



U3848/A/B/C

LINEAR INTEGRATED CIRCUIT

HIGH PERFORMANCE CURRENT MODE PWM CONTROLLERS

DESCRIPTION

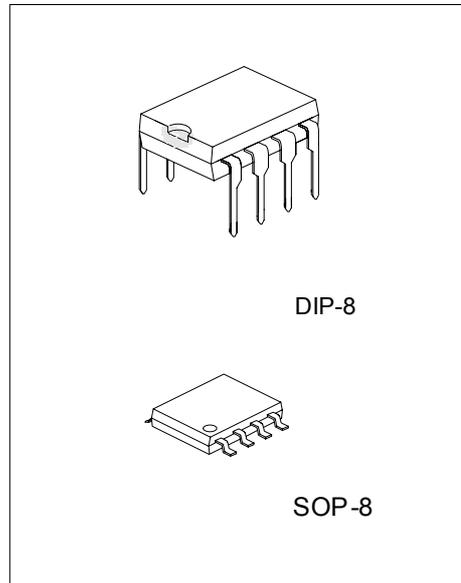
The UTC U3848/A/B/C is designed to provide several special enhancements to satisfy the needs: Power-Saving mode for low standby power, Over Current Protection (OCP), Over Voltage Protection (OVP), Over Load Protection (OLP), Over Temperature Protection (OTP) etc protection features. IC will be shutdown when either protection arise and can auto-restart. Its frequency may be defined by user through resistor R_T to external ground. UVLO featuring typical start-up current $20\mu A$, and $V_{CC(ON)}$ 12.6V, $V_{CC(OFF)}$ 8.1V. Lower typical operation current I_{CC} 3.7mA at inactive output. The output stage, suitable for driving N-Channel MOSFETs, can operate to duty cycles approach 70%. The U3848/A/B/C are fully pin-to-pin compatible with UC3842. But pin R_T only connected a resistor to ground to decide switch frequency, and pin FB with an $4k\Omega$ pull up resistor to internal reference voltage. The U3848/A/B/C also have soft-start function avoiding overshoot, and controlled driver output rise edge time t_R for low EMI.

FEATURES

- * Low startup and operation current
- * User defined switching frequency(Norm is 70kHz)
- * Max duty cycle 70%
- * Power-saving mode for low power
- * Under voltage lockout with hysteresis
- * Over temperature protection
- * Overload protection
- * Over voltage protection
- * Leading edge blanking
- * Soft start

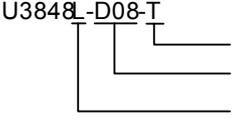
ORDERING INFORMATION

Order Number		Package	Packing
Normal	Lead Free Plating		
U3848-D08-T	U3848L-D08-T	DIP-8	Tube
U3848-S08-R	U3848L-S08-R	SOP-8	Tape Reel
U3848-S08-T	U3848L-S08-T	SOP-8	Tube
U3848A-D08-T	U3848AL-D08-T	DIP-8	Tube
U3848A-S08-R	U3848AL-S08-R	SOP-8	Tape Reel
U3848A-S08-T	U3848AL-S08-T	SOP-8	Tube
U3848B-D08-T	U3848BL-D08-T	DIP-8	Tube
U3848B-S08-R	U3848BL-S08-R	SOP-8	Tape Reel
U3848B-S08-T	U3848BL-S08-T	SOP-8	Tube
U3848C-D08-T	U3848CL-D08-T	DIP-8	Tube
U3848C-S08-R	U3848CL-S08-R	SOP-8	Tape Reel
U3848C-S08-T	U3848CL-S08-T	SOP-8	Tube

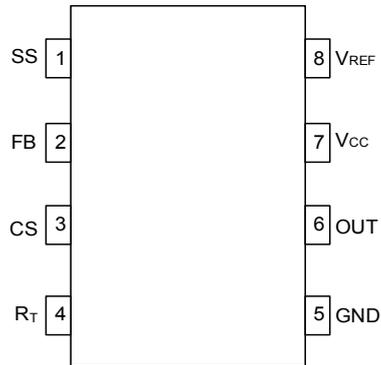


*Pb-free plating product number:
U3848L/U3848AL/U3848BL/U3848CL

■ ORDERING INFORMATION(Cont.)

