GENERAL DESCRIPTION

XR2130A is a spacing saving single chip lithium-ion/polymer battery protection IC. Integrating power MOSFET and only two external components makes the protection board highly compact. XR2130A has full protection including over charging voltage protection, over discharging protection, over current protection, short protection and over temperature protection. The very low standby current drains little current from the cell while in storage. XR2130A is available in 5 PIN SOT23 package.

FEATURES

· Integrate low Rdson Power MOSFET
· Ultra-small SOT23-5 Package
· Over-temperature Protection
· Two-steps Over current protection
· High-accuracy Voltage Detection
· Low Current Consumption
  - Operation Mode: 1.7μA typ.
  - Power-down Mode: 0.17μA typ.
RoHS Compliant and Lead (Pb) Free

APPLICATIONS

One-Cell Lithium-ion Battery Pack
Lithium-Polymer Battery Pack

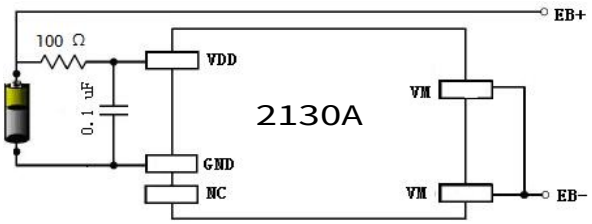


Figure 1. Typical Application Circuit

PIN DESCRIPTION

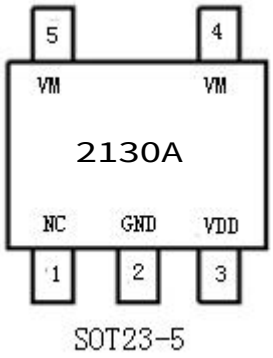


Figure 2. PIN Configuration

Number	Name	Description
1	NC	NC
2	GND	Ground, connect the negative terminal of the battery to this pin
3	VDD	Power Supply
4,5	VM	The negative terminal of the battery pack. The internal FET switch connects this terminal to GND

