ART150PE; ART150PEG

Power LDMOS transistor

AMPLEON

Rev. 1 — 13 January 2023 **Product data sheet**

1. Product profile

1.1 General description

Based on Advanced Rugged Technology (ART), this 150 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 [1]	6.78	63	150	-	86.5
CW	41	60	150	29.2	85.6
CW	41	65	150	31.7	80
CW [2]	108	65	150	31.0	81.7
CW pulsed [2][3]	108	65	150	31.5	81.4

[1] Class EF2 generator.

[2] Test circuit.

[3] t_p = 100 μs; δ = 10 %.

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

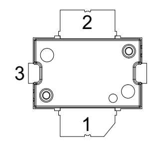
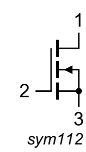
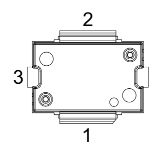
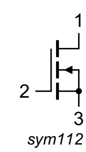
1.3 Applications

- Industrial, scientific and medical applications
  - Plasma generators
  - MRI systems
  - 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
ART150PE (TO-270-2F-1)			
1	drain		
2	gate		
3	source [1]		
ART150PEG (TO-270-2G-1)			
1	drain		
2	gate		
3	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)
TO-270-2F-1	ART150PEXY	9349 604 91538	TR7; 100-fold; 24 mm; dry pack	100
	ART150PEZ	9349 604 91515	TR13; 500-fold; 24 mm; dry pack	500
TO-270-2G-1	ART150PEGXY	9349 604 92538	TR7; 100-fold; 24 mm; dry pack	100
	ART150PEGZ	9349 604 92515	TR13; 500-fold; 24 mm; dry pack	500

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.

5. Thermal characteristics

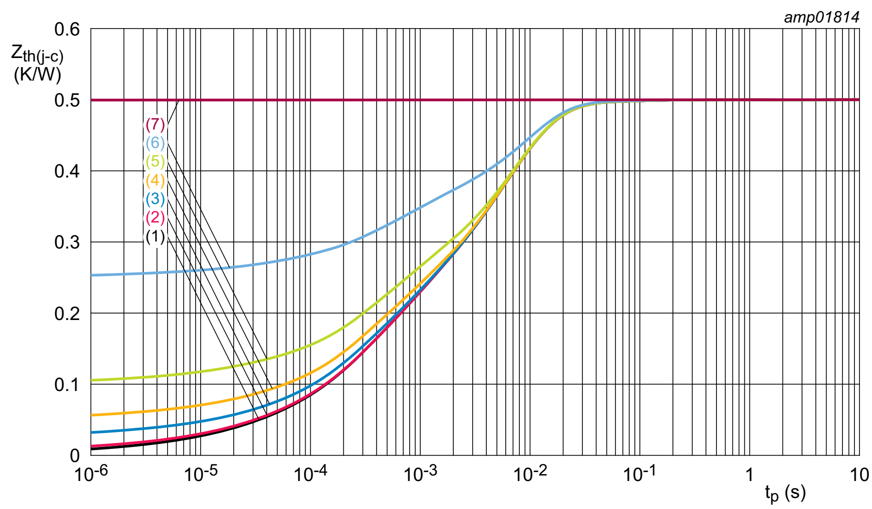
Table 5. Thermal characteristics

According to standard MIL-STD-883E.

Symbol	Parameter	Conditions		Typ	Unit
$R_{th(j-c)}$	thermal resistance from junction to case	T_j = 57 °C, measured under RF condition	[1][2]	0.50	K/W

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

[2] See Figure 1.



(1) δ = 0.1 % (single pulse)

(2) δ = 1 %

(3) δ = 5 %

(4) δ = 10 %

(5) δ = 20 %

(6) δ = 50 %

(7) δ = 100 % (steady state)

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

6. Characteristics

Table 6. DC characteristics

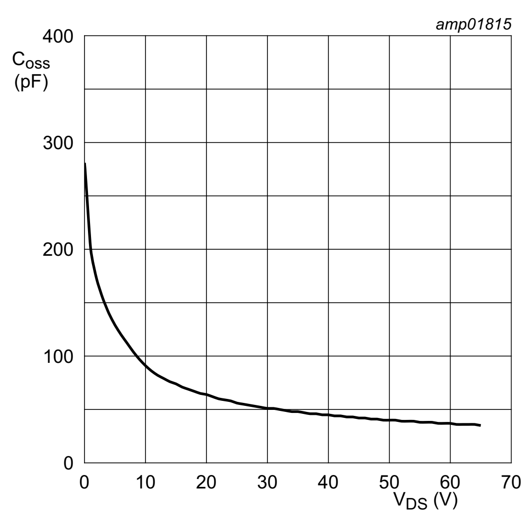
T_j = 25 °C; unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{(BR)DSS}$	drain-source breakdown voltage	V_{GS} = 0 V; I_D = 1.11 mA	203	208	-	V
$V_{GS(th)}$	gate-source threshold voltage	V_{DS} = 20 V; I_D = 111 mA	1.5	2.1	2.5	V
I_{DSS}	drain leakage current	V_{GS} = 0 V; V_{DS} = 65 V	-	-	1.4	μA
I_{DSX}	drain cut-off current	V_{GS} = $V_{GS(th)}$ + 3.75 V; V_{DS} = 20 V	-	15.1	-	A
I_{GSS}	gate leakage current	V_{GS} = 11 V; V_{DS} = 0 V	-	-	140	nA
$R_{DS(on)}$	drain-source on-state resistance	V_{GS} = $V_{GS(th)}$ + 3.75 V; I_D = 3.885 A	-	0.497	-	Ω

