

CEF20N65SA

650V ▲ 150mΩ ▲ 20A^{Note 4} ▲ Si MOSFET

SILICON Si MOSFET ▲ THT type

N-channel enhancement mode

UL94V-0 rated flame retardant epoxy

TO220F-3L package ▲ Electrical insulated mounting tab

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

High power and current handling capability



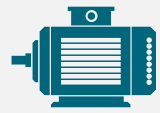




MAXIMUM RATINGS

| Parameter ($T_C = 25^\circ\text{C}$, unless otherwise noted) | | Characteristics |
|--|----------------------------|---|
| Drain-Source Voltage | V_{DS} | 650V |
| Gate-Source Voltage | V_{GS} | $\pm 30\text{V}$ |
| Continuous Drain Current at $T_C = 25^\circ\text{C}$ | I_D | 20A ^{Note 4} |
| Continuous Drain Current at $T_C = 100^\circ\text{C}$ | I_D | 13A ^{Note 4} |
| Pulsed Drain Current ^{Note 1} | I_{DM} ^{Note 5} | 80A ^{Note 4} |
| Maximum Power Dissipation at $T_C = 25^\circ\text{C}$ | P_D | 35W |
| Power Dissipation Derating above 25°C | ΔP_D | 0.28W/ $^\circ\text{C}$ |
| Single Pulsed Avalanche Energy ^{Note 6} | E_{AS} | 607.5mJ |
| Single Pulsed Avalanche Current ^{Note 6} | I_{AS} | 4.5A |
| Operating and Storage Temperature Range | T_J, T_{STG} | -55°C to $+150^\circ\text{C}$ |

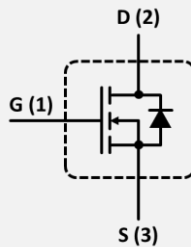
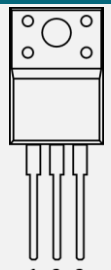
THERMAL CHARACTERISTICS

| Parameter | Symbol | Limit |
|---|--------------|------------------------|
| Thermal Resistance, Junction-to-Case | R_{TH_JC} | 3.6 $^\circ\text{C/W}$ |
| Thermal Resistance, Junction-to-Ambient | R_{TH_JA} | 65 $^\circ\text{C/W}$ |

APPLICATIONS

| EV Charging | Industrial Inverters | Motors & Drives | Power Factor Correction | Renewable Energy | SMPS | UPS |
|---|---|---|---|--|---|---|
|  |  |  |  |  |  |  |

