DOCUMENT CHANGE REQUEST

DCR number 376	Changes required for: N/A	Originator: S Jeffery
Date: 2007/09/21	Date sent: 2007/09/21	Organisation: ESA/ESTEC
Status: IMPLEMENTED		

Title:	Transistors MOSFET P-Channel Power, based on types 2N6849 and 2N6851		
Number:	5206/003	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 Variant 01).

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. Maximum Ratings table: Remark "Over Top" added for Drain-Source, Gate-Source and Gate-Drain voltages.

4. Deletion of obsolete Variant 02 from the available range (not supported by Semelab).

5. Maximum Ratings table: reference to Columns of the Type Variants table replaced by specific ratings (due to the reduction from two Type Variants to a single Type Variant) and columns deleted from Type Variants table accordingly.

6. Maximum Ratings table: Drain Current Characteristic when Tcase = +100°C deleted.

DCR number 376	Changes required for: N/A	Originator: S Jeffery
Date: 2007/09/21	Date sent: 2007/09/21	Organisation: ESA/ESTEC
Status: IMPLEMENTED		

7. Maximum Ratings table: reference to Note 3 for Source Current Characteristic deleted.

8. Maximum Ratings table: Characteristic "Total Power Dissipation" re-named "Power Dissipation"; remark "At Tcase = +25°C" corrected to "At Tcase < or = +25°C".

9. Addition of the following note (Note 5) to the Maximum Ratings table: "For Variants with tin-lead plating or hot solder dip lead finish all testing performed at Tamb >+125°C shall be carried out in a 100% inert atmosphere.".

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

11. Figure 1(b) Maximum Safe Operating Area moved to be a note (Note 4) to the Maximum Ratings table.

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

13. Figure 2 re-named "Physical Dimensions and Terminal Identification" and amended (the 'standardised' TO-39 package drawing has been used to represent the TO-205AF package). Notes amended.

14. Para. 4.2 Deviations from Generic Specification: Deviations re-written per the latest ESCC Generic Specification and "VERIFICATION OF SAFE OPERATING AREA" Para. added; Deviations from Special In-process Controls moved to be a new Para. "WAFER LOT ACCEPTANCE".

15. Para. 4.3.3 Terminal Strength: Erroneous text "Applied Force : 2.2 Newtons. Duration : 10 seconds" deleted.

16. Para. 4.4.1 Case requirements corrected to reflect the TO-205AF metal can package.

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

18. Para. 4.5.1 Required part marking corrected: Lead Identification deleted (not applicable to "TO-" packages) and ESCC qualified components symbol added.

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

20. Table 2, Characteristic "Breakdown Voltage Drain-Source" re-named "Drain-Source Breakdown Voltage" and Symbol amended (was BVDSS, now V(BR)DSS).

21. Table 2, Characteristic "Gate Threshold Voltage" re-named "Gate-Source Threshold Voltage".

22. Table 2, Characteristic "Drain Current": VDS Test Condition amended from a Note reference to -80V.

23. Table 2, Characteristic "Drain-Source ON Resistance" re-named "Drain-Source On-state Resistance".

24. Table 2, Characteristic "Drain-Source ON Voltage" re-named "Drain-Source On-state Voltage".

DCR number 376	Changes required for: N/A	Originator: S Jeffery
Date: 2007/09/21	Date sent: 2007/09/21	Organisation: ESA/ESTEC
Status: IMPLEMENTED		

25. Table 2, Characteristic "Body Drain Diode Forward Voltage" re-named "Diode Forward Voltage" and Test Condition VGS = 0V added.

26. Table 2, Characteristic "Forward Transconductance": Test Method corrected (was 3455, now 3475).

27. Table 2, Characteristics "Turn-on Delay Time", "Rise Time", "Turn-off Delay Time" and "Fall Time" revised (Test Method reference corrected to 3459 (was 3251) for tr, td(off) and tf; Note references in Test Conditions replaced by specific values).

28. Table 2, Characteristic "Common-Source Input Capacitance" re-named "Small-Signal Common-Source Short-Circuit Input Capacitance".

