TRANSISTORS, MICROWAVE, GaN HEMT POWER BAR, DC – 6GHz

BASED ON TYPES CHK8101-SYC, CHK8201-SYA AND CHKA012bSYA

ESCC Detail Specification No. 5614/009

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DCR No.	CHANGE DESCRIPTION

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. 5010

(b) MIL-STD-883, Test Method Standard, Microcircuits

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: 561400901

- Detail Specification Reference: 5614009
- 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	Number of Transistors	Case (Note 1)	Lead Material and Finish (Note 2)	Weight max g
01	CHK8101-SYC	1	Ceramic-Metal, Flanged, Type C	P14	2
02	CHK8201-SYA	2	Ceramic-Metal, Flanged, Type A	P14	2
03	CHKA012bSYA	1	Ceramic-Metal, Flanged, Type A	P14	2

NOTES:

1. See Para. 1.8.
2. The lead 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	Units	Remarks
Drain-Source Voltage	V_{DS}	60	V	
Gate-Source Voltage Range	V_{GS}	-10 to +2	V	
Mean Forward-Mode Gate Current Variant 01 Variant 02 Variant 03	$I_{G\_FWD\_MEAN}$	 32 64 200	mA	Note 1
Input Power	P_{in}	See Note 2	dBm	
Operating Temperature Range	T_{op}	-40 to +85	°C	T_{amb}
Storage Temperature Range	T_{stg}	-55 to +150	°C	
Thermal Resistance, junction-to-case Variant 01 Variant 02 Variant 03	$R_{th(j-c)}$	 6.1 3 1.26	°C/W	CW, T_J = +200°C T_{case} = +115°C, P_D = 14W T_{case} = +95°C, P_D = 35W T_{case} = +96°C, P_D = 82.7W
Junction Temperature	T_J	+230	°C	
Soldering Temperature	T_{sol}	+245	°C	Note 3

NOTES:

1. Mean Forward-Mode Gate Current at saturation, with RF signal.
2. Linked to and limited by I_G. The maximum Input Power, P_{in_max}, is dependent on frequency and should not exceed the maximum Power-Added Efficiency (PAEmax) +1dB.
3. Duration 5 seconds maximum at a distance of not less than 0.5mm from the device body and the same lead shall not be resoldered until 3 minutes have elapsed.

1.6 SAFE OPERATING AREA

The safe operating areas with respect to multipaction and corona phenomena in a vacuum environment are shown below:

Characteristics	Symbols	Maximum Ratings	Units	Remarks
Drain-Source Voltage RF Excursion (pulse mode)	V_{DS_peak}	≤133	V	Multipaction phenomena (see Note 1)
		≤138	V	Corona phenomena (See Note 2)

NOTES:

1. For multipaction:
   - Pressure: 1.5×10^{-5} mbar
   - Frequency: 1.25GHz
   - T_{test_board}: -30 to +70°C
2. For corona:
   - Pressure: 900 to 1.5×10^{-5} mbar
   - Frequency: 1.25GHz
   - T_{test_board}: -30 to +70°C

