CU6901V for True NoStandBy

SLS (SRC/LLC+SR) Controller with 1 FM+2 PWMs+Kick Modes Power System can be either Voltage source or Current source Titanium+, EuP lot6, Server Grade, PC, TV, LED, AC Adapter, IPC

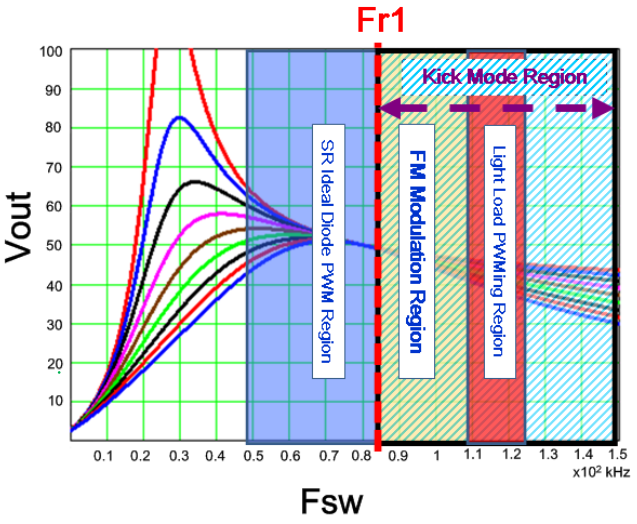
GENERAL DESCRIPTION

CU6901V is a SLS, SRC/LLC + SR resonant controller and it can operate at both SRC and LLC region with synchronous rectification to achieve high efficiency. Its unique features: FM+2PWMING+kick modes. It is used for DC-DC conversion in offline application.

Light load regulation is accomplished by transitioning the controller from frequency modulation mode into PWM mode. We call this is Light load PWMING function. When ac turn off, bulk input voltage will drop. The switching frequency is below the highest resonant point frequency fr1=$1/2\pi\sqrt{LrCr}$;Lr: resonant choke; Cr: resonant cap . SR Ideal Diode PWMING for synchronous drivers is accomplished by comparing the voltage signal at the RSET pin to RTCT ramp. The pulse-width reduction will happen when switching frequency below the highest resonant point frequency fr1. The CU6901V has 1 FM+2 PWMING+Kick modes to have the optimal balance performance between hold-up time and efficiency. The operate region shown as fig1.

CU6901V system has a constant voltage feedback loop with precision 2.5V VFB reference, and current loop for output current regulation.

Fig1 FM+2 PWMING +Kick Modes



FEATURES

- Patented
- 90+ Controller
- Smaller and Thinner Transformer
- > 20ms with reasonable Bulk Cap(hold up time)
- SLS, SRC/LLC + SR resonant controller
- 4 Gate Drivers: Typical Peak Drive from 12V Supply: (PMOS~120 ohm and NMOS~50 ohm).
- UVLO =10.5V with 1.5V Hysteresis.
- 39V max WindingDiode Input LDO with 10.3V Vcc Output and it can source 30mA
- FM + 2 PWMING + Kick Modes Operation
- SR Ideal Diode PWMING (cross resonant frequency and work for both sides of resonant frequency)

  No Need to Sense Current
- Light Load PWMING (light load regulation)
- Kick-mode operation at extreme light load for high efficiency
- No Photo-Couple Current @ normal operating mode to save 50mW at Super Light Load Condition
- Easy to Meet EuP lot 6 and Energy Star
- GM FEAO, FM modulation Error Amplifier
- Soft start Capability with Shutdown Function.
- Precision 2.5V VFB threshold for constant voltage feedback loop.
- Precision 7.5V Ilimit threshold for Constant Current feedback loop
- OVP protection, UL1950 Vfb protection, Constant Current with CMRRIO4VA, and Thermal Shut Down (OPTION)
- Fault indicator for OVP, Current Limit and Thermal Shut Down with ~ 25-300mS delay
- CU6901VA Family for Adaptor Application
- CU6901VP Family for PC Application

CU6901V for True NoStandBy

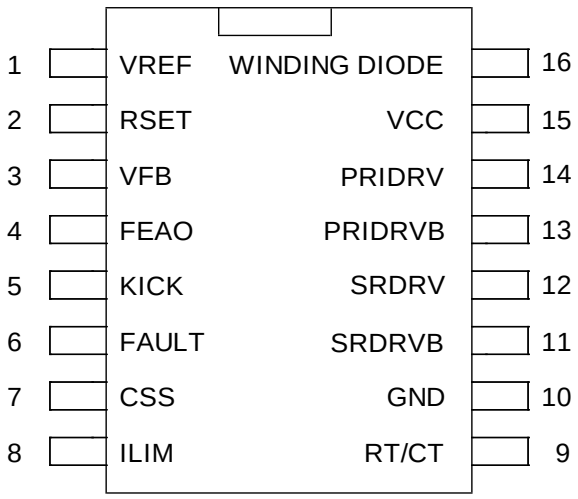
SLS (SRC/LLC+SR) Controller with 1 FM+2 PWMs+Kick Modes Power System can be either Voltage source or Current source Titanium+, EuP lot6, Server Grade, PC, TV, LED, AC Adapter, IPC

