JW7715

Synchronous Rectifier Controller

Parameters Subject to Change Without Notice

DESCRIPTION

JW7715 is a synchronous rectifier controller, used for the secondary side rectification of isolation topologies, such as Flyback, Forward, Half Bridge, Full Bridge and LLC converter. By driving an external MOSFET, JW7715 is able to significantly improve the efficiency comparing with the conventional Diode rectifier.

When JW7715 senses V_{ds} of MOSFET less than -300mV, it turns on the MOSFET. Once the V_{ds} is greater than -10mV, JW7715 turns off the MOSFET.

JW7715 supports multiple operation modes, such as DCM, CrCM, CCM and Quasi-Resonant. By implementing the Joulwatt proprietary technology, JW7715 is able to handle CCM operation.

JW7715 is available in SOT23-6 package..

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FEATURES

- Supports DCM, Quasi-Resonant, CrCM and CCM operation
- Support the isolation topologies, such as Flyback, Forward, Half Bridge, Full Bridge and LLC converter
- Supports High-side and Low-side Rectification
- Output voltage directly supply VCC
- Low quiescent current
- Under-voltage protection
- Fast driver capability for CCM operation
- SOT23-6 package

APPLICATIONS

- Flyback and LLC converters
- Adaptor
- LCD and PDP TV

TYPICAL APPLICATION

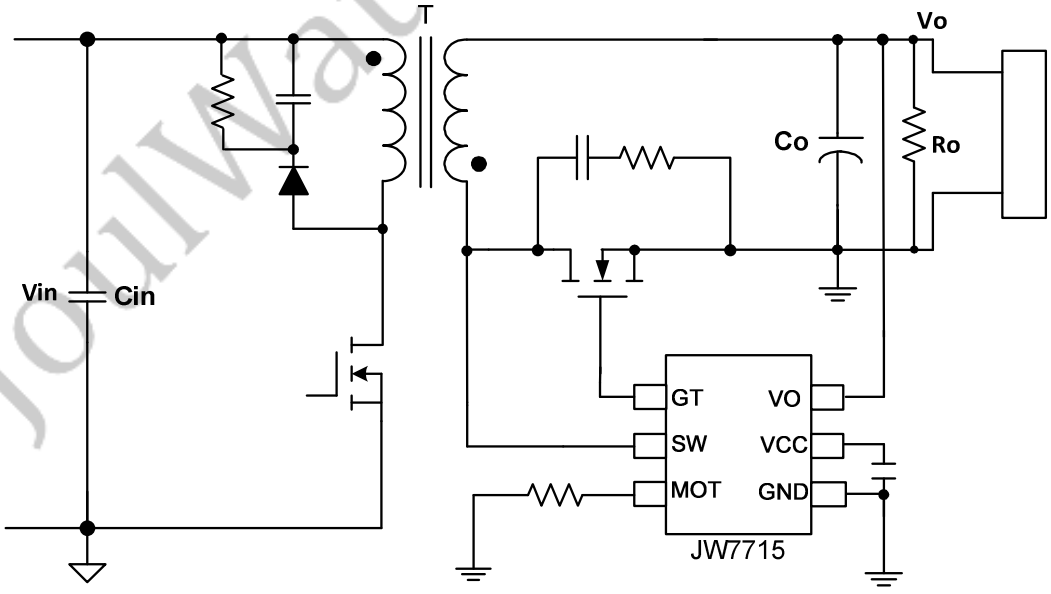

Figure A: JW7715 Typical Application for Flyback Converter with Low Output Voltage.

