2N5153HR

Hi-Rel PNP bipolar transistor 80 V - 5 A

Datasheet - production data

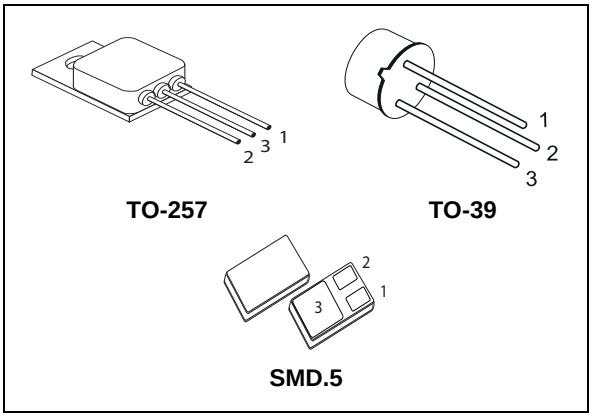
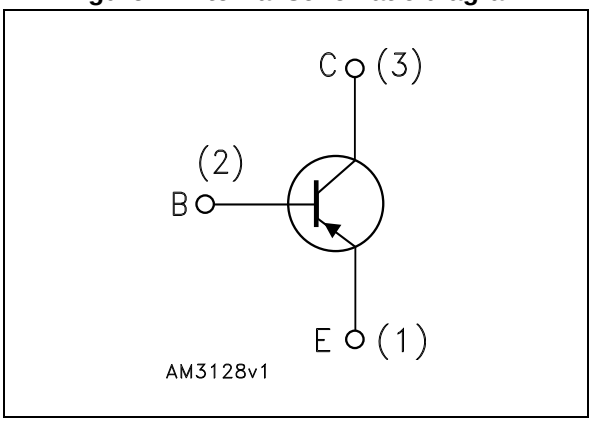


Figure 1. Internal schematic diagram



Features

BV_{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

Device	Qualification system	Agency specification	Package	Other features	EPPL
2N5153RSHRG	ESCC	5204/002	SMD.5	Emitter on Pin 1 - 100 krad: ESCC LDR	Yes
2N5153SHRG	ESCC	5204/002	SMD.5	Emitter on Pin 1	Yes
2N5153RHRx	ESCC	5204/002	TO-39	100 krad: ESCC LDR	-
2N5153HRx	ESCC	5204/002	TO-39	-	-
2N5153RESYHRx	ESCC	5204/002	TO-257	100 krad : ESCC LDR	-
2N5153ESYHRx	ESCC	5204/002	TO-257	-	-

Contents

1 Electrical ratings

Table 2. 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 $T_{amb} \leq 25$ °C for TO-39 for TO-257 $T_C \leq 25$ °C for TO-39 for TO-257 for SMD.5	 1 3.3 10 35 35	 W W W W W
TSTG	Storage temperature	-65 to 200	°C
TJ	Max. operating junction temperature	200	°C

Table 3. Thermal data for through-hole packages

Symbol	Parameter		TO-39	TO-257	Unit
R_{thJC}	Thermal resistance junction-case	max	17.5	5	°C/W
R_{thJA}	Thermal resistance junction-ambient	max	175	53	°C/W

Table 4. Thermal data for SMD package

Symbol	Parameter		SMD.5	Unit
R_{thJC}	Thermal resistance junction-case	max	5	°C/W

