

## HM10N65D / HM10N65F

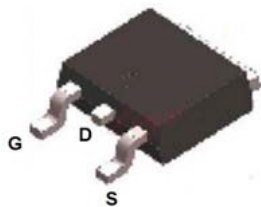
### 650V N-Channel MOSFET

#### General Description

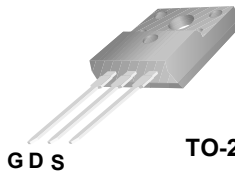
This Power MOSFET is produced using SL semi's advanced planar stripe DMOS technology. This advanced technology has been especially tailored to minimize on-state resistance, provide superior switching performance, and withstand high energy pulse in the avalanche and commutation mode. These devices are well suited for high efficiency switched mode power supplies, active power factor correction based on half bridge topology.

#### Features

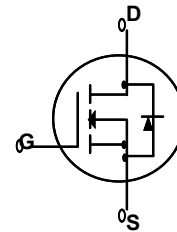
- 10A, 650V,  $R_{DS(on)} = 1.09\Omega @ V_{GS} = 10V$
- Low gate charge ( typical 52nC)
- High ruggedness
- Fast switching
- 100% avalanche tested
- Improved dv/dt capability



TO-263-2L



TO-220F



#### Absolute Maximum Ratings T<sub>C</sub> = 25°C unless otherwise noted

Symbol	Parameter	HM10N65D	HM10N65F	Units
V <sub>DSS</sub>	Drain-Source Voltage	650		V
I <sub>D</sub>	Drain Current - Continuous (T <sub>C</sub> = 25°C) - Continuous (T <sub>C</sub> = 100°C)	10	10*	A
		7	7	A
I <sub>DM</sub>	Drain Current - Pulsed (Note 1)	30	30*	A
V <sub>GSS</sub>	Gate-Source Voltage	± 30		V
E <sub>AS</sub>	Single Pulsed Avalanche Energy (Note 2)	865		mJ
E <sub>AR</sub>	Repetitive Avalanche Energy (Note 1)	23.1		mJ
dv/dt	Peak Diode Recovery dv/dt (Note 3)	4.5		V/ns
P <sub>D</sub>	Power Dissipation (T <sub>C</sub> = 25°C) - Derate above 25°C	231	54	W
		1.85	0.43	W/°C
T <sub>J</sub> , T <sub>STG</sub>	Operating and Storage Temperature Range	-55 to +150		°C
T <sub>L</sub>	Maximum lead temperature for soldering purposes, 1/8" from case for 5 seconds	300		°C

\* Drain current limited by maximum junction temperature.

#### Thermal Characteristics

Symbol	Parameter	HM10N65D	HM10N65F	Units
R <sub>θJC</sub>	Thermal Resistance, Junction-to-Case	0.54	2.33	°C/W
R <sub>θCS</sub>	Thermal Resistance, Case-to-Sink Typ.	0.5	--	°C/W
R <sub>θJA</sub>	Thermal Resistance, Junction-to-Ambient	62.5	62.5	°C/W

**Electrical Characteristics**  $T_C = 25^\circ\text{C}$  unless otherwise noted

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
<b>Off Characteristics</b>						
$BV_{DSS}$	Drain-Source Breakdown Voltage	$V_{GS} = 0\text{ V}, I_D = 250\ \mu\text{A}$	650	--	--	V
$\Delta BV_{DSS} / \Delta T_J$	Breakdown Voltage Temperature Coefficient	$I_D = 250\ \mu\text{A}$ , Referenced to $25^\circ\text{C}$	--	0.7	--	$\text{V}/^\circ\text{C}$
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS} = 650\text{ V}, V_{GS} = 0\text{ V}$	--	--	1	$\mu\text{A}$
		$V_{DS} = 520\text{ V}, T_C = 125^\circ\text{C}$	--	--	10	$\mu\text{A}$
$I_{GSSF}$	Gate-Body Leakage Current, Forward	$V_{GS} = 30\text{ V}, V_{DS} = 0\text{ V}$	--	--	100	nA
$I_{GSSR}$	Gate-Body Leakage Current, Reverse	$V_{GS} = -30\text{ V}, V_{DS} = 0\text{ V}$	--	--	-100	nA

