

N-Channel Enhancement Mode Power MOSFET

Description

SMIRF5N65 is an N-channel enhancement mode power MOS field effect transistor. The improved planar stripe cell and the improved guard ring terminal have been especially tailored to minimize on-state resistance, provide superior switching performance, and withstand high energy pulse in the avalanche and commutation mode.

These devices are widely used in AC-DC power suppliers, DC/DC converters and H-bridge PWM motor drivers.

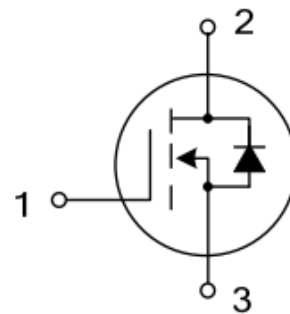
General Features

- 5A, 650V, $R_{DS(on)}$ (typ.)= 1.9ohm@ $V_{GS}=10V$
- Low Gate charge
- Low C_{rss}
- Fast Switching
- Improved dv/dt Capability

Application

- Power switching application
- Hard switched and high frequency circuits
- Uninterruptible power supply

I_D	5A
V_{DSS}	650V
$R_{dson (max)}$	2.3Ω($V_{GS}=10V, I_D=2.5A$)
Q_g	15nC



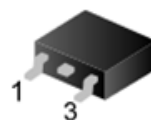
1.Gate 2.Drain 3.Source



TO-220



TO-220F



TO-252



TO-251

**Order Information**

Order Information	Marking ID	Package	Packing Type Supplied As
SMIRF5N65TBRL	IRF5N65	TO251-3L	2400 Units on Box
SMIRF5N65T9RL	IRF5N65	TO252-2L	3000 Units on Reel
SMIRF5N65T2TL	IRF5N65	TO220F-3L	1000 units on Box, 5000 units on Carton
SMIRF5N65T1TL	IRF5N65	TO220-3L	1000 units on Box, 5000 units on Carton

Absolute Maximum Ratings Ta=25 °C unless otherwise noted

Parameter	Symbol	Value	Unit
Drain-source Voltage	V_{DS}	650	V
Gate-source Voltage	V_{GS}	± 30	V
Continuous Drain Current(Ta=25°C)	I_D	5	A
Drain Current-Pulsed	I_{DM}	20	A
Total Dissipation (Ta=25°C)	TO251	55	W
	TO252	50	
	TO220	30	
	TO220F	30	
Junction Temperature	T_J	150	°C
Storage Temperature	T_{STG}	-65 to 150	°C
Single Pulse Avalanche Energy	E_{AS}	210	mJ
ESD HBM(Human Body Mode)		≥ 2000	V
ESD MM(Machine Mode)		≥ 200	V

Electrical Characteristics Ta = 25°C

PARAMETER	Symbol	Test Condition	MIN	TYP	MAX	UNIT
Drain-source Breakdown Voltage	BV_{DSS}	$V_{GS}=0V, I_D=250\mu A$	650			V
Gate Threshold Voltage	$V_{GS(TH)}$	$V_{GS}=V_{DS}, I_D=250\mu A$	2.0		4.0	V
Drain-source Leakage Current	I_{DSS}	$V_{DS}=650V, V_{GS}=0V$			25	μA
Drain-Source Diode Forward Voltage	V_{SD}	$V_{GS}=0V, I_S=5A$			1.4	V
Gate-body Leakage Current ($V_{DS} = 0$)	I_{GSS}	$V_{GS}=\pm 30V$			± 100	nA
Static Drain-source On Resistance	$R_{DS(ON)}$	$V_{GS}=10V, I_D=2.5A$		1.9	2.3	Ω

Thermal Characteristics Ta=25°C

PARAMETER		Symbol	TYP	MAX	UNIT
Maximum Junction-to-case (note1)	TO251,TO252	R _{QJC}		2.5	°C/W
	TO220F,TO220			3	°C/W
Maximum Junction-to-Ambient	TO251,TO252	R _{QJA}		63	°C/W
	TO220F,TO220			80	

