

3MHz, Output Adjustable, 2A Synchronous Buck Converter for RF Power Amplifiers

DESCRIPTION

The ETA3411 is a high-efficiency, DC-to-DC step-down switching regulator optimized for powering RF power amplifiers. It has a high switching frequency of 3MHz and is capable of delivering up to 2A of output current. The device operates from an input voltage range of 2.1V to 5.5V and provides an adjustable output voltage from 0.6V to V_{IN} by tracking an external reference voltage. Therefore, the ETA3411 is ideal for powering RF PAs because power levels of PAs can be controlled by an external envelope signal and the system efficiency is optimized.

ETA3411 is housed in a tiny DFN1.6x1.6-6 and DFN2x2-8L package.

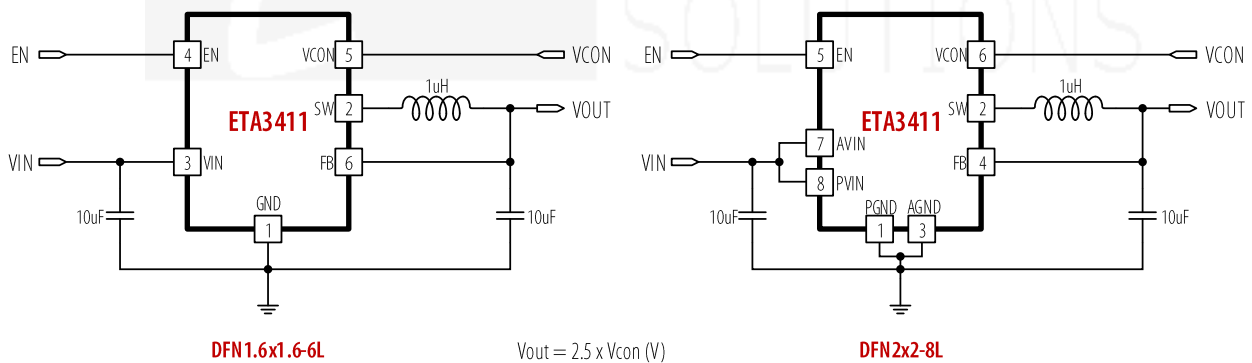
FEATURES

- ◆ External Reference signal
- ◆ Standby Current 33uA ($V_{out}=1.2V$, $I_{out}=0A$)
- ◆ Up to 96% Efficiency
- ◆ Up to 2A Max Output Current
- ◆ 3MHz Frequency
- ◆ Light Load operation
- ◆ Internal Compensation
- ◆ Tiny DFN1.6x1.6-6L and DFN2x2-8L Package

APPLICATIONS

- ◆ RF PA
- ◆ NB-IOT
- ◆ Cellphone

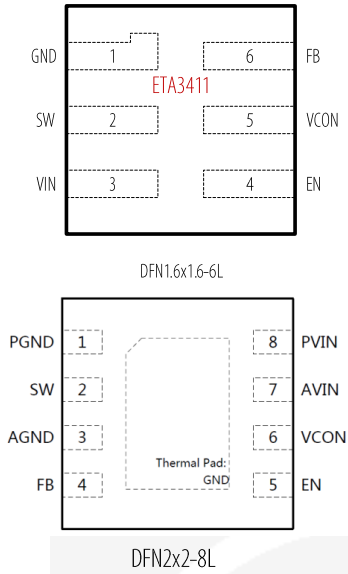
TYPICAL APPLICATION



ORDERING INFORMATION

PART No.	PACKAGE	TOP MARK	Pcs/Reel
ETA3411FDCG	DFN1.6x1.6-6L	COYW	3000
ETA3411D2I	DFN2x2-8L	ETA3411 YWW2L	3000

PIN CONFIGURATION



ABSOLUTE MAXIMUM RATINGS

(Note: Exceeding these limits may damage the device. Exposure to absolute maximum rating conditions for long periods may affect device reliability.)