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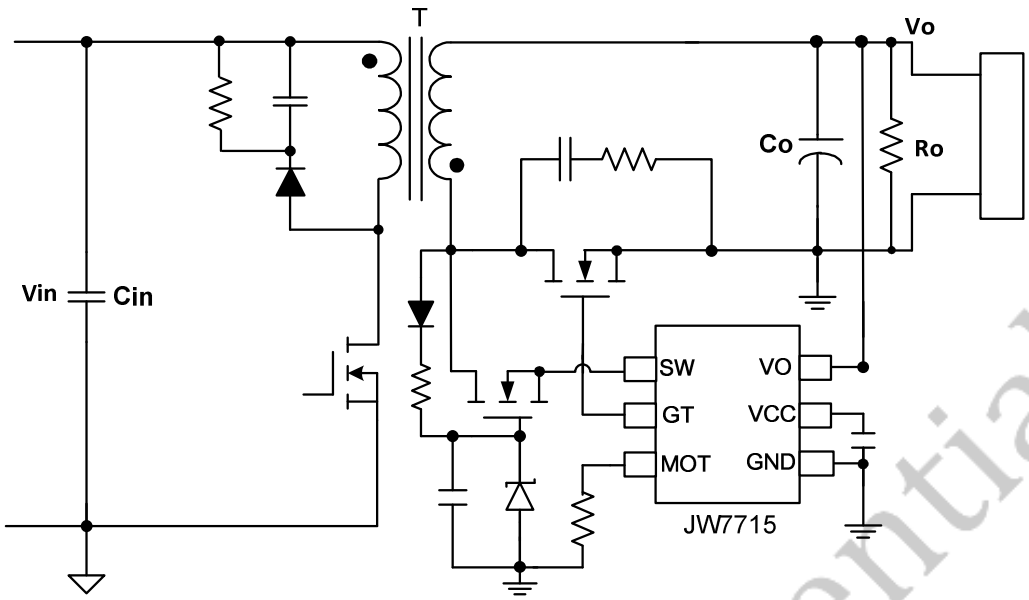

Figure B: JW7715 Typical Application for Flyback Converter with High Output Voltage.

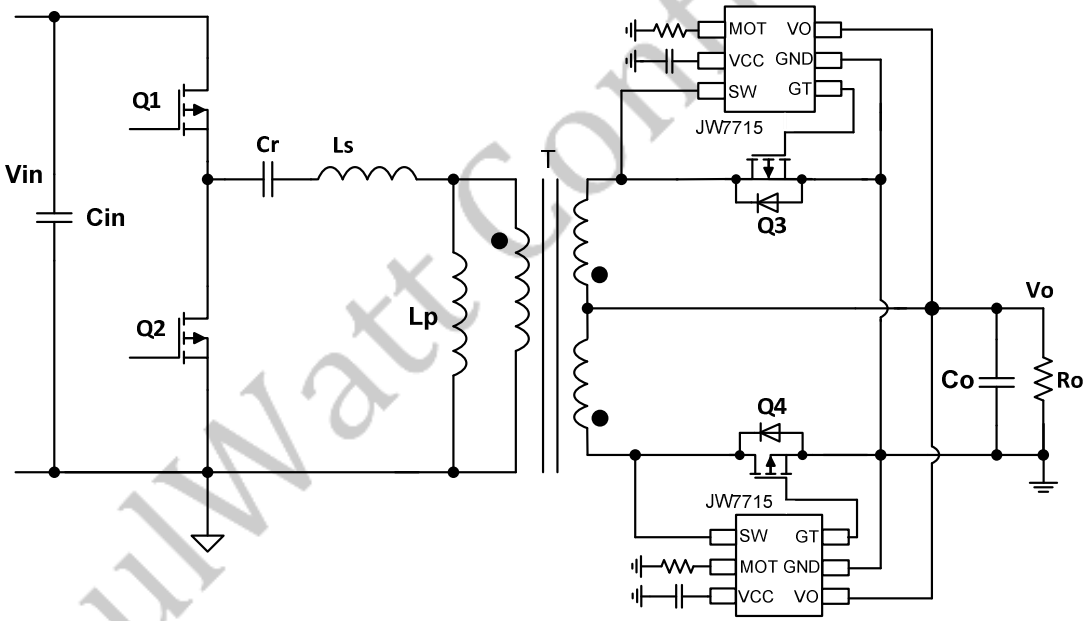

Figure C: JW7715 Typical Application for LLC Converter.

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ORDER INFORMATION

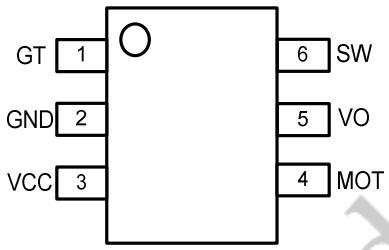
LEAD FREE FINISH	TAPE AND REEL	PACKAGE	TOP MARKING
JW7715SOTB#PBF	JW7715SOTB#TRPBF	SOT23-6	JWE3

Note：

JWXXXXPPPP#TRPBF
- Pb Free
- Tape and Reel（If "TR" is not shown, it means Tube）
- Package Code
- Part Number

