



life.augmented

# Rad-hard products for Space applications



# 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.

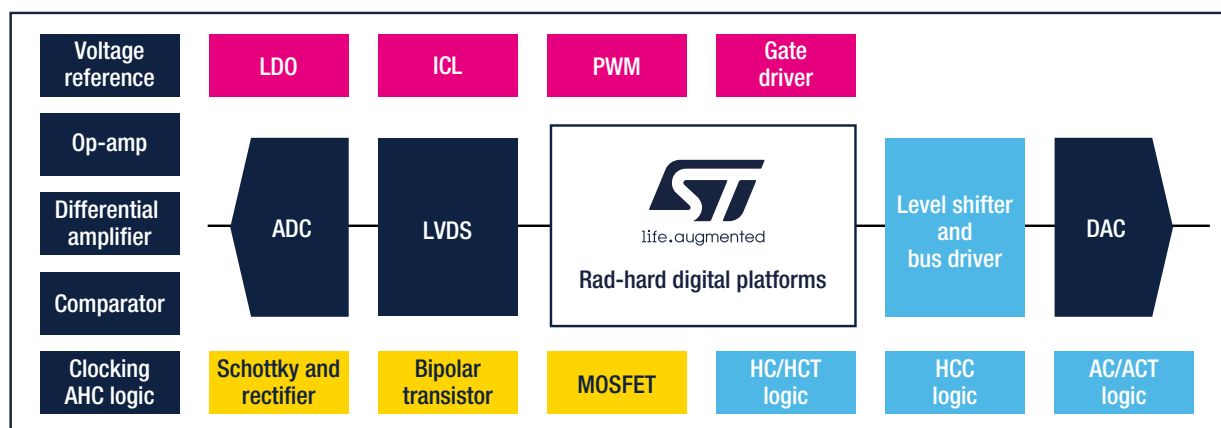
From our earliest involvement in space, our semiconductor and package technologies have flown in the majority of space crafts and missions, including the James Webb Space Telescope and Artemis moon exploration program.

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.

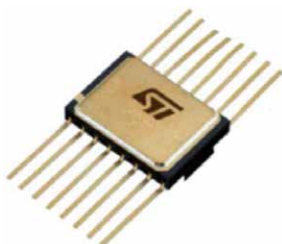
Regarding new space, ST is currently releasing a new series of rad-hard companion chips in plastic packages for LEO constellations and enabling a new generation of GEO VHTS software-defined communications satellites through technologies and extended foundry services that draw from our space and hardening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

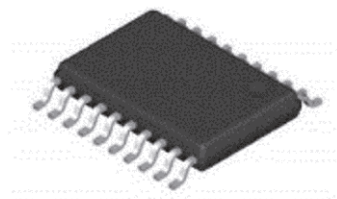
### A PORTFOLIO OF PRODUCTS AND TECHNOLOGIES



QML-V, ESCC, and JANS products



Rad-hard plastic for LEO and New Space

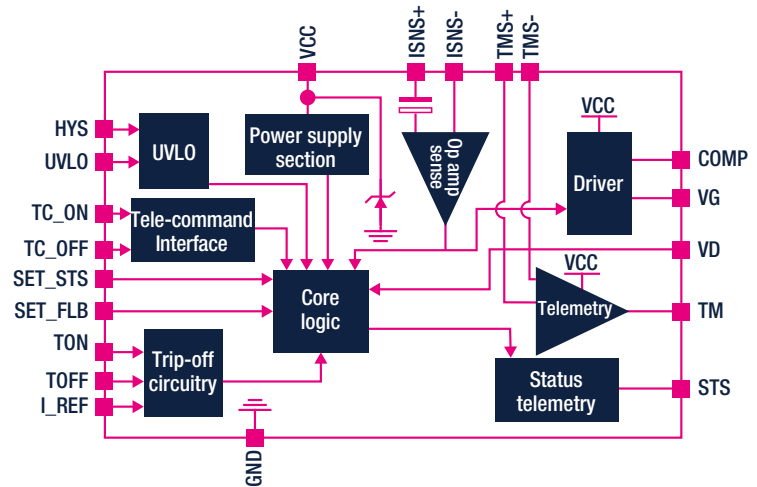


# Power management

## 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

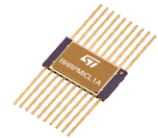


### TYPICAL APPLICATION

- 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

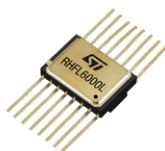


Flat-20

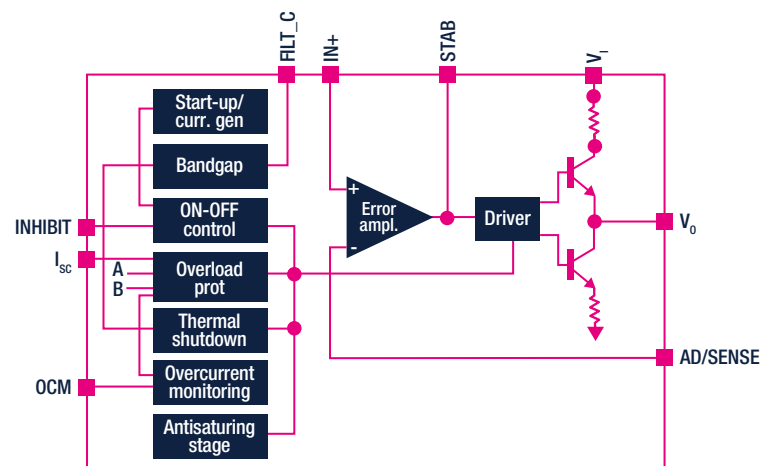
## RHFL6000L RAD-HARD VERY LOW VOLTAGE LDO SMD: 5962F15216

