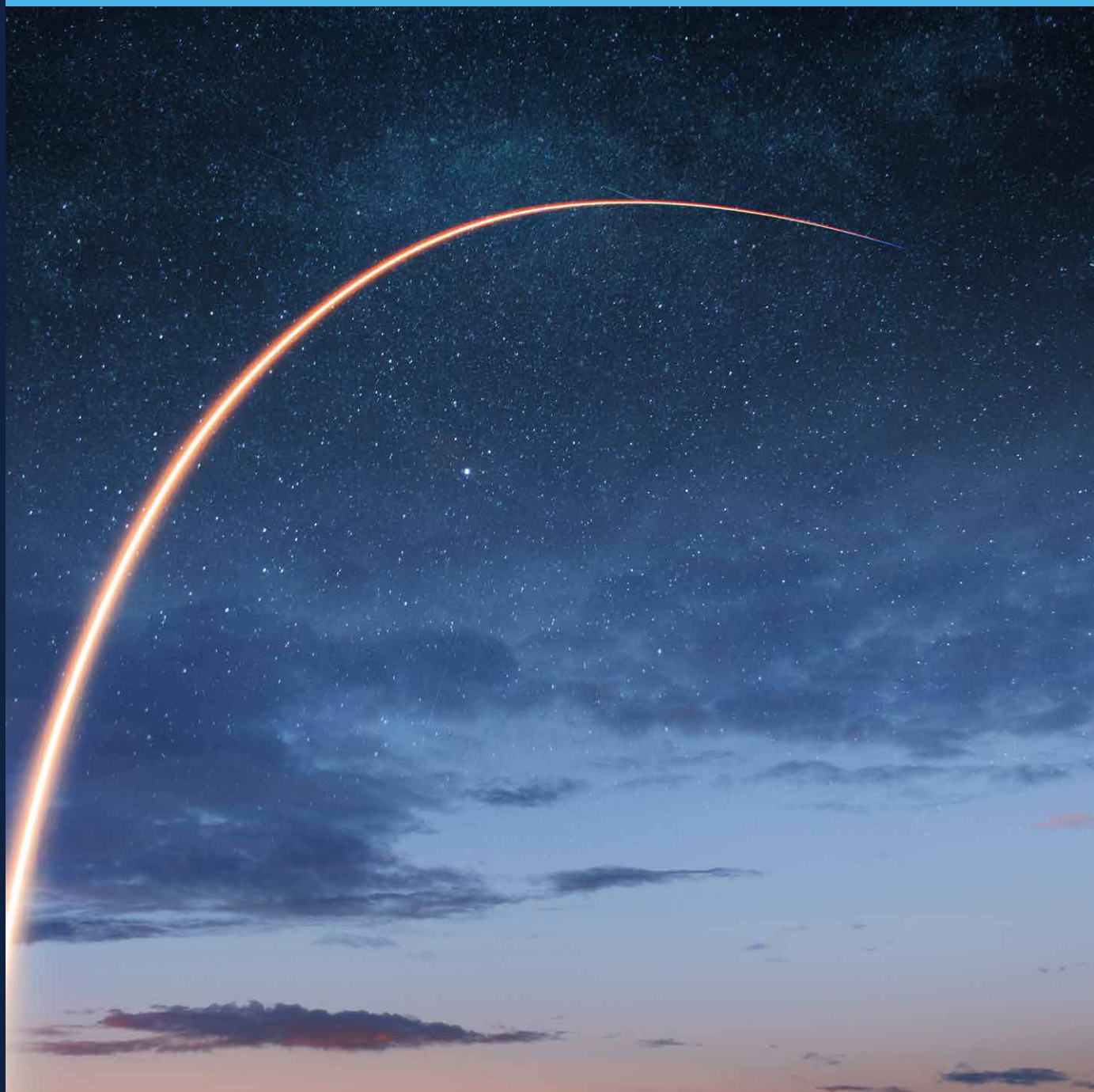




# Rad-hard products for Space applications



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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 and QML standards. We are recognized for our product quality and reliability, our flexible service options, and our longevity commitment for the supply of legacy products.

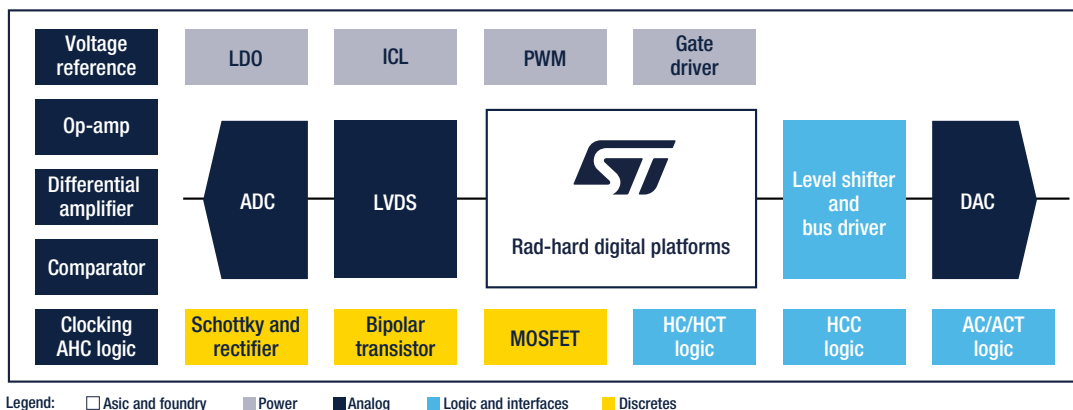
From our earliest involvement in space, our semiconductor and package technologies have flown in the majority of space crafts and missions, including the James Webb Space telescope and Artemis moon exploration program.

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.

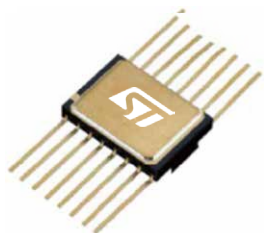
Regarding new space, ST is currently releasing a new series of rad-hard companion chips in plastic packages for LEO constellations and enabling a new generation of GEO VHTS software-defined communications satellites through technologies and extended foundry services that draw from our space and hardening 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.

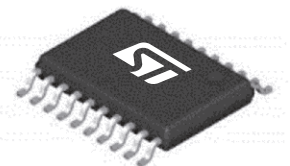
## A PORTFOLIO OF PRODUCTS AND TECHNOLOGIES



### Ceramic hermetic package for ESCC and QML



### Plastic AEC-Q10x for New Space

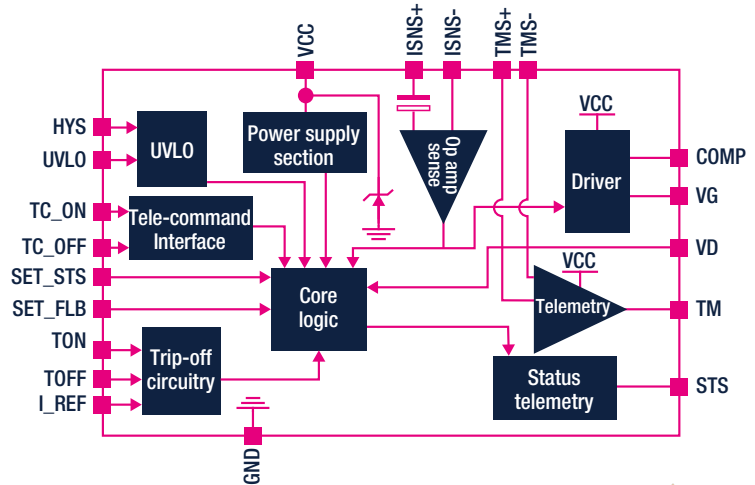


# Power management

## 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

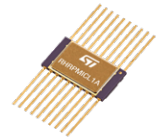


### TYPICAL APPLICATION

- Load protection
- Electronic fuse
- Current limitation

### RADIATION PERFORMANCE

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

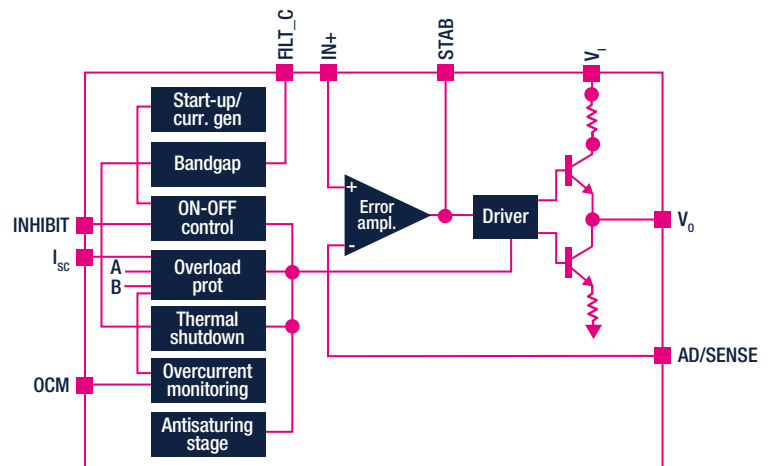


Flat-20

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

### KEY FEATURES

- Extended operating  $V_{in}$  range: 3.0 to 12 V
- $V_{out}$  min: 0.6 V
- $I_{out}$ : 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 & SEB free up to 120 MeV.cm<sup>2</sup>/mg
- Fully characterized SET



Flat-16P

## QML-V linear voltage regulators

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	
<a href="#">RHFL6000A</a>	Adjustable positive	300 ELDRS <sup>(5)</sup> free at 100 krad(Si)	120/120 <sup>(3)</sup>	<a href="#">5962F15216</a>	2.5 to 12	1.23	2.0	Flat-16P	
<a href="#">RHFL6000L</a>	Adjustable positive			<a href="#">5962F15216</a>		0.6			
<a href="#">RHFL4913A</a>	Adjustable positive		120/86		<a href="#">5962F02524</a>	3 to 12	1.23	3.0	Flat-16P <sup>(6)</sup> , SMD5C
<a href="#">RHFL4913XX15</a>	1.5 V fixed positive				<a href="#">5962F15215</a>		1.46		
<a href="#">RHFL4913XX18<sup>(4)</sup></a>	1.5 V fixed positive				TBD		1.75		
<a href="#">RHFL4913XX25</a>	2.5 V fixed positive				<a href="#">5962F02534</a>		2.45		
<a href="#">RHFL4913XX33</a>	3.3 V fixed positive				<a href="#">5962F02535</a>	3.23	Flat-16P <sup>(6)</sup> , SMD.5, TO-257		
<a href="#">RHFL4913XX50</a>	5.0 V fixed positive				<a href="#">5962F02536</a>	4.9			
<a href="#">RHFL7913A</a>	Adjustable negative				<a href="#">5962F02532</a>	-12 to -3	-9.5		Flat-16P <sup>(6)</sup> , SMD5C

- (1) All products include 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) Enhanced low dose rate sensitivity  
 (6) I<sub>out</sub> = 2 A max

## QML-V current limiter

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
<a href="#">RHRPMICL1A</a>	Integrated current limiter	100 ELDRS <sup>(3)</sup> free	125/125/9	<a href="#">5962R17211</a>	8.5 to 52	3 operating modes <sup>(4)</sup>	Flat-20

