

ART2K0TFE; ART2K0TFES; ART2K0TFEG

Power LDMOS transistor

Rev. 2 — 31 July 2024

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 _{DS} | P _L | G _p | η _D |
|---------------|-------|-----------------|----------------|----------------|----------------|
| | (MHz) | (V) | (W) | (dB) | (%) |
| CW pulsed [1] | 108 | 65 | 2000 | 29.1 | 73.3 |

[1] Test circuit: $t_p = 100 \mu\text{s}$; $\delta = 10 \%$.

1.2 Features and benefits

- High breakdown voltage enables class E operation up to $V_{DS} = 53 \text{ V}$
- Qualified up to a maximum of $V_{DS} = 65 \text{ V}$
- Characterized from 30 V to 65 V to support a wide range of applications
- Integrated thermal sensor
- 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
- Broadcast
 - ◆ FM radio
 - ◆ VHF TV
- Communications
 - ◆ Non cellular communications
 - ◆ UHF radar

2. Pinning information

Table 2. Pinning

| Pin | Description | Simplified outline | Graphic symbol |
|-----------------------------------|--|--------------------|----------------|
| ART2K0TFE (ACC-1230-6F-3) | | | |
| 1 | drain1 | | |
| 2 | drain2 | | |
| 3 | gate1 | | |
| 4 | gate2 | | |
| 5 | source [1] | | |
| 6 | temperature sense FET1 [2] | | |
| 7 | temperature sense FET2 [2] | | |
| ART2K0TFES (ACC-1230-6F-2) | | | |
| 1 | drain1 | | |
| 2 | drain2 | | |
| 3 | gate1 | | |
| 4 | gate2 | | |
| 5 | source [1] | | |
| 6 | temperature sense FET1 [2] | | |
| 7 | temperature sense FET2 [2] | | |
| ART2K0TFEG (ACC-1230-6G-2) | | | |
| 1 | drain1 | | |
| 2 | drain2 | | |
| 3 | gate1 | | |
| 4 | gate2 | | |
| 5 | source [1] | | |
| 6 | temperature sense FET1 [2] | | |
| 7 | temperature sense FET2 [2] | | |

[1] Connected to flange.

[2] The ART2K0TFE, ART2K0TFES and ART2K0TFEG are equipped with a thermal sense FET and can be used to sense the die temperature during operation of the device. This thermal FET is electrically disconnected from the RF power FETs on the die and share only a common ground. The sensor is operated by applying a fixed voltage to its input pin and monitor the current, which is temperature depended.

3. Ordering information

Table 3. Ordering information

| Package name | Orderable part number | 12NC | Packing description | Min. orderable quantity (pieces) |
|---------------|-----------------------|----------------|-------------------------------------|----------------------------------|
| ACC-1230-6F-3 | ART2K0TFEJ | 9349 607 63118 | TR13; 100-fold; 56 mm; non-dry pack | 100 |
| ACC-1230-6F-2 | ART2K0TFESJ | 9349 606 36118 | TR13; 100-fold; 56 mm; non-dry pack | 100 |
| ACC-1230-6G-2 | ART2K0TFEGJ | 9349 606 35118 | 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 | | -6 | +11 | V |
| V_{TS} | temperature sensor voltage | | -9 | +5.5 | 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

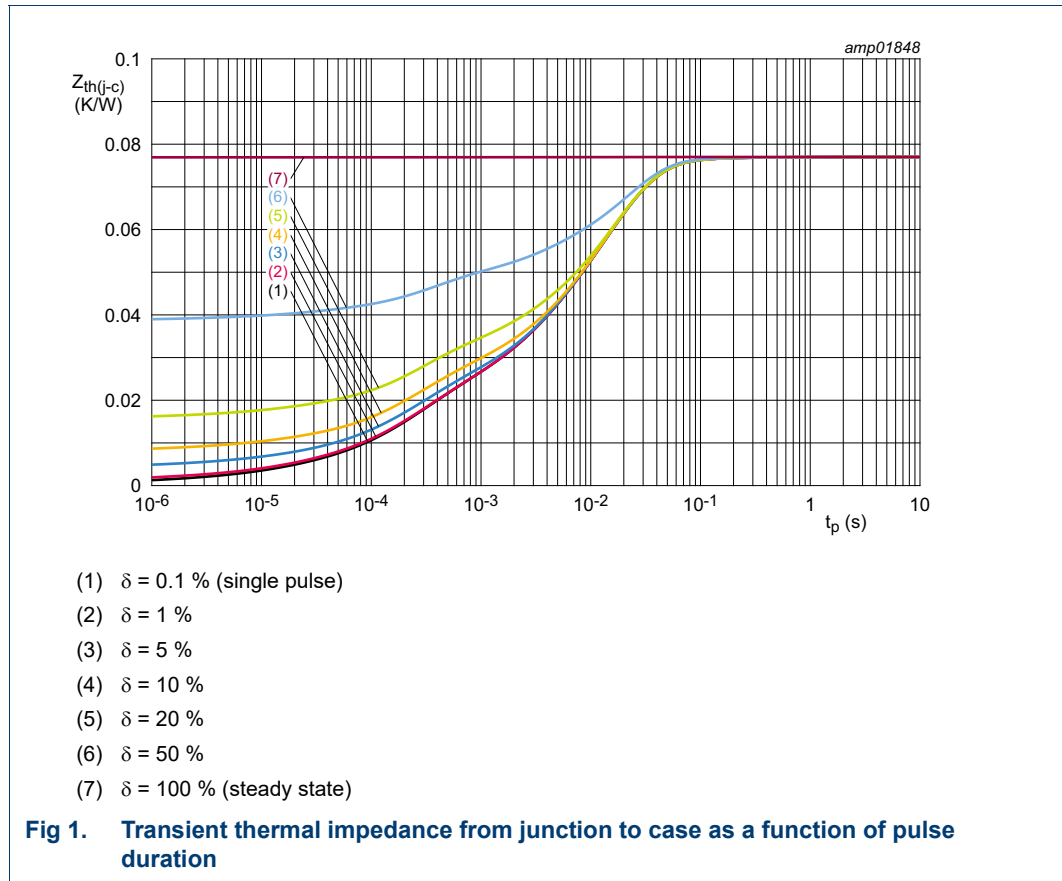
Table 5. Thermal characteristics

According to standard MIL-STD-883E.

