRHMF16N20 <sup>(5)</sup>	200 V, 16 A			100	5205/034	200	16	90	78
<b>P-channel</b>									
STRH12P10	100 V, 12 A	100	60	5205/029	100	12	300	48	TO-257AA
STRH40P10	100 V, 34 A			5205/025		34	75	194	TO-254AA

(1) Drain-source breakdown voltage

(2) Drain current

(3) Drain-source on resistance

(4) Total gate charge

(5) Contact your sales office for qualification status.

# LEO series

## PLASTIC RAD-HARD FOR NEW SPACE

### KEY FEATURES

- ST Proprietary specification optimized for LEO and MEO
- Rad-rad dice assembled on lines for AEC-Q100 products
- AEC-Q100 based qualification, manufacturing, and screening flows
- Space specific tests include: radiation, outgassing, CSAM, WLAT...
- Space like product life cycle management

### LEO series product versions

Version	Definition
Dummy samples	Worst case final packaging for mounting qualification
Development samples	Evaluation and development
Flight models	Compliant with ST LEO specification

### RADIATION HARDNESS

- TID: 50 krad(Si)
- TNID: characterized<sup>(1)</sup>
- SEL-free at 43 MeV.cm<sup>2</sup>/mg<sup>(2)</sup>
- SET/SEU/SEFI Characterized<sup>(3)</sup>

### GENERIC CHARACTERISTICS

- -40 to +125°C
- Gold wires
- NiPdAu finishing
- Space compliant outgassing<sup>(4)</sup>

### QUALITY ASSURANCE

- AEC-Q100 based framework
- Statistical process control
- ST LEO generic specification

#### Notes

(1) When relevant, @3.10<sup>15</sup> proton/cm<sup>2</sup>

(2) When achievable SEL-free up to 62.5 MeV.cm<sup>2</sup>/mg

(3) When relevant, up to 62.5 MeV.cm<sup>2</sup>/mg

(4) Recovery mass loss<1%, collected volatile condensable material<0.1%

## LEOAD128 RAD-HARD INDUSTRY STANDARD 1 MSPS 8-CHANNEL 12-BIT ADC

### KEY FEATURES

- Industry standard pinout without conversion glitch
- Sampling rate: 1 Msps
- 12-bit successive-approximation (SAR) architecture
- 11.1 ENOB min.
- 4.5 mW max @ 3.3 V 1 Msps, 3 μW in shut-down 3.3 V supply and I/Os
- 8-to-1-channel single input multiplexer
- SPI compatible

### RADIATION PERFORMANCE

- RHA guaranteed at 50 krad(Si) ELDRS
- SEL-free up to 62.5 MeV.cm<sup>2</sup>/mg @ 125°C
- SET/SEU report available on request



TSSOP-20

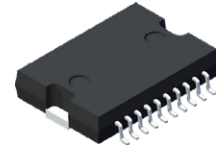
# LEO3910 RAD-HARD LINEAR POSITIVE VOLTAGE REGULATOR

## KEY FEATURES

- Input voltage range: 3 to 12 V
- Output voltage range: 1.23 to 9 V
- Output current: 2 A max
- Low drop voltage: 0.5 V @  $I_o = 1\text{ A}$ , 1.0 V @  $I_o = 2\text{ A}$
- Inhibit pin
- $V_o$  current sink capability for easy power down sequencing
- Overtemperature protection and adjustable overcurrent protection
- High dissipation PowerSO-20 with slug down

## RADIATION PERFORMANCE

- RHA guaranteed at 50 krad(Si) ELDRS
- TNID report on request
- SEL free up to 62.5 MeV.cm<sup>2</sup>/mg
- SET report available on request



PowerSO-20

## LEO rad-hard series in plastic packages for New Space

Compliant with ST LEO generic specification  
 AEC-Q100 based quality assurance  
 SEL free up to at least 43 MeV.cm<sup>2</sup>/mg, tested up to 62.5 MeV.cm<sup>2</sup>/mg<sup>(1)</sup>  
 TNID characterized  
 Temperature range -40 to 125°C