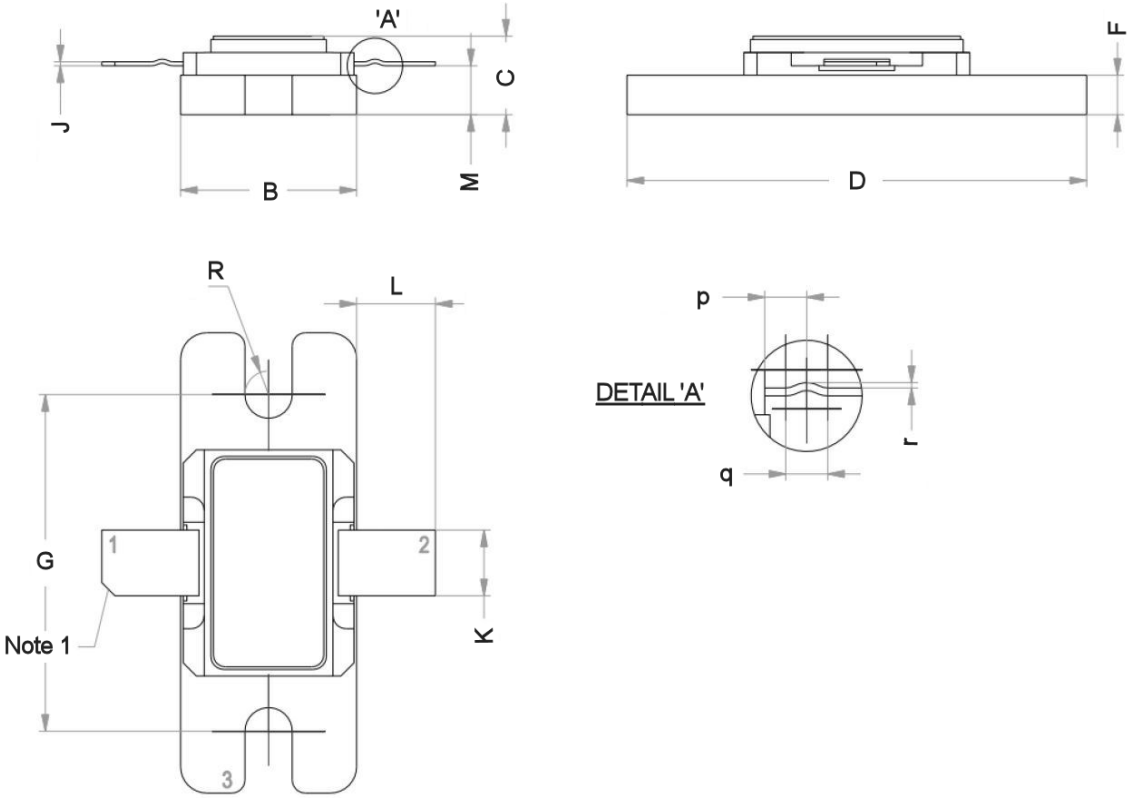
1.7 HANDLING PRECAUTIONS

These devices are susceptible to damage by electrostatic discharge. Therefore suitable precautions shall be employed for protection during all phases of manufacture test, packaging, shipping and handling.

These components are categorised as Class 1 per ESCC Basic Specification No. 23800 with a Minimum Critical Path Failure Voltage of 100V.

1.8 PHYSICAL DIMENSIONS AND TERMINAL IDENTIFICATION

1.8.1 Variant 01 – Ceramic-Metal Flanged Package, Type C



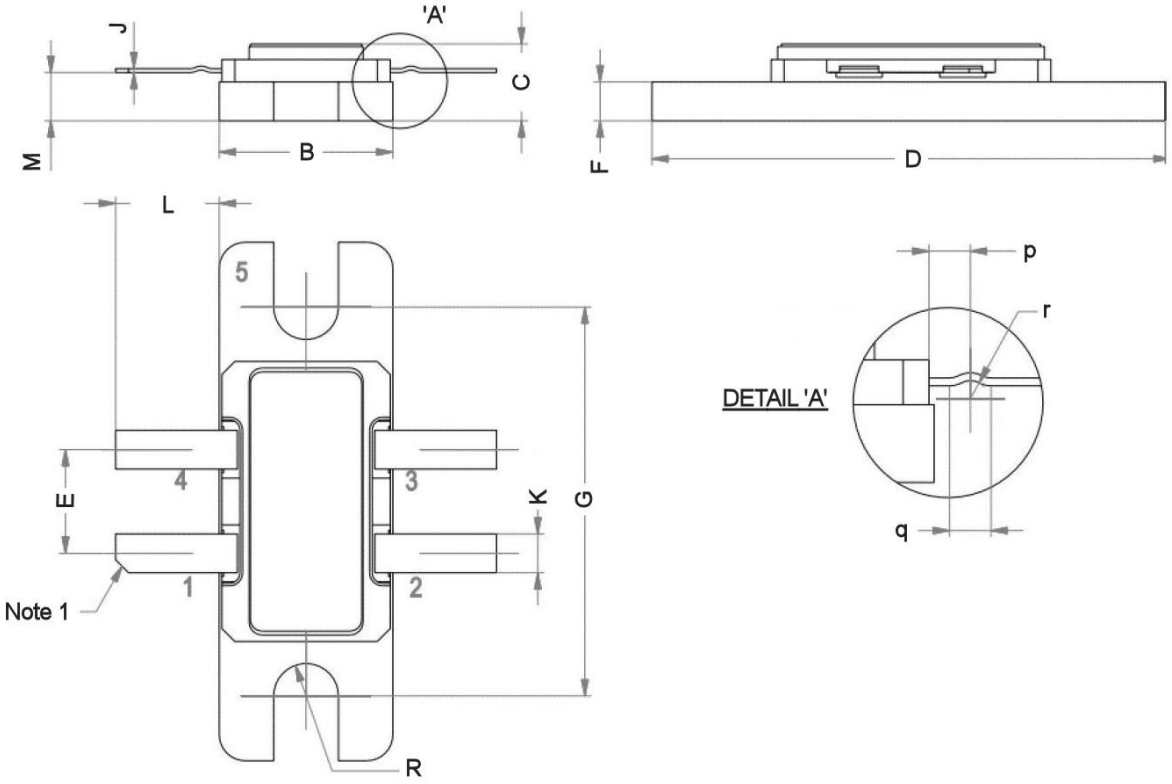
Symbols	Dimensions mm		Notes
	Min	Max	
B	6.55	6.85	2
C	-	3	
D	17.35	17.65	
F	1.35	1.65	
G	12.65	12.95	
J	0.13	0.2	
K	2.35	2.65	2
L	2.7	3.3	2
M	1.665	2.065	2
R	0.75	1.05	3
p	0.8 Typical		2, 4
q	0.8 Typical		2, 4
r	0.1 Typical		2, 4

