

Hi-Rel PNP bipolar transistor -80 V, -5 A

Datasheet - production data

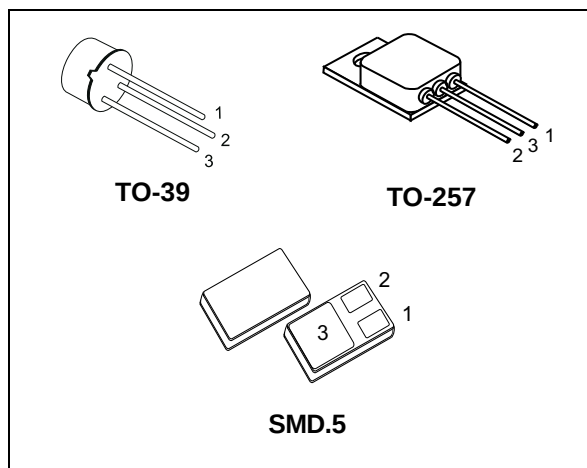
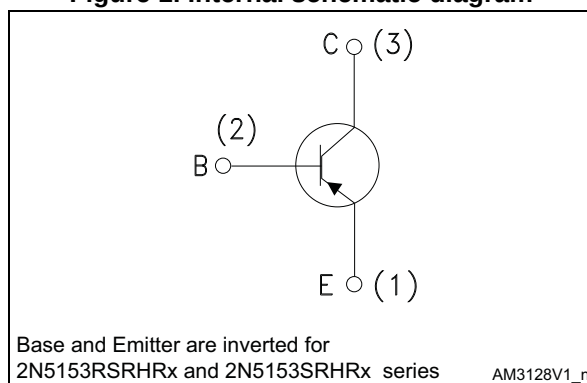


Figure 1. Internal schematic diagram



Features

Parameter	Value
V_{CEO}	-80 V
I_C (max.)	-5 A
h_{FE} at -10 V, -150 mA	> 70
Operating temperature range	-65 °C to +200 °C

- Hi-Rel PNP bipolar transistor
- Linear gain characteristics
- ESCC qualified
- European preferred part list - EPPL
- Radiation level: lot specific total dose contact marketing for specified level

Description

The 2N5153HR is a silicon planar epitaxial PNP transistor in TO-39, TO-257 and SMD.5 packages. It is specifically designed for aerospace Hi-Rel applications and ESCC qualified according to the 5204-002 specification. In case of conflict between this datasheet and ESCC detailed specification, the latter prevails.

Table 1. Device summary

Order code	Quality level	Agency specification	Package	Other features	EPPL
2N5153HRx	ESCC	5204/002	TO-39	-	Yes
2N5153RHRx				100 krad ESCC LDR	
2N5153ESYHRx			TO-257	-	
2N5153RESYHRx				100 krad ESCC LDR	
2N5153RSRHRx			SMD.5	100 krad LDR, emitter on pin 1	
2N5153SHRxx				Emitter on pin 1	
2N5153RSRHRx				100 krad LDR, emitter on pin 2	
2N5153SRHRx				Emitter on pin 2	

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1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value		Unit
		TO-39	TO-257 SMD.5	
V _{CBO}	Collector-base voltage (I _E = 0 A)	-100		V
V _{CEO}	Collector-emitter voltage (I _B = 0 A)	-80		
V _{EBO}	Emitter-base voltage (I _C = 0 A)	-5.5		
I _C	Collector current	-5		A
P _{TOT}	Total dissipation at T _{amb} ≤ 25 °C	1	3.3	W
	Total dissipation at T _{case} ≤ 25 °C	10	35	
T _{STG}	Storage temperature range	-65 to 200		°C
T _J	Operating junction temperature range			

Table 3. Thermal data

Symbol	Parameter	Value		Unit
		TO-39	TO-257 SMD.5	
$R_{thJ-case}$	Thermal resistance junction-case	17.5	5	°C/W
$R_{thJ-amb}$	Thermal resistance junction-ambient	175	53	