<b>On Characteristics</b>						
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS} = V_{GS}, I_D = 250\ \mu\text{A}$	2.0	--	4.0	V
$R_{DS(on)}$	Static Drain-Source On-Resistance	$V_{GS} = 10\text{ V}, I_D = 6.0\text{ A}$	--	0.87	1.09	$\Omega$

<b>Dynamic Characteristics</b>						
$C_{iss}$	Input Capacitance	$V_{DS} = 25\text{ V}, V_{GS} = 0\text{ V},$ $f = 1.0\text{ MHz}$	--	1850	--	pF
$C_{oss}$	Output Capacitance		--	180	--	pF
$C_{rss}$	Reverse Transfer Capacitance		--	20	--	pF

<b>Switching Characteristics</b>							
$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = 325\text{ V}, I_D = 10\text{ A},$ $R_G = 25\ \Omega$	--	30	--	ns	
$t_r$	Turn-On Rise Time		--	90	--	ns	
$t_{d(off)}$	Turn-Off Delay Time		(Note 4, 5)	--	140	--	ns
$t_f$	Turn-Off Fall Time		(Note 4, 5)	--	90	--	ns
$Q_g$	Total Gate Charge	$V_{DS} = 520\text{ V}, I_D = 10\text{ A},$ $V_{GS} = 10\text{ V}$	--	52	-	nC	
$Q_{gs}$	Gate-Source Charge		(Note 4, 5)	--	8.5	--	nC
$Q_{gd}$	Gate-Drain Charge		(Note 4, 5)	--	20.0	--	nC

<b>Drain-Source Diode Characteristics and Maximum Ratings</b>						
$I_S$	Maximum Continuous Drain-Source Diode Forward Current	--	--	10	--	A
$I_{SM}$	Maximum Pulsed Drain-Source Diode Forward Current	--	--	30	--	A
$V_{SD}$	Drain-Source Diode Forward Voltage	$V_{GS} = 0\text{ V}, I_S = 10\text{ A}$	--	--	1.4	V
$t_{rr}$	Reverse Recovery Time	$V_{GS} = 0\text{ V}, I_S = 10\text{ A},$	--	430	--	ns
$Q_{rr}$	Reverse Recovery Charge	$di_F / dt = 100\text{ A}/\mu\text{s}$ (Note 4)	--	5.0	--	$\mu\text{C}$

- Notes:**
1. Repetitive Rating : Pulse width limited by maximum junction temperature
  2.  $L = 11.0\text{mH}, I_{AS} = 10\text{ A}, V_{DD} = 50\text{ V}, R_G = 25\ \Omega$ , Starting  $T_J = 25^\circ\text{C}$
  3.  $I_{SD} \leq 10\text{ A}, di/dt \leq 200\text{ A}/\mu\text{s}, V_{DD} \leq BV_{DSS}$ , Starting  $T_J = 25^\circ\text{C}$
  4. Pulse Test : Pulse width  $\leq 300\ \mu\text{s}$ , Duty cycle  $\leq 2\%$
  5. Essentially independent of operating temperature

