

650V, 5A N-Channel MOSFET

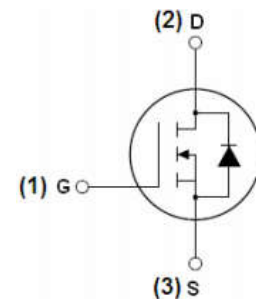
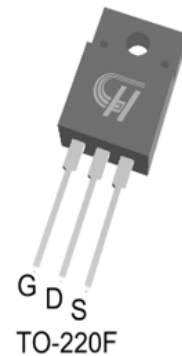
Features

- * $V_{DS} = 650V$, $I_D = 5A$
 $R_{DS(ON)} = 2.5\Omega$ (Typ.) @ $V_{GS} = 10V$
- * Unrivalled gate charge: $Q_g = 13.7nC$ (Typ.)
- * Low intrinsic capacitances
- * Excellent switching characteristics
- * Extended safe operating area
- * Lead free available (RoHS compliant)
- * TO-220F package for good heat dissipation

Applications

- High efficiency Switched Mode Power Supplies
- Electronic Ballast
- LED Power Supply

Pin Description and Schematic



N-Channel MOSFET

Package Marking And Ordering Information

Device	Marking ^[1]	Device Package	Quantity
HCR5N65FT2FBP	HCR5N65F xx	TO-220F	1000pcs

Note 1. "HCR5N65F" identifies the product; "xx" is the date code.

650V, 5A N-Channel MOSFET

Absolute Maximum Ratings

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

Parameter	Symbol	HCR5N65F	Unit
Drain-source voltage ($V_{GS} = 0V$)	V_{DS}	650	V
Gate-source voltage ($V_{DS} = 0V$), AC ($f > 1\text{Hz}$)	V_{GS}	± 30	V
Continuous drain current, $T_J = 25^\circ\text{C}$	I_D	5	A
Continuous drain current, $T_J = 100^\circ\text{C}$	$I_D(100^\circ\text{C})$	2.5	A
Pulsed drain current (Note 1)	I_{DM}	20	A
Maximum power dissipation	P_D	36	W
Derate above 25°C	P_D	0.48	W/ $^\circ\text{C}$
Single pulsed avalanche energy (Note 2)	E_{AS}	128	mJ
Avalanche current (Note 2)	I_{AR}	4	A
Peak diode recovery dv/dt (Note 3)	dv/dt	5.0	V/ns
Maximum lead temperature for soldering	T_L	300	$^\circ\text{C}$
Operating junction and storage temperature range	T_J, T_{stg}	-55 to 150	$^\circ\text{C}$

Note 1. Pulse width is limited by maximum junction temperature.

Note 2. $L = 10\text{mH}$, $I_{AR} = 9.5\text{A}$, $V_{DD} = 50\text{V}$, $R_G = 25\Omega$; starting $T_J = 25^\circ\text{C}$.

Note 3. $I_{SD} \leq 8\text{A}$, $di/dt \leq 100\text{A}/\mu\text{s}$, $V_{DD} \leq BV_{DSS}$; starting $T_J = 25^\circ\text{C}$.

Thermal Characteristics

Parameter	Symbol	HCR5N65F	Unit
Thermal resistance, junction to case (maximum)	$R_{\theta JC}$	3.47	$^\circ\text{C}/\text{W}$
Thermal resistance, junction to ambient (maximum)	$R_{\theta JA}$	62.5	$^\circ\text{C}/\text{W}$

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Electrical Characteristics
 $T_A = 25^\circ\text{C}$, unless otherwise noted

Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
On/Off States						
Drain-source breakdown voltage	BV_{DSS}	$V_{GS} = 0V, I_D = 250\mu A$	650	-	-	V
Breakdown voltage temperature coefficient	$\Delta BV_{DSS}/\Delta T_J$	$I_D = 250\mu A$, referenced to 25°C	-	0.6	-	$V/^\circ\text{C}$
Zero gate voltage drain current	I_{DSS}	$V_{DS} = 650V, V_{GS} = 0V$, $T_C = 25^\circ\text{C}$	-	-	10	μA
Zero gate voltage drain current	I_{DSS}	$V_{DS} = 520V, T_C = 125^\circ\text{C}$	-	-	100	μA
Gate-body leakage current	I_{GSS}	$V_{DS} = 0V, V_{GS} = \pm 30V$	-	-	± 100	nA
Gate-threshold voltage	$V_{GS(TH)}$	$V_{GS} = V_{DS}, I_D = 250\mu A$	2.0	-	4.0	V
Drain-source on-resistance	$R_{DS(on)}$	$V_{GS} = 10V, I_D = 5A$	-	-	2.5	Ω

