Single Inductor buck-boost Converter

General Description

The LN3440 devices provide a power supply solution for products powered by either three-cell AA or one-cell Li-ion battery, and 5.0V adapter. It is a current mode buck-boost converter intended for small, low power applications. The LN3440 switches at 1.7MHz and allows the use of tiny, low cost capacitors and inductors. Internal soft-start results in small inrush current and extends battery life.

The LN3440 features automatic shifting to power save mode at light loads. The LN3440 includes under-voltage lockout, current limiting, and thermal overload protection to prevent damage in the event of an output overload.

The humidity level of the package is MSL3 for civil use, and MSL1 for vehicle regulation.

Package

- DFN3030-10L

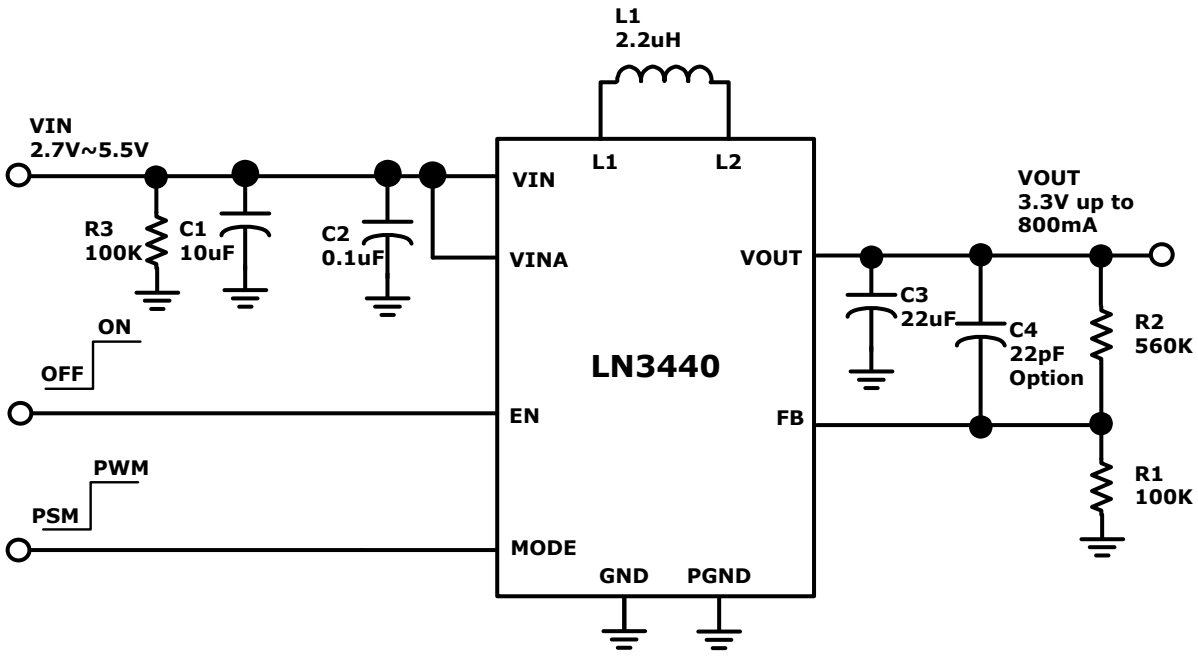
Applications

- Portable Mobile Device
- Wireless Communication Equipment
- Battery-Powered Equipment

Features

- 2.7V to 5.5V Input Voltage
- 1.7MHz Fixed Switching Frequency
- Internal 2.0A Switch Current Limit
- Adjustable Output Voltage
- Internal Compensation
- Up to 5V Output Voltage
- Automatic Power Save Mode
- at Light Loads
- up to 95% Efficiency

Typical Application Circuit



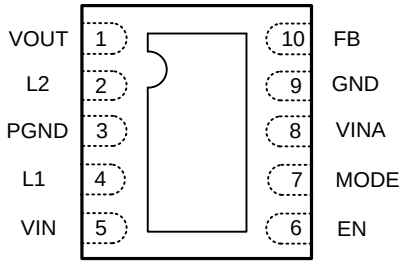
$$VOUT = 0.5 \times \left(1 + \frac{R2}{R1}\right)$$

