

GENERAL DESCRIPTION

The OB3333 is a dimmable, high power factor, monolithic flyback controller with advanced features to provide high efficiency control and high accuracy constant current output for LED lighting applications.

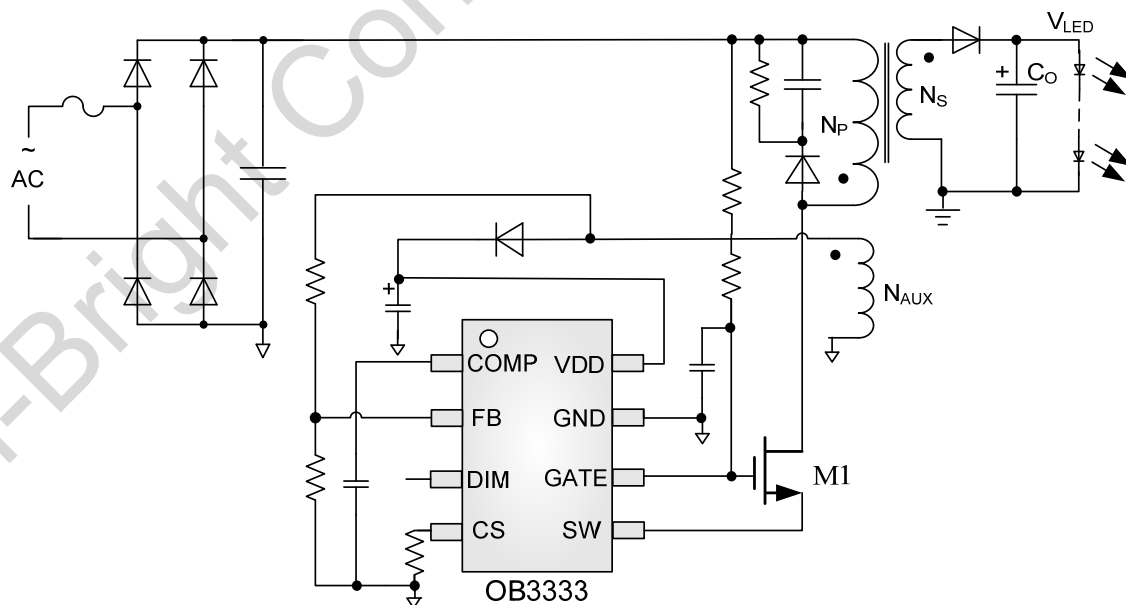
OB3333 offers fast startup feature by charging VDD through the SW pin, a constant on-time control for power factor correction (PFC), zero current detector (ZCD) to ensure transition mode (TM) operation, an error amplifier for accurate current regulation and on-chip MOSFET for switching.

OB3333 offers a dimmable function, the LED current can be controlled by setting the duty cycle of PWM waveform into the DIM pin.

OB3333 offers comprehensive protection coverage including VDD under voltage lockout (UVLO), VDD over voltage protection, load voltage over voltage protection, cycle-by-cycle current limiting, over temperature protection, LED string open/short protection, driver output clamping for external power MOSFET protection.

OB3333 is offered in SOP8 package.

TYPICAL APPLICATION



FEATURES

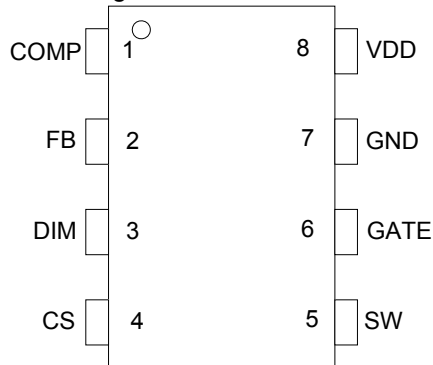
- Primary-Side Control with Single Stage PFC Topology
- Dimmable LED current control
- Minimized BOM Count
- Fast startup time (typical <math><0.5\text{S}</math>)
- Transition Mode (TM) operation
- Source drive operation mode
- Cycle-by-Cycle Current Limiting (OCP)
- VDD Over Voltage Protection
- Output Over Voltage Protection
- Over-temperature Protection
- VDD Under Voltage Lockout (UVLO)
- LED string open protection
- LED string short protection
- Transformer saturation protection

APPLICATIONS

- Dimmable LED lighting

GENERAL INFORMATION
Terminal Assignment

In SOP8 Package.


