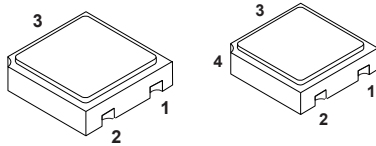


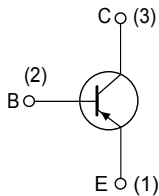
## Rad-hard 60 V, 0.6 A PNP transistor



LCC-3

UB

Pin 4 in UB is connected to the metallic lid.



DS10460

## Features

$V_{CBO}$	$I_C(\text{max.})$	$H_{FE}$ at 10 V, 150 mA	$T_j(\text{max.})$
60 V	ESCC	0.5 A	> 100
			200 °C

- Hermetic packages
- ESCC qualified
- 100 krad

## Description

This bipolar transistor is able to operate under severe environment conditions and radiation exposure providing high immunity to total ionizing dose (TID).

Qualified as per ESCC 5202/001 specification and available in LCC-3 and UB hermetic packages, it is specifically recommended for space and harsh environment applications and suitable for low current and high precision circuits such preamplifiers, oscillators, current mirror configuration.

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

## Product summary

Product status link
<a href="#">2N2907AHR</a>

Product summary				
Part-number	Qualification system	Agency specification	Package	Radiation level
2N2907ARUBx	ESCC Flight	5202/001	UB	100 krad
2N2907AUBx	ESCC Flight	5202/001	UB	-
SOC2907ARHRx	ESCC Flight	5202/001	LCC-3	100 krad
SOC2907AHRx	ESCC Flight	5202/001	LCC-3	-

Note: See [Table 7](#) for ordering information.

# 1 Electrical ratings

Note: For PNP transistor voltage and current polarity is reversed.

**Table 1. Absolute maximum ratings**

Symbol	Parameter	Value	Unit
$V_{CBO}$	Collector-base voltage ( $I_E = 0$ )	-60	V
$V_{CEO}$	Collector-emitter voltage ( $I_B = 0$ )	-60	V
$V_{EBO}$	Emitter-base voltage ( $I_C = 0$ )	-5	V
$I_C$	Collector current	0.5	A
$P_{TOT}$	Total dissipation at $T_{amb} \leq 25\text{ °C}$	LCC-3 and UB	0.4
		LCC-3 and UB <sup>(1)</sup>	0.73
$T_{OP}$	Operating temperature range	-65 to 200	°C
$T_J$	Max. operating junction temperature	200	°C

1. When mounted on a 15 x 15 x 0.6 mm ceramic substrate.

**Table 2. Thermal data**

Symbol	Parameter	LCC-3 and UB Value	Unit
$R_{thJA}$	Thermal resistance junction-ambient (max.)	437.5 240 <sup>(1)</sup>	°C/W

