



TRANSISTORS, LOW POWER, NPN

BASED ON TYPE 2N2857

ESCC Detail Specification No. 5201/014

Issue 4	October 2015
---------	--------------



LEGAL DISCLAIMER AND COPYRIGHT

European Space Agency, Copyright © 2015. All rights reserved.

The European Space Agency disclaims any liability or responsibility, to any person or entity, with respect to any loss or damage caused, or alleged to be caused, directly or indirectly by the use and application of this ESCC publication.

This publication, without the prior permission of the European Space Agency and provided that it is not used for a commercial purpose, may be:

- copied in whole, in any medium, without alteration or modification.
- copied in part, in any medium, provided that the ESCC document identification, comprising the ESCC symbol, document number and document issue, is removed.

DOCUMENTATION CHANGE NOTICE

(Refer to <https://escies.org> for ESCC DCR content)

DCR No.	CHANGE DESCRIPTION
946	Specification upissued to incorporate editorial changes per DCR.

TABLE OF CONTENTS

1	GENERAL	5
1.1	SCOPE	5
1.2	APPLICABLE DOCUMENTS	5
1.3	TERMS, DEFINITIONS, ABBREVIATIONS, SYMBOLS AND UNITS	5
1.4	THE ESCC COMPONENT NUMBER AND COMPONENT TYPE VARIANTS	5
1.4.1	The ESCC Component Number	5
1.4.2	Component Type Variants	5
1.5	MAXIMUM RATINGS	5
1.6	PHYSICAL DIMENSIONS AND TERMINAL IDENTIFICATION	6
1.7	FUNCTIONAL DIAGRAM	7
1.8	MATERIALS AND FINISHES	7
2	REQUIREMENTS	8
2.1	GENERAL	8
2.1.1	Deviations from the Generic Specification	8
2.2	MARKING	8
2.3	TERMINAL STRENGTH	8
2.4	ELECTRICAL MEASUREMENTS AT ROOM, HIGH AND LOW TEMPERATURES	8
2.4.1	Room Temperature Electrical Measurements	8
2.4.2	High and Low Temperatures Electrical Measurements	10
2.5	PARAMETER DRIFT VALUES	11
2.6	INTERMEDIATE AND END-POINT ELECTRICAL MEASUREMENTS	11
2.7	POWER BURN-IN CONDITIONS	11
2.8	OPERATING LIFE CONDITIONS	11

1 GENERAL

1.1 SCOPE

This specification details the ratings, physical and electrical characteristics and test and inspection data for the component type variants and/or the range of components specified below. It supplements the requirements of, and shall be read in conjunction with, the ESCC Generic Specification listed under Applicable Documents.

1.2 APPLICABLE DOCUMENTS

The following documents form part of this specification and shall be read in conjunction with it:

- (a) ESCC Generic Specification No. 5000
- (b) MIL-STD-750, Test Methods and Procedures for Semiconductor Devices

1.3 TERMS, DEFINITIONS, ABBREVIATIONS, SYMBOLS AND UNITS

For the purpose of this specification, the terms, definitions, abbreviations, symbols and units specified in ESCC Basic Specification No. 21300 shall apply.

1.4 THE ESCC COMPONENT NUMBER AND COMPONENT TYPE VARIANTS

1.4.1 The ESCC Component Number

The ESCC Component Number shall be constituted as follows:

Example: 520101401

- Detail Specification Reference: 5201014
- Component Type Variant Number: 01

1.4.2 Component Type Variants

The component type variants applicable to this specification are as follows:

Variant Number	Based on Type	Case	Lead/Terminal Material and Finish	Weight max g
01	2N2857	TO-72	D2	0.4

The lead/terminal material and finish shall be in accordance with the requirements of ESCC Basic Specification No. 23500.

1.5 MAXIMUM RATINGS

The maximum ratings shall not be exceeded at any time during use or storage.

Maximum ratings shall only be exceeded during testing to the extent specified in this specification and when stipulated in Test Methods and Procedures of the ESCC Generic Specification.