### 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



Flat-16P



### RADIATION PERFORMANCE

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

## 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><br>[krad(Si)] | SEL/SET threshold <sup>(2)</sup><br>[MeV.cm <sup>2</sup> /mg] | QML-V SMD# | V <sub>CC</sub> range<br>[V] | V <sub>OUT</sub> min.<br>[V] | I <sub>OUT</sub> max.<br>[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 | 4.8 to 12                    | 3.23                         |                              | Flat-16P <sup>(5)</sup> , SMD.5, T0-257 |
| RHFL4913XX50             | 5.0V fixed positive |                                      |                                                               | 5962F02536 | 5.5 to 12                    | 4.9                          |                              |                                         |
| RHFL7913A                | Adjustable negative |                                      |                                                               | 5962F02532 | -12 to -3                    | -9.5                         |                              | Flat-16P <sup>(4)</sup> , SMD5C         |

(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><br>[krad(Si)] | SEL/SEB/SET threshold <sup>(2)</sup><br>[MeV.cm <sup>2</sup> /mg] | QML-V SMD# | V <sub>CC</sub> range<br>[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><br>[krad(Si)] | SEL/SEB/SET threshold <sup>(2)</sup><br>[MeV.cm <sup>2</sup> /mg] | QML-V SMD# | V <sub>CC</sub> range<br>[V] | I <sub>SOURCE</sub> /I <sub>SINK</sub><br>peak per gate<br>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><br>[krad(Si)] | SEE threshold<br>[MeV.cm <sup>2</sup> /mg] | ESCC detail specification | V <sub>CC</sub> range<br>[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                  |         |

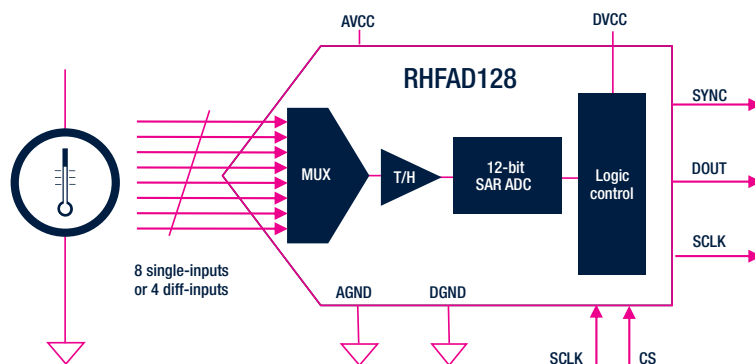
(1) The products include only bipolar structures. They are therefore only tested at low dose rates.

# Analog

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

### KEY FEATURES

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

### 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 Msps, 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 Msps, pipeline                     |                    | 120/120/120                                                     | 5962F05217 | 2.5 to 3.3                | ±2/±0.5                      | Differential/parallel | 100                            | S0-48                  |
| RHF1401     | 14-bit 20 Msps, 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

