

TSC170F045

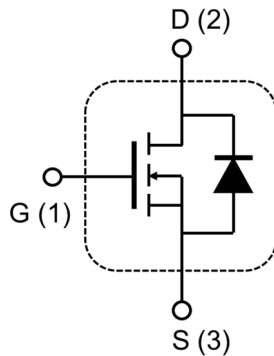
Silicon Carbide Power MOSFET

N-CHANNEL ENHANCEMENT MODE

TO-247-3L



Inner Circuit



Product Summary

V_{DS}	1700V
I_D(@25°C)	58A
R_{DS(on)}	45mΩ



Features

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

Applications

- ◆ SMPS / UPS / PFC
- ◆ Auxiliary Power Supplies

Benefits

- ◆ Higher System Efficiency
- ◆ Parallel Device Convenience
- ◆ High Temperature Application
- ◆ High Frequency Operation
- ◆ 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	1700	V
Continuous Drain Current	I _D	V _{GS} =20V, T _C =25°C	58	A
		V _{GS} =20V, T _C =110°C	35	
Pulse Drain Current	I _{D, pulse}	t _{PW} limitation per Fig.17	75	
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	1700			V
Gate Threshold Voltage	V _{GS(th)}	V _{DS} =10V, I _{DS} =20mA		2.3		V
Zero Gate Voltage Drain Current	I _{DSS}	V _{DS} =1700V, V _{GS} =0V		<1	100	μA
		V _{DS} =1700V, 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} =30A		45	70	mΩ
		V _{GS} =20V, I _{DS} =30A, T _j =150°C		85		
Input Capacitance	C _{iss}	V _{GS} =0V, V _{DS} =1000V f=1MHz, V _{AC} =25mV		4141		pF
Output Capacitance	C _{oss}			145		
Reverse Transfer Capacitance	C _{rss}			25		
Effective Output Capacitance, Energy Related	C _{o(er)}	V _{GS} =0V, V _{DS} =0 to 1000V		187		
Effective Output Capacitance, Time Related	C _{o(tr)}	I _D =const., V _{GS} =0V, V _{DS} =0 to 1000V		253		
Turn On Delay Time	t _{d(on)}	V _{DS} =1200V V _{GS} =-4/+20V I _D =30A, R _L =40Ω R _{G(ext)} = 2.7 Ω		51		ns
Rise Time	t _r			53		
Turn Off Delay Time	t _{d(off)}			59		
Fall Time	t _f			22		
C _{oss} Stored Energy	E _{oss}	V _{GS} =0V, V _{DS} =1200V f=1MHz, V _{AC} =25mV		119		μJ
Turn-on Switching Energy	E _{on}	V _{DS} =1200V		194*		
Turn-off Switching Energy	E _{off}	V _{GS} =0/20V, I _D =30A R _{G(ext)} = 2.7 Ω		326*		
Internal Gate Resistance	R _{G(int.)}	f=1MHz, V _{AC} =25mV		0.7		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} =7.5A	2.7	V
Continuous Diode Forward Current	I _s	V _{GS} =0V, T _C =25°C	32	A
Reverse Recovery Time	t _{rr}	V _{GS} =0V, I _{SD} =30A, V _{DS} =400V, di/dt=300A/μs	81	ns
Reverse Recovery Charge	Q _{rr}		274	nC
Peak Reverse Recovery Current	I _{rrm}		6.4	A

Gate Charge Characteristics ($T_j=25^\circ\text{C}$)

Parameter	Symbol	Test Conditions	Value	Unit
Gate to Source Charge	Q_{GS}	$V_{DS}=1200\text{V}$, $V_{GS}=-5/+20\text{V}$, $I_D=30\text{A}$	79	nC
Gate to Drain Charge	Q_{GD}		99	
Total Gate Charge	Q_G		304	
Gate plateau voltage	V_{pl}		7.5	V