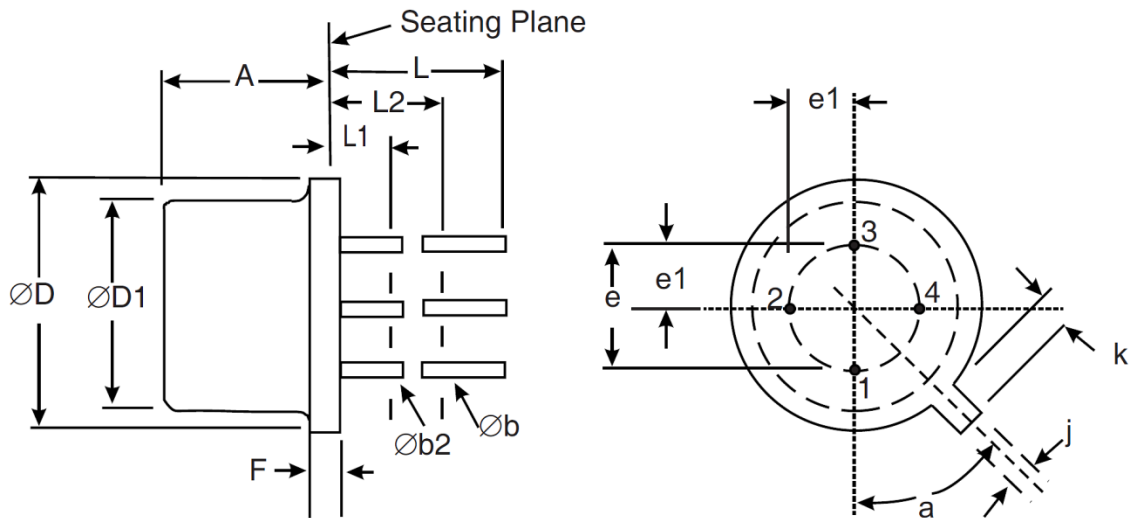
Characteristics	Symbols	Maximum Ratings	Unit	Remarks
Collector-Base Voltage	V_{CBO}	30	V	Over entire operating temperature range
Collector-Emitter Voltage	V_{CEO}	15	V	
Emitter-Base Voltage	V_{EBO}	2.5	V	
Collector Current	I_C	40	mA	Continuous
Power Dissipation	P_{tot1}	200	mW	At $T_{amb} \leq +25^{\circ}C$
	P_{tot2}	300	mW	At $T_{case} \leq +25^{\circ}C$
Thermal Resistance, Junction-to-Ambient	$R_{th(j-a)}$	750	$^{\circ}C/W$	
Thermal Resistance, Junction-to-Case	$R_{th(j-c)}$	500	$^{\circ}C/W$	
Operating Temperature Range	T_{op}	-55 to +175	$^{\circ}C$	
Storage Temperature Range	T_{stg}	-65 to +200	$^{\circ}C$	
Soldering Temperature	T_{sol}	+235	$^{\circ}C$	Note 1

NOTES:

- Duration 10 seconds maximum at a distance of not less than 1.5mm from the device body and the same lead shall not be resoldered until 3 minutes have elapsed.

1.6 **PHYSICAL DIMENSIONS AND TERMINAL IDENTIFICATION**

Metal Can Package (TO-72) - 4 Lead



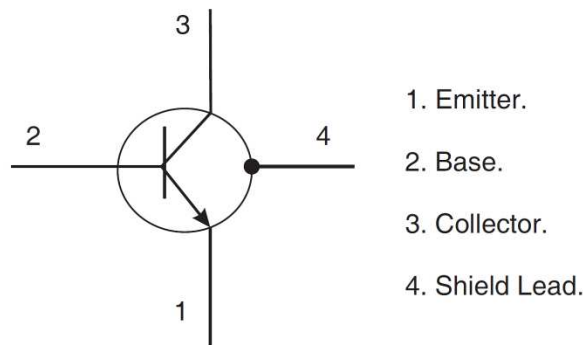
Symbols	Dimensions mm		Notes
	Min	Max	
A	4.32	5.33	
Øb	0.406	0.533	2, 3
Øb2	0.406	0.483	2, 3
ØD	5.31	5.84	

Symbols	Dimensions mm		Notes
	Min	Max	
ØD1	4.52	4.95	
e	2.54 BSC		5
e1	1.27 BSC		5
F	-	0.762	
j	0.914	1.17	
k	0.711	1.22	4
L	12.7	-	2, 3
L1	-	1.27	2, 3
L2	6.35	-	2, 3
a	45° BSC		5, 6

NOTES:

- Terminal identification is specified by reference to the tab position where lead 1 = emitter, lead 2 = base, lead 3 = collector and lead 4 = shield lead (connected to the case).
- Applies to all leads.
- Øb2 applies between L1 and L2. Øb applies between L2 and 12.7mm from the seating plane. Diameter is uncontrolled within L1 and beyond 12.7mm from the seating plane.
- Measured from the maximum diameter of the actual device.
- Leads having maximum diameter 0.483mm measured in the gauging plane 1.37 (+0.025, -0)mm below the seating plane of the device shall be within 0.178mm of their true position relative to a maximum-width-tab.
- Measured from the tab centreline.

1.7 FUNCTIONAL DIAGRAM



- Emitter.
- Base.
- Collector.
- Shield Lead.

NOTES:

- The shield lead is internally connected to the case.