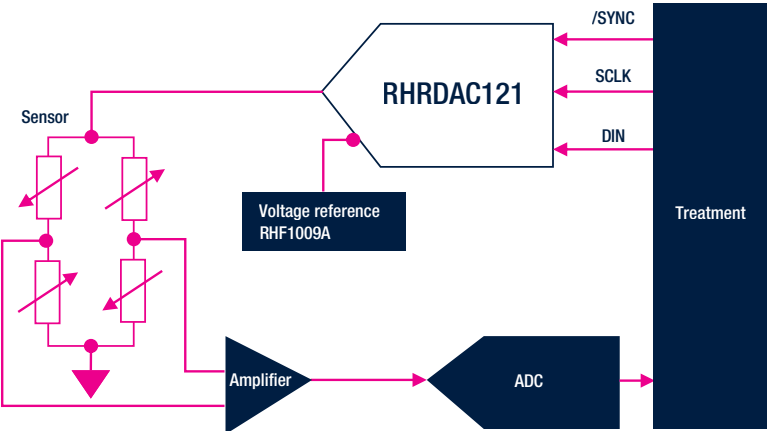
(3) Successive approximation registers

(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<br>[krad(Si)] | SEL threshold <sup>(1)</sup><br>[MeV.cm <sup>2</sup> /mg] | QML-V<br>SMD# | V <sub>cc</sub> range<br>[V] | I <sub>cc</sub> max/<br>operator [mA] | Slew rate<br>typ.(V/μs) | Rail to rail<br>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<br>[krad(Si)] | SEL threshold <sup>(1)</sup><br>[MeV.cm <sup>2</sup> /mg] | QML-V<br>SMD# | V <sub>cc</sub> range<br>[V] | I <sub>cc</sub> max/<br>operator [mA] | Rail to rail<br>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<br>[krad(Si)] | SEL threshold <sup>(1)</sup><br>[MeV.cm <sup>2</sup> /mg] | QML-V<br>SMD# | V <sub>cc</sub> range<br>[V] | I <sub>cc</sub> max/<br>operator [mA] | Rail to rail<br>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<br>[krad(Si)] | SEL threshold <sup>(1)</sup><br>[MeV.cm <sup>2</sup> /mg] | QML-V<br>SMD# | V <sub>KA</sub><br>[V] | I <sub>K</sub> range<br>[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

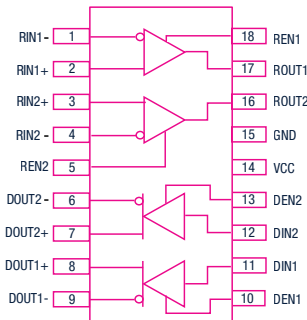
### KEY FEATURES

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

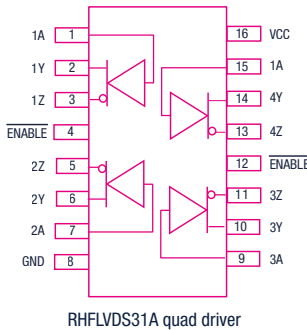


RHFLVDSR2D2 dual driver/receiver



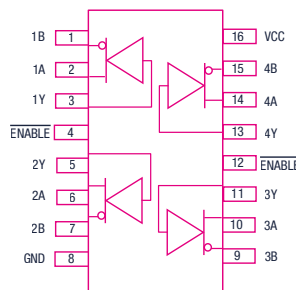
Flat package with grounded lid

### SMD: 5962F98651



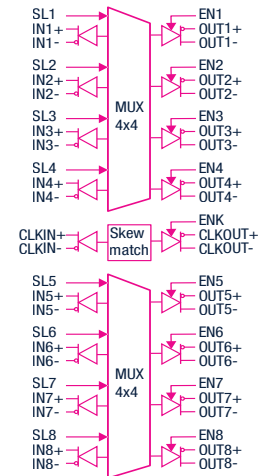
RHFLVDS31A quad driver

### SMD: 5962F98652



RHFLVDS32A quad receiver

### SMD: 5962F01537



RHFLVDS2281 dual 4x4 crosspoint switch

## 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# | $V_{CC}$ range [V] | Data rate max. [Mbps] | $V_{ICM}$ <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.

