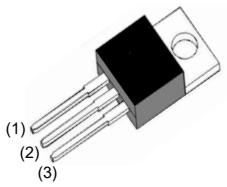
16N60(F)

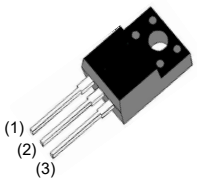
16A N-Channel Power MOSFET

Features

- Low gate charge
- Fast switching
- Improved dv/dt capability
- RoHS product



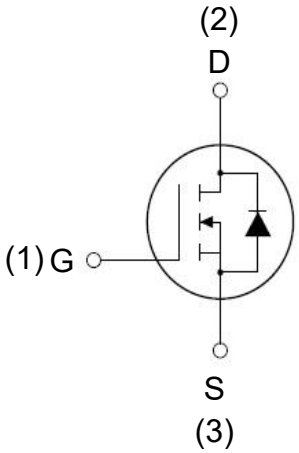
TO-220AB
16N60



ITO-220AB
16N60F

Mechanical Data

Case : Molded plastic body
Terminals : Solder plated, solderable per MIL-STD-750,Method 2026
Polarity : As marked
Mounting Position: Any



Schematic diagram

Application

- Cell Phone Charger
- Standby Power
- LED power supplies

Maximum Ratings And Electrical Characteristics

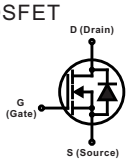
Ratings at 25℃ ambient temperature unless otherwise specified. Single phase half-wave 60Hz, resistive or inductive load, for capacitive load current derate by 20%.

ABSOLUTE MAXIMUM RATINGS (T_C = 25°C unless otherwise specified)					
SYMBOL	PARAMETER	TEST CONDITIONS		VALUE	UNIT
V_{DSS}	Drain to Source voltage	T_J=25°C to 150°C		600	V
V_{DGR}	Drain to Gate voltage	R_{GS}=20KΩ		600	
V_{GS}	Gate to Source voltage			±30	
I_D	Continuous Drain Current	T_C=25°C		16	A
		T_C=100°C			
I_{DM}	Pulsed Drain current(Note 1)			48	
I_{AR}	Avalanche current(Note 1)			5.3	
E_{AR}	Repetitive avalanche energy(Note 1)	I_{AR}=16A, R_{GS}=50Ω, V_{GS}=10V		1.34	mJ
E_{AS}	Single pulse avalanche energy(Note 2)	I_{AS}=5.3A, L=7.1mH		355	
dv/dt	MOSFET dv/dt ruggedness(Note 3)			100	V/ns
	Peak diode recovery dv/dt(Note 3)			20	
P_D	Total power dissipation	T_C=25°C	16N60	134.4	W
			16N60F	35.7	
	Derate above 25°C	T_C=25°C	16N60	1.08	W/°C
			16N60F	0.29	
T_J	Operation junction temperature			-55 to 150	°C
T_{STG}	Storage temperature			-55 to 150	
T_L	Maximum soldering temperature, for 10 seconds	1.6mm from case		300	
	Mounting torque, #6 32 or M3 screw			10 (1.1)	lbf·in (N·m)

Note: 1.Repetitive rating: pulse width limited by junction temperature..
2.I_{AS} = 5.3A, V_{DD} = 50V, R_{GS} = 25Ω, starting T_J=25°C.
3.I_{SD} ≤ 16A, di/dt ≤ 200A/μs, V_{DD} = 380V, starting T_J=25°C.

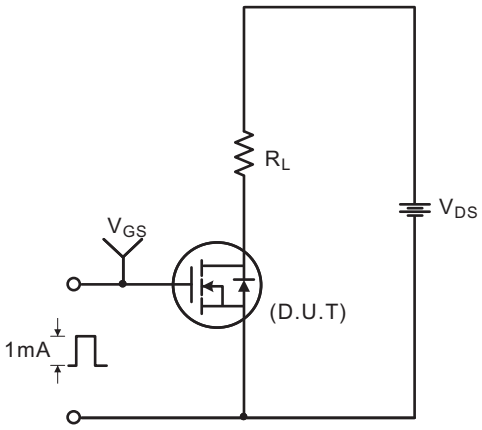
THERMAL RESISTANCE						
SYMBOL	PARAMETER		Min.	Typ.	Max.	UNIT
$R_{th(j-c)}$	Thermal resistance, junction to case	16N60			0.93	°C/W
		16N60F			3.5	
$R_{th(c-s)}$	Thermal resistance, case to heatsink			0.5		
$R_{th(j-a)}$	Thermal resistance, junction to ambient				62.5	

