

# CED6405

-60V ▲ 39mΩ ▲ -20A ▲ Si MOSFET

SILICON Si MOSFET ▲ THT type

P-channel enhancement mode

UL94V-0 rated flame retardant epoxy

TO251 (E-PAK) 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	$V_{DS}$	-60V
Gate-Source Voltage	$V_{GS}$	$\pm 25\text{V}$
Continuous Drain Current	$I_D$	-20A
Pulsed Drain Current <sup>Note 1</sup>	$I_{DM}$	-80A
Maximum Power Dissipation at $T_c = 25^\circ\text{C}$	$P_D$	36W
Power Dissipation Derating above $25^\circ\text{C}$	$\Delta P_D$	0.29W/ $^\circ\text{C}$
Operating and Storage Temperature Range	$T_J, T_{STG}$	$-55^\circ\text{C}$ to $+150^\circ\text{C}$

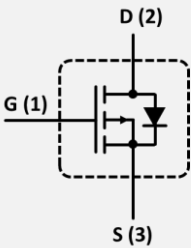
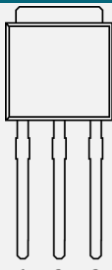
## THERMAL CHARACTERISTICS

Parameter	Symbol	Limit
Thermal Resistance, Junction-to-Case	$R_{TH\_JC}$	3.5 $^\circ\text{C}/\text{W}$
Thermal Resistance, Junction-to-Ambient <sup>Note 2</sup>	$R_{TH\_JA}$	50 $^\circ\text{C}/\text{W}$

## APPLICATIONS

DC/DC Converter	DC Fan	Load Switches	Power Banks	USB Storage
				

## 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
<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 4</sup>						
Gate Threshold Voltage	$V_{GS} = V_{DS}, I_D = -250\mu A$	$V_{GS(th)}$	-1		-3	V
Static Drain-Source On-Resistance	$V_{GS} = -10V, I_D = -20A$	$R_{DS(ON)}$		39	48	m $\Omega$
Static Drain-Source On-Resistance	$V_{GS} = -4.5V, I_D = -20A$	$R_{DS(ON)}$		48	62	m $\Omega$
<b>Dynamic Characteristics</b> <sup>Note 4</sup>						
Input Capacitance	$V_{DS} = -25V, V_{GS} = 0V, f = 1MHz$	$C_{ISS}$		1320		pF
Output Capacitance	$V_{DS} = -25V, V_{GS} = 0V, f = 1MHz$	$C_{OSS}$		125		pF
Reverse Transfer Capacitance	$V_{DS} = -25V, V_{GS} = 0V, f = 1MHz$	$C_{RSS}$		80		pF
<b>Switching Characteristics</b> <sup>Note 4</sup>						
Turn-On Delay Time	$V_{DD} = -48V, V_{GS} = -10V, I_D = -20A, R_{G(ext)} = 6\Omega$	$t_{D(ON)}$		13		ns
Turn-On Rise Time	$V_{DD} = -48V, V_{GS} = -10V, I_D = -20A, R_{G(ext)} = 6\Omega$	$t_R$		8		ns
Turn-Off Delay Time	$V_{DD} = -48V, V_{GS} = -10V, I_D = -20A, R_{G(ext)} = 6\Omega$	$t_{D(OFF)}$		48		ns
Turn-Off Fall Time	$V_{DD} = -48V, V_{GS} = -10V, I_D = -20A, R_{G(ext)} = 6\Omega$	$t_F$		15		ns
Total Gate Charge	$V_{DS} = -48V, V_{GS} = -10V, I_D = -20A$	$Q_G$		26		nC
Gate Source Charge	$V_{DS} = -48V, V_{GS} = -10V, I_D = -20A$	$Q_{GS}$		3		nC
Gate Drain Charge	$V_{DS} = -48V, V_{GS} = -10V, I_D = -20A$	$Q_{GD}$		9		nC
<b>Drain-Source Diode Characteristics and Maximum Ratings</b>						
Drain-Source Diode Forward Current <sup>Note 2</sup>		$I_S$			-20	A
Drain-Source Diode Forward Voltage <sup>Note 3</sup>	$V_{GS} = 0V, I_S = -9A$	$V_{SD}$			-1.5	V

### Notes

- 1: Repetitive Rating: Pulse width limited by maximum junction temperature
- 2: Surface Mounted on FR4 Board,  $t \leq 10\text{sec}$ .
- 3: Pulse Test: Pulse Width  $\leq 300\mu\text{s}$ , Duty Cycle  $\leq 2\%$ .
- 4: Guaranteed by design, not subject to production testing.