■ Ordering Information

LN3440P①②③-④

Designator	Symbol	Description
①	A	Feedback voltage 0.5V
②	D	DFN3030-10L
③	R	Embossed Tape: Standard Feed
	L	Embossed Tape: Reverse Feed
④	G	Green EMC
	Q	Compliant with IECQ-100 standard

■ Pin Configuration

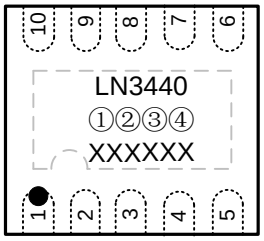


DFN3030-10L
(TOP VIEW)

Pin Mumber	Pin Name	Function
1	VOUT	Buck-boost Converter Output
2	L2	Boost Connection for Inductor
3	PGND	Power Ground
4	L1	Buck Connection for Inductor
5	VIN	Power Input
6	EN	Chip Enable
7	MODE	Operation Mode(=1:PWM;=0:PSM/PWM)
8	VINA	Control Input
9	GND	Ground
10	FB	Feedback Voltage, VFB=0.5V
Exposed Thermal pad	-	Exposed Thermal pad is connected to PGND

Marking Rule

- **DFN3*3-10L**



DFN3030-10L
(TOP VIEW)

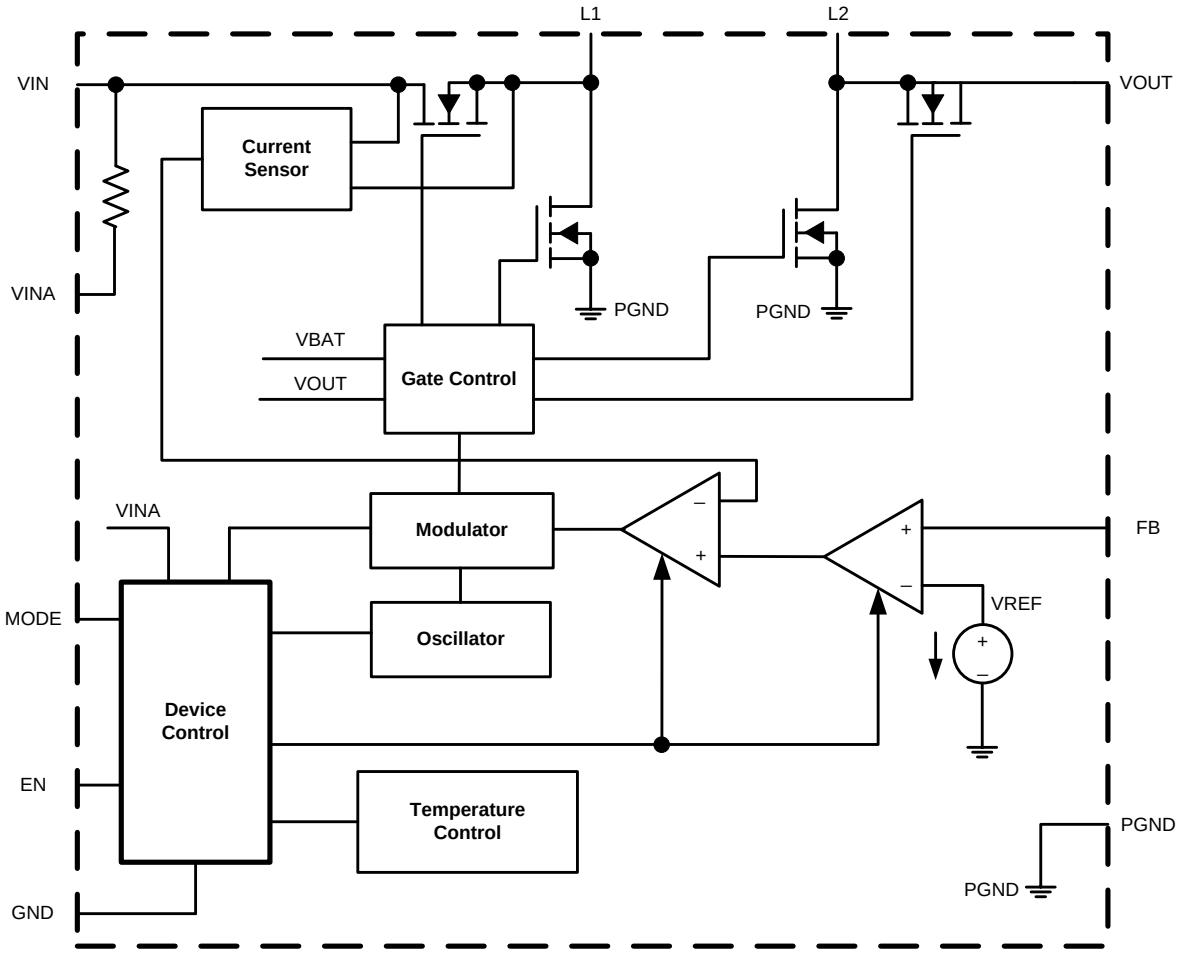
①②③ represents product name.