| Symbol | Parameter | Conditions | Typ | Unit | |
|---------------|--|--|--------|-------|-----|
| $R_{th(j-c)}$ | thermal resistance from junction to case | $T_j = 95\text{ °C}$, measured under RF condition | [1][2] | 0.077 | K/W |

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

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



6. Characteristics

Table 6. DC characteristics

$T_j = 25\text{ }^\circ\text{C}$; 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 | $V_{DS} = 20\text{ V}; I_D = 550\text{ mA}$ | 1.6 | 2.1 | 2.6 | V |
| $V_{TS(th)}$ | temperature sensor threshold voltage | $I_{TS} = 0.7\text{ mA}$ | 1.75 | 2.3 | 2.75 | V |
| I_{DSS} | drain leakage current | $V_{GS} = 0\text{ V}; V_{DS} = 65\text{ V}$ | - | - | 2.8 | μA |
| I_{DSX} | drain cut-off current | $V_{GS} = V_{GS(th)} + 3.75\text{ V}; V_{DS} = 20\text{ V}$ | - | 76 | - | A |
| I_{GSS} | gate leakage current | $V_{GS} = 11\text{ V}; V_{DS} = 0\text{ V}$ | - | - | 280 | nA |
| $R_{DS(on)}$ | drain-source on-state resistance | $V_{GS} = V_{GS(th)} + 3.75\text{ V}; I_D = 19.25\text{ A}$ | - | 0.107 | - | Ω |

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 | $V_{GS} = 0\text{ V}$; $V_{DS} = 65\text{ V}$; $f = 1\text{ MHz}$ | - | 1.88 | - | pF |
| C_{iss} | input capacitance | $V_{GS} = 0\text{ V}$; $V_{DS} = 65\text{ V}$; $f = 1\text{ MHz}$ | - | 598 | - | pF |
| C_{oss} | output capacitance | $V_{GS} = 0\text{ V}$; $V_{DS} = 65\text{ V}$; $f = 1\text{ MHz}$ | - | 179 | - | pF |

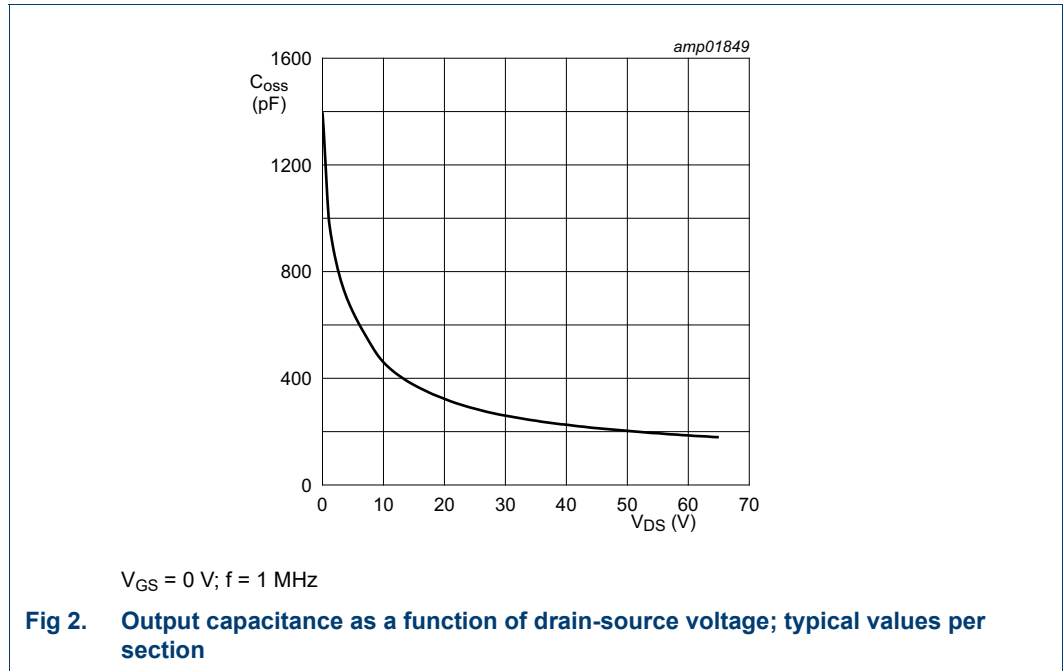


Fig 2. Output capacitance as a function of drain-source voltage; typical values per section

Table 8. RF characteristics

Test signal: pulsed RF; $t_p = 100\text{ }\mu\text{s}$; $\delta = 5\%$; $f = 108\text{ MHz}$; 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 | 29 | - | dB |
| RL_{in} | input return loss | $P_L = 2000\text{ W}$ | - | -15 | - | dB |
| η_D | drain efficiency | $P_L = 2000\text{ W}$ | 68 | 73 | - | % |

7. Test information

7.1 Ruggedness in class-AB operation

The ART2K0TFE, ART2K0TFES and ART2K0TFEG 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; $t_p = 100\text{ }\mu\text{s}$; $\delta = 10\%$; $f = 108\text{ MHz}$.

