TOWARD
RELAYS

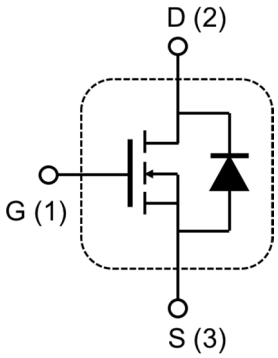
TSC065F020

Silicon Carbide Power MOSFET

N-CHANNEL ENHANCEMENT MODE

TO-247-3L

Inner Circuit



Product Summary

V_{DS}	650V
$I_{D(@25°C)}$	110A
$R_{DS(on)}$	20mΩ

RoHS COMPLIANT Halogen free

Features

- Low On-Resistance
- Low Capacitance
- Avalanche Ruggedness
- Halogen Free, RoHS Compliant

Benefits

- Higher System Efficiency
- Parallel Device Convenience
- High Temperature Application
- High Frequency Operation

Applications

- SMPS / UPS / PFC
- EV Charging Station & Motor Drives
- Power Inverters & DC/DC Converters
- Solar/ Wind Renewable Energy

Maximum Ratings (T_C=25°C)

Parameter	Symbol	Test Conditions	Value	Unit
Drain – Source Voltage	$V_{DS, max}$	V_{GS}=0V, I_{DS}=100μA	650	V
Continuous Drain Current	I_D	V_{GS}=20V, T_C=25°C	110	A
		V_{GS}=20V, T_C=110°C	64	
Pulse Drain Current	$I_{D, pulse}$	t_{PW} limitation per Fig.17	304	
Avalanche energy, Single Pulse	E_{AS}	V_{DD}=100V, I_D=18A	4	J
Power Dissipation	P_D	T_C=25°C	338	W
Gate Source Voltage (static)	$V_{GS, op}$	Static	-5/+20	V
Gate Source Voltage (dynamic)	$V_{GS, max}$	AC (f > 1Hz)	-10/+25	
Junction & Storage Temperature	T_j , T_{stg}		-55/+150	°C
Soldering Temperature	T_L		260	

Electrical Characteristics (T_j=25°C)

Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
Drain-Source Breakdown Voltage	$V_{(BR)DSS}$	V_{GS}=0V, I_{DS}=100μA	650			V
Gate Threshold Voltage	$V_{GS(th)}$	V_{DS}=10V, I_{DS}=20mA	1.5	2.2	3.5	V
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS}=650V, V_{GS}=0V		<1	100	μA
		V_{DS}=650V, V_{GS}=0V T_j=150°C		10	500	
Gate-Source Leakage Current	I_{GSS}	V_{GS}=20V, V_{DS}=0V			250	nA
Drain-Source On-State Resistance	$R_{DS(on)}$	V_{GS}=20V, I_{DS}=50A		20	26	mΩ
		V_{GS}=20V, I_{DS}=50A, T_j=150°C		27		
Input Capacitance	C_{iss}	V_{GS}=0V, V_{DS}=400V f=1MHz, V_{AC}=25mV		4130		pF
Output Capacitance	C_{oss}			353		
Reverse Transfer Capacitance	C_{rss}			53		
Effective Output Capacitance, Energy Related	$C_{o(er)}$	V_{GS}=0V, V_{DS}=0 to 400V		440		
Effective Output Capacitance, Time Related	$C_{o(tr)}$	I_D=const., V_{GS}=0V, V_{DS}=0 to 400V		583		
Turn On Delay Time	$t_{d(on)}$	V_{DS}=400V, V_{GS}=-4/+20V, I_D=35A, R_L=11.4Ω, $R_{G(ext)}$= 2.7 Ω		29		ns
Rise Time	t_r			51		
Turn Off Delay Time	$t_{d(off)}$			30		
Fall Time	t_f			16		
C_{oss} Stored Energy	E_{oss}	V_{GS}=0V, V_{DS}=400V f=1MHz, V_{AC}=25mV		46		μJ
Turn-on Switching Energy	E_{on}	V_{DS}=400V, V_{GS}=0/20V, I_D=50A, $R_{G(ext)}$= 2.7 Ω		71*		
Turn-off Switching Energy	E_{off}			116*		
Internal Gate Resistance	$R_{G(int.)}$	f=1MHz, V_{AC}=25mV		0.6		Ω

*Based on the results of calculation, note that the energy loss caused by the reverse recovery of FWD is not included in E_{on}.