<p>U3848L-D08-T</p>  <p>(1)Packing Type (2)Package Type (3)Lead Plating</p>	<p>(1) R: Tape Reel, T: Tube (2) D08: DIP-8, S08: SOP-8 (3) L: Lead Free Plating, Blank: Pb/Sn</p>
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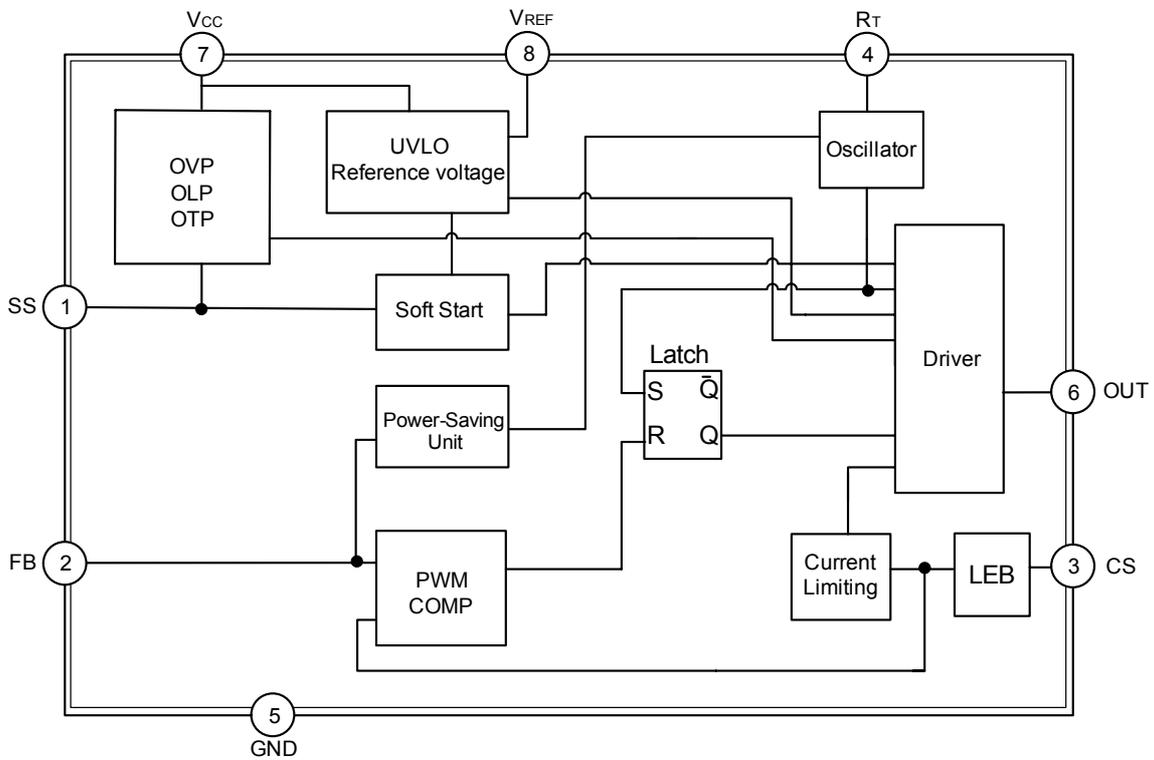
■ PIN CONFIGURATION



■ PIN DESCRIPTION

PIN	SYMBOL	FUNCTION
1	SS	Soft-start
2	FB	Feedback
3	CS	Controller current sense input
4	R _T	The resistor controlling switch frequency
5	GND	Ground
6	OUT	Output to the gate of external power MOS
7	V _{CC}	Supply voltage
8	V _{REF}	Inter 6.3V reference voltage, connected with the filter capacitor

■ BLOCK DIAGRAM



Explain: OLP (Over Load Protection)
 OVP (Over Voltage Protection)
 OTP (Over Temperature Protection)
 UVLO (Under Voltage Latch-Out)
 LEB (Led Edge Blanking)
 SS (Soft Start)

■ ABSOLUTE MAXIMUM RATINGS (Ta = 25°C, V_{CC}=15V, R_T=75kΩ, unless otherwise specified)

PARAMETER	SYMBOL	RATINGS	UNIT
Supply Voltage	V _{CC}	26	V
Input Voltage to FB Pin	V _{FB}	-0.3 ~ 6.2	V
Input Voltage to CS Pin	V _{CS}	-0.3 ~ 2.8	V
Input Voltage to RT Pin	V _{RT}	-0.3 ~ 6.2	V
Junction Temperature	T _J	+150	°C
Operating Temperature	T _{OPR}	-40 ~ +125	°C
Storage Temperature	T _{STG}	-50 ~ +150	°C

Note Absolute maximum ratings are those values beyond which the device could be permanently damaged.

Absolute maximum ratings are stress ratings only and functional device operation is not implied.

