

## Low-Power Off-Line CC/CV Switch

### FEATURES

- Constant-Current (CC) and Constant-Voltage (CV) with Primary Side Control
- Proprietary technology enabling high efficiency and fast dynamic response
- No audible noise over entire operating range
- Built-in power NPN
- Built-in Cable Compensation
- Built-in Line Compensation
- Primary-side feedback eliminates opto-coupler and TL431
- Cycle-by-Cycle Current Limiting
- Over Temperature Protection
- VCC Over Voltage Protection
- Open Circuit Protection

### TYPICAL APPLICATION

- Adapter/Charger for Cell/Cordless Phones, PDAs, MP3 and Other Portable Apparatus
- Standby and Auxiliary Power Supplies Set Top Boxes (STB)
- AC/DC LED Driver applications

### DESCRIPTION

The FT838NB/FT838RNA controller device is optimized for high-performance, low power switching mode power supply applications. The FT838NB/FT838RNA facilitates CC/CV charger design by eliminating an opto-coupler and TL431. Its highly integrated functions such as Under Voltage Lockout (UVLO), Leading Edge Blanking (LEB) and built-in cable compensation offer the users a high efficiency and low cost solution for AC/DC power applications.

Power supplies built with FT838NB can achieve both highest average efficiency and fast dynamic load response. FT838RNA is optimized for LED driver applications with slightly higher (~22uA) standby current.

Furthermore, FT838NB/FT838RNA features fruitful protections like Open Circuit Protection and Over Temperature Protection to eliminate the external protection circuits and provide reliable operations. FT838NB/FT838RNA is available in SOP8 package.

**TYPICAL APPLICATION CIRCUIT**

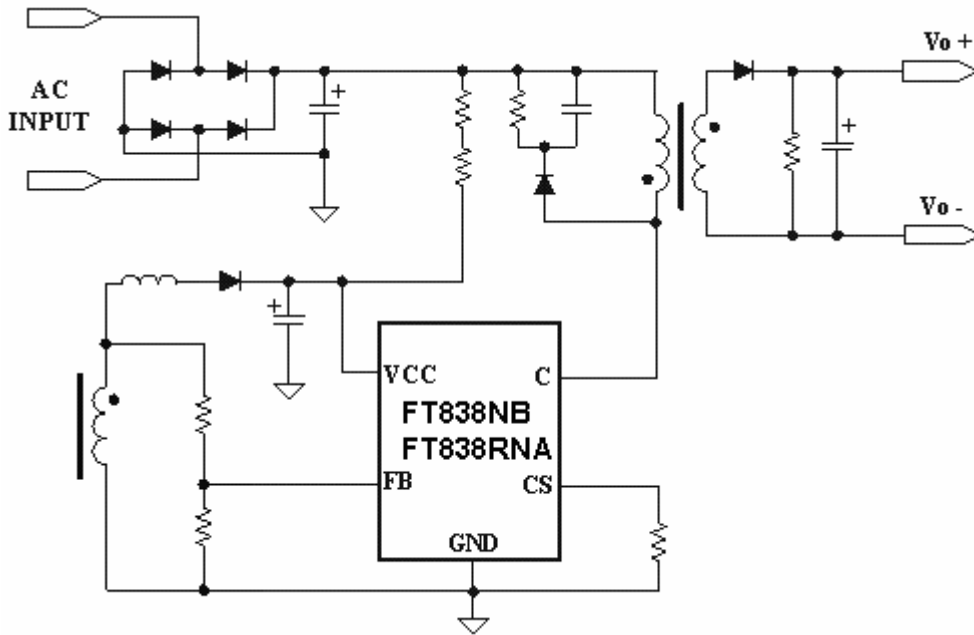


Figure 1: Typical Application Circuit

**ABSOLUTE MAXIMUM RATINGS**

FB to GND.....	-0.3V to +7V
CS to GND.....	-0.3V to +7V
VCC to GND.....	-0.3V to +30V
C to GND.....	-0.3V to +700V
Operating Temperature Range.....	-40°C to +125°C
Junction Temperature.....	-40°C to +150°C
Storage Temperature Range .....	-60°C to +150°C
ESD Protection HBM.....	2000V
ESD Protection MM.....	200V

