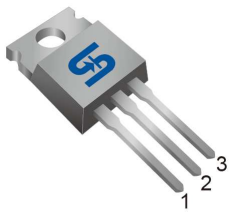




TO-220



ITO-220



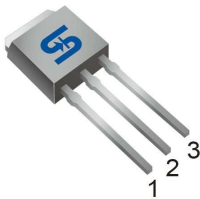
**Pin Definition:**

1. Gate
2. Drain
3. Source

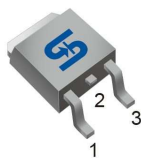
**Key Parameter Performance**

Parameter	Value	Unit
$V_{DS}$	650	V
$R_{DS(on)}$ (max)	3.37	$\Omega$
$Q_g$	13.46	nC

TO-251 (IPAK)



TO-252 (DPAK)



**Application**

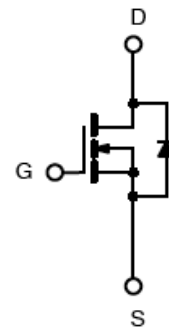
- Power Supply.
- Lighting

**Ordering Information**

Part No.	Package	Packing
TSM4NB65CZ C0G	TO-220	50pcs / Tube
TSM4NB65CI C0G	ITO-220	50pcs / Tube
TSM4NB65CH C5G	TO-251	75pcs / Tube
TSM4NB65CP 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** ( $T_C = 25^\circ\text{C}$  unless otherwise noted)

Parameter	Symbol	Limit			Unit
		IPAK/DPAK	ITO-220	TO-220	
Drain-Source Voltage	$V_{DS}$	650			V
Gate-Source Voltage	$V_{GS}$	$\pm 30$			V
Continuous Drain Current <sup>(Note 1)</sup>	$I_D$	$T_C = 25^\circ\text{C}$			A
		$T_C = 100^\circ\text{C}$			A
Pulsed Drain Current <sup>(Note 2)</sup>	$I_{DM}$	16			A
Single Pulse Avalanche Energy <sup>(Note 3)</sup>	$E_{AS}$	31.2			mJ
Total Power Dissipation @ $T_C = 25^\circ\text{C}$	$P_{TOT}$	50	25	70	W
Operating Junction Temperature	$T_J$	-55 to +150			$^\circ\text{C}$
Storage Temperature Range	$T_{STG}$	-55 to +150			$^\circ\text{C}$



### Thermal Performance

Parameter	Symbol	Limit			Unit
		IPAK/DPAK	ITO-220	TO-220	
Thermal Resistance - Junction to Case	$R_{\theta JC}$	2.5	5	1.78	$^{\circ}C/W$
Thermal Resistance - Junction to Ambient	$R_{\theta JA}$	83	62.5	62.5	$^{\circ}C/W$