Built-in SiC Diode Characteristics (T_j=25°C)

Parameter	Symbol	Test Conditions	Typ.	Unit
Inverse Diode Forward Voltage	V_{SD}	V_{GS}=0V, I_{SD}=10A	2.6	V
Continuous Diode Forward Current	I_S	V_{GS}=0V, T_C=25°C	63	A
Reverse Recovery Time	t_{rr}	V_{GS}=0V, I_{SD}=30A, V_{DS}=400V, di/dt=300A/μs	77	ns
Reverse Recovery Charge	Q_{rr}		301	nC
Peak Reverse Recovery Current	I_{rrm}		6.9	A

Gate Charge Characteristics (T_j=25°C)

Parameter	Symbol	Test Conditions	Value	Unit
Gate to Source Charge	Q_{GS}	V_{DS}=400V, V_{GS}=-5/+20V, I_D=50A	80	nC
Gate to Drain Charge	Q_{GD}		75	
Total Gate Charge	Q_G		287	
Gate plateau voltage	V_{pl}		7.6	V

Thermal Resistance

Parameter	Symbol	Value	Unit
Thermal Resistance, Junction to Case	$R_{\theta,JC}$	0.37	K/W

Typical Device Performance

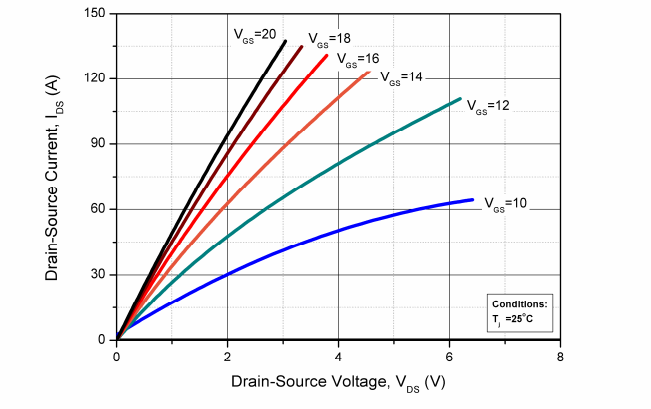


Fig. 1 Forward Output Characteristics at T_j = 25°C

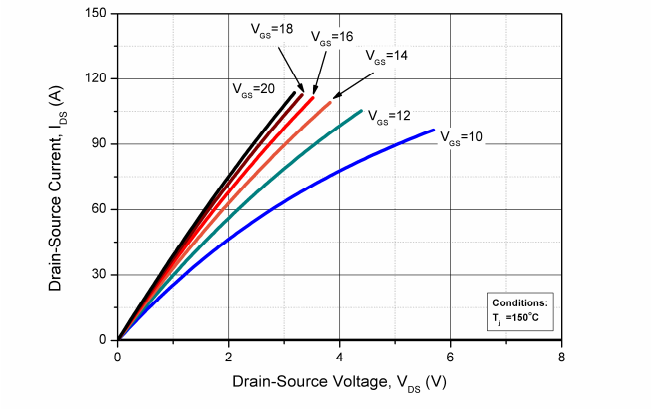


Fig. 2 Forward Output Characteristics at T_j = 150°C

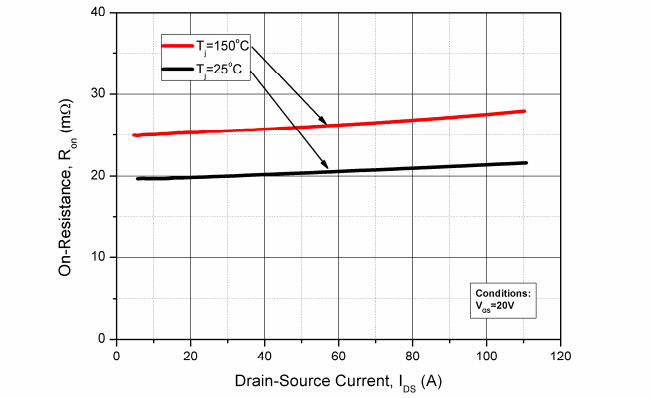


Fig. 3 On-Resistance vs. Drain Current for Various T_j

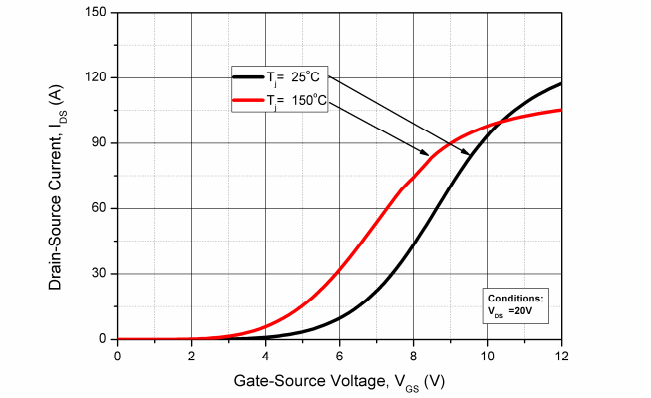


Fig. 4 Transfer Characteristics for Various T_j

Typical Device Performance

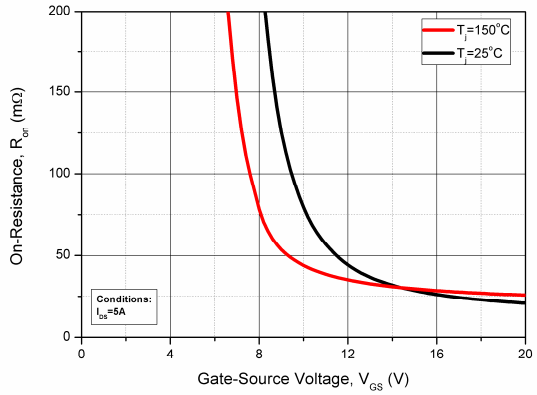


Fig. 5 On-Resistance vs. Gate Voltage for Various T_j