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

**PIN CONFIGURATION**

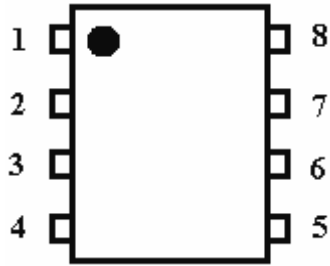


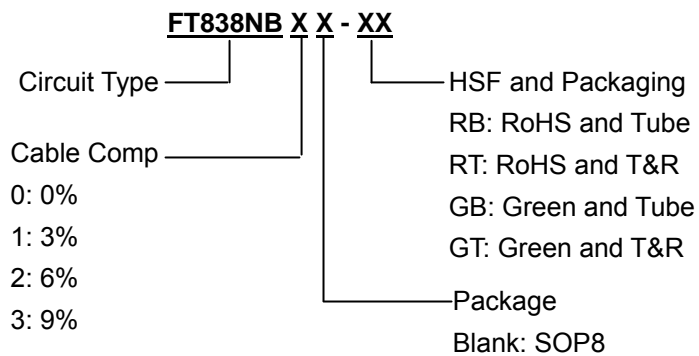
Figure 2: Pin Assignments

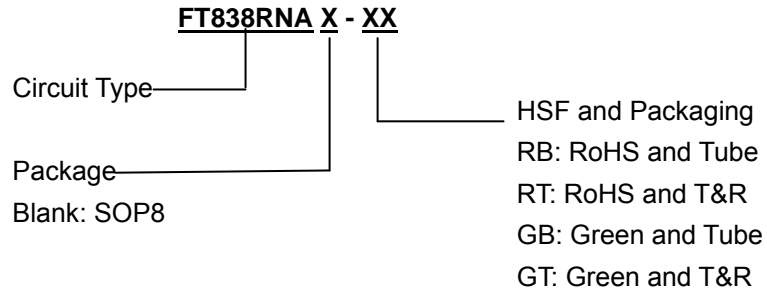
**TERMINAL DESCRIPTION**

Pin	Name	Description
1	<b>CS</b>	Primary current sense
2	<b>FB</b>	Output voltage feedback pin
3	<b>VCC</b>	Supply voltage
4	<b>NC</b>	No connection
5	<b>GND</b>	Ground.
6		
7	<b>C</b>	The collector of the power NPN. This pin is connected to the primary lead of the transformer
8		

Table 1

**ORDERING INFORMATION**





**FT838NB①/FT838RNA**

Device	DESIGNATOR	SYMBOL	Options
FT838NB①	①	0	Cable Comp = 0%
		1	Cable Comp = 3%
		2	Cable Comp = 6%
		3	Cable Comp = 9%
FT838RNA	/	/	Cable Comp = 0% For LED driver applications

