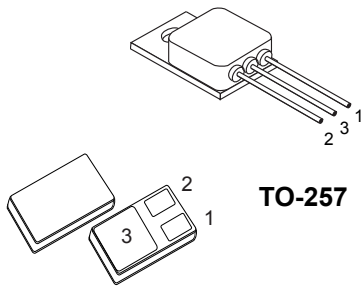
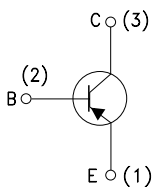


Rad-Hard 80 V, 5 A PNP bipolar transistor



TO-257

SMD.5



Base and Emitter are inverted for
2N5153RSRHRx and 2N5153SRHRx series

AM3128V1_n

Features

V_{CEO}	$I_C(max.)$	h_{FE} at 5 V, 2.5 A	Operating temperature range
80 V	5 A	> 70	-65 °C to +200 °C

- Hermetic package
- ESCC qualified
- Up to 100 krad(Si) low dose rate

Description

The 2N5153HR is a bipolar transistor able to operate under severe environment conditions and radiation exposure. It provides high reliability performance and immunity to the total ionizing dose (TID).

Qualified as per ESCC 5204/002 specification and available in SMD.5 and TO-257 hermetic packages, it is specifically recommended for space and harsh environment applications and suitable for power suppliers, battery switch and linear bias supply circuits.

In case of discrepancies between this datasheet and the relevant agency specification, the latter takes precedence.

Product status link

[2N5153HR](#)

Product summary

Product summary				
Device	Qualification system	Agency specification	Package	Remarks
2N5153ESYHRx	ESCC Flight	5204/002	TO-257	-
2N5153RESYHRx	ESCC Flight	5204/002	TO-257	100 krad
2N5153RSRHRx	ESCC Flight	5204/002	SMD.5	100 krad, emitter on pin 1
2N5153SHRx	ESCC Flight	5204/002	SMD.5	Emitter on pin 1
2N5153RSRHRx	ESCC Flight	5204/002	SMD.5	100 krad, emitter on pin 2
2N5153SRHRx	ESCC Flight	5204/002	SMD.5	Emitter on pin 2

1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base voltage ($I_E = 0$)	100	V
V_{CEO}	Collector-emitter voltage ($I_B = 0$)	80	V
V_{EBO}	Emitter-base voltage ($I_C = 0$)	5.5	V
I_C	Collector current	5	A
P_{TOT}	Total dissipation at $T_{amb} \leq 25\text{ °C}$ for TO-257 and SMD.5	3.3	W
	Total dissipation at $T_{case} \leq 25\text{ °C}$ for TO-257 and SMD.5	35	W
T_{STG}	Storage temperature range	-65 to 200	°C
T_J	Max. operating junction temperature	200	°C

Table 2. Thermal data

Symbol	Parameter	Value for TO-257 and SMD.5	Unit
$R_{thj-case}$	Thermal resistance junction-case	5	°C/W
$R_{thj-amb}$	Thermal resistance junction-ambient	53	°C/W

