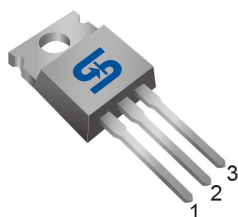
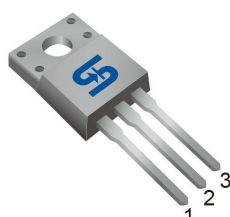




TO-220



ITO-220



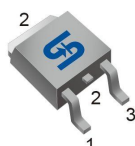
Pin Definition:

1. Gate
2. Drain
3. Source

Key Parameter Performance

Parameter	Value	Unit
V_{DS}	60	V
$R_{DS(on)}$ (max)	$V_{GS} = 10V$	23
	$V_{GS} = 4.5V$	28
Q_g	28	nC

TO-252 (DPAK)



Features

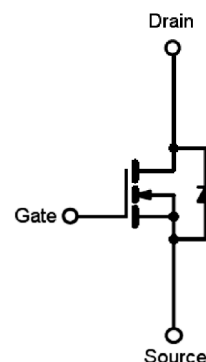
- 100% avalanche tested
- Fast Switching

Ordering Information

Part No.	Package	Packing
TSM230N06CZ C0G	TO-220	50pcs / Tube
TSM230N06CI C0G	ITO-220	50pcs / Tube
TSM230N06CP ROG	TO-252	2.5kpcs / 13+Reel

Note: %G+denotes for Halogen- and Antimony-free as those which contain <900ppm bromine, <900ppm chlorine (<1500ppm total Br + Cl) and <1000ppm antimony compounds

Block Diagram



N-Channel MOSFET

Absolute Maximum Ratings ($T_c = 25^\circ C$ unless otherwise noted)

Parameter	Symbol	Limit			Unit
		TO-220	ITO-220	DPAK	
Drain-Source Voltage	V_{DS}	60			V
Gate-Source Voltage	V_{GS}	± 20			V
Continuous Drain Current ^(Note 1)	I_D	$T_c = 25^\circ C$			A
		$T_c = 100^\circ C$			A
Pulsed Drain Current ^(Note 2)	I_{DM}	200			A
Single Pulse Avalanche Energy ^(Note 3)	E_{AS}	42			mJ
Power Dissipation @ $T_c = 25^\circ C$	P_D	104	42	53	W
Operating Junction Temperature	T_J	150			$^\circ C$
Storage Temperature Range	T_{STG}	-55 to +150			$^\circ C$



Thermal Performance

Parameter	Symbol	Limit			Unit
		TO-220	ITO-220	DPAK	
Thermal Resistance - Junction to Case	R_{JC}	1.2	3	2	°C/W
Thermal Resistance - Junction to Ambient	R_{JA}	62	62	62	

Electrical Specifications ($T_C = 25^\circ\text{C}$ unless otherwise noted)

