

HM5030 Series-High input Voltage Linear Li-Ion Battery Charger

GENERAL DESCRIPTION

The HM5030 Series is a complete constant current & constant voltage linear charger for single cell lithium-ion batteries. Its SOT23-5 package and low external component counts make the HM5030 Series ideally suited for portable applications. Furthermore, the HM5030 Series is specifically designed to work within USB power specifications.

No external sense resistor is needed, and no blocking diode is required due to the internal MOSFET architecture. The charge voltage is fixed at 4.2V/4.3V/4.35V/4.4V, and the charge current can be programmed externally with a single resistor. The HM5030 automatically terminates the charge cycle when the charge current drops to 1/10 the programmed value after the final float voltage is reached.

When the input supply (wall adapter or USB supply) is removed, the HM5030 automatically enters a low current state, dropping the battery drain current to less than 2uA. The HM5030 can be put into shutdown mode, reducing the supply current to 50uA.

Under-voltage lockout, automatic recharge and two status pins to indicate charge and charge termination.

FEATURES

- 30V standoff input voltage at VCC pin
- Programmable Charge Current Up to 600mA
- No MOSFET, Sense Resistor or Blocking Diode Required
- Complete Linear Charger in SOT23-5 Package for single Cell Lithium-Ion Batteries
- Charges Single Cell Li-Ion Batteries Directly from USB Port
- Preset 4.2V/4.3V/4.35V/4.4V Charge Voltage with $\pm 1\%$ Accuracy
- Charge Current Monitor Output for Gas Gauging
- Automatic Recharge
- CC/10 Charge Termination
- 50uA Supply Current in Shutdown
- 2.9V Trickle Charge Threshold
- Soft-Start Limits Inrush Current
- ESD HBM 2KV
- Available in SOT23-5 Package

APPLICATIONS

- Cellular Telephones, PDAs, MP3 /MP4 Players
- E-cigarettes
- Bluetooth
- GPS Applications

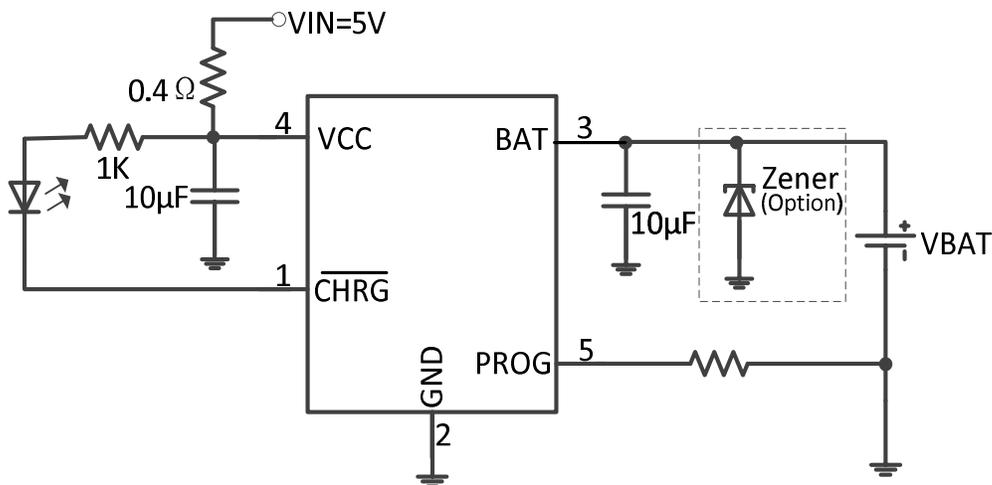


Figure1 .Typical Application Circuit

ORDERING INFORMATION

PART NUMBER (note1)	VBAT	MARK (note2)
HM5030A	4.2V	XC30XXYW
HM5030B	4.3V	XC30XXBYW
HM5030C	4.35V	XC30XXCYW
HM5030D	4.4V	XC30XXDYW