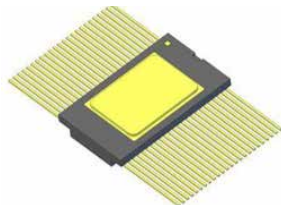
(2) Input common mode voltage

## RHFXH163245 1.8 TO 3.3 V 16-BIT LEVEL SHIFTER

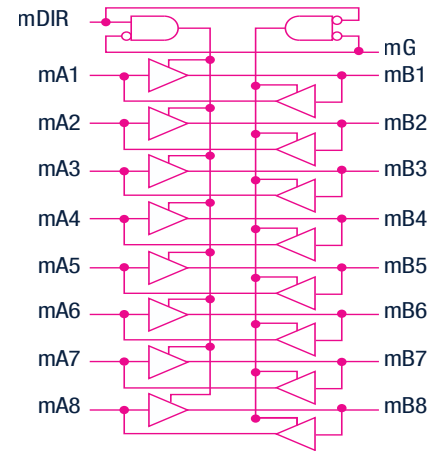
### SMD: 5962F11207

#### 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

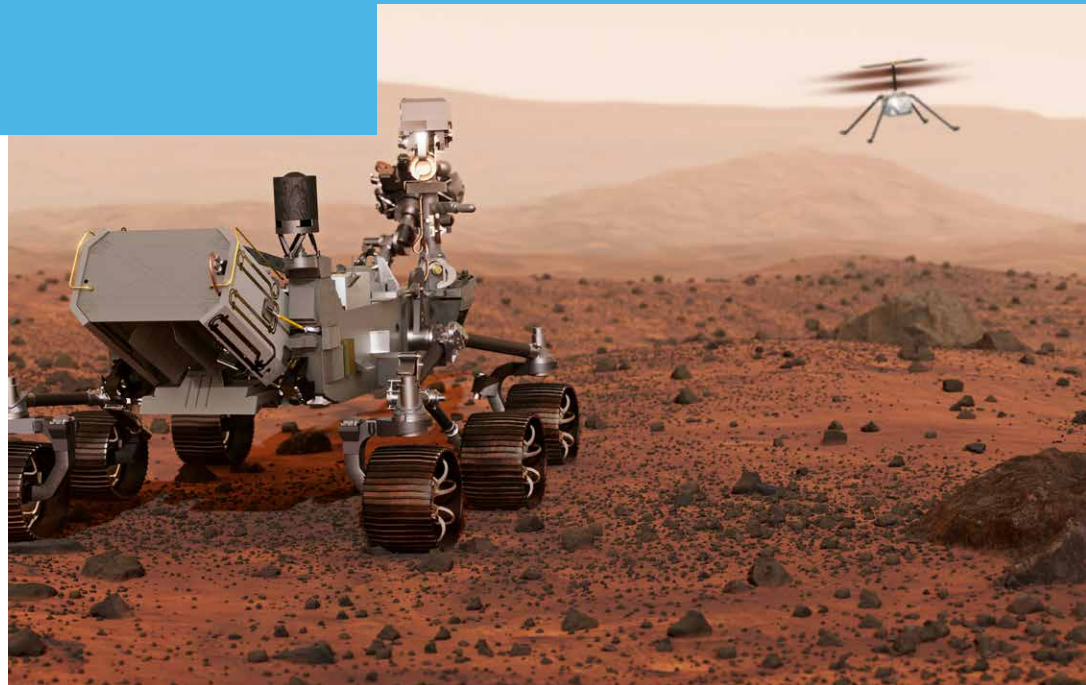
Cold spare

Grounded metallic lid versions on all parts

Temperature range: -55 to +125°C

| Part number      | Description                                                 | TID RHA<br>[krad(Si)] | SEL/SET/SEU<br>threshold <sup>(1)</sup><br>[MeV.cm <sup>2</sup> /mg] | QML-V<br>SMD# | V <sub>cc</sub> range<br>[V] | Prop. time<br>max [ns] | I <sub>cc</sub> max<br>[A] | Package<br>(2) |
|------------------|-------------------------------------------------------------|-----------------------|----------------------------------------------------------------------|---------------|------------------------------|------------------------|----------------------------|----------------|
| Level shifters   |                                                             |                       |                                                                      |               |                              |                        |                            |                |
| 54VCXH163245     | 16-bit bidirectional<br>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<br>3.3 to 5.0 V level shifter          | 100                   | 120/21/—                                                             | 5962R98580    | 2.3 to 6.0                   | 8                      | 100                        |                |
| Bus transceivers |                                                             |                       |                                                                      |               |                              |                        |                            |                |
| 54VCXH162244     | 16-bit bus buffer,<br>resistance on bus A                   | 300                   | 110/110/—                                                            | 5962F05210    | 1.8 to 3.3                   | 3.4                    | 20                         | Flat-48        |
| 54VCXH162245     | 16-bit bidirectional bus buffer,<br>resistance on bus A     |                       |                                                                      | 5962F05208    |                              |                        |                            |                |
| 54VCXHR162245    | 16-bit bidirectional bus buffer,<br>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.



## Rad-hard logic series overview

| ESCC                                                                          | ESCC                                                                                            | QML-V                                                                                                                                                                                                                           | QML-V                                                                                                                                 | QML-V                                                                                                                                                                                                 |
|-------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| HCC4000                                                                       | 54HC - HCT                                                                                      | 54AC – ACT                                                                                                                                                                                                                      | VCX                                                                                                                                   | AHC                                                                                                                                                                                                   |
| 100 krad(Si)<br>SEL free @ 120 MeV.cm <sup>2</sup> /mg<br>SEU characterized   | 50 / 100 krad(Si) <sup>(1)</sup><br>SEL free @ 110 MeV.cm <sup>2</sup> /mg<br>SEU characterized | 300 krad(Si)<br>SEL free @ 110MeV.cm <sup>2</sup> /mg<br>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<br>AC/ACT16xxx 16-bit bus interfaces<br>Level shifter 2.3 to 5 V                                                                                                                                            | Level shifter 1.65 to 3.6 V                                                                                                           | AHC00<br>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

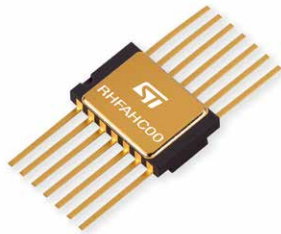
### SMD: 5962F20207

#### KEY FEATURES

- Static supply current between  $V_{il}$  and  $V_{ih}$ : 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