2 Electrical characteristics

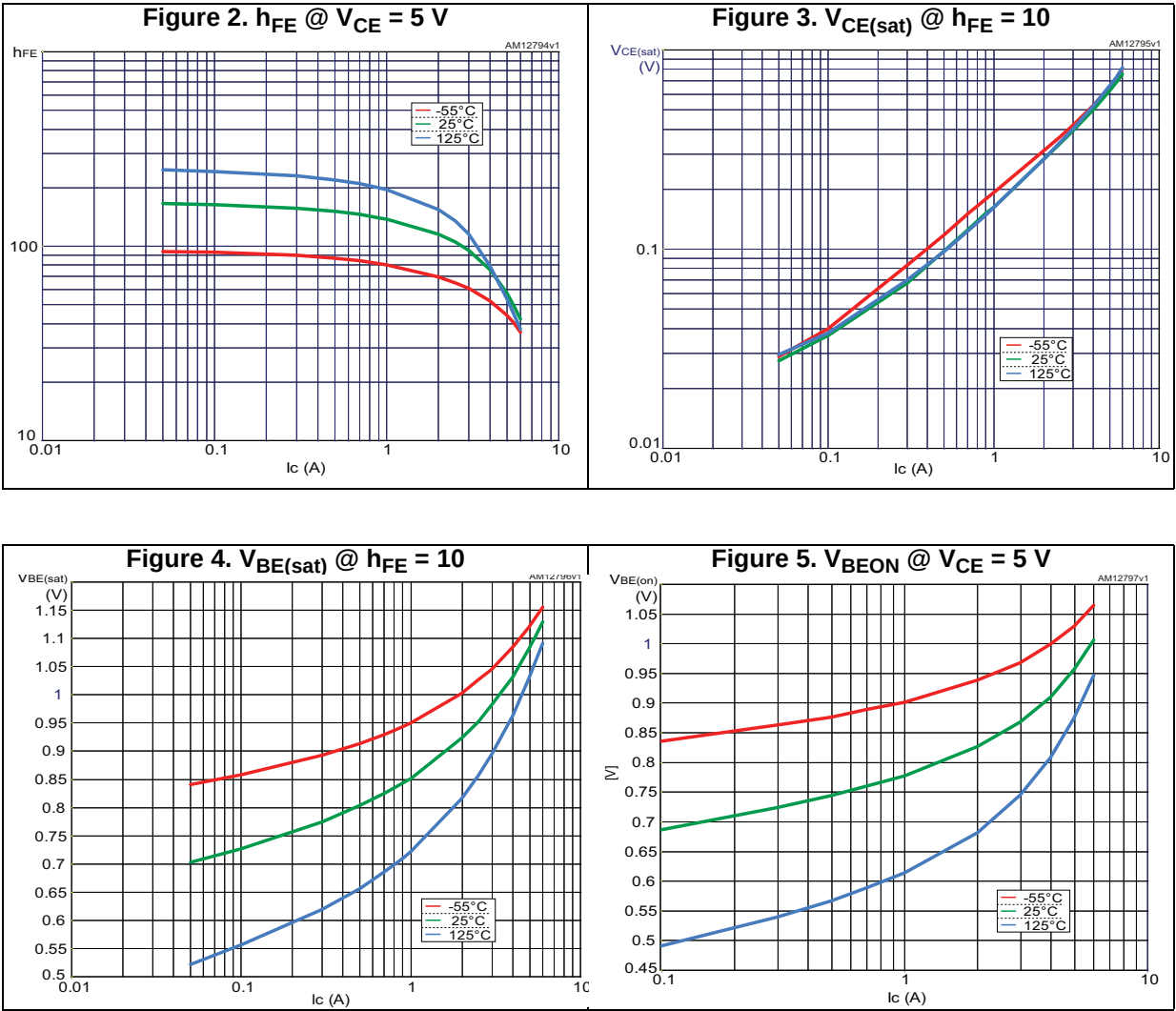
$T_{\text{case}} = 25\text{ °C}$ unless otherwise specified

