

# Data Sheet

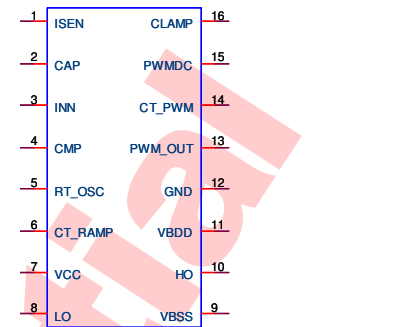
## L165

High Performance PWM Controller

Version: A1-002

**Features:**

- 400V half bridge driver
- Integrated bootstrap FET
- 12V ~ 20V operation voltage
- Feed back control stabilizes load current
- Latched off protection
- Built-in low frequency PWM dimmer
- Built-in UVLO
- SOP 16 pins package
- Low power CMOS process

**Pin Layout:****General Description:**

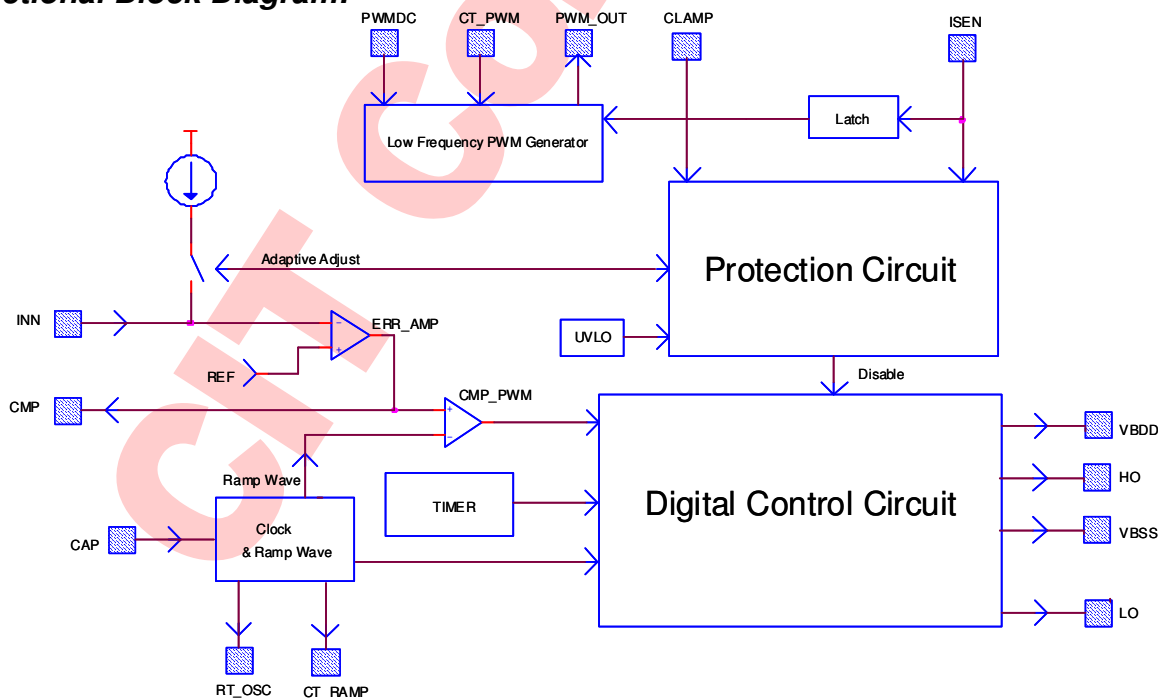
L165 integrated circuit provides essential PWM features for half bridge converter. It is a 400V half bridge driver integrated bootstrap FET provides feedback control can stabilize load current. Its built-in low frequency PWM dimming provides users more flexible applications. It also provides latched off protection feature may make the system more reliable. L165 is available in SOP16 package.