Note1: In HM5030X description, X may be A or B or C or D

Note2: "YW" is manufacture date code, "Y" means the year, "W" means the week

PIN CONFIGURATION

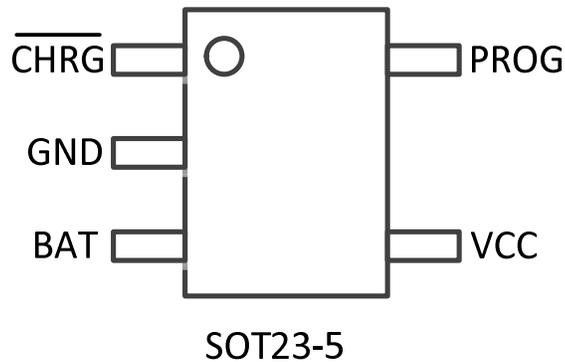


Figure 2.PINConfiguration

PIN DESCRIPTION

PIN NUMBER	PIN NAME	PIN DESCRIPTION
1,	$\overline{\text{CHRG}}$	Open-Drain Charge Status Output.
2	GND	Ground
3	BAT	Charge Current Output.
4	VCC	Positive Input Supply Voltage.
5	PROG	Charge Current Program, Charge Current Monitor and Shutdown Pin.

ABSOLUTE MAXIMUM RATINGS

(Note: Do not exceed these limits to prevent damage to the device. Exposure to absolute maximum rating conditions for long periods may affect device reliability.)

PARAMETER	VALUE	UNIT
Input Supply Voltage VCC	VSS-0.3 ~ VSS+30	V
PROG pin Voltage Vprog	VSS-0.3 ~ 10	V
BAT pin Voltage Vbat	VSS-0.3 ~ 11	V
CHRG pin Voltage Vchrg	VSS-0.3 ~ 10	V
BAT pin Current Ibat	0.75	A
PROG pin Current Iprog	0.75	mA
Operating Ambient Temperature	-40 to 85	°C
Maximum Junction Temperature	150	°C
Storage Temperature	-55 to 150	°C
Lead Temperature (Soldering, 10 sec)	260	°C

ELECTRICAL CHARACTERISTICS

(VCC = 5.0V, Vbat=3.5V TA= 25°C unless otherwise specified)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Input Voltage Tolerance			4.25		26	V
Input over Voltage protection	V _{OVp}			6.8		V
The Hysteresis Voltage of V _{OVp}				0.4		V
Input Voltage Range			4.25		6	V
Input supply current	I _{CC}	Charge mode, R _{PROG} =10K		350	2000	uA
		Standby mode, Vbat=4.3V		150	500	uA
		Shutdown mode(V _{CC} <V _{bat} or V _{CC} <V _{UV})		50	200	uA
BAT pin Current	I _{BAT}	R _{PROG} =200k, Current mode	4	5	6	mA
		R _{PROG} =100k, Current mode	8	9.5	11	mA
		R _{PROG} =10k, Current mode	85	95	105	mA
		R _{PROG} =2k, Current mode	425	475	525	mA
		Standby mode, Vbat=4.3V	0	-2.5	-6	uA
		Shutdown mode		1	2.5	uA
		Sleep mode, V _{CC} =0V		0.3	2.5	uA

Regulated Charge Voltage(HM5030A)	Vfloat	0°C ≤ TA ≤ 85°C, Icharge = 40mA	4.158	4.2	4.242	V
Regulated Charge Voltage(HM5030B)			4.257	4.3	4.343	V
Regulated Charge Voltage(HM5030C)			4.307	4.35	4.394	V
Regulated Charge Voltage(HM5030D)			4.356	4.4	4.444	V
PROG pin Voltage	Vprog	R _{PROG} = 2k, Current mode	0.93	1.0	1.07	V
Trickle charge current	Itrikl	Vbat < Vtrikl, Rprog=2k	85	95	105	mA
Trickle charge Threshold Voltage	Vtrikl	R _{PROG} = 10K, Vbat Rising	2.7	2.9	3.1	V
Trickle voltage hysteresis voltage	Vtrhys	R _{PROG} = 10K	0.08	0.12	0.16	V
Recharge Battery threshold Voltage	Δ Vrecg	V _{FLOAT} - V _{RECHRG}		105	150	mV
Under voltage Lockout Threshold	VUVLO	BAT = 3.5V, IN Rising	3.05	3.4	3.75	V
VCC under voltage lockout hysteresis	Vuvhys			600		mV
CHRG pin Output low voltage	Vchrg	Ichrg=5mA		1.2	2	V
Thermal Shutdown Temperature	TSHDN			140		°C
Thermal Shutdown Hysteresis	ΔTSHDN			20		°C