2 Electrical characteristics

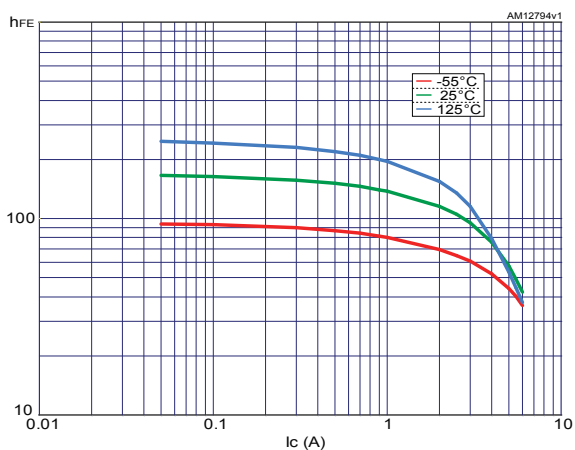
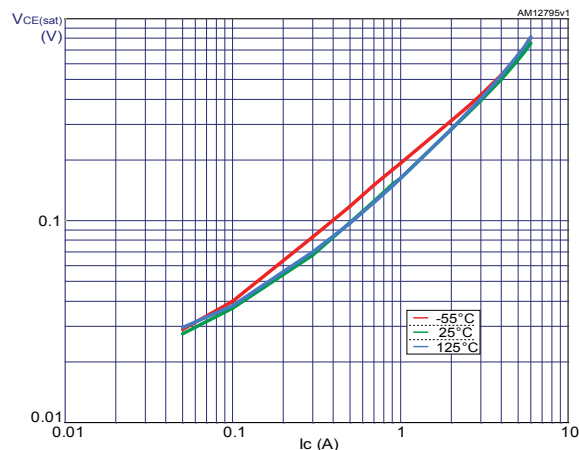
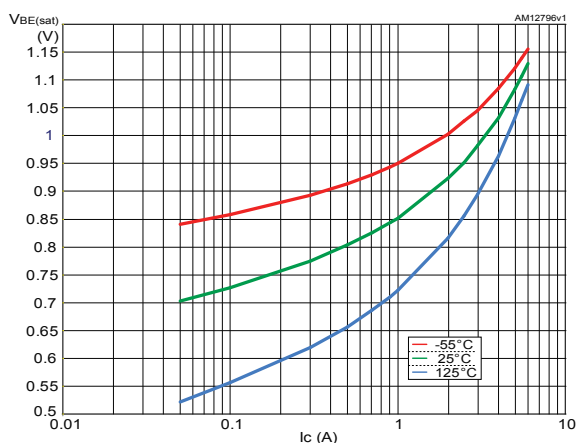
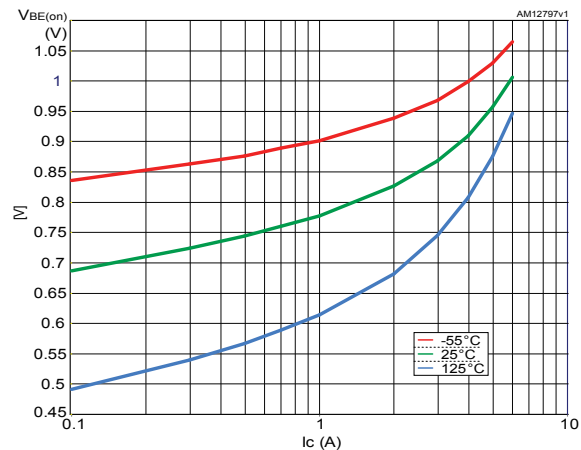
Table 3. Electrical characteristics ($T_{amb} = 25\text{ °C}$ unless otherwise specified)