All pins Voltage.....	-0.3V to 6V
SW to ground current.....	Internally limited
Maximum Power Dissipation.....	1300mW
Operating Temperature Range.....	-40°C to 85°C
Storage Temperature Range.....	-55°C to 150°C
Thermal Resistance θ_{JC} θ_{JA}	
DFN2x2-8.....	20.....75 °C/W
DFN1.6x1.6-6.....	70 °C/W
Lead Temperature (Soldering, 10ssec)	260°C
ESD HBM (Human Body Mode)	2KV
ESD MM (Machine Mode)	200V

ELECTRICAL CHARACTERISTICS

(V_{IN} = 3.6V, unless otherwise specified. Typical values are at T_A = 25°C.)

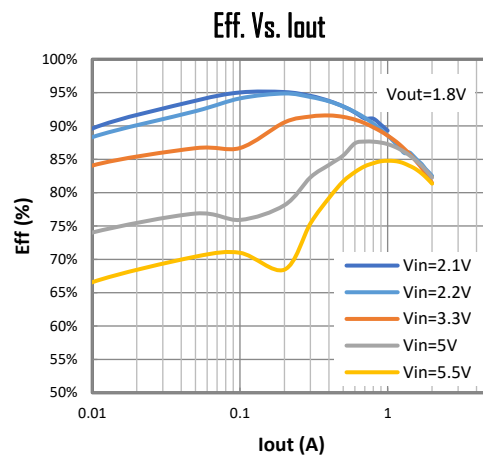
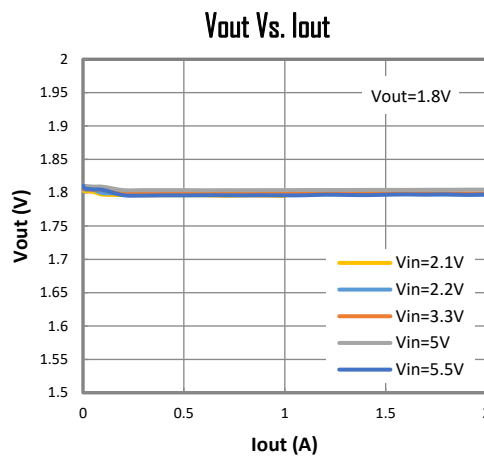
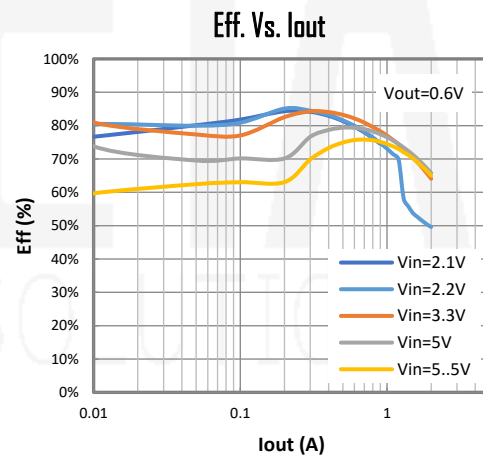
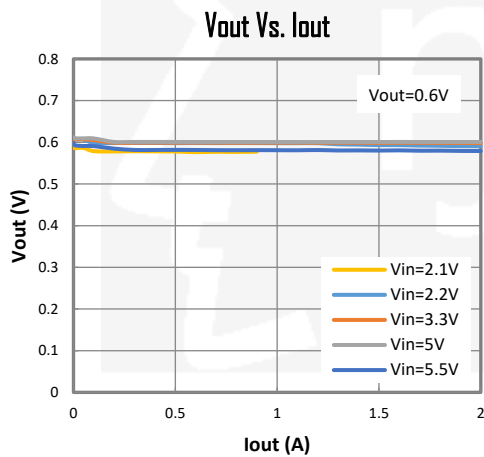
PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Input Voltage Range		2.1		5.5	V
Input UVLO	Rising, Hysteresis=200mV		2.1		V
Input Supply Current	$V_{con}=1V$,		30		μA
Input Shutdown Current	$V_{EN}=0V$		0.1	1	μA
$V_{fb,MIN}$	Feedback voltage at minimum setting, $V_{con}=0.24V$		0.6		V
$V_{fb,MAX}$	Feedback voltage at maximum setting, $V_{con}=1.36V, V_{in}=3.9V$		3.4		V
Load Regulation			0.15		%/A
Line Regulation	$V_{IN}=2.7$ to 5.5V		0.04		%/V
Switching Frequency		2.4	3	3.9	MHz
NMOS Switch On Resistance	$I_{SW}=200mA$		100	150	m Ω
PMOS Switch On Resistance	$I_{SW}=200mA$		80	120	m Ω
PMOS Switch Current Limit		2.5	3		A
SW Leakage Current	$V_{OUT}=5.5V, V_{SW}=0$ or 5.5V, $V_{EN}=GND$			10	μA
EN, Vcon Input Current				1	μA
EN Input Low Voltage				0.4	V
EN Input High Voltage(Rising)		1.05			V
EN Input High Voltage(Falling)		0.95			V
Thermal Shutdown	Rising, Hysteresis = 15°C		160		°C

