Pages 1 to 14

TRANSISTORS, LOW POWER, PNP

BASED ON TYPE 2N3962

ESCC Detail Specification No. 5202/015

Issue 2	September 2009

Document Custodian: European Space Agency - see https://escies.org

LEGAL DISCLAIMER AND COPYRIGHT

DOCUMENTATION CHANGE NOTICE

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

DCR No.	CHANGE DESCRIPTION
439, 455	Specification up issued to incorporate editorial and technical 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 6
1.6 Physical Dimensions and Terminal Identification 7
1.6.1 Metal Can Package (TO-18) - 3 lead 7
1.6.2 Chip Carrier Package (CCP) - 3 terminal 8
1.7 Functional Diagram 9
1.8 Materials and Finishes 9

2. **REQUIREMENTS** **9**

2.1 General 9
2.1.1 Deviations from the Generic Specification 9
2.2 Marking 10
2.3 Terminal Strength 10
2.4 Electrical Measurements at Room, High and Low Temperatures 10
2.4.1 Room Temperature Electrical Measurements 10
2.4.2 High and Low Temperatures Electrical Measurements 12
2.5 Parameter Drift Values 12
2.6 Intermediate and End-Point Electrical Measurements 13
2.7 High Temperature Reverse Bias Burn-in Conditions 13
2.8 Power Burn-in Conditions 14
2.9 Operating Life Conditions 14

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: 520201501

- Detail Specification Reference: 5202015
- Component Type Variant Number: 01 (as required)

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/or Finish	Weight max g
01	2N3962	TO-18	D2	0.4
02	2N3962	TO-18	D3 or D4	0.4
03	2N3962	TO-18	D7	0.4
04	2N3962	CCP	2	0.06
05	2N3962	CCP	4	0.06

The lead/terminal material and/or 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.

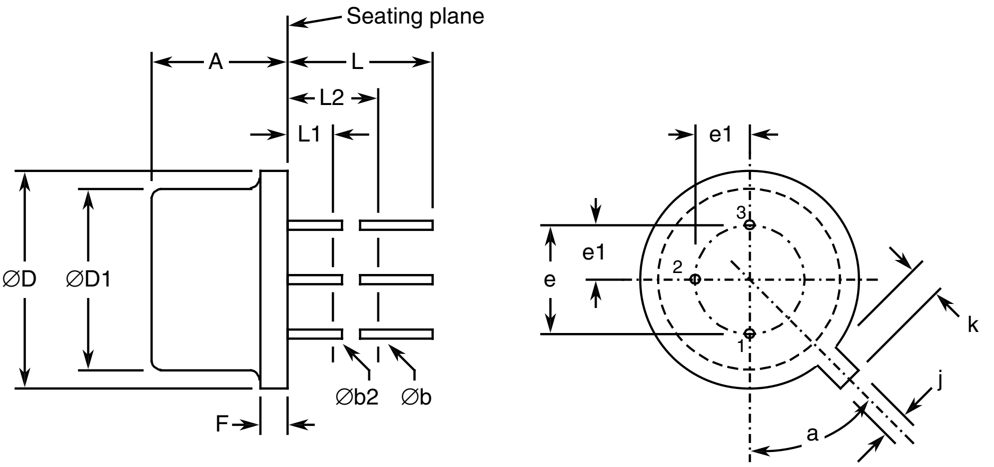
Characteristics	Symbols	Maximum Ratings	Unit	Remarks
Collector-Base Voltage	V_{CBO}	-60	V	Over entire operating temperature range
Collector-Emitter Voltage	V_{CEO}	-60	V	
Emitter-Base Voltage	V_{EBO}	-6	V	
Collector Current	I_C	-200	mA	Continuous
Power Dissipation For TO-18 and CCP	P_{tot1}	0.36	W	At $T_{amb} \leq +25^{o}C$ Note 1
For CCP	P_{tot2}	0.58 (Note 2)	W	
For TO-18	P_{tot3}	1.2	W	At $T_{case} \leq +25^{o}C$ Note 1
Operating Temperature Range	T_{op}	-65 to +200	^{o}C	Note 3
Storage Temperature Range	T_{stg}	-65 to +200	^{o}C	Note 3
Soldering Temperature	T_{sol}		^{o}C	
For TO-18		+260		Note 4
For CCP		+245		Note 5

NOTES:

1. For T_{amb} or $T_{case} > +25^{o}C$, derate linearly to 0W at $+200^{o}C$.
2. When mounted on an 8 x 10 x 0.6mm ceramic substrate.
3. For Variants with tin-lead plating or hot solder dip lead finish all testing, and any handling, performed at $T_{amb} > +125^{o}C$ shall be carried out in a 100% inert atmosphere.
4. 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.
5. Duration 5 seconds maximum and the same terminal shall not be resoldered until 3 minutes have elapsed.