Note1: Surface Mounted on FR4 Board, t ≤ 10 sec

Dynamic Characteristics Ta = 25 °C

PARAMETER	Symbol	Test Condition	MIN	TYP	MAX	UNIT
Input Capacitance	C _{iss}	V _{DS} =25V, V _{GS} =0V, f=1.0MHZ		560	600	pF
output Capacitance	C _{oss}			70	78	pF
Reverse Transfer Capacitance	C _{rss}			8	10	pF

Switching Characteristics Ta=25 °C

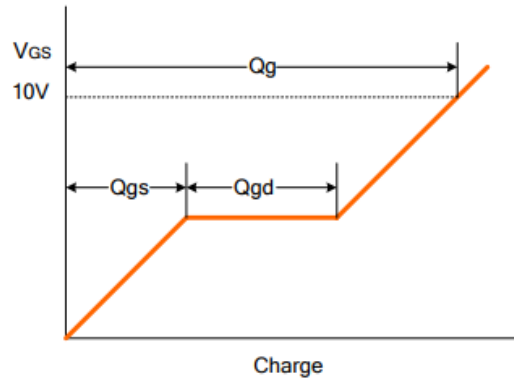
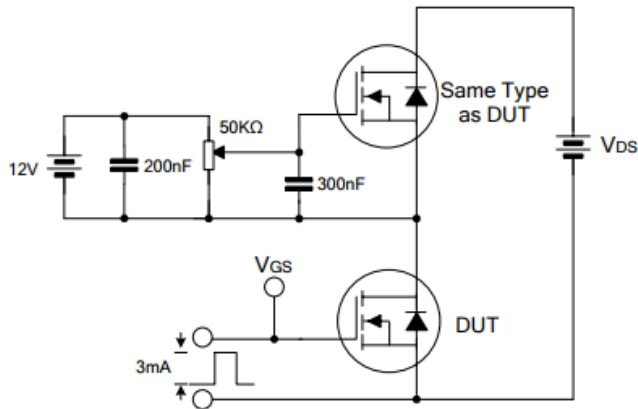
PARAMETER	Symbol	Test Condition	MIN	TYP	MAX	UNIT
Turn-On Delay Time	T _{d(on)}	V _{DS} =300V, I _D =5A, R _G =25Ω		13	26	nS
Turn-On Rise Time	T _r			45	8	nS
Turn-Off Delay Time	T _{d(off)}			38	120	nS
Turn-Off Rise Time	T _f			35	85	nS
Total Gate Charge	Q _g	V _{DS} =480V, I _D =5A, V _{GS} =10V		15		nC
Gate-Source Charge	Q _{gs}			2.5		nC
Gate-Drain Charge	Q _{gd}			6.6		nC

Drain-Source Diode Maximum Ratings and Characteristics Ta=25 °C

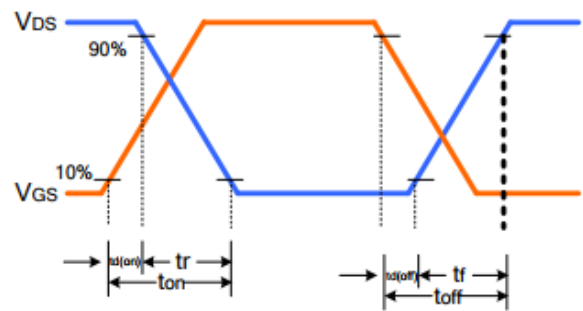
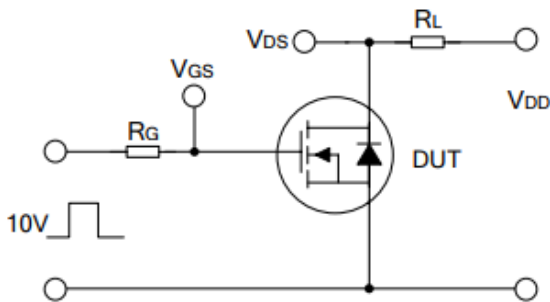
PARAMETER	Symbol	Test Condition	MIN	TYP	MAX	UNIT
Max. Diode Forward Current	I _s	Integral Reverse P-N Junction Diode in the MOSFET			5	A
Pulsed Source Current	I _{sm}				20	
Diode Forward Voltage	V _{SD}	V _{GS} =0V, I _s =5A			1.5	V
Reverse Recovery Time	T _{rr}	V _{GS} =0V, I _s =5A, dI _F /dt=100A/μs		270		nS
Reverse Recovery Charge	Q _{rr}				1.9	