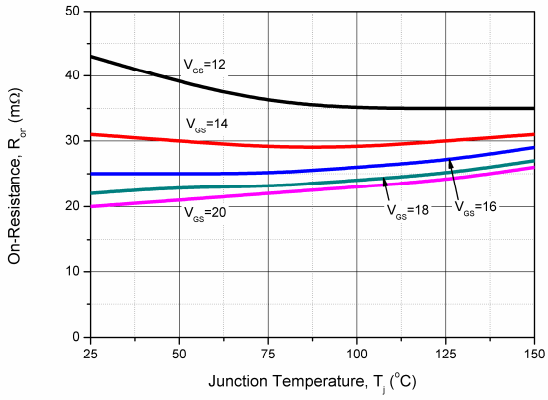


Fig. 6 On-Resistance vs. Temperature for Various Gate Voltage

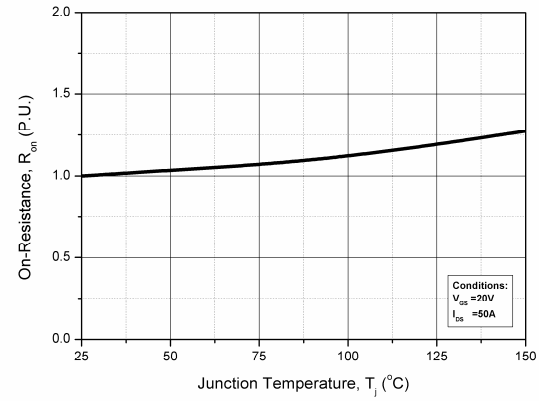


Fig. 7 Normalized On-Resistance vs. Temperature

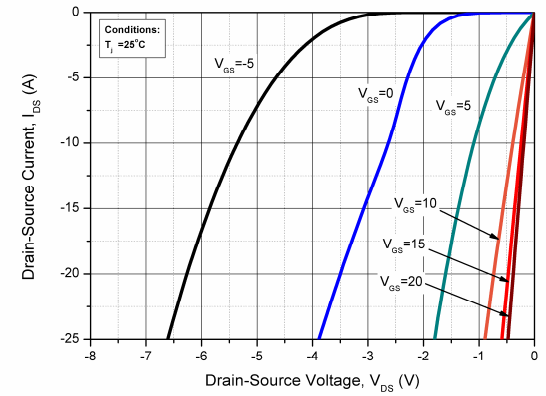


Fig. 8 Reverse Output Characteristics at T_j = 25°C

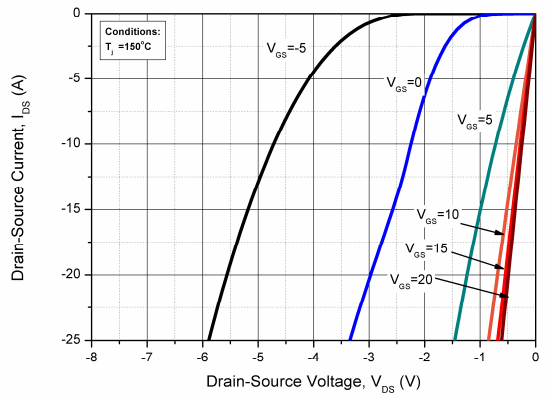


Fig. 9 Reverse Output Characteristics at T_j = 150°C

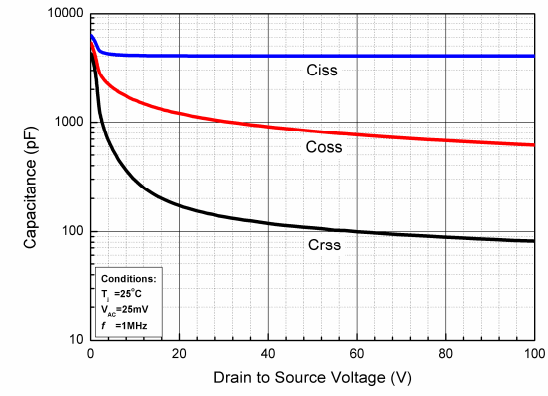


Fig. 10 Capacitances vs. Drain to Source Voltage (0 - 100V)

Typical Device Performance

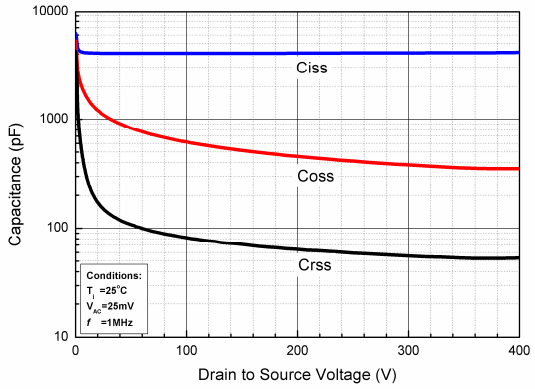


Fig. 11 Capacitances vs. Drain to Source Voltage (0 - 400V)