APPLICATIONS

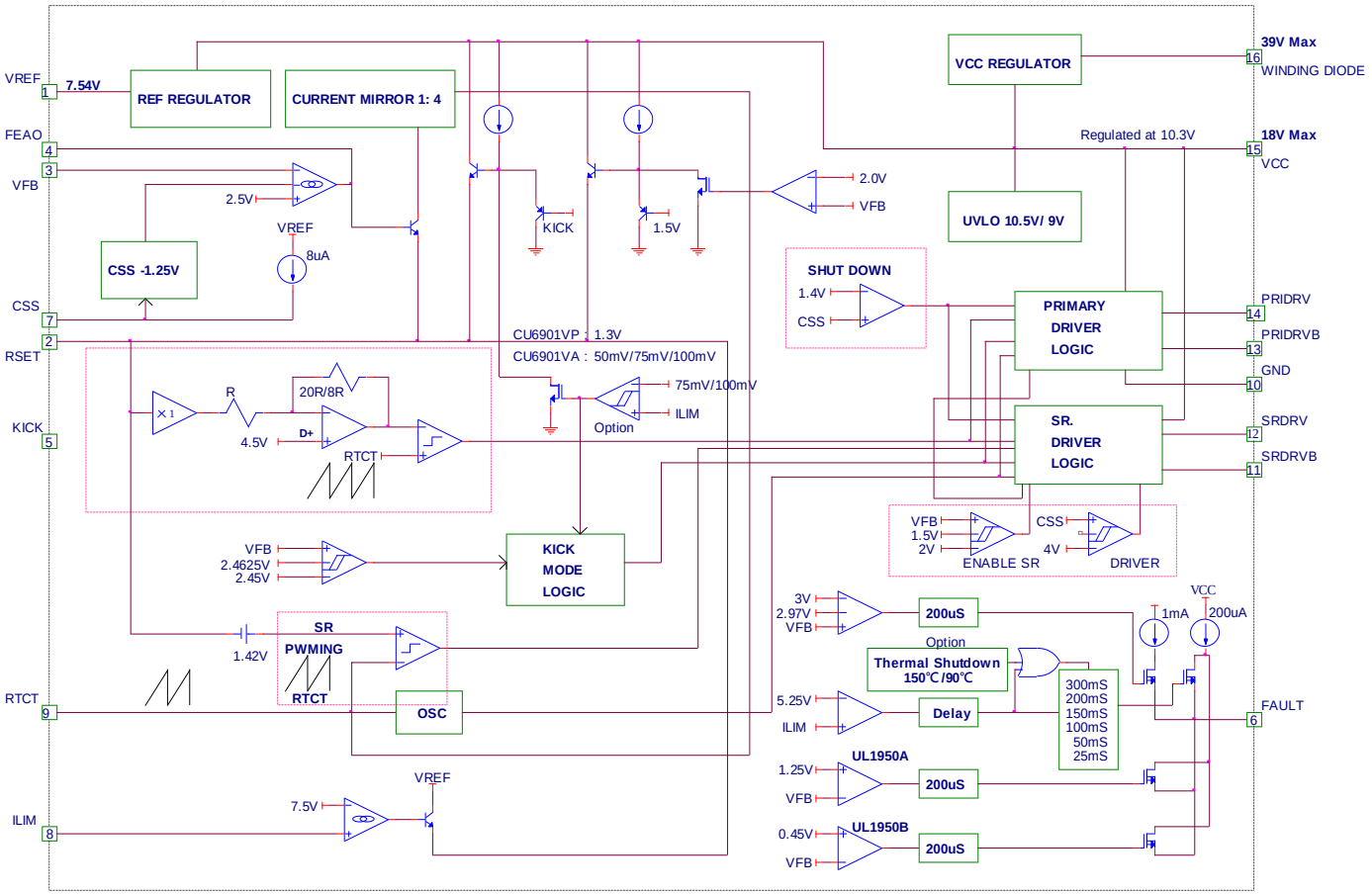
- TV Power Supply
- Pair with CU6502V for No StandBy Auxiliary Power Supply, Isolated AC to DC or DC-DC Power Supply. CU6901V controller is located at secondary side.
- CU6901V can control 4 Mosfets (2 Mosfets of Half Bridge and 2 Mosfets of SR) for Output Power < 700W
- CU6901V can control 6 Mosfets (4 Mosfets of Full Bridge and 2 Mosfets of SR) for Output Power > 1000W

CU6901V Pin Configuration

SOP-16 TOP View



SIMPLIFIED BLOCK DIAGRAM



PIN DESCRIPTION

Pin No.	Symbol	Description	Operating Voltage			
			Min.	Typ.	Max.	Unit
1	VREF	Buffered output for the 7.5V voltage reference		7.5		V
2	RSET	External resistor which convert FEAO voltage signal into current signal (V to I) for frequency modulation. SR is PWMING Control, when RSET lower than 1.5V.	0		5.5	V
3	VFB	Non-inverting input into resonant error amplifier and UL1950 (Vfb < 1.25V) protection input	0	2.5	3.5	V
4	FEAO	Resonant error amplifier output and compensation node for frequency modulation control.	0		7.5	V
5	KICK	Need a resistor divider from Vref to externally set Kick voltage level. When Kick = 1.5V, Vfb < 2.45V and Ilimit < 100mV, system switching at ~ fr1 at super light load. Usually, set Kick = 4V; therefore, system switching at ~ 2.666 x fr1 at super light load; system switching frequency at super light load ~ fr1 x Kick Voltage / 1.5V. (but use the design tool and use Rset = Kick Voltage to see approximated Kick switching frequency) When Vfb > 2.4625V, all drives are off during Kick Mode. This mode we call it “SLS Kick Mode” for super light load.	0		6	V
6	FAULT	Fault indicator for OVP, Current Limit or Over Temperature with 25mS delay. When ILIM>5.2V, Fault pin Current = 200uA and Vfb>3.0V, Fault pin Current = 1mA	0		VCC+0.3	V
7	CSS	Soft start for FM/PWM operation with 1.4V enable threshold.	0		7.5	V
8	ILIM	Two main functions: 1. Constant Current with threshold ~ 7.5V and OCP threshold ~ 5.25V 2. Entering Kick Mode: PC Vth ~ 1.3V (**CU6901VP**) and AC Adapter Vth ~ 100mV/75mV/50mV with ~ 100mV/75mV hysteresis (**CU6901VA**)	0	5.5	8.0	V
9	RTCT	Oscillator timing components which set the minimum frequency.	1.2		3	V
10	GND	Ground				
11	SDRVB	Synchronous MOSFET driver output.	-0.3		VCC	V
12	SDRV	Synchronous MOSFET driver output.	-0.3		VCC	V
13	PRIDRVB	Primary side MOSFET driver output.	-0.3		VCC	V
14	PRIDRV	Primary side MOSFET driver output.	-0.3		VCC	V
15	VCC	Positive supply for the IC	9	15	18	V
16	WINDING DIODE	39V max WindingDiode-Vcc LDO input, High Voltage input for VCC Voltage regulator	11	20	39	V

ORDERING INFORMATION

CU6901VA□IS

- Package : SOP-16
- -40˚C ~ +125˚C
- A for Gain=8 / Vth-=50mV / Hyst.=75mV
- B for Gain=8 / Vth-=75mV / Hyst.=75mV
- C for Gain=8 / Vth-=100mV / Hyst.=75mV
- D for Gain=8 / Vth-=100mV / Hyst.=100mV
- A for Adaptor type

CU6901VP□IS

- Package : SOP-16
- -40˚C ~ +125˚C
- A for Gain=8 / Vth-=1.3V / Hyst.=100mV
- B for Gain=20 / Vth-=1.3V / Hyst.=100mV
- P for PC type

Part Number	Temperature Range	Package
CU6901VAAISTR*	-40℃ to 125℃	16-Pin SOP (S16)
CU6901VABISTR*	-40℃ to 125℃	16-Pin SOP (S16)
CU6901VACISTR*	-40℃ to 125℃	16-Pin SOP (S16)
CU6901VADISTR*	-40℃ to 125℃	16-Pin SOP (S16)
CU6901VPAISTR*	-40℃ to 125℃	16-Pin SOP (S16)
CU6901VPBISTR*	-40℃ to 125℃	16-Pin SOP (S16)

* TR : Package is Tape & Reel

ABSOULTE MAXIMUM RATINGS (TA=25℃, unless otherwise specified.)

The following ratings designate persistent limits beyond which damage to the device may occur.