Test Circuit

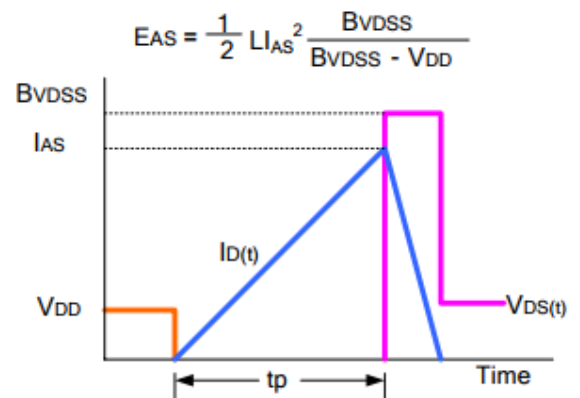
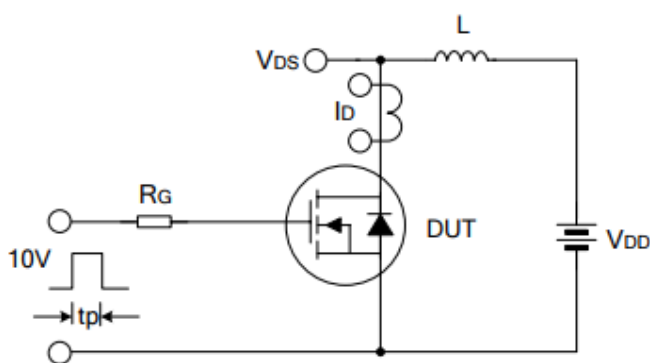
Gate Charge Test Circuit & Waveform