■ OPERATING RANGE

PARAMETER	SYMBOL	RATINGS	UNIT
Supply Voltage	V _{CC}	8.2 ~ 21	V

■ ELECTRICAL CHARACTERISTICS (Ta = 25°C, V_{CC}=15V, R_T=75kΩ, unless otherwise specified)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT		
SUPPLY SECTION								
Start Up Current	I _{STR}	V _{CC} =12.5V		27	45	μA		
Supply Current with switch	OFF	I _{OFF} V _{SS} = 0, I _{FB} = 0		3.7	5.5	mA		
	ON	I _{ON} V _{SS} = 5V, I _{FB} = 0		4.0	6.0	mA		
UNDER-VOLTAGE LOCKOUT SECTION								
Start Threshold Voltage	V _{THD(ON)}		11.8	12.6	13.4	V		
Min. Operating Voltage	V _{CC(MIN)}		7.6	8.1	8.6	V		
Hysteresis	V _{CC(HY)}			4.5		V		
INTERNAL VOLTAGE REFERENCE								
Reference Voltage	V _{REF}	measured at pin V _{REF}	6.1	6.3	6.6	V		
CONTROL SECTION								
Switch Frequency	Normal	F _(SW)	V _{FB} = 4V	U3848/B(Note1)	85	95	105	kHz
				U3848A/C(Note2)	61	68	75	kHz
	Power-Saving		V _{FB} = 1V		17	20	23	kHz
Duty Cycle	MAX	D _{MAX}		65	70	75	%	
	MIN	D _{MIN}	V _{FB} < 0.5V	0			%	
V _{FB} Operating Level	MIN	V _{MIN}		0.5			V	
	MAX	V _{MAX}				4.4	V	
Feedback Resistor	R _{FB}		2.6	3.8	5.0	kΩ		
External Resistor for controlling Current Source of OSC	R _T			75		kΩ		
Soft-Start Time	T _{SS}	C _{SS} =0.05μF		6		ms		
		C _{SS} =0.1μF		12		ms		
		C _{SS} =1μF		120		ms		
PROTECTION SECTION								
OVP threshold	V _(OVP)	V _{SS} < 3.5V, V _{FB} > 5V	15.2	16	16.8	V		
OLP threshold	V _{FB(OLP)}	V _{SS} > 5.4V	4.4	4.6	4.9	V		
OTP threshold	T _(THR)		120	135	150	°C		
OVP Disable threshold	V _{SS(DEACT)}	V _{FB} > 5V, V _{CC} > 17V	3.7	3.9	4.2	V		
OLP Enable threshold	V _{SS(ACT)}	V _{FB} > 5V	4.9	5.1	5.4	V		
Spike Blanking time	T _{SB}			7.2		μs		
CURRENT LIMITING SECTION								
LEB	t _{LEB}			220		ns		

■ ELECTRICAL CHARACTERISTICS(Cont.)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
DRIVER OUTPUT SECTION						
Output Voltage Low State	V_{OL}	$I_{SOURCE} = 200 \text{ mA}$			2.5	V
Output Voltage High State	V_{OH}	$I_{SINK} = 200 \text{ mA}$	12.2			V
Output Voltage Rise Time	U3848B	t_R	$C_L = 1.0 \text{ nF}$	70	150	ns
	U3848C			200	300	ns
	U3848/A			300	400	ns
Output Voltage Fall Time	t_F	$C_L = 1.0 \text{ nF}$		50	90	ns

Note: 1. $R_T=65k\Omega$ should be connected for U3848/ U3848B.

2. U3848A/C denote U3848A and U3848C.

FUNCTIONAL DESCRIPTION

The internal reference voltages and bias circuit work at $V_{CC} > 12.6V$, and shutdown at $V_{CC} < 8.1V$.

(1) Soft-Start

When every IC power on, driver output duty cycle will be decided by voltage V_{SS} on soft-start capacitor and V_{CS} on current sense resistor at beginning. After V_{SS} reach 5.1V, the whole soft-start phase end, and driver duty cycle depend on V_{FB} and V_{CS} . The relation among V_{SS} , V_{FB} and V_{OUT} as followed FIG.3, here soft-start phase $T_{soft-start}$ should more than V_{OUT} start-up phase $T_{start-up}$, otherwise, IC will enter false OLP protection state. Because after the soft-start phase end, if V_{OUT} remain in lower voltage, V_{FB} more than 4.6V, then IC enter false OLP state.

Furthermore, soft-start phase should end before V_{CC} reach $V_{CC(MIN)}$ during V_{CC} power on. Otherwise, if soft-start phase remain not end before V_{CC} reach $V_{CC(MIN)}$ during V_{CC} power on, IC will enter auto-restart phase and not set up V_{OUT} .

Finally soft-start also set OVP active phase. OVP active phase between $V_{SS}=0$ and $V_{SS}=3.8V$, OVP will not be sensed after V_{SS} reach 3.8V. The Soft-start phase T_{SS} :

$$T_{SS} = \begin{cases} 6 \text{ ms} & (C_{SS}=0.05\mu F) \\ 12 \text{ ms} & (C_{SS}=0.1\mu F) \\ 120 \text{ ms} & (C_{SS}=1\mu F) \end{cases}$$