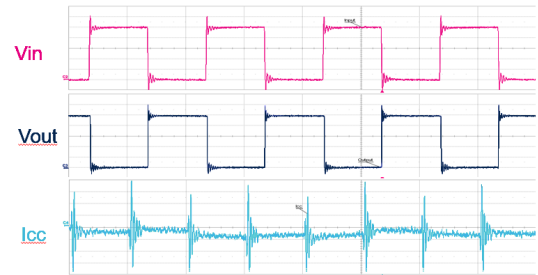


Flat-14 with grounded lid

#### 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



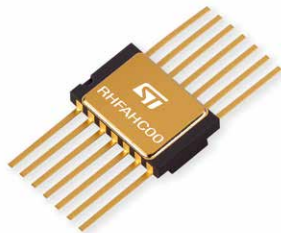
Icc peak: 9.7 mA, Icc avg: 1.72 mA

## RHFAHC00 RAD-HARD, HIGH-SPEED QUAD NAND GATE

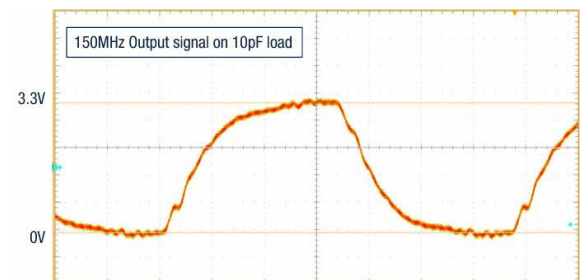
### SMD: 5962F20207

#### 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<br>[krad(Si)] | SEL/SET/SEU<br>threshold <sup>(1)</sup><br>[MeV.cm <sup>2</sup> /mg] | QML-V<br>SMD | V <sub>cc</sub> range<br>[V] | Frequency<br>max. [MHz] | Tr/Tf <sup>(2)</sup><br>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<br>[krad(Si)] | SEL/SET/SEU<br>threshold <sup>(1)</sup><br>[MeV.cm <sup>2</sup> /mg] | QML-V<br>SMD | V <sub>cc</sub> min.<br>[V] | V <sub>cc</sub> max.<br>[A] | Temperature<br>range<br>[°C] | Package         |
|-------------|----------------------------------------------------|-----------------------|----------------------------------------------------------------------|--------------|-----------------------------|-----------------------------|------------------------------|-----------------|
| AC Logic    |                                                    |                       |                                                                      |              |                             |                             |                              |                 |
| 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<br>[krad(Si)] | SEL/SET/SEU<br>threshold <sup>(1)</sup><br>[MeV.cm <sup>2</sup> /mg] | QML-V<br>SMD | V <sub>cc</sub><br>min.<br>[V] | V <sub>cc</sub><br>max<br>[A] | Temperature<br>range<br>[°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<br>[krad(Si)] | SEL/SET/SEU<br>threshold <sup>(1)</sup><br>[MeV.cm <sup>2</sup> /mg] | ESCC detail<br>specification | V <sub>cc</sub><br>min.<br>[V] | V <sub>cc</sub><br>max.<br>[A] | Package          |
|-------------------------|--------------------------------------------------|-------------------|----------------------------------------------------------------------|------------------------------|--------------------------------|--------------------------------|------------------|
| HC Logic                |                                                  |                   |                                                                      |                              |                                |                                |                  |
| 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 retrig. 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/–                                                             | 9205013                      |                                |                                | 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<br>[krad(Si)] | SEL/SET/SEU<br>threshold <sup>(1)</sup><br>[MeV.cm <sup>2</sup> /mg] | ESCC detail<br>specification | V <sub>CC</sub><br>min.<br>[V] | V <sub>CC</sub><br>max.<br>[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 PISO 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<br>[krad(Si)] | SEL/SET/SEU<br>threshold <sup>(1)</sup><br>[MeV.cm <sup>2</sup> /mg] | ESCC detail<br>specification | V <sub>CC</sub><br>min.<br>[V] | V <sub>CC</sub><br>max.<br>[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<br>[krad(Si)] | SEL/SET/SEU<br>threshold <sup>(1)</sup><br>[MeV.cm <sup>2</sup> /mg] | ESCC detail<br>specification | V <sub>CC</sub><br>min.<br>[V] | V <sub>CC</sub><br>max.<br>[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<br>[krad(Si)] | SEL/SET/SEU<br>threshold <sup>(1)</sup><br>[MeV.cm <sup>2</sup> /mg] | ESCC detail<br>specification | V <sub>CC</sub><br>min.<br>[V] | V <sub>CC</sub><br>max.<br>[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

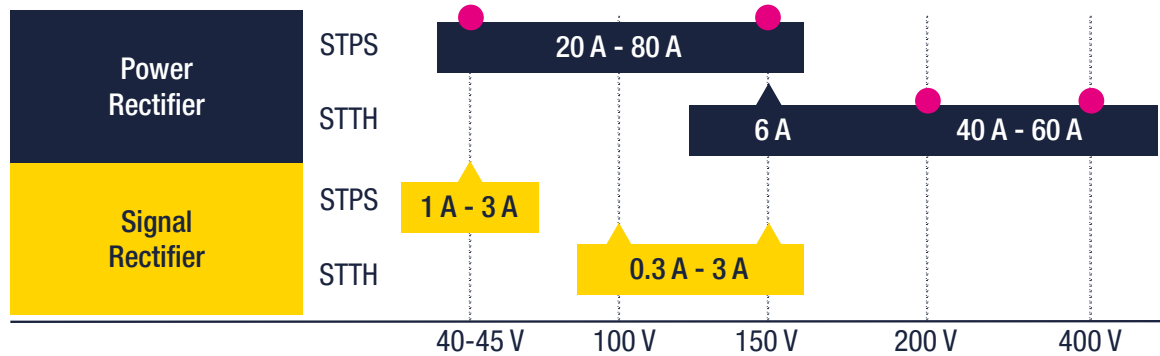
## NEW POWER RECTIFIER SERIES UP TO 80 A AND 400 V