1. When mounted on a 15 x 15 x 0.6 mm ceramic substrate.

## 2 Electrical characteristics

### 2.1 Electrical characteristics

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

Symbol	Parameter	Test conditions	Min.	Max.	Unit
$I_{CBO}$	Collector-base cut-off current ( $I_E = 0$ )	$V_{CB} = 50\text{ V}$		10	nA
		$V_{CB} = 50\text{ V}, T_{amb} = 150\text{ °C}$		10	$\mu\text{A}$
$I_{CEX}$	Collector-emitter cut-off current	$V_{CE} = 30\text{ V}, V_{BE} = -0.5\text{ V}$		50	nA
$V_{(BR)CBO}$	Collector-base breakdown voltage ( $I_E = 0$ )	$I_C = 10\text{ }\mu\text{A}$	60		V
$V_{(BR)CEO}^{(1)}$	Collector-emitter breakdown voltage ( $I_B = 0$ )	$I_C = 10\text{ mA}$	60		V
$V_{(BR)EBO}$	Emitter-base breakdown voltage ( $I_C = 0$ )	$I_C = 10\text{ }\mu\text{A}$	5		V
$V_{CE(sat)}^{(1)}$	Collector-emitter saturation voltage	$I_C = 150\text{ mA}, I_B = 15\text{ mA}$		0.4	V
$V_{BE(sat)}^{(1)}$	Base-emitter saturation voltage	$I_C = 150\text{ mA}, I_B = 15\text{ mA}$		1.3	V
$h_{FE}^{(1)}$	DC current gain	$I_C = 0.1\text{ mA}, V_{CE} = 10\text{ V}$	75		
		$I_C = 10\text{ mA}, V_{CE} = 10\text{ V}$	100		
		$I_C = 150\text{ mA}, V_{CE} = 10\text{ V}$	100	300	
		$I_C = 500\text{ mA}, V_{CE} = 10\text{ V}$	50		
$h_{fe}$	Small signal current gain	$I_C = 20\text{ mA}, f = 100\text{ MHz}, V_{CE} = 20\text{ V}$	2		
$C_{OBO}$	Output capacitance ( $I_E = 0$ )	$100\text{ kHz} \leq f \leq 1\text{ MHz}, V_{CB} = 10\text{ V}$		8	pF
$t_{on}$	Turn-on time	$I_{CC} = 150\text{ mA},$ $I_{B1} = 15\text{ mA},$ $V_{CC} = 30\text{ V}$		45	ns
$t_{off}$	Turn-off time	$I_{CC} = 150\text{ mA},$ $I_{B1} = -I_{B2} = 15\text{ mA},$ $V_{CC} = 30\text{ V}$		300	ns

1. Pulsed duration = 300  $\mu\text{s}$ , duty cycle  $\leq 1.5\%$

## 2.2 Radiation assurance

100 krad part numbers are guaranteed in radiation as per ESCC 22900 and in compliance with ESCC 5202/001 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](#).

**Table 4. ESCC 5202/001 post radiation electrical characteristics ( $T_{amb} = 25\text{ °C}$  unless otherwise specified)**

Symbol	Parameter	Test conditions	Min.	Typ.	Max	Unit
$I_{CBO}$	Collector cut-off current ( $I_E = 0$ )	$V_{CB} = 50\text{ V}$		-	10	nA
$I_{CEX}$	Collector-emitter cut-off current	$V_{CE} = 30\text{ V}$ , $V_{BE} = -0.5\text{ V}$		-	50	nA
$V_{(BR)CBO}$	Collector-base breakdown voltage ( $I_E = 0$ )	$I_C = 10\text{ }\mu\text{A}$	60	-		V
$V_{(BR)CEO}^{(1)}$	Collector-emitter breakdown voltage ( $I_B = 0$ )	$I_C = 10\text{ mA}$	60			V
$V_{(BR)EBO}$	Emitter-base breakdown voltage ( $I_C = 0$ )	$I_E = 10\text{ }\mu\text{A}$	5	-		V
$V_{CE(sat)}^{(1)}$	Collector-emitter saturation voltage	$I_C = 150\text{ mA}$ , $I_B = 15\text{ mA}$		-	0.4	V
$V_{BE(sat)}^{(1)}$	Base-emitter saturation voltage	$I_C = 150\text{ mA}$ , $I_B = 15\text{ mA}$		-	1.3	V
$[h_{FE}]^{(1)}$	Post irradiation gain calculation <sup>(2)</sup>	$I_C = 0.1\text{ mA}$ , $V_{CE} = 10\text{ V}$	[30]	-		
		$I_C = 10\text{ mA}$ , $V_{CE} = 10\text{ V}$	[50]	-		
		$I_C = 150\text{ mA}$ , $V_{CE} = 10\text{ V}$	[50]	-	300	
		$I_C = 500\text{ mA}$ , $V_{CE} = 10\text{ V}$	[25]	-		

1. Pulsed duration = 300  $\mu\text{s}$ , duty cycle  $\geq 2\%$

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, shall be as specified in MILSTD-750 method 1019.