PIN CONFIGURATION

TOP VIEW



SOT23-6

ABSOLUTE MAXIMUM RATING[1)]

SW PIN 80V
VO PIN 30V
VCC, GT PIN.....5V
Maximum Power Dissipation[2)].....0.5W
Junction Temperature[3)].....150ºC
Lead Temperature 260ºC
Storage Temperature.....-65ºC to150ºC

RECOMMENDED OPERATING CONDITIONS

SW Pin.....4.7V to 70V
VO Pin.....4.7V to 20V
VCC, GT PIN.....4V to 6V
Operation Junction Temp. ..... -40ºC to 125ºC

THERMAL PERFORMANCE[4)]

	θ_{JA}	θ_{Jc}
SOT23-6	220	130ºC/W

Note：

1) Exceeding these ratings may damage the device.

2) TA=25℃. The maximum allowable power dissipation is a function of the maximum junction temperature T_J(MAX), the junction-to-ambient thermal resistance θ_{JA}, and the ambient temperature T_A. The maximum allowable continuous power dissipation at any ambient temperature is calculated by $P_D(MAX)=(T_J(MAX)-T_A)/\theta_{JA}$.

3) The JW7715 guarantees robust performance from -40°C to 150°C junction temperature. The junction temperature range specification is assured by design, characterization and correlation with statistical process controls.

4) Measured on JESD51-7, 4-layer PCB.

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ELECTRICAL CHARACTERISTICS

TA = 25ºC, unless otherwise stated

Item	Symbol	Condition	Min.	Typ.	Max.	Units
VCC Section						
VCC Voltage	VCC	SW=40V, VCC=2.2uF		5.80		V
VCC Startup voltage	$V_{CC\_Startup}$			4.05		V
VCC UVLO	V_{CC_UVLO}			3.95		V
Operation Current (Switching)	I_{SW}	GT=5nF, Fsw=100KHz		3.2		mA
Operation Current (GT On)	I_{VCC}	GT=5nF,VCC=2.2uF		1.0		mA
Quiescent Current	I_q	VCC=4.5V, VCC=2.2uF		24		uA
Gate Section						
Gate Turn on Threshold	V_{MOS_ON}			-300		mV
Gate Turn off Threshold	V_{MOS_OFF}			-10		mV
Gate Turn off Threshold in MOT	$V_{MOS\_OFF\_MOT}$			50		mV
Gate Turn on Voltage	V_{GT}	SW=32V, VCC=2.2uF	V_{CC}-1	V_{CC}		V
Gate Pull up current	I_{GU}	GT=1V		0.5		A
Gate Pull down current	I_{GD}	GT=5V		5.5		A
Gate Minimum on Time	T_{MIN_ON}	RMOT=100K		1.5		uS
		RMOT=0Ω		700		nS
Gate Minimum off Time	T_{MIN_OFF}			550		nS
Turn-on total delay	T_{DON}	R_{GATE}=0Ω， C_{LOAD}=5nF		84		nS
		R_{GATE}=0Ω， C_{LOAD}=10nF		94		
Turn-off total delay	T_{DOF}	R_{GATE}=0Ω， C_{LOAD}=5nF		22.4		nS
		R_{GATE}=0Ω， C_{LOAD}=10nF		32.4		
SW and VO Section						
VCC Charge Current	I_{CV}	SW=32V, VCC=3.5V		44		mA
SW Control Voltage	V_{MOS_REG}			-60		mV
SW Control Voltage MAX	$V_{MOS\_REG\_MAX}$			-180		mV
VO Enable Charge Voltage	V_{O_EN}	VCC=3V, SW=0V		4.55		V
VO Disable Charge Voltage	V_{O_DIS}	VCC=3V, SW=0V		4.35		V
VO Charge Current	I_{VO_CHG}	SW=0V, VCC=3.5V，VO=5V		33		mA
Vo Short-circuit Detection Voltage	V_{O_SHORT}			2.1		V