Table 2

**MARKING RULE**

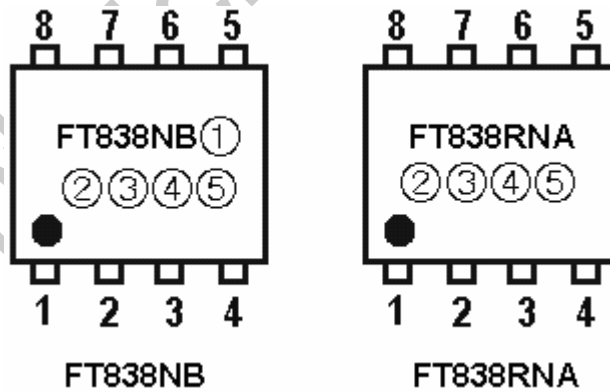
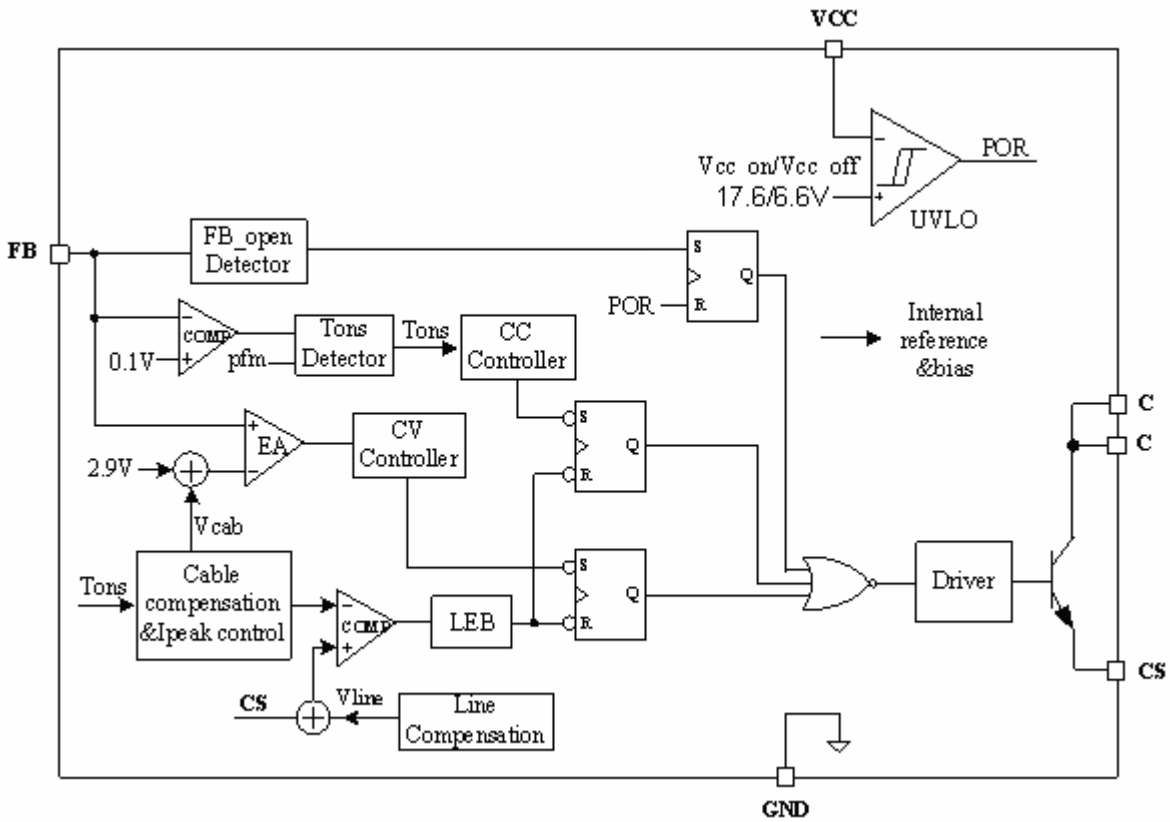


Figure 3: Marking Rule

- ①: Represents Version (0,1,2 or 3)
- ②③④⑤: for internal reference

**Block Diagram**



**Figure4: FT838NB/FT838RNA Block Diagram**

**ELECTRICAL CHARACTERISTICS**

(For typical values Tj=25°C, Vcc=12V, unless otherwise noted)