Symbol	Information
PAD	External feedback、PWM/PSM、DFN3*3-10L

④ represents the production batch number.

Note: XXXXXX represents quality information code.

Function Block Diagram



■ Absolute Maximum Ratings

Parameter	Symbol	Maximum Rating	Unit
Input voltage	V_{IN}	Vss-0.3～Vss+6.5	V
Output voltage	V_{OUT}	Vss-0.3～Vss+6.5	
	V_{L1}/V_{L2}	Vss-0.3～Vss+6.5	
	V_{L1}/V_{L2} （t≤10ns）	-2.5～6.5	
L1/L2 Current	I_L	2	A
Power Dissipation	P_D	500	mW
Operating ambient temperature	T_{opr}	-40～＋80	℃
Storage ambient temperature	T_{stg}	-40～＋125	
ESD Level (HBM)	V_{ESD}	2000	V

Caution : The absolute maximum ratings are rated values exceeding which the product could suffer physical damage. These values must therefore not be exceeded under any conditions.

■ Electrical Characteristics

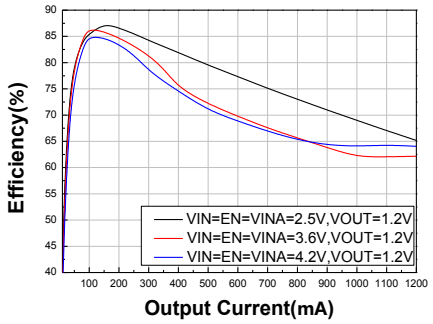
(T_a=25℃, V_{IN}=3.6V，unless otherwise noted)

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Output voltage	V_{OUT}	-	1.2	-	5	V
Input voltage	V_{IN}	-	2.7	-	5.5	
FB Voltage	V_{FB}	MODE=”1”	490	500	510	mV
VIN under voltage lockout threshold	UVLO_R	-	-	2.1	-	V
VIN under voltage lockout hysteresis	UVLO_HYS	-	-	200	-	mV
OVP	OVP_R	-	-	6.25	-	V
OVP hysteresis	OVP_HYS	-	-	-	0.7	mV
Shutdown mode	I_{OFF}	V_{EN}<V_{ENL}	-	0.01	1	μA
Quiescent Current	I_Q	V_{IN}=3.6V	-	16	-	μA
Switching frequency	F_S	-	-	1.7	-	MHz
Boost Maximum Duty Cycle	D_{MAX}	V_{FB}=0V	85	-	-	%
HS FET On Resistance	R_{DSON_H}	V_{IN}=3.6V，I_L=0.1A	-	200	-	mΩ
LS FET On Resistance	R_{DSON_L}	V_{IN}=3.6V，I_L=0.1A	-	200	-	mΩ
L1/L2 Current Limit	I_L	V_{IN}=4.2V	2	-	-	A
Line regulation	ΔV_{LINE}	I_{OUT}=0.5A，V_{IN}=2.7V to 5.0V	-	0.4	-	%
Load regulation	ΔV_{LOAD}	V_{IN}=3.6V，V_{OUT}=3.3V，I_{LOAD}=10mA to 0.8A	-	0.4	-	%
EN Input High Voltage	V_{ENH}	V_{IN}=3.6V	1.1	-	-	V