Typical Characteristics

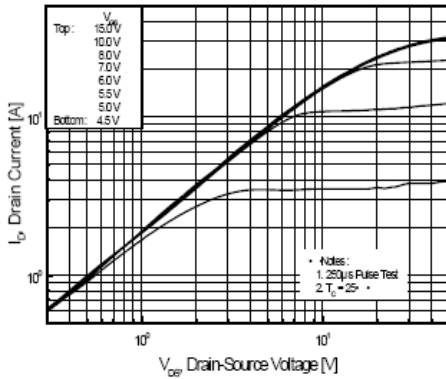


Figure 1. On-Region Characteristics

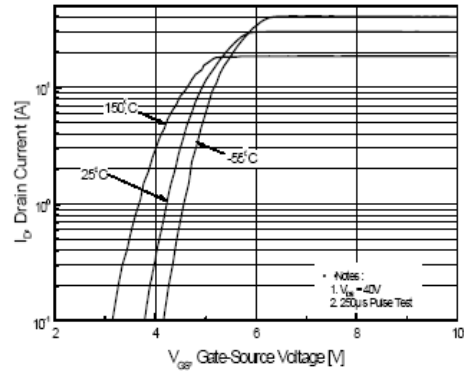


Figure 2. Transfer Characteristics

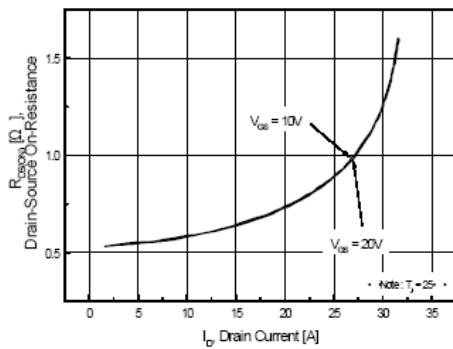


Figure 3. On-Resistance Variation vs Drain Current and Gate Voltage

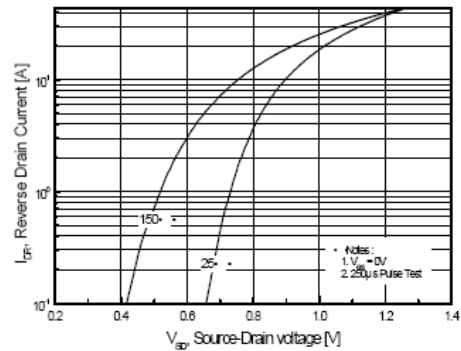


Figure 4. Body Diode Forward Voltage Variation with Source Current and Temperature

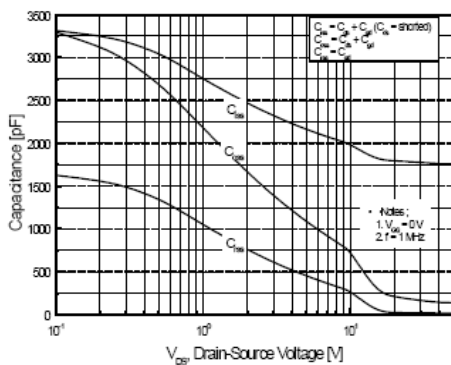


Figure 5. Capacitance Characteristics

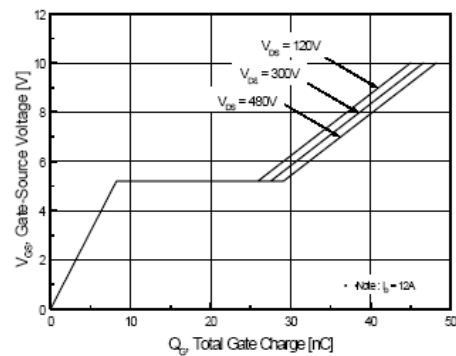


Figure 6. Gate Charge Characteristics

Typical Characteristics (Continued)

