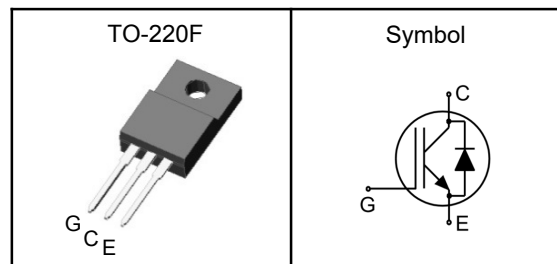


**650V/10A Field Stop Trench IGBT**
**Features**

- Trench FS II Technology
- Very low  $V_{CE(sat)}$
- High speed switching
- ROHS Compliant

**Applications**

- Inverter welding machine
- Motor drives
- UPS

**Pin Description**


$V_{CES}$	650	V
$V_{CE(sat)-Typ}$	1.4	V
$I_C$	10	A

**Absolute Maximum Ratings** ( $T_C=25^{\circ}C$ , Unless Otherwise Noted)

Parameter	Symbol	Rating	Units
Collector-Emitter Voltage	$V_{CES}$	650	V
Gate- Emitter Voltage	$V_{GES}$	$\pm 30$	V
Collector Current <sup>1</sup>	$I_C$	15	A
Collector Current <sup>1</sup>	$I_C$	10	A
Pulsed Collector Current <sup>2</sup>	$I_{CM}$	20	A
Diode Continuous Forward Current	$I_F$	20	A
Diode Continuous Forward Current	$I_F$	10	A
Diode Pulsed Forward Current	$I_{FM}$	24	A
Power Dissipation	$P_D$	32	W
Power Dissipation	$P_D$	16	W
Storage Temperature Range	$T_{STG}$	-55 to 150	$^{\circ}C$
Operating Junction Temperature Range	$T_J$	-55 to 175	$^{\circ}C$

**Thermal Characteristics**

Parameter	Symbol	Typ	Max	Unit
Thermal Resistance Junction-Ambient	$R_{\theta JA}$	---	65	$^{\circ}C/W$
Thermal Resistance Junction to case for IGBT	$R_{\theta JC}$	---	4.6	$^{\circ}C/W$
Thermal Resistance Junction to case for Diode	$R_{\theta JCD}$	---	5.6	$^{\circ}C/W$