2 Electrical characteristics

T_{case} = 25 °C unless otherwise specified

Table 5. Electrical characteristics

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

1. Pulsed duration = 300 µs, duty cycle £ 1.5%

2.1 Electrical characteristics (curves)

Figure 2. h_{FE} @V_{CE} = 5 V

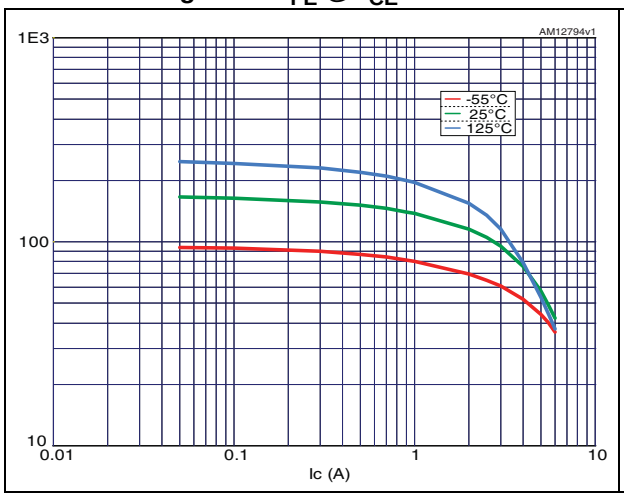


Figure 3. V_{CEsat} @ h_{FE} = 10

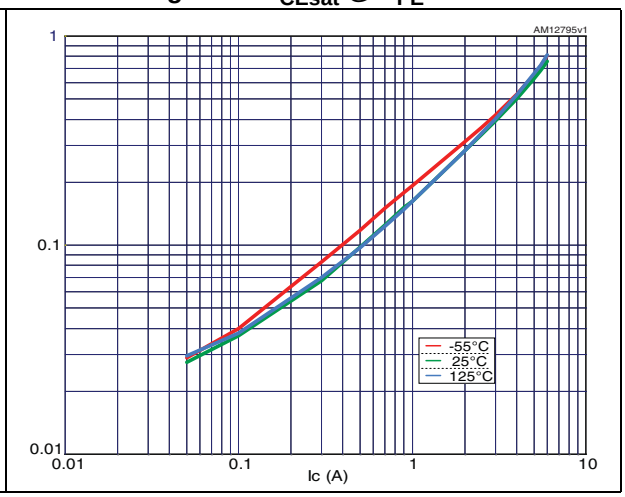


Figure 4. V_{BEsat} @ h_{FE} = 10

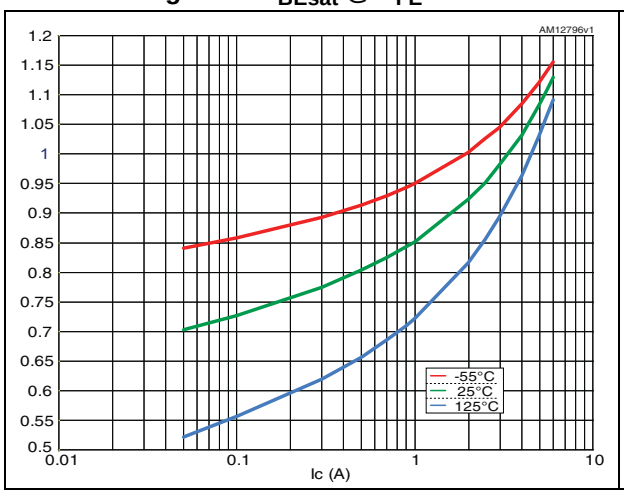
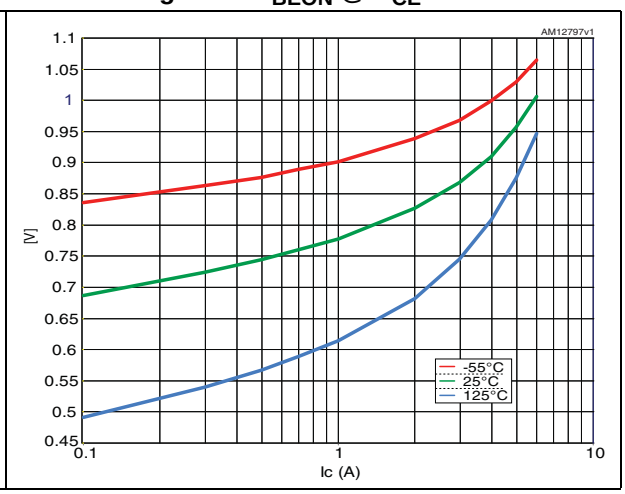
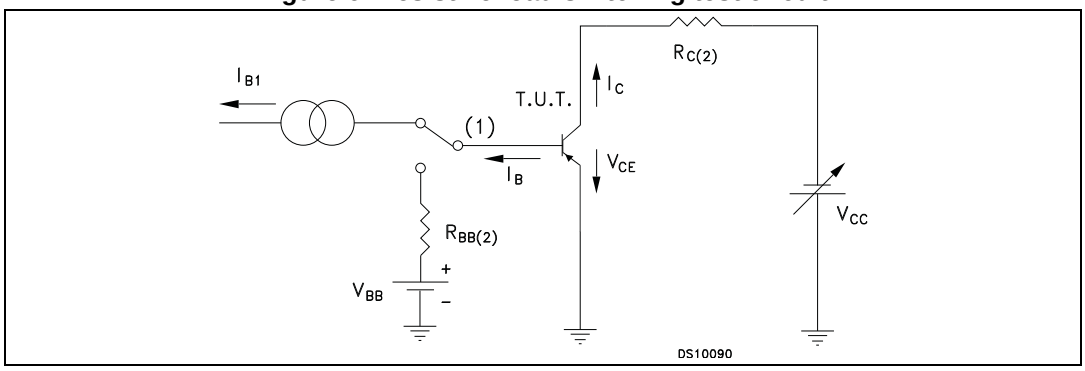