## REFERENCE DATA ▲ TYPICAL DEVICE PERFORMANCE

Fig. 1 • Output Characteristics

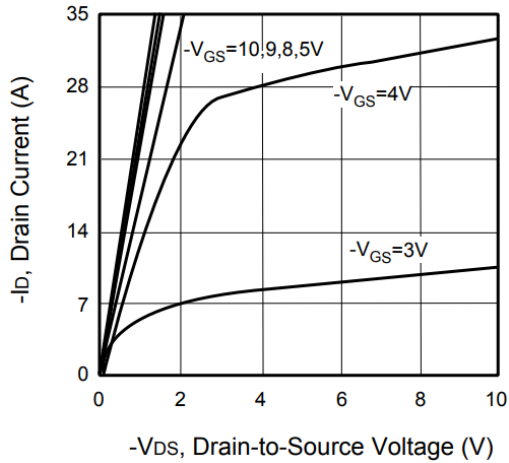


Fig. 2 • Transfer Characteristics

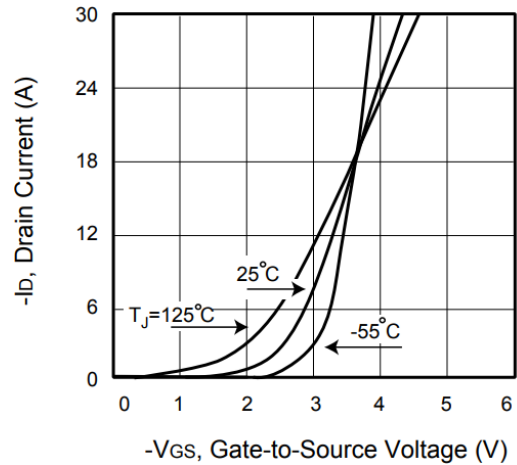


Fig. 3 • Capacitance

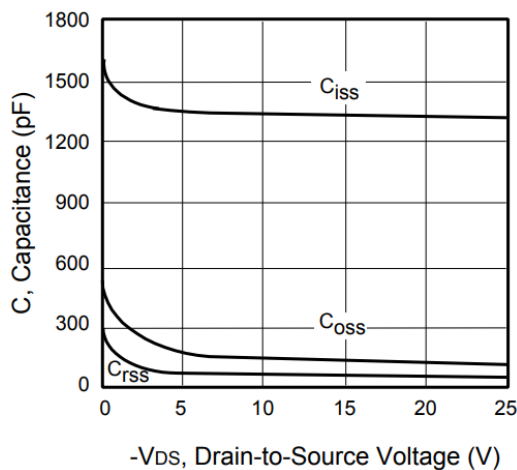


Fig. 4 • On-Resistance Variation with Temperature

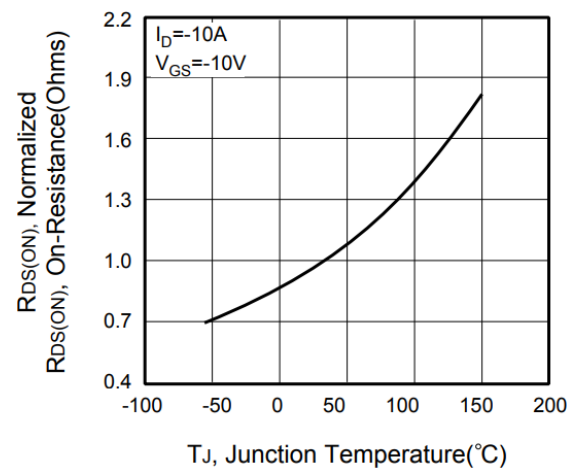


Fig. 5 • Gate Threshold Variation with Temperature

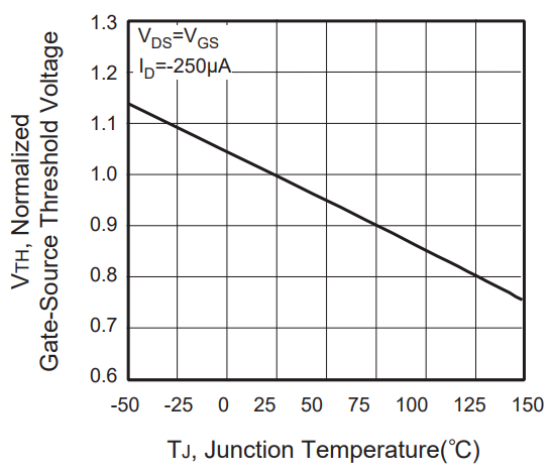
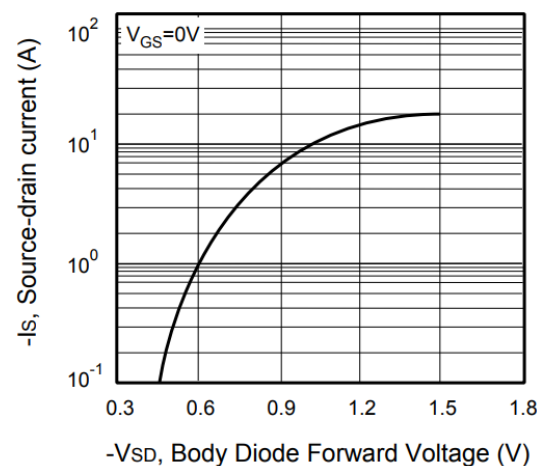


