

# ART2K0FE; ART2K0FES; ART2K0FEG

Power LDMOS transistor

Rev. 5 — 8 July 2022

AMPLEON

Product data sheet

## 1. Product profile

### 1.1 General description

Based on Advanced Rugged Technology (ART), this 2000 W LDMOS RF power transistor has been designed to cover a wide range of applications for ISM, broadcast and communications. The unmatched transistor has a frequency range of 1 MHz to 400 MHz.

Table 1. Application information

Test signal	f	V <sub>DS</sub>	P <sub>L</sub>	G <sub>p</sub>	η <sub>D</sub>
	(MHz)	(V)	(W)	(dB)	(%)
CW	41.0	65	1600	29.0	79
CW	60.0	65	1750	26.8	80
CW pulsed [1]	64.0	63	2180	27.5	78
CW [2]	87.5 to 108	60	1650	26	83.5
DVB-T [3][4]	170 to 240	63	250	21	48
CW	352	65	1500	19	74

[1]  $t_p = 10 \mu s$ ;  $\delta = 10 \%$ .

[2] Center band performance numbers across the indicated frequency range.

[3] Typical performance numbers across the indicated frequency range.

[4] Symmetric Ultra Wideband Doherty.

### 1.2 Features and benefits

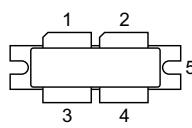
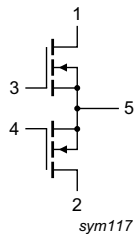
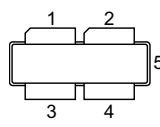
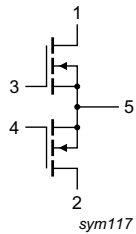
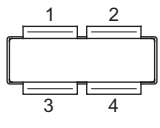
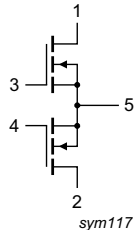
- High breakdown voltage enables class E operation up to  $V_{DS} = 53 V$
- Qualified up to a maximum of  $V_{DS} = 65 V$
- Characterized from 30 V to 65 V to support a wide range of applications
- Integrated dual sided ESD protection enables class C operation and complete switch off of the transistor
- Excellent ruggedness with no device degradation
- High efficiency
- Excellent thermal stability
- Designed for broadband operation
- For RoHS compliance see the product details on the Ampleon website

### 1.3 Applications

- Industrial, scientific and medical applications
  - ◆ Plasma generators
  - ◆ MRI systems
  - ◆ CO<sub>2</sub> lasers
  - ◆ Particle accelerators
- Broadcast
  - ◆ FM radio
  - ◆ VHF TV
- Communications
  - ◆ Non cellular communications
  - ◆ UHF radar

## 2. Pinning information

Table 2. Pinning

Pin	Description	Simplified outline	Graphic symbol
ART2K0FE (SOT539AN)			
1	drain1		
2	drain2		
3	gate1		
4	gate2		
5	source <a href="#">[1]</a>		
ART2K0FES (SOT539BN)			
1	drain1		
2	drain2		
3	gate1		
4	gate2		
5	source <a href="#">[1]</a>		
ART2K0FEG (SOT1248C)			
1	drain1		
2	drain2		
3	gate1		
4	gate2		
5	source <a href="#">[1]</a>		

[1] Connected to flange.

### 3. Ordering information

Table 3. Ordering information

Package name	Orderable part number	12NC	Packing description	Min. orderable quantity (pieces)
SOT539AN	ART2K0FEU	9349 602 80112	Tray; 20-fold; non-dry pack	60
SOT539BN	ART2K0FESU	9349 605 38112	Tray; 20-fold; non-dry pack	60
SOT1248C	ART2K0FEGJ	9349 605 37118	TR13; 100-fold; 56 mm; non-dry pack	100

### 4. Limiting values

Table 4. Limiting values

In accordance with the Absolute Maximum Rating System (IEC 60134).

Symbol	Parameter	Conditions	Min	Max	Unit
$V_{DS}$	drain-source voltage	[1]	-	200	V
$V_{GS}$	gate-source voltage		-9	+13	V
$T_{stg}$	storage temperature		-65	+150	°C
$T_j$	junction temperature	[2]	-	225	°C

[1] Specified over lifetime at maximum operating temperature.

[2] Continuous use at maximum temperature will affect the reliability, for details refer to the online MTF calculator.