Characteristic		Symbol	Min	Typ	Max	Unit
<b>Current Sense</b>						
Maximum Current Threshold		Vcs_max	541	552	563	mV
Leading Edge Blanking Duration		Tleb	350	400	450	ns
Propagation Delay (OUT=1.0nF to GND)		Tpd			200	ns
<b>Feedback Section</b>						
Feedback Voltage Threshold		Vfb	2.856	2.9	2.944	V
CCM protection Threshold Level		Vcp		100		mV
<b>Supply Section</b>						
Start Up Threshold Voltage		Vcc_on	16.5	17.6	18.5	V
Under Voltage Lockout Voltage		Vcc_off	6	6.6	7	V
VCC Start Up Current	FT838NB	Istart_up		2	5	uA
	FT838RNA		14	22	30	
Operating Current		Iop	0.4	0.5	0.7	mA
<b>Protection Section</b>						
Feedback Loop Open Protection		I <sub>fb_open</sub>	120	140	160	uA
VCC Over Voltage Protection		Vcc_OVP	26	27.5	29	V
Over Temperature Protection		T_OTP		145		°C
<b>Compensation</b>						
Line Compensation (I <sub>fb</sub> =1mA)		V <sub>line</sub>	30	33	36	mV
Cable compensation	0	Kcab		0		%
	1			3		
	2			6		
	3			9		
<b>Power NPN Section</b>						
Characteristic	Test condition	Symbol	Min	Typ	Max	Unit
Collector-Base breakdown voltage	I <sub>c</sub> =0.1mA	V <sub>cb0</sub>	700			V
Collector-Emitter breakdown voltage	I <sub>c</sub> =1mA	V <sub>ceo</sub>	400			V
Emitter-Base breakdown voltage	I <sub>E</sub> =0.1mA	V <sub>ebo</sub>	9			V
Collector-Emitter saturation voltage	I <sub>B</sub> =0.25A, I <sub>C</sub> =1A	V <sub>CEsat</sub>		0.3	0.9	V
Base-Emitter saturation voltage	I <sub>B</sub> =0.25A, I <sub>C</sub> =1A	V <sub>BEsat</sub>		0.9	1.2	V
Maximum collector current	V <sub>c</sub> =2V	I <sub>cm</sub>	0.4	0.45		A

Table 3

## FUNCTIONAL DESCRIPTION

### Operating Description

FT838NB/FT838RNA is a cost effective and high-performance AC-DC power supply controller for off-line low power AC-DC applications including battery chargers, adaptors and LED lighting. The constant voltage (CV) and constant current (CC) control are achieved accurately without the secondary feedback circuit.

### Start up Control

Start-up current of FT838NB is very low so that a start-up resistor with high resistance and low-wattage is allowed to supply the start-up power for the controller. The large value startup resistor minimizes the power loss in operations and allows quick start up. FT838RNA increases the start-up current slightly to ensure the smooth shutting down operations in LED lighting applications with relaxed requirement on external board design.

### Operating current

The operating current of FT838NB/FT838RNA is as low as 500uA. Good efficiency is achieved with the low operating current. Low operating current also reduces the Vcc hold-up capacitance requirement.

### Constant voltage (CV) and constant current (CC) Operation

The FT838NB/FT838RNA can accurately achieve CV/CC characteristic output without secondary side voltage and current-feedback circuits. It operates in CV mode to regulate the output voltage by capturing the auxiliary winding feedback voltage at FB pin. The auxiliary winding feedback voltage is proportional to secondary winding, so it provides controller the feedback signal from secondary side and achieves constant-voltage output. In CC mode, the controller detects the secondary discharger peak current and the discharger time, which determines the off-time of the base driver to make the output average current constant.

### Primary peak current modulation

Primary peak current is constant at constant current mode. And primary peak current is modulated at constant voltage mode for the purposes of good dynamic load response and no audible noise over entire operating range. According to the output loading current the current threshold voltage is modulated from 0.55V to 0.27V. The current threshold voltage is 0.55V at rated load and 0.27V at light load.

### Leading edge blanking

Each time the power NPN transistor is switched on, a turn-on spike occurs at the sense resistor. To avoid premature termination of the switching pulse, a 400ns leading edge blanking time is built in. Conventional RC filtering can therefore be omitted. During this blanking period, the current limit comparator is disabling and cannot switch off the base driver.

### Under voltage lockout (UVLO)

FT838NB/FT838RNA turn-on Vcc\_on and turn-off Vcc\_off are 17.6 V and 6.6 V, respectively. During start-up, the hold-up capacitor must to be charged to 17.6V through the start-up resistor. The hold-up capacitor continues to supply Vcc until power can be delivered from the auxiliary winding of the transformer. Vcc must not drop below 6.6 V during this start-up process. This UVLO hysteresis window ensures that hold-up capacitor is sufficient to supply Vcc during start-up.