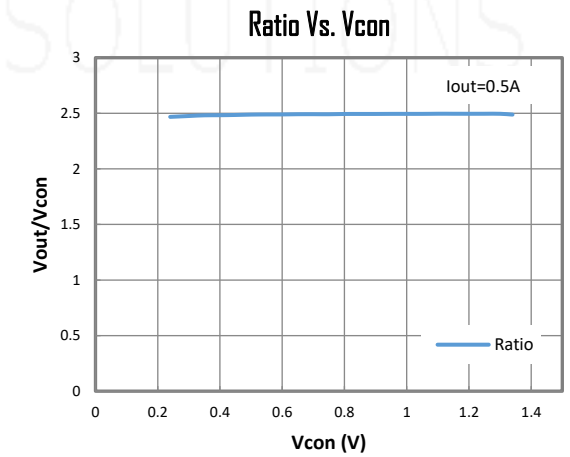
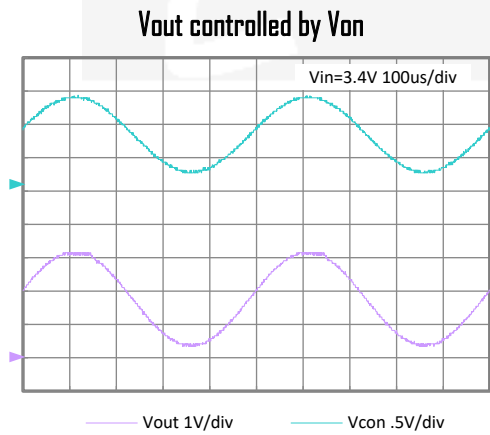
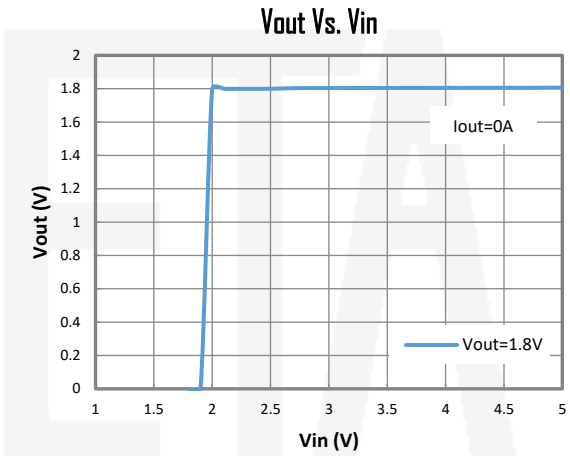
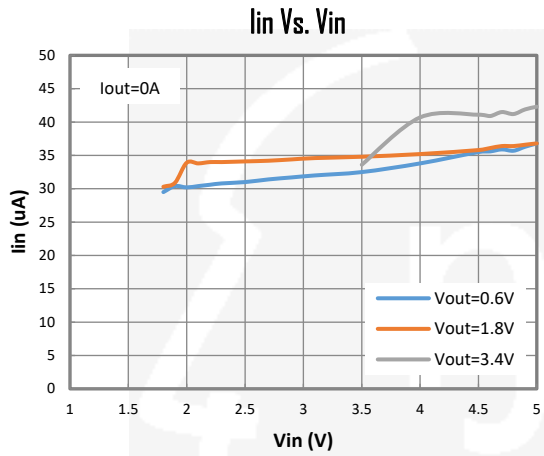
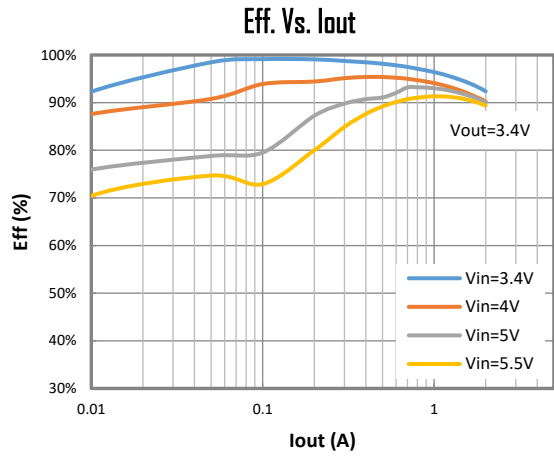
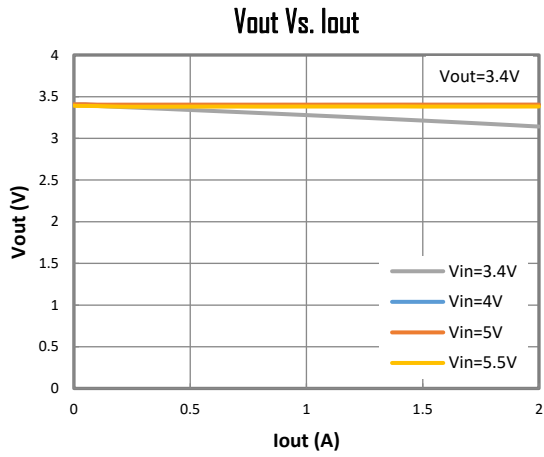
PIN DESCRIPTION