### 5. Thermal characteristics

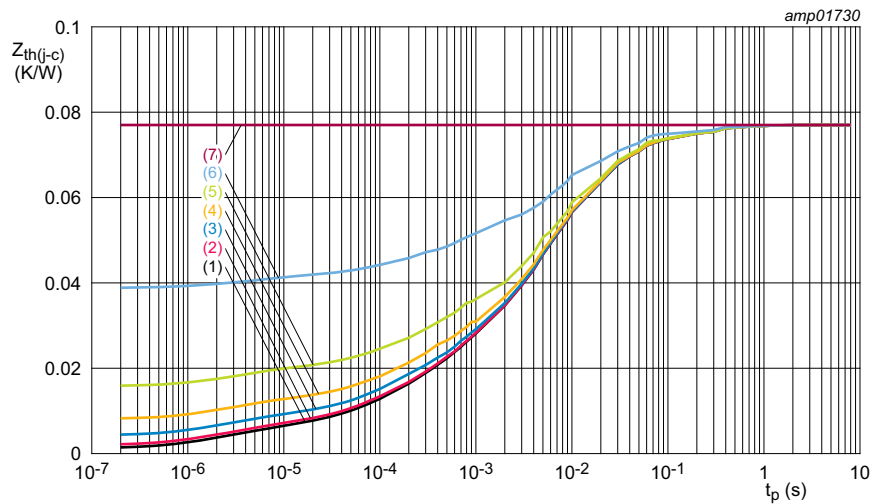
Table 5. Thermal characteristics

Symbol	Parameter	Conditions	Typ	Unit
$R_{th(j-c)}$	thermal resistance from junction to case	$T_j = 95\text{ °C}$ [1][2]	0.077	K/W
$Z_{th(j-c)}$	transient thermal impedance from junction to case	$T_j = 95\text{ °C}$ ; $t_p = 100\text{ }\mu\text{s}$ ; $\delta = 10\%$ [3]	0.018	K/W

[1]  $T_j$  is the junction temperature.

[2]  $R_{th(j-c)}$  is measured under RF conditions.

[3] See [Figure 1](#).



**Fig 1. Transient thermal impedance from junction to case as a function of pulse duration**

## 6. Characteristics

**Table 6. DC characteristics**

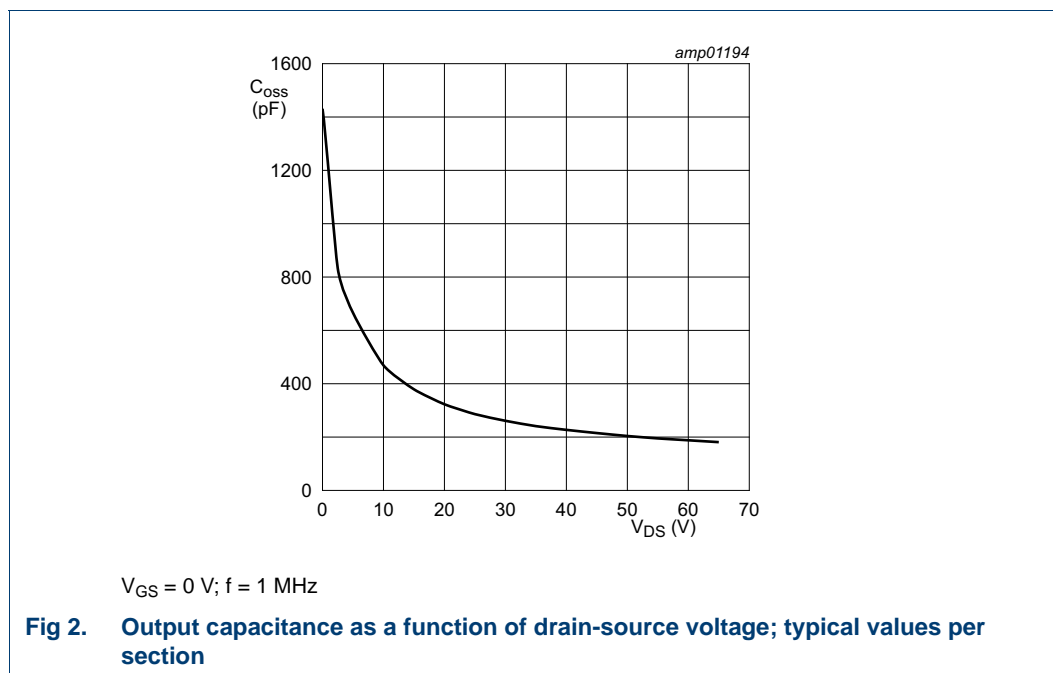
$T_j = 25\text{ }^{\circ}\text{C}$ ; per section unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{(BR)DSS}$	drain-source breakdown voltage	$V_{GS} = 0\text{ V}$ ; $I_D = 5.5\text{ mA}$	203	208	-	V
$V_{GS(th)}$	gate-source threshold voltage	$V_{DS} = 20\text{ V}$ ; $I_D = 550\text{ mA}$	1.5	2.1	2.5	V
$I_{DSS}$	drain leakage current	$V_{GS} = 0\text{ V}$ ; $V_{DS} = 65\text{ V}$	-	-	2.8	$\mu\text{A}$
$I_{DSX}$	drain cut-off current	$V_{GS} = V_{GS(th)} + 3.75\text{ V}$ ; $V_{DS} = 20\text{ V}$	-	77	-	A
$I_{GSS}$	gate leakage current	$V_{GS} = 13\text{ V}$ ; $V_{DS} = 0\text{ V}$	-	-	280	nA
$R_{DS(on)}$	drain-source on-state resistance	$V_{GS} = V_{GS(th)} + 3.75\text{ V}$ ; $I_D = 19.25\text{ A}$	-	0.100	-	$\Omega$