Symbol	Parameter		Value	Unit
WINDINGDIODE	39V WindingDiode-Vcc LDO input		39	V
WINDINGDIODE	39V WindingDiode-Vcc		-0.5	V
VCC	DC Supply Voltage		18	V
SRDRV	SRDRV Voltage		GND-0.3 to VCC+0.3	V
SRDRVB	SRDRVB Voltage		GND-0.3 to VCC+0.3	V
PRIDRV	PRIDRV Voltage		GND-0.3 to VCC+0.3	V
PRIDRVB	PRIDRVB Voltage		GND-0.3 to VCC+0.3	V
Driver (Pin11~Pin14)	Driver Voltage (period less than 50ns)		GND-3.0 to VCC+0.3	V
	Driver Voltage (period less than 25ns)		GND-5.0 to VCC+0.3	V
	Driver Out Sink or Source		0.12	A
	Driver Out Sink or Source (period less than 5us)		0.25	A
VREF	VREF Voltage		GND-0.3 to 8	V
VREF	VREF Transient Voltage (period less than 2ms)		8.5	V
VREF	VREF Transient Voltage (period less than 300us)		10	V
IREF	VREF Current		5	mA
RTCT	RTCT Voltage		-0.3 to VREF+0.3	V
ILIM	ILIM Voltage		-0.3 to VREF+0.3	V
CSS	CSS Voltage		-0.3 to VCC+0.3	V
FAULT	PWM Error Amplifier Output Voltage		-0.3 to VREF+0.3	V
KICK	During KICK Mode, Kick voltage to set N times of resonant frequency; usually with external resistor divider from Vref, set Kick = 2.5V		-0.3 to VREF+0.3	V
FEAO	Resonant Error Amplifier Output Voltage		-0.3 to VREF+0.3	V
VFB	Non-Inverting Input Into Resonant Error Amplifier Voltage		-0.3 to VREF+0.3	V
RSET	V to I Voltage		-0.3 to VREF+0.3	V
Junction Temperature	T_J	Plastic SOP16	150	℃
Storage Temperature Range	T_{STG}		-65 to 150	℃
Operating Temperature Range	T_A		-40 to 125	℃
Thermal Resistance	θ_{JA}		105	℃/W
Case Temperature	θ_{JC}		31.25	℃/W

ELECTRICAL CHARACTERISTICS

Test conditions:
(VCC=13V, RT=37K±1%, CT=680PF±1%, Rset1=32K±1% ; Rset2=192K±1%,Freq. = 118 KHz, Duty Cycle=45% , Temp=-40 ~ 125 ℃, unless otherwise specified.)

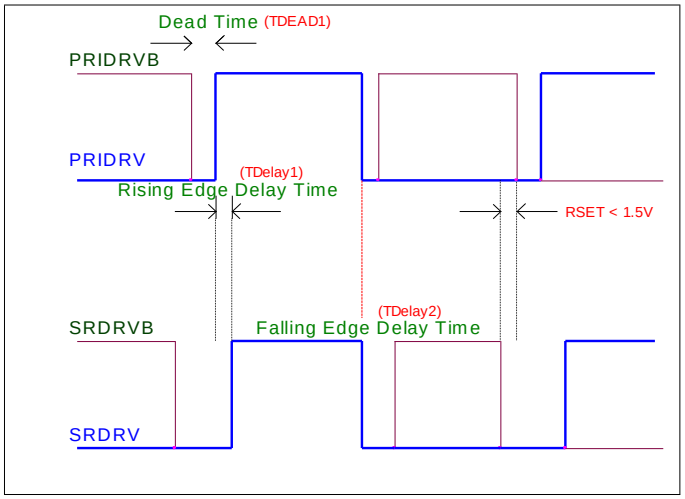
Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
VREF (Pin1) test						
Reference Voltage	VREF	TA=25℃; Iref=1mA	7.43	7.54	7.65	V
Line Regulation		11.5V < Vcc < 16.5V		10	25	mV
Load Regulation		0mA < Iref < 5mA, TA=25℃		25	50	mV
VCC (Pin15)						
VCC Start up voltage	Vstart		9.9	10.5	11.1	V
VCC Turn off voltage			8.4	9	9.6	V
VCC Start up current		TA=25℃	20	50	80	uA
UVLO Hysteresis	Hys		1.3	1.5	1.7	V
Operating Current@	ICC	TA=25℃ @ Min. Freq.	0.9	1.2	1.6	mA
Operating Current@Kick Mode	ICC	TA=25℃Non-Switching		0.6	0.8	mA
VCC Regulated Voltage		TA=25℃ VIN > 12V	9.7	10.3	10.7	V
SRDRVB , SRDRV , PRIDRVB , PRIDRV (Pin 11,12,13,14)						
PMOS Rdson	Rout	TA=25℃	100	120	140	Ohm
NMOS Rdson	Rout	TA=25℃	30	50	70	Ohm
Delaytime=PRIDRV rising time to PRIDRVB falling time	TDead[1]	TA=25℃	520	610	700	ns
Rising Edge Delay Between PRIDRV and SRDRV(TDelay[1])	TDelay[1]	TA=25℃	240		320	ns
Falling Edge Delay Between SRDRV and PRIDRV(TDelay[2])	TDelay[2]	TA=25℃		0		ns
Duty Cycle Range			40		47	%
ILIM (Pin8) For CU6901VA						
ILIMIT Constant 1 (Option for Constant Current function)		TA=25 and CSS> 6.0V	7.35	7.5	7.65	V
ILIMIT(OCP)		TA=25℃	5.15	5.25	5.35	V
Entering Kick Mode threshold 1	CU6901VAA	Work with CMRRIO4VA	40	50	60	mV
Entering Kick Mode threshold 2	CU6901VAB	Work with CMRRIO4VA	65	75	85	mV
Entering Kick Mode threshold 3	CU6901VAC	Work with CMRRIO4VA	90	100	110	mV
Hysteresis		Work with CMRRIO4VA	60	75	90	mV
Entering Kick Mode threshold 4	CU6901VAD	Work with CMRRIO4VA	90	100	110	mV
Hysteresis		Work with CMRRIO4VA	85	100	115	mV
ILIM (Pin8) For CU6901VP						
ILIMIT(OCP)		TA=25℃	5.15	5.25	5.35	V
Entering Kick Mode threshold				1.3		V
Hysteresis				100		mV