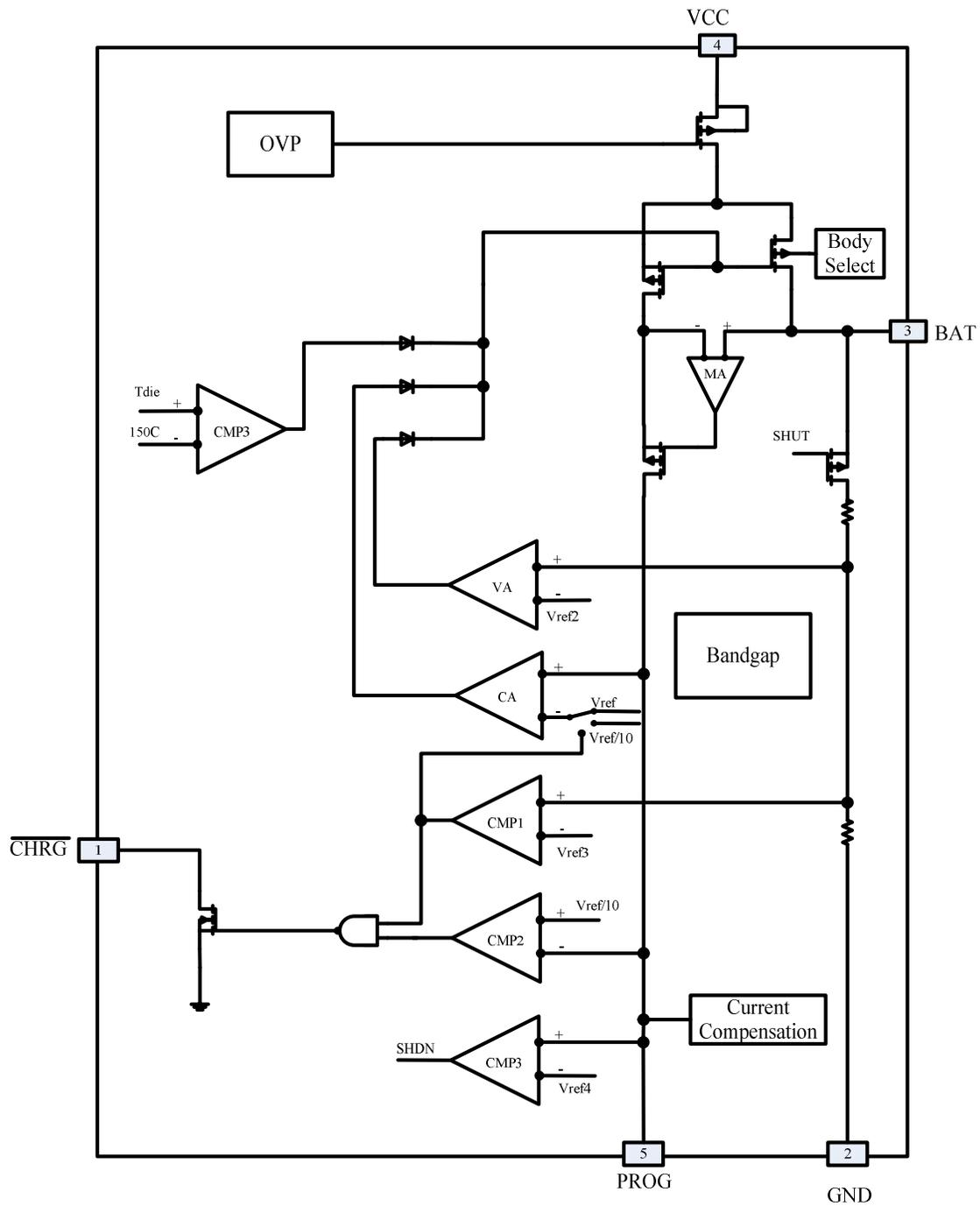


Figure3 Block Diagram

PIN FUNCTION

CHRG (PIN 1): Open-Drain Charge Status Output.