Fig. 6 • Body Diode Forward Voltage Variation with Source Current



## REFERENCE DATA ▲ TYPICAL DEVICE PERFORMANCE

Fig. 7 • Gate Charge

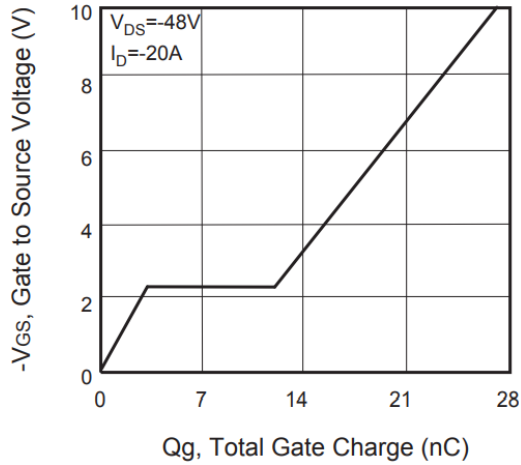


Fig. 8 • Maximum Safe Operating Area

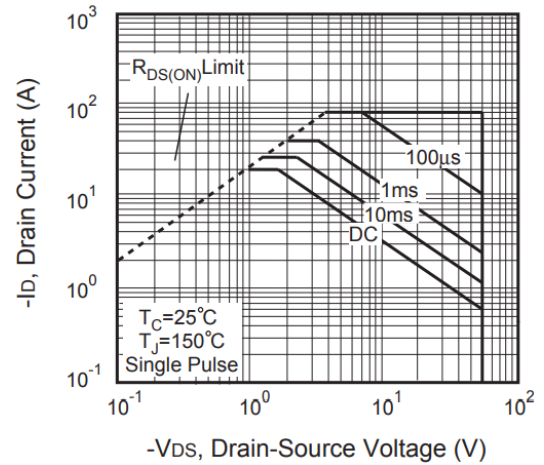