Table 4. Electrical characteristics

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

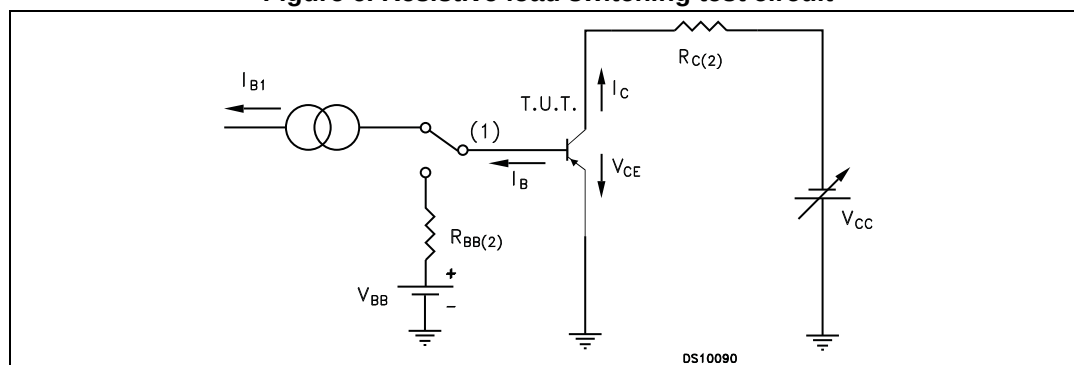
1. Pulsed duration = 300 μs , duty cycle $\leq 2\%$

3 Electrical characteristics (curves)



3.1 Test circuit

Figure 6. Resistive load switching test circuit



1) Fast electronic switch

2) Non-inductive resistor

4 Radiation hardness assurance

The products guaranteed in radiation within the ESCC system fully comply with the ESCC 5204/002 and ESCC 22900 specifications.

ESCC radiation assurance

Each product lot is tested according to the ESCC basic specification 22900, with a minimum of 11 samples per diffusion lot and 5 samples per wafer, one sample being kept as unirradiated sample, all of them being fully compliant with the applicable ESCC generic and/or detailed specification.

ST goes beyond the ESCC specification by performing the following procedure:

- 11 pieces per wafer tested, 5 biased at least 80% of $V_{(BR)CEO}$, 5 unbiased and 1 kept for reference
- Irradiation at 0.1 rad (Si)/s
- Acceptance criteria of each individual wafer if as 100 krad guaranteed if all 10 samples comply with the post radiation electrical characteristics provided in

[Table 5](#)

Delivery together with the parts of the radiation verification test (RVT) report of the particular wafer used to manufacture the products. This RVT includes the value of each parameter at 30, 50, 70 and 100 krad (Si) and after 24 hour annealing at room temperature and after an additional 168 hour annealing at 100 °C.

Table 5. ESCC 5204/002 post radiation electrical characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector cut-off current	$I_E = 0 \text{ A}$, $V_{CB} = -60 \text{ V}$		-	-1	μA
I_{EBO}	Emitter cut-off current	$I_C = 0 \text{ A}$, $V_{EB} = -4 \text{ V}$			-1	μA
		$I_C = 0 \text{ A}$, $V_{EB} = -5.5 \text{ V}$			-1	mA
I_{CEO}	Collector cut-off current	$I_B = 0 \text{ A}$, $V_{CE} = -40 \text{ V}$			-50	μA
$V_{(BR)CEO}^{(1)}$	Collector-emitter breakdown voltage	$I_B = 0 \text{ A}$, $I_C = -100 \text{ mA}$	-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 MILSTD-750 method 1019.