7.2 Impedance information

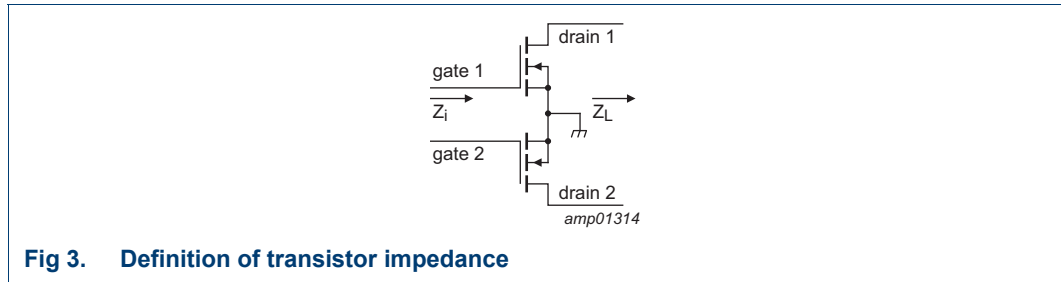


Fig 3. Definition of transistor impedance

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 (MHz) | Z_i (Ω) | Z_L (Ω) |
|------------|-----------------------|-----------------------|
| 108 | $2.4 - j8.9$ | $3.9 + j1.0$ |

7.3 Graphical data thermal sensor

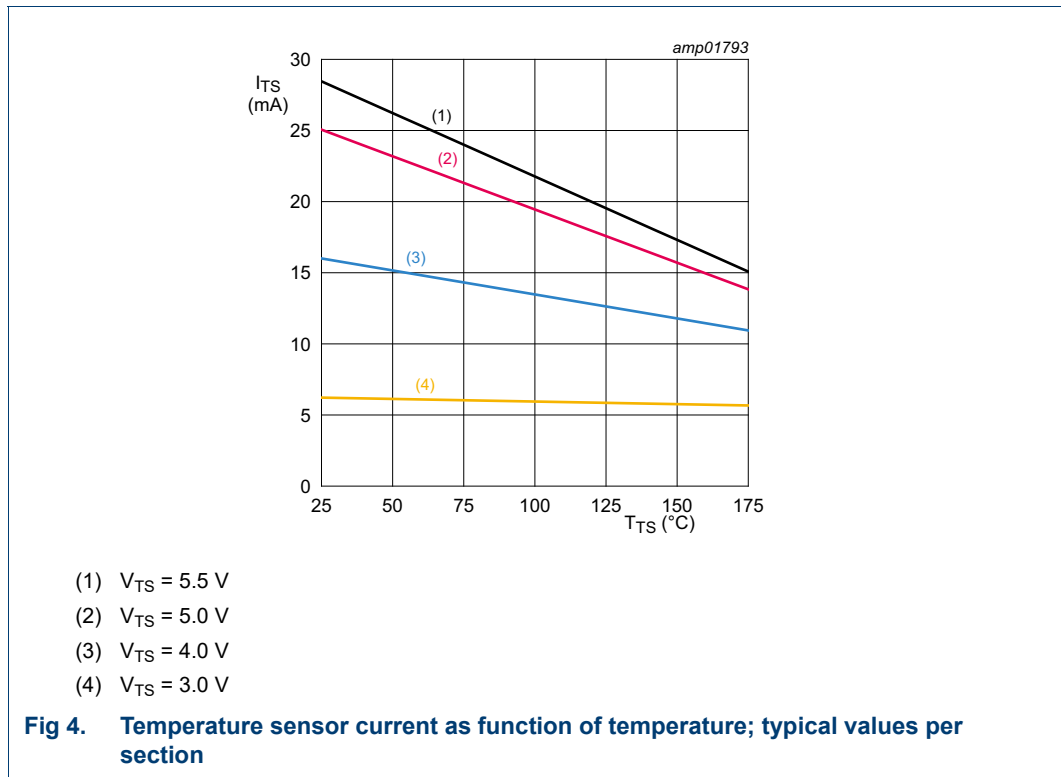


Fig 4. Temperature sensor current as function of temperature; typical values per section

