

# CEB22N06

60V ▲ 41mΩ ▲ 21.8A ▲ Si MOSFET

SILICON Si MOSFET ▲ SMD type

N-channel enhancement mode

UL94V-0 rated flame retardant epoxy

TO263 (D2PAK) package ▲ MSL 3

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	$V_{DS}$	60V
Gate-Source Voltage	$V_{GS}$	$\pm 20\text{V}$
Continuous Drain Current at $T_C = 25^\circ\text{C}$	$I_D$	21.8A
Pulsed Drain Current <sup>Note 1</sup>	$I_{DM}$ <sup>Note 4</sup>	87.2A
Maximum Power Dissipation at $T_C = 25^\circ\text{C}$	$P_D$	50W
Power Dissipation Derating above $25^\circ\text{C}$	$\Delta P_D$	$0.4\text{W}/^\circ\text{C}$
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	$R_{TH\_JC}$	$2.5^\circ\text{C}/\text{W}$
Thermal Resistance, Junction-to-Ambient	$R_{TH\_JA}$	$62.5^\circ\text{C}/\text{W}$

## APPLICATIONS

Battery Management Systems	DC/DC Converter	DC Fan	Industrial Control	Power Switches

## PIN DESCRIPTION

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

## 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	$V_{GS} = 0V, I_D = 250\mu A$	$BV_{DSS}$	60			V
Zero Gate Voltage Drain Current	$V_{DS} = 60V, V_{GS} = 0V$	$I_{DSS}$			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	$V_{GS} = V_{DS}, I_D = 250\mu A$	$V_{GS(th)}$	1		3	V
Static Drain-Source On-Resistance	$V_{GS} = 10V, I_D = 11A$	$R_{DS(ON)}$		41	50	m $\Omega$
Static Drain-Source On-Resistance	$V_{GS} = 5V, I_D = 9A$	$R_{DS(ON)}$		50	60	m $\Omega$
<b>Dynamic Characteristics</b> <sup>Note 3</sup>						
Input Capacitance	$V_{DS} = 25V, V_{GS} = 0V, f = 1MHz$	$C_{ISS}$		570		pF
Output Capacitance	$V_{DS} = 25V, V_{GS} = 0V, f = 1MHz$	$C_{OSS}$		150		pF
Reverse Transfer Capacitance	$V_{DS} = 25V, V_{GS} = 0V, f = 1MHz$	$C_{RSS}$		35		pF
<b>Switching Characteristics</b> <sup>Note 3</sup>						
Turn-On Delay Time	$V_{DD} = 30V, V_{GS} = 10V, I_D = 21A, R_{G(ext)} = 45\Omega$	$t_{D(ON)}$		10		ns
Turn-On Rise Time	$V_{DD} = 30V, V_{GS} = 10V, I_D = 21A, R_{G(ext)} = 45\Omega$	$t_R$		7		ns
Turn-Off Delay Time	$V_{DD} = 30V, V_{GS} = 10V, I_D = 21A, R_{G(ext)} = 45\Omega$	$t_{D(OFF)}$		99		ns
Turn-Off Fall Time	$V_{DD} = 30V, V_{GS} = 10V, I_D = 21A, R_{G(ext)} = 45\Omega$	$t_F$		28		ns
Total Gate Charge	$V_{DS} = 48V, V_{GS} = 10V, I_D = 21A$	$Q_G$		17		nC
Gate Source Charge	$V_{DS} = 48V, V_{GS} = 10V, I_D = 21A$	$Q_{GS}$		1		nC
Gate Drain Charge	$V_{DS} = 48V, V_{GS} = 10V, I_D = 21A$	$Q_{GD}$		5		nC
<b>Drain-Source Diode Characteristics and Maximum Ratings</b>						
Drain-Source Diode Forward Current		$I_S$			15.2	A
Drain-Source Diode Forward Voltage <sup>Note 2</sup>	$V_{GS} = 0V, I_S = 21A$	$V_{SD}$			1.5	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: Pulse width limited by safe operating area.

