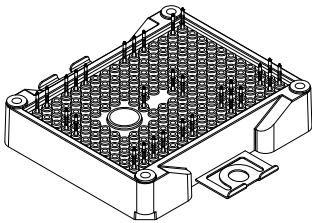
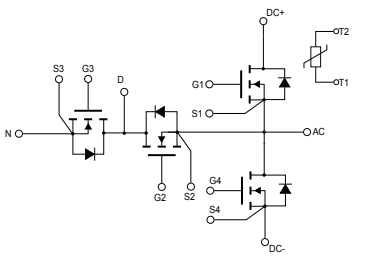


## ACEPACK 2 power module, 3-level topology, 1200 V, 13 mΩ typ. SiC Power MOSFET gen.2 with NTC



ACEPACK 2



### Features

- 3-level topology
- ACEPACK 2 power module
  - 13 mΩ of typical  $R_{DS(on)}$  each switch
  - Insulation voltage UL certified of 2.5 kVrms
  - Integrated NTC temperature sensor
  - DBC Cu-Al<sub>2</sub>O<sub>3</sub>-Cu based
  - Press fit contact pins

### Applications

- DC/DC converter

### Description

This ACEPACK 2 power module represents a leg of a T-type 3-level inverter topology that integrates the advanced silicon carbide Power MOSFET technology from STMicroelectronics. This module leverages the innovative properties of the wide-bandgap SiC material and a high-thermal-performance substrate. The result is exceptionally low on-resistance per unit area and excellent switching performance that is virtually independent of temperature. An NTC sensor completes the design.



#### Product status link

[A2U12M12W2-F2](#)

#### Product summary

|                   |               |
|-------------------|---------------|
| <b>Order code</b> | A2U12M12W2-F2 |
| <b>Marking</b>    | A2U12M12W2-F2 |
| <b>Package</b>    | ACEPACK 2     |
| <b>Packing</b>    | Tray          |
| <b>Leads type</b> | Press fit     |

## 1 Electrical rating

$T_J = 25\text{ °C}$  unless otherwise specified.

**Table 1. Absolute maximum ratings**

| Symbol   | Parameter   | Value      | Unit |
|----------|---|------------|------|
| $V_{DS}$ | Drain-source voltage  | 1200       | V    |
| $V_{GS}$ | Gate-source voltage   | -10 to 22  | V    |
|          | Gate-source voltage, recommended operating values               | -5 to 18   |      |
| $I_D$    | Drain current (continuous) at $T_H = 25\text{ °C}$              | 75         | A    |
| $I_{DM}$ | Repetitive peak drain current                                   | 150        | A    |
| $T_J$    | Maximum junction temperature                                    | 175        | °C   |
|          | Operating junction temperature range under switching conditions | -40 to 150 |      |

1. Pulse width limited by maximum junction temperature.

**Table 2. Thermal data**

| Symbol     | Parameter   | Value | Unit |
|------------|---|-------|------|
| $R_{thJH}$ | Thermal resistance, junction-to-heat sink ( $TIM = 80\text{ }\mu\text{m}$ , $\lambda = 3\text{ W}\cdot\text{m}^{-1}\cdot\text{°C}^{-1}$ ) | 0.46  | °C/W |

## 2 Electrical characteristics

**Table 3. On/off-state**

| Symbol        | Parameter                         | Test conditions   | Min. | Typ. | Max. | Unit |
|---------------|-----------------------------------|---|------|------|------|------|
| $V_{(BR)DSS}$ | Drain-source breakdown voltage    | $V_{GS} = 0\text{ V}$ , $I_D = 1\text{ mA}$   | 1200 |      |      | V    |
| $R_{DS(on)}$  | Static drain-source on-resistance | $V_{GS} = 18\text{ V}$ , $I_D = 75\text{ A}$  |      | 13   | 17   | mΩ   |
|               |                                   | $V_{GS} = 18\text{ V}$ , $I_D = 75\text{ A}$ , $T_J = 150\text{ °C}$                    |      | 20   |      |      |
| $V_{GS(th)}$  | Gate threshold voltage            | $I_D = 10\text{ mA}$ , $V_{DS} = V_{GS}$  | 1.9  | 3.0  | 4.9  | V    |
| $I_{DSS}$     | Zero gate voltage drain current   | $V_{DS} = 1200\text{ V}$ , $V_{GS} = 0\text{ V}$  |      |      | 200  | μA   |
| $I_{GSS}$     | Gate-body leakage current         | $V_{DS} = 0$ , $V_{GS} = -10\text{ to }22\text{ V}$                                     |      |      | ±1   | μA   |
| $C_{iss}$     | Input capacitance                 | $f = 1\text{ MHz}$ , $V_{DS} = 800\text{ V}$ , $V_{GS} = 0\text{ V}$                    |      | 7000 |      | pF   |
| $C_{oss}$     | Output capacitance                |   |      | 440  |      | pF   |
| $C_{rss}$     | Reverse transfer capacitance      |   |      | 56   |      | pF   |
| $R_G$         | Intrinsic gate resistance         | $f = 1\text{ MHz}$ , $I_D = 0\text{ A}$   |      | 1    |      | Ω    |
| $Q_g$         | Total gate charge                 | $V_{DS} = 450\text{ V}$ , $V_{GS} = -5\text{ to }18\text{ V}$ ,<br>$I_D = 100\text{ A}$ |      | 298  |      | nC   |
| $Q_{gs}$      | Gate-source charge                |   |      | 96   |      | nC   |
| $Q_{gd}$      | Gate-drain charge                 |   |      | 108  |      | nC   |

