

**Features**

- 2.5 to 5.5V supply voltage operating range.
- Low current consumption: 1mA in operation,
- 50 kHz or 100kHz operation frequency .
- Built-in maximum duty control.
- Push-pull output.
- Built-in soft start circuit.
- Built-in auto-discharge function.
- Built-in auto-refresh function.

**Applications**

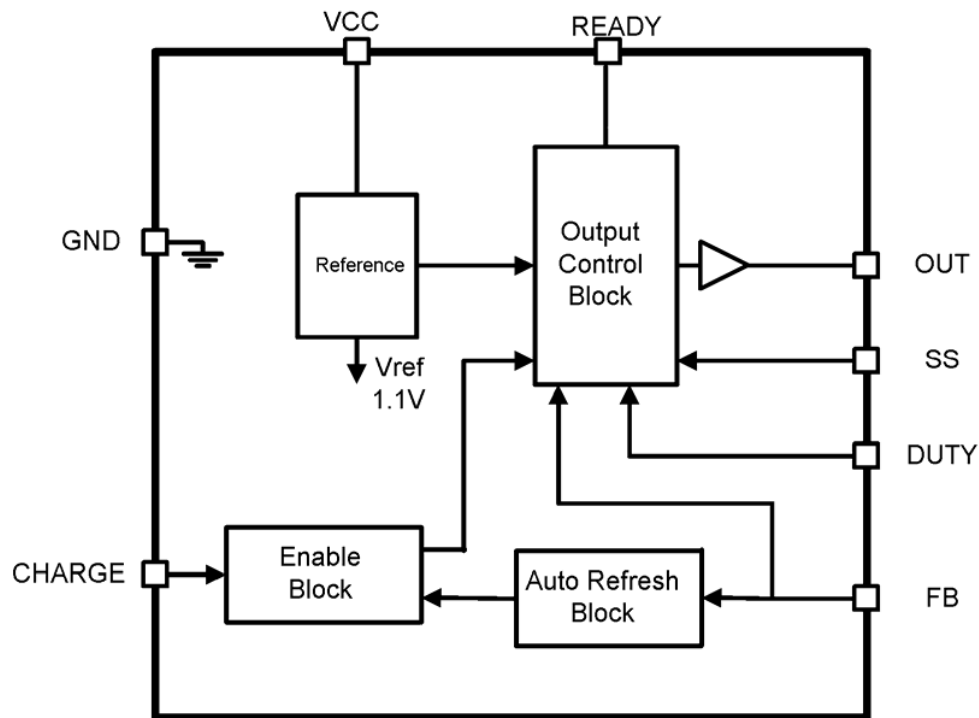
- Digital Still Cameras flash unit

**General Description**

The AT1452 is a charger control IC for Photoflash capacitor with soft start function, adjustable maximum duty cycle, auto-refresh and auto-discharge (soft start capacitor) circuit. Adjustable soft start is programmed with an external capacitor on SS pin. The control technique allows for the use of external resistor to change the switching duty and use of transformer to control the input current. Automatic refresh allows the capacitor to remain charged while output voltage dropped 10%. A logic high on the CHARGE pin initiates charging, while the READY pin signals that the capacitor is fully charged. It is ideal for DSC flash unit.

*\* Protected by U.S. Patent #6,724,989*

**Block Diagram**



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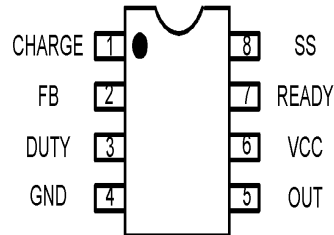
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### Pin Configuration



### Ordering Information

Part number	Package	Marking
AT1452AP	TSSOP8	AT1452AP
AT1452AP_GRE	TSSOP8,Green	AT1452AP, date code with one bottom line
AT1452BP	TSSOP8	AT1452BP
AT1452BP_GRE	TSSOP8,Green	AT1452BP, date code with one bottom line