### 2.3 Electrical characteristics (curves)

Figure 1. DC current gain ( $V_{CE} = 1\text{ V}$ )

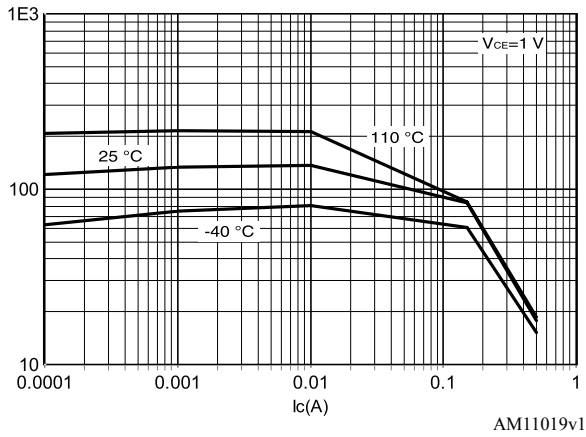


Figure 2. DC current gain ( $V_{CE} = 10\text{ V}$ )

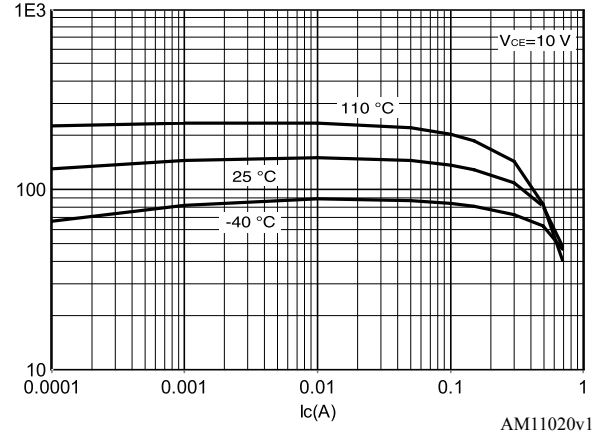


Figure 3. Collector emitter saturation voltage

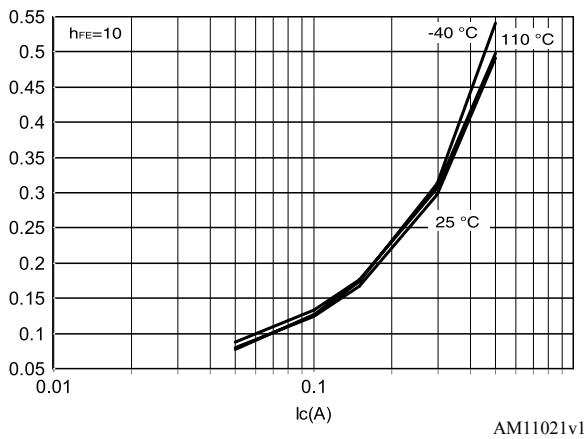
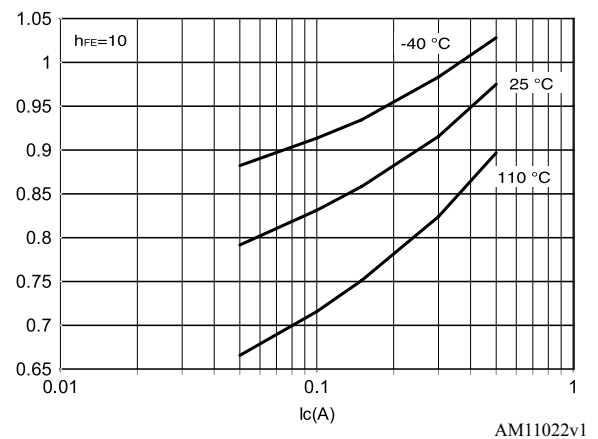


Figure 4. Base emitter saturation voltage ( $h_{FE} = 10$ )

