DOCUMENT CHANGE REQUEST

DCR number 275	Changes required for: General	Originator: Ron Fidler
Date: 2006/08/08	Date sent: 2006/08/08	Organisation: ESA/ESTEC
Status: IMPLEMENTED		

Title:	Transistors High Power PNP, based on type 2N5153		
Number:	5204/002	Issue:	2

Other documents affected:

Page:

Total re-write

Paragraph:

Total re-write

Original wording:

Proposed wording:

Total reformat of this Detail Specification as part of the ongoing conversion to the ESCC format.
See below for summary of changes and attached Issue 3 Draft A of the specification.

Note:
Known support for active procurement against this specification includes the following Manufacturer:
STM/F (Variants 01, 02, 04 and 05 are QPL listed)

Summary of changes to the current format, layout and content is as follows:

1. Rewording and restructure of various sections and paragraphs of the specification plus other editorial changes based on the layout and editorial content of other Detail Specifications already converted to ESCC format.

2. Deletion of any redundant paragraphs and information, e.g. Test circuits and mechanical paragraph.

3. Para 1.7 - High Temperature Test Precautions requirements moved to be a note to the Maximum Ratings table.

4. Deletion of Variant 03 from the available range (not supported by STM).

5. Figure 1(a) Parameter Derating Requirements - moved to be a note to the Maximum Ratings table.

6. Figure 1(b) Safe Operating Area . also moved to be a note to the Maximum Ratings table. VCE voltages amended to use negative convention for PNP transistor.

7. New paragraph for Beryllium Oxide handling precautions added for type variants with the TO-257 package.

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8. Figure 2(a) - Dimensions .a. and .b. corrected from "NOMINAL" to "BSC". The drawing harmonised with TO-39 outlines for similar STM components.

9. Figure 2(b) - Dimension .I. corrected to .fI. and .M. to .fM..

10. Figure 2(c) . Dimension .e. corrected .Typical. to .BSC.

11. Figure 3 . Note added stating that the lid is not connected to any terminal for SMD.5 pack

12. Para 4.3.2 - Weight requirements moved to Component Type Variants table.

13. Para 4.4.1 - Case requirements amended to delete sealing methods.

14. Para 4.5.3 - Requirement for marking of the testing level letter from the ESCC Component Number deleted as per latest ESCC No. 21700.

15. Table 2 . V(BR)CEO, ICES, ICEO, IEBO1 and IEBO2 test conditions zero current or voltage conditions deleted. These are covered by the bias conditions added to each test.

16. Table 2 . .Test condition A. added to both VBE(SAT) tests.

17. Table 2 . Test definition for hfe corrected.

18. Table 2 and Figure 4 - For ton and toff tests a new Note 4 added which fully defines the tests based upon the test circuits and conditions used by STM and MIL specification, showing the test circuit and the corrected waveforms.

19. Table 2 - The LTPD7 sample for AC parameters tests (designated by "Note 2") replaced by an equivalent fixed sample of 32 components with 0 failures (or 100%).

20. Table 3 (High & Low Temp Electricals) - 100% inspection changed to a sample of 5 components with 0 failures (or 100%) (In line with new generic 5000 Issue 2). New Note 1 added to cover this. Tolerances added to the test temperatures. Test conditions changed per Table 2 amendments.

21. Table 4 - Absolute limits from Table 2 have been added for information.

22. New Appendix A for STMICROELECTRONICS (F) - added.
Note - STM is an ESCC QPL listed manufacturer and this device is ESCC qualified; accordingly there is an ESCC approved PID for this device. These amendments are considered technically acceptable on this basis. DCR 154 also covers these changes and has been approved.

Justification:

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Justification (see also change details for each item above):

1. Part of the ongoing activity of conversion of cover-sheeted ESA/SCC specifications to the ESCC format.

2. To make the format and presentation consistent with the various other ESCC Detail Specifications already converted to ESCC format (e.g. 54HCMOS and CMOS 4000B series of ESCC IC specifications).