**Recommended Operating Condition:**

Supply Voltage.....12V ~ 20V  
 Operating Ambient Temperature..... -20 ~ 85 °C  
 Operating Frequency (CT\_RAMP).....2K ~ 340KHz  
 Operating Frequency (LO, HO).....1K ~ 170KHz

**Absolute Ratings**

Supply Voltage.....20V  
 Operating Ambient Temperature.....-20 ~ 85 °C  
 Operating Junction Temperature.....+155 °C  
 Storage Temperature.....-55 ~ 150 °C

**Functional Block Diagram:**

**Pin Description:**

Pin No.	Symbol	I/O	Descriptions
1	ISEN	I	Load detection pin. The abnormal load situation is detected if a less than 1.8V voltage kept for 32 cycles of the 2 <sup>nd</sup> low frequency PWM on this pin.
2	CAP	I/O	The lamp detection pin.
3	INN	I	The inverting input of the error amplifier.
4	CMP	O	Output of the error amplifier.
5	RT_OSC	I/O	Initial frequency control pin.
6	CT_RAMP	I/O	Oscillator pin.
7	VCC	I	The power supply pin.
8	LO	O	Low side gate driver output.
9	VBSS	I/O	High side floating return.
10	HO	O	High side gate driver output.
11	VBDD	I/O	High side gate driver floating supply voltage
12	GND	I/O	The ground pin.
13	PWM_OUT	O	The output pin of the 2 <sup>nd</sup> low frequency PWM generator. A 1.5V or floating two state output is provided through this pin.
14	CTPWM	I/O	With the internal reference current and an external capacitor connected here can set the operation frequency of the 2 <sup>nd</sup> low frequency PWM generator with 1.66V ~ 3.3V triangle wave output.
15	PWMDC	I	The 2 <sup>nd</sup> Low frequency PWM controlling input. A PWM output comes out by comparing this DC input and the 1.66 ~ 3.3V triangle wave that is generated by CTPWM.
16	CLAMP	I	Output adjustment. If a > 3.7 V voltage is detected, there will be a ~ 60uA current will flow into the INN pin to adjust the output of the error amplifier pin CMP to regulate the output voltage.

---

**Functional Description:****Reset Mode**

The reset mode is defined when VCC is below 8V. In this mode, L165 will reset its internal status.

**Under Voltage Locked Out, UVLO (UVLO mode)**

The under-voltage lock-out mode (UVLO) is defined when VCC is below the turn-on threshold voltage of the IC. In this mode, an ultra low supply current supplies the IC.

**Start Up of Sub Power (Sub Power Mode)**

When VCC is higher than the turn-on threshold voltage (12V) of L165, IC will start up its sub power. In this mode, there will be a very narrow duty cycle outputting to activate the load about 7 cycles. The period of sub power mode is set by the resistor connected at RT\_OSC pin.

**Start Up of Lamp Ignition (Ignition mode)**

After the start up of sub power, L165 will start to kick-off the lamp. In this state, all the protection functions are turned off. L165 starts its oscillator and outputs PWM signals to ignite the lamp.

In this state, there is no signal output of PWM\_OUT of PWM dimming function. The lamp start up time is set by the resistor connected at RT\_OSC.

**Lamp Operation (Operation Mode)**

When the lamp is ignited successful after the start up time, the lamp current is established to a stable level. ISEN detects the lamp current and CLAMP detects the lamp voltage.

**Lamp off (Fault Mode)**

When the lamp fault is detected, L165 will latch off its output. There are two detection circuits used for lamp operation, one is ISEN that used to detect the lamp current, another is the CLAMP pin that used to detect the lamp voltage. If ISEN detects a lower than 1.8V or CLAMP detects a higher than 3.7V, L165 will latch off its outputs.

**To set the feed back function**

With a resistor detects the lamp current and feeds to INN pin, L165 will regulate its output frequency and duty.

**To set the 2<sup>nd</sup> PWM Generator**

With a capacitor connected in CT\_PWM pin can set the frequency of 2<sup>nd</sup> PWM generator. This signal will compare with a received PWMDC signal and have an output in PWMOUT pin. Therefore, this signal can be used for PWM dimming or other specified application.

**DC/AC Characteristics:**

Ta=25°C unless otherwise specified.