# REFERENCE DATA ▲ TYPICAL DEVICE PERFORMANCE

Fig. 1 • Output Characteristics

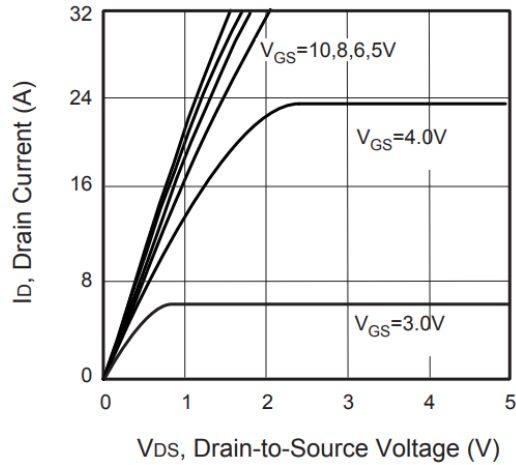


Fig. 2 • Transfer Characteristics

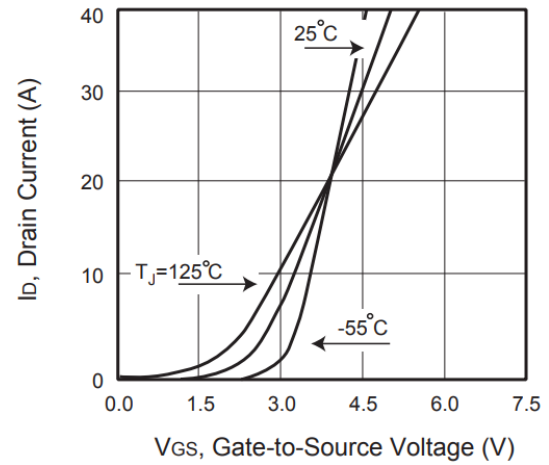


Fig. 3 • Capacitance

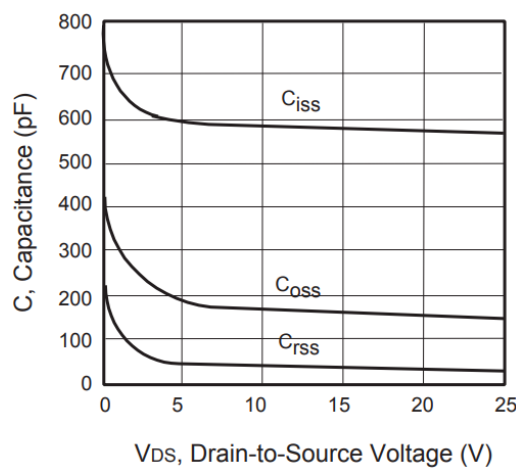


Fig. 4 • On-Resistance Variation with Temperature

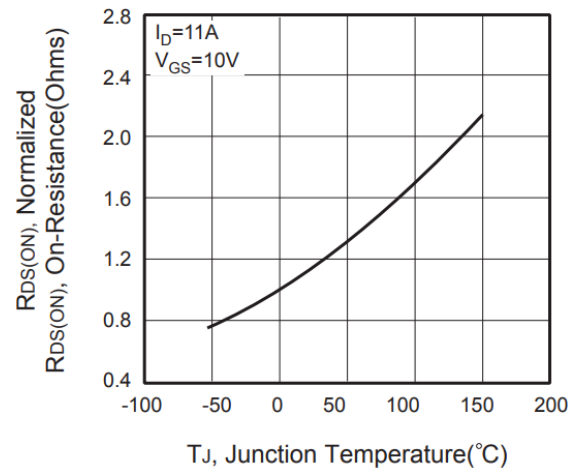


Fig. 5 • Gate Threshold Variation with Temperature

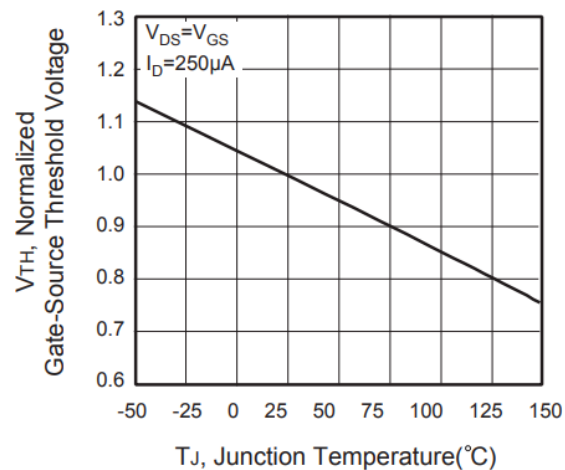
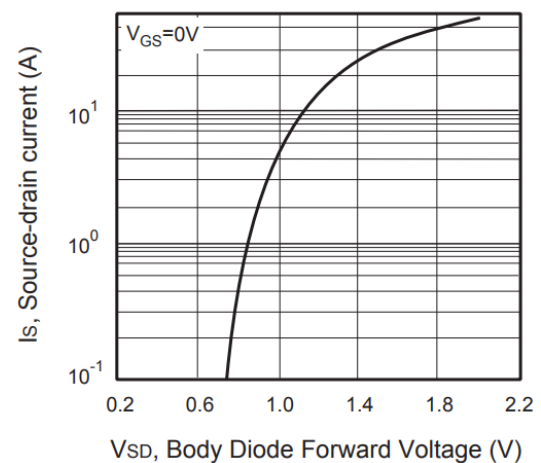