Table 7. AC characteristics

T_j = 25 °C; unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
C_{rs}	feedback capacitance	V_{GS} = 0 V; V_{DS} = 65 V; f = 1 MHz	-	0.88	-	pF
C_{iss}	input capacitance	V_{GS} = 0 V; V_{DS} = 65 V; f = 1 MHz	-	116	-	pF
C_{oss}	output capacitance	V_{GS} = 0 V; V_{DS} = 65 V; f = 1 MHz	-	35	-	pF



V_{GS} = 0 V; f = 1 MHz

Fig 2. Output capacitance as a function of drain-source voltage; typical values

Table 8. RF characteristics

Test signal: CW pulsed; t_p = 100 μs; δ = 10 %; f = 108 MHz; RF performance at V_{DS} = 65 V; I_{Dq} = 20 mA; T_{case} = 25 °C; unless otherwise specified; in a class-AB production test circuit.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
G_p	power gain	P_L = 150 W	29	31.2	-	dB
RL_{in}	input return loss	P_L = 150 W	-	–24	–9	dB
η_D	drain efficiency	P_L = 150 W	70	75.3	-	%

7. Test information

7.1 Ruggedness in class-AB operation

The ART150PE and ART150PEG are capable of withstanding a load mismatch corresponding to VSWR $\geq$ 65 : 1 through all phases under the following conditions: V_{DS} = 65 V; I_{Dq} = 20 mA; P_L = 150 W; f = 108 MHz; CW and CW pulsed (t_p = 100 μs; δ = 10 %).

7.2 Impedance information

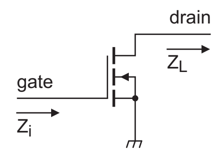
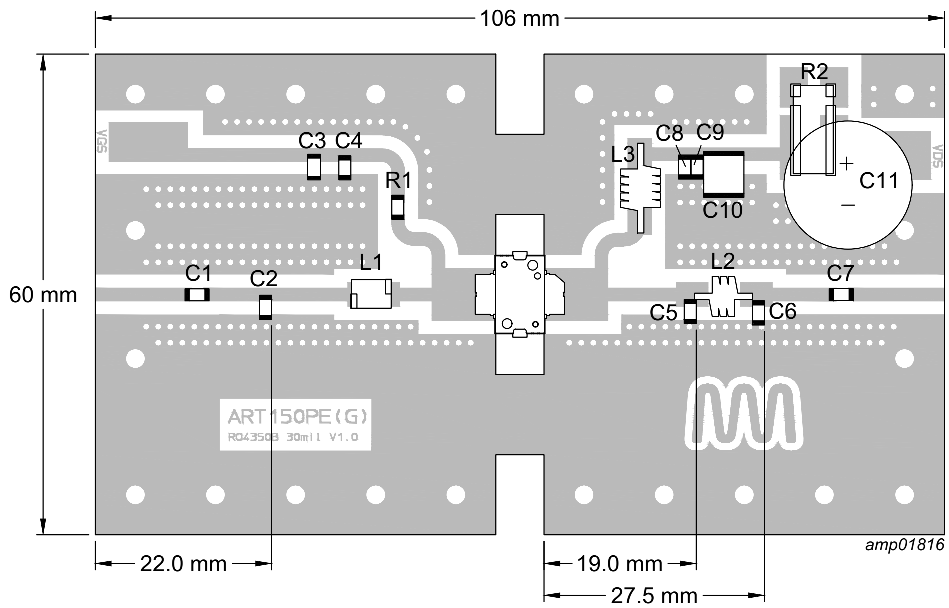


Fig 3. Definition of transistor impedance

Table 9. Typical impedance
Simulated Z_i and Z_L device impedance; impedance info at V_{DS} = 65 V and P_L = 150 W.

f	Z_i	Z_L
(MHz)	(Ω)	(Ω)
108	5.2 – j22.6	12.1 + j4.7

7.3 Test circuit



Printed-Circuit Board (PCB): RO4350B; ε_r = 3.48 F/m; thickness = 0.762 mm.
See Table 10 for a list of components.

Fig 4. Component layout

Table 10. List of components
For test circuit see Figure 4.

