



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**

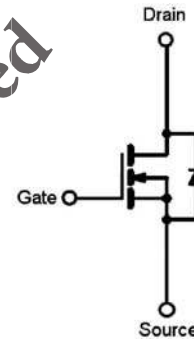
- 100% avalanche tested
- Fast Switching

**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	$V_{GS}$	$\pm 20$			V
Continuous Drain Current <sup>(Note 1)</sup>	$I_D$	$T_C = 25^\circ C$			A
		$T_C = 100^\circ C$			A
Pulsed Drain Current <sup>(Note 2)</sup>	$I_{DM}$	200			A
Single Pulse Avalanche Energy <sup>(Note 3)</sup>	$E_{AS}$	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	DKPAK	
Thermal Resistance - Junction to Case	$R_{\theta JC}$	1.2	3	2	°C/W
Thermal Resistance - Junction to Ambient	$R_{\theta JA}$	62	62	62	

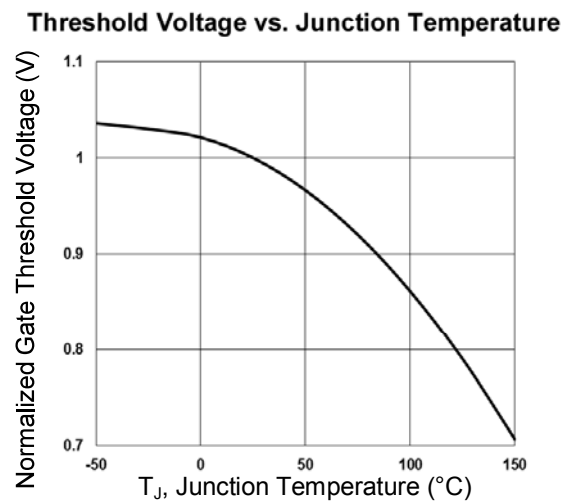
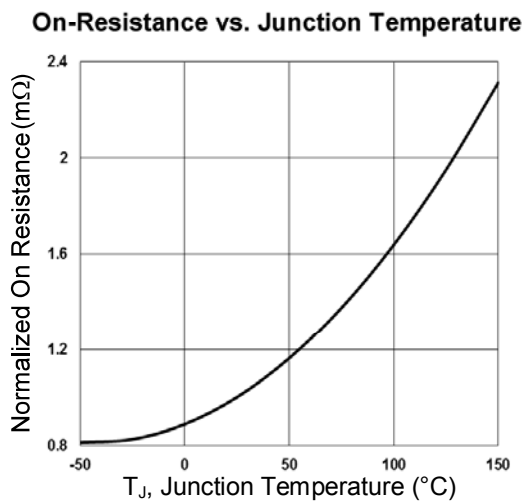
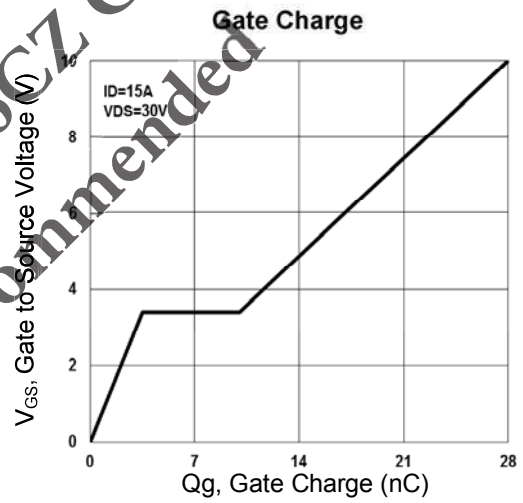
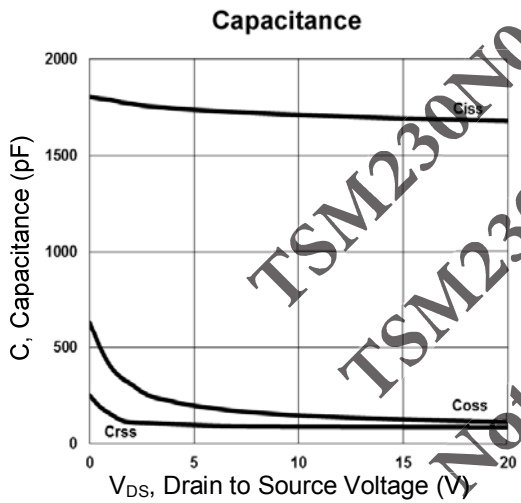
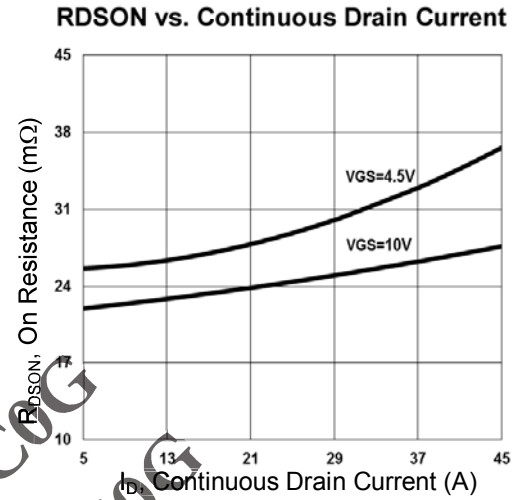
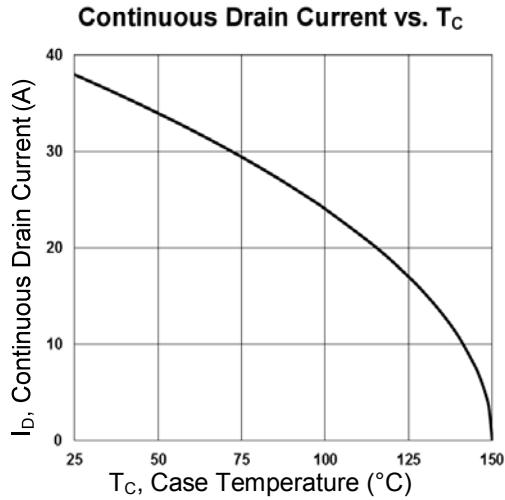
### Electrical Specifications ( $T_C = 25^\circ\text{C}$ unless otherwise noted)

