Features

- Planar Mosfets
- Excellent $R_{DS(on)}$
- Low Gate Charge
- High current Capability
- Green product RoHS compliant

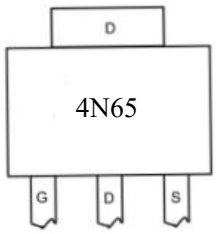
Bvdss	Rdson	ID
650V	2.3Ω	4A

Application

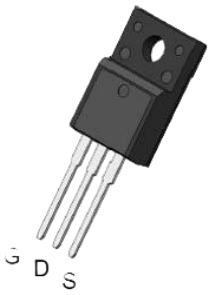
RoHS

- Power factor correction (PFC)
- Switching power supply (SMPS)
- LED driver

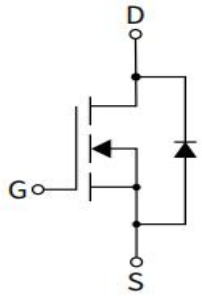
Package



Marking and pin assignment



TO-220F Top view



Schematic diagram

Package Marking and Ordering Information

Device Marking	Device	Device Package	Quantity
4N65	HL4N65RF	TO-220F	50

Absolute Maximum Ratings (T_J=25℃ unless otherwise noted)

Parameter		Symbol	Value	Unit
Drain-Source Voltage		V_{DS}	650	V
Gate-Source Voltage		V_{GS}	±30	V
Continuous Drain Current[1]	T_C=25℃	I_D	4	A
	T_C=100℃		2.6	A
Pulsed Drain Current[2]		I_{DM}	16	A
Body-Diode Continuous Current		I_S	4	A
Avalanche Current[3]		I_{AS}	4.6	A
Single Pulsed Avalanche Energy[3]		EAS	84	mJ
Total Power Dissipation[4]	T_C = 25℃	P_D	114	W
	T_C=100℃		45	
Operating Junction Temperature Range		T_J	-55 ~ 150	℃
Storage Temperature Range		T_{STG}	-55 ~ 150	℃

Thermal Resistance Ratings

Parameter	Symbol	Value	Unit
Thermal Resistance Junction-Ambient	$R_{\theta JA}$	63	℃/W
Thermal Resistance Junction-Case	$R_{\theta JC}$	4.2	℃/W

Ordering Information

Ordering Number	Package	Pin Assignment			Packing
Halogen Free		G	D	S	
HL4N65RF	TO-220F	1	2	3	Tube

Electrical Characteristics (T_J=25℃unless otherwise noted)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Drain-Source Breakdown Voltage	BV_{DSS}	I_D=250μA, V_{GS}=0V	650	-	-	V
Drain-Source Leakage Current	I_{DSS}	V_{DS}=650V, V_{GS}=0V,T_J=25°C	-	-	1	μA
		V_{DS}=650V,V_{GS}=0V,T_J=55°C	-	-	5	
Gate-Source Leakage Current	I_{GSS}	V_{GS}=±30V,V_{DS}=0V	-	-	±100	nA
Gate Threshold Voltage	$V_{GS(th)}$	V_{GS}=V_{DS} , I_D=250uA	2.5	3.4	4.5	V
Static Drain-Source On-Resistance	$R_{DS(on)}$	V_{GS}=10V, I_D=2A	-	2300	2600	mΩ
Forward Transconductance	gfs	V_{DS}=5V,I_D=2A	-	3	-	S
Gate Resistance	R_g	V_{GS}=0V,V_{DS}=0V, f=1MHz	-	1.1	-	Ω
Total Gate Charge	Q_g	V_{DS}=520V,V_{GS}=10V, I_D=4A	-	17.9	-	nC
Gate Source Charge	Q_{gs}		-	7.5	-	
Gate Drain Charge	Q_{gd}		-	4.3	-	
Turn-On Delay Time	$T_{d(on)}$	V_{DS}= 325V, I_D=4A,R_G=25Ω	-	17	-	ns
Rise Time	T_r		-	27	-	
Turn-Off Delay Time	$T_{d(off)}$		-	31	-	
Fall Time	T_f		-	21	-	
Input Capacitance	C_{iss}	V_{GS}=0V,V_{DS}=25V, f=1MHz	-	525	-	pF
Output Capacitance	C_{oss}		-	53	-	
Reverse Transfer Capacitance	C_{rss}		-	5.7	-	
Continuous Source Current	I_S	V_G=V_D=0V,Force Current	-	-	-	A
Diode Forward Voltage	V_{SD}	I_S=2A,V_{GS}=0V	-	0.8	1.2	V
Reverse Recovery Time	t_{rr}	V_R=400V,I_F=4A,di/dt=100A/μs	-	213	-	ns