Parameter	Conditions	Symbol	Min	Typ	Max	Unit
Static						
Drain-Source Breakdown Voltage	$V_{GS} = 0V, I_D = 250\mu\text{A}$	BV_{DSS}	60	--	--	V
Drain-Source On-State Resistance	$V_{GS} = 10V, I_D = 20A$	$R_{DS(ON)}$	--	20	23	m
	$V_{GS} = 4.5V, I_D = 12A$		--	23	28	
Gate Threshold Voltage	$V_{DS} = V_{GS}, I_D = 250\mu\text{A}$	$V_{GS(TH)}$	1.2	1.8	2.5	V
Zero Gate Voltage Drain Current	$V_{DS} = 60V, V_{GS} = 0V$	I_{DSS}	--	--	1	μA
	$V_{DS} = 48V, T_J = 125^\circ\text{C}$		--	--	10	
Gate Body Leakage	$V_{GS} = \pm 20V, V_{DS} = 0V$	I_{GSS}	--	--	± 100	nA
Forward Transconductance ^(Note 4)	$V_{DS} = 10V, I_D = 10A$	g_{fs}	--	9	--	S
Dynamic						
Total Gate Charge ^(Note 4,5)	$V_{DS} = 30V, I_D = 15A, V_{GS} = 10V$	Q_g	--	28	--	nC
Gate-Source Charge ^(Note 4,5)		Q_{gs}	--	3.5	--	
Gate-Drain Charge ^(Note 4,5)		Q_{gd}	--	6.5	--	
Input Capacitance	$V_{DS} = 25V, V_{GS} = 0V, f = 1.0\text{MHz}$	C_{iss}	--	1680	--	pF
Output Capacitance		C_{oss}	--	115	--	
Reverse Transfer Capacitance		C_{rss}	--	85	--	
Switching						
Turn-On Delay Time ^(Note 4,5)	$V_{DD} = 30V, I_D = 1A, V_{GS} = 10V, R_G = 6$	$t_{d(on)}$	--	7.2	--	ns
Turn-On Rise Time ^(Note 4,5)		t_r	--	38	--	
Turn-Off Delay Time ^(Note 4,5)		$t_{d(off)}$	--	34	--	
Turn-Off Fall Time ^(Note 4,5)		t_f	--	8.2	--	
Source-Drain Diode Ratings and Characteristic						
Maximum Continuous Drain-Source Diode Forward Current	Integral reverse diode in the MOSFET	I_S	--	--	50	A
Maximum Pulse Drain-Source Diode Forward Current		I_{SM}	--	--	200	A
Diode-Source Forward Voltage	$V_{GS} = 0V, I_S = 1A$	V_{SD}	--	--	1	V
Reverse Recovery Time ^(Note 4)	$V_{GS} = 0V, I_S = 1A$	t_{rr}	--	19.6	--	ns
Reverse Recovery Charge ^(Note4)	$dl_F/dt = 100A/\mu\text{s}$	Q_{rr}	--	14.2	--	nC

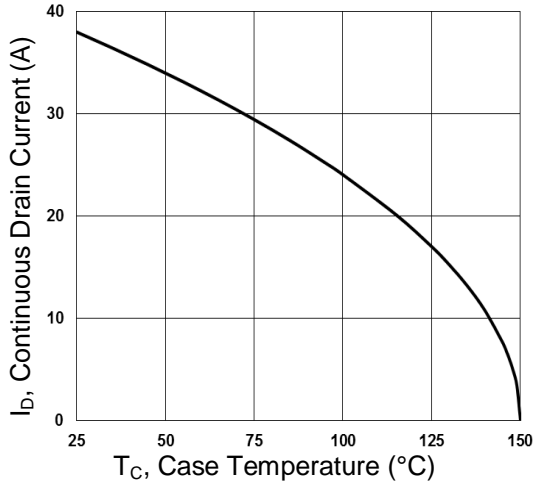
Note:

- Limited by maximum junction temperature
- Pulse width limited by safe operating area
- $L = 0.1\text{mH}, I_{AS} = 29A, V_{DD} = 25V, R_G = 25$, Starting $T_J = 25^\circ\text{C}$
- Pulse test: pulse width $m300\mu\text{s}$, duty cycle $m2\%$
- Switching time is essentially independent of operating temperature.

