



# CEP25A04

40V ▲ 1.8mΩ ▲ 200A ▲ Si MOSFET

SILICON Si MOSFET ▲ THT type

N-channel enhancement mode

UL94V-0 rated flame retardant epoxy

TO220-3L package

Super high dense cell density for extremely low  $R_{DS(ON)}$

**High power and current handling capability**






## MAXIMUM RATINGS

| Parameter ( $T_C = 25^\circ\text{C}$ , unless otherwise noted) |                | Characteristics                             |
|----------------------------------------------------------------|----------------|---------------------------------------------|
| Drain-Source Voltage                                           | $V_{DS}$       | 40V                                         |
| Gate-Source Voltage                                            | $V_{GS}$       | $\pm 20\text{V}$                            |
| Continuous Drain Current at $T_C = 25^\circ\text{C}$           | $I_D$          | 200A                                        |
| Continuous Drain Current at $T_C = 100^\circ\text{C}$          | $I_D$          | 126A                                        |
| Pulsed Drain Current <sup>Note 1</sup>                         | $I_{DM}$       | 800A                                        |
| Maximum Power Dissipation at $T_C = 25^\circ\text{C}$          | $P_D$          | 166W                                        |
| Power Dissipation Derating above $25^\circ\text{C}$            | $\Delta P_D$   | $1.32\text{W}/^\circ\text{C}$               |
| Single Pulsed Avalanche Energy <sup>Note 4</sup>               | $E_{AS}$       | 760mJ                                       |
| Single Pulsed Avalanche Current <sup>Note 4</sup>              | $I_{AS}$       | 39A                                         |
| Operating and Storage Temperature Range                        | $T_J, T_{STG}$ | $-55^\circ\text{C}$ to $+150^\circ\text{C}$ |

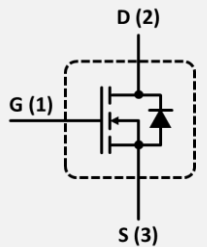
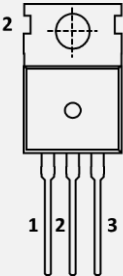
## THERMAL CHARACTERISTICS

| Parameter                               | Symbol       | Limit                         |
|-----------------------------------------|--------------|-------------------------------|
| Thermal Resistance, Junction-to-Case    | $R_{TH\_JC}$ | $0.75^\circ\text{C}/\text{W}$ |
| Thermal Resistance, Junction-to-Ambient | $R_{TH\_JA}$ | $62.5^\circ\text{C}/\text{W}$ |

## APPLICATIONS

| Battery Management Systems                                                          | DC/DC Converter                                                                     | High Side Switches                                                                  | Industrial Control                                                                    | Low Side Switches                                                                     |
|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
|  |  |  |  |  |

## PIN DESCRIPTION

| Circuit Diagram                                                                     | Outline - Front View                                                                | Pin No.     | Description             |
|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------|-------------------------|
|  |  | 1<br>2<br>3 | Gate<br>Drain<br>Source |

