DOCUMENT CHANGE REQUEST

DCR number 388	Changes required for: General	Originator: S Jeffery
Date: 2007/10/24	Date sent: 2007/10/24	Organisation: ESA/ESTEC
Status: IMPLEMENTED		

Title:	Transistors Power NPN, based on type 2N2880		
Number:	5203/025	Issue:	1

Other documents affected:

Page:

Total re-write.

Paragraph:

Total re-write.

Original wording:

Proposed wording:

Total reformat of this specification as part of the ongoing conversion to the ESCC format. See below for summary of changes and attached Issue 2 Draft A of the specification.

Note: Known support for active procurement against this specification includes the following manufacturers:

SEMELAB/UK (not ESCC qualified but are currently willing to support the procurement of Variants 10 and 12).

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

1. Rewording and restructuring 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 redundant paragraphs and information such as Mechanical Requirements.

3. Title: Full definition added ("High Power" to reflect the Specification's Publication Code = 29: Transistors High Power NPN).

4. Para. 1.7 High Temperature Test Precautions requirements moved to be a note (Note 2) to the Maximum Ratings table.

5. Deletion of obsolete Variants 01, 02, 09 and 11 from the available range (not supported by Semelab).

6. Maximum Ratings table: Remark "Over entire operating temperature range" added for Collector-Base, Collector-Emitter and Emitter-Base voltages.

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7. Maximum Ratings table, Characteristic "Power Dissipation (Continuous)": "(Continuous)" deleted; remark "at Tcase <or= +100deg.C" added and "At Tcase = +100deg.C" deleted from associated note (Note 1).

8. Figure 1(a) Parameter Derating Information moved to be a note to the Maximum Ratings table ("Note 1" amended).

9. Figure 1(b) Forward Bias Safe Operating Area (Maximum Continuous d.c.) amended and moved to be a note to the Maximum Ratings table.

10. Para. 4.3.2 Weight requirements moved to Component Type Variants table.

11. Figure 2 re-named "Physical Dimensions and Terminal Identification"; Figure 2(a) deleted (all related Variants are obsolete); Figures 2(b) and 2(c) amended (standardisation of the TO-257 and introduction of a "TO-257G" package, which replaces the existing 'TO-257 with glass-to-metal seals' package and is based on the 'standardised' TO-257 package).

12. Figure 3, Functional Diagram: Figure 3(a) deleted (Variants 01 and 02 are obsolete) and Figure 3(b) amended.

13. Para. 4.2 Deviations from Generic Specification: Deviations revised/re-written per the latest ESCC Generic Specification; Deviations regarding "Total Dose Irradiation Testing" deleted â.. a "Total Dose Radiation Testing" Para. has been introduced instead.

14. Para. 4.4.1 Case requirements corrected to reflect the TO-257 and TO-257G metal flange mount packages.

15. Para. 4.4.2 Lead Material and Finish replaced by a reference to the Component Type Variants Para.

16. Para. 4.5.1 Required part marking corrected: Lead Identification deleted (not applicable to "TO-" packages); ESCC qualified components symbol added; warning sign for Beryllium Oxide added.

17. Delete requirement for marking of the test level letter from the ESCC Component Number as per latest ESCC No. 21700.

18. Total Dose Irradiation Level designation and note revised.

19. Para. 4.7.6, Verification of Safe Operating Area, revised.

20. Room Temperature (Ambient) for electrical measurements, etc, amended from +25+/-3deg.C to +22+/-3deg.C.

21. Table 2, Characteristic "Collector-Emitter Sustaining Voltage" re-named "Collector-Emitter Breakdown Voltage"; Symbol amended from VCEO(SUS) to V(BR)CEO; Limits corrected from 100V min. to 80V min.

22. Table 2, Characteristic "Emitter-Base Breakdown Voltage": Symbol corrected from BVEBO to V(BR)EBO.

23. Table 2, Characteristics "Collector-Emitter Cut-off Current 1" and "Collector-Emitter Cut-off Current 2" combined and re-

named "Collector-Emitter Cut-off Current"; ICEX Test Condition amended (was VEB=0.5V, now VBE=-500mV).