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

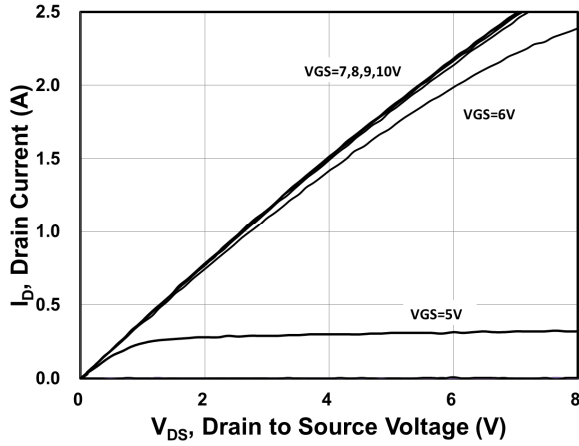
Parameter	Conditions	Symbol	Min	Typ	Max	Unit
<b>Static</b> (Note 4)						
Drain-Source Breakdown Voltage	$V_{GS} = 0V, I_D = 250\mu A$	$BV_{DSS}$	650	--	--	V
Drain-Source On-State Resistance	$V_{GS} = 10V, I_D = 2A$	$R_{DS(ON)}$	--	2.7	3.37	$\Omega$
Gate Threshold Voltage	$V_{DS} = V_{GS}, I_D = 250\mu A$	$V_{GS(TH)}$	2.5	3.6	4.5	V
Zero Gate Voltage Drain Current	$V_{DS} = 650V, V_{GS} = 0V$	$I_{DSS}$	--	--	1	$\mu A$
Gate Body Leakage	$V_{GS} = \pm 30V, V_{DS} = 0V$	$I_{GSS}$	--	--	$\pm 100$	nA
Forward Transfer Conductance	$V_{DS} = 40V, I_D = 2A$	$g_{fs}$	--	2.6	--	S
<b>Dynamic</b> (Note 5)						
Total Gate Charge	$V_{DS} = 480V, I_D = 4A,$ $V_{GS} = 10V$	$Q_g$	--	13.46	--	nC
Gate-Source Charge		$Q_{gs}$	--	2.98	--	
Gate-Drain Charge		$Q_{gd}$	--	6.66	--	
Input Capacitance	$V_{DS} = 25V, V_{GS} = 0V,$ $f = 1.0MHz$	$C_{iss}$	--	549	--	pF
Output Capacitance		$C_{oss}$	--	75	--	
Reverse Transfer Capacitance		$C_{rss}$	--	18	--	
<b>Switching</b> (Note 6)						
Turn-On Delay Time	$V_{GS} = 10V, I_D = 4A,$ $V_{DD} = 300V, R_G = 25\Omega$	$t_{d(on)}$	--	11	--	ns
Turn-On Rise Time		$t_r$	--	20	--	
Turn-Off Delay Time		$t_{d(off)}$	--	30	--	
Turn-Off Fall Time		$t_f$	--	19	--	
<b>Source-Drain Diode Ratings and Characteristic</b> (Note 4)						
Source Current	Integral reverse diode in the MOSFET	$I_S$	--	--	4	A
Source Current (Pulse)		$I_{SM}$	--	--	16	A
Diode Forward Voltage	$I_S = 4A, V_{GS} = 0V$	$V_{SD}$	--	--	1.13	V

#### Notes:

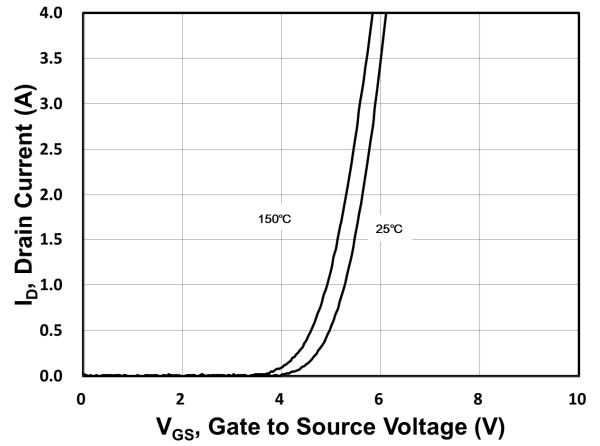
1. Current limited by package
2. Pulse width limited by the maximum junction temperature
3.  $L = 10mH, I_{AS} = 2.4A, V_{DD} = 50V, R_G = 25\Omega, \text{Starting } T_J = 25^{\circ}C$
4. Pulse test:  $PW \leq 300\mu s, \text{duty cycle} \leq 2\%$
5. For DESIGN AID ONLY, not subject to production testing.
6. Switching time is essentially independent of operating temperature.