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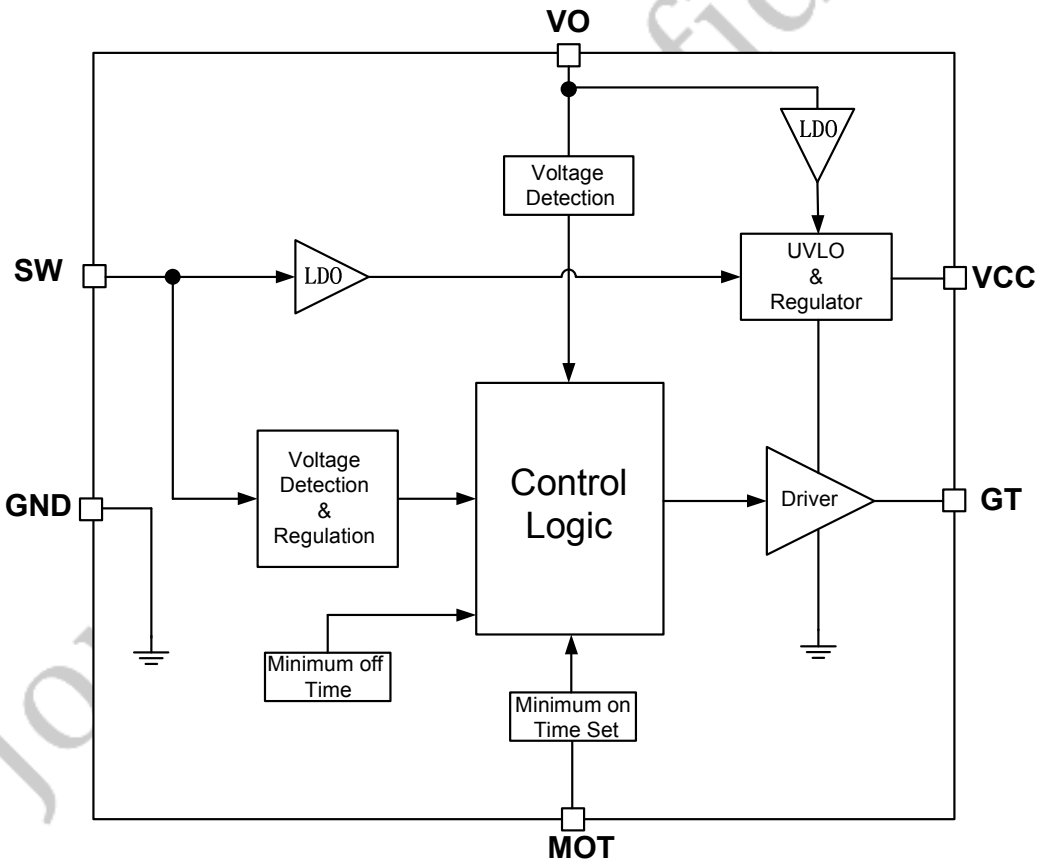
PIN DESCRIPTION

Pin No.	Name	Description
1	GT	Drive the External NMOSFET.
2	GND	Ground.
3	VCC	Power supply. Bypass a Capacitor Between VCC and GND.
4	MOT	Set the minimum on-time, floating the pin means 1.5uS
5	VO	Output Voltage Sensing and Charging to VCC.
6	SW	External Power MOSFET Drain Voltage Sensing. Charging to VCC.

BLOCK DIAGRAM



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FUNCTIONAL DESCRIPTION

Operation

JW7715 is a synchronous rectifier controller which combined with external MOSFET can replace the Schottky Barrier Diode. It supports all operations, such as DCM, CrCM, (Quasi-Resonant) and CCM when adopted in flyback or LLC converters.

Startup

During the startup period, when the VCC is lower than startup voltage, the external MOSFET is turned off. The current flows though body diode before the VCC reaches to the startup voltage Vcc_startup.

Under-Voltage Lockout (UVLO)

When the VCC is below UVLO threshold, the external MOSFET is turned off and pulled low internally. Once the VCC exceeds the startup voltage Vcc_startup, the parts is activated again.

LDO Charging Logic

JW7715 have two internal LDO to charge the VCC pin. When VO is lower than 4.55V, JW7715 can power itself through the internal LDO connected to SW pin during the SR turn-off period, which means primary the primary side MOSFET is turned on and SW presents a positive voltage. A capacitor between VCC and GND is required to store the energy and supply to IC during the SR turn-on period.

The other internal LDO is connected from VO to VCC, it charges VCC pin when VO is higher than 4.55V.

