

1. Product profile

1.1 General description

Based on Advanced Rugged Technology (ART), this 450 W LDMOS RF 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 650 MHz.

Table 1. Application information

Test signal	f (MHz)	V _{DS} (V)	P _L (W)	G _p (dB)	η _D (%)
CW	41	50	300	24.5	76
CW	41	65	450	25	72
CW pulsed [1][2]	108	50	350	28	75
CW pulsed [1][2]	225	65	450	27	77.5
CW [2]	225	65	450	26.5	77.0

[1] t_p = 100 µs; δ = 10 %.

[2] Test circuit.

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

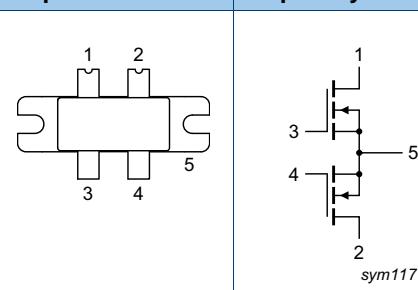
1.3 Applications

- Industrial, scientific and medical applications
 - ◆ Plasma generators
 - ◆ MRI systems
 - ◆ CO₂ lasers
 - ◆ Particle accelerators
 - ◆ Defrosting
- Broadcast
 - ◆ FM radio
 - ◆ VHF TV

- Radar
 - ◆ Non cellular communications
 - ◆ UHF radar

2. Pinning information

Table 2. Pinning

Pin	Description	Simplified outline	Graphic symbol
1	drain1		
2	drain2		
3	gate1		
4	gate2		
5	source	[1]	

[1] Connected to flange.

3. Ordering information

Table 3. Ordering information

Package name	Orderable part number	12NC	Packing description	Min. orderable quantity (pieces)
SOT1121A	ART450FEU	9349 606 65112	Tray; 20-fold; non-dry pack	60

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

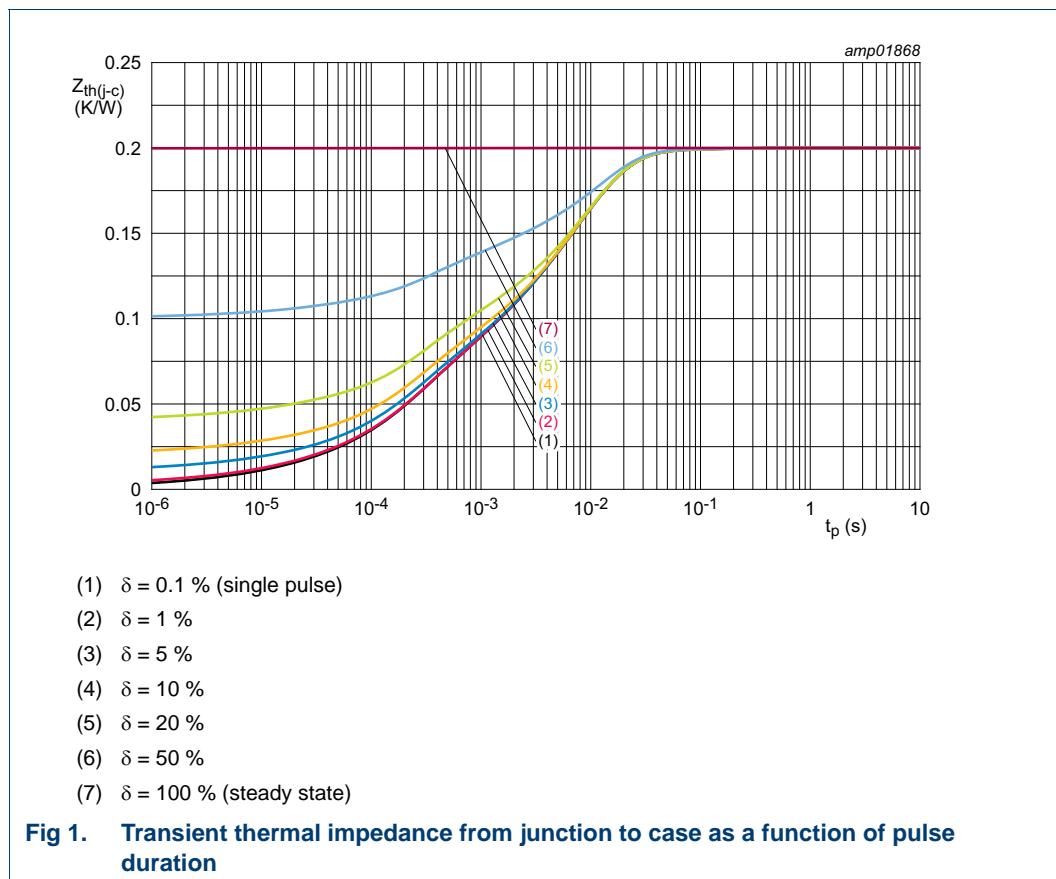
Table 5. Thermal characteristics

According to standard MIL-STD-883E.

