

**NPS20N65F**

650V N-channel Enhancement MOSFET



**VOLTAGE** 650 Volts

**CURRENT** 20 Amperes

**TO-220F**

**Marking and Polarity**

**FEATURES**

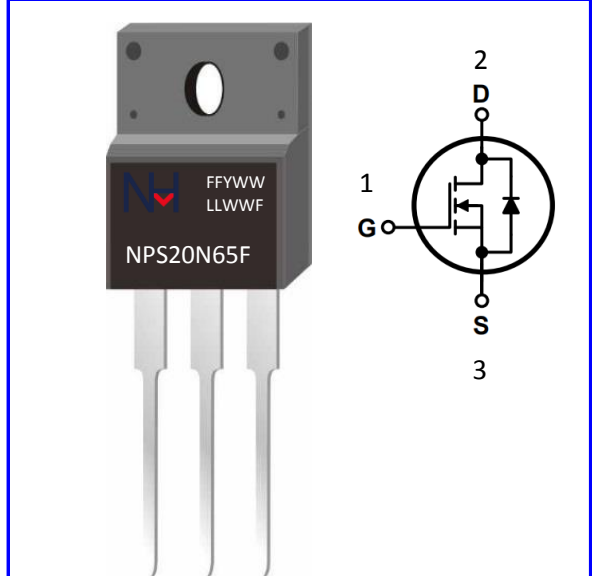
- Low RDS(ON)
- Ultra Low Gate Charge
- RoHS Compliant
- 100% UIS and RG Tested

**TYPICAL APPLICATIONS**

- Adapter, PC, PD, Charger
- Switched mode power supplies (SMPS)
- Uninterruptible Power Supply (UPS)

**PRODUCT SUMMARY**

|              |      |    |
|--------------|------|----|
| VDS@TJMin.   | 650  | V  |
| ID           | 20   | A  |
| RDS(ON) ,MAX | 0.38 | Ω  |
| QG, Typ      | 20.0 | nC |



Remark: 1 2 3

- ①. NH=niuhang trademark;
- ②. FF=Product line code, According to actual changes  
YWW=Data code, According to actual changes  
LLWWF=Internal code, According to actual changes
- ③. NPS20N65F=Module.

**Absolute Maximum Ratings (Ratings at 25°C ambient temperature unless otherwise specified )**

| Parameter                         | Symbol    | Ratings     | Unit |
|-----------------------------------|-----------|-------------|------|
| Drain-Source Voltage              | $V_{DS}$  | 650         | V    |
| Gate-Source Voltage               | $V_{GS}$  | ±30         | V    |
| Continuous Drain Current (Note 1) | $I_D$     | Ta=25°C     | 20   |
|                                   |           | Ta=100°C    | 13   |
| Drain Current-Pulsed              | $I_{DM}$  | (Note 1)    | 33   |
| Total Dissipation                 | $P_D$     | 80          | W    |
| Junction Temperature              | $T_J$     | -55 to +150 | °C   |
| Storage temperature range         | $T_{STD}$ | -55 to +150 | °C   |
| Single Pulse Avalanche Energy     | $E_{AS}$  | 1200        | mJ   |

**Thermal Characteristics (Ratings at 25°C ambient temperature unless otherwise specified )**

| Parameter                              | Symbol          | Max  | Unit |
|----------------------------------------|-----------------|------|------|
| Thermal Resistance Junction to Ambient | $R_{\theta JA}$ | 80.0 | °C/W |
| Thermal Resistance Junction-Case       | $R_{\theta JC}$ | 1.6  | °C/W |

- Note:
1. Repetitive Rating : Pulse width limited by maximum junction temperature
  2. L=79mH, IAS=20A, VDD=50V, RG=25Ω, Starting TJ =25°C