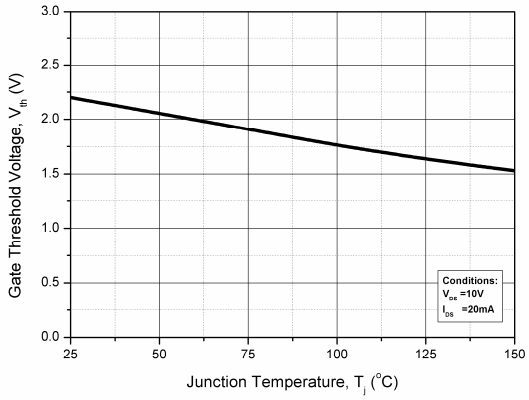


Fig. 12 Threshold Voltage vs. Temperature

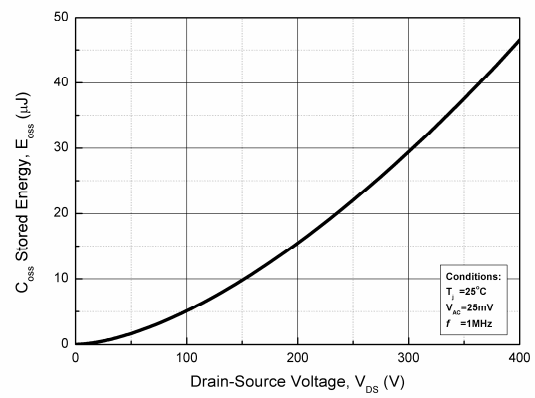


Fig. 13 Output Capacitor Stored Energy

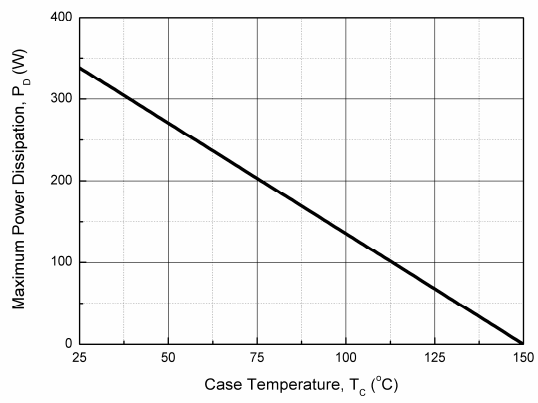


Fig. 14 Maximum Power Dissipation Derating vs. Case Temperature

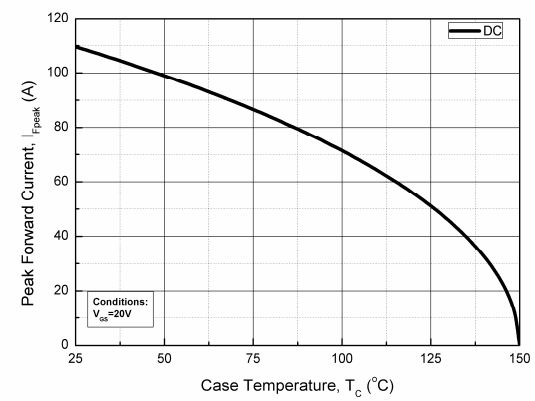


Fig. 15 Drain Current Derating vs. Case Temperature

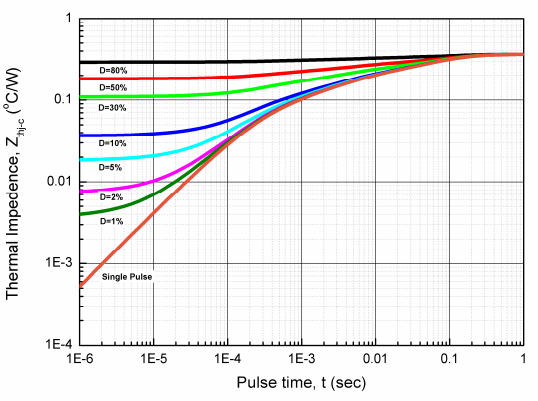


Fig. 16 Transient Junction to Case Thermal Impedance

Typical Device Performance

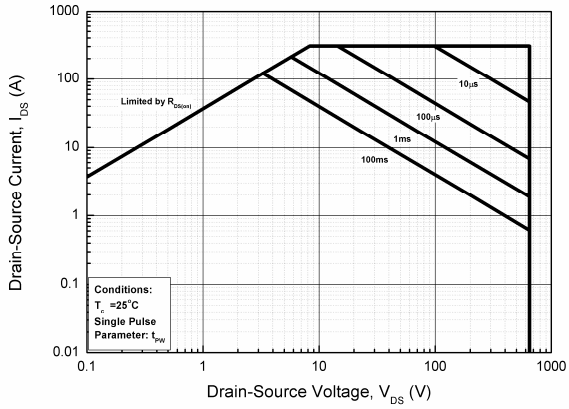


Fig. 17 Safe Operating Area

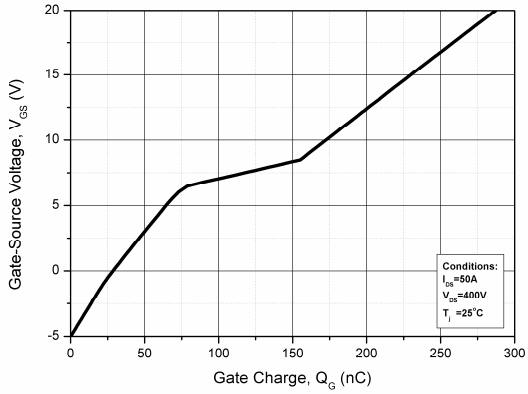


Fig. 18 Gate Charge Characteristics

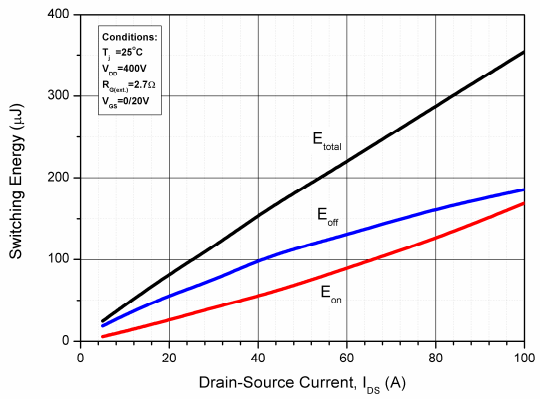


