DOCUMENT CHANGE REQUEST

DCR number 386	Changes required for: General	Originator: S Jeffery
Date: 2007/10/24	Date sent: 2007/10/24	Organisation: ESA/ESTEC
Status: IMPLEMENTED		

Title:	Transistors Field-Effect N-Channel, based on types 2N4416 and 2N4416A		
Number:	5205/004	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 01 and 02).

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 entire operating temperature range" added for Drain-Source, Gate-Source and Gate-Drain voltages.

4. Maximum Ratings table: Characteristic "Total Power Dissipation (see Figure 1)" re-named "Power Dissipation" and reference to Figure 1 deleted, Remark amended from "Tamb = +25deg.C" to "Tamb <or= +25deg.C".

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

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

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7. Figure 2 re-named "Physical Dimensions and Terminal Identification"; Notes revised (addition of Note 1 about Terminal Identification and Note 2 "applies to all leads" for dims. 'Ã.b', 'Ã.b2', 'L', 'L1' and 'L2').

8. Para. 4.2 Deviations from Generic Specification: Deviations revised/re-written per the latest ESCC Generic Specification.

9. Para. 4.4.1 Case requirements corrected to reflect the TO-72 metal can package.

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

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

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

13. Table 2, Characteristic "Total Gate Leakage Current" re-named "Gate Reverse Leakage Current".

14. Table 2, Characteristic "Gate Source Voltage" re-named "Gate-Source Forward Voltage"; Symbol corrected from VGS to VGSF; Test Method reference "See Figure 4(b)" deleted and replaced with "3403".

15. Table 2, Characteristic "Input Capacitance" re-named "Small-Signal Common-Source Short-Circuit Input Capacitance"; Test Conditions "VGS = 15V" and "VDS = 0V" corrected to "VDS = 15V" and "VGS = 0V".

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

17. Table 2, Characteristic "Modulus of Forward Transfer Admittance" re-named "Modulus of Small-Signal Common-Source Short-Circuit Forward Transfer Admittance"; Test Method 3475 and associated Test Conditions deleted; Unit corrected (was ms, now mS).

18. Table 2, Characteristic "Modulus of Output Admittance" re-named "Modulus of Small-Signal Common-Source Short-Circuit Output Admittance"; Test Method 3475 and associated Test Conditions deleted; Unit corrected (was Âµs, now ÂµS).

19. Table 2, Characteristic "Power Gain (Neutralised)" re-named "Small-Signal Common-Source Insertion Power Gain (Neutralised)"; Test Method reference "See Figure 4(a)" deleted; Test Condition "RG = 1kOhm" added.

20. Table 2, Characteristic "Noise Factor": Symbol amended to "NF" (was "F"); Test Method reference "See figure 4(a)" deleted.

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

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22. Figure 4(a) corrected and moved to be a note (Note 3) to Room Temperature Electrical Measurements.

23. Table 3, Characteristic "Total Gate Leakage Current" re-named "Gate Reverse Leakage Current"; tolerance added to test temperature.

24. 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.

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

26. Table 4, Characteristic "Total Gate Leakage Current" re-named "Gate Reverse Leakage Current".

27. Tables 2, 3 and 4 - Test Conditions column: addition of Test, or Bias, Conditions for referenced MIL-STD-750 Test Methods as and where applicable.

28. Table 5 amended: Tolerance added to test temperature; duration changed from being a note to a characteristic; separate paragraph "Operating Life Conditions" added.

29. Table 6, Characteristic "Total Gate Leakage Current" re-named "Gate Reverse Leakage Current".

Justification:

(see also change details for each item above)

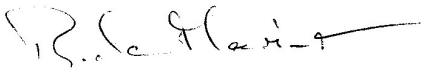
1. Part of the ongoing activity of conversion of cover-sheeted ESA/SCC Specifications to the ESCC format.

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 make corrections to technical errors in the previous issue.

5. Standardisation of the TO-72 package in all applicable ESCC Detail Specifications.

Attachments:
5205004_Issue_2_-_Draft_A.pdf, null
Modifications:
The following Change Items also apply: Maximum Ratings table: Characteristic Gate-Drain Voltage amended (max. rating for Variant 01 is -30V and max. rating for Variant 02 is -35V). Maximum Ratings table: Maximum Operating Temperature is amended (was +200, now +150). Parameter Derating Information: Maximum Ambient Temperature is amended (was +200°C, now +150°C). Room Temperature Electrical Measurements: Limits for Small-Signal Common-Source Short-Circuit Reverse Transfer Capacitance is amended to 0.8pF max. for both Variants. .....
Approval signature:

Date signed:
2007-10-24

TRANSISTORS, FIELD-EFFECT, N-CHANNEL

BASED ON TYPE 2N4416 AND 2N4416A

ESCC Detail Specification No. 5205/004

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: 520500401

- Detail Specification Reference: 5205004
- 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	2N4416	TO-72	D2	0.9
02	2N4416A	TO-72	D2	0.9

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.

