



Pages 1 to 16

TRANSISTORS, HIGH POWER, PNP

BASED ON TYPE BUX78

ESCC Detail Specification No. 5204/006

| | |
|---------|---------------|
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| DCR No. | CHANGE DESCRIPTION |
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| 187, 335 | 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: 520400603

- Detail Specification Reference: 5204006
- Component Type Variant Number: 03 (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 |
|----------------|---------------|--------|-----------------------------------|--------------|
| 03 | BUX78 | TO-66 | F9 | 6.4 |
| 04 | BUX78 | TO-66 | F2 | 6.4 |
| 05 | BUX78 | TO-66 | F3 or F4 | 6.4 |
| 06 | BUX78 | TO-257 | H2 | 5 |
| 07 | BUX78 | TO-257 | H4 | 5 |

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 4 |
| Emitter-Base Voltage | V_{EBO} | -6 | V | Over T_{op} |
| Collector Current | I_C | -5 | A | Continuous Note 4 |
| Base Current | I_B | -800 | mA | Continuous |
| Power Dissipation For TO-66 For TO-257 | P_{tot} | 40 35 | W | At $T_{case} \leq +25^{\circ}C$ Note 1 |
| Operating Temperature Range | T_{op} | -65 to +200 | $^{\circ}C$ | Note 2 |
| Storage Temperature Range | T_{stg} | -65 to +200 | $^{\circ}C$ | Note 2 |
| Soldering Temperature | T_{sol} | +260 | $^{\circ}C$ | Note 3 |
| Thermal Resistance, Junction to Case For TO-66 For TO-257 | $R_{th(j-c)}$ | 4.4 5 | $^{\circ}C/W$ | |

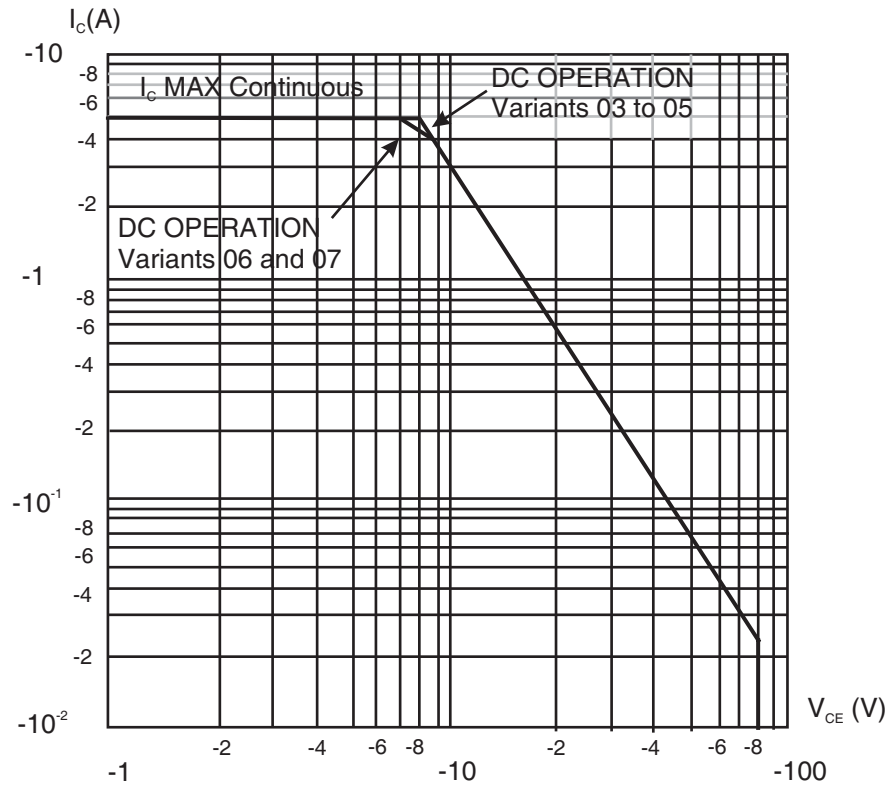
NOTES:

1. For $T_{case} > +25^{\circ}C$, derate linearly to 0W at $+200^{\circ}C$.
2. For Variants with tin-lead plating or hot solder dip lead finish all testing performed at $T_{amb} > +125^{\circ}C$ 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. Safe Operating Area applies as follows:

Maximum Safe Operating Area Graph

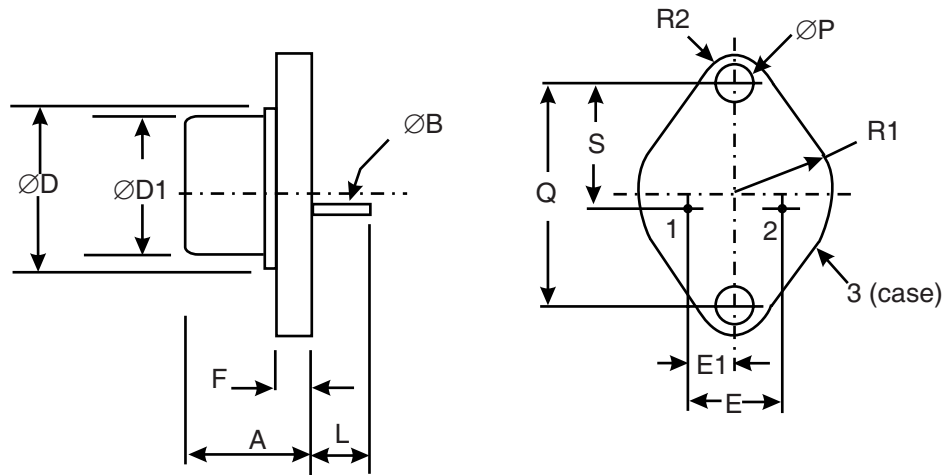


1.6 HANDLING PRECAUTIONS

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.

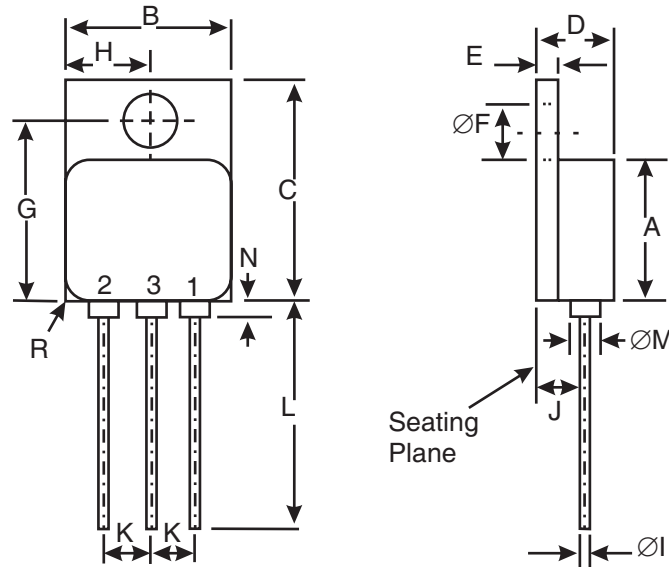
1.7 PHYSICAL DIMENSIONS AND TERMINAL IDENTIFICATION

1.7.1 Metal Flange Mount Package (TO-66) - 2 lead



| Symbols | Dimensions mm | | Notes |
|------------------|---------------|-------|-------|
| | Min | Max | |
| A | 6.35 | 8.64 | |
| $\varnothing B$ | 0.71 | 0.86 | 2 |
| $\varnothing D$ | - | 15.74 | |
| $\varnothing D1$ | 11.94 | 12.7 | |
| E | 4.83 | 5.34 | |
| E1 | 2.36 | 2.72 | |
| F | 1.27 | 1.91 | |
| L | 9.14 | - | |
| $\varnothing P$ | 3.61 | 3.86 | 3 |
| Q | 24.33 | 24.43 | |
| R1 | - | 8.89 | |
| R2 | 2.92 | 3.68 | |
| S | 14.48 | 14.99 | |

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



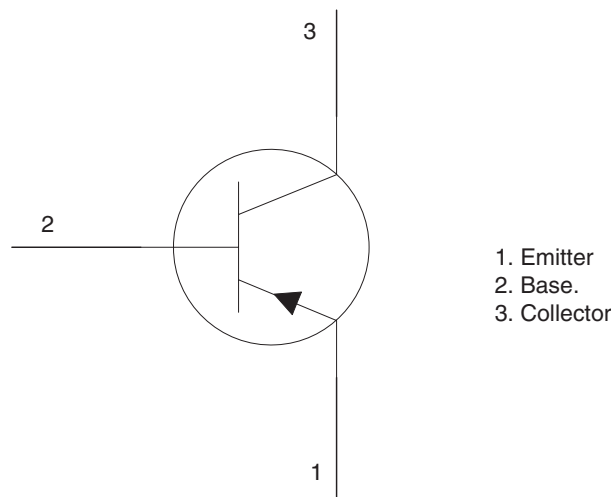
| Symbols | Dimensions mm | | Notes |
|-----------------|---------------|-------|-------|
| | Min | Max | |
| A | 10.41 | 10.67 | |
| B | 10.41 | 10.67 | |
| C | 16.51 | 16.76 | |
| D | 4.7 | 5.33 | |
| E | 0.89 | 1.14 | |
| $\varnothing F$ | 3.56 | 3.81 | |
| G | 13.39 | 13.64 | |
| H | 5.13 | 5.38 | |
| $\varnothing I$ | 0.64 | 0.89 | 2 |
| J | 2.92 | 3.16 | |
| K | 2.41 | 2.67 | |
| L | 15.24 | 16.51 | |
| $\varnothing M$ | 2.29 Typical | | 2 |
| N | - | 0.71 | 2 |
| 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 (TO-257) or Case (TO-66) = collector.
2. Applies to all leads.
3. Applies to both mounting holes.

