CEB12N65

650V ▲ 610mΩ ▲ 12A ▲ 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 $R_{DS(ON)}$
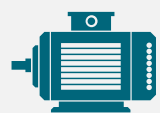**High power and current handling capability**

MAXIMUM RATINGS

Parameter (T_C = 25°C, unless otherwise noted)		Characteristics
Drain-Source Voltage	V_{DS}	650V
Gate-Source Voltage	V_{GS}	±30V
Continuous Drain Current at T_C = 25°C	I_D	12A
Pulsed Drain Current [Note 1]	I_{DM} [Note 5]	48A
Maximum Power Dissipation at T_C = 25°C	P_D	250W
Power Dissipation Derating above 25°C	ΔP_D	1.67W/°C
Single Pulsed Avalanche Energy [Note 6]	E_{AS}	607mJ
Single Pulsed Avalanche Current [Note 6]	I_{AS}	4.5A
Operating and Storage Temperature Range	T_J, T_{STG}	-55°C to +175°C
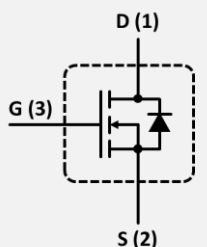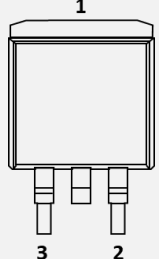
THERMAL CHARACTERISTICS

Parameter	Symbol	Limit
Thermal Resistance, Junction-to-Case	R_{TH_JC}	0.6°C/W
Thermal Resistance, Junction-to-Ambient	R_{TH_JA}	62.5°C/W

APPLICATIONS

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

PIN DESCRIPTION

Circuit Diagram	Outline ▪ Bottom View	Pin No.	Description
D (1) / G (3) / S (2)	1 / 3 / 2	1 / 2 / 3	Drain / Source / Gate

ELECTRICAL CHARACTERISTICS ▲ T$_C$ = 25°C, unless otherwise noted

Item	Condition	Symbol	Min.	Typ.	Max.	Unit
Off Characteristics						
Drain-Source Breakdown Voltage	V$_{GS}$ = 0V, I$_D$ = 250µA	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$_D$ = 250µA	V$_{GS(th)}$	2		4	V
Static Drain-Source On-Resistance	V$_{GS}$ = 10V, I$_D$ = 5.5A	R$_{DS(ON)}$		610	730	mΩ
Dynamic Characteristics [Note 3]						
Input Capacitance	V$_{DS}$ = 25V, V$_{GS}$ = 0V, f = 1MHz	C$_{ISS}$		1745		pF
Output Capacitance	V$_{DS}$ = 25V, V$_{GS}$ = 0V, f = 1MHz	C$_{OSS}$		205		pF
Reverse Transfer Capacitance	V$_{DS}$ = 25V, V$_{GS}$ = 0V, f = 1MHz	C$_{RSS}$		20		pF
Switching Characteristics [Note 3]						
Turn-On Delay Time	V$_{DD}$ = 300V, V$_{GS}$ = 10V, I$_D$ = 12A, R$_{G(ext)}$ = 25Ω	t$_{D(ON)}$		31		ns
Turn-On Rise Time	V$_{DD}$ = 300V, V$_{GS}$ = 10V, I$_D$ = 12A, R$_{G(ext)}$ = 25Ω	t$_R$		129		ns
Turn-Off Delay Time	V$_{DD}$ = 300V, V$_{GS}$ = 10V, I$_D$ = 12A, R$_{G(ext)}$ = 25Ω	t$_{D(OFF)}$		106		ns
Turn-Off Fall Time	V$_{DD}$ = 300V, V$_{GS}$ = 10V, I$_D$ = 12A, R$_{G(ext)}$ = 25Ω	t$_F$		63		ns
Total Gate Charge	V$_{DS}$ = 400V, V$_{GS}$ = 10V, I$_D$ = 12A	Q$_G$		45		nC
Gate Source Charge	V$_{DS}$ = 400V, V$_{GS}$ = 10V, I$_D$ = 12A	Q$_{GS}$		8		nC
Gate Drain Charge	V$_{DS}$ = 400V, V$_{GS}$ = 10V, I$_D$ = 12A	Q$_{GD}$		21		nC
Drain-Source Diode Characteristics and Maximum Ratings						
Drain-Source Diode Forward Current		I$_S$			12	A
Drain-Source Diode Forward Voltage [Note 2]	V$_{GS}$ = 0V, I$_S$ = 12A	V$_{SD}$			1.4	V