7.4 Test circuit

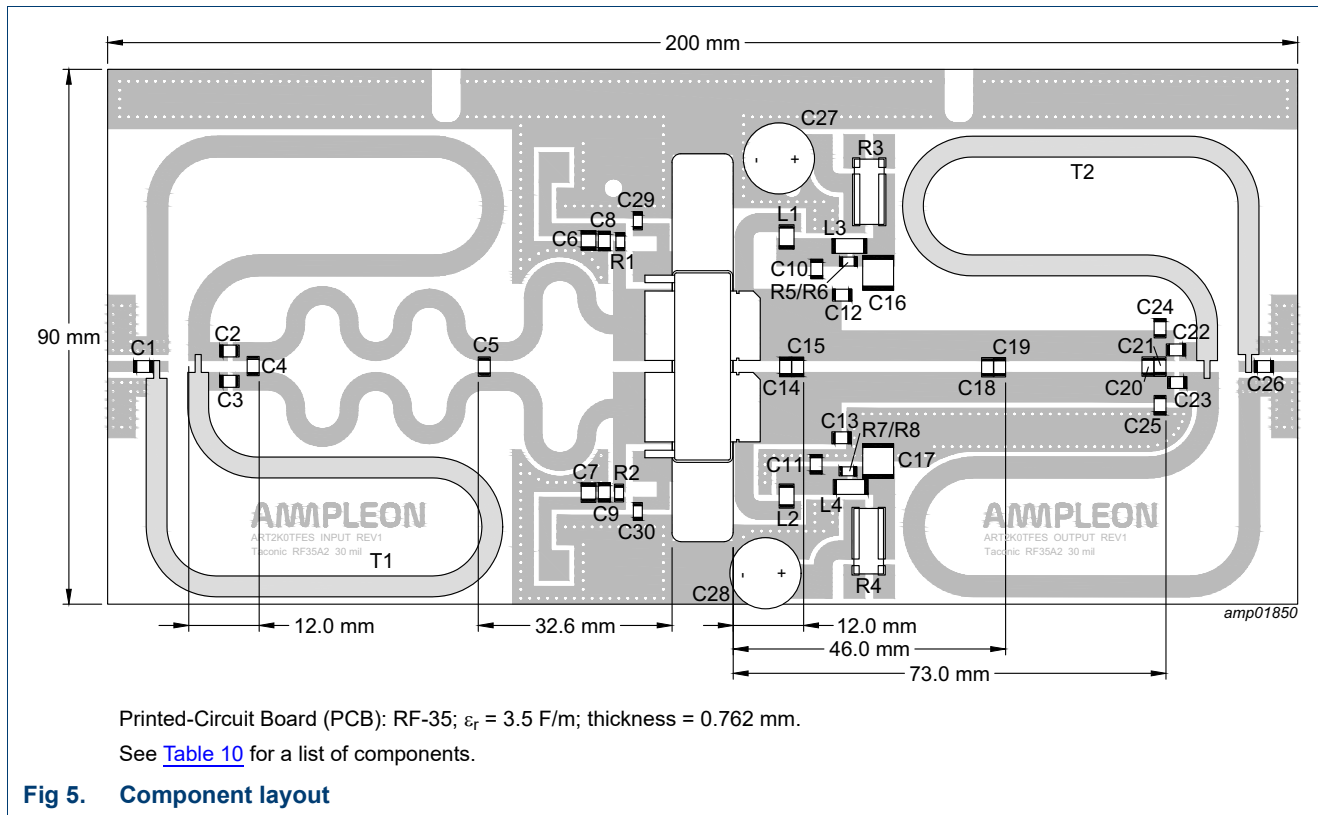


Table 10. List of components

For test circuit see [Figure 5](#).

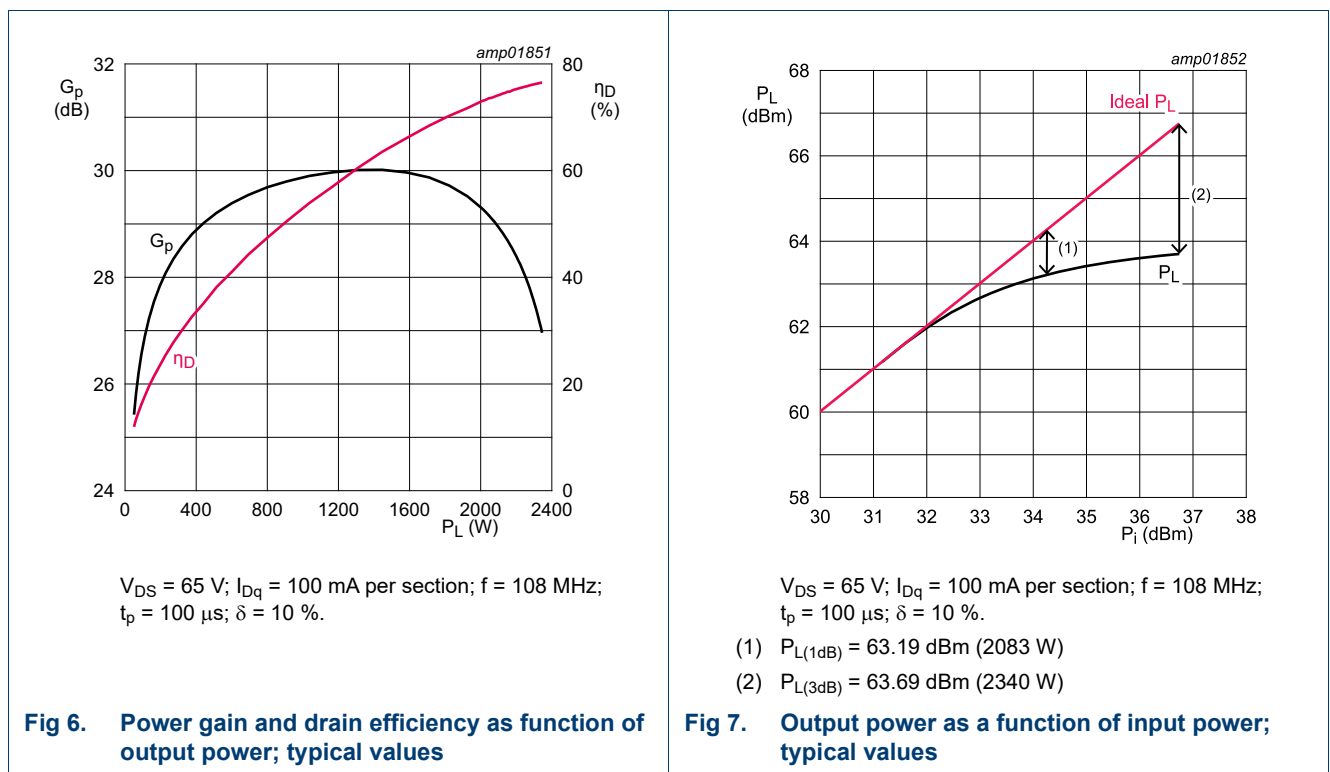
| Component | Description | Value | Remarks |
|------------------|-----------------------------------|---------------------|----------------------------|
| C1, C26 | multilayer ceramic chip capacitor | 470 pF | [1] |
| C2, C3 | multilayer ceramic chip capacitor | 68 pF | [1] |
| C4 | multilayer ceramic chip capacitor | 43 pF | [1] |
| C5 | multilayer ceramic chip capacitor | 240 pF | [1] |
| C6, C7 | multilayer ceramic chip capacitor | 4.7 μ F, 50 V | Murata: GRM32ER71H475KA88L |
| C8, C9, C10, C11 | multilayer ceramic chip capacitor | 820 pF | [1] |
| C12, C13 | multilayer ceramic chip capacitor | 180 pF | [1] |
| C14, C15 | multilayer ceramic chip capacitor | 39 pF | [1] |
| C16, C17 | multilayer ceramic chip capacitor | 4.7 μ F, 100 V | TDK: C5750X7R2A475KT/A |
| C18, C19 | multilayer ceramic chip capacitor | 56 pF | [1] |
| C20, C21 | multilayer ceramic chip capacitor | 51 pF | [1] |
| C22, C23 | multilayer ceramic chip capacitor | 120 pF | [1] |
| C24, C25 | multilayer ceramic chip capacitor | 20 pF | [1] |
| C27, C28 | electrolytic capacitor | 2200 μ F, 100 V | |
| C29, C30 | multilayer ceramic chip capacitor | 1 μ F, 25 V | SMD 1206 |
| L1, L2 | square air core inductor | 47 nH | Coilcraft: 1515SQ-47N |
| L3, L4 | square air core inductor | 82 nH | Coilcraft: 1515SQ-82N |