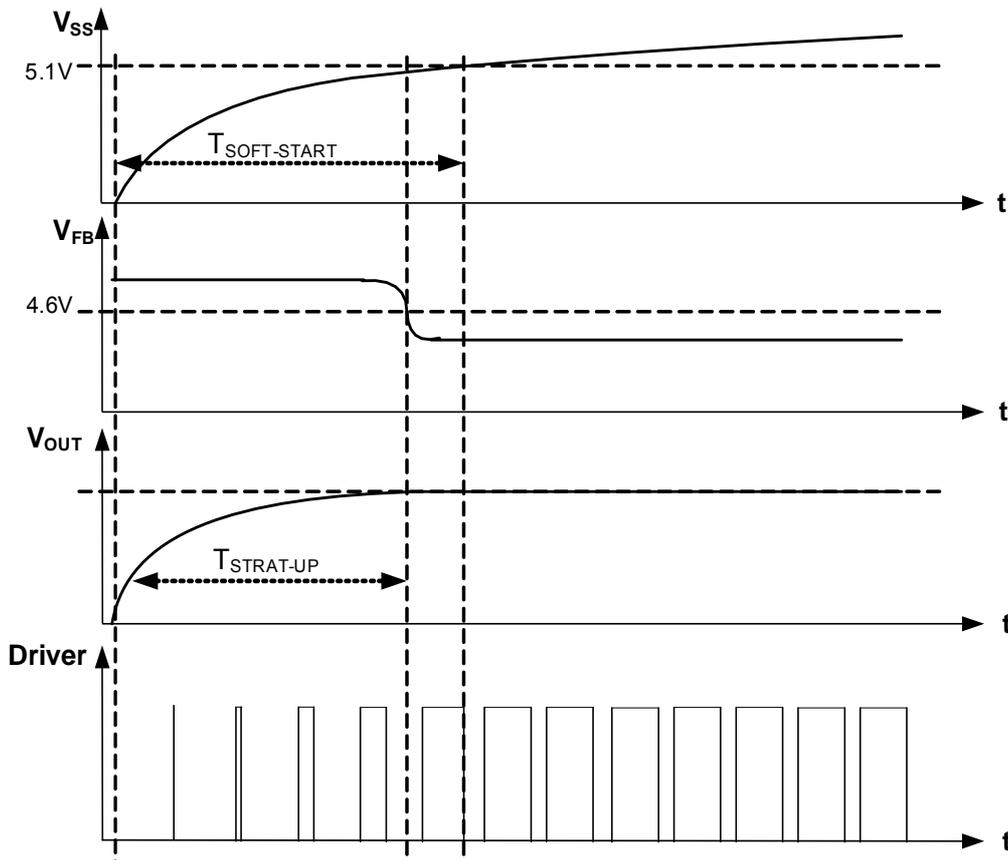


FIG.3 Soft-start phase

■ FUNCTIONAL DESCRIPTION(Cont.)

(2) Switch Frequency Set

The maximum switch frequency decided by an external resistor R_T connected between pin R_T and ground. Then the maximum switch frequency will depend on user requirement. The relation curve between f_{SW} and R_T as followed FIG.5 under the condition of $P_{OUT}=8W$. The equation between f_{SW} and R_T as followed (1-2) for U3848A/C, (1-3) for U3848/B:

$$f_{SW} = -0.61 \cdot R_T + 115.7 \text{-----(1-2)}$$

$$f_{SW} = -1.1 \cdot R_T + 167.5 \text{-----(1-3)}$$

After R_T connected, switch frequency is also modulated by output power P_{OUT} during IC operating. So lower switch frequency at lower load, which more and more improve IC's efficiency at light load. Switch frequency is decreased minimum at no load, then the U3848/B will operate at Power-Saving mode for Lower standby power. The relation curve between f_{SW} and P_{OUT} as followed FIG.4 under the condition of $R_T=75k\Omega$. The frequency wave of U3848A/C is similar with U3848/B's, and for them, maximum frequency point is 70kHz.

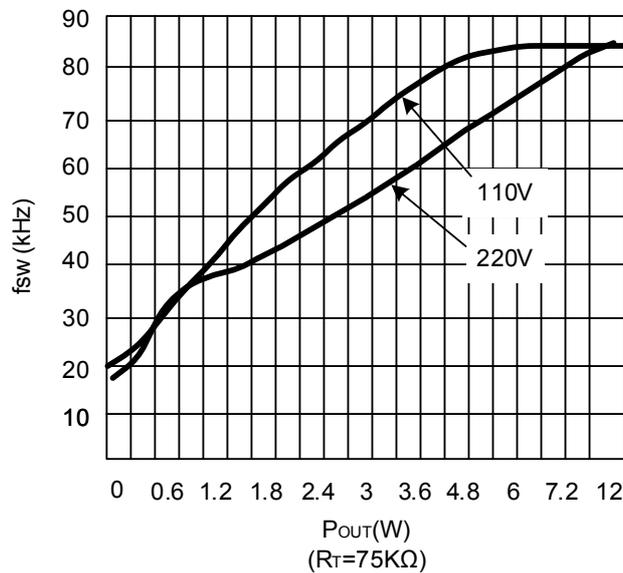


FIG.4 The relation curve between f_{SW} and output power P_{OUT}

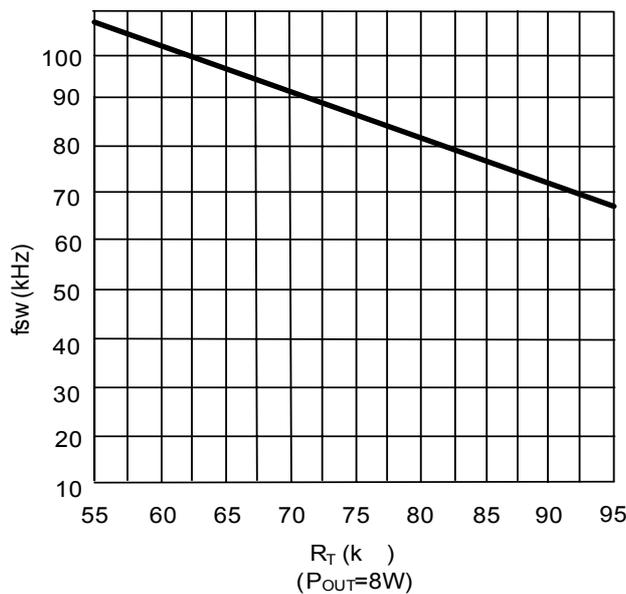


FIG.5 The relation curve between f_{SW} and R_T

FUNCTIONAL DESCRIPTION(Cont.)