Parameter	Conditions	Symbol	Min	Typ	Max	Unit
<b>Static</b>						
Drain-Source Breakdown Voltage	$V_{GS} = 0V, I_D = 250\mu A$	$BV_{DSS}$	60	--	--	V
Drain-Source On-State Resistance	$V_{GS} = 10V, I_D = 20A$	$R_{DS(ON)}$	--	20	23	mΩ
	$V_{GS} = 4.5V, I_D = 12A$		--	23	28	
Gate Threshold Voltage	$V_{DS} = V_{GS}, I_D = 250\mu A$	$V_{GS(TH)}$	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
<b>Dynamic</b>						
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	--	
<b>Switching</b>						
Turn-On Delay Time (Note 4,5)	$V_{DD} = 30V, I_D = 1A, V_{GS} = 10V, R_G = 6\Omega$	$t_{d(on)}$	--	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	--	
<b>Source-Drain Diode Ratings and Characteristic</b>						
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 (Note 4)	$di/dt = 100A/\mu s$	$Q_{rr}$	--	14.2	--	nC

#### Note:

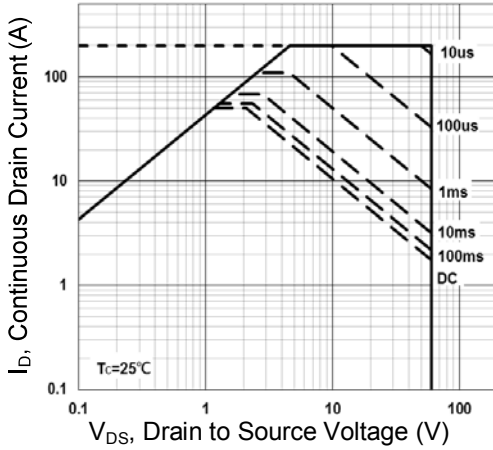
- Limited by maximum junction temperature
- Pulse width limited by safe operating area
- $L = 0.1\text{mH}, I_{AS} = 29A, V_{DD} = 25V, R_G = 25\Omega$ , Starting  $T_J = 25^\circ\text{C}$
- Pulse test: pulse width  $\leq 300\mu s$ , duty cycle  $\leq 2\%$
- Switching time is essentially independent of operating temperature.

### Electrical Characteristics Curve

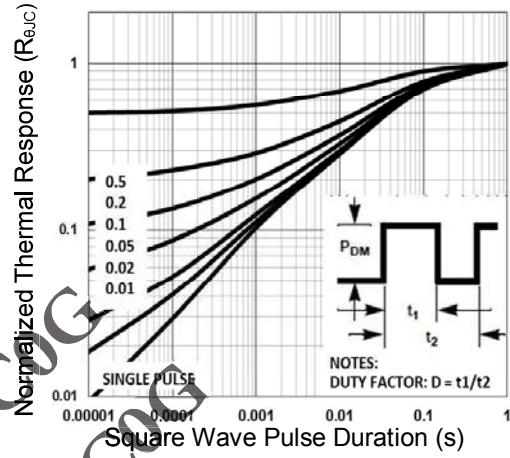


### Electrical Characteristics Curve

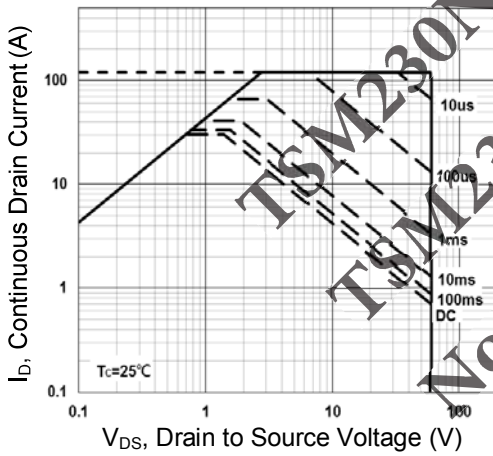
Maximum Safe Operating Area (TO-220)



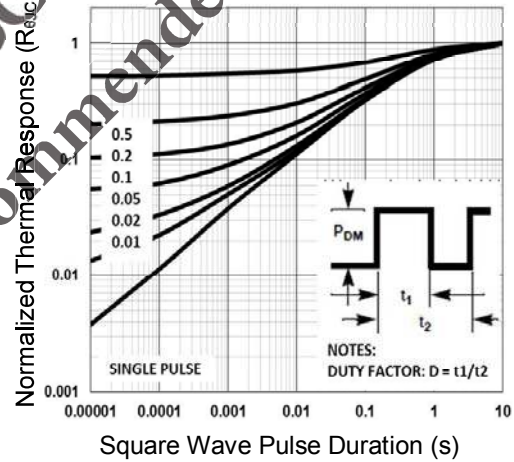
Normalized Thermal Transient Impedance (TO-220)



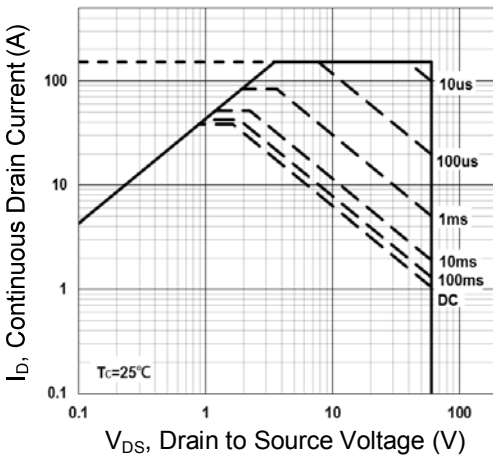
Maximum Safe Operating Area (ITO-220)