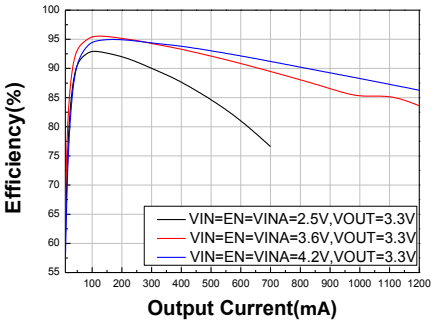
EN Input Low Voltage	V_{ENL}	V_{IN}=3.6V	-	-	0.6	V
Thermal Shutdown	T_{SHD}	V_{IN}=3.6V，I_{LOAD}=10mA	-	140	-	℃
Thermal Shutdown hysteresis	T_{SHD_HYS}	V_{IN}=3.6V，I_{LOAD}=10mA	-	20	-	℃

■ Typical Performance Characteristics

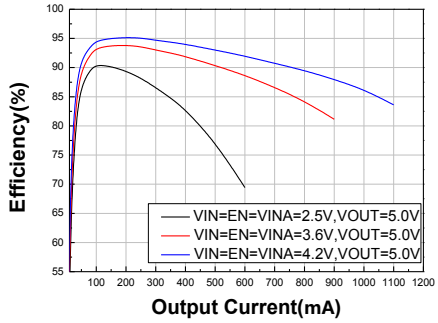
1、Efficiency @ VOUT=1.2V



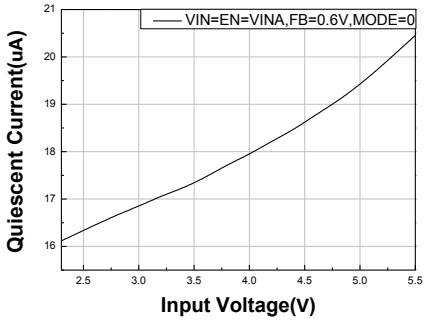
2、Efficiency @ VOUT=3.3V



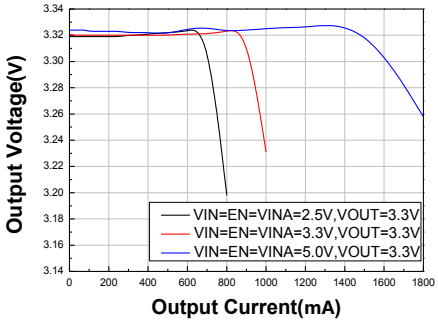
3、Efficiency @ VOUT=5.0V



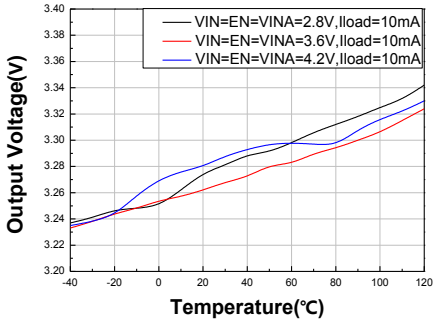
4、Quiescent Current



5、Output Voltage Vs. ILOAD

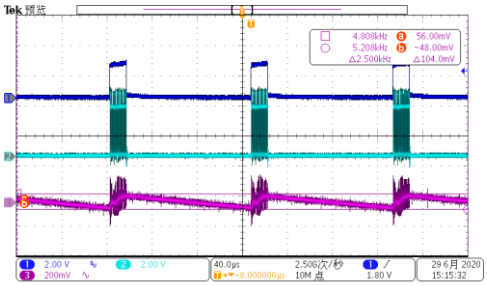


6、Output Voltage Vs. Temperature,
VIN=3.6V，MODE=1，ILOAD=10mA



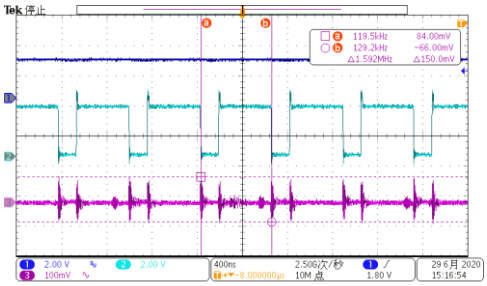
7、PSM Steady State Test

VIN= 2.5V, VOUT=3.3V，ILOAD =10mA, MODE=0