**Table 7. AC characteristics**

$T_j = 25\text{ }^{\circ}\text{C}$ ; per section unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$C_{rs}$	feedback capacitance	$V_{GS} = 0\text{ V}$ ; $V_{DS} = 65\text{ V}$ ; $f = 1\text{ MHz}$	-	1.73	-	pF
$C_{iss}$	input capacitance	$V_{GS} = 0\text{ V}$ ; $V_{DS} = 65\text{ V}$ ; $f = 1\text{ MHz}$	-	610	-	pF
$C_{oss}$	output capacitance	$V_{GS} = 0\text{ V}$ ; $V_{DS} = 65\text{ V}$ ; $f = 1\text{ MHz}$	-	181	-	pF



**Table 8. RF characteristics**

Test signal: pulsed RF;  $t_p = 100 \mu\text{s}$ ;  $\delta = 5 \%$ ;  $f = 108 \text{ MHz}$ ; RF performance at  $V_{DS} = 65 \text{ V}$ ;  $I_{DQ} = 50 \text{ mA}$  per section;  $T_{case} = 25 \text{ }^\circ\text{C}$ ; unless otherwise specified; in a class-AB production test circuit.

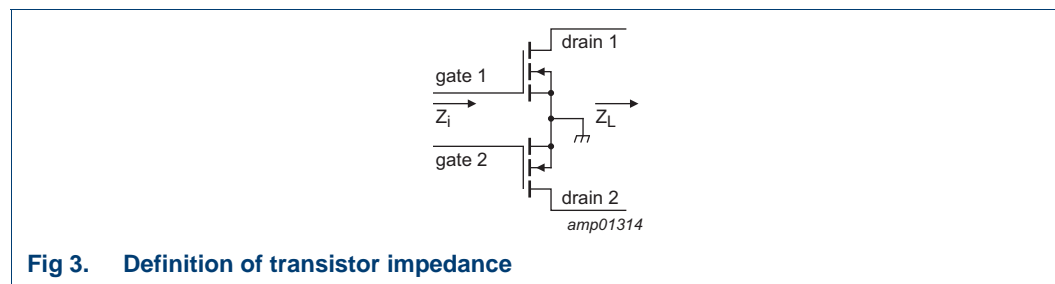
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$G_p$	power gain	$P_L = 2000 \text{ W}$	27.0	28.4	-	dB
$RL_{in}$	input return loss	$P_L = 2000 \text{ W}$	-	-13.9	-	dB
$\eta_D$	drain efficiency	$P_L = 2000 \text{ W}$	69.0	72.1	-	%

## 7. Test information

### 7.1 Ruggedness in class-AB operation

The ART2K0FE, ART2K0FES and ART2K0FEG are capable of withstanding a load mismatch corresponding to  $VSWR \geq 65 : 1$  through all phases under the following conditions:  $V_{DS} = 65 \text{ V}$ ;  $I_{DQ} = 100 \text{ mA}$  per section;  $P_L = 2000 \text{ W}$  pulsed;  $t_p = 100 \mu\text{s}$ ;  $\delta = 10 \%$ ;  $f = 108 \text{ MHz}$ .