(3) Protection section

U3848/A/B/C takes on more protection functions such as OLP, OVP and OTP etc. In case of those failure modes for continual 7.2 μ s (blanking time), the driver is shut down. At the same time, IC enters auto-restart, V_{CC} power on and driver is reset after V_{CC} power on again.

OLP

After soft-start phase end ($V_{SS}>5.1V$), IC will shutdown driver if over load state occurs (corresponding to $V_{FB}>4.6V$) for continual 7.2 μ s. OLP function will not inactive during soft-start phase. OLP case as followed **FIG.6**. The test circuit as followed **FIG.8** for U3848/A/B/C.

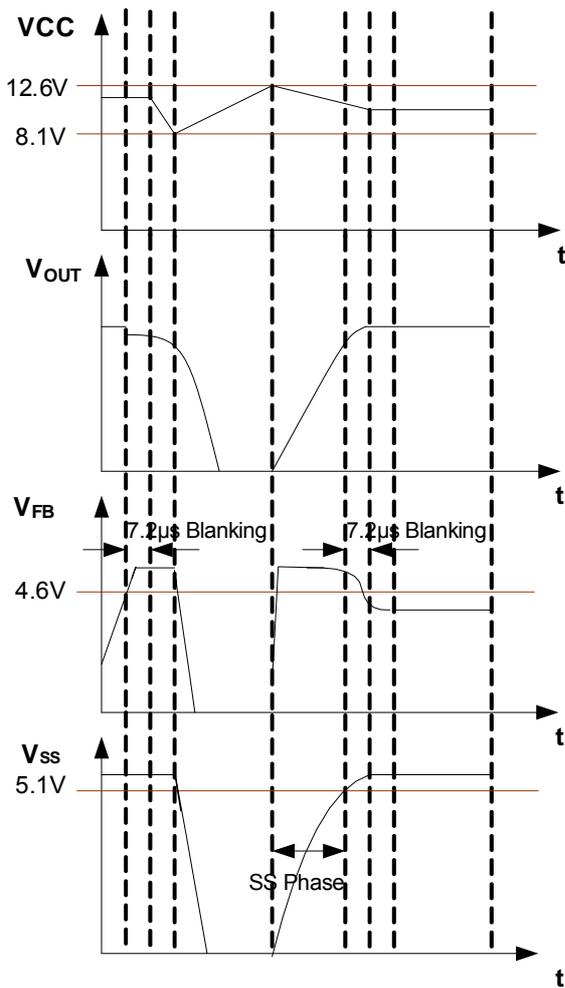


FIG.6 OLP case

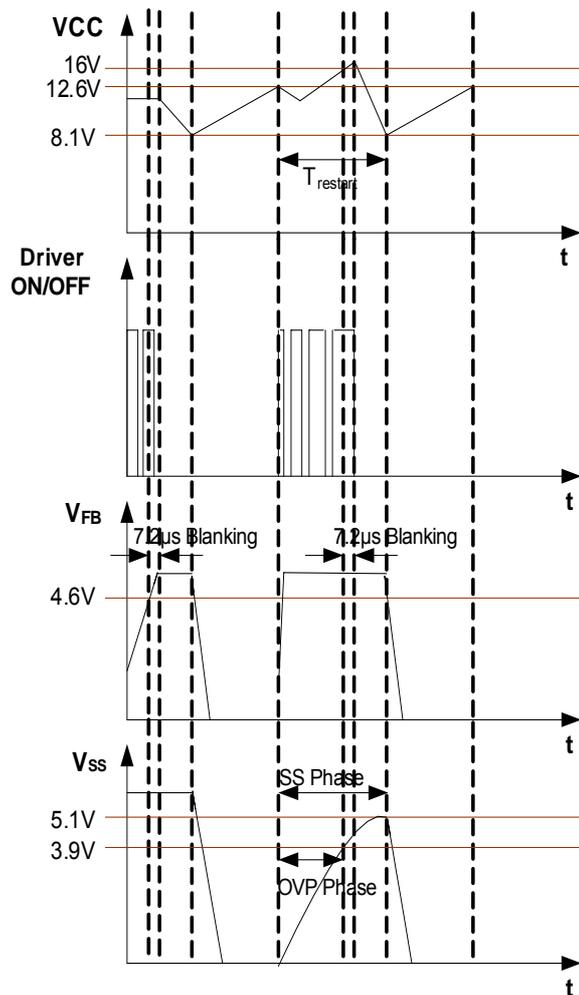


FIG.7 OVP case

OVP

Power supply V_{CC} 's OVP function are enabled only when $V_{SS}<3.9V$ & $V_{FB}>4.6V$ during soft-start phase. During above condition, driver will be shutdown if over voltage state occurs ($V_{CC}>16V$) for continual 7.2 μ s. OVP function will not inactive after soft-start phase. OLP case as followed **FIG.7**. The test circuit as followed **FIG.9** for U3848/A/B/C.

OTP

OTP will shut down driver when junction temperature T_J of internal circuits is more than threshold 135 $^{\circ}C$ for continual 7.2 μ s.