Symbol	Parameter	Conditions	Typ	Unit
$R_{th(j-c)}$	thermal resistance from junction to case	$T_j = 75^\circ\text{C}$, measured under RF condition	[1][2]	0.2 K/W

[1] Refer to application note AN221014 on the Ampleon website.

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



6. Characteristics

Table 6. DC characteristics

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

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{(BR)DSS}$	drain-source breakdown voltage	$V_{GS} = 0\text{ V}$; $I_D = 1.5\text{ mA}$	203	208	-	V
$V_{GS(th)}$	gate-source threshold voltage	$V_{DS} = 20\text{ V}$; $I_D = 111\text{ mA}$	1.6	2.1	2.6	V
I_{DSS}	drain leakage current	$V_{GS} = 0\text{ V}$; $V_{DS} = 65\text{ V}$	-	-	1.4	μA

Table 6. DC characteristics ...continued
 $T_j = 25^\circ\text{C}$; unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
I_{DSX}	drain cut-off current	$V_{GS} = V_{GS(th)} + 3.75\text{ V}$; $V_{DS} = 20\text{ V}$	-	21	-	A
I_{GSS}	gate leakage current	$V_{GS} = 13\text{ V}$; $V_{DS} = 0\text{ V}$	-	-	140	nA
$R_{DS(on)}$	drain-source on-state resistance	$V_{GS} = V_{GS(th)} + 3.75\text{ V}$; $I_D = 3.885\text{ A}$	-	0.340	-	Ω

Table 7. AC characteristics

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

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
C_{rs}	feedback capacitance	$V_{GS} = 0\text{ V}$; $f = 1\text{ MHz}$				
		$V_{DS} = 50\text{ V}$	-	-	0.36	pF
		$V_{DS} = 65\text{ V}$	-	-	0.33	pF
C_{iss}	input capacitance	$V_{GS} = 0\text{ V}$; $V_{DS} = 65\text{ V}$; $f = 1\text{ MHz}$				
		$V_{DS} = 50\text{ V}$	-	-	178	pF
		$V_{DS} = 65\text{ V}$	-	-	178	pF
C_{oss}	output capacitance	$V_{GS} = 0\text{ V}$; $V_{DS} = 65\text{ V}$; $f = 1\text{ MHz}$				
		$V_{DS} = 50\text{ V}$	-	-	52	pF
		$V_{DS} = 65\text{ V}$	-	-	46	pF

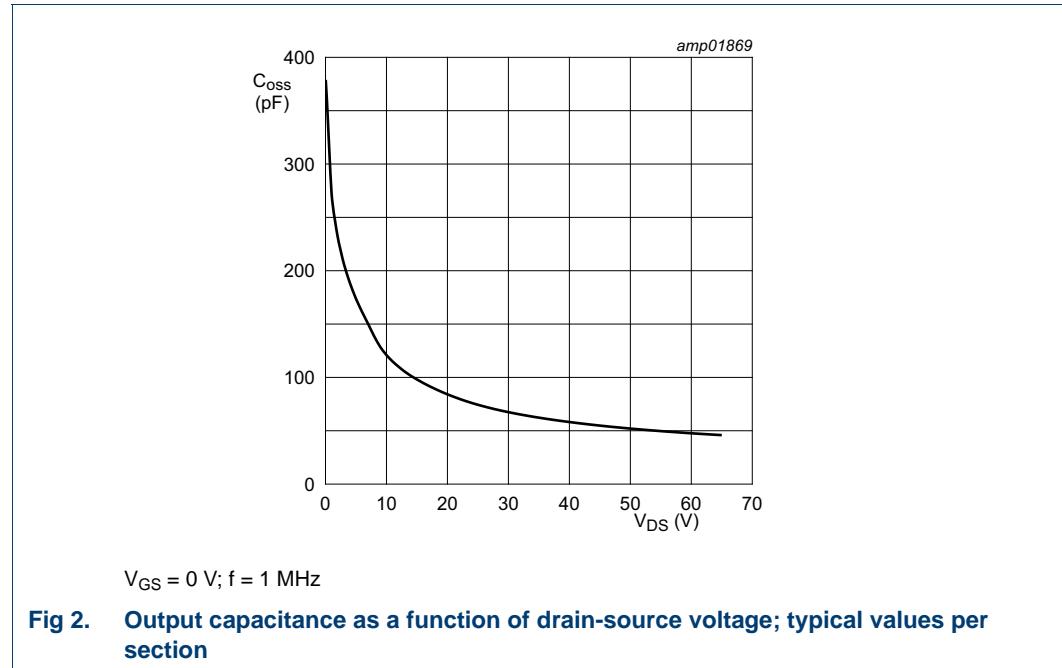


Table 8. RF characteristics

Test signal: CW pulsed; $t_p = 100 \mu\text{s}$; $\delta = 10\%$; $f = 225 \text{ MHz}$; RF performance at $V_{DS} = 65 \text{ V}$; $I_{Dq} = 25 \text{ mA}$; $T_{case} = 25^\circ\text{C}$; unless otherwise specified; in a class-AB production test circuit.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
G_p	power gain	$P_L = 450 \text{ W}$	25.7	27.0	-	dB
RL_{in}	input return loss	$P_L = 450 \text{ W}$	-	-15.5	-9	dB
η_D	drain efficiency	$P_L = 450 \text{ W}$	70	74	-	%