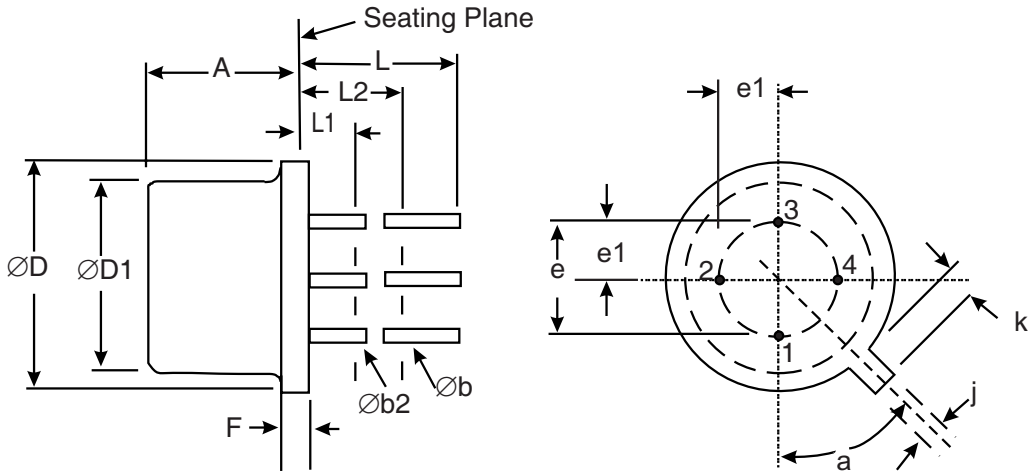
Characteristics	Symbols	Maximum Ratings	Unit	Remarks
Drain-Source Voltage	V_{DS}	30	V	Over entire operating temperature range
Gate-Source Voltage Variant 01 Variant 02	V_{GS}	 -30 -35	V	
Gate-Drain Voltage	V_{GD}	-30	V	
Gate Current	I_G	10	mA	
Power Dissipation	P_{tot}	300	mW	At $T_{amb} \leq +25^oC$ Note 1
Operating Temperature Range	T_{op}	-55 to +200	^oC	
Storage Temperature Range	T_{stg}	-65 to +200	^oC	
Soldering Temperature	T_{sol}	+235	^oC	Note 3

NOTES:

1. For $T_{amb} > +25^oC$, derate linearly to 0W at $+200^oC$.
2. 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-72) - 4 lead



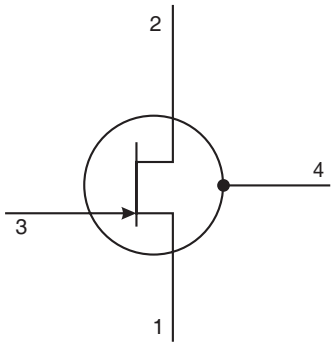
Symbols	Dimensions mm		Notes
	Min	Max	
A	4.32	5.33	
Øb	0.406	0.533	2, 3
Øb2	0.406	0.483	2, 3
ØD	5.31	5.84	

Symbols	Dimensions mm		Notes
	Min	Max	
ØD1	4.52	4.95	
e	2.54 TP		5
e1	1.27 TP		5
F	-	0.762	
j	0.914	1.17	
k	0.711	1.22	4
L	12.7	-	2, 3
L1	-	1.27	2, 3
L2	6.35	-	2, 3
a	45^{o} TP		5, 6

NOTES:

1. Terminal identification is specified by reference to the tab position where lead 1 = source, lead 2 = drain, lead 3 = gate and lead 4 = connected to the case.
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. Measured from the maximum diameter of the actual device.
5. 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.
6. Measured from the tab centreline.

1.7 FUNCTIONAL DIAGRAM



1. Source.
2. Drain.
3. Gate.
4. Connected to 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

(a) Deviation from Screening Tests - Chart F3

Power Burn-in and the subsequent Parameter Drift Values (Final Measurements) shall be omitted.

2.2 WAFER LOT ACCEPTANCE

SEM Inspection shall be performed.

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 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 5 Newtons for a period of 10 seconds.

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

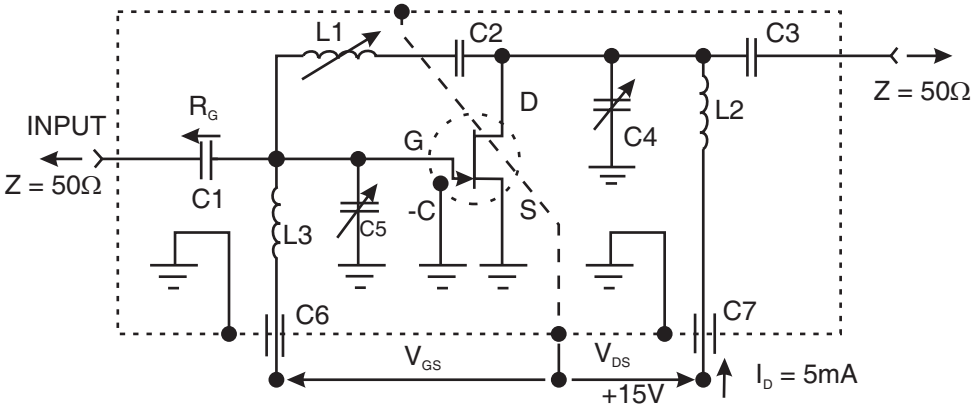
The measurements shall be performed at T_{amb}=+22 ±3°C.