3. To make the content consistent with the proposed ESCC format Generic Specification No.5000 issue 2

4. To incorporate specific deviations requested by manufacturer STM within appendix A which are considered technically acceptable (based on the ESCC approved PID for this and other ESCC qualified components manufactured by STM).

5. Update manufacturers' current products availability.

6. To make corrections to several technical errors in the previous issue.

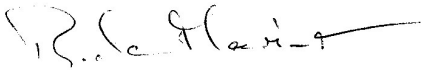
Attachments:

5204002.pdf, null

Modifications:

Variant 03 not to be deleted

Approval signature:



Date signed:

2006-08-08

TRANSISTORS, HIGH POWER, PNP

BASED ON TYPE 2N5153

ESCC Detail Specification No. 5204/002

Issue 3 - Draft A	July 2006

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

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DOCUMENTATION CHANGE NOTICE

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

DCR No.	CHANGE DESCRIPTION
187, TBD	Specification up issued to incorporate editorial and technical changes per DCRs.

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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: 520400201

- Detail Specification Reference: 5204002
- 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 Finish	Weight max g
01	2N5153	TO-39	D2	1.5
02	2N5153	TO-39	D3 or D4	1.5
04	2N5153	TO-257	H2	5
05	2N5153	TO-257	H4	5
06	2N5153	SMD.5	Q14	2

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}	-100	V	Over T_{op}
Collector-Emitter Voltage	V_{CEO}	-80	V	Over T_{op} Note 5
Emitter-Base Voltage	V_{EBO}	-5.5	V	Over T_{op}
Collector Current	I_C	-5	A	Continuous Note 5
Power Dissipation For TO-39 For TO-257 and SMD.5	P_{tot1}	 1 3.3	W	At $T_{amb} \leq +25^oC$ Note 1
For TO-39 For TO-257 and SMD.5	P_{tot2}	10 35	W	At $T_{case} \leq +25^oC$ Note 1
Operating Temperature Range	T_{op}	-65 to +200	^oC	Note 2
Storage Temperature Range	T_{stg}	-65 to + 200	^oC	Note 2
Soldering Temperature For TO-39 and TO-257 For SMD.5	T_{sol}	 +260 +245	^oC	 Note 3 Note 4
Thermal Resistance, Junction to Case For TO-39 For TO-257 and SMD.5	$R_{th(j-c)}$	 17.5 5	$^oC/W$	