1.8 MATERIALS AND FINISHES

Materials and finishes shall be as follows:

- Case
The case shall be hermetically sealed and have a metal body with hard glass seals.
- Leads/Terminals
As specified in Component Type Variants.

2 REQUIREMENTS

2.1 GENERAL

The complete requirements for procurement of the components specified herein are as stated in this specification and the ESCC Generic Specification. Permitted deviations from the Generic Specification, applicable to this specification only, are listed below.

Permitted deviations from the Generic Specification and this Detail Specification, formally agreed with specific Manufacturers on the basis that the alternative requirements are equivalent to the ESCC requirement and do not affect the component's reliability, are listed in the appendices attached to this specification.

2.1.1 Deviations from the Generic Specification

- (a) Deviation from Screening Tests - Chart F3
High Temperature Reverse Bias Burn-in and the subsequent Final Measurements for HTRB shall be omitted.

2.2 MARKING

The marking shall be in accordance with the requirements of ESCC Basic Specification No. 21700 and as follows.

The information to be marked on the component shall be:

- (a) The ESCC qualified components symbol (for ESCC qualified components only).
- (b) The ESCC Component Number.
- (c) Traceability information.

2.3 TERMINAL STRENGTH

The test conditions for terminal strength, tested as specified in the ESCC Generic Specification, shall be as follows:

Test Condition: E, lead fatigue.

2.4 ELECTRICAL MEASUREMENTS AT ROOM, HIGH AND LOW TEMPERATURES

Electrical measurements shall be performed at room, high and low temperatures.

2.4.1 Room Temperature Electrical Measurements

The measurements shall be performed at $T_{amb} = +22 \pm 3^{\circ}C$.

Characteristics	Symbols	MIL-STD-750 Test Method	Test Conditions	Limits		Units
				Min	Max	
Collector-Base Breakdown Voltage	$V_{(BR)CBO}$	3001	$I_C = 1\mu A$ Bias Condition D	30	-	V
Collector-Emitter Breakdown Voltage	$V_{(BR)CEO}$	3011	$I_C = 3mA$ Bias Condition D	15	-	V
Emitter-Base Breakdown Voltage	$V_{(BR)EBO}$	3026	$I_E = 10\mu A$ Bias Condition D	2.5	-	V

Characteristics	Symbols	MIL-STD-750 Test Method	Test Conditions	Limits		Units
				Min	Max	
Collector-Base Cut-off Current	I_{CBO}	3036	$V_{CB} = 15V$ Bias Condition D	-	10	nA
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	3071	$I_C = 10mA, I_B = 1mA$	-	400	mV
Base-Emitter Saturation Voltage	$V_{BE(sat)}$	3066	$I_C = 10mA, I_B = 1mA$ Condition A	-	1	V
Forward-Current Transfer Ratio	h_{FE}	3076	$V_{CE} = 1V, I_C = 3mA$	30	150	-
High Frequency Small-Signal Current Gain	h_{fe}	3306	$V_{CE} = 6V, I_C = 5mA$ $f = 100MHz$ Notes 1, 2	10	-	-
Input Capacitance	C_{ibo}	3240	$V_{EB} = 500mV, I_E = 0A$ $f = 1MHz$ Notes 1, 2	-	2	pF
Output Capacitance	C_{obo}	3236	$V_{CB} = 10V, I_E = 0A$ $f = 1MHz$ Note 1	-	1.7	pF
Noise Figure	NF	3246	$V_{CE} = 10V, I_C = 1.5mA$ $f = 450MHz, R_C = 50\Omega$ Note 1	-	5	dB
Small-Signal Power Gain	G_{pe}	-	$V_{CE} = 6V, I_C = 1.5mA$ $f = 450MHz$ Notes 1, 3	12.5	21	dB

NOTES:

1. For AC characteristics read and record measurements shall be performed on a sample of 32 components with 0 failures allowed. Alternatively a 100% inspection may be performed.
2. Shield lead connected to ground.
3. Small-signal power gain shall be measured using the circuit shown below. Each transistor shall be tuned for maximum power gain. The measuring circuit shall be decoupled from the transistor supply. To prevent damage to the transistor, the supply voltage shall be switched off before the transistor is inserted into the measuring jig.

Calibration Procedure

Input and output of the sweep generator are short-circuited by connecting A and B with the attenuator in position 10dB. The calibration voltage is adjusted to a calibration line of the sweep generator. Subsequently, A and B are connected to the measuring circuit and the total attenuation is adjusted to 10dB.

Transition Losses

After calibration of the sweep generator, a transistor is tuned for maximum power output in the circuit. Next, the transistor is replaced by a standard short and the input stub tuned to minimum attenuation.