**650V/10A Field Stop Trench IGBT**

**Electrical Characteristics (T<sub>J</sub>=25°C, unless otherwise noted)**

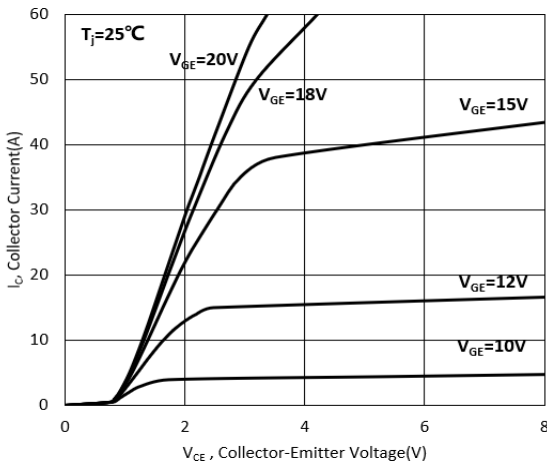
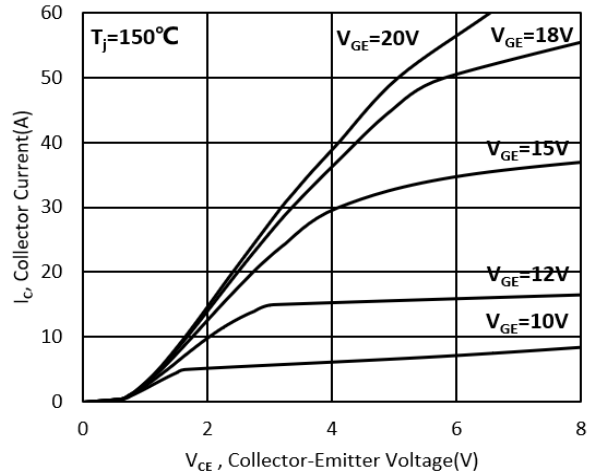
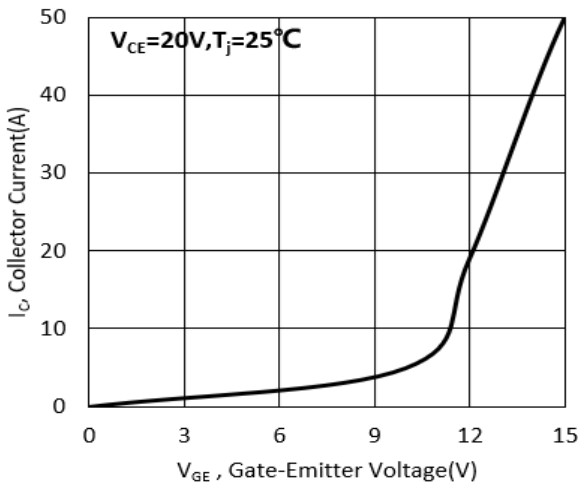
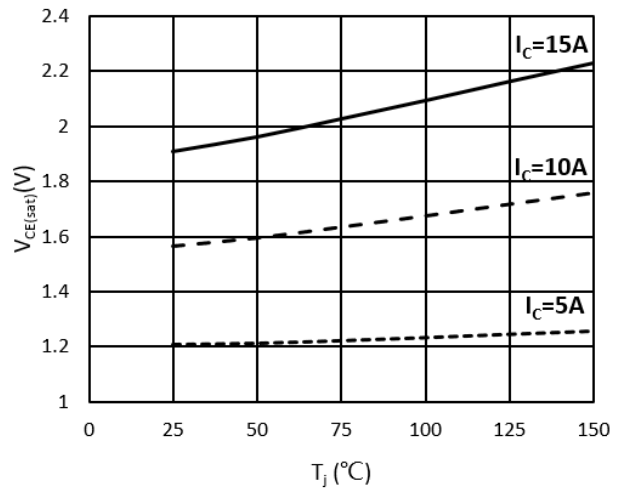
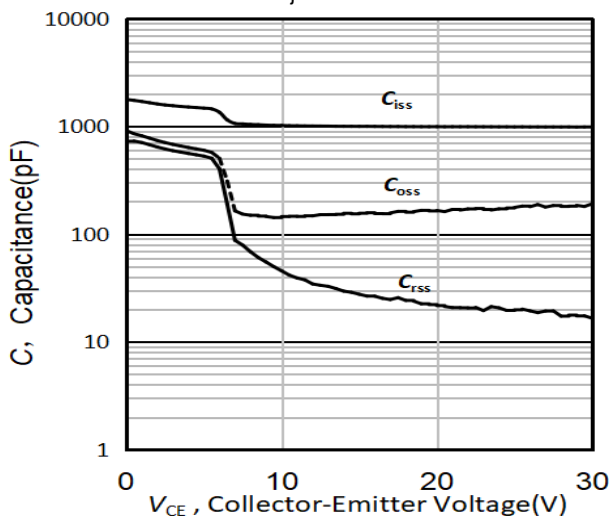
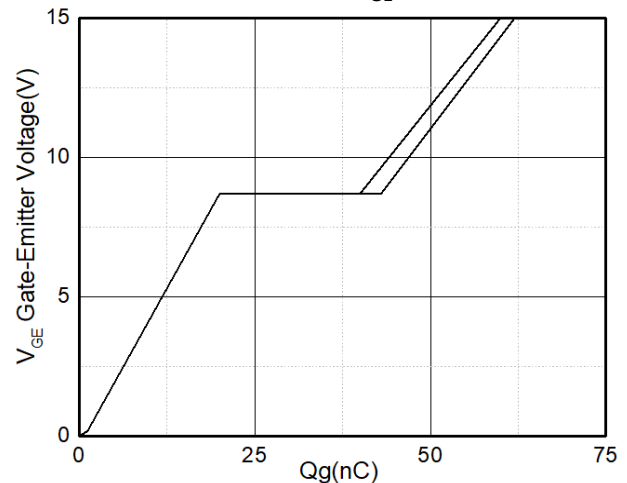
Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Collector-Emitter Breakdown Voltage	V <sub>(BR)CES</sub>	V <sub>GE</sub> =0V, I <sub>C</sub> =0.25mA	650	---	---	V
Collector-Emitter Saturation Voltage	V <sub>CE(sat)</sub>	V <sub>GE</sub> =15V, I <sub>C</sub> =10A, T <sub>J</sub> =25°C	---	1.4	1.8	V
		V <sub>GE</sub> =15V, I <sub>C</sub> =10A, T <sub>J</sub> =125°C	---	1.65	---	V
Gate Threshold Voltage	V <sub>GE(th)</sub>	V <sub>CE</sub> =V <sub>GE</sub> , I <sub>C</sub> =150uA	4.5	---	6.5	V
Collector-Emitter Leakage Current	I <sub>CES</sub>	V <sub>CE</sub> =650V, V <sub>GE</sub> =0V, T <sub>J</sub> =25°C	---	---	0.01	mA
		V <sub>CE</sub> =650V, V <sub>GE</sub> =0V, T <sub>J</sub> =150°C	---	---	1	mA