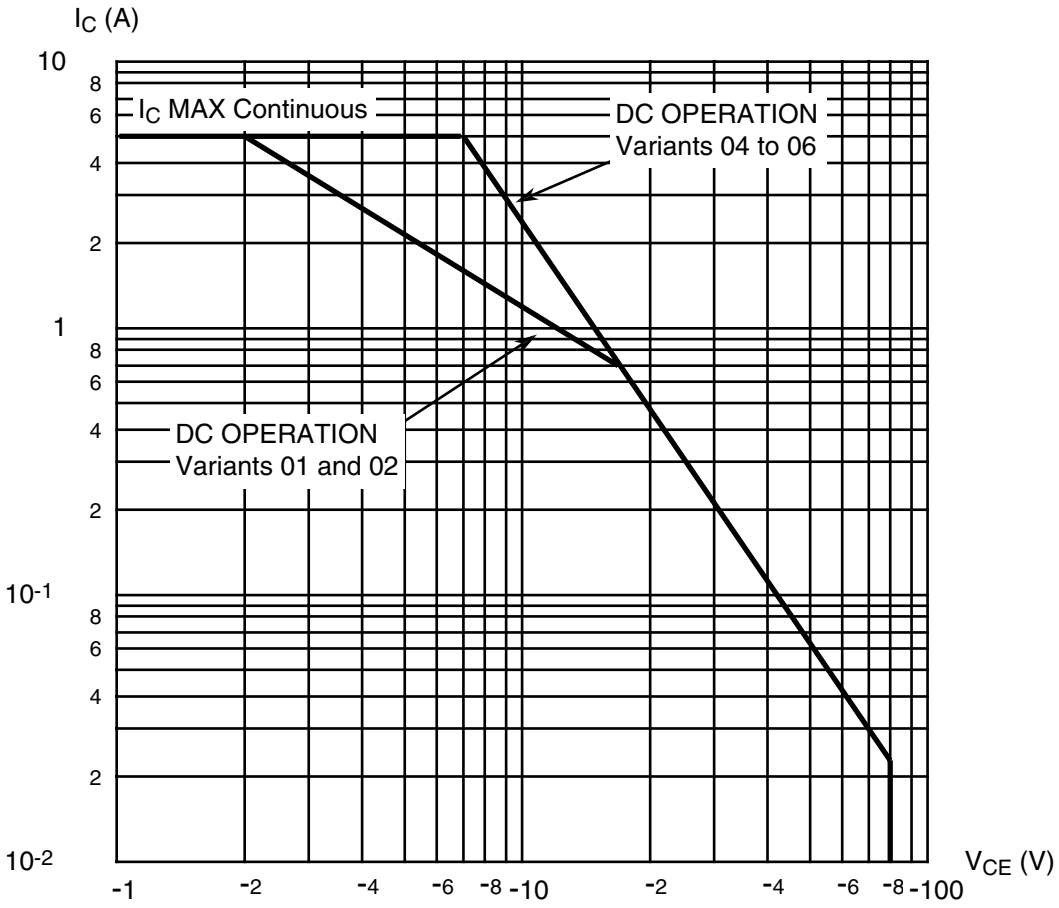
NOTES:

1. For T_{amb} or $T_{case} > +25^oC$, derate linearly to 0W at $+200^oC$.
2. For Variants with tin-lead plating or hot solder dip lead finish all testing performed at $T_{amb} > +125^oC$ shall be carried out in a 100% inert atmosphere.
3. 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.
4. Duration 5 seconds maximum and the same package shall not be resoldered until 3 minutes have

elapsed.