7. Test information

7.1 Ruggedness in class-AB operation

The ART450FE is capable of withstanding a load mismatch corresponding to $VSWR = 65 \geq 1$ through all phases under the following conditions: $V_{DS} = 65 \text{ V}$; $I_{Dq} = 25 \text{ mA}$ per section; $P_L = 450 \text{ W}$ pulsed; $t_p = 100 \mu\text{s}$; $\delta = 10\%$; $f = 225 \text{ MHz}$.

7.2 Impedance information

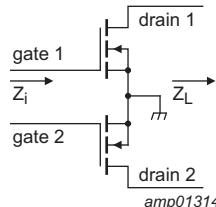


Fig 3. Definition of transistor impedance

Table 9. Typical impedance

Simulated Z_i and Z_L device impedance; impedance info at $V_{DS} = 65 \text{ V}$ and $P_L = 450 \text{ W}$.

f (MHz)	Z_i (Ω)	Z_L (Ω)
225	$3.3 - j14.6$	$12.3 + j7.9$

7.3 Test circuit

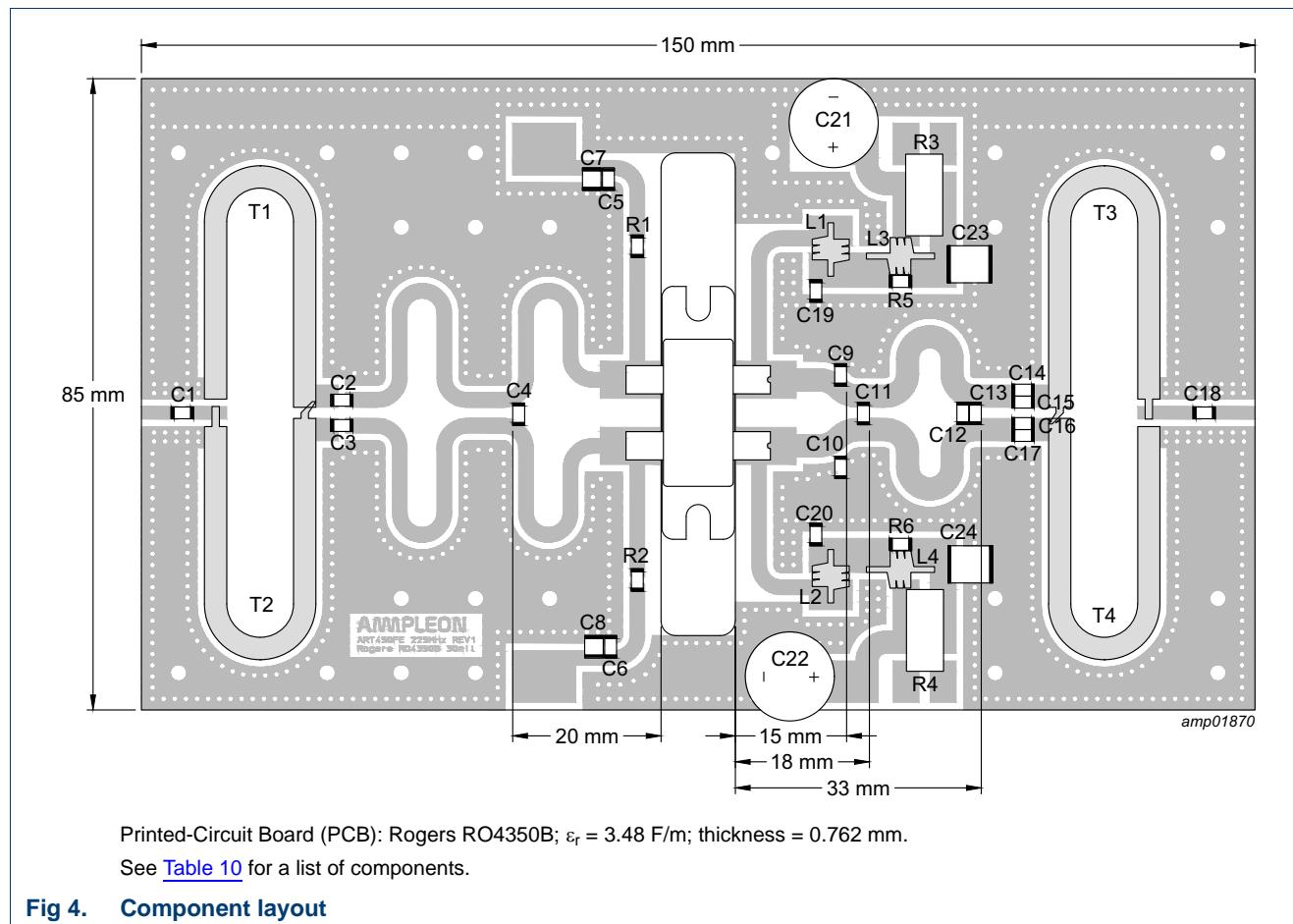


Fig 4. Component layout

Table 10. List of components

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

Component	Description	Value	Remarks
C1, C18	multilayer ceramic chip capacitor	100 pF	[1] [2]