ELECTRICAL CHARACTERISTICS

Test conditions:
(VCC=13V, RT=37K±1%, CT=680PF±1%, Rset1=32K±1% ; Rset2=192K±1%,Freq. = 118 KHz, Duty Cycle=45% , Temp=-40 ~ 125 ℃, unless otherwise specified.)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
CSS (Pin 7)						
Soft Start Current	Iss	TA=25℃	6	8	10	uA
Enable Voltage	Ven	TA=25℃	1.2	1.4	1.5	V
Enable Hysteresis	Vhys	TA=25℃		65		mV
FALUT (Pin 6)						
Current when FAULT Hi (OCP)	Ifault	TA=25℃, ILIM>5.2V		200		uA
Current when FAULT Hi (OVP)	Ifault	TA=25℃, Vfb>3.0V		1		mA
FEAO Resonant Error Amplifier (Pin 4)						
Input Voltage Range					6	V
Transconductance	GMV	VFB±25mV, TA=25℃	34	45	65	umho
FEAO Sink Current		VFB +25mV , TA=25℃	-1.6	-1	0	uA
FEAO Source Current		VFB -25mV , TA=25℃	0	1	1.6	uA
VFB (Pin3)						
Feedback Reference Voltage		TA=25℃	2.48	2.5	2.52	V
OVP VTH			2.75	3	3.5	V
UL1950A Vfb protection threshold		SS > 6.0V	1.125	1.25	1.375	V
UL1950B Vfb protection threshold		4.0V<SS<6.0V	0.35	0.45	0.55	V
KICK (Pin 5)						
Input Voltage Range					6.3	V
Kick Mode fsw at ~ fr1		Kick = 1.75V and Ilimit = 50mV and Vfb = 2.44V		95		KHZ
Kick Mode fsw at fsw max		Kick = 6.0V and Ilimit = 50mV and Vfb = 2.44V		250		KHZ
RTCT Oscillator test ; RT=37K±1%;CT=680pF±1%, (Pin 9)						
Initial Accuracy		TA=25℃, 2*PRIDRV Freq	110	115	120	Khz
Ramp Valley to Peak Voltage	Peak voltage:3V;Valley voltage:1.25V			1.75		V
Maximum Duty cycle	Duty test	Force FEAO when RSET=2.5V		41		%
Minimum Duty Cycle	Duty test	Force FEAO when RSET=4.6V		25		%
SR Ideal Diode function test: Rset1=32K±1% ; Rset2=192K±1% , Pin2 to Gnd=Rset1; Pin2 to Vref=Rset2; VKICK=1.75V, ILIMIT=0.5V						
Maximum Duty cycle	TA=25℃ , When Feao=2.2V		40	42	45	%
	FEAO=2.2V at frequency (define resonant frequency)		76	81	85	KHZ
Minimum Duty cycle	TA=25℃ , sweep Feao; when FEAO=0V		26	30	34	%
Frequency at Minimum Duty cycle	TA=25℃ , when FEAO=0V		55	58	60	KHz

TIMING DIAGRAM



OSCILLATOR RT/CT (Pin 9)

The oscillator frequency is determined by the values of RT and CT.

Design for RT/CT frequency:

$f_{osc} = 1 / (t_{RAMP} + t_{DEADTIME})$

$t_{RAMP} = RT * CT * \ln((V_{REF} + I_{CHG}*RT - 1.25)/(V_{REF} + I_{CHG}*RT - 3))$ where

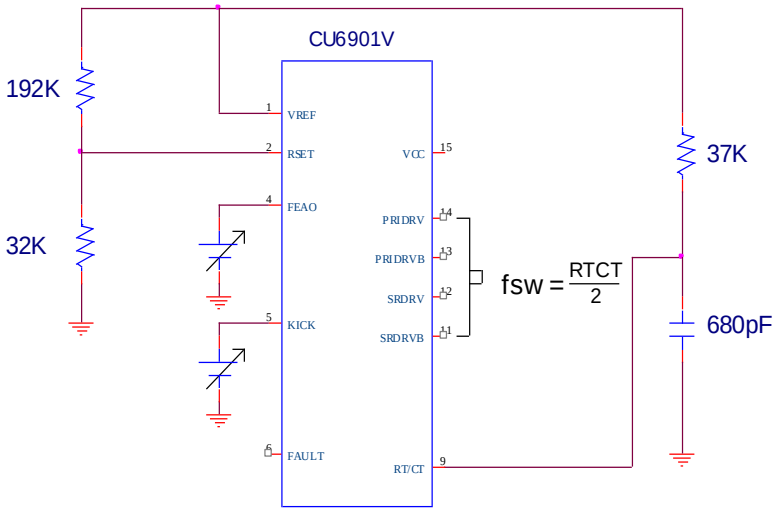
I_{CHG} = ICHG current= 4*((FEAO-VBE)/RSET1-(VREF-VRset)/Rset2+((D_in+) -VRset)/Rdeao1)

4 for current mirror multiply 4

R_{SET1}=Pin1 to Gnd resistor; Pin9 RTCT peak voltage=3V; valley=1.25V

(TDEAD[1]): Dead Time between PRIDRV and PRIDRVB: Discharge CT

tDEADTIME=770*CT



RESONANT SECTION

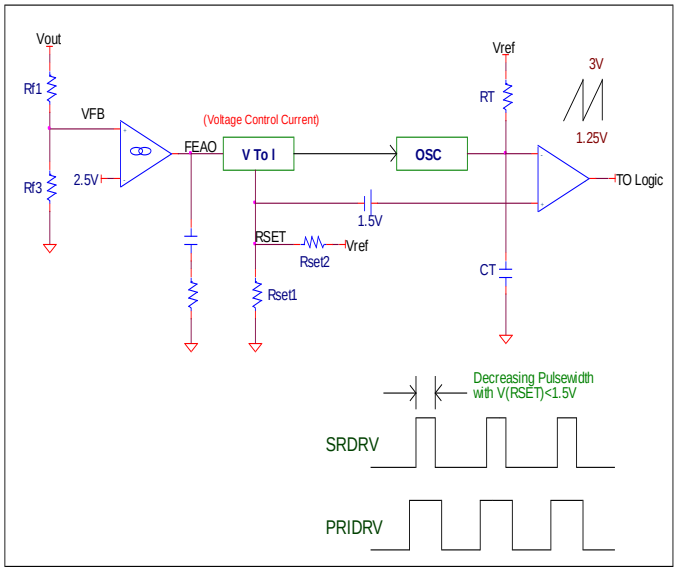
FM Modulator

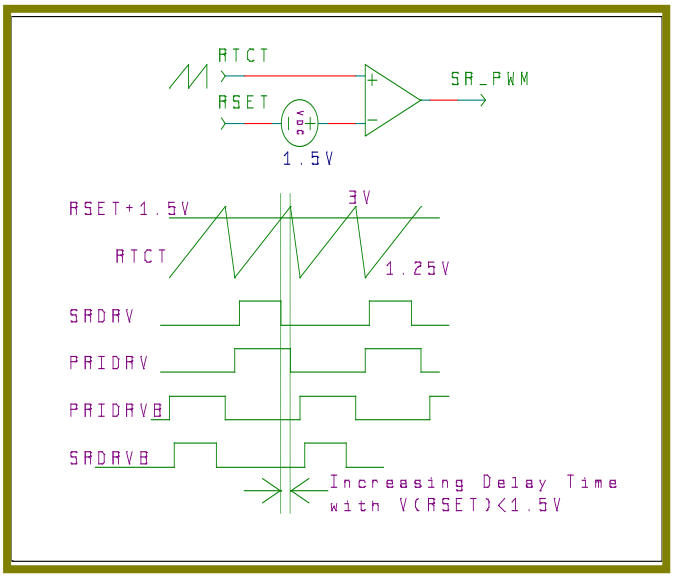
Frequency modulation of the resonant controller section is accomplished by controlling the **charging current** of the oscillator through resonant error amplifier. The switching frequency of the resonant section is ½ of the oscillator frequency (RT/CT Pin9). Compensation is accomplished by connecting Rfeao and Cfeao in series to FEAO (Pin4).

2 PWMINGS:

SR Ideal Diode PWMING (Synchronous Rectification without sensing current)

SR Ideal Diode PWMING for synchronous drivers is accomplished by comparing the voltage signal at the RSET (Pin2) to RTCT (Pin9) ramp. The pulse-width reduction happens when the voltage at the RSET (Pin2) is lower than 1.5V. This allows safe operation of the power converter with synchronous rectification when the switching frequency is **below the highest resonant point frequency fr1**. Avoid Mosfet reverse current in SR application.