**Table 4. Switching energy**

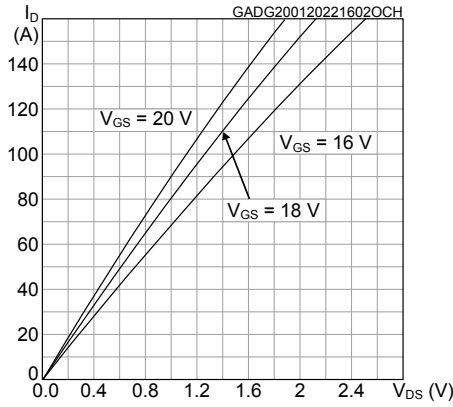
| Symbol    | Parameter                 | Test conditions   | Min. | Typ. | Max. | Unit |
|-----------|---------------------------|---|------|------|------|------|
| $E_{on}$  | Turn-on switching energy  | $V_{DS} = 450\text{ V}$ , $I_D = 75\text{ A}$ ,<br>$R_{G(on)} = 5.6\text{ Ω}$ , $R_{G(off)} = 1\text{ Ω}$ ,<br>$V_{GS} = -5\text{ to }18\text{ V}$                            | -    | 0.52 | -    | mJ   |
| $E_{off}$ | Turn-off switching energy |   |      | -    | 0.32 |      |
| $E_{on}$  | Turn-on switching energy  | $V_{DS} = 450\text{ V}$ , $I_D = 75\text{ A}$ ,<br>$R_{G(on)} = 5.6\text{ Ω}$ , $R_{G(off)} = 1\text{ Ω}$ ,<br>$V_{GS} = -5\text{ to }18\text{ V}$ ,<br>$T_J = 150\text{ °C}$ | -    | 0.46 | -    | mJ   |
| $E_{off}$ | Turn-off switching energy |   |      | -    | 0.33 |      |

**Table 5. Source-drain diode**

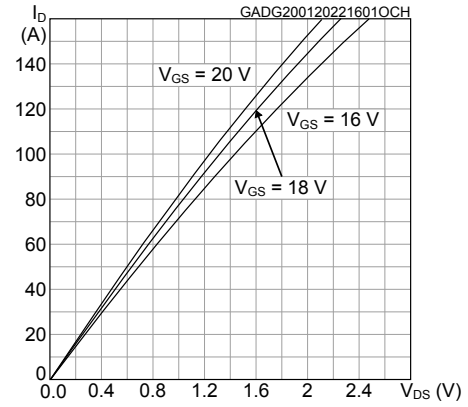
| Symbol    | Parameter                | Test conditions  | Min. | Typ. | Max. | Unit |
|-----------|--------------------------|--|------|------|------|------|
| $V_{SD}$  | Forward on voltage drop  | $V_{GS} = 0\text{ V}$ , $I_{SD} = 75\text{ A}$                               | -    | 2.9  | -    | V    |
| $E_{rr}$  | Reverse recovery energy  | $V_{DD} = 450\text{ V}$ , $I_{SD} = 75\text{ A}$ ,<br>$V_{GS} = -5\text{ V}$ | -    | 182  | -    | μJ   |
| $t_{rr}$  | Reverse recovery time    |  | -    | 20   | -    | ns   |
| $Q_{rr}$  | Reverse recovery charge  |  | -    | 546  | -    | nC   |
| $I_{RRM}$ | Reverse recovery current |  | -    | 46   | -    | A    |