29. Table 2, Characteristic "Common-Source Output Capacitance" re-named "Small-Signal Common-Source Short-Circuit Output Capacitance" and incorrect Test Method (3453) replaced with "-".

30. Table 2, Characteristic "Common-Source Reverse Transfer Capacitance" re-named "Small-Signal Common-Source Short-Circuit Reverse Transfer Capacitance".

31. Table 2: Sampling note for AC parameters tests amended to be a fixed sample of 32 components with 0 failures (or 100%).

32. Figures 4(b) and 4(c) amended and moved to be notes (Notes 4 & 5) to Room Temperature Electrical Measurements.

33. Tables 3(a) and 3(b) combined to form a single table "High and Low Temperatures Electrical Measurements", with test temperatures defined in the Test Conditions.

34. Table 3, Characteristic "Gate Threshold Voltage" re-named "Gate-Source Threshold Voltage".

35. Table 3, Characteristic "Drain Current": VDS Test Condition amended from a Note reference to â..80V.

36. Table 3, Characteristic "Drain-Source ON Resistance" re-named "Drain-Source On-state Resistance".

37. 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.

38. Table 4: 'Spec and/or Test Method' and 'Test Conditions' columns removed; absolute limits have been added for information.

39. Table 4, Characteristic "Gate Threshold Voltage" re-named "Gate-Source Threshold Voltage".

40. Table 4, Characteristic "Drain-Source ON Resistance" re-named "Drain-Source On-state Resistance".

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

DOCUMENT CHANGE REQUEST

DCR number 376	Changes required for: N/A	Originator: S Jeffery
Date: 2007/09/21	Date sent: 2007/09/21	Organisation: ESA/ESTEC
Status: IMPLEMENTED		

Methods as and where applicable.

42. Table 5(a) re-named "High Temperature Reverse Bias Burn-in Conditions" and amended: Test Method and condition added as required by the new Generic 5000 Issue 3; "Minimum" added to Test Condition for duration.

43. Table 5(b) re-named "Power Burn-in Conditions" and amended: Test Method and Condition added as required by the new Generic 5000 Issue 3; Note 1 re-written; Test Conditions for Junction Temperature and Drain-Source Voltage replaced by reference to Note 1; "Minimum" added to Test Condition for duration.

44. Figure 5(a) deleted; Figure 5(b) amended and moved to Note 1 of Power Burn-in Conditions.

45. Table 6, 'Spec and/or Test Method' and 'Test Conditions' columns removed.

46. Table 6, Characteristic "Gate Threshold Voltage" re-named "Gate-Source Threshold Voltage".

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.

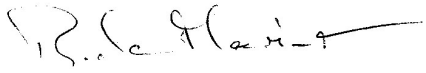
2. To make the format and presentation consistent with the various other ESCC Detail Specifications already converted to ESCC format.

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

4. To introduce a standard note about testing at temperatures >+125°C which was missing from the previous issue.

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

6. Standardisation of the TO-205AF package in all applicable ESCC Detail Specifications.

Attachments:
5206003_Issue_2_-_Draft_A.pdf, null
Modifications:
N/A
Approval signature:

Date signed:
2007-09-21

TRANSISTORS, POWER, MOSFET, P-CHANNEL

BASED ON TYPE 2N6849

ESCC Detail Specification No. 5206/003

Issue 2 - Draft A	August 2007

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

LEGAL DISCLAIMER AND COPYRIGHT

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:

520600301

- Detail Specification Reference: 5206003
- Component Type Variant Number: 01

1.4.2 Component Type Variants

The component type variants applicable to this specification are as follows:

Variant No.	Based on Type	Case	Lead/Terminal Material and Finish	Weight max g
01	2N6849	TO-205AF	D2	1.1

