TRANSISTORS, LOW POWER, PNP

BASED ON TYPE 2N2907A

ESCC Detail Specification No. 5202/001

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DCR No.	CHANGE DESCRIPTION
1684	Specification updated to incorporate changes per DCR.

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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: 520200104R

- Detail Specification Reference: 5202001
- Component Type Variant Number: 04 (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	Terminal Finish (Note 1)	Weight max g	Total Dose Radiation Level Letter (Note 2)
04	2N2907A	CCP (3 Terminal)	2	0.06	R [100krad(Si)]
05	2N2907A	CCP (3 Terminal)	4	0.06	R [100krad(Si)]
06	2N2907A	CCP (4 Terminal)	2	0.06	R [100krad(Si)]
07	2N2907A	CCP (4 Terminal)	4	0.06	R [100krad(Si)]
08	2N2907A	Die (Note 3)	N/A	N/A	R [100krad(Si)]
09	2N2907A	Die (Note 4)	N/A	N/A	Note 4

NOTES:

1. The terminal finish shall be in accordance with the requirements of ESCC Basic Specification No. 23500.
2. 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.
3. Variant 08 is a die with 2.85μm top metallisation, see Para. 1.6.3.
4. Variant 09 is a die with 2μm top metallisation, see Para. 1.6.3, and is not available with Total Dose Radiation Testing.

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.

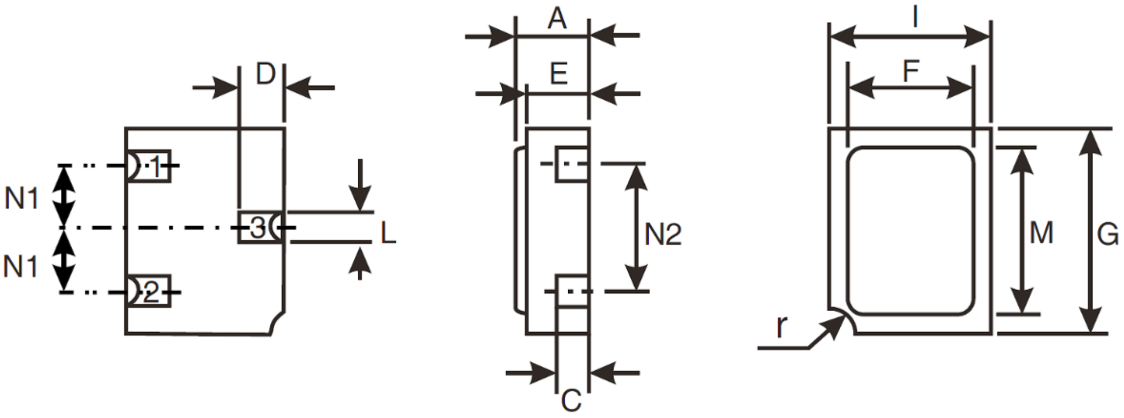
Characteristics	Symbols	Maximum Ratings	Unit	Remarks
Collector-Base Voltage	V_{CBO}	-60	V	Over entire operating temperature range
Collector-Emitter Voltage	V_{CEO}	-60	V	
Emitter-Base Voltage	V_{EBO}	-5	V	
Collector Current: For CCP (Variants 04, 05, 06, 07)	I_C	-500	mA	Continuous
Power Dissipation: For CCP (Variants 04, 05, 06, 07)	P_{tot}	0.4	W	At $T_{amb} \leq +25°C$
Thermal Resistance, Junction-to-Ambient	$R_{th(j-a)}$	437.5	°C/W	
Operating Temperature Range	T_{op}	-65 to +200	°C	Note 1
Storage Temperature Range	T_{stg}	-65 to +200	°C	Note 1
Soldering Temperature: For CCP (Variants 04, 05, 06, 07)	T_{sol}	+245	°C	Note 2

NOTES:

1. For Variants 05, 07 with hot solder dip lead finish, all testing, and any handling, performed at $T_{amb} > +125°C$ shall be carried out in a 100% inert atmosphere.
2. 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 Chip Carrier Package (CCP) - 3 terminal (Variants 04, 05)