Dynamic Characteristics

Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
Input capacitance	C_{iss}	$V_{DS} = 25V, V_{GS} = 0V$, $f = 1\text{MHz}$	-	620	-	pF
Output capacitance	C_{oss}		-	70	-	pF
Reverse transfer capacitance	C_{rss}		-	8	-	pF

Gate Charge Characteristics

Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
Total gate charge	Q_g	$V_{DS} = 520V, I_D = 5A$, $V_{GS} = 10V$ (Notes 4, 5)	-	13.7	-	nC
Gate-source charge	Q_{gs}		-	2.9	-	nC
Gate-drain charge	Q_{gd}		-	4.6	-	nC

Notes 4 and 5: see the following page.

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Electrical Characteristics (Continued)
 $T_A = 25^\circ\text{C}$, unless otherwise noted

Switching Characteristics

Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
Turn-on delay time	$t_{d(on)}$	$V_{DD} = 300\text{V}$, $I_D = 5\text{A}$, $R_G = 25\Omega$, $V_{GS} = 10\text{V}$ (Notes 4, 5)	-	13	35	ns
Rise time	t_r		-	45	100	ns
Turn-off delay time	$t_{d(off)}$		-	25	60	ns
Fall time	t_f		-	35	80	ns

Drain-Source Diode Characteristics

Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
Source-drain current (body diode)	I_{SD}	$T_C = 25^\circ\text{C}$	-	-	5	A
Pulsed source-drain current (body diode)	I_{SDM}		-	-	16	A
Forward on voltage	V_{SD}	$T_J = 25^\circ\text{C}$, $V_{GS} = 0\text{V}$, $I_{SD} = 5\text{A}$	-	-	1.35	V
Reverse recovery time	t_{rr}	$V_{GS} = 0\text{V}$, $I_S = 5\text{A}$, $di/dt = 100\text{A}/\mu\text{s}$ (Note 4)	-	390	-	ns
Reverse recovery charge	Q_{rr}		-	1.5	-	μC

Note 4. Pulse test: pulse width $\leq 300\mu\text{s}$, duty cycle $\leq 2\%$.

Note 5. Essentially independent of operating temperature.

