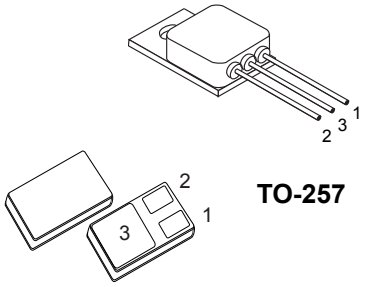
2N5153HR

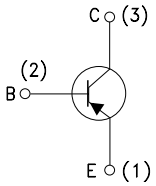
Datasheet

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

Product status link
2N5153HR

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 PNP bipolar transistor specifically designed and housed in hermetic packages for aerospace and Hi-Rel applications. It is qualified in the ESCC qualification system (ESCC 5000 compliance).

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

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
2N5153RSHRx	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

T_C= 25 °C unless otherwise specified

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} ≤ 25 °C for TO-257 and SMD.5	3.3	W
	Total dissipation at T_{case} ≤ 25 °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
$R_{thj\text{-}case}$	Thermal resistance junction-case	5	°C/W
$R_{thj\text{-}amb}$	Thermal resistance junction-ambient	53	°C/W

2 Electrical characteristics

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

Symbol	Parameter	Test conditions	Min.	Max.	Unit
I_{CES}	Collector cut-off current	V_{CB} = 60 V, I_E = 0 A		1	µA
		V_{CB} = 60 V, I_E = 0 A, T_{amb} = 150 °C		10	
I_{CEO}	Collector cut-off current	V_{CE} = 40 V, I_B = 0 A		50	µA
I_{EBO}	Emitter cut-off current	V_{EB} = 4 V, I_C = 0 A		1	µA
		V_{EB} = 5.5 V, I_C = 0 A		1	mA
$V_{(BR)CEO}$ (1)	Collector-emitter breakdown voltage	I_C = 100 mA, I_B = 0 A	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		1.45	V
		I_C = 5 A, I_B = 0.5 A		2.2	
h_{FE}	DC current gain	I_C = 50 mA, V_{CE} = 5 V	50		
		I_C = 2.5 A, V_{CE} = 5 V	70	200	
		I_C = 5 A, V_{CE} = 5 V	40		
		I_C = 2.5 A, V_{CE} = 5 V, T_{amb} = -55 °C	35		
h_{fe}	AC forward current transfer ratio	I_C = 500 mA, f = 20 MHz, V_{CE} = 5 V	3.5		
C_{obo}	Output capacitance	I_E = 0 A, f = 1 MHz, V_{CB} = 10 V		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			1.3	µs

1. *Pulsed duration = 300 µs, duty cycle ≤ 2%*

Voltage and current values are intended as negative.