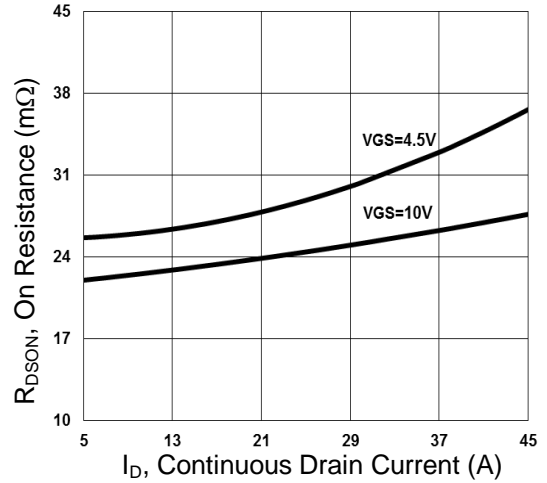


Electrical Characteristics Curve

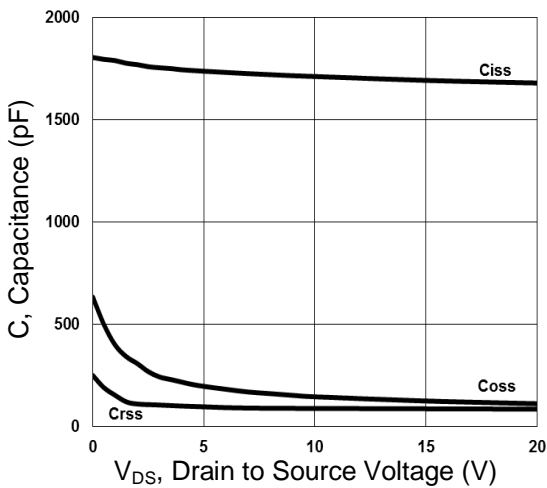
Continuous Drain Current vs. T_c



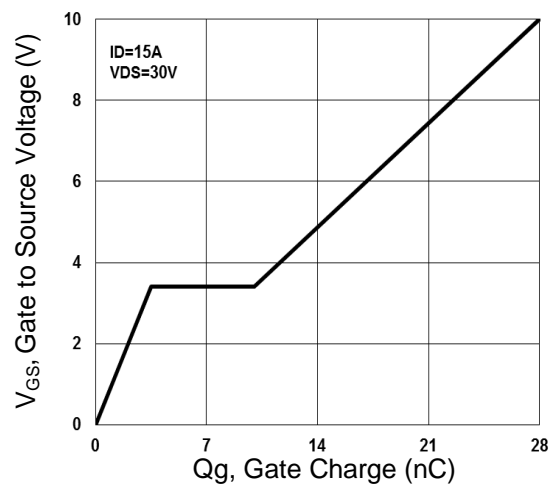
$R_{DS(on)}$ vs. Continuous Drain Current



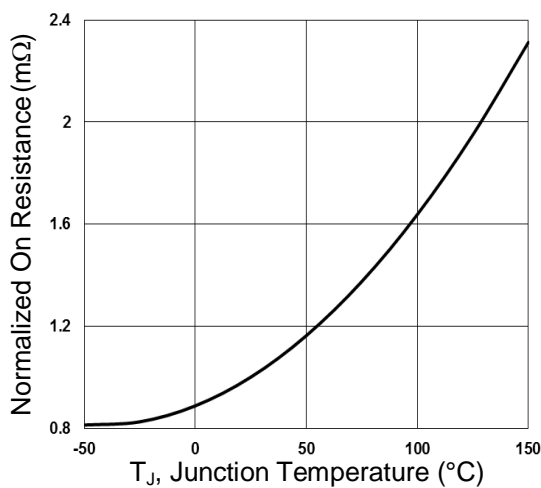
Capacitance



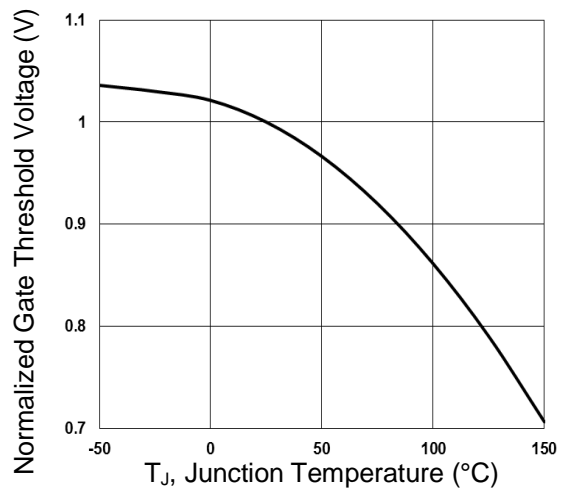
Gate Charge



On-Resistance vs. Junction Temperature



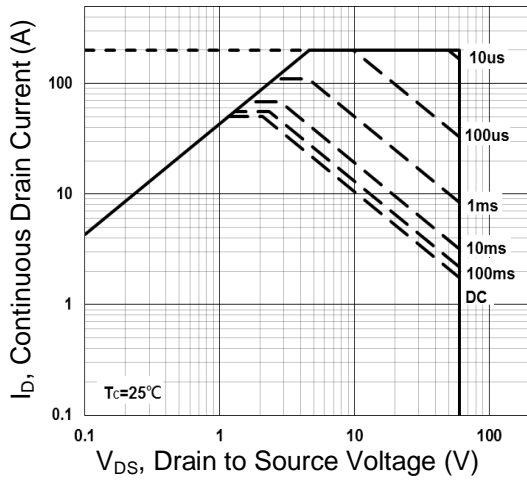
Threshold Voltage vs. Junction Temperature



