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AL2010

Current-Mode PWM Step-Down DC-DC Convertor

GENERAL DISCRIPTION

AL2010 is the Current-Mode Synchronous Step-Down DC-DC Convertor which offers excellent transient response. Output voltage is selectable between 0.8V and 5.0V by the external resister. Input voltage range is between 3.0V and 5.5V, and it is the most suitable to generate 1.0V, 1.2V, and 1.8V. Power MOSFETs are built in AL2010, which is maximum current is 2.5A. The switching frequency is selectable between 300 kHz and 4 MHz by the external resister. For the protections, AL2010 has Over-Current protection, Low-Input Voltage protection, and Power-Good function.

FEATURE

■ **Step Down DCDC Converter**

・Input Voltage Range: 3.0V to 5.5V

・Output Voltage Range: 0.8V to 5.0V (by the external resister)

・Maximum Output Load Current: 2.5A

・Operation Temperature: -40°C to 85°C

・Switching Frequency: 300kHz to 4MHz (Selectable by an external resister. And Available External
   Synchronous Mode by the external clock)

・Low Input Voltage Protection

・Power-Good Function

・Over-Current Protection (Automatic recovery type)

・Thermal Protection

・Internal Reference Voltage: ±1.5% (Ta = 25 °C)

・Maximum Duty: 100%

・Soft Start Function

・PKG: TSSOPE-16

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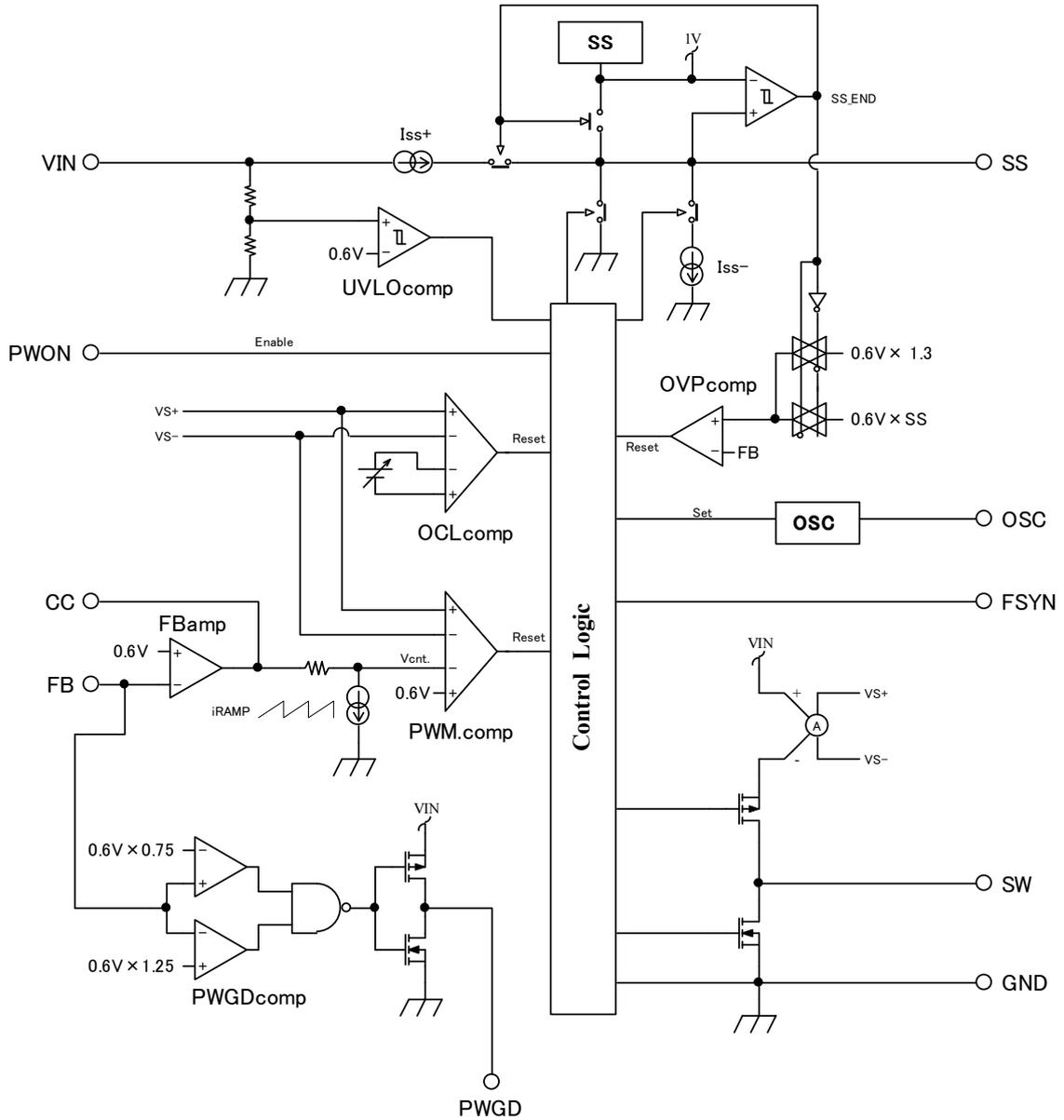
BLOCK DIAGRAM