3 Electrical characteristics (curves)

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

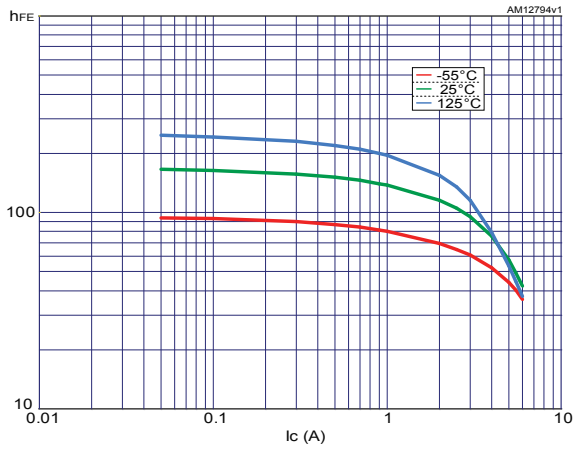


Figure 2. $V_{CE(sat)}$ at h_{FE} = 10

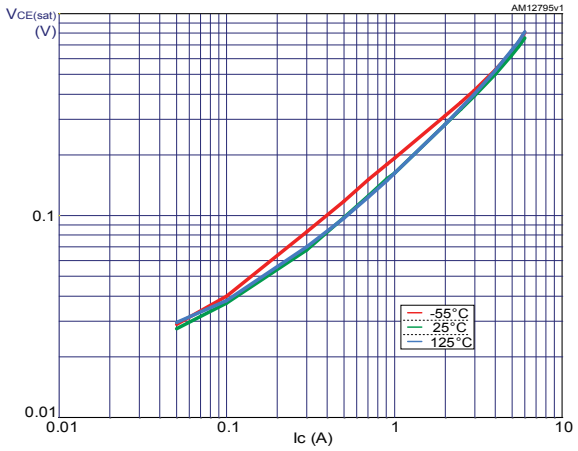


Figure 3. $V_{BE(sat)}$ at h_{FE} = 10

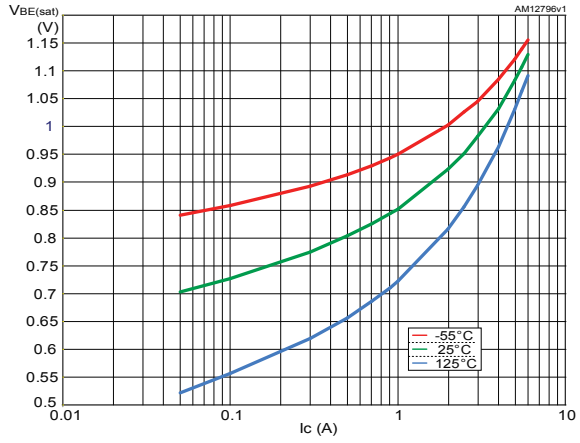
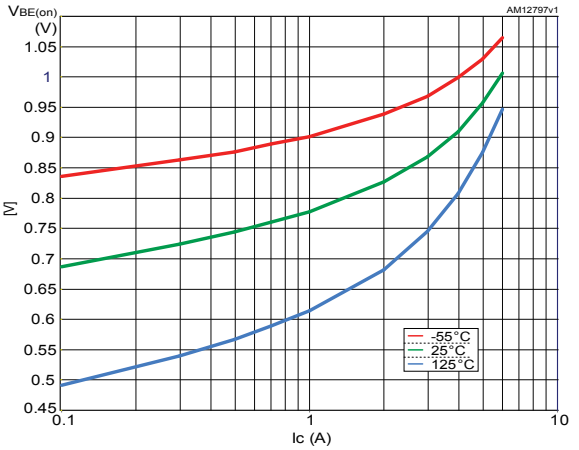
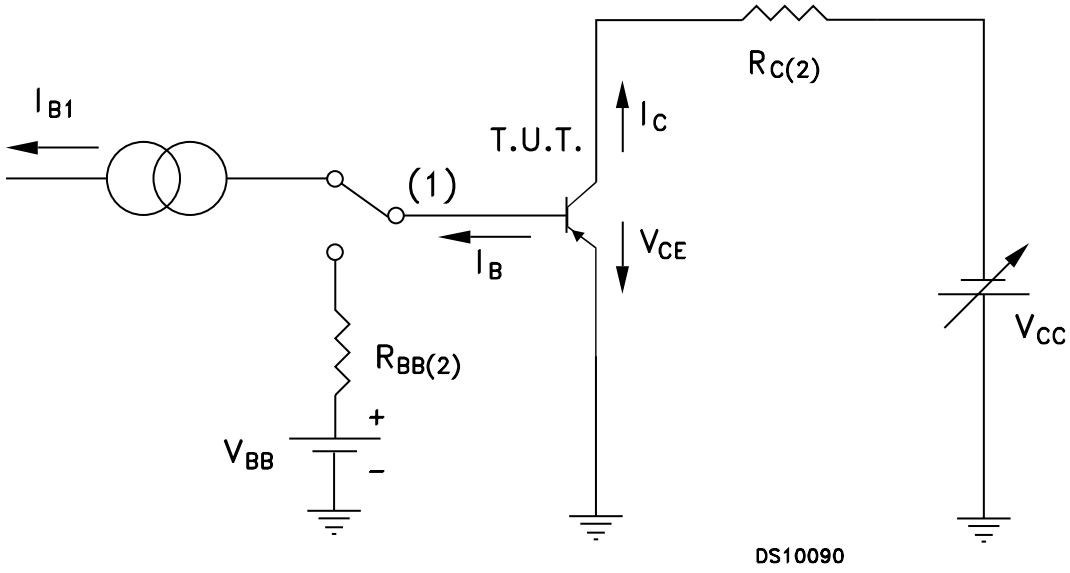


Figure 4. V_{BEON} at V_{CE} = 5 V



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 °C unless otherwise specified)