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**Electrical Characteristics** (Ratings at 25°C ambient temperature unless otherwise specified )

| Parameter                                              | Symbol       | Test Conditions                  | Min. | Typ. | Max. | Unit |
|--------------------------------------------------------|--------------|----------------------------------|------|------|------|------|
| Static off Characteristics                             |              |                                  |      |      |      |      |
| Drain-Source Breakdown Voltage                         | $BV_{DSS}$   | VGS=0V,ID=250uA                  | 650  | -    | -    | V    |
| Drain-Source Leakage Current                           | $I_{DSS}$    | VDS=650V,VGS=0V                  | -    | -    | 1    | uA   |
| Gate-Body Leakage Current                              | $I_{GSS}$    | VGS=±30V,VDS=0V                  | -    | -    | ±100 | nA   |
| Static on Characteristics                              |              |                                  |      |      |      |      |
| Gate Threshold Voltage                                 | $V_{GS(TH)}$ | VGS=VDS,ID=800uA                 | 2.0  | 3.0  | 4.0  | V    |
| Drain-Source On Resistance                             | $R_{DS(ON)}$ | VGS=10V,ID=10A                   | -    | 0.38 | 0.50 | mΩ   |
| Dynamic Characteristics                                |              |                                  |      |      |      |      |
| Input Capacitance                                      | $C_{iss}$    | VDS=400V,VGS=0V,<br>f=1000KHz    | -    | 3060 | -    | pF   |
| Output Capacitance                                     | $C_{oss}$    |                                  | -    | 250  | -    | pF   |
| Reverse Transfer Capacitance                           | $C_{rss}$    |                                  | -    | 18   | -    | pF   |
| Switching Paramters                                    |              |                                  |      |      |      |      |
| Turn-On Delay Time                                     | $t_{d(on)}$  | VDS=25V,VGS=0V,<br>f=1.0MHz      | -    | 36   | -    | ns   |
| Turn-On Rise Time                                      | $t_r$        |                                  | -    | 80   | -    | ns   |
| Turn-Off Delay Time                                    | $t_{d(off)}$ |                                  | -    | 170  | -    | ns   |
| Turn-Off Rise Time                                     | $t_f$        |                                  | -    | 80   | -    | ns   |
| Gate Resistance                                        | $R_g$        | f=1MHZ,ID=0A(open drain)         | -    | 2.2  | -    | Ω    |
| Total Gate Charge                                      | $Q_g$        | VDS=520V,ID=20A,<br>VGS=10V      | -    | 60   | -    | nC   |
| Gate-Source Charge                                     | $Q_{gs}$     |                                  | -    | 11   | -    | nC   |
| Gate-Drain Charge                                      | $Q_{gd}$     |                                  | -    | 26   | -    | nc   |
| Drain-Source Diode Characteristics and Maximum Ratings |              |                                  |      |      |      |      |
| Max. Diode Forward Cuurent                             | $I_S$        |                                  | -    | -    | 20   | A    |
| Max. Pulsed Forward Cuurent                            | $I_{SM}$     |                                  | -    | -    | 80   | A    |
| Diode Forward Voltage                                  | $V_{SD}$     | VGS=0V,IS=4.0A                   | -    | 0.88 | 1.5  | V    |
| Reverse Recovery Time                                  | $t_{rr}$     | VR=400V,IF=20A,<br>di/dt=100A/us | -    | 400  | -    | ns   |
| Reverse Recovery Charge                                | $Q_{rr}$     |                                  | -    | 4.0  | -    | μC   |

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### Typical Characteristics Curves