## ELECTRICAL CHARACTERISTICS ▲ $T_C = 25^\circ\text{C}$ , unless otherwise noted

| Item                                                          | Condition                                                     | Symbol       | Min. | Typ. | Max. | Unit       |
|---------------------------------------------------------------|---------------------------------------------------------------|--------------|------|------|------|------------|
| <b>Off Characteristics</b>                                    |                                                               |              |      |      |      |            |
| Drain-Source Breakdown Voltage                                | $V_{GS} = 0V, I_D = 250\mu A$                                 | $BV_{DSS}$   | 40   |      |      | V          |
| Zero Gate Voltage Drain Current                               | $V_{DS} = 40V, V_{GS} = 0V$                                   | $I_{DSS}$    |      |      | 1    | $\mu A$    |
| Gate Body Leakage Current, Forward                            | $V_{GS} = 20V, V_{DS} = 0V$                                   | $I_{GSSF}$   |      |      | 100  | nA         |
| Gate Body Leakage Current, Reverse                            | $V_{GS} = -20V, V_{DS} = 0V$                                  | $I_{GSSR}$   |      |      | -100 | nA         |
| <b>On Characteristics</b> <sup>Note 2</sup>                   |                                                               |              |      |      |      |            |
| Gate Threshold Voltage                                        | $V_{GS} = V_{DS}, I_D = 250\mu A$                             | $V_{GS(th)}$ | 2    |      | 4    | V          |
| Static Drain-Source On-Resistance                             | $V_{GS} = 10V, I_D = 30A$                                     | $R_{DS(ON)}$ |      | 1.8  | 2.3  | m $\Omega$ |
| Static Drain-Source On-Resistance                             | $V_{GS} = 9V, I_D = 30A$                                      | $R_{DS(ON)}$ |      | 1.9  | 2.5  | m $\Omega$ |
| <b>Dynamic Characteristics</b> <sup>Note 3</sup>              |                                                               |              |      |      |      |            |
| Input Capacitance                                             | $V_{DS} = 15V, V_{GS} = 0V, f = 1MHz$                         | $C_{ISS}$    |      | 6120 |      | pF         |
| Output Capacitance                                            | $V_{DS} = 15V, V_{GS} = 0V, f = 1MHz$                         | $C_{OSS}$    |      | 1715 |      | pF         |
| Reverse Transfer Capacitance                                  | $V_{DS} = 15V, V_{GS} = 0V, f = 1MHz$                         | $C_{RSS}$    |      | 1330 |      | pF         |
| <b>Switching Characteristics</b> <sup>Note 3</sup>            |                                                               |              |      |      |      |            |
| Turn-On Delay Time                                            | $V_{DD} = 15V, V_{GS} = 10V, I_D = 15A, R_{G(ext)} = 1\Omega$ | $t_{D(ON)}$  |      | 44   |      | ns         |
| Turn-On Rise Time                                             | $V_{DD} = 15V, V_{GS} = 10V, I_D = 15A, R_{G(ext)} = 1\Omega$ | $t_R$        |      | 35   |      | ns         |
| Turn-Off Delay Time                                           | $V_{DD} = 15V, V_{GS} = 10V, I_D = 15A, R_{G(ext)} = 1\Omega$ | $t_{D(OFF)}$ |      | 79   |      | ns         |
| Turn-Off Fall Time                                            | $V_{DD} = 15V, V_{GS} = 10V, I_D = 15A, R_{G(ext)} = 1\Omega$ | $t_F$        |      | 33   |      | ns         |
| Total Gate Charge                                             | $V_{DS} = 15V, V_{GS} = 10V, I_D = 50A$                       | $Q_G$        |      | 235  |      | nC         |
| Gate Source Charge                                            | $V_{DS} = 15V, V_{GS} = 10V, I_D = 50A$                       | $Q_{GS}$     |      | 47   |      | nC         |
| Gate Drain Charge                                             | $V_{DS} = 15V, V_{GS} = 10V, I_D = 50A$                       | $Q_{GD}$     |      | 88   |      | nC         |
| <b>Drain-Source Diode Characteristics and Maximum Ratings</b> |                                                               |              |      |      |      |            |
| Drain-Source Diode Forward Current                            |                                                               | $I_S$        |      |      | 138  | A          |
| Drain-Source Diode Forward Voltage <sup>Note 2</sup>          | $V_{GS} = 0V, I_S = 30A$                                      | $V_{SD}$     |      |      | 1.2  | V          |

### Notes

- 1: Repetitive Rating: Pulse width limited by maximum junction temperature.
- 2: Pulse Test: Pulse Width  $\leq 300\mu s$ , Duty Cycle  $\leq 2\%$ .
- 3: Guaranteed by design, not subject to production testing.
- 4:  $L = 1mH, I_{AS} = 39A, V_{DD} = 24V, R_G = 25\Omega$ , Starting  $T_J = 25^\circ\text{C}$ .