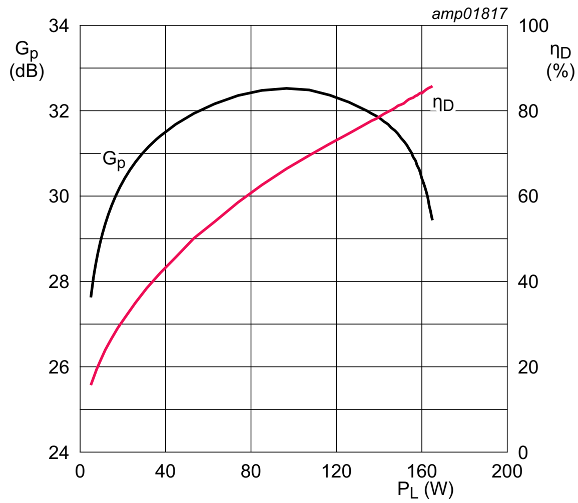
Component	Description	Value	Remarks
C1, C4, C7	multilayer ceramic chip capacitor	1 nF [1][2]	
C2	multilayer ceramic chip capacitor	110 pF [1][2]	
C3	multilayer ceramic chip capacitor	4.7 μF, 100 V	Murata: GRM31CC72A475KE11L
C5	multilayer ceramic chip capacitor	20 pF [1][2]	
C6	multilayer ceramic chip capacitor	62 pF [1][2]	
C8, C9	multilayer ceramic chip capacitor	620 pF [1][2]	
C10	multilayer ceramic chip capacitor	4.7 μF, 100 V	TDK: CGA9N2X7R2A465K230
C11	electrolytic capacitor	470 μF, 100 V	
L1	midi spring air core inductor	39 nH	Coilcraft: 1812SMS-39N
L2	air inductor	3 turns, D = 5 mm	1 mm copper wire (39 nH)
L3	air inductor	5 turns, D = 5 mm	1 mm copper wire (82 nH)
R1	chip resistor	5.1 kΩ	SMD 1206
R2	chip resistor	0.01 Ω	FC4L110R010FER

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

[2] Vertical mounted

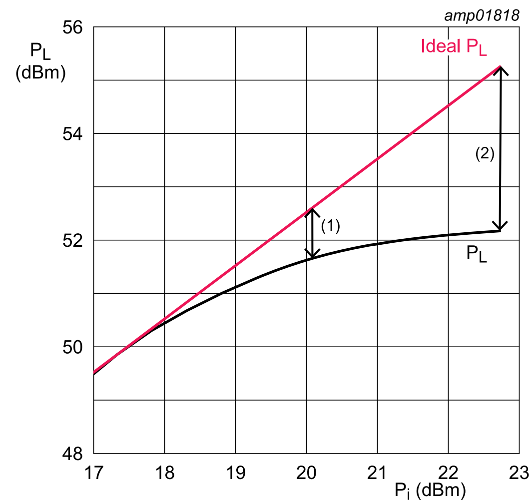
7.4 Graphical data

7.4.1 1-Tone CW pulsed



V_{DS} = 65 V; I_{Dq} = 20 mA; f = 108 MHz; t_p = 100 μs; δ = 10 %.

Fig 5. Power gain and drain efficiency as function of output power; typical values

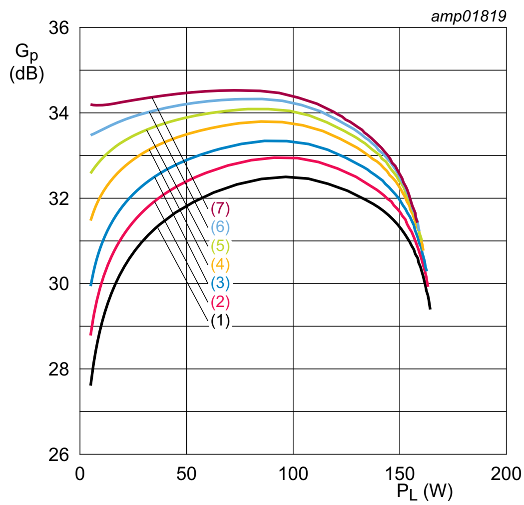


V_{DS} = 65 V; I_{Dq} = 20 mA; f = 108 MHz; t_p = 100 μs; δ = 10 %.

(1) $P_{L(1dB)}$ = 51.70 dBm (148 W)

(2) $P_{L(3dB)}$ = 52.17 dBm (165 W)

Fig 6. Output power as a function of input power; typical values



V_{DS} = 65 V; f = 108 MHz; t_p = 100 μs; δ = 10 %.

(1) I_{Dq} = 20 mA

(2) I_{Dq} = 50 mA

(3) I_{Dq} = 100 mA

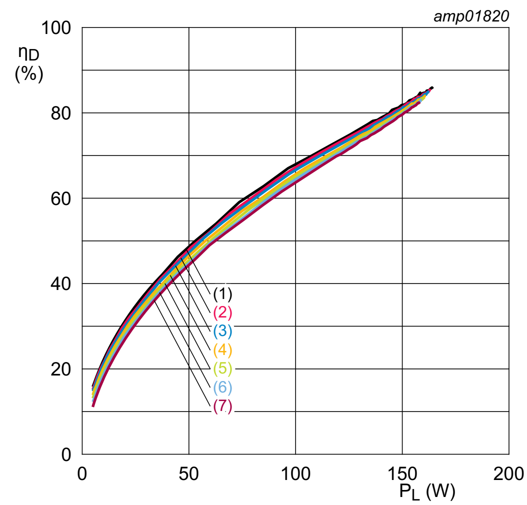
(4) I_{Dq} = 200 mA

(5) I_{Dq} = 300 mA

(6) I_{Dq} = 400 mA

(7) I_{Dq} = 500 mA

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



V_{DS} = 65 V; f = 108 MHz; t_p = 100 μs; δ = 10 %.