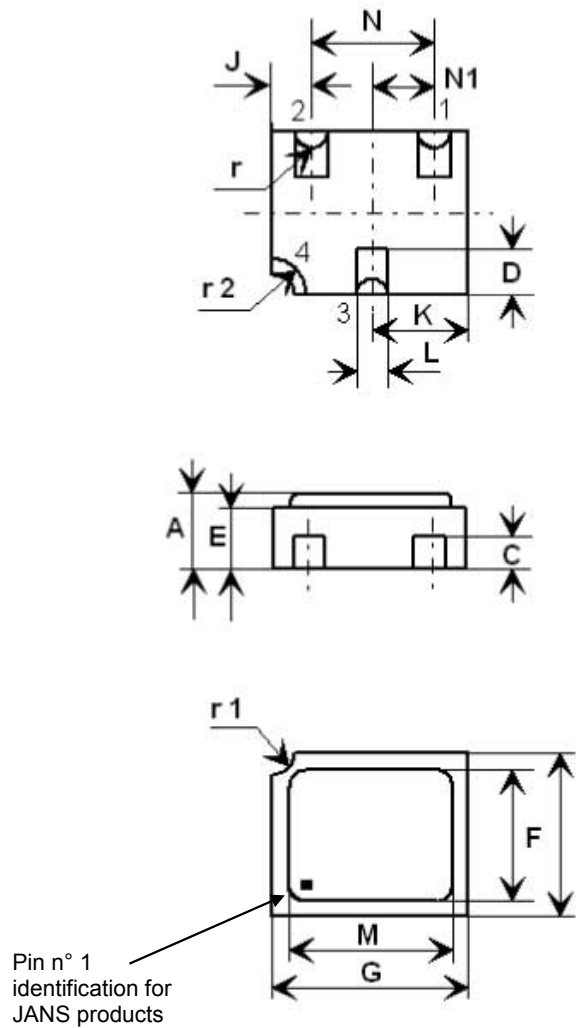


### 3 Package information

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](http://www.st.com). ECOPACK is an ST trademark.

#### 3.1 UB package information

Figure 5. UB package outline



- Pad 1: Emitter
- Pad 2: Base
- Pad 3: Collector
- Pad 4: Shielding connected to the lid