Notes

1: Repetitive Rating: Pulse width limited by maximum junction temperature

2: Pulse Test: Pulse Width ≤ 300µs, Duty Cycle ≤ 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$_G$ = 25Ω, Starting T$_J$ = 25°C

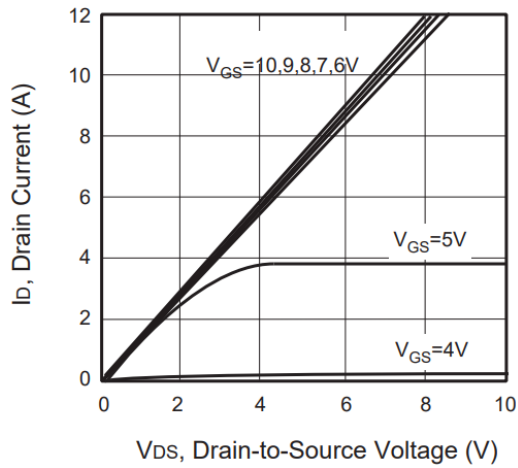# REFERENCE DATA ▲ TYPICAL DEVICE PERFORMANCE

Fig. 1 ▪ Output Characteristics

V_{GS}=10,9,8,7,6V

V_{GS}=5V

V_{GS}=4V

I_D, Drain Current (A) vs V_{DS}, Drain-to-Source Voltage (V)

Fig. 2 ▪ Transfer Characteristics

25°C

T_J=125°C

-55°C

I_D, Drain Current (A) vs V_{GS}, Gate-to-Source Voltage (V)

Fig. 3 ▪ Capacitance

C_{iss}

C_{oss}

C_{rss}

C, Capacitance (pF) vs V_{DS}, Drain-to-Source Voltage (V)
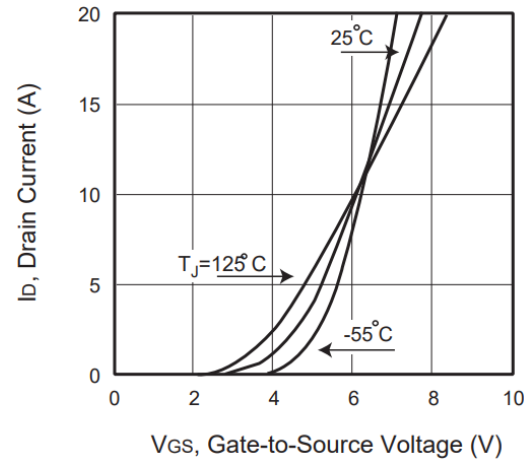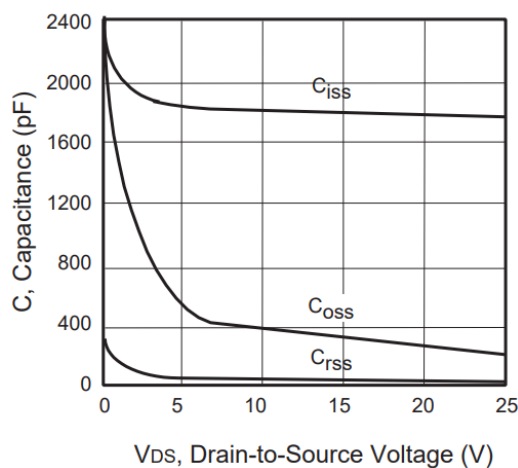
Fig. 4 ▪ On-Resistance Variation with Temperature

I_D=5.5A
V_{GS}=10V

$R_{DS(ON)}$, Normalized $R_{DS(ON)}$, On-Resistance (Ohms) vs T_J, Junction Temperature (°C)
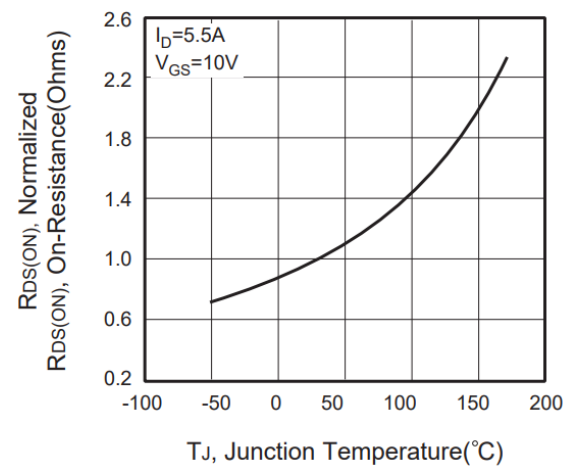
Fig. 5 ▪ Gate Threshold Variation with Temperature