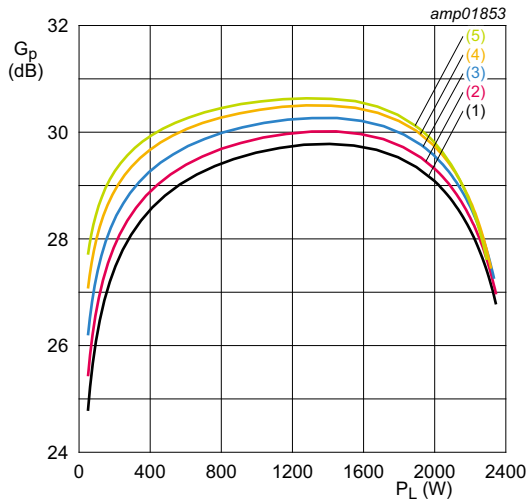
Table 10. List of components ...continued
For test circuit see [Figure 5](#).

| Component | Description | Value | Remarks |
|----------------|-----------------|--------------|-----------------|
| R1, R2 | chip resistor | 4.7 kΩ | SMD 1206 |
| R3, R4 | chip resistor | 0.01 Ω | FC4L110R010FER |
| R5, R6, R7, R8 | chip 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.

7.5 Graphical data

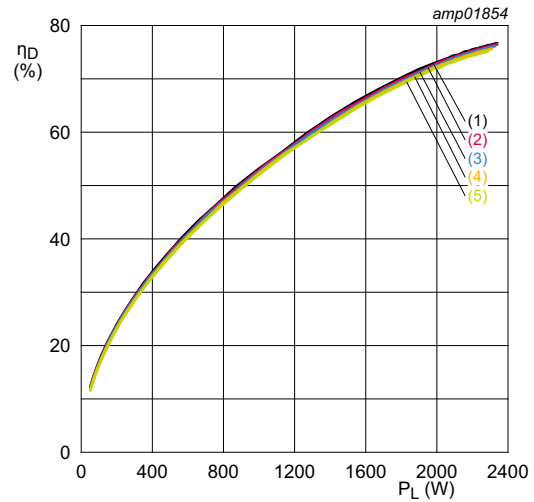




$V_{DS} = 65 \text{ V}; f = 108 \text{ MHz}; t_p = 100 \text{ } \mu\text{s}; \delta = 10 \text{ } \%$.

- (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

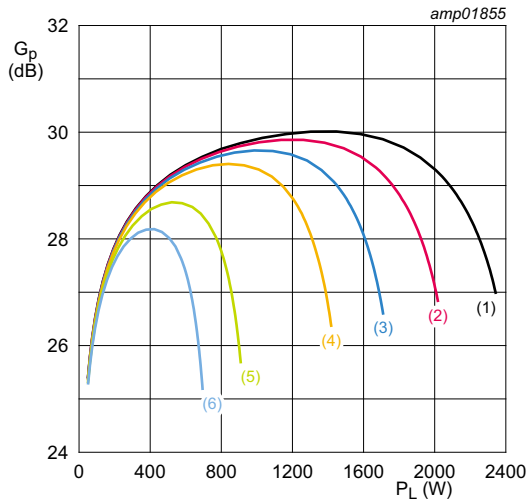
Fig 8. Power gain as a function of output power; typical values



$V_{DS} = 65 \text{ V}; f = 108 \text{ MHz}; t_p = 100 \text{ } \mu\text{s}; \delta = 10 \text{ } \%$.

- (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

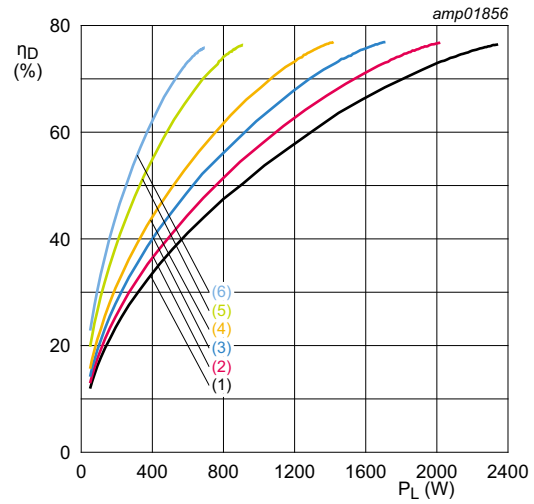
Fig 9. Drain efficiency as a function of output power; typical values



$I_{Dq} = 100$ mA per section; $f = 108$ 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. Power gain as a function of output power; typical values



$I_{Dq} = 100$ mA per section; $f = 108$ 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 11. Drain efficiency as a function of output power; typical values