Reverse Recovery Charge	Q_{rr}		-	1.5	-	μC

Notes:

1. Computed continuous current assumes the condition of T_{J_Max} while the actual continuous depends on the thermal & Electromechanical application board design.

2.Repetitive Rating: Pulse Width Limited by Maximum Junction Temperature.

3.This singe-pulse measurement was taken under the following condition [L=10mH,VGS=10V,VDS=50V] while its value is limited by T_{J_Max}=150°C.

4.The power dissipation P_D is based on T_{J_Max}=150℃.

5.This value is guaranteed by design hence it is not included in the production test.

Typical Performance Characteristics

Figure 1: Saturation Characteristics

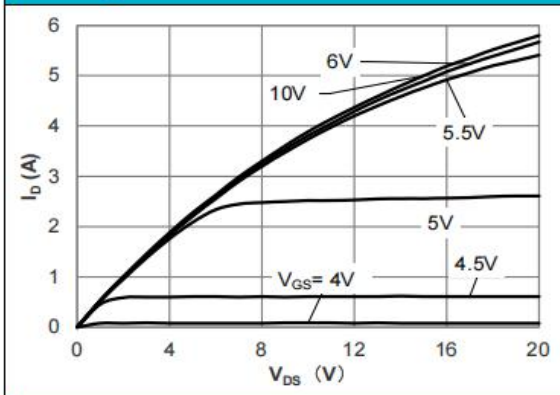