PIN DESCRIPTION

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

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

| Item | Condition | Symbol | Min. | Typ. | Max. | Unit |
|---|--|--------------|------|------|------|------------|
| Off Characteristics | | | | | | |
| Drain-Source Breakdown Voltage | $V_{GS} = 0V, I_D = 250\mu A$ | BV_{DSS} | 650 | | | V |
| Zero Gate Voltage Drain Current | $V_{DS} = 650V, V_{GS} = 0V$ | I_{DSS} | | | 1 | μA |
| Gate Body Leakage Current, Forward | $V_{GS} = 30V, V_{DS} = 0V$ | I_{GSSF} | | | 100 | nA |
| Gate Body Leakage Current, Reverse | $V_{GS} = -30V, V_{DS} = 0V$ | I_{GSSR} | | | -100 | nA |
| On Characteristics ^{Note 2} | | | | | | |
| Gate Threshold Voltage | $V_{GS} = V_{DS}, I_D = 250\mu A$ | $V_{GS(th)}$ | 2 | | 4 | V |
| Static Drain-Source On-Resistance | $V_{GS} = 10V, I_D = 20A$ | $R_{DS(ON)}$ | | 150 | 180 | m Ω |
| Dynamic Characteristics ^{Note 3} | | | | | | |
| Input Capacitance | $V_{DS} = 150V, V_{GS} = 0V, f = 1MHz$ | C_{ISS} | | 1570 | | pF |
| Output Capacitance | $V_{DS} = 150V, V_{GS} = 0V, f = 1MHz$ | C_{OSS} | | 95 | | pF |
| Reverse Transfer Capacitance | $V_{DS} = 150V, V_{GS} = 0V, f = 1MHz$ | C_{RSS} | | 15 | | pF |
| Switching Characteristics ^{Note 3} | | | | | | |
| Turn-On Delay Time | $V_{DD} = 520V, V_{GS} = 10V, I_D = 10A, R_{G(ext)} = 6\Omega$ | $t_{D(ON)}$ | | 29 | | ns |
| Turn-On Rise Time | $V_{DD} = 520V, V_{GS} = 10V, I_D = 10A, R_{G(ext)} = 6\Omega$ | t_R | | 10 | | ns |
| Turn-Off Delay Time | $V_{DD} = 520V, V_{GS} = 10V, I_D = 10A, R_{G(ext)} = 6\Omega$ | $t_{D(OFF)}$ | | 76 | | ns |
| Turn-Off Fall Time | $V_{DD} = 520V, V_{GS} = 10V, I_D = 10A, R_{G(ext)} = 6\Omega$ | t_F | | 8 | | ns |
| Total Gate Charge | $V_{DS} = 520V, V_{GS} = 10V, I_D = 10A$ | Q_G | | 42 | | nC |
| Gate Source Charge | $V_{DS} = 520V, V_{GS} = 10V, I_D = 10A$ | Q_{GS} | | 7 | | nC |
| Gate Drain Charge | $V_{DS} = 520V, V_{GS} = 10V, I_D = 10A$ | Q_{GD} | | 15 | | nC |
| Drain-Source Diode Characteristics and Maximum Ratings | | | | | | |
| Drain-Source Diode Forward Current | | I_S | | | 8 | A |
| Drain-Source Diode Forward Voltage | $V_{GS} = 0V, I_S = 8A$ | V_{SD} | | | 1.2 | V |
| Reverse Recovery Time | $I_D = 20A, di/dt = 100A/\mu s$ | t_{RR} | | 257 | | ns |
| Reverse Recovery Charge | $I_D = 20A, di/dt = 100A/\mu s$ | Q_{RR} | | 3.04 | | μC |
| Peak Reverse Recovery Current | $I_D = 20A, di/dt = 100A/\mu s$ | I_{RR} | | 22 | | A |
| Max. Diode Commutation Speed | $V_{DS} = 0...400V, V_{GS} < 20A, T_J = 25^\circ C$ | dI_F/dt | | | 1100 | A/ μs |
| Reverse Diode dV/dt ruggedness, $V_{DS} = 0...480V, I_{SD} < I_D$ | $I_{DR} = 10A, V_{GS} = 0V, V_{DD} = 400V$ | dV/dt | | | 50 | V/ns |
| MOSFET dV/dt ruggedness, $V_{DS} = 0...480V$ | $I_{DR} = 10A, V_{GS} = 0V, V_{DD} = 400V$ | dV/dt | | | 160 | V/ns |

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: Limited only by maximum temperature allowed.
- 5: Pulse width limited by safe operating area.
- 6: $L = 60mH, I_{AS} = 4.5A, V_{DD} = 50V, R_G = 25\Omega$, Starting $T_J = 25^\circ C$

