SKI6291-DM

1MHz, 2.5A Current Mode PWM Boost Converter

Description

SKI6291 is a current-mode boost DC-DC converter featuring pulse-width modulation (PWM) circuitry and an integrated 0.2Ω power MOSFET, delivering high power efficiency. Its internal compensation network reduces the number of external components required by up to six. The non-inverting input of the error amplifier is connected to a 0.6V precision reference voltage, and the internal soft-start function minimizes inrush current.

Housed in an SOT-23-6 package, the SKI6291 saves PCB space in applications.

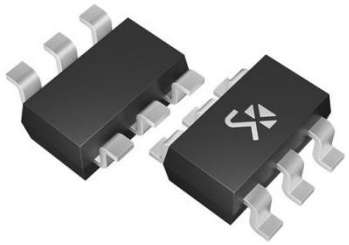
Features

- Adjustable output voltage up to 12V
- Internal fixed PWM frequency: 1.0MHz
- Precision feedback reference voltage: 0.6V(±2%)
- Integrated 0.2Ω, 2.5A, 16V power MOSFET
- Shutdown current: 0.1μA
- Over-temperature protection(OTP)
- Over-voltage protection(OVP)
- Adjustable over-current protection: 0.5A~2.5A
- Package type: SOT-23-6

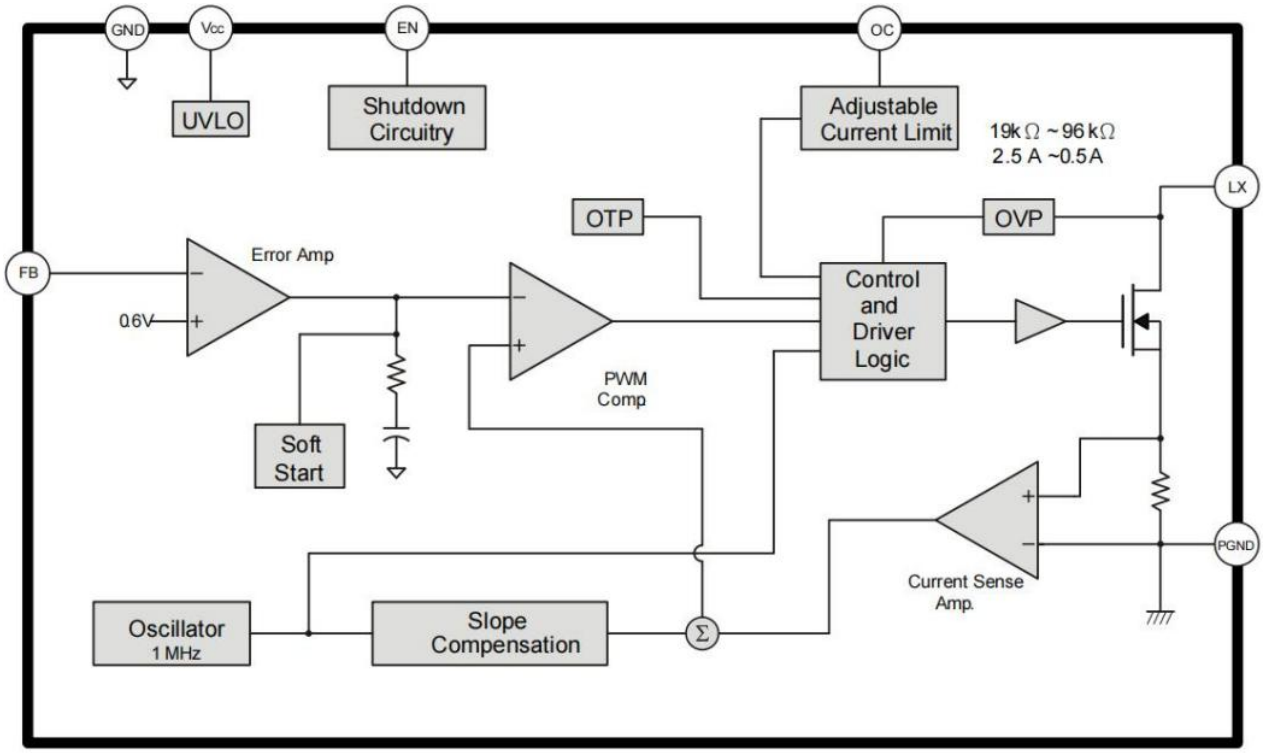
Applications

- Chargers
- Handheld devices
- Portable products

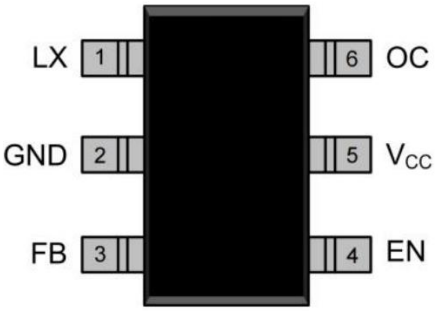
Package Outline Drawing



Function Block Diagram



Pin Description

Pin Number	Pin Name	I/O	Description	Pin Configuration Diagram
1	LX	O	Power switch output	
2	GND	P	IC ground	
3	FB	I	Inverting input of the error amplifier	
4	EN	I	Enable control(active high)	
5	V_{CC}	P	IC power supply	
6	OC	I	Adjustable current limit (floating available)	

Absolute Maximum Ratings (T_A=25℃ unless otherwise noted)

Parameter	Symbol	Value	Unit
Supply Voltage	V_{CC}	6	V
LX Voltage	V_{LX}	16	V
EN, FB Voltage	V_{EN},V_{FB}	6	V
Power Dissipation	P_D	455	mW