## 2.1 Electrical characteristics (curves)

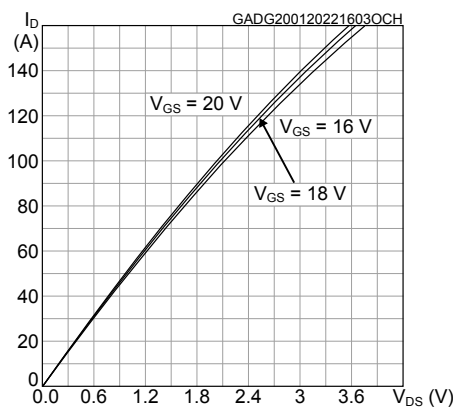
**Figure 1. Typical output characteristics ( $T_J = -40\text{ }^\circ\text{C}$ )**



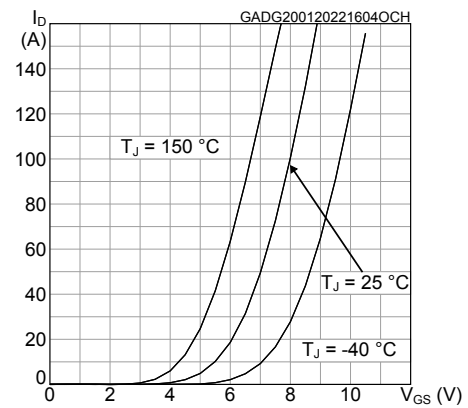
**Figure 2. Typical output characteristics ( $T_J = 25\text{ }^\circ\text{C}$ )**



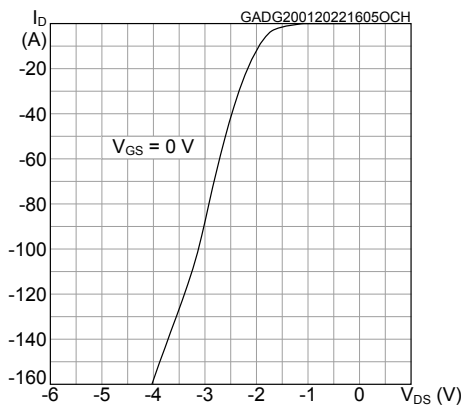
**Figure 3. Typical output characteristics ( $T_J = 150\text{ }^\circ\text{C}$ )**



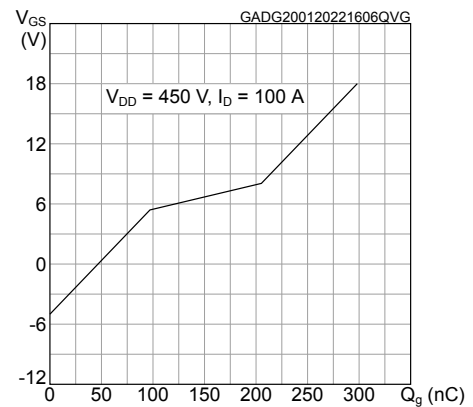
**Figure 4. Typical transfer characteristics**



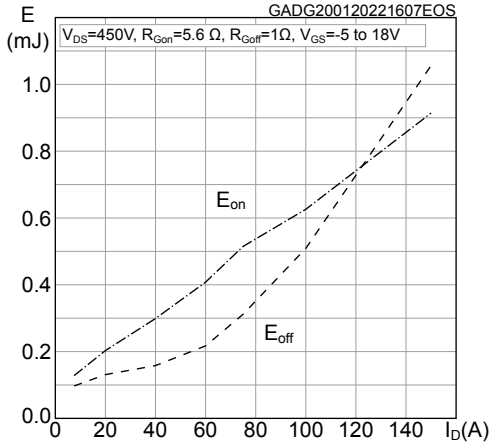
**Figure 5. Typical diode forward characteristics (terminal)**



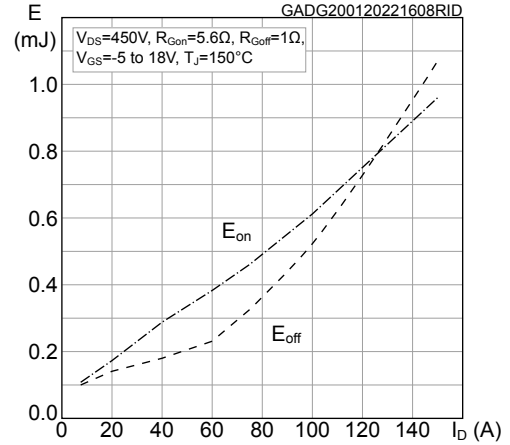
**Figure 6. Typical gate charge characteristics**