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
Drain-Source Voltage	V_{DS}	-100	V	Over T_{op} Note 4
Gate-Source Voltage	V_{GS}	±20	V	Over T_{op}
Drain-Gate Voltage	V_{DG}	-100	V	Over T_{op}
Drain Current	I_D	-6.5	A	Continuous At T_{case}=+25°C Notes 2, 3, 4
Source Current	I_S	-6.5	A	Continuous At T_{case}=+25°C Note 2
Drain Current Pulsed	I_{DM}	-25	A	Peak Note 2
Power Dissipation	P_{tot}	25	W	At T_{case}=+25°C Note 1
Operating Temperature Range	T_{op}	-55 to +150	°C	Note 5
Storage Temperature Range	T_{stg}	-55 to +150	°C	Note 5
Soldering Temperature	T_{sol}	+300	°C	Note 6
Thermal Resistance, Junction to Case	$R_{th(j-c)}$	5	°C/W	

NOTES:

1. For T_{case} > +25°C, derate linearly to 0W at +150°C.
2. These ratings apply at the case. Leads are not capable of carrying maximum drain or source

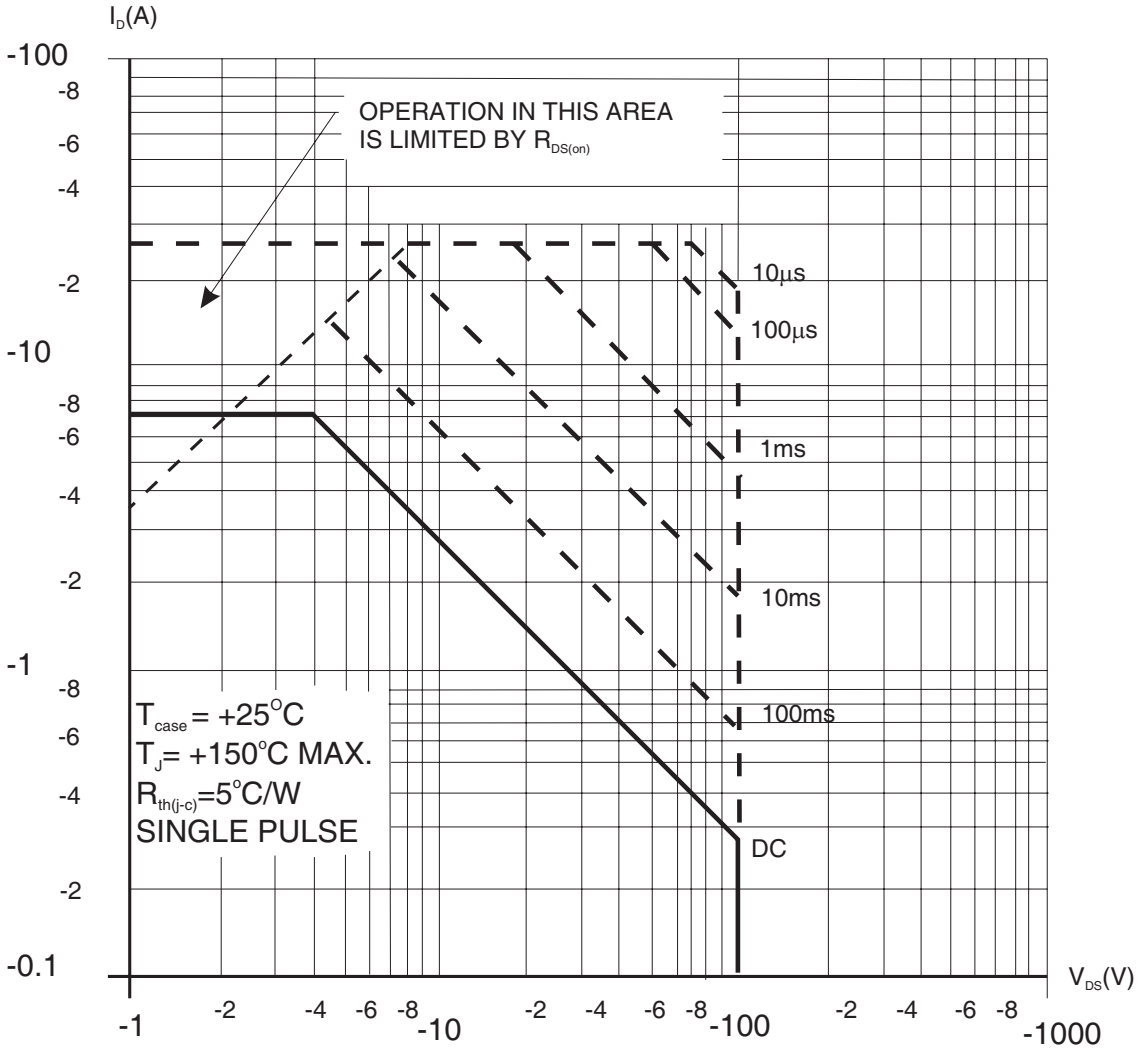
currents beyond 2mm from the case without heatsink.