Resistive Switching Test Circuit & Waveform



Unclamped Inductive Switching Test Circuit & Waveform



Typical Electrical And Thermal Characteristics

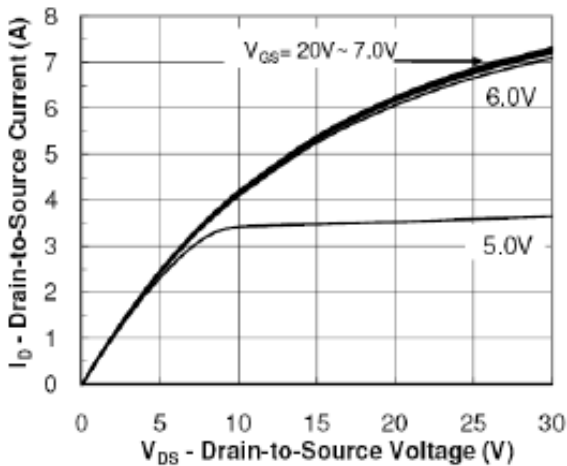


Figure 1: Output Characteristics

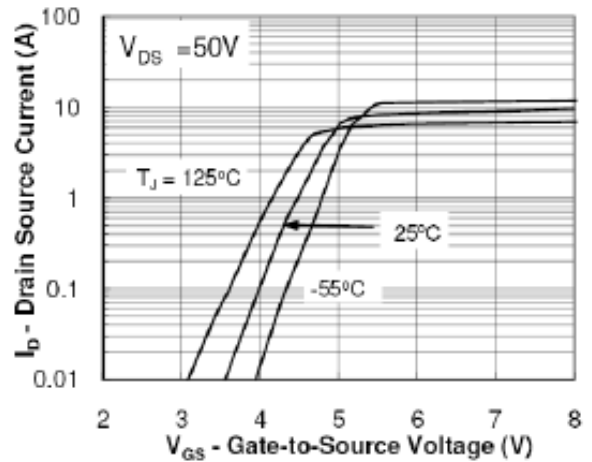


Figure 2: Transfer Characteristics

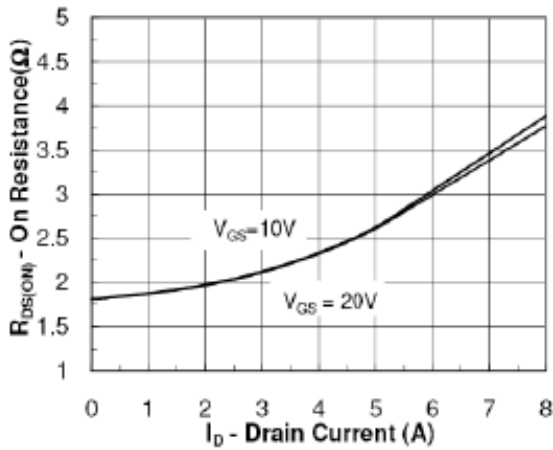
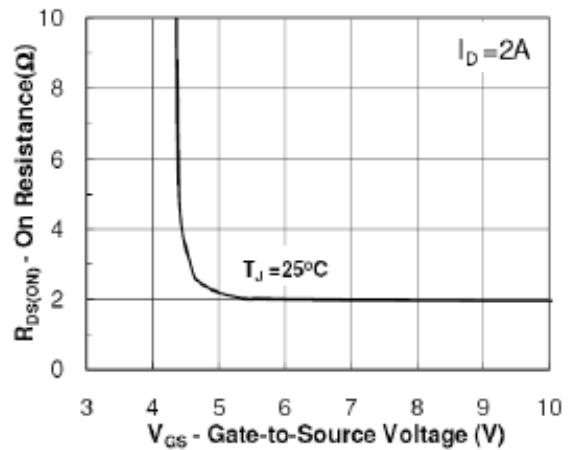