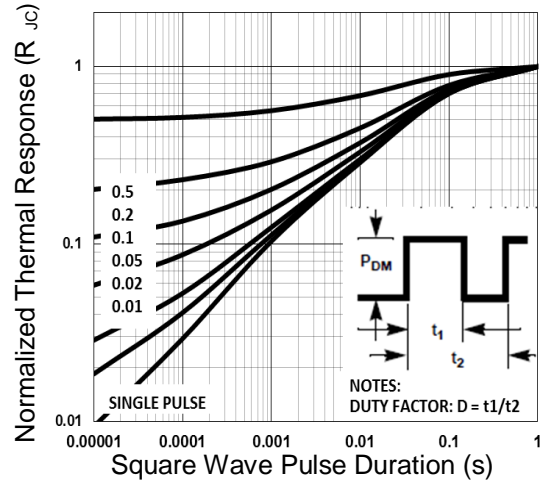


Electrical Characteristics Curve

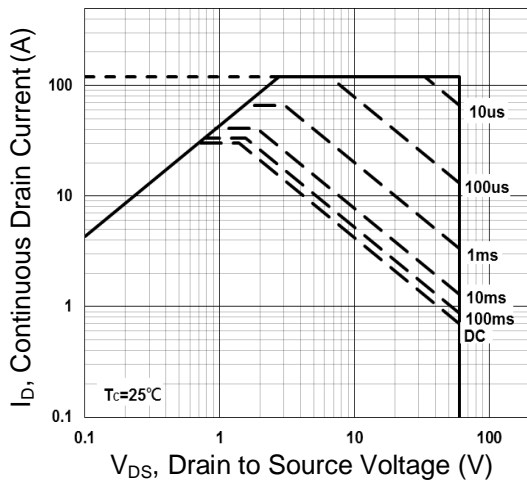
Maximum Safe Operating Area (TO-220)



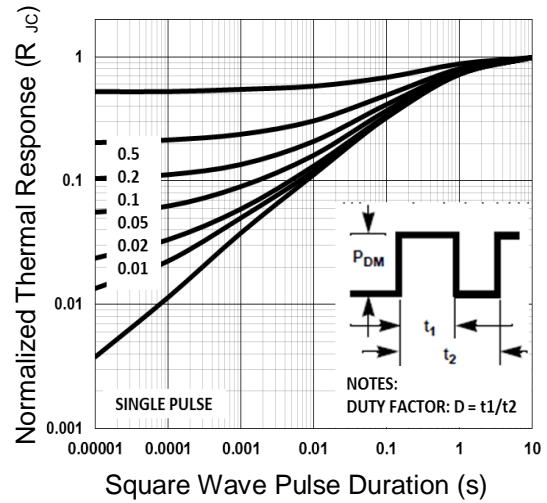
Normalized Thermal Transient Impedance (TO-220)



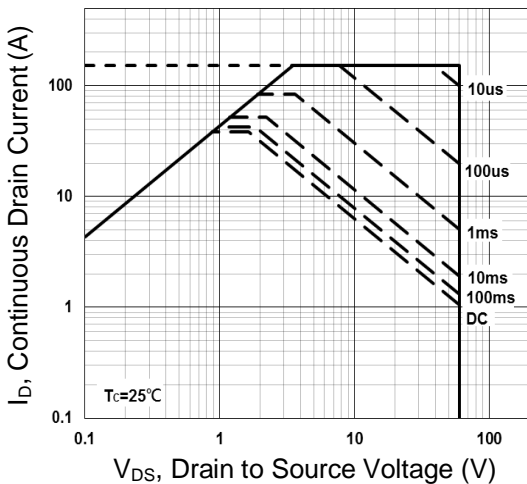
Maximum Safe Operating Area (ITO-220)