- (1) The products integrate 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 upon request, provides the complete characterization including descriptions of the actual impacts.  
 (3) Enhanced low dose rate sensitivity  
 (4) Retriggerable, latched and fold-back

## 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
<a href="#">RHRPM4423</a>	Dual low-side inverting	100 ELDRS <sup>(3)</sup> free	70/70/18	<a href="#">5962R99511</a>	4.65 to 18	5.5/4.5	Flat-10, Flat-16
<a href="#">RHRPM4424</a>	Dual low-side non-inverting			<a href="#">5962R99560</a>			

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

## 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
<a href="#">ST1843</a>	Current mode PWM controller	50	120	<a href="#">9108/020</a>	7 to 30	100	Flat-8
<a href="#">ST1845</a>		100		<a href="#">9108/021</a>		50	

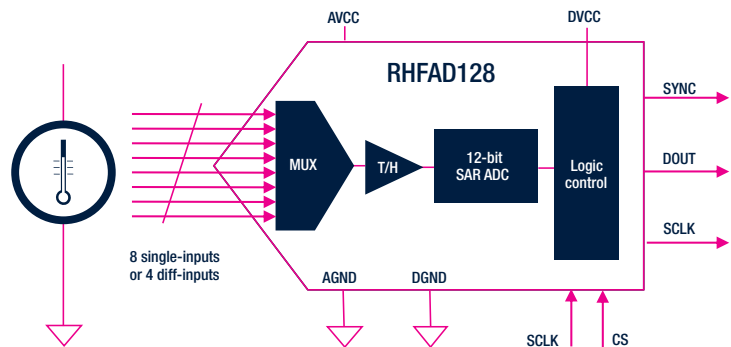
- (1) The products include only bipolar structures. They are therefore only tested at low dose rates.

# Analog

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

### KEY FEATURES

- SAR architecture
- Industry standard pinout
- 50 ksp/s–1 Msps 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

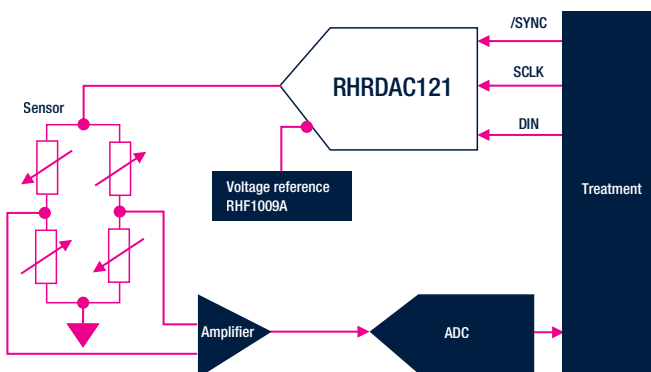


Flat-16 with grounded lid

### RADIATION PERFORMANCE

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

## RHRDAC121 RAD-HARD, 12-BIT DIGITAL-TO-ANALOG CONVERTER SMD: 5962F21208



Flat-10 with grounded lid

### 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

### 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

# RHF1201/RHRF1401: RAD-HARD 12/14 BIT PIPELINE ADC

SMD: 5962-05217/5962-06260

**KEY FEATURES**

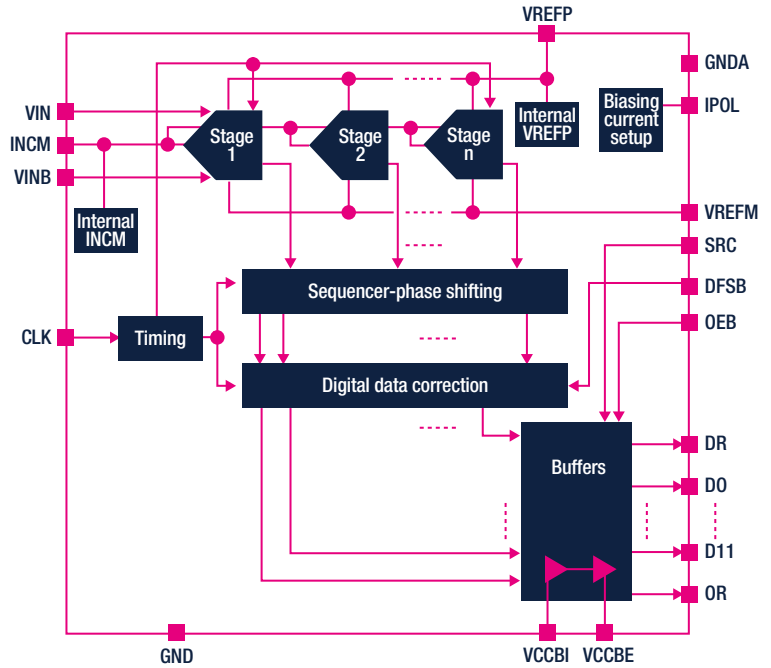
- Sampling range up to 50/20 Msps
- Input range: 2 Vpp differential
- 2.5 V/3.3 V compatible Digital I/O
- Sample and hold
- Low consumption: 100/85 mW
- Internal/External V-ref

## RADIATION PERFORMANCE

- 300 krad(Si) ELDRS free
- SEL & SEF free up to 110 MeV.cm<sup>2</sup>/mg @ 125°C
- SET & SEU: Report available upon request



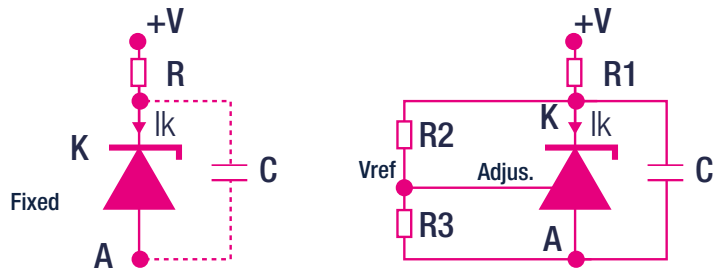
SO-48



# RHF100 AND RHF1009A RAD-HARD PRECISION V-REF

SMD: 5962F14225/9562F14222

	Key features	
	RHF100	RHF1009A
Type	Fixed	Fixed
V <sub>OUT</sub>	1.2 V, 0.15% min	2.5 V to 5.5 V, 0.1% min
I <sub>kmin</sub>	40 μA	
TempCo	5 ppm/°C typ	10 ppm/°C typ
Techno	BiCMOS 0.25 μm	
SMD	5962F14225	5962F14222



## RADIATION PERFORMANCE

- RHA guaranteed 300 krad(Si)
- SEL free up to 110 MeV.cm<sup>2</sup>/mg @ 125°C
- SET Report available upon request



Flat-10

**RHF484 RAD-HARD PRECISION QUAD OPERATIONAL AMPLIFIER**  
**SMD: 5962F08222**

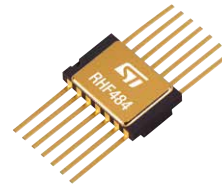
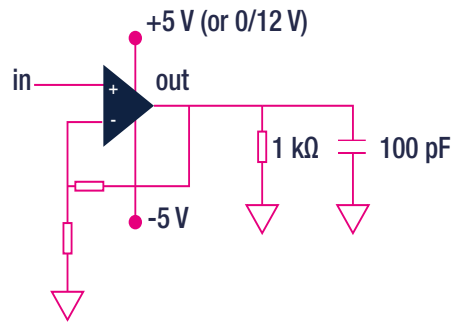
**KEY FEATURES**

- Vcc range: 4 to 14 V
- GBP: 8 MHz
- Slew-rate: 3 V/μs
- Capa-load capability
- Consumption: 2.2 mA/operator
- Input Offset: 100 μV
- Noise: 8 nV/√Hz

**RADIATION PERFORMANCE**

- RHA guaranteed 300 krad(Si)
- SEL free up to 120 MeV.cm<sup>2</sup>/mg @ 125°C
- SET: Report available upon request

**Typical schematic**



Flat-14W

**RHF330 RAD-HARD 1 GHZ OPERATIONAL AMPLIFIER**  
**SMD: 5962F07231**

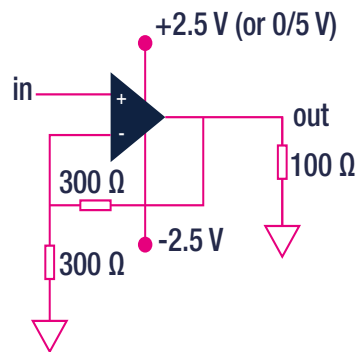
**KEY FEATURES**

- Vdd to Vcc: 4.5 to 5.5 V
- Bandwidth: 1.0 GHz @ Gain=2
- Low Consumption: Icc = 16 mA
- Io up to to +/- 360 mA min
- Slew Rate: 1800 V/μs
- Voltage noise: 1.3 nV/√Hz
- Distortion: SFDR = -78 dB @ 10 MHz
- BiCMOS7: SiGe 0.25 μm (FR)

**RADIATION PERFORMANCE**

- TID: 300 krad(Si)
- SEL free up to 110 MeV.cm<sup>2</sup>/mg @ 125°C
- Low SET: Report available upon request

**Typical schematic**



Flat-8



## QML-V data converters

Grounded metallic lid versions

Demoboard 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#	Sub-series dependent	V <sub>cc</sub> range [V]	INL/DNL <sup>(2)</sup> [LSB]	Power typ. <sup>(5)</sup> [mW]	Package
<b>A/D converters</b>					<b>Input/Output</b>				
<b>RHFAD128</b>	12-bit, 1 Msps, 8-channel, SAR <sup>(3)</sup>	300	135/32/62	5962F18204	Differential/SPI	2.7 to 3.6	±1.1/±0.9	6	Flat-16 <sup>(4)</sup>
<b>RHF1201</b>	12-bit, 50 Msps, pipeline		120/120/120	5962F05217	Differential/parallel	2.5 to 3.3	±2/±0.5	100	SO-48
<b>RHF1401</b>	14-bit 20 Msps, pipeline		120/120/120	5962F06260		2.5 to 3.3	±2/±1	85	SO-48
<b>D/A converters</b>					<b>F<sub>clock</sub> [MHz]</b>				
<b>RHRDAC121</b>	12-bit, differential in, SPI out	100	125	5962R21208	20	1.8 to 3.6	±4/±0.7	0.6	Flat-10
<b>RHRDAC1612</b>	16-bit, sigma-delta, differential in, parallel out			5962F16211	0.012	2.3 to 3.6	±4.5/±0.3	15	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

(3) Successive approximation registers

(4) Grounded Metallic lid

(5) At nominal sampling rate

## 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
<b>RHF1009A</b>	Adjustable shunt, 0.15% 30ppm/°C	300	120	5962F14222	2.5 to 5.5	0.06 to 12	Flat-10
<b>RHF100</b>	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.

