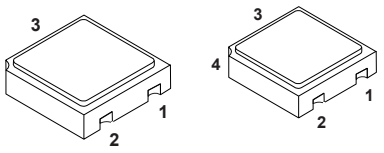
2N3700HR

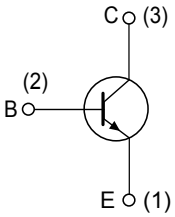
Datasheet

Rad-Hard 80 V, 1 A NPN transistor



LCC-3 **UB**

Pin 4 in UB is connected to the metallic lid.



DS10450

Features

V_{CEO}	I_C(max.)	h_{FE} at 10 V, 150 mA	T_j(max.)
80 V	1 A	> 100	200 °C

- Hermetic packages
- ESCC qualified
- 100 krad

Description

The 2N3700HR is a bipolar transistor able to operate under severe environment conditions and radiation exposure providing high immunity to total ionizing dose (TID).

Qualified as per ESCC 5201/004 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 status link
2N3700HR

Product summary

Product summary			
Part-number	**ESCC specification**	**Package**	**Radiation level**
2N3700RUBx	5201/004	UB	100 krad
2N3700UBx		UB	-
SOC3700RHRx		LCC-3	100 krad
SOC3700HRx		LCC-3	-

Note: See Table 7 for ordering information.

1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter		Value	Unit
V_{CBO}	Collector-base voltage (I_E = 0)		140	V
V_{CEO}	Collector-emitter voltage (I_B = 0)		80	V
V_{EBO}	Emitter-base voltage (I_C = 0)		7	V
I_C	Collector current		1	A
P_{TOT}	Total dissipation at $T_{amb} \leq 25$ °C	LCC-3 and UB	0.5	W
		LCC-3 and UB(1)	0.76	
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
RthJA	Thermal resistance junction-ambient (max)	350	°C/W
		230(1)	

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

2 Electrical characteristics

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

Symbol	Parameter	Test conditions	Min.	Max.	Unit
I_{CBO}	Collector-base cut-off current (I_E = 0)	V_{CB} = 90 V		10	nA
		V_{CB} = 90 V, T_{amb} = 150 °C		10	µA
I_{EBO}	Emitter cut-off current (I_C = 0)	V_{EB} = 5 V		10	nA
$V_{(BR)CBO}$	Collector-base breakdown voltage (I_E = 0)	I_C = 100 µA	140		V
$V_{(BR)CEO}$ (1)	Collector-emitter breakdown voltage (I_B = 0)	I_C = 30 mA	80		V
$V_{(BR)EBO}$	Emitter-base breakdown voltage (I_C = 0)	I_E = 100 µA	7		V
$V_{CE(sat)}$ (1)	Collector-emitter saturation voltage	I_C = 150 mA, I_B = 15 mA		0.2	V
		I_C = 500 mA, I_B = 50 mA		0.5	
$V_{BE(sat)}$ (1)	Base-emitter saturation voltage	I_C = 150 mA, I_B = 15 mA		1.1	V
h_{FE} (1)	DC current gain	I_C = 10 mA, V_{CE} = 10 V	90		
		I_C = 150 mA, V_{CE} = 10 V	100	300	
		I_C = 500 mA, V_{CE} = 10 V	50		
		I_C = 150 mA, V_{CE} = 10 V, T_{amb} = -55 °C	40		
h_{fe}	Small signal current gain	I_C = 50 mA, f = 20 MHz, V_{CE} = 10 V	5		
C_{obo}	Output capacitance (I_E = 0)	f = 1 MHz, V_{CB} = 10 V		12	pF
C_{ibo}	Intput capacitance (I_C = 0)	f = 1 MHz, V_{EB} = 0.5 V		60	pF

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

2.1 Radiation assurance

Radiation test are guaranteed in compliance with ESCC 22900 and ESCC 5201/004 specifications.