## REFERENCE DATA ▲ TYPICAL DEVICE PERFORMANCE

Fig. 1 • Output Characteristics

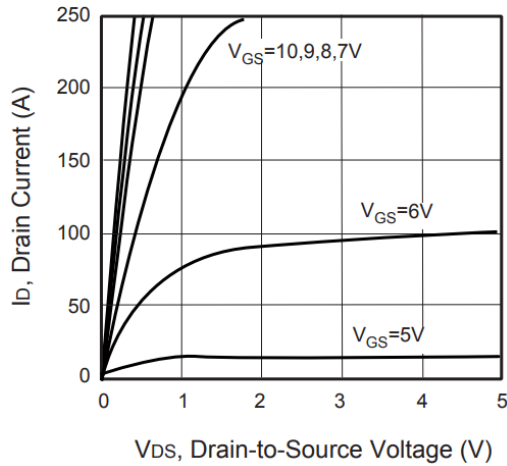


Fig. 2 • Transfer Characteristics

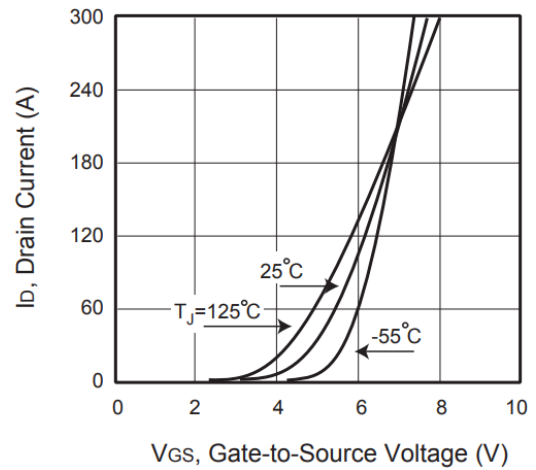


Fig. 3 • Capacitance

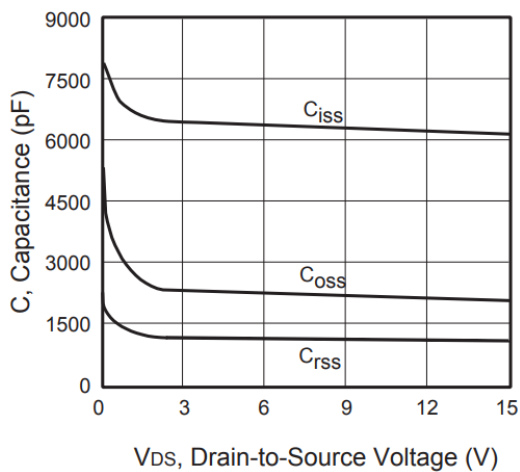


Fig. 4 • On-Resistance Variation with Temperature

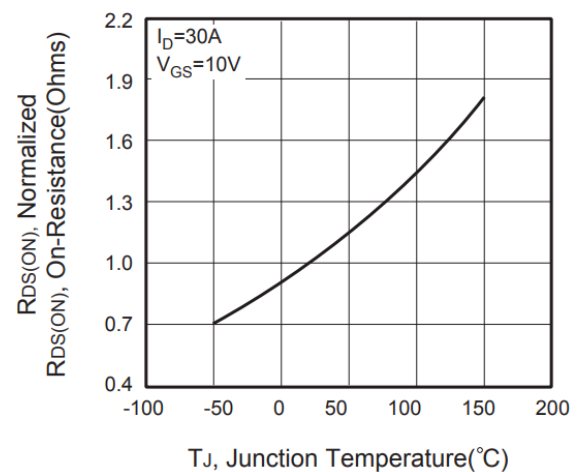


Fig. 5 • Gate Threshold Variation with Temperature

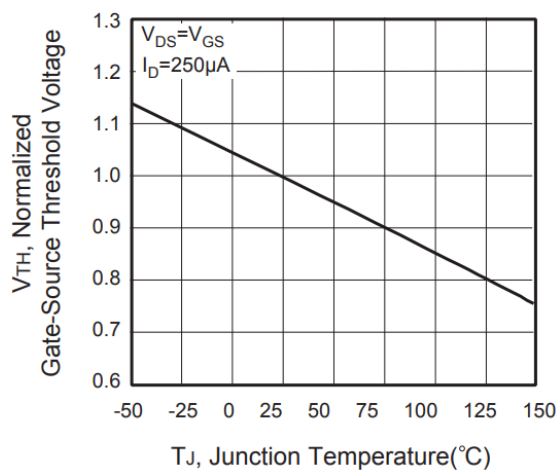
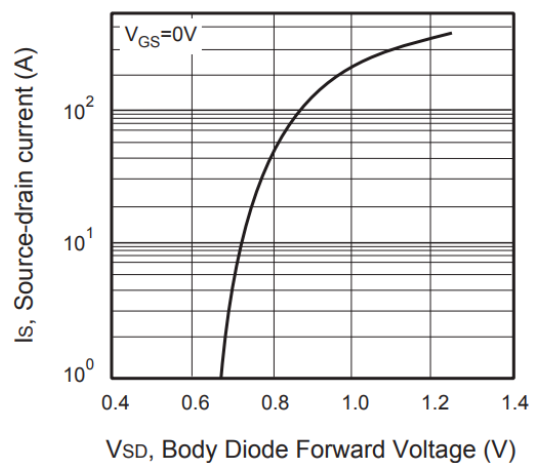