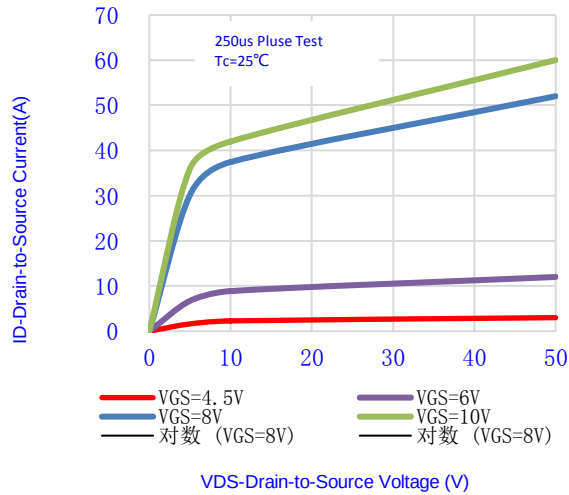


Fig.1-Output Characteristics

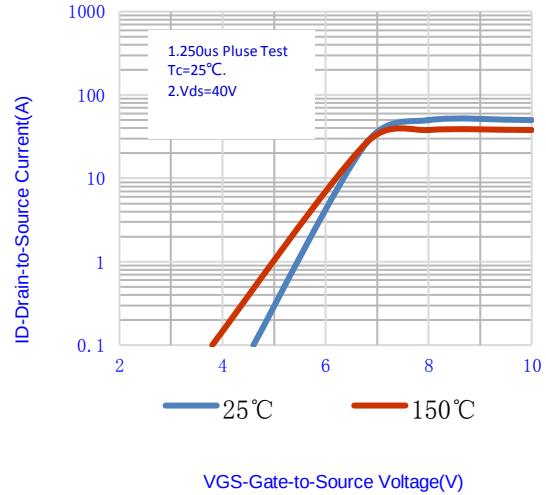


Fig.2- Transfer Characteristics

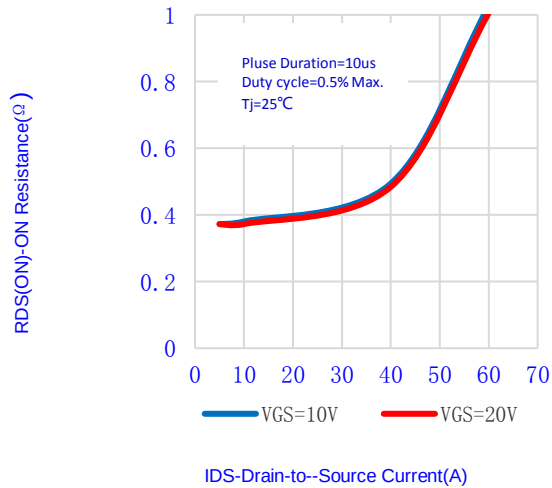


Fig.3- On Resistance vs. Drain Current

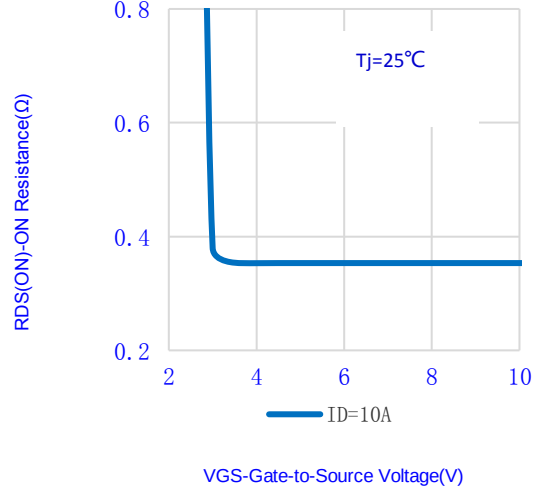


Fig.4- On Resistance vs. Gate Source Voltage

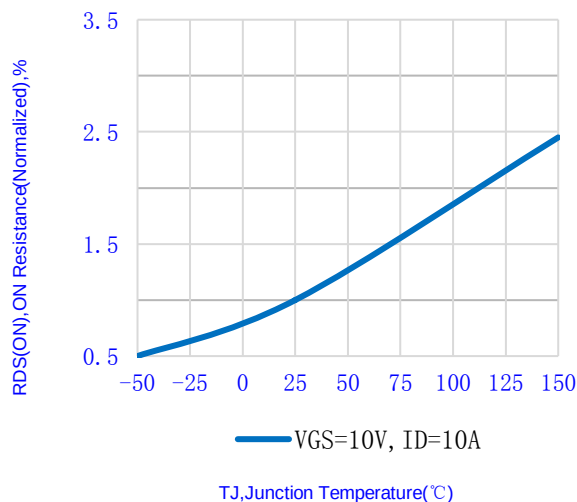


Fig.5- On Resistance vs. Junction Temperature