REFERENCE DATA ▲ TYPICAL DEVICE PERFORMANCE

Fig. 1 • Output Characteristics

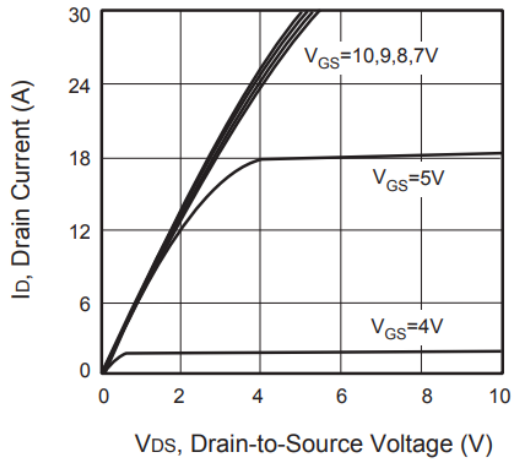


Fig. 2 • Transfer Characteristics

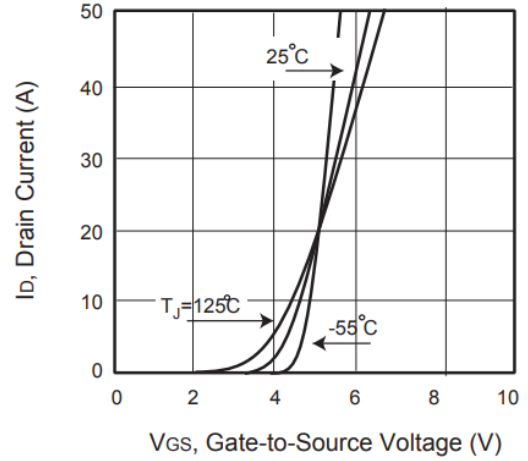


Fig. 3 • Capacitance

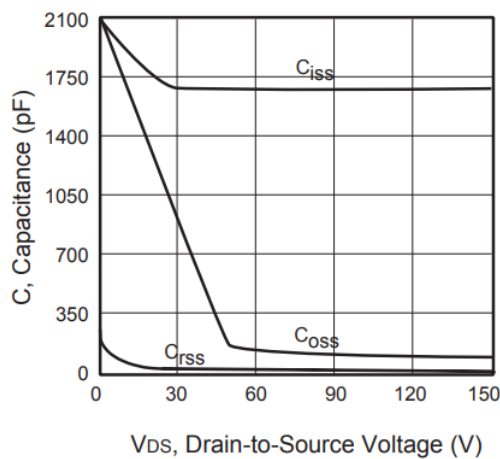


Fig. 4 • On-Resistance Variation with Temperature

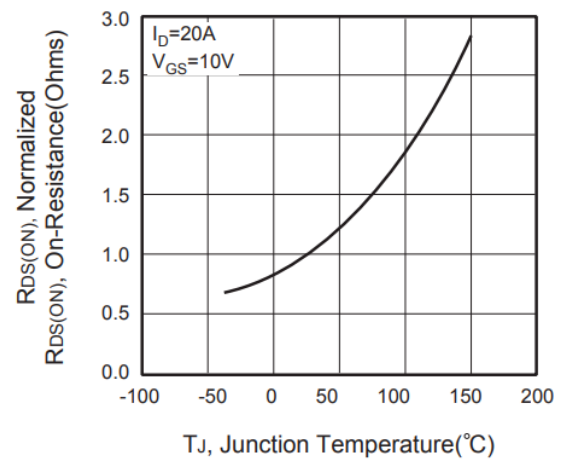


Fig. 5 • Gate Threshold Variation with Temperature

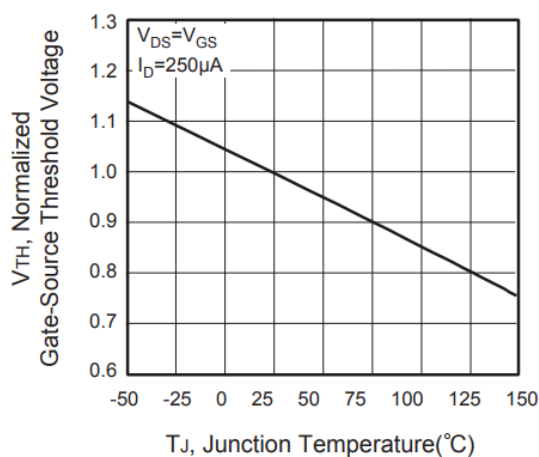
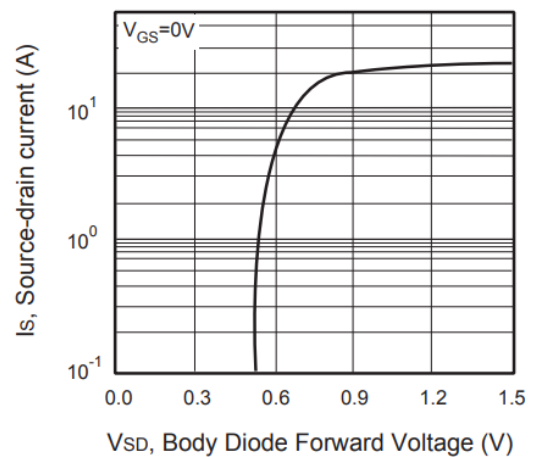