Thermal Resistance(1)	θ_{JA}	220	℃/W
Junction Temperature	T_J	150	℃
Operating Temperature	T_A	-20~+85	℃
Storage Temperature	T_{STG}	-65~+150	℃
Lead Temperature(soldering, 10s)	T_W	260	℃

Note: (1).θ_{JA} is measured in natural convection at T_A=25℃ on a low-effective-thermal-conductivity test board per JEDEC 51-3 thermal measurement standards.

(2).Exceeding the above limit values may cause permanent damage to the chip.

Recommended Operating Conditions (T_A=25℃ unless otherwise noted)

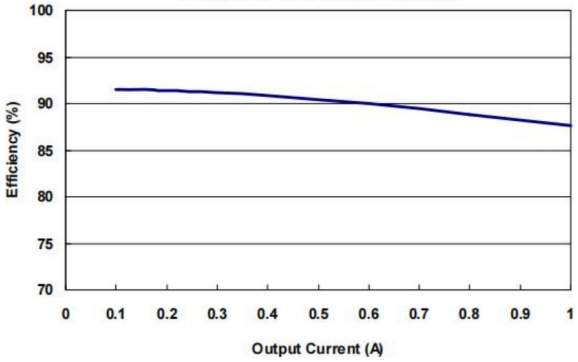
Parameter	Symbol	Min	Max	Unit
Supply Voltage	V_{CC}	2.6	5.5	V

Electrical Characteristics(T_A=25℃, V_{CC}=3.3 V unless otherwise noted)

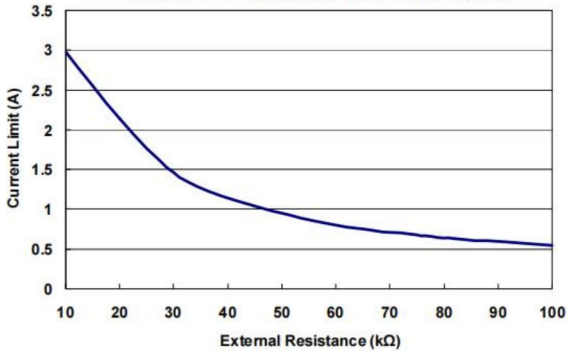
Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
System Power Input						
Input Supply Voltage	V_{CC}		2.6		5.5	V
Under-Voltage Lockout	V_{UVLO}			2.2		V
Under-Voltage Output Hysteresis				0.1		V
Quiescent Current	I_{ST}	V_{FB}=0.66V,No switching		0.19		mA
Average Supply Current	I_{OP}	V_{FB}=0.55V,switching		1.50		mA
Shutdown Current	I_{OFF}	V_{EN}=GND		0.1		μA
Oscillator						
Operating Frequency	F_{OSC}	V_{FB}=1.0V	0.8	1.0	1.2	MHz
Frequency vs. Voltage Coefficient	Δf/ΔV	V_{CC}=2.6V~5.5V		5		%
Maximum Duty cycle	T_{DUTY}			90		%
Reference Voltage						
Reference Voltage	V_{REF}		0.588	0.6	0.612	V
Linearity		V_{CC}=2.6V~5.5V		0.2		%/V
Enable Control						
Enable Voltage	V_{ENH}		0.96			μA
Shutdown Voltage	V_{ENL}				0.6	V
MOSFET						
On-Resistance	$R_{DS(ON)}$	I_{LX}=2A		0.2		Ω
Protection						
OCP Current	I_{OCP}			2.5		A
Adjustable Range of OCP Current	I_{OPC}	External adjustment resistor: 19K~96K	0.5		2.5	A
OPT Temperature	T_{OTP}			+150		℃