### Electrical Characteristics Curves

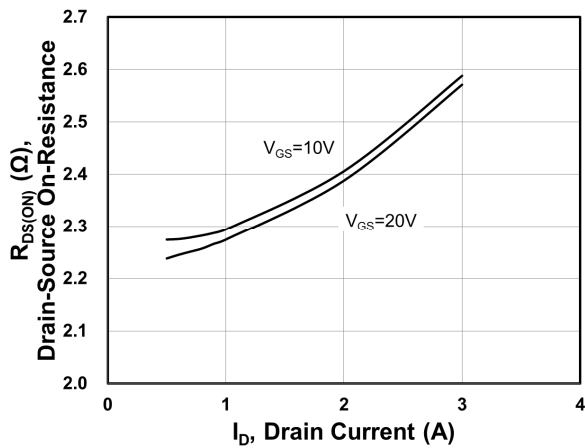
**Output Characteristics**



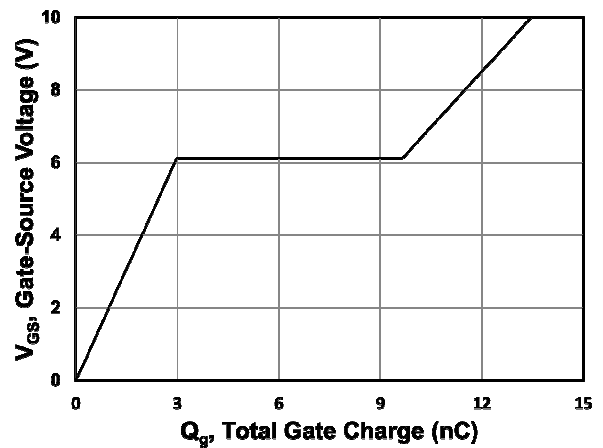
**Transfer Characteristics**



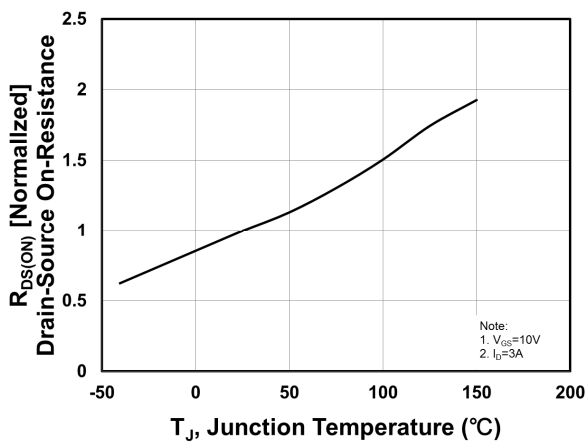
**On-Resistance vs. Drain Current**



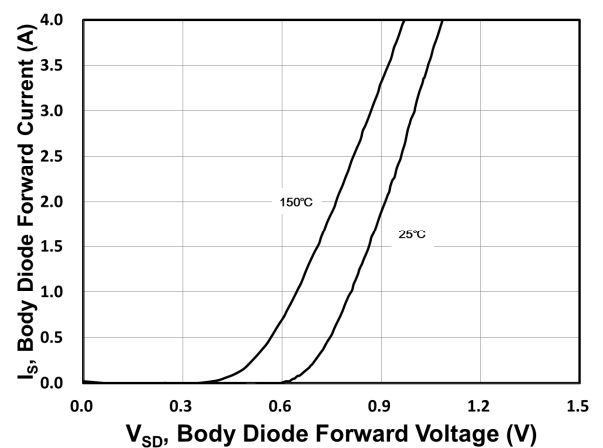
**Gate-Source Voltage vs. Gate Charge**



**On-Resistance vs. Junction Temperature**

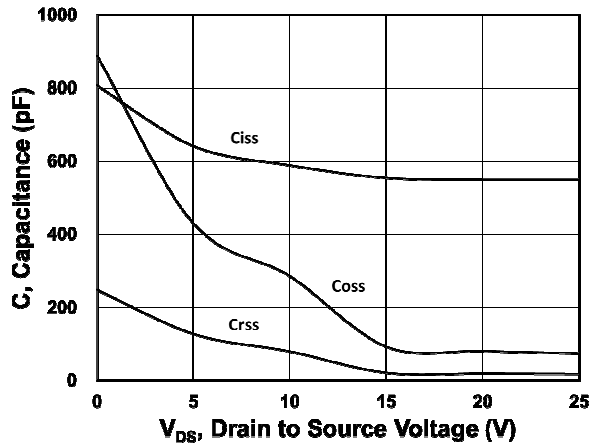