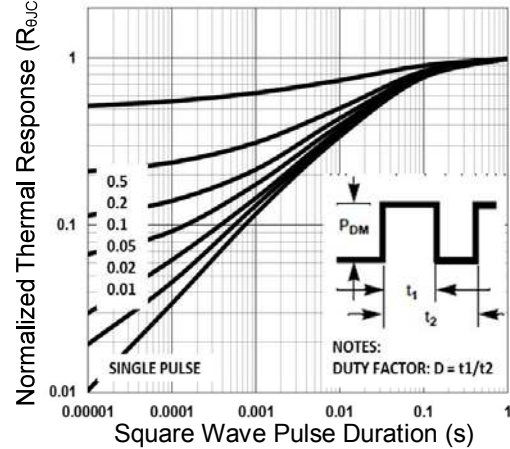
Normalized Thermal Transient Impedance (ITO-220)



Maximum Safe Operating Area (TO-252)

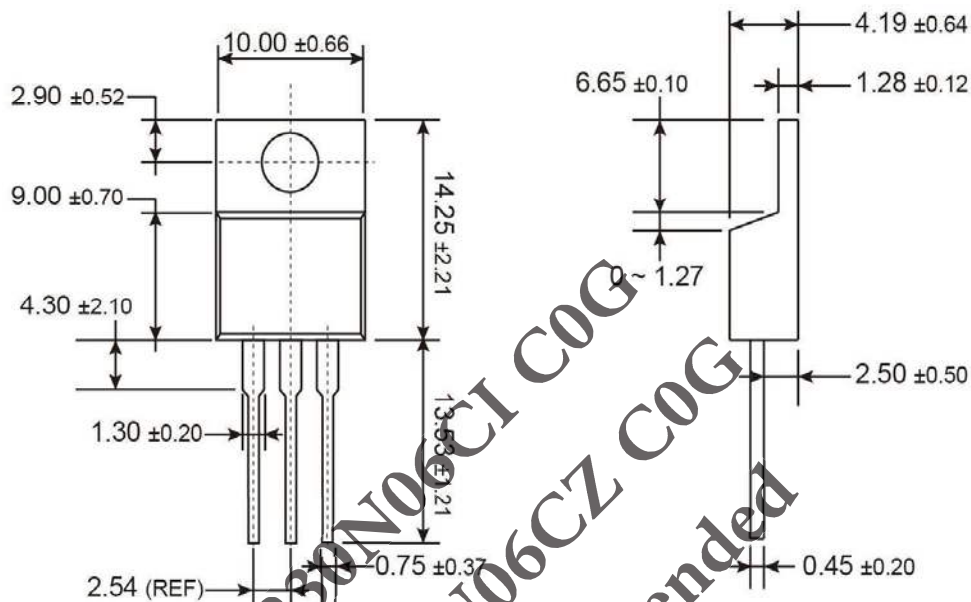


Normalized Thermal Transient Impedance (TO-252)