Fig. 19 Clamped Inductive Switching Energy vs. Drain Current (V_{DD}=400V)*

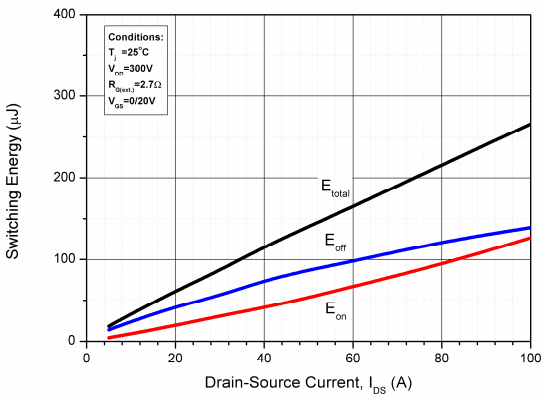


Fig. 20 Clamped Inductive Switching Energy vs. Drain Current (V_{DD}=300V)*

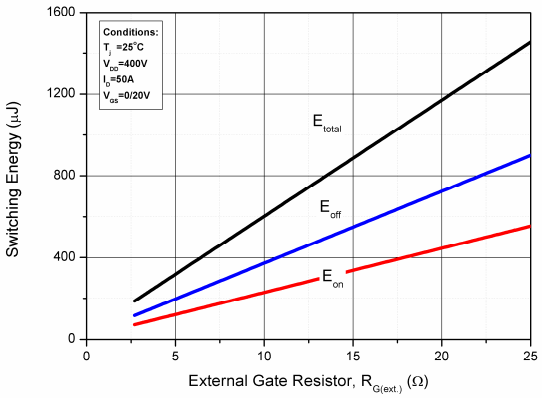
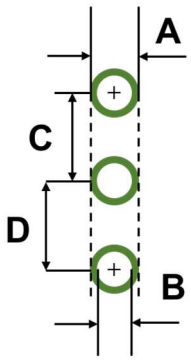


Fig. 21 Clamped Inductive Switching Energy vs. External Gate Resistor ($R_{G(ext.)}$)*

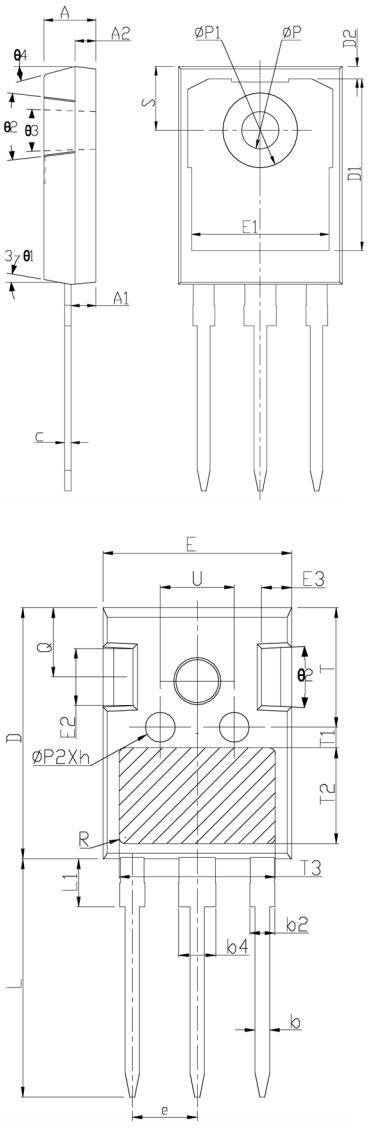
*Based on the results of calculation, note that the energy loss caused by the reverse recovery of FWD is not included in E_{on}.

Recommended Solder Pad Layout (TO-247-3L)



Mechanical Parameters			
Parameter	Symbol	Typical	Unit
Length	A	3.048	mm
	B	2.032	
	C	5.436	
	D	5.436	

Mechanical Parameters