**Protection control**

With rich protection features of FT838NB/FT838RNA, excellent power supply system reliability can be achieved. The protection features including cycle by cycle current limiting, Vcc over voltage protection and clamp, over temperature protection, feedback loop open circuit protection and Vcc under voltage lockout.

**Integrated NPN**

Power NPN is integrated in FT838NB/FT838RNA for low cost and/or space limited applications.

**Output cable compensation**

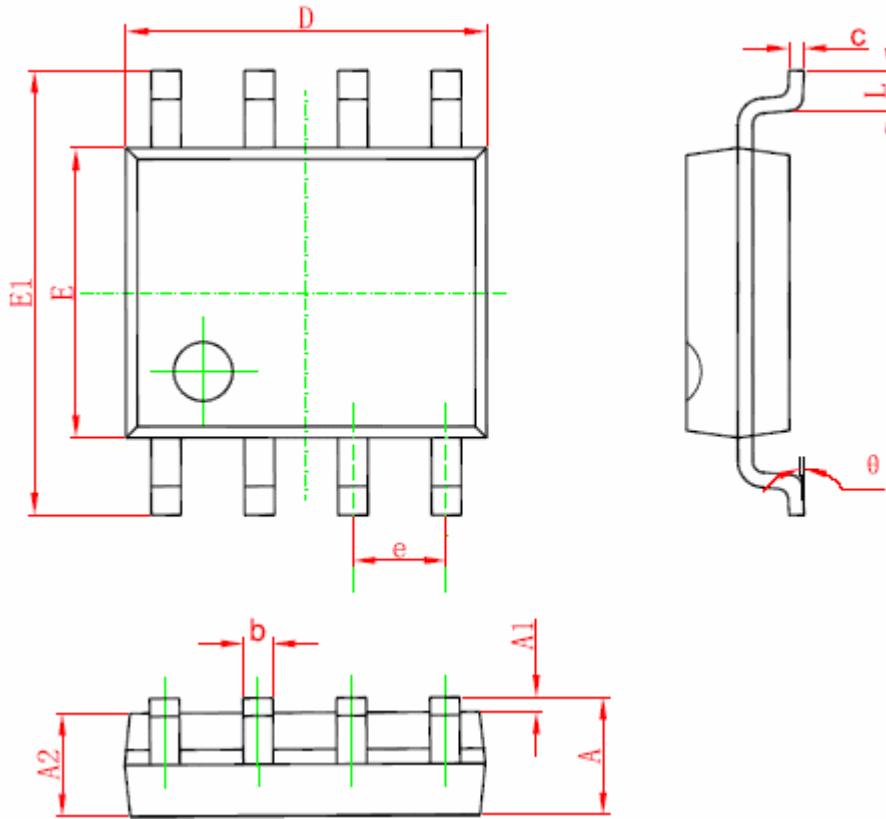
The output cable compensation provides a constant output voltage at the end of the cable over the entire load range in constant voltage mode. As the converter load increase from no-load to the peak current load, the voltage drop introduced across the output cable is compensated by increasing the feedback pin reference voltage.

Fremontmicro USA Use Only



**DIP8 PACKAGE OUTLINE DIMENSIONS**

**SOP8 Package**



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.006	0.010
D	4.700	5.100	0.185	0.200
E	3.800	4.000	0.150	0.157
E1	5.800	6.200	0.228	0.244
e	1.270 (BSC)		0.050 (BSC)	
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°

**Fremont Micro Devices (SZ) Limited**

#5-8, 10/F, Changhong Building, Ke-Ji Nan 12 Road, Nanshan District, Shenzhen

Tel: (86 755) 86117811

Fax: (86 755) 86117810

**Fremont Micro Devices (Hong Kong) Limited**

#16, 16/F, Blk B, Veristrong Industrial Centre, 34-36 Au Pui Wan Street, Fotan, Shatin, Hong Kong

Tel: (852) 27811186

Fax: (852) 27811144

**Fremont Micro Devices (USA), Inc.**

42982 Osgood Road Fremont, CA 94539

Tel: (1-510) 668-1321

Fax: (1-510) 226-9918

Web Site: <http://www.fremontmicro.com/>

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