### 7.2 Impedance information



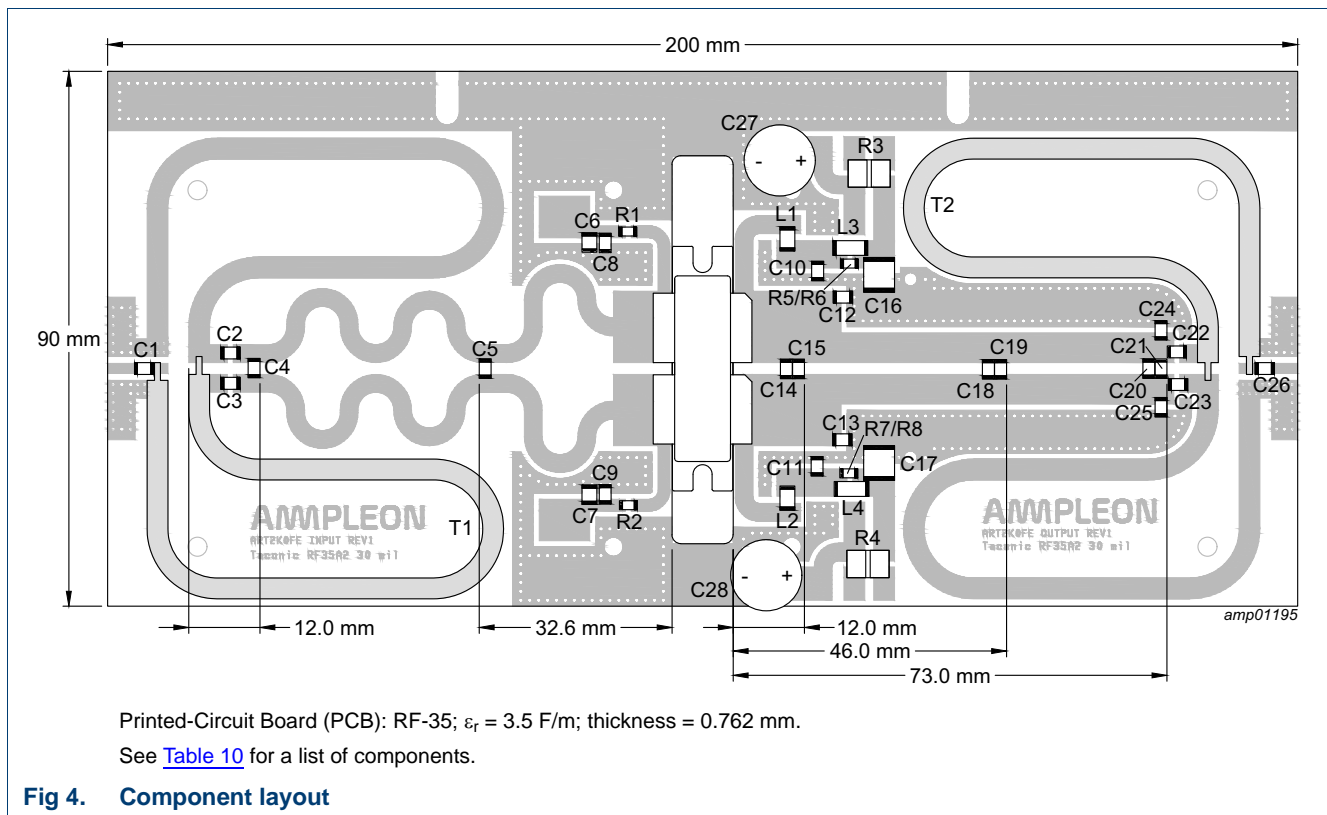
**Fig 3. Definition of transistor impedance**

**Table 9. Typical push-pull impedance**

Simulated  $Z_i$  and  $Z_L$  device impedance; impedance info at  $V_{DS} = 65 \text{ V}$  and  $P_L = 2000 \text{ W}$ .

f	$Z_i$	$Z_L$
(MHz)	( $\Omega$ )	( $\Omega$ )
108	$2.4 - j8.7$	$3.8 + j1.0$

### 7.3 Test circuit



**Fig 4. Component layout**

**Table 10. List of components**

For test circuit see [Figure 4](#).