Turn On Phase

When the synchronous MOEFET is conducting, current flows through the body diode of MOSFET, which generates a negative voltage V_{SW} across it. When V_{SW} is lower than V_{MOS_ON}, the part will pull the gate high to turn on the synchronous MOSFET after turn on delay time T_{DON}.

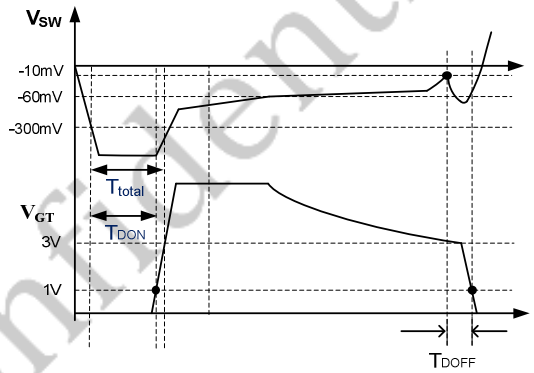

Figure-1 Turn on delay and turn off delay

Conducting Phase

When the synchronous MOSFET is turn on, the drain source voltage V_{SW} it is determined by its on resistance and the current through it. The part adjusts the gate voltage and regulates the Vsw to a internal threshold (typical -60mV) after the synchronous MOSFET turn on. When the V_{SW} is lower than -60mV, the gate keep its maximum voltage. And the synchronous MOSFET is fully on.

The V_{SW} rises when the current follow through the MOSFET decreases. The gate voltage will be decreased to increase its on resistance and regulate the V_{SW} around -60mV.

Figure 2 and Figure 3 show the theoretical waveforms when a Flyback converter operated in DCM mode and CCM mode respectively.

The control circuit contains a minimum on time

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function. The V_{SW} voltage may have a parasitic ring when the synchronous MOSFET turns on. So a minimum on time (MOT) is very important to avoid the MOSFET turn off threshold is false triggered. During the minimum time, the gate can still be turned off if V_{SW} touches a positive threshold value, +50mV.

It should be noted that the typical regulation threshold (-60mV) during MOSFET on time is not fixed, it can be internally changed to ensure the proper operation under CCM mode.

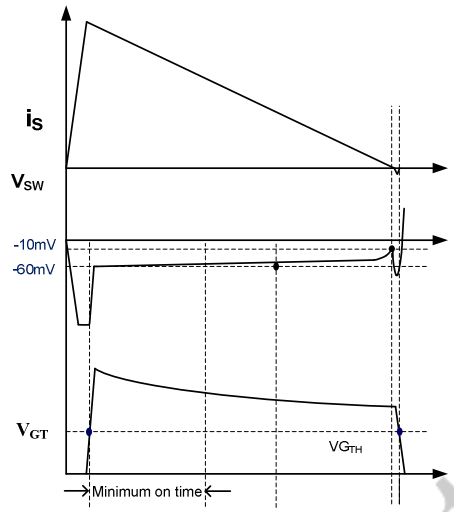

Figure-2 Conducting phase for DCM mode

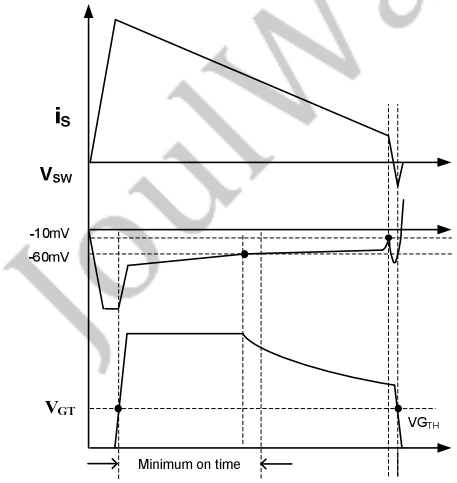

Figure-3 Conducting phase for CCM mode

Turn Off Phase

After synchronous MOSFET conducting, once the voltage V_{SW} touches the MOSFET turn off threshold (-10mV), the gate is pulled to low after a turn off delay time T_{DOFF}. A 550nS blanking time is necessary to avoid error trigger.

Minimum on-time (MOT)

MOT stands for the minimum on time of synchronous MOSFET or the maximum duty cycle of primary MOSFET, The MOT can be adjusted by a resistor connected to MOT pin. The relation between MOT and the resistor is shown in Figure 4. Floating MOT will result in a maximum on time (~1.5uS), and shorting MOT to GND turns out to a minimum on time (~700nS) for high frequency applications.