Part number	Description	TID RHA [krad(Si)]	SEL/SET/SEU <sup>(1)</sup> [MeV.cm <sup>2</sup> /mg]	V <sub>cc</sub> range [V]	Key features	Package
<b>Power management</b>						
LEO3910	2 A positive low drop voltage regulator	50	62.5/62.5/-	3 to 12	Vdrop: 350 mV @ I <sub>out</sub> =400 mA	PSO20
<b>Data converters</b>						
LEO0AD128	1 Msps 12-bit ADC, with 8-input MUX	50	62.5/-/-	2.7 to 3.6	Serial output	TSSOP20
<b>LVDS</b>						
LEO1VDSRD	LVDS driver-receiver, 400 Mbps	50	62.5/-/-	3.0 to 3.6	Enhanced common mode and VCC range	TSSOP20
<b>Logic</b>						
LEOAC00	Quad 2-input NAND gate	50	62.5/-/-	2.0 to 6.0	High speed, 10 ns prop. delay	TSSOP20
LEOAC08	Quad 2-input AND gate					
LEOAC14	Hex inverter					
LEOAC32	Quad 2-input OR gate					
LEOAC74	Dual D-type flip-flop					
LEOAC244	Octal bus buffer					

(1) SET and SEU values are the characterization limits. See datasheets for more information

# Services

ST integrates a wide range of standard services in our space supply chain. These services can be classified into the following categories:

- Date code services, including single lot date code, age-related requests, and where possible, requests for parts from a specific wafer lot
- Test data, ranging from partial to full test data
- The following quality assurance services:
  - DPA: destructive part analysis by ST or by a third-party
  - PRECAP: on-site validation of the parts before they are hermetically sealed.
  - Customer source inspection (CSI): on-site review of the test and manufacturing data
  - BUYOFF: on-site customer validation of shipments in view of test and manufacturing data
  - CLASS-S-xx: specific screening for customers requiring the Class S standard
- Other services include requests for ESCC-qualified products in die form, dummy samples for mounting qualification, and a variety of less common services grouped under a generic part code.

Date code
SLDC1-xx\$: single lot date code
DATECODE3-xx\$: DC max. 3 years
DATECODE2-xx\$: DC max. 2 years
DATECODE1-xx\$: DC max. 1 year
D3SLDC-xx\$: SLDC + DC max. 3 years
D2SLDC-xx\$: SLDC + DC max. 2 years
SPECIF-WLOT-xx\$: specific wafer lot request

Test data
DPACK-CDROM-xx: full datapack
LVT1-xx: ESCC Chart F4 Group 1 data
LVT2-xx: ESCC Chart F4 Group 2 data
LVT3-xx: ESCC Chart F4 Group 3 data
GROUP-D-xx: QML Group D summary

Quality assurance
DPA-xx: destructive part analysis
PRECAP-xx\$: on-site precap
CSI-xx\$: on-site cust. source inspection
BUYOFF-xx\$: on-site buyoff

Other services
DIE-QA-LOT-xx\$: ESCC in die form—standard option
WLQ-xx\$: ESCC in die form—premium option
SPACEDUMMY-xx: dummy samples
CHARGE-MAT-xx: other services with physical shipment
CHARGE1-xx\$: other services w/o physical shipment

Note : contact your ST representative for information on the specific xx value that applies to the product you need the service for.

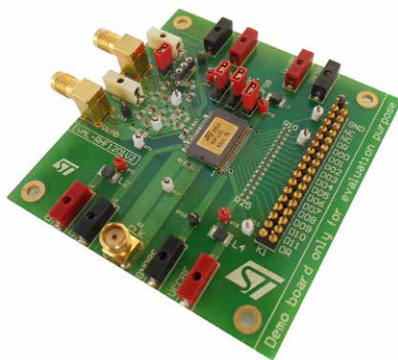


## EVALUATION BOARDS AND DOCUMENTATION

ST offers a series of evaluation boards and detailed documentation like application notes to help designers test and evaluate our rad-hard components. ST also provides technical notes covering specific quality assurance or services.