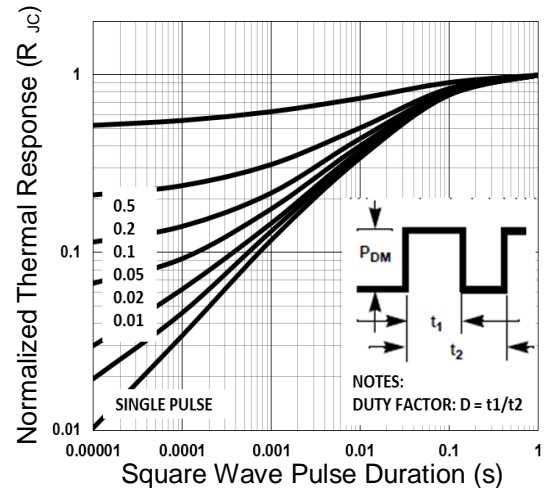
Normalized Thermal Transient Impedance (ITO-220)



Maximum Safe Operating Area (TO-252)

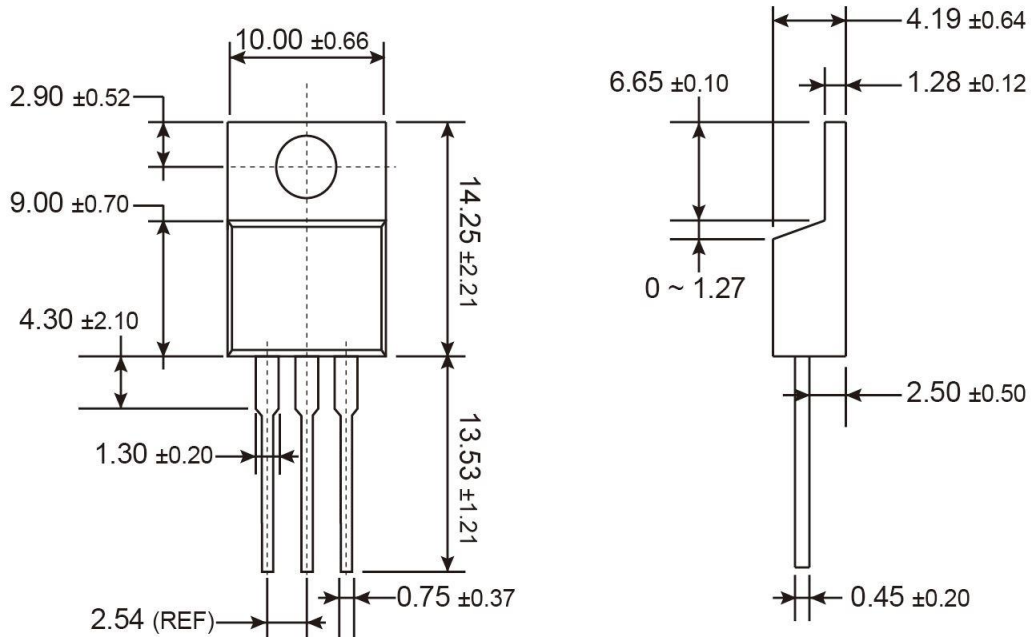


Normalized Thermal Transient Impedance (TO-252)