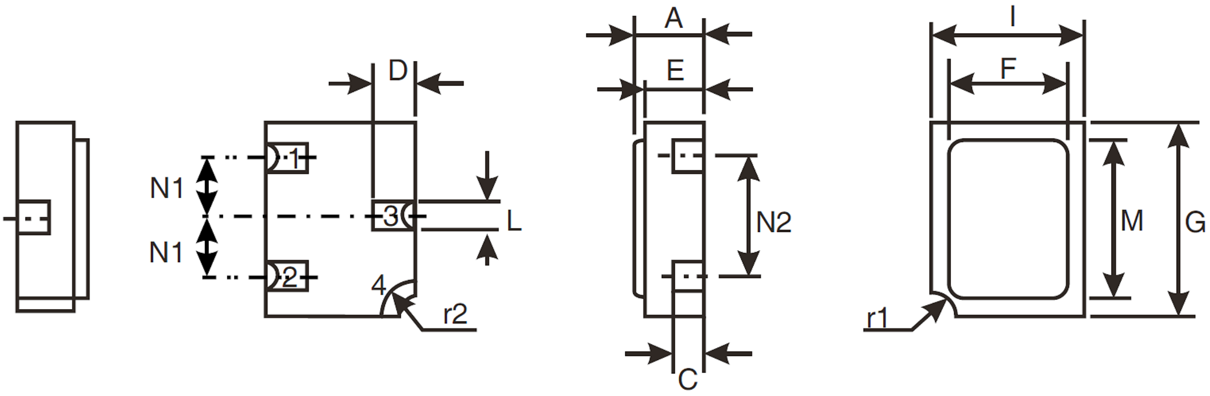


Symbols	Dimensions mm		Notes
	Min	Max	
A	1.15	1.5	
C	0.45	0.56	2
D	0.6	0.91	2
E	0.91	1.12	
F	1.9	2.15	
G	2.9	3.25	
I	2.4	2.85	
L	0.4	0.6	2
M	2.4	2.65	
N1	0.855	1.055	
N2	1.8	2	
r	0.3 TYPICAL		1

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.

1.6.2 Chip Carrier Package (CCP) - 4 terminal (Variants 06, 07)

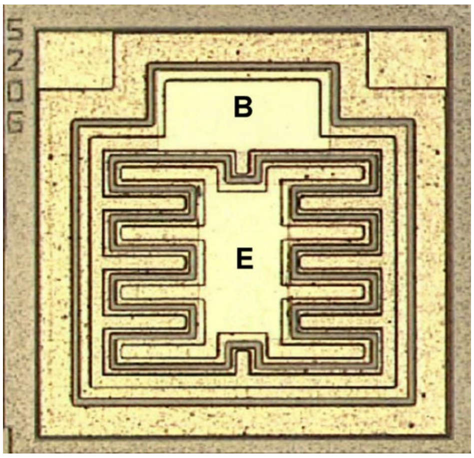


Symbols	Dimensions mm		Notes
	Min	Max	
A	1.15	1.5	
C	0.45	0.56	2
D	0.6	0.91	2
E	0.91	1.12	
F	1.9	2.15	
G	2.9	3.25	
I	2.4	2.85	
L	0.4	0.6	2
M	2.4	2.65	
N1	0.855	1.055	
N2	1.8	2	
r1	0.3 TYPICAL		1
r2	0.56 TYPICAL		1

NOTES:

1. Terminal identification is specified by reference to the corner notch position where terminal 1 = emitter, terminal 2 = base, terminal 3 = collector, terminal 4 = shielding connected to the lid.
2. Applies to terminals 1, 2, 3.

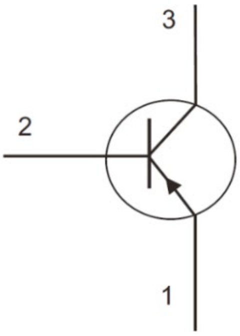
1.6.3 Die (Variants 08, 09)



NOTES:

1. Die materials and dimensions:
   - Die substrate: Silicon
   - Die length: 508 µm
   - Die width: 508 µm
   - Die thickness: 230 ±20µm
   - Top Glassivation: P-Vapox with thickness: 720 ±80nm and Nitride with thickness 540 ±60nm
   - Top metallisation:
     - Variant 08: Al/Si (1%) with thickness: 2.85 ±0.15µm
     - Variant 09: Al/Si (1%) with thickness: 2 ±0.2µm
   - Backside metallisation: Au with thickness: 1.48 ±0.12µm
   - Emitter pad dimensions: 154 × 84 µm
   - Base pad dimensions: 163 × 80 µm
2. Terminal identification: B = Base, E = Emitter
3. Bias details: backside contact = Collector

1.7 FUNCTIONAL DIAGRAM



1. Emitter.

2. Base.

3. Collector.

4. Shield.

NOTES:

1. For 3 terminal CCP (Variants 04, 05) the lid is not connected to any terminal.
2. For 4 terminal CCP (Variants 06, 07) the shielding terminal is connected to the lid.
3. For Die Components (Variants 08, 09), the terminal numbering and the Shield are not applicable.