C2, C3	multilayer ceramic chip capacitor	18 pF	[1] [2]
C4, C14, C15, C16, C17	multilayer ceramic chip capacitor	27 pF	[1] [2]
C5, C6, C19, C20	multilayer ceramic chip capacitor	620 pF	[1] [2]
C7, C8	multilayer ceramic chip capacitor	4.7 μ F, 100 V	Murata: GRM31CC72A475KE11L
C9, C10, C11	multilayer ceramic chip capacitor	22 pF	[1] [2]
C12, C13	multilayer ceramic chip capacitor	15 pF	[1] [2]
C21, C22	electrolytic capacitor	1000 μ F, 100 V	
C23, C24	multilayer ceramic chip capacitor	4.7 μ F, 100 V	TDK: CGA9N2X7R2A465K230
L1, L2	air core inductor	33 nH	Coilcraft: 1812SMS-33NGL
L3, L4	air core inductor	82 nH	Coilcraft 1812SMS-82NGL
R1, R2	chip resistor	510 Ω	SMD 1206

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

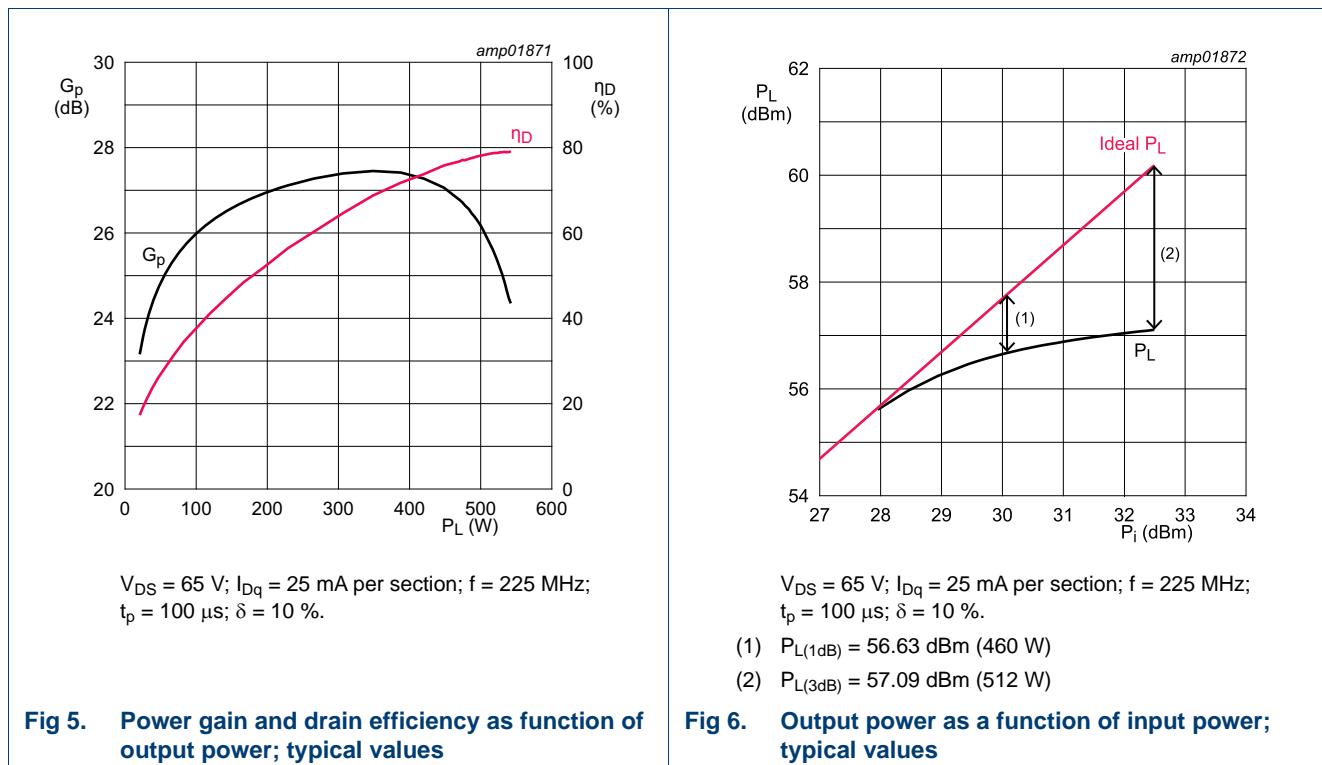
Component	Description	Value	Remarks
R3, R4	chip resistor	0.01 Ω	FC4L110R010FER
R5, R6	chip resistor	10 Ω , 2 x 20 Ω in parallel	SMD 1206
T1, T2, T3, T4	hand formable coax	50 Ω , 68 mm	Sucoform 141