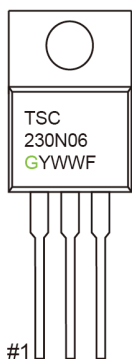


TO-220 Mechanical Drawing



Unit: Millimeters

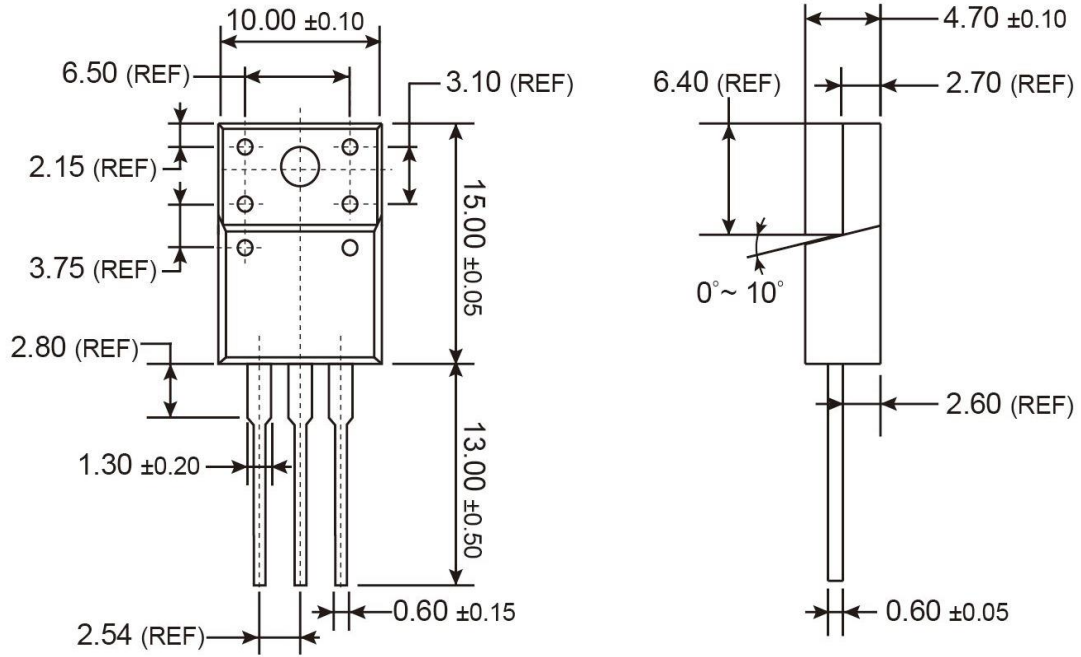
Marking Diagram



- G** = Halogen Free
- Y** = Year Code
- WW** = Week Code (01~52)
- F** = Factory Code

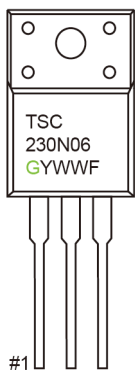


ITO-220 Mechanical Drawing



Unit: Millimeters

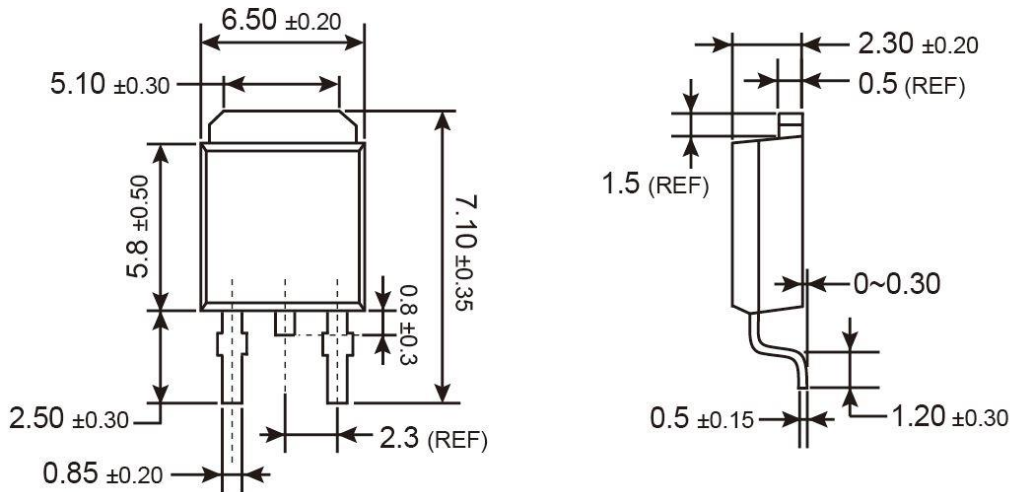
Marking Diagram



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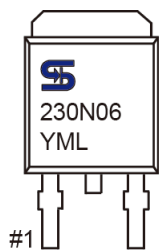


TO-252 Mechanical Drawing



Unit: Millimeters

Marking Diagram



- Y** = Year Code
- M** = Month Code for Halogen Free Product
(**O**=Jan, **P**=Feb, **Q**=Mar, **R**=Apr, **S**=May, **T**=Jun, **U**=Jul, **V**=Aug, **W**=Sep, **X**=Oct, **Y**=Nov, **Z**=Dec)
- L** = Lot Code

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