TRANSISTORS, LOW POWER RF, NPN

BASED ON TYPE 2N3019

ESCC Detail Specification No. 5201/011

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DOCUMENTATION CHANGE NOTICE

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DCR No.	CHANGE DESCRIPTION
757	Specification upissued to incorporate technical changes per DCR. Specification converted into MSWord. Changes in presentation are possible.

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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: 520101103R

- Detail Specification Reference: 5201011
- Component Type Variant Number: 03 (as required)
- Total Dose Radiation Level Letter: R (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 Finish	Weight max g	Total Dose Radiation Level Letter
03	2N3019	TO-39	D2	2	R [100kRAD(Si)]
04	2N3019	TO-39	D3 or D4	2	R [100kRAD(Si)]

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

Total dose radiation level letters are defined in ESCC Basic Specification No. 22900. If an alternative radiation test level is specified in the Purchase Order, the letter shall be changed accordingly.

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.

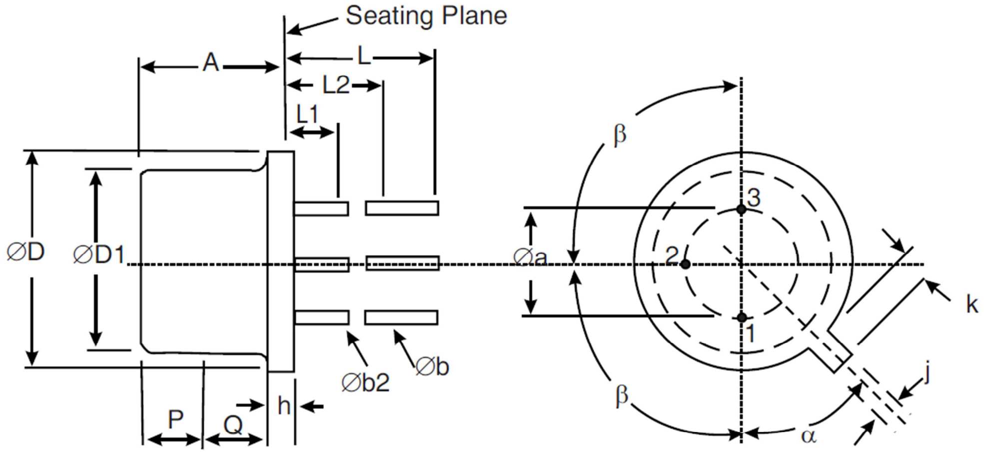
Characteristics	Symbols	Maximum Ratings	Unit	Remarks
Collector-Base Voltage	V_{CBO}	140	V	Over entire operating temperature range
Collector-Emitter Voltage	V_{CEO}	80	V	
Emitter-Base Voltage	V_{EBO}	7	V	
Collector Current	I_C	1	A	Continuous
Power Dissipation	P_{tot1}	0.8	W	At $T_{amb} \leq +25^{\circ}C$
	P_{tot2}	5	W	At $T_{case} \leq +25^{\circ}C$
Thermal Resistance, Junction-to-Ambient	$R_{th(j-a)}$	218.8	$^{\circ}C/W$	
Thermal Resistance, Junction-to-Case	$R_{th(j-c)}$	35	$^{\circ}C/W$	
Operating Temperature Range	T_{op}	-65 to +200	$^{\circ}C$	Note 1
Storage Temperature Range	T_{stg}	-65 to +200	$^{\circ}C$	Note 1
Soldering Temperature	T_{sol}	+260	$^{\circ}C$	Note 2

NOTES:

1. For Variants with tin-lead plating or hot solder dip lead finish all testing, and any handling, performed at $T_{amb} > +125^{\circ}C$ shall be carried out in a 100% inert atmosphere.
2. 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-39) - 3 LEAD

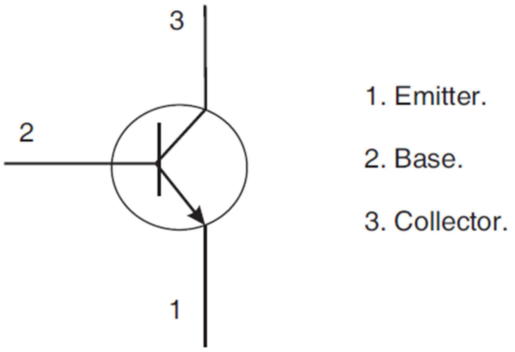


Symbols	Dimensions mm		Notes
	Min	Max	
Øa	4.83	5.35	
A	6	6.6	
Øb	0.4	0.533	2, 3
Øb2	0.4	0.483	2, 3
ØD	8.31	9.4	
ØD1	7.75	8.51	5
h	0.229	3.18	
j	0.71	0.864	
k	0.737	1.14	4
L	12.7	19	2
L1	-	1.27	2, 3
L2	6.35	-	2, 3
P	2.54	-	5
Q	-	-	6
α	45^o BSC		1, 7
β	90^o BSC		1