8. Package outline

Flanged ceramic package; 2 Mounting holes; 6 leads

ACC-1230-6F-3

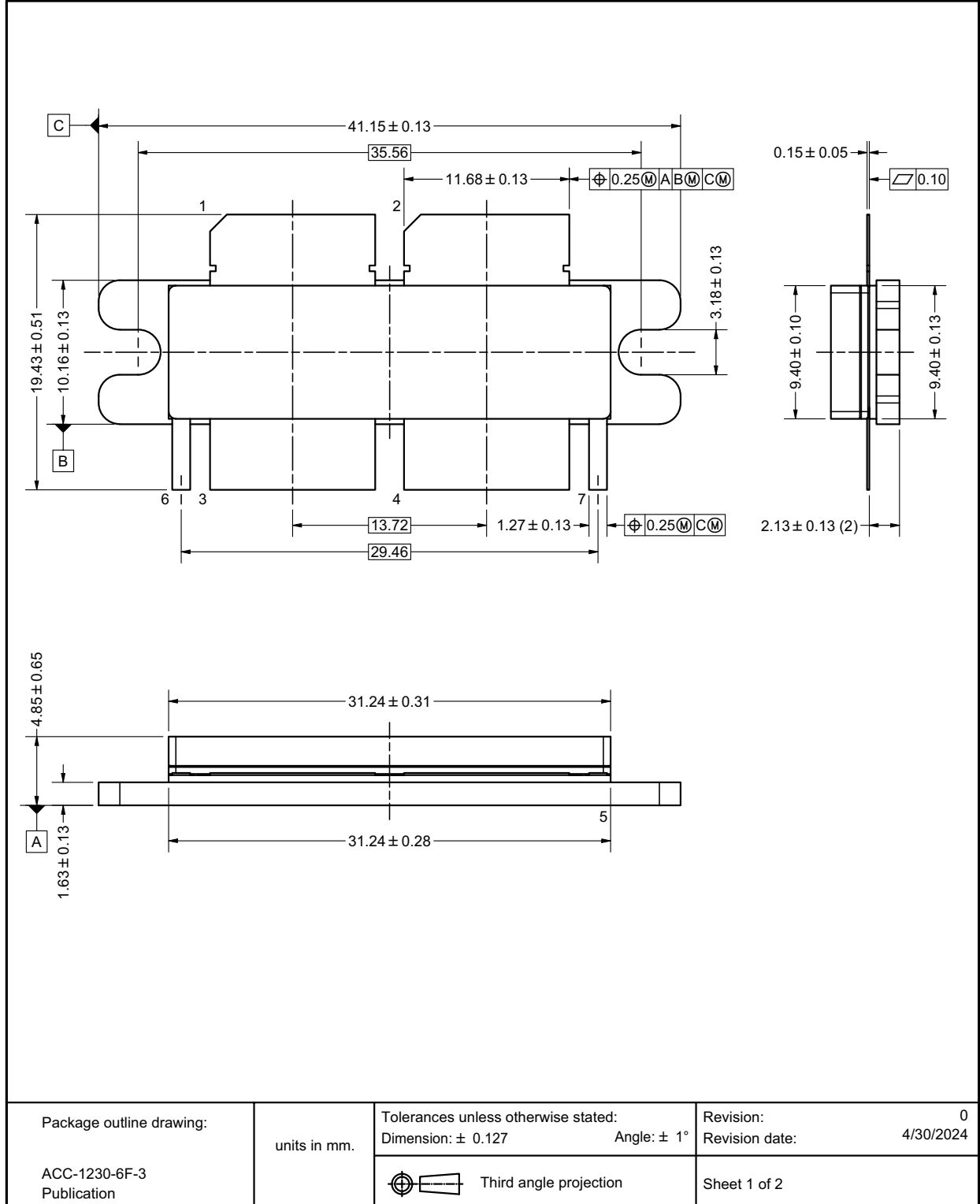


Fig 12. Package outline ACC-1230-6F-3 (sheet 1 of 2)

Earless flanged ceramic package; 6 leads

ACC-1230-6F-2

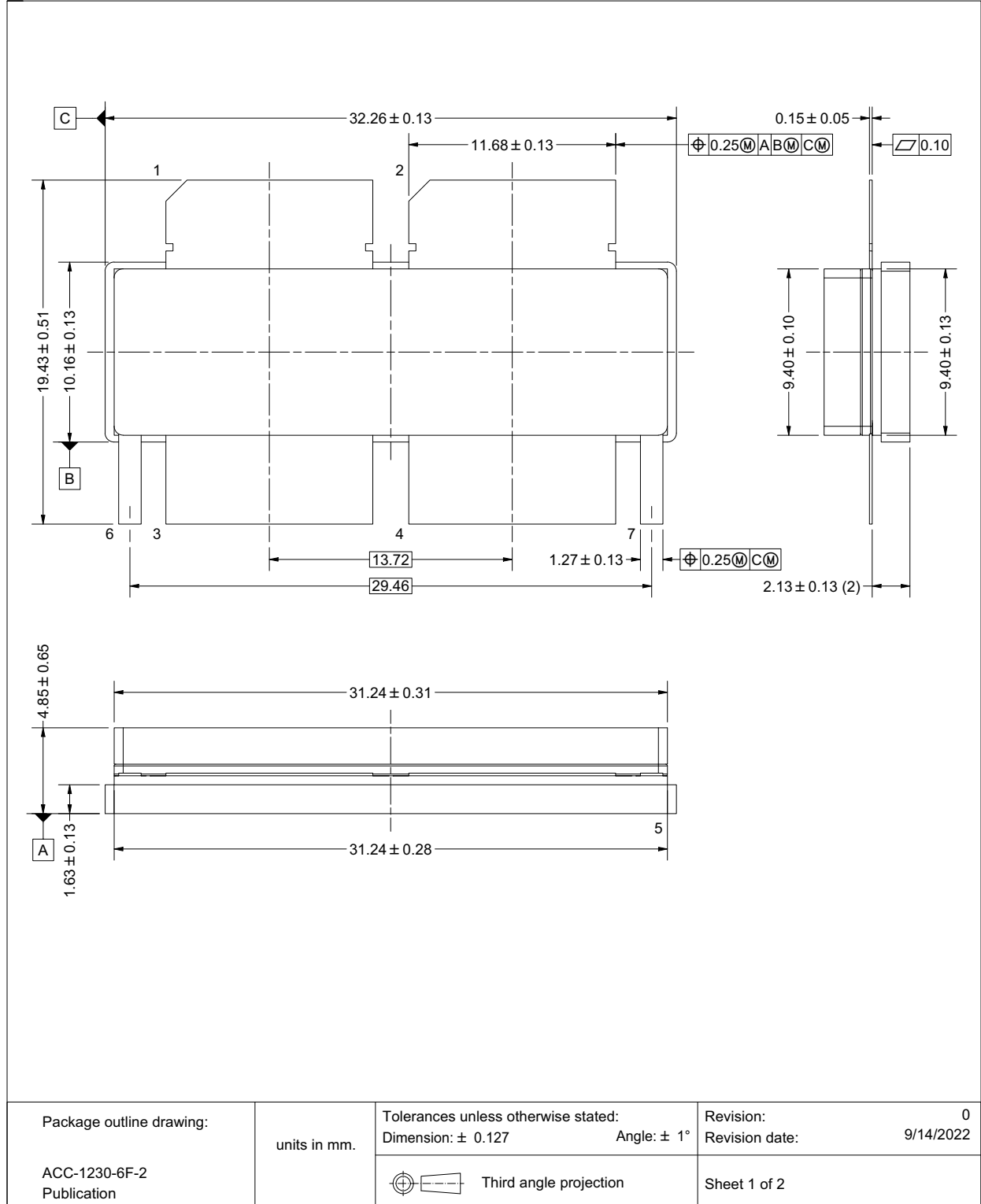


Fig 14. Package outline ACC-1230-6F-2 (sheet 1 of 2)