Gate to Emitter Leakage Current	I <sub>GES</sub>	V <sub>GE</sub> =20V, V <sub>CE</sub> =0V	---	---	250	nA
Total Gate Charge	Q <sub>g</sub>	V <sub>CC</sub> =300V, V <sub>GE</sub> =15V, I <sub>C</sub> =10A	---	58	---	nC
Gate to Emitter Charge	Q <sub>ge</sub>		---	---	---	nC
Gate to Collector Charge	Q <sub>gc</sub>		---	---	---	nC
Turn-On Delay Time	t <sub>d(ON)</sub>	V <sub>CE</sub> =400V, V <sub>GE</sub> =0/15V, R <sub>G</sub> =10Ω, I <sub>C</sub> =10A, T <sub>J</sub> =25°C Inductive Load	---	47	---	ns
Rise Time	t <sub>r</sub>		---	28	---	
Turn-Off Delay Time	t <sub>d(off)</sub>		---	103	---	
Fall Time	t <sub>f</sub>		---	80	---	mJ
Turn-On Switching Loss	E <sub>on</sub>		---	0.17	---	
Turn-Off Switching Loss	E <sub>off</sub>		---	0.20	---	
Total Switching Loss	E <sub>ts</sub>	---	0.37	---		
Input Capacitance	C <sub>ies</sub>	V <sub>CE</sub> =25V, V <sub>GE</sub> =0V, f=1MHz	---	1000	---	pF
Output Capacitance	C <sub>oes</sub>		---	45	---	
Reverse Transfer Capacitance	C <sub>res</sub>		---	16	---	