Symbol	Parameter	Test conditions	Min.	Max.	Unit
I_{CES}	Collector cut-off current	$V_{CB} = 60\text{ V}$, $I_E = 0\text{ A}$		1	μA
		$V_{CB} = 60\text{ V}$, $I_E = 0\text{ A}$, $T_{amb} = 150\text{ °C}$		10	
I_{CEO}	Collector cut-off current	$V_{CE} = 40\text{ V}$, $I_B = 0\text{ A}$		50	μA
I_{EBO}	Emitter cut-off current	$V_{EB} = 4\text{ V}$, $I_C = 0\text{ A}$		1	μA
		$V_{EB} = 5.5\text{ V}$, $I_C = 0\text{ A}$		1	mA
$V_{(BR)CEO}^{(1)}$	Collector-emitter breakdown voltage	$I_C = 100\text{ mA}$, $I_B = 0\text{ A}$	80		V
$V_{CE(sat)}^{(1)}$	Collector-emitter saturation voltage	$I_C = 5\text{ A}$, $I_B = 0.5\text{ A}$		1.5	V
$V_{BE(sat)}^{(1)}$	Base-emitter saturation voltage	$I_C = 2.5\text{ A}$, $I_B = 0.25\text{ A}$		1.45	V
		$I_C = 5\text{ A}$, $I_B = 0.5\text{ A}$		2.2	
h_{FE}	DC current gain	$I_C = 50\text{ mA}$, $V_{CE} = 5\text{ V}$	50		
		$I_C = 2.5\text{ A}$, $V_{CE} = 5\text{ V}$	70	200	
		$I_C = 5\text{ A}$, $V_{CE} = 5\text{ V}$	40		
		$I_C = 2.5\text{ A}$, $V_{CE} = 5\text{ V}$, $T_{amb} = -55\text{ °C}$	35		
h_{fe}	AC forward current transfer ratio	$I_C = 500\text{ mA}$, $f = 20\text{ MHz}$, $V_{CE} = 5\text{ V}$	3.5		
C_{obo}	Output capacitance	$I_E = 0\text{ A}$, $f = 1\text{ MHz}$, $V_{CB} = 10\text{ V}$		250	pF
t_{on}	Turn-on time	$V_{CC} = 30\text{ V}$, $V_{BB} = 4\text{ V}$,		0.5	μs
t_{off}	Turn-off time	$V_{in} \approx 51\text{ V}$, $I_C = 5\text{ A}$, $I_{B1} = I_{B2} = 0.5\text{ A}$		1.3	μs

1. Pulsed duration = 300 μs , duty cycle $\leq 2\%$

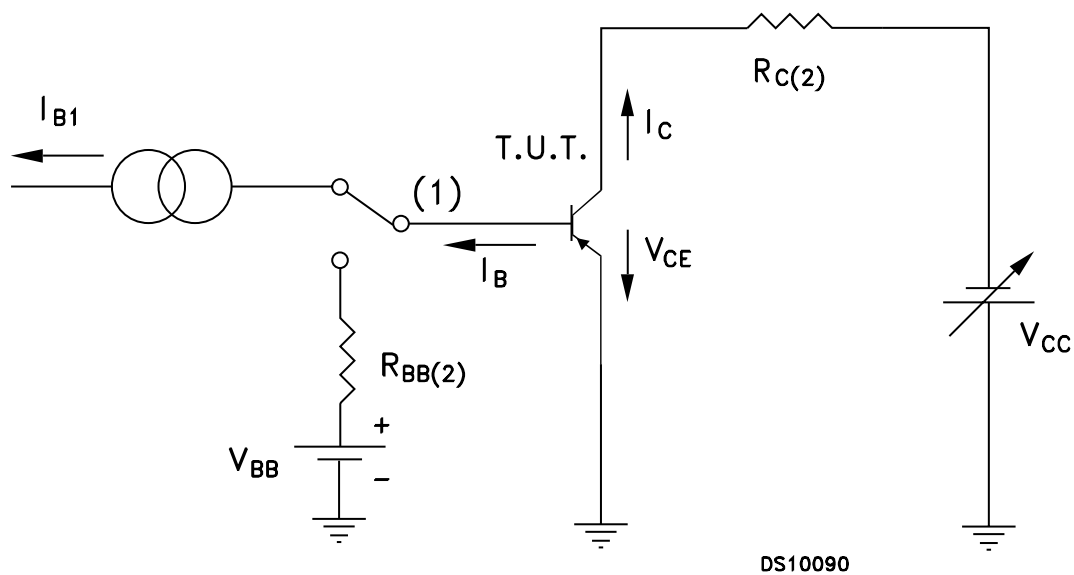
Voltage and current values are intended as negative.

3 Electrical characteristics (curves)

Figure 1. h_{FE} at $V_{CE} = 5\text{ V}$

Figure 2. $V_{CE(sat)}$ at $h_{FE} = 10$

Figure 3. $V_{BE(sat)}$ at $h_{FE} = 10$

Figure 4. $V_{BE(on)}$ at $V_{CE} = 5\text{ V}$


3.1 Test circuits

Figure 5. ESCC resistive load switching test circuit



Note: (1) Fast electronic switch

Note: (2) Non-inductive resistor

4 Radiation hardness assurance

This products is guaranteed in radiation as per ESCC 22900 and in compliance with ESCC 5204/002 specification.