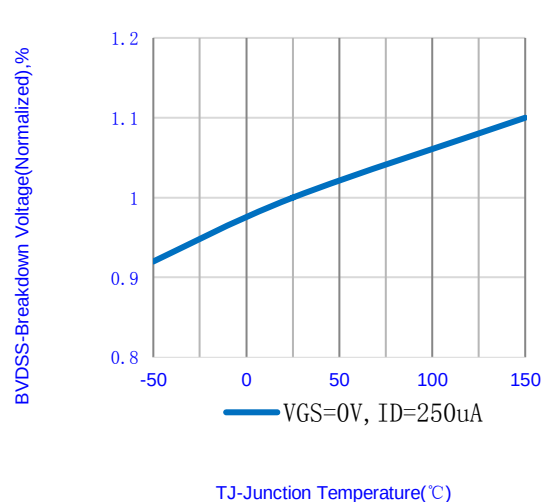


Fig.6- Breakdown Voltage vs. Junction Temperature

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## Typical Characteristics Curves

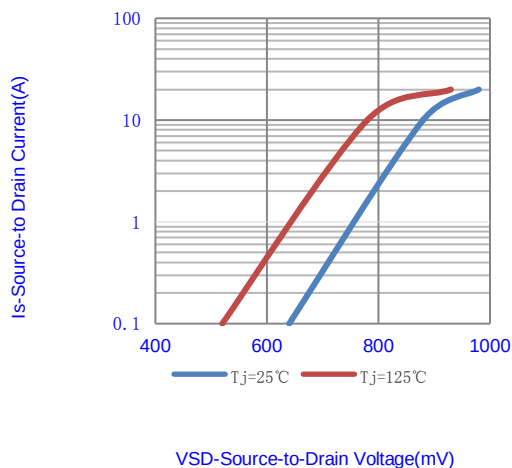


Fig.7- Source-Drain Diode Forward Voltage

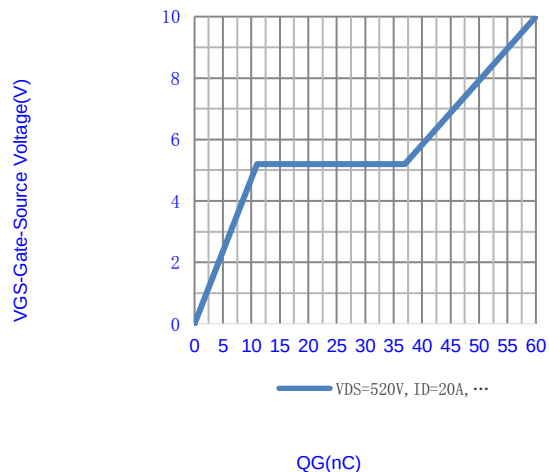


Fig.8- Gate Charge Waveform

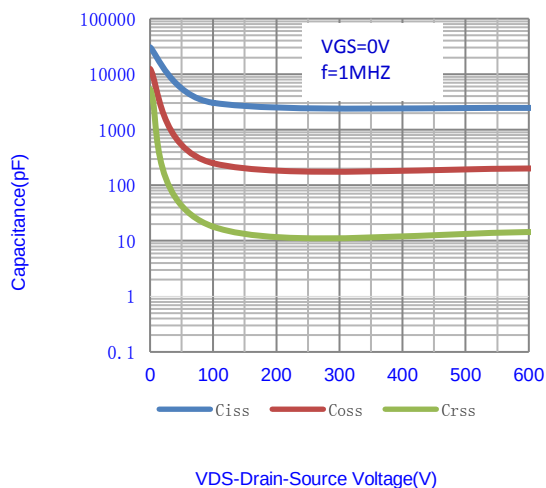


Fig.9- Gate-Source Voltage-VGS(V)