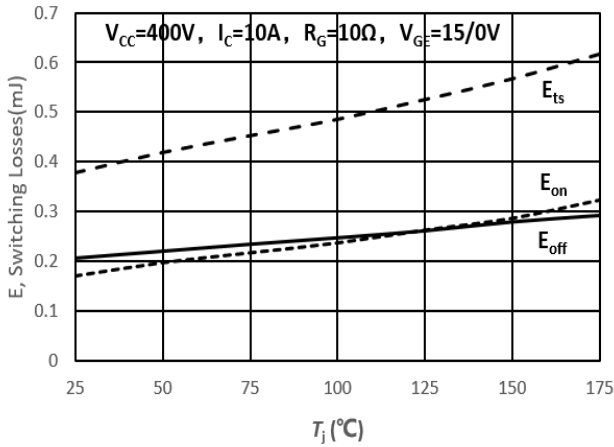
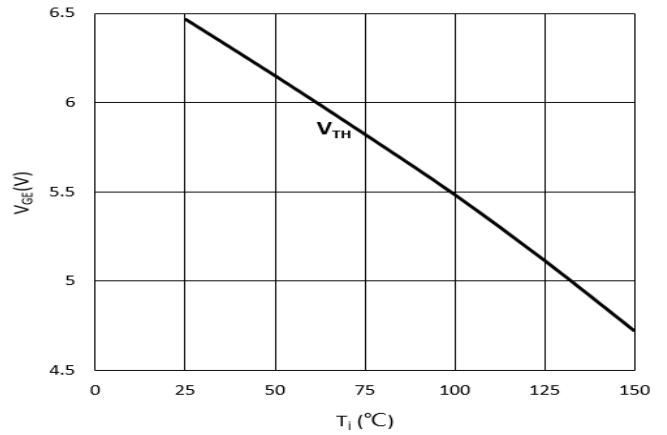
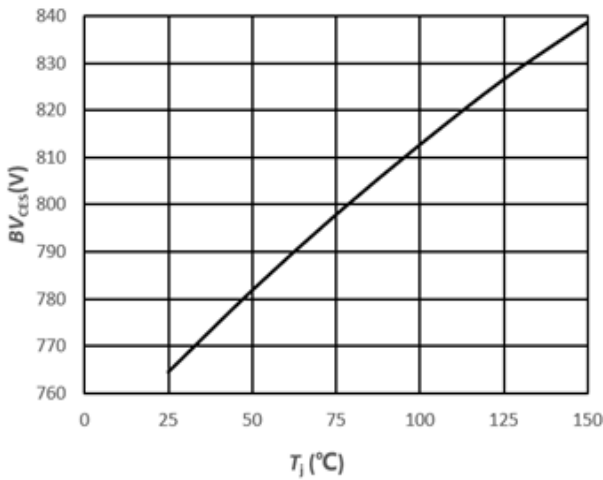
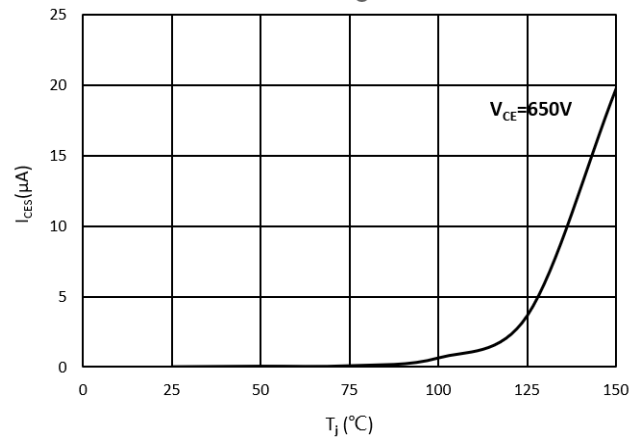
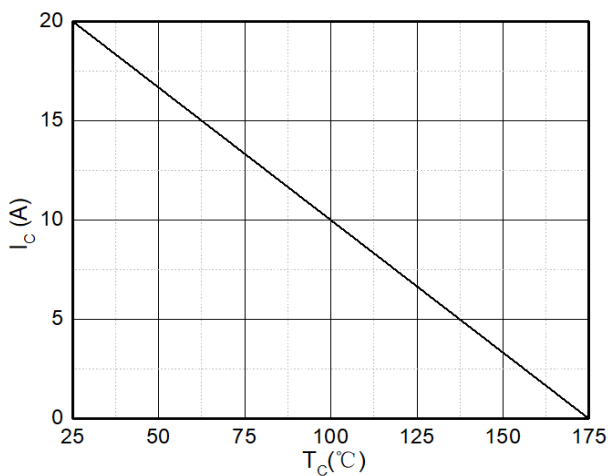
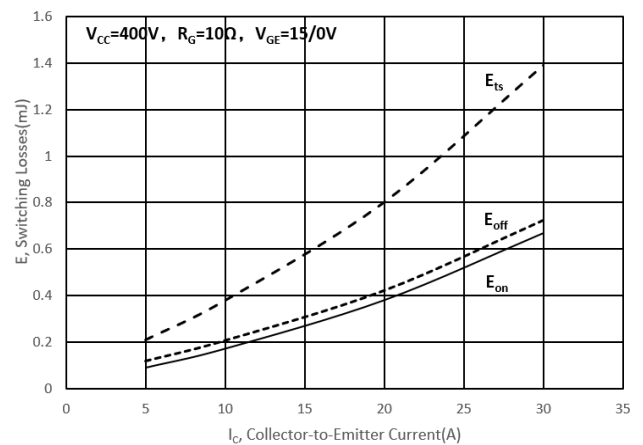
**Drain-Source Diode Characteristics**