Figure 1.   AL2010 Block Diagram

Pin Location & TYPICAL OPERATION CIRCUIT
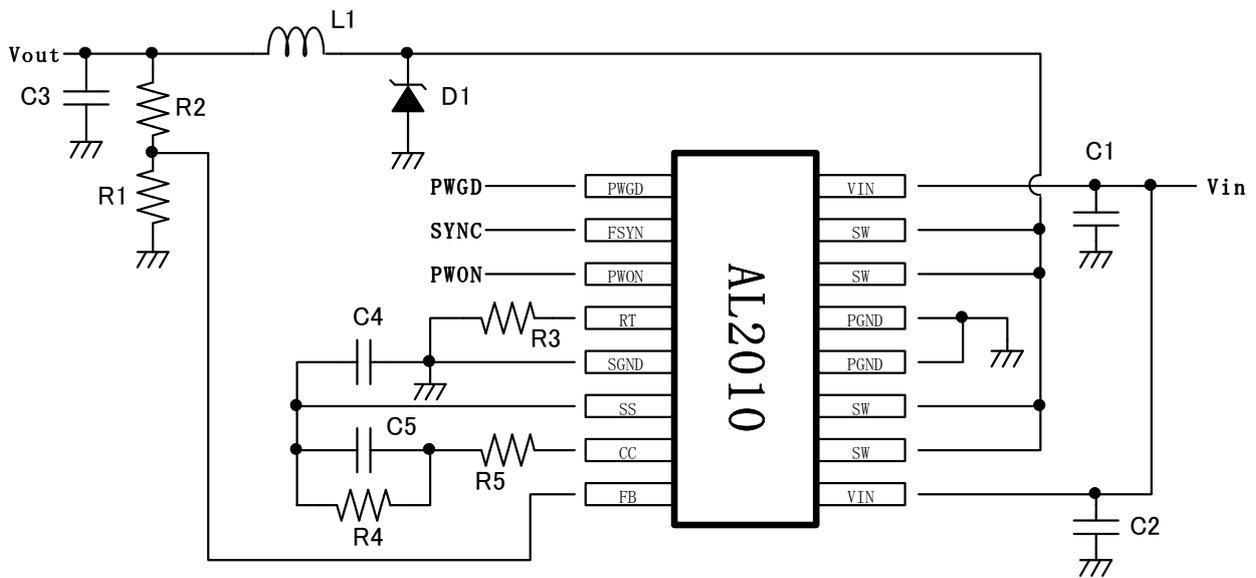
Figure 2. Pin Location (Top View)

PIN & FUNCTION

No.	Pin Name	Function	No.	Pin Name	Function
1	PWGD	Power-Good	9	VIN	Supply Input
2	FSYN	External Synchronous Clock Input	10	SW	Switching Node Output
3	PWON	Power-On	11	SW	Switching Node Output
4	RT	Frequency Setting	12	PGND	Power Ground
5	SGND	Signal Ground	13	PGND	Power Ground
6	SS	Soft Start	14	SW	Switching Node Output
7	CC	Output of Feedback Amplifier	15	SW	Switching Node Output
8	FB	Feedback Input	16	VIN	Supply Input

ABSOLUTE MAXIMUM RATING

(Gnd=0V; Note 1)

Parameter	Symbol	Min	Max	Units
VIN pin	VIN	−0.3	6.0	V
SW pin	VSW	−0.3	Vin + 0.3	V
All pins (Except SW pin, VIN pin)	VIND	−0.3	Vin	V
Junction Temperature	TJ		125	°C
Operating Ambient Temperature	TA	−40	85	°C
Storage Ambient Temperature	TSTG	−40	150	°C
Power Dissipation (Ta = 25°C)	Pd		2000	mW

Note1. All voltages with respect to ground.

WARNING: Operation at or beyond these limits may result in permanent damage to the device.
Normal operation is not guaranteed at these extremes.

RECOMMENDED OPERATING CONDITIONS

(Gnd=0V)

Parameter	Symbol	Min	Typ	Max	Units
VIN pin voltage	Vin	3.0	–	5.5	V
Output Current	Iout	0	–	2.5	A
Operating Ambient Temperature	Ta	−40	–	85	°C

*AKPD assumes no responsibility for the usage beyond the conditions in this datasheet.