Each lot is tested in radiation according to the following procedure:

- Radiation condition of 0.1 rad (Si)/s
- Test of 11 samples by wafer, 5 biased at 80% of $V_{(BR)CEO}$, 5 unbiased and for reference
- Acceptance criteria of each wafer at 100 krad if all 10 samples comply with the post radiation electrical characteristics as per Table 4.
- Radiation verification test (RVT) report is delivered with the lot manufactured with the wafer of the tested samples

RVT includes the value of each parameter at 30, 50, 70 and 100 krad (Si), post annealing at 24 hour / 25°C and and post annealing at 168 hours / 100°C.

Table 4. ESCC 5204/002 post radiation electrical characteristics ($T_{amb} = 25^{\circ}\text{C}$ unless otherwise specified)

Symbol	Parameter	Test conditions	Min.	Max.	Unit
I_{CES}	Collector cut-off current	$V_{CB} = 60\text{ V}, I_E = 0\text{ A}$		1	μA
I_{CEO}	Collector cut-off current	$V_{CE} = 40\text{ V}, I_B = 0\text{ A}$		50	μA
I_{EBO}	Emitter cut-off current	$V_{EB} = 4\text{ V}, I_C = 0\text{ A}$		1	μA
		$V_{EB} = 5.5\text{ V}, I_C = 0\text{ A}$		1	mA
$V_{(BR)CEO}^{(1)}$	Collector-emitter breakdown voltage	$I_C = 100\text{ mA}, I_B = 0\text{ A}$	80		V
$V_{CE(sat)}^{(1)}$	Collector-emitter saturation voltage	$I_C = 5\text{ A}, I_B = 0.5\text{ A}$		1.5	V
$V_{BE(sat)}^{(1)}$	Base-emitter saturation voltage	$I_C = 2.5\text{ A}, I_B = 0.25\text{ A}$		1.45	V
		$I_C = 5\text{ A}, I_B = 0.5\text{ A}$		2.2	
$[h_{FE}]^{(1)}$	Post irradiation gain calculation ⁽²⁾	$I_C = 50\text{ mA}, V_{CE} = 5\text{ V}$	[25]		
		$I_C = 2.5\text{ A}, V_{CE} = 5\text{ V}$	[35]	200	
		$I_C = 5\text{ A}, V_{CE} = 5\text{ V}$	[20]		

1. Pulsed duration = 300 μs , duty cycle $\leq 2\%$

2. The post-irradiation gain calculation of $[h_{FE}]$, made using h_{FE} measurements from prior to and on completion of irradiation testing and after each annealing step if any, is as specified in MIL-STD-750 method 1019.