Fig. 6 • Body Diode Forward Voltage Variation with Source Current



## REFERENCE DATA ▲ TYPICAL DEVICE PERFORMANCE

Fig. 7 • Gate Charge

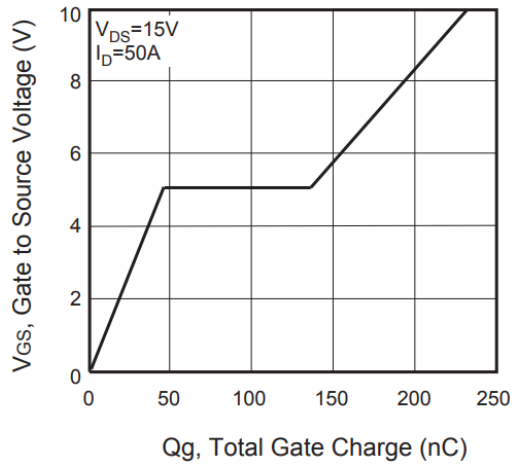


Fig. 8 • Maximum Safe Operating Area

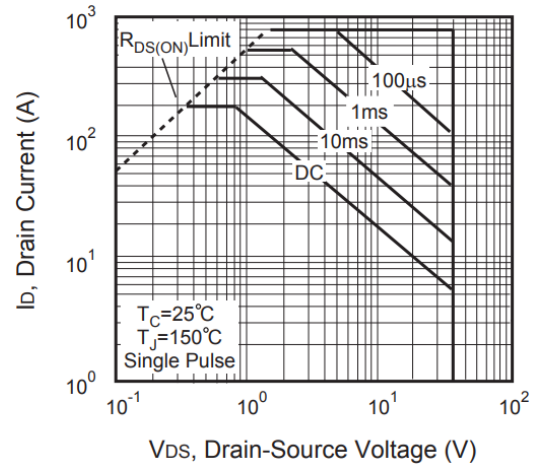


Fig. 9 • Breakdown Voltage Variation vs. Temperature

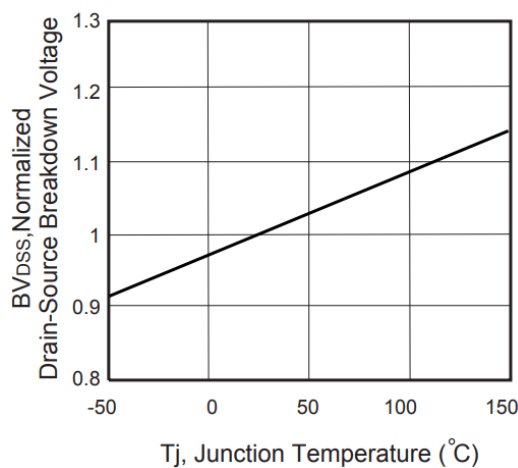


Fig. 10 • Switching Test Circuit

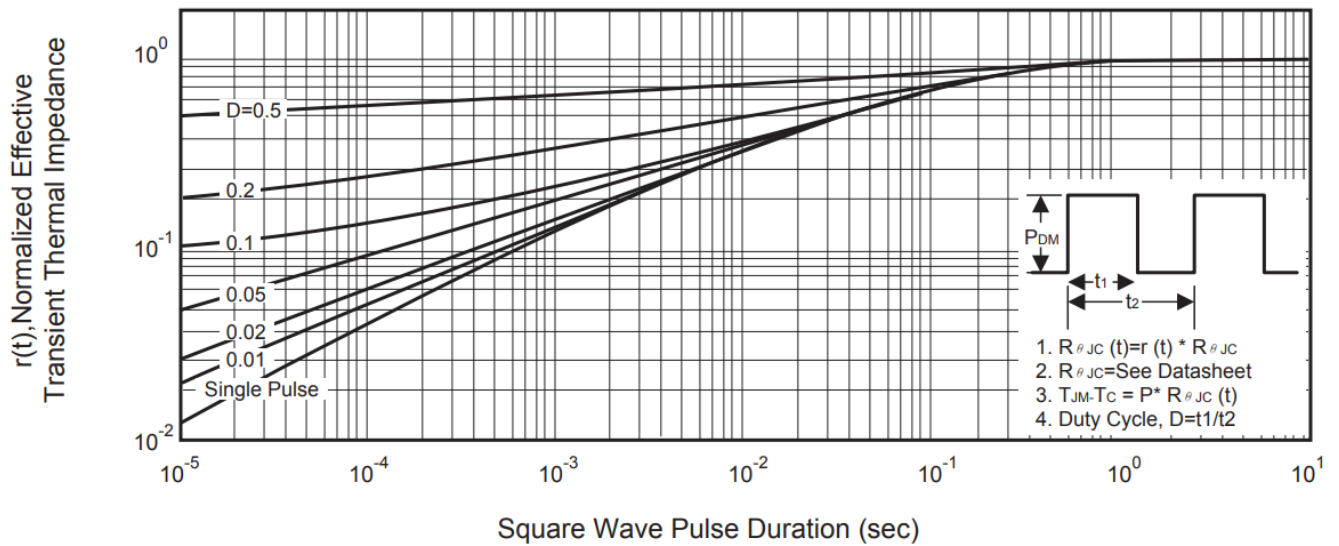


Fig. 11 • Switching Waveforms

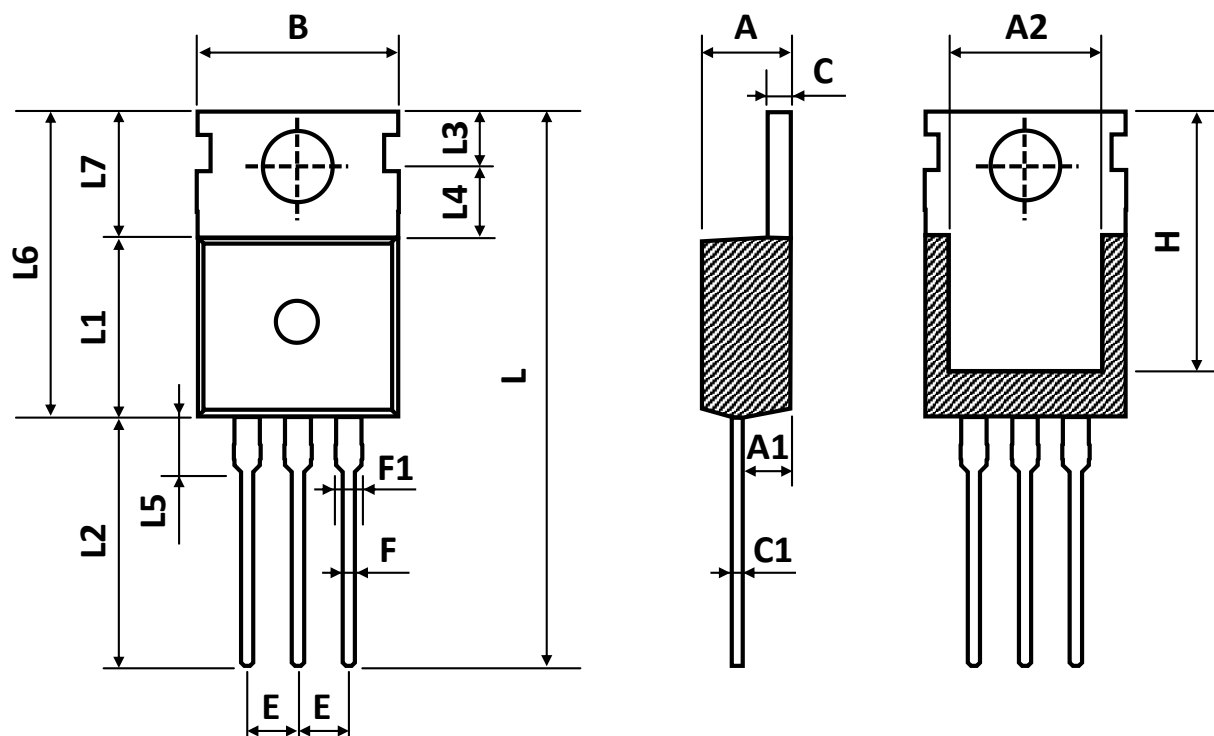


## REFERENCE DATA ▲ TYPICAL DEVICE PERFORMANCE

Fig. 12 • Normalized Thermal Transient Impedance Curve



## PACKAGE OUTLINE

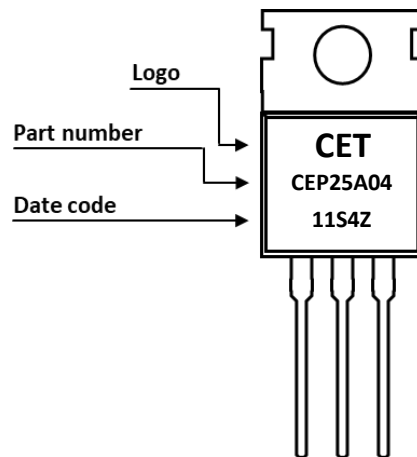


| Sym | Millimeters<br>(Min.) | Millimeters<br>(Typ.) | Millimeters<br>(Max.) |