Package Dissipation Rating

Package	R θ JA (°C/W)
SOP8	150

Absolute Maximum Ratings

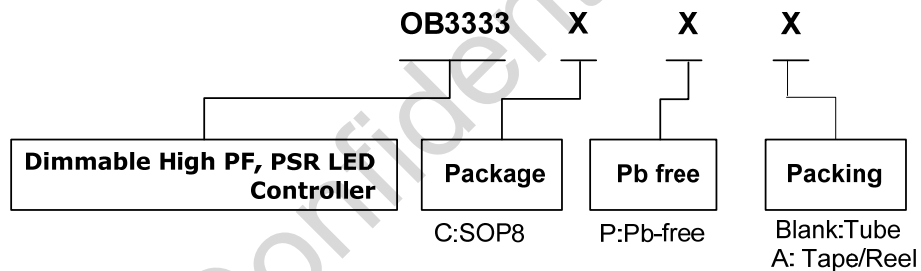
Parameter	Value
VDD Input Voltage to GND	-0.3V to 24V
GATE to GND	-0.7V to 24V
SW to GND	-0.7V to 24V
FB, COMP, DIM and CS to GND	-0.7V to 7V
Operating Ambient Temp. T _A	-40 ~ 85°C
Operating Junction Temp. T _J	-40 ~ 150°C
Min/Max Storage Temp. T _{stg}	-55 ~ 150°C
Lead Temp. (10 Sec)	260 °C

Ordering Information

Part Number	Description
OB3333CP	8 Pin SOP, Pb free in Tube
OB3333CPA	8 Pin SOP, Pb free in T&R

Note1: All Devices are offered in Pb-free Package if not otherwise noted.

Note2: Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. These are stress ratings only, functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute maximum-rated conditions for extended periods may affect device reliability.



Marking Information



Y: Year Code
 WW: Week Code (01-52)
 ZZZ: Lot Code
 C: SOP8
 P: Pb-free Package
 S: Internal Code(Optional)

Terminal Assignment

Number	Pin Name	I/O	Pin Function
1	COMP	I/O	Loop compensation pin. Connect to a compensation network to stabilize the LED driver and achieve a constant LED driver current.
2	FB	I/O	Feedback pin. When activated, a new switching cycle starts. Connect this pin through a resistor divider from the auxiliary winding to ground. This pin is also used for output over voltage protection (OVP).
3	DIM	I/O	PWM dimming signal input. The LED current can be controlled by the duty cycle of the PWM waveform at the DIM pin.
4	CS	I/O	Current sense input pin.
5	SW	I/O	Drain of internal MOSFET.
6	GATE	I/O	The gate voltage clamp of external power MOSFET.
7	GND	P	Ground.
8	VDD	P	Power supply voltage pin.