Typical Operating Characteristics(T_A=25℃, V_{CC}=3.3 V, V =5V unless otherwise noted)

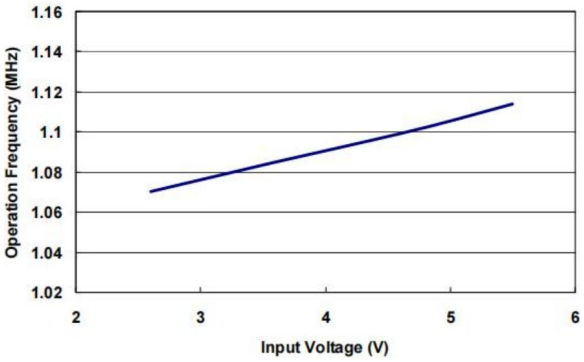
Efficiency vs. Output Current



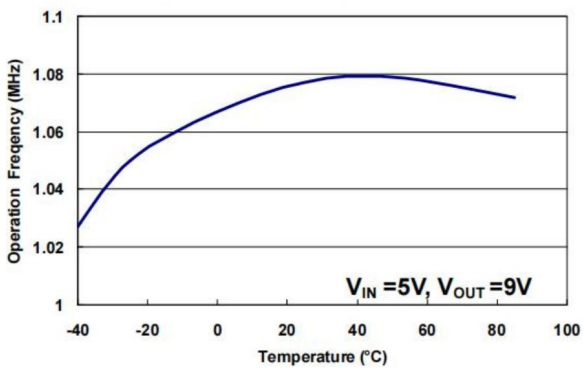
Current Limit vs. External Resistance (Roc)



