■ INTRODUCTION

The CE1610A is a current limited P-channel MOSFET power switch designed for high-side load switching applications. This switch operates with inputs ranging from 2.5V to 5.5V, making it ideal for both 3V and 5V systems. An integrated current-limiting circuit protects the input supply against large currents which may cause the supply to fall out of regulation. The CE1610A is also protected from thermal overload which limits power dissipation and junction temperatures. It can be used to control loads that require up to 1A. Current limit threshold is programmed with a resistor from SET to ground.

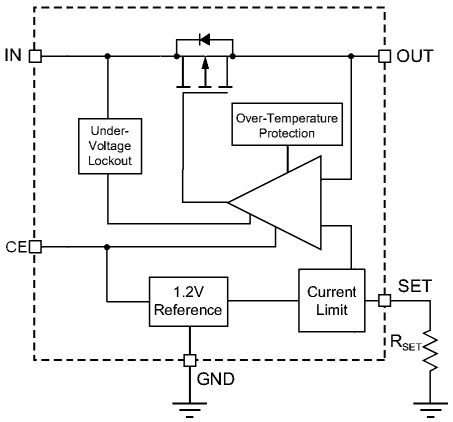
■ FEATURES

- Low quiescent current: 9μA(Typ.)
- Shutdown Current: <1μA
- Programmable Over-Current Threshold
- Fast Transient Response: 400ns Response to Short Circuit
- Input Voltage: 2.5V~5.5V
- Low $R_{DS(ON)}$ Internal Switches: 145mΩ
- Only 2.5V Needed for ON/OFF Control
- Under-Voltage Lockout
- Thermal Fault Protection
- 4kV ESD Rating
- Temperature Range: -40°C to +85°C
- Package: SOT-23-5

■ APPLICATIONS

- Hot-Plug Power Supplies
- Battery-Charger Circuits
- Motherboard USB Power Switch
- Notebook Computers
- Personal Communication Devices
- USB Device Power Switch

■ BLOCK DIAGRA



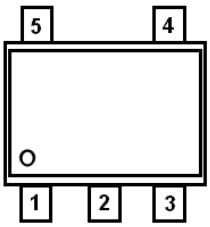
■ ORDER INFORMATION

CE1610①②③

DESIGNATOR	SYMBOL	DESCRIPTION
①	A	I_{LIM} =1A@R_{SET}=6.8kΩ
②	H	CE High Active
	L	CE Low Active
③	M	Package： SOT-23-5

■ PIN CONFIGURATION

SOT-23-5
(Top View)



PIN NUMBER	SYMBOL	FUNCTION
1	OUT	P-channel MOSFET drain. Connect a 0.47μF capacitor from OUT to GND.
2	GND	Ground Pin
3	SET	Current limit set input. A resistor from SET to ground sets the current limit for the switch.
4	CE	Chip Enable input. Two versions are available, active-high and active-low. See Ordering Information for details.
5	IN	P-channel MOSFET source. Connect a 1μF capacitor from IN to GND.

■ ABSOLUTE MAXIMUM RATINGS

(Unless otherwise specified, Ta=25°C)

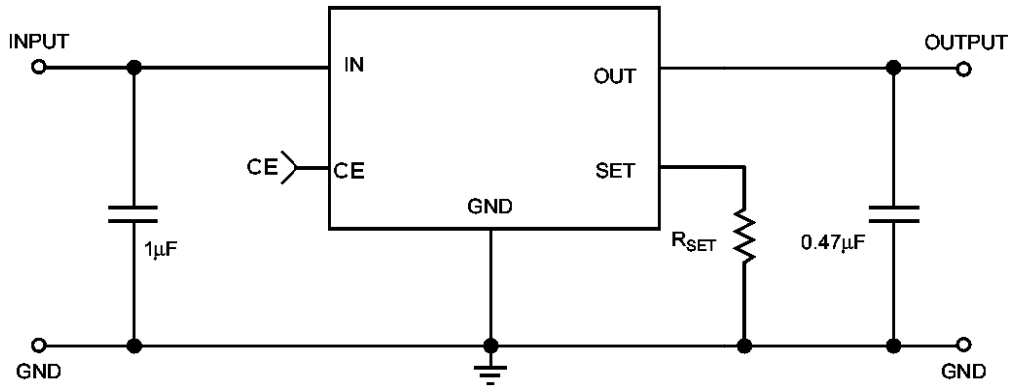
PARAMETER		SYMBOL	RATINGS	UNITS
Input Voltage		V_{IN}	-0.3~ 6	V
CE, SET, OUT Voltage		V_{CE},V_{SET},V_{OUT}	-0.3~V_{IN}+0.3	V
Maximum Continuous Switch Current		I_{MAX}	2	A
Power Dissipation	SOT-23-5	Pd	400	mW
Operating Temperature Range		T_{opr}	-40~+85	℃
Junction Temperature		T_j	125	℃
Storage Temperature		T_{stg}	-40~+125	℃
ESD Rating2 - HBM 4000 V		V_{ESD}	4000	V
Soldering Temperature & Time		T_{solder}	260℃, 10s	