Figure 5. V_{BEON} @ V_{CE} = 5 V



2.2 Test circuit

Figure 6. Resistive load switching test circuit



1. Fast electronic switch
2. Non-inductive resistor

3 Radiation hardness assurance

The products guaranteed in radiation within the ESCC system fully comply with the ESCC 5201/002 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:

- Test of 11 pieces by wafer, 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 6*
- 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 6. ESCC 5201/002 post radiation electrical characteristics

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

1. Pulsed duration = 300 µs, duty cycle ≤ 1.5%
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, shall be as specified in MILSTD-750 method 1019

4 Package mechanical data

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.

4.1 TO-257

Figure 7. TO-257 mechanical drawing

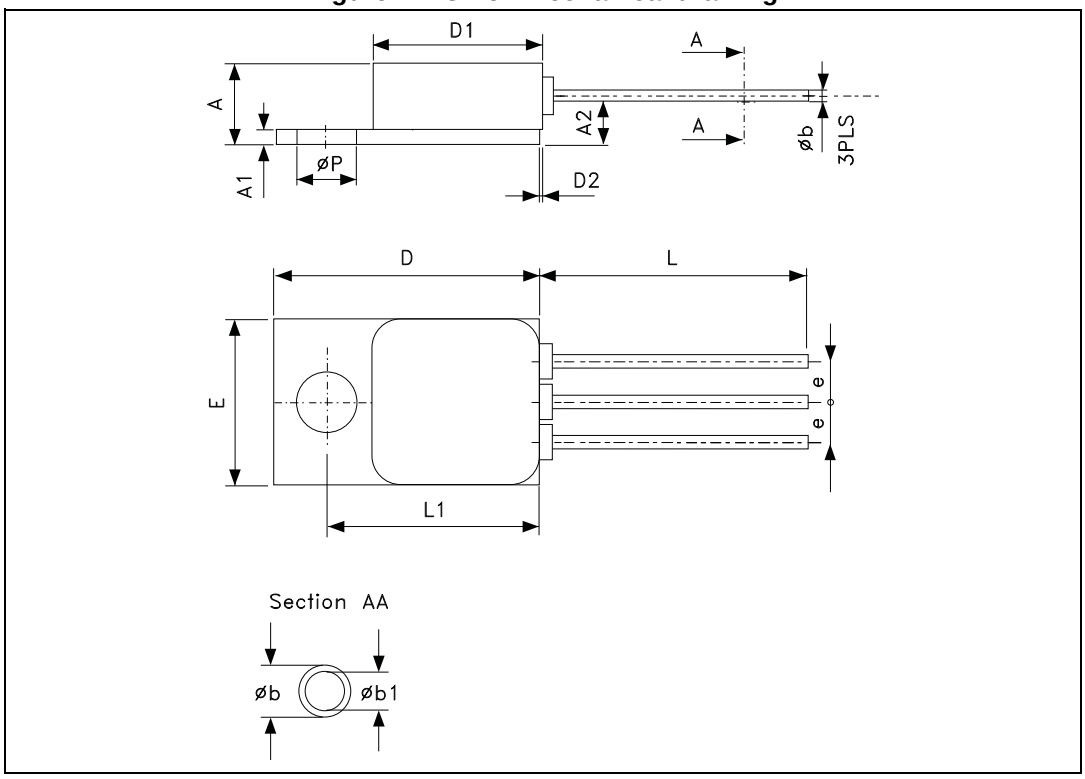


Figure 8. TO-257 mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.83		5.08
A1	0.89		1.14
A2		3.05	
b	0.64		1.02
b1	0.64	0.76	0.89
D	16.38		16.89
D1	10.41		10.92
D2			0.97
e		2.54	
E	10.41		10.67
L	12.70		19.05
L1	13.39		13.64
P	3.56		3.81