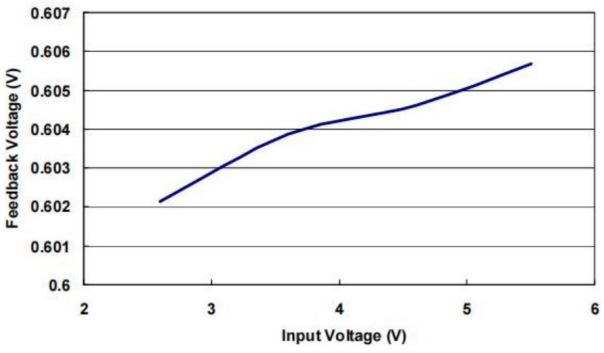
Operation Frequency vs. Input Voltage



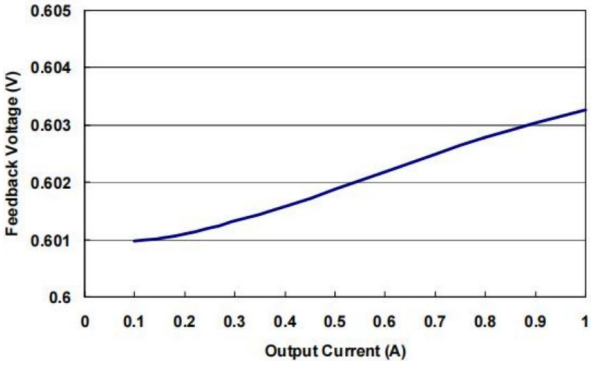
Operation Frequency vs. Temperature



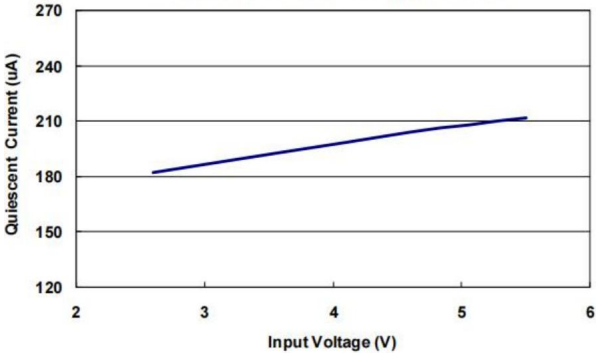
Reference Voltage vs. Input Voltage



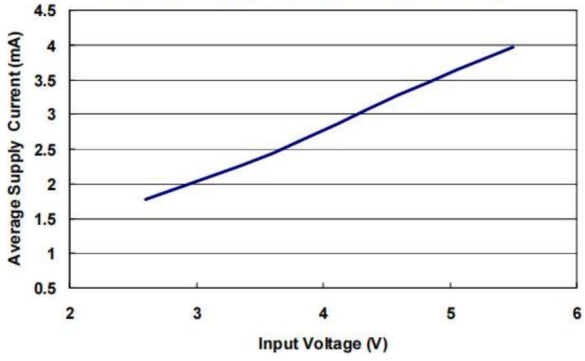
Reference Voltage vs. Output Current



Quiescent Current vs. Input Voltage



Average Supply Current vs. Input Voltage



Functional Description

Operation

SKI6291 is a current-mode boost converter operating at a fixed switching frequency of 1MHz with PWM control. Its control loop adopts peak current mode control, incorporating a slope compensation circuit in the current signal to enable stable operation of the power MOSFET at duty cycles greater than 50%. The integrated 16V/2.5A/0.2Ω MOSFET provides a high output voltage. When the output voltage exceeds the OVP threshold of 15V, the PWM signal will be immediately turned off.

Soft-Start Function

A soft-start circuit is integrated to avoid inrush current during power-on. With the integrated soft-start circuit, the output of the error amplifier is clamped by the internal soft-start function, causing the PWM pulse width to increase gradually, thereby reducing the input inrush current.

Current Limiting Process

The peak switching current of SKI6291 can be programmable controlled by adjusting the resistor between OC and GND. The resistance value is set between 19k and 96k, corresponding to a current limit range of 0.5A to 2.5A. Keep the wiring to this pin as short as possible and do not connect a capacitor to this pin.

The over-current protection point is set according to the following formula:

$$I_{OCP} = \frac{48000}{R3}$$

Over-Temperature Protection(OTP)

When the internal junction temperature exceeds the OTP threshold temperature of 150℃, the SKI6291 will automatically turn off the power MOSFET. When the junction temperature drops by 30℃ below the threshold, the power MOSFET will resume operation.

Over-Voltage Protection(OVP)

In some cases, the resistive voltage divider may be floating, causing the PWM signal to operate at the maximum duty cycle, and the output voltage will be boosted to an increasingly high level. When the output voltage exceeds the OVP threshold, the PWM signal will be turned off.

Inductor Selection

The inductance value is determined by different conditions. For general application circuits, an inductance value of 3.3μH to 4.7μH is recommended. There are three important inductor specifications: DC resistance, saturation current, and core loss. A low DC resistance ensures better power efficiency, and it will

greatly prevent inductor saturation, thereby ensuring the stability of the circuit system and reducing core loss at 1MHz.

Capacitor Selection

The output capacitor needs to maintain the DC voltage. Low ESR capacitors are preferred. X5R and X7R ceramic capacitors are recommended to reduce output voltage ripple, as these capacitors have lower equivalent series resistance (ESR) and a wider operating temperature range.