## QML-V amplifiers and comparators

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
<b>Operational amplifiers</b>									
<b>RHF310A</b>	120 MHz high-speed single CFA <sup>(2)</sup>	300	110	5962F07233	4.5 to 5.5	0.4	115	No/No	Flat-8
<b>RHF330A</b>	1 GHz low noise single CFA <sup>(2)</sup>			5962F07231		16.6	1800		
<b>RHF350A</b>	550 MHz low noise single CFA <sup>(2)</sup>			5962F07232		4.1	700		
<b>RHF43B</b>	8 MHz precision single VFA <sup>(3)</sup>	100	120	5962F06237	3.0 to 16	2.2	3	No/Yes	Flat-8
<b>RHF484</b>	8 MHz precision quad VFA <sup>(3)</sup>			5962F08222	4.0 to 14	2.2	3		Flat-14W
<b>RHR61</b>	0.7 MHz low power single VFA <sup>(3)</sup>	100	120	5962F16204	1.5 to 5.5	0.06	0.3		Flat-8
<b>RHR64</b>	0.7 MHz power quad VFA <sup>(3)</sup>			5962F16205		0.06	30		Flat-14
<b>Differential amplifiers</b>									
<b>RHF200</b>	420 MHz noninverting, high impedance in	300	110	5962F17210	4.5 to 5.5	27	550	No/Yes	Flat-16
<b>Comparators</b>									
<b>RHR801</b>	7 ns, push-pull output	100	120	5962R10215	2.5 to 5.5	1.4	2100	Yes/-	Flat-16

(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) Current feedback amplifier

(3) Voltage feedback amplifier

# Interfaces

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

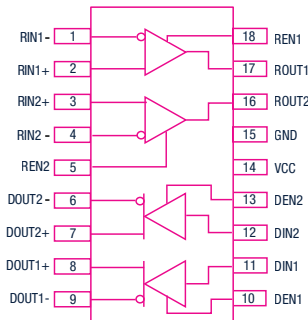
### KEY FEATURES

- Industry standard pinout
- 400 Mbps (200 MHz)
- Large common mode: -4 to +5 V
- $V_{cc}$ : 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

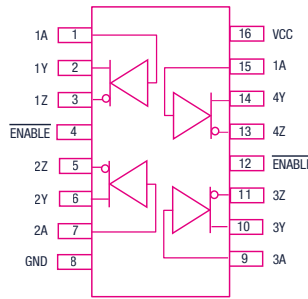


RHFLVDSR2D2 dual driver/receiver



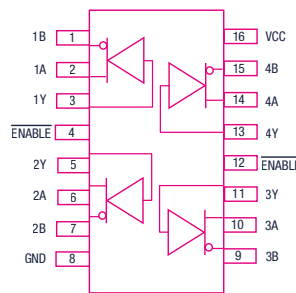
Flat package with grounded lid

### SMD: 5962F98651



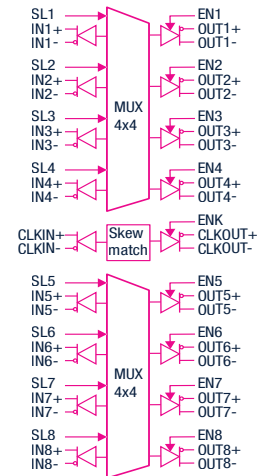
RHFLVDS31A quad driver

### SMD: 5962F98652



RHFLVDS32A quad receiver

### SMD: 5962F01537



RHFLVDS2281 dual 4x4 crosspoint switch



Flat-64 with grounded lid

## 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

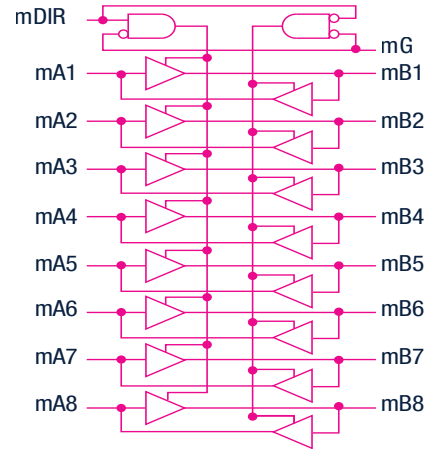
## SMD: 5962F11207

### 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>								
<a href="#">54VCXH163245</a>	16-bit bidirectional 1.8 to 3.3 V level shifter	300	110/110/-	<a href="#">5962F11207</a>	1.8 to 3.6	3.4	20	Flat-48
<a href="#">54AC164245</a>	16-bit bidirectional 3.3 to 5.0 V level shifter	100	120/21/-	<a href="#">5962R98580</a>	2.3 to 6.0	8	100	
<b>Bus transceivers</b>								
<a href="#">54VCXH162244</a>	16-bit bus buffer, resistance on bus A	300	110/110/-	<a href="#">5962F05210</a>	1.8 to 3.3	3.4	20	Flat-48
<a href="#">54VCXH162245</a>	16-bit bidirectional bus buffer, resistance on bus A			<a href="#">5962F05208</a>				
<a href="#">54VCXHR162245</a>	16-bit bidirectional bus buffer, resistance on bus A & B			<a href="#">5962F05213</a>				
<a href="#">54AC16244</a>	16-bit bus buffer		125/8/60	<a href="#">5962F04210</a>	2.0 to 6.0	10	4	
<a href="#">54ACT16244</a>	16-bit TTL bus buffer			<a href="#">5962F92022</a>	4.5 to 5.5		40	
<a href="#">54AC16245</a>	16-bit bidirectional bus buffer			<a href="#">5962R98580</a>	2.0 to 6.0		4	
<a href="#">54ACT16245</a>	16-bit TTL bidirectional bus buffer			<a href="#">5962F92023</a>	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

### Widest choice of functions

	PLLs	Oscillators
Counters	Adders	Transceivers
Decoders	Multiplexers	Buffers
Gates	Flip-flops	Latches

### 5 series ESCC or QML-V qualified

Series	Voltage Range (V)	Speed Max (MHz)	Radiation (krad(Si))	Qualification
CMOS4000B	3 to 15	10	100	• esa
HC/HCT	2 to 6	30	50/100	• esa
AC/ACT	2 to 6	70	300	QML-V
VCX	1.65 to 3.6	100	300	QML-V
AHC	1.65 to 3.6	150+	300	QML-V

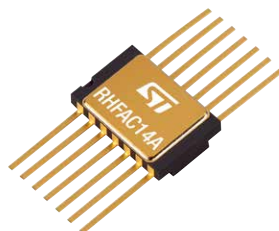
## RHFAC14A LOW POWER HEX SCHMIDT TRIGGER SMD: 5962F20207

### KEY FEATURES

- Static supply current between  $V_{ll}$  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

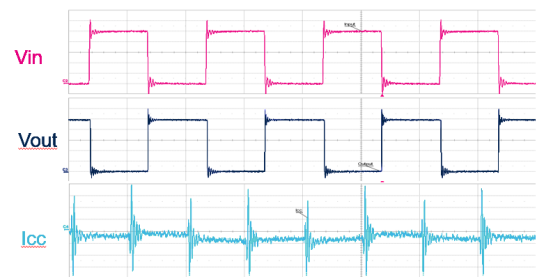


Flat-14 with grounded lid

### 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 @ $V_{cc} = 5.0 V$

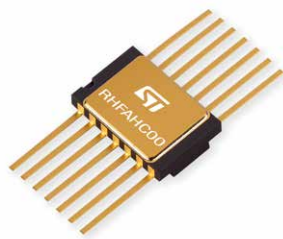
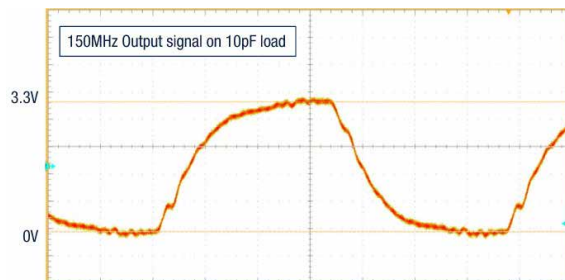


I<sub>cc</sub> peak: 9.7 mA, I<sub>cc</sub> avg: 1.72 mA

## 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

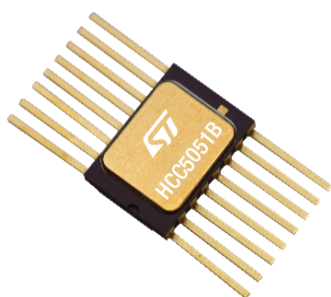
## HCC4051B: RAD-HARD 8-BIT ANALOG MULTIPLEXER ESCC DETAILED SPECIFICATION: 9202/047

### KEY FEATURES

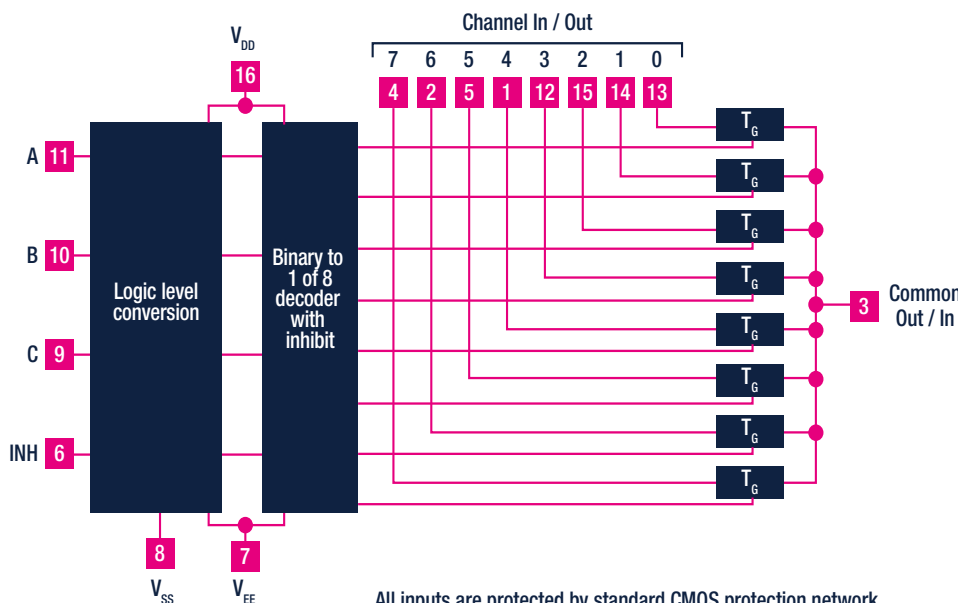
- Vcc range: 3 to 15 V
- Frequency response: 20 MHz typ
- Industry standard

### RADIATION HARDNESS

- TID: 100 krad(Si)
- SEL free up to 120 MeV.cm<sup>2</sup>/mg
- SET: Report available upon request



Flat-16E



All inputs are protected by standard CMOS protection network.