DFN1.6x1.6 PIN #	DFN2x2 PIN #	NAME	DESCRIPTION
1		GND	Ground
	1	PGND	Power Ground. Bypass with a 10μF ceramic capacitor to PVIN
2	2	SW	Inductor Connection. Connect an inductor Between SW and the regulator output.
3		VIN	Power supply voltage. Bypass with a 10μF ceramic capacitor to GND
	3	AGND	Analog Ground, Connect to PGND
6	4	FB	Feedback Input. Connect to the output at output inductor
4	5	EN	Enable pin for the IC. Drive this pin to high to enable the part, low to disable.
5	6	VCON	Voltage control analog input. VCON controls Vout in PWM mode. $V_{out}=2.5 \times V_{CON}$.
	7	AVIN	Analog Power. Short externally to PVIN
	8	PVIN	Supply Voltage. Bypass with a 10μF ceramic capacitor to PGND

TYPICAL CHARACTERISTICS

(Typical values are at $T_A = 25^\circ\text{C}$ unless otherwise specified.)





APPLICATION INFORMATION

FUNCTION DESCRIPTION

The ETA3411 high efficiency switching regulator is a small, simple, DC-to-DC step-down converter capable of delivering up to 2.5A of output current. The device operates in pulse-width modulation (PWM) at 3MHz from a 2.1V to 5.5V input voltage and provides an output voltage from 0.6V to V_{IN} , making the ETA3411 ideal for on-board post-regulation applications. An internal synchronous rectifier improves efficiency and eliminates the typical Schottky free-wheeling diode. Using the on resistance of the internal high-side MOSFET to sense switching currents eliminates current-sense resistors, further improving efficiency and cost.

Loop Operation

ETA3411 uses a PWM current-mode control scheme. An open-loop comparator compares the integrated voltage-feedback signal against the sum of the amplified current-sense signal and the slope compensation ramp. At each rising edge of the internal clock, the internal high-side MOSFET turns on until the PWM comparator terminates the on cycle. During this on-time, current ramps up through the inductor, sourcing current to the output and storing energy in the inductor. The current mode feedback system regulates the peak inductor current as a function of the output voltage error signal. During the off cycle, the internal high-side P-channel MOSFET turns off, and the internal low-side N-channel MOSFET turns on. The inductor releases the stored energy as its current ramps down while still providing current to the output.

Current Sense

An internal current-sense amplifier senses the current through the high-side MOSFET during on time and produces a proportional current signal, which is used to sum with the slope compensation signal. The summed signal then is compared with the error amplifier output by the PWM comparator to terminate the on cycle.

Current Limit

There is a cycle-by-cycle current limit on the high-side MOSFET. When the current flowing out of SW exceeds this limit, the high-side MOSFET turns off and the synchronous rectifier turns on. ETA3411 utilizes a frequency fold-back mode to prevent overheating during short-circuit output conditions. The device enters frequency fold-back mode when the FB voltage drops below 200mV, limiting the current to I_{PEAK} and reducing power dissipation. Normal operation resumes upon removal of the short-circuit condition.