Parameter	Test Conditions	Min.	Typ.	Max.	Unit
<b>Supply Voltages</b>					
Pin VCC input		12		20	V
Chip start-up quiescent current	15V supply voltage		450		uA
Chip consumed current	15V supply voltage		2.5		mA
<b>Error Amplifier Reference Voltage</b>					
Non-Inverting input of the error amplifier	Measure INN 15V supply voltage		1.25		V
Line regulation			2	20	mV
<b>Under Voltage Look Out</b>					
Positive Going Threshold	Note3		12		V
Hysteresis			4		V
<b>The 1<sup>st</sup> High Frequency Ramp Wave Generator</b>					
Operating Frequency (CT_RAMP)	Note1 The output driver (LO, HO) frequency is the half of the CT_RAMP frequency	2		340	KHz
<b>The 2<sup>nd</sup> Low Frequency PWM Generator</b>					
Ramp Wave Peak(CTPWM)	VCC=15V		3.3		V
Ramp Wave Valley(CTPWM)			1.66		V
PWM Frequency		100		1000	Hz
Control voltage of 0 % duty cycle on pin PWMDC			3.33		V
Output voltage of Pin PWMOUT for making the logic "high".			1.5		V
Pin PWMOUT output for making the logic "low"			Floating		
Maximum Duty Cycle			100		%
<b>Error Amplifier</b>					
Open loop gain	Note2		90		dB
Unit gain band width			7.5		MHz
<b>Power On Initialization and Latched Off Protection Enable</b>					
Power on latched off protection time	2 <sup>nd</sup> frequency =500Hz		64		ms
<b>Load Detection</b>					
Pin ISEN detection lower threshold	VCC=15V		1.8		V
<b>Output Detection and Adaptive Adjusting</b>					
Pin CLAMP detection lower threshold	VCC=15V		3.7		V
<b>Output of the 1<sup>st</sup> PWM (OUT1, OUT2) (C<sub>load</sub>=1000pF)</b>					
Rising Time			80	160	nS
Falling Time			45	75	nS
Delay Time		0.7	1	1.3	uS

Note 1. The output driver (LO, HO) frequency is the half of the CT\_RAMP frequency.

Note 2. Only guaranteed by simulation or sampled evaluation during -20~+85°C. Not 100% tested.

Note 3. The voltages of the output drivers are pulled to GND in each off states.

**Layout Notice:**

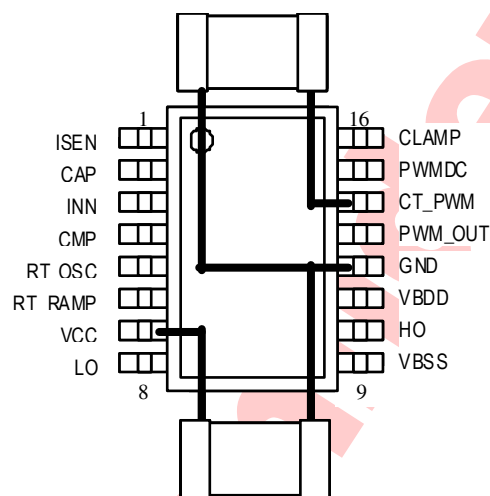
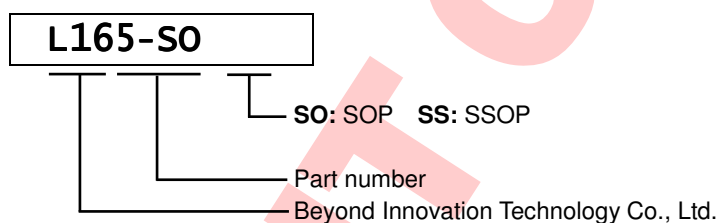
Some of the pins are very sensitive to noise. Please follow the bellowing guideline to make the layout:

Note 1. Please keep the capacitor between VCC and GND as close as possible. Noisy IC VCC may trigger UVLO.

Note 2. Please keep the capacitor between CT\_PWM and GND as close as possible.

Note 3. ISEN pin control the operation frequency. Please keep the noise level as low as possible of this path to the operation frequency be well controlled.