## QML-V AC/ACT/AHC 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> range. [V]	Package <sup>(3)</sup>
<b>AHC Logic</b>						
<b>RHFOSC04</b>	120 MHz <sup>(2)</sup> Crystal oscillator driver and divider	300	125/125/125	<a href="#">5962F20207</a>	2.3 to 3.6	Flat-10
<b>RHFAHC00</b>	150 MHz <sup>(2)</sup> Quad high speed NAND gate		125/62/125	<a href="#">5962F18202</a>		Flat-14
<b>AC Logic</b>						
<b>54AC00</b>	Quad 2-input NAND gate	300	125/17 <sup>(4)</sup> /33 <sup>(4)</sup>	<a href="#">5962F87549</a>	2.0 to 6.0	Flat-14, DIL-14
<b>54AC02</b>	Quad 2-input NOR gate		125/17/33 <sup>(4)</sup>	<a href="#">5962F87612</a>		Flat-14, DIL-14
<b>54AC04</b>	Hex inverter		125/17 <sup>(4)</sup> /33 <sup>(4)</sup>	<a href="#">5962F87609</a>		Flat-14, DIL-14
<b>54AC08</b>	Quad 2-input AND gate		125/17 <sup>(4)</sup> /33 <sup>(4)</sup>	<a href="#">5962F87615</a>		Flat-14, DIL-14
<b>54AC10</b>	Triple 3-input NAND gate		125/17 <sup>(4)</sup> /33 <sup>(4)</sup>	<a href="#">5962F87610</a>		Flat-14
<b>54AC11</b>	Triple 3-input AND gate		125/17 <sup>(4)</sup> /33 <sup>(4)</sup>	<a href="#">5962F87611</a>		Flat-14
<b>54AC14</b>	Hex Schmitt inverter		125/17 <sup>(4)</sup> /33 <sup>(4)</sup>	<a href="#">5962F87624</a>		Flat-14, DIL-14
<b>54AC14A</b>	Hex Schmitt inverter low power		125/17 <sup>(4)</sup> /33 <sup>(4)</sup>	<a href="#">5962F87624</a>		Flat-14
<b>54AC32</b>	Quad 2-input OR gate		125/17 <sup>(4)</sup> /33 <sup>(4)</sup>	<a href="#">5962F87614</a>		Flat-14, DIL-14
<b>54AC74</b>	Dual D-type flip-flop with preset & clear		125/8/8	<a href="#">5962F88520</a>		Flat-14, DIL-14
<b>54AC86</b>	Quad exclusive OR		125/17 <sup>(4)</sup> /33 <sup>(4)</sup>	<a href="#">5962F89550</a>		Flat-14
<b>54AC138</b>	3-to-8 line decoder inverter		125/17 <sup>(4)</sup> /33 <sup>(4)</sup>	<a href="#">5962F87622</a>		Flat-16, DIL-16
<b>54AC139</b>	Dual 2-to-4 line decoder/demultiplexer		125/17 <sup>(4)</sup> /33 <sup>(4)</sup>	<a href="#">5962F87623</a>		Flat-16
<b>54AC151</b>	8-channel multiplexer		125/17 <sup>(4)</sup> /33 <sup>(4)</sup>	<a href="#">5962F87691</a>		Flat-16
<b>54AC157</b>	Quad 2-channel multiplexer		125/17 <sup>(4)</sup> /33 <sup>(4)</sup>	<a href="#">5962F89539</a>		Flat-16
<b>54AC161</b>	Synchronous binary counter with asynchronous clear		125/8/8	<a href="#">5962F89561</a>		Flat-16
<b>54AC174</b>	Hex D-type flip-flop with clear		125/8/8	<a href="#">5962F87626</a>		Flat-16
<b>54AC191</b>	4 bit synchronous binary up/down counter		125/8/8	<a href="#">5962F89749</a>		Flat-16, DIL-16
<b>54AC240</b>	Octal bus buffer 3-state inverter		125/33 <sup>(5)</sup> /33 <sup>(5)</sup>	<a href="#">5962F87550</a>		Flat-20
<b>54AC244</b>	Octal bus buffer 3-state with OE by nimble		125/33 <sup>(5)</sup> /33 <sup>(5)</sup>	<a href="#">5962F87552</a>		Flat-20
<b>54AC245</b>	Octal bus transceiver 3-state with OE and T/R		125/33 <sup>(5)</sup> /33 <sup>(5)</sup>	<a href="#">5962F87758</a>		Flat-20
<b>54AC273</b>	Octal D-type flip-flop with clear		125/8/8	<a href="#">5962F87756</a>		Flat-20
<b>54AC373</b>	Octal D-type latch 3-state		125/17 <sup>(4)</sup> /8 <sup>(4)</sup>	<a href="#">5962F87555</a>		Flat-20
<b>54AC374</b>	Octal D-type flip-flop 3-state		125/17 <sup>(4)</sup> /8 <sup>(4)</sup>	<a href="#">5962F87694</a>		Flat-20
<b>54AC541</b>	Octal bus buffer 3-state		125/33 <sup>(5)</sup> /33 <sup>(5)</sup>	<a href="#">5962F88706</a>		Flat-20
<b>54AC574</b>	Octal D-type flip-flop 3-state		125/17 <sup>(4)</sup> /8 <sup>(4)</sup>	<a href="#">5962F96773</a>		Flat-20
<b>54AC2525</b>	1-to-8 skew clock driver		125/17 <sup>(4)</sup> /33 <sup>(4)</sup>	<a href="#">5962F92174</a>		Flat-14
<b>54AC16244</b>	16-bit buffer 3-state with OE by nimble		125/33 <sup>(5)</sup> /33 <sup>(5)</sup>	<a href="#">5962F04210</a>		Flat-48
<b>54AC16245</b>	16-bit transceiver 3-state with OE and DIR by byte		125/33 <sup>(5)</sup> /33 <sup>(5)</sup>	<a href="#">5962F04211</a>		Flat-48
<b>54AC16373</b>	16-bit D-type latch 3-state		125/17 <sup>(4)</sup> /8 <sup>(4)</sup>	<a href="#">5962F04212</a>		Flat-48
<b>54AC16374</b>	16-bit D-type flip-flop 3-state		125/17 <sup>(4)</sup> /8 <sup>(4)</sup>	<a href="#">5962F04213</a>		Flat-48
<b>54AC164245</b>	16-bit 3 to 5 V level shifter transceiver 3-state		100	120/21/-		<a href="#">5962R98580</a>

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]	Package <sup>(3)</sup>
<b>ACT logic</b>						
<b>54ACT00</b>	Quad 2-input NAND gate	300	125/17 <sup>(4)</sup> /33 <sup>(4)</sup>	5962F87699	4.5 to 5.5	Flat-14
<b>54ACT02</b>	Quad 2-input NOR gate		125/17 <sup>(4)</sup> /33 <sup>(4)</sup>	5962F89791		Flat-14
<b>54ACT04</b>	Hex inverter		125/17 <sup>(4)</sup> /33 <sup>(4)</sup>	5962F89734		Flat-14
<b>54ACT08</b>	Quad 2-input AND gate		125/17 <sup>(4)</sup> /33 <sup>(4)</sup>	5962F89547		Flat-14, DIL-14
<b>54ACT10</b>	Triple 3-input NAND gate		125/17 <sup>(4)</sup> /33 <sup>(4)</sup>	5962F92182		Flat-14
<b>54ACT11</b>	Triple 3-input AND gate		125/17 <sup>(4)</sup> /33 <sup>(4)</sup>	5962F90772		Flat-14
<b>54ACT14</b>	Hex Schmitt inverter		125/17 <sup>(4)</sup> /33 <sup>(4)</sup>	5962F96813		Flat-14
<b>54ACT32</b>	Quad 2-input OR gate		125/17 <sup>(4)</sup> /33 <sup>(4)</sup>	5962F89736		Flat-14
<b>54ACT74</b>	Dual D-type flip-flop with preset & clear		125/8/8	5962F87525		Flat-14
<b>54ACT86</b>	Quad exclusive OR		125/17 <sup>(4)</sup> /33 <sup>(4)</sup>	5962F90687		Flat-14
<b>54ACT138</b>	3-to-8 line decoder inverter		125/17 <sup>(4)</sup> /33 <sup>(4)</sup>	5962F87554		Flat-16
<b>54ACT139</b>	Dual 2-to-4 line decoder/demultiplexer		125/17 <sup>(4)</sup> /33 <sup>(4)</sup>	5962F87553		Flat-16
<b>54ACT157</b>	Quad 2-channel multiplexer		125/17 <sup>(4)</sup> /33 <sup>(4)</sup>	5962F89688		Flat-16
<b>54ACT161</b>	Synchronous binary counter with asynchronous clear		125/8/8	5962F91722		Flat-16
<b>54ACT240</b>	Octal bus buffer 3-state inverter		125/33 <sup>(5)</sup> /33 <sup>(5)</sup>	5962F87759		Flat-20
<b>54ACT244</b>	Octal bus buffer 3-state with OE by nimble		125/33 <sup>(5)</sup> /33 <sup>(5)</sup>	5962F87760		Flat-20
<b>54ACT245</b>	Octal bus transceiver 3-state with OE and T/R		125/33 <sup>(5)</sup> /33 <sup>(5)</sup>	5962F87663		Flat-20
<b>54ACT273</b>	Octal D-type flip-flop with clear		125/8/8	5962F01527		Flat-20
<b>54ACT373</b>	Octal D-type latch 3-state		125/17 <sup>(4)</sup> /8 <sup>(4)</sup>	5962F87556		Flat-20
<b>54ACT374</b>	Octal D-type flip-flop 3-state		125/17 <sup>(4)</sup> /8 <sup>(4)</sup>	5962F87631		Flat-20
<b>54ACT541</b>	Octal bus buffer 3-state		125/33 <sup>(5)</sup> /33 <sup>(5)</sup>	5962F89795		Flat-20
<b>54ACT574</b>	Octal D-type flip-flop 3-state		125/17 <sup>(4)</sup> /8 <sup>(4)</sup>	5962F89601		Flat-20
<b>54ACT16244</b>	16-bit buffer 3-state with OE by nimble		125/33 <sup>(5)</sup> /33 <sup>(5)</sup>	5962F92022		Flat-48
<b>54ACT16245</b>	16-bit transceiver 3-state with OE and DIR by byte		125/33 <sup>(5)</sup> /33 <sup>(5)</sup>	5962F92023		Flat-48
<b>54ACT16373</b>	16-bit D-type latch 3-state		125/17 <sup>(4)</sup> /8 <sup>(4)</sup>	5962F92024		Flat-48
<b>54ACT16374</b>	16-bit D-type flip-flop 3-state		125/17 <sup>(4)</sup> /8 <sup>(4)</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) Characterization frequency. Not tested in production

(3) Contact ST sales representative for availability of DIL versions on other products