Figure 2: Transfer Characteristics

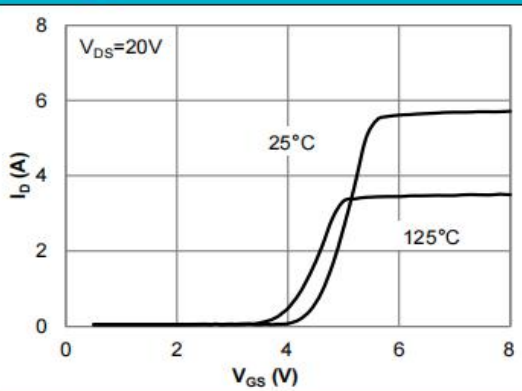


Figure 3: $R_{DS(ON)}$ vs. Drain Current

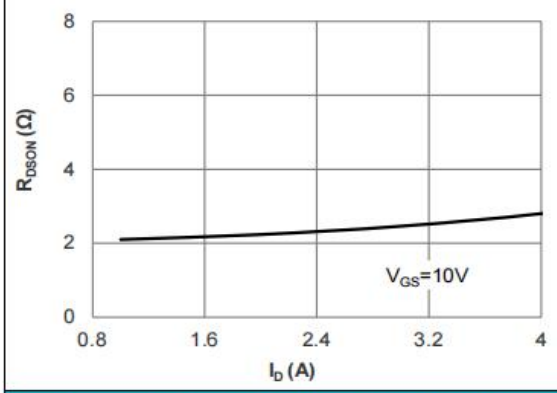


Figure 4: $R_{DS(ON)}$ vs. Junction Temperature

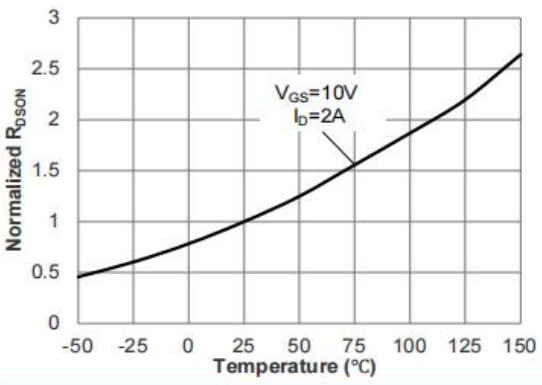


Figure 5: $R_{DS(ON)}$ vs. Gate-Source Voltage

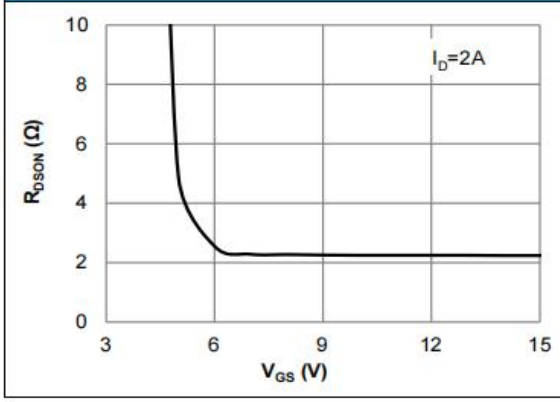


Figure 6: Body-Diode Characteristics

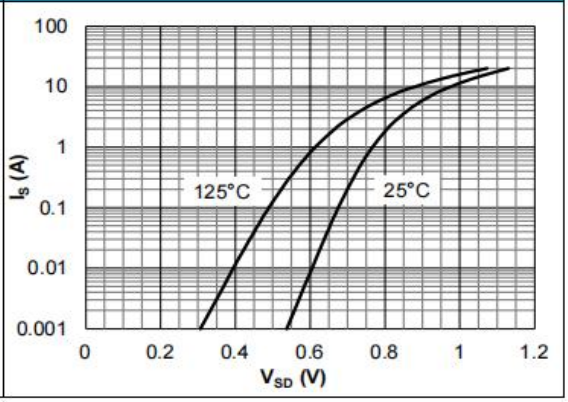


Figure 7: Gate-Charge characteristics

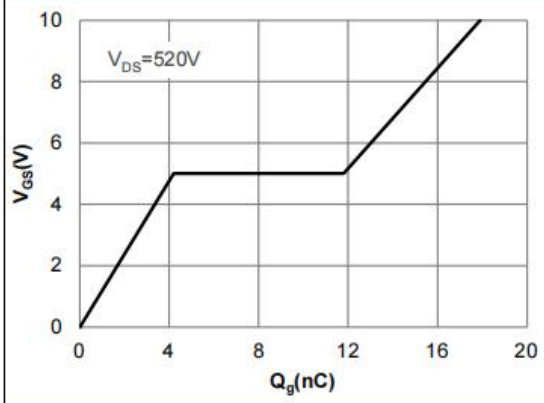


Figure 8: Capacitance characteristics

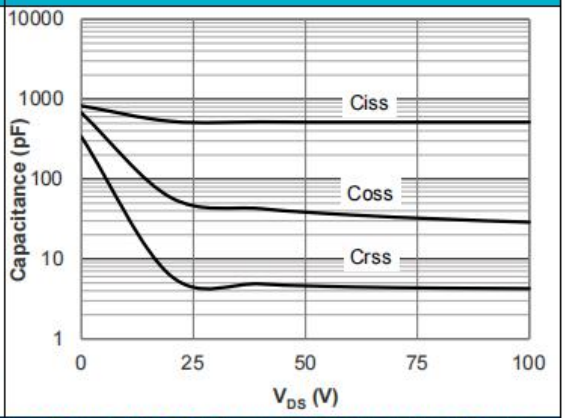


Figure 9: Current De-rating

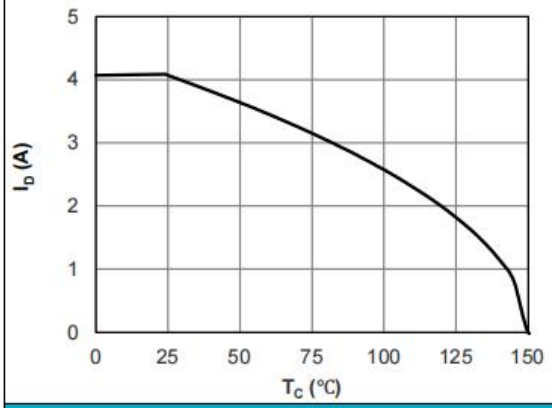


Figure 10: Maximum Safe Operating Area (TO-220C/TO-263)