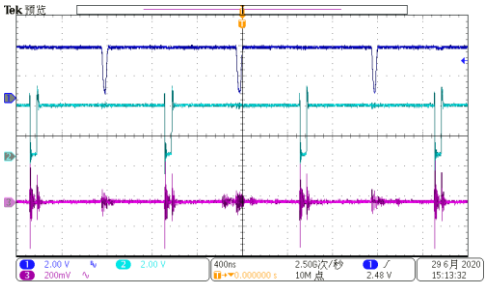
8、PWM Steady State Test

VIN= 4.2V, VOUT=3.3V，ILOAD =10mA, MODE=1

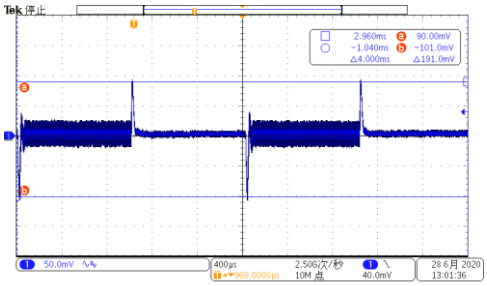


9、Buck & Boost Coexist Test

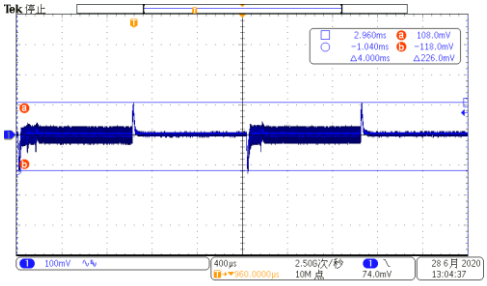
VIN=3.4V，VOUT=3.3V，ILOAD =300mA



10、Load Transient Response(VIN=2.5V，VOUT=3.3V，MODE=1，ILOAD =1mA to 500mA to 1mA)

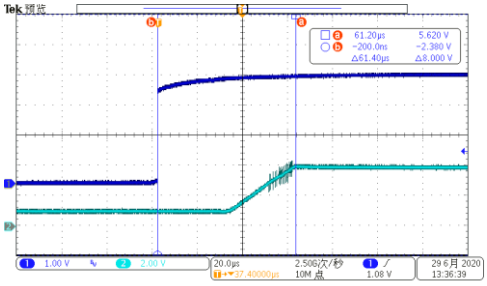


11、Load Transient Response(VIN=3.6V，VOUT=3.3V，MODE=1，ILOAD =10mA to 800mA to 10mA)

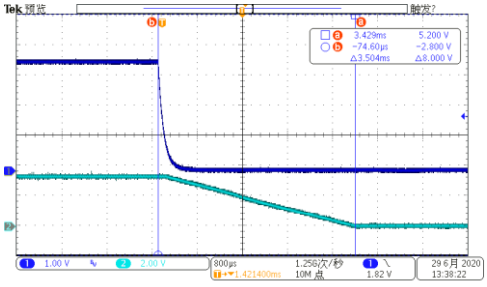


12、Startup After EN

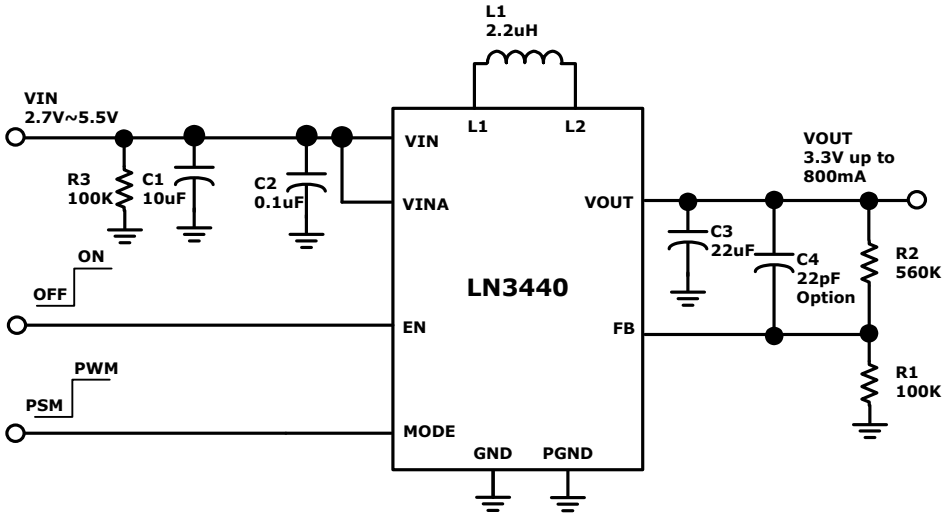
VIN=3.6V, VOUT=3.3V，ILOAD =100mA



13、EN Shutdown



Application Information



- **Output Voltage Set**

LN3440PFDR is fixed output voltage 3.3V, FB pin should be directly connected with VOUT.