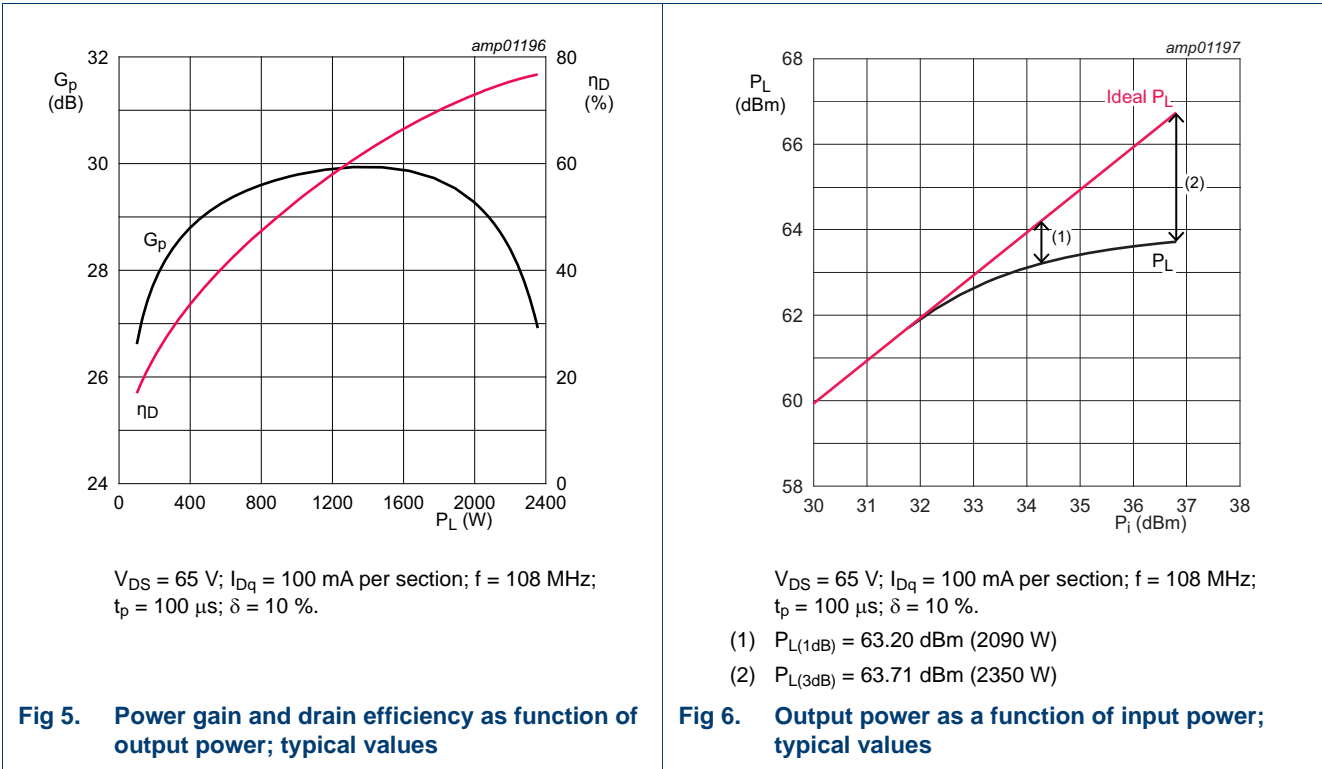
Component	Description	Value	Remarks
C1, C26	multilayer ceramic chip capacitor	470 pF <a href="#">[1]</a>	
C2, C3	multilayer ceramic chip capacitor	68 pF <a href="#">[1]</a>	
C4	multilayer ceramic chip capacitor	43 pF <a href="#">[1]</a>	
C5	multilayer ceramic chip capacitor	240 pF <a href="#">[1]</a>	
C6, C7	multilayer ceramic chip capacitor	4.7 $\mu$ F, 50 V	Murata: GRM32ER71H475KA88L
C8, C9, C10, C11	multilayer ceramic chip capacitor	820 pF <a href="#">[1]</a>	
C12, C13	multilayer ceramic chip capacitor	180 pF <a href="#">[1]</a>	
C14, C15	multilayer ceramic chip capacitor	39 pF <a href="#">[1]</a>	
C16, C17	multilayer ceramic chip capacitor	4.7 $\mu$ F, 100 V	TDK: C5750X7R2A475KT/A
C18, C19	multilayer ceramic chip capacitor	56 pF <a href="#">[1]</a>	
C20, C21	multilayer ceramic chip capacitor	51 pF <a href="#">[1]</a>	
C22, C23	multilayer ceramic chip capacitor	120 pF <a href="#">[1]</a>	
C24, C25	multilayer ceramic chip capacitor	20 pF <a href="#">[1]</a>	
C27, C28	electrolytic capacitor	2200 $\mu$ F, 100 V	
L1, L2	air inductor	47 nH	Coilcraft: 1515SQ-47N
L3, L4	air inductor	82 nH	Coilcraft: 1515SQ-82N
R1, R2	resistor	4.7 k $\Omega$	SMD 1206

Table 10. List of components ...continued  
For test circuit see [Figure 4](#).

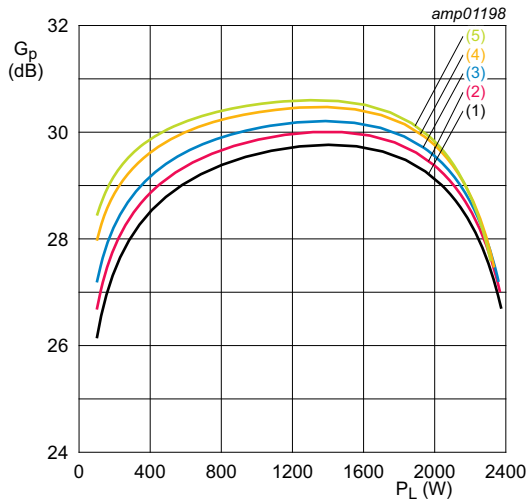
Component	Description	Value	Remarks
R3, R4	resistor	0.01 Ω	Vishay: WSHP2818
R5, R6, R7, R8	resistor	9.1 Ω	SMD 1206
T1, T2	semi rigid coax	50 Ω, 160 mm	EZ141-AL-TP/M17

[1] American Technical Ceramics type 100B or capacitor of same quality.