■ ELECTRICAL CHARACTERISTICS

CE1610A **(V_{IN}=5.0V, Ta=25℃, unless otherwise specified)**

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
Operation Voltage	V_{IN}			2.5		5.5	V
Quiescent Current	I_Q	V_{IN}=5V, CE=Active, I_{OUT}=0			9	25	μA
Off Supply Current	$I_{Q(OFF)}$	CE=Inactive, V_{IN}=5.5V				1	μA
Off Switch Current	$I_{SD(OFF)}$	CE=Inactive, V_{IN}=5.5V,V_{OUT}=0V			0.01	1	μA
Under-Voltage Lockout	V_{UVLO}	Rising Edge, 1% Hysteresis			1.8	2.4	V
On Resistance	$R_{DS(ON)}$	V_{IN}=5.0V			145	180	mΩ
		V_{IN}=4.5V			150		
		V_{IN}=3.0V			190	230	
Current Limit	I_{LIM}	R_{SET}=6.8kΩ		0.75	1.0	1.25	A
Minimum Current Limit	$I_{LIM(MIN)}$				150		mA
CE Input Low Voltage	$V_{CE(L)}$	V_{IN}=2.7V~5.5V				0.8	V
CE Input High Voltage	$V_{CE(H)}$	V_{IN}=2.7V~3.6V		2.0			V
		V_{IN}=4.5V~5.5V		2.4			
CE Input Leakage	$I_{LEAK(CE)}$	V_{ON}=5.5V			0.01	1	μA
Current Limit Response Time	T_{RESP}	V_{IN}=5.0V			0.4		μs
Turn-Off Time	T_{OFF}	V_{IN}=5.0V，R_L=10Ω			4	12	μs
Turn-On Time	T_{ON}	V_{IN}=5.0V，R_L=10Ω			12	200	μs
Over-Temperature Threshold	T_{SD}	V_{IN}=5.0V	TJ Increasing		125		℃
			TJ Decreasing		115		

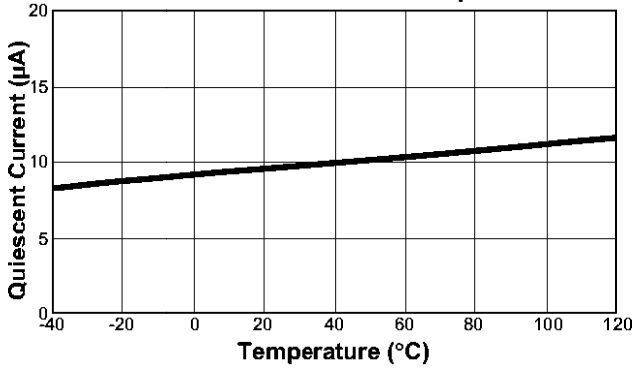
■ TYPICAL APPLICATION



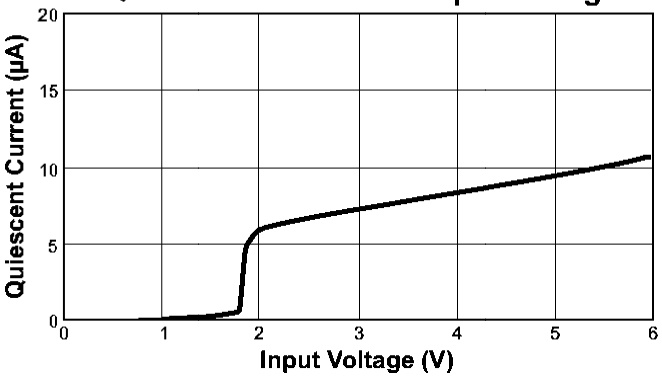
■ TYPICAL PERFORMANCE CHARACTERISTICS

(Unless otherwise noted, V_{IN}=5V, T_A=25℃)