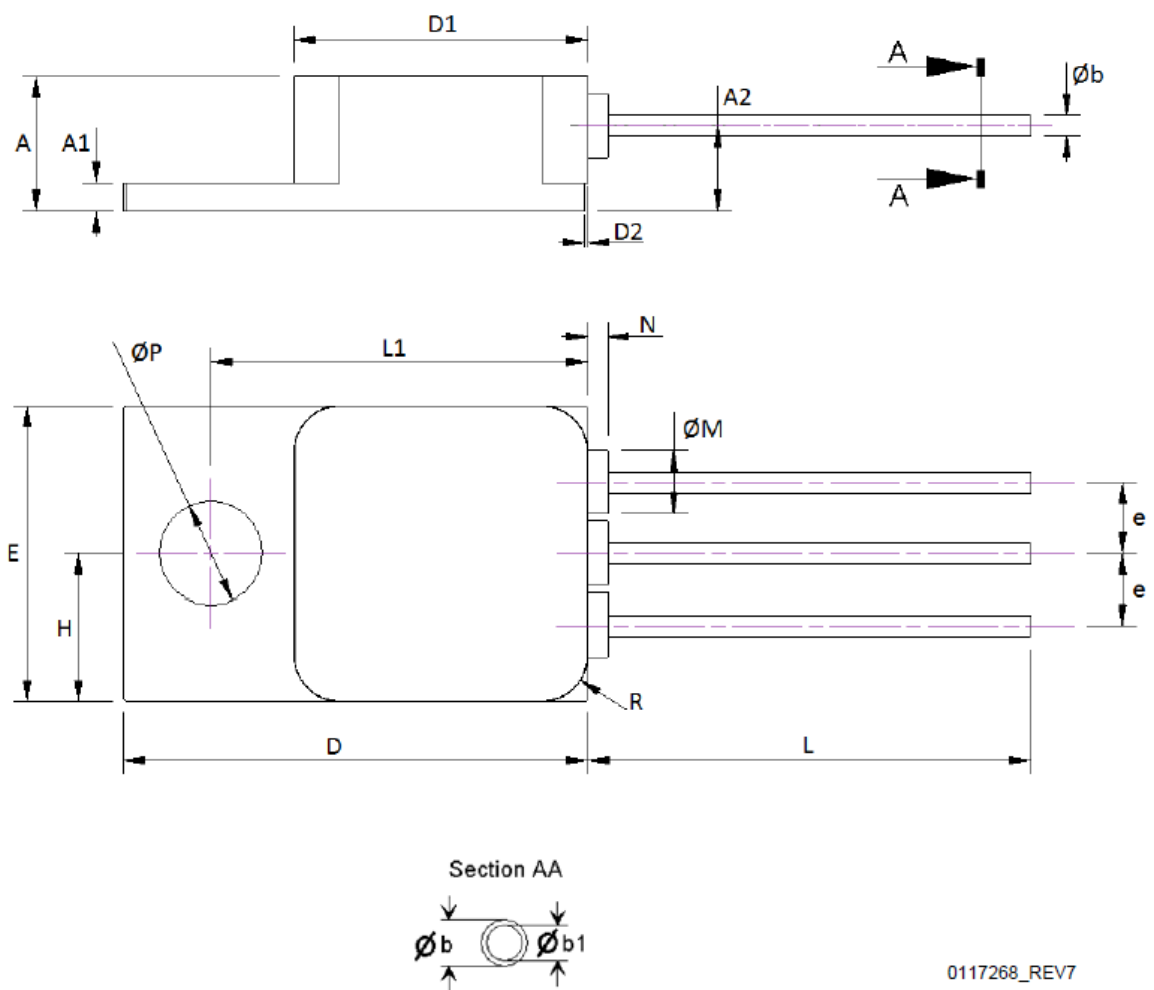
Voltage and current values are intended as negative.

5 Package information

In order to meet environmental requirements, ST offers these devices in different grades of **ECOPACK** packages, depending on their level of environmental compliance. ECOPACK specifications, grade definitions and product status are available at: www.st.com. ECOPACK is an ST trademark.