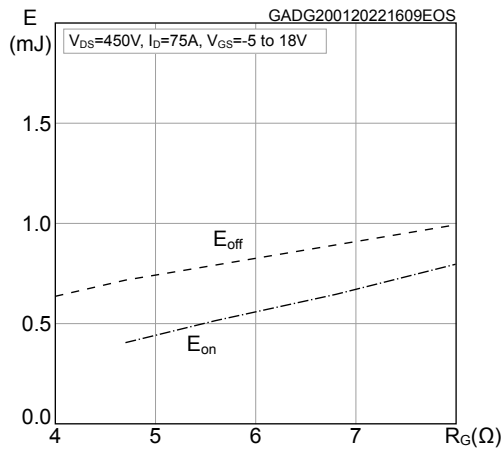
**Figure 7. Typical switching energy vs drain current**  
( $T_J = 25^\circ\text{C}$ )



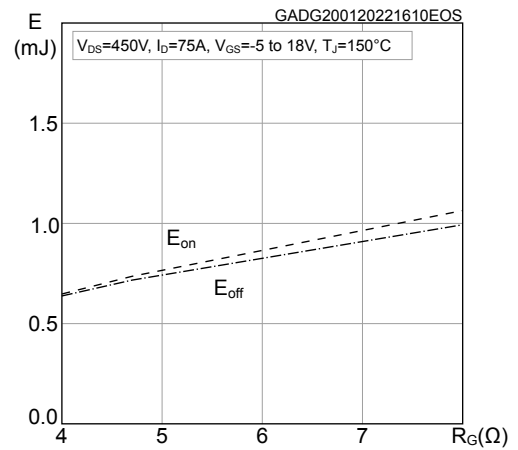
**Figure 8. Typical switching energy vs drain current**  
( $T_J = 150^\circ\text{C}$ )



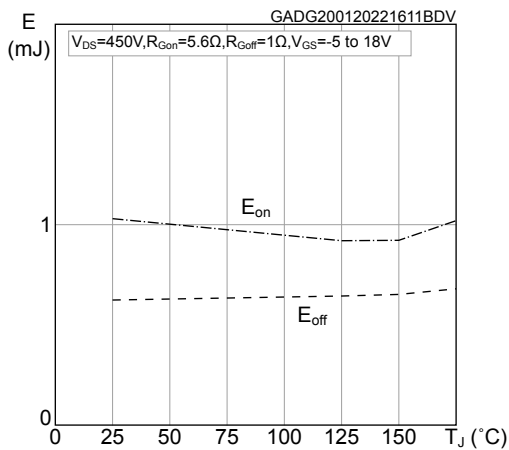
**Figure 9. Typical switching energy vs gate resistance**  
( $T_J = 25^\circ\text{C}$ )



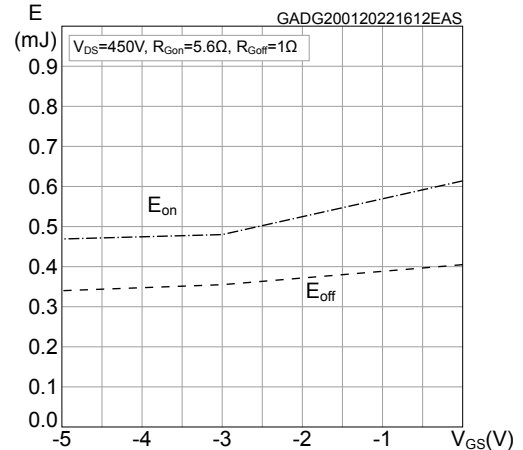
**Figure 10. Typical switching energy vs gate resistance**  
( $T_J = 150^\circ\text{C}$ )



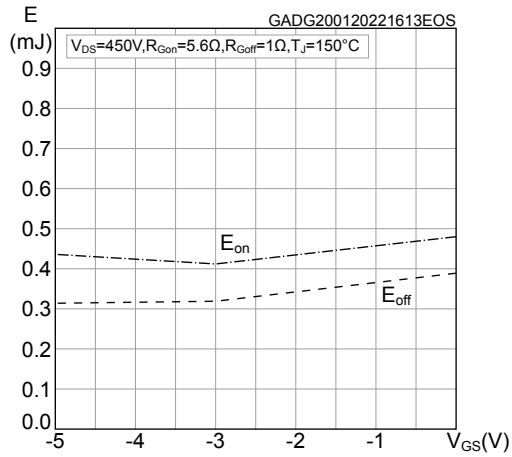
**Figure 11. Typical switching energy vs temperature**