24. Table 2, Characteristics "D.C. Forward Current Transfer Ratio 1" and "D.C. Forward Current Transfer Ratio 2" combined and re-named "Forward-Current Transfer Ratio".

25. Table 2, Characteristics "Collector-Emitter Saturation Voltage 1" and "Collector-Emitter Saturation Voltage 2" combined and re-named "Collector-Emitter Saturation Voltage".

26. Table 2, Characteristic "High Frequency Forward Current Gain" re-named "Magnitude of Small-Signal Short-Circuit Forward-Current Transfer Ratio"; Symbol corrected from hfe to |hfe|.

27. Table 2, Characteristic "Open Circuit Output Capacitance" re-named "Output Capacitance"; "IE=0A" added to Test Conditions.

28. Table 2, Characteristics "Pulse Rise Time (Unsaturated) 1", "Pulse Storage Time (Unsaturated) 1" and "Pulse Fall Time (Unsaturated) 1" re-named "Pulse Rise Time, Unsaturated Mode", "Pulse Storage Time, Unsaturated Mode" and "Pulse Fall Time, Unsaturated Mode" respectively; Symbols tr(1), ts(1) and tf(1) amended to tr(U), ts(U) and tf(U) respectively.

29. Table 2, Characteristics "Pulse Rise Time (Saturated) 2", "Pulse Storage Time (Saturated) 2" and "Pulse Fall Time (Saturated) 2" re-named "Pulse Rise Time, Saturated Mode", "Pulse Storage Time, Saturated Mode" and "Pulse Fall Time, Saturated Mode" respectively; Symbols tr(2), ts(2) and tf(2) amended to tr(S), ts(S) and tf(S) respectively; Test Condition "VBB=10V" added to each of the three characteristics.

30. Table 2: Replace LTPD7 sampling for AC parameters tests (designated by "Note 2") with an equivalent fixed sample of 32 components with 0 failures (or 100%).

31. Figures 4(a) and 4(b) amended and moved to be notes (Note 3 and Note 4) to Room Temperature Electrical Measurements.

32. Table 3, Characteristic "Collector-Base Cut-off Current 1" re-named "Collector-Base Cut-off Current".

33. Table 3, Characteristic "D.C. Forward Current Transfer Ratio 1" re-named "Forward-Current Transfer Ratio 1".

34. Table 3 (High and Low Temperature Electrical Measurements): 100% inspection has been replaced by a sample of 5 components with 0 failures, or 100%, in line with the new Generic 5000 Issue 3.

35. Table 4: Absolute limits have been added for information.

36. Table 4, Characteristic "Collector-Emitter Cut-off Current 2" re-named "Collector-Emitter Cut-off Current".

37. Table 4, Characteristic "D.C. Forward Current Transfer Ratio 1" re-named "Forward-Current Transfer Ratio 1".

38. Tables 2, 3 and 4 - Test Conditions column: addition of Test, or Bias, Conditions for referenced MIL-STD-750 Test

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Methods as and where applicable.

39. Table 6, Characteristic "Collector-Emitter Cut-off Current 2" re-named "Collector-Emitter Cut-off Current".

40. Table 6, Characteristic "D.C. Forward Current Transfer Ratio 1" re-named "Forward-Current Transfer Ratio 1".

41. Figure 6 amended and moved to be a note in the "Total Dose Radiation Testing" Para.

42. Table 7, Characteristics "D.C. Forward Current Transfer Ratio 1" and "D.C. Forward Current Transfer Ratio 2" combined and re-named "Forward-Current Transfer Ratio"; "Note 1" deleted from Change Limits and replaced by "â..".

43. Table 7: Absolute limits have been added for information.

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.

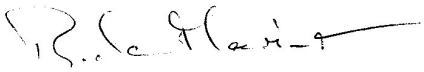
2. To make the format and presentation consistent with the various other ESCC Detail Specifications already converted to ESCC format.