ELECTRICAL CHARACTERISTICS

(Vin=5.0V, Ta=25°C, unless otherwise specified)

Parameter	Symbol	Conditions	Min	Typ	Max	Units
Operating Input Voltage Range	Vin		3.0	-	5.5	V
Feedback REF Voltage	V_{FB_ref}		591	600	609	mV
Operation Current Consumption	I_{SUULY}	No Switching	0.48	0.8	1.12	mA
Stand-by Current	Istandby	Power-Off	-	-	10	μA
Load Regulation *1	ΔV_{LOAD}		-	1	-	%
MOSFET $R_{DS(ON)}$	Rpmos	PMOS $R_{DS(ON)}$	10	65	100	mΩ
	Rnmos	NMOS $R_{DS(ON)}$	10	65	100	mΩ
Over-Current Detection	Ioclpeak		3.15	4.5	-	A
Oscillator Frequency	fosc		300	-	4000	kHz
FSYN Input Frequency Range	Fext300	RT=702kΩ (at 300kHz)	240	-	360	kHz
	Fext2000	RT=100kΩ (at 2MHz)	1600	-	2400	kHz
Oscillator Accuracy	facu	RT=100kΩ (at 2MHz)	-20	0	20	%
Maximum ON Duty	MAXDuty	*2	-	-	100	%
UVLO	Vuvlo	Voltage at Lock	2.30	2.50	2.84	V
UVLO Return Voltage		Voltage at Release	2.36	2.70	2.90	V
UVLO (Hysteresis)	Vuv_hys	UVLO Hysteresis Width	0.06	0.20	-	V
Output Over Voltage Detection	Vovp	against V_{FB_ref}	+26	+30	+34	%
Charge Current (to Capacitor of Soft Start)	Iss+	Css=0V → 1.0V (at rise)	18.0	20.0	22.0	μA
Discharge Current (to Capacitor of Soft Start)	Iss-	Css=1.0V → 0.40V (at fall)	0.75	1.0	1.25	μA
Thermal Protection Detection *2			-	150	-	°C
Thermal Protection Hysteresis *2			-	15	-	°C
Power Good Detection		against V_{FB_ref}	±16	±20	±24	%
Power Good non-Detection		against V_{FB_ref}	±21	±25	±29	%
Power Good Hysteresis			±3	±5	±7	%
Power-ON Threshold	Vponl		-	-	0.4	V
Power-OFF Threshold	Vponh		1.5	-	-	V
Power-ON Hysteresis			50	100	150	mV
gm (CC pin)			400	500	600	μS

*1. For reference value by the recommended circuit
*2. Guaranteed by design and characterization

DC CHARACTERISTICS

(Ta=25°C, unless otherwise specified)

| Parameter	Symbol	Condition	Min	Typ	Max	Units
FSYN(Input pin) Threshold Voltage	VEih		0.7*VDD	–	–	V
	VEil		–	–	0.3*VDD	V
PWGD(Output pin) Voltage	VPoh	Ipoh=-100μA	VDD-0.4	–	–	V
	VPol	Ipol=100μA	–	–	0.4	V