4. Radius of body corner, 4 places.

1.8 FUNCTIONAL DIAGRAM



NOTES:

1. For TO-66, the collector is internally connected to the case.
2. For TO-257, the case is not connected to any lead.

1.9 MATERIALS AND FINISHES

Materials and finishes shall be as follows:

- a) Case
For the metal flange mount (TO-66) package the case shall be hermetically sealed and have a metal body with hard glass seals.
For the metal flange mount (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

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.
- (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:

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

$T_{case} = +25^{\circ}C$

$V_{CE} = -12V$

$I_C = -2A$

Operating Time $\leq 100ms$

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 $T_{amb} = +22 \pm 3^{\circ}C$.

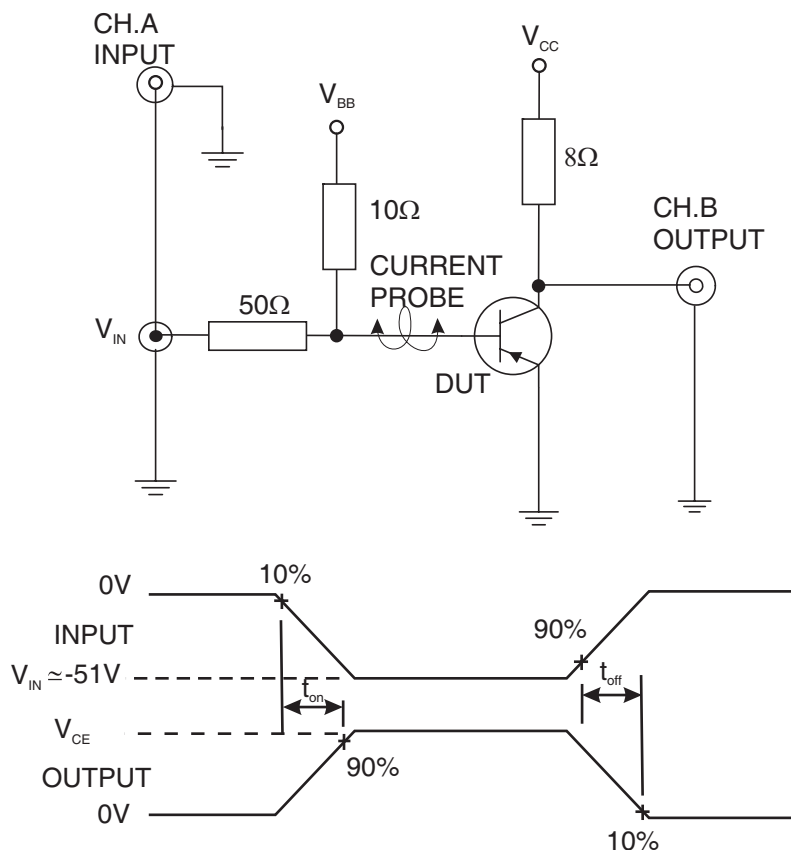
| Characteristics | Symbols | MIL-STD-750 Test Method | Test Conditions | Limits | | Units |
|-------------------------------------|---------------|-------------------------|---|--------|-----|---------|
| | | | | Min | Max | |
| Collector-Emitter Breakdown Voltage | $V_{(BR)CEO}$ | 3011 | $I_C = -50mA$ Bias condition D Note 1 | -80 | - | V |
| | $V_{(BR)CES}$ | 3011 | $I_C = -2mA$ Bias condition C | -100 | - | V |
| Emitter-Base Breakdown Voltage | $V_{(BR)EBO}$ | 3026 | $I_E = -1mA$ Bias condition D | -6 | - | V |
| Collector-Emitter Cut-off Current | I_{CEO} | 3041 | $V_{CE} = -60V$ Bias condition D | - | -10 | μA |