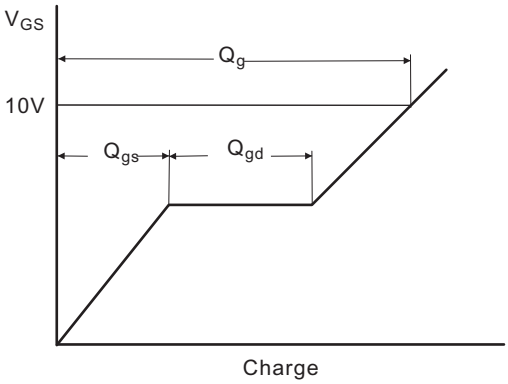
ELECTRICAL CHARACTERISTICS (T_C = 25°C unless otherwise specified)						
SYMBOL	**PARAMETER**	**TEST CONDITIONS**	**Min.**	**Typ.**	**Max.**	**UNIT**
OFF CHARACTERISTICS						
$V_{(BR)DSS}$	Drain to source breakdown voltage	I_D = 250μA, V_{GS} = 0V	600			V
$\Delta V_{(BR)DSS}/\Delta T_J$	Breakdown voltage temperature coefficient	I_D = 1mA, V_{DS} =V_{GS}		0.73		V/ºC
I_{DSS}	Drain to source leakage current	V_{DS}=600V, V_{GS}=0V, T_C = 25°C			1	μA
		V_{DS}=480V, V_{GS}=0V, T_C=125°C				
I_{GSS}	Gate to source forward leakage current	V_{GS} = 30V, V_{DS} = 0V			100	nA
	Gate to source reverse leakage current	V_{GS} = -30V, V_{DS} = 0V			-100	
ON CHARACTERISTICS						
$R_{DS(ON)}$	Static drain to source on state resistance	V_{GS} = 10V, I_D = 8.0A			0.56	Ω
		V_{GS} = 10V, I_D = 1.0A				
$V_{GS(TH)}$	Gate threshold voltage	V_{GS}=V_{DS}, I_D=250μA	2		4	V
g_{fs}	Forward transconductance	V_{DS} = 40V, ID = 8A		13		S
DYNAMIC CHARACTERISTICS						
C_{ISS}	Input capacitance	V_{DS} = 100V, V_{GS} = 0V, f =1MHz		1630	2170	pF
C_{OSS}	Output capacitance			70	95	
C_{RSS}	Reverse transfer capacitance			5	10	
C_{OSS}	Output capacitance	V_{DS} = 380V, V_{GS} = 0V, f =1MHz		40	60	
C_{oss}eff.	Effective output capacitance	V_{DS} = 0 to 480V, V_{GS} = 0V		176		
SWITCHING CHARACTERISTICS						
$t_{d(ON)}$	Turn on delay time	V_{DD} = 380V, V_{GS} = 10V I_D = 8A, R_{GS} = 4.7Ω (Note1,2)		15.8	41.6	ns
t_r	Rise time			15.5	41	
$t_{d(OFF)}$	Turn off delay time			60.3	130.6	
t_f	Fall time			20.2	50.4	
Q_G	Total gate charge	V_{DD} = 380V, V_{GS} = 10V I_D = 8A, (Note1,2)		40.2	52.3	nC
Q_{GS}	Gate to source charge			6.7		
Q_{GD}	Gate to drain charge (Miller charge)			12.9		
ESR	Equivalent series resistance (G S)	Drain open		2.9		Ω

SOURCE TO DRAIN DIODE RATINGS AND CHARACTERISTICS (T_C = 25°C unless otherwise specified)						
SYMBOL	**PARAMETER**	**TEST CONDITIONS**	**Min.**	**Typ.**	**Max.**	**UNIT**
V_{SD}	Diode forward voltage	I_{SD} = 8A, V_{GS} = 0V			1.2	V
Is (I_{SD})	Continuous source to drain current	Integral reverse P N junction diode in the MOSFET 			16	A
I_{SM}	Pulsed source current				48	
t_{rr}	Reverse recovery time	I_{SD} = 8A, V_{GS} = 0V, dI_F/dt = 100A/μs		319		ns
Q_{rr}	Reverse recovery charge			4.4		μC