Diode Selection

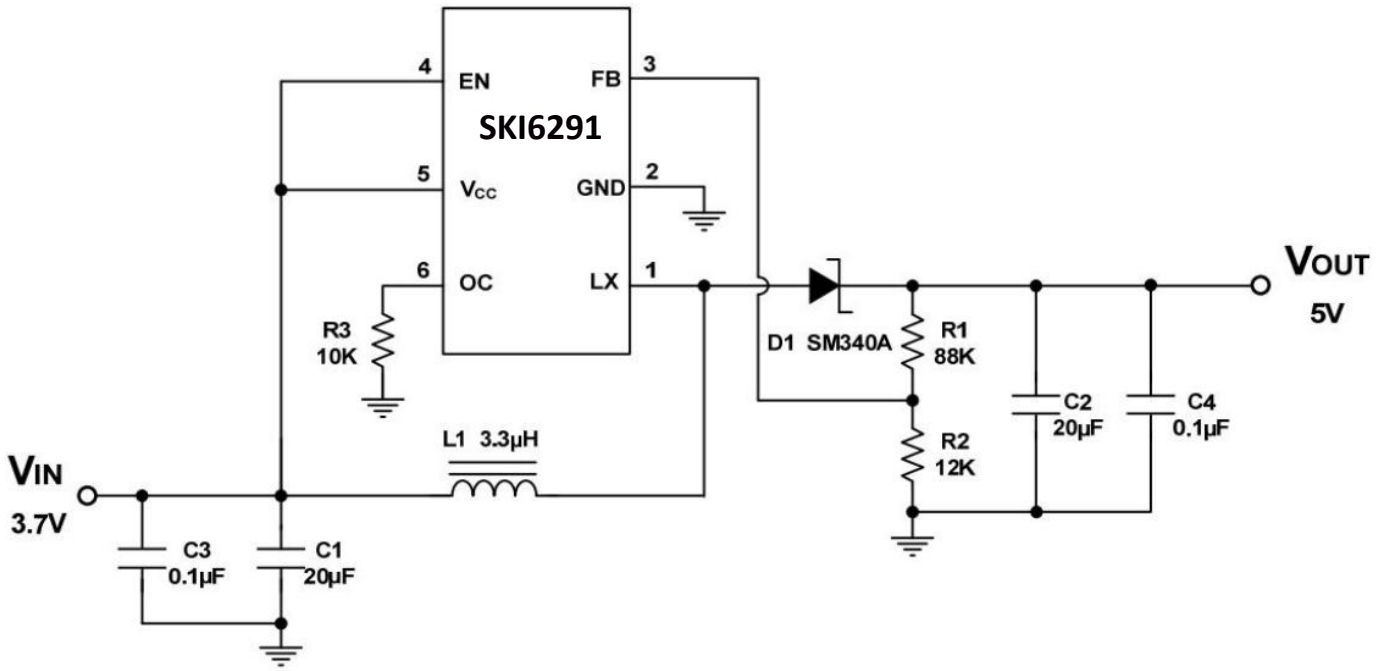
Schottky diodes with fast recovery time and low forward voltage are recommended. Ensure that the average current and peak rated current of the diode exceed the average output current and peak inductor current. In addition, the reverse breakdown voltage of the diode must exceed the output voltage.

Output Voltage Programming

The output voltage is set by a resistive voltage divider from the output voltage to FB. The output voltage is calculated as follows:

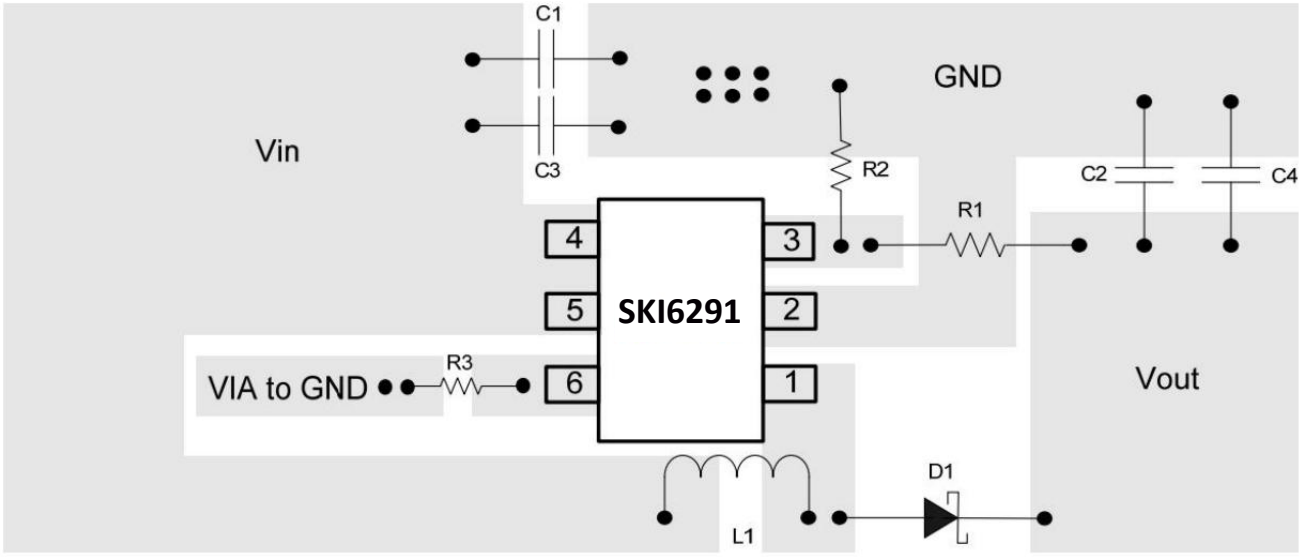
$$V_{OUT} = 0.6V * (1 + \frac{R1}{R2})$$