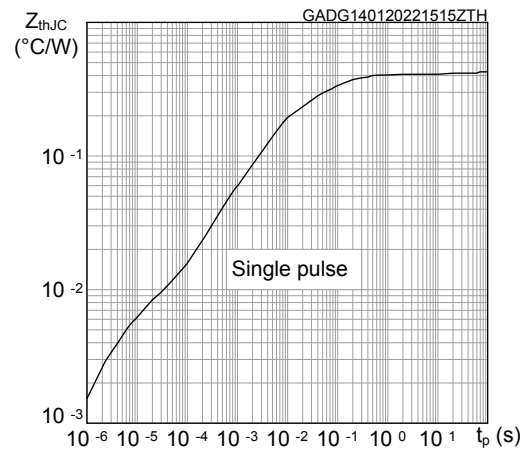
**Figure 12. Typical switching energy vs  $V_{GS}$  ( $T_J = 25^\circ\text{C}$ )**



**Figure 13. Typical switching energy vs  $V_{GS}$  ( $T_J = 150^\circ\text{C}$ )**



**Figure 14. Maximum transient thermal impedance**

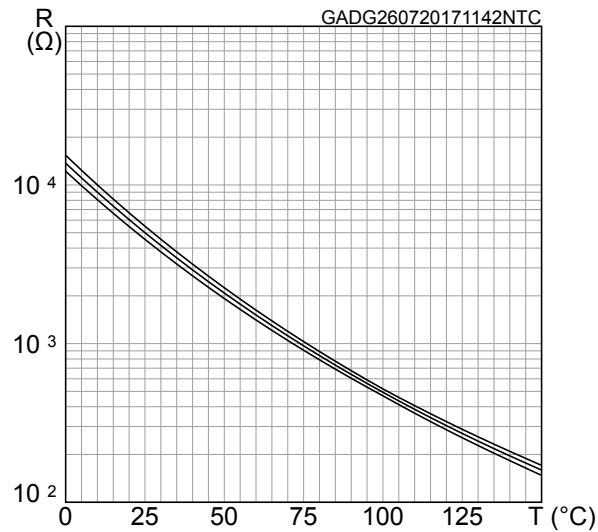


### 3 NTC

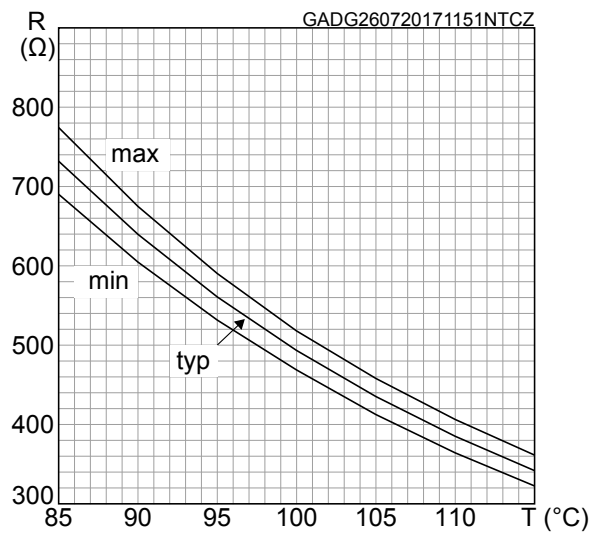
**Table 6. Absolute maximum ratings for NTC temperature sensor, considered as stand-alone**

| Symbol               | Parameter                   | Test condition  | Min. | Typ. | Max. | Unit |
|----------------------|-----------------------------|-----------------|------|------|------|------|
| R <sub>25</sub>      | Resistance rating           | T = 25 °C       |      | 5    |      | kΩ   |
| R <sub>100</sub>     | Resistance rating           | T = 100 °C      |      | 493  |      | Ω    |
| ΔR <sub>100</sub> /R | Resistance tolerance        |                 | -5   |      | 5    | %    |
| B                    | B value                     | T = 25 to 50 °C |      | 3375 |      | K    |
|                      |                             | T = 25 to 85 °C |      | 3411 |      |      |
| T                    | Operating temperature range |                 | -40  |      | 150  | °C   |