When the battery is charging, the $\overline{\text{CHRG}}$ pin is pulled low by an internal N-channel MOSFET. When the charge cycle is completed, CHRG pin will be in a high-impedance state.

GND (PIN 2): Ground.

BAT (PIN 3): Charge Current Output.

Provides charge current to the battery and regulates the final float voltage to 4.2V/4.3V/4.35V/4.4V. An internal precision resistor divider from this pin sets the float voltage which is disconnected in shutdown mode.

VCC (PIN 4): Positive Input Supply Voltage.

Provides power to the charger, VCC can range from 4.25V to 6.5V and should be bypassed with at least a 10uF capacitor. When VCC drops to within 30mV of the BAT pin voltage, the HM5030 enters shutdown mode, dropping IBAT to less than 2uA.

PROG (PIN 5): Charge Current Program, Charge Current Monitor and Shutdown Pin.

The charge current is programmed by connecting a 1% resistor, RPROG, to ground. When charging in constant-current mode, this pin serves to 1V. In all modes, the voltage on this pin can be used to measure the charge current using the following formula:

$$\text{IBAT} = (\text{VPROG}/\text{RPROG}) \times 950.$$

The PROG pin can also be used to shut down the charger. Disconnecting the program resistor from ground allows a compensated current to pull the PROG pin high. When it reaches the 1.21V shutdown threshold voltage, the charger enters shutdown mode, charging stops and the input supply current drops to 50uA. Reconnecting RPROG to ground will return the charger to normal operation.

OPERATION

CHARGE CYCLE OVERVIEW

When a battery charge cycle begins, the battery charger first determines if the battery is deeply discharged. If the battery voltage is below V_{trikl} , typically 2.9V, an automatic trickle charge feature sets the battery charge current to 10% of the full-scale value.

Once the battery voltage is above 2.9V, the battery charger begins charging in constant-current mode. When the battery voltage approaches the 4.2V/4.3V/4.35V/4.4V required to maintain a full charge, otherwise known as the float voltage, the charge current begins to decrease as the HM5030 switches into constant-voltage mode.

TRICKLE CHARGE AND CHARGE TERMINATION

Any time the battery voltage is below V_{trikl} , the charger goes into trickle charge mode and reduces the charge current to 10% of the full-scale current. If for any reason the battery voltage rises above V_{trikl} , the charger will resume charging. When the battery is charging, the CHRG pin is pulled low by an internal N-channel MOSFET. When the charge cycle is completed, CHRG pin will be in a high-impedance state.

When the battery voltage reach the regulated charge voltage, typically 4.2V/4.3V/4.35V/4.4V and the charger current is below 10% of fast charge setting current, charging of the battery will discontinue and no more current will be delivered

CHARGE STATUS INDICATION

The $\overline{\text{CHRG}}$ pin indicates the status of the battery charger. Four possible states are represented by charging , complete ,fault ,floating.