8206487 rev.6

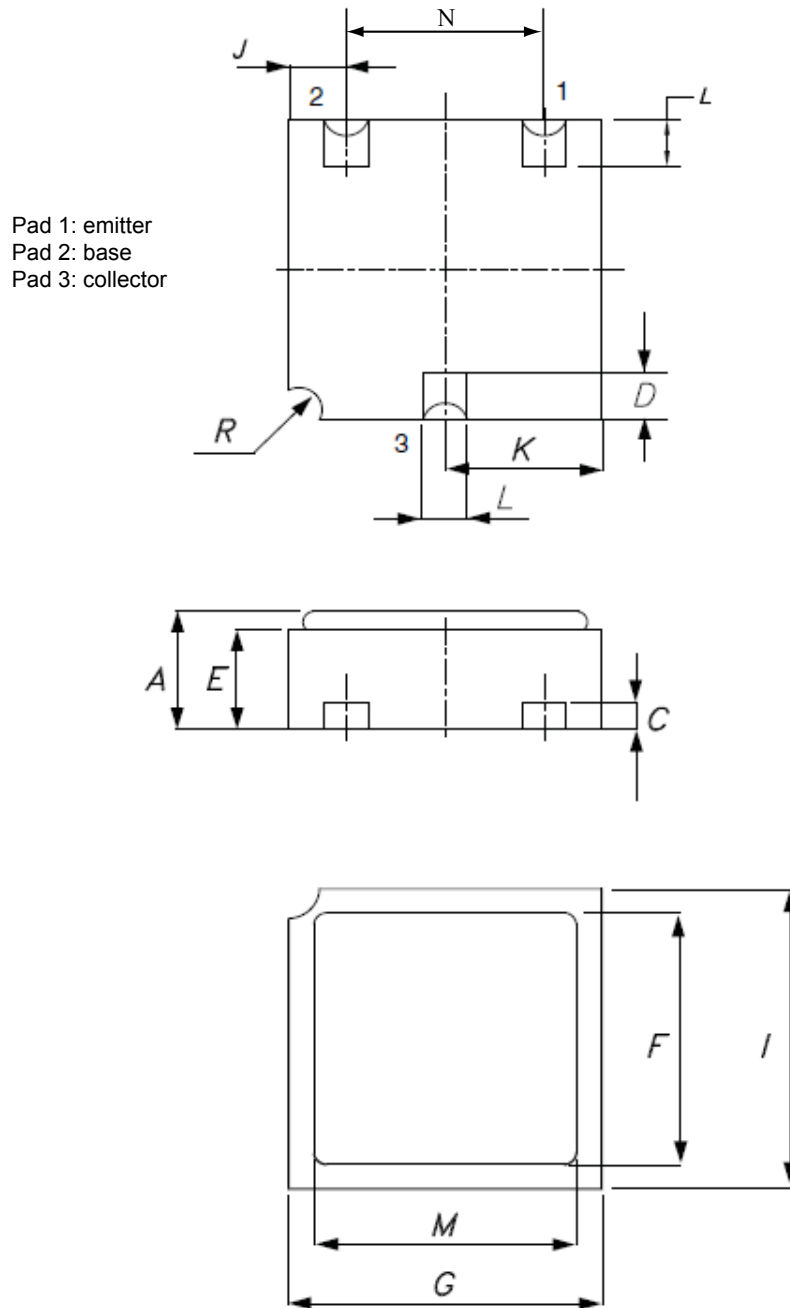
Note: For JANS products: the pin out numbering for emitter and base is inverted (base is designated pin 1 and emitter pin 2)

Table 5. UB package mechanical data

Symbols	Dimensions in mm			Dimensions in inches (for reference only)		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	1.16		1.42	0.045		0.056
C	0.46	0.51	0.56	0.018	0.020	0.022
D	0.56	0.76	0.96	0.024	0.030	0.036
E	0.92	1.02	1.12	0.036	0.040	0.044
F	1.95	2.03	2.11	0.077	0.080	0.083
G	2.92	3.05	3.18	0.115	0.120	0.125
I	2.41	2.54	2.67	0.095	0.100	0.105
J	0.42	0.57	0.72	0.0165	0.0225	0.0285
K	1.37	1.52	1.67	0.054	0.060	0.066
L	0.41	0.51	0.61	0.016	0.020	0.024
M	2.46	2.54	2.62	0.097	0.100	0.103
N	1.81	1.91	2.01	0.071	0.075	0.079
N1	0.91	0.96	1.02	0.036	0.038	0.040
r		0.20			0.008	
r1		0.30			0.012	
r2		0.56			0.022	

### 3.2 LCC-3 package information

Figure 6. LCC-3 package outline



0041211 rev.14



Table 6. LCC-3 package mechanical data

Symbols	Dimensions in mm			Dimensions in inches (for reference only)		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	1.16		1.42	0.046		0.056
C	0.45	0.50	0.56	0.018	0.020	0.022
D	0.60	0.56	0.96	0.024	0.022	0.038
E	0.91	1.01	1.12	0.036	0.040	0.044
F	1.95	2.03	2.11	0.077	0.080	0.083
G	2.92	3.05	3.17	0.115	0.120	0.125
I	2.41	2.54	2.66	0.095	0.100	0.105
J	0.42	0.57	0.72	0.0165	0.0225	0.0285
K	1.37	1.52	1.67	0.054	0.060	0.066
L	0.40	0.50	0.60	0.016	0.020	0.024
M	2.46	2.54	2.62	0.097	0.100	0.103
N	1.80	1.90	2.00	0.071	0.075	0.079
R		0.30			0.012	