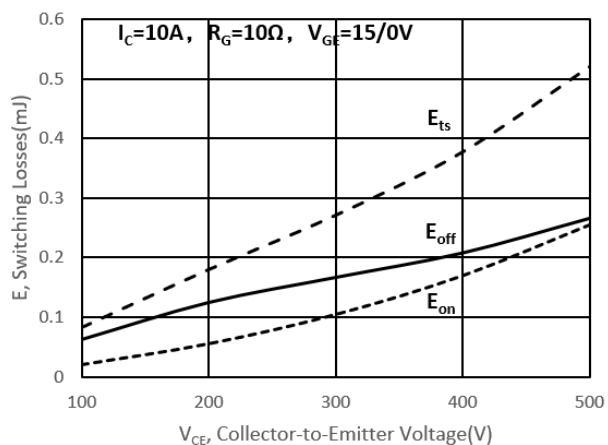
Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Diode Forward Voltage	V <sub>F</sub>	V <sub>GE</sub> =0V, I <sub>F</sub> =10A, T <sub>J</sub> =25°C	---	1.65	1.95	V
Reverse Recovery Time	t <sub>rr</sub>	I <sub>F</sub> =10A, V <sub>CC</sub> =400V, di/dt=350A/μs, T <sub>J</sub> =25°C	---	66	---	nS
Reverse Recovery Charge	Q <sub>rr</sub>		---	0.23	---	uC
Diode Peak Reverse Recovery Current	I <sub>rrm</sub>		---	5.55	---	A