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Typical Characteristics

$T_J = 25^\circ\text{C}$, unless otherwise noted

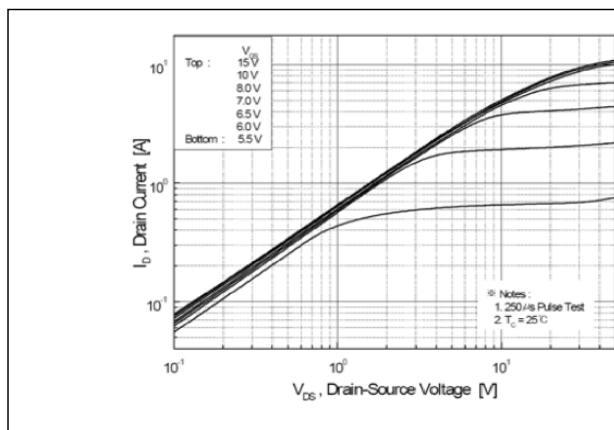


Figure 1. On-Region Characteristics

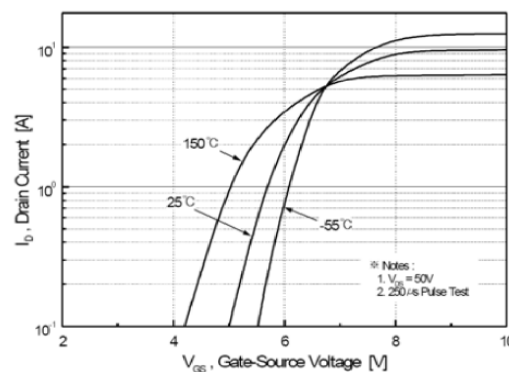


Figure 2. Transfer Characteristics

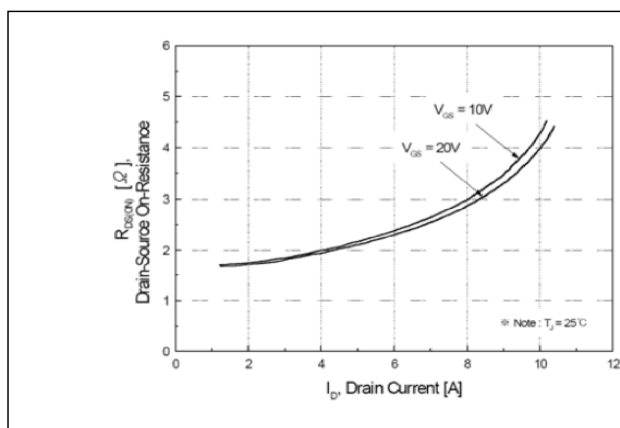


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