3. For T_{case} > +25°C, I_D is derated using the following formula:

$$-I_D(A) = \sqrt{\frac{P_{rated}(W)}{0.6}}, \text{ where } P_{rated}(W) = 25 - (0.2\ x(T_{case} - 25))$$

4. Safe Operating Area applies as follows:

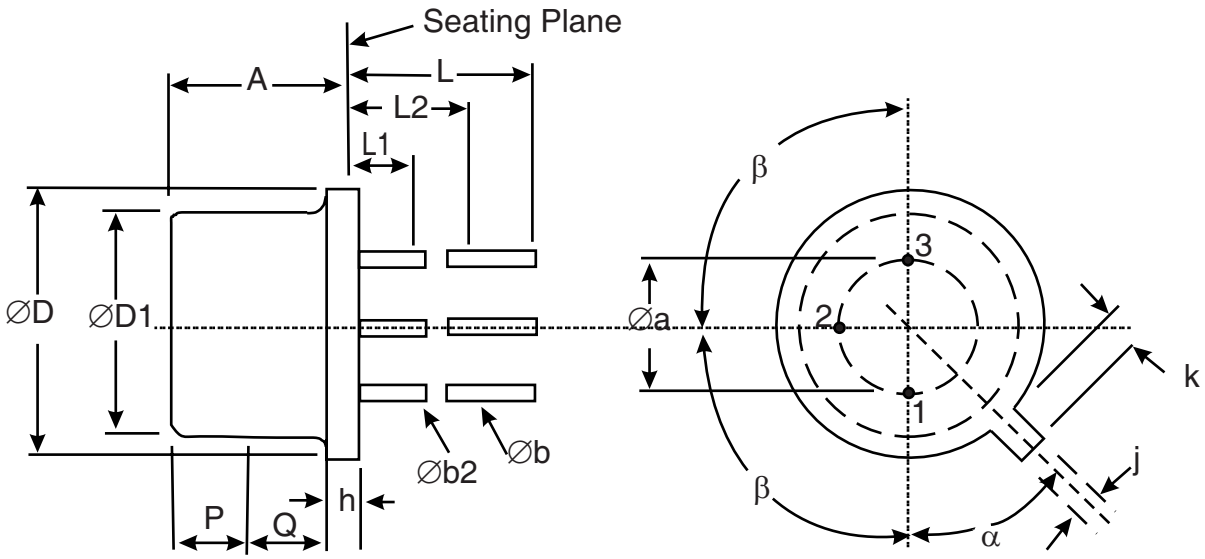
Maximum Safe Operating Area Graph



5. 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.
6. 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

1.6.1 Metal Can Package (TO-205AF) - 3 Lead



Symbols	Dimensions mm		Notes
	Min	Max	
Øa	5.08 BSC		4
A	4.07	4.57	
Øb	0.4	0.533	2, 3
Øb2	0.4	0.483	2, 3
ØD	8.51	9.4	
ØD1	7.75	8.51	6
h	0.229	1.27	
j	0.71	0.864	
k	0.737	1.14	5
L	12.7	19	2
L1	-	1.27	2, 3
L2	6.35	-	2, 3
P	2.54	-	6
Q	-	-	7
α	45° BSC		1, 8
β	90° BSC		1

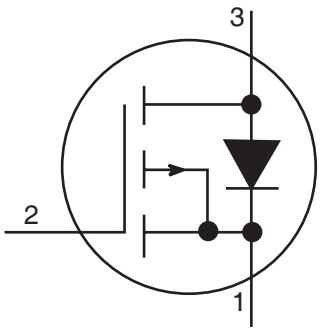
NOTES:

1. Terminal identification is specified by reference to the tab position where Lead 1 = source, Lead 2 = gate and Lead 3 = drain.
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. Leads having maximum diameter 0.483mm measured in the gauging plane 1.37(+0.025,-0)mm below the seating plane of the device shall be within 0.178mm of their true position relative to a maximum-width-tab.
5. Measured from the maximum diameter of the actual device.
6. This zone is controlled for automatic handling. The variation in actual diameter within this zone shall not exceed 0.254mm.
7. The details of outline in this zone are optional.
8. Measured from the Tab Centreline.

1.7 FUNCTIONAL DIAGRAM



1. Source.
2. Gate.
3. Drain.

NOTES:

1. The drain 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

Verification of Safe Operating Area tests shall be performed after Power Burn-In and before Parameter Drift Values (Final Measurements).

2.2 WAFER LOT ACCEPTANCE

SEM Inspection shall be performed as defined in Chart F2 and Para. 5.3.2 of the ESCC Generic Specification.

2.3 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.

2.4 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 method and conditions shall be as follows:

MIL-STD-750, Test Method 3474. T_{case} = +25 ±10°C.

Test Number 1:	Single pulse, duration 100ms. V_{DS} = -80V, I_D = -310mA, R_S = 8.06Ω.
Test Number 2:	Single pulse, duration 100ms. V_{DS} = -3.85V, I_D = -6.5A, R_S = 383mΩ.

2.5 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.

2.6 ELECTRICAL MEASUREMENTS AT ROOM, HIGH AND LOW TEMPERATURES

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

2.6.1 Room Temperature Electrical Measurements

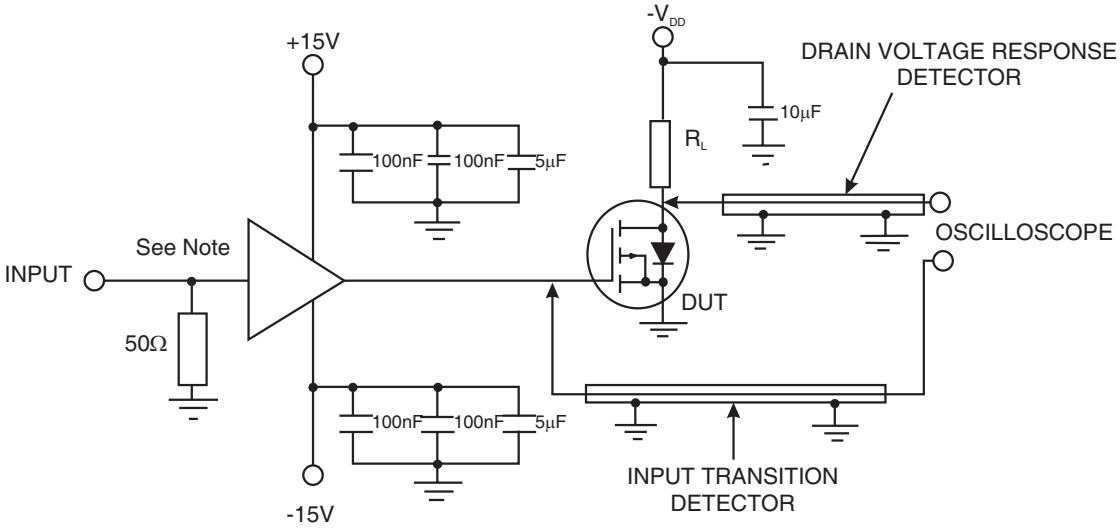
The measurements shall be performed at T_{amb}=+22 ±3°C.