**Note:**

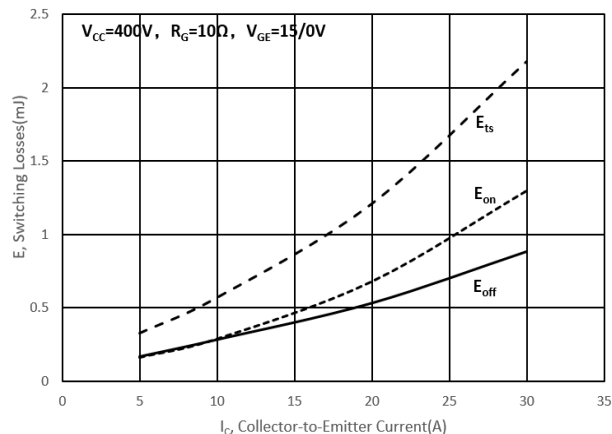
- 1.The data tested by surface mounted on a 1 inch<sup>2</sup> FR-4 board with 2OZ copper.
- 2.The data tested by pulsed , pulse width ≤ 300us , duty cycle ≤ 2%

**650V/10A Field Stop Trench IGBT**
**Typical Characteristics**

**Figure 1. Typical output characteristic**  
 $(T_j = 25^\circ\text{C})$ 

**Figure 2. Typical output characteristic**  
 $(T_j = 150^\circ\text{C})$ 

**Figure 3. Typical transfer characteristic**  
 $(T_j = 25^\circ\text{C})$ 

**Figure 4.  $V_{CESAT}$  as a function of junction temperature**  
 $(V_{GE} = 15\text{V})$ 

**Figure 5. Capacitance characteristic**  
 $(V_{GE} = 0\text{V}, f = 1\text{MHz})$ 

**Figure 6. Typical gate charge**  $(I_C = 10\text{A})$

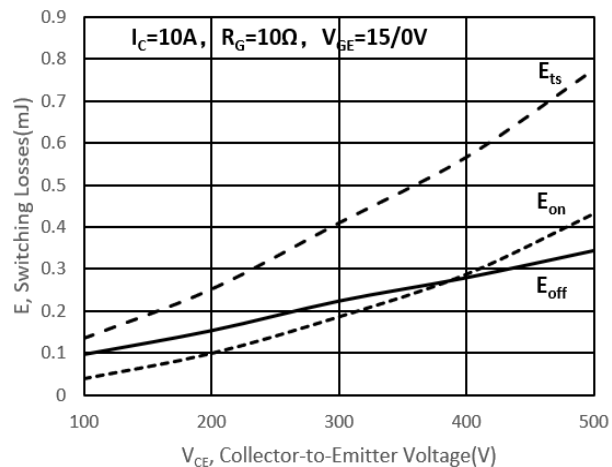
**650V/10A Field Stop Trench IGBT**

**Figure 7.  $E_{on}$ ,  $E_{off}$  as a function of junction temperature**

**Figure 8.  $V_{TH}$  as a function of junction temperature ( $I_{CE}=250\mu A$ )**

**Figure 9. BV as a function of junction temperature ( $I_{CE}=250\mu A$ )**

**Figure 10.  $I_{CES}$  leakage current as a function of junction temperature**

**Figure 11. Collector current as a function of case temperature ( $V_{GE}\geq 15V$ ,  $T_j\leq 175^\circ C$ )**

**Figure 12.  $E_{on}$ ,  $E_{off}$  as a function of  $I_C$  ( $T_j=25^\circ C$ )**

**650V/10A Field Stop Trench IGBT**


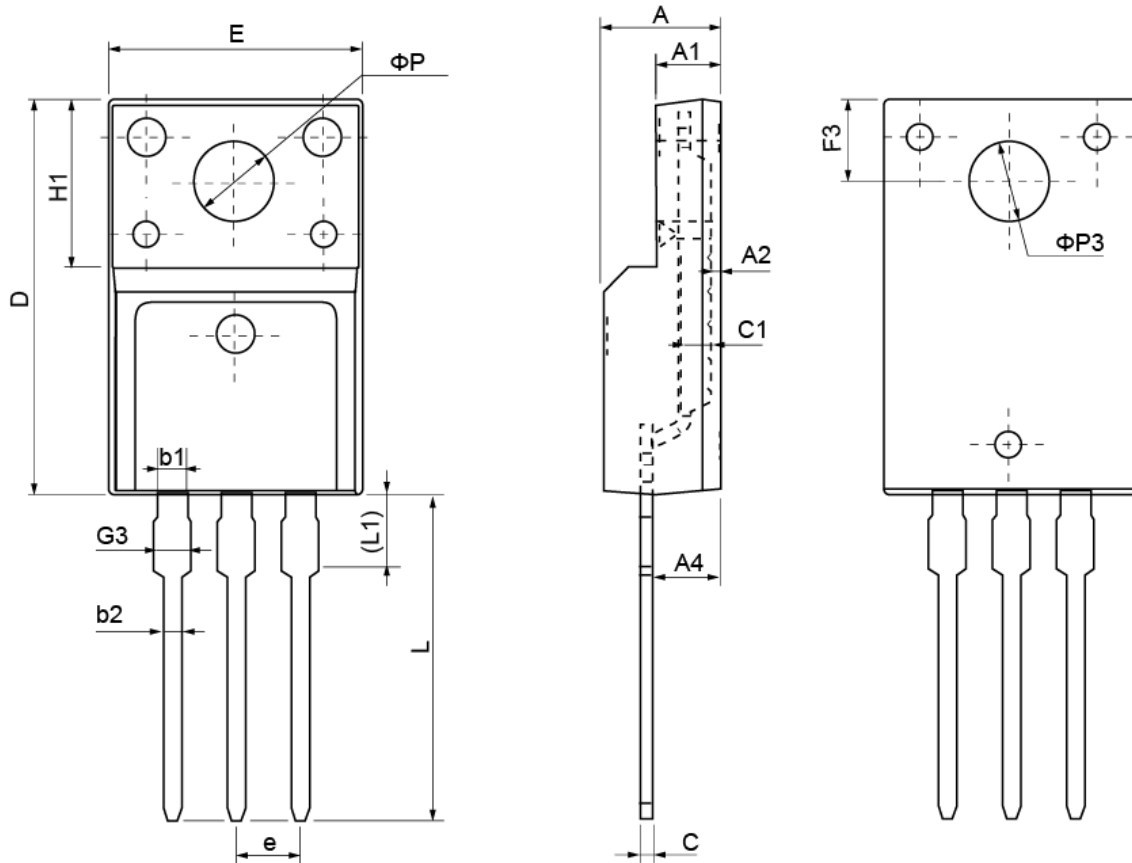
**Figure 13.  $E_{on}, E_{off}$  as a function of  $V_{CE}$  ( $T_j=25^\circ C$ )**



**Figure 14.  $E_{on}, E_{off}$  as a function of  $I_C$  ( $T_j=150^\circ C$ )**



**Figure 15.  $E_{on}, E_{off}$  as a function of  $V_{CE}$  ( $T_j=150^\circ C$ )**

**650V/10A Field Stop Trench IGBT**
**TO-220F Package Outline Dimensions**


Symbol	Dimensions (unit:mm)			Symbol	Dimensions (unit:mm)		
	Min	Typ	Max		Min	Typ	Max
<b>A</b>	4.40	4.70	5.00	<b>H1</b>	6.70 REF		
<b>A1</b>	2.30	2.55	2.80	<b>L</b>	12.30	12.98	13.30
<b>A2</b>	0.30	0.50	0.70	<b>L1</b>	2.95	3.10	3.50
<b>A4</b>	2.45	2.80	3.05	<b><math>\phi P</math></b>	3.03	3.20	3.50
<b>c</b>	0.30	0.50	0.70	<b><math>\phi P3</math></b>	3.15	3.45	3.65
<b>c1</b>	1.20	1.30	1.40	<b>b1</b>	1.10	1.30	1.45
<b>D</b>	15.40	15.90	16.40	<b>b2</b>	0.60	0.80	1.00
<b>E</b>	9.86	10.16	10.46	<b>F3</b>	3.05	3.30	3.55
<b>e</b>	2.54 BSC			<b>G3</b>	1.15	1.35	1.55