3. To make the content consistent with ESCC Generic Specification No. 5000 Issue 3.

4. To update the current product availability by the manufacturer(s), and consequently remove any obsolete Variants.

5. To make corrections to technical errors in the previous issue.

6. Standardisation of the TO-257 package in all applicable ESCC Detail Specifications.

Attachments:
5203025_Issue_2_-_Draft_A.pdf, null
Modifications:
Maximum Ratings table: Characteristic Collector-Base Voltage amended from 150V to 110V (consistent with the sole supporting Manufacturer's data sheet). 11. Changed wording as follows: Figure 2 re-named "Physical Dimensions and Terminal Identification"; Figure 2(a) deleted (all related Variants are obsolete); Figures 2(b) and 2(c) amended (standardisation of the TO-257 package). 14. Changed wording as follows: Case requirements corrected to reflect the TO-257 metal flange mount packages.
Approval signature:

Date signed:
2007-10-24

TRANSISTORS, HIGH POWER, NPN

BASED ON TYPE 2N2880

ESCC Detail Specification No. 5203/025

Issue 2 - Draft A	October 2007

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
TBD	Specification up issued to incorporate editorial and technical changes per DCR.

TABLE OF CONTENTS

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: 520302510F

- Detail Specification Reference: 5203025
- Component Type Variant Number: 10 (as required)
- Total Dose Radiation Level Letter: F (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
10	2N2880	TO-257G	H3 or H4	5	F[50kRAD(Si)]
12	2N2880	TO-257	H3 or H4	5	F[50kRAD(Si)]

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

The total dose radiation level letter shall be as defined in ESCC Basic Specificaiton 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_{CB}	150	V	Over T_{op}
Collector-Emitter Voltage	V_{CE}	80	V	Over T_{op}
Emitter-Base Voltage	V_{EB}	8	V	Over T_{op}
Collector Current	I_C	5	A	Continuous Note 3
Base Current	I_B	500	mA	Continuous
Power Dissipation	P_{tot}	20	W	At $T_{case} \leq$ +100°C Note 1
Operating Temperature Range	T_{op}	-65 to +200	°C	Note 2
Storage Temperature Range	T_{stg}	-65 to +200	°C	Note 2
Soldering Temperature	T_{sol}	+260	°C	Note 4
Thermal Resistance	$R_{th(j-c)}$	5	°C/W	

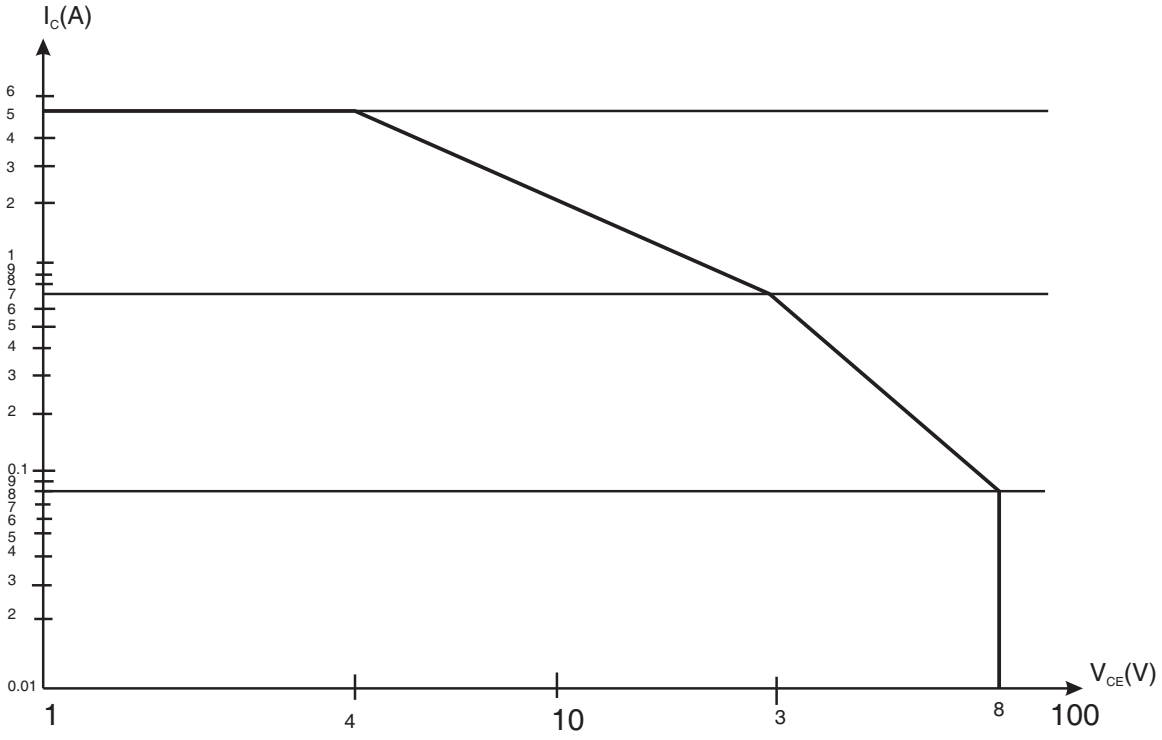
NOTES:

1. For T_{case} > +100°C, derate linearly to 0W at +200°C.
2. For Variants with tin-lead plating or hot solder dip lead finish all testing performed at T_{amb} > +125°C

shall be carried out in a 100% inert atmosphere.

3. Safe operating area (continuous DC) applies as follows:

MAXIMUM SAFE OPERATING AREA GRAPH



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.

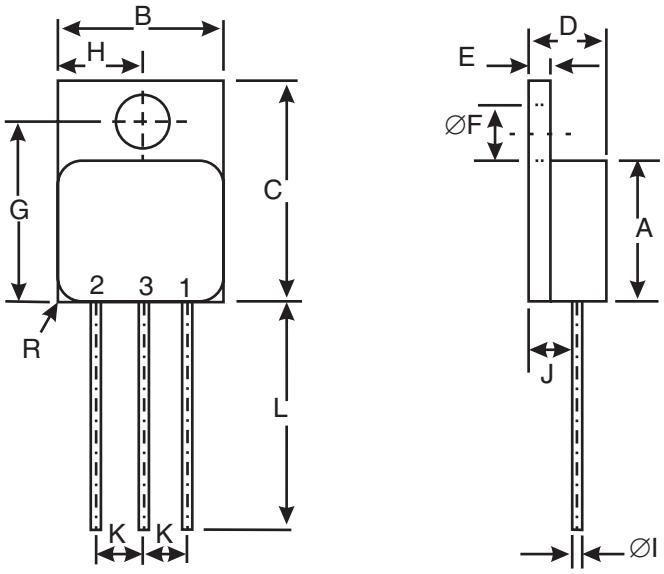
1.6 HANDLING PRECAUTIONS

The TO-257G package and the TO-257 package both contain Beryllium Oxide (BeO) and therefore they must not be ground, machined, sandblasted or subjected to any mechanical operation which will produce dust. Their cases must not be subjected to any chemical processes (e.g. etching) which will produce fumes.

1.7 PHYSICAL DIMENSIONS AND TERMINAL IDENTIFICATION

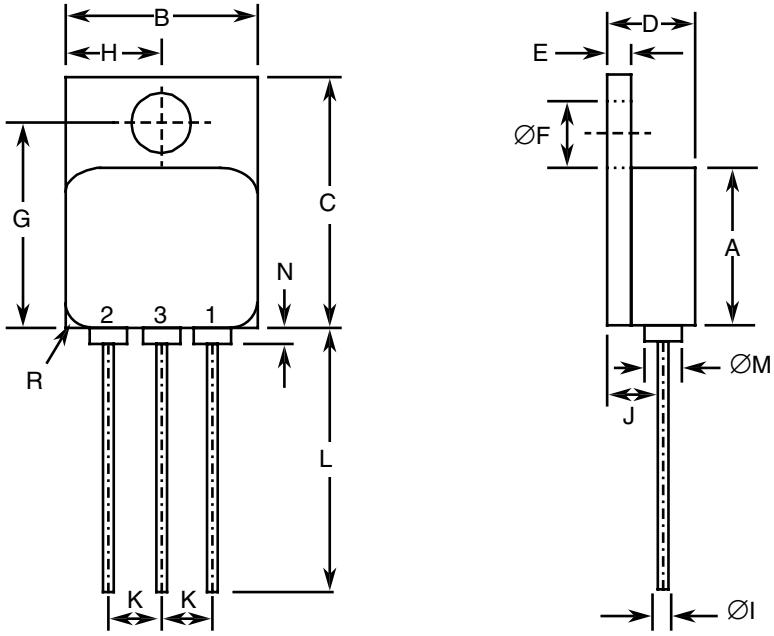
Consolidated notes follow the case drawings and dimensions.