RTCT
RSET
SR_PWM
1.5V
RSET+1.5V
3V
RTCT
1.25V
SRDRV
PRIDRV
PRIDRVB
SRDRVB
Increasing Delay Time
with V(RSET)<1.5V

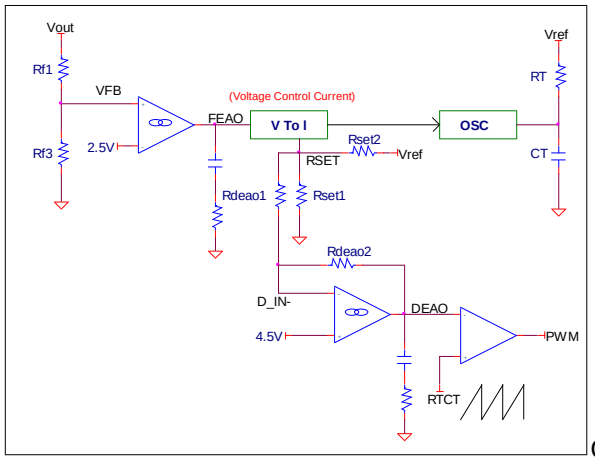
SR Ideal Diode PWMING

Light Load PWMING to prevent Output OVP due to high frequency parasitic capacitance at output rectifier nodes which causes SRC becomes PRC (Parallel Resonant Converter) at high frequency

In a typical Application, low gain configuration accomplished by connecting R_{deao1} and R_{deao2} in the closed loop configuration. The gain for the PWM is determined by R_{deao1} and R_{deao2} where the gain is equal to $-R_{deao2}/R_{deao1}$ ~ 8 (Set internally). The voltage of VR_{set} at which the controller goes into FM and PWM simultaneously is equal to :

$VRset = D\_IN+ \times (1+R_{deao1}/R_{deao2}) - (R_{deao1}/R_{deao2}) \times 3$ where 3 is the peak voltage of RTCT

VR_{SET} from VR_{set} to $VR_{set} + 1.75 \times R_{deao1}/R_{deao2}$ will cause the duty cycle from 50% to 0% while the frequency will vary proportionally according to $1.75*R_{deao1}/R_{deao2}$ where 1.75 is the peak-to-peak voltage of the RTCT ramp. For CU6901V, internally is set to Rdeao2 = 8*Rdeao1 and D_IN+ = 4.5V.



Gain=8/Din_+=4.5V

Super Light Load with Kick (Pin5) and ILIM (Pin8) and Kick Mode Switching Frequency

Kick (Pin5) voltage level requires to be set by external circuit; usually, 2 resistors to form a resistor divider from Vref (please refer the typical application). When **ILIM < 100mV** for **CU6901VA**, AC Adapter Application (For **CU6901VP**, PC Power Supply Application, Kick Mode threshold, **ILIM ~ 1.3V**), the controller goes to Kick mode. RSET is clamped to 1.75V, and RTCT frequency will be determined by RT, CT and Kick voltage. Vfb will start dropping and when Vfb reaches below 2.45V (where is factory programmed hysteresis), the controller is turned back on again. As Vfb will start rising, and when Vfb reaches above 2.4625V (where is factory programmed hysteresis), the output drivers are disabled and Iccq is reduced to 0.6mA.

Kick Mode Switching Frequency

Quick Approximation:

If Kick (Pin5) = 1.5V (Set by external circuit), during Kick Mode and Vfb < 2.45V, fsw ~ fr1. If Kick = 4V (Set by external circuit), during Kick Mode and Vfb < 2.45V, fsw ~ 2.6667 x fr1.

Using CU6901V design Tool to see Kick Mode Switching Frequency:

During Kick Mode (ILIM < Kick Mode Threshold and Vfb < 2.45V), Kick Pin voltage level ~ Rset Pin voltage level. Change Rset value in **design tool** to see the Kick Mode Switching Frequency.

Setting different Kick (Pin5) voltage level will optimize the best efficiency at Super Light Load; however, it may need to trade off between efficiency at Super Light Load, Audible Noise, and Output Ripple.

Entering Kick Mode for Super Light Load (Usually, Input Power < 8W for best audible noise requirement)

To Enter Kick Mode, ILIM (Pin8) needs to less than Kick Mode threshold **(It is not the Kick Pin Voltage!!! Kick (Pin5) is to set the switching frequency at Kick Mode).** When ILIM < Kick Mode threshold and CSS (Pin7) > 6.0V, CU6901V enters Kick Mode:

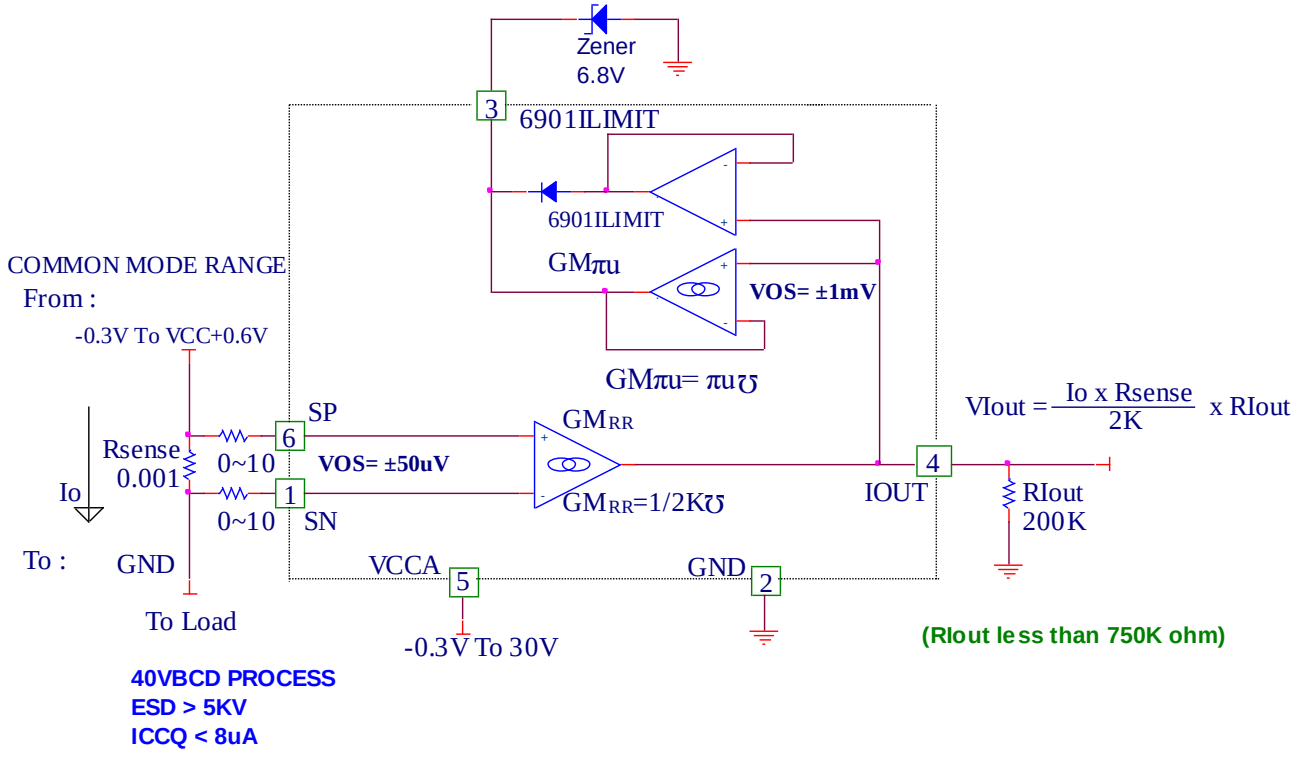
CU6901VP for PC Power Supply application: To enter Kick Mode, ILIM < Kick Mode threshold ~ 1.3V and CSS (Pin7) > 6.0V