7.4 Graphical data

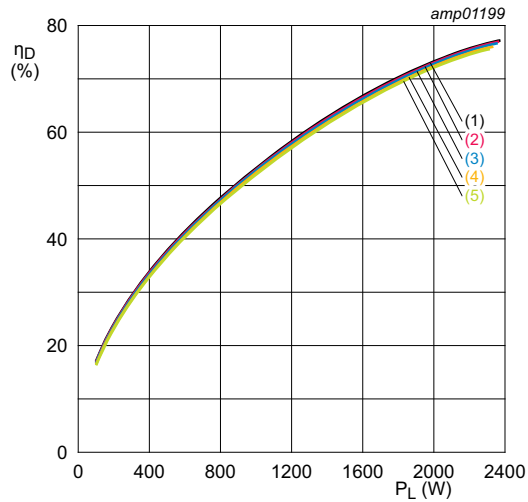






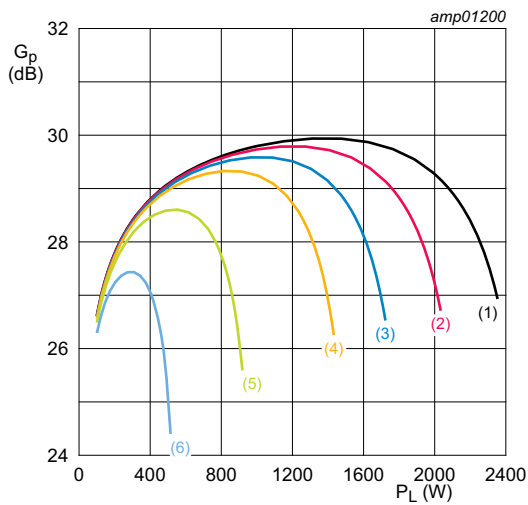
- $V_{DS} = 65\text{ V}$ ;  $f = 108\text{ MHz}$ ;  $t_p = 100\text{ }\mu\text{s}$ ;  $\delta = 10\text{ }\%$ .
- (1)  $I_{Dq} = 50\text{ mA}$  per section
  - (2)  $I_{Dq} = 100\text{ mA}$  per section
  - (3)  $I_{Dq} = 200\text{ mA}$  per section
  - (4)  $I_{Dq} = 400\text{ mA}$  per section
  - (5)  $I_{Dq} = 600\text{ mA}$  per section

**Fig 7. Power gain as a function of output power; typical values**



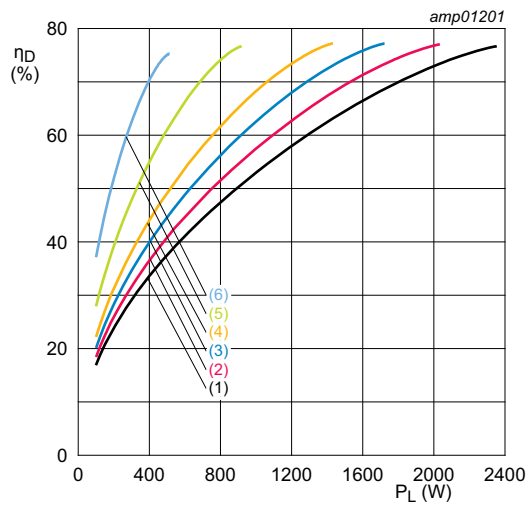
- $V_{DS} = 65\text{ V}$ ;  $f = 108\text{ MHz}$ ;  $t_p = 100\text{ }\mu\text{s}$ ;  $\delta = 10\text{ }\%$ .
- (1)  $I_{Dq} = 50\text{ mA}$  per section
  - (2)  $I_{Dq} = 100\text{ mA}$  per section
  - (3)  $I_{Dq} = 200\text{ mA}$  per section
  - (4)  $I_{Dq} = 400\text{ mA}$  per section
  - (5)  $I_{Dq} = 600\text{ mA}$  per section

**Fig 8. Drain efficiency as a function of output power; typical values**



- $I_{DQ} = 100$  mA per section;  $f = 108$  MHz;  $t_p = 100$   $\mu$ s;  
 $\delta = 10$  %.
- (1)  $V_{DS} = 65$  V
  - (2)  $V_{DS} = 60$  V
  - (3)  $V_{DS} = 55$  V
  - (4)  $V_{DS} = 50$  V
  - (5)  $V_{DS} = 40$  V
  - (6)  $V_{DS} = 30$  V

Fig 9. Power gain as a function of output power; typical values



- $I_{DQ} = 100$  mA per section;  $f = 108$  MHz;  $t_p = 100$   $\mu$ s;  
 $\delta = 10$  %.
- (1)  $V_{DS} = 65$  V
  - (2)  $V_{DS} = 60$  V
  - (3)  $V_{DS} = 55$  V
  - (4)  $V_{DS} = 50$  V
  - (5)  $V_{DS} = 40$  V
  - (6)  $V_{DS} = 30$  V