Earless flanged ceramic package; 6 leads

ACC-1230-6G-2

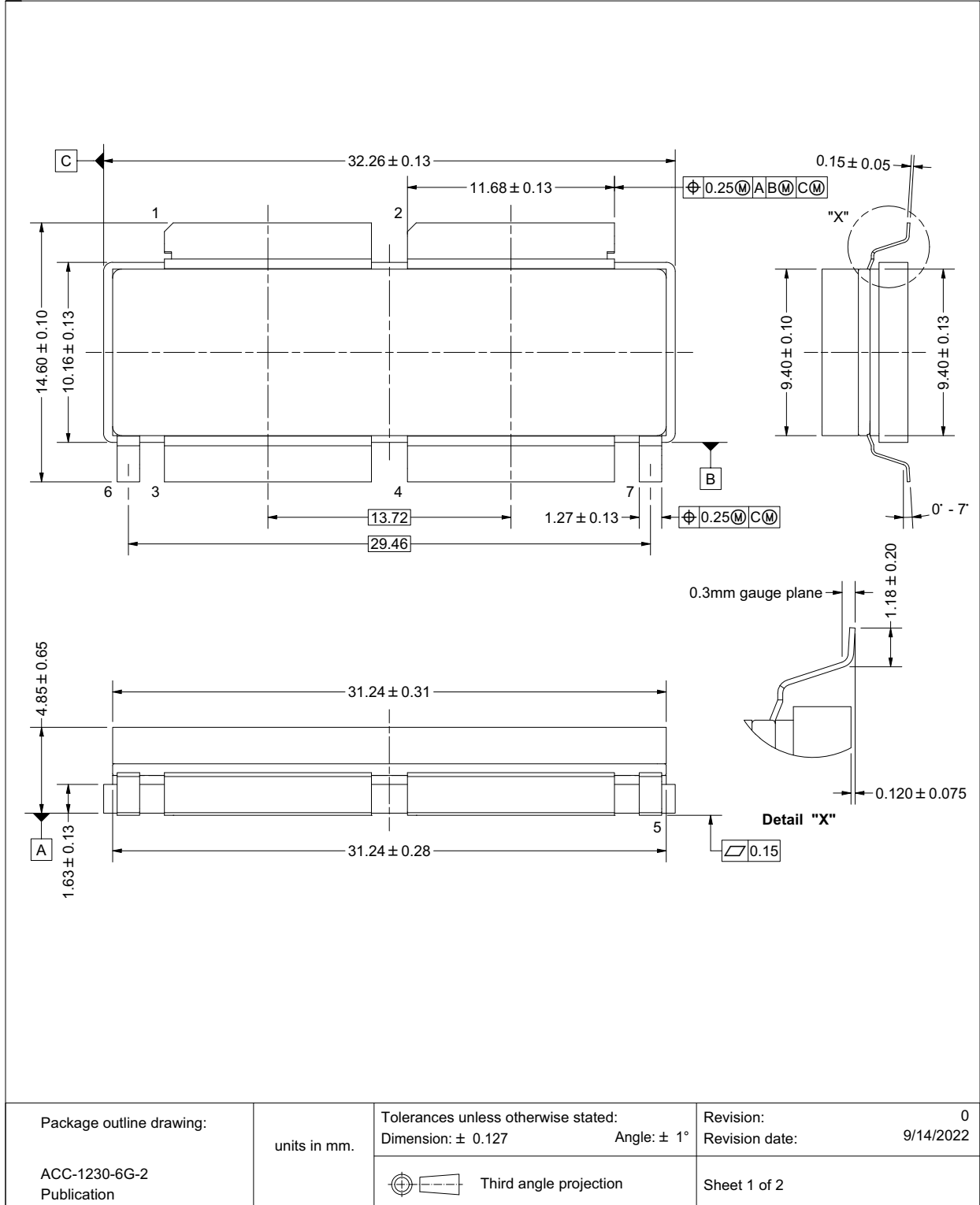


Fig 16. Package outline ACC-1230-6G-2 (sheet 1 of 2)

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

10. Abbreviations

Table 12. Abbreviations

| Acronym | Description |
|---------|--|
| CW | Continuous Wave |
| ESD | ElectroStatic Discharge |
| FM | Frequency Modulation |
| FET | Field-Effect Transistor |
| 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 |
|-------------------------------|--|--------------------|---------------|---------------------------|
| ART2K0TFE_2K0TFES_2K0TFEG v.2 | 20240731 | Product data sheet | - | ART2K0TFES_ART2K0TFEG v.1 |
| Modifications: | <ul style="list-style-type: none"> This data sheet now describes the ART2K0TFE, ART2K0TFES and ART2K0TFEG products Section 2 on page 2: updated section Table 3 on page 2: updated table Table 6 on page 4: updated table Section 8 on page 11: updated section | | | |
| ART2K0TFES_ART2K0TFEG v.1 | 20230707 | 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

Draft — The document is a draft version only. The content is still under internal review and subject to formal approval, which may result in modifications or additions. Ampleon does not give any representations or warranties as to the accuracy or completeness of information included herein and shall have no liability for the consequences of use of such information.

Short data sheet — A short data sheet is an extract from a full data sheet with the same product type number(s) and title. A short data sheet is intended for quick reference only and should not be relied upon to contain detailed and full information. For detailed and full information see the relevant full data sheet, which is available on request via the local Ampleon sales office. In case of any inconsistency or conflict with the short data sheet, the full data sheet shall prevail.