(4) At 3.0 Volts

(5) At 4.5 Volts, 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 generic specification	V <sub>cc</sub> range [V]	F <sub>max</sub> <sup>(2)</sup> [MHz]	Package <sup>(3)</sup>	
<b>HC Logic</b>								
<a href="#">M54HC00</a>	Quad 2-input NAND gate	50	125/15/-	<a href="#">9201/105</a>	2.0 to 6.0	55	Flat-14E; DIL-14	
<a href="#">M54HC02</a>	Quad 2-input NOR gate		125/15/-	<a href="#">9201/113</a>		55	Flat-14E; DIL-14	
<a href="#">M54HC03</a>	Quad 2-input NAND open drain		125/15/-	<a href="#">9201/114</a>		40	Flat-14E	
<a href="#">M54HC04</a>	Hex inverter		125/15/-	<a href="#">9401/033</a>		52	Flat-14E; DIL-14	
<a href="#">M54HC08</a>	Quad 2-input AND gate		125/15/-	<a href="#">9201/106</a>	2.4 to 6.0	41	Flat-14E; DIL-14	
<a href="#">M54HC10</a>	Triple 3-input NAND gate		125/15/-	<a href="#">9201/107</a>	2.0 to 6.0	50	Flat-14E	
<a href="#">M54HC11</a>	Triple 3-input AND gate		125/15/-	<a href="#">9201/117</a>		40	Flat-14E; DIL-14	
<a href="#">M54HC14</a>	Hex Schmitt inverter		125/18/-	<a href="#">9409/007</a>		35	Flat-14E; DIL-14	
<a href="#">M54HC27</a>	Triple 3-input NOR gate		125/15/-	<a href="#">9201/109</a>		52	Flat-14E	
<a href="#">M54HC32</a>	Quad 2-input OR gate		125/15/-	<a href="#">9201/111</a>		50	Flat-14E; DIL-14	
<a href="#">M54HC74</a>	Dual D-type flip-flop with preset & clear		125/18/-	<a href="#">9203/050</a>		25	Flat-14E; DIL-14	
<a href="#">M54HC85</a>	4-bit magnitude comparator		125/15/-	<a href="#">9209/004</a>		21	Flat-16E	
<a href="#">M54HC86</a>	Quad exclusive OR gate		125/15/-	<a href="#">9201/119</a>		41	Flat-14E; DIL-14	
<a href="#">M54HC109</a>	Dual J-K flip-flop with preset & clear		125/18/-	<a href="#">9306/048</a>		27	Flat-16E	
<a href="#">M54HC123</a>	Dual retriggerable monostable multivibrator with clear		125/18/-	<a href="#">9207/006</a>		15	Flat-16E; DIL-16	
<a href="#">M54HC125</a>	Quad bus buffer 3-state		125/14/-	<a href="#">9401/039</a>		50	Flat-14E	
<a href="#">M54HC132</a>	Quad 2-input Schmitt NAND gate		125/18/-	<a href="#">9201/120</a>		40	Flat-14E; DIL-14	
<a href="#">M54HC138</a>	3-to-8 line decoder inverter		125/15/-	<a href="#">9408/046</a>		25	Flat-16E; DIL-16	
<a href="#">M54HC139</a>	Dual 2-to-4 line decoder/demultiplexer		125/15/-	<a href="#">9205/017</a>		22	Flat-16E	
<a href="#">M54HC148</a>	8-to-3 line priority encoder		125/15/-	<a href="#">9410/017</a>		2.0 to 6.0	21	Flat-16E; DIL-16
<a href="#">M54HC151</a>	8-channel multiplexer		125/15/-	<a href="#">9408/054</a>		23	Flat-16E	
<a href="#">M54HC153</a>	Dual 4-channel multiplexer		125/15/-	<a href="#">9408/038</a>		34	Flat-16E; DIL-16	
<a href="#">M54HC154</a>	4-to-16 line decoder/demultiplexer		125/15/-	<a href="#">9205/023</a>		25	Flat-24	
<a href="#">M54HC157</a>	Quad 2-channel multiplexer		125/15/-	<a href="#">9408/057</a>		40	Flat-16E; DIL-16	
<a href="#">M54HC160</a>	Synchronous decade counter with async. clear		125/18/-	<a href="#">9205/062</a>		25	Flat-16E; DIL-16	
<a href="#">M54HC161</a>	Synchronous binary counter with async. clear		125/18/-	<a href="#">9204/059</a>		25	Flat-16E	
<a href="#">M54HC164</a>	8-bit SIPO shift register		125/18/-	<a href="#">9306/041</a>		25	Flat-14E; DIL-14	
<a href="#">M54HC165</a>	8-bit PISO shift register		125/18/-	<a href="#">9306/042</a>	25	Flat-16E; DIL-16		
<a href="#">M54HC166</a>	8-bit PISO shift register with clear		125/18/-	<a href="#">9306/043</a>	25	Flat-16E		
<a href="#">M54HC174</a>	Hex D-type flip-flop with clear		125/18/-	<a href="#">9306/052</a>	27	Flat-16E		
<a href="#">M54HC175</a>	Quad D-type flip-flop with clear		125/18/-	<a href="#">9203/052</a>	30	Flat-16E; DIL-16		
<a href="#">M54HC191</a>	4-bit synchronous binary up/down counter		125/18/-	<a href="#">9204/066</a>	20	Flat-16E		
<a href="#">M54HC193</a>	Synchronous up/down binary counter	125/18/-	<a href="#">9204/065</a>	16	Flat-16E; DIL-16			
<a href="#">M54HC237</a>	3-to-8 line decoder latch	125/15/-	<a href="#">9205/021</a>	21	Flat-16E			



Part number	Description	TID [krad(Si)]	SEL/SET/SEU threshold <sup>(1)</sup> [MeV.cm <sup>2</sup> /mg]	ESCC generic specification	V <sub>cc</sub> range [V]	F <sub>max</sub> <sup>(2)</sup> [MHz]	Package <sup>(3)</sup>		
<a href="#">M54HC240</a>	Octal bus buffer 3-state inverter	50	125/14/-	<a href="#">9401/034</a>	2.0 to 6.0	50	Flat-20E		
<a href="#">M54HC244</a>	Octal bus buffer 3-state		125/14/-	<a href="#">9401/048</a>		43	Flat-20E; DIL-20		
<a href="#">M54HC245</a>	Octal bus transceiver 3-state		125/14/-	<a href="#">9405/013</a>		50	Flat-20E; DIL-20		
<a href="#">M54HC251</a>	8-channel multiplexer 3-state		125/14/-	<a href="#">9408/048</a>		23	Flat-16E		
<a href="#">M54HC257</a>	Quad 2-channel multiplexer 3-state		125/14/-	<a href="#">9408/047</a>		33	Flat-16E		
<a href="#">M54HC259</a>	8-bit addressable latch		125/18/-	<a href="#">9203/073</a>		27	Flat-16E		
<a href="#">M54HC273</a>	Octal D-type flip-flop with clear		125/18/-	<a href="#">9203/053</a>		27	Flat-20E; DIL-20		
<a href="#">M54HC373</a>	Octal D-type latch 3-state		125/18/-	<a href="#">9203/059</a>		33	Flat-20E; DIL-20		
<a href="#">M54HC374</a>	Octal D-type flip-flop 3-state		125/18/-	<a href="#">9203/060</a>		30	Flat-20E; DIL-20		
<a href="#">M54HC393</a>	Dual binary counter		125/18/-	<a href="#">9204/074</a>		25	Flat-14E; DIL-14		
<a href="#">M54HC540</a>	Octal bus buffer 3-state inverter		125/14/-	<a href="#">9401/049</a>		40	Flat-20E		
<a href="#">M54HC541</a>	Octal bus buffer 3-state		125/14/-	<a href="#">9401/047</a>		40	Flat-20E; DIL-20		
<a href="#">M54HC573</a>	Octal D-type latch 3-state		125/18/-	<a href="#">9202/072</a>		28	Flat-20E; DIL-20		
<a href="#">M54HC574</a>	Octal D-type flip-flop 3-state		125/18/-	<a href="#">9203/054</a>		30	Flat-20E; DIL-20		
<a href="#">M54HC595</a>	8-bit shift register output latch 3-state		125/18/-	<a href="#">9306/051</a>		27	Flat-16E; DIL-16		
<a href="#">M54HC597</a>	8-bit latch/shift register		125/18/-	<a href="#">9306/054</a>		27	Flat-16E		
<a href="#">M54HC688</a>	8-bit equality comparator		125/15/-	<a href="#">9209/005</a>		23	Flat-20E		
<a href="#">M54HC4020</a>	14-stage binary counter		125/18/-	<a href="#">9204/070</a>		25	Flat-16E		
<a href="#">M54HC4040</a>	12-stage binary counter		125/18/-	<a href="#">9204/069</a>		25	Flat-16E; DIL-16		
<a href="#">M54HC4049</a>	Hex buffer/converter inverter		125/15/-	<a href="#">9401/037</a>		50	Flat-16E; DIL-16		
<a href="#">M54HC4050</a>	Hex buffer/converter		125/15/-	<a href="#">9401/038</a>		50	Flat-16E; DIL-16		
<a href="#">M54HC4051</a>	Single 8-channel analog mux/demux		125/15/-	<a href="#">9408/064</a>		83	Flat-16E; DIL-16		
<a href="#">M54HC4053</a>	Triple 2-channel analog mux/demux		125/15/-	<a href="#">9408/065</a>		83	Flat-16E; DIL-16		
<a href="#">M54HC4060</a>	14-stage binary counter/oscillator		125/18/-	<a href="#">9204/076</a>		20	Flat-16E; DIL-16		
<a href="#">M54HC4066</a>	Quad bilateral switch		125/15/-	<a href="#">9408/052</a>		83	Flat-14E; DIL-14		
<a href="#">M54HC4094</a>	8-bit SIPO shift register 3-state		125/18/-	<a href="#">9306/050</a>		20	Flat-16E		
<a href="#">M54HC4514</a>	4-to-16 line decoder latch		125/18/-	<a href="#">9205/019</a>		18	Flat-24; DIL24N		
HCT Logic									
<a href="#">M54HCT74</a>	Dual D-type flip-flop with preset & clear		50	125/18/-		<a href="#">9203/070</a>	4.5 to 5.5	25	Flat-20
<a href="#">M54HCT244</a>	Octal bus buffer 3-state			125/14/-		<a href="#">9402/009</a>		35	Flat-20E; DIL-20
<a href="#">M54HCT245</a>	Octal bus transceiver 3-state	125/14/-		<a href="#">9405/014</a>		35	Flat-20		

(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

(3) Contact ST sales representative for availability of DIL versions on other products