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-39 package information

Figure 7. TO-39 package outline

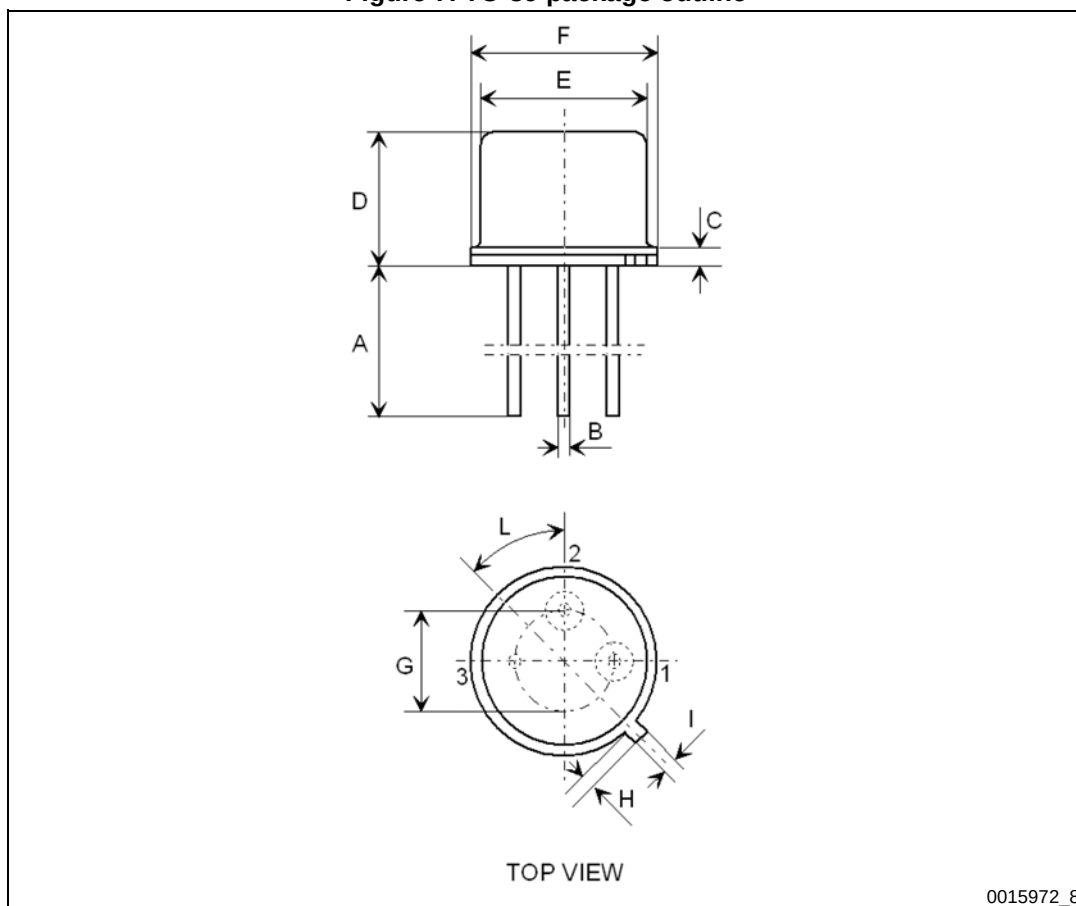


Table 6. TO-39 package mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	12.70	13.50	14.30
B	0.40	0.45	0.49
C	0.58		0.74
D	6.00		6.40
E	8.15	8.20	8.25
F	9.10		9.40
G	4.93	5.08	5.23
H	0.86	0.91	0.96
I	0.77	0.80	0.86
L	42 °	45 °	48 °