5. Safe Operating Area applies as follows:

Maximum Safe Operating Area Graph

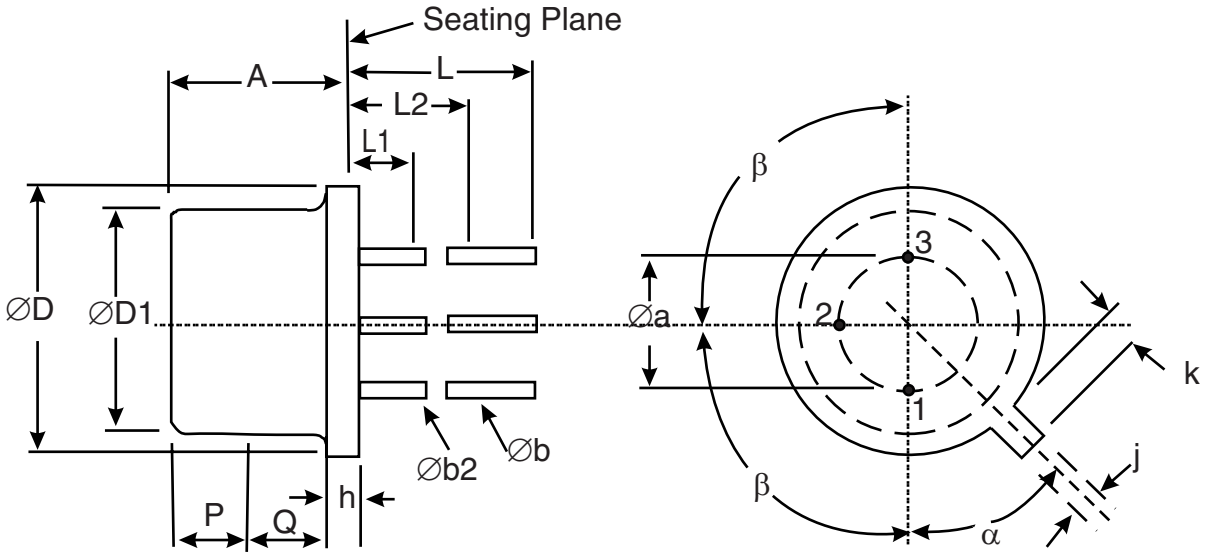


1.6 HANDLING PRECAUTIONS

The TO-257 package contains Beryllium Oxide (BeO) and therefore it must not be ground, machined, sandblasted or subjected to any mechanical operation which will produce dust. The case must not be subjected to any chemical process (e.g. etching) which will produce fumes.

1.7 PHYSICAL DIMENSIONS AND TERMINAL IDENTIFICATION

1.7.1 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	
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° BSC		1, 7
β	90° BSC		1

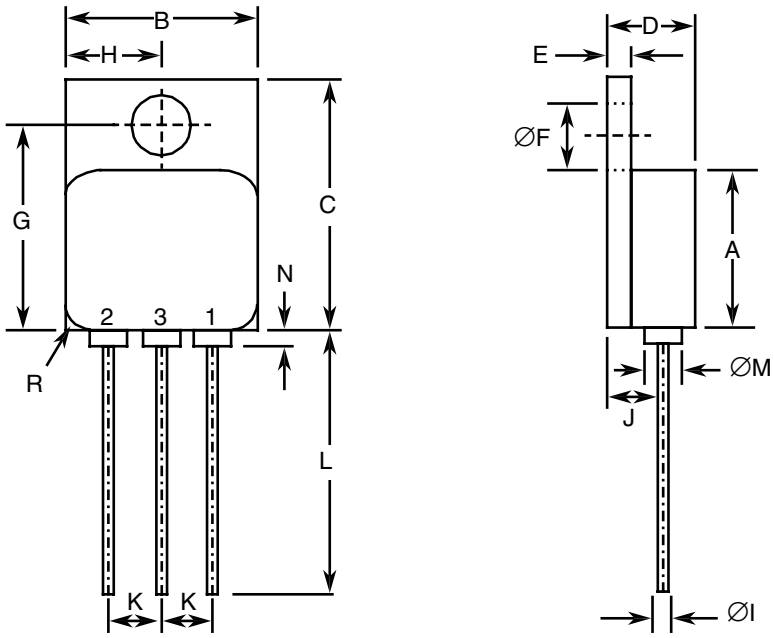
NOTES:

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 L1 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.