**Source-Drain Diode Forward Current vs. Voltage**

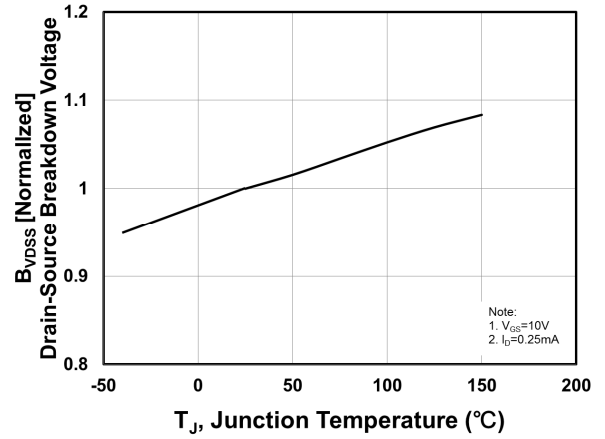


### Electrical Characteristics Curves

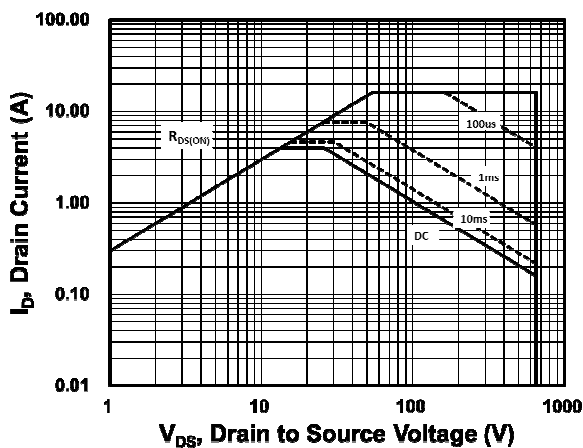
Capacitance vs. Drain-Source Voltage



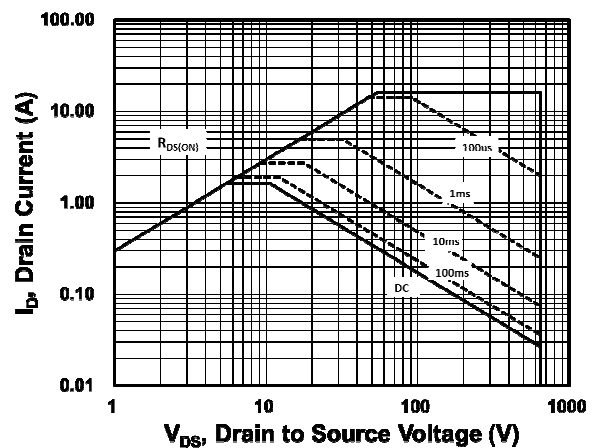
BV<sub>DSS</sub> vs. Junction Temperature



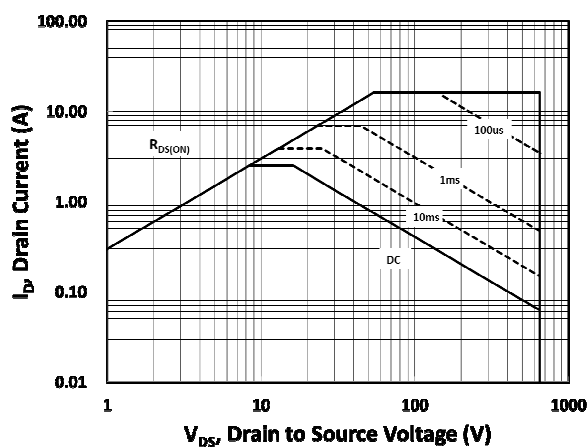
Maximum Safe Operating Area (TO-220)