RECOMMENDED CIRCUITRY & PCB LAYOUT
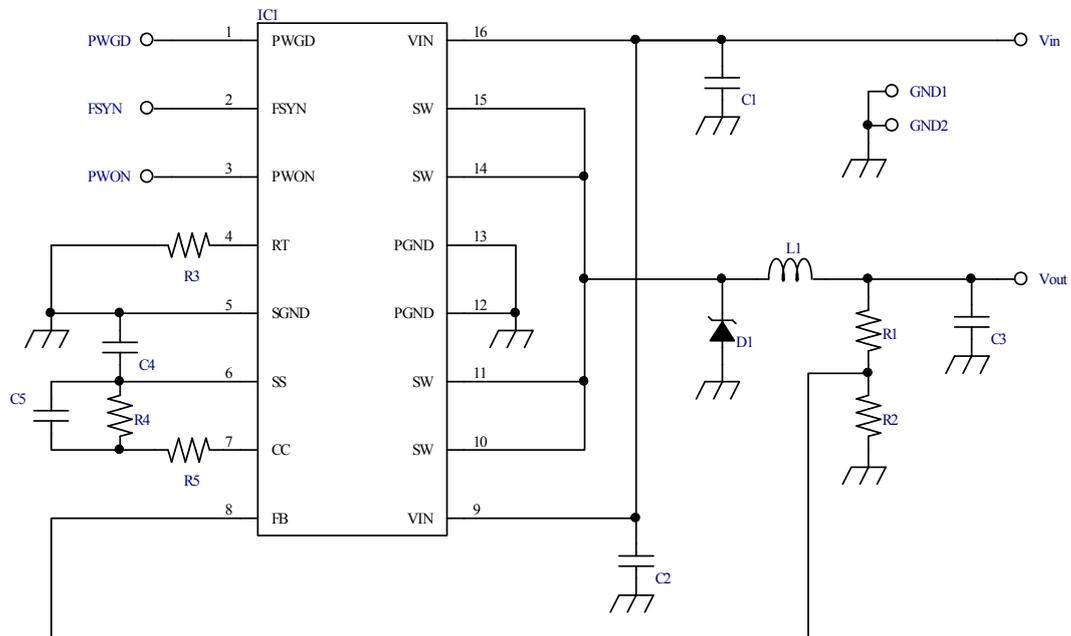

Figure 3. One Example of Recommended Circuitry
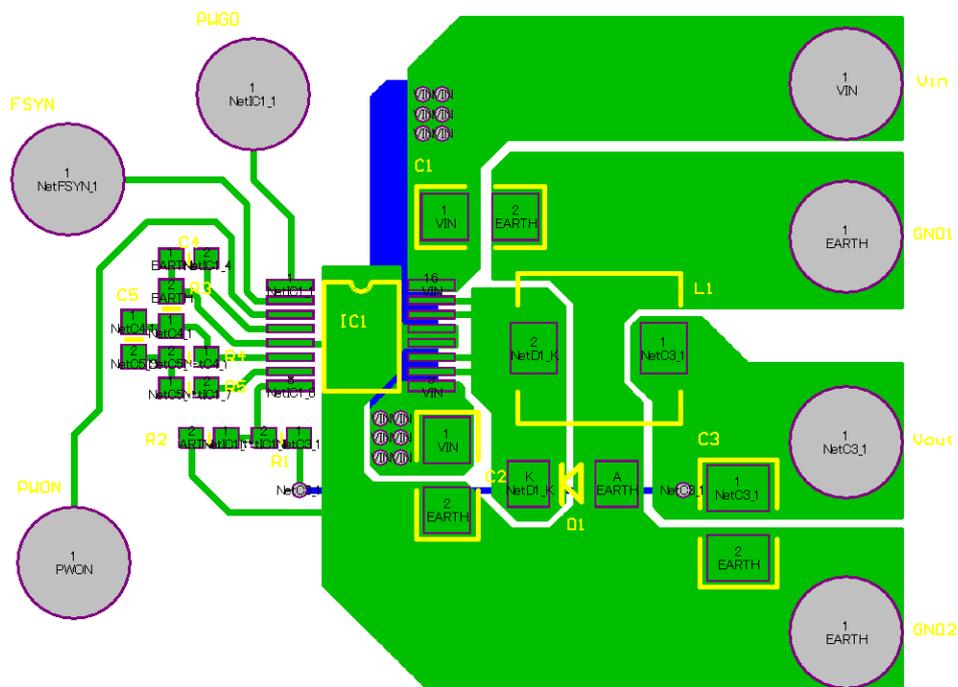
Figure 4. PCB LAYOUT

PIN DISCRIPTION

1 pin_PWGD:
Power-Good pin. When the output voltage achieved to ±20% of set voltage, this pin becomes "Hi".

2 pin_FSYN:
External Synchronous Clock Input pin. Internal pull-up resistor is 300kΩ. The external clock within ±20% of relative value is available, which is to the internal clock, and it is set by the resistor at RT pin.

3 pin_PWON:
Power-ON pin. It starts in the voltage which is 1.5V and more.

4 pin_RT:
The setup pin of operation frequency. It is the setup by a resistor.

5 pin_SGND:
Signal Ground pin.

6 pin_SS:
Soft Start pin. It should connect the capacitor of 0.047uF and more between SS pin and GND. It charges an external capacitor at the time of startup, and Soft Start works. And, when the AL2010 is in the protection state of over current, the external capacitor is discharged and it makes the stop time in a hiccup operation.

7 pin_CC:
Output pin of Output Voltage Feedback Amplifier. A resistor and a capacitor are placed in a parallel connection, and those are connected between CC pin and Vref/SS pin. And those compensate a phase of an amplifier.

8 pin_FB:
Input pin of Output Voltage Feedback Amplifier. The voltage is controlled so that this pin voltage becomes 0.6V. Two resistors for the feedback should be placed in a series between the output stage and GND, and the connected point of two should be connected to FB pin.

9 pin, 16pin_VIN:
Input pin of Main Power Voltage. A capacitor should be placed between VIN pin and GND, which is 4.7uF and more.

10 pin, 11 pin, 14 pin, 15 pin_SW:
Output pin of the internal switching MOSFET.

12 pin, 13 pin_PGND:
Power Ground pin.