A:50kHz B:100kHz

### Pin Description

Pin No.	Symbol	I/O	Description
1	CHARGE	I	Charge enable input
2	FB	I	Error amplifier input
3	DUTY	I	Duty control input
4	GND	-	Ground
5	OUT	O	Push-pull output
6	VCC	-	Power supply
7	READY	O	Charge ready open drain output
8	SS	I	Soft-start setting

### Absolute Maximum Ratings

Parameter	Condition	Rated Value		Unit
		Min.	Max.	
Power Supply Voltage	—	-	+6.5	V
Source Average Current of OUT	—	-	-50	mA
Sink Average Current of OUT	—	-	50	mA
Input Voltage to Error Amplifier	—	-	6.5	V
Continuous power dissipation	TSSOP8 (T <sub>a</sub> =+25°C)	-	450	mW
	SOP8 (T <sub>a</sub> =+25°C)	-	500	mW
Operating temperature	—	-30	+85	°C
Junction temperature	—	-	+125	°C
Storage temperature	—	-40	+150	°C
Lead temperature	—	-	+300	°C

Stresses beyond those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

### Recommended Operating Conditions

(T<sub>a</sub>=+25°C)

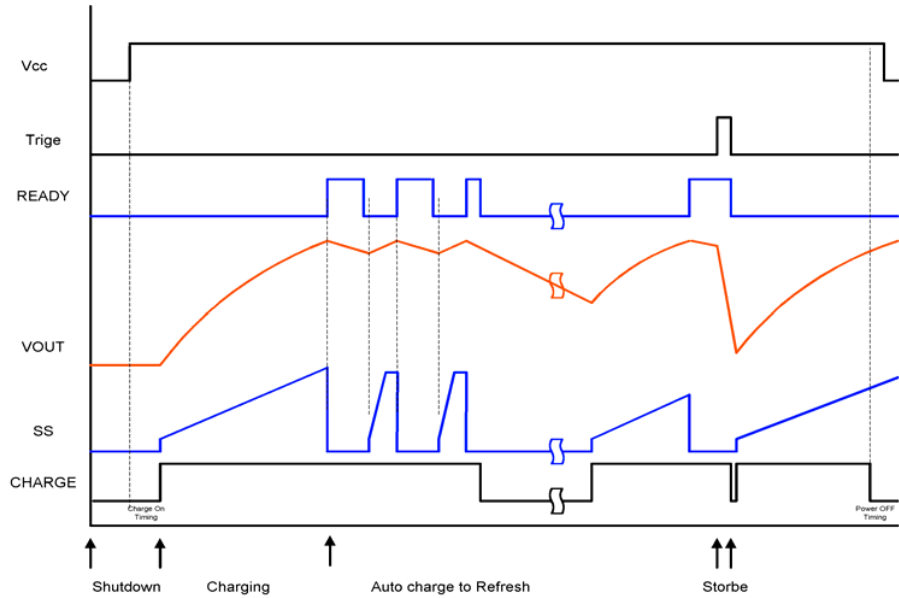
Parameter	Symbol	Values			Unit
		Min.	Typ.	Max.	
Power supply voltage	V <sub>CC</sub>	2.5	--	5.5	V
Operating temperature	T <sub>OP</sub>	-30	+25	+85	°C