1.8 MATERIALS AND FINISHES

1.8.1 Materials and Finishes of Packaged Components

For Variants 04, 05, 06, 07, the materials and finishes shall be as follows:

(a) Case
The case shall be hermetically sealed and have a ceramic body with a Kovar lid.

(b) Leads/Terminals
As specified in Para. 1.4.2, Component Type Variants.

1.8.2 Materials and Finishes of Die Components

For Variants 08 and 09, the materials and finishes shall be as specified in Para. 1.6.3.

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 or its primary package shall be:

(a) The ESCC qualified components symbol (for ESCC qualified components only).
(b) The ESCC Component Number (see Para. 1.4.1).
(c) Traceability information.

2.3 ELECTRICAL MEASUREMENTS AT ROOM, HIGH AND LOW TEMPERATURES

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

2.3.1 Room Temperature Electrical Measurements

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

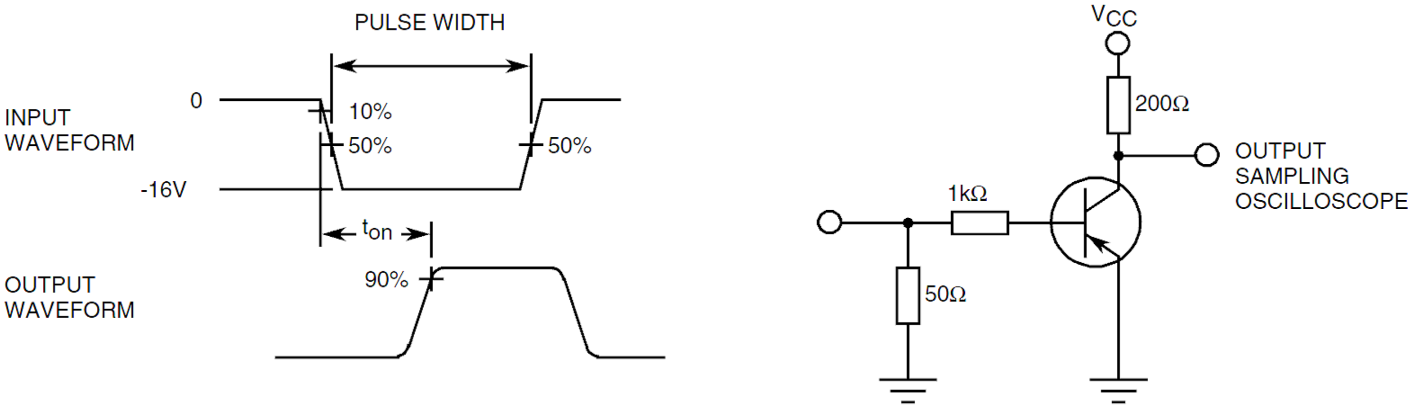
Characteristics	Symbols	MIL-STD-750 Test Method	Test Conditions	Limits		Units
				Min	Max	
Collector-Emitter Breakdown Voltage	$V_{(BR)CEO}$	3011	I_C = -10mA Note 1 Bias condition D	-60	-	V
Collector-Base Breakdown Voltage	$V_{(BR)CBO}$	3001	I_E = -10µA Bias condition D	-60	-	V
Emitter-Base Breakdown Voltage	$V_{(BR)EBO}$	3026	I_E = -10µA Bias condition D	-5	-	V
Collector-Emitter Cut-off Current	I_{CEX}	3041	V_{CE} = -30V, V_{BE} = 500mV Bias condition C	-	-50	nA
Collector-Base Cut-off Current	I_{CBO}	3036	V_{CB} = -50V Bias condition D	-	-10	nA
Forward-Current Transfer Ratio	h_{FE1}	3076	V_{CE} = -10V, I_C = -100µA	75	-	-
	h_{FE2}		V_{CE} = -10V, I_C = -10mA	100	-	-
	h_{FE3}		V_{CE} = -10V, I_C = -150mA Note 1	100	300	-
	h_{FE4}		V_{CE} = -10V, I_C = -500mA Note 1	50	-	-
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	3071	I_C = -150mA, I_B = -15mA Note 1	-	-400	mV
Base-Emitter Saturation Voltage	$V_{BE(sat)}$	3066	I_C = -150mA, I_B = -15mA Test condition A Note 1	-	-1.3	V
Magnitude of Small-Signal Short-Circuit Forward-Current Transfer Ratio	$\|h_{fe}\|$	3306	I_C = -20mA, V_{CE} = -20V f = 100MHz Notes 2, 3	2	-	-
Output Capacitance	C_{obo}	3236	V_{CB} = -10V, I_E = 0mA 100kHz ≤ f ≤ 1MHz Notes 2, 3	-	8	pF
Turn-on Time	t_{on}	-	V_{CC} = -30V, I_C = -150mA I_B = -15mA Notes 2, 3, 4	-	45	ns
Turn-off Time	t_{off}	-	V_{CC} = -30V, I_C = -150mA I_B = -15mA Notes 2, 3, 5	-	300	ns