### Evaluation boards

Part number	Description
EVAL-RHF100	Demoboard RHF100
EVAL-RHF1009A	Demoboard RHF1009A
EVAL-RHF43BV1	Demoboard RHF43 & RHF484
EVAL-RHF310V1	Demoboard RHF310
EVAL-RHF330V1	Demoboard RHF330
EVAL-RHF350V1	Demoboard RHF350
EVAL-RHF1201V2	Demoboard RHF1201
EVAL-RHF1401V2	Demoboard RHF1401
EVAL-RHRICL1ATV1	Demoboard RHRPMICL triggereable mode
EVAL-RHRICL1ALV1	Demoboard RHRPMICL latched mode
EVAL-RHRICL1AFV1	Demoboard RHRPMICL foldback mode



### Technical and application notes

Part number	Description
TN0873	DIE2HR/D2HR manufacturing and quality specification
TN1181	Engineering model quality level
TN1313	Evaluation model quality level
TN1418	Development Samples quality level - LEO series
TN0985	Class S equivalent for CMOS4000B and 54HCMOS series
TN1292	M54HCxx and M54HCTxx series 100 krad(Si) versions
TN1188	Chip storage and handling for aerospace products with silver backside
TN1352	Mounting and handling guideleines for pin through holes hermetic packages
TN1379	STPS80A150CHR die-form version
AN5666	ST space products in die form
AN5790	RHFAD128 operating description
AN2984	Miimizing the SET-related effects on the output of a linear voltage regulator
AN5175	RHFL6000A
AN4441	RHFLVDS32A start time
AN4442	Two-channel LVDS repeater with the RHFLVDSR2D2
AN4443	Fail-safe feature of the RHFLVDS32A and RHFLVDSR2D2
AN2149	Integrated bus hold circuitry—VCX series
AN5485	Rad-hard crystal oscillator driver and divider—RHFOSC04

## RADIATION REPORTS, MACROMODELS, AND CAD MODELS

Detailed radiation reports are available on request to ST sales representative. They include a complete characterization of the product under single effect events.

The product macromodels are available online from the CAD Tools tab of each product page. The default format is PSpice, with Eldo and ADS models supported by some products.

Symbols, footprints, and 3D models are also available through the CAD tools tab on the ST website. Requests for models not yet available are often processed within a few days.

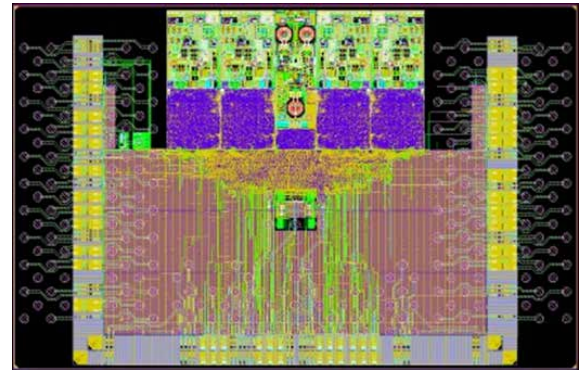
# ASICs

## ST SPACE ASIC OFFER RAD-HARD ASIC PLATFORMS

STMicroelectronics has an established expertise in radiation-hardened, application-specific ICs (ASIC) for the space industry. We offer two complete space technology platforms, including libraries, IPs, and tools and methods developed by our experts in radiation hardening through decades of experimentation and testing. We are now also opening radiation-capable technologies such as CMOS mixed signal, power, and RF architectures to selected ASIC and foundry customers.

ST's space facility in Rennes (France) is central to its supply chain, which includes ESCC or QML certification and package technologies. Our network of partners ensures that customers can find comprehensive support during solution development and prototyping phases.

The offer primarily addresses the ASIC requirements for prime contractors, payload and subsystem suppliers, as well as foundry with services (Foundry+) for fabless chip makers.



65 nm ASIC



## RAD-HARD AND RAD-CAPABLE TECHNOLOGIES

ST technologies available for space are either rad-hard or rad-capable..

Rad-hard technologies include dedicated rad-hard libraries and hard IPs, and may also involve specific tools and hardening guidelines.

Rad-capable technologies implement design features that are proven through theoretical analysis, specific radiation tests, and flight history, and essentially allow the development of rad-hard products 'by design'.

The table below summarizes ST's proprietary technology portfolio available for Space ASICs

## ST main rad-hard and rad-capable technologies

Technology	Scope	Key feature	Status
28nm FDSOI	Digital, analog, RF		Flying LEO, GEO
65 nm	Digital, analog		QML-V
BICMOS55	RF, digital	$f_T = 400 \text{ GHz} - f_{MAX} = 500 \text{ GHz}$	Development
BICMOS9MW	RF, digital	$f_T = 220 \text{ GHz} - f_{MAX} = 280 \text{ GHz}$	Flying LEO
HCMOS9A	Digital, analog		Flying GEO
BCD6s SOI	Power IC	Up to 190 V	Flying GEO
IPD	Passive RF		Flying LEO
CMOS Imaging	Image sensors	Large pixels, IR	Flying GEO