Fig. 6 • Body Diode Forward Voltage Variation with Source Current



## REFERENCE DATA ▲ TYPICAL DEVICE PERFORMANCE

Fig. 7 • Gate Charge

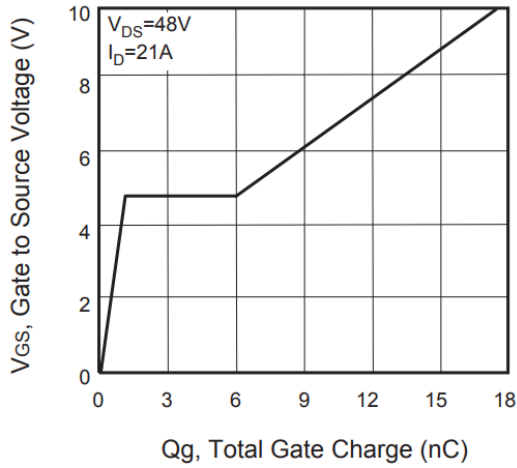


Fig. 8 • Maximum Safe Operating Area

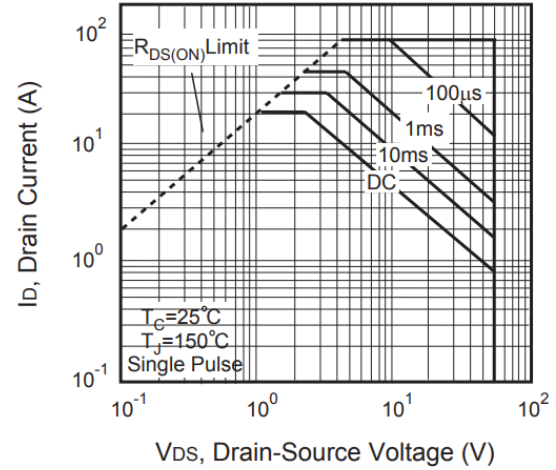


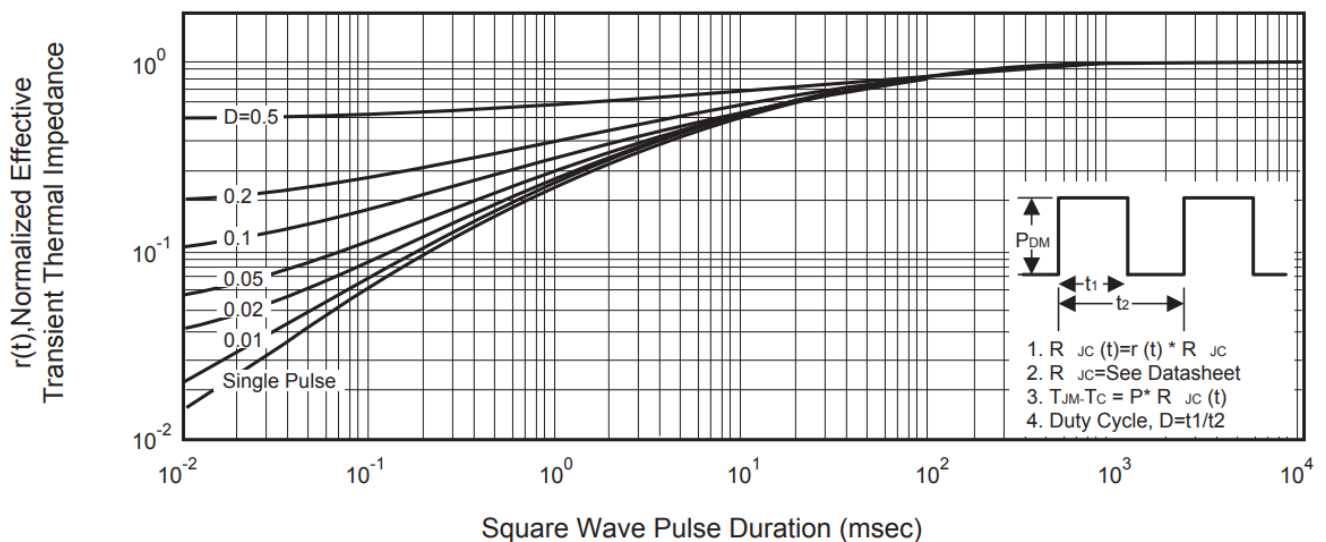
Fig. 9 • Switching Test Circuit



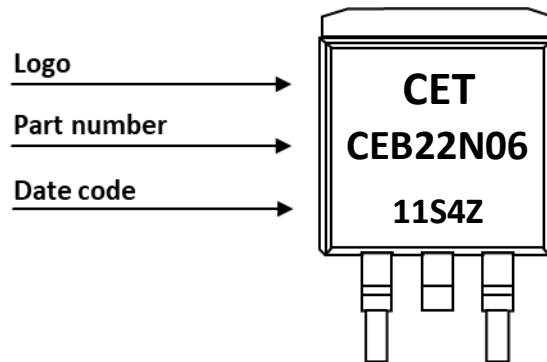
Fig. 10 • Switching Waveforms



Fig. 11 • Normalized Thermal Transient Impedance Curve



## 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

## PACKAGE OUTLINE



Sym	Millimeters (Min.)	Millimeters (Typ.)	Millimeters (Max.)
A	4.37	4.57	4.77
A1	1.22	1.27	1.42
A2	2.49	2.69	2.89
A3	0.00	0.13	0.25
b	0.70	0.81	0.96
b1	1.17	1.27	1.47
c	0.30	0.38	0.53
D1	8.50	8.70	8.90
D4	6.60	-	-

Sym	Millimeters (Min.)	Millimeters (Typ.)	Millimeters (Max.)
E	9.86	10.16	10.36
E5	7.06	-	-
e	2.54 BSC		
H	14.70	15.10	15.50
H2	1.07	1.27	1.47
L	2.00	2.30	2.60
L1	1.40	1.55	1.70
L4	0.25 BSC		
θ	0°	5°	9°

## ORDERING INFORMATION

Part Number	Package	Packing	Reel Qty.	Inner Box Qty.	Outer Box Qty.
CEB22N06	TO263 (D2PAK)	Reel	800pcs	800pcs	6,400pcs