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

1. *Pulsed duration = 300 µs, duty cycle ≤ 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

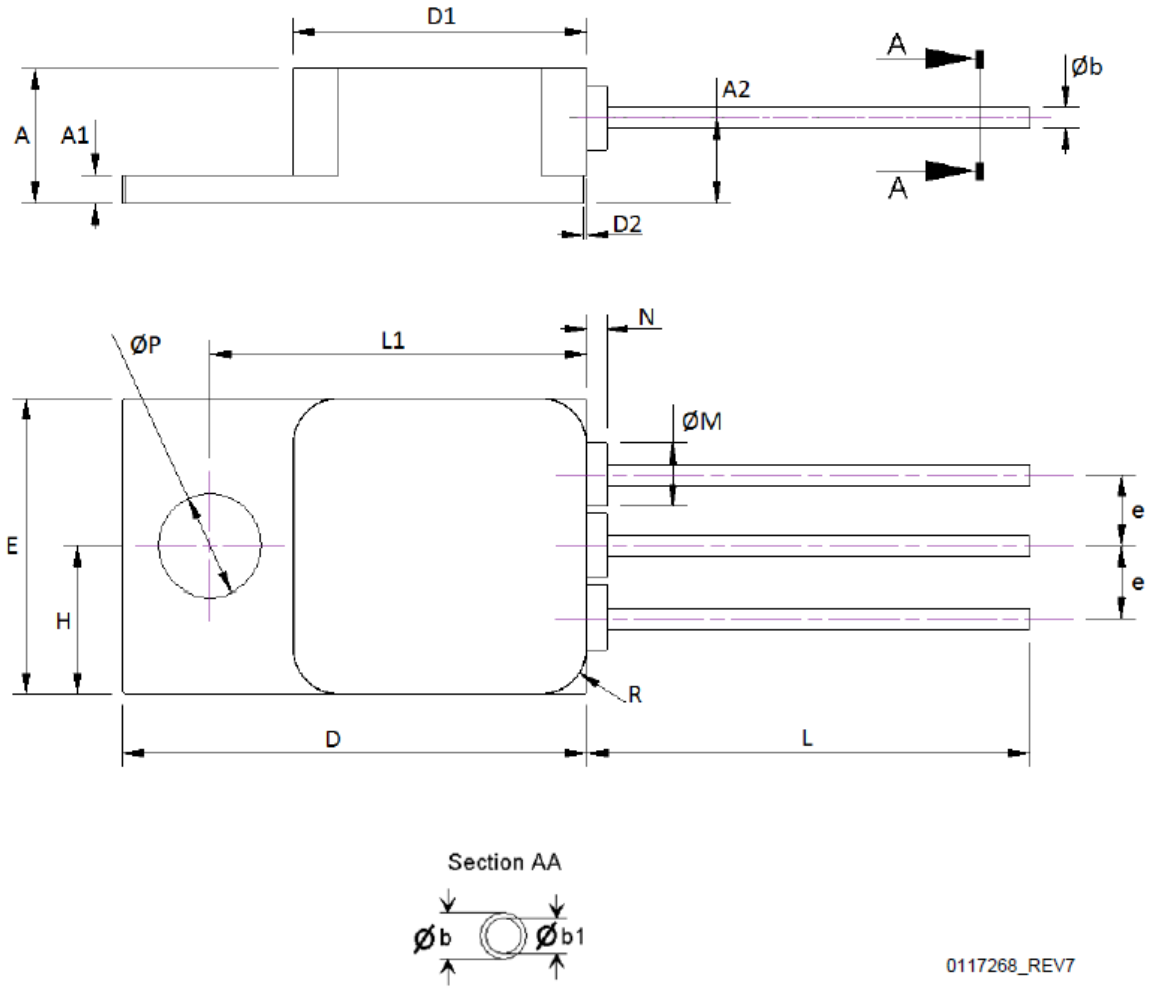


Table 5. **TO-257 package mechanical data**

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	-

5.2 SMD.5 package information

Figure 7. **SMD.5 package outline**

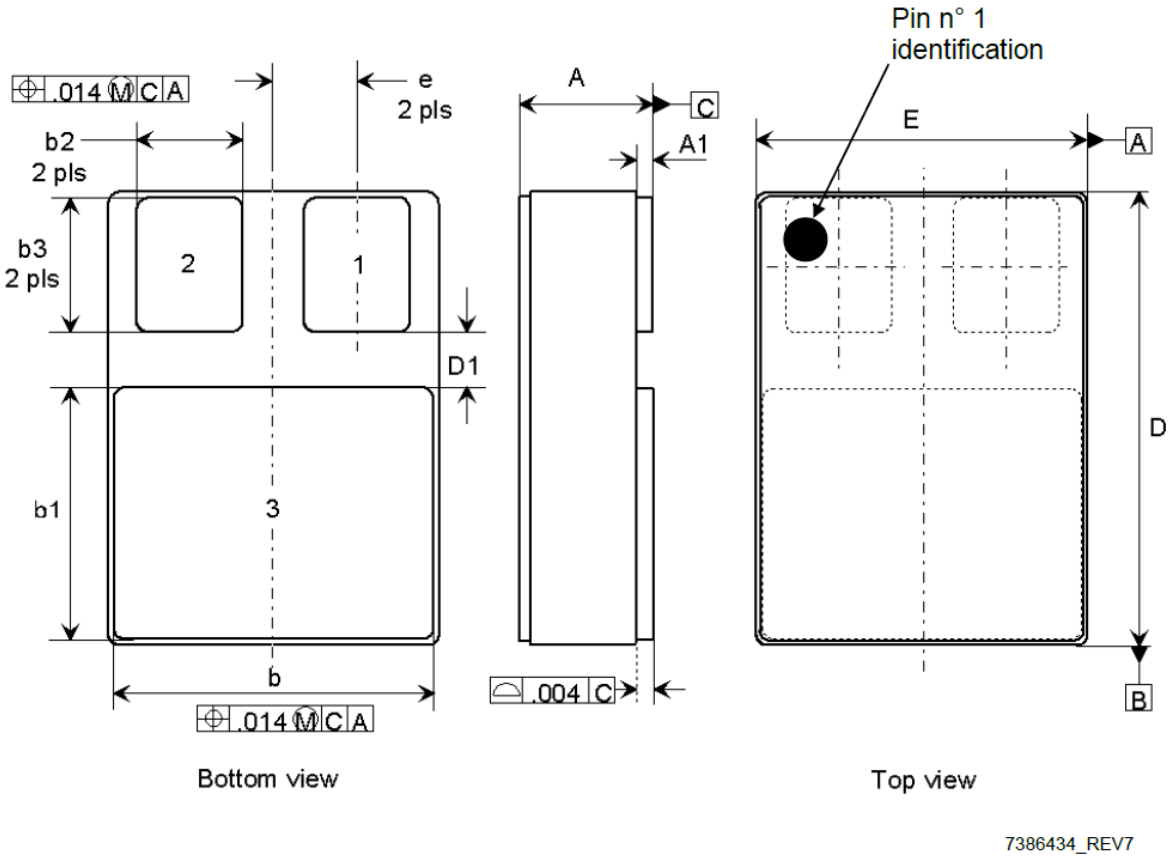


Table 6. **SMD.5 package mechanical data**

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	

6 Ordering information

Table 7. Ordering information

Part number	Agency specification	EPPL	Quality level	Radiation level	Pin-out	Package	Mass	Lead finish	Marking[1]	Packing
2N5153ESY1	-		Engineering model	-	-	TO-257	5 g	Gold	2N5153ESY1 + BeO	Strip pack
2N5153ESYHRG	5204/002/04	Yes	ESCC	-	-			Gold	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	2 g	Gold	2N5153S1	
2N5153RSHRG	5204/002/06R	Yes	ESCC	100 krad	Emitter on pin 1				520400206R	
2N5153RSHRGW	5204/002/06R	Yes	ESCC	100 krad	Emitter on pin 1				520400206R	Tape and reel
2N5153SHRG	5204/002/06	Yes	ESCC	-	Emitter on pin 1				520400206	Strip pack
2N5153SHRGW	5204/002/06	Yes	ESCC	-	Emitter on pin 1				520400206	Tape and reel
2N5153SR1	-	-	Engineering model	-	Emitter on pin 2				2N5153SR1	Strip pack
2N5153RSRHRG	5204/002/07R	Yes	ESCC	100 krad	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, 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.