Function Block Diagram

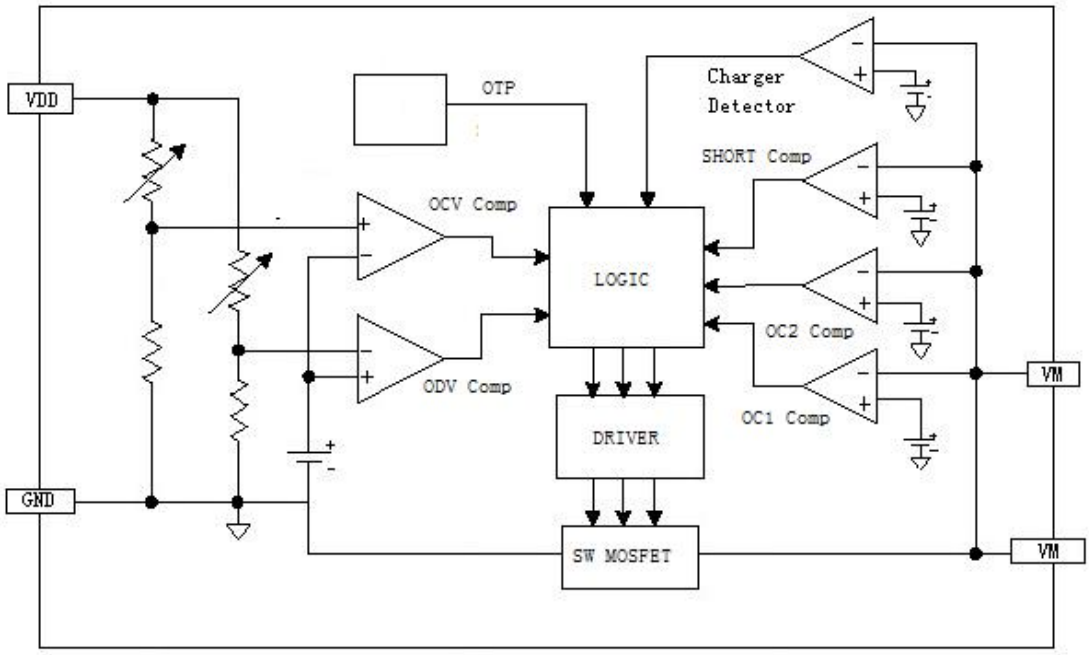


Figure 3. Functional Block Diagram

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
VDD input pin voltage	-0.3 to 6	V
VM input pin voltage	-5 to 10	V
Operating Ambient Temperature	-40 to 85	°C
Maximum Junction Temperature	125	°C
Storage Temperature	-55 to 150	°C
Lead Temperature (Soldering, 10 sec)	300	°C
Power Dissipation at T=25°C	0.4	W
Package Thermal Resistance (Junction to Ambient) θJA	80	°C/W
Package Thermal Resistance (Junction to Case) θJC	20	°C/W
ESD	2000	V

ABSOLUTE MAXIMUM RATINGS

Typically T_A = 27°C, VDD=3.7V unless otherwise specified

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
Detection Voltage						
Overcharge Protection Voltage	V_{OCV}		4.25	4.30	4.35	V
Overcharge Protection Release Voltage	V_{OCR}		4.04	4.10	4.16	V
Overdischarge Protection Voltage	V_{ODV}		2.65	2.75	2.85	V
Overdischarge Protection Release Voltage	V_{ODR}		2.9	3.0	3.1	V
Charger Detection Voltage	V_{CHA}		-0.07	-0.12	-0.2	V
Detection Current						
Class1 Overdischarge Protection Current	I_{OCI1}	V_{DD}=3.5V	2.1	3	3.9	A
Class2 Overdischarge Protection Current	I_{OCI2}	V_{DD}=3.5V	6	7.5	9	A
Load Short-Circuiting Detection	I_{SHORT}	V_{DD}=3.5V	10	18	25	A
Overcharge Protection Current	I_{CHA}	V_{DD}=3.5V	3.3	4.5	5.5	A
Current Consumption						
Current Consumption in Normal Operation	I_{OPE}	$V_{D\cdot D}$=3.5V VM =0V		1.7	4	μA
Current Consumption in power Down	I_{PDN}	V_{DD}=2.0V VM pin floating		0.17		μA
VM Internal Resistance						
Internal Resistance between VM and V_{DD}	R_{VMD}	V_D=3.5V VM=1.0V		320		kΩ
Internal Resistance between VM and GND	R_{VMS}	V_{DD}=2.0V VM=1.0V		100		kΩ
FET on Resistance						
Equivalent FET on Resistance	$R_{DS(ON)}$	V_{DD}=3.6V I_{VM}=1.0A	35	40	45	mΩ
Over Temperature Protection						
Over Temperature Protection	T_{SHD+}			140		°C
Over Temperature Recovery Degree	T_{SHD-}			120		°C
Detection Delay Time						
Overcharge Voltage Detection Delay Time	t_{OCV}			120		mS
Overdischarge Voltage Detection Delay Time	t_{ODV}			120		mS
Overdischarge Current1 Delay Time	t_{IOV1}	V_{DD}=3.5V		10		mS

Overdischarge Current2 Delay Time	t_{IOV2}	V_{DD}=3.5V		3		mS
Load Short-Circuiting Detecti on Delay Time	t_{SHORT}	V_{DD}=3.5V		150		uS

Description of Operation

Overcharge Protection

When the voltage of the battery cell exceeds the overcharge protection voltage (V_{OCV}) beyond the overcharge delay time (t_{OCV}) period, charging is inhibited by turning off power MOSFET. The overcharge condition is released in two cases:
1. The voltage of the battery cell becomes lower than the overcharge release voltage (V_{OCR}) through self-discharge.
2. The voltage of the battery cell falls below the overcharge protection voltage (V_{OCV}) and a load is connected. When the battery voltage is above V_{OCV}, the overcharge condition will not release even a load is connected to the pack.