### Electrical Characteristics

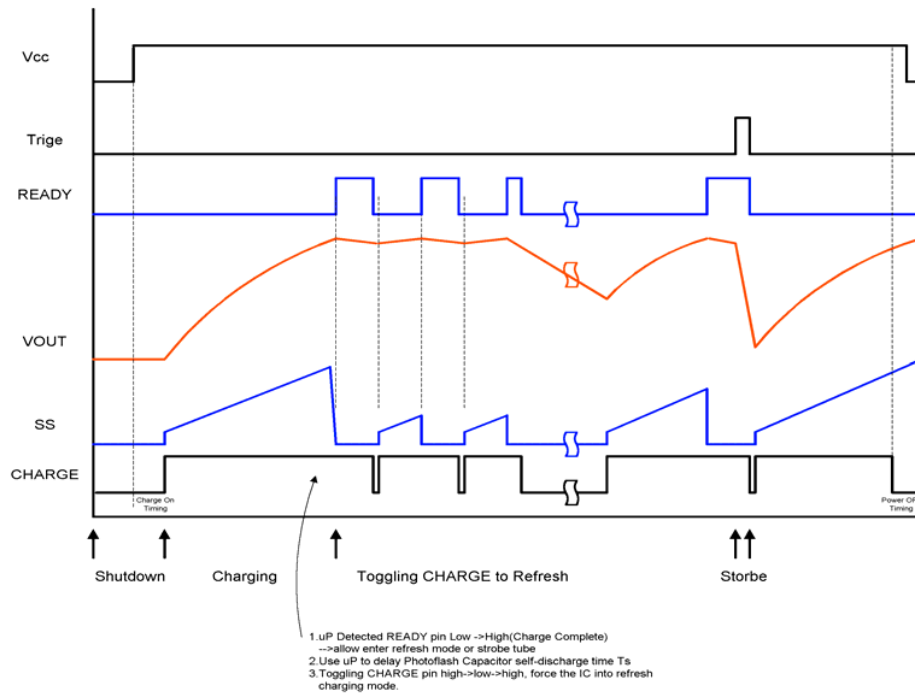
(VCC = 3.3V, T<sub>a</sub> = +25°C, unless otherwise noted.)

Parameter		Symbol	Condition	Values			Unit
				Min.	Typ.	Max.	
Entire device	Input Supply Range	V <sub>CC</sub>		2.5	--	5.5	V
	Feedback Voltage	V <sub>FB</sub>	T <sub>a</sub> = +25°C	1.080	1.100	1.120	V
	Reference Variation with Temperature		T <sub>a</sub> = -30°C to +85°C	-2%	-	2%	%
	Auto-Refresh Level	V <sub>FB1</sub>	V <sub>FB1</sub> / V <sub>FB</sub>	-	90	-	%
	Feedback Voltage line-regulation	V <sub>FB-Line</sub>	VCC=2.5V to 5.5V	-5	1	5	mV
	Standby current	I <sub>CCS</sub>	CHARGE=GND	-	-	400	μA
	Operating Current	I <sub>CC</sub>	Duty=50%, f <sub>OSC</sub> =50KHz	-	1.0	-	mA
Oscillator	Frequency	fosc	A	40	50	60	kHZ
			B	90	100	110	kHZ
Soft-Start and Duty Section	Threshold voltage of SS	V <sub>SS,0</sub>	Duty Cycle=0%	-	0.3	-	V
	Threshold voltage of SS	V <sub>SS,100</sub>	Duty Cycle=90%	-	1.1	-	V
	Charging current	I <sub>SS</sub>	V <sub>SS</sub> =0V	0.7	1.0	1.5	μA
	Maximum duty cycle	T <sub>DUTY</sub>		80	83	90	%
Output Section	Output source current	I <sub>SOURCE</sub>	Duty ≥ 95%, OUT=0V	-	-130	-80	mA
	Output sink current	I <sub>SINK</sub>	Duty ≤ 5%, OUT=5V	65	100	-	mA
	Output ON resistor	R <sub>OH</sub>	OUT = -15mA	-	18	30	Ω
	Output OFF resistor	R <sub>OL</sub>	OUT = 15mA	-	16	25	Ω
Charge ON/OFF Section	Active mode Threshold	V <sub>ONH</sub>		2.0			V
	Disable mode Threshold	V <sub>ONL</sub>				0.8	V

**Timing Chart**



**AT1452 Auto Refresh Mode**



**AT1452 Charge Toggling Refresh Mode**

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## DUTY Setting

The DUTY resistor selection depends on Duty Cycle , choose the component using the following equation:

$$V_{DUTY}(V) = 0.3 + \frac{DUTY}{1.15}$$
$$R_{DUTY}(K\Omega) = \frac{15}{\left(\frac{1.1}{V_{DUTY}}\right) - 1.073}$$

Example:

Set duty cycle is 50%

$$V_{DUTY} = 0.3 + \frac{0.5}{1.15} = 0.734$$

$$R_{DUTY} = \frac{15}{\left(\frac{1.1}{0.734}\right) - 1.073} \approx 35.2K\Omega$$