Fig. 6 • Body Diode Forward Voltage Variation with Source Current



REFERENCE DATA ▲ TYPICAL DEVICE PERFORMANCE

Fig. 7 • Gate Charge

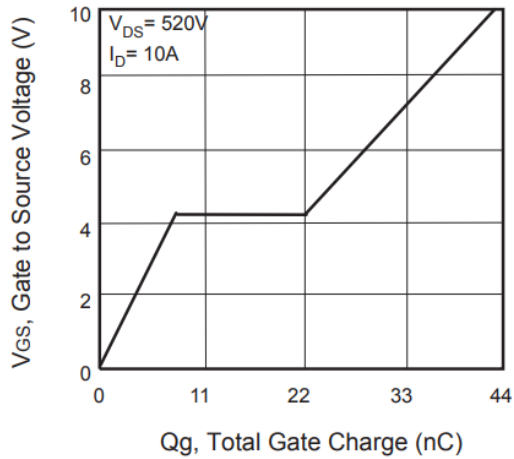


Fig. 8 • Maximum Safe Operating Area

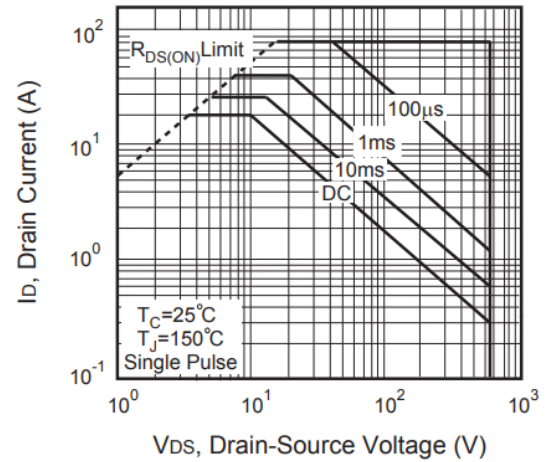


Fig. 9 • Breakdown Voltage Variation vs. Temperature

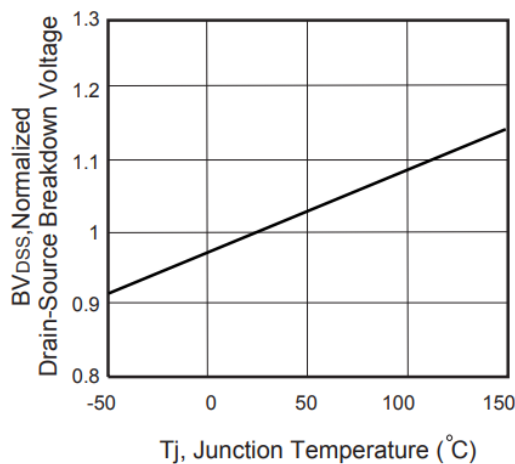


Fig. 10 • Switching Test Circuit

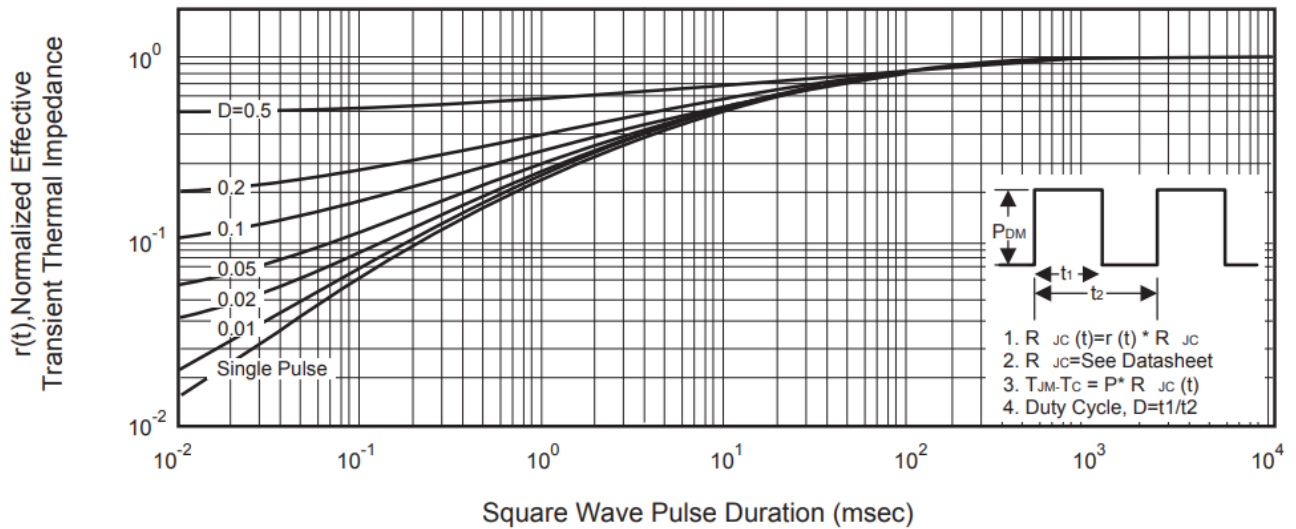


Fig. 11 • Switching Waveforms

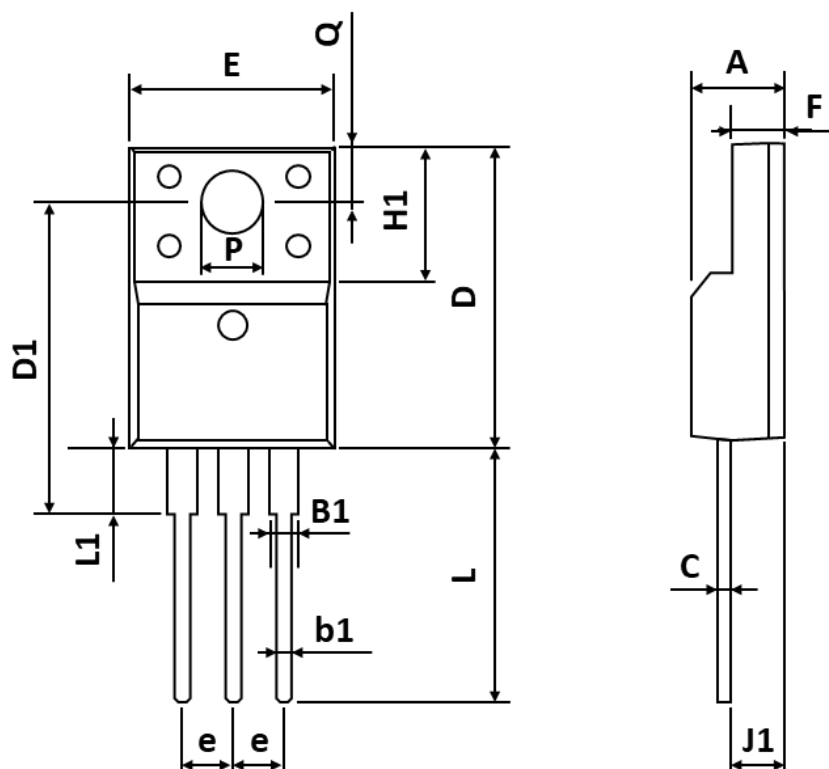


REFERENCE DATA ▲ TYPICAL DEVICE PERFORMANCE

Fig. 12 • Normalized Thermal Transient Impedance Curve



PACKAGE OUTLINE

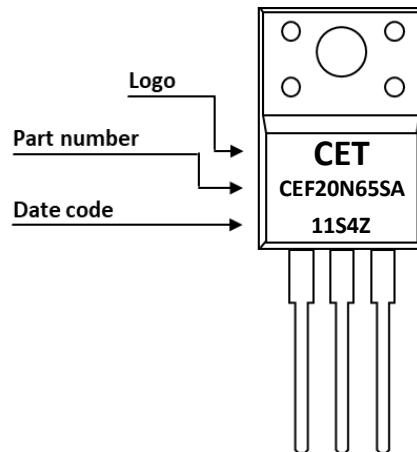