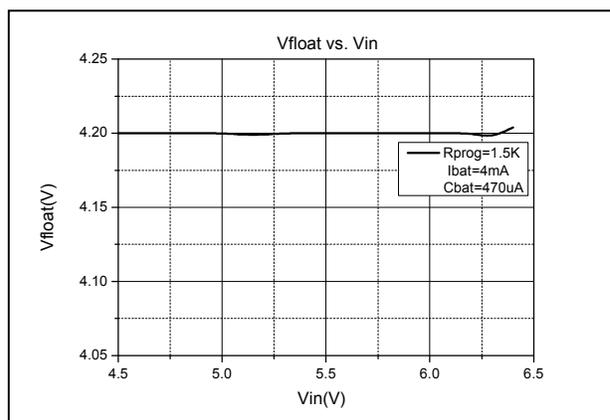
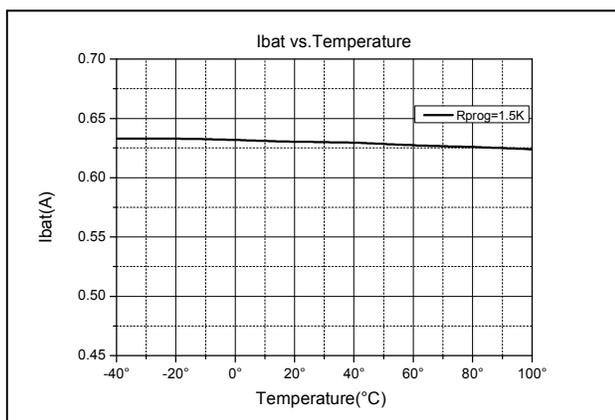
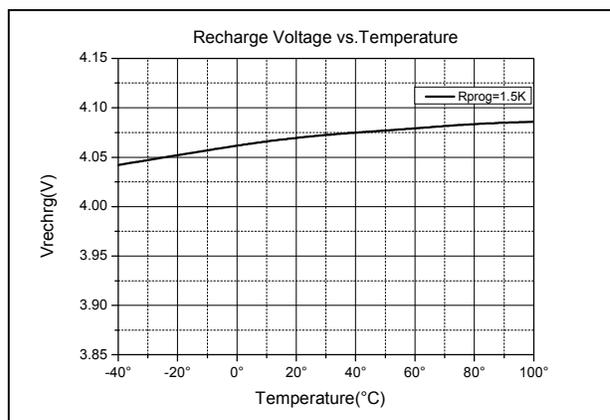
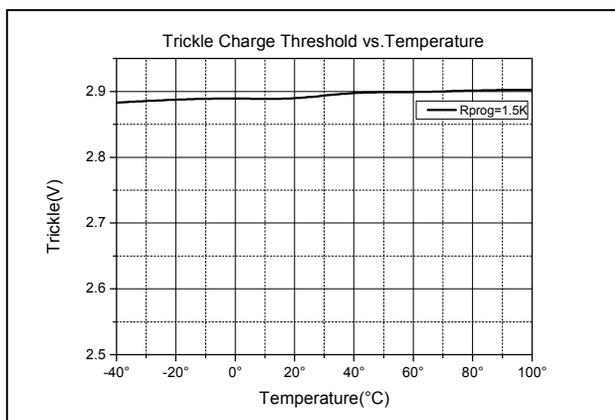
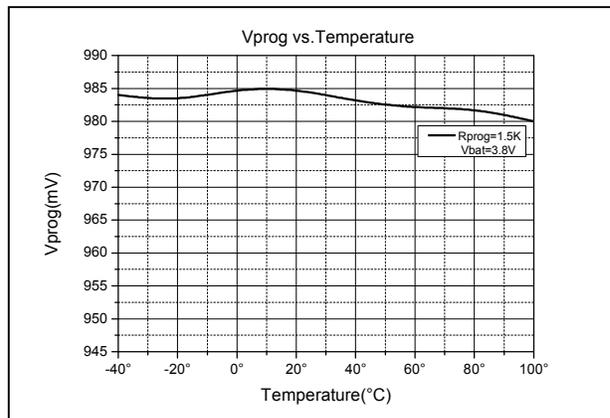
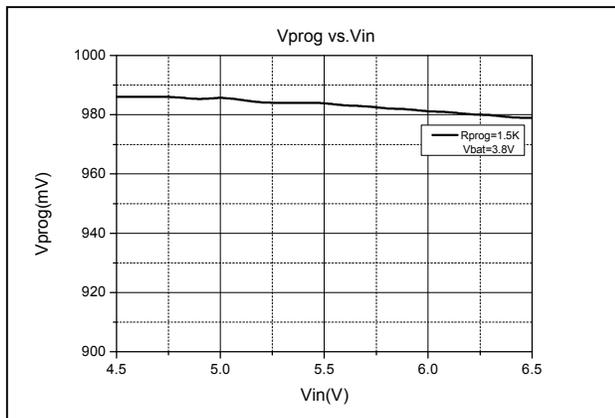
Table 1 illustrates the four possible states of them when the battery charger is active.