Overdischarge Protection

When the voltage of the battery cell goes below the overdischarge protection voltage (V_{ODV}) beyond the overdischarge delay time (t_{ODV}) period, discharging is inhibited. Inhibition of discharging is immediately released when the voltage of the battery cell becomes higher than overdischarge release voltage (V_{ODR}).

Overcurrent Protection

When the discharging current becomes higher than a specified Overdischarge Current and beyond over discharge current delay time period, discharging is inhibited. Inhibition of discharging is immediately released when the load is released or the impedance between EB+ and EB- is larger than 500kΩ. The XR2130A provides three over current detection levels (3A, 7A and 18A) with three over current delay time (t_{IOV1}, t_{IOV2} and t_{SHORT}) corresponding to each over current detection level.

Over Temperature Protection

When IC temperature becomes higher than a specified value, XR2130A will turn off Power MOSFET whatever in discharging or charging condition. In discharging condition, Inhibition of discharging is released when temperature lower than Over Temperature Recovery Degree and load also released. In charging condition, Inhibition of charging is released when temperature lower than over temperature recovery degree and charger also removed.

Over Charging Current Protection

When the charging current becomes higher than discharge protection Current (I_{CHA}) and beyond over discharge current delay time period, charging is inhibited. Inhibition of charging is immediately released when the charger is removed.

Charger detection after Overdischarge

When over discharge occurs, discharging is inhibited. However, charging is still permitted through the parasitic diode of MOSFET. Once the charger is connected to the battery pack, XR2130A detects the voltage between VM and GND is below charge detection threshold voltage (V_{CHA}), Power MOSFET will turn on when Battery cell voltage is higher than Overdischarge Protection Voltage.

Power Saving after Overdischarge

When overdischarge occurs, the XR2130A will enter into power-down mode.