5.1 TO-257 package information

Figure 6. TO-257 package outline



0117268_REV7

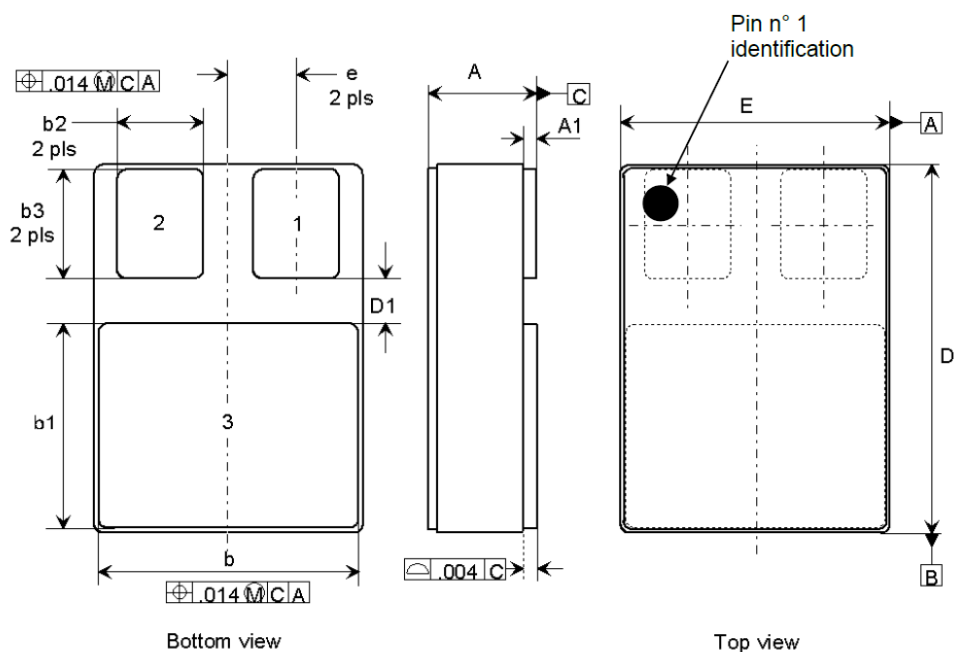
Table 5. TO-257 package mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.83	4.95	5.08
A1	0.89	1.02	1.14
A2	2.91	3.05	3.18
b	0.64	-	1.02
b1	0.64	0.76	0.89
D	16.51	16.64	16.76
D1	10.41	10.54	10.67
D2	-	-	0.97
e	2.41	2.54	2.67
E	10.41	10.54	10.67
H	5.13	5.25	5.38
L	15.24	15.88	16.51
L1	13.39	13.51	13.64
M	2.16	2.29	2.41
N	-	-	0.71
P	3.56	3.68	3.81
R	-	1.65	-

Note: The case is not connected to any pin.

5.2 SMD.5 package information

Figure 7. SMD.5 package outline



7386434_REV7

Table 6. SMD.5 package mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	2.84		3.30
A1	0.25	0.38	0.51
b	7.13	7.26	7.39
b1	5.58	5.72	5.84
b2	2.28	2.41	2.54
b3	2.92	3.05	3.18
D	10.03	10.16	10.28
D1	0.76		
E	7.39	7.52	7.64
e		1.91	

Note: The lid is not connected to any pin.