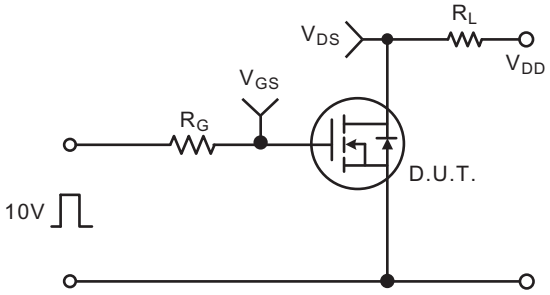
Note: 1. Pulse test: Pulse width ≤ 300μs, duty cycle ≤ 2%.
2. Essentially independent of operating temperature.

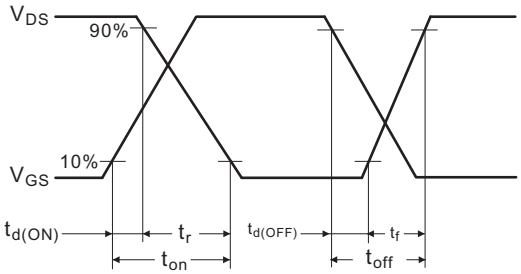
■ Gate charge test circuit & waveform



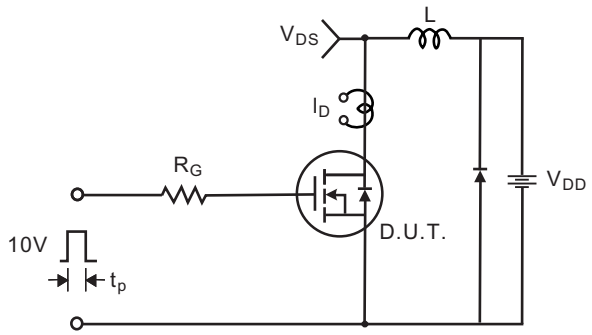


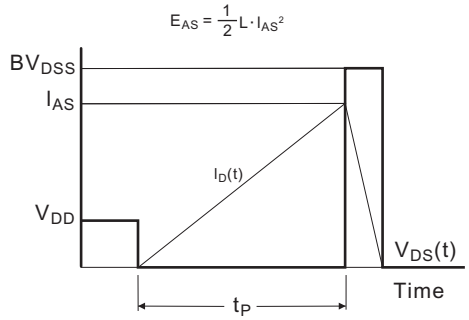
■ RESISTIVE SWITCHING TEST CIRCUIT & WAVEFORM