Timing Diagram

1. Overcharge(OCV) State →Load Discharge State →Normal State

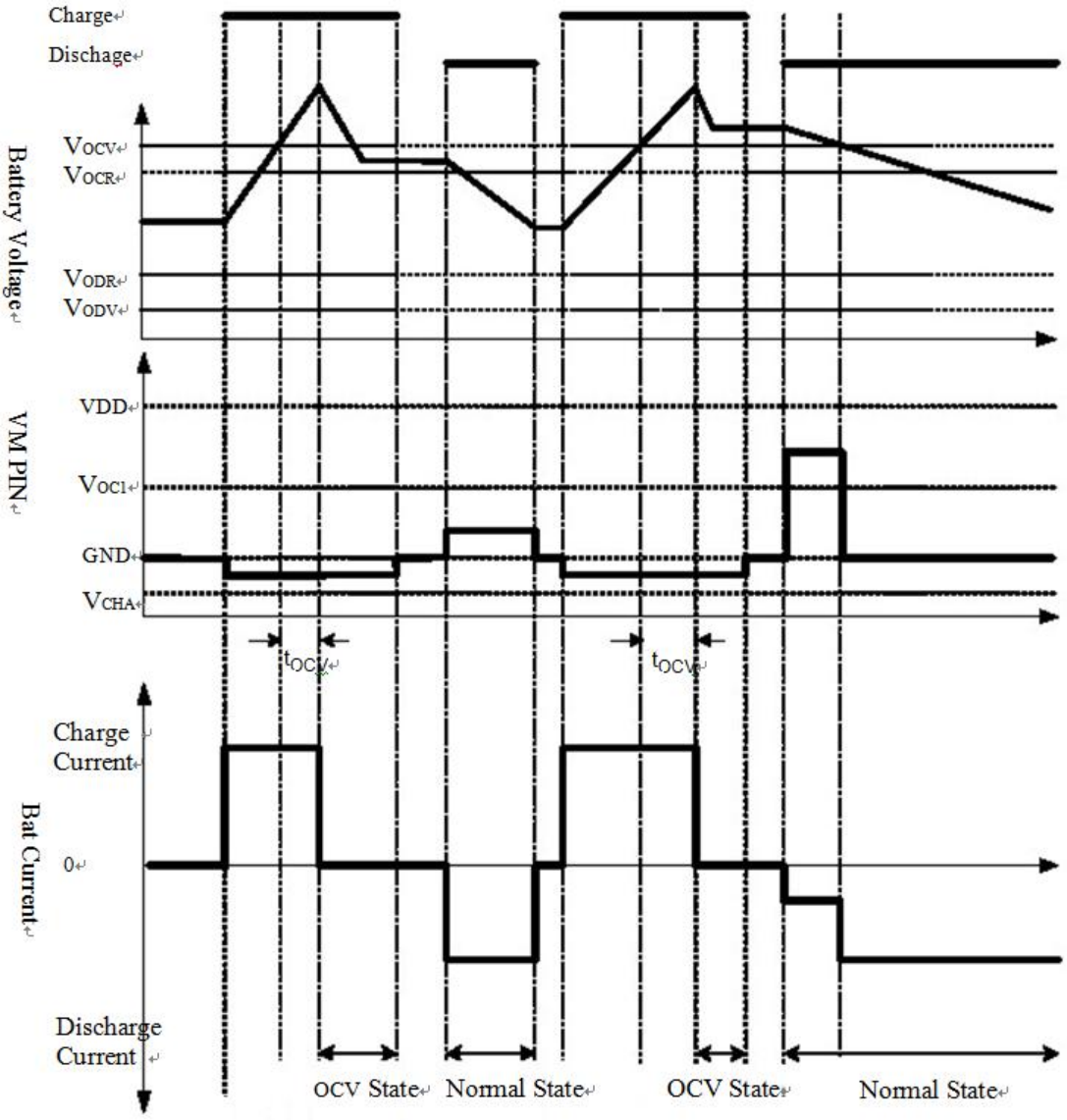


Figure 4. Charge, Discharge and Normal state timing

2. Over Discharge(ODV) State →Charging by a Charger →Normal State

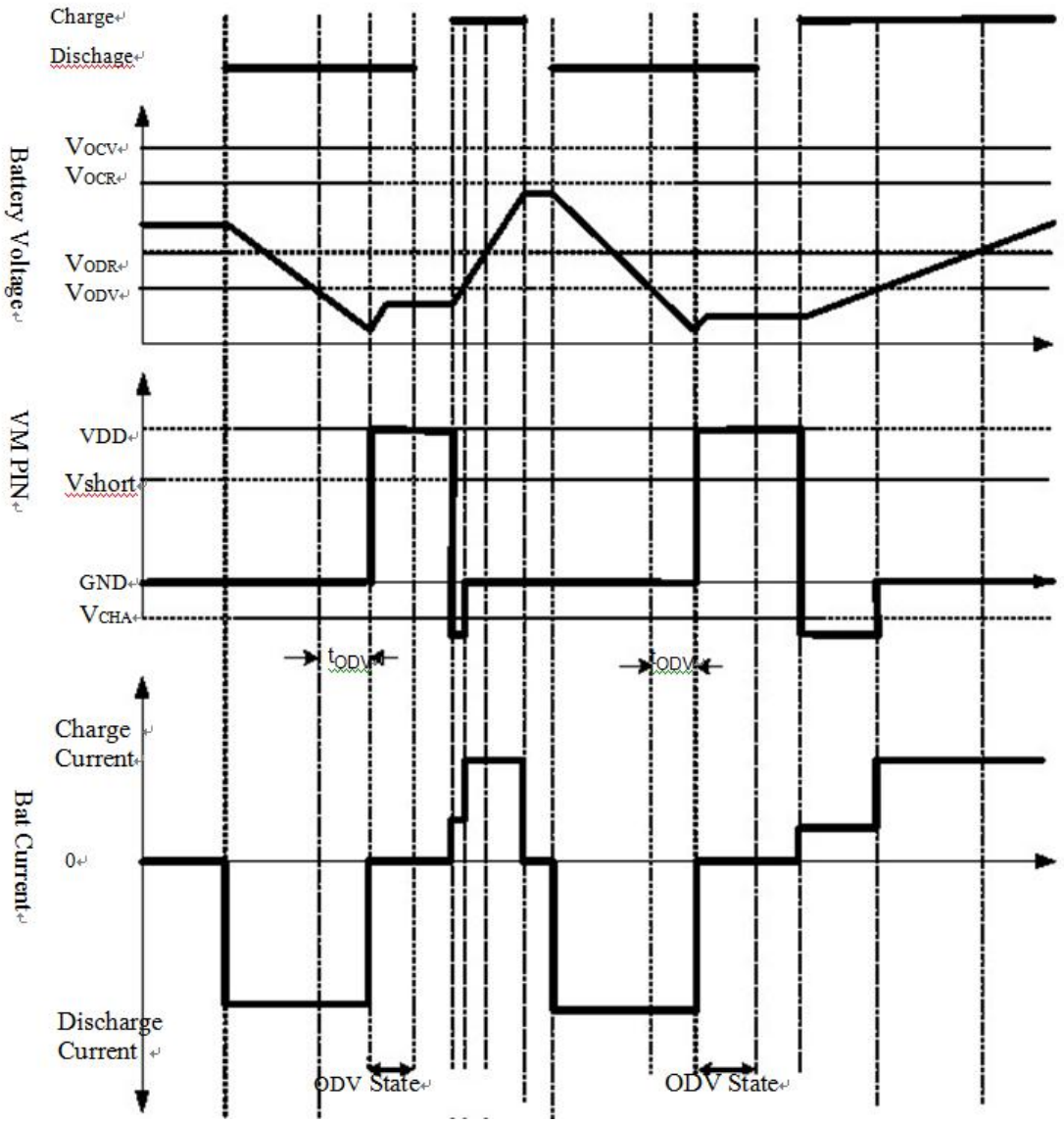


Figure 5. Over Discharge, Charge and Normal state timing

3. Over Discharge Current (ODC)State →Normal State

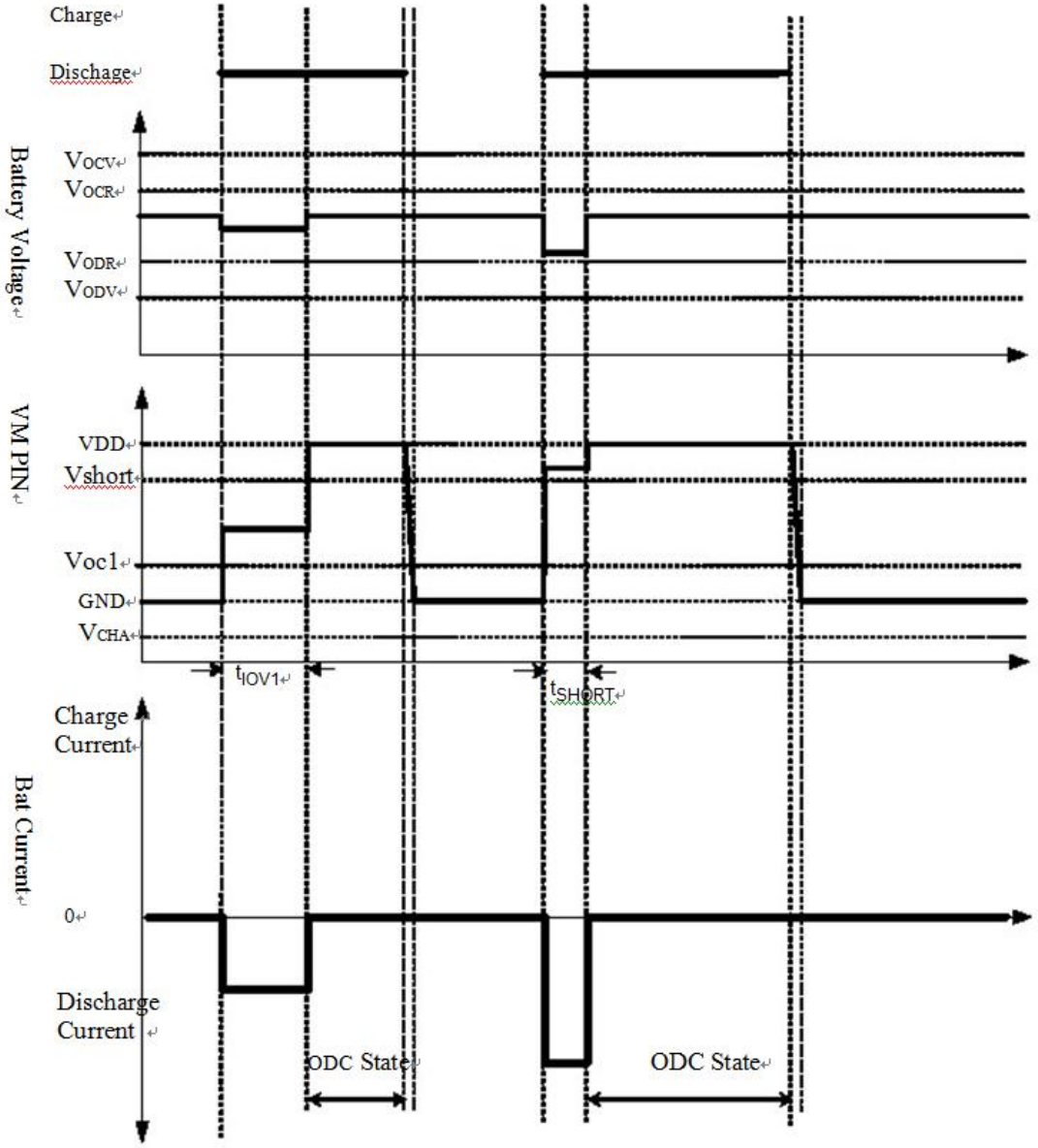