5.2 TO-257 package information

Figure 8. TO-257 package outline

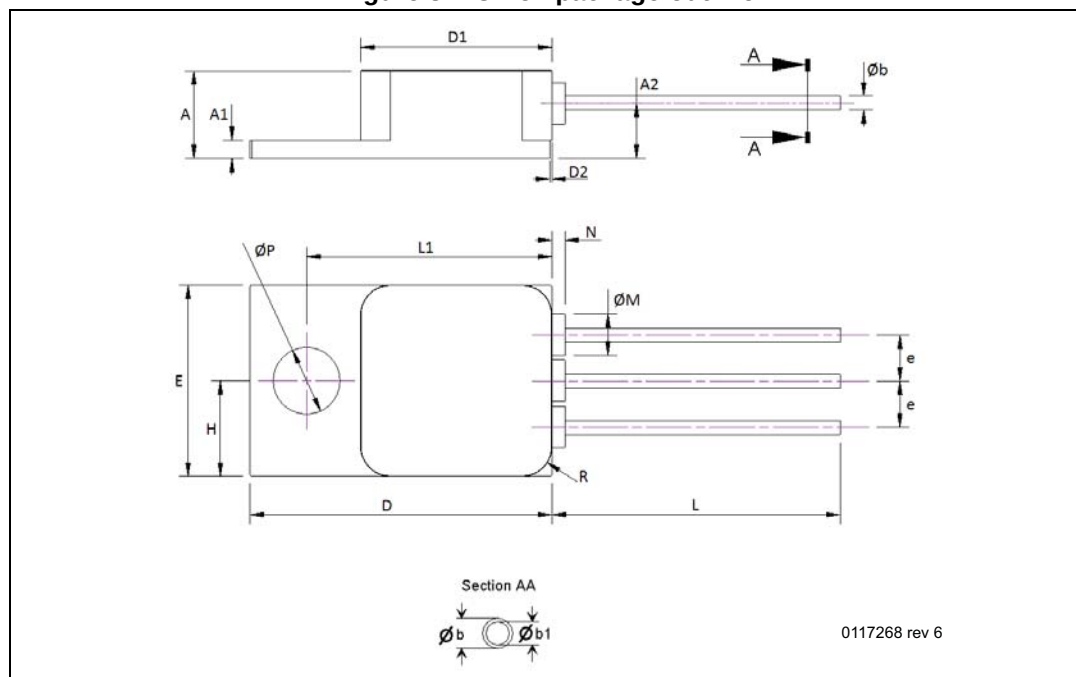


Table 7. TO-257 package mechanical data

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	0.74	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	