Characteristics	Symbols	MIL-STD-750 Test Method	Test Conditions	Limits		Units
				Min	Max	
Drain-Source Breakdown Voltage	$V_{(BR)DSS}$	3407	I_D=-250µA V_{GS}=0V Bias condition C	-100	-	V
Gate-Source Threshold Voltage	$V_{GS(th)}$	3403	$V_{DS} \geq V_{GS}$ I_D=-250µA	-2	-4	V
Gate-Body Leakage Current	I_{GSS}	3411	V_{GS}=-20V V_{DS}=0V Bias condition C	-	-100	nA
Drain Current	I_{DSS}	3413	V_{DS}=-80V V_{GS}=0V Bias condition C	-	-250	µA
Drain-Source On-state Resistance	$r_{DS(on)}$	3421	V_{GS}=-10V I_D=-4.1A Test Condition A Notes 1, 2	-	300	mΩ
Drain-Source On-state Voltage	$V_{DS(on)}$	3405	V_{GS}=-10V I_D=-6.5A Test Condition A Notes 1, 2	-	-2	V
Diode Forward Voltage	V_{SD}	4011	V_{GS}=0V I_S=-6.5A Note 1	-2	-4.3	V
Forward Trans-conductance	g_{fs}	3475	V_{DS}=-5V I_D=-4.1A Notes 1, 3	2.5	7.5	S
Turn-on Delay Time	$t_{d(on)}$	3459	I_D=-4.1A V_{DD}=-42V Notes 3, 4	-	60	ns
Rise Time	t_r	3459	I_D=-4.1A V_{DD}=-42V Notes 3, 4	-	140	ns
Turn-off Delay Time	$t_{d(off)}$	3459	I_D=-4.1A V_{DD}=-42V Notes 3, 4	-	140	ns
Fall Time	t_f	3459	I_D=-4.1A V_{DD}=-42V Notes 3, 4	-	140	ns
Small-Signal Common-Source Short-Circuit Input Capacitance	C_{iss}	3431	V_{DS}=-25V V_{GS}=0V f=1MHz Note 3	500	950	pF

Characteristics	Symbols	MIL-STD-750 Test Method	Test Conditions	Limits		Units
				Min	Max	
Small-Signal Common-Source Short-Circuit Output Capacitance	C_{oss}	-	V_{DS}=-25V V_{GS}=0V f=1MHz Notes 3, 5	150	450	pF
Small-Signal Common-Source Short-Circuit Reverse Transfer Capacitance	C_{rss}	3433	V_{DS}=-25V V_{GS}=0V f=1MHz Note 3	50	200	pF

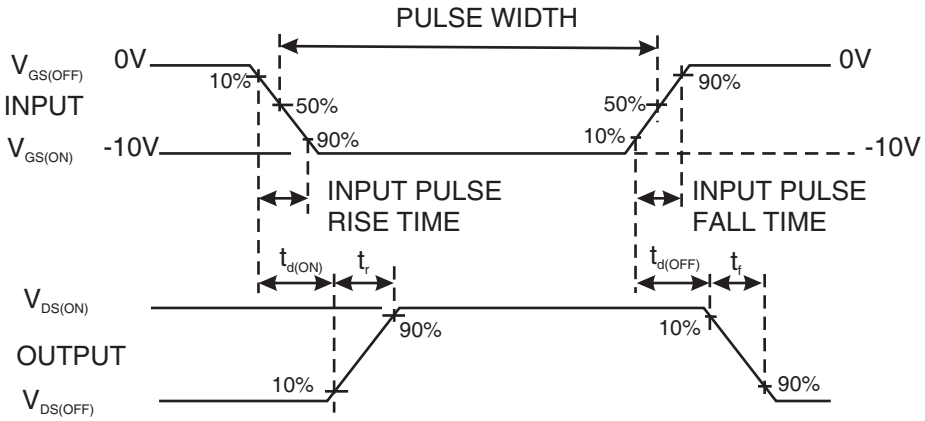
NOTES:

1. Pulsed measurement: Pulse Width ≤ 300µs, Duty Cycle ≤ 2%.
2. $r_{DS(on)}$ and $V_{DS(on)}$ measurements shall be made no more than 2mm 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. $t_{d(on)}$, t_r, $t_{d(off)}$ and t_f 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, Pulse Width ≤ 3s, Period ≤ 1ms, Amplitude = 0V to -10V. The input transition and drain voltage response detectors shall have rise and fall response times such that doubling these responses will not affect the results greater than the precision of measurement. The current through these detectors shall be sufficiently small so that doubling it does not affect the results greater than the precision of measurement.