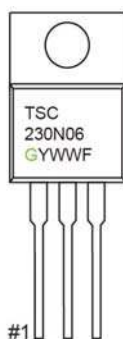


**TO-220 Mechanical Drawing**



Unit: Millimeters

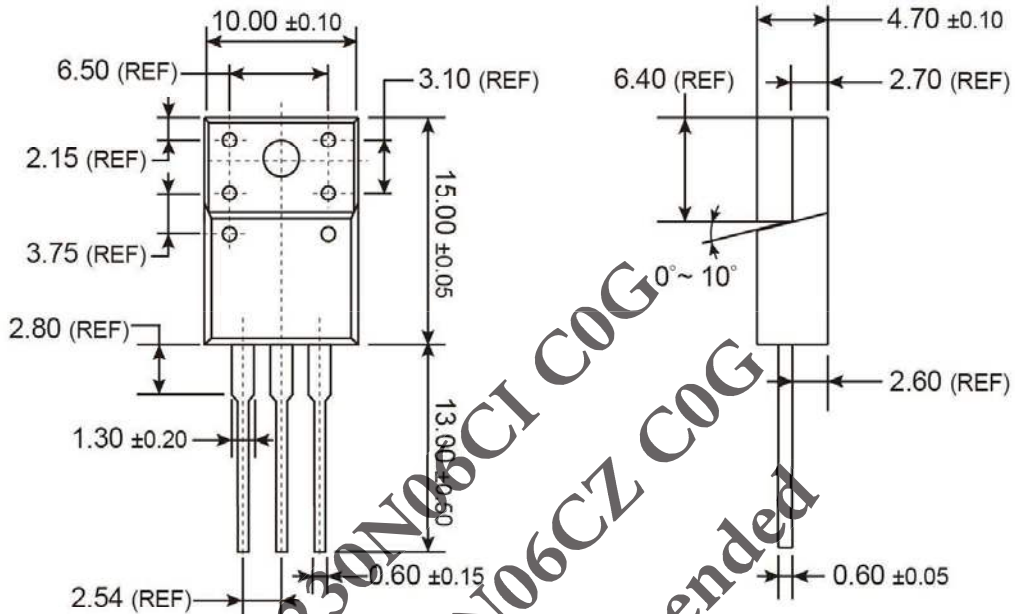
**Marking Diagram**



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

TSM230N06CI COG  
TSM230N06CZ COG  
Not Recommended

### ITO-220 Mechanical Drawing



Unit: Millimeters

### Marking Diagram

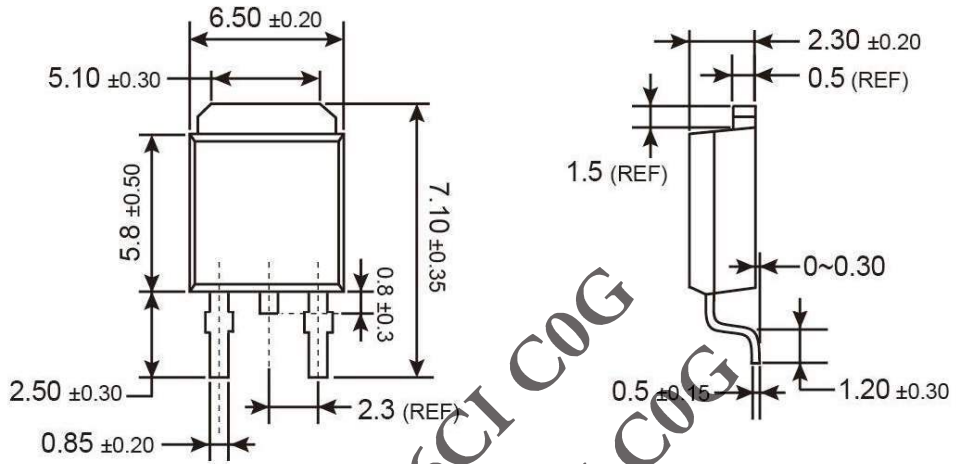


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TSM230N06CI COG  
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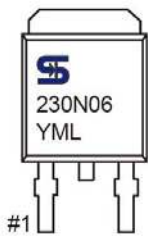


**TO-252 Mechanical Drawing**



Unit: Millimeters

**Marking Diagram**



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

TSM230N06CI COG  
TSM230N06CZ COG  
Not Recommended

TSM230N06CI COG  
TSM230N06CZ COG  
Not Recommended

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