1.6 PHYSICAL DIMENSIONS AND TERMINAL IDENTIFICATION

1.6.1 Metal Can Package (TO-18) - 3 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	
ØD1	4.52	4.95	
e	2.54 BSC		4
e1	1.27 BSC		4
F	-	0.762	
j	0.914	1.17	
k	0.711	1.22	5
L	12.7	-	2
L1	-	1.27	3
L2	6.35	-	3
a	45° BSC		1, 4, 6

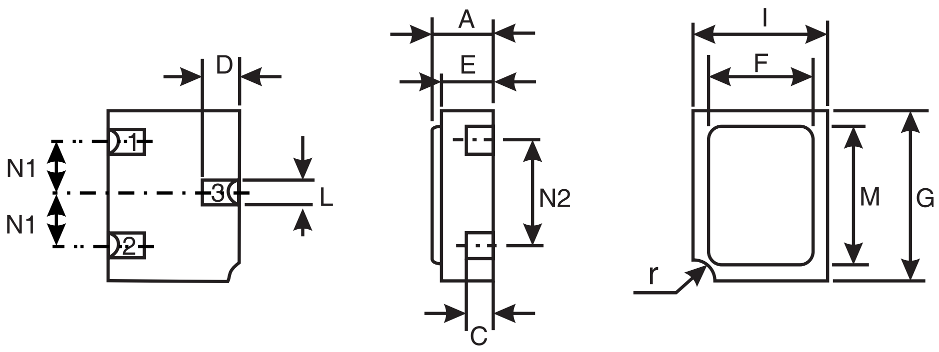
NOTES:

1. Terminal identification is specified by reference to the tab position where lead 1 = emitter, lead 2 = base, lead 3 = collector.
2. Applies to all leads.
3. 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.
4. 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.

5. Measured from the maximum diameter of the actual device.
6. Tab centreline.

1.6.2 Chip Carrier Package (CCP) - 3 terminal

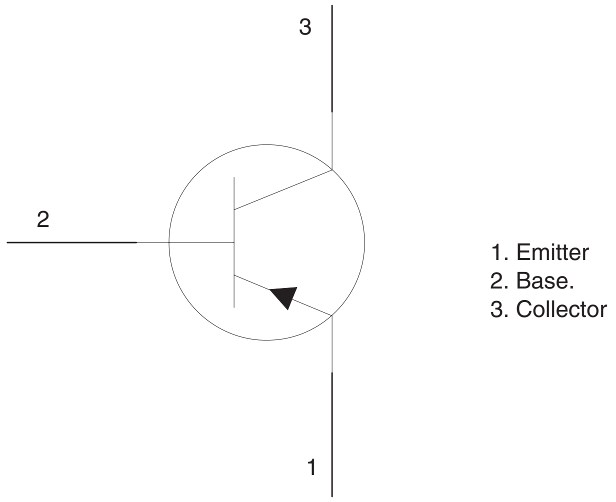


Symbols	Dimensions mm		Notes
	Min	Max	
A	1.15	1.5	
C	0.45	0.56	2
D	0.6	0.91	2
E	0.91	1.12	
F	1.9	2.15	
G	2.9	3.25	
I	2.4	2.85	
L	0.4	0.6	2
M	2.4	2.65	
N1	0.855	1.055	
N2	1.8	2	
r	0.3 TYPICAL		1

NOTES:

1. Terminal identification is specified by reference to the corner notch position where terminal 1 = emitter, terminal 2 = base, terminal 3 = collector.
2. Applies to all terminals.

1.7 FUNCTIONAL DIAGRAM



NOTES:

1. For TO-18, the collector is internally connected to the case.
2. For CCP, the lid is not connected to any terminal.

1.8 MATERIALS AND FINISHES

Materials and finishes shall be as follows:

a) Case

For the metal can package the case shall be hermetically sealed and have a metal body with hard glass seals.

For the chip carrier package the case shall be hermetically sealed and have a ceramic body with a Kovar lid.

b) 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

None.

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:

For TO-18, 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 $T_{amb}=+22 \pm 3^{o}C$.