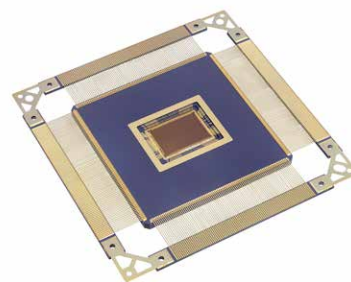
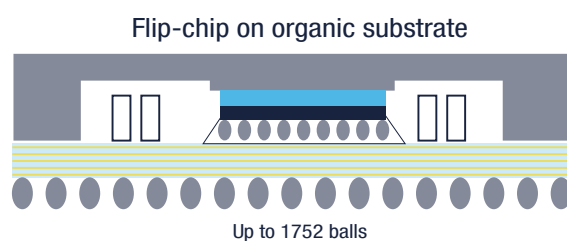
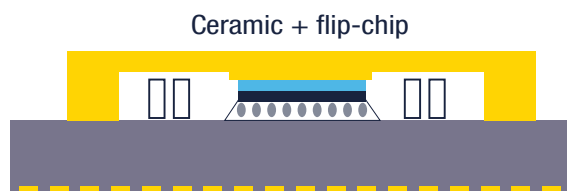
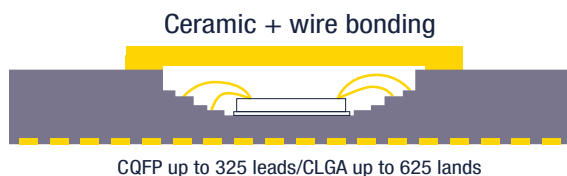
## SPACE PACKAGING AND QUALIFICATION

ST proposes a complete supply chain through its ASIC production and foundry-plus-services (Foundry+) offer. The assembly of all 'traditional space' products is performed at the ST's ESCC and QML certified facility in Rennes (France), while assembly with standard plastic packages supporting 'new space' requirements is performed in our Asian facilities.

Part of the space facility in Rennes, a flip-chip line compatible with both ceramic and organic substrates supports the needs of both traditional and new space, as well as sovereign assembly.

For ASIC and Foundry+ customers, ST can manage assembly in ceramic hermetic packages according to traditional space requirements through one of the following methods:

1. Wire bonding up to CQFP352 and CLGA up to 625 balls (packages with ball pitch down to 0.8 mm) for mid-density, mixed-signal devices up to 65 nm, as well as power ASICs and Foundry+ products.
2. In a flip-chip line up to 1752 balls up to 45 x 45 mm on ceramic or organic substrates, with optional thermal enhancement.



## Ecosystem for design support and low-cost prototyping

Technologies like 28 nm fully depleted silicon-on-insulator (FDSOI), 65 nm and BiCMOSxx are highly suitable for new developments. Some design houses have already used them to develop rad-hard ‘by design’ components for space applications. ST aims to extend such support to other rad-capable technologies proposed for space ASIC and Foundry+. Most of these technologies qualify for ST’s low-cost prototyping and multi-project wafer (MPW) services, although some restrictions may apply.

### Working models

ST proposes different levels of contribution and added value, from a pure foundry model to pure ASIC, summarized in the table below.

### ASIC and Foundry+ working models

Activity	ASIC model		Foundry model		Comments
	Customer	ST	Customer	ST	
<b>Design kit delivery</b>		Default		Default	Rad-hard kit in some technologies
<b>Hard IPs</b>		Optional		Optional	
<b>Design</b>	Default		Default		
<b>Layout &amp; hardening</b>		Default	Default	Optional	Hardening to mission profile
<b>Post layout simulation</b>	Default		Default		
<b>Diffusion</b>		Default		Default	MPW with reduced libraries in some technologies
<b>T84 data</b>				Default	
<b>Test patterns</b>	Default		Default		
<b>Wafer sort</b>		Default	Default	Optional	
<b>Packaging</b>		Optional	Default	Optional	
<b>Final test</b>		Optional	Default	Optional	
<b>Space qual.</b>		Optional	Optional	Optional	ESCC, QML-V or customized
<b>ST deliverables</b>	Design kit with libraries Good parts Support		Design kit with libraries T84 Support		
<b>Customer deliverables</b>	RTL file Test patterns		GDS2 file Test patterns		

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