## Output Voltage Setting

$$V_{OUT} = \frac{R1 + R2}{R2} \times V_{FB}$$

$$V_{FB} = 1.1V$$

**Soft-Start Setting**

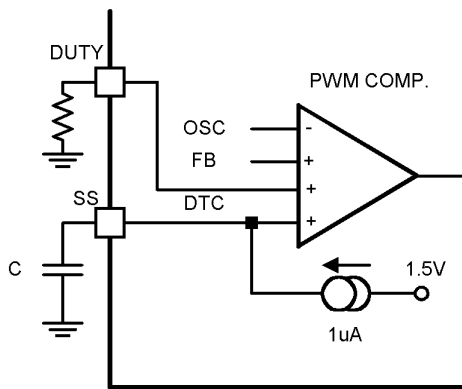
The soft start operation is determined by the capacitor connected to the SS terminal. It can calculate the soft start time  $T_s(s)$ .

$$C \times \frac{\Delta V}{\Delta t} = I \rightarrow C \times \frac{V_{DUTY} - 0.3}{\Delta t} = 1\mu A$$

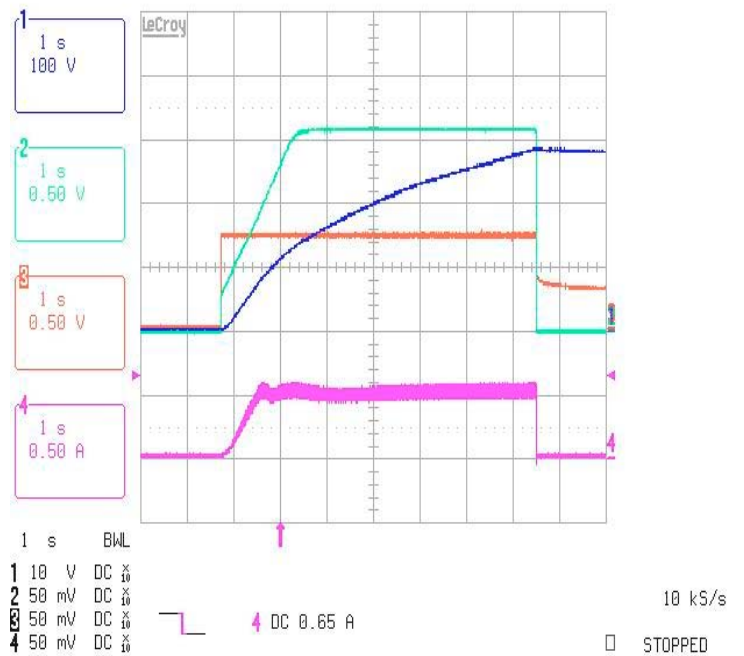
$$T_s(s) = (V_{DUTY} - 0.3) \times C(\mu F)$$

Example: (Fig C)