FUNCTIONAL DESCRIPTION(Cont.)

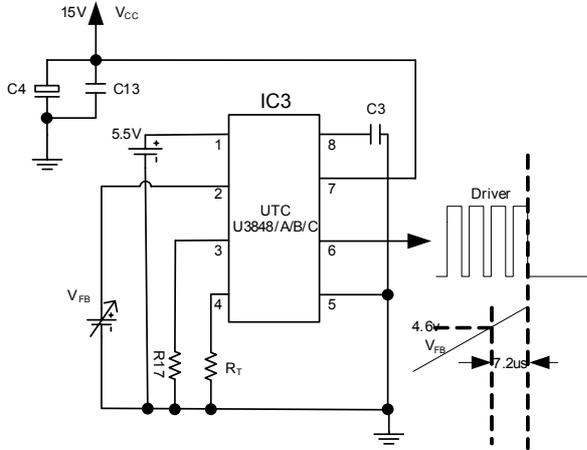


FIG.8 OLP test circuit

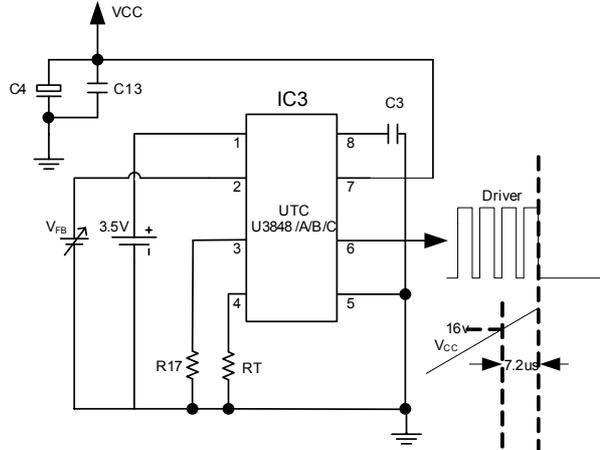


FIG.9 OVP test circuit

(4) Driver Output Section

Rise edge time of driver output is about 200ns for avoiding Low EMI. When driver output $V_{OL(MAX)}$ is less than 2.5V with 200mA source current, and $V_{OH(MIN)}$ is more than 12.2V with 200mA sink current.

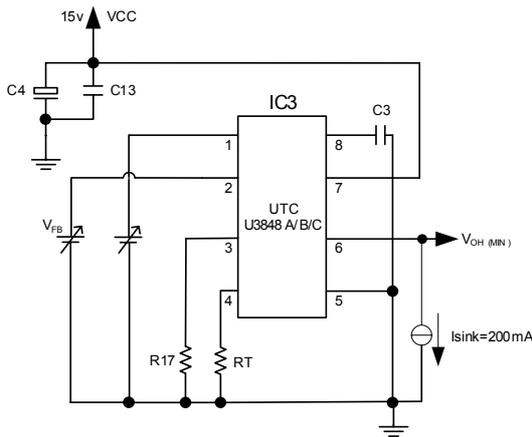


FIG.10 driver test circuit with sink current

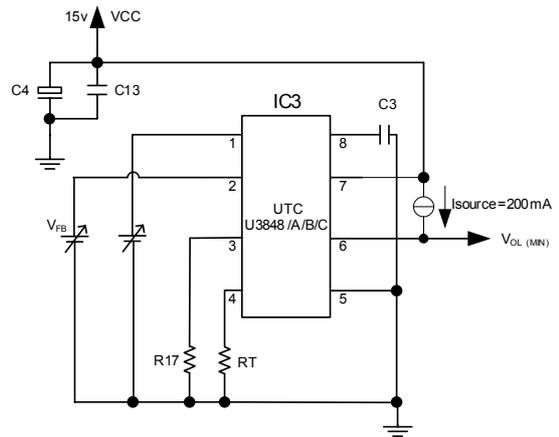


FIG.11 driver test circuit with source current

(5) External power switch MOS transistor

Because U3848/A/B/C driver output voltage Low level threshold is about 2.5V, User may apply power MOS transistors with bigger threshold. 4N60 is recommended normally.