NOTES:

1. Terminal identification is specified by reference to the tab position where Lead 1 = emitter, Lead 2 = base, and 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. Measured from the maximum diameter of the actual device.
5. This zone is controlled for automatic handling. The variation in actual diameter within this zone shall not exceed 0.254mm.
6. The details of outline in this zone are optional.
7. Measured from the Tab Centreline

1.7 FUNCTIONAL DIAGRAM



NOTES:

1. The collector is internally connected to the case.

1.8 MATERIALS AND FINISHES

Materials and finishes shall be as follows:

(a) Case
The case shall be hermetically sealed and have a metal body with hard glass seals.
(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

2.1.1.1 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

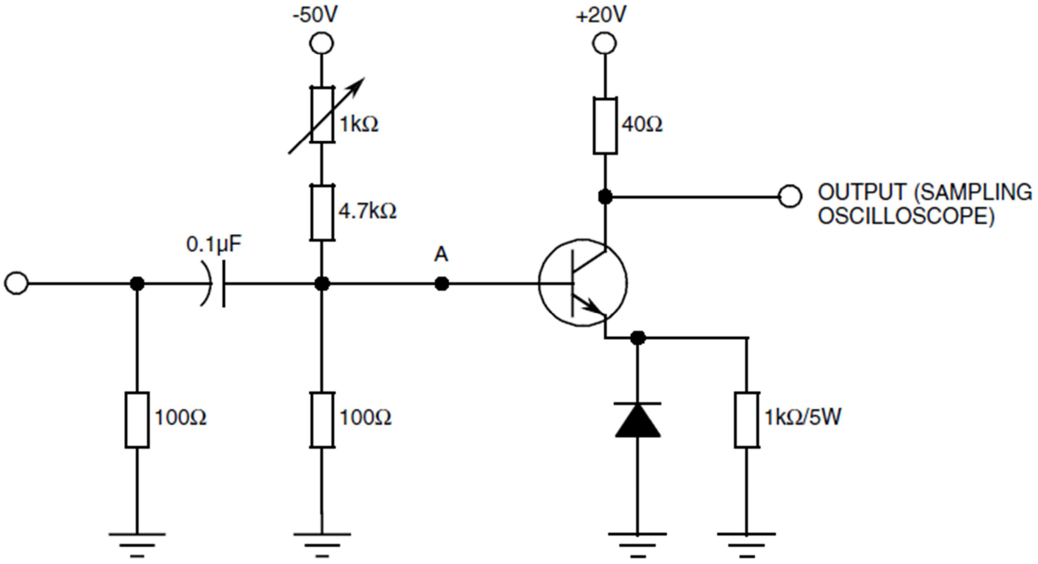
The measurements shall be performed at $T_{amb} = +22 \pm 3^{o}C$.

Characteristics	Symbols	MIL-STD-750 Test Method	Test Conditions	Limits		Units
				Min	Max	
Collector-Base Breakdown Voltage	$V_{(BR)CBO}$	3001	I_C = 100µA, Bias Condition D	140	-	V
Collector-Emitter Breakdown Voltage	$V_{(BR)CEO}$	3011	I_C = 30mA, Bias Condition D Note 1	80	-	V
Emitter-Base Breakdown Voltage	$V_{(BR)EBO}$	3026	I_E = 100µA, Bias Condition D	7	-	V
Collector-Emitter Cut-off Current	I_{CES}	3041	V_{CE} = 90V, Bias Condition C	-	10	nA
Emitter-Base Cut-off Current	I_{EBO}	3061	V_{EB} = 5V, Bias Condition D	-	10	nA
Collector-Emitter Saturation Voltage	$V_{CE(sat)1}$	3071	I_C = 150mA I_B = 15mA Note 1	-	200	mV
	$V_{CE(sat)2}$	3071	I_C = 500mA I_B = 50mA Note 1	-	500	mV
Base-Emitter Saturation Voltage	$V_{BE(sat)}$	3066	Test Condition A I_C = 150mA I_B = 15mA Note 1	-	1.1	V
Forward-Current Transfer Ratio	h_{FE1}	3076	V_{CE} = 10V ; I_C = 150mA Note 1	100	300	-
	h_{FE2}	3076	V_{CE} = 10V ; I_C = 100µA Note 1	50	200	-
	h_{FE3}	3076	V_{CE} = 10V ; I_C = 10mA Note 1	90	-	-
	h_{FE4}	3076	V_{CE} = 10V ; I_C = 500mA Note 1	50	200	-
	h_{FE5}	3076	V_{CE} = 10V ; I_C = 1A Note 1	15	-	-