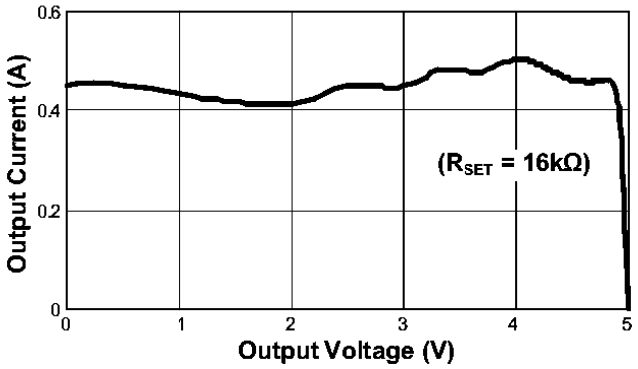
Quiescent Current vs. Temperature



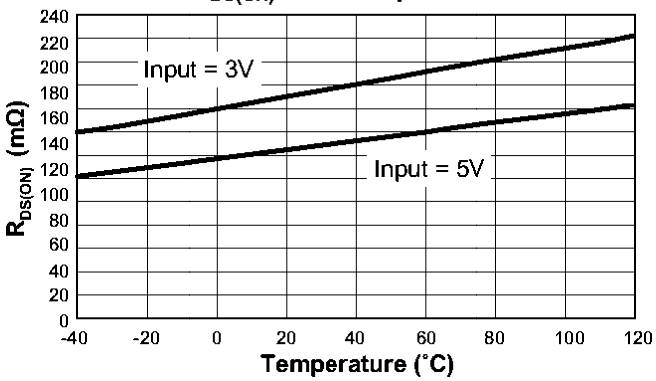
Quiescent Current vs. Input Voltage



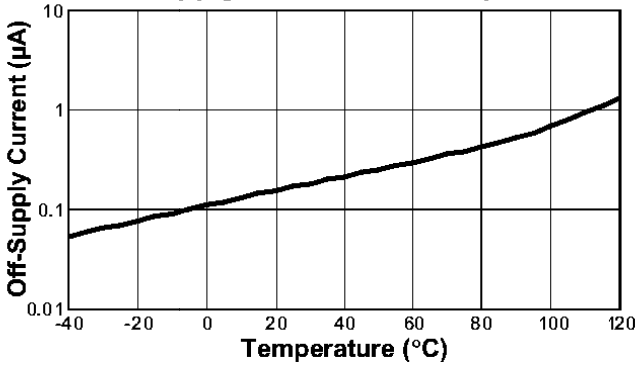
Output Current vs. Output Voltage



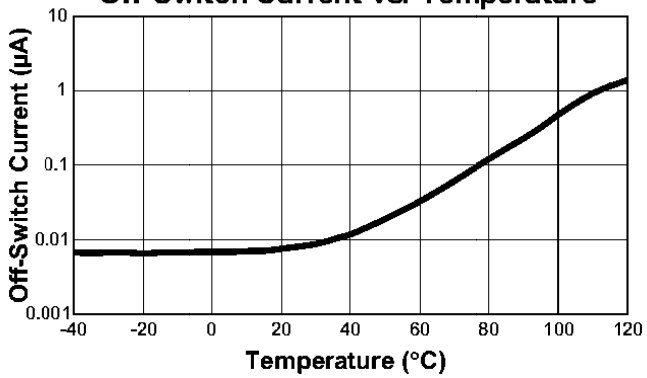
$R_{DS(ON)}$ vs. Temperature



Off-Supply Current vs. Temperature