NOTES:

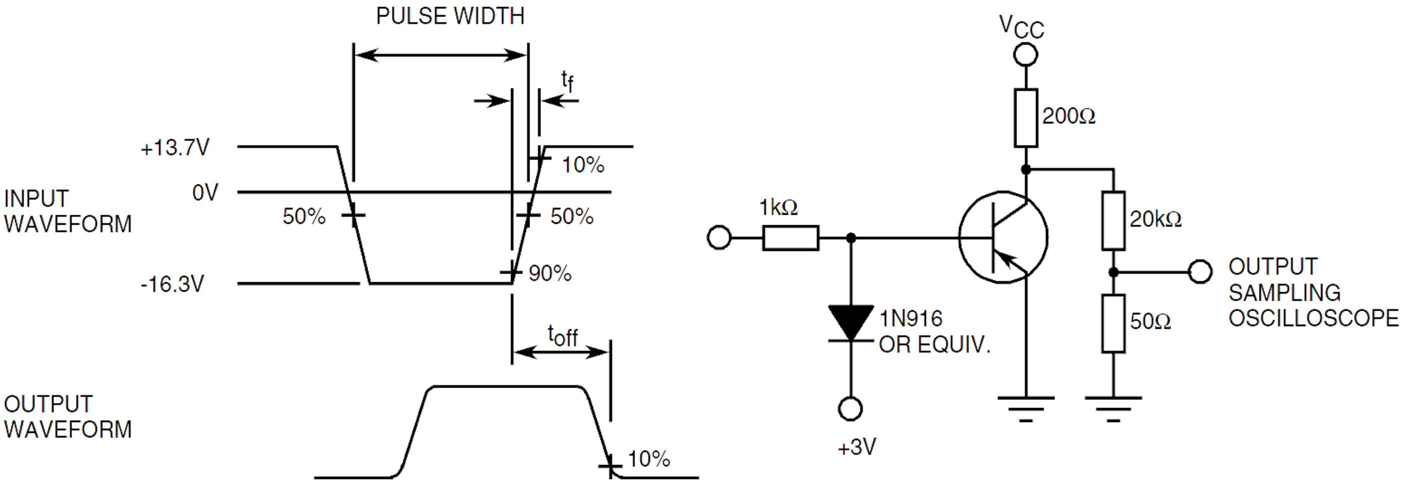
1. Pulse measurement: Pulse Width ≤ 300µs, Duty Cycle ≤ 1%
2. For Packaged Components (Variants 04, 05, 06, 07), all AC characteristics read and record measurements shall be performed on a sample of 32 components with 0 failures allowed. Alternatively, a 100% inspection may be performed.

3. For Die Components (Variants 08, 09), all AC characteristics read and record measurements shall be performed on either a sample of 32 components or 100% of the Packaged Test Sublot, whichever is less, with 0 failures allowed.

4. t_{on} 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, Pulse Width = 200 ±10ns, Duty Cycle ≤ 2%. The output waveform shall be monitored on an oscilloscope with the following characteristics: Z_{IN} ≥ 100kΩ, input capacitance ≤ 12pF, t_r ≤ 5ns.



5. t_{off} 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_f ≤ 2ns, Pulse Width = 10 to 100µs, Duty Cycle ≤ 2%. The output waveform shall be monitored on an oscilloscope with the following characteristics: Z_{IN} ≥ 100kΩ, input capacitance ≤ 12pF, t_r ≤ 5ns.