4.2 TO-39

Figure 9. TO-39 drawing

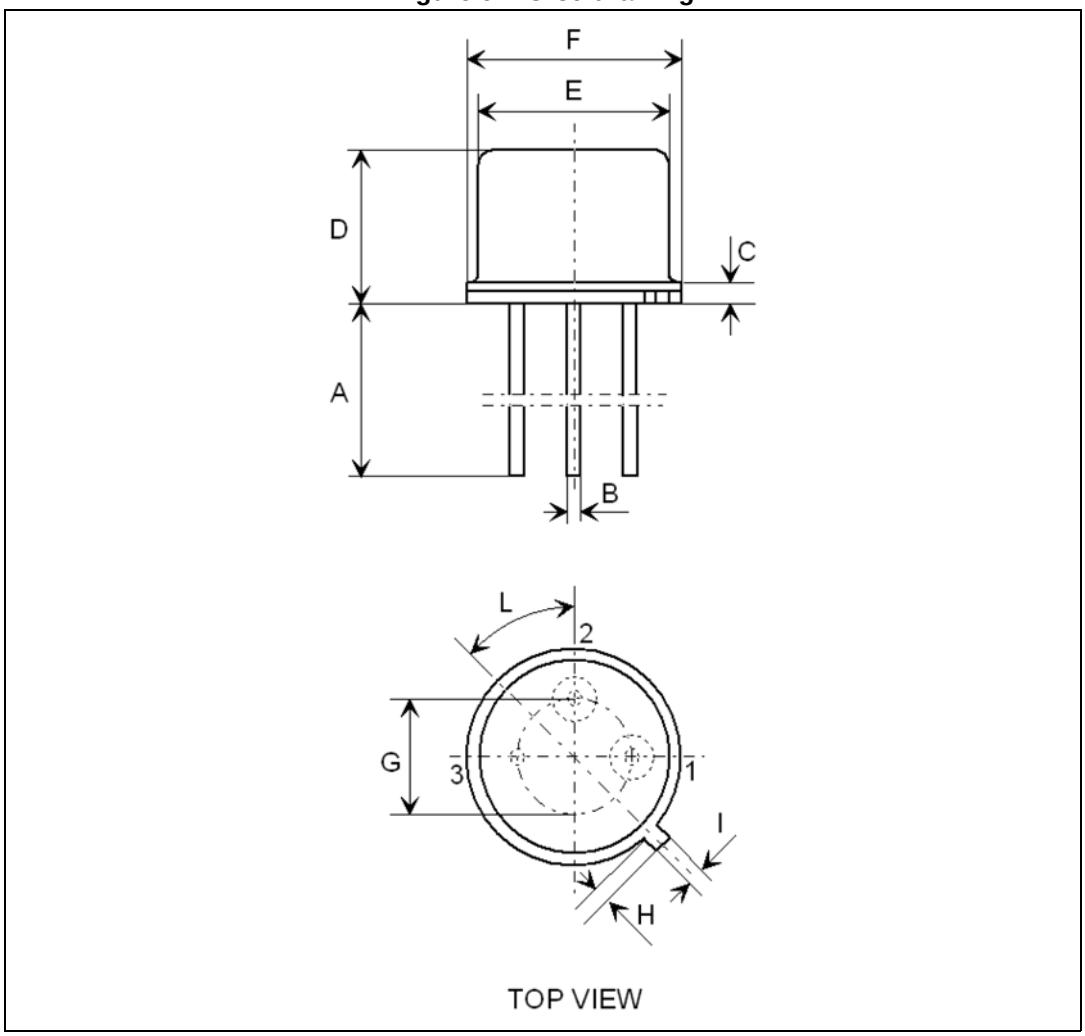


Table 7. TO-39 mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	-	12.70	14.20
B		0.40	0.49
C		0.58	0.74
D		6.00	6.40
E		8.15	8.25
F		9.10	9.20
G		4.93	5.23
H		0.85	0.95
I		0.75	0.85
L		42°	48°