CU6901VA for AC Adapter application: To enter Kick Mode, ILIM < Kick Mode threshold ~ 50mV and ~100mV (~75mV hysteresis) and CSS (Pin7) > 6.0V. For Other Kick Mode thresholds, please consult with Champion FAE/Sales.

(Again, Kick Mode Threshold ≠ Kick Pin Voltage. It is not the Kick Pin Voltage!!! Kick (Pin5) is to set the switching frequency at Kick Mode)

CMRRIO4VA + CU6901VA for AC Adapter, TV, IPC… Applications

To enter Kick Mode or to leave Kick Mode automatically in the AC Adapter Application, **CMRRIO4VA** + **CU6901VA** is a required set.



CMRRIO4VA Block Diagram

Description of CMRRIO4VA (a 40V Rail-to-Rail Current Sense Amplifier for CU6901V family)

Since SLS (SRC, LLC and SR) current waveforms are almost sinusoid waveform, after 2 hefty capacitors between Rsense, to sense an average output current, **CMRRIO4VA** is utilized. **CMRRIO4VA** has a Rail-to-Rail Transconductance Amplifier + **πμ** Transconductance Amplifier // Peak Detector.

Rail-to-Rail Transconductance Amplifier: SN (Pin1), **SP** (Pin6) and **IOUT** (Pin4) in SOT23-6 package for **CMRRIO4VA**

SN(Pin1) Senses - and SP(Pin6) Senses + of Rsense. IOUT(Pin4) of **CMRRIO4VA** is the Transconductance Amplifier Output pin and it is a current output. (The voltage difference between SP (Pin6) and SN (Pin1) x 1/2K = IOUT current because the Transconductance of GMv in **CMRRIO4VA** = 1/2K is a constant-linear GM. Its Common Mode voltage range is from -0.3V to Vcc +0.6V. It works for output is 12V, 0V, output ~ Vcc, or output shorted. If Vcc of **CMRRIO4VA** = 40V, the common mode voltage (SP and SN) < 30V.

The voltage level of IOUT (Pin4) of **CMRRIO4VA** with RIout, IOUT x RIOUT = Output Current x Rsense x 1/2K

πμ Transconductance Amplifier // Peak Detector: 6901ILIMIT(Pin3), and **IOUT**(Pin4) in SOT23-6 package for **CMRRIO4VA**

Usually, **IOUT** (Pin4) has a RIout // a capacitor which forms a pole to keep IOUT voltage level < 300mV to avoid tripping the Peak Detector of **CMRRIO4VA**. The Peak Detector of **CMRRIO4VA** will be activated when **IOUT** (Pin4) voltage level > Diode voltage ~ 0.65V. Therefore, if **IOUT** (Pin4) voltage level < 300mV, the Peak Detector of CMRRIO4VA is disabled. Usually, IOUT (Pin4) pole ~ 100Hz. On other word, if IOUT < Diode Voltage, Peak Detector is disable and **πμ Transconductance Amplifier** is active.

Usually, 6901's ILIMIT signal is generated by the output of 2 devices of **CMRRIO4VA**, **πμ Transconductance Amplifier // Peak Detector which is called "6901ILIMIT" in CMRRIO4VA. 6901ILIMIT** (Pin3) has an external capacitor ~ 5nF to set pole frequency ~ 100Hz. The 100Hz pole and IOUT (Pin4) pole (usually, 100Hz too) is to average the signal of Sinusoid Current in SLS (SRC, LLC and SR). With these two poles, ILIM (Pin8) is almost a DC level.

Output Shorted or Constant Current Mode when ILIM (Pin8) > 7.5V

When **IOUT** (Pin4 of **CMRRIO4VA**) >~ 650mV, **a Diode voltage**, the Peak Detector which // with **πμ** Transconductance Amplifier is activated. If the **IOUT** voltage level < the diode voltage, the peak detector is disabled. To activate the Peak Detector and to disable **πμ Transconductance Amplifier, IOUT** is less than **a Diode voltage** which usually is **~ 650mV at room temperature.** When Peak Detector of **CMRRIO4VA** is activated, 6901ILIMIT (Pin3) of **CMRRIO4VA** can source current up to 1mA. The voltage level of 6901ILIMIT (Pin3) of **CMRRIO4VA** can charge up fast. When 6901ILIMIT (Pin3) of **CMRRIO4VA** (= ILIM (Pin8) of CU6901V) reaches 7.5V. The constant current function is activated and RSET (Pin2) of CU6901V pulls up and switching frequency goes up. In the meantime, it will trip FAULT ((Pin6) of CU6901V) logic. FAULT (Pin6 of CU6901V) will pull up and it can supply up to 200uA. FAULT (Pin6 of CU6901V) is designed to talk to the SD ((Pin6) of CU6500(2)V) with a photo couple. After SD ((Pin6) of CU6500(2)VA) > ~ 2.5V and with ~400uS to 1mS, the power supply system can go into "Retry" Mode. After SD ((Pin6) of CU6500(2)VA) > ~ 6.0V and with ~ 400uS to 1mS, the power supply system can go into "LATCH" Mode ; After SD ((Pin6) of CU6500(2)VB) > ~ 2.5V and with ~ 400uS to 1mS, the power supply system can go into "LATCH" Mode.

Soft Start and Enable (CSS Pin7 when CSS > 1.4V)

Soft start of the FM and PWM is controlled by the selection of the external capacitor at CSS (Pin7) . CSS is called SS here. A typical current source of 8uA supplies the charging current for the capacitor. Soft start of the FM and PWM begins at 1.4V. When SS is less than 1.3V, FEAO is forced to VREF by internal circuit. When CSS is above 1.3V, FEAO is no longer forced to VREF. As soon as CSS is above 1.4V, FEAO frequency modulation loop becomes active (VFB-(SS-1)*GMV and FEAO Voltage will be determined by the FEAO error amplifier which is a function of SS signal and the VFB signal. When SS rise reach to 3.5V, it mean main converter into close loop control. The soft start pin CSS also serves as an enable function. The output drivers are enabled when CSS pin reached 1.4V.