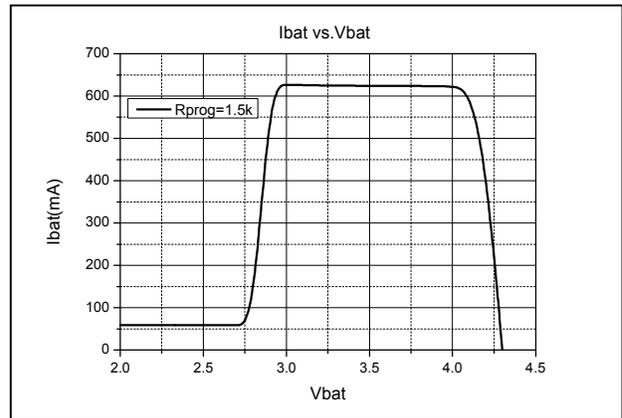
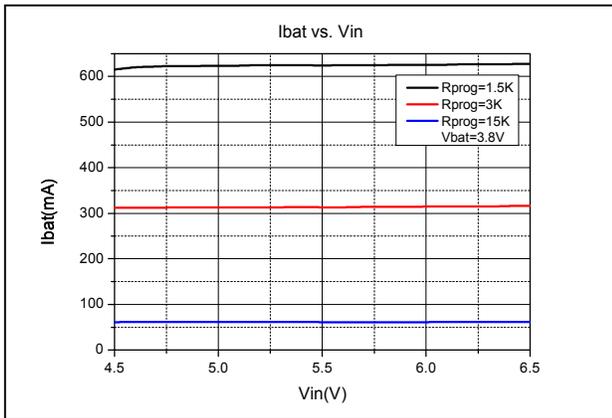
Charge Status	$\overline{\text{CHRG}}$ LED
Charging	ON
Complete	OFF
Fault UVLO	OFF
Floating BAT Pin C=10uF and Battery unavailable	$\overline{\text{CHRG}}$ LED TWINKLE(About 1~4s)

AUTOMATIC RECHARGE

After the battery charger terminates, it will remain off, drawing only microamperes of current from the battery. If the portable product remains in this state long enough, the battery will eventually self-discharge. To ensure that the battery is always topped off, a charge cycle will automatically begin when the battery voltage falls below V_{RECHRG} (typically 4.08V).

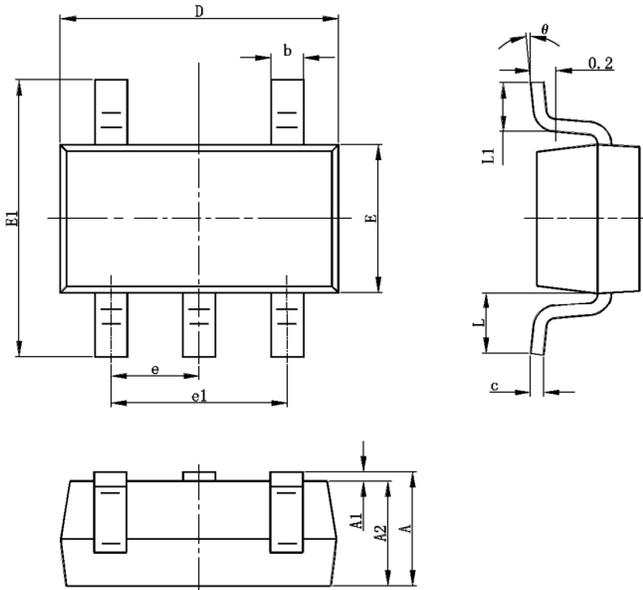
TYPICAL PERFORMANCE CHARACTERISTICS





PACKAGE OUTLINE

SOT23-5 PACKAGE OUTLINE AND DIMENSION



SYMBOL	DIMENSION IN MILIMETERS		DIMENSION 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	0.400	0.012	0.016
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 TYP		0.037 TYP	
e1	1.800	2.000	0.071	0.079
L	0.700 REF		0.028 REF	
L1	0.300	0.600	0.012	0.024
θ	0°	8°	0°	8°