5.3 SMD.5 package information

Figure 9. SMD.5 package outline

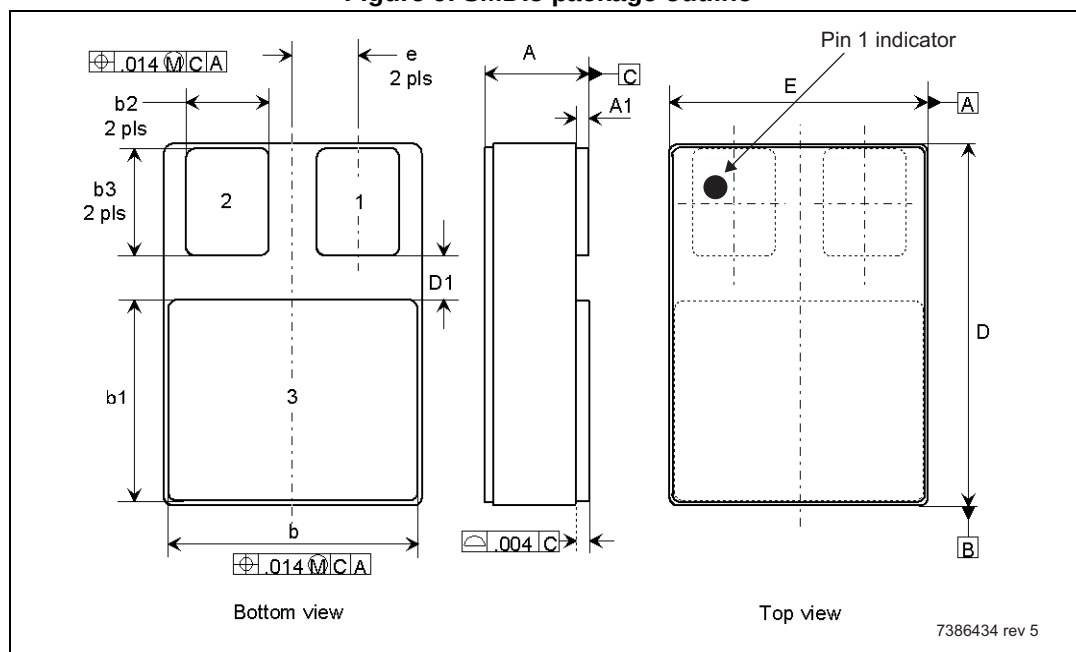


Table 8. SMD.5 package mechanical data

Dim.	mm			Inch		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	2.84	3.00	3.15	0.112	0.118	0.124
A1	0.25	0.38	0.51	0.010	0.015	0.020
b	7.13	7.26	7.39	0.281	0.286	0.291
b1	5.58	5.72	5.84	0.220	0.225	0.230
b2	2.28	2.41	2.54	0.090	0.095	0.100
b3	2.92	3.05	3.18	0.115	0.120	0.125
D	10.03	10.16	10.28	0.935	0.400	0.405
D1	0.76			0.030		
E	7.39	7.52	7.64	0.291	0.296	0.301
e		1.91			0.075	



6 Ordering information

Table 9. Order code

Order code	Agency specification	EPPL	Quality level	Other features	Package	Lead finish	Marking ⁽¹⁾	Packing
2N51531	-	-	Engineering model	-	TO-39	Gold	2N51531	Strip pack
2N5153HRG	5204/002/01	Yes	ESCC	-		Gold	520400201	
2N5153HRT	5204/002/02	Yes	ESCC	-		Solder dip	520400202	
2N5153RHRG	5204/002/01R	Yes	ESCC	100 krad ESCC LDR		Gold	520400201R	
2N5153RHRT	5204/002/02R	Yes	ESCC	100 krad ESCC LDR		Solder dip	520400202R	
2N5153ESY1	-	-	Engineering model	-	TO-257	Gold	2N5153ESY1 + BeO	
2N5153ESYHRG	5204/002/04	Yes	ESCC	-		Gold	520400204 + BeO	
2N5153ESYHRT	5204/002/05	Yes	ESCC	-		Solder dip	520400205 + BeO	
2N5153RESYHRG	5204/002/04R	Yes	ESCC	100 krad ESCC LDR		Gold	520400204R + BeO	
2N5153RESYHRT	5204/002/05R	Yes	ESCC	100 krad ESCC LDR		Solder dip	520400205R + BeO	
2N5153S1	-	-	Engineering model	Emitter on pin 1	SMD.5	Gold	2N5153S1	
2N5153RSHRG	5204/002/06R	Yes	ESCC	100 krad LDR, emitter on pin 1			520400206R	
2N5153SHRG	5204/002/06	Yes	ESCC	Emitter on pin 1			520400206	
2N5153SR1	-	-	Engineering model	Emitter on pin 2			2N5153SR1	
2N5153RSRHRG	5204/002/07R	Yes	ESCC	100 krad LDR, emitter on pin 2			520400207R	
2N5153SRHRG	5204/002/07	Yes	ESCC	Emitter on pin 2			520400207	

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, datecode, country of origin (FR), ESA logo, serial number of the part within the assembly lot.

Contact ST sales office for information about the specific conditions for:

- Products in die form
- Tape and reel packing

7 Shipping details

7.1 Date code

Date code xyywwz is structured as per the table below:

Table 10. Date code

Type	x	yy	ww	z
EM (ESCC)	3	Last two digits of the year	Week digits	Lot index within the week
ESCC flight				

7.2 Documentation

Table 11. Documentation provided for each type of product

Quality level	Radiation level	Documentation
Engineering model		Last two digits of the year
ESCC flight	100 krad	Certificate of conformance
		0.1 rad/s radiation verification test report

8 Revision history

Table 12. Document revision history

Date	Revision	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.

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