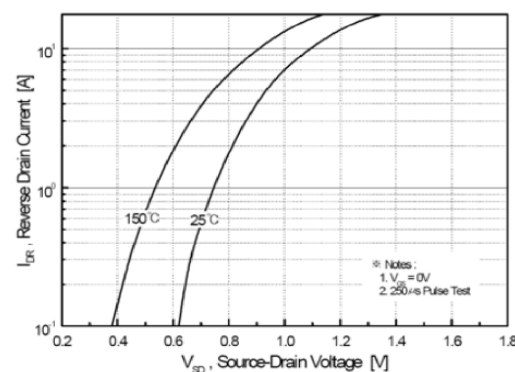


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

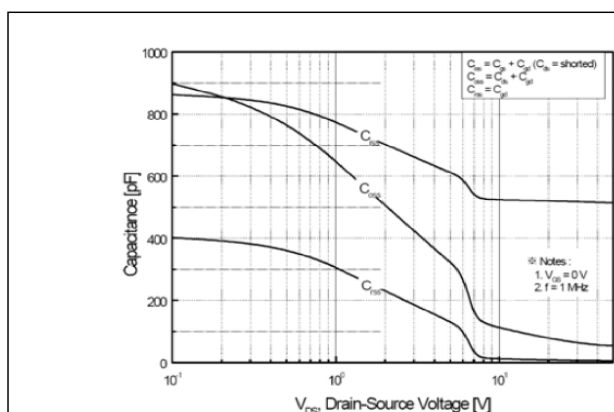


Figure 5. Capacitance Characteristics

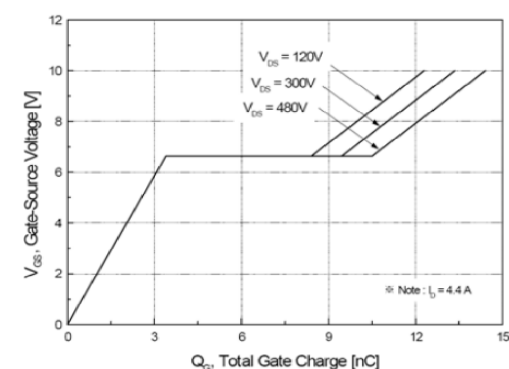
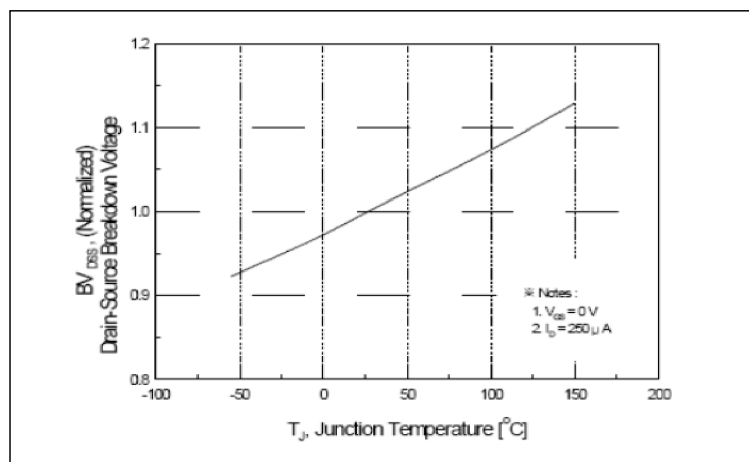
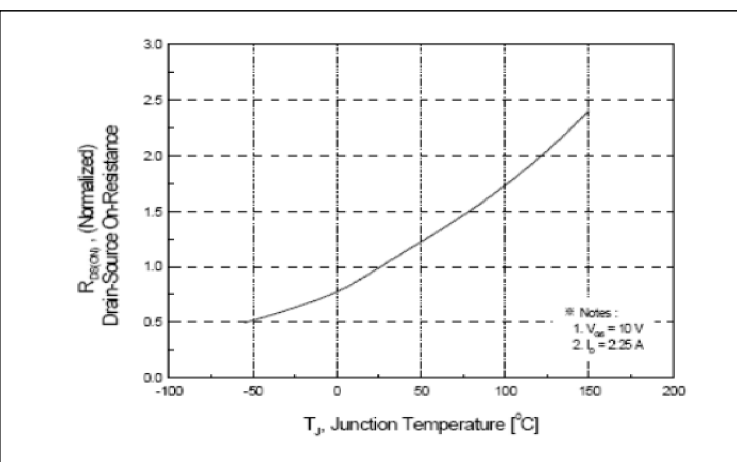
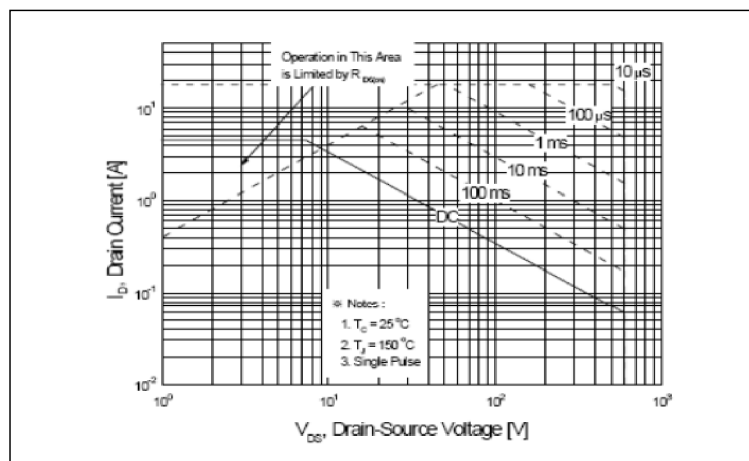
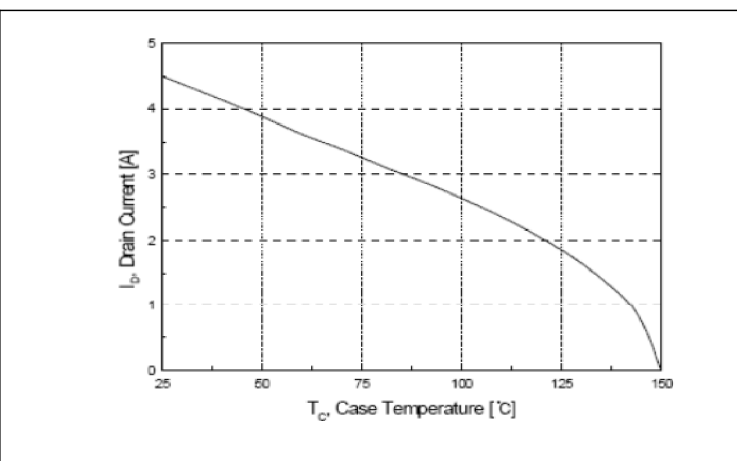
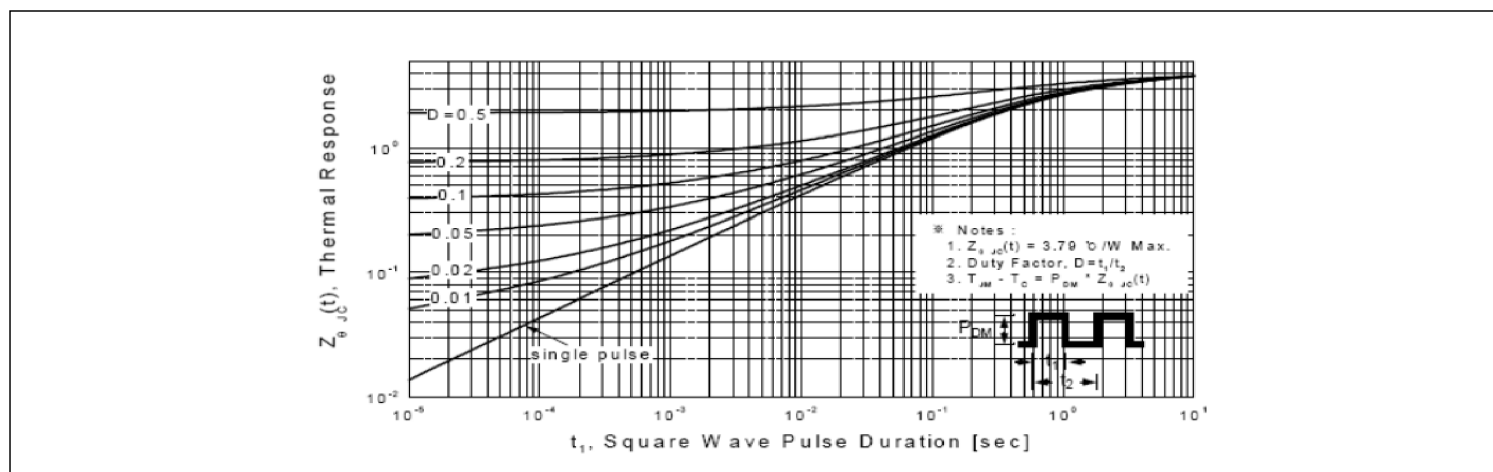