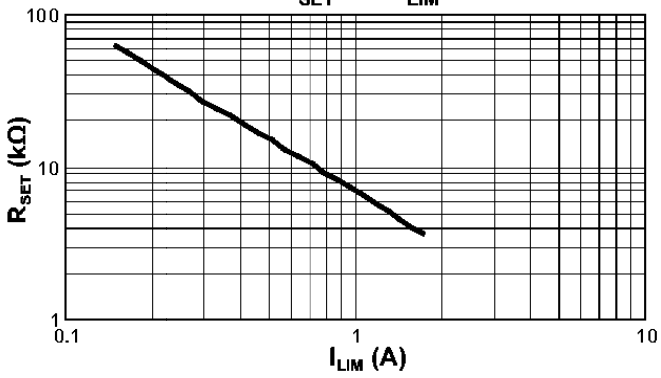
Off-Switch Current vs. Temperature



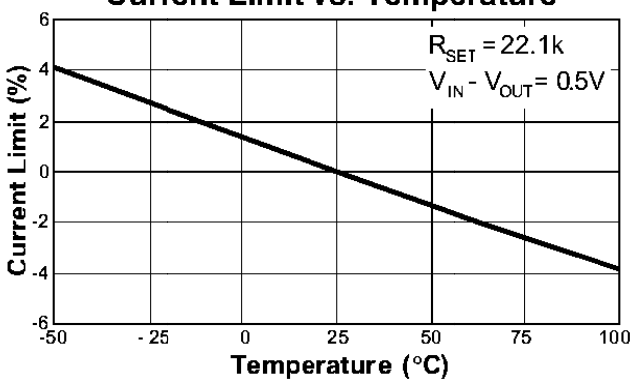
■ TYPICAL PERFORMANCE CHARACTERISTICS

(Unless otherwise noted, V_{IN}=5V, T_A=25℃)

R_{SET} vs. I_{LIM}

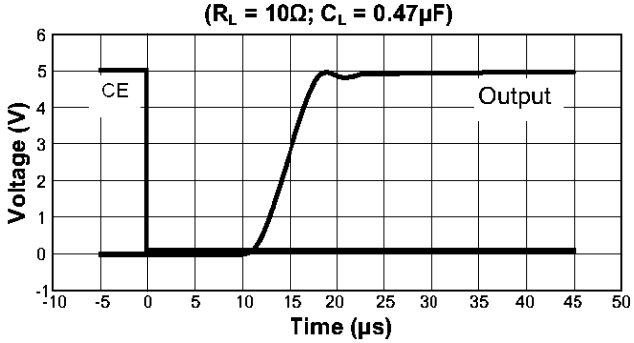


Current Limit vs. Temperature



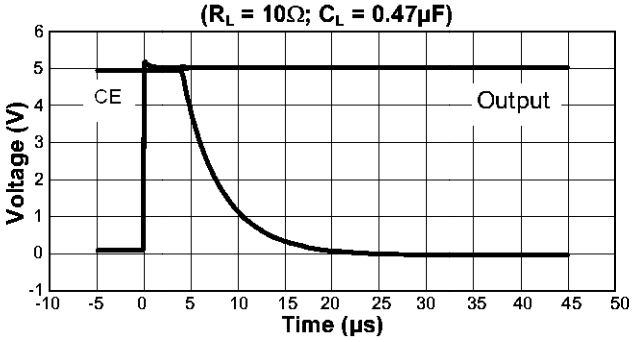
Turn-On

(R_L = 10Ω; C_L = 0.47μF)