Characteristics	Symbols	MIL-STD-750 Test Method	Test Conditions	Limits		Units
				Min	Max	
Magnitude of Small-Signal Short-Circuit Forward-Current Transfer Ratio	$\|h_{fe}\|$	3306	V_{CE} = 10V, I_C = 50mA f = 20MHz Note 2	5	20	-
Small Signal Short-Circuit Forward-Current Transfer Ratio	h_{fe}	3206	V_{CE} = 5V, I_C = 1mA f = 1kHz Note 2	80	400	-
Output Capacitance	C_{obo}	3236	V_{CB} = 10V, I_E = 0A f = 1MHz Note 2	-	12	pF
Input Capacitance	C_{ibo}	3240	V_{EB} = 500mV I_C = 0A f = 1MHz Note 2	-	60	pF
Noise Figure	NF	3246	V_{CE} = 10V, I_C = 100µA R_g = 1kΩ Power Bandwidth = 200kHz Note 2	-	4	dB
Collector-Base Time Constant	t_{CB}	-	V_{CB} = 10V, I_C = 10mA f = 79.8MHz Notes 2, 3	-	400	ps
Pulse Response	t_{on} , t_{off}	-	Notes 2, 4	-	30	ns

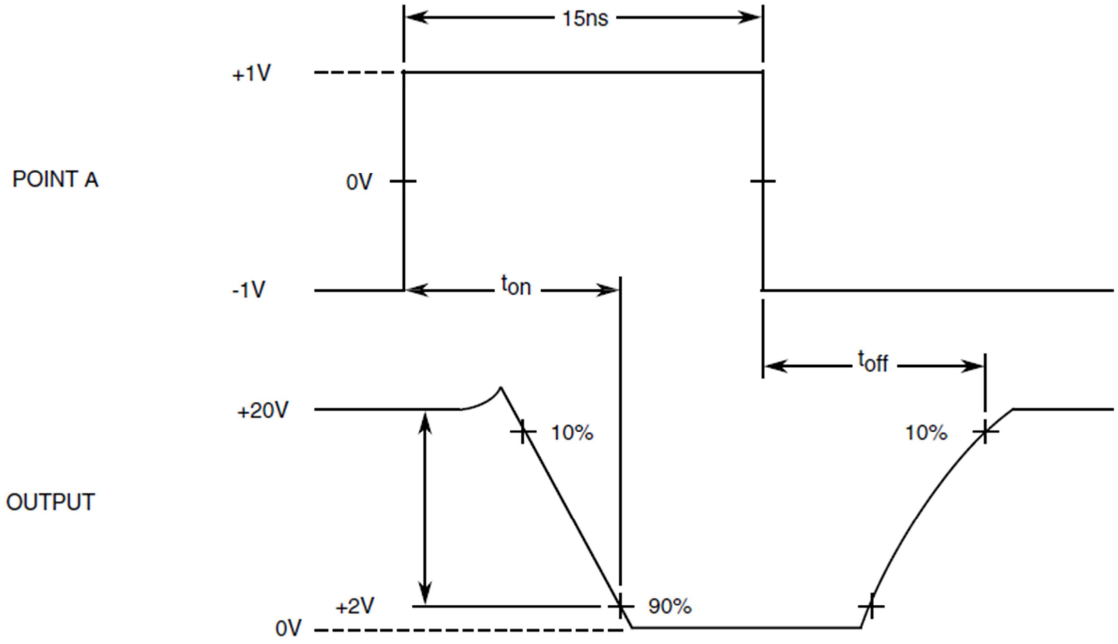
NOTES:

1. Pulse measurement: Pulse Width ≤ 300µs, Duty Cycle ≤ 1%
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.
3. This parameter is measured by applying an RF signal voltage of 1Vrms across the collector-base and measuring the ac voltage drop (V_{eb}) using a high impedance RF voltmeter across the emitter-base. The collector-base time constant is then calculated as follows:
   τ_{CB} (in ps) = 2 x V_{eb} (in mV)
4. Pulse response shall be measured using the following test circuit. The input waveform shall be supplied by a pulse generator with the following characteristics: Z_{OUT} = 50Ω, t_r ≤ 2ns, Duty Cycle ≤ 2%. The output waveform shall be monitored on an oscilloscope with the following characteristics : Z_{IN} ≥ 100kΩ, C_{IN} ≤ 12pF, t_r ≤ 5ns.



Diode is 1N3064 or equivalent.

VOLTAGE WAVEFORMS



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} = 90V, Bias Condition C	-	10	µA
Forward-Current Transfer Ratio 1	h_{FE1}	3076	T_{amb} = -55 (+5 -0)°C V_{CE} = 10V I_C = 150mA Note 2	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. Pulse measurement: Pulse Width ≤ 300µs, Duty Cycle ≤ 1%.