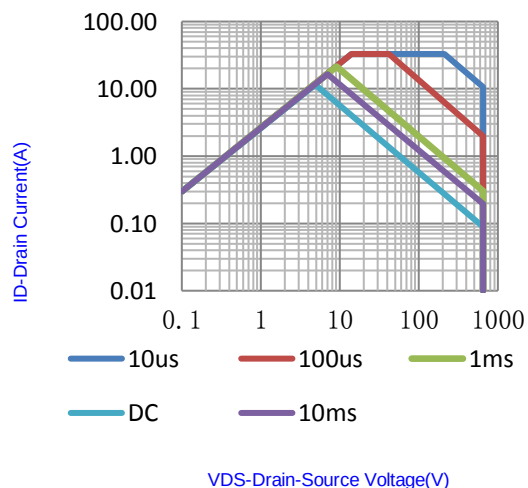


Fig.10- Maximum Safe Operating Area(SOA)

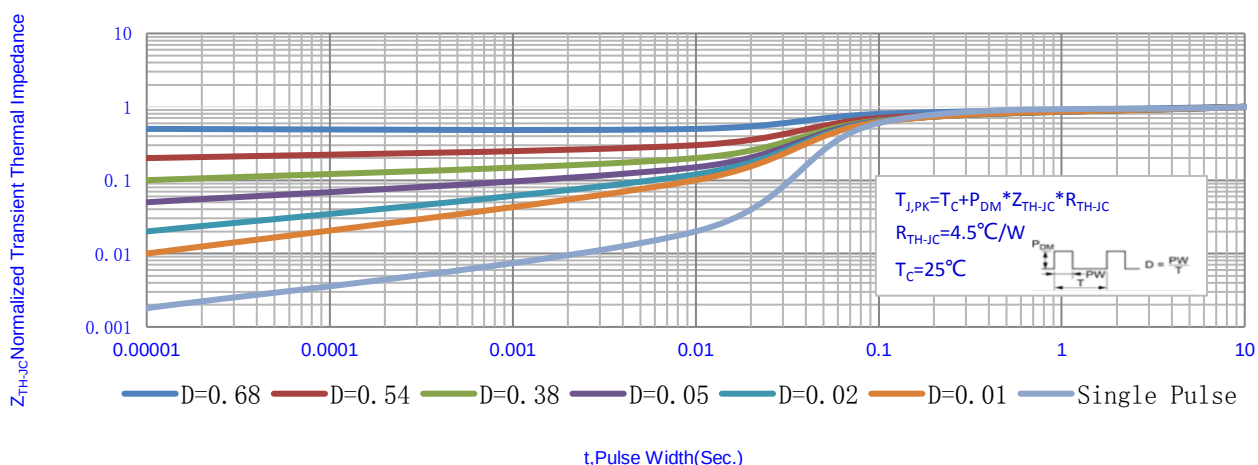


Fig.11- Normalized Transient Thermal Impedance vs. Pulse Width

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### Test Circuit & Waveform

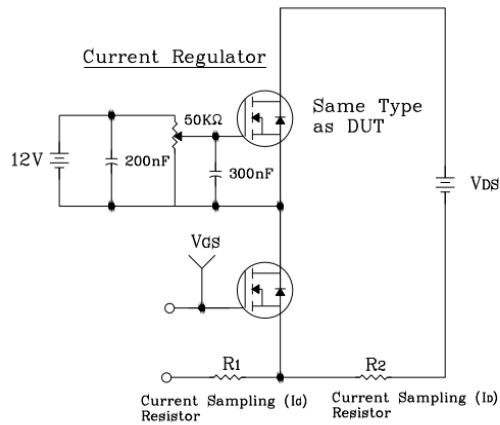


Fig.12- Gate Charge Test Circuit & Waveform

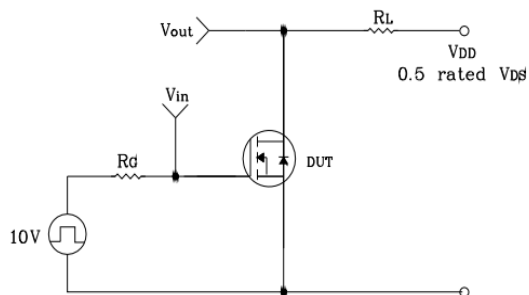


Fig.13- Resistive Switching Test Circuit & Waveform

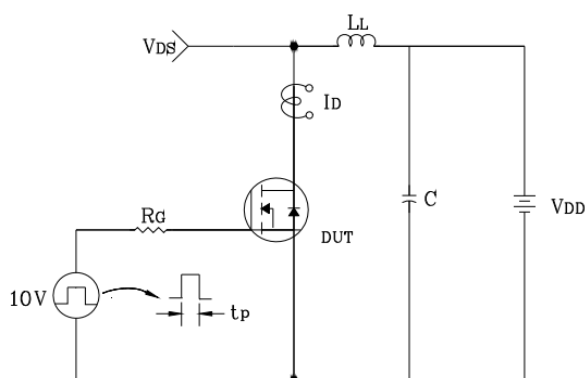


Fig.14- EAS Test Circuit & Waveform

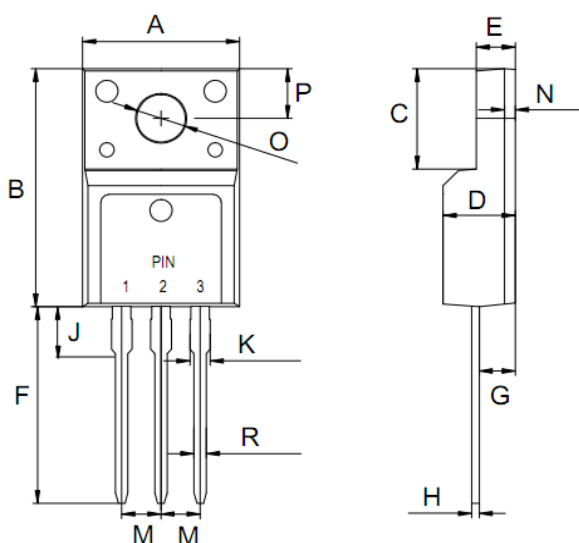
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**OUTLINE DRAWINGS**

**TO-220F**



**OUTLINE DIMENSIONS**

| Dim. | Millimeters |      |       | Inches |      |      |
|------|-------------|------|-------|--------|------|------|
|      | Min.        | Typ. | Max.  | Min.   | Typ. | Max. |
| A    | 10.00       | -    | 10.50 | 0.39   | -    | 0.41 |
| B    | 15.40       | -    | 16.20 | 0.61   | -    | 0.64 |
| C    | 6.48        | -    | 6.88  | 0.26   | -    | 0.27 |