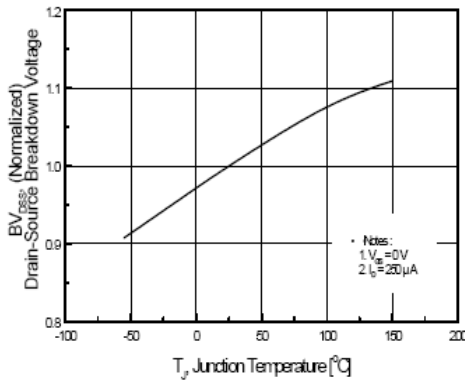


Figure 7. Breakdown Voltage Variation vs Temperature

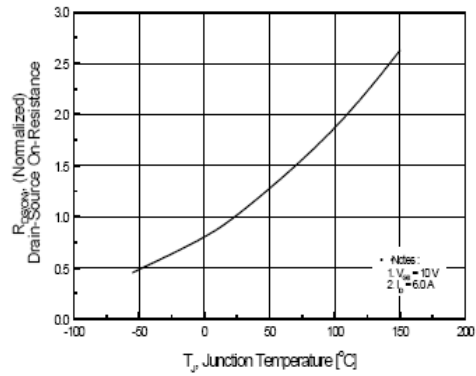


Figure 8. On-Resistance Variation vs Temperature

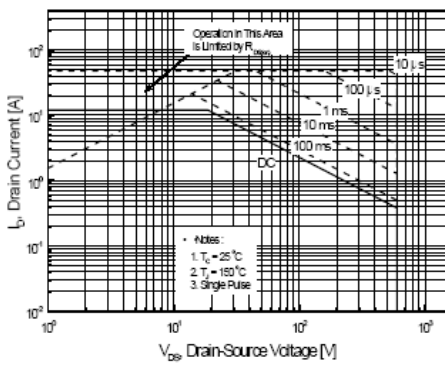


Figure 9-1. Maximum Safe Operating Area for HM10N65D

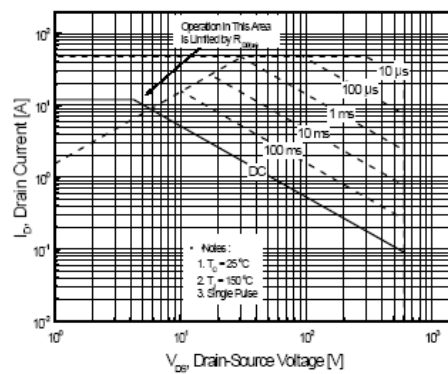


Figure 9-2. Maximum Safe Operating Area for HM10N65F

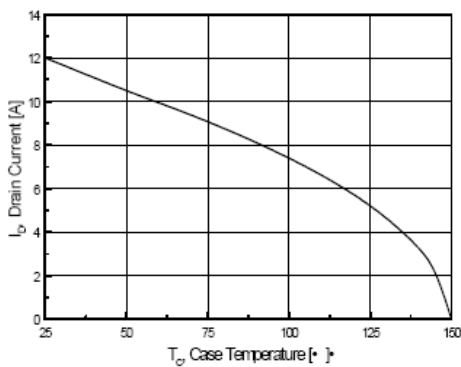


Figure 10. Maximum Drain Current vs Case Temperature

Typical Characteristics (Continued)