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}	±5 or (1) ±100%	-	10	nA
Forward-Current Transfer Ratio 1	h_{FE1}	±15%	100	300	-

NOTES:

1. Whichever is the greater referred to the 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 1	h_{FE1}	100	300	-
Collector-Emitter Saturation Voltage 2	$V_{CE(sat)2}$	-	800	mV

2.7 POWER BURN-IN CONDITIONS

Characteristics	Symbols	Conditions	Units
Ambient Temperature	T_{amb}	+25 (+0 -5)	^{o}C
Power Dissipation	P_{tot}	800	mW
Collector-Base Voltage	V_{CB}	60	V

2.8 OPERATING LIFE CONDITIONS

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

2.9 TOTAL DOSE RADIATION TESTING

All lots shall be irradiated in accordance with ESCC Basic Specification No. 22900, low dose rate (window 2: 36 to 360 RAD/h).

2.9.1 Bias Conditions and Total Dose Level for Total dose Radiation Testing

The following bias conditions shall be used for Total Dose Radiation Testing:

Characteristics	Symbols	Test Conditions	Units
Ambient Temperature	T_{amb}	+20 ± 5	^{o}C
Bias Condition 1: Collector-Emitter Voltage	V_{CES}	$\geq 75\% \ V_{(BR)CEO}$	V
Bias Condition 2: Collector-Emitter Voltage	V_{CES}	0	V

The total dose level applied shall be as specified in the component type variant information herein or in the Purchase Order.

2.9.2 Electrical Measurements for Radiation Testing

Prior to irradiation testing the devices shall have successfully met Room Temperature Electrical Measurements specified herein.

Unless otherwise stated the measurements shall be performed at T_{amb} = +22 ±3℃.

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

The parameters to be measured during and on completion of irradiation testing are shown below.

Characteristics	Symbols	MIL-STD-750 Test Method	Test Conditions	Limits		Units
				Min	Max	
Collector-Base Breakdown Voltage	$V_{(BR)CBO}$	See Room Temperature Electrical Measurements	See Room Temperature Electrical Measurements	140	-	V
Collector-Emitter Breakdown Voltage	$V_{(BR)CEO}$	See Room Temperature Electrical Measurements	See Room Temperature Electrical Measurements	80	-	V
Emitter-Base Breakdown Voltage	$V_{(BR)EBO}$	See Room Temperature Electrical Measurements	See Room Temperature Electrical Measurements	7	-	V
Collector-Emitter Cut-off Current	I_{CES}	See Room Temperature Electrical Measurements	See Room Temperature Electrical Measurements	-	10	nA
Emitter-Base Cut-off Current	I_{EBO}	See Room Temperature Electrical Measurements	See Room Temperature Electrical Measurements	-	10	nA
Collector-Emitter Saturation Voltage	$V_{CE(sat)1}$	See Room Temperature Electrical Measurements	See Room Temperature Electrical Measurements	-	200	mV
	$V_{CE(sat)2}$			-	500	mV
Base-Emitter Saturation Voltage	$V_{BE(sat)}$	See Room Temperature Electrical Measurements	See Room Temperature Electrical Measurements	-	1.1	V
Forward-Current Transfer Ratio (post irradiation gain calculation) (Note 1)	$[h_{FE1}]$	3076	$V_{CE} = 10V$, $I_C = 150mA$	[50]	300	-
	$[h_{FE2}]$		$V_{CE} = 10V$, $I_C = 100\mu A$	[25]	200	-
	$[h_{FE3}]$		$V_{CE} = 10V$, $I_C = 10mA$	[45]	-	-
	$[h_{FE4}]$		$V_{CE} = 10V$, $I_C = 500mA$	[25]	200	-
	$[h_{FE5}]$		$V_{CE} = 10V$, $I_C = 1A$	[7.5]	-	-

NOTES:

1. 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 MIL-STD-750 Method 1019.

APPENDIX 'A'

AGREED DEVIATIONS FOR STMICROELECTRONICS (F)

ITEMS AFFECTED	DESCRIPTION OF DEVIATIONS
Deviations from Room Temperature Electrical Measurements	All AC characteristics (Room Temperature Electrical Measurement Note 2) may be considered guaranteed but not tested if successful pilot lot testing has been performed on the wafer lot which includes AC characteristic measurements per the Detail Specification. A summary of the pilot lot testing shall be provided if required by the Purchase Order.
Deviations from High and Low Temperatures Electrical Measurements	All characteristics specified may be considered guaranteed but not tested if successful pilot lot testing has been performed on the wafer lot which includes characteristic measurements at high and low temperatures per the Detail Specification. A summary of the pilot lot testing shall be provided if required by the Purchase Order.
Deviations from Screening Tests - Chart F3	Solderability is not applicable unless specifically stipulated in the Purchase Order.