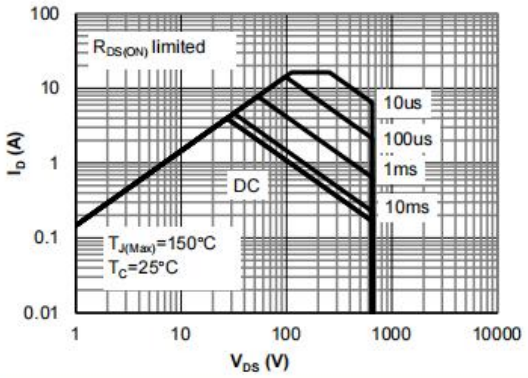


Figure 11: Maximum Safe Operating Area (TO-220F)

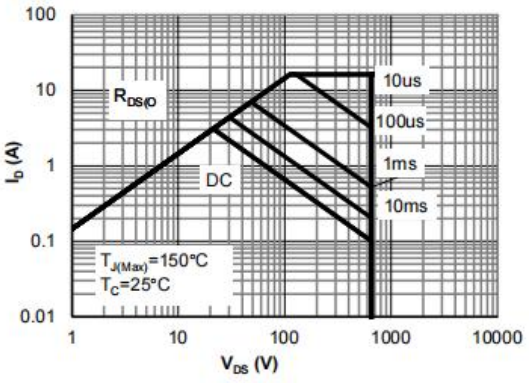


Figure 12: Normalized Maximum Transient Thermal Impedance(TO-220C/TO-263)

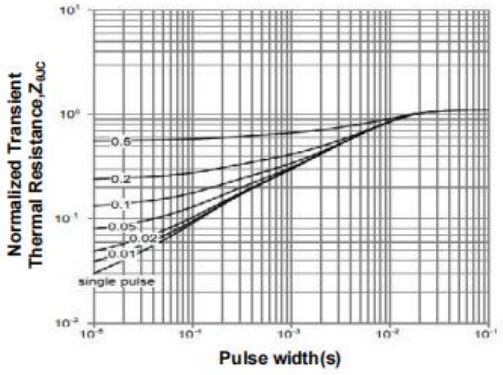
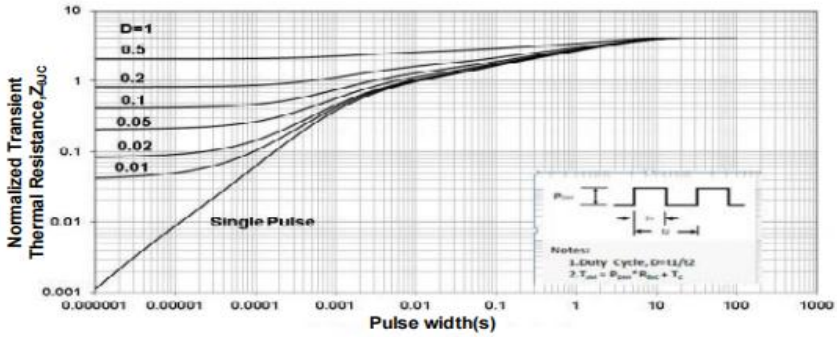


Figure 13: Normalized Maximum Transient Thermal Impedance(TO-220F)