| D    | 4.50        | -    | 4.90  | 0.18   | -    | 0.19 |
| E    | 2.35        | -    | 2.75  | 0.09   | -    | 0.11 |
| F    | 12.50       | -    | -     | 0.49   | -    | -    |
| G    | 2.40        | -    | 3.00  | 0.09   | -    | 0.12 |
| H    | 0.40        | -    | 0.60  | 0.02   | -    | 0.02 |
| J    | 2.20        | -    | 4.20  | 0.09   | -    | 0.17 |
| M    | 2.40        | -    | 2.70  | 0.09   | -    | 0.11 |
| N    | 0.80        | -    | 1.10  | 0.03   | -    | 0.04 |
| K    | 1.20        | -    | 1.50  | 0.05   | -    | 0.06 |
| R    | 0.60        | -    | 1.00  | 0.02   | -    | 0.04 |
| O    | 3.10        | -    | 3.70  | 0.12   | -    | 0.15 |
| P    | 3.00        | -    | 4.00  | 0.12   | -    | 0.16 |

**PACKING INFORMATION**

**TO-220F**

| Package Method | Inner Box Size L×W×H(mm) | Quantity (pcs/box) | Carton Size L×W×H(mm) | Quantity (box/carton) |
|----------------|--------------------------|--------------------|-----------------------|-----------------------|
| Box Package    | 570×153×47               | 1000               | 580×250×180           | 5000                  |