(1) I_{Dq} = 20 mA

(2) I_{Dq} = 50 mA

(3) I_{Dq} = 100 mA

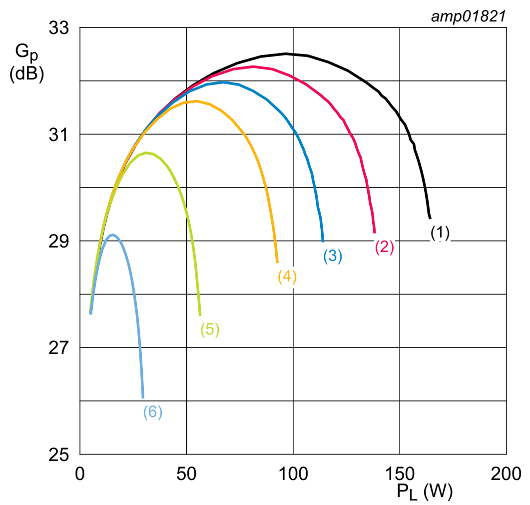
(4) I_{Dq} = 200 mA

(5) I_{Dq} = 300 mA

(6) I_{Dq} = 400 mA

(7) I_{Dq} = 500 mA

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



I_{Dq} = 20 mA; f = 108 MHz; t_p = 100 μs; δ = 10 %.

(1) V_{DS} = 65 V

(2) V_{DS} = 60 V

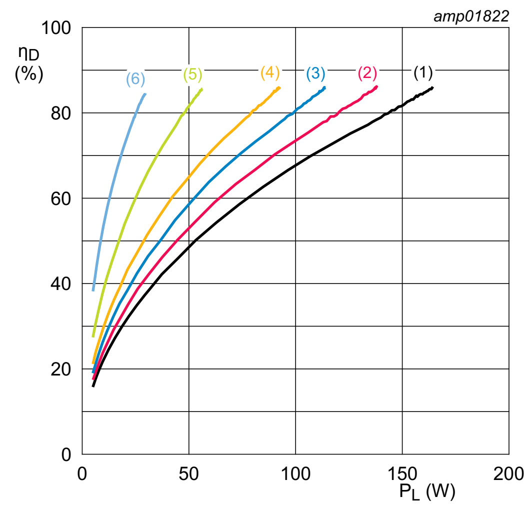
(3) V_{DS} = 55 V

(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} = 20 mA; f = 108 MHz; t_p = 100 μs; δ = 10 %.

(1) V_{DS} = 65 V

(2) V_{DS} = 60 V

(3) V_{DS} = 55 V

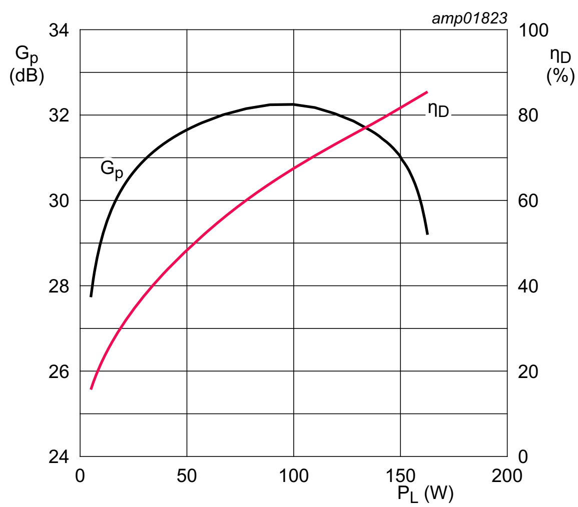
(4) V_{DS} = 50 V

(5) V_{DS} = 40 V

(6) V_{DS} = 30 V

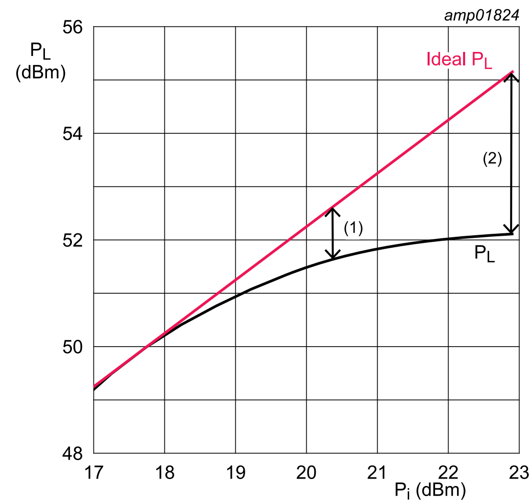
Fig 10. Drain efficiency as a function of output power; typical values

7.4.2 1-Tone CW



V_{DS} = 65 V; I_{Dq} = 20 mA; f = 108 MHz.

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

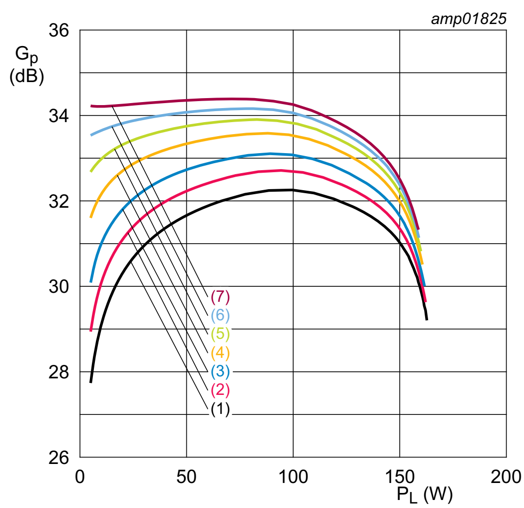


V_{DS} = 65 V; I_{Dq} = 20 mA; f = 108 MHz.