Protection and System goes to Retry Mode or Latch Mode

a) **VFBOVP (OVP)**:
When VFB > 3.0V with 30mV hysteresis O.V.P detect with ~ 200uS de-bounce delay
Output drivers are immediate set low for VFBOVP. After VFB >3.0V and with 200uS de-bounce delay, FAULT (Pin6) is pulled up through a photo couple to yank up SD ((Pin6) of CU6502V) family and FAULT (Pin6) can provide at least 1mA.

b) **ILIM > 5.25V due to over current condition (OCP)**:
When ILIM > 5.25V with 25mS/50mS/100mS/150mS/200mS/300mS delay, Fault (Pin6) pulled high to yank up SD ((Pin6) of CU6502V) family; so CU6502V family can command either “Latch” Mode or “Retry” Mode. If ILIM reaches 7.5V, the power supply system will become a constant current source instead of a constant voltage source by modulating and pulling up RSET. After ILIM > 5.25V with 25mS/50mS/100mS/150mS/200mS/300mS delay, FAULT (Pin6) is pulled up and provide at least 200uA.

c) **VFB < 1.25V (UL1950A)** (Tell your FAE to enable this protection)
When VFB < 1.25V and CSS > 6.0V, all the gate drivers are disabled and after 200uS delay, FAULT (Pin6) is pulled up and provide at least 200uA

d) **VFB < 0.45V (UL1950B)**
When VFB < 0.45V and CSS > 3.0V, all the gate drivers are disabled and FAULT (Pin6) pulled up and provide at least 200uA

e) **Thermal Shut Down Protection** (Tell your FAE to enable this protection)
When temperature exceeds 150℃, all the gate drives are disabled, and gate drives are enable again when the temperature drops below 90℃. After 200uS delay, FAULT (Pin6) is pulled up and provide at least 200uA.

FAULT (Pin6): Design to interface CU6500/02V family for Retry Mode or Latch Mode

At **OCP** (ILIM > 5.25V with 25mS/50mS/100mS/150mS/200mS/300mS delay), **OVP** (VFB>3.0V with 200uS delay), **UL1950A** (VFB < 1.25V and CSS > 6.0V with 200uS delay), **UL1950B** (VFB< 0.45V and CSS >3.0V with 200uS delay) or **Thermal ShutDown** (Junction Temperature > 150 degree C with 200uS delay) with the each designed delay time, FAULT (Pin6) is pulled up and it will provide at least 200uA but at OVP, FAULT (Pin6) current is at least 1mA. Usually, it is externally connected with a photocouple to signal the other side of isolation IC (usually, it is CU6502V). By yanking SD (Pin6 of CU6502V) up, CU6502V can go to either “LATCH” Mode or “Retry” Mode**)**
When Fault provides > 200uA, it means to enable “Retry Mode” with CU6502VA and when Fault provides > 1mA, it means to enable “Latch Mode” with CU6502VA. CU6502VA has both “Retry Mode (2.5V<SD<6.0V)” and “Latch Mode (SD>6.0V)”.

WindingDiode (Pin16) and Vcc (Pin15)

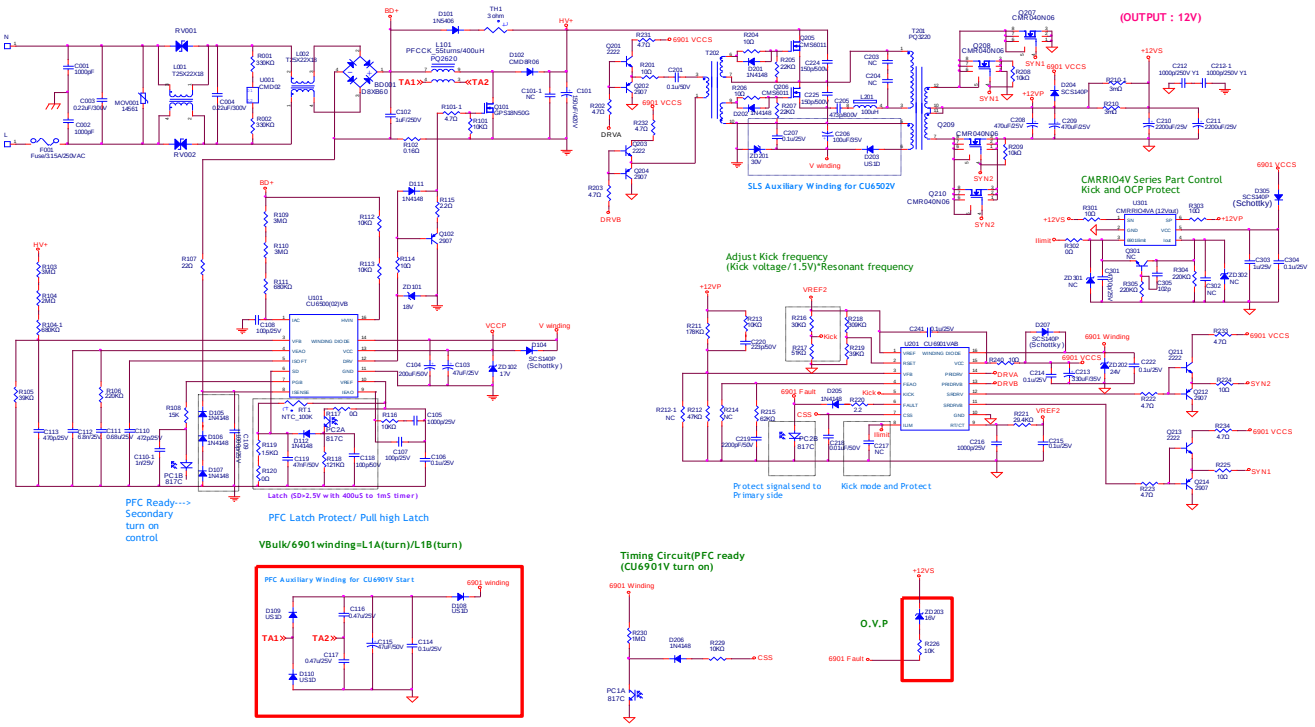
CU6901V has 39V max input with 10.3V output Vcc Linear Regulator which can deliver up to 30mA. Usually, this WindingDiode-Vcc LDO only enabled to work during start up. During start up, WindingDiode (Pin16) takes the energy from the primary PFC Boost Converter inductor; after main output 12V is generated, a schottky diode between main 12V output and Vcc (Pin15) will force Vcc > 10.3V and it will stop the energy transfer from WindingDiode-Vcc LDO.