1.7.1 Metal Flange Mount Package (TO-257G) - 3 lead



Symbols	Dimensions mm		Notes
	Min	Max	
A	10.41	10.92	
B	10.41	10.92	
C	16.26	17.02	
D	4.7	5.33	
E	0.64	0.89	
ØF	3.56	3.81	
G	13.2	13.72	
H	5.13	5.55	
ØI	0.89	1.14	2
J	2.65	2.75	2, 3
K	2.41	2.67	
L	12.7	14.73	
R	1.65 Typical		4

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

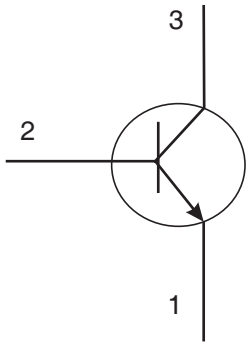


Symbols	Dimensions mm		Notes
	Min	Max	
A	10.41	10.92	
B	10.41	10.92	
C	16.26	17.02	
D	4.7	5.33	
E	0.64	0.89	
∅F	3.56	3.81	
G	13.2	13.72	
H	5.13	5.55	
∅I	0.89	1.14	2
J	2.65	2.75	2, 3
K	2.41	2.67	
L	12.7	14.73	
R	1.65 Typical		4

1.7.3 Notes to Physical Dimensions and Terminal Identification

1. Terminal identification is specified by the component's geometry where Lead 1 = emitter, Lead 2 = base and Lead 3 = collector.
2. Applies to all leads.
3. Measured from the seating plane to the centreline of the lead.
4. Radius of body corner, 4 places

1.8 FUNCTIONAL DIAGRAM



1. Emitter.
2. Base.
3. Collector.

NOTES:
1. The case is not connected to any lead.

1.9 MATERIALS AND FINISHES

Materials and finishes shall be as follows:

a) Case
For the TO-257G package the case shall be hermetically sealed and have a metal body with hard glass seals and the lid shall be welded.
For the TO-257 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.

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.
(d) Warning sign for Beryllium Oxide.

2.3 TERMINAL STRENGTH

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

Test condition A, tension, with an applied force of 20N for a duration of 15s.

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} = +100(+0 - 5)°C.
Operating Time ≤ 1s.
Test Number 1: V_{CE} = 80V, I_C = 80mA.
Test Number 2: V_{CE} = 29V, I_C =680mA.

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.