(1) $P_{L(1dB)}$ = 51.66 dBm (147 W)

(2) $P_{L(3dB)}$ = 52.11 dBm (163 W)

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



V_{DS} = 65 V; f = 108 MHz.

(1) I_{Dq} = 20 mA

(2) I_{Dq} = 50 mA

(3) I_{Dq} = 100 mA

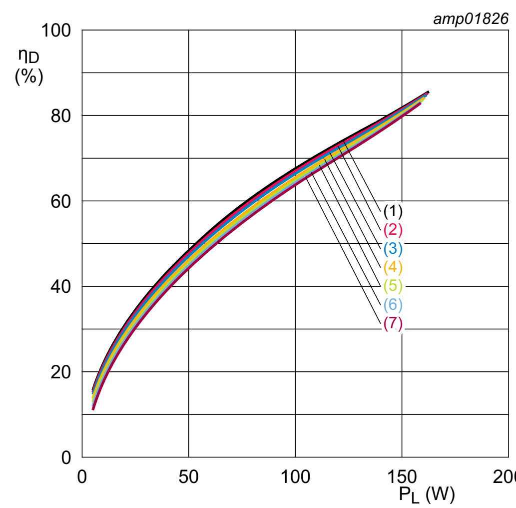
(4) I_{Dq} = 200 mA

(5) I_{Dq} = 300 mA

(6) I_{Dq} = 400 mA

(7) I_{Dq} = 500 mA

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



V_{DS} = 65 V; f = 108 MHz.

(1) I_{Dq} = 20 mA

(2) I_{Dq} = 50 mA

(3) I_{Dq} = 100 mA

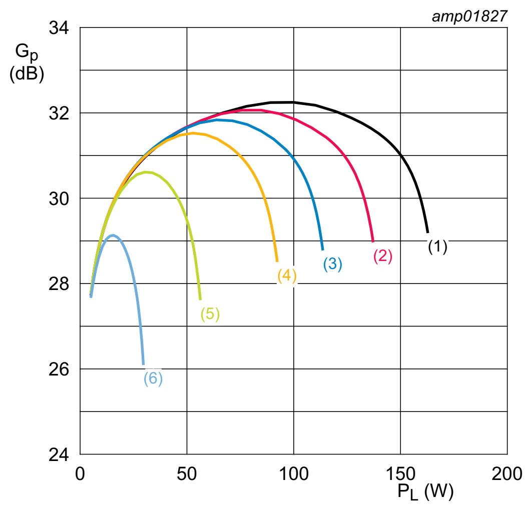
(4) I_{Dq} = 200 mA

(5) I_{Dq} = 300 mA

(6) I_{Dq} = 400 mA

(7) I_{Dq} = 500 mA

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



I_{Dq} = 20 mA; f = 108 MHz.

(1) V_{DS} = 65 V

(2) V_{DS} = 60 V

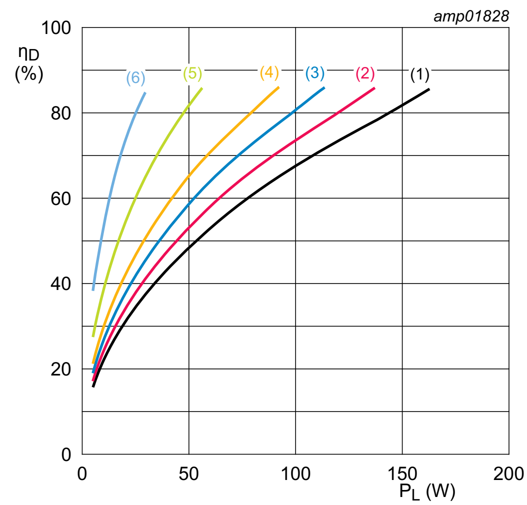
(3) V_{DS} = 55 V

(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} = 20 mA; f = 108 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