Note 4. Following figure is an example of making shortest traces between CT\_PWM, VCC and GND. The layout traces are under the IC.

**Order Information:**

P/N	Package	MOQ	SPQ	Remarks
L165-SO	SOP-16	2500	2500 / Reel	Green

## Soldering Information

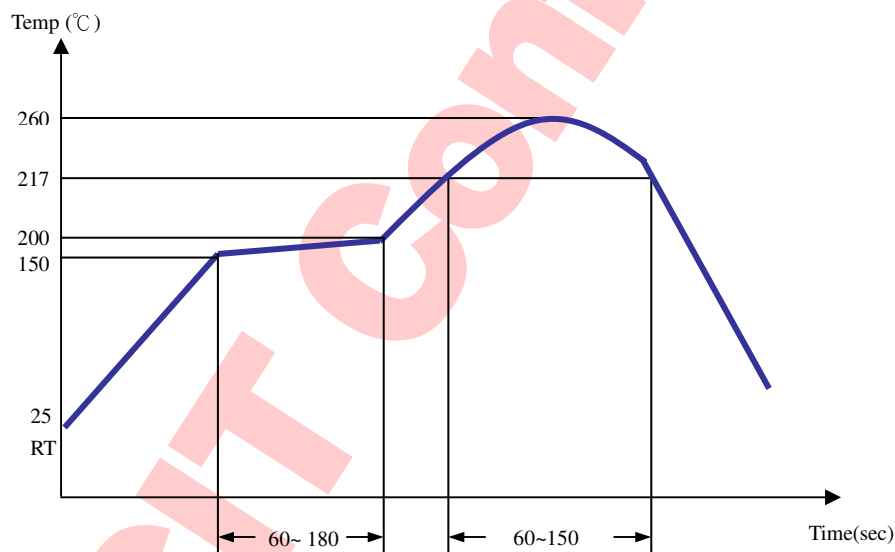
### Reflow Soldering:

The choice of heating method may be influenced by plastic QFP package). If infrared or vapor phase heating is used and the package is not absolutely dry (less than 0.1% moisture content by weight), vaporization of the small amount of moisture in them can cause cracking of the plastic body. Preheating is necessary to dry the paste and evaporate the binding agent. Preheating duration: 45 minutes at 45 °C.

Reflow soldering requires solder paste (a suspension of fine solder particles, flux and binding agent) to be applied to the printed-circuit board by screen printing, stenciling or pressure-syringe dispensing before package placement. Several methods exist for reflowing; for example, convection or convection/infrared heating in a conveyor type oven. Throughput times (preheating, soldering and cooling) vary between 100 and 200 seconds depending on heating method.

Typical reflow peak temperatures range from 215 to 270 °C depending on solder paste material. The top-surface temperature of the packages should preferable be kept below 245 °C for thick/large packages (packages with a thickness  $\geq 2.5$  mm or with a volume  $\geq 350$  mm<sup>3</sup> so called thick/large packages). The top-surface temperature of the packages should preferable be kept below 260 °C for thin/small packages (packages with a thickness < 2.5 mm and a volume < 350 mm<sup>3</sup> so called thin/small packages).

Stage	Condition	Duration
1'st Ram Up Rate	max3.0+/-2°C/sec	-
Preheat	150°C ~200°C	60~180 sec
2'nd Ram Up	max3.0+/-2°C/sec	-
Solder Joint	217°C above	60~150 sec
Peak Temp	260 +0/-5°C	20~40 sec
Ram Down rate	6°C/sec max	-



### Wave Soldering:

Conventional single wave soldering is not recommended for surface mount devices (SMDs) or printed-circuit boards with a high component density, as solder bridging and non-wetting can present major problems.

### Manual Soldering:

Fix the component by first soldering two diagonally-opposite end leads. Use a low voltage (24 V or less) soldering iron applied to the flat part of the lead. Contact time must be limited to 10 seconds at up to 300 °C. When using a dedicated tool, all other leads can be soldered in one operation within 2 to 5 seconds between 270 and 320 °C.

**Package Information:**SOP type :