LN3440PADR is adjustable version, the output voltage is determined by the resistor divider connected at the FB pin, and the voltage can be calculated by:

$$VOUT = VFB \times (1 + \frac{R2}{R1})$$

The recommended value of R1 is kΩ.

- **Input Capacitor**

At least 10uF capacitor is recommended in typical application.

- **Output Capacitor**

The output capacitors also affect the system stability and transient response, and a 22uF ceramic capacitor is recommended in typical application.

- **Inductor**

The inductor value in boost mode can be calculated from the following formula:

$$L = \frac{VIN \times (VOUT - VIN)}{VOUT \times \Delta IL \times fs},$$

where ΔIL is the inductor ripple current, is about 40% of the input current.

If VIN=2.7V, VOUT=3.3V, fs=1.7MHz, IOUT=500mA, EFFI=85%, L=1.1uH.

The inductor value in buck mode can be calculated from the following formula:

$$L = \frac{(VIN - VOUT) \times D}{\Delta IL \times fs},$$

where D is duty cycle in buck mode，D=VOUT/VIN; ΔIL is the inductor ripple current，is about 40% of the maximum output current.

If VIN=5.5V, VOUT=3.3V, fs=1.7MHz, IMAX=1A, L=0.86uH.

For high efficiencies, the inductor should have a low DC resistance to minimize conduction losses.

Recommended inductor rang is 1.5uH to 3.3uH in typical application.

- **PCB Layout Note**

For minimum noise problem and best operating performance, the PCB is preferred to following the guidelines as reference.

1. Place the input/output capacitor as close to LN3440 as possible to eliminate noise.

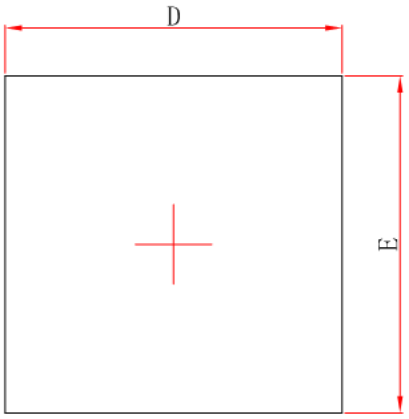
2. Use wide and short traces for the power track of VIN to inductor to VOUT

3. Put the feedback trace as far away from the inductor and noisy power traces as possible.

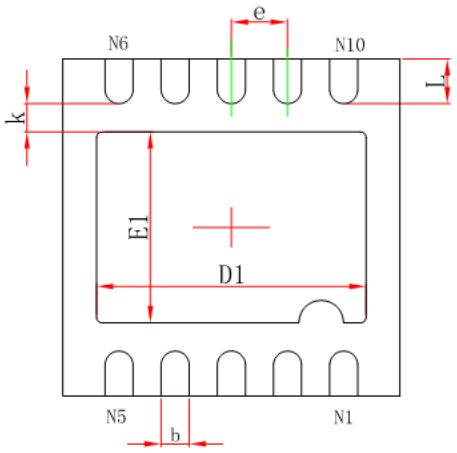
4. Separate GND and PGND: Do not connect GND and PGND directly at the bottom of the IC.

Package Information

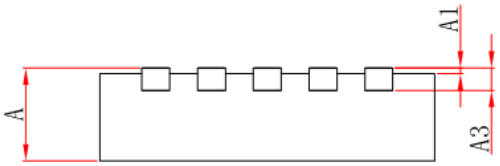
- DFN3*3-10L



Top View



Bottom View



Side View

Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	0.700/0.800	0.800/0.900	0.028/0.031	0.031/0.035
A1	0.000	0.050	0.000	0.002
A3	0.203REF.		0.008REF.	
D	2.900	3.100	0.114	0.122
E	2.900	3.100	0.114	0.122
D1	2.300	2.500	0.091	0.098
E1	1.600	1.800	0.063	0.071
k	0.200MIN.		0.008MIN.	
b	0.180	0.300	0.007	0.012
e	0.500TYP.		0.020TYP.	
L	0.300	0.500	0.012	0.020