| Characteristics | Symbols | MIL-STD-750 Test Method | Test Conditions | Limits | | Units |
|--|---------------|----------------------------|---|--------|------|-------|
| | | | | Min | Max | |
| Collector-Base Cut-off Current | I_{CBO} | 3036 | $V_{CB}=-80V$ Bias condition D | - | -500 | nA |
| Emitter-Base Cut- off Current | I_{EBO} | 3061 | $V_{EB}=-4V$ Bias condition D | - | -500 | nA |
| Forward-Current Transfer Ratio | h_{FE1} | 3076 | $V_{CE}=-5V$; $I_C = -500mA$ Note 1 | 70 | - | - |
| | h_{FE2} | 3076 | $V_{CE}=-5V$; $I_C = -2A$ Note 1 | 50 | 200 | - |
| | h_{FE3} | 3076 | $V_{CE}=-5V$; $I_C = -5A$ Note 1 | 30 | - | - |
| Collector-Emitter Saturation Voltage | $V_{CE(sat)}$ | 3071 | $I_C=-5A$ $I_B=-500mA$ Notes 1, 2 | - | -1 | V |
| Base-Emitter Saturation Voltage | $V_{BE(sat)}$ | 3066 | $I_C=-5A$ $I_B=-500mA$ Test condition A Notes 1, 2 | - | -1.3 | V |
| High Frequency Small Signal Current Gain | h_{fe} | 3306 | $V_{CE}=-5V$, $I_C=-500mA$ $f=20MHz$ Note 3 | 2.5 | - | - |
| Turn-on Time | t_{on} | - | $I_C=-5A$, $I_{B1}=-500mA$ $I_{B2}=500mA$ $V_{CC}=-40V$ $V_{BB}=4V$ $V_{IN}\approx-51V$ Notes 3, 4 | - | 300 | ns |
| Turn-off Time | t_{off} | - | $I_C=-5A$, $I_{B1}=-500mA$ $I_{B2}=500mA$ $V_{CC}=-40V$ $V_{BB}=4V$ $V_{IN}\approx-51V$ Notes 3, 4 | - | 700 | ns |

NOTES:

1. Pulsed measurement: Pulse Width $\leq 300\mu s$, Duty Cycle $\leq 2\%$.
2. Saturation voltages are measured 6mm from the case.
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: $t_r \leq 20ns$, Pulse Width = $10\mu s$, Duty Cycle = 1%. The sampling oscilloscope for CH.A and CH.B shall have the characteristics $Z_{IN} \geq 100k\Omega$, $C_{IN} \leq 12pF$ and $t_r \leq 5ns$. 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_{CBO} | 3036 | $T_{amb}=+150(+0-5)^{\circ}C$ $V_{CE}=-80V$, Bias Condition D | - | -150 | μA |
| Forward-Current Transfer Ratio 4 | h_{FE4} | 3076 | $T_{amb}=-55(+5-0)^{\circ}C$ $V_{CE}=-5V$ $I_C=-1A$ Note 2 | 25 | - | - |

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 $\leq 300\mu s$, Duty Cycle $\leq 2\%$.

2.6 PARAMETER DRIFT VALUES

Unless otherwise specified, the measurements shall be performed at $T_{amb}=+22 \pm 3^{\circ}C$.

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 | |
| Emitter-Base Cut-off Current | I_{EBO} | ± 100 | - | -500 | nA |
| Forward-Current Transfer Ratio 2 | h_{FE2} | $\pm 25\%$ | 50 | 200 | - |
| Collector-Emitter Saturation Voltage | $V_{CE(sat)}$ | ± 100 | - | -1000 | mV |

2.7 INTERMEDIATE AND END-POINT ELECTRICAL MEASUREMENTS

Unless otherwise specified, the measurements shall be performed at $T_{amb} = +22 \pm 3^{\circ}C$.

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_{CEO} | - | -10 | μA |
| Forward-Current Transfer Ratio 2 | h_{FE2} | 50 | 200 | - |
| Collector-Emitter Saturation Voltage | $V_{CE(sat)}$ | - | -1 | V |

2.8 HIGH TEMPERATURE REVERSE BIAS BURN-IN CONDITIONS

| Characteristics | Symbols | Conditions | Units |
|------------------------|-----------|-------------|-------------|
| Ambient Temperature | T_{amb} | +150(+0 -5) | $^{\circ}C$ |
| Emitter-Base Voltage | V_{EB} | -4.5 | V |
| Collector-Base Voltage | V_{CB} | -80 | V |
| Duration | t | 48 minimum | hours |

NOTES:

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

2.9 POWER BURN-IN CONDITIONS

| Characteristics | Symbols | Conditions | Units |
|-------------------|------------|--|-------------|
| Case Temperature | T_{case} | +100(+0-5) | $^{\circ}C$ |
| Power Dissipation | P_{tot} | As per Maximum Ratings P_{tot} derated at the specified T_{case} | W |

| Characteristics | Symbols | Conditions | Units |
|------------------------|----------|------------|-------|
| Collector-Base Voltage | V_{CB} | -10 | 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 |
|--|--|
| <p>Deviations from Room Temperature Electrical Measurements</p> | <p>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.</p> |
| <p>Deviations from High and Low Temperatures Electrical Measurements</p> | <p>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.</p> |