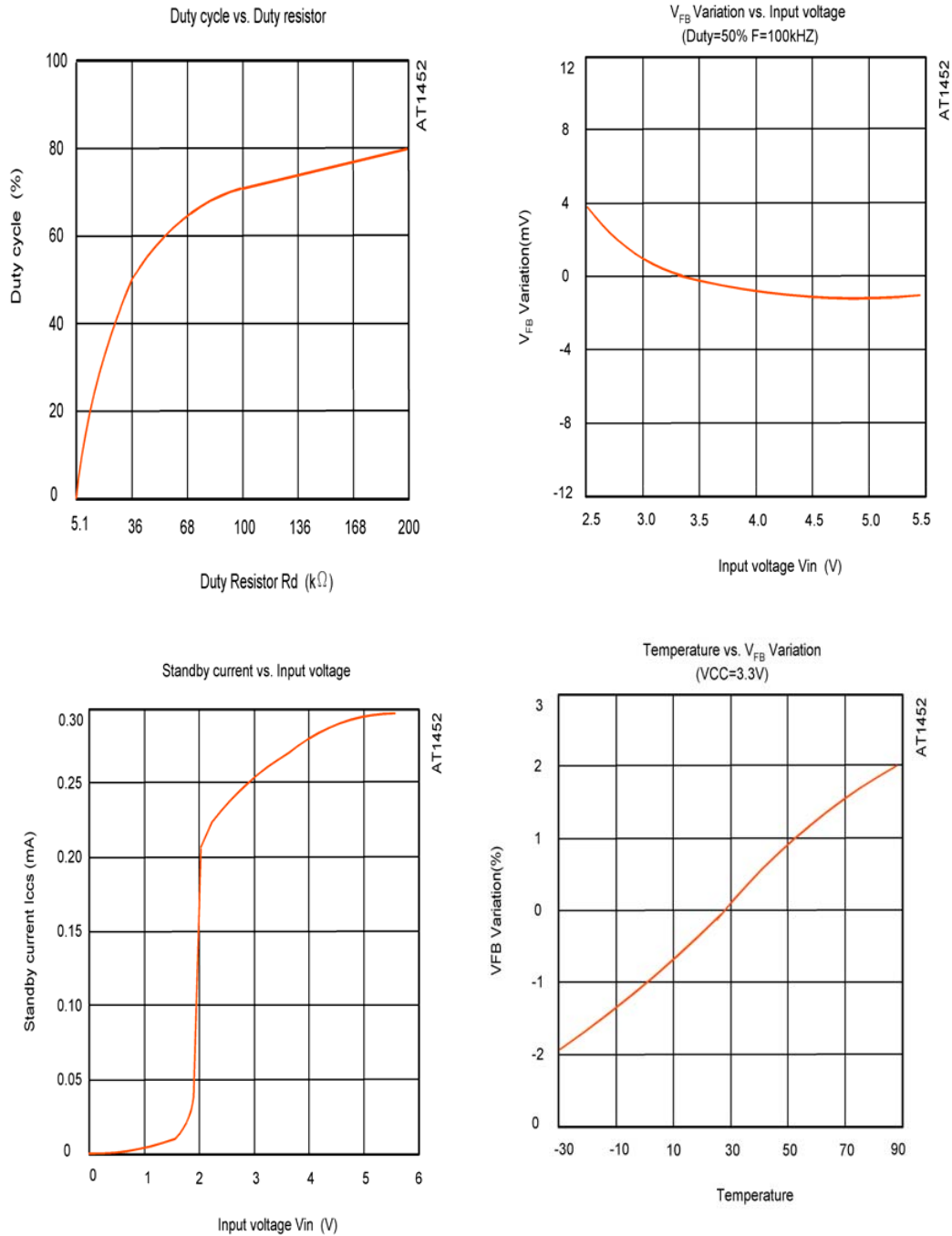
$R_5=47K \rightarrow V_{DUTY}=0.790V$   
 $\rightarrow T_s(s)=(0.790-0.3)*1=0.49(sec)$



CH1:V<sub>OUT</sub> CH2:SS CH3:DUTY CH4:I<sub>BAT</sub>



**Typical Curve**



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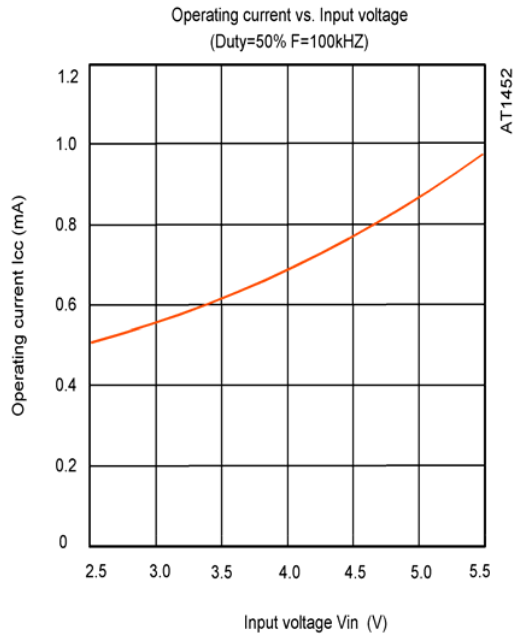
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