V_{DS}=V_{GS}
I_D=250µA

V_{TH}, Normalized Gate-Source Threshold Voltage vs T_J, Junction Temperature (°C)
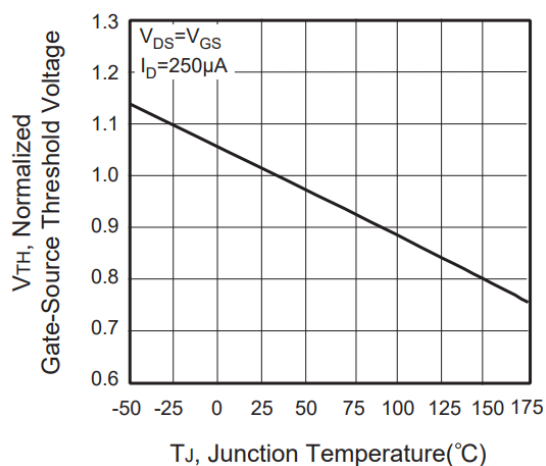
Fig. 6 ▪ Body Diode Forward Voltage Variation with Source Current

V_{GS}=0V

I_S, Source-drain current (A) vs V_{SD}, Body Diode Forward Voltage (V)
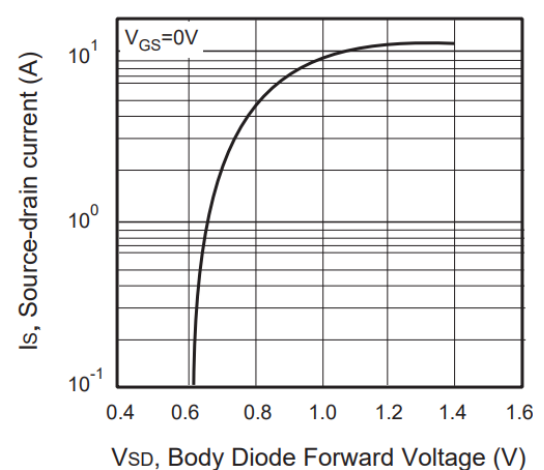
REFERENCE DATA ▲ TYPICAL DEVICE PERFORMANCE
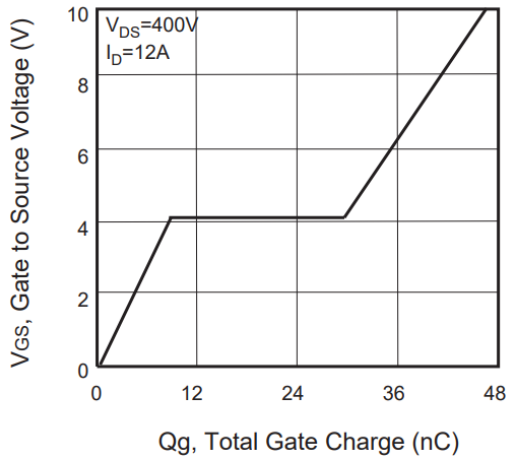
Fig. 7 ▪ Gate Charge	Fig. 8 ▪ Maximum Safe Operating Area
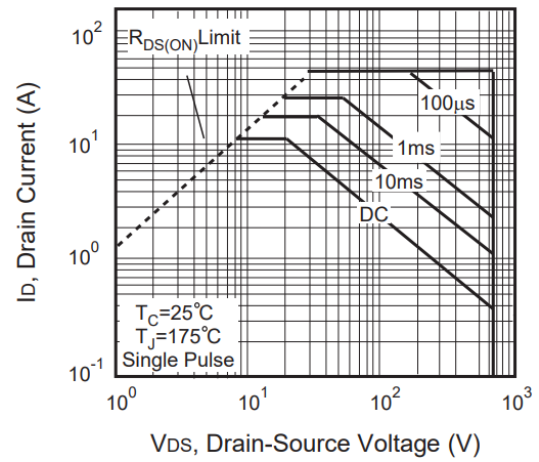
Fig. 9 ▪ Switching Test Circuit	Fig. 10 ▪ Switching Waveforms
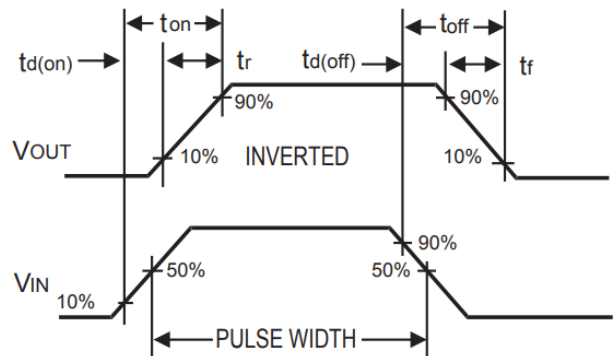
Fig. 11 ▪ Normalized Thermal Transient Impedance Curve