Functional Block Diagram

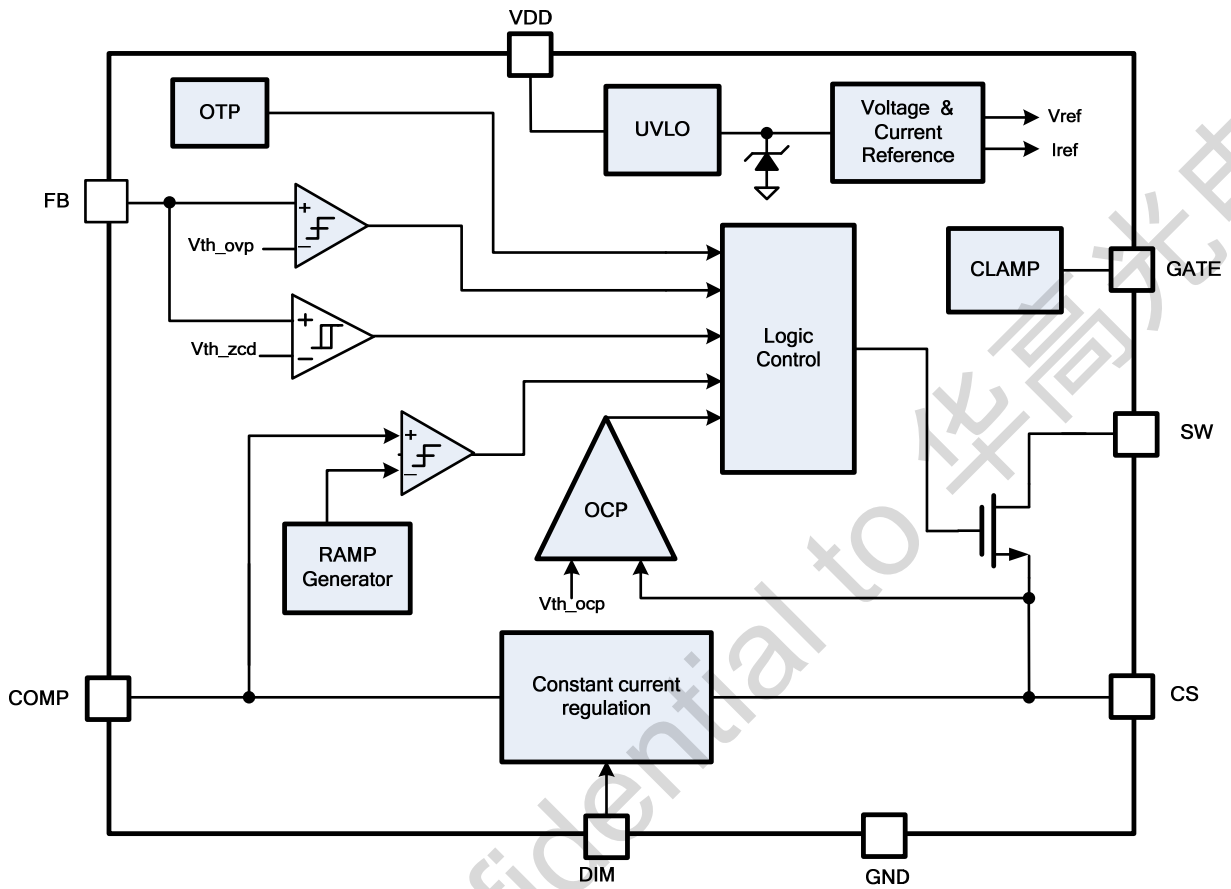


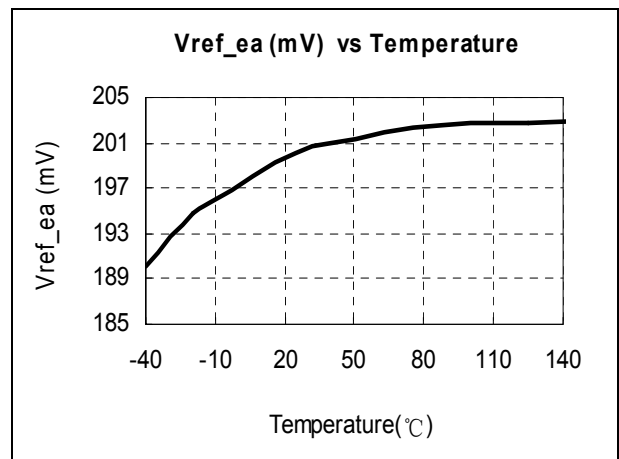
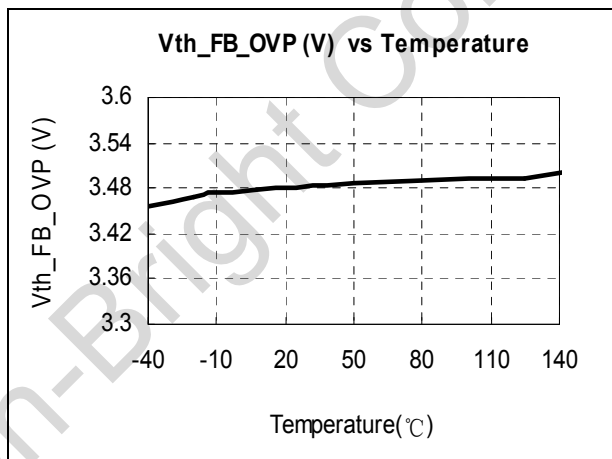
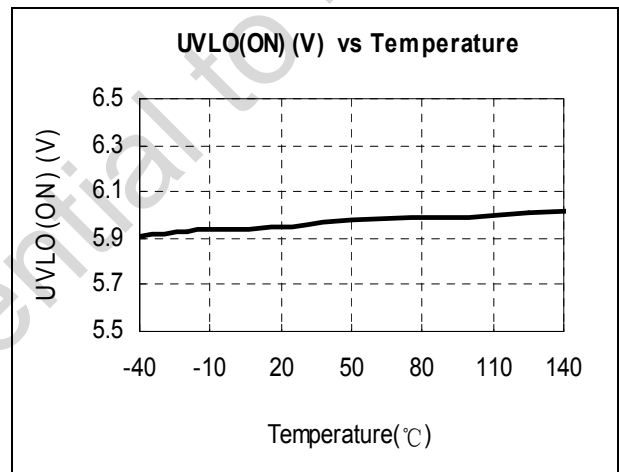
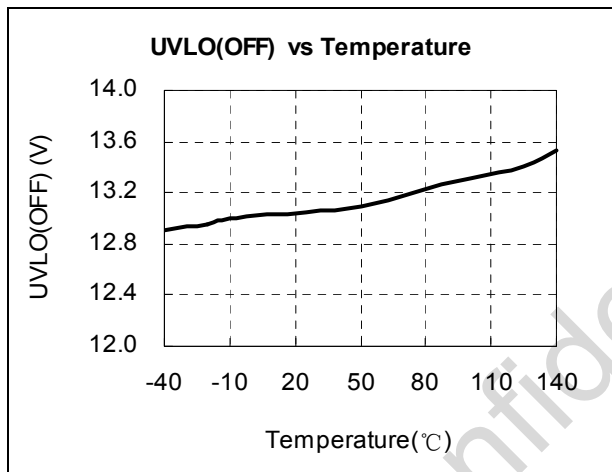