4.3 SMD.5

Figure 10. TSMD.5 drawing

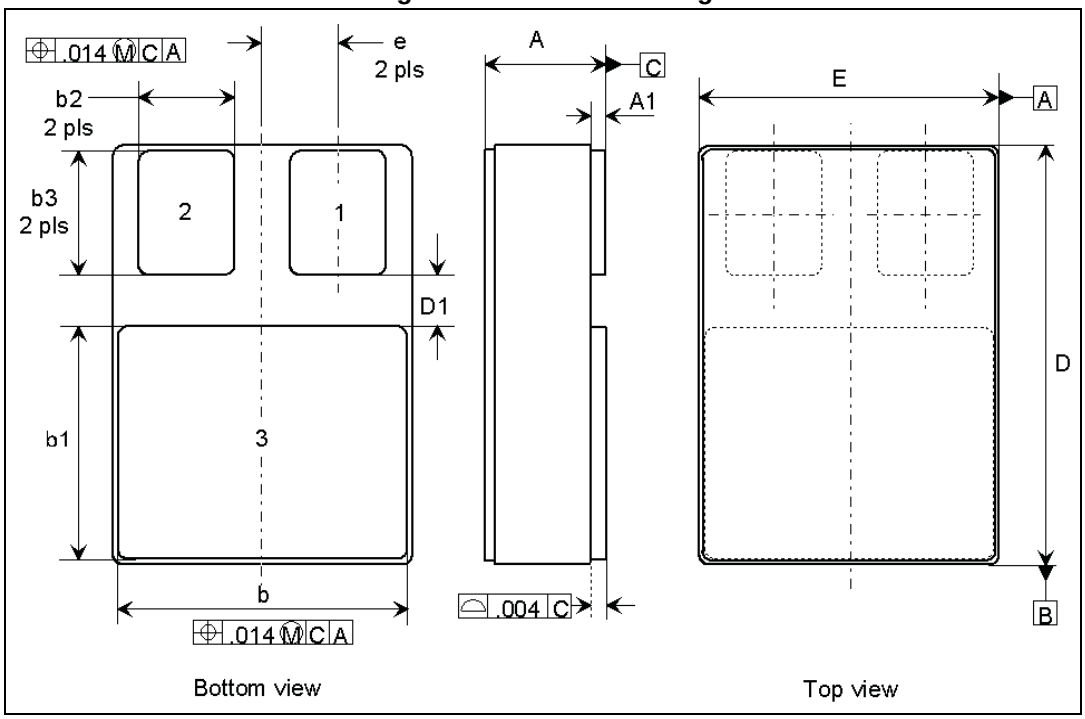


Table 8. SMD.5 mechanical data

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
	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		0.685
E	7.39	7.52	7.64	0.291	0.296	0.301
e		1.91			0.075	

5 Order codes

Table 9. Order codes

CPN	Agency specification	EPPL	Quality level	Other features	Package	Lead finish	Marking(1)	Packing
2N5153S1	-	-	Engineering model ESCC	Emitter on Pin 1	SMD.5	Gold	2N5153S1	Strip Pack
2N5153ESY1	-	-	Engineering model ESCC	-	TO-257	Gold	2N5153ESY1 + BeO	Strip Pack
2N5153RSHRG	5204/002/06R	Yes	ESCC	Emitter on Pin 1 - 100 krad : ESCC LDR	SMD.5	Gold	520400206R	Strip Pack
2N5153SHRG	5204/002/06	Yes	ESCC	Emitter on Pin 1	SMD.5	Gold	520400206	Strip Pack
2N5153RHRG	5204/002/01R	-	ESCC	100 krad : ESCC LDR	TO-39	Gold	520400201R	Strip Pack
2N5153RHRT	5204/002/02R	-	ESCC	100 krad : ESCC LDR	TO-39	Solder Dip	520400202R	Strip Pack
2N5153HRG	5204/002/01	-	ESCC	-	TO-39	Gold	520400201	Strip Pack
2N5153HRT	5204/002/02	-	ESCC	-	TO-39	Solder Dip	520400202	Strip Pack
2N5153RESYHRG	5204/002/04R	-	ESCC	100 krad : ESCC LDR	TO-257	Gold	520400204R + BeO	Strip Pack
2N5153RESYHRT	5204/002/05R	-	ESCC	100 krad : ESCC LDR	TO-257	Solder Dip	520400205R + BeO	Strip Pack
2N5153ESYHRG	5204/002/04	-	ESCC	-	TO-257	Gold	520400204 + BeO	Strip Pack
2N5153ESYHRT	5204/002/05	-	ESCC	-	TO-257	Solder Dip	520400205 + BeO	Strip Pack

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 the specific conditions for:

- Products in die form
- Tape and reel packing

6 Shipping details

6.1 Date code

Date code xyywwz is structured as below table:

Table 10. Date code

	x	yy	ww	z
EM (ESCC)	3	last two digits of the year	week digits	lot index in the week
ESCC FLIGHT	-			

6.2 Documentation

Table 11. Documentation provided for each type of product

Quality level	Radiation level	Documentation
Engineering model	-	-
ESCC Flight	-	Certificate of conformance
	100 krad	Certificate of conformance
		0.1 rad/s radiation verification test report

7 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 2.1: Electrical characteristics (curves) on page 5*
12-Dec-2013	4	Updated *Table 1: Device summary* and *Section 4: Package mechanical data*. Added *Section 3: Radiation hardness assurance*, *Section 5: Order codes* and *Section 6: Shipping details*.
28-Mar-2014	5	Updated *Table 1: Device summary* and *Table 9: Order codes*. Minor text changes.

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