1. $R_{\theta JC}(t) = r(t) * R_{\theta JC}$
2. $R_{\theta JC}$ = See Datasheet
3. $T_{JM} - T_C = P * R_{\theta JC}(t)$
4. Duty Cycle, $D = t1/t2$

Square Wave Pulse Duration (msec)

PART MARKING

Logo

Part number

Date code

CET
CEB12N65
11S4Z

DATE CODE

Example: 11S4Z

11S4Z

Year

Month

Day

Serial No.

Product Type
Z: Pb-free
G: Green Product
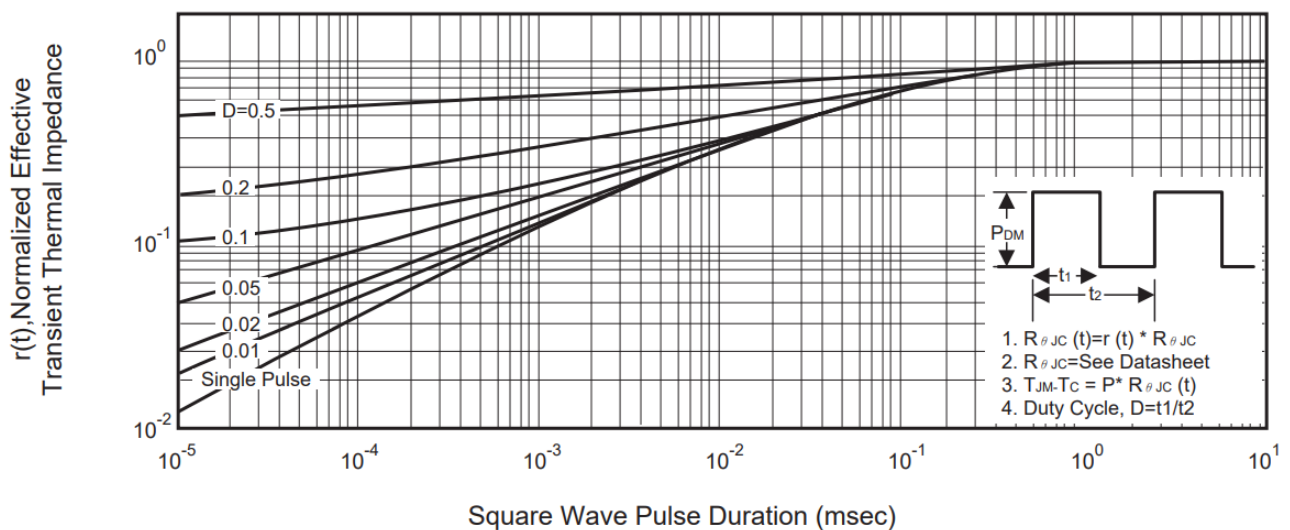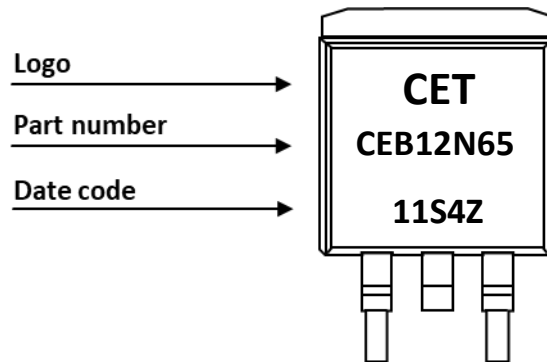
Coding list for „Day"