NOTES:

1. Terminal identification is by means of a chamfer on Lead 1 and the package configuration, where Lead 1 is the Gate, Lead 2 is the Drain and the heatsink (flange) is Ground/Source.
2. Applies to both leads.

3. Applies in two places.
4. This dimension applies to the stress-relief region of the lead and is for information only.

1.8.2 Variants 02 and 03 – Ceramic-Metal Flanged Package, Type A



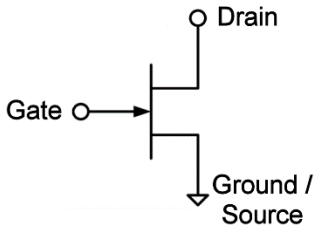
Symbols	Dimensions mm		Notes
	Min	Max	
B	6.55	6.85	2
C	-	3	
D	19.85	20.15	
E	3.85	4.15	3
F	1.35	1.65	
G	14.85	15.15	
J	0.13	0.2	
K	1.35	1.65	2
L	3.5	4.5	2
M	1.665	2.065	2
R	1.1	1.4	3
p	0.775	0.825	2, 4
q	0.8 Typical		2, 4
r	0.2	0.5	2, 4

NOTES:

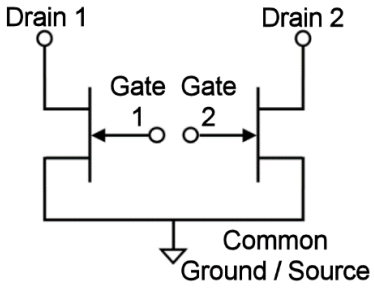
1. Terminal identification is by means of a chamfer on Lead 1 and the package configuration. For Variant 02 (single transistor), Leads 1 and 4 are the Gate, Leads 2 and 3 are the Drain and the heatsink is Ground/Source. For Variant 03 (dual transistor), Lead 1 and Lead 4 are the two Gates, Lead 2 and Lead 3 are the two Drains and the heatsink (flange) is common Ground/Source.
2. Applies to all leads.
3. Applies in two places.
4. This dimension applies to the stress-relief region of the lead and is for information only.

1.9 FUNCTIONAL DIAGRAMS

1.9.1 Variants 01 and 03



1.9.2 Variant 02



1.10 MATERIALS AND FINISHES

Materials and finishes shall be as follows:

(a) Case and Heatsink
The case shall be hermetically sealed and have a ceramic body with a metal lid and a heatsink made of copper alloy with gold plating (gold 1µm minimum) over nickel underplating (nickel 2µm minimum).

(b) Leads
As specified in Para. 1.4.2 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 Deviations from Production Control – Chart F2

(a) Bond Strength shall be performed in accordance with MIL-STD-883 Test Method 2011, Test Condition D.