TIMING CHART AT START-UP
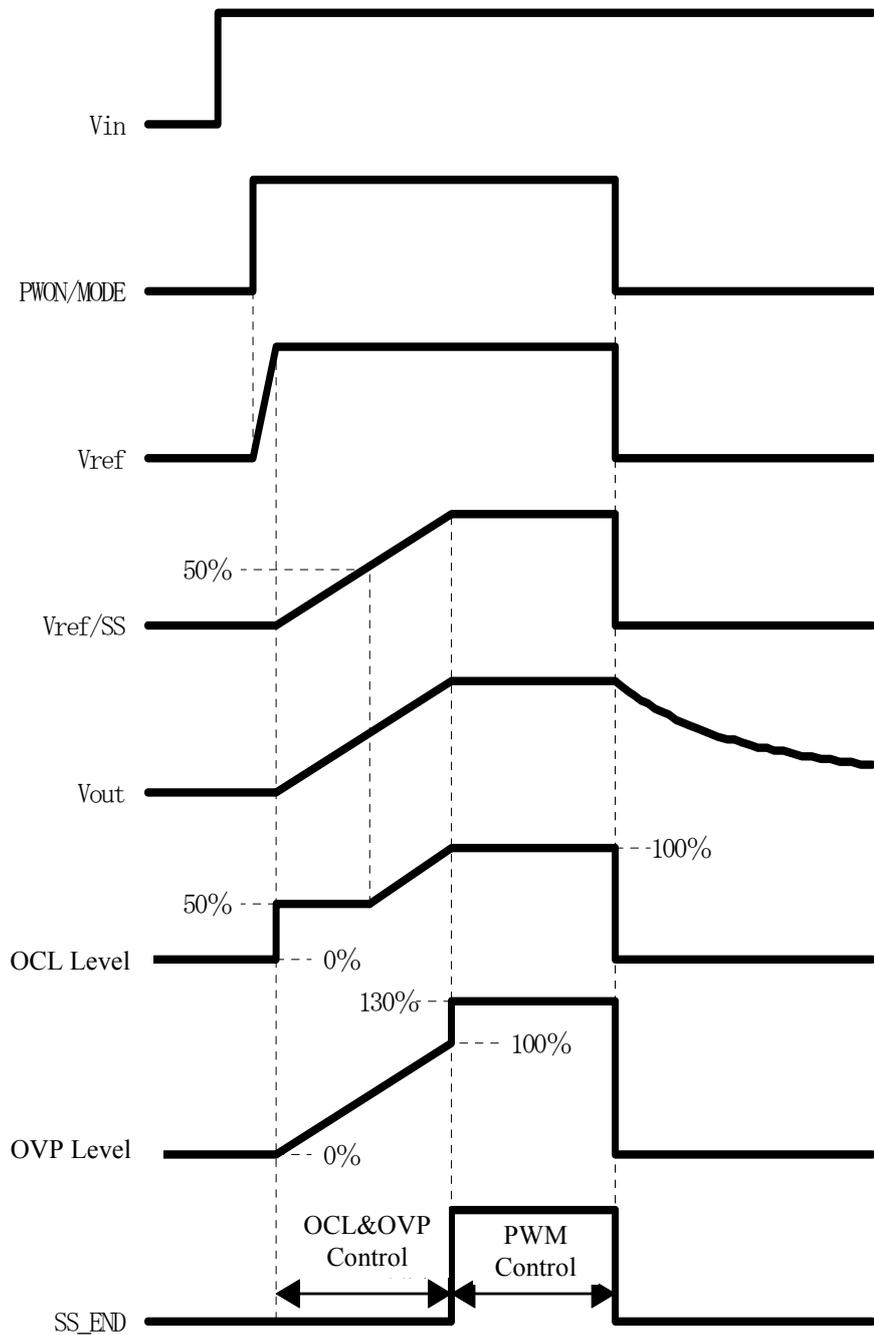
Figure 5.   Start Up Timing