## 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 generic specification	V <sub>cc</sub> range [V]	Package <sup>(3)</sup>
<a href="#">HCC4001B</a>	Quad 2-input NOR gate	100	120/120/120	<a href="#">9201/041</a>	3 to 15	Flat-14E, DIL-14
<a href="#">HCC4002B</a>	Dual 4-input NOR gate		120/120/120	<a href="#">9201/042</a>		Flat-14E, DIL-14
<a href="#">HCC4011B</a>	Quad 2-input NAND gate		120/120/120	<a href="#">9201/043</a>		Flat-14E, DIL-14
<a href="#">HCC4013B</a>	Dual D flip-flop		120/120/120	<a href="#">9203/023</a>		Flat-14E, DIL-14
<a href="#">HCC4014B</a>	8-stage Static synchronous shift register		120/120/60	<a href="#">9306/014</a>		Flat-16E, DIL-16
<a href="#">HCC4015B</a>	Dual 4-stage static shift register		120/120/60	<a href="#">9306/015</a>		Flat-16E, DIL-16
<a href="#">HCC4017B</a>	Decade counter/divider		120/120/120	<a href="#">9204/020</a>		Flat-16E
<a href="#">HCC4018B</a>	Presetable divide-by N counter		120/120/120	<a href="#">9204/021</a>		Flat-16E
<a href="#">HCC4019B</a>	Quad AND/OR select gate		120/120/120	<a href="#">9202/051</a>		Flat-16E
<a href="#">HCC4020B</a>	14-stage binary/ripple counter		120/120/36	<a href="#">9204/022</a>		Flat-16E
<a href="#">HCC4021B</a>	8-stage static shift register		120/120/60	<a href="#">9306/016</a>		Flat-16E
<a href="#">HCC4022B</a>	Divide-By-8 counter/divider		120/120/120	<a href="#">9204/023</a>		Flat-16E
<a href="#">HCC4024B</a>	7-stage binary/ripple counter		120/120/36	<a href="#">9204/024</a>		Flat-14E, DIL-14
<a href="#">HCC4027B</a>	Dual J-K master-slave flip-flop		120/120/120	<a href="#">9203/022</a>		Flat-16E, DIL-16
<a href="#">HCC4028B</a>	BCD-to-decimal decoder		120/120/120	<a href="#">9205/010</a>		Flat-16E
<a href="#">HCC4029B</a>	Presetable up/down counter		120/120/120	<a href="#">9204/025</a>		Flat-16E, DIL-16
<a href="#">HCC4030B</a>	Quad exclusive OR gate		120/120/120	<a href="#">9201/047</a>		Flat-14E, DIL-14
<a href="#">HCC4040B</a>	12-stage binary/ripple counter		120/120/36	<a href="#">9204/026</a>		Flat-16E, DIL-16
<a href="#">HCC4041UB</a>	Quad true complement buffer		120/120/120	<a href="#">9202/040</a>		Flat-14E
<a href="#">HCC4043B</a>	Quad 3-state NOR R/S latch		120/120/120	<a href="#">9202/042</a>		Flat-16E, DIL-16
<a href="#">HCC4046B</a>	Micropower phase locker Loop		120/120/120	<a href="#">9202/044</a>		Flat-16E, DIL-16
<a href="#">HCC4047B</a>	Monostable/astable multivibrator		120/120/120	<a href="#">9207/003</a>		Flat-14E, DIL-14
<a href="#">HCC4049UB</a>	Hex inverting buffer/converter		120/120/120	<a href="#">9202/045</a>		Flat-16E, DIL-16
<a href="#">HCC4050B</a>	Hex non-inverting buffer/converter		120/120/120	<a href="#">9202/046</a>		Flat-16E, DIL-16
<a href="#">HCC4051B</a>	Single 8-channel analog mux/demux		120/120/120	<a href="#">9202/047</a>		Flat-16E, DIL-16
<a href="#">HCC4052B</a>	Differential 4-channel analog mux/demux		120/120/120	<a href="#">9202/048</a>		Flat-16E, DIL-16
<a href="#">HCC4053B</a>	Triple 2-channel analog mux/demux		120/120/120	<a href="#">9202/049</a>		Flat-16E, DIL-16
<a href="#">HCC4060B</a>	14-stage counter/divider AND oscillator		120/120/120	<a href="#">9204/052</a>		Flat-16E
<a href="#">HCC4063B</a>	4-bit magnitude comparator		120/120/120	<a href="#">9209/001</a>		Flat-16E, DIL-16
<a href="#">HCC4066B</a>	Quad bilateral switch		120/120/120	<a href="#">9408/005</a>		Flat-14E, DIL-14
<a href="#">HCC4067B</a>	Single 16-channel analog mux/demux		120/120/120	<a href="#">9408/009</a>		Flat-24E, DIL-24
<a href="#">HCC4068B</a>	8-input NAND/AND gate		120/120/120	<a href="#">9201/061</a>		Flat-14E
<a href="#">HCC4069UB</a>	Hex inverter		120/120/120	<a href="#">9401/010</a>		Flat-14E
<a href="#">HCC4070B</a>	Quad exclusive OR gate		120/120/120	<a href="#">9201/048</a>		Flat-14E, DIL-14
<a href="#">HCC4071B</a>	Quad 2-input OR gate		120/120/120	<a href="#">9201/063</a>		Flat-14E, DIL-14
<a href="#">HCC4072B</a>	Dual 4-input OR gate		120/120/120	<a href="#">9201/082</a>		Flat-14E, DIL-14
<a href="#">HCC4073B</a>	Triple 3-input AND gate		120/120/120	<a href="#">9201/064</a>		Flat-14E, DIL-14
<a href="#">HCC4075B</a>	Triple 3-input OR gate		120/120/120	<a href="#">9201/065</a>		Flat-14E
<a href="#">HCC4077B</a>	Quad exclusive NOR gate		120/120/120	<a href="#">9201/055</a>		Flat-14E, DIL-14

Part number	Description	TID [krad(Si)]	SEL/SET/SEU threshold <sup>(1)</sup> [MeV.cm <sup>2</sup> /mg]	ESCC generic specification	V <sub>cc</sub> range [V]	Package <sup>(3)</sup>
<b>HCC4081B</b>	Quad 2-input AND gate	100	120/120/120	<a href="#">9201/052</a>	3 to 15	Flat-14E, DIL-14
<b>HCC4093B</b>	Quad 2-input NAND Schmitt trigger		120/120/120	<a href="#">9409/002</a>		Flat-14E, DIL-14
<b>HCC4094B</b>	8-stage shift-and-store bus register		120/120/60	<a href="#">9306/026</a>		Flat-16E, DIL-16
<b>HCC4098B</b>	Dual monostable multivibrator		120/120/120	<a href="#">9206/003</a>		Flat-16E, DIL-16
<b>HCC40103B</b>	Presettable 8-bit binary down counter		120/120/120	<a href="#">9204/036</a>		Flat-16E
<b>HCC40106B</b>	Hex Schmitt trigger		120/120/120	<a href="#">9409/005</a>		Flat-14E, DIL-14
<b>HCC40109B</b>	Quad low-to-high voltage level shifter		120/120/120	<a href="#">9407/003</a>		Flat-16E, DIL-16
<b>HCC40174B</b>	Hex D flip-flop		120/120/120	<a href="#">9203/038</a>		Flat-16E
<b>HCC4503B</b>	Hex buffer 3-state non-inverter		120/120/120	<a href="#">9401/030</a>		Flat-16E, DIL-16
<b>HCC4512B</b>	8-channel data select. with 3-state output		120/120/120	<a href="#">9408/006</a>		Flat-16E
<b>HCC4514B</b>	4-bit latch/4-to-16 line decoder output high		120/120/120	<a href="#">9408/012</a>		Flat-24E, DIL-24
<b>HCC4516B</b>	Presettable 4-bit binary up/down counter		120/120/120	<a href="#">9204/045</a>		Flat-16E
<b>HCC4520B</b>	Dual binary up-down counter		120/120/120	<a href="#">9204/028</a>		Flat-16E
<b>HCC4538B</b>	Dual precision monostable multivibrator		120/120/120	<a href="#">9207/007</a>		Flat-16E, DIL-16
<b>HCC4555B</b>	Dual 1-of-4 decoder/demux output high		120/120/120	<a href="#">9408/011</a>		Flat-16E
<b>HCC4556B</b>	Dual 1-of-4 decoder/demux output low		120/120/120	<a href="#">9408/025</a>		Flat-16E

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

(2) Contact ST sales representative for availability of DIL versions on other products



# Discretes

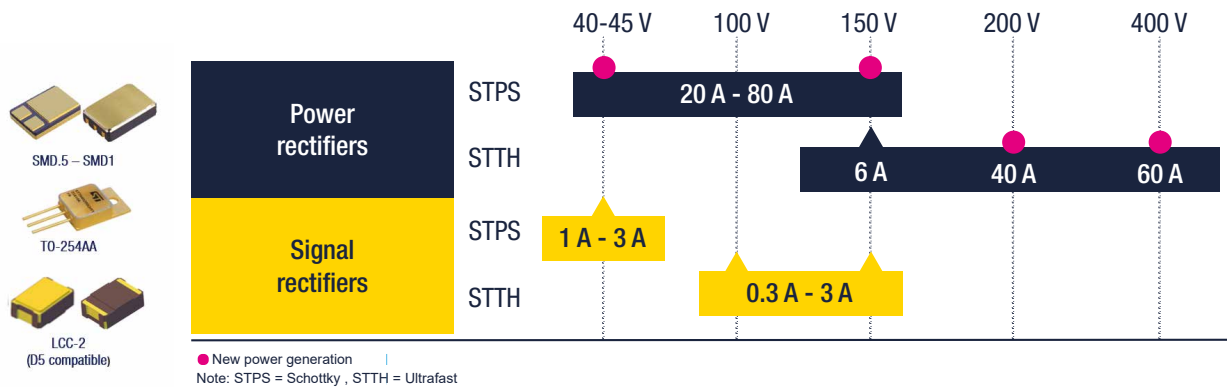
## NEW POWER RECTIFIER SERIES UP TO 80 A AND 400 V

### 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

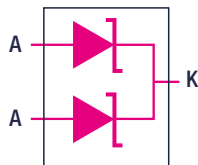
### RADIATION PERFORMANCE

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



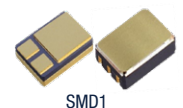
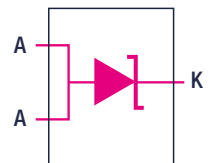
### STPS60A150CHR MONOLITHIC DUAL SCHOTTKY ESCC: 5106/023

Key features	
$V_{RRM}$	150 V
$I_F$	2 x 30 A
$V_F$	0.83 V max @ 30 A - 125°C
$I_{FSM}$	2 x 190 A
$dV/dt$	10 kV/ $\mu$ s max
$T_j$	175°C max
Techno	Full planar



### STTH60400HR ULTRA FAST RECTIFIER ESCC: 5103/032

Key features	
$V_{RRM}$	400 V
$I_F$	60 A
$V_F$	1.15 V max @ 60 A - 125°C
$I_{FSM}$	500 A
$t_{RR}$	80 ns
$T_j$	175°C max
Techno	Full high voltage planar



### RADIATION PERFORMANCE

- TID RHA guaranteed at 3 Mrad(Si)
- SEB free up to 60 MeV.cm<sup>2</sup>/mg @ 100%  $V_{RRM}$
- PIST functional up to 60 MeV.cm<sup>2</sup>/mg @ 85%  $V_{RRM}$
- PIST full compliance up to 32 MeV.cm<sup>2</sup>/mg @ 100%  $V_{RRM}$

### RADIATION PERFORMANCE

- TID RHA guaranteed at 3 Mrad(Si)
- SEB free up to 60 MeV.cm<sup>2</sup>/mg @ 100%  $V_{RRM}$
- PIST full compliance up to 60 MeV.cm<sup>2</sup>/mg @ 100%  $V_{RRM}$