**Figure 15. NTC typical resistance vs temperature**



**Figure 16. NTC resistance vs temperature, zoom**



## 4 Package

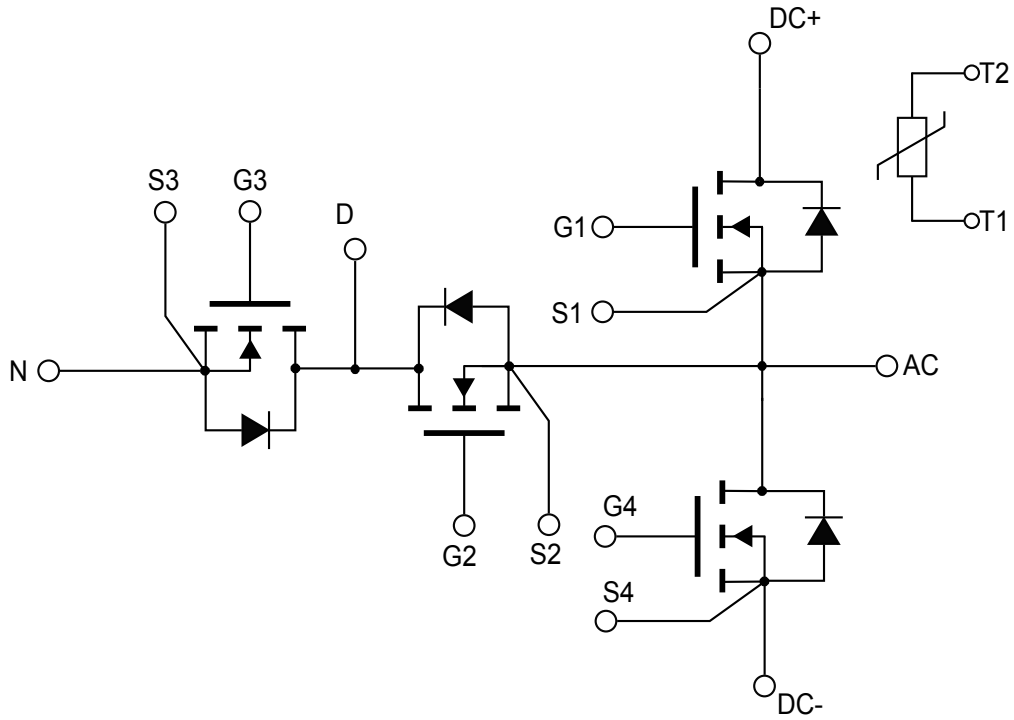
Table 7. ACEPACK 2 package

| Symbol    | Parameter   | Min. | Typ. | Max. | Unit  |
|-----------|---|------|------|------|-------|
| $V_{ISO}$ | Isolation withstand voltage applied between each pin and heat sink plate (AC voltage, $t = 60$ s) | 2.5  |      |      | kVrms |
| $M_d$     | Mounting torque (M4 screw)  | 2.0  |      | 2.3  | N•m   |
| CTI       | Comparative tracking index  | 200  |      |      |       |
| $L_s$     | Stray inductance module loop  |      | 10   |      | nH    |
| $T_{stg}$ | Storage temperature range   | -40  |      | 125  | °C    |



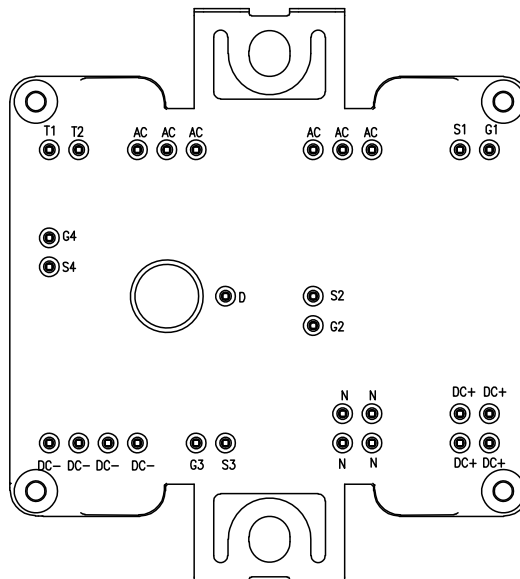
## 5 Electrical topology and pin description