2.3.2 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} = 50V, Bias Condition D	-	-10	μA

NOTES:

1. Measurements shall be performed on a sample basis as specified in the Generic Specification.

2.4 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 Para. 2.3.1, 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}	±2 or (1) ±100%	-	-10	nA
Forward-Current Transfer Ratio 3	h_{FE3}	±15%	100	300	-
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	±50 or (1) ±15%	-	-400	mV

NOTES:

1. Whichever is the greater referred to the initial value.

2.5 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 Para. 2.3.1, 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 3	h_{FE3}	100	300	-
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	-	-400	mV

2.6 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}	-50	V
Duration	t	48 minimum	Hours

2.7 POWER BURN-IN CONDITIONS

Characteristics	Symbols	Test Conditions	Units
Ambient Temperature	T_{amb}	+20 to +50	°C
Power Dissipation	P_{tot}	As per Para. 1.5, Maximum Ratings. Derate P_{tot1} at the chosen T_{amb} using the specified $R_{th(j-a)}$.	W
Collector-Base Voltage	V_{CB}	40	V

2.8 OPERATING LIFE CONDITIONS

The conditions shall be as specified in Para. 2.7, Power Burn-in Conditions.

2.9 TOTAL DOSE RADIATION TESTING

Total dose radiation testing is not applicable to Variant 09.

All lots of Variants 04, 05, 06, 07, 08 shall be irradiated in accordance with ESCC Basic Specification No. 22900, low dose rate (window 2: 36rad(Si) to 360rad(Si) per hour).

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	°C
Bias Condition 1: Collector-Emitter Voltage	V_{CES}	$\geq$ 65% $V_{(BR)CEO}$	V
Bias Condition 2: Collector-Emitter Voltage	V_{CES}	0	V

The total dose level applied shall be as specified in Para. 1.4.2 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 in Para. 2.3.1.

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

Unless otherwise specified the test methods and test conditions shall be as per the corresponding test defined in Para. 2.3.1, 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-Emitter Breakdown Voltage	$V_{(BR)CEO}$	See Para. 2.3.1	See Para. 2.3.1	-60	-	V
Collector-Base Breakdown Voltage	$V_{(BR)CBO}$	See Para. 2.3.1	See Para. 2.3.1	-60	-	V
Emitter-Base Breakdown Voltage	$V_{(BR)EBO}$	See Para. 2.3.1	See Para. 2.3.1	-5	-	V
Collector-Emitter Cut-off Current	I_{CEX}	See Para. 2.3.1	See Para. 2.3.1	-	-50	nA
Collector-Base Cut-off Current	I_{CBO}	See Para. 2.3.1	See Para. 2.3.1	-	-10	nA
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	See Para. 2.3.1	See Para. 2.3.1	-	-400	mV
Base-Emitter Saturation Voltage	$V_{BE(sat)}$	See Para. 2.3.1	See Para. 2.3.1	-	-1.3	V
Forward-Current Transfer Ratio (post irradiation gain calculation) (Note 1)	[h_{FE1}]	3076	V_{CE} = -10V, I_C = -100µA	[30]	-	-
	[h_{FE2}]		V_{CE} = -10V, I_C = -10mA	[50]	-	-
	[h_{FE3}]		V_{CE} = -10V, I_C = -150mA	[50]	300	-
	[h_{FE4}]		V_{CE} = -10V, I_C = -500mA	[25]	-	-

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
Para. 2.1.1, Deviations from the Generic Specification: Para. 8, Test Methods and Procedures	For qualification and qualification maintenance, or procurement of qualified or unqualified components, the following replacement test method specifications shall be used instead of the following ESCC Basic Specifications: No. 20400, Internal Visual Inspection: replaced by MIL-STD-750 Test Method 2072. No. 20500, External Visual Inspection: replaced by MIL-STD-750 Test Method 2071. No. 20900, Radiographic Inspection of Electronic Components: replaced by MIL-STD-750 Test Method 2076.
Para. 2.1.1, Deviations from the Generic Specification: Deviations from Production Control - Chart F2	Special In-Process Controls - Internal Visual Inspection. For CCP packages (Variants 04, 05, 06, 07), the criteria specified for voids in the fillet and minimum die mounting material around the visible die perimeter for die mounting defects may be omitted providing that a radiographic inspection to verify the die-attach process is performed on a sample basis in accordance with STMicroelectronics procedure 0076637.
Para. 2.1.1, Deviations from the Generic Specification: Deviations from Screening Tests - Chart F3	Solderability is not applicable unless specifically stipulated in the Purchase Order.
Para. 2.3.1, Room Temperature Electrical Measurements	All AC characteristics (Para. 2.3.1 Notes 2 and 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.
Para. 2.3.2, 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.