Figure 3: On Resistance Vs Drain Current



Source Voltage

Figure 4: On Resistance Vs Gate

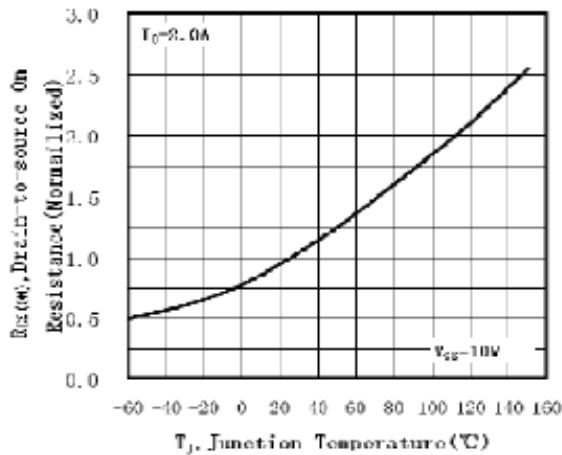


Figure 5: On Resistance Vs Junction Temperature Characteristics

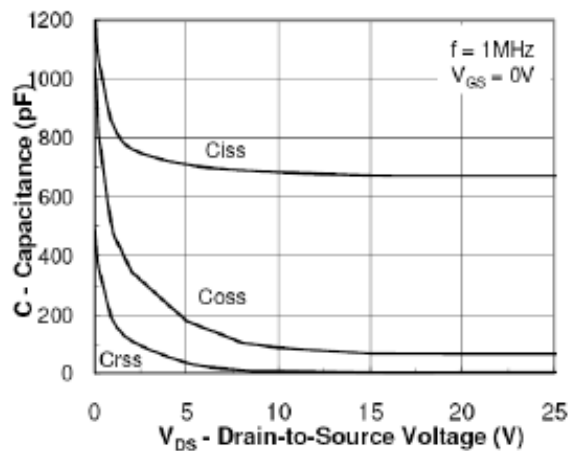


Figure 6: Capacitance Characteristics

Characteristics Curve

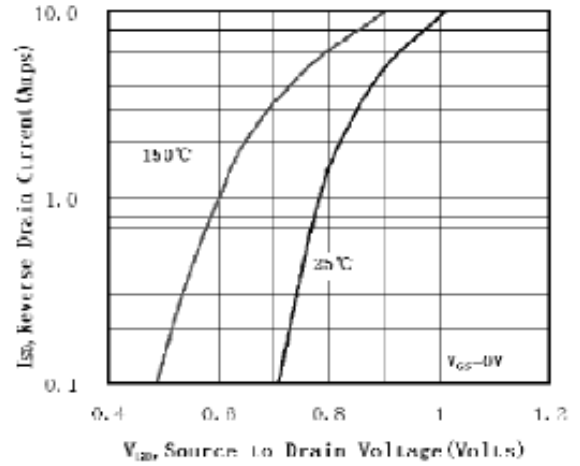
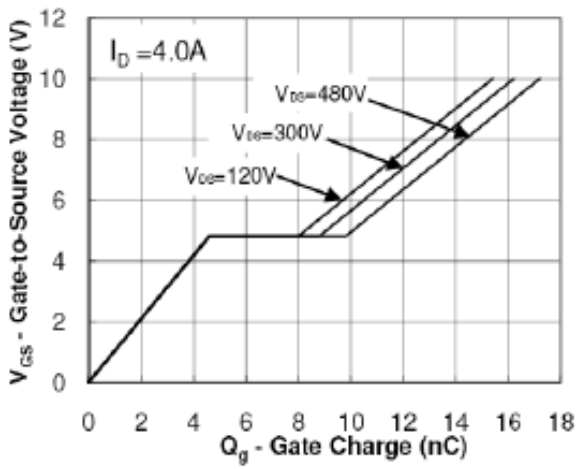


Figure7: Gate Charge Waveform
Forward Voltage

Figure8: Source-Drain Diode

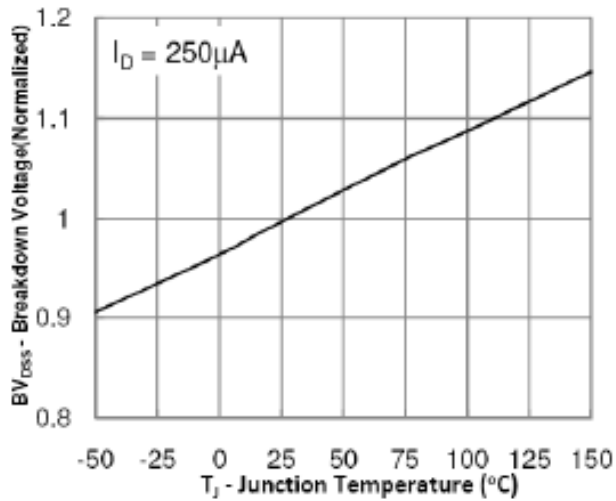
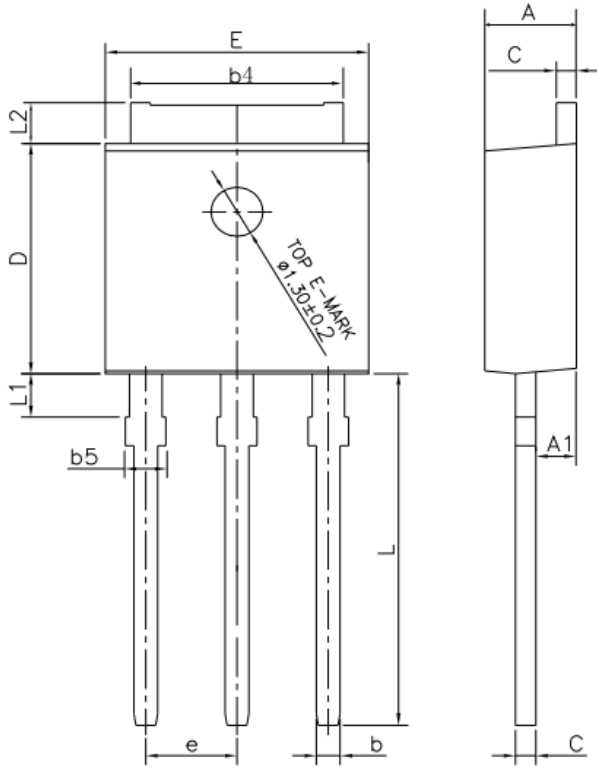