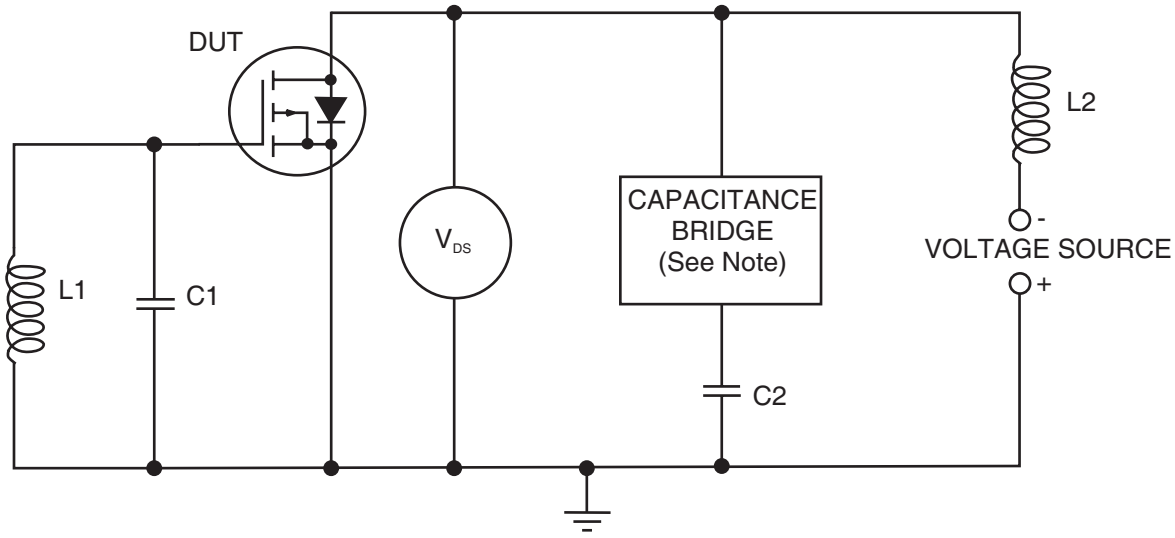


NOTE: The amplifier shall be a suitable voltage follower/buffer amplifier.

VOLTAGE WAVEFORMS



5. C_{oss} shall be measured using the test circuit shown below.



NOTE: The capacitance bridge shall have low DC resistance between its output terminals and should be capable of carrying the test current without affecting the desired accuracy of measurement.

2.6.2 High and Low Temperatures Electrical Measurements

Characteristics	Symbols	MIL-STD-750 Test Method	Test Conditions Note 1	Limits		Units
				Min	Max	
Gate-Source Threshold Voltage	$V_{GS(th)}$	3403	$V_{DS} \geq V_{GS}$ I_D=-250µA T_{amb}=+125(+0-5)°C T_{amb}=-55(+5-0)°C	 -1 -	 - -5	V
Gate-Body Leakage Current	I_{GSS}	3411	T_{amb}=+125(+0-5)°C V_{GS}=-20V V_{DS}=0V Bias condition C	-	-200	nA
Drain Current	I_{DSS}	3413	T_{amb}=+125(+0-5)°C V_{DS}=-80V V_{GS}=0V Bias condition C	-	-1	mA
Drain-Source On-state Resistance	$r_{DS(on)}$	3421	T_{amb}=+125(+0-5)°C V_{GS}=-10V I_D=-4.1A Test Condition A Notes 2, 3	-	540	mΩ

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%.
3. $r_{DS(on)}$ measurements shall be made no more than 2mm from the case.