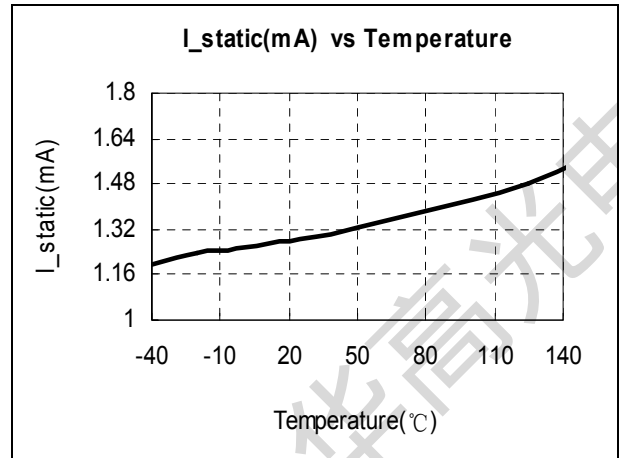
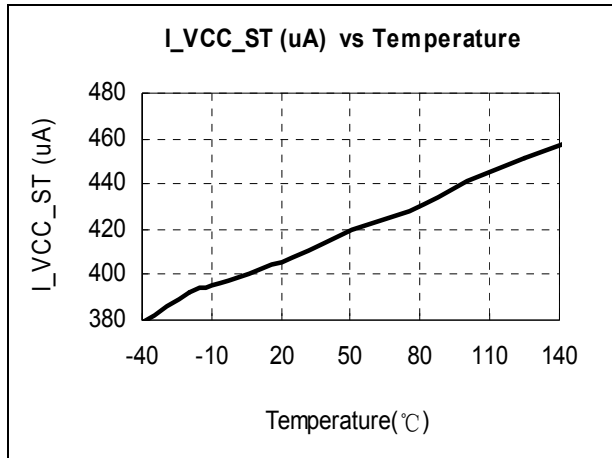
Figure2: OB3333 Functional Block Diagram

Electrical Characteristics

 VDD=16V, T_A=25°C, if not otherwise noted.