## RECOMMENDED PAD LAYOUT



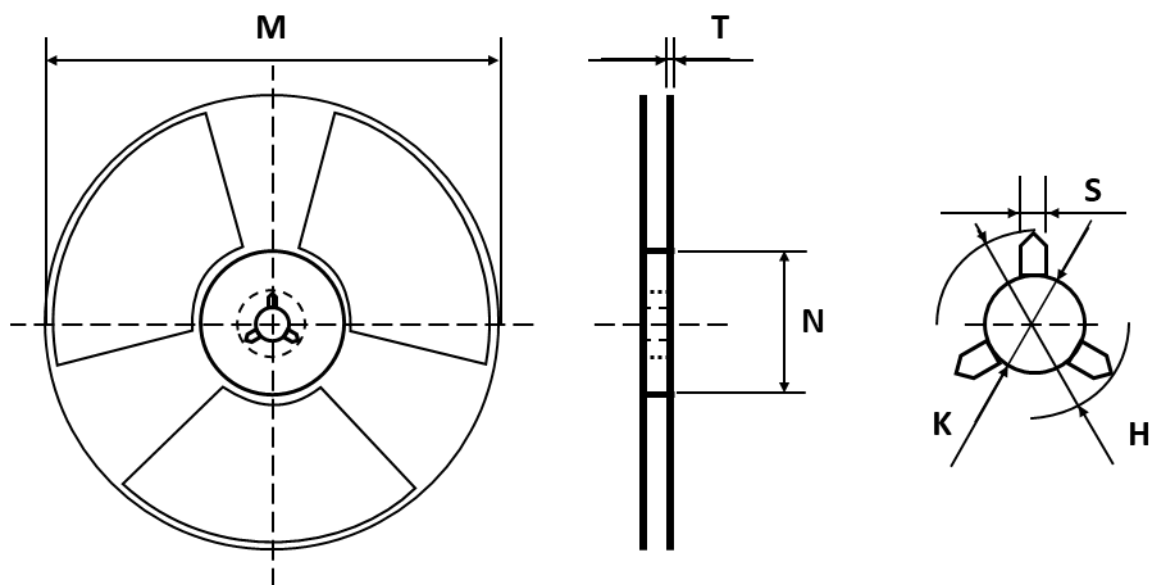
Sym	Millimeters (Min.)	Millimeters (Typ.)	Millimeters (Max.)
F1	-	12.20	-
F2	-	16.90	-
F3	-	2.54	-
F4	-	5.08	-

Sym	Millimeters (Min.)	Millimeters (Typ.)	Millimeters (Max.)
F5	-	2.54	-
F6	-	1.60	-
F7	-	9.75	-

### Notes:

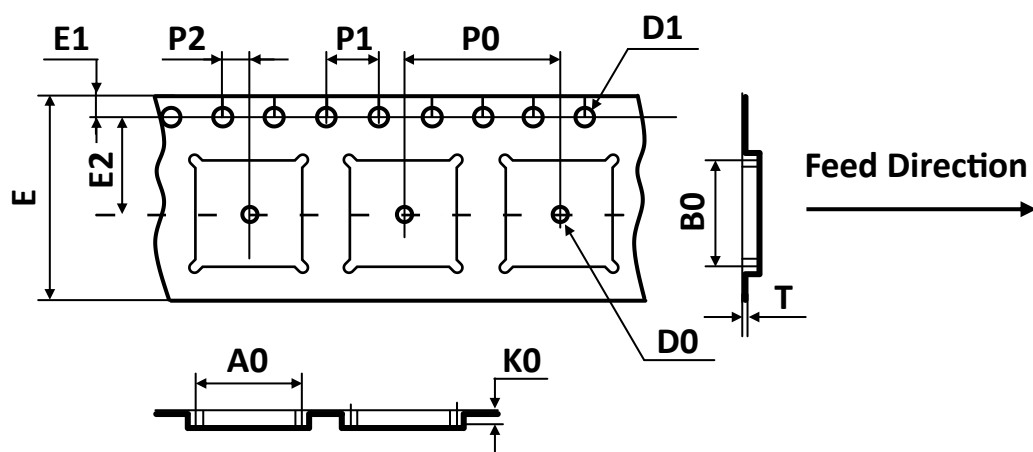
1. The suggested land pattern dimensions have been provided for reference only.
2. For further information, please reference document IPC-7351A.