|-----|-----------------------|-----------------------|-----------------------|
| A   | 4.43                  | 4.53                  | 4.63                  |
| A1  | 2.30                  | 2.40                  | 2.50                  |
| A2  | 7.70                  | 7.90                  | 8.10                  |
| B   | 9.80                  | 10.00                 | 10.20                 |
| C   | 1.25                  | 1.30                  | 1.40                  |
| C1  | 0.45                  | 0.50                  | 0.60                  |
| D   | 3.45                  | 3.60                  | 3.70                  |
| E   | 2.45                  | 2.54                  | 2.60                  |
| F   | 0.70                  | 0.80                  | 0.95                  |
| F1  | 1.15                  | 1.33                  | 1.50                  |
| L   | 26.80                 | 28.80                 | 30.80                 |
| L1  | 9.20                  | 9.30                  | 9.40                  |
| L2  | 12.80                 | 13.10                 | 13.40                 |
| L3  | 2.70                  | 2.80                  | 2.90                  |
| L4  | 3.50                  | 3.70                  | 3.80                  |
| L5  | 2.60                  | 2.90                  | 3.20                  |
| L6  | 15.40                 | 15.80                 | 16.20                 |
| L7  | 6.20                  | 6.50                  | 6.80                  |
| H   | 12.95                 | 13.25                 | 13.55                 |