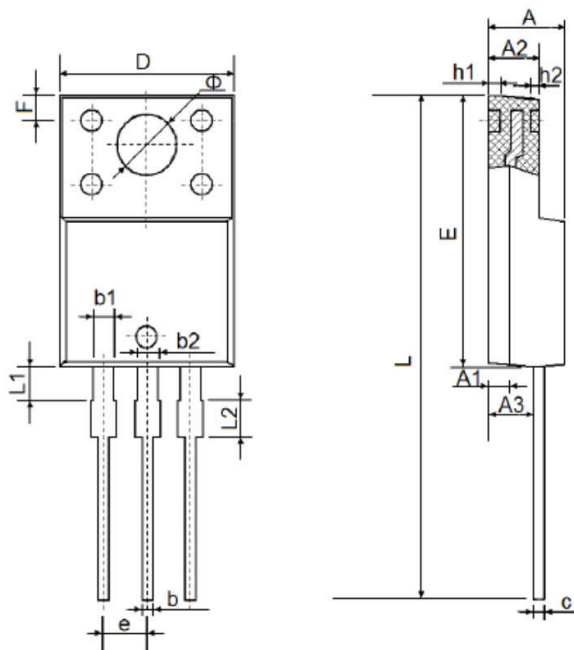
Figure 6. Gate Charge Characteristics

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Typical Characteristics (Continued)