Figure 17. Electrical topology and pin description



GADG240720201013GT

Figure 18. Package top view with pinout

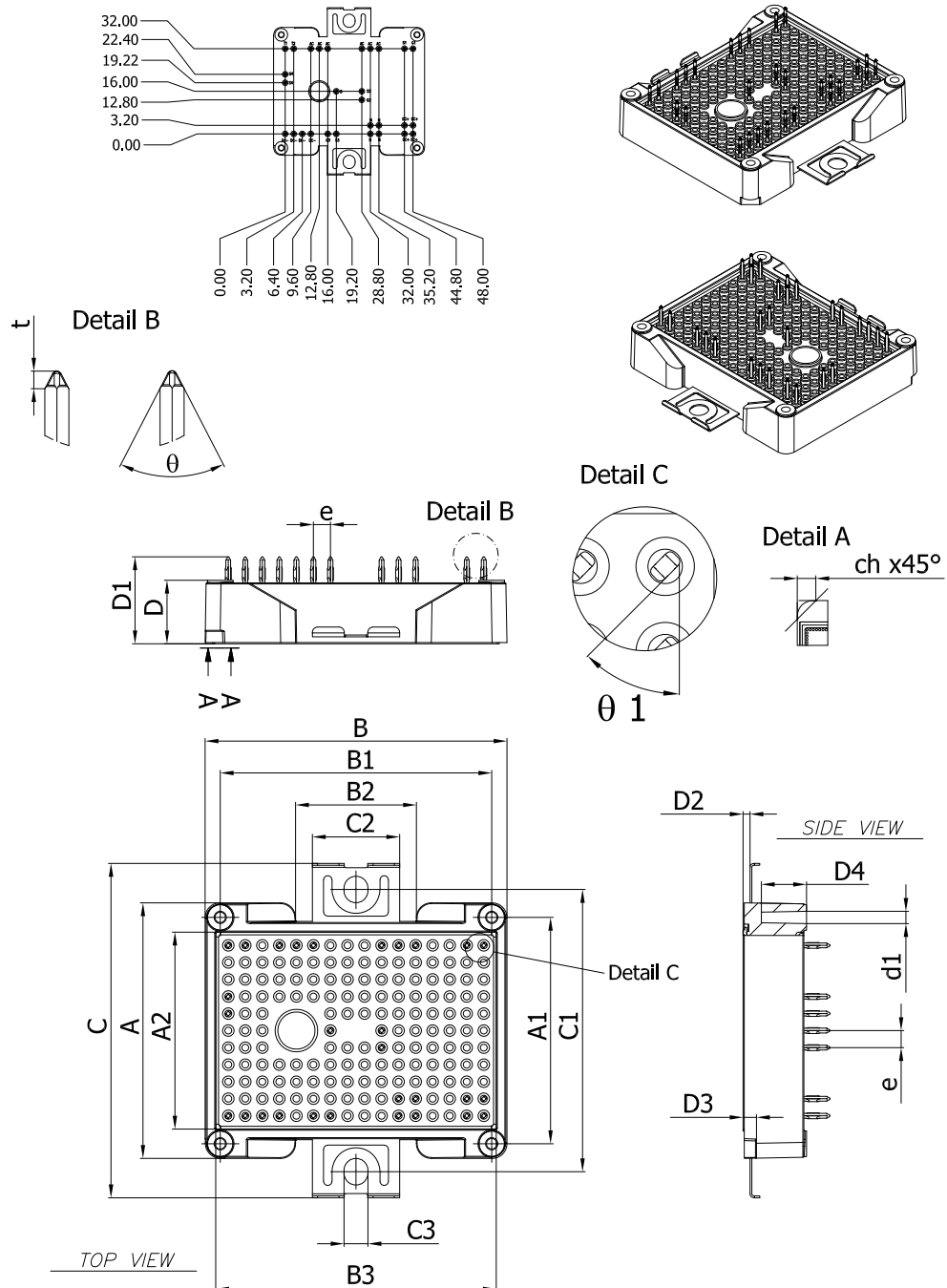


## 6 Package information

In order to meet environmental requirements, ST offers these devices in different grades of **ECOPACK** packages, depending on their level of environmental compliance. ECOPACK specifications, grade definitions and product status are available at: [www.st.com](http://www.st.com). ECOPACK is an ST trademark.