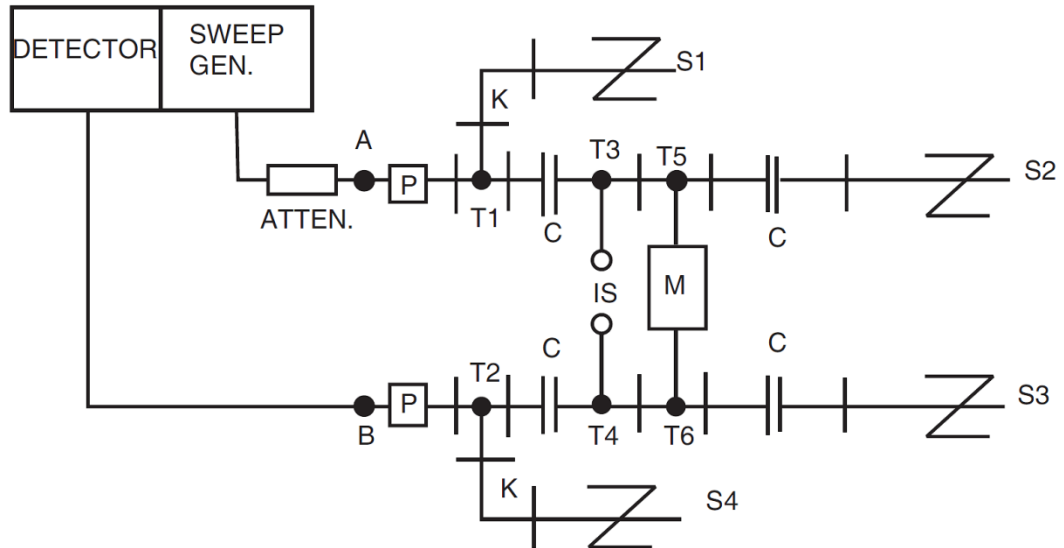
The loss in output impedance transition = total loss/2

The same procedure shall be repeated for input impedance transition.

The measurement values shall be corrected according to the losses in impedance.

Gain Measurement

After tuning for maximum output (gain), the small-signal power gain = measured gain + losses T1 and T2.



- C = Coupling capacitor
- K = Coaxial knee
- S1, S2, S3, S4 = Coaxial stub
- T1, T2, ...T6 = Coaxial "T"s
- P = 3dB pad
- IS = Bias insertion unit
- M = Transistor mounting

2.4.2 High and Low Temperatures Electrical Measurements

Characteristics	Symbols	MIL-STD-750 Test Method	Test Conditions Note 1	Limits		Units
				Min	Max	
Collector-Base Cut-off Current	I_{CBO}	3036	$T_{amb} = +150 (+0 -5)^{\circ}C$ $V_{CB} = 15V$ Bias Condition D	-	1	μA
Forward-Current Transfer Ratio	h_{FE}	3076	$T_{amb} = -55 (+5 -0)^{\circ}C$ $V_{CE} = 1V, I_C = 3mA$	10	-	-

NOTES:

1. Read and record measurements shall be performed on a sample of 5 components with 0 failures allowed. Alternatively a 100% inspection may be performed.

2.5 PARAMETER DRIFT VALUES

Unless otherwise specified, the measurements shall be performed at $T_{amb} = +22 \pm 3^{\circ}\text{C}$.

The test methods and test conditions shall be as per the corresponding test defined in Room Temperature Electrical Measurements.

The drift values (Δ) shall not be exceeded for each characteristic specified. The corresponding absolute limit values for each characteristic shall not be exceeded.

Characteristics	Symbols	Limits			Units
		Drift Value Δ	Absolute		
			Min	Max	
Collector-Base Cut-off Current	I_{CBO}	± 3	-	10	nA
Forward-Current Transfer Ratio	h_{FE}	$\pm 25\%$	30	150	-

2.6 INTERMEDIATE AND END-POINT ELECTRICAL MEASUREMENTS

Unless otherwise specified, the measurements shall be performed at $T_{amb} = +22 \pm 3^{\circ}\text{C}$.

The test methods and test conditions shall be as per the corresponding test defined in Room Temperature Electrical Measurements.

The limit values for each characteristic shall not be exceeded.

Characteristics	Symbols	Limits		Units
		Min	Max	
Collector-Base Cut-off Current	I_{CBO}	-	10	nA
Forward-Current Transfer Ratio 2	h_{FE2}	30	150	-

2.7 POWER BURN-IN CONDITIONS

Characteristics	Symbols	Test Conditions	Units
Ambient Temperature	T_{amb}	$+22 \pm 3$	$^{\circ}\text{C}$
Power Dissipation	P_{tot}	200	mW
Collector-Base Voltage	V_{CB}	12	V

2.8 OPERATING LIFE CONDITIONS

The conditions shall be as specified for Power Burn-in.