Maximum Safe Operating Area (ITO-220)

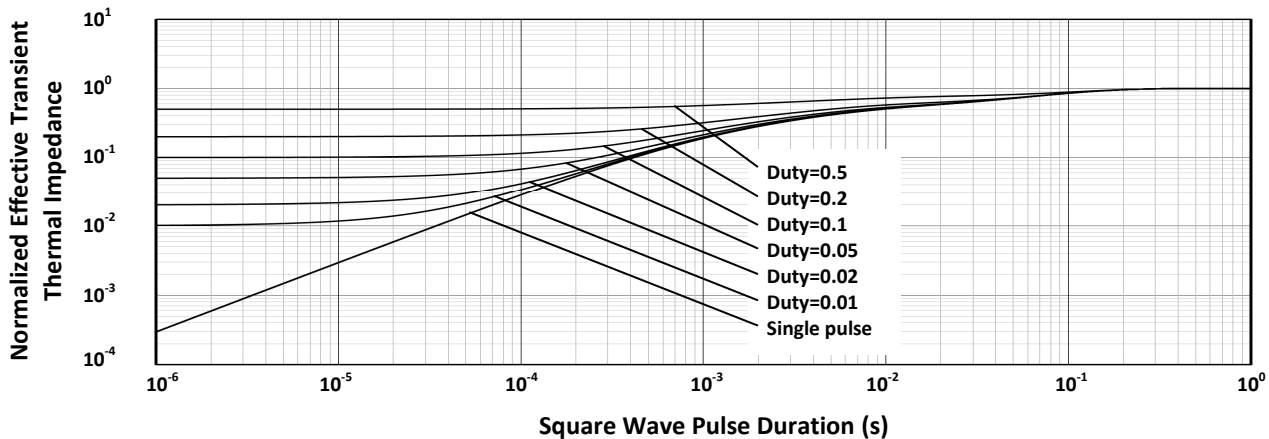


Maximum Safe Operating Area (DPAK/IPAK)