### KEY FEATURES & BENEFITS

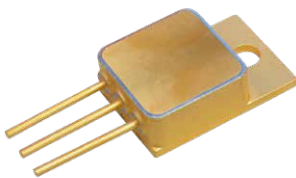
- Junction temperature range: -65 to 175°C
- $V_f$  guaranteed at multiple  $T_j$  and  $I_f$  values
- Schottky diodes:  $dV/dt$  specified at 10 V/ns

### 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<br>[Mrad(Si)] | SEE threshold <sup>(1)</sup><br>[MeV.cm <sup>2</sup> /mg] | ESCC<br>detailed<br>specification | V <sub>RRM</sub> <sup>(2)</sup><br>max [V] | I <sub>F</sub> <sup>(3)</sup><br>max [A] | V <sub>F</sub> <sup>(4)</sup> @<br>125°C<br>max [V] | t <sub>RR</sub> <sup>(5)</sup><br>max [ns] | T <sub>J</sub> range <sup>(6)</sup><br>[°C] | Package          |
|----------------------------|-------------------------------|-------------------|-----------------------------------------------------------|-----------------------------------|--------------------------------------------|------------------------------------------|-----------------------------------------------------|--------------------------------------------|---------------------------------------------|------------------|
| Schottky rectifiers        |                               |                   |                                                           |                                   |                                            |                                          |                                                     |                                            |                                             |                  |
| 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                                  | T0-254AA         |
| STPS6045HR                 | Dual CC <sup>(8)</sup>        | —                 | —                                                         | 5106/018                          |                                            | 40                                       | 0.75                                                | —                                          | -65 to 175                                  | T0-254           |
| 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/<br>T0-254 |
| STPS40100HR <sup>(7)</sup> | Dual CC <sup>(8)</sup>        | —                 | —                                                         | 5106/019                          |                                            | 40                                       | 0.90                                                | —                                          | -65 to 175                                  | T0-254AA         |
| STPS40A150CHR              | Dual CC <sup>(8)</sup>        | 3                 | No SEB @ 60                                               | 5106/023                          | 150                                        | 40                                       | 0.79                                                | —                                          | -65 to 175                                  | T0-254AA         |
| 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            |
| Ultrafast rectifiers       |                               |                   |                                                           |                                   |                                            |                                          |                                                     |                                            |                                             |                  |
| 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                                  | T0-254AA         |
| 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

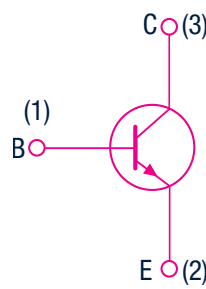
## 2ST15300 RAD-HARD 300 V, 5 A NPN BIPOLAR TRANSISTOR ESCC: 5201/020

### KEY FEATURES

- Linear gain characteristics
- Inductive load ruggedness

### TYPICAL APPLICATIONS

- Electrical propulsion
- Inductive load switches
- Linear amplifiers



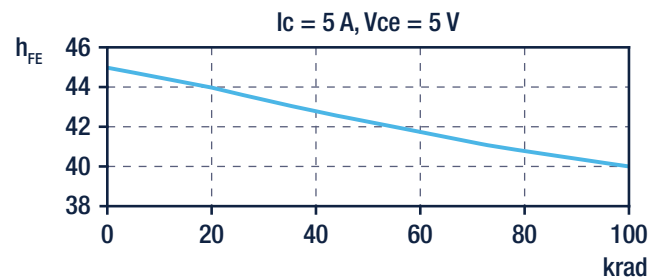
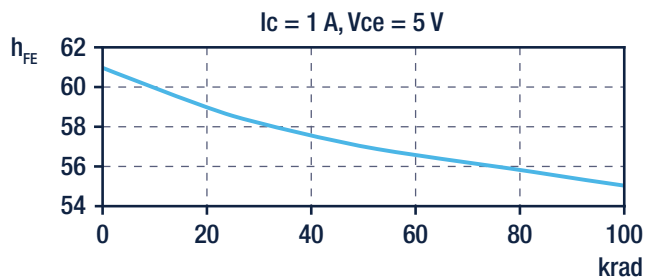
### RADIATION PERFORMANCE

- 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

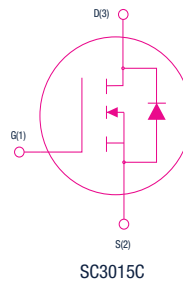
- Low  $R_{DS(on)}$  and superior dynamic performance
- Superior stability in extended reliability test
- Very low drift under total ionised dose exposure