(b) Die Shear shall be performed in accordance with MIL-STD-883 Test Method 2019.

2.1.1.2 Deviations from Screening Tests for Packaged Components – Chart F3A

(a) Burn-in 1 shall be performed in accordance with MIL-STD-883 Test Method 1015, Test Conditions A and B, as follows:

Step 1 of 2 – Steady-state, reverse bias (Test Condition A)
- Duration: 10 hours minimum
- Test Temperature: T_{amb} +125°C

Step 2 of 2 – Steady-state, forward bias (Test Condition B)
- Duration: 10 hours minimum
- Test Temperature: T_J +200°C

(b) Burn-in 2 shall be performed in accordance with MIL-STD-883 Test Method 1015, Test Condition B.
- Duration: 240 hours
- Test Temperature: T_J +200°C

(c) Radiographic Inspection shall be performed in accordance with MIL-STD-883 Test Method 2012.

(d) Seal shall be performed in accordance with MIL-STD-883 Test Method 1014, Test Conditions A_2 (Fine Leak) and C_1 (Gross Leak).

(e) External Visual Inspection shall be performed in accordance with MIL-STD-883 Test Method 2009.

2.1.1.3 Deviations from Qualification and Periodic Tests for Packaged Components - Chart F4A

(a) Temperature Cycling shall be performed in accordance with MIL-STD-883 Test Method 1010 (100 cycles, -55°C / +150°C).

(b) Mechanical Shock shall be performed in accordance with MIL-STD-883 Test Method 2002, Test Condition B.

(c) Vibration shall be performed in accordance with MIL-STD-883 Test Method 2007, Test Condition A.

(d) Constant Acceleration shall be performed in accordance with MIL-STD-883 Test Method 2001, Test Condition E, Y_1 axis only.

(e) Moisture Resistance shall be performed in accordance with MIL-STD-883 Test Method 1004, no bias.

(f) Seal shall be performed in accordance with MIL-STD-883 Test Method 1014, Test Conditions A_2 (Fine Leak) and C_1 (Gross Leak).

(g) Operating Life shall be performed in accordance with MIL-STD-883 Test Method 1015, Test Condition B.

(h) External Visual Inspection shall be performed in accordance with MIL-STD-883 Test Method 2009.

(i) Solderability shall be performed in accordance with MIL-STD-883 Test Method 2003.

(j) Terminal Strength shall be performed in accordance with MIL-STD-883 Test Method 2004, Test Conditions A (Tension) and B_2 (Lead Fatigue).

(k) Internal Visual Inspection shall be performed in accordance with MIL-STD-883 Test Method 2010.

(l) Bond Strength shall be performed in accordance with MIL-STD-883 Test Method 2011, Test Condition D.

(m) Die Shear shall be performed in accordance with MIL-STD-883 Test Method 2019.

2.2 MARKING

The marking shall be in accordance with the requirements of ESCC Basic Specification No. 21700. The information to be marked and the order of precedence shall be as follows:

(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 BOND STRENGTH

The test conditions for bond strength, tested as specified in Para. 2.1.1 Deviations from the Generic Specification, are as follows:

- Test Condition D, wire pull (double bond). 24 wires (4 wires per die) shall be tested.

No failures are permitted.

2.4 DIE SHEAR

Die shear shall be performed in accordance with the requirements specified in Para. 2.1.1 Deviations from the Generic Specification.

No failures are permitted.

2.5 TERMINAL STRENGTH

The test conditions for terminal strength, tested as specified in Para. 2.1.1 Deviations from the Generic Specification, shall be as follows:

- Test Condition A, tension, with a force of 2.22N and a duration of 30s
- Test Condition B_2, lead fatigue. The force shall be 2.246N. Each lead shall be tested for three 90° ±5° arcs.

No failures are permitted.

2.6 ELECTRICAL MEASUREMENTS AT ROOM, HIGH AND LOW TEMPERATURES

2.6.1 Room Temperature Electrical Measurements

The measurements shall be performed at T_{amb} = +25 ±3°C.