Thermal Resistance

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

Typical Device Performance

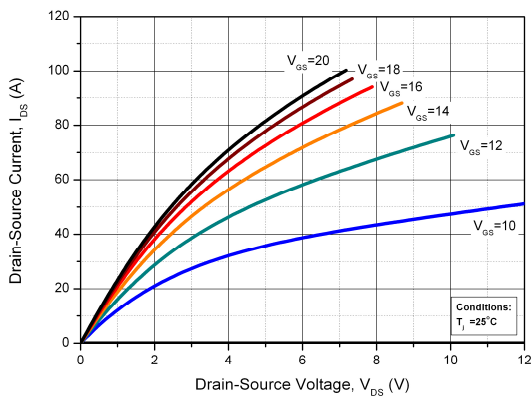


Fig. 1 Forward Output Characteristics at $T_j = 25^\circ\text{C}$

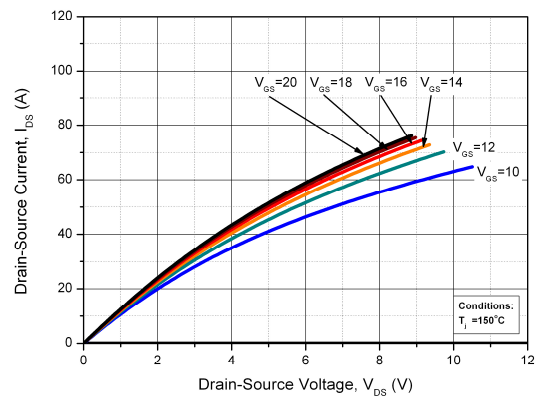


Fig. 2 Forward Output Characteristics at $T_j = 150^\circ\text{C}$

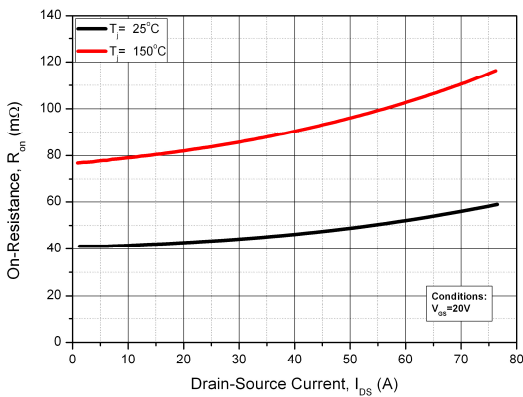


Fig. 3 On-Resistance vs. Drain Current for Various T_j

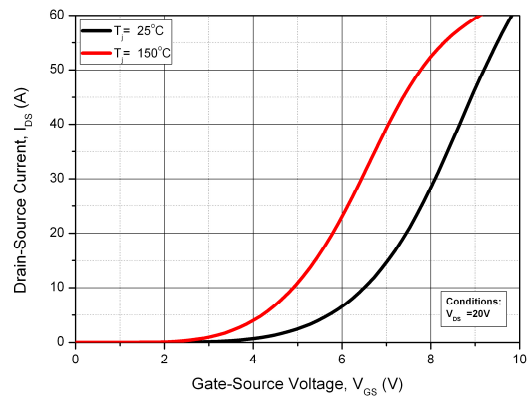


Fig. 4 Transfer Characteristics for Various T_j

Typical Device Performance

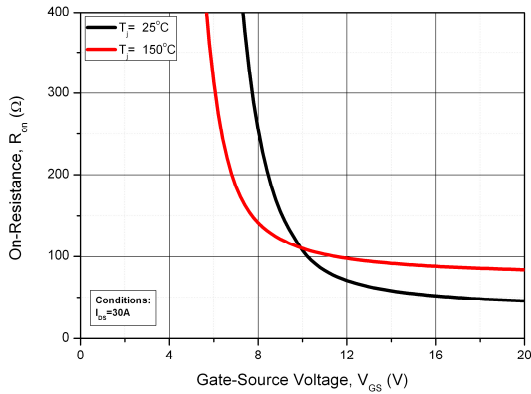


Fig. 5 On-Resistance vs. Gate Voltage for Various T_j

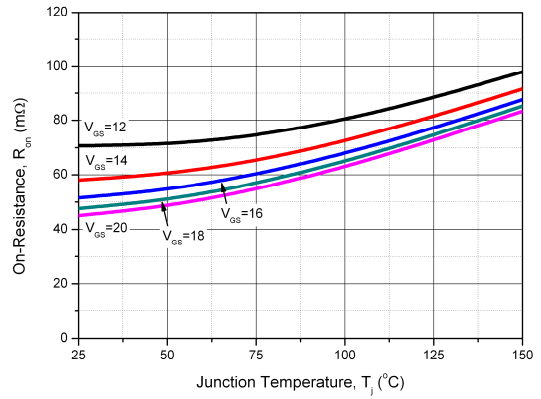