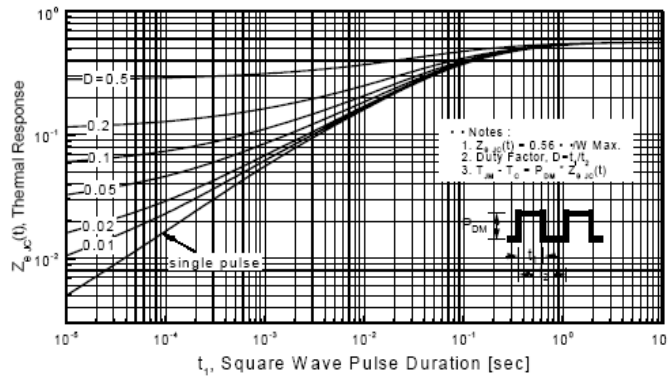


Figure 11-1. Transient Thermal Response Curve for HM10N65D

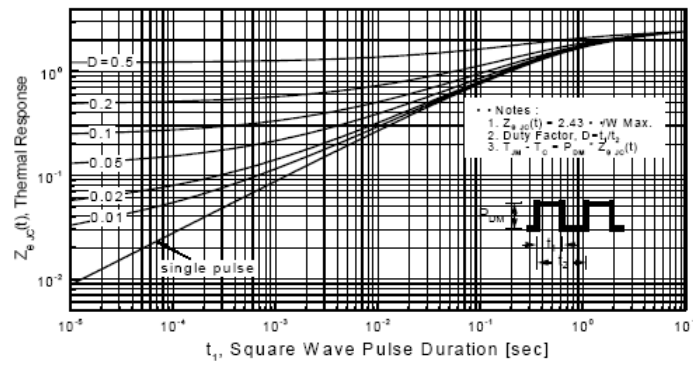
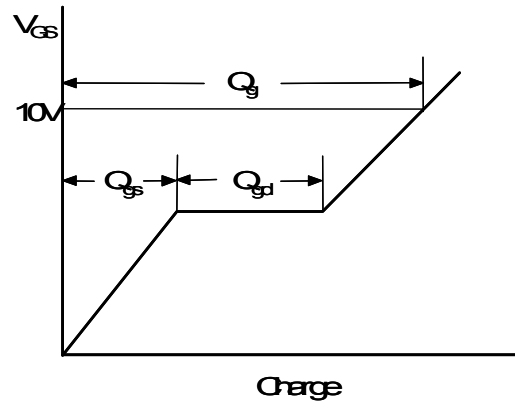
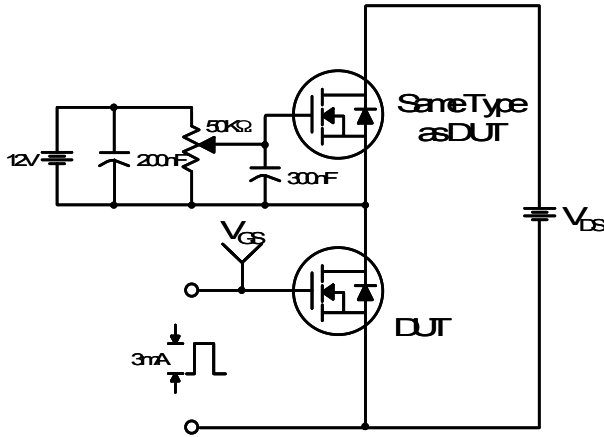
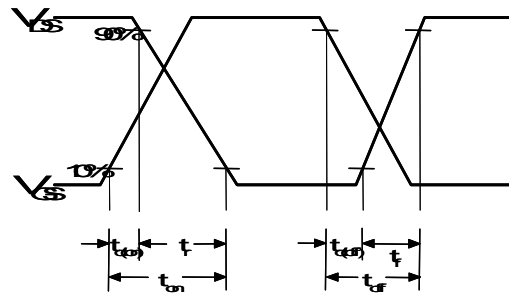
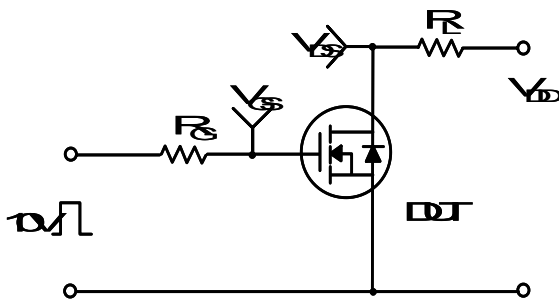


Figure 11-2. Transient Thermal Response Curve for HM10N65F

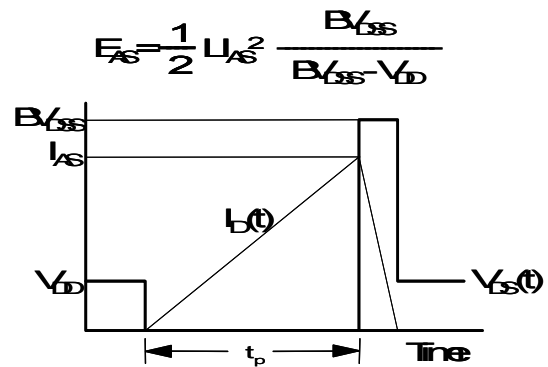
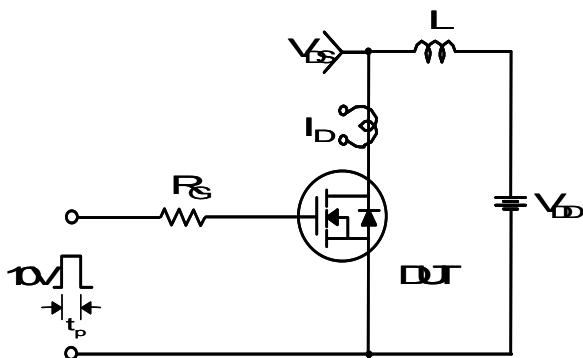
Gate Charge Test Circuit & Waveform