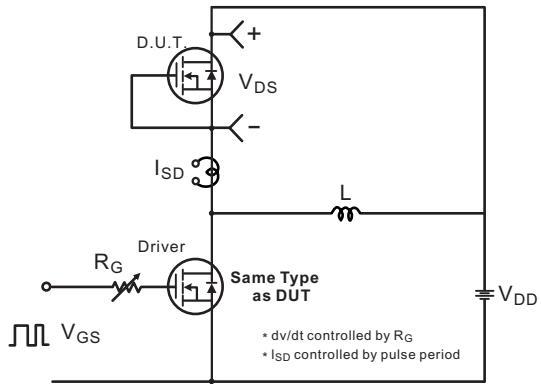


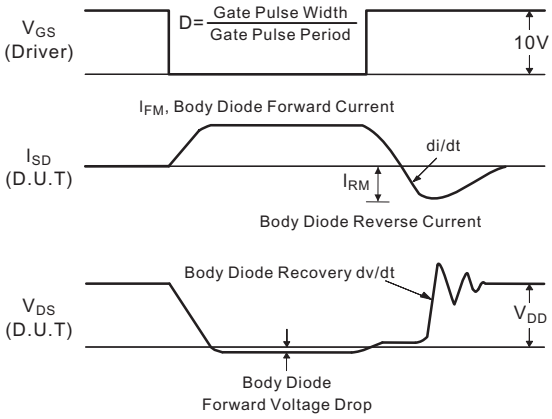
■ UNCLAMPED INDUCTIVE SWITCHING TEST CIRCUIT & WAVEFORMS





■ PEAK DIODE RECOVERY dv/dt TEST CIRCUIT & WAVEFORMS





■ TYPICAL CHARACTERISTICS

Fig.1 On-State characteristics

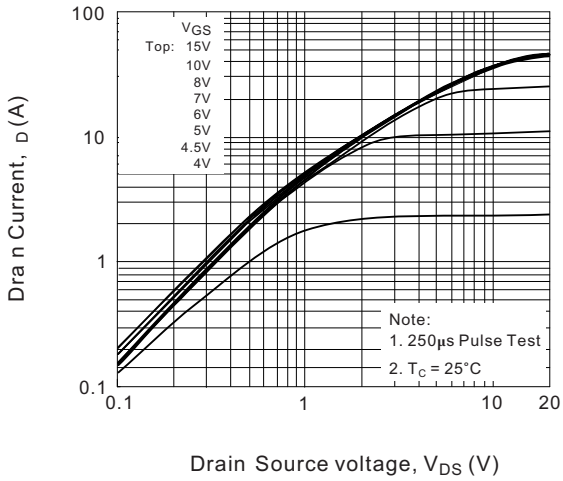


Fig.2 Transfer characteristics

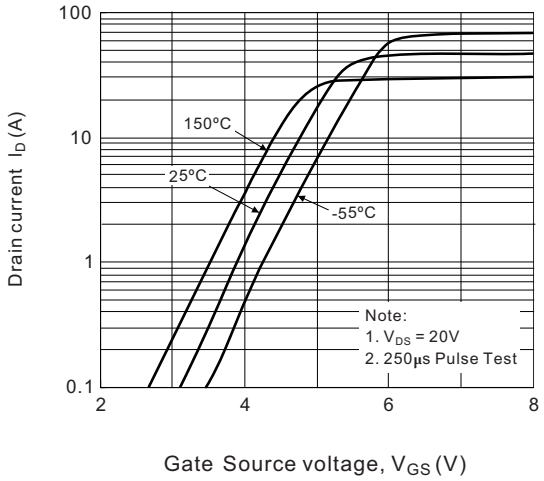


Fig.3 On-Resistance variation vs. drain current and gate voltage

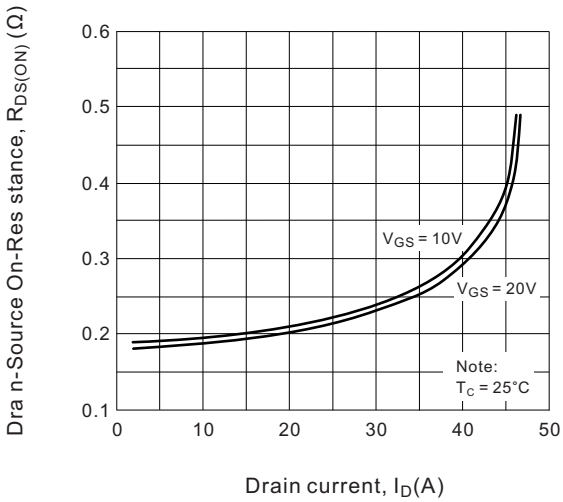