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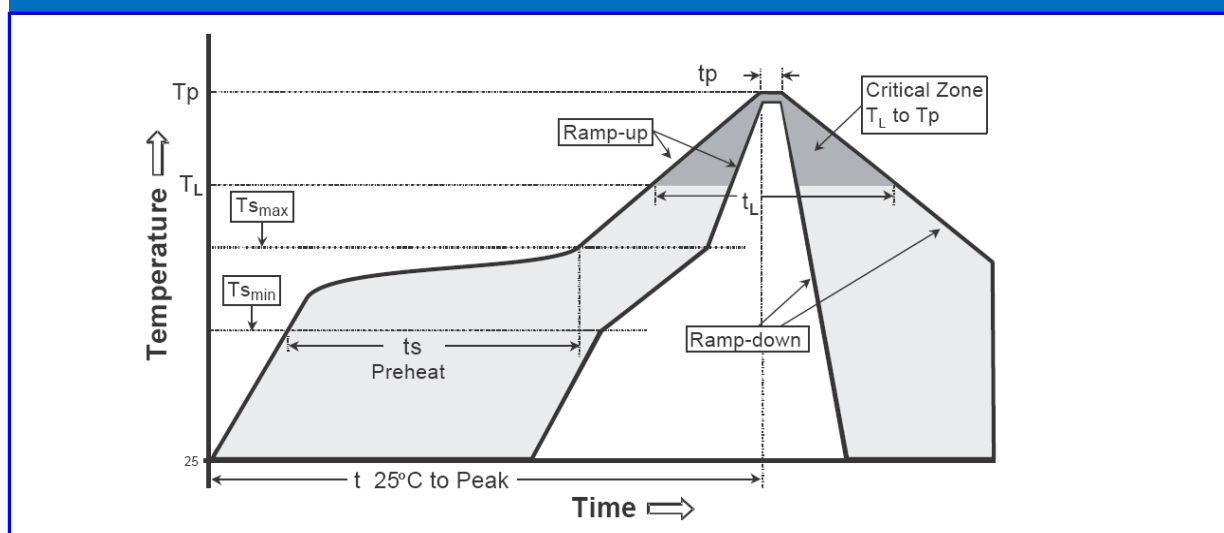
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**Recommended wave soldering condition**

|                 |                  |                 |
|-----------------|------------------|-----------------|
| Product         | Peak Temperature | Soldering Time  |
| Pb-free devices | 260 +0/-5 °C     | 5 +1/-1 seconds |

**Recommended temperature profile for IR reflow**



| Profile feature                                                                                                  | Sn-Pb eutectic Assembly          | Pb-free Assembly                 |
|------------------------------------------------------------------------------------------------------------------|----------------------------------|----------------------------------|
| Average ramp-up rate ( $T_{smax}$ to $T_P$ )                                                                     | 3°C/second max.                  | 3°C/second max.                  |
| Preheat<br>-Temperature Min( $T_{smin}$ )<br>-Temperature Max( $T_{smax}$ )<br>-Time( $t_{smin}$ to $t_{smax}$ ) | 100°C<br>150°C<br>60-120 seconds | 150°C<br>200°C<br>60-180 seconds |
| Time maintained above:<br>-Temperature ( $T_L$ )<br>- Time ( $t_L$ )                                             | 183°C<br>60-150 seconds          | 217°C<br>60-150 seconds          |
| Peak Temperature( $T_P$ )                                                                                        | 240 +0/-5 °C                     | 260 +0/-5 °C                     |
| Time within 5°C of actual peak temperature( $t_p$ )                                                              | 10-30 seconds                    | 20-40 seconds                    |
| Ramp down rate                                                                                                   | 6°C/second max.                  | 6°C/second max.                  |
| Time 25 °C to peak temperature                                                                                   | 6 minutes max.                   | 8 minutes max.                   |

Note : All temperatures refer to topside of the package, measured on the package body surface.

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