6

Ordering information

Table 7. Ordering information

Part number	Agency specification	Quality level	Radiation level	Pin-out	Package	Weight	Lead finish	Marking ⁽¹⁾	Packing
2N5153ESY1	-	Engineering model	-	-	TO-257	5 g	Gold	2N5153ESY1 + BeO	Strip pack
2N5153ESYHRG	5204/002/04	ESCC	-	-				520400204 + BeO	
2N5153ESYHRT	5204/002/05		-	-			Solder dip	520400205 + BeO	
2N5153RESYHRG	5204/002/04R		100 krad	-			Gold	520400204R + BeO	
2N5153RESYHRT	5204/002/05R		100 krad	-			Solder dip	520400205R + BeO	
2N5153S1	-	Engineering model	-	Emitter on pin 1	SMD.5	1 g	Gold	2N5153S1	Strip pack
2N5153RSHRG	5204/002/06R	ESCC	100 krad	Emitter on pin 1				520400206R	
2N5153RSHRT	5204/002/09R	ESCC	100 krad	Emitter on pin 1			Solder dip	520400209R	Strip pack
2N5153RSHRTW	5204/002/09R	ESCC	100 krad	Emitter on pin 1				520400209R	Tape and reel
2N5153RSHRGW	5204/002/06R	ESCC	100 krad	Emitter on pin 1			Gold	520400206R	
2N5153SHRG	5204/002/06	ESCC	-	Emitter on pin 1				520400206	Strip pack
2N5153SHRT	5204/002/09	ESCC	-	Emitter on pin 1			Solder dip	520400209	
2N5153SHRTW	5204/002/09	ESCC	-	Emitter on pin 1				520400209	Tape and reel
2N5153SHRGW	5204/002/06	ESCC	-	Emitter on pin 1				520400206	
2N5153SR1	-	Engineering model	-	Emitter on pin 2			Gold	2N5153SR1	Strip pack
2N5153RSRHRG	5204/002/07R	ESCC	100 krad	Emitter on pin 2				520400207R	Tape and reel
2N5153RSRHRGW	5204/002/07R	ESCC	100 krad	Emitter on pin 2				520400207R	
2N5153RSRHRT	5204/002/10R	ESCC	100 krad	Emitter on pin 2			Solder dip	520400210R	Strip pack
2N5153RSRHRTW	5204/002/10R	ESCC	100 krad	Emitter on pin 2				520400210R	Tape and reel
2N5153SRHRG	5204/002/07	ESCC	-	Emitter on pin 2			Gold	520400207	Strip pack
2N5153SRHRGW	5204/002/07	ESCC	-	Emitter on pin 2				520400207	Tape and reel
2N5153SRHRT	5204/002/10	ESCC	-	Emitter on pin 2			Solder dip	520400210	Strip pack
2N5153SRHRTW	5204/002/10	ESCC	-	Emitter on pin 2				520400210	Tape and reel





1. *Specific marking only. The full marking includes in addition: For the Engineering Models: ST logo, date code; country of origin (FR). For ESCC flight parts: ST logo, date code, country of origin (FR), ESA logo, serial number of the part within the assembly lot.*

Contact ST sales office for information about specific conditions for products in die form.

7 Other information

7.1 Date code

Date code information is described in the table below.

Table 8. Date codes

Model	Date codes ⁽¹⁾
EM	3yywwN
ESCC	yywwN

1. yy = year, ww = week number, N = lot index in the week.

7.2 Documentation

The table below provide a summary of the documentation provided with each type of products.

Table 9. Default documentation provided with the parts

Quality level	Radiation level	Documentation
Engineering model	-	-
ESCC	-	Certificate of conformance. ESCC qualification maintenance lot reference.
ESCC	100 Krad	Certificate of conformance. ESCC qualification maintenance lot reference. Radiation data ⁽¹⁾ at 30 / 50 / 70 / 100 krad at 0.1 rad / s.

1. For key parameters on 5 biased parts + 5 unbiased parts from the same wafer as the delivered part. See Radiation hardness assurance for details.

Revision history

Table 10. Document revision history

Date	Version	Changes
10-Dec-2008	1	Initial release.
08-Jan-2010	2	Modified Table 1: Device summary.
12-Sep-2012	3	Added: Section 3: Electrical characteristics (curves).
12-Dec-2013	4	Updated Table 1: Device summary and Section 5: Package information. Added Section 4: Radiation hardness assurance, Section 6: Ordering information and Section 7: Shipping details.
28-Mar-2014	5	Updated Table 1: Device summary and Table 10: Ordering information. Minor text changes.
29-Apr-2015	6	Added Figure 6. Updated Section 5.1: TO-257 package information.
04-Apr-2016	7	Added part number 2N5153RSRHRG. Document updated accordingly. Updated Section 5.1: TO-257 package information.
29-Apr-2016	8	Updated title, package silhouette, Figure 1: Internal schematic diagram and Table 1: Device summary in cover page. Updated Section 5: Package information and Section 6: Ordering information. Minor text changes.
28-Oct-2016	9	Added Table 6: Product mass summary.
03-Jun-2020	10	Removed TO-39 package information. Updated Section 5.1 TO-257 package information , Section 5.2 SMD.5 package information and Ordering information. Minor text changes.
05-Oct-2021	11	Updated Table 7 and Description.
09-Nov-2022	12	Updated Table 7 .

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