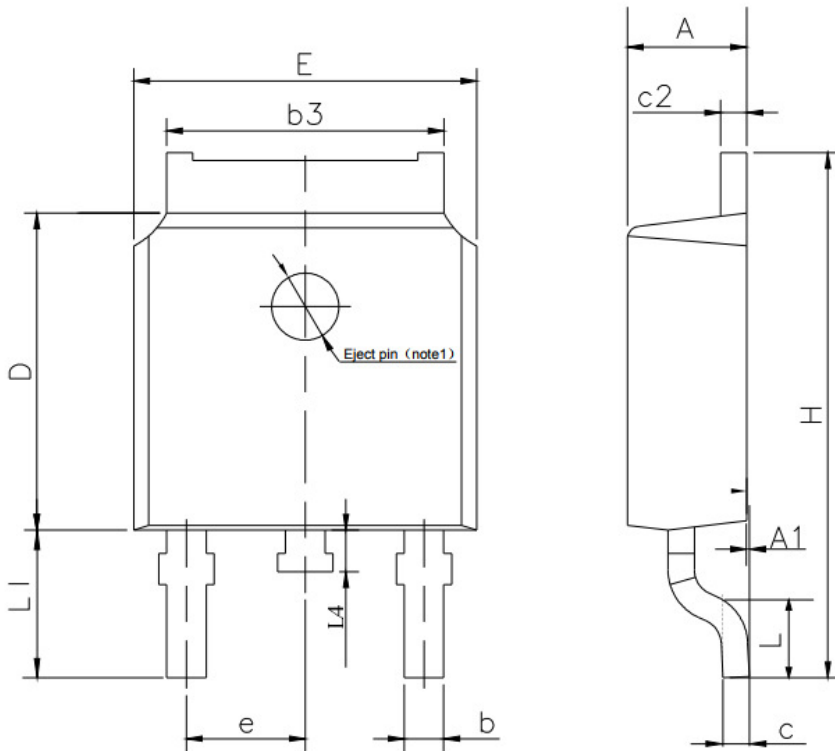
Figure9: Breakdown Voltage Vs Junction Temperature

Outline Information (TO251-3L)



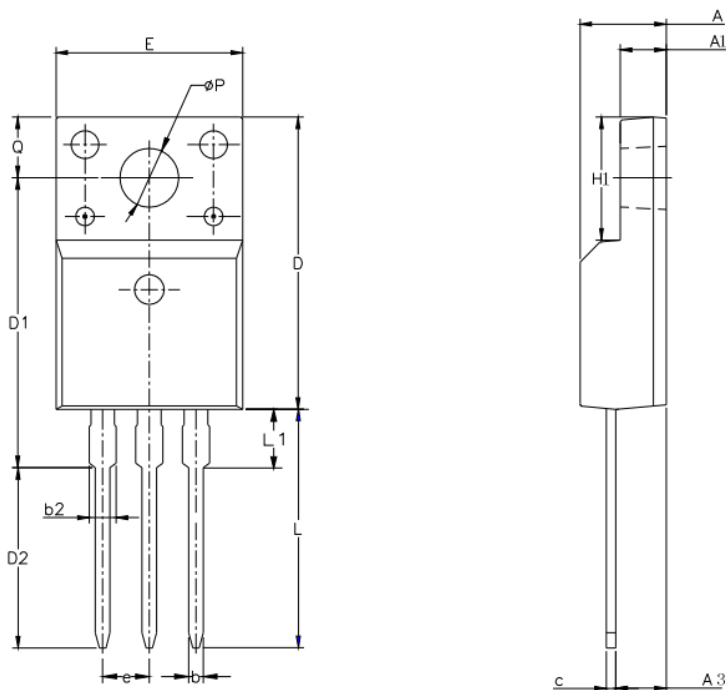
SYMBOL	MIN	NOM	MAX
A	2.18	2.30	2.39
A1	0.89	1.00	1.14
b	0.56	---	0.89
b4	4.95	5.33	5.46
b5	---	---	1.05
c	0.46	---	0.61
D	5.97	6.10	6.27
E	6.35	6.60	6.73
e	2.29 BCS		
L	8.89	9.30	9.65
L1	0.95	---	1.50
L2	0.89	---	1.27