### 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>)

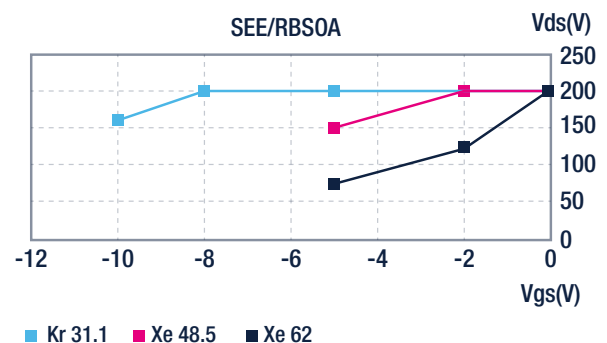
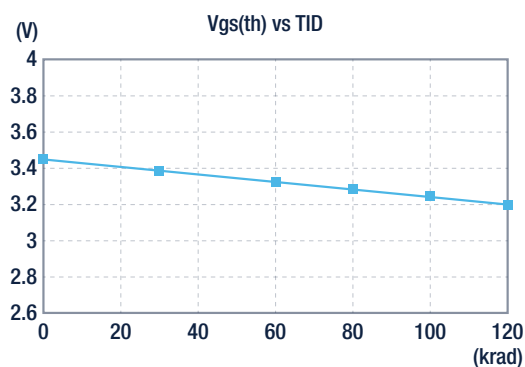


SC3015C



SMD.5

### Radiation performance



## ESCC and DLA bipolar transistors

Temperature range -65 to 200°C

| Part number                          | Description  | TID<br>[krad(Si)] | Agency<br>qualification | Agency<br>specification | V <sub>CB0</sub> <sup>(1)</sup> max<br>[V] | I <sub>c</sub> <sup>(2)</sup> max<br>[A] | h <sub>FE</sub> <sup>(3)</sup><br>min | Package         |
|--------------------------------------|--------------|-------------------|-------------------------|-------------------------|--------------------------------------------|------------------------------------------|---------------------------------------|-----------------|
| NPN transistor                       |              |                   |                         |                         |                                            |                                          |                                       |                 |
| 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             |
| NPN dual matched bipolar transistors |              |                   |                         |                         |                                            |                                          |                                       |                 |
| 2N2920AHR                            | 60 V, 0.03 A | -                 | ESCC                    | 5207/002                | 60                                         | 0.03                                     | 300                                   | Flat-8, LCC-6   |
| PNP transistor                       |              |                   |                         |                         |                                            |                                          |                                       |                 |
| 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 |
| PNP dual matched bipolar transistors |              |                   |                         |                         |                                            |                                          |                                       |                 |
| 2N3810HR                             | 60 V, 0.05 A | 100               | ESCC                    | 5207/005                | 60                                         | 0.05                                     | 125                                   | Flat-8, LCC-6   |
| NPN and PNP complementary pair       |              |                   |                         |                         |                                            |                                          |                                       |                 |
| 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<br>[krad(Si)] | SEB and SEGR<br>threshold<br>[MeV.cm <sup>2</sup> /mg] | ESCC detail<br>specification | $V_{BDS}^{(1)}$<br>[V] | $I_D^{(2)}$<br>[A] | $R_{DS(on)}^{(3)}$<br>max [mΩ] | $Qg^{(4)}$<br>max [nC] | Package  |
|----------------------------|-------------|-------------------|--------------------------------------------------------|------------------------------|------------------------|--------------------|--------------------------------|------------------------|----------|
| N-channel                  |             |                   |                                                        |                              |                        |                    |                                |                        |          |
| 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                     | SMD.5    |
| P-channel                  |             |                   |                                                        |                              |                        |                    |                                |                        |          |
| 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

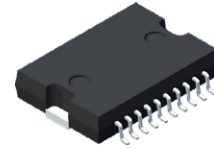
## LEO3910 RAD-HARD LINEAR POSITIVE VOLTAGE REGULATOR

### 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 @  $I_o = 1$  A, 1.0 V @  $I_o = 2$  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<br>[krad(Si)] | SEL/SET/SEU <sup>(1)</sup><br>[MeV.cm <sup>2</sup> /mg] | V <sub>cc</sub> range<br>[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 @<br>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<br>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.<br>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   |

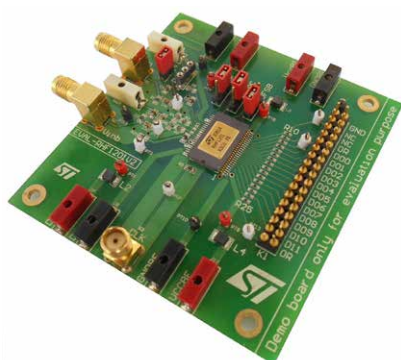
Note : contact your ST representative for information on the specific xx value that applies to the product you need the service for.

## 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. 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                          |
|------------------|--------------------------------------|
| 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, 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.