Soft-start

ETA3411 has an internal soft-start circuitry to reduce supply inrush current during startup conditions. When the device exits under-voltage lockout (UVLO), shutdown mode, or restarts following a thermal-overload event, the soft-start circuitry slowly ramps up current available at SW.

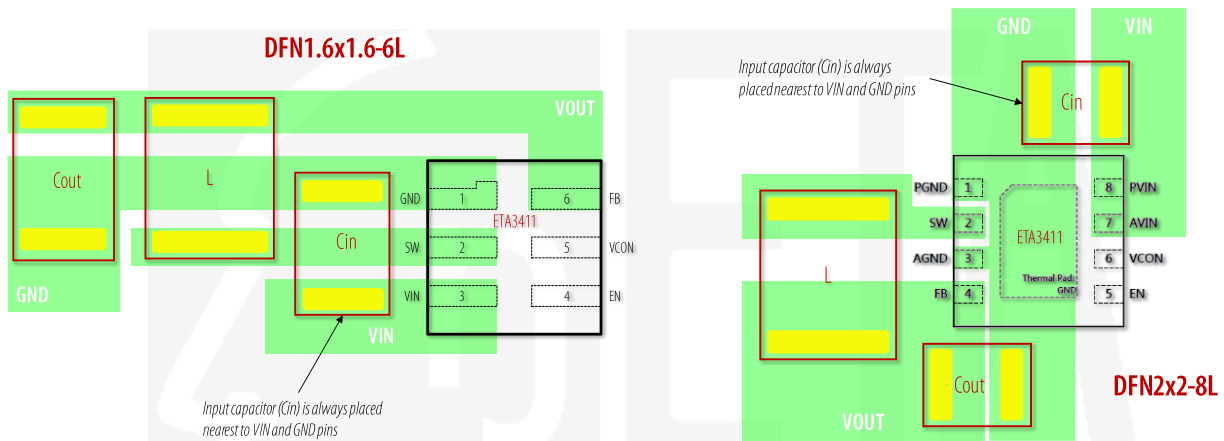
UVLO and Thermal Shutdown

If V_{IN} drops below 1.9V, the UVLO circuit inhibits switching. Once V_{IN} rises above 2.1V, the UVLO clears, and the soft-start sequence activates. Thermal-overload protection limits total power dissipation in the device. When the junction temperature exceeds $T_J = +160^\circ\text{C}$, a thermal sensor forces the device into shutdown, allowing the die to cool. The thermal sensor turns the device on again after the junction temperature cools by 30°C , resulting in a pulsed output during continuous overload conditions. Following a thermal-shutdown condition, the soft-start sequence begins.

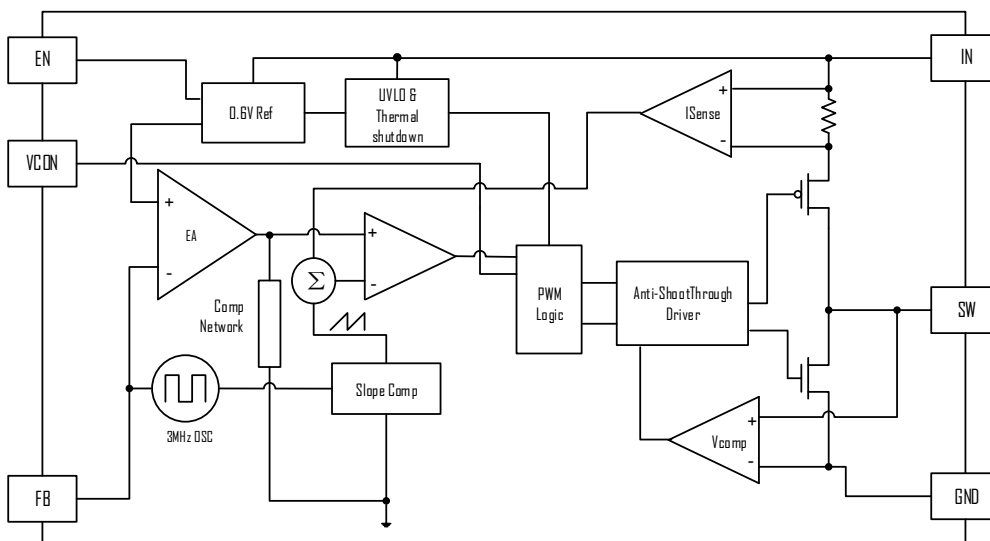
RECOMMENDED PERIPHERAL COMPONENT (L and C)