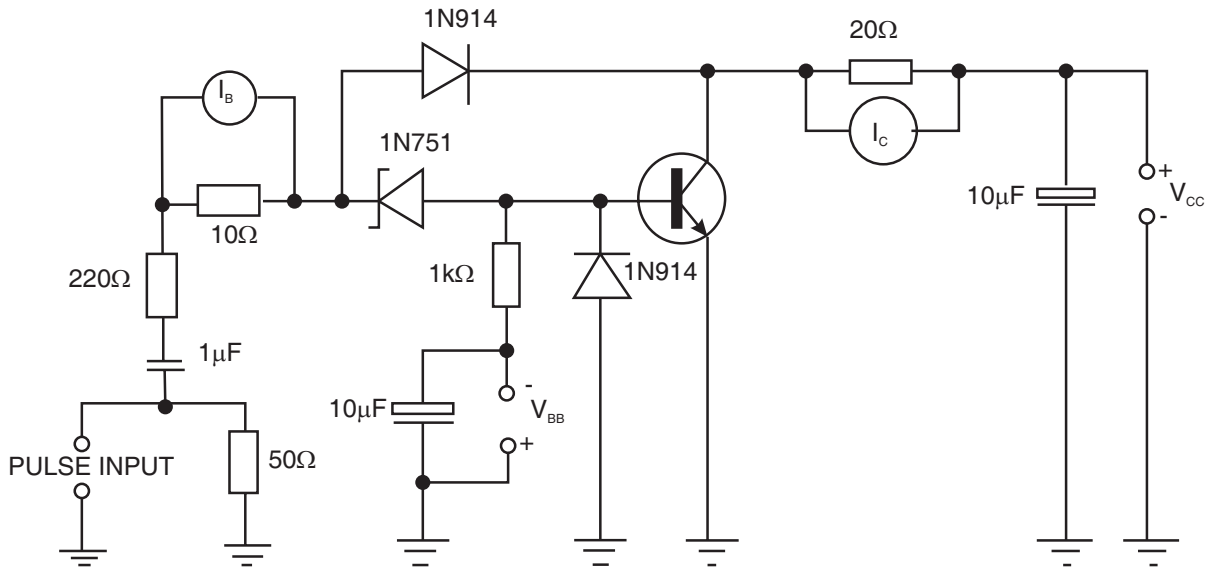
Characteristics	Symbols	MIL-STD-750 Test Method	Test Conditions	Limits		Units
				Min	Max	
Collector-Emitter Breakdown Voltage	$V_{(BR)CEO}$	3011	I_C = 100mA Bias condition D Note 1	80	-	V
Emitter-Base Breakdown Voltage	$V_{(BR)EBO}$	3026	I_E =10µA Bias condition D	8	-	V
Collector-Base Cut-off Current	I_{CBO}	3036	V_{CB}=60V Bias condition D	-	100	nA

Characteristics	Symbols	MIL-STD-750 Test Method	Test Conditions	Limits		Units
				Min	Max	
Collector-Emitter Cut-off Current	I_{CEX}	3041	V_{CE}=150V V_{BE}=-500mV Bias condition A	-	10	µA
	I_{CEO}	3041	V_{CE} =50V Bias condition D	-	100	µA
Emitter-Base Cut-off Current	I_{EBO}	3061	V_{EB} =5V Bias condition D	-	100	nA
Forward-Current Transfer Ratio	h_{FE1}	3076	V_{CE}=5V, I_C =1A Note 1	40	120	-
	h_{FE2}	3076	V_{CE}=5V, I_C =5A Note 1	15	-	-
Collector-Emitter Saturation Voltage	$V_{CE(sat)1}$	3071	I_C=1A I_B=100mA Note 1	-	250	mV
	$V_{CE(sat)2}$	3071	I_C=5A I_B=500mA Note 1 Test Condition A	-	2	V
Base-Emitter Saturation Voltage	$V_{BE(sat)1}$	3066	I_C=1A I_B=100mA Test Condition A Note 1	-	1.2	V
Magnitude of Small-Signal Short-Circuit Forward-Current Transfer Ratio	$\|h_{fe}\|$	3306	V_{CE}=10V I_C=1A f=10MHz Notes 1, 2	3	-	-
Output Capacitance	C_{obo}	3236	V_{CB}=10V I_E=0A f=1MHz Note 2	-	150	pF
Pulse Rise Time, Unsaturated Mode	$t_{r(u)}$	-	I_C=1A I_B=100mA V_{CC}=25V V_{BB}=10V Notes 2, 3	-	80	ns
Pulse Storage Time, Unsaturated Mode	$t_{s(u)}$	-	I_C=1A I_B=100mA V_{CC}=25V V_{BB}=10V Notes 2, 3	-	60	ns

