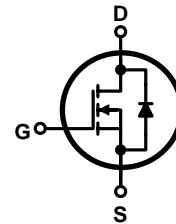
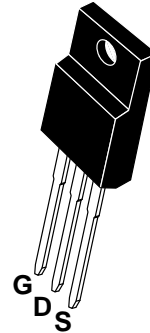




## PIN Connection TO-220F

$V_{DSS}$	650	V
$I_D$	16	A
$P_D (T_C=25^\circ\text{C})$	64	W
$R_{DS(ON)}$	0.43	$\Omega$



## Marking Diagram



Y = Year  
A = Assembly Location  
WW = Work Week  
FIR16N65F = Specific Device Code

## Features

- I Fast Switching
- I Low ON Resistance( $R_{dson} \leq 0.5\Omega$ )
- I Low Gate Charge (Typical Data:50nC)
- I Low Reverse transfer capacitances(Typical:21pF)
- I 100% Single Pulse avalanche energy Test

## Applications

Automotive、 DC Motor Control and Class D Amplifier.

## Absolute (Tc= 25°C unless otherwise specified)

Symbol	Parameter	Rating	Units
$V_{DSS}$	Drain-to-Source Voltage	650	V
$I_D$	Continuous Drain Current	16	A
	Continuous Drain Current $T_C = 100^\circ\text{C}$	9.5	A
$I_{DM}^{a1}$	Pulsed Drain Current	60	A
$V_{GS}$	Gate-to-Source Voltage	$\pm 30$	V
$E_{AS}^{a2}$	Single Pulse Avalanche Energy	980	mJ
$E_{AR}^{a1}$	Avalanche Energy ,Repetitive	32	mJ
$I_{AR}^{a1}$	Avalanche Current	6.3	A
$dv/dt^{a3}$	Peak Diode Recovery dv/dt	5.0	V/ns
$P_D$	Power Dissipation	64	W
	Derating Factor above 25°C	0.51	W/°C
$T_J, T_{stg}$	Operating Junction and Storage Temperature Range	150, -55 to 150	°C
$T_L$	Maximum Temperature for Soldering	300	°C



**Electrical Characteristics** (Tc= 25°C unless otherwise specified):

OFF Characteristics						
Symbol	Parameter	Test Conditions	Rating			Units
			Min.	Typ.	Max.	
V <sub>DSS</sub>	Drain to Source Breakdown Voltage	V <sub>GS</sub> =0V, I <sub>D</sub> =250μA	650	--	--	V
ΔBV <sub>DSS</sub> /ΔT <sub>J</sub>	Bvdss Temperature Coefficient	I <sub>D</sub> =250uA, Reference 25°C	--	0.6	--	V/°C
I <sub>DSS</sub>	Drain to Source Leakage Current	V <sub>DS</sub> = 500V, V <sub>GS</sub> = 0V, T <sub>a</sub> = 25°C	--	--	1	μA
		V <sub>DS</sub> = 400V, V <sub>GS</sub> = 0V, T <sub>a</sub> = 125°C	--	--	10	
I <sub>GSS(F)</sub>	Gate to Source Forward Leakage	V <sub>GS</sub> = +30V	--	--	100	nA
I <sub>GSS(R)</sub>	Gate to Source Reverse Leakage	V <sub>GS</sub> = -30V	--	--	-100	nA

ON Characteristics						
Symbol	Parameter	Test Conditions	Rating			Units
			Min.	Typ.	Max.	
R <sub>DS(ON)</sub>	Drain-to-Source On-Resistance	V <sub>GS</sub> =10V, I <sub>D</sub> =8.0A	--	0.43	0.5	Ω
V <sub>GS(TH)</sub>	Gate Threshold Voltage	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250μA	2.0		4.0	V
Pulse width tp ≤ 380μs, δ ≤ 2%						

Dynamic Characteristics						
Symbol	Parameter	Test Conditions	Rating			Units
			Min.	Typ.	Max.	
g <sub>fs</sub>	Forward Transconductance	V <sub>DS</sub> =15V, I <sub>D</sub> =8.0A	--	18	--	S
C <sub>iss</sub>	Input Capacitance	V <sub>GS</sub> = 0V V <sub>DS</sub> = 25V f = 1.0MHz	--	2600	--	pF
C <sub>oss</sub>	Output Capacitance		--	206	--	
C <sub>rss</sub>	Reverse Transfer Capacitance		--	21	--	

Resistive Switching Characteristics						
Symbol	Parameter	Test Conditions	Rating			Units
			Min.	Typ.	Max.	
t <sub>d(ON)</sub>	Turn-on Delay Time	I <sub>D</sub> = 16A V <sub>DD</sub> = 250V V <sub>GS</sub> = 10V R <sub>G</sub> = 6.1Ω	--	38	--	ns
t <sub>r</sub>	Rise Time		--	99	--	
t <sub>d(OFF)</sub>	Turn-Off Delay Time		--	149	--	
t <sub>f</sub>	Fall Time		--	95	--	
Q <sub>g</sub>	Total Gate Charge	I <sub>D</sub> = 16A V <sub>DD</sub> = 250V V <sub>GS</sub> = 10V	--	50	--	nC
Q <sub>gs</sub>	Gate to Source Charge		--	12	--	
Q <sub>gd</sub>	Gate to Drain ("Miller") Charge		--	20	--	



Source-Drain Diode Characteristics						
Symbol	Parameter	Test Conditions	Rating			Units
			Min.	Typ.	Max.	
$I_S$	Continuous Source Current (Body Diode)		--	--	16	A
$I_{SM}$	Maximum Pulsed Current (Body Diode)		--	--	60	A
$V_{SD}$	Diode Forward Voltage	$I_S=16A, V_{GS}=0V$	--	--	1.5	V
$t_{rr}$	Reverse Recovery Time	$I_S=16A, T_j = 25^\circ C$	--	582		ns
$Q_{rr}$	Reverse Recovery Charge	$dI_F/dt=100A/us, V_{GS}=0V$	--	4.7		$\mu C$
Pulse width $t_p \leq 380\mu s, \delta \leq 2\%$						

Symbol	Parameter	Typ.	Units
$R_{\theta JC}$	Junction-to-Case	1.95	$^\circ C/W$
$R_{\theta JA}$	Junction-to-Ambient	62.5	$^\circ C/W$

<sup>a1</sup>: Repetitive rating; pulse width limited by maximum junction temperature

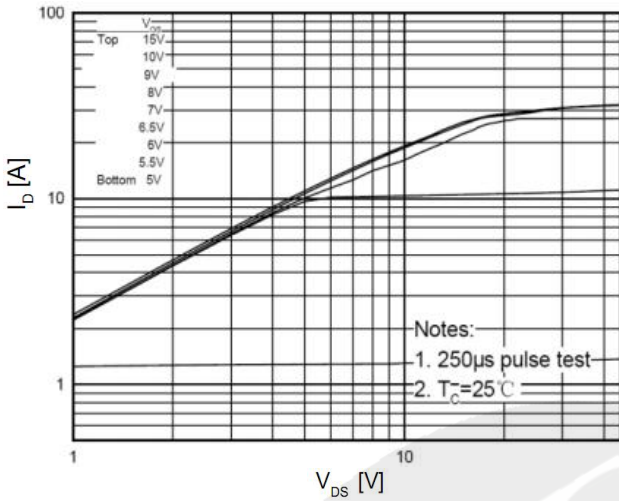
<sup>a2</sup>:  $L=10.0mH, I_D=14.1A, Start T_j=25^\circ C$

<sup>a3</sup>:  $I_{SD}=16A, di/dt \leq 100A/us, V_{DD} \leq BV_{DS}, Start T_j=25^\circ C$

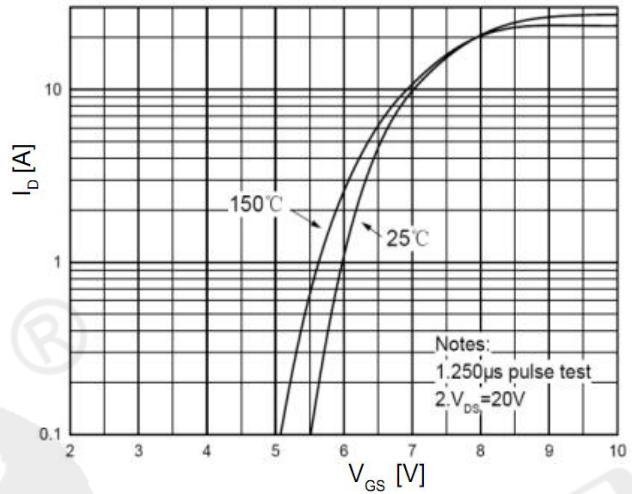


### Characteristic Curves

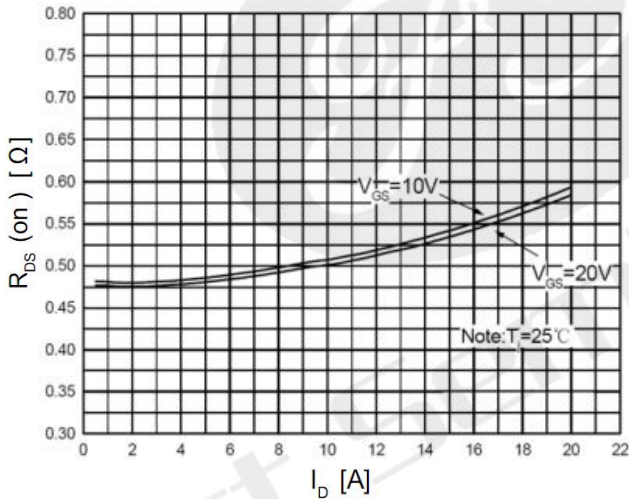
#### On-Regin Characteristics



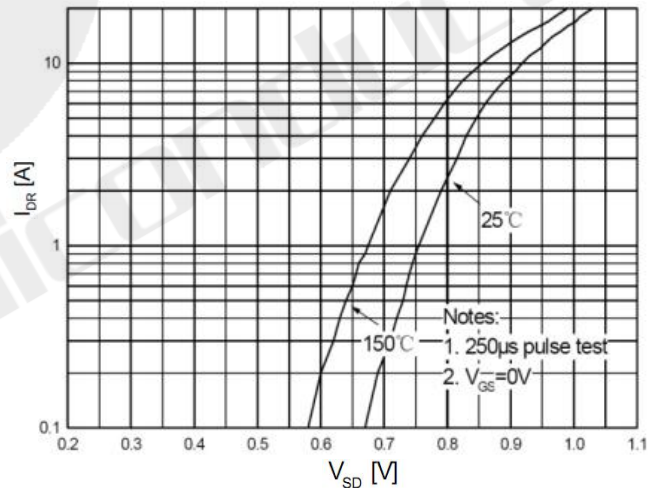
#### Transfer Characteristics



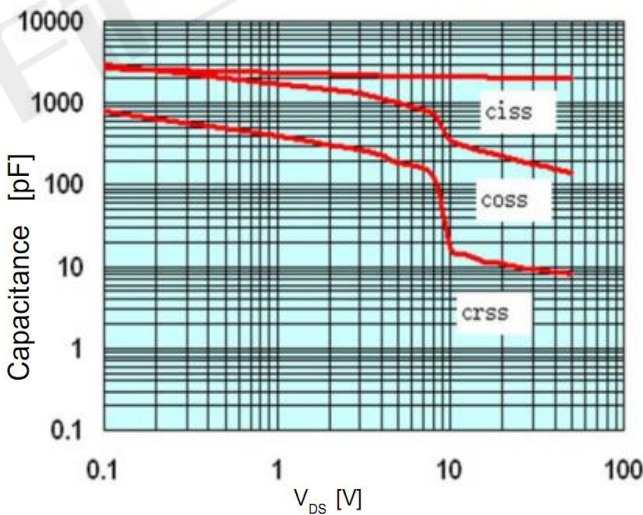
#### On-Resistance Variation vs. Drain Current and Gate Voltage



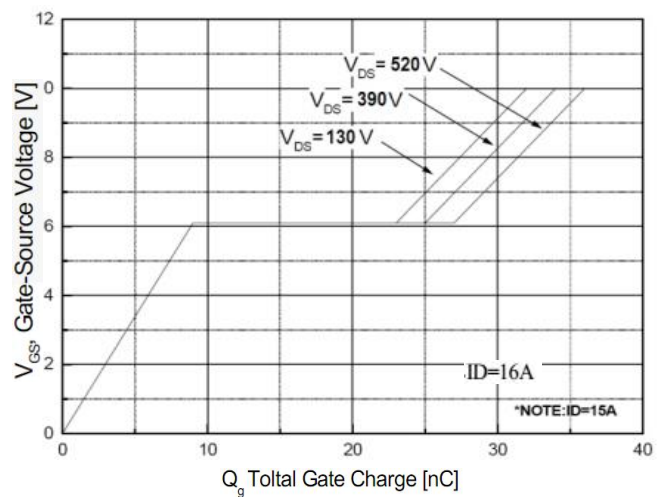
#### Body Diode Forward Voltage Variation vs. Source Current and Temperature



#### Capacitance Characteristics

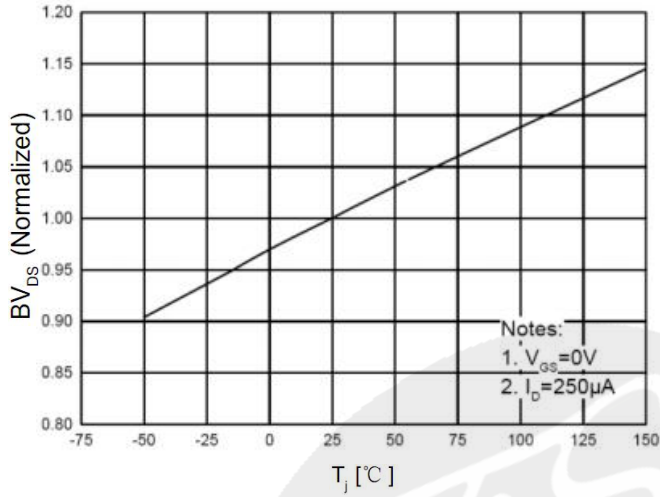


#### Gate Charge Characteristics

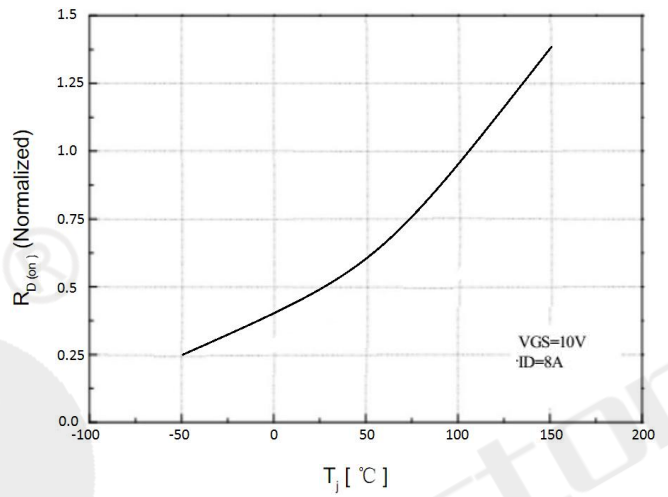




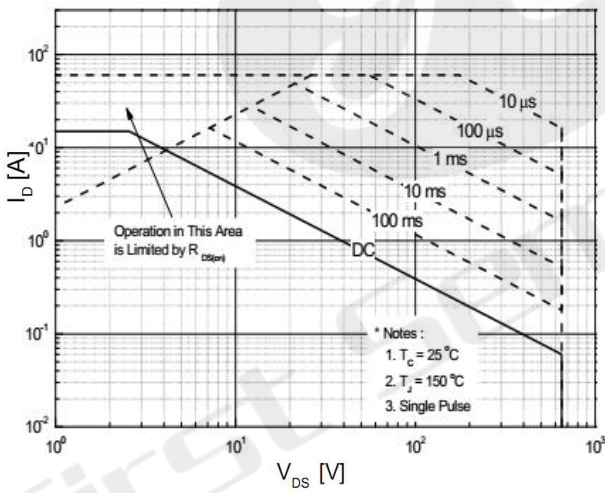
### Breakdown Voltage Variation vs. Temperature



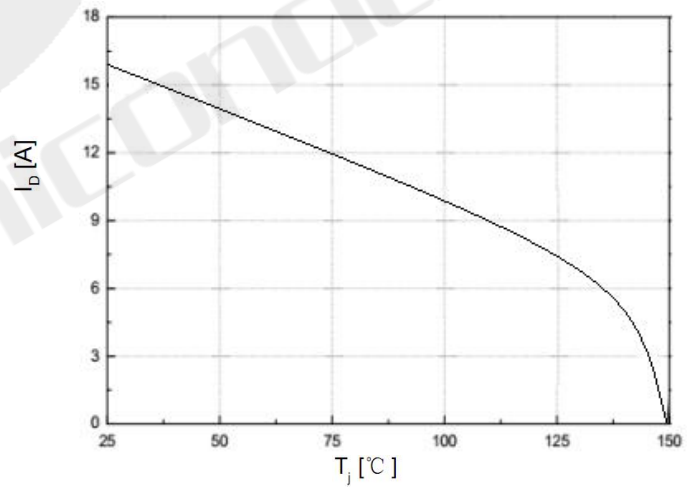
### On-Resistance Variation vs. Temperature



### Maximum Safe Operating Area



### Maximum Drain Current Vs. Case Temperature



Test Circuit and Waveform

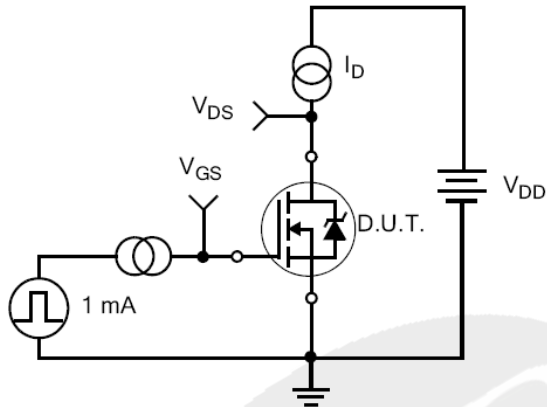


Figure 17. Gate Charge Test Circuit

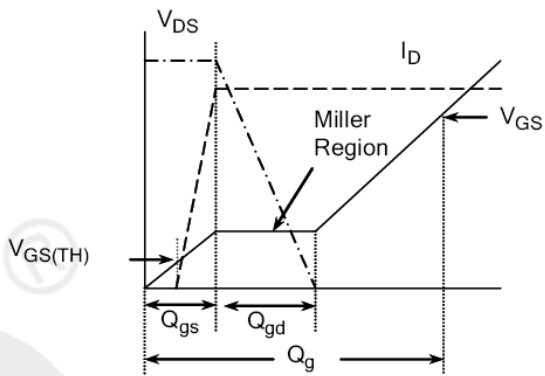


Figure 18. Gate Charge Waveform

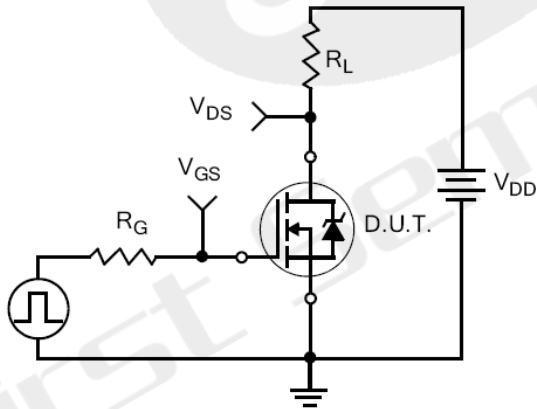


Figure 19. Resistive Switching Test Circuit

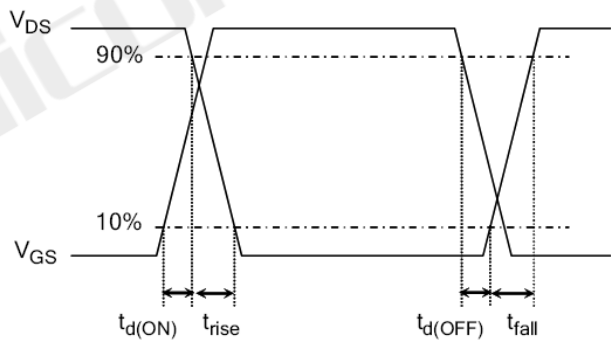


Figure 20. Resistive Switching Waveforms

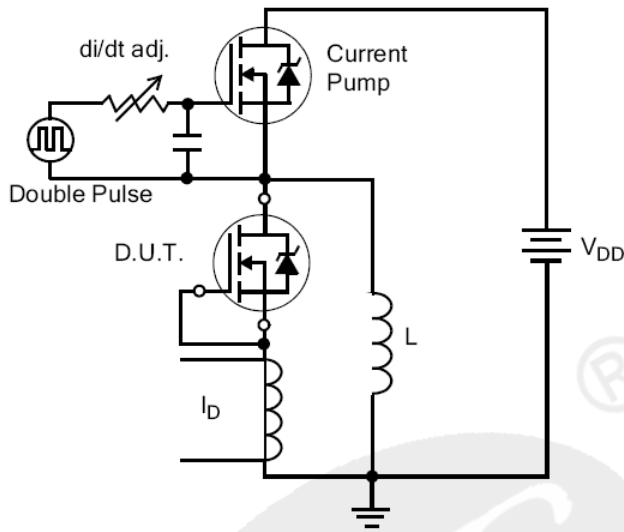


Figure 21. Diode Reverse Recovery Test Circuit

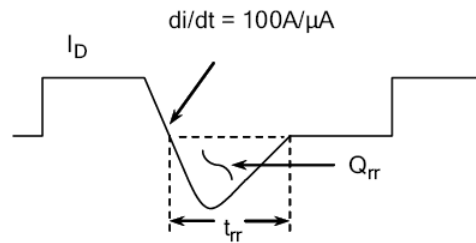


Figure 22. Diode Reverse Recovery Waveform

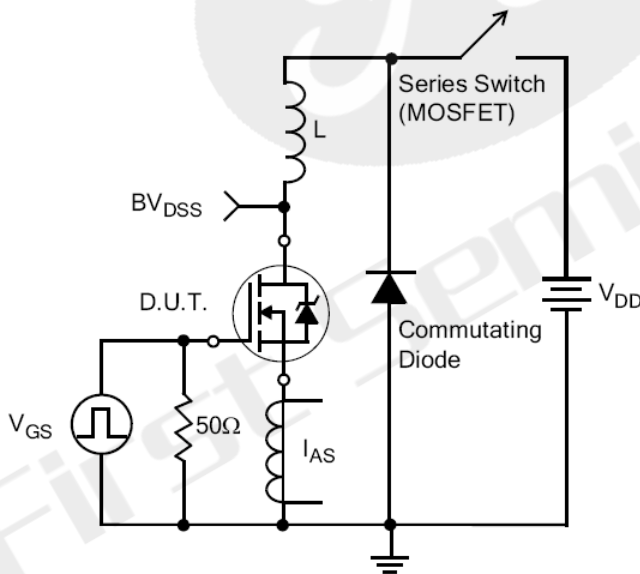


Figure 23. Unclamped Inductive Switching Test Circuit

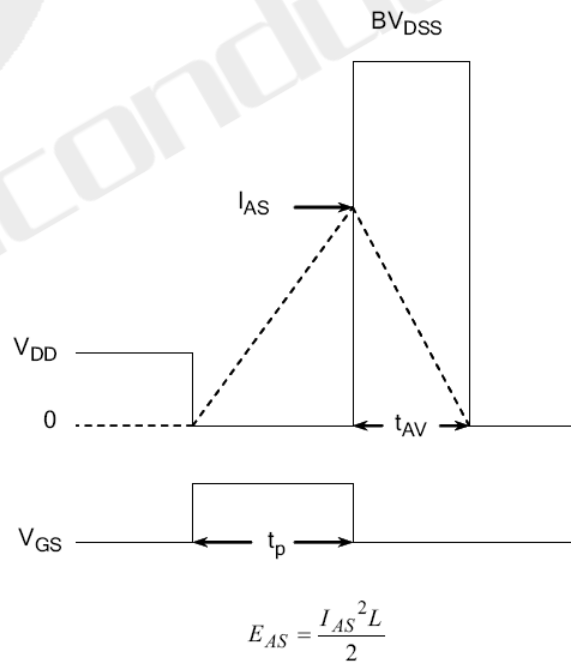


Figure 24. Unclamped Inductive Switching Waveforms







Declaration

- FIRST reserves the right to change the specifications, the same specifications of products due to different packaging line mold, the size of the appearance will be slightly different, shipped in kind, without notice! Customers should obtain the latest version information before ordering, and verify whether the relevant information is complete and up-to-date.
- Any semiconductor product under certain conditions has the possibility of failure or failure, The buyer has the responsibility to comply with safety standards and take safety measures when using FIRST products for system design and manufacturing, To avoid To avoid potential failure risks, which may cause personal injury or property damage!
- Product promotion endless, our company will wholeheartedly provide customers with better products!

**ATTACHMENT**

Revision History

Date	REV	Description	Page
2020.01.01	1.0	Initial release	