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

- Standard dose rate window (typical at 0.1 rad / sec.)
- Test of 11 samples (5 biased at 80% of BVceo, 5 unbiased and 1 for reference)
- Acceptance criteria in compliance with the post radiation electrical characteristics as per Table 4.

Table 4. ESCC 5201/004 post radiation electrical characteristics (T_{amb} = 25 °C unless otherwise specified)

Symbol	Parameter	Test conditions	Min.	Max	Unit
I_{CBO}	Collector cut-off current (I_E = 0)	V_{CB} = 90 V		10	nA
I_{EBO}	Emitter cut-off current (I_C = 0)	V_{EB} = 5 V		10	nA
$V_{(BR)CBO}$	Collector-base breakdown voltage (I_E= 0)	I_C = 100 µA	140		V
$V_{(BR)CEO}$(1)	Collector-emitter breakdown voltage (I_B = 0)	I_C = 30 mA	80		V
$V_{(BR)EBO}$	Emitter-base breakdown voltage (I_C= 0)	I_E = 100 µA	7		V
$V_{CE(sat)}$(1)	Collector-emitter saturation voltage	I_C = 150 mA, I_B = 15 mA		0.2	V
		I_C = 500 mA, I_B = 50 mA		0.5	
$V_{BE(sat)}$(1)	Base-emitter saturation voltage	I_C = 150 mA, I_B = 15 mA		1.1	V
[h_{FE}](1)	Post irradiation gain calculation (2)	I_C = 10 mA, V_{CE} = 10 V	[45]		
		I_C = 150 mA, V_{CE} = 10 V	[50]	300	
		I_C= 500 mA, V_{CE}= 10 V	[25]		

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

2.2 Electrical characteristics (curves)

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

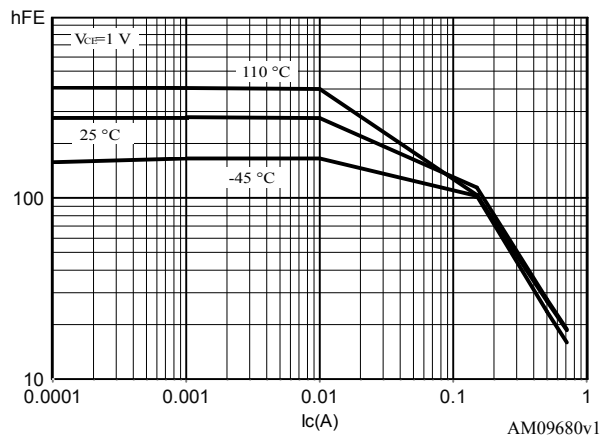


Figure 2. DC current gain (V_{CE} = 10 V)