Outline Information (TO252-2L)



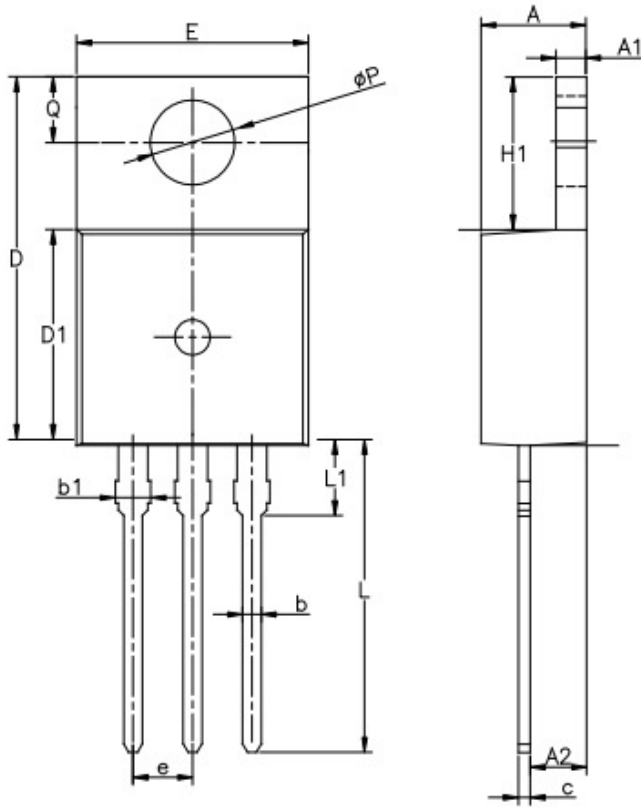
SYMBOL	MIN	NOM	MAX
A	2.10	2.30	2.50
A1	0	---	0.127
b	0.66	0.76	0.89
b3	5.10	5.33	5.46
c	0.45	---	0.65
c2	0.45	---	0.65
D	5.80	6.10	6.40
E	6.30	6.60	6.90
e	2.30TYP		
H	9.60	10.10	10.60
L	1.40	1.50	1.70
L1	2.90REF		
L4	0.60	0.80	1.00

Outline Information (TO220F-3L)



SYMBOL	MIN	NOM	MAX
A	4.42	4.70	5.02
A1	2.30	2.54	2.80
A3	2.50	2.76	3.10
b	0.70	0.80	0.90
b2	—	—	1.47
c	0.35	0.50	0.65
D	15.25	15.87	16.25
D1	15.30	15.75	16.30
D2	9.30	9.80	10.30
E	9.73	10.16	10.36
e	2.54BCS		
H1	6.40	6.68	7.00
L	12.48	12.98	13.48
L1	/	/	3.50
øP	3.00	3.18	3.40
Q	3.05	3.30	3.55

Outline Information (TO220-3L)



SYMBOL	MIN	NOM	MAX
A	4.30	4.50	4.70
A1	1.00	1.30	1.50
A2	1.80	2.40	2.80
b	0.60	0.80	1.00
b1	1.00	—	1.60
c	0.30	—	0.70
D	15.10	15.70	16.10
D1	8.10	9.20	10.00
E	9.60	9.90	10.40
e	2.54BSC		
H1	6.10	6.50	7.00
L	12.60	13.08	13.60
L1	—	—	3.95
ϕP	3.40	3.70	3.90
Q	2.60	—	3.20