## ESCC qualified 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>										
<b>1N5822U</b>	Single	3	-	<a href="#">5106/020</a>	40	3	0.485	-	-65 to 150	LCC-2B
<b>1N5819U</b>	Single	3	-	<a href="#">5106/021</a>	45	1	0.45	-	-65 to 150	LCC-2B
<b>STPS40A45CHR</b>	Dual CC <sup>(7)</sup>	3	No SEB @ 60	<a href="#">5106/024</a>		40	0.61	-	-65 to 175	TO-254AA
<b>STPS80A45CHR</b>	Dual CC <sup>(7)</sup>	3	No SEB @ 60	<a href="#">5106/024</a>	80	0.74	-	-65 to 175	SMD.5	
<b>STPS40A150CHR</b>	Dual CC <sup>(7)</sup>	3	No SEB @ 60	<a href="#">5106/023</a>	150	40	0.79	-	-65 to 175	TO-254AA
<b>STPS60A150CHR</b>	Dual CC <sup>(7)</sup>	3	No SEB @ 60	<a href="#">5106/023</a>		60	0.83	-	-65 to 175	SMD.5
<b>STPS80A150CHR</b>	Dual CC <sup>(7)</sup>	3	No SEB @ 60 <sup>(8)</sup>	<a href="#">5106/023</a>		80	0.88	-	-65 to 175	SMD.5
<b>Ultrafast rectifiers</b>										
<b>1N6640U</b>	Single	3	Immune	<a href="#">5101/027</a>	75	0.3	1.06	9	-65 to 175	LCC-2D
<b>1N6642U</b>	Single	3		<a href="#">5101/026</a>	100	0.3	1.2	9	-65 to 175	LCC-2D
<b>1N5806U</b>	Single	3		<a href="#">5101/014</a>	150	2.5	1	30	-65 to 175	LCC-2A
<b>1N5811U</b>	Single	3		<a href="#">5101/013</a>	150	6	0.955	35	-65 to 175	LCC-2B
<b>BYW81HR</b>	Single	-		<a href="#">5103/029</a>	200	15	1.15	40	-55 to 150	SMD.5
<b>STTH40200CHR</b>	Dual CC <sup>(7)</sup>	3		<a href="#">5103/033</a>	200	40	1.02	60	-65 to 175	TO-254AA
<b>STTH60200CHR</b>	Dual CC <sup>(7)</sup>	3		<a href="#">5103/033</a>	200	60	0.95	60	-65 to 175	SMD1
<b>STTH60400HR</b>	Single	3		<a href="#">5103/032</a>	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) Common cathode

(8) @ 85% V<sub>RRM</sub> max

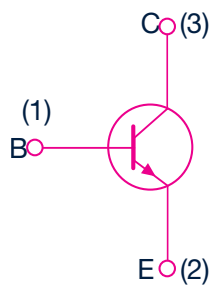
## 2ST15300 RAD-HARD 300 V, 5 A NPN BIPOLAR TRANSISTOR ESCC: 5201/020

**KEY FEATURES**

- Linear gain characteristics
- Inductive load ruggedness

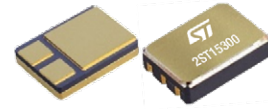
**TYPICAL APPLICATIONS**

- Electrical propulsion
- Inductive load switches
- Linear amplifiers



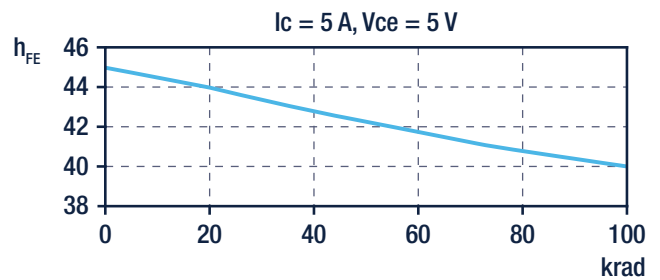
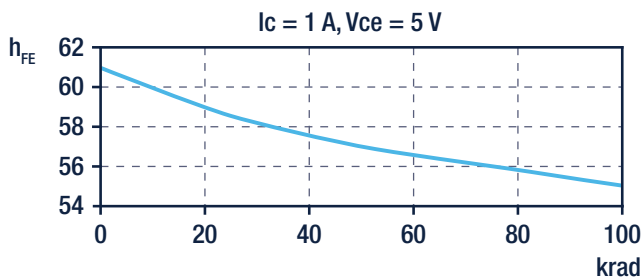
### RADIATION PERFORMANCE

- 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**

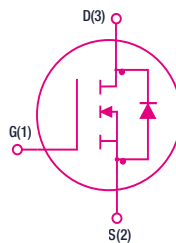
- Low  $R_{DS(on)}$  and superior dynamic performance
- Superior stability in extended reliability test
- Very low drift under total ionized dose exposure

**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>)

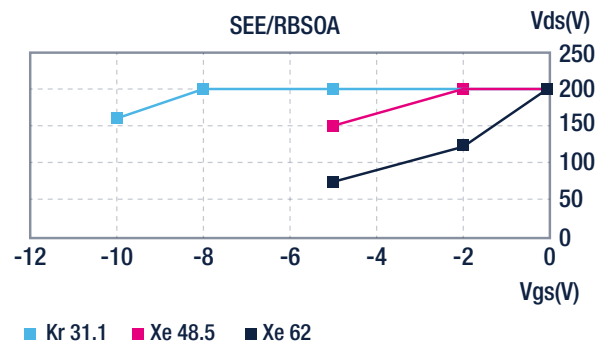
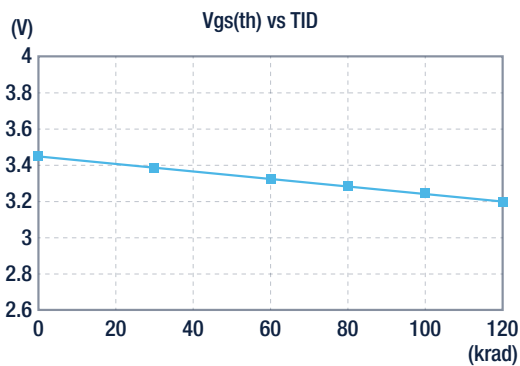


SC3015C



SMD.5

### Radiation performance



## ESCC bipolar transistors

Temperature range -65 to 200°C

Part number	Description	TID [krad(Si)]	ELDRS <sup>(1)</sup>	ESCC detailed specification	V <sub>CB0</sub> <sup>(2)</sup> max [V]	I <sub>c</sub> <sup>(3)</sup> max [A]	h <sub>FE</sub> <sup>(4)</sup> min	Package
<b>NPN transistor</b>								
<a href="#">2N2222AHR</a>	Single	100 <sup>(5)</sup>	Yes	<a href="#">5201/002</a>	50	0.8	100	LCC-3, UB
<a href="#">2N2484HR</a>	Single	-	-	<a href="#">5201/001</a>	60	0.05	100	LCC-3, UB
<a href="#">2N2920AHR</a>	Matched pair	-	-	<a href="#">5207/002</a>	60	0.03	300	LCC-6, Flat-8
<a href="#">2N3700HR</a>	Single	100 <sup>(5)</sup>	Yes	<a href="#">5201/004</a>	80	1	100	LCC-3, UB
<a href="#">2N5154HR</a>	Single		(6)	<a href="#">5203/010</a>	80	5	70	SMD.5, TO-257
<a href="#">2N5551HR</a>	Single		Yes	<a href="#">5201/019</a>	160	0.5	80	LCC-3, UB
<a href="#">2ST15300</a>	Single		Yes	<a href="#">5201/020</a>	300	5	55	SMD.5
<b>PNP transistor</b>								
<a href="#">2N2907AHR</a>	Single	100 <sup>(5)</sup>	Yes	<a href="#">5202/001</a>	-60	-0.6	100	LCC-3, UB
<a href="#">2N3810HR</a>	Matched pair		Yes	<a href="#">5207/005</a>	-60	-0.05	150	LCC-6, Flat-8
<a href="#">2N5153HR</a>	Single		(6)	<a href="#">5204/002</a>	-80	-5	70	SMD.5, TO-257
<a href="#">2N5401HR</a>	Single		Yes	<a href="#">5202/014</a>	-150	-0.5	60	LCC-3, UB
<b>NPN and PNP complementary pair</b>								
<a href="#">2ST3360</a>	Complementary pair	100	Yes	<a href="#">5207/009</a>	-60/60	-0.8/0.8	160	Flat-8

(1) Enhanced low dose rate sensitivity

(2) Collector-emitter voltage

(3) Collector current

(4) Gain

(5) Selected versions

(6) Not characterized

## 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 <sub>BDSS</sub> <sup>(1)</sup> [V]	I <sub>D</sub> <sup>(2)</sup> [A]	R <sub>DS(on)</sub> <sup>(3)</sup> max [mΩ]	Qg <sup>(4)</sup> max [nC]	Package
<b>N-channel</b>									
<a href="#">STRH40N6</a>	60 V, 30 A	50	60	<a href="#">5205/024</a>	60	30	45	52	SMD.5
<a href="#">STRH100N6</a>	60 V, 40 A			<a href="#">5205/022</a>		40	13.5	160	TO-254AA
<a href="#">STRH8N10</a>	100 V, 6 A			100	<a href="#">5205/023</a>	6	300	22	SMD.5
<a href="#">STRH100N10</a>	100 V, 48 A				<a href="#">5205/021</a>	48	35	162	TO-254AA
<a href="#">STRHMF16N20</a>	200 V, 16 A	100		<a href="#">5205/034</a>	200	16	90	78	SMD.5
<b>P-channel</b>									
<a href="#">STRH12P10</a>	100 V, 12 A	100	60	<a href="#">5205/029</a>	100	12	300	48	TO-257AA
<a href="#">STRH40P10</a>	100 V, 34 A			<a href="#">5205/025</a>		34	75	194	TO-254AA

(1) Drain-source breakdown voltage

(2) Drain current

(3) Drain-source on resistance

(4) Total gate charge

# LEO series

## PLASTIC RAD-HARD FOR NEW SPACE

### KEY FEATURES

- ST Proprietary specification optimized for LEO and MEO
- Rad-rad dice assembled on lines used for AEC-Q100/Q101 products
- AEC-Q100/Q101 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 or 100 krad(Si)
- TNID: characterized<sup>(1)</sup>
- SEL/SEB-free up to at least 43 MeV.cm<sup>2</sup>/mg
- SET/SEU/SEFI Characterized<sup>(2)</sup>

#### Notes

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

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

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

(4) SOD128F packaged diodes

### GENERIC CHARACTERISTICS

- -40 to +125°C
- Gold wires/copper clip<sup>(4)</sup>
- NiPdAu finishing
- Space compliant outgassing<sup>(3)</sup>

### QUALITY ASSURANCE

- AEC-Q100/Q101 based framework
- Statistical process control
- ST LEO generic specification

Refer to [TN1432](#) for more information on the generic specification of the LEO series

## 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



## LEO1N58XX SERIES OF SMALL SIGNAL DIODES AND RECTIFIERS

Schottky diodes characterized up to 60 MeV.cm<sup>2</sup>/mg

### KEY FEATURES

- ESCC qualified dice in automotive qualified SOD128-Flat
- Enhanced forward voltage ( $V_F$ ) and surge current ( $I_{FSM}$ )
- Full radiation guarantee : TID, SEE and TNID
- Effective cost of ownership