■ TYPICAL APPLICATION CIRCUIT

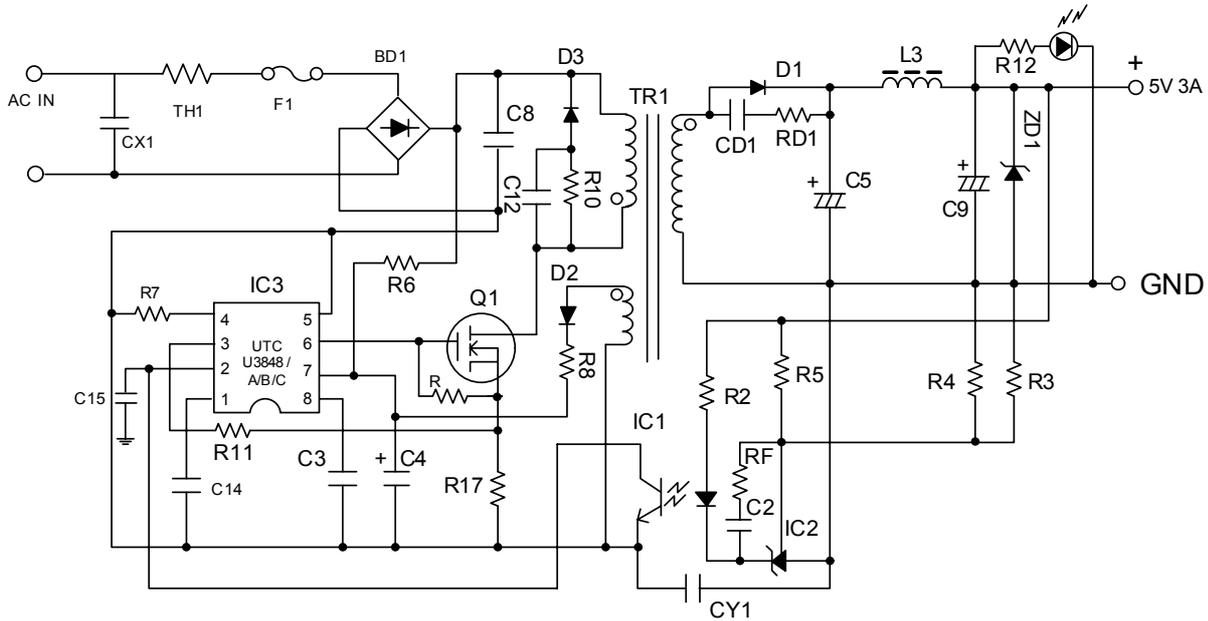


FIG.12 U3848/A/B/C Typical Application Circuit

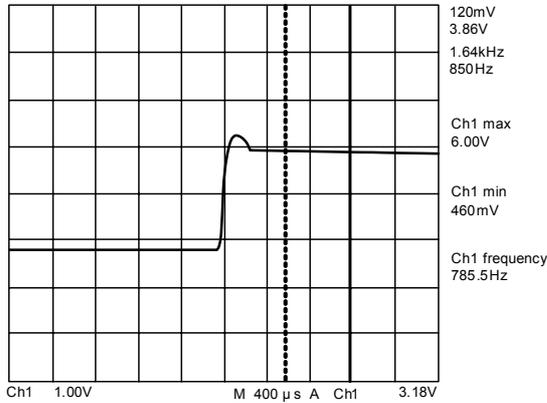
Table1 Components Reference description for U3848/A/B/C application circuit

C12	CC	10nF/1000V	D3	Diode	UF1007		R	R	470KΩ	1/8W
C14	CC	100nF/50V	IC1	IC	PC817		TH1		SCK-103	
C2	CC	33nF/50V	IC2	IC	TL431CLP		BD1	R	KBP-208	
CX1		104/275V	IC3	IC	U3848/A/B/C		RD1	R	10Ω	1/8W
C5	EC	1000uF/15V	L3	L	1.2uH		R12	R	3.3kΩ	1/8W
C4	CC	22uF/50V	Q1	MOS	4N60		TR1		optional	
C8	EC	68uF/400V	R7	R	68KΩ	1/8W	RF	R	4.7kΩ	1/8W
C9	EC	1000uF/16V	R17	R	1.2Ω/1W	1/8W	C15	CC	0.1μF/50V	
CD1	CC	1nF/1KV	R2	R	680Ω	1/8W				
CY1	CC	4.7nF/250V	R3	R	ADJ	1/8W				
D1	Diode	C63-004	R4	R	5.6KΩ	1/8W				
D2	Diode	1N4148	R5	R	5.6KΩ	1/8W				

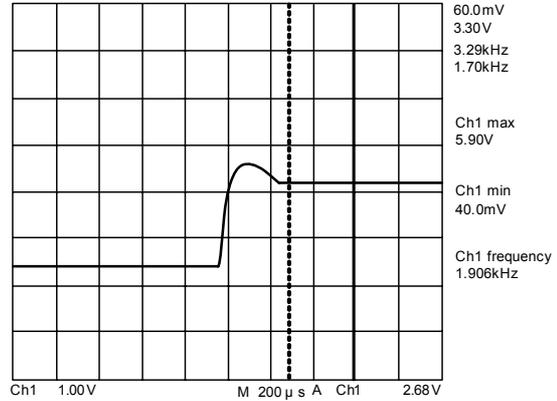
Note: C5 and C9 are lower ESR capacitors.

■ TYPICAL CHARACTERISTICS(Cont.)