Figure 7. Breakdown Voltage Variation vs. Temperature

Figure 8. On-Resistance Variation vs. Temperature

Figure 9. Maximum Safe Operating Area

Figure 10. Maximum Drain Current vs. Case Temperature

Figure 11. Transient Thermal Response Curve

Package Dimensions

HCR5N65F - TO-220F Package

Unit: mm

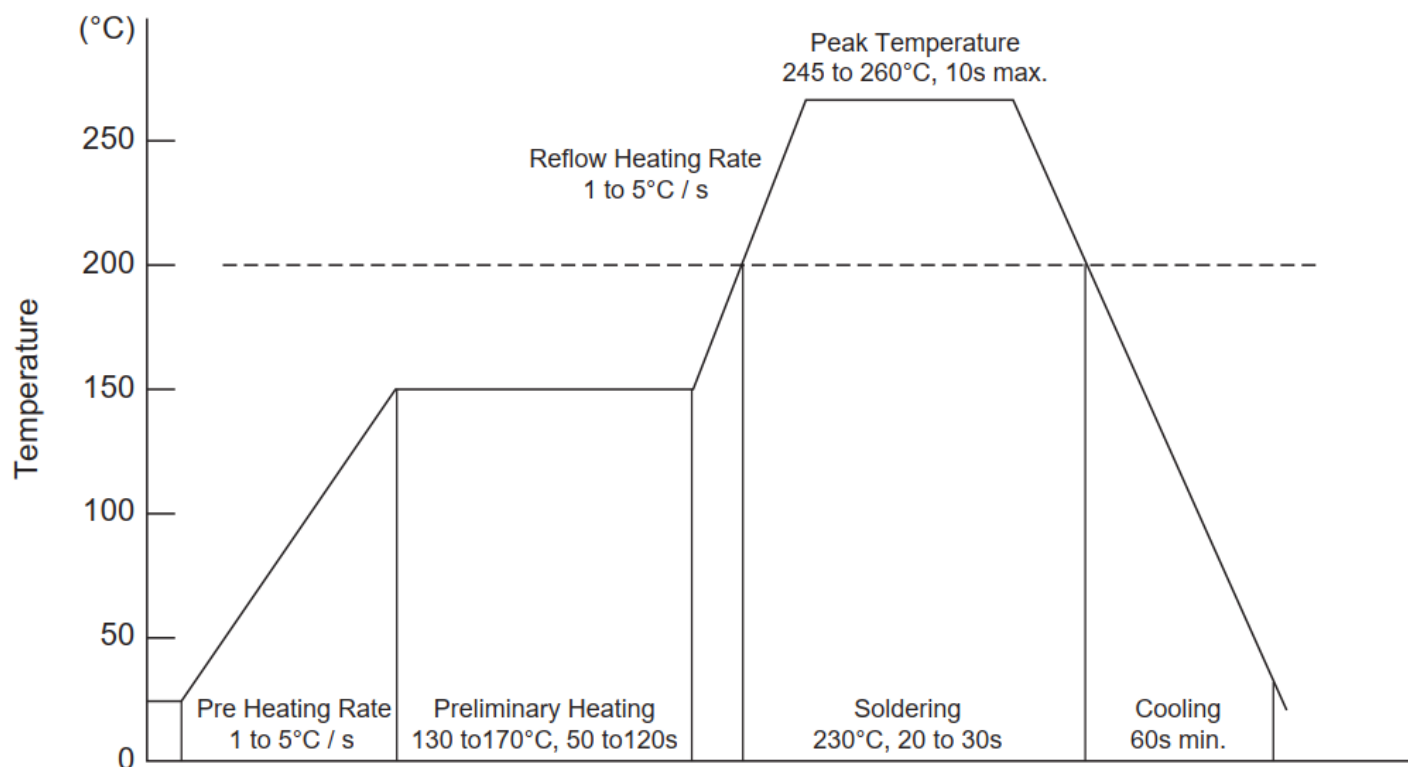


Symbol	Dimensions in Millimeters		Dimensions in Inches	
	Min.	Max.	Min.	Max.
A	4.300	4.700	0.169	0.185
A1	1.300REF		0.051REF	
A2	2.800	3.200	0.110	0.126
A3	2.500	2.900	0.098	0.114
b	0.500	0.750	0.020	0.030
b1	1.100	1.350	0.043	0.053
b2	1.500	1.750	0.059	0.069
c	0.500	0.750	0.020	0.030
D	9.960	10.360	0.392	0.408
E	14.800	15.200	0.583	0.598
e	2.540TYP.		0.100TYP	
F	2.700REF		0.106REF	
Φ	3.500REF		0.138REF	
h1	0.800REF		0.031REF	
h2	0.500REF		0.020REF	
L	28.000	28.400	1.102	1.118
L1	1.700	1.900	0.067	0.075
L2	1.900	2.100	0.075	0.083

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Conditions of Soldering and Storage

Recommended condition of reflow soldering



Recommended peak temperature is over 245°C. If peak temperature is below 245°C, you may adjust the following parameters:

- Time length of peak temperature (longer)
- Time length of soldering (longer)
- Thickness of solder paste (thicker)

Conditions of hand soldering

- Temperature: 300°C
- Time: 3s max
- Times: one time

Storage conditions

- Temperature: 5 to 40°C
- Humidity: 30 to 80% RH
- Recommended period: One year after manufacturing