Fig.4 Body diode forward voltage variation vs. Source current and Temperatue

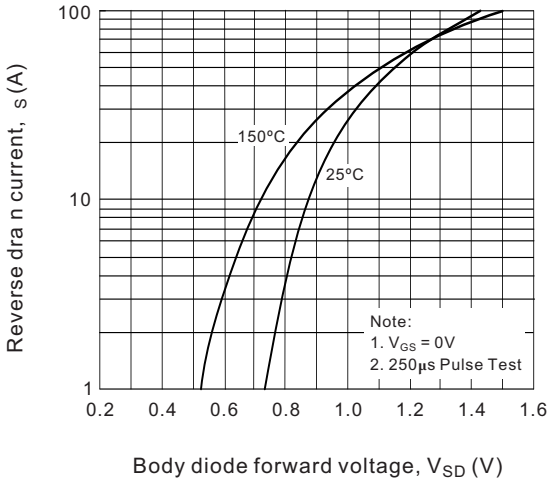


Fig.5 Capacitance characteristics

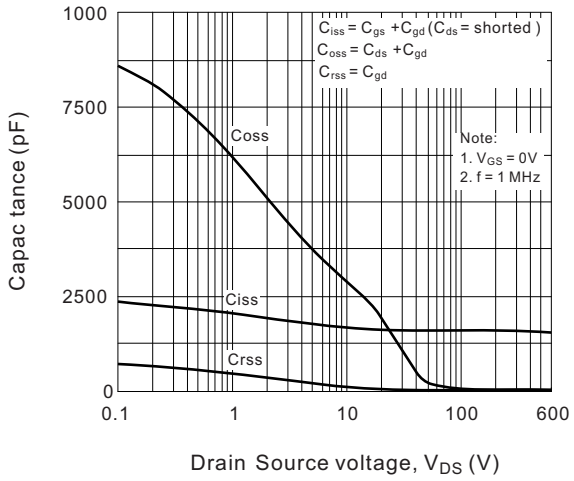


Fig.6 Gate charge characteristics

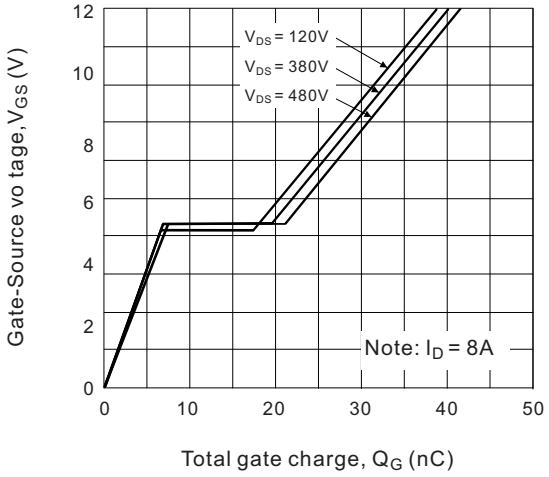


Fig.7 Breakdown voltage variation vs. Temperature

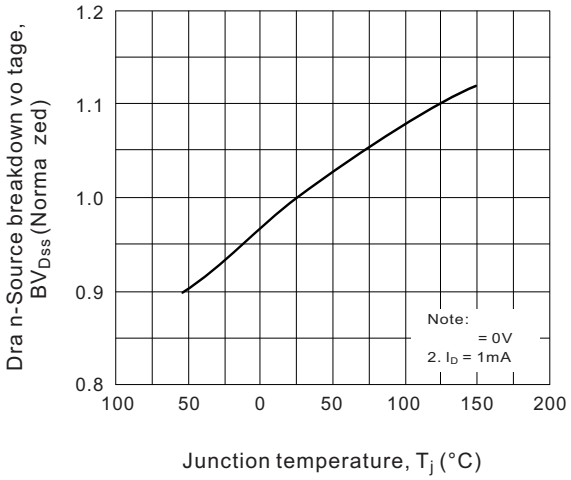


Fig.8 On-Resistance variation vs. Temperature

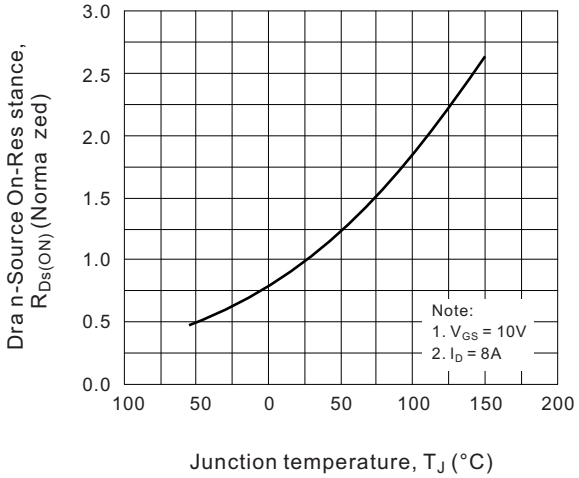


Fig.9 Maximum safe operating area (16N60)