TIMING CHART AT OVER CURRENT PROTECTION
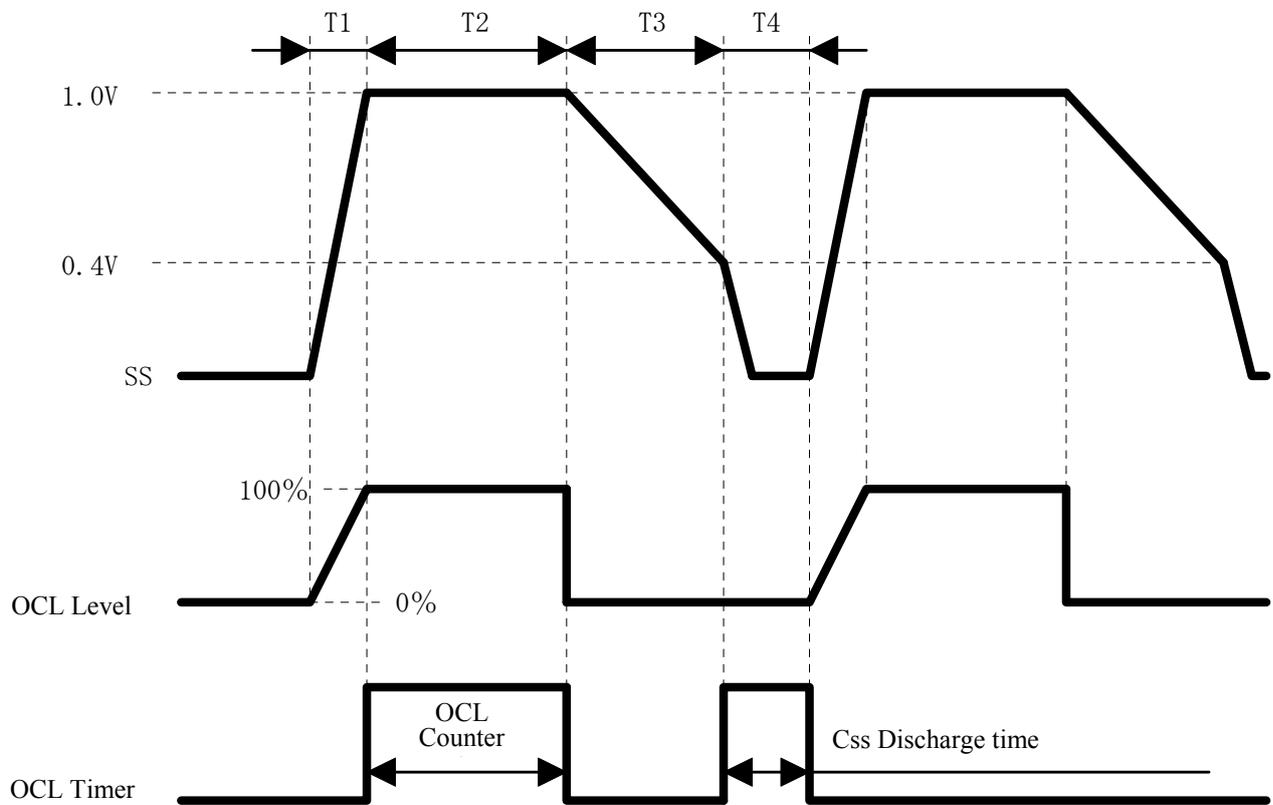
When Css=0.1uF, T1: Soft Start Time is 5ms, T3: Rest Time is 60ms,
T2: 256us（512 clocks/2MHz）、T4: 192us（384 clock/2MHz）

When Css=0.22uF, T1: Soft Start Time is 11ms, T3: Rest Time is132ms

Figure 6. Over Current Protection Timing

TIMING CHART BY EXTERNAL SYNCHRONOUS

1 : 2   Fixed   Un-Fixed

Internal Clock

(1)

FSYN   Vth>0.4V

$\overline{PG}$

(2)
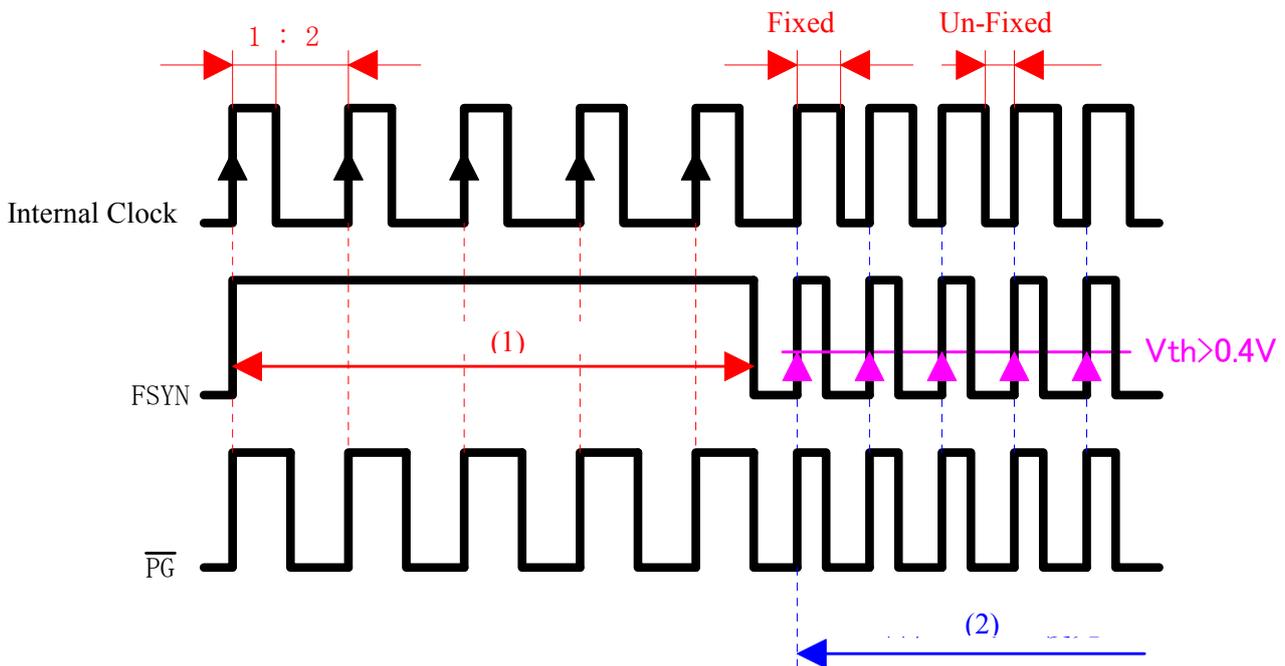
(1) When the period of "FSYN=Hi" is longer than one cycle of Internal Clock, the operation clock is according to Internal Clock.
(2) When the period of "FSYN=Hi" is shorter than one cycle of Internal Clock, the operation clock is according to External Clock.