Component	Description	Manufacturer
Cin	10uF, Ceramic capacitor, 6.3V, X5R, size 0603, GRM188R60J106ME47D	Murata
Cout	10uF, Ceramic capacitor, 6.3V, X5R, size 0603, GRM188R60J106ME47D	Murata
L	1uH, MPIM201610E1R0M-LF, DCR 45mohm, 3.5A	Microgate
L	1uH, WPN201610M1R0MT, DCR 75mohm, 2A	Sunlord
L	0.47uH, WPN201610MR47MT, DCR 37mohm, 3A	Sunlord
L	0.47uH, 1.6A, size 0806, LQM2MPNR47NGOL	Murata

PCB GUIDELINES

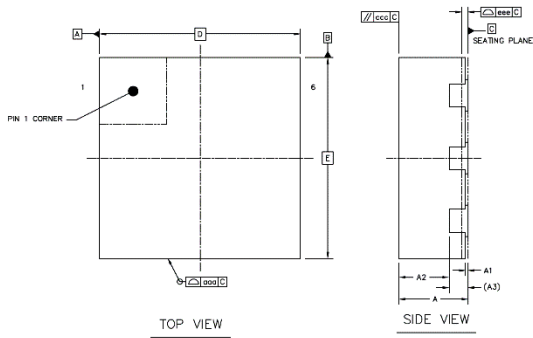


BLOCK DIAGRAM

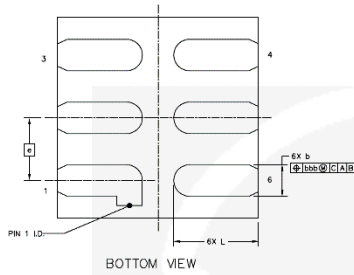


PACKAGE OUTLINE

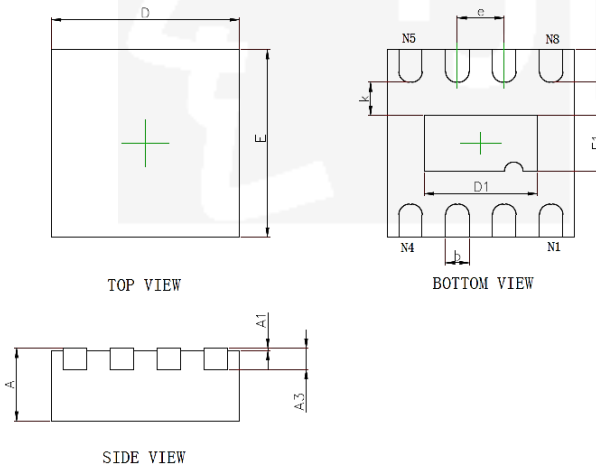
Package: DFN1.6x1.6-6L



	SYMBOL	MIN	NOM	MAX
TOTAL THICKNESS	A	0.5	0.55	0.6
STAND OFF	A1	0	0.02	0.05
MOLD THICKNESS	A2	---	0.4	---
L/F THICKNESS	A3	0.152 REF		
LEAD WIDTH	b	0.2	0.25	0.3
BODY SIZE	X	D		
	Y	E		
LEAD PITCH	e	0.5 BSC		
LEAD LENGTH	L	0.625	0.675	0.725
PACKAGE EDGE TOLERANCE	aaa	0.1		
MOLD FLATNESS	ccc	0.1		
COPLANARITY	eee	0.05		
LEAD OFFSET	bbb	0.1		



Package: DFN2x2-8L



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	1.924	2.076	0.076	0.082
E	1.924	2.076	0.076	0.082
D1	1.100	1.300	0.043	0.051
E1	0.500	0.700	0.020	0.028
k	0.200MIN.		0.008MIN.	
b	0.200	0.300	0.008	0.012
e	0.500TYP.		0.020TYP.	
L	0.274	0.426	0.011	0.017