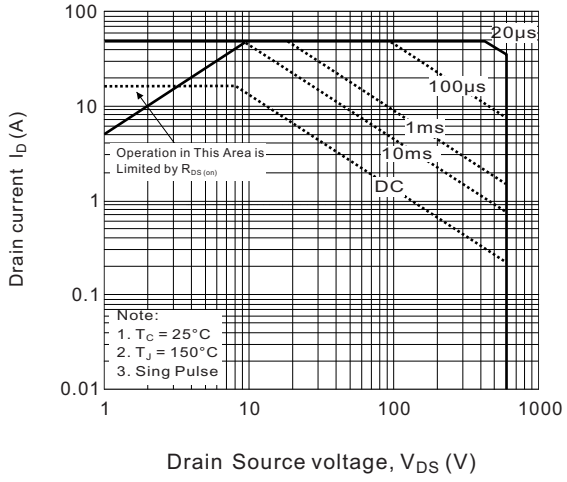


Fig.10 Maximum safe operating area (16N60F)

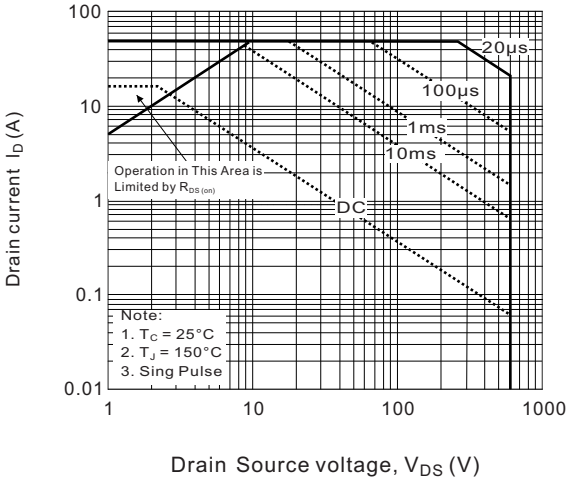


Fig.11 Maximum drain current vs. Case temperature

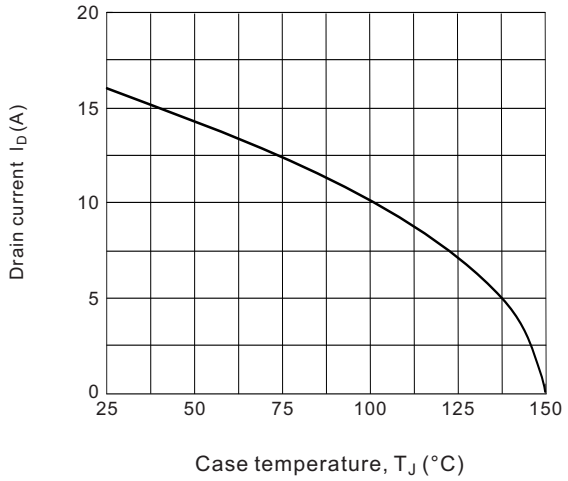


Fig.11-1 Transient thermal response curve for 16N60

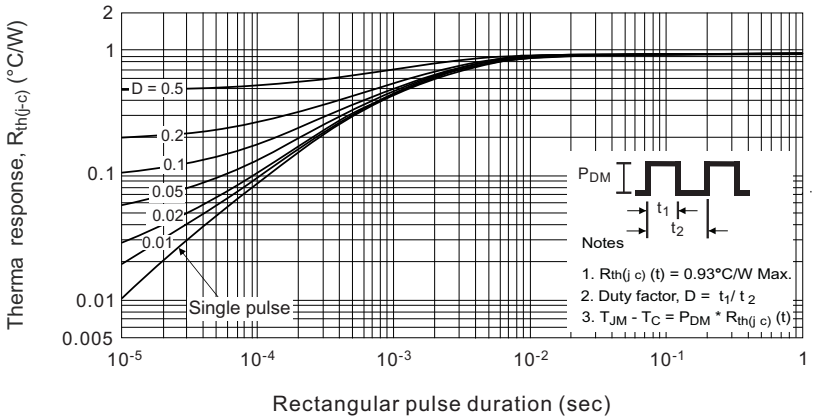
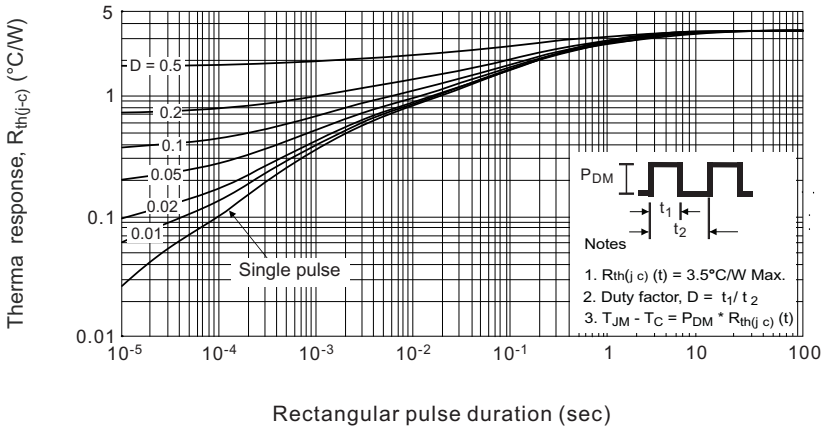
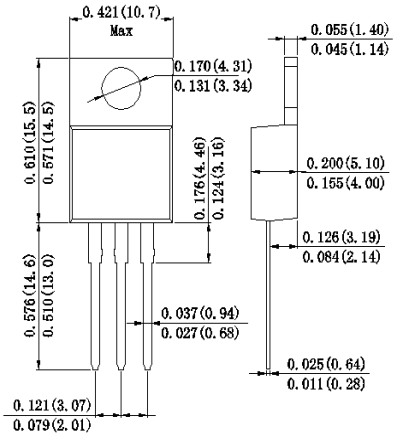


Fig.11-2 Transient thermal response curve for 16N60F

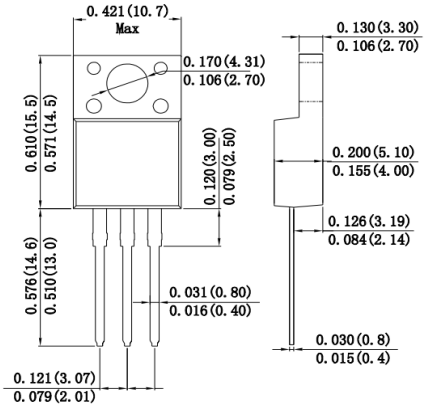


Outline Drawing

TO-220AB

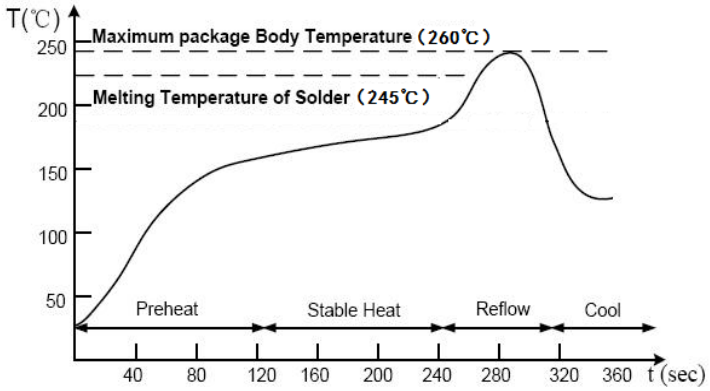


ITO-220AB



Note: Dimensions in inches and (millimeters)

Suggested Soldering Temperature Profile



Note

- Recommended reflow methods: IR, vapor phase oven, hot air oven, wave solder.
- The device can be exposed to a maximum temperature of 260°C for 10 seconds.
- Devices can be cleaned using standard industry methods and solvents.
- If reflow temperatures exceed the recommended profile, devices may not meet the performance requirements.

Package Information

Package Specifications

Package	Tube (mm)	Q'TY/Tube (Kpcs)	Box Size (mm)	QTY/Box (Kpcs)	Carton Size (mm)	Q'TY/Carton (Kpcs)
TO-220AB	525*31.9*6.4	0.05	545*150*45	1.0	575*245*170	5.0
ITO-220AB	525*31.9*6.4	0.05	545*150*45	1.0	575*245*170	5.0