SOD128-Flat

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

ST proprietary LEO optimized generic specification  
 AEC-Q100 /Q101 based quality assurance  
 SEL free up to 62 MeV.cm<sup>2</sup>/mg  
 Characterized TNID @ 1.10<sup>13</sup> proton/cm<sup>2</sup>

Part number	Description	TID [krad(Si)]	SEL free/SET/SEU <sup>(1)</sup> [MeV.cm <sup>2</sup> /mg]	V <sub>cc</sub> range [V]	Key features	Temperature range [°C]	Package
<b>Power management</b>							
<b>LE03910</b>	2 A positive low drop voltage regulator	50	62.5/62.5/-	3 to 12	Vdrop: 350 mV @ I <sub>out</sub> =400 mA	-40 to 125	PS036
<b>LEOPOL<sup>(1)</sup></b>	Up to 6 A buck DC/DC converter	50	62.5/tbd/tbd <sup>(2)</sup>	3 to 12	V <sub>out</sub> = 0.8 V min; soft start; full protections set Multi device out of phase current sharing	-40 to 125	PS036
<b>Data converters</b>							
<b>LE0AD128</b>	1 Msps 12-bit ADC, with 8-input MUX	50	62.5/-/-	2.7 to 3.6	Serial output		TSS0P20
<b>LVDS</b>							
<b>LE0LVDSRD</b>	LVDS driver-receiver, 400 Mbps	50	62.5/-/-	3.0 to 3.6	Enhanced common mode and VCC range		TSS0P20
<b>Logic</b>							
<b>LE0AC00</b>	Quad 2-input NAND gate	50	62.5/-/-	2.0 to 6.0	High speed, 10 ns prop. delay		TSS0P20
<b>LE0AC08</b>	Quad 2-input AND gate						
<b>LE0AC14</b>	Hex inverter						
<b>LE0AC32</b>	Quad 2-input OR gate						
<b>LE0AC74</b>	Dual D-type flip-flop						
<b>LE0AC244</b>	Octal bus buffer						
<b>Diodes and Rectifier</b>							
<b>LE01N5822<sup>(1)</sup></b>	3 A, 40 V Schottky diode	300	SEB : 62.5	up to 40	V <sub>F</sub> = 0.39 V max @ 3 A/125°C	-40 to +175	SOD128-Flat
<b>LE01N5819<sup>(1)</sup></b>	1 A, 45 V Schottky diode			up to 45	V <sub>F</sub> = 0.43 V max @ 1A/125°C		
<b>LE01N5811<sup>(1)</sup></b>	6 A, 150 V ultrafast rectifier			up to 150	V <sub>F</sub> = 0.9V max @ 6 A/150°C		

(1) Under development

(2) Data not available at the time of printing

# 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
CLASS-S-xx: up-screen to class S like

Other services <sup>(1)</sup>
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

(1) contact ST sales representative for other services such as Residual Gas Analysis or duplicate copy of the certificate of conformance

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

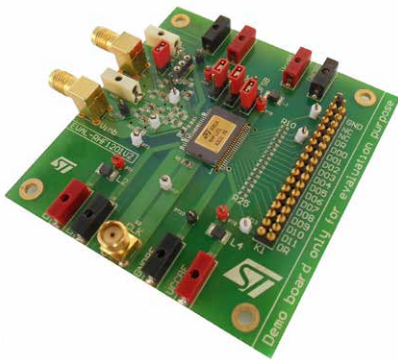
# Ecosystem

## 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. You will find all the latest documentation from the resources tab of the Space products page on [www.st.com](http://www.st.com).

### Evaluation boards

Part number	Description
<a href="#">EVAL-RHF100</a>	Demoboard RHF100
<a href="#">EVAL-RHF1009A</a>	Demoboard RHF1009A
<a href="#">EVAL-RHF43BV1</a>	Demoboard RHF43 & RHF484
<a href="#">EVAL-RHF310V1</a>	Demoboard RHF310
<a href="#">EVAL-RHF330V1</a>	Demoboard RHF330
<a href="#">EVAL-RHF350V1</a>	Demoboard RHF350
<a href="#">EVALRHAD128V2</a>	Demoboard RHFAD128
<a href="#">EVAL-RHF1201V2</a>	Demoboard RHF1201
<a href="#">EVAL-RHF1401V2</a>	Demoboard RHF1401
<a href="#">EVAL-RHRICL1ATV1</a>	Demoboard RHRPMICL triggerable mode
<a href="#">EVAL-RHRICL1ALV1</a>	Demoboard RHRPMICL latched mode
<a href="#">EVAL-RHRICL1AFV1</a>	Demoboard RHRPMICL foldback mode



### Technical and application notes

Part number	Description
<a href="#">TN0873</a>	DIE2HR/D2HR manufacturing and quality specification
<a href="#">TN1181</a>	Engineering model quality level
<a href="#">TN1313</a>	Evaluation model quality level
<a href="#">TN1418</a>	Development Samples quality level - LEO series
<a href="#">TN0985</a>	Class S equivalent for CMOS4000B and 54HCMOS series
<a href="#">TN1292</a>	M54HCxx and M54HCTxx series 100 krad(Si) versions
<a href="#">TN1188</a>	Chip storage and handling for aerospace products with silver backside
<a href="#">TN1352</a>	Mounting and handling guidelines for pin through holes hermetic packages
<a href="#">TN1379</a>	STPS80A150CHR die-form version
<a href="#">AN5666</a>	ST space products in die form
<a href="#">AN5790</a>	RHFAD128 operating description
<a href="#">AN2984</a>	Minimizing the SET-related effects on the output of a linear voltage regulator
<a href="#">AN5175</a>	RHFL6000A
<a href="#">AN4441</a>	RHFLVDS32A start time
<a href="#">AN4442</a>	Two-channel LVDS repeater with the RHFLVDSR2D2
<a href="#">AN4443</a>	Fail-safe features of the RHFLVDS32A and RHFLVDSR2D2
<a href="#">AN2149</a>	Integrated bus hold circuitry–VCX series
<a href="#">AN5485</a>	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, or using ST's online support at [www.st.com](http://www.st.com)/support. 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.

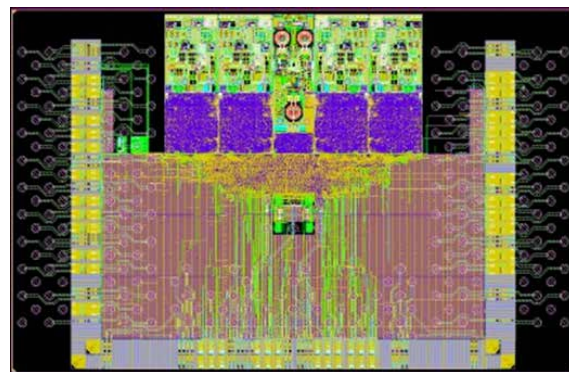
# ASICs

## ST SPACE ASIC OFFER RAD-HARD ASIC PLATFORMS

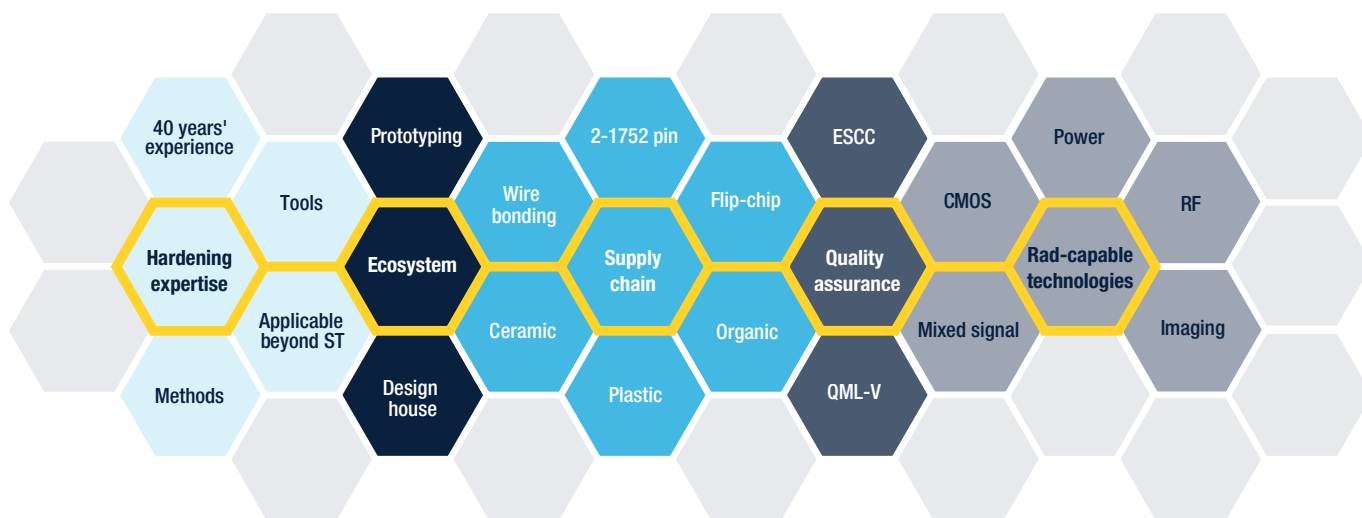
STMicroelectronics has an established expertise in radiation-hardened, application-specific ICs (ASIC) for the space industry. We offer two complete space technology platforms, including libraries, IPs, and tools and methods developed by our experts in radiation hardening through decades of experimentation 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 features	Status
28 nm FDSOI	Digital, analog, RF		Flying LEO, GEO
65 nm	Digital, analog		QML-V
BICMOS55X	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

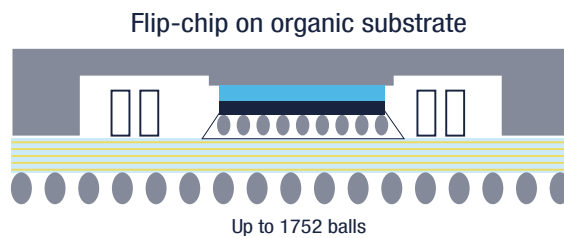
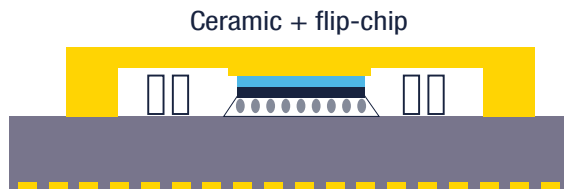
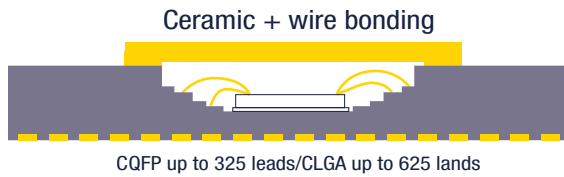
## SPACE PACKAGING AND QUALIFICATION

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.

For more information about MPW, please contact our partner CIME-P at <https://cime-p.cime.grenoble-inp.fr>

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



# At STMicroelectronics we create technology that starts with You



Order code: **BR2405RHSA**

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