Fig 10. Drain efficiency as a function of output power; typical values

## 8. Package outline

Flanged balanced ceramic package; 2 mounting holes; 4 leads

SOT539AN

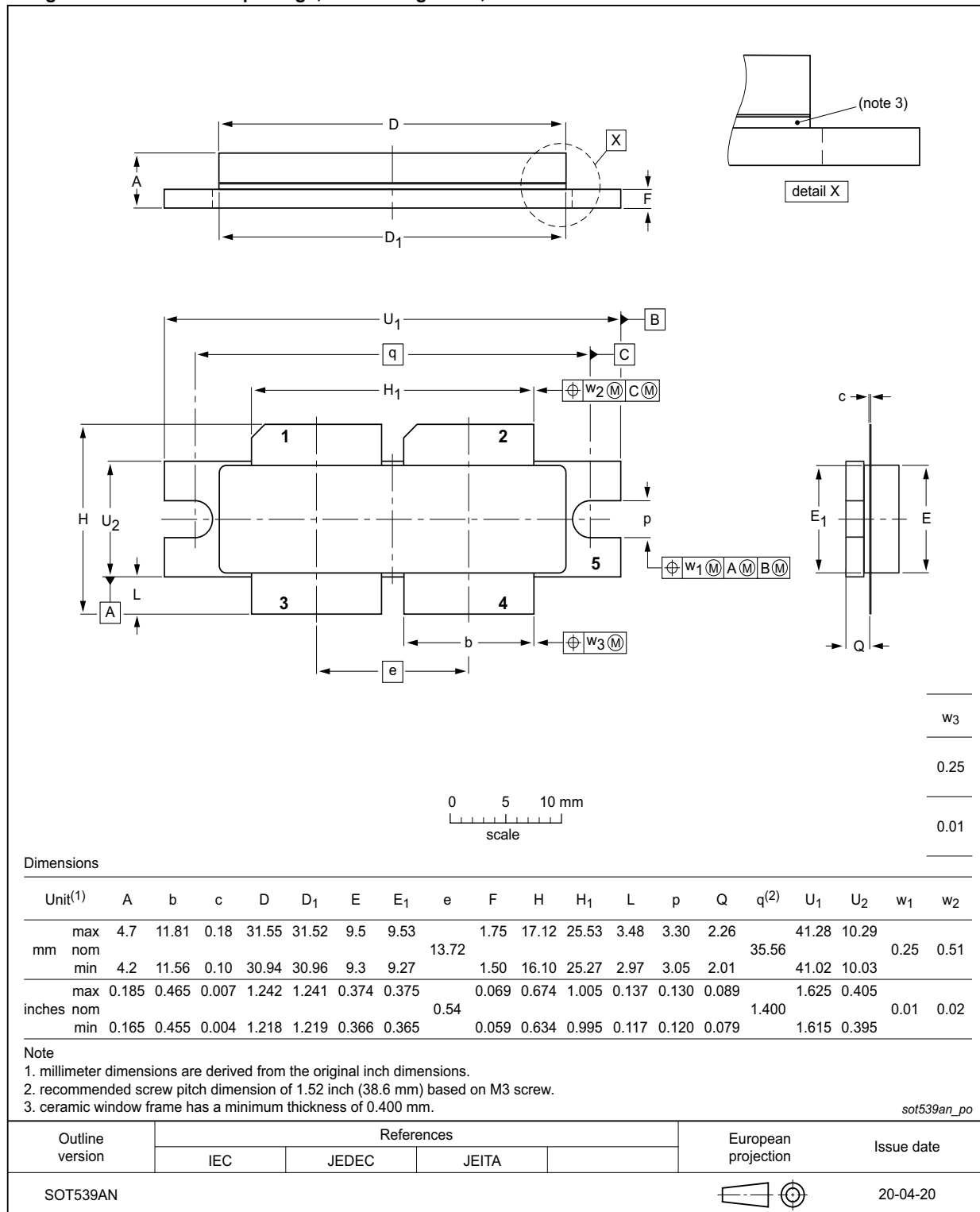


Fig 11. Package outline SOT539AN



Earless flanged LDMOST ceramic package; 4 leads

SOT1248C

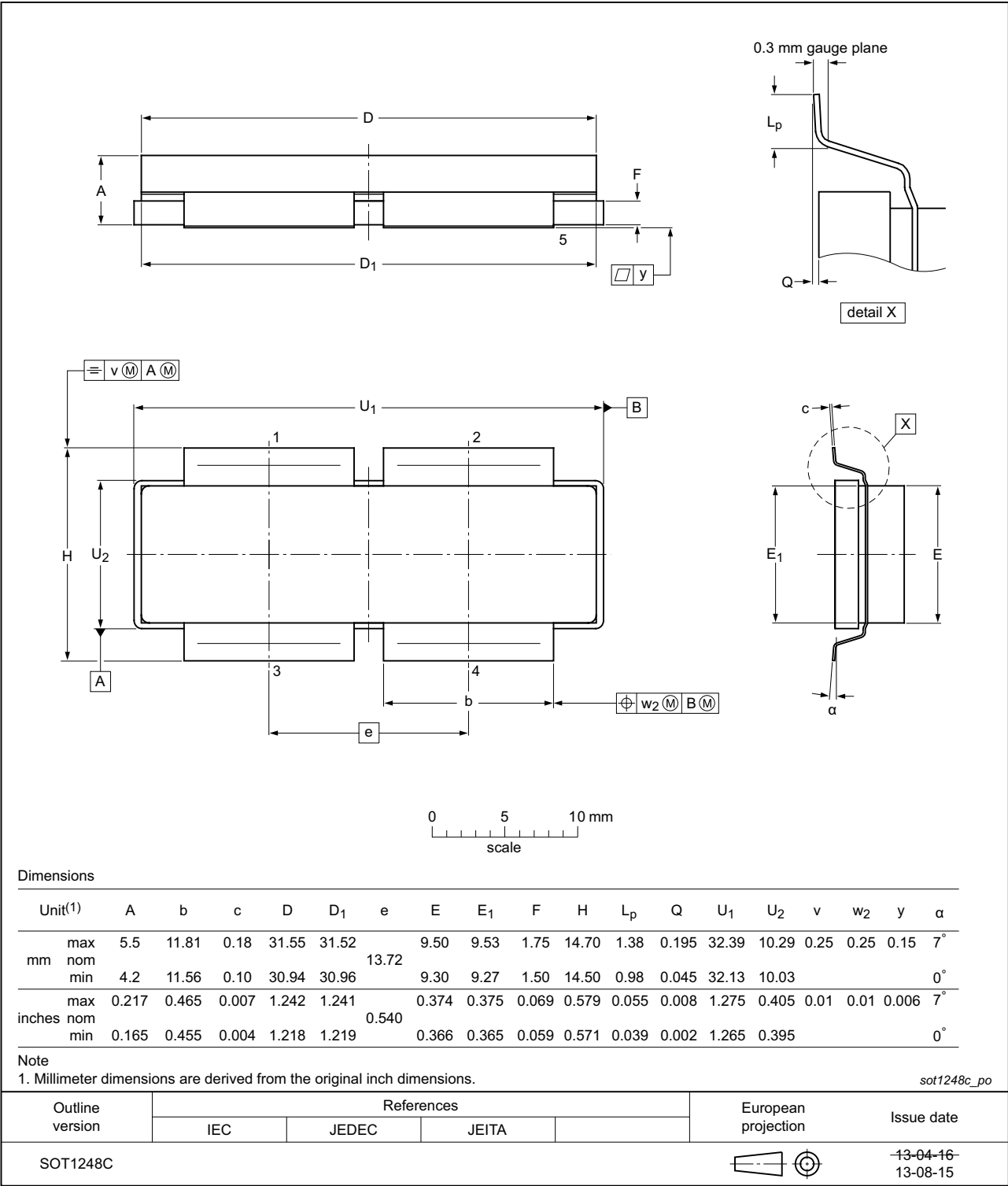


Fig 13. Package outline SOT1248C

## 9. Handling information

### CAUTION



This device is sensitive to ElectroStatic Discharge (ESD). Observe precautions for handling electrostatic sensitive devices.

Such precautions are described in the *ANSI/ESD S20.20*, *IEC/ST 61340-5*, *JESD625-A* or equivalent standards.

**Table 11. ESD sensitivity**

ESD model	Class
Charged Device Model (CDM); According to ANSI/ESDA/JEDEC standard JS-002	C2A <a href="#">[1]</a>
Human Body Model (HBM); According to ANSI/ESDA/JEDEC standard JS-001	2 <a href="#">[2]</a>

[1] CDM classification C2A is granted to any part that passes after exposure to an ESD pulse of 500 V.

[2] HBM classification 2 is granted to any part that passes after exposure to an ESD pulse of 2000 V.

## 10. Abbreviations

**Table 12. Abbreviations**

Acronym	Description
CW	Continuous Wave
DVB-T	Digital Video Broadcast - Terrestrial
ESD	ElectroStatic Discharge
FM	Frequency Modulation
ISM	Industrial, Scientific and Medical
LDMOS	Laterally Diffused Metal-Oxide Semiconductor
MRI	Magnetic Resonance Imaging
MTF	Median Time to Failure
RoHS	Restriction of Hazardous Substances
SMD	Surface Mounted Device
UHF	Ultra High Frequency
VHF	Very High Frequency
VSWR	Voltage Standing Wave Ratio

## 11. Revision history

Table 13. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