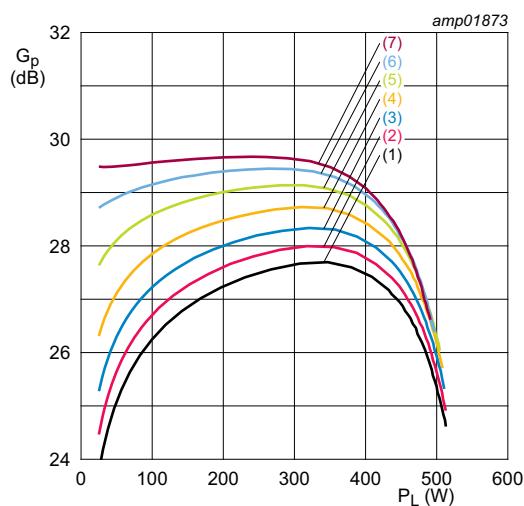
[1] American Technical Ceramics type 800B or capacitor of same quality.

[2] Vertical mounted.

7.4 Graphical data

7.4.1 1-Tone CW pulsed

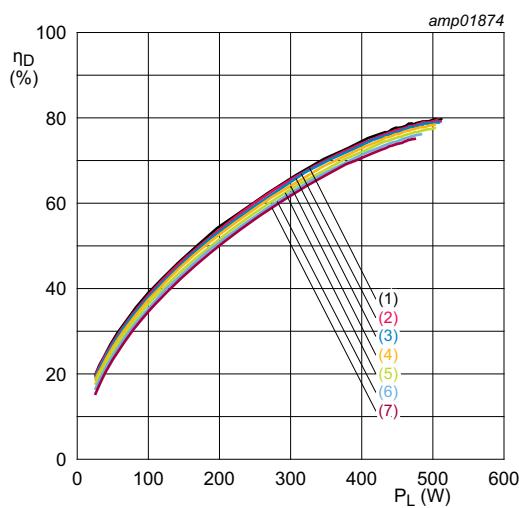




$V_{DS} = 65$ V; $f = 225$ MHz; $t_p = 100$ μ s; $\delta = 10$ %.

- (1) $I_{Dq} = 25$ mA per section
- (2) $I_{Dq} = 50$ mA per section
- (3) $I_{Dq} = 100$ mA per section
- (4) $I_{Dq} = 200$ mA per section
- (5) $I_{Dq} = 400$ mA per section
- (6) $I_{Dq} = 600$ mA per section
- (7) $I_{Dq} = 800$ mA per section

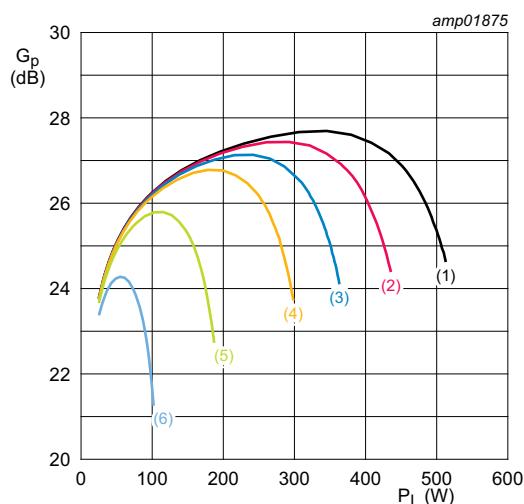
Fig 7. Power gain as a function of output power; typical values



$V_{DS} = 65$ V; $f = 225$ MHz; $t_p = 100$ μ s; $\delta = 10$ %.