Fig. 9 • Breakdown Voltage Variation vs. Temperature

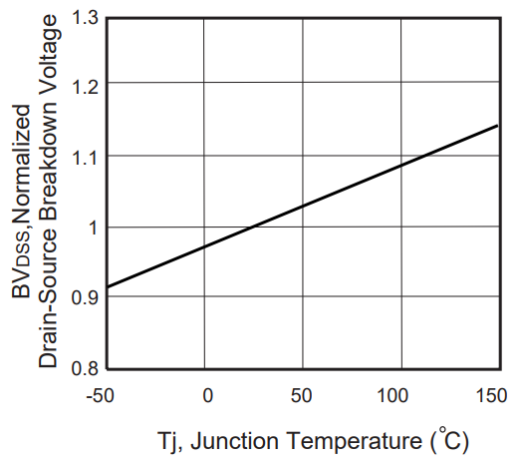


Fig. 10 • Switching Test Circuit

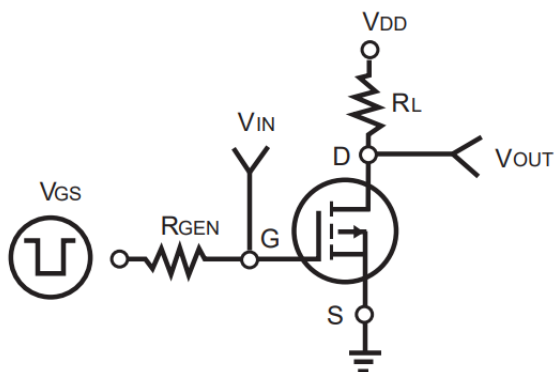
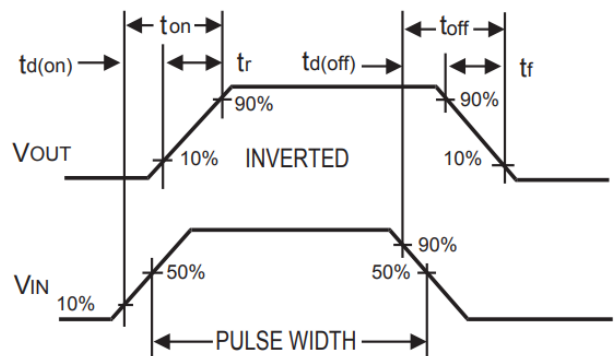
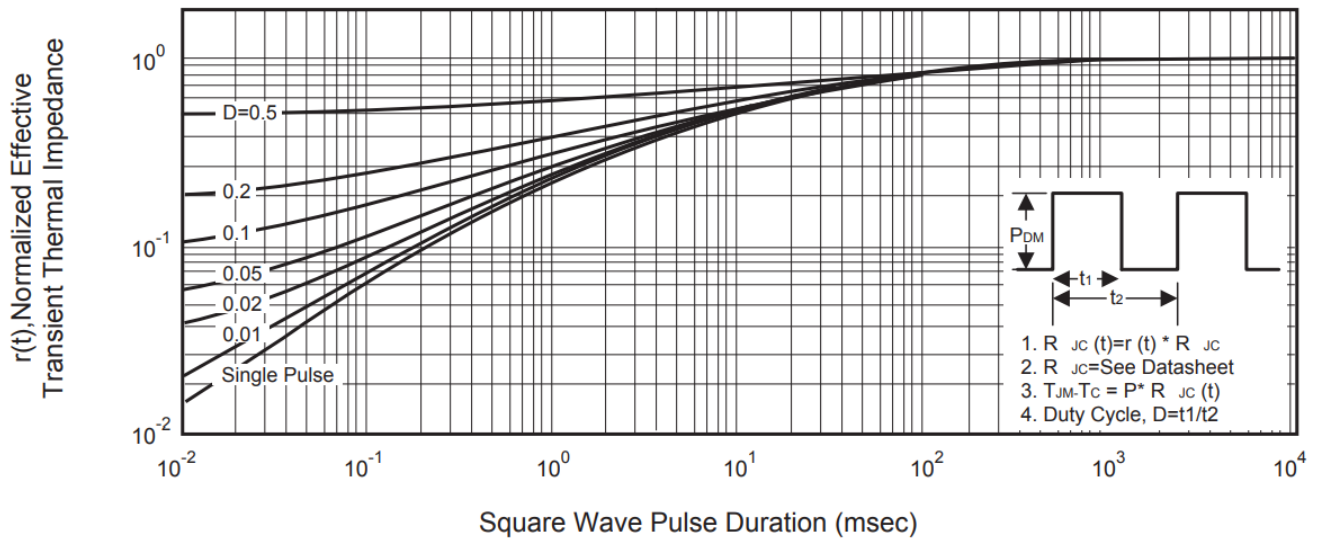