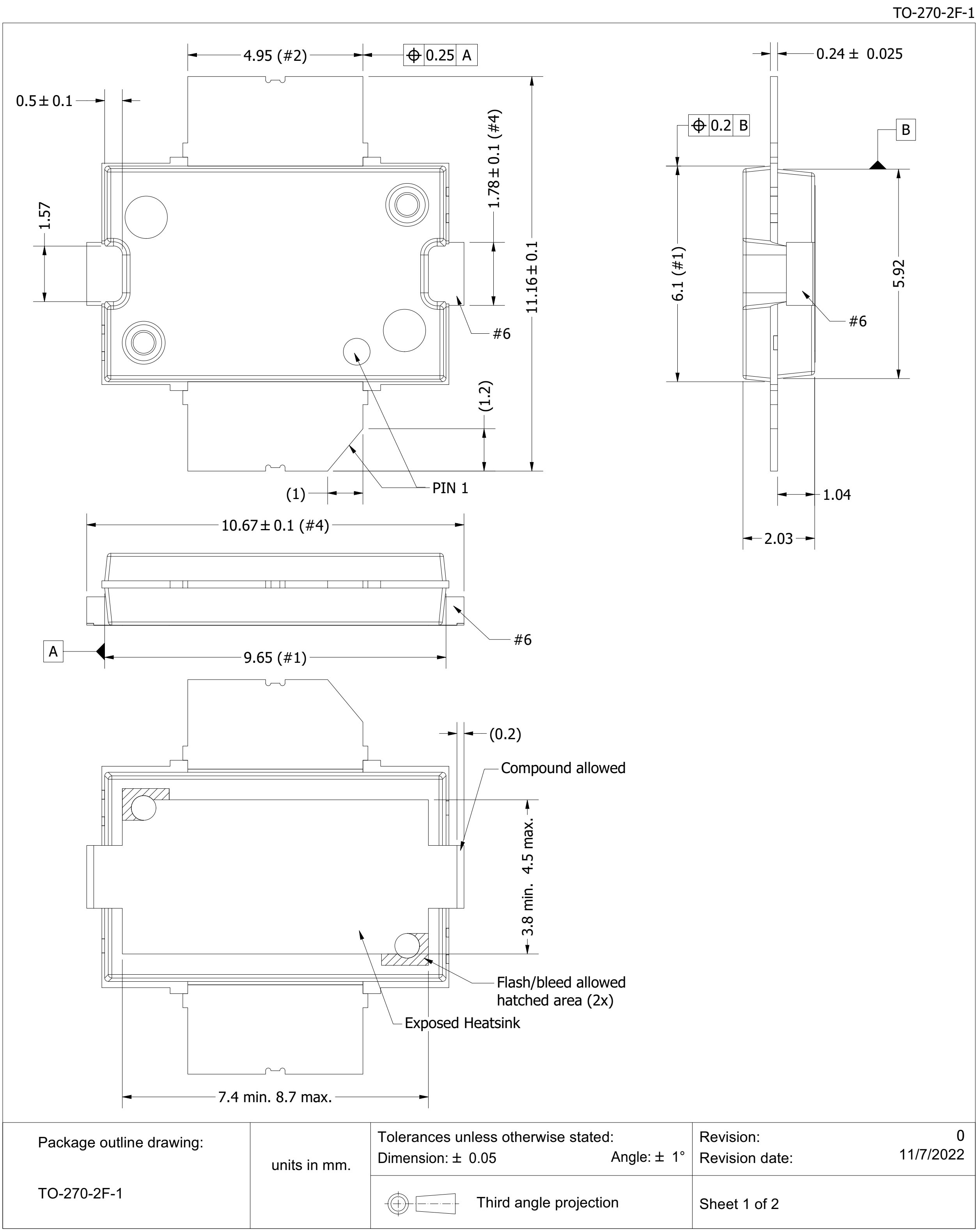
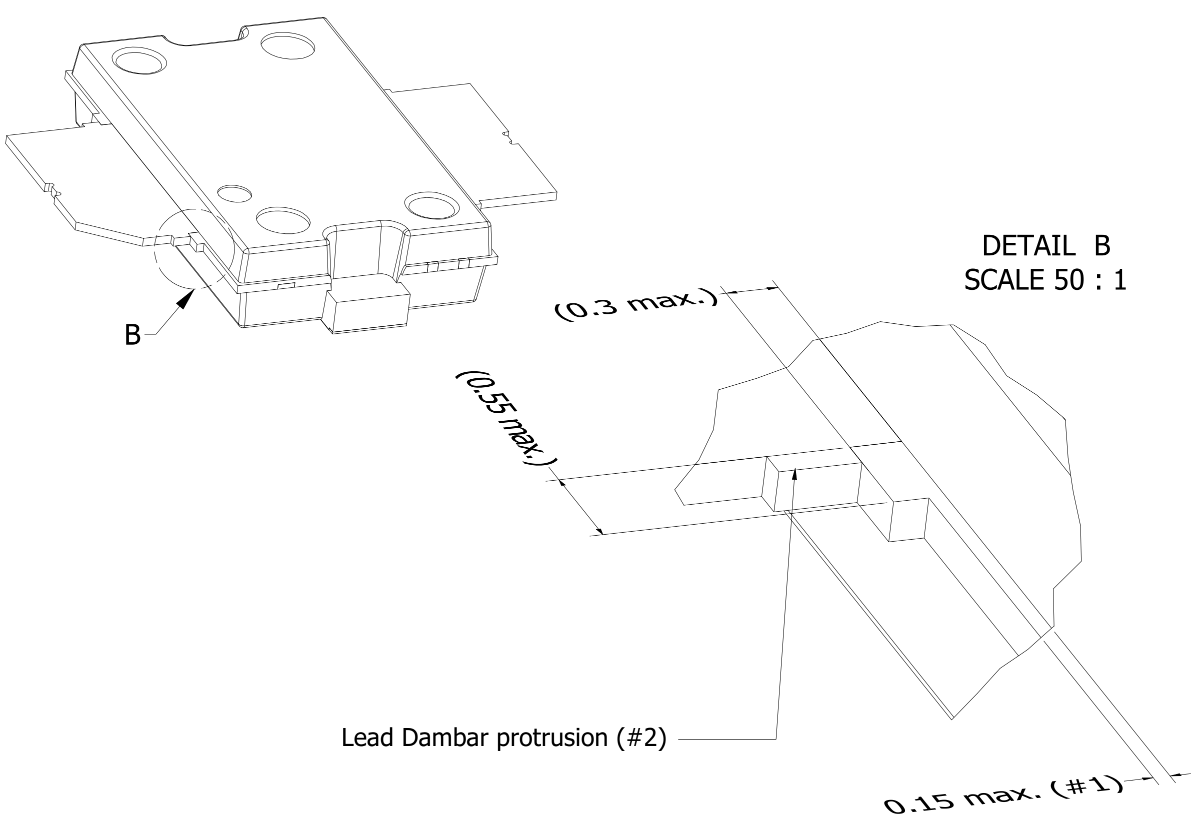