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.
CEB12N65	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
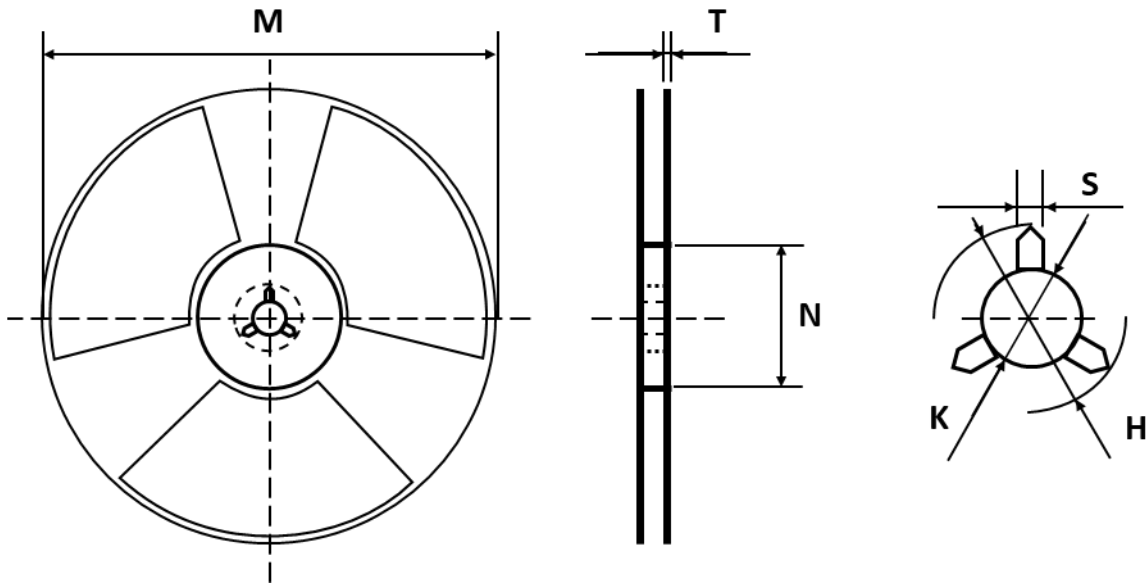
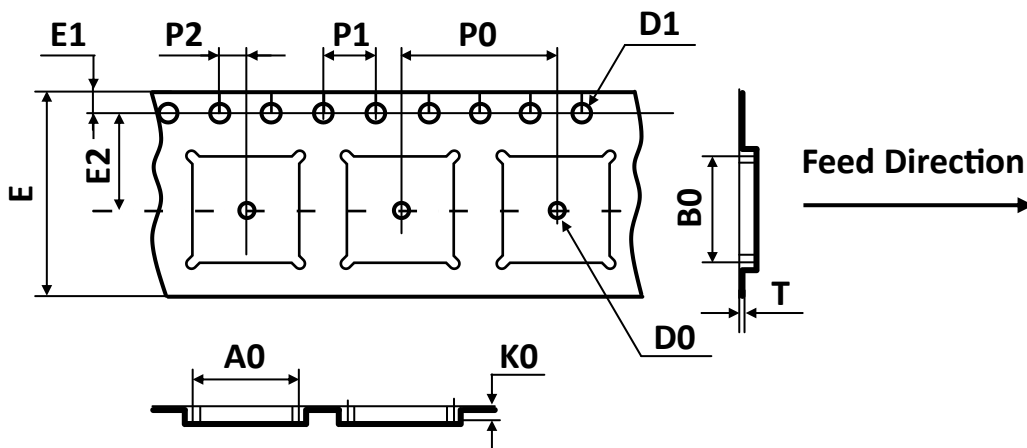| Tape Size	Reel Size	M	N	T	H	K	S
24mm	Ø330	Ø330.00	Ø100.00	2.10	22.00	13.00	2.00
		±2.00	±0.50	±0.20	±0.50	+0.50 -0.20	+0.50 -0.20

TAPE DIMENSIONS ▲ All dimensions in mm

Feed Direction

Package	A0	B0	K0	D0	D1	E	E1	E2	P0	P1	P2	T
TO263 (D²PAK)	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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