Characteristics	Symbols	Test Conditions	Limits		Units
			Min	Max	
Quiescent Current	I_{D_Q}	f = 1.3GHz, V_D = 50V (Note 1)			mA
		Variant 01: P_{in} = 0dBm	90	110	
		Variant 02: P_{in} = 0dBm	180	220	
		Variant 03: P_{in} = 10dBm	576	704	
Drain Current (at saturation)	I_D	f = 1.3GHz, V_D = 50V (Note 1)			A
		Variant 01: P_{in} = PAEmax	0.55	0.85	
		Variant 02: P_{in} = PAEmax	1.3	1.9	
		Variant 03: P_{in} = PAEmax	3	5.5	
Gate Leakage Current	I_{GL}	V_D = 50V, V_G = -7V			mA
		Variant 01	-0.4	-	
		Variant 02	-0.8	-	
		Variant 03	-2.56	-	
Linear Gain	$G_{L1.3}$	f = 1.3GHz, V_D = 50V (Note 1)			dB
		Variant 01: P_{in} = 0dBm	17.5	-	
		Variant 02: P_{in} = 0dBm	20.5	-	
		Variant 03: P_{in} = 10dBm	19	-	
Output Power (at saturation)	P_{out}	f = 1.3GHz, V_D = 50V (Note 1)			dBm
		Variant 01: P_{in} = PAEmax	42	-	
		Variant 02: P_{in} = PAEmax	45.5	-	
		Variant 03: P_{in} = PAEmax	49.5	-	

NOTES:

1. Pulsed measurement, pulse duration < 1s, single pulse. I_G may exceed the applicable $I_{G\_FWD\_MEAN}$ value specified in Para. 1.5.

2.6.2 High and Low Temperatures Electrical Measurements

The measurements shall be performed at T_{amb} = +85 (+0 -3) °C and T_{amb} = -40 (+3 -0) °C.

Characteristics	Symbols	Test Conditions (Note 1)	Limits		Units
			Min	Max	
Linear Gain	$G_{L1.3}$	f = 1.3GHz, V_D = 50V (Note 2)			dB
		Variant 01: P_{in} = 0dBm	16.2	-	
		Variant 02: P_{in} = 0dBm	19.3	-	
		Variant 03: P_{in} = 10dBm	17.9	-	
Output Power (at saturation)	P_{out}	f = 1.3GHz, V_D = 50V (Note 2)			dBm
		Variant 01: P_{in} = PAEmax	41.6	-	
		Variant 02: P_{in} = PAEmax	45.3	-	
		Variant 03: P_{in} = PAEmax	49.1	-	

NOTES:

1. Measurements shall be performed on a sample of 5 components. In the event of any failure a 100% inspection shall be performed.
2. Pulsed measurement, pulse duration < 1s, single pulse. I_G may exceed the applicable $I_{G\_FWD\_MEAN}$ value specified in Para. 1.5.

2.7 PARAMETER DRIFT VALUES

Unless otherwise specified, the measurements shall be performed at T_{amb} = +25 ±3°C.

The test conditions shall be as per the corresponding test defined in Para. 2.6.1 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	
Quiescent Current	I_{D_Q}	±20%			mA
Variant 01			90	110	
Variant 02			180	220	
Variant 03			576	704	
Drain Current (at saturation)	I_D	±20%			A
Variant 01			0.55	0.85	
Variant 02			1.3	1.9	
Variant 03			3	5.5	
Gate Leakage Current (pinch-off)	I_{GL_HV}	Note 1			mA
Variant 01			-0.4	-	
Variant 02			-0.8	-	
Variant 03			-2.56	-	
Linear Gain	$G_{L1.3}$	±1			dB
Variant 01			17.5	-	
Variant 02			20.5	-	
Variant 03			19	-	
Output Power (at saturation)	P_{out}	±1			dBm
Variant 01			42	-	
Variant 02			45.5	-	
Variant 03			49.5	-	

NOTES:

1. The Drift Value (Δ) Limit is ≤ 10 times the value of the previous measurement.

2.8 INTERMEDIATE AND END-POINT ELECTRICAL MEASUREMENTS

Unless otherwise specified, the measurements shall be performed at T_{amb} = +25 ±3°C.

The test conditions shall be as per the corresponding test defined in Para. 2.6.1 Room Temperature Electrical Measurements.