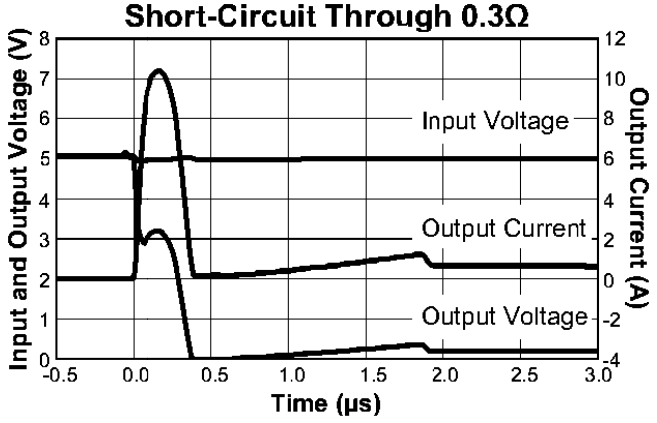


Turn-Off

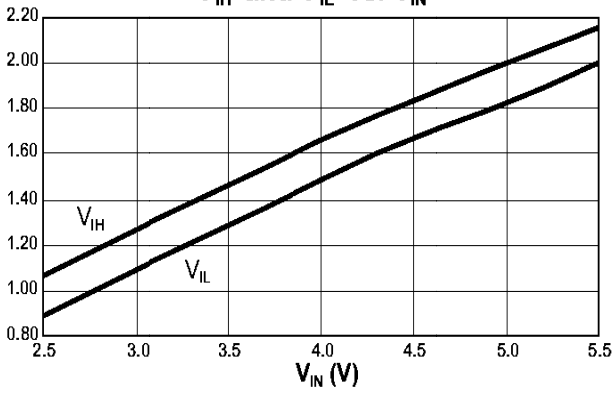
(R_L = 10Ω; C_L = 0.47μF)



Short-Circuit Through 0.3Ω



V_{IH} and V_{IL} vs. V_{IN}



OPERATION

Setting Current Limit

In most applications, the variation in I_{LIM} must be taken into account when determining R_{SET}. The I_{LIM} variation is due to processing variations from part to part, as well as variations in the voltages at IN and OUT, plus the operating temperature. See charts "Current Limit vs. Temperature" and "Output Current vs. Output Voltage." Together, these three factors add up to a ±25% tolerance (see I_{LIM} specification in Electrical Characteristics section). Figure 1 illustrates a cold device with a statistically higher current limit and a hot device with a statistically lower current limit, both with R_{SET} equal to 10.5kΩ. While the chart, "R_{SET} vs. I_{LIM}" indicates an I_{LIM} of 0.7A with an R_{SET} of 10.5kΩ, this figure shows that the actual current limit will be at least 0.525A and no greater than 0.880A.

To determine R_{SET}, start with the maximum current drawn by the load and multiply it by 1.33 (typical I_{LIM} = minimum I_{LIM} / 0.75). This is the typical current limit value. Next, refer to "R_{SET} vs. I_{LIM}" and find the R_{SET} that corresponds to the typical current limit value. Choose the largest resistor available that is less than or equal to it. The maximum current is derived by multiplying the typical current for the chosen R_{SET} in the chart by 1.25. A few standard resistor values are listed in Table 1.

R_{SET} (kΩ)	Current Limit Typ.(mA)	Device Will Not Current Limit Below (mA)	Device Always Current Limits Below (mA)
40.2	200	150	250
30.9	250	188	313
24.9	300	225	375
22.1	350	263	438
19.6	400	300	500
17.8	450	338	563
16.2	500	375	625
14.7	550	413	688
13.0	600	450	750
10.5	700	525	875
8.87	800	600	1000
7.50	900	675	1125
6.81	1000	750	1250
6.04	1100	825	1375
5.49	1200	900	1500
4.99	1300	975	1625
4.64	1400	1050	1750

Table 1: Current Limit R_{SET} Values

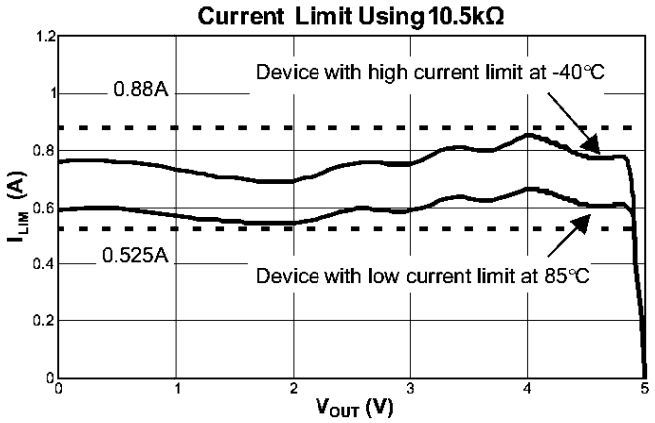


Fig.1 Current Limit Using 10.5kΩ

Example: A USB port requires 0.5A. 0.5A multiplied by 1.33 is 0.665A. From the chart named "R_{SET} vs. I_{LIM}," R_{SET} should be less than 11kΩ. 10.5kΩ is a standard value that is a little less than 11kΩ but very close. The chart reads approximately 0.700A as a typical I_{LIM} value for 10.5kΩ. Multiplying 0.700A by 0.75 and 1.25 shows that the CE1610A will limit the load current to greater than 0.525A but less than 0.875A.