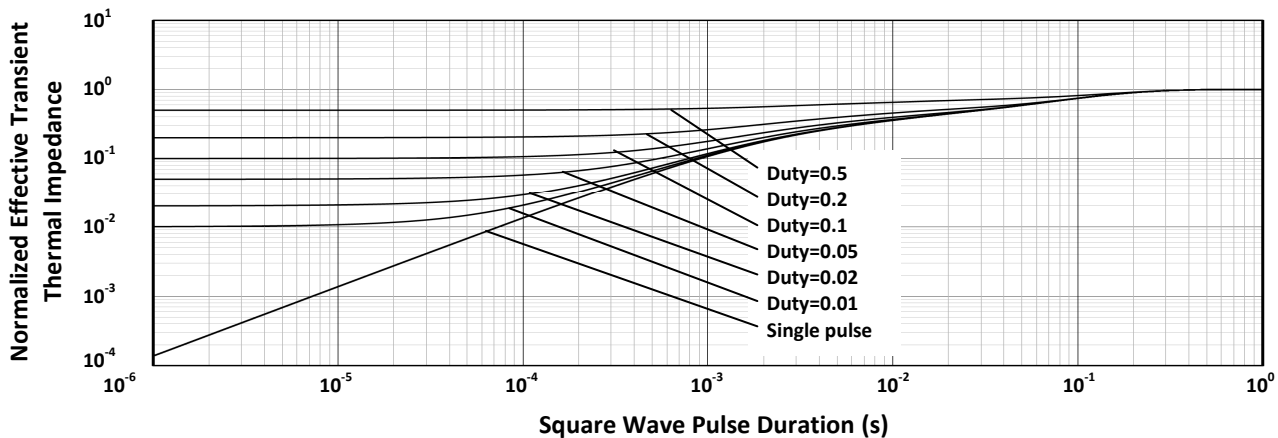


**Electrical Characteristics Curves**

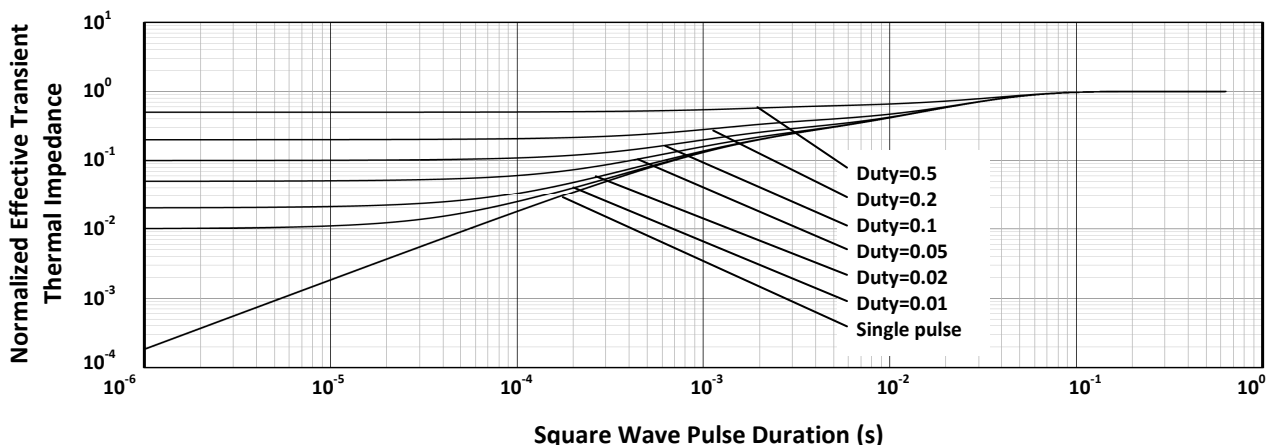
**Normalized Thermal Transient Impedance, Junction-to-Case (TO-220)**