Symbol	Parameter	Test Conditions	Min	Typ.	Max	Unit
Supply Voltage Section						
I _{VDD_ST}	Standby Current	VDD=14V		450	500	μA
I _{static}	Static Current	VDD=16V, no switching		1.2	1.5	mA
UVLO(ON)	Under Voltage Lockout Enter	VDD falling	5.5	6.0	6.5	V
UVLO(OFF)	Under Voltage Lockout Exit	VDD rising	12.3	13	13.7	V
VDD_HOLD	VDD Hold Voltage	VDD failing	7	7.5	8	V
VDD_OVP	VDD Over Voltage Protection			22.5		V
Current Sense Section						
TLEB	LEB time			300		ns
V _{th_oc}	Over Current Threshold		0.95	1.00	1.05	V
V _{th_oc_short}	Over Current Threshold when VFB < 0.5V		0.45	0.50	0.55	V
T _{d_oc}	OCP Propagation Delay			40		ns
FB Section						
V _{ovp}	Output over voltage protection		3.395	3.500	3.605	V
T _{fb_leb}	FB leading edge blanking time		1.5	2.0	2.5	us
Gm amplifier section						
V _{ref}	EA Reference Voltage		0.196	0.200	0.204	V
G _m	EA Transconductance Gain			100		us
PWM Control Section						
T _{off_max}	Re-start timer period			75		us
T _{on_max}	Maximum on time			25		us
F _{max}	Maximum operation frequency			100		kHz
Temperature Section						
OTP	OTP trigger threshold			150		°C
Gate Section						
V _{clamp_startup}	Gate clamp voltage at startup			22		V
V _{clamp_op}	Gate clamp voltage at operation			15.7		V
I _{clamp}	Gate clamp current at operation			10		mA
SW Section						
R _{ds_on}	On-chip MOSFET on resistor			0.4		Ω
DIM Section						
V _{th_DIM_high}	DIM logic high level		2			V
V _{th_DIM_low}	DIM logic low level				0.8	V
f _{DIM}	DIM logic frequency		30		50	KHz

TYPICAL PERFORMANCE CHART



Function Description

General Operation

The OB3333 is a dimmable, primary-side-control and high power factor flyback PWM controller specialized for LED lighting application. It operates in primary side sensing and regulation, thus opto-coupler and TL431 are not required. The transition mode control greatly reduces the switch turn-on loss, improves the conversion efficiency. It provides very good power factor.

The principle of operation can be understood by referring to the block diagram.

Startup

When system starts up, the GATE pin is charged by the line voltage through a resistor and finally clamped at 22V (typical). When Gate pin voltage reaches the external MOSFET threshold, the external MOSFET turns on and the VDD pin is directly charged by line voltage through MOSFET and the path from SW to internal charge control circuit. This results in a faster startup than conventional startup structure. When the VDD voltage exceeds UVLO_OFF threshold voltage (typical 13.5V), the IC starts to switch and the internal charge control circuit stop charging VDD, and the VDD is supplied by the AUX windings instead of line voltage. When AUX windings positive voltage is not high enough to charge VDD and VDD voltage drops below the VDD hold threshold voltage (typical 7.5V), the internal charging circuit is turned on again and charges VDD up and holds its voltage at 7.5V. Therefore, output voltage can operate in a wide range with this function.

UVLO

An under-voltage lockout with a hysteresis control is provided on VDD. When the voltage at this pin exceeds a threshold of approximately 13.5V, the IC starts the normal operation. If the voltage at this pin drops below a threshold of approximately 6V, the IC stops switching operation. The IC resumes switching operation when the voltage at pin VDD recovers to a voltage above 13.5V (typical).

LED Constant Current Regulation

OB3333 uses the primary side constant current control method to accurately control the LED current. The average LED current can be approximated as:

$$I_{LED}[mA] = \eta * \frac{N}{2} * \frac{200[mV]}{R_{CS}[\Omega]} * D$$

η — The transformer coupling coefficient.

N — Turn ratio of primary side winding to secondary side winding.

Rcs — the sensing resistor connected between CS pin and GND.

D — Duty cycle of the PWM waveform at DIM pin.

Zero Current Detection

OB3333 performs zero current detection (ZCD) through FB pin by monitoring the voltage activity on the auxiliary windings in series with external resistors. This voltage features output voltage. When the stored energy of the flyback transformer fully release to the output, the voltage at FB pin decreases. When FB pin voltage falls below 0.3V (typical), an internal ZCD comparator is triggered and a new PWM switching cycle is initiated.

Maximum and Minimum On-Time

The minimum on-time of the system is determined by the LEB time (typical 300ns). The IC limits the on-time to a maximum value of approximately 25us (typical).

Output OVP Protection

The output over-voltage condition is monitored independently through the voltage at FB pin. During normal operation, when the voltage at FB pin exceeds a threshold of approximately 3.5V (typical), the over-voltage protection function is activated and the driver is turned off immediately.