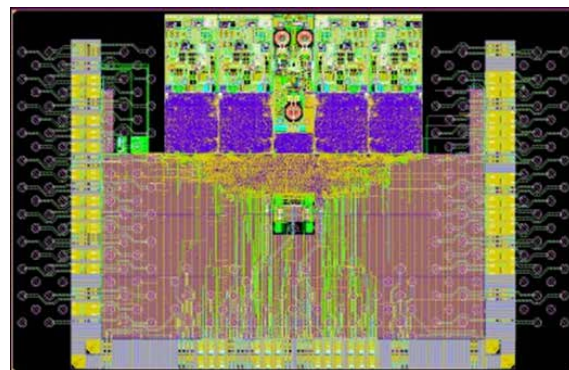
# ASICs

## ST SPACE ASIC OFFER RAD-HARD ASIC PLATFORMS

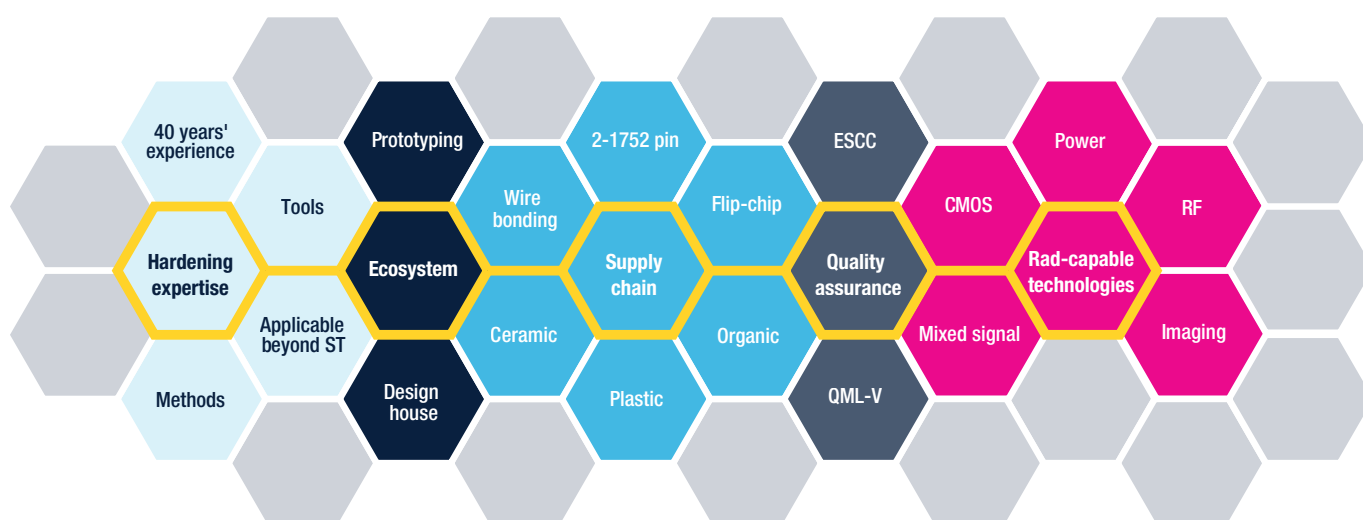
STMicroelectronics has an established expertise in radiation-hardened, application-specific ICs (ASIC) for the space industry. We offer two complete space technology platforms, including libraries, IPs, and tools and methods developed by our experts in radiation hardening through decades of experimentation 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.



6S 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

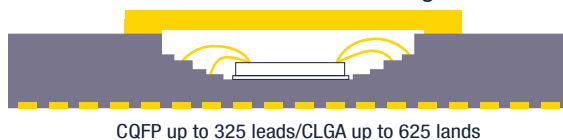
ST proposes a complete supply chain through its ASIC production and foundry-plus-services (Foundry+) offer. The assembly of all 'traditional space' products is performed at the ST's ESCC and QML certified facility in Rennes (France), while assembly with standard plastic packages supporting 'new space'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

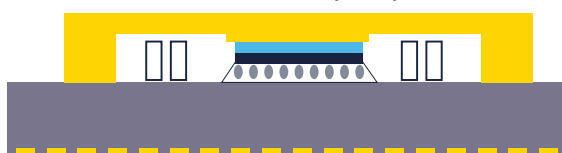
For ASIC and Foundry+ customers, ST can manage assembly in ceramic hermetic packages according to traditional space requirements through one of the following methods:

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.

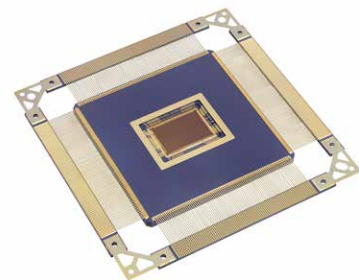
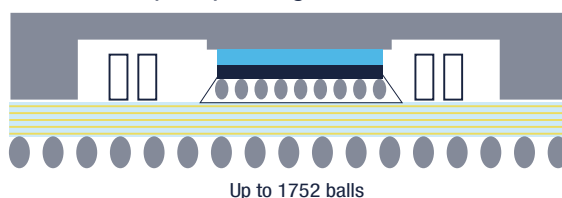
Ceramic + wire bonding



Ceramic + flip-chip



Flip-chip on organic substrate



## 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       |                                                 |
| 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<br>Good parts<br>Support |          | Design kit with libraries<br>T84<br>Support |          |                                                 |
| Customer deliverables  | RTL file<br>Test patterns                          |          | GDS2 file<br>Test patterns                  |          |                                                 |