| Sym | Millimeters (Min.) | Millimeters (Typ.) | Millimeters (Max.) |
|-----|-----------------------|-----------------------|-----------------------|
| A | 4.500 | - | 5.000 |
| B1 | 1.000 | - | 1.500 |
| b1 | 0.700 | - | 0.950 |
| C | 0.420 | - | 0.700 |
| D | 15.670 | - | 16.070 |
| D1 | 14.800 | - | 16.000 |
| E | 9.960 | - | 10.360 |
| e | 2.340 | - | 2.740 |
| F | 2.340 | - | 2.740 |
| H1 | 6.480 | - | 6.900 |
| J1 | 2.550 | - | 2.950 |
| L | 12.080 | - | 13.480 |
| L1 | 2.230 | - | 3.650 |
| Q | 3.100 | - | 3.500 |
| P | 2.980 | - | 3.380 |

ORDERING INFORMATION

| Part Number | Package | Packing | Tube Qty. | Inner Box Qty. | Outer Box Qty. |
|-------------|------------|---------|-----------|----------------|----------------|
| CEF20N65SA | TO-220F-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 | | | | | | | | | |

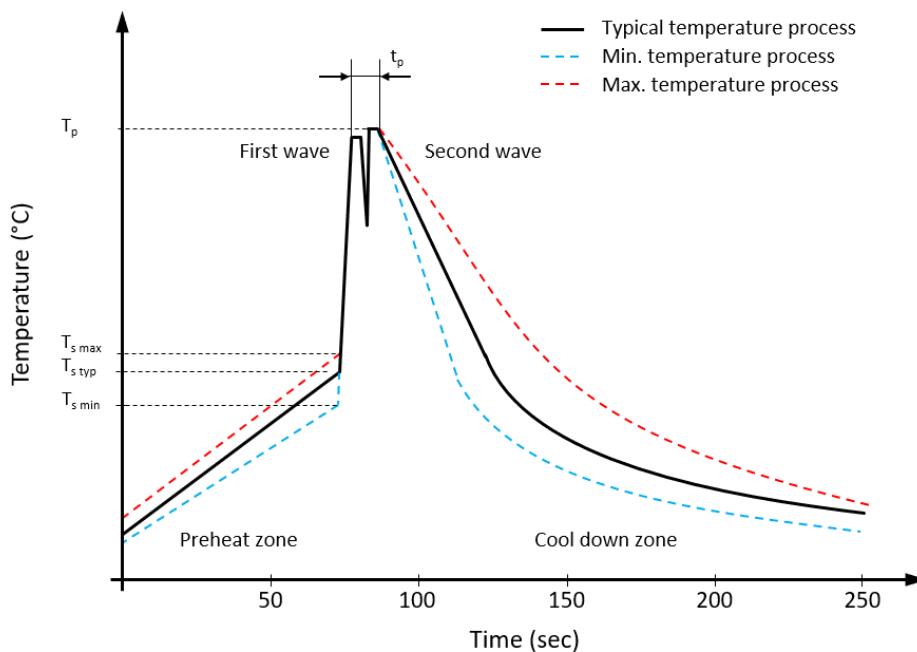
Coding list for „Month“

| | | | | | |
|-----|-----|-----|-----|-----|-----|
| 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 | $T_{s\ typ}$ | 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 Max. 5 second each wave | Max. 10 seconds 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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| | | | |

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