VDD OVP Protection

VDD is supplied with auxiliary winding output after startup. When VDD is higher than 22.5V (typical), VDD OVP protection is triggered and driver is shut down and the device enters power on startup sequence thereafter.

LED String Open Protection

When LED string open happens, the positive plateau of FB voltage rise up due to the auxiliary winding voltage increases. If the voltage at FB pin is higher than a threshold of approximately 3.5V (typical), the over-voltage protection function is activated and the driver is turned off immediately.

LED String Short Protection

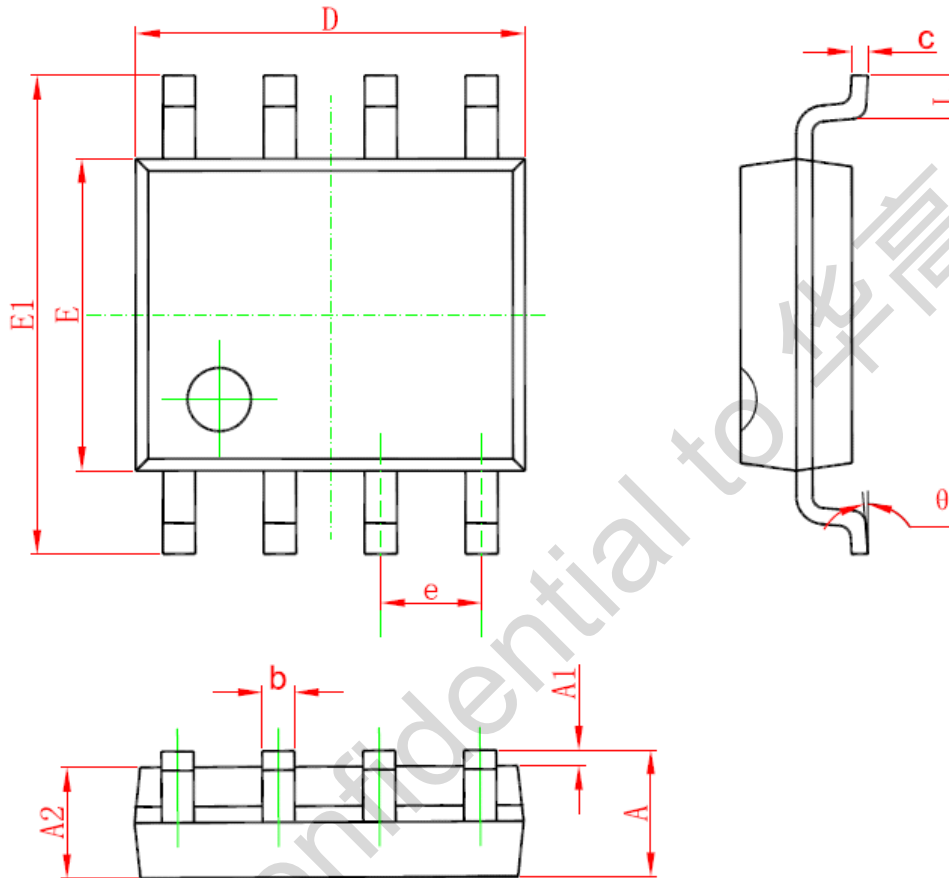
When LED string is short, the positive plateau of FB voltage from auxiliary winding falls to near zero. If the voltage at FB pin is lower than a threshold of approximately 0.45V (typical), the threshold of OCP drops from 1V (typical) to 0.5V (typical). At this situation, COMP pin voltage will increase. When COMP pin voltage reaches 4.2V, the switching is stopped immediately.

Thermal Shutdown

OB3333 provides an on chip thermal shutdown protection. The IC will stop switching when the junction temperature exceeds the thermal shutdown temperature, typically 150 °C

PACKAGE MECHANICAL DATA

SOP8 PACKAGE OUTLINE DIMENSIONS



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.350	1.750	0.053	0.069
A1	0.050	0.250	0.002	0.010
A2	1.250	1.650	0.049	0.065
b	0.310	0.510	0.012	0.020
c	0.100	0.250	0.004	0.010
D	4.700	5.150	0.185	0.203
E	3.800	4.000	0.150	0.157
E1	5.800	6.200	0.228	0.244
e	1.270 (BSC)		0.050 (BSC)	
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°

Important Notice

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