1.7.2 Metal Flange Mount Package (TO-257) - 3 lead

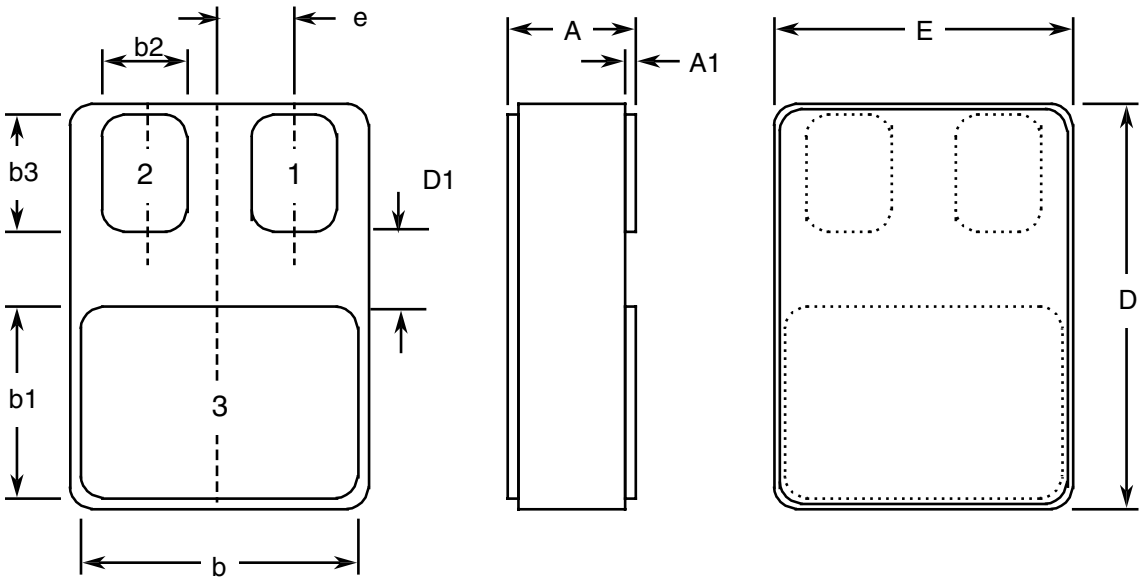


Symbols	Dimensions mm		Notes
	Min	Max	
A	10.41	10.67	
B	10.41	10.67	
C	16.51	16.76	
D	4.7	5.33	
E	0.89	1.14	
ØF	3.56	3.81	
G	13.39	13.64	
H	5.13	5.38	
ØI	0.64	0.89	2
J	2.92	3.18	
K	2.41	2.67	
L	15.24	16.51	
ØM	2.29 Typical		2
N	-	0.71	2

Symbols	Dimensions mm		Notes
	Min	Max	
R	1.65 Typical		3

NOTES:
1. Terminal identification is specified by the components geometry where Lead 1 = emitter, Lead 2 = base and Lead 3 = collector.
2. Applies to all leads.
3. Radius of body corner, 4 places.

1.7.3 Surface Mount Package (SMD.5) - 3 terminal



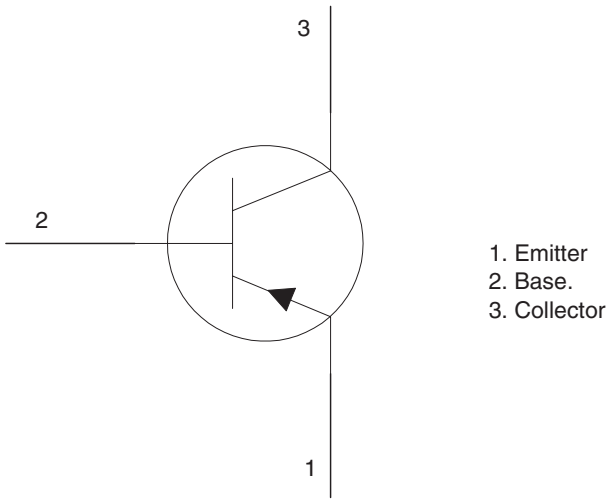
Symbols	Dimensions mm		Notes
	Min	Max	
A	2.84	3.15	
A1	0.25	0.51	
b	7.13	7.39	
b1	5.58	5.84	
b2	2.28	2.54	2
b3	2.92	3.18	2
D	10.03	10.28	
D1	0.76	-	2
E	7.39	7.64	
e	1.91 BSC		2

NOTES:
1. Terminal identification is specified by the components geometry where Terminal 1 = emitter,

Terminal 2 = base and Terminal 3 = collector.

2. 2 places.

1.8 FUNCTIONAL DIAGRAM



NOTES:

1. For TO-39, the collector is internally connected to the case.
2. For TO-257, the case is not connected to any lead.
3. For SMD.5, the lid is not connected to any terminal.

1.9 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 metal flange mount package the case shall be hermetically sealed and have a metal body. The leads pass through ceramic eyelets brazed into the frame and the lid shall be welded.

For the surface mount 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

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.

2.1.1.2 Deviation from Qualification and Periodic Tests - Chart F4

For SMD.5, Terminal Strength is not applicable.

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.
(d) Warning sign for Beryllium Oxide (TO-257 only)

2.3 TERMINAL STRENGTH

The test conditions for terminal strength, tested as specified in the ESCC Generic Specification, shall be as follows:
For TO-39, Test Condition: E, lead fatigue.
For TO-257, Test Condition: A, tension, with an applied force of 10N for a duration of 10s.