- (1) $I_{Dq} = 25$ mA per section
- (2) $I_{Dq} = 50$ mA per section
- (3) $I_{Dq} = 100$ mA per section
- (4) $I_{Dq} = 200$ mA per section
- (5) $I_{Dq} = 400$ mA per section
- (6) $I_{Dq} = 600$ mA per section
- (7) $I_{Dq} = 800$ mA per section

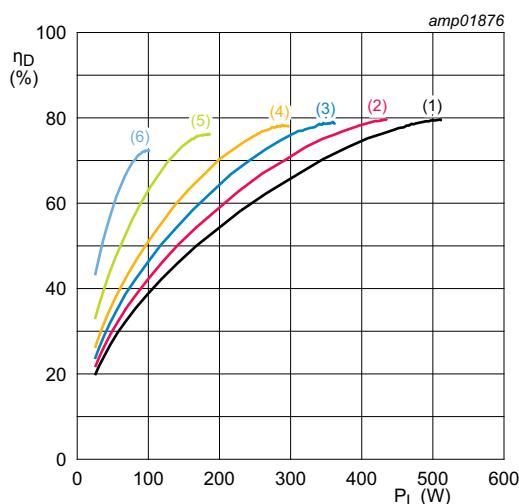
Fig 8. Drain efficiency as a function of output power; typical values



$I_{Dq} = 25$ mA per section; $f = 225$ MHz; $t_p = 100$ μ 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

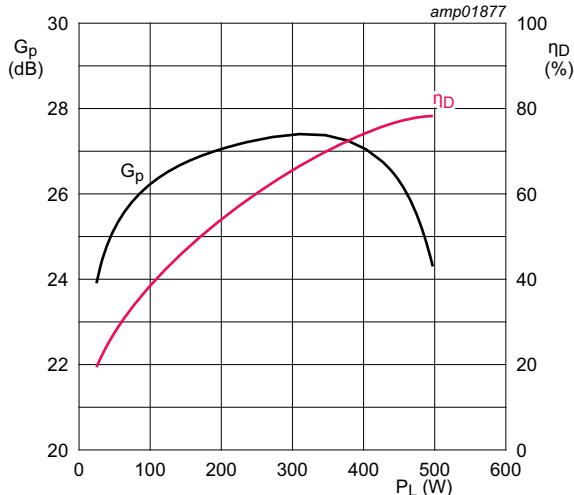


$I_{Dq} = 25$ mA per section; $f = 225$ MHz; $t_p = 100$ μ s;
 $\delta = 10$ %.

- (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

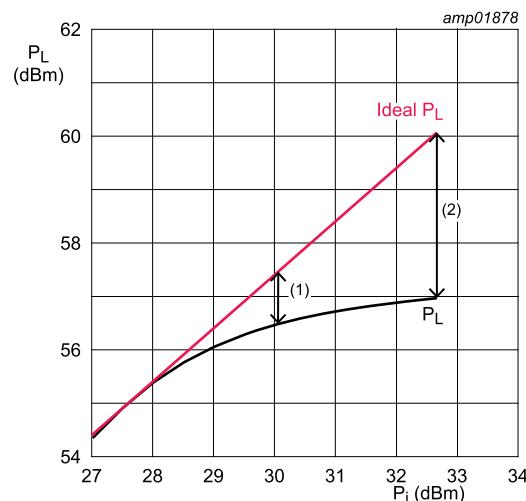
Fig 10. Drain efficiency as a function of output power; typical values

7.4.2 1-Tone CW



$V_{DS} = 65$ V; $I_{Dq} = 25$ mA per section; $f = 225$ MHz.

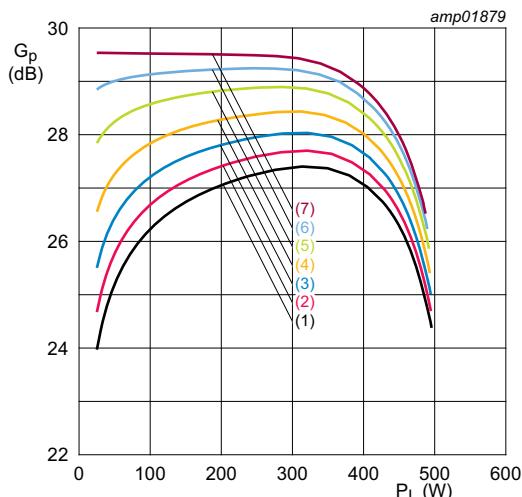
Fig 11. Power gain and drain efficiency as function of output power; typical values



$V_{DS} = 65$ V; $I_{Dq} = 25$ mA per section; $f = 225$ MHz.

- (1) $P_{L(1dB)} = 56.49$ dBm (446 W)
- (2) $P_{L(3dB)} = 56.95$ dBm (496 W)

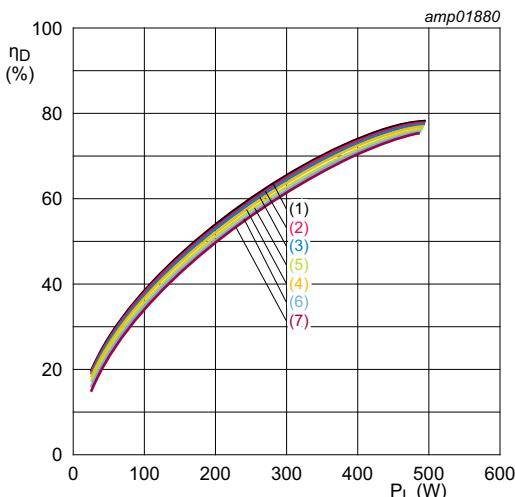
Fig 12. Output power as a function of input power; typical values



$V_{DS} = 65$ V; $f = 225$ MHz.