Figure 6. Over Discharge current and Normal state timing

TYPICAL APPLICATION

As shown in Figure 8, the bold line is the high density current path which must be kept as short as possible. For thermal management, ensure that these trace widths are adequate. C1 is a decoupling capacitor which should be placed as close as possible to XR2130A.

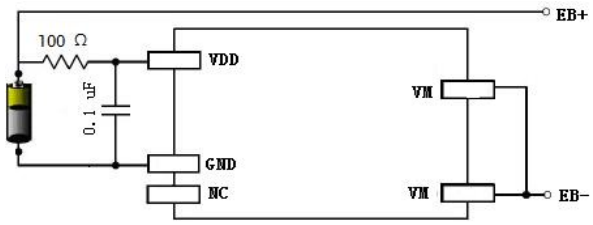


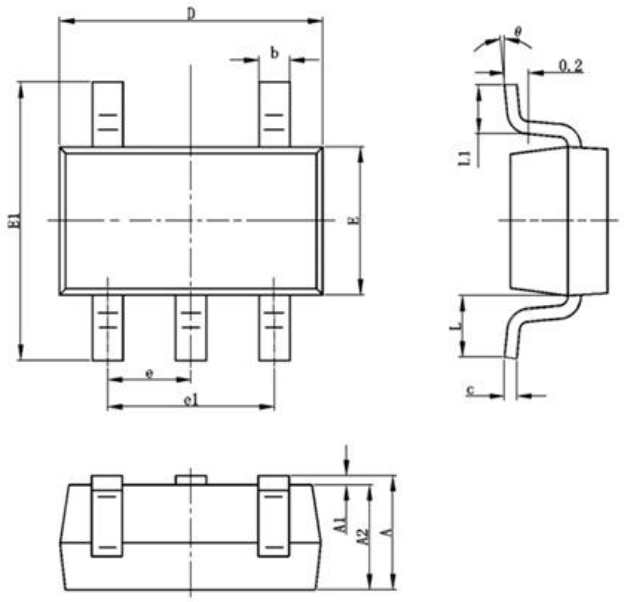
Figure 8. Typical Battery Protection Circuit

Precautions

- Pay attention to the operating conditions for input/output voltage and load current so that the power loss in XR2130A does not exceed the power dissipation of the package.
- Do not apply an electrostatic discharge to this XR2130A that exceeds the performance ratings of the built-in electrostatic protection circuit.

PACKAGE OUTLINE

SOT23-5 PACKAGE OUTLINE AND DIMENSIONS



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°