2.4 VERIFICATION OF SAFE OPERATING AREA

The Safe Operating Area shall be verified as specified in the ESCC Generic Specification and Maximum Ratings herein. The test conditions shall be:
Test Method = MIL-STD-750, Method 3051, Continuous DC
T_{case} = +25°C
V_{CE} = -18V
I_C = -500mA
Operating Time ≤ 50ms

2.5 ELECTRICAL MEASUREMENTS AT ROOM, HIGH AND LOW TEMPERATURES

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

2.5.1 Room Temperature Electrical Measurements

The measurements shall be performed at T_{amb}=+22 ±3°C.

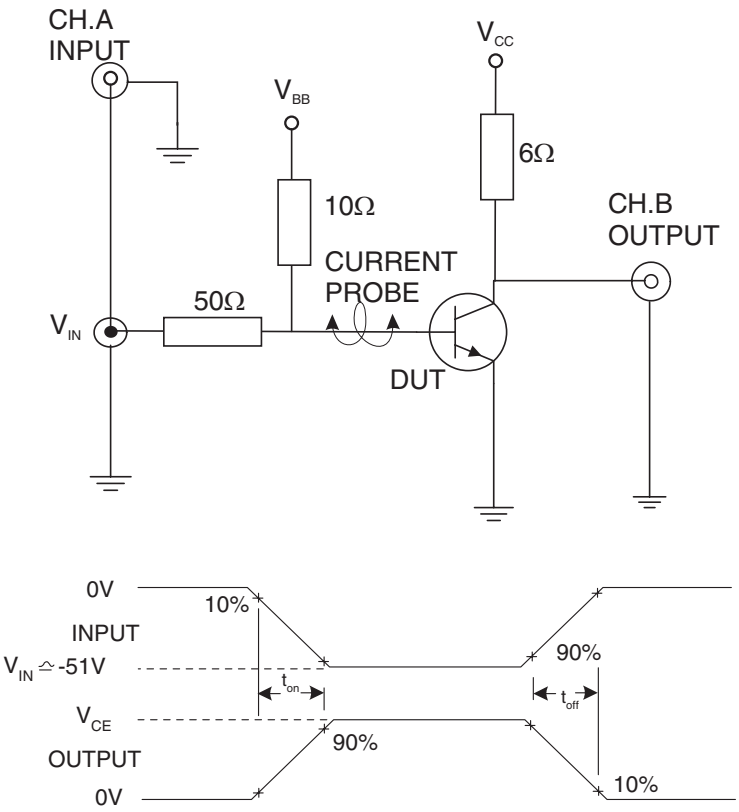
Characteristics	Symbols	MIL-STD-750 Test Method	Test Conditions	Limits		Units
				Min	Max	
Collector-Emitter Breakdown Voltage	$V_{(BR)CEO}$	3011	I_C =-100mA Bias condition D Note 1	-80	-	V

Characteristics	Symbols	MIL-STD-750 Test Method	Test Conditions	Limits		Units
				Min	Max	
Collector-Emitter Cut-off Current	I_{CES}	3041	V_{CE} = -60V Bias condition C	-	-1	µA
	I_{CEO}	3041	V_{CE} = -40V Bias condition D	-	-50	µA
Emitter-Base Cut-off Current	I_{EBO1}	3061	V_{EB}=-4V Bias condition D	-	-1	µA
	I_{EBO2}	3061	V_{EB} =-5.5V Bias condition D	-	-1	mA
Forward-Current Transfer Ratio	h_{FE1}	3076	V_{CE}=-5V ; I_C = -50mA, Note 1	50	-	-
	h_{FE2}	3076	V_{CE}=-5V ; I_C = -2.5A. Note 1	70	200	-
	h_{FE3}	3076	V_{CE}=-5V ; I_C =-5A, Note 1	40	-	-
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	3071	I_C=-5A I_B=-500mA Note 1, 2	-	-1.5	V
Base-Emitter Saturation Voltage	$V_{BE(sat)1}$	3066	I_C=-2.5A I_B=-250mA Test condition A Note 1, 2	-	-1.45	V
	$V_{BE(sat)2}$	3066	I_C=-5A I_B=-500mA Test condition A Note 1, 2	-	-2.2	V
High Frequency Small Signal Current Gain	h_{fe}	3306	V_{CE}=-5V, I_C=-500mA f=20MHz Note 3	3.5	-	-
Output Capacitance	C_{obo}	3236	V_{CB}=-10V, I_E=0A f=1MHz Note 3	-	250	pF
Turn-on Time	t_{on}	-	I_C=-5A, I_{B1}=-500mA I_{B2}=500mA V_{CC}=-30V V_{BB}=4V V_{IN}≈-51V Notes 3, 4	-	500	ns