Fig 17. Package outline TO-270-2F-1 (sheet 1 of 2)

TO-270-2F-1

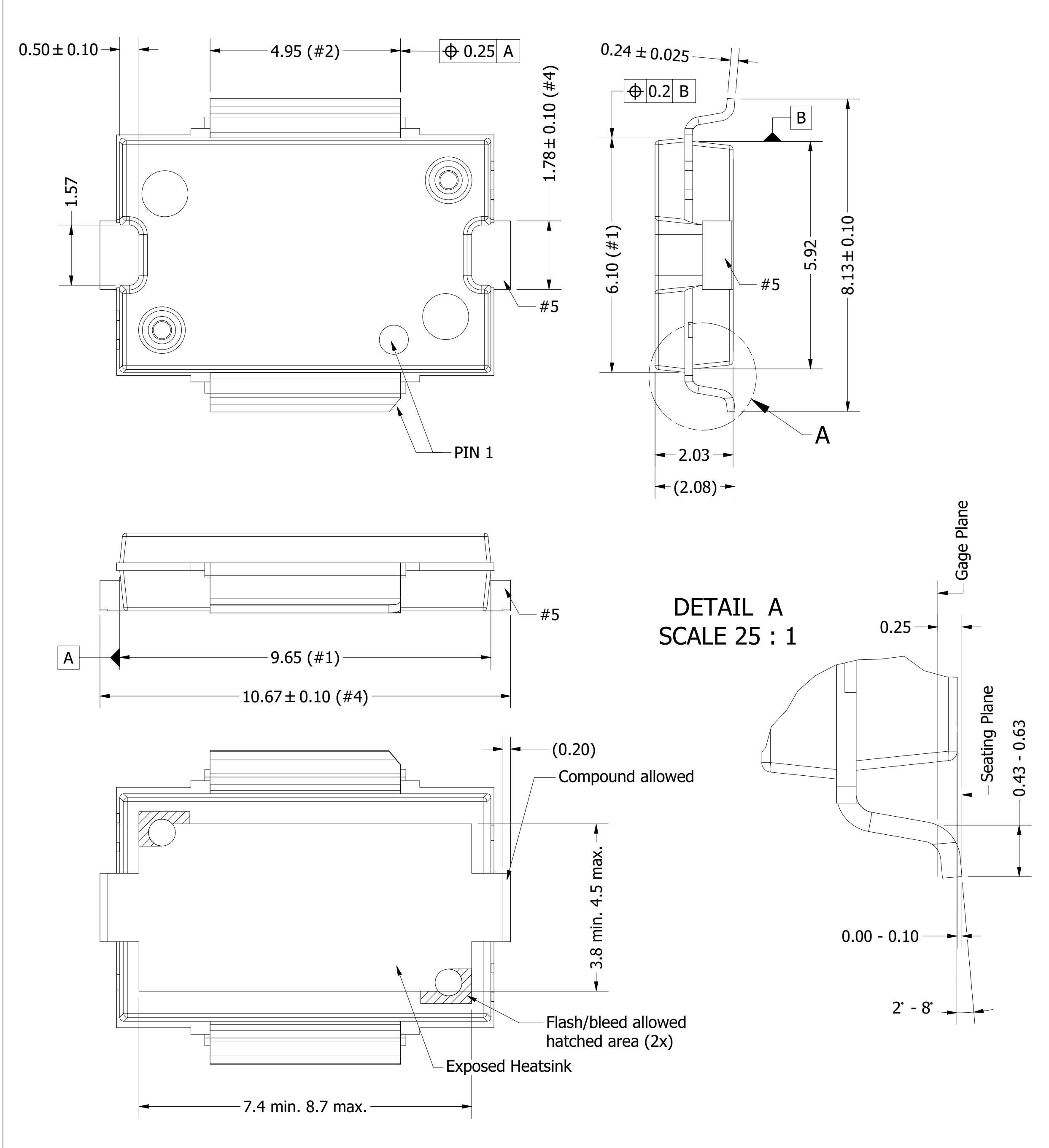
Drawing Notes	
Items	Description
(1)	Dimensions are excluding mold protrusion. The mold protrusion is maximum 0.15 mm per side. See also detail B. In the dambar area max. protrusion is 0.55 mm. max. in length and 0.3 mm. max. in width (4x). See also detail B.
(2)	The lead dambar (metal) protrusions are not included. Add 0.14 mm max to the total lead dimension at the dambar location.
(3)	The leads and exposed heatsink are plated with matte Tin (Sn).
(4)	Dimensions (Heatsink ears) 10,67 and 1,78 do not include mouldprotrusion. Overall Max. dimensions incl. mould protrusions is 10.92 mm. (max.) and 2.03 mm. (max.).
(5)	Lead coplanarity over the leads is 0,1 mm. maximum.
(6)	Surfaces may remain unplated (not solderable surfaces).