**Normalized Thermal Transient Impedance, Junction-to-Case (ITO-220)**

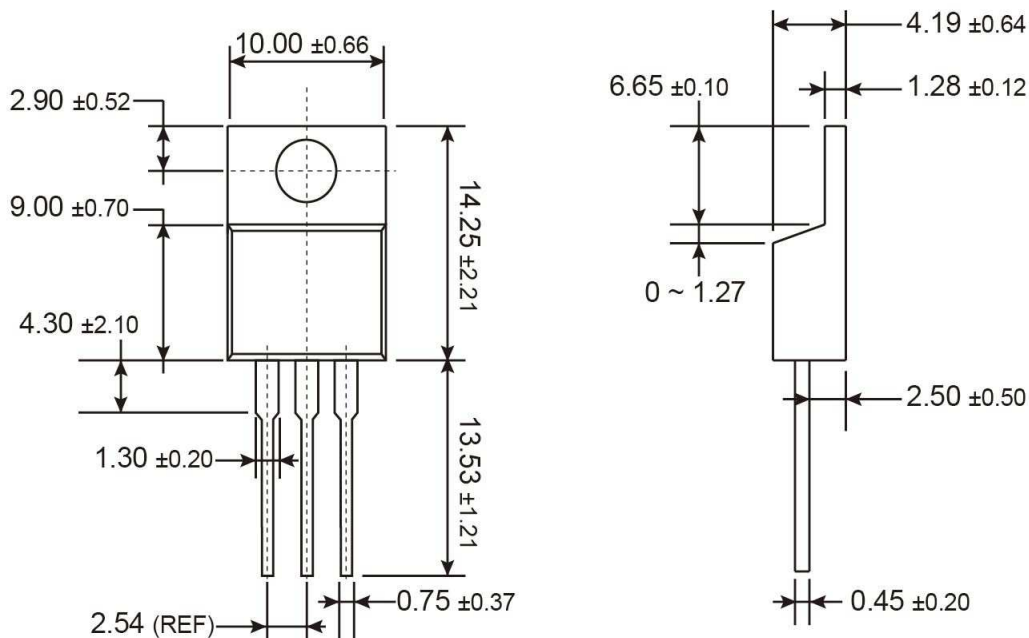


**Normalized Thermal Transient Impedance, Junction-to-Case (DPAK/IPAK)**



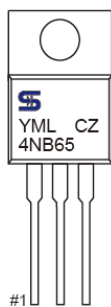


**TO-220 Mechanical Drawing**



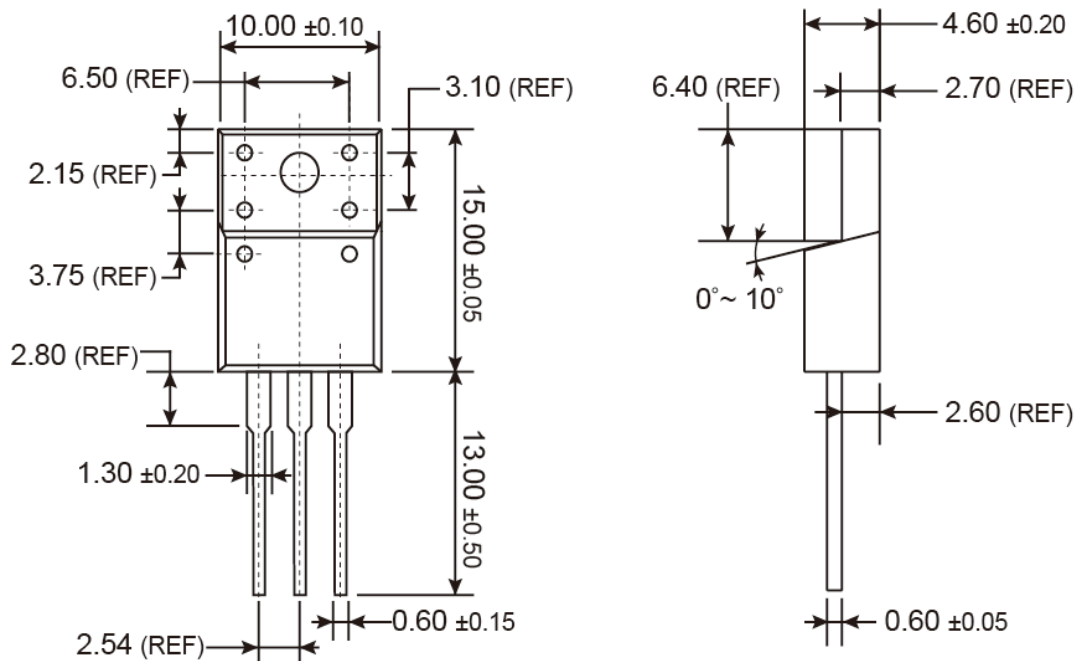
Unit: Millimeters

**Marking Diagram**



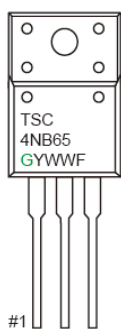
- Y** = Year Code
- M** = Month Code for Halogen Free Product
  - O** =Jan    **P** =Feb    **Q** =Mar    **R** =Apr
  - S** =May    **T** =Jun    **U** =Jul    **V** =Aug
  - W** =Sep    **X** =Oct    **Y** =Nov    **Z** =Dec
- L** = Lot Code