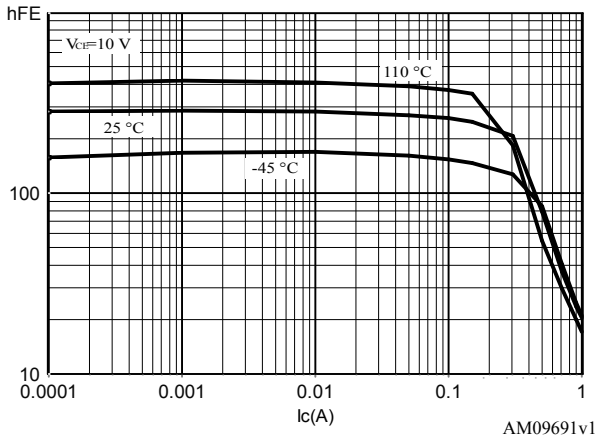


Figure 3. Collector emitter saturation voltage

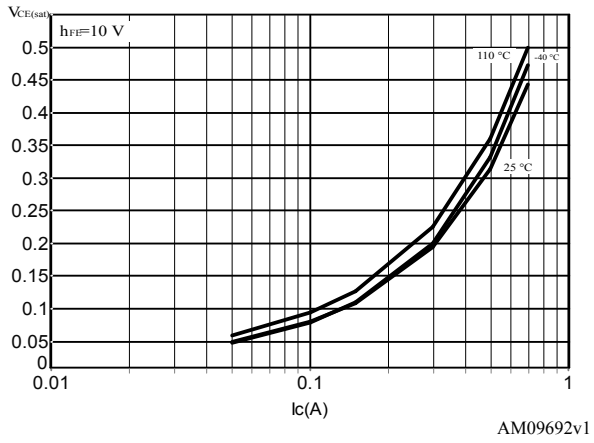
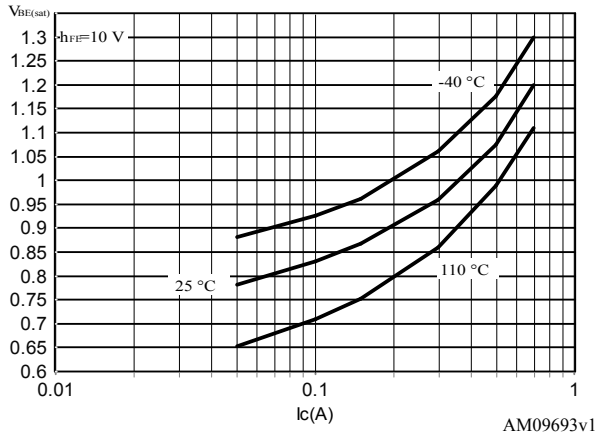
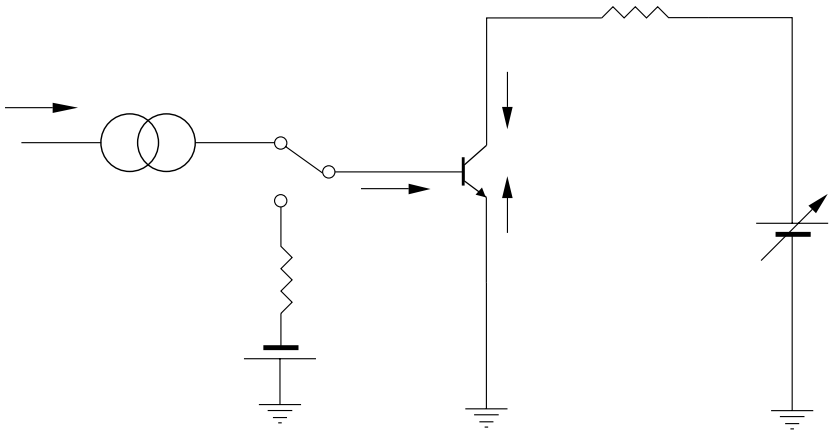


Figure 4. Base emitter saturation voltage (h_{FE} = 10)