2.7 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	
Gate-Source Threshold Voltage	$V_{GS(th)}$	±20%	-2	-4	V
Gate-Body Leakage Current	I_{GSS}	±20 or (1) ±100%	-	-100	nA
Drain Current	I_{DSS}	±25 or (1) ±100%	-	-250	µA
Drain-Source On-state Resistance	$r_{DS(on)}$	±20%	-	300	mΩ

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

2.8 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	
Gate-Source Threshold Voltage	$V_{GS(th)}$	-2	-4	V
Gate-Body Leakage Current	I_{GSS}	-	-100	nA
Drain Current	I_{DSS}	-	-250	µA

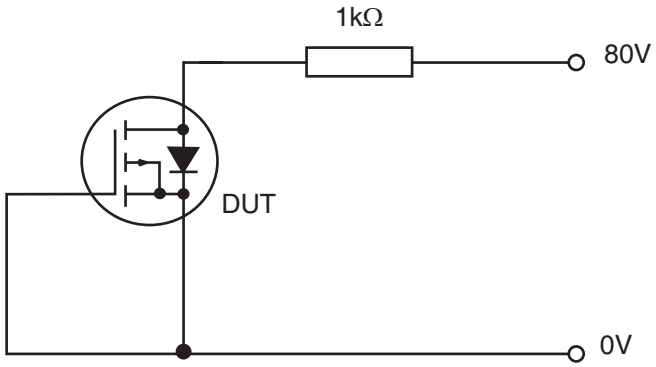
2.9 HIGH TEMPERATURE REVERSE BIAS BURN-IN CONDITIONS

MIL-STD-750, Test Method 1039, Condition A.

Characteristics	Symbols	Test Conditions	Units
Ambient Temperature	T_{amb}	+150(+0-5)	^{o}C
Drain-Source Voltage	V_{DS}	80	V
Gate-Source Voltage	V_{GS}	0	V
Duration	t	72 minimum	hours

NOTES:

1. High temperature reverse bias burn-in shall be performed using the circuit shown below.



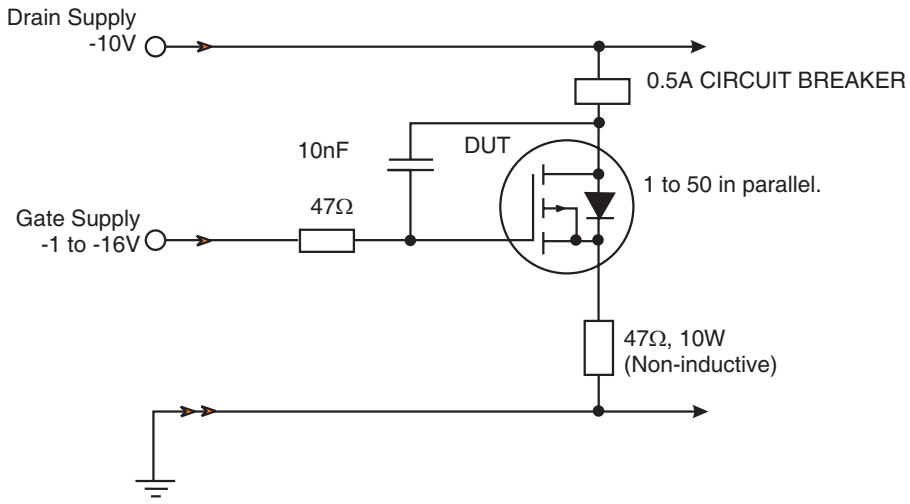
2.10 POWER BURN-IN CONDITIONS

MIL-STD-750, Test Method 1039, Condition B.

Characteristics	Symbols	Test Conditions	Units
Junction Temperature	T_J	Note 1	^{o}C
Drain-Source Voltage	V_{DS}	Note 1	V
Gate-Source Voltage	V_{GS}	-1 to -16	V
Duration	t	240 minimum	hours

NOTES:

1. Using the circuit shown below, power shall be applied to the device to achieve a junction temperature of +140 ±10^{o}C. The junction temperature shall be calculated as follows:
   $T_J(^{o}C) = V_{DS}(V) \times I_D(A) \times R_{th(j-c)}(^{o}C/W) + T_{case}(^{o}C)$, where
   V_{DS} = -10V,
   $R_{th(j-c)}$ = 5^{o}C/W,
   T_{case} is the highest temperature recorded on the case at any point during the test, and
   I_D = as required, but not exceeding the limits given in Maximum Ratings.



2.11 OPERATING LIFE CONDITIONS

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