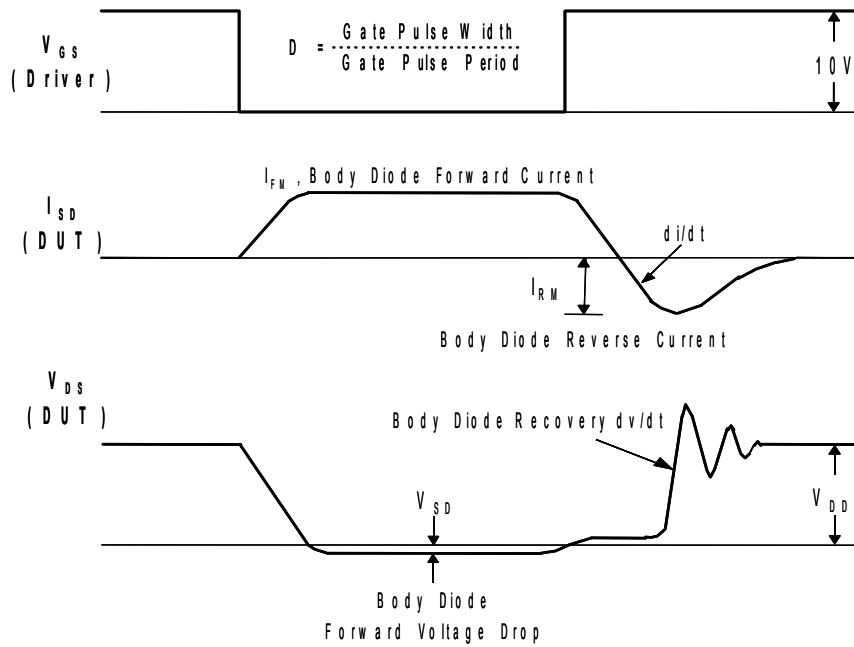
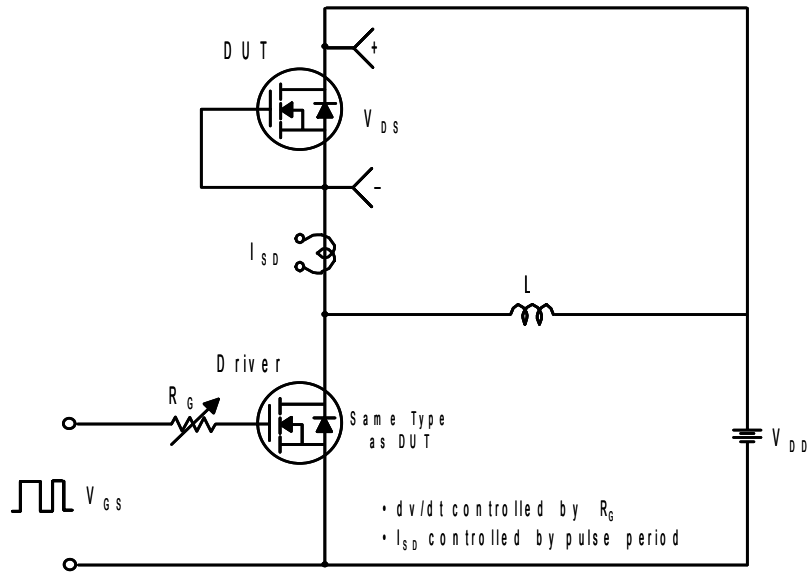
Resistive Switching Test Circuit & Waveforms