Fig. 6 On-Resistance vs. Temperature for Various Gate Voltage

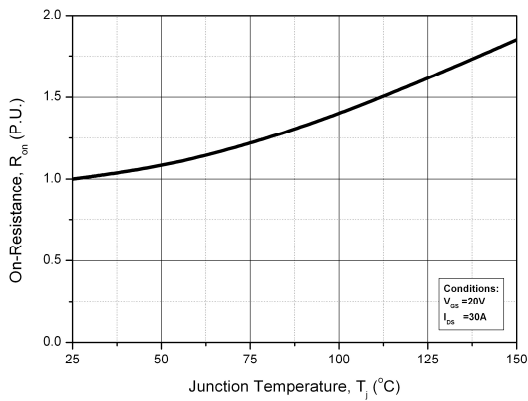


Fig. 7 Normalized On-Resistance vs. Temperature

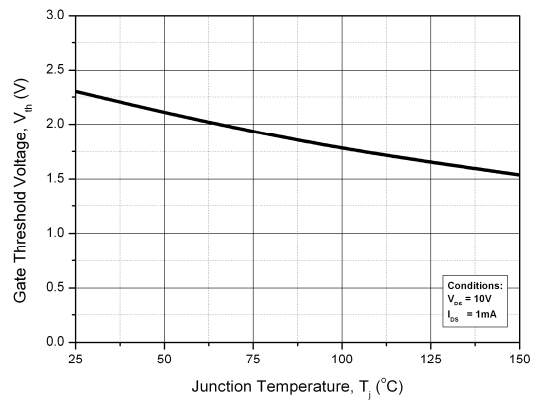


Fig. 8 Threshold Voltage vs. Temperature

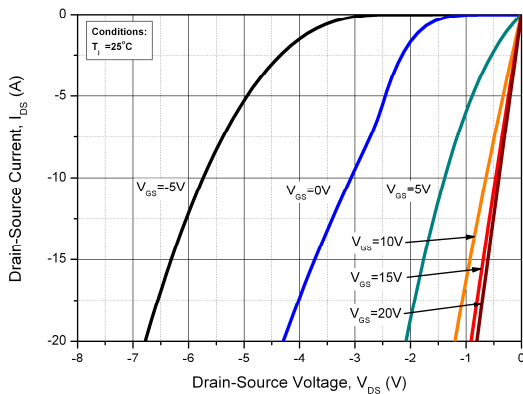


Fig. 9 Reverse Output Characteristics at $T_j = 25^\circ\text{C}$

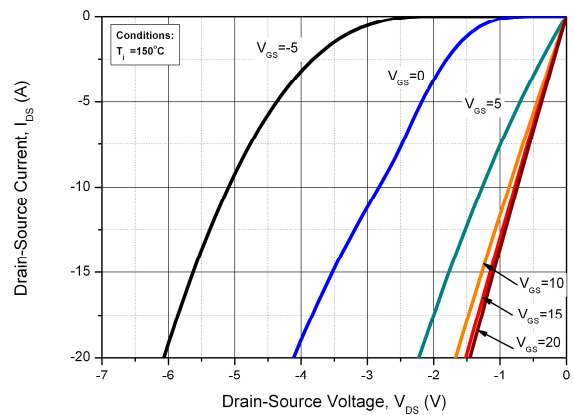


Fig. 10 Reverse Output Characteristics at $T_j = 150^\circ\text{C}$

Typical Device Performance

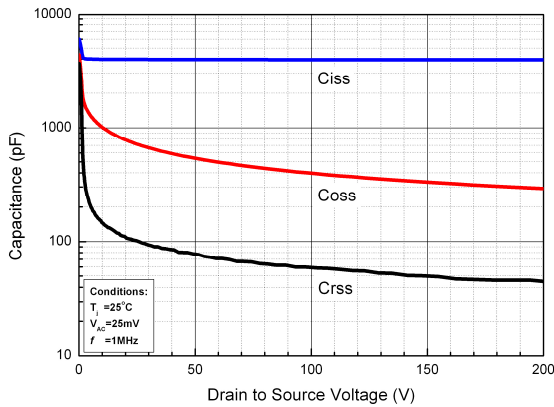


Fig. 11 Capacitances vs. Drain to Source Voltage (0 - 200V)

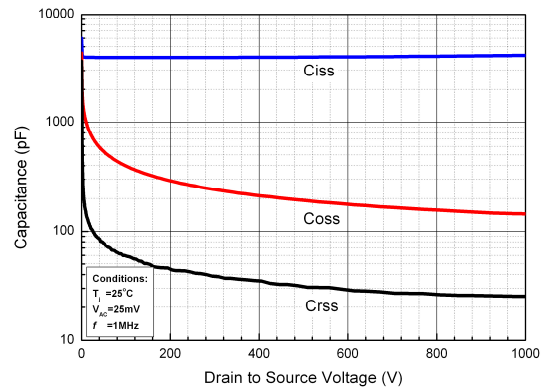


Fig. 12 Capacitances vs. Drain to Source Voltage (0 - 1000V)