NOTES:
1.All dimensions are in mm.
2.Tolerance: ±0.05mm.

SYMBOL	DIMENSIONS IN MILLIMETERS		
	MIN	NOM	MAX
A	4.75	5.00	5.25
A1	2.16	2.41	2.66
A2	1.85	2.00	2.15
b	1.11	1.21	1.35
b2	1.90	2.01	2.25
b4	2.90	3.01	3.25
c	0.51	0.61	0.75
D	20.60	21.00	21.40
D1	16.15	16.55	16.95
D2	1.00	1.20	1.40
E	15.50	15.80	16.10
E1	13.00	13.30	13.60
E2	4.70	5.00	5.30
E3	2.25	2.50	2.75
e	5.44BSC		
h	0.00	0.10	0.25
L	19.52	19.92	20.32
L1	-	-	4.30
ΦP	3.35	3.60	3.85
ΦP1	-	-	7.30
ΦP2	2.25	2.50	2.75
Q	5.50	5.80	6.10
S	6.15BSC		
R	0.50REF		
T	9.70	-	10.30
T1	1.65REF		
T2	8.00REF		
T3	12.80REF		
U	5.90	-	6.50
θ1	4°	7°	10°
θ2	2°	5°	8°
θ3	1°	-	2°
θ4	10°	15°	20°

*The information provided herein is subject to change without notice.