Unclamped Inductive Switching Test Circuit & Waveforms



Peak Diode Recovery dv/dt Test Circuit & Waveforms

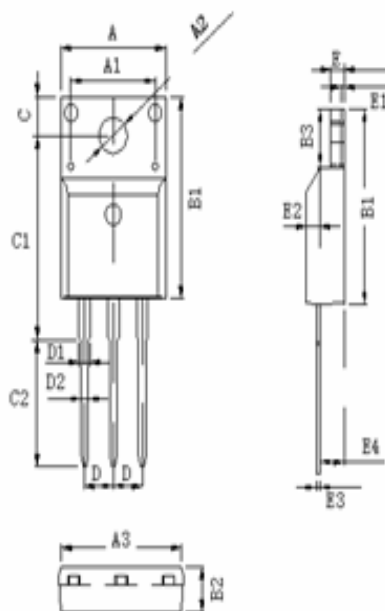


Package Dimensions

TO-220F

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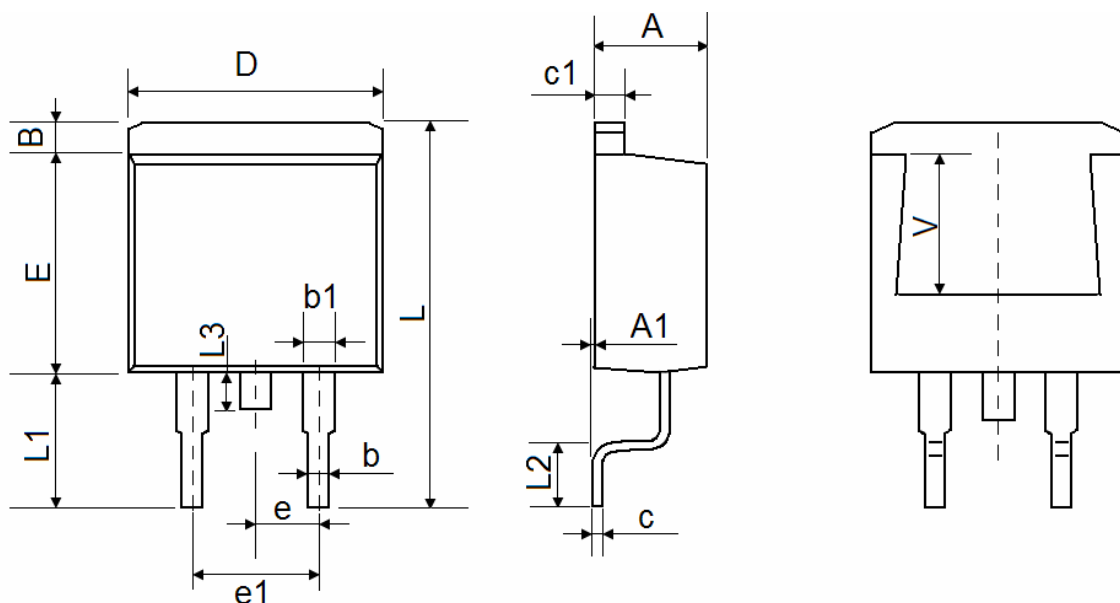
TO-220F 外形尺寸图



DIM.	MILLIMETERS.	
A	10.03 ± 0.20	
A1	7.00	
A2	3.12 ± 0.10	
A3	9.70 ± 0.20	
B1	15.75 ± 0.20	
B2	4.72 ± 0.20	
B3	6.70 ± 0.20	
C	3.30 ± 0.10	
C1	15.80 ± 0.20	
C2	9.80 ± 0.2	
D	Typical 2.54	
D1	1.47 (MAX)	
D2	0.80 ± 0.10	
E	2.55 ± 0.20	
E1	0.70	
E2	1.00 × 45°	
E3	0.50	+0.1, -0.05
E4	2.80 ± 0.20	



TO-263-2L Package Information



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	4.470	4.670	0.176	0.184
A1	0.000	0.150	0.000	0.006
B	1.170	1.370	0.046	0.054
b	0.710	0.910	0.028	0.036
b1	1.170	1.370	0.046	0.054
c	0.310	0.530	0.012	0.021
c1	1.170	1.370	0.046	0.054
D	10.010	10.310	0.394	0.406
E	8.500	8.900	0.335	0.350
e	2.540 TYP.		0.100 TYP.	
e1	4.980	5.180	0.196	0.204
L	15.050	15.450	0.593	0.608
L1	5.080	5.480	0.200	0.216
L2	2.340	2.740	0.092	0.108
L3	1.300	1.700	0.051	0.067
V	5.600 REF		0.220 REF	