2.3 Test circuits

Figure 5. **Resistive load switching test circuit**



Note: (1) Fast electronic switch

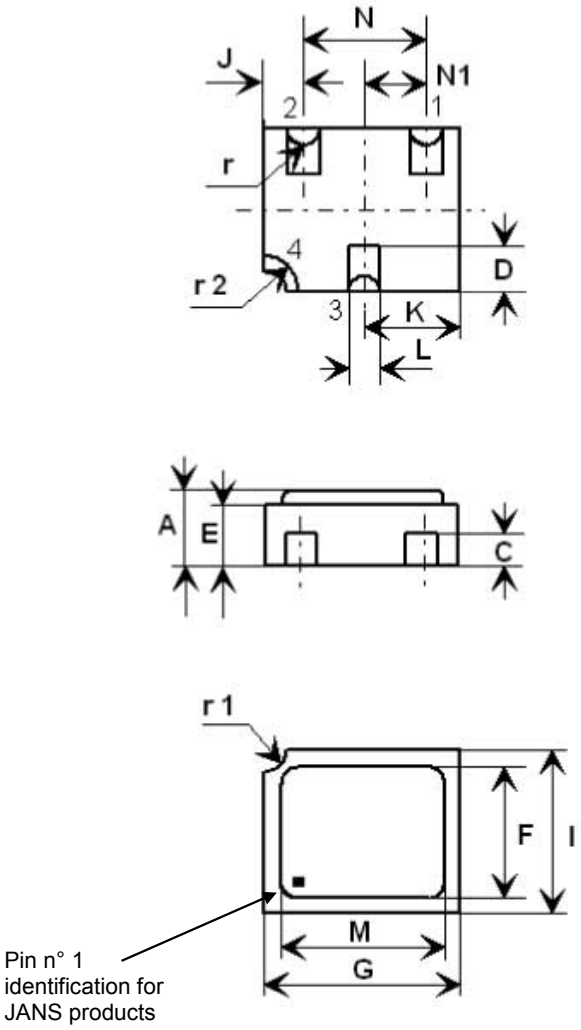
Note: (2) Non-inductive resistor

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. ECOPACK is an ST trademark.