Product specification — The information and data provided in a Product data sheet shall define the specification of the product as agreed between Ampleon and its customer, unless Ampleon and customer have explicitly agreed otherwise in writing. An agreement according to which the functions and qualities of Ampleon products exceed those described in the Product data sheet is invalid.

12.3 Disclaimers

Maturity — After the relevant product(s) have passed the Release Gate in Ampleon's release process, Ampleon will confirm the final version in writing.

Limited warranty and liability — Ampleon uses its best efforts to keep the information in this document accurate and reliable. However, Ampleon gives no representations or warranties, expressed or implied, as to the accuracy or completeness of such information and assumes no liability for the consequences of the use of such information. Ampleon is not liable for content provided by an external information source.

In no event and irrespective of the legal basis (contract, tort (including negligence) statutory liability, misrepresentation, indemnity or any other area of law) shall Ampleon be liable for any indirect, incidental, punitive, special or consequential damages (including but without limitation loss of profit or revenue, loss of use or loss of production, loss of data, cost of capital, cost of substitute goods, property damage external to the Ampleon products and any damage, expenditure or loss arising out of such damage, business interruption, costs related to the removal or replacement of any products or rework charges) or any of the foregoing suffered by any third party.

Notwithstanding any damages that customer might incur for any reason whatsoever, Ampleon's aggregate and cumulative liability towards customer for the products described herein shall be limited in accordance with the *Terms and conditions of commercial sale* of Ampleon.

Right to make changes — Ampleon reserves the right to change information including but without limitation specifications and product descriptions published in this document at any time and without notice. This document supersedes and replaces all information regarding these products supplied prior to the publication hereof.

Suitability for use — Ampleon products are not designed, authorized or warranted to be suitable for use in life support, life-critical or safety-critical systems or equipment, nor in applications where failure or malfunction of an Ampleon product can reasonably be expected to result in personal injury, death or severe property or environmental damage. Insofar as a customer or another party nevertheless uses Ampleon products unlawfully for such purposes, Ampleon and its suppliers are not liable for any damages.

Applications — Applications that are described herein for any of these products are for illustrative purposes only. Ampleon makes no representation or warranty that such applications will be suitable for the specified use without further testing or modification.

Customers are responsible for the design and operation of their applications and products using Ampleon products, and Ampleon is not liable for any assistance with applications or customer product design. It is customer's sole responsibility to determine whether the Ampleon product is suitable and fit for the customer's applications and products planned, as well as for the planned application and use of customer's third party customer(s). Customers shall provide appropriate design and operating safeguards to minimize the risks associated with their applications and products.

Ampleon is not liable related to any default, damage, costs or problem which is based on any weakness or default in the customer's applications or products, or the application or use by customer's third party customer(s). Customer is responsible for and shall do all necessary testing for the customer's applications and products using Ampleon products in order to avoid a default of the applications and the products or of the application or use by customer's third party customer(s). Ampleon is not liable in this respect.

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.

Terms and conditions of commercial sale — Ampleon products are sold subject to the general terms and conditions of commercial sale, as published at <http://www.ampleon.com/terms>, unless otherwise agreed in a valid written individual agreement. In the event of signing an individual agreement the terms and conditions of the respective agreement shall apply. Ampleon hereby expressly objects to and rejects the validity of customer's terms and conditions regarding the purchase of Ampleon products by customer.

No offer to sell or license — Nothing in this document may be interpreted or construed as an offer to sell products that is open for acceptance or the grant, conveyance or implication of any license under any copyrights, patents or other industrial or intellectual property rights.

Export control — This document as well as the item(s) described herein may be subject to export control regulations. Export might require a prior authorization from competent authorities.

Non-automotive qualified products — Unless this data sheet expressly states that this specific Ampleon product is automotive qualified, the product is not suitable for automotive use. It is neither qualified nor tested in accordance with automotive testing or application requirements. Ampleon is not liable for inclusion and/or use of non-automotive qualified products in automotive equipment or applications.

In the event that customer breaches this and uses the products for design and use in automotive applications in accordance with automotive specifications and standards, (a) Ampleon gives no warranty, representation

or other guarantees of any kind with respect to such automotive applications, use and specifications, and (b) such use is solely and exclusively at customer's own risk, and (c) customer fully indemnifies Ampleon against any and all liability, damages or failed product claims, including against third parties, arising out of customer's design and use of the product for automotive applications.

Translations — A non-English (translated) version of a document is for reference only. The English version shall prevail in case of any discrepancy between the translated and English versions.

12.4 Trademarks

Notice: All referenced brands, product names, service names and trademarks are the property of their respective owners.

13. Contact information

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

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

14. Contents

| | | |
|-----------|--|-----------|
| 1 | Product profile | 1 |
| 1.1 | General description | 1 |
| 1.2 | Features and benefits | 1 |
| 1.3 | Applications | 1 |
| 2 | Pinning information | 2 |
| 3 | Ordering information | 2 |
| 4 | Limiting values | 3 |
| 5 | Thermal characteristics | 3 |
| 6 | Characteristics | 4 |
| 7 | Test information | 5 |
| 7.1 | Ruggedness in class-AB operation | 5 |
| 7.2 | Impedance information | 6 |
| 7.3 | Graphical data thermal sensor | 6 |
| 7.4 | Test circuit | 7 |
| 7.5 | Graphical data | 8 |
| 8 | Package outline | 11 |
| 9 | Handling information | 17 |
| 10 | Abbreviations | 17 |
| 11 | Revision history | 17 |
| 12 | Legal information | 18 |
| 12.1 | Data sheet status | 18 |
| 12.2 | Definitions | 18 |
| 12.3 | Disclaimers | 18 |
| 12.4 | Trademarks | 19 |
| 13 | Contact information | 19 |
| 14 | Contents | 20 |

Please be aware that important notices concerning this document and the product(s) described herein, have been included in section 'Legal information'.

© Ampleon Netherlands B.V. 2024. All rights reserved.

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

Date of release: 31 July 2024

Document identifier: ART2K0TFE_2K0TFES_2K0TFEG