- (1) $I_{Dq} = 25$ mA per section
- (2) $I_{Dq} = 50$ mA per section
- (3) $I_{Dq} = 100$ mA per section
- (4) $I_{Dq} = 200$ mA per section
- (5) $I_{Dq} = 400$ mA per section
- (6) $I_{Dq} = 600$ mA per section
- (7) $I_{Dq} = 800$ mA per section

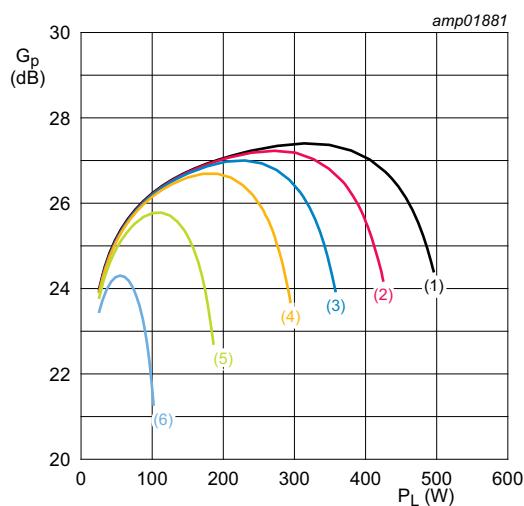
Fig 13. Power gain as a function of output power; typical values



$V_{DS} = 65$ V; $f = 225$ MHz.

- (1) $I_{Dq} = 25$ mA per section
- (2) $I_{Dq} = 50$ mA per section
- (3) $I_{Dq} = 100$ mA per section
- (4) $I_{Dq} = 200$ mA per section
- (5) $I_{Dq} = 400$ mA per section
- (6) $I_{Dq} = 600$ mA per section
- (7) $I_{Dq} = 800$ mA per section

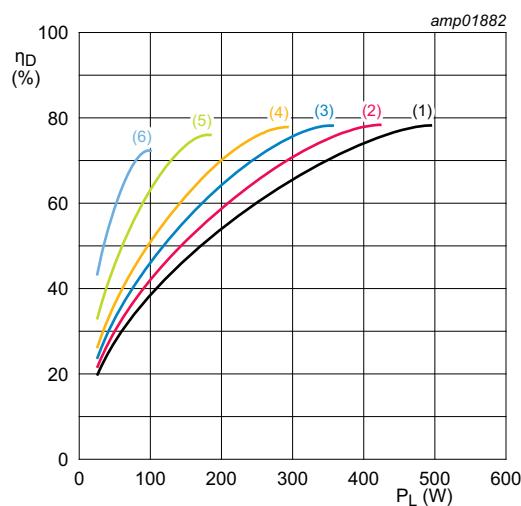
Fig 14. Drain efficiency as a function of output power; typical values



$I_{Dq} = 25$ mA per section; $f = 225$ MHz.

- (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 15. Power gain as a function of output power; typical values



$I_{Dq} = 25$ mA per section; $f = 225$ MHz.