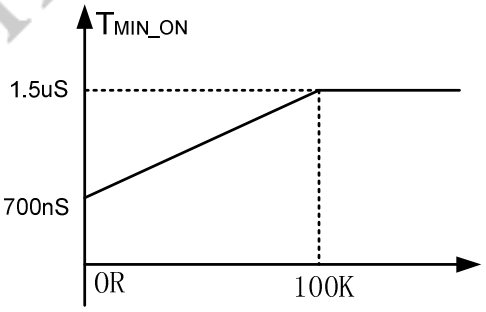

Figure-4 t_{MOT} v.s. R_{MOT}

Output Voltage Detection

The JW7715 has output voltage detection function via VO pin. To avoid the gate error turn on during starting-up period, the whole SR control logic is disabled when the VO voltage is lower than 2.1V. VCC is charged from VO pin when VO is higher than 4.55V to save power loss caused by the LDO when charging from SW pin to VCC pin.

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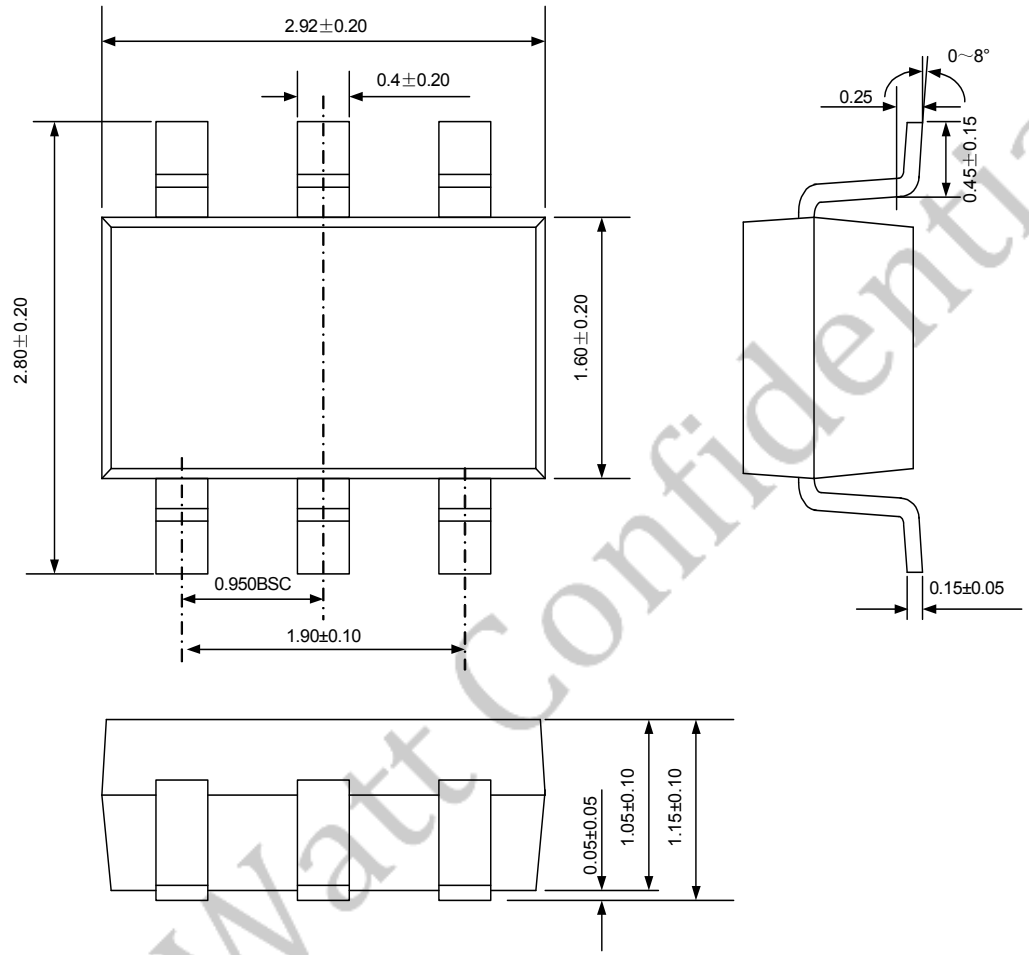
PACKAGE OUTLINE

SOT23-6 **UNIT: mm**



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