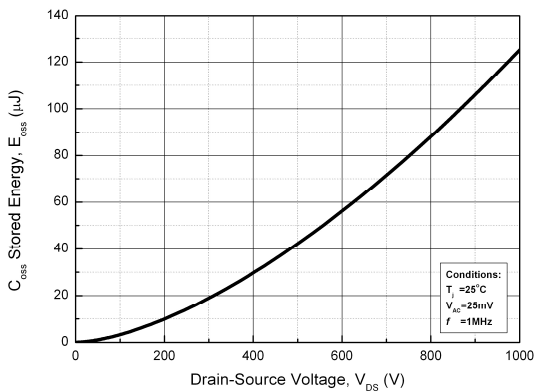


Fig. 13 Output Capacitor Stored Energy

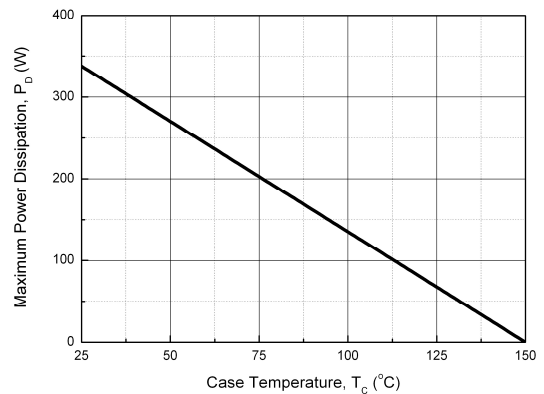


Fig. 14 Maximum Power Dissipation Derating vs. Case Temperature

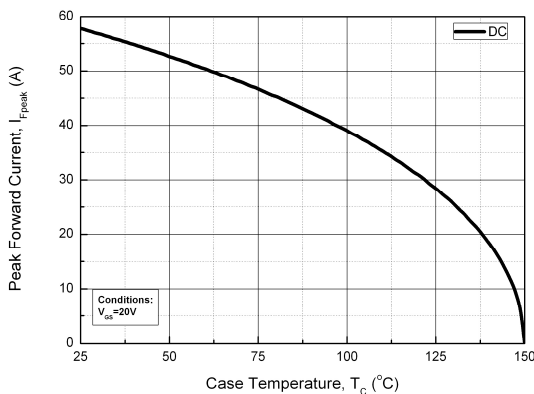


Fig. 15 Drain Current Derating vs. Case Temperature

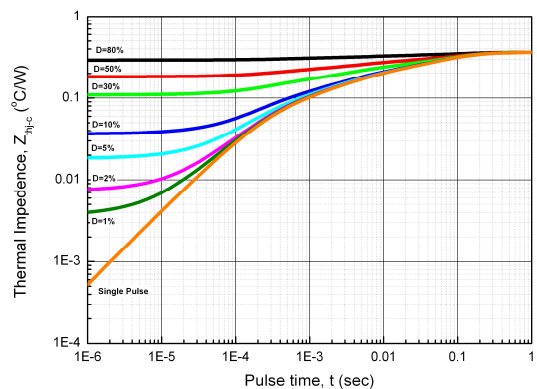


Fig. 16 Transient Junction to Case Thermal Impedance

Typical Device Performance

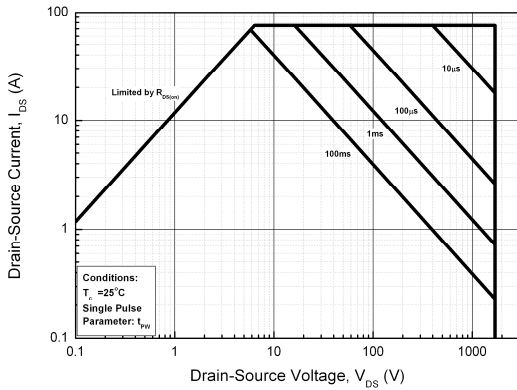


Fig. 17 Safe Operating Area

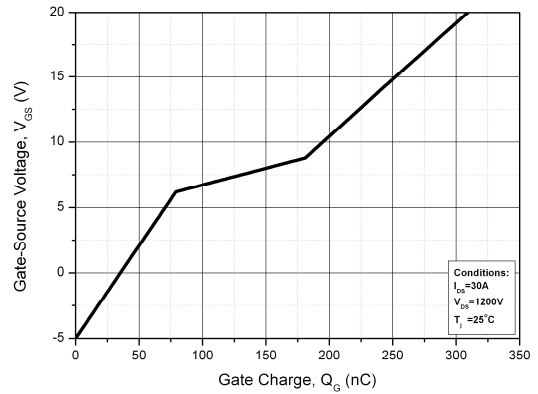


Fig. 18 Gate Charge Characteristics

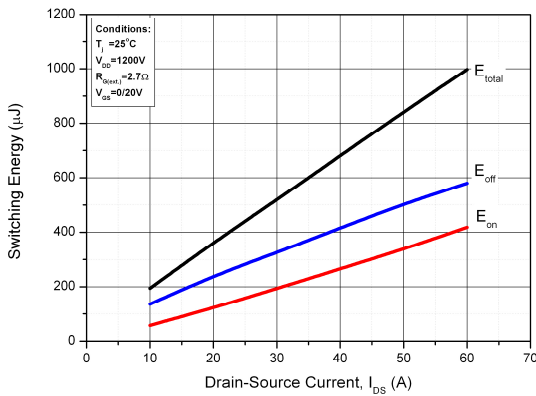


Fig. 19 Clamped Inductive Switching Energy vs. Drain Current ($V_{DD} = 1200\text{V}$)*

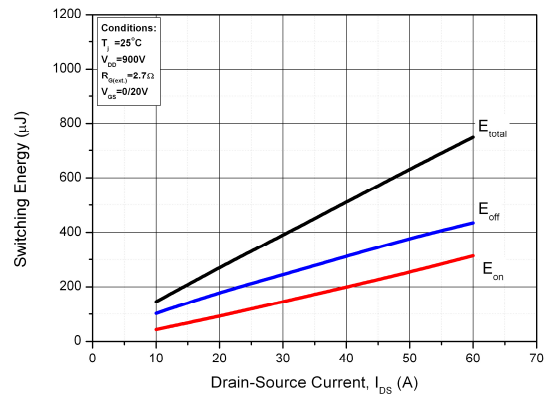