Typical Application Circuit



Layout Considerations

1. Power wiring, including GND wiring, LX wiring, and V_{CC} wiring, should be as short, wide, and direct as possible.
2. Avoid routing V_{OUT} traces near V_{CC}. When the system receives noise, it will cause excessive ripple that exceeds the absolute maximum rating of V_{CC}, damaging the chip.
3. The switching nodes of LX, L, and D require wide and short wiring to reduce EMI.
4. Place C_{IN} as close to the V_{CC} pin as possible to maintain input voltage stability and filter out pulses in the input current.
5. The resistive voltage divider resistors R1 and R2 must be directly connected to the FB pin as closely as possible.
6. FB is a sensitive node and should be kept away from the switching node LX.
7. The GND of the I_C, C_{IN}, and C_{OUT} should be directly connected to the ground plane as closely as possible.

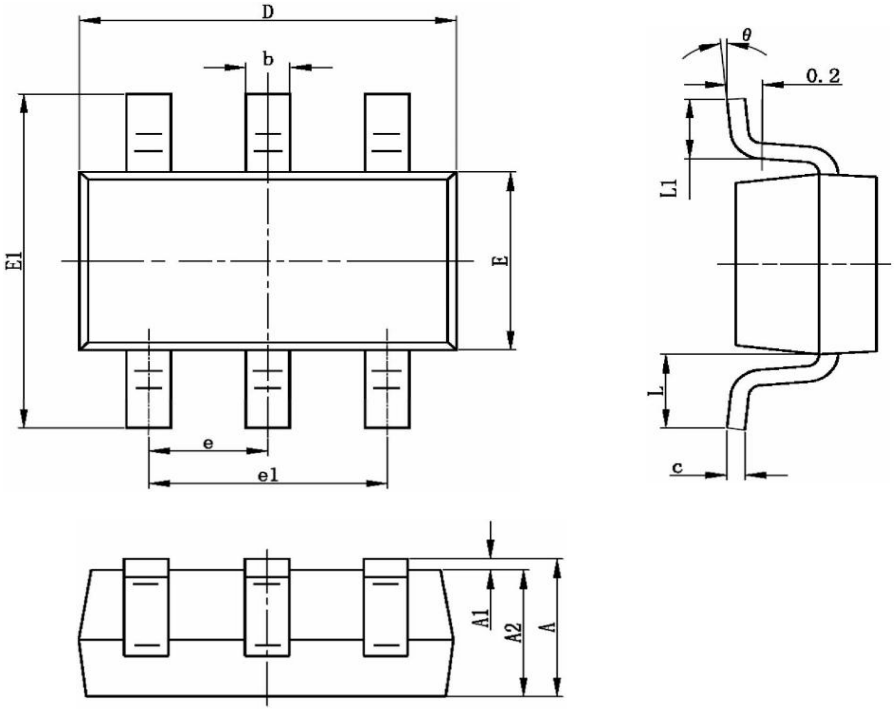


Recommended Layout

Package Information

SOT-23-6

Dimensions in mm



Symbol	Dimensions In Millimeters			Symbol	Dimensions In Millimeters		
	Min	Nom	Max		Min	Nom	Max
A	1.050	-	1.250	E1	2.650	-	2.950
A1	0.000	-	0.001	e	0.950 TYP		
A2	1.050	-	1.150	e1	1.800	-	2.000
b	0.300	-	0.400	L	0.700 REF		
c	0.100	-	0.200	L1	0.300	-	0.600
D	2.820	-	3.020	θ	0°	-	8°
E	1.500	-	1.700				

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