Test Circuit and Waveform

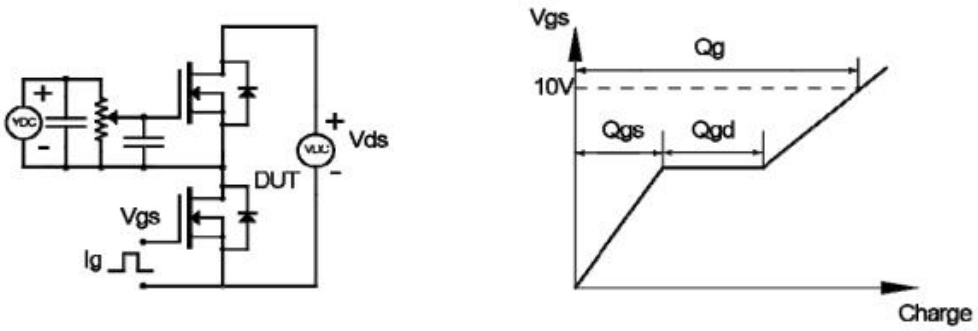


Figure1: Gate Charge Test Circuit & Waveforms

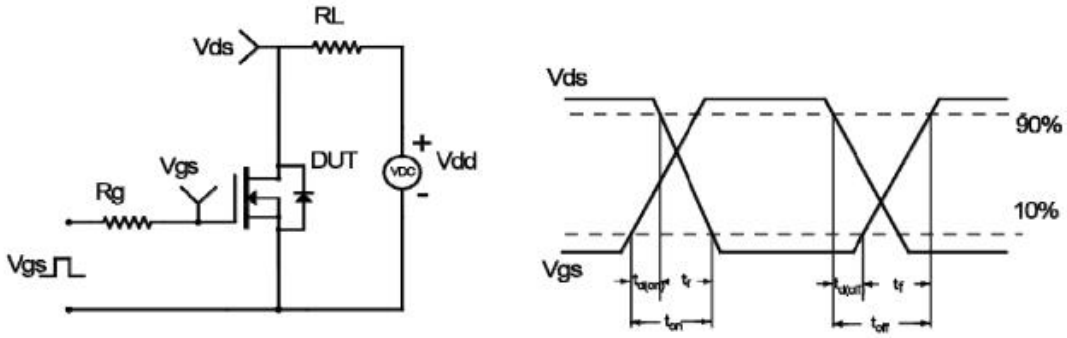


Figure2: Resistive Switching Test Circuit & Waveforms

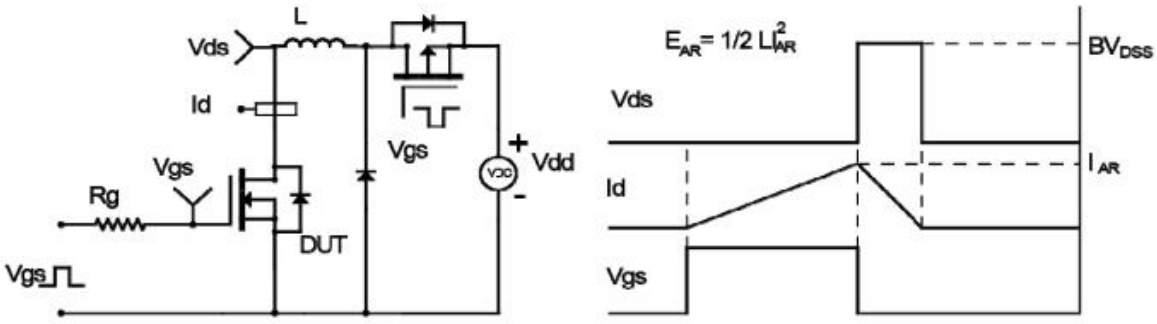


Figure3: Unclamped Inductive Switching (UIS) Test Circuit & Waveforms

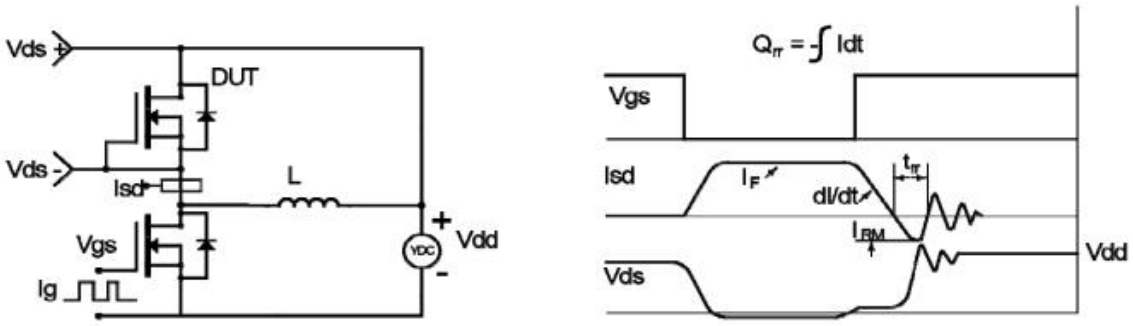
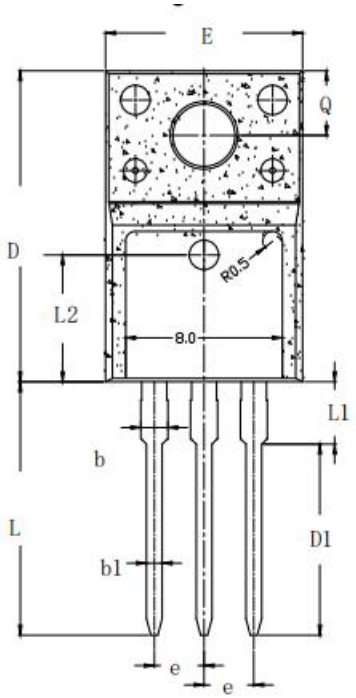
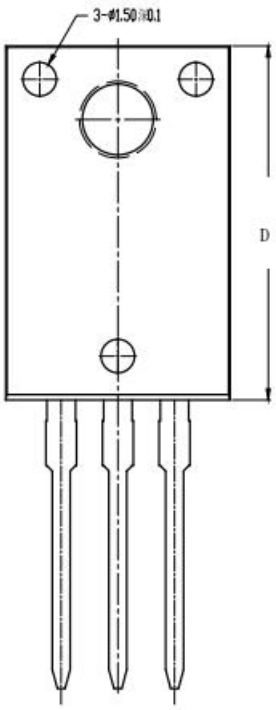


Figure4: Diode Recovery Test Circuit & Waveforms