Operation in Current Limit

When a heavy load is applied to the output of the CE1610A, the load current is limited to the value of I_{LIM} determined by R_{SET}. Since the load is demanding more current than I_{LIM}, the voltage at the output drops. This causes the CE1610A to dissipate a larger than normal quantity of power, and its die temperature to increase. When the die temperature exceeds an over-temperature limit, the CE1610A will shut down until is has cooled sufficiently, at which point it will startup again. The CE1610A will continue to cycle on and off until the load is removed, power is removed, or until a logic high level is applied to ON.

Enable Input

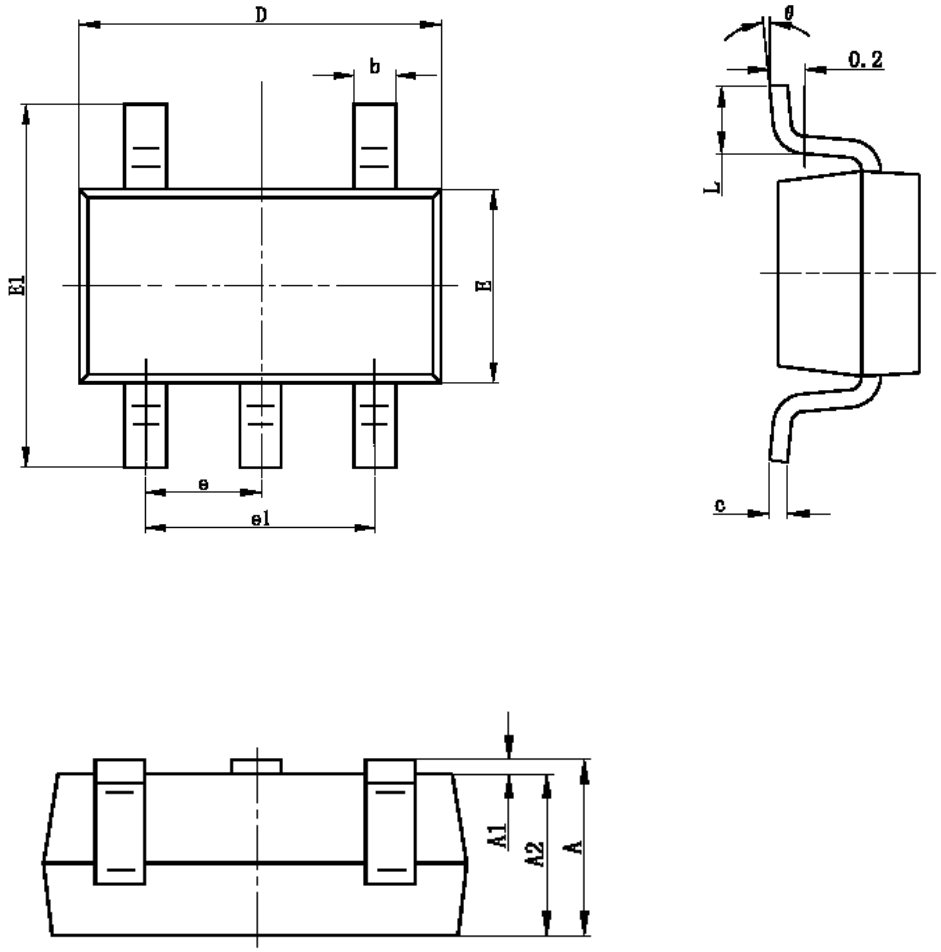
In many systems, power planes are controlled by integrated circuits which run at lower voltages than the power plane itself. The enable input ON of the CE1610A has low and high threshold voltages that accommodate this condition. The threshold voltages are compatible with 5V TTL and 2.5V to 5V CMOS.

Reverse Voltage

The CE1610A is designed to control current flowing from IN to OUT. If a voltage is applied to OUT which is greater than the voltage on IN, large currents may flow. This could cause damage to the CE1610A.

■ PACKAGING INFORMATION

- **SOT23-5 Package Outline Dimensions**



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950(BSC)		0.037(BSC)	
e1	1.800	2.000	0.071	0.079
L	0.300	0.600	0.012	0.024
θ	0°	8°	0°	8°