3.1 UB package information

Figure 6. UB package outline



Pad 1: Emitter

Pad 2: Base

Pad 3: Collector

Pad 4: Shielding connected to the lid

8206487 rev.6

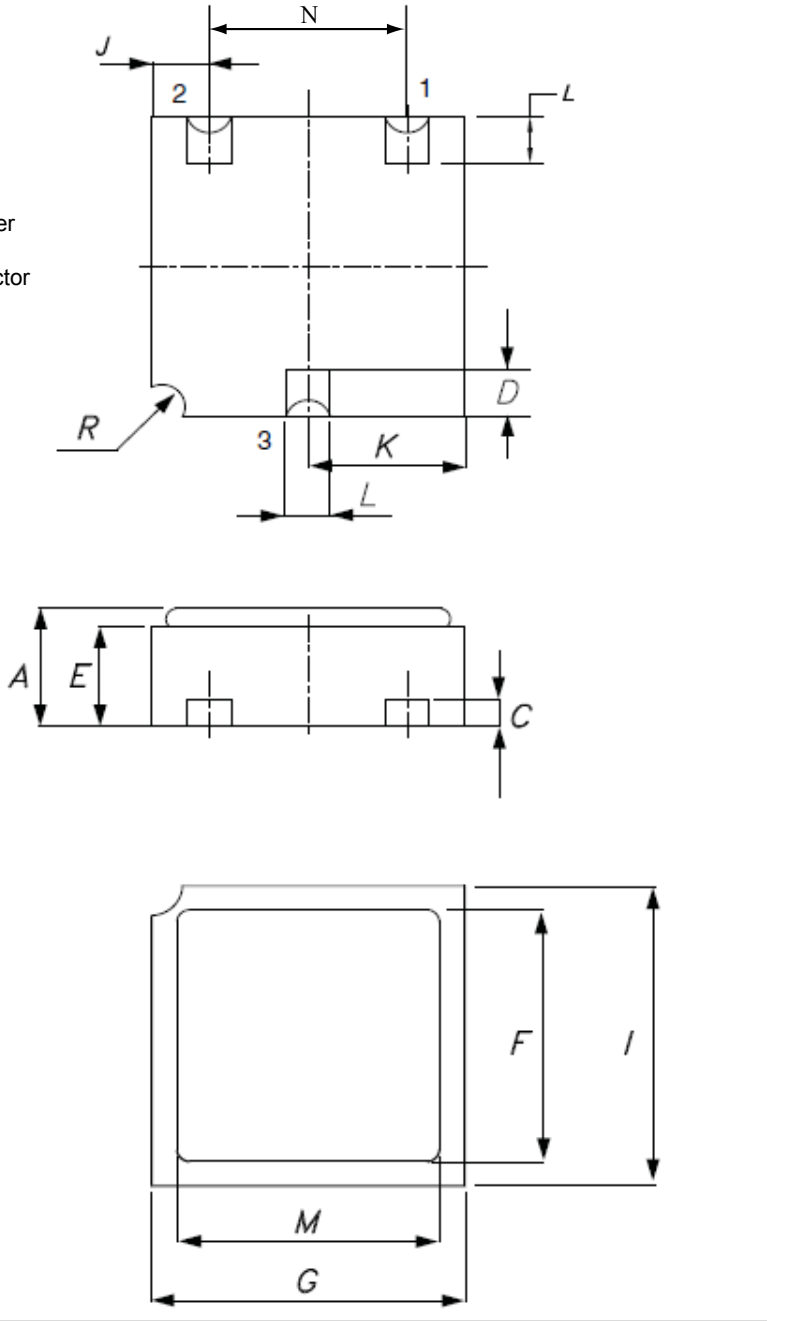
Table 5. **UB package mechanical data**

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 7. **LCC-3 package outline**

Pad 1: emitter
Pad 2: base
Pad 3: collector



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	ESCC specification	Screening option	Radiation level	Package	Mass	Lead finish	Marking[1]	Packing
2N3700UB1	-	Engineering model	-	UB	0.6 g	Gold	2N3700UB1	WafflePack
SOC37001	-		-	LCC-3			SOC37001	
2N3700RUBG	5201/004/06R	Flight model	100 krad	UB		Gold	520100406R	
2N3700RUBT	5201/004/07R					Solder Dip	520100407R	
2N3700UBG	5201/004/06		-			Gold	520100406	
2N3700UBT	5201/004/07		-			Solder Dip	520100407	
SOC3700RHRG	5201/004/04R		100 krad	LCC-3		Gold	520100404R	
SOC3700RHRT	5201/004/05R					Solder Dip	520100405R	
SOC3700RHRTW	5201/004/05R					Solder Dip	520100405R	Tape and reel
SOC3700HRG	5201/004/04		-			Gold	520100404	WafflePack
SOC3700HRT	5201/004/05		-			Solder Dip	520100405	
SOC3700HRTW	5201/004/05		-			Solder Dip	520100405	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.

5 Other information

5.1 Traceability information

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

Screening options	Radiation level	Documentation
Engineering model	-	Certificate of conformance
Flight model	-	Certificate of conformance ESCC qualification maintenance lot reference
	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
10-Jan-2008	1	Initial release.
07-Jan-2010	2	Modified Table 1: Device summary
26-Jul-2010	3	Modified Table 1: Device summary, added Table 10 on page 15
30-Nov-2011	4	– Modified: Table 6 on page 9 – Added: Section 2.3: Electrical characteristics (curves) – Minor text change in the document title on the coverpage
17-Apr-2013	5	Added: Section 3: Radiation hardness assurance
11-Jun-2013	6	Updated order codes in Table 1: Device summary and Table 12: Ordering information. Updated Section 3: Radiation hardness assurance. Minor text changes.
18-Sep-2013	7	Updated order codes in Table 1: Device summary and Table 12: Ordering information.
25-Mar-2014	8	Updated order codes in Table 1: Device summary and Table 12: Ordering information. Updated Section 3: Radiation hardness assurance.
29-May-2014	9	Updated Table 1: Device summary and Table 12: Ordering information.
29-Jul-2014	10	Updated Table 5: ESCC 5201/004 electrical characteristics.
20-Jul-2015	11	Updated Section 4: Package information. Minor text changes.
19-Aug-2015	12	Updated Section 4.3: TO-18 package information. Minor text changes.
29-Apr-2020	13	Removed TO-18 package information. Minor text changes.
03-Feb-2021	14	Updated Table 1, Table 4, Figure 7, Table 7 and Table 1. Removed Radiation summary table. Minor text changes.
03-Jan-2022	15	Updated features, description and product summary. Updated Table 1, Table 2, Table 7 and Table 9. Minor text changes.

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