The external clock which is as the relative value within ±20% of the internal clock frequency which depends on the resistor of RT pin can be inputted to AL2010.

VIN

200k Ω

FSYN

Gate Input

External Synchronous Clock

Open Collector or Open Drain It must be less than 0.4V.
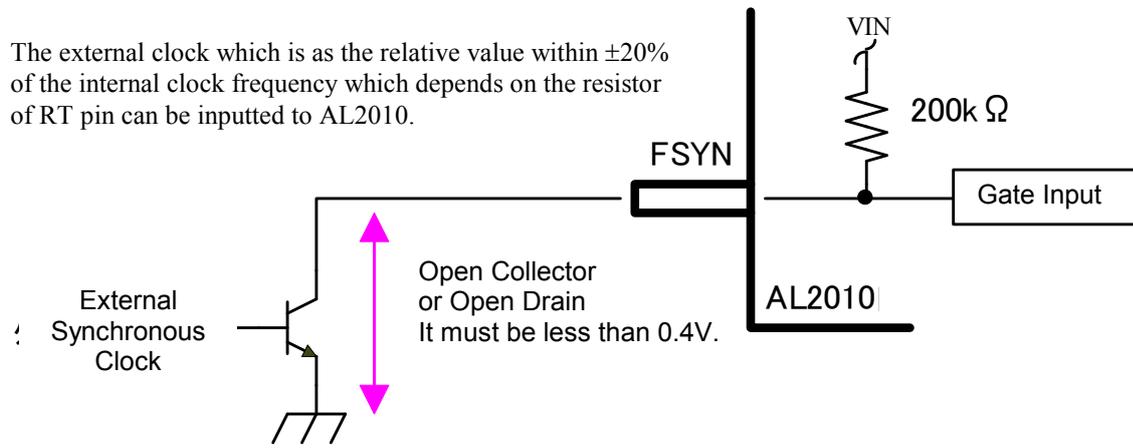
AL2010

Figure 7.   External Synchronous Timing

CHARACTERISTIC EXAMPLE
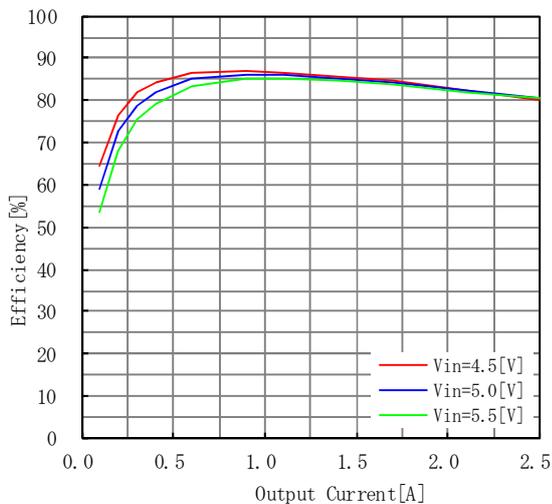
Vin=5V Vout=1.8V f=2.2MHz   Vin=5V Vout=1.5V f=2.0MHz
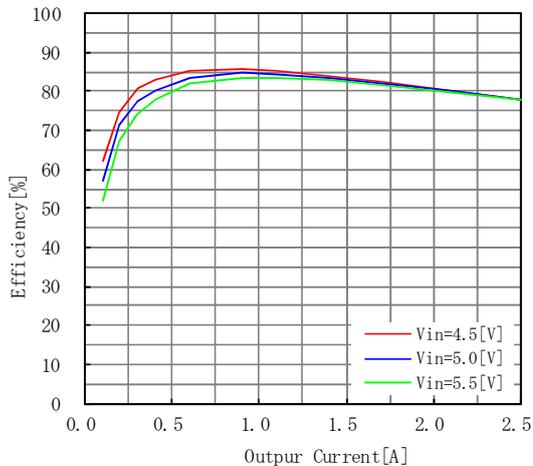
Figure 8.   Characteristic Example