## REEL DIMENSIONS ▲ All dimensions in mm



Tape Size	Reel Size	M	N	T	H	K	S
24mm	Ø330	Ø330.00	Ø100.00	2.10	22.00	13.00	2.00
		±2.00	±0.50	±0.20	±0.50	+0.50 -0.20	+0.50 -0.20

## TAPE DIMENSIONS ▲ All dimensions in mm

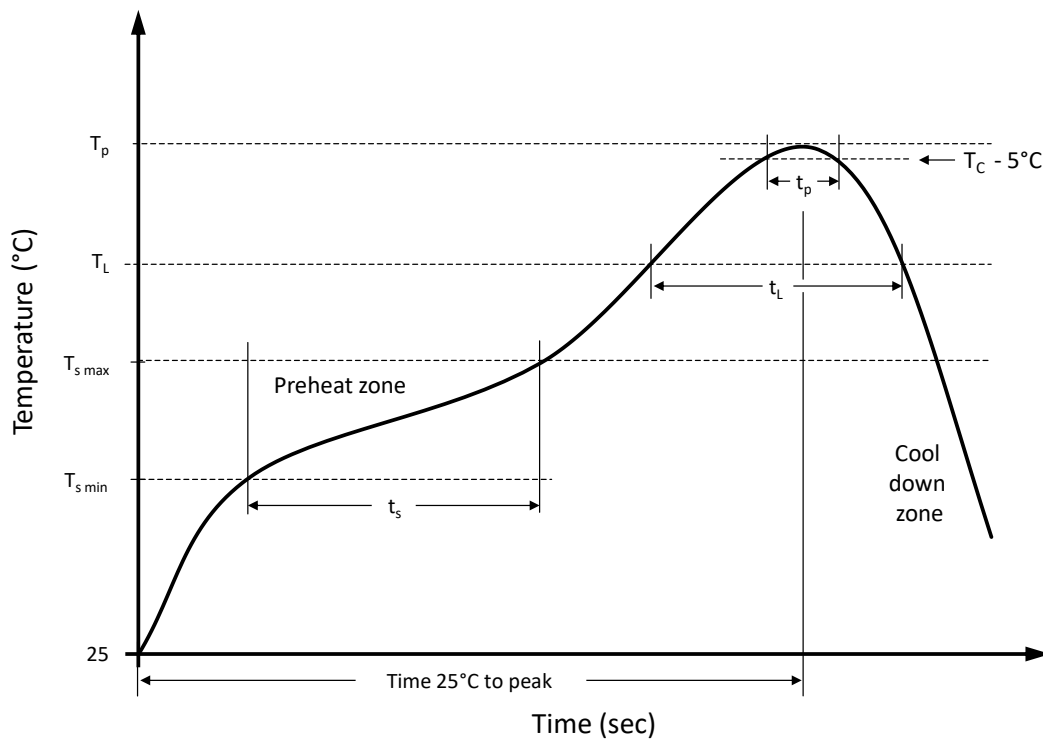


Package	A0	B0	K0	D0	D1	E	E1	E2	P0	P1	P2	T
TO263 (D <sup>2</sup> PAK)	10.80	16.30	4.85	1.50	1.55	24.00	1.75	11.50	16.00	4.00	2.00	0.35
	±0.10	±0.10	±0.10	±0.10	±0.05	±0.30	±0.10	±0.10	±0.10	±0.10	±0.10	±0.05

**Note:** All dimensions meet EIA-481-D requirements.



## RECOMMENDED REFLOW SOLDERING PROFILE



### Recommended reflow soldering conditions ▲ Refer to JEDEC J-STD-020E

Profile Features		Sn-Pb Eutetic Assembly	Pb-Free Assembly
Preheat temperature min.	$T_{s \min}$	100 °C	150 °C
Preheat temperature max.	$T_{s \max}$	150 °C	200 °C
Preheat time $t_s$ from $T_{s \min}$ to $T_{s \max}$	$t_s$	120 seconds	120 seconds
Ramp-up rate ( $T_L$ to $T_p$ )		max. 3 °C/second	max. 3 °C/second
Liquidous temperature	$T_L$	183 °C	217 °C
Time $t_L$ maintained above $T_L$	$t_L$	150 seconds max.	150 seconds max.
Peak package body temperature	$T_p$	235°C	260°C
Timeframe of within 5°C below and up to max actual peak body temperature	$t_p$	20 seconds max.	30 seconds max.
Ramp-down rate ( $T_L$ to $T_p$ )		max. 6 °C/second	max. 6 °C/second
Time 25°C to peak temperature		max. 6 minutes	max. 8 minutes

## REVISION TABLE

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

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