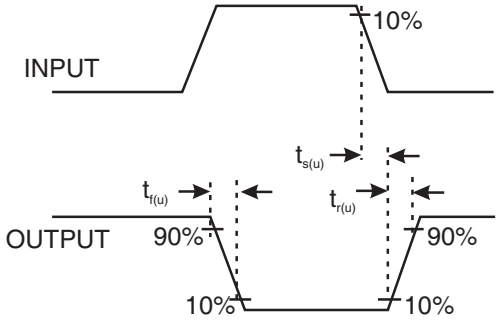
Characteristics	Symbols	MIL-STD-750 Test Method	Test Conditions	Limits		Units
				Min	Max	
Pulse Fall Time, Unsaturated Mode	$t_{f(u)}$	-	I_C=1A I_B=100mA V_{CC}=25V V_{BB}=10V Notes 2, 3	-	80	ns
Pulse Rise Time, Saturated Mode	$t_{r(s)}$	-	I_C=1A I_B=100mA V_{CC}=20V V_{BB}=10V Notes 2, 4	-	300	ns
Pulse Storage Time, Saturated Mode	$t_{s(s)}$	-	I_C=1A I_B=100mA V_{CC}=20V V_{BB}=10V Notes 2, 4	-	2	µs
Pulse Fall Time, Saturated Mode	$t_{f(s)}$	-	I_C=1A I_B=100mA V_{CC}=20V V_{BB}=10V Notes 2, 4	-	350	ns

NOTES:

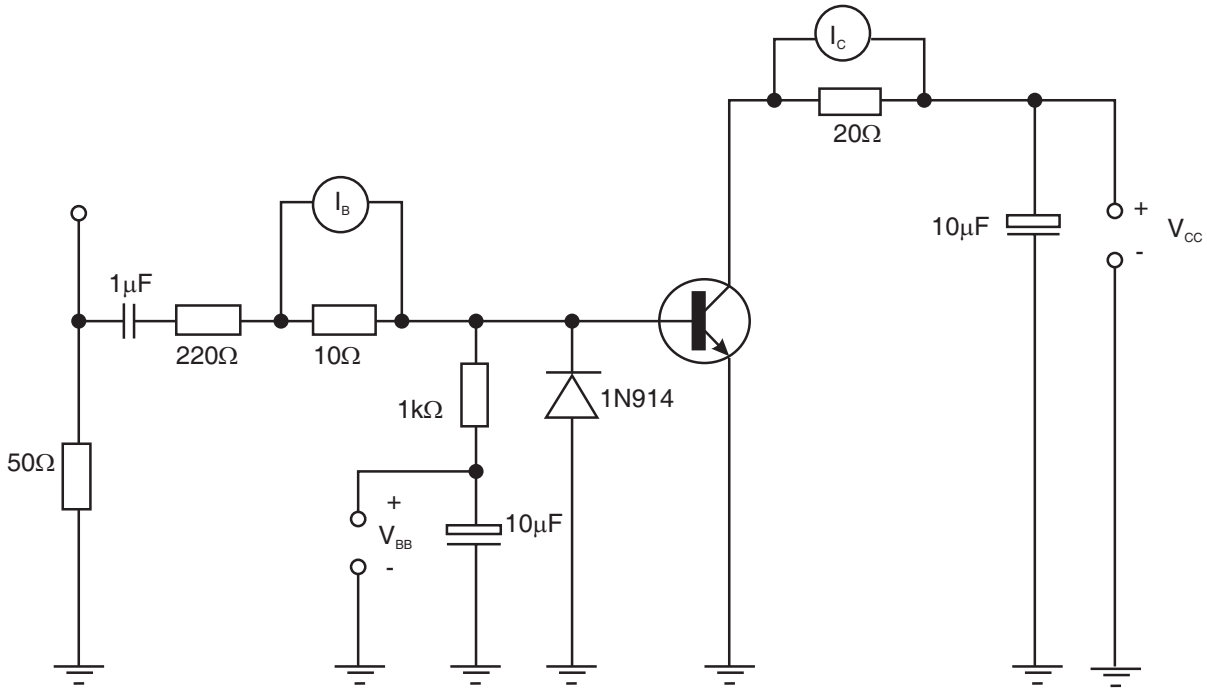
1. Pulsed measurement: Pulse Width ≤ 330µs, Duty Cycle ≤ 2%.
2. For AC characteristics read and record measurements shall be performed on a sample of 32 components with 0 failures allowed. Alternatively a 100% inspection may be performed.
3. Unsaturated mode pulse times shall be measured using the following test circuit:



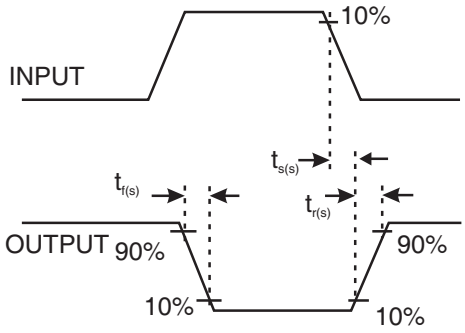
VOLTAGE WAVEFORMS



4. Saturated mode pulse times shall be measured using the following test circuit:



VOLTAGE WAVEFORMS



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_{CBO}	3036	T_{amb}=+150(+0-5)°C V_{CB}=60V Bias condition D	-	50	μA

Characteristics	Symbols	MIL-STD-750 Test Method	Test Conditions Note 1	Limits		Units
				Min	Max	
Forward-Current Transfer Ratio 1	h_{FE1}	3076	T_{amb}=-55(+0-5)°C V_{CE}=5V ; I_C =1A Note 2	15	-	-

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 ≤ 330µs, 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_{CEX}	±1	-	10	µA
Forward-Current Transfer Ratio 1	h_{FE1}	±25%	40	120	-
Collector-Emitter Saturation Voltage 1	$V_{CE(sat)1}$	±50	-	250	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_{CEX}	-	10	µA
Forward-Current Transfer Ratio 1	h_{FE1}	40	120	-
Collector-Emitter Saturation Voltage 1	$V_{CE(sat)1}$	-	250	mV

2.8 POWER BURN-IN CONDITIONS

Characteristics	Symbols	Conditions	Units
Case Temperature	T_{case}	+100 (+0 -5)	^{o}C
Power Dissipation	P_{tot}	20	W
Collector-Base Voltage	V_{CB}	10	V

2.9 OPERATING LIFE CONDITIONS

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

2.10 TOTAL DOSE RADIATION TESTING

2.10.1 Bias Conditions and Total Dose Level for Total Dose Radiation Testing

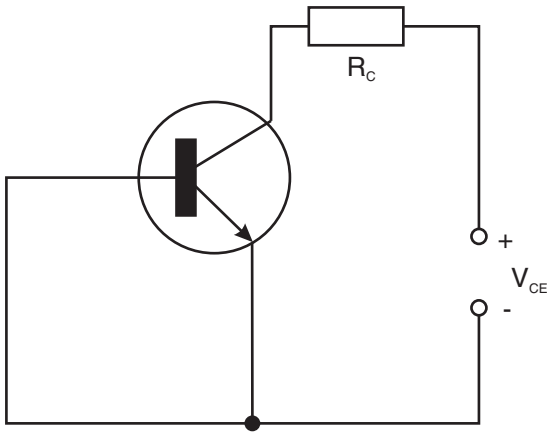
Continuous bias shall be applied during radiation testing as specified below.

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

Characteristics	Symbols	Test Conditions	Units
Ambient Temperature	T_{amb}	+ 22 ± 3	^{o}C
Collector-Emitter Voltage	V_{CE}	70	V

NOTES:

1. Resistor R_C= 2.2kΩ. Bias circuit is shown below:



2.10.2 Electrical Measurements for Total Dose Radiation Testing

Prior to radiation 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^{o}C.
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 radiation testing are shown below.

Characteristics	Symbols	Limits			Units
		Drift Values Δ	Absolute		
			Min	Max	
Collector-Base Cut-off Current	I_{CBO}	±10	-	100	nA
Emitter-Base Cut-off Current	I_{EBO}	±100	-	100	nA
Forward-Current Transfer Ratio	h_{FE1}	-	40	120	-
	h_{FE2}	-	15	-	-
Collector-Emitter Saturation Voltage 1	$V_{CE(sat)1}$	±75	-	250	mV