MARKING
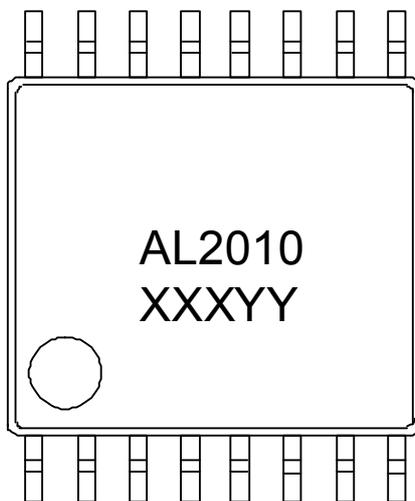
1) Pin #1 indication
2) Date Code : XXXYY (5 digits)
    XXX: Date Code
    YY: Lot#
3) Marketing Code : AL2010

Figure 9.   Package Marking (Top View)

PACKAGE INFORMATION

16pin TSSOPE（Unit：mm）
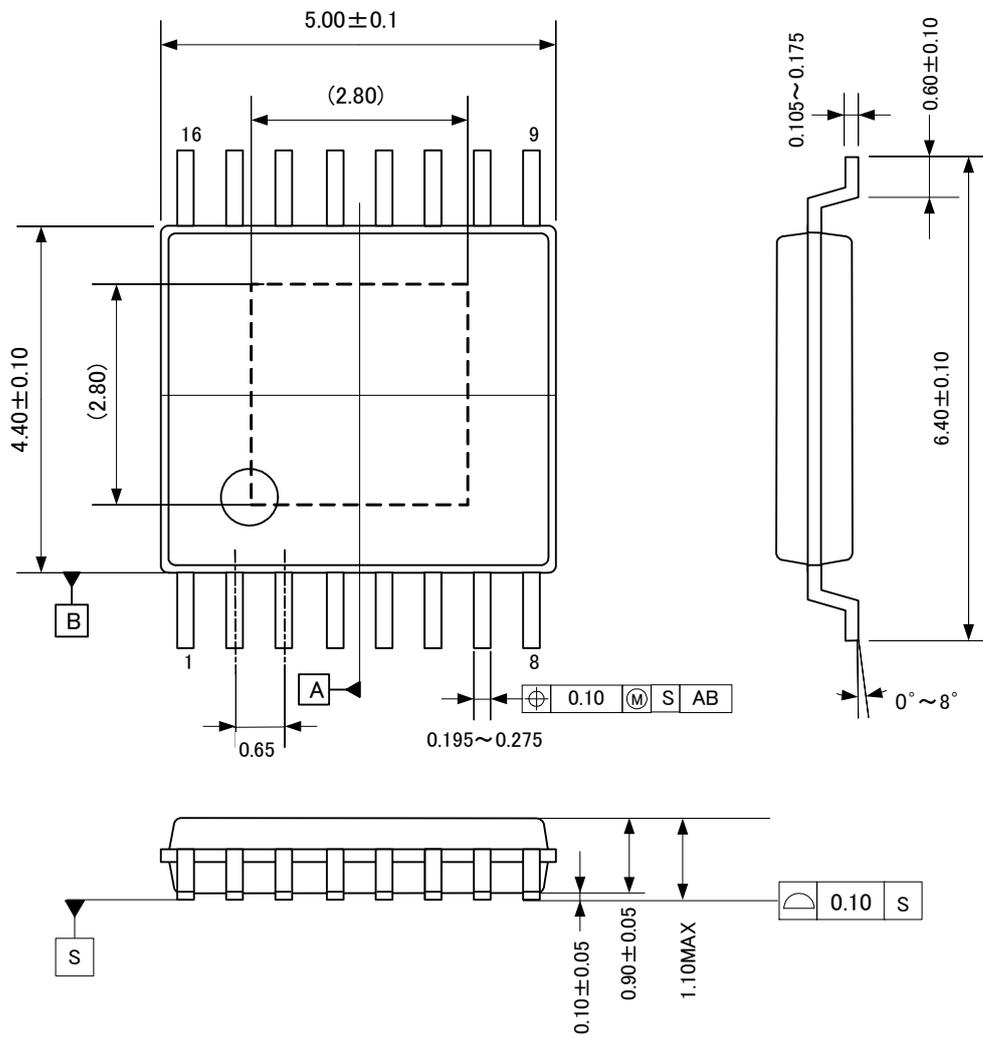
（Unit: mm）

Figure 10. Package Dimensions

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