Characteristics	Symbols	MIL-STD-750 Test Method	Test Conditions	Limits		Units
				Min	Max	
Collector-Emitter Breakdown Voltage	$V_{(BR)CEO}$	3011	I_C = -10mA Note 1 Bias condition D	-60	-	V
Collector-Base Breakdown Voltage	$V_{(BR)CBO}$	3001	I_C = -10µA Bias condition D	-60	-	V
Emitter-Base Breakdown Voltage	$V_{(BR)EBO}$	3026	I_E = -10µA Bias condition D	-6	-	V
Emitter-Base Cut-off Current	I_{EBO}	3061	V_{EB} = -4V Bias condition D	-	-10	nA
Collector-Emitter Cut-off Current	I_{CES}	3041	V_{CE} = -50V Bias condition D	-	-10	nA
Forward-Current Transfer Ratio	h_{FE1}	3076	V_{CE}=-5V ; I_C =-1µA	60	-	-
	h_{FE2}	3076	V_{CE}=-5V ; I_C =-10µA	100	300	-
	h_{FE3}	3076	V_{CE}=-5V ; I_C =-1mA Note 1	100	450	-
	h_{FE4}	3076	V_{CE}=-5V ; I_C =-50mA Note 1	90	-	-
Collector-Emitter Saturation Voltage	$V_{CE(sat)1}$	3071	I_C=-10mA I_B=-500nA Note 1	-	-250	mV
	$V_{CE(sat)2}$	3071	I_C=-50mA I_B=-5mA Note 1	-	-400	mV
Base-Emitter Saturation Voltage	$V_{BE(sat)1}$	3066	I_C=-10mA I_B=-500nA Test condition A Note 1	-	-900	mV
	$V_{BE(sat)2}$	3066	I_C=-50mA I_B=-5mA Test condition A Note 1	-	-950	mV
Small-Signal Current Gain	h_{fe1}	3206	V_{CE}=-5V, I_C=-1mA f=1kHz Note 2	100	550	-
	h_{fe2}	3206	V_{CE}=-5V, I_C=-500nA f=20MHz Note 2	2	8	-

Characteristics	Symbols	MIL-STD-750 Test Method	Test Conditions	Limits		Units
				Min	Max	
Output Capacitance	C_{obo}	3236	V_{CB}=-5V, I_E=0A f=1MHz Note 2	-	6	pF
Input Capacitance	C_{ibo}	3240	V_{EB}=-500mV I_C=0A f=1MHz Note 2	-	15	pF
Noise Figure	NF	3246	V_{CE}=-5V I_C=-20µA R_G=10kΩ f=10Hz to 10kHz Note 2	-	3	dB

NOTES:

1. Pulse measurement: Pulse Width ≤ 300µs, Duty Cycle ≤ 2%.
2. 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.

2.4.2 High and Low Temperatures Electrical Measurements

Characteristics	Symbols	MIL-STD-750 Test Method	Test Conditions Note 1	Limits		Units
				Min	Max	
Collector-Emitter Cut-off Current	I_{CES}	3041	T_{amb}=+150 (+0 -5)°C V_{CE}=-50V Bias condition D	-	-10	µA
Forward-Current Transfer Ratio 2	h_{FE2}	3076	T_{amb}=-55 (+5 -0)°C V_{CE}=-5V I_C=-10µA	40	-	-

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 ±3°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-Emitter Cut-off Current	I_{CES}	±2 or (1) ±100%	-	-10	nA
Forward-Current Transfer Ratio 2	h_{FE2}	±15%	100	300	-
Collector-Emitter Saturation Voltage 2	$V_{CE(sat)2}$	±30 or (1) ±15%	-	-400	mV

NOTES:

1. Whichever is the greater referred to initial value.

2.6 INTERMEDIATE AND END-POINT ELECTRICAL MEASUREMENTS

Unless otherwise specified, the measurements shall be performed at T_{amb}=+22 ±3°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-Emitter Cut-off Current	I_{CES}	-	-10	nA
Forward-Current Transfer Ratio 2	h_{FE2}	100	300	-
Collector-Emitter Saturation Voltage 2	$V_{CE(sat)2}$	-	-400	mV

2.7 HIGH TEMPERATURE REVERSE BIAS BURN-IN CONDITIONS

Characteristics	Symbols	Test Conditions	Units
Ambient Temperature	T_{amb}	+150 (+0 -5)	°C
Collector-Base Voltage	V_{CB}	48	V
Duration	t	48 minimum	Hours

2.8 POWER BURN-IN CONDITIONS

Characteristics	Symbols	Test Conditions	Units
Ambient Temperature	T_{amb}	+20 to +50	^oC
Power Dissipation	P_{tot}	As per Maximum Ratings P_{tot1} derated at the chosen T_{amb}	W
Collector-Base Voltage	V_{CB}	-40	V

2.9 OPERATING LIFE CONDITIONS

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