The limit values for each characteristic shall not be exceeded.

Characteristics	Symbols	Limits			Units
		Drift Value Δ	Absolute		
			Min	Max	
Quiescent Current	I_{D_Q}	±20%			mA
Variant 01			90	110	
Variant 02			180	220	
Variant 03			576	704	
Drain Current (at saturation)	I_D	±20%			A
Variant 01			0.55	0.85	
Variant 02			1.3	1.9	
Variant 03			3	5.5	
Gate Leakage Current (pinch-off)	I_{GL_HV}	Note 1			mA
Variant 01			-0.4	-	
Variant 02			-0.8	-	
Variant 03			-2.56	-	
Linear Gain	$G_{L1.3}$	±1			dB
Variant 01			17.5	-	
Variant 02			20.5	-	
Variant 03			19	-	
Output Power (at saturation)	P_{out}	±1			dBm
Variant 01			42	-	
Variant 02			45.5	-	
Variant 03			49.5	-	

NOTES:

1. The Drift Value (Δ) Limit is ≤ 10 times the value of the previous measurement.

2.9 BURN-IN 1 CONDITIONS

Characteristics	Symbols	Test Conditions	Units
Burn-in Temperature	T_{amb}	+125 (+0 -5) (Note 1)	°C
Junction Temperature	T_J	+200 (+0 -5) (Note 2)	°C
Gate Voltage	V_G	-7 (Note 1)	V
		V_{GS} shall be adjusted to attain the specified T_J (Note 2)	V
Drain Voltage	V_D	50	V

NOTES:

1. This condition only applies to the reverse bias burn-in (Step 1 of 2) specified in Para. 2.1.1.2(a).
2. This condition only applies to the forward bias burn-in (Step 2 of 2) specified in Para. 2.1.1.2(a).

2.10 BURN-IN 2 CONDITIONS

Characteristics	Symbols	Test Conditions	Units
Junction Temperature	T_J	+200 (+0 -5)	°C
Drain Voltage	V_D	50	V

2.11 OPERATING LIFE CONDITIONS

The conditions shall be as specified in Para. 2.10 Burn-in 2 Conditions.

APPENDIX 'A'

AGREED DEVIATIONS FOR UMS (F)

Items Affected	Description of Deviations
Para. 2.1.1.1, Deviations from Production Control – Chart F2	On completion of Assembly, a Radiographic Inspection shall be performed in accordance with MIL-STD-883 Test Method 2012 to determine the presence of voids. For each component, the following critera shall be met: • There shall be no voids larger than 0.01mm^2 under the active area of the die, and • There shall be no voids larger than 0.0225mm^2 under the remaining area of the die, and • The total combined area of voids shall be no greater than 2% of the die backside area. Any/all failed components shall be removed from the lot and at no future time be resubmitted to the requirements of the Generic Specification.

APPENDIX 'B'

DISPLACEMENT DAMAGE AND SINGLE EVENT EFFECTS INFORMATION - UMS (F)

(a) Displacement Damage (DD):

DD test results showed no influence of proton irradiation on the electrical performance up to a tested fluence of 10^{12} p/cm^2

(b) Heavy Ions:

All devices tested under irradiation survived static DC bias conditions up to V_{DS} = 95V under a range of gate bias between -3.5V and -9V, and with fluence levels up to 1.E+06 ions/cm^2 (Xe ions).

Heavy Ion test results showed Single Event Burn-out (SEB) levels for gate and drain RF voltage excursions for transistors operating in class AB, as follows. The voltage excursion values have been derived from simulation.

Characteristics	Symbols	Maximum Ratings	Units	Remarks
Drain-Source Voltage RF Excursion (maximum)	V_{DS_peak}	≤ 125	V	Xe ions (LET-Si = 62.5) Fluence = 1.E+07 ions/cm^2
Gate-Source Voltage RF Excursion (minimum)	V_{GS_peak}	≥ -6	V	
Drain-Source Voltage RF Excursion (maximum)	V_{DS_peak}	≤ 125	V	Rh ions (LET-Si = 46.1) Fluence = 1.E+07 ions/cm^2
Gate-Source Voltage RF Excursion (minimum)	V_{GS_peak}	≥ -9	V	