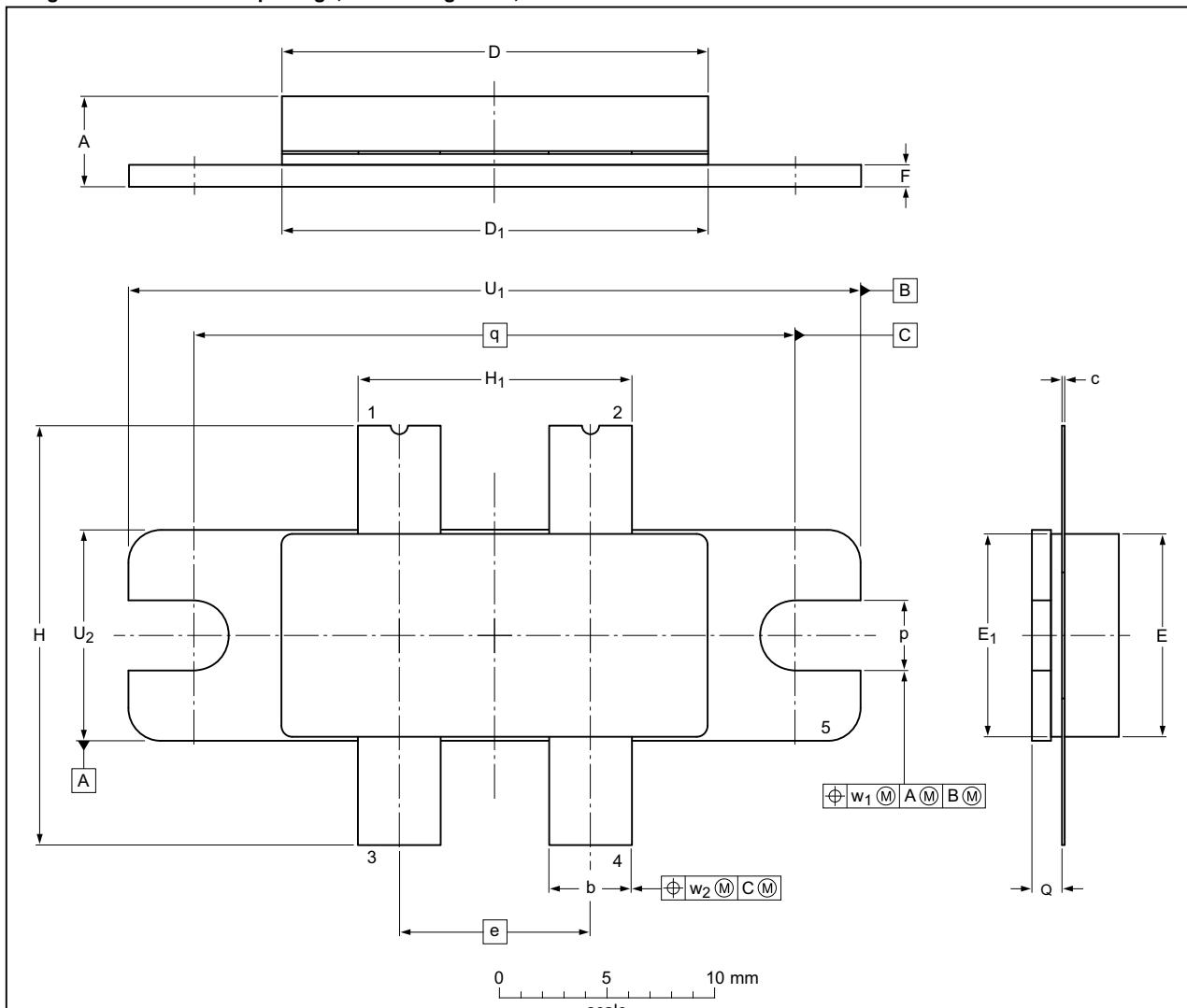
- (1) $V_{DS} = 65$ V
- (2) $V_{DS} = 60$ V
- (3) $V_{DS} = 55$ V
- (4) $V_{DS} = 50$ V
- (5) $V_{DS} = 40$ V
- (6) $V_{DS} = 30$ V

Fig 16. Drain efficiency as a function of output power; typical values

8. Package outline

Flanged LDMOST ceramic package; 2 mounting holes; 4 leads

SOT1121A



Dimensions

Unit ⁽¹⁾	A	b	c	D	D ₁	e	E	E ₁	F	H	H ₁	p	Q ⁽²⁾	q	U ₁	U ₂	w ₁	w ₂
mm	max 4.75	3.94	0.18	20.02	19.96		9.53	9.53	1.14	19.94	12.83	3.38	1.70		34.16	9.91		
mm	nom						8.89							27.94			0.25	0.51
mm	min 3.45	3.68	0.10	19.61	19.66		9.27	9.27	0.89	18.92	12.57	3.12	1.45		33.91	9.65		
inches	max 0.187	0.155	0.007	0.788	0.786		0.375	0.375	0.045	0.785	0.505	0.133	0.067		1.345	0.39		
inches	nom						0.35							1.1		0.01	0.02	
inches	min 0.136	0.145	0.004	0.772	0.774		0.365	0.365	0.035	0.745	0.495	0.123	0.057		1.335	0.38		

Note

1. millimeter dimensions are derived from the original inch dimensions.

2. dimension is measured 0.030 inch (0.76 mm) from the body.

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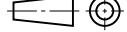
Outline version	References				European projection	Issue date
	IEC	JEDEC	JEITA			
SOT1121A						09-10-12-10-02-02

Fig 17. Package outline SOT1121A

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 [1]
Human Body Model (HBM); According to ANSI/ESDA/JEDEC standard JS-001	2 [2]

[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
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
ART450FE v.2	20240125	Product data sheet	-	ART450FE v.1
Modifications:		<ul style="list-style-type: none"> • Table 2 on page 2: changed name pin 2 to drain2 • Figure 1 on page 3: updated figure 		
ART450FE v.1	20230714	Product data sheet	-	-

12. Legal information

12.1 Data sheet status

Document status ^{[1][2]}	Product status ^[3]	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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Limiting values — Stress above one or more limiting values (as defined in the Absolute Maximum Ratings System of IEC 60134) will cause permanent damage to the device. Limiting values are stress ratings only and (proper) operation of the device at these or any other conditions above those given in the Recommended operating conditions section (if present) or the Characteristics sections of this document is not guaranteed. Constant or repeated exposure to limiting values will permanently and irreversibly affect the quality and reliability of the device.

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12.4 Trademarks

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13. Contact information

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