TYPICAL APPLCATION CIRCUIT

OUTPUT : 12V

PFC Part / CU6500(2)VB

SLS Part / CU6901V



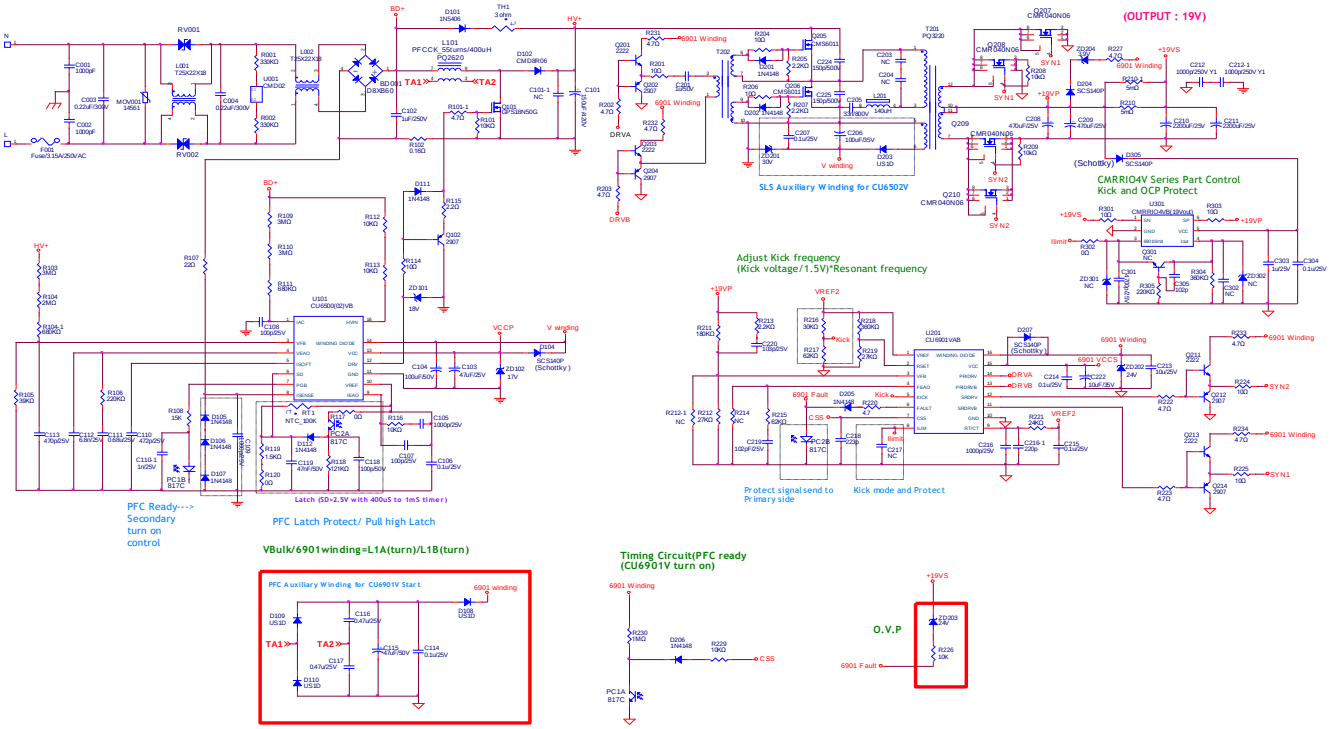
VBulk/6901winding=L1A(turn)/L1B(turn)

Timing Circuit(PFC ready
(CU6901V turn on)

OUTPUT : 19V

PFC Part / CU6500(2)VB

SLS Part / CU6901V

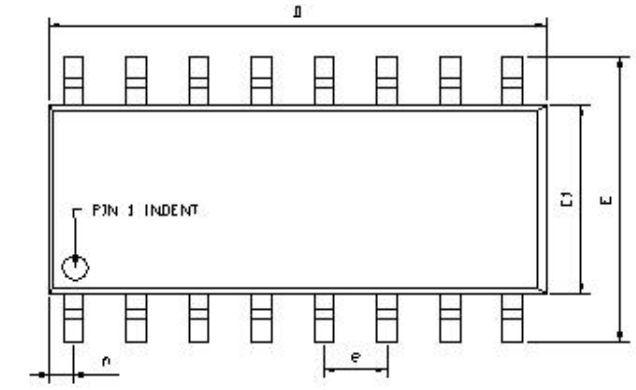


VBulk/6901winding=L1A(turn)/L1B(turn)

Timing Circuit(PFC ready
(CU6901V turn on)

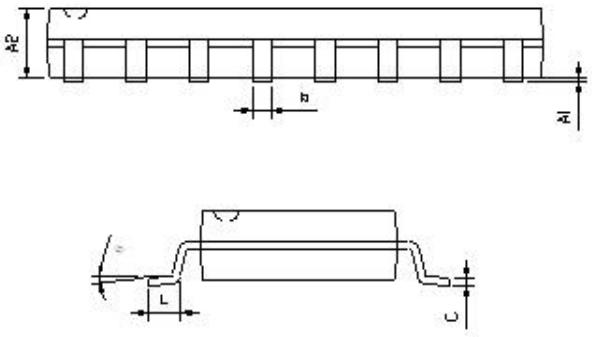
PACKAGE DIMENSION

16-PIN SOP (S16)



SYMBOLS	DIMENSIONS IN MILLIMETERS			DIMENSIONS IN INCHS		
	MIN	NOM	MAX	MIN	NOM	MAX
A1	0.10	----	0.25	0.004	----	0.010
A2	1.40	----	1.55	0.055	----	0.061
b	0.30	----	0.51	0.012	----	0.020
C	0.15	----	0.26	0.006	----	0.010
D	9.80	----	10.06	0.386	----	0.396
E	5.79	----	6.20	0.228	----	0.244
E1	3.76	----	4.01	0.148	----	0.158
e	----	1.27	----	----	0.050	----
L	0.38	----	0.69	0.015	----	0.035
m	0.43	----	0.69	0.017	----	0.027
θ	0°	----	8°	0°	----	8°

EXPOSED PAD DIMENSION : (opt)
PAD SIZE: X=2.3 , Y=2.8



NOTES:
1. JEDEC OUTLINE : MS-012 AC
2. DIMENSIONS "D" DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH, PROTRUSIONS AND GATE BURRS SHALL NOT EXCEED 0.15mm. PER SIDE.
3. DIMENSIONS "E1" DOES NOT INCLUDE INTER-LEAD FLASH, OR PROTRUSIONS. INTER-LEAD FLASH AND PROTRUSIONS SHALL NOT EXCEED 0.25mm PER SIDE.

IMPORTANT NOTICE

Champion Microelectronic Corporation (CMC) reserves the right to make changes to its products or to discontinue any integrated circuit product or service without notice, and advises its customers to obtain the latest version of relevant information to verify, before placing orders, that the information being relied on is current.

A few applications using integrated circuit products may involve potential risks of death, personal injury, or severe property or environmental damage. CMC integrated circuit products are not designed, intended, authorized, or warranted to be suitable for use in life-support applications, devices or systems or other critical applications. Use of CMC products in such applications is understood to be fully at the risk of the customer. In order to minimize risks associated with the customer's applications, the customer should provide adequate design and operating safeguards.

CMC assumes to no liability to customer product design or application support. CMC warrants the performance of its products to the specifications applicable at the time of sale.

HsinChu Headquarter

5F, No. 11, Park Avenue II,
Science-Based Industrial Park,
HsinChu City, Taiwan
TEL: +886-3-5679979
FAX: +886-3-5679909

Sales & Marketing

21F., No. 96, Sec. 1, Sintai 5th Rd., Sijhih City,
Taipei County 22102,
Taiwan, R.O.C.
TEL: +886-2-2696 3558
FAX: +886-2-2696 3559