## ORDERING INFORMATION

| Part Number | Package   | Packing | Tube Qty. | Inner Box Qty. | Outer Box Qty. |
|-------------|-----------|---------|-----------|----------------|----------------|
| CEP25A04    | TO-220-3L | Tube    | 50pcs     | 1,000pcs       | 4,000pcs       |

## PART MARKING



## DATE CODE

Example: 11S4Z



Coding list for „Day“

|    |    |    |    |    |    |    |    |    |    |
|----|----|----|----|----|----|----|----|----|----|
| 1  | 2  | 3  | 4  | 5  | 6  | 7  | 8  | 9  | A  |
| 01 | 02 | 03 | 04 | 05 | 06 | 07 | 08 | 09 | 10 |
| B  | C  | D  | E  | F  | G  | H  | I  | J  | K  |
| 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| L  | M  | N  | O  | P  | Q  | R  | S  | T  | U  |
| 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 |
| V  |    |    |    |    |    |    |    |    |    |
| 31 |    |    |    |    |    |    |    |    |    |

Coding list for „Month“

|     |     |     |     |     |     |
|-----|-----|-----|-----|-----|-----|
| 1   | 2   | 3   | 4   | 5   | 6   |
| Jan | Feb | Mar | Apr | May | Jun |
| 7   | 8   | 9   | A   | B   | C   |
| Jul | Aug | Sep | Oct | Nov | Dec |

Coding list for „Year“

|      |      |      |      |      |
|------|------|------|------|------|
| 0    | 1    | 2    | 3    | 4    |
| 2020 | 2021 | 2022 | 2023 | 2024 |
| 5    | 6    | 7    | 8    | 9    |
| 2025 | 2026 | 2027 | 2028 | 2029 |

## RECOMMENDED WAVE SOLDERING PROFILE ▲ THT PACKAGE



### Classification wave soldering profile ▲ Refer to EN 61760-1: 2006

| Profile Features                                     |                     | Value ▲ Sn-Pb Assembly                     | Value ▲ Pb-free Assembly                   |
|------------------------------------------------------|---------------------|--------------------------------------------|--------------------------------------------|
| Preheat temperature min.                             | $T_{s \min}$        | 100 °C                                     | 100 °C                                     |
| Preheat temperature typical                          | $T_{s \text{ typ}}$ | 120 °C                                     | 120 °C                                     |
| Preheat temperature max.                             | $T_{s \max}$        | 130 °C                                     | 130 °C                                     |
| Preheat time $t_s$ from $T_{s \min}$ to $T_{s \max}$ | $t_s$               | 70 seconds                                 | 70 seconds                                 |
| Peak temperature                                     | $T_p$               | 235 °C to 260 °C                           | 245 °C to 260 °C                           |
| Time of actual peak temperature                      | $t_p$               | Max. 10 seconds<br>Max. 5 second each wave | Max. 10 seconds<br>Max. 5 second each wave |
| Ramp-down rate min.                                  |                     | ~ 2 °C/second                              | ~ 2 °C/second                              |
| Ramp-down rate typical                               |                     | ~ 3.5 °C/second                            | ~ 3.5 °C/second                            |
| Ramp-down rate max.                                  |                     | ~ 5 °C/second                              | ~ 5 °C/second                              |
| Time 25°C to 25°C                                    |                     | 4 minutes                                  | 4 minutes                                  |



## REVISION TABLE

| Revision | Date       | Status          | Notes               |
|----------|------------|-----------------|---------------------|
| 001      | 30/09/2022 | Initial release | Initial publication |
|          |            |                 |                     |
|          |            |                 |                     |
|          |            |                 |                     |
|          |            |                 |                     |
|          |            |                 |                     |

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