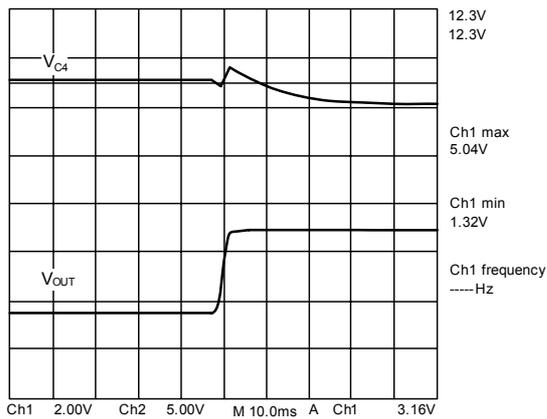
Feedback Voltage During Loadjump From10%
Up To 100% Load ($V_{DCIN}=120V$)



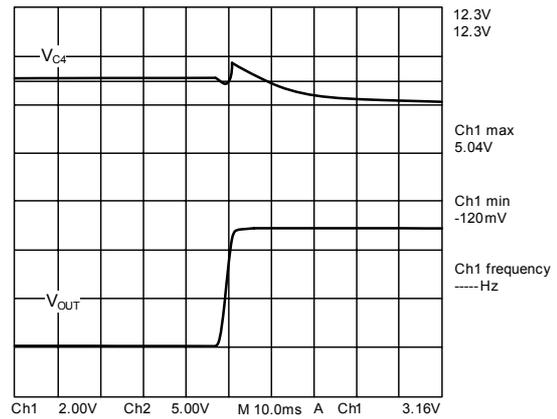
Feedback Voltage During Loadjump From10%
Up To 100% Load ($V_{DCIN}=350V$)



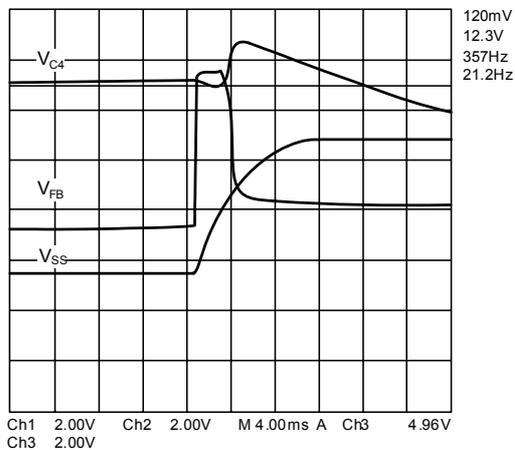
Startup With Full Load Condition At $V_{DCIN}=120V$,
 V_{C4} and V_{out}



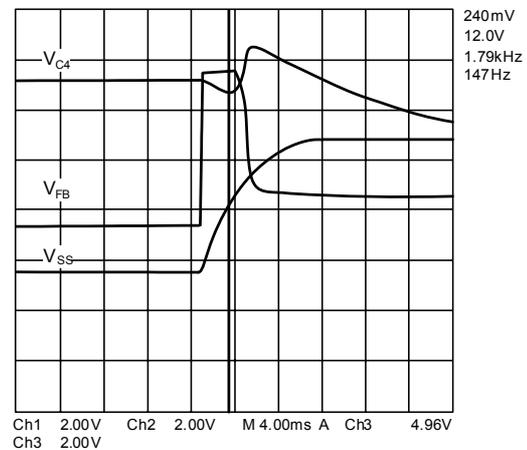
Startup With Full Load Condition At $V_{DCIN}=350V$,
 V_{C4} and V_{out}



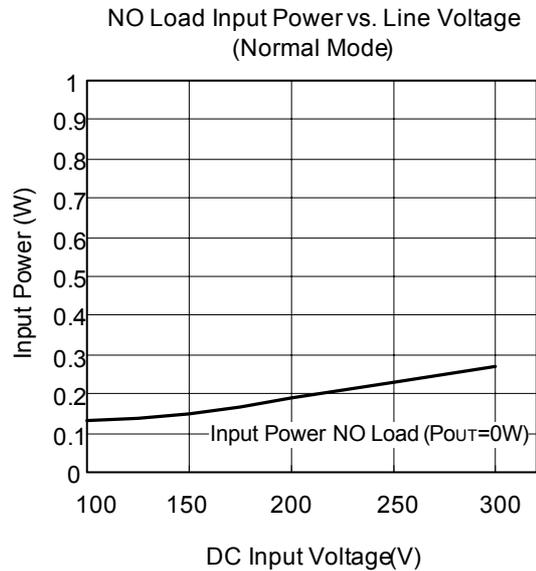
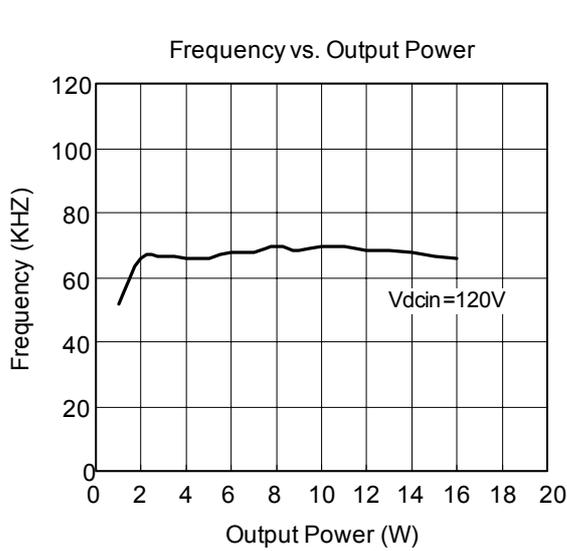
Startup Behavior At Nominal Load Condition $V_{DCIN}=120V$



Startup Behavior At Nominal Load Condition $V_{DCIN}=350V$



■ TYPICAL CHARACTERISTICS(Cont.)



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