### 6.1 ACEPACK 2 3-level T-type press fit package information

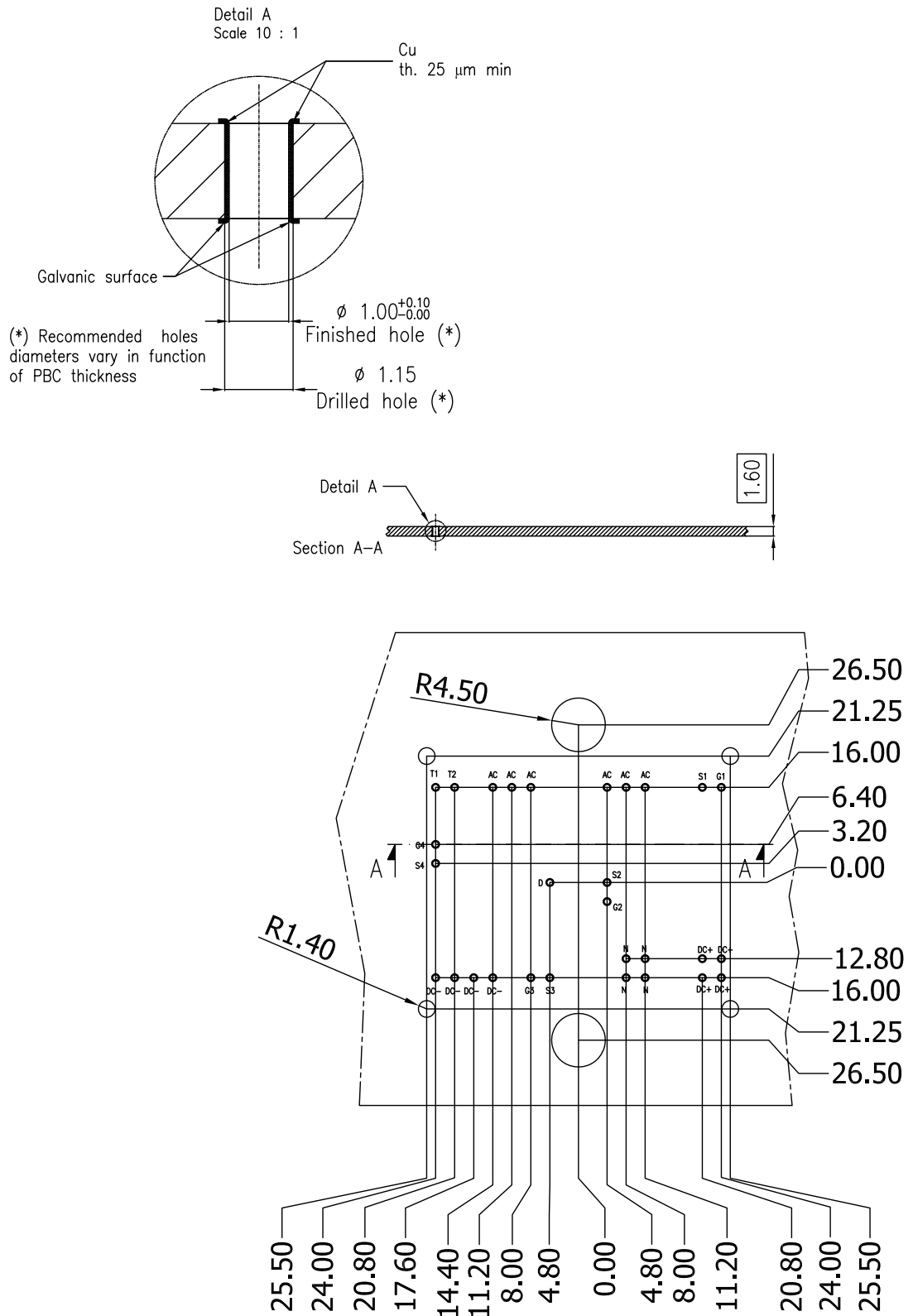
**Figure 19. ACEPACK 2 3-level T-type press fit package outline (dimensions are in mm)**



8569722\_12\_3L\_T-type

**Table 8. ACEPACK 2 3-level T-type press fit mechanical data**

| Dim. | mm        |       |       |
|------|-----------|-------|-------|
|      | Min.      | Typ.  | Max.  |
| A    | 47.70     | 48.00 | 48.30 |
| A1   | 42.30     | 42.50 | 42.70 |
| A2   | 37.00 REF |       |       |
| B    | 56.40     | 56.70 | 57.00 |
| B1   | 50.85     | 51.00 | 51.15 |
| B2   | 22.40     | 22.70 | 23.00 |
| B3   | 52.70 REF |       |       |
| C    | 62.30     | 62.80 | 63.30 |
| C1   | 52.90     | 53.00 | 53.10 |
| C2   | 16.20     | 16.40 | 16.60 |
| C3   | 4.40      | 4.50  | 4.60  |
| D    | 11.65     | 12.00 | 12.35 |
| D1   | 15.90     | 16.40 | 16.90 |
| D2   | 1.10      | 1.30  | 1.50  |
| D3   | 2.30      | 2.50  | 2.70  |
| D4   |           |       | 8.50  |
| t    | 0.30      | 0.40  | 0.50  |
| θ    | 52°       | 60°   | 68°   |
| θ1   |           | 45°   |       |
| e    | 3.20 BSC  |       |       |
| d1   | 2.30 REF  |       |       |
| ch   | 3.50 REF  |       |       |

**Figure 20. ACEPACK 2 3-level T-type press fit recommended PCB holes layout (dimensions are in mm)**


8569722\_12\_3L\_T-type\_recomm\_PCB\_hol\_lay

## Revision history

**Table 9. Document revision history**

| Date        | Revision | Changes  |
|-------------|----------|--|
| 14-Sep-2021 | 1        | First release.   |
| 11-Feb-2022 | 2        | Updated title, features and description in cover page.<br>Updated Table 2. Thermal data, Table 3. On/off-state, and Table 5. Source-drain diode.<br>Updated Table 7. ACEPACK 2 package.<br>Updated Section 2.1 Electrical characteristics (curves).<br>Minor text changes. |

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