## 4 Ordering information

**Table 7. Ordering information**

Part number	Agency specification	Quality level	Radiation level	Package	Mass	Lead finish	Marking
2N2907AUB1	-	Engineering model	-	UB	0.6 g	Gold	2N2907AUB1
SOC2907A1	-	Engineering model	-	LCC-3			SOC2907A1
2N2907ARUBG	5202/001/06R	ESCC	100 krad	UB		Gold	5202/001/06R
2N2907ARUBT	5202/001/07R					Solder Dip	5202/001/07R
2N2907ARUBTW	5202/001/07R		Solder Dip			5202/001/07R	
2N2907AUBG	5202/001/06		-			5202/001/06	
2N2907AUBT	5202/001/07		-			5202/001/07	
SOC2907ARHRG	5202/001/04R		ESCC			100 krad	LCC-3
SOC2907ARHRT	5202/001/05R	Solder Dip		5202/001/05R			
SOC2907ARHRTW	5202/001/05R	Solder Dip		5202/001/05R			
SOC2907AHRG	5202/001/04	-		5202/001/04			
SOC2907AHRT	5202/001/05	-		5202/001/05			
SOC2907AHRTW	5202/001/05	-		5202/001/05			
						Gold	
					Solder Dip		

1. *Specific marking only. The full marking includes in addition: For the Engineering Models: ST logo, date code; country of origin (FR). For the Standard Models: 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.

## 5 Other information

### 5.1 Traceability information

The date code in formation is structured as described in the table below.

**Table 8. Date codes**

Model	Date code
EM	3yywwN
ESCC	yywwN

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

### 5.2 Documentation

**Table 9. Documentation provided for each type of product**

Quality level	Radiation level	Documentation
Engineering model	-	Certificate of conformance
ESCC	-	Certificate of conformance ESCC qualification maintenance lot reference
ESCC	100 krad	Certificate of conformance ESCC qualification maintenance lot reference Radiation verification test (RVT) report at 25 / 50 / 70 / 100 krad at 0.1 rad / s.

## Revision history

**Table 10. Document revision history**

Date	Revision	Changes
09-Feb-2009	1	Initial release.
05-Jan-2010	2	Modified Table 1: Device summary
30-Nov-2011	3	Minor text changes in the document title and description on the coverpage
14-May-2012	4	New package inserted (UB). Updated: – Table 1: Device summary, Table 2: Absolute maximum ratings and Table 3: Thermal data. – Section 2: Electrical characteristics and Section 4: Package mechanical data. Added: – Section : and Section 6: Shipping details.
03-Jun-2013	5	Added: – New section Radiation hardness assurance – Corrected the revision number and dates of revision 3.
18-Sep-2013	6	Updated Table 1: Device summary and Table 13: Ordering information
05-May-2014	7	Updated Table 1: Device summary, Table 13: Ordering information and Section 3: Radiation hardness assurance. Added Figure 2: Safe operating area for TO-18 and Figure 3: Safe operating area for LCC-3
29-May-2014	8	Added note 1 in Table 13: Ordering information.
21-Aug-2015	9	Modified: Section 4.3: TO-18 package information Minor text changes.
02-Dec-2015	10	Updated Figure 2.: Safe operating area for TO-18 and Figure 3.: Safe operating area for LCC-3. Minor text chages.
16-Apr-2020	11	Removed TO-18 package information. Minor text changes.
02-Feb-2021	12	Updated Table 1, Table 1, Table 4, Figure 6, Table 7 and Table 9. Removed Radiation summary table. Minor text changes.
16-Nov-2021	13	Updated Features, Description and Product summary on cover page. Updated Table 1, Table 2, Table 7, Table 8 and Table 9. Updated Section 2 Electrical characteristics.

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