Package outline drawing: TO-270-2F-1	units in mm.	Tolerances unless otherwise stated: Dimension: ± 0.05 Angle: ± 1°	Revision: 0 Revision date: 11/7/2022
		Third angle projection	Sheet 2 of 2

Fig 18. Package outline TO-270-2F-1 (sheet 2 of 2)

TO-270-2G-1

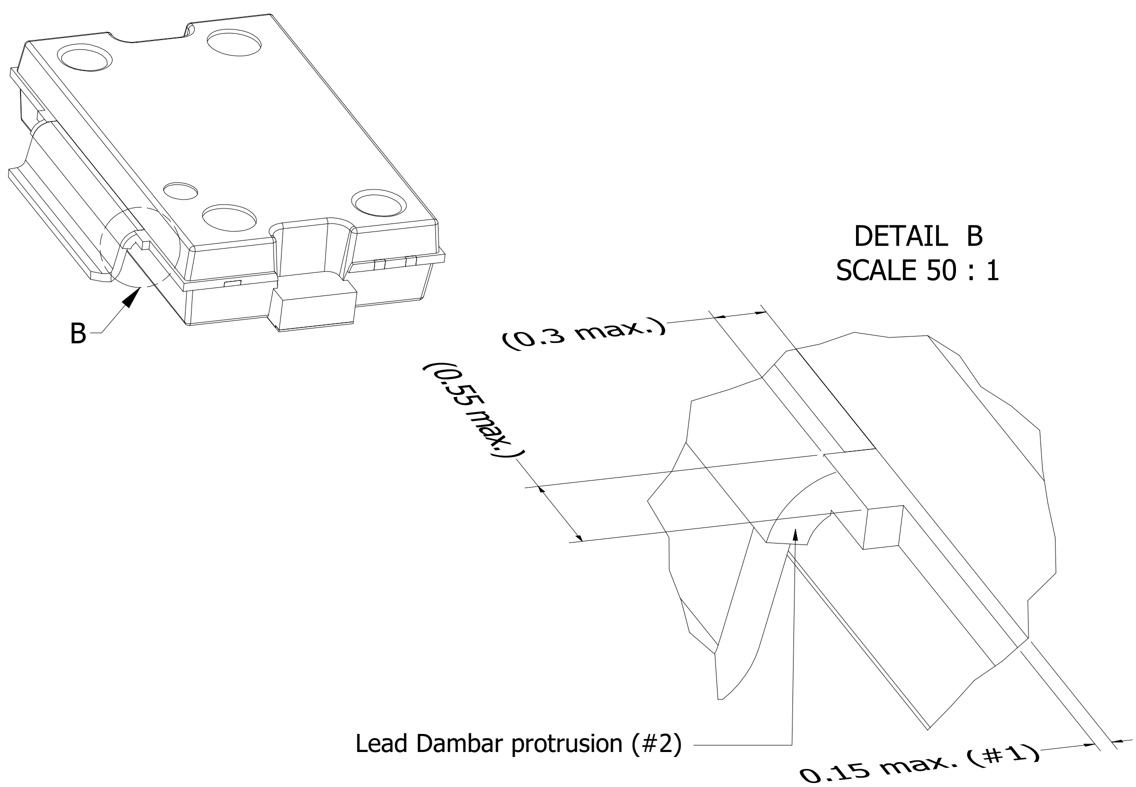


Package outline drawing: TO-270-2G-1	units in mm.	Tolerances unless otherwise stated: Dimension: ± 0.05 Angle: ± 1°	Revision: 0 Revision date: 11/7/2022
		Third angle projection	Sheet 1 of 2

Fig 19. Package outline TO-270-2G-1 (sheet 1 of 2)

TO-270-2G-1

Drawing Notes	
Items	Description
(1)	Dimensions are excluding mold protrusion. The mold protrusion is maximum 0.15 mm per side. See also detail B. In the dambar area max. protrusion is 0.55mm max. in lenght and 0.3 mm max. in width (4x) See also detail B.
(2)	The lead dambar (metal) protrusions are not included. Add 0.14 mm max to the total lead dimension at the dambar location.
(3)	The leads and exposed heatsink are plated with matte Tin (Sn).
(4)	Dimensions (Heatsink ears) 10,67 and 1,78 do not include mouldprotrusion. Overall Max. dimensions incl. mould protrusions is 10,92 mm. (max.) and 2,03 mm. (max.).
(5)	Surfaces may remain unplated (not solderable surfaces).



Package outline drawing: TO-270-2G-1	units in mm.	Tolerances unless otherwise stated: Dimension: ± 0.05 Angle: ± 1°	Revision: 0 Revision date: 11/7/2022
		Third angle projection	Sheet 2 of 2

Fig 20. Package outline TO-270-2G-1 (sheet 2 of 2)

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
SMD	Surface Mounted Device
RoHS	Restriction of Hazardous Substances
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
ART150PE_ART150PEG v.1	20230113	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.

12.2 Definitions

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14. Contents

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