Characteristics	Symbols	MIL-STD-750 Test Method	Test Conditions	Limits		Units
				Min	Max	
Turn-off Time	t_{off}	-	I_C=-5A, I_{B1}=-500mA I_{B2}=500mA V_{CC}=-30V V_{BB}=4V V_{IN}≈-51V Notes 3, 4	-	1.3	µs

NOTES:

1. Pulse measurement: Pulse Width ≤ 300µs, Duty Cycle ≤ 2%
2. For TO-39, saturation voltages are measured 6mm from header.
3. 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.
4. t_{on} and t_{off} shall be measured using the following test circuit. The input waveform shall be supplied by a pulse generator with the following characteristics: t_r ≤ 20ns, Pulse Width = 10µs, Duty Cycle = 1%. The sampling oscilloscope for CH.A and CH.B shall have the characteristics Z_{IN} ≥ 100kΩ, C_{IN} ≤ 12pF and t_r ≤ 5ns. Adjustment of V_{IN} shall be made with a suitable current probe to achieve the specified I_{B1} and I_{B2} test conditions, where I_{B1} is the on-state base current and I_{B2} is the post off-state base current.



2.5.2 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_{CES}	3041	T_{amb}=+150(+0-5)˚C V_{CE}=-60V, Bias Condition C	-	-10	µA
Forward-Current Transfer Ratio 2	h_{FE2}	3076	T_{amb}=-55(+5-0)˚C V_{CE}=-5V I_C=-2.5A Note 2	35	-	-

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

2.6 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}	±100	-	-1000	nA
Forward-Current Transfer Ratio 2	h_{FE2}	±25%	70	200	-
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	±100	-	-1500	mV

2.7 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}	-	-1	µA
Forward-Current Transfer Ratio 2	h_{FE2}	70	200	-
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	-	-1.5	V

2.8 HIGH TEMPERATURE REVERSE BIAS BURN-IN CONDITIONS

Characteristics	Symbols	Conditions	Units
Ambient Temperature	T_{amb}	+150	^{o}C
Emitter-Base Voltage	V_{EB}	-4.5	V
Collector-Base Voltage	V_{CB}	-60	V
Duration	t	48	hours

2.9 POWER BURN-IN CONDITIONS

2.9.1 Power Burn-in Conditions (TO-39)

Characteristics	Symbols	Conditions	Units
Ambient Temperature	T_{amb}	+20 to +50 (1)	^{o}C
Power Dissipation	P_{tot}	As per Maximum Ratings P_{tot1} derated at the chosen T_{amb}	W
Collector-Base Voltage	V_{CB}	-20	V

NOTES:
1. No heat sink nor forced air directly on the device shall be permitted.

2.9.2 Power Burn-in Conditions (TO-257 and SMD.5)

Characteristics	Symbols	Conditions	Units
Case Temperature	T_{case}	+100(+0 -5)	^{o}C
Power Dissipation	P_{tot}	As per Maximum Ratings P_{tot2} derated at the specified T_{case}	W
Collector-Base Voltage	V_{CB}	-20	V

2.10 OPERATING LIFE CONDITIONS

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

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 3) 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.