Fig. 11 • Switching Waveforms

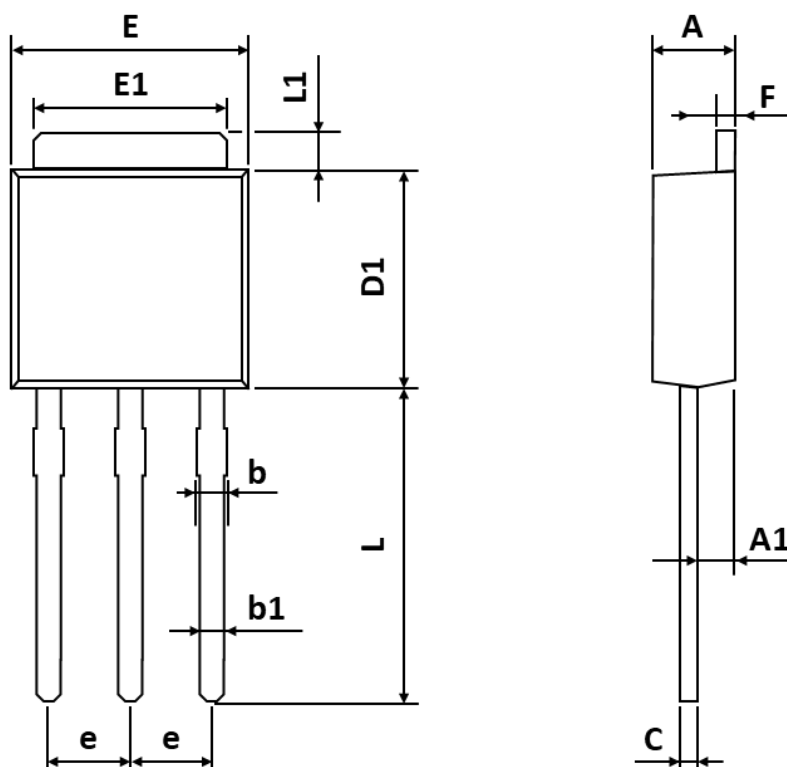


## REFERENCE DATA ▲ TYPICAL DEVICE PERFORMANCE

Fig. 12 • Normalized Thermal Transient Impedance Curve



## PACKAGE OUTLINE

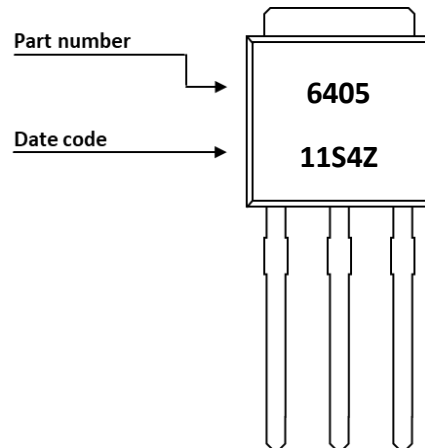


Sym	Millimeters (Min.)	Millimeters (Typ.)	Millimeters (Max.)
A	2.180	-	2.400
A1	0.860	-	1.500
b	0.700	-	0.960
b1	0.700	-	0.860
C	0.400	-	0.610
D1	5.400	-	6.630
E	6.050	-	7.010
E1	4.950	-	5.460
e	1.980	-	2.590
F	0.400	-	0.890
L	8.500	-	9.650
L1	0.500	-	1.800

## ORDERING INFORMATION

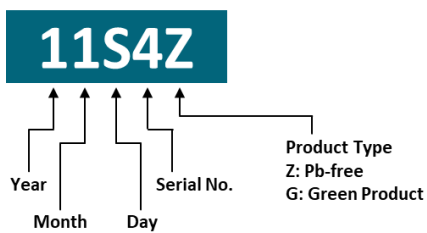
Part Number	Package	Packing	Tube Qty.	Inner Box Qty.	Outer Box Qty.
CED6405	TO251 (E-PAK)	Tube	80pcs	4,000pcs	16,000pcs

## 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									

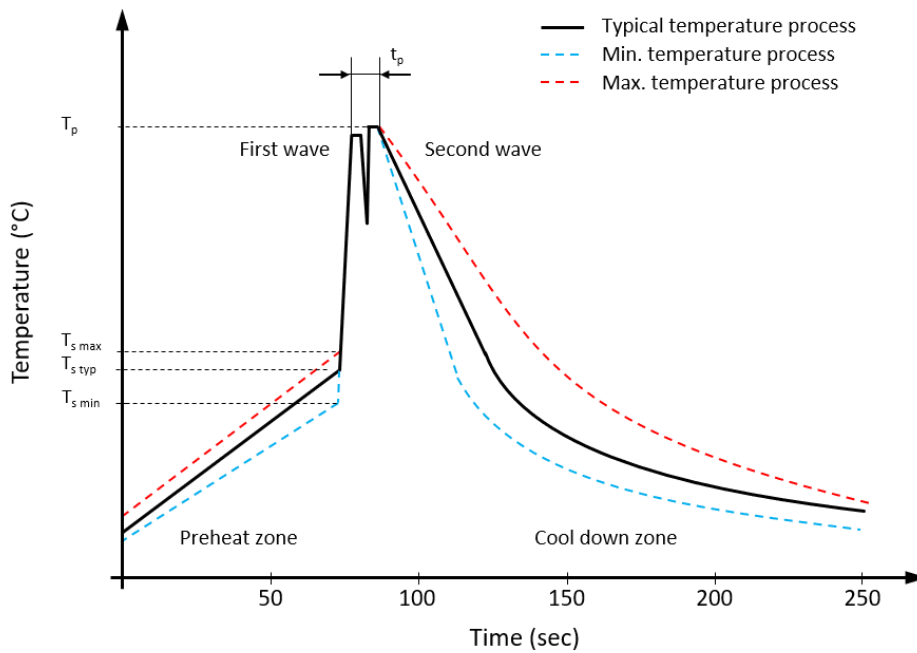
Coding list for „Month“

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.	$T_{s \text{ min}}$	100 °C	100 °C
Preheat temperature typical	$T_{s \text{ typ}}$	120 °C	120 °C
Preheat temperature max.	$T_{s \text{ max}}$	130 °C	130 °C
Preheat time $t_s$ from $T_{s \text{ min}}$ to $T_{s \text{ max}}$	$t_s$	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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