Fig. 20 Clamped Inductive Switching Energy vs. Drain Current ($V_{DD} = 900\text{V}$)*

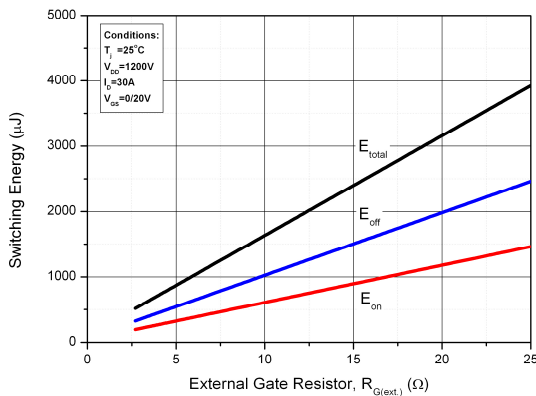
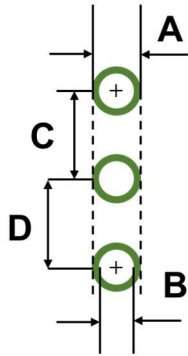


Fig. 21 Clamped Inductive Switching Energy vs. External Gate Resistor ($R_{G(ext)}$)*

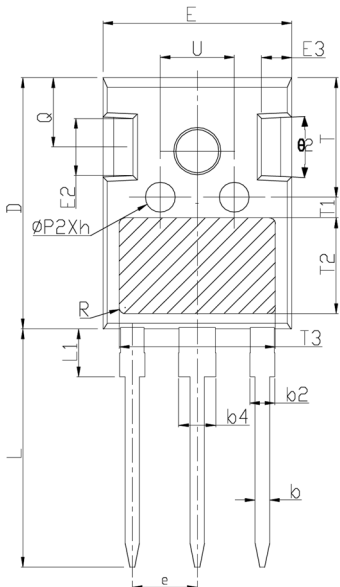
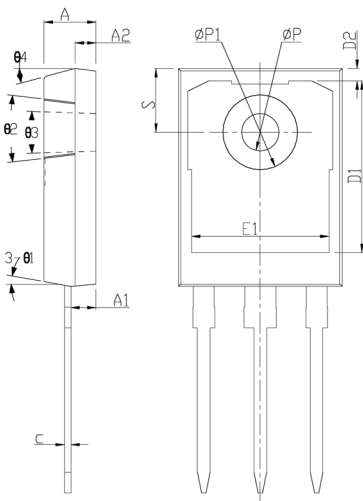
*Based on the results of calculation, note that the energy loss caused by the reverse recovery of FWD is not included in E_{on} .

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: $\pm 0.05\text{mm}$.

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
ØP	3.35	3.60	3.85
ØP1	-	-	7.30
ØP2	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
Ø1	4°	7°	10°
Ø2	2°	5°	8°
Ø3	1°	-	2°
Ø4	10°	15°	20°

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