### ITO-220 Mechanical Drawing



Unit: Millimeters

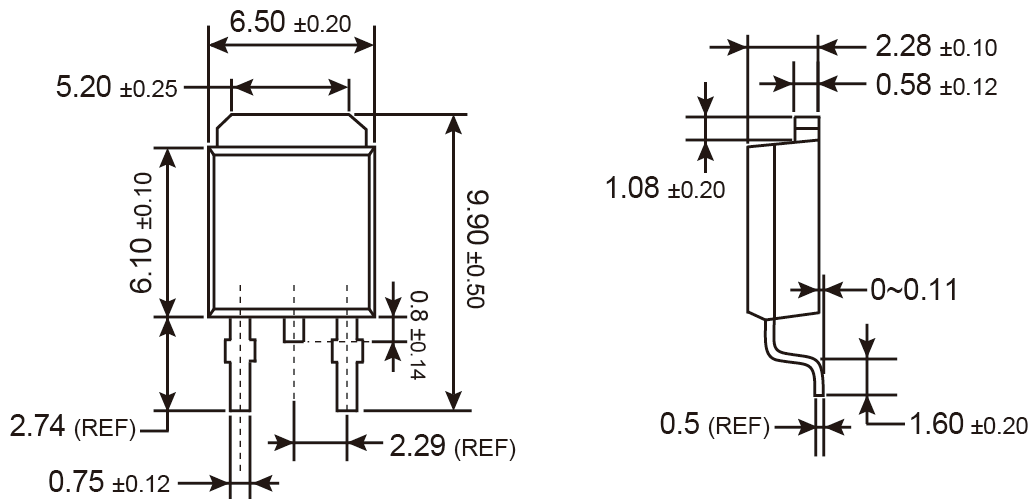
### Marking Diagram



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

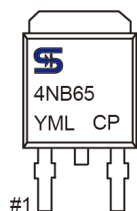


### TO-252 (DPAK) Mechanical Drawing



Unit: Millimeters

### Marking Diagram

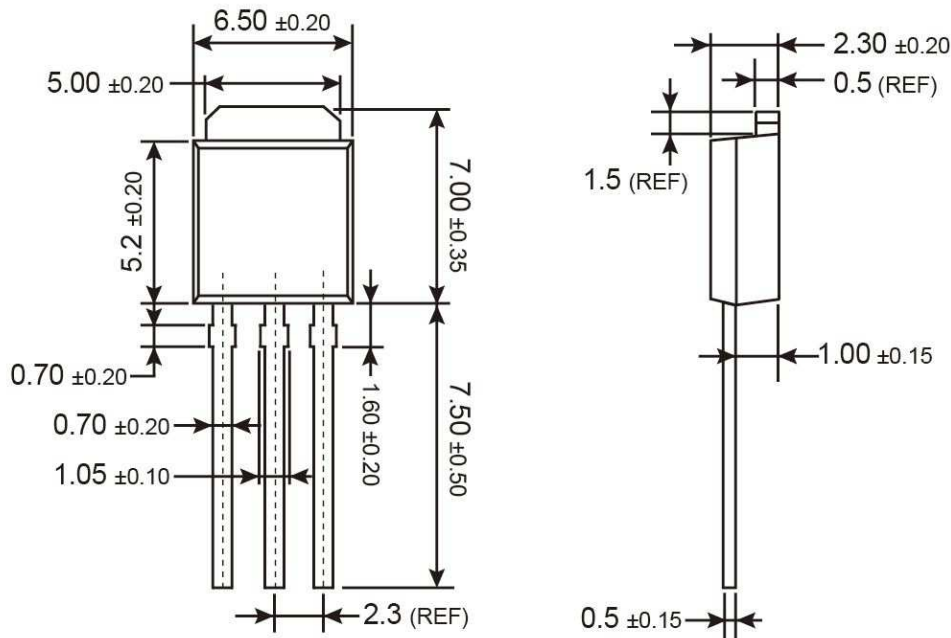


- Y = Year Code
- M = Month Code for Halogen Free Product
  - O =Jan    P =Feb    Q =Mar    R =Apr
  - S =May    T =Jun    U =Jul    V =Aug
  - W =Sep    X =Oct    Y =Nov    Z =Dec
- L = Lot Code



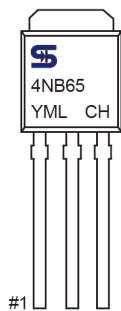


**TO-251 (IPAK) Mechanical Drawing**



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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