ART2K0FE_2K0FES_2K0FEG v.5	20220708	Product data sheet	-	ART2K0FE_2K0FES_2K0FEG v.4
Modifications:	<ul style="list-style-type: none"> <li>• <a href="#">Table 4 on page 3</a>: changed values gate-source voltage</li> <li>• <a href="#">Table 6 on page 5</a>: changed value gate-source voltage</li> </ul>			
ART2K0FE_2K0FES_2K0FEG v.4	20220322	Product data sheet	-	ART2K0FE v.3
ART2K0FE v.3	20210618	Product data sheet	-	ART2K0FE v.2
ART2K0FE v.2	20200508	Product data sheet	-	ART2K0FE v.1
ART2K0FE v.1	20200114	Objective data sheet	-	-

## 12. Legal information

### 12.1 Data sheet status

Document status <sup>[1][2]</sup>	Product status <sup>[3]</sup>	Definition
Objective [short] data sheet	Development	This document contains data from the objective specification for product development.
Preliminary [short] data sheet	Qualification	This document contains data from the preliminary specification.
Product [short] data sheet	Production	This document contains the product specification.

[1] Please consult the most recently issued document before initiating or completing a design.

[2] The term 'short data sheet' is explained in section "Definitions".

[3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the Internet at URL <http://www.ampleon.com>.

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## 12.5 Trademarks

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For more information, please visit: <http://www.ampleon.com>

For sales office addresses, please visit: <http://www.ampleon.com/sales>

## 14. Contents

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Date of release: 8 July 2022

Document identifier: ART2K0FE\_2K0FES\_2K0FEG