Characteristics	Symbols	MIL-STD-750 Test Method	Test Conditions	Limits		Units
				Min	Max	
Gate Reverse Leakage Current	I_{GSS}	3411	V_{DS}=0V V_{GS}=-20V Bias condition C	-	-100	pA
Gate-Source Breakdown Voltage Variant 01 Variant 02	$V_{(BR)GSS}$	3401	V_{DS}=0V I_G=1µA Bias condition C	 -30 -35	 - -	V
Gate-Source Forward Voltage	V_{GSF}	3403	V_{DS}=0V I_G=1mA	-	1	V
Gate-Source Cut-off Voltage Variant 01 Variant 02	$V_{GS(off)}$	3403	V_{DS}=15V I_D=1nA	 - -2.5	 -6 -6	V
Drain Current	I_{DSS}	3413	V_{DS}=15V Bias condition C Note 1	5	15	mA
Gate-Source Voltage	V_{GS}	3403	V_{DS}=15V I_D=500nA	-1	-5.5	V
Small-Signal Common-Source Short-Circuit Input Capacitance	C_{iss}	3431	V_{DS}=15V V_{GS}=0V f=1MHz Note 2	-	4	pF
Small-Signal Common-Source Short-Circuit Reverse Transfer Capacitance Variant 01 Variant 02	C_{rss}	3433	V_{DS}=15V V_{GS}=0V f=1MHz Note 2	 - -	 0.9 0.8	pF
Modulus of Small-Signal Common-Source Short-Circuit Forward Transfer Admittance	$\lvert Y_{21s}\rvert$	3455	V_{DS}=15V V_{GS}=0V f=1kHz Notes 1, 2	4.5	7.5	mS
Modulus of Small-Signal Common-Source Short-Circuit Output Admittance	$\lvert Y_{22s}\rvert$	3453	V_{DS}=15V V_{GS}=0V f=1kHz Notes 1, 2	-	50	µS
Small-Signal Common-Source Insertion Power Gain (Neutralised)	G_P	-	V_{DS}=15V I_D=5mA R_G=1kΩ f=400MHz Notes 2, 3	10	-	dB

Characteristics	Symbols	MIL-STD-750 Test Method	Test Conditions	Limits		Units
				Min	Max	
Noise Factor	NF	-	V_{DS}=15V I_D=5mA R_G=1kΩ f=400MHz Notes 2, 3	-	4	dB

NOTES:

1. Pulsed measurement: Pulse Width ≤ 300µs, 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. Small-signal common-source insertion power gain (neutralised) and noise factor shall be measured using the following test circuit.



Adjust V_{GS} for I_D = 5mA and V_{GS} < 0V

Capacitor	Required Value
C1	1.8pF
C2	27pF
C3	1pF
C4	0.8 - 8 pF
C5	0.8 - 8 pF
C6	1nF
C7	1nF

Inductor	Value (nH)	No. of Turns	Characteristics
L1	200	6	No. 24 enamelled copper wire, close wound on 5.563mm ceramic coil form

Inductor	Value (nH)	No. of Turns	Characteristics
L2	30	1	No. 16 enamelled copper wire, 9.525mm ID (air core)
L3	22	1/2	No. 16 enamelled copper wire, 6.35mm ID (air core)

2.5.2 High and Low Temperatures Electrical Measurements

Characteristics	Symbols	MIL-STD-750 Test Method	Test Conditions Note 1	Limits		Units
				Min	Max	
Gate Reverse Leakage Current	I_{GSS}	3411	T_{amb}=+150(+0-5)°C V_{DS}=0V V_{GS}=-20V Bias condition C	-	-200	nA

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.

2.6 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	
Gate Reverse Leakage Current	I_{GSS}	±50 or (1) ±100%	-	-100	pA
Gate-Source Cut-off Voltage Variant 01 Variant 02	$V_{GS(off)}$	±10%	 - -2.5	 -6 -6	V
Drain Current	I_{DSS}	±15%	5	15	mA

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

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	
Gate Reverse Leakage Current	I_{GSS}	-	-100	pA
Gate-Source Cut-off Voltage Variant 01 Variant 02	$V_{GS(off)}$	 - -2.5	 -6 -6	V
Drain Current	I_{DSS}	5	15	mA

2.8 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}	0	V
Gate-Source Voltage	V_{GS}	-21	V
Duration	t	168 Minimum	Hours

2.9 OPERATING LIFE CONDITIONS

The conditions shall be as specified for High Temperature Reverse Bias Burn-in, except the duration shall be as specified in the ESCC Generic Specification.