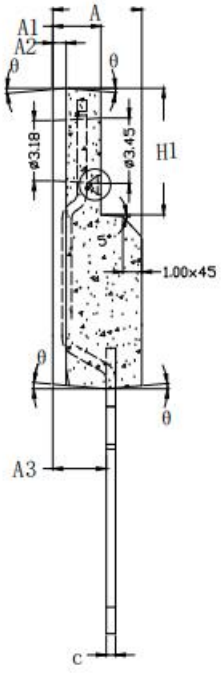
Package Dimensions TO-220F



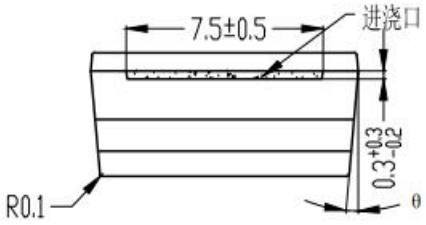
TOP VIEW



BOTTOM VIEW



SIDE VIEW



SIDE VIEW

SYMBOL	MILLIMETER		
	MIN	TYP.	MAX
A	4.60	4.70	4.80
A1	2.39	2.54	2.69
A2	0.60	0.70	0.80
A3	2.81	2.82	2.83
b	1.61	1.62	1.63
b1	-	0.80	-
c	-	0.50	-
D	15.72	15.87	16.02
D1	-	9.75	-
E	9.91	10.06	10.21
e	2.54 BSC		
H1	6.67	6.68	6.69
L	12.90	12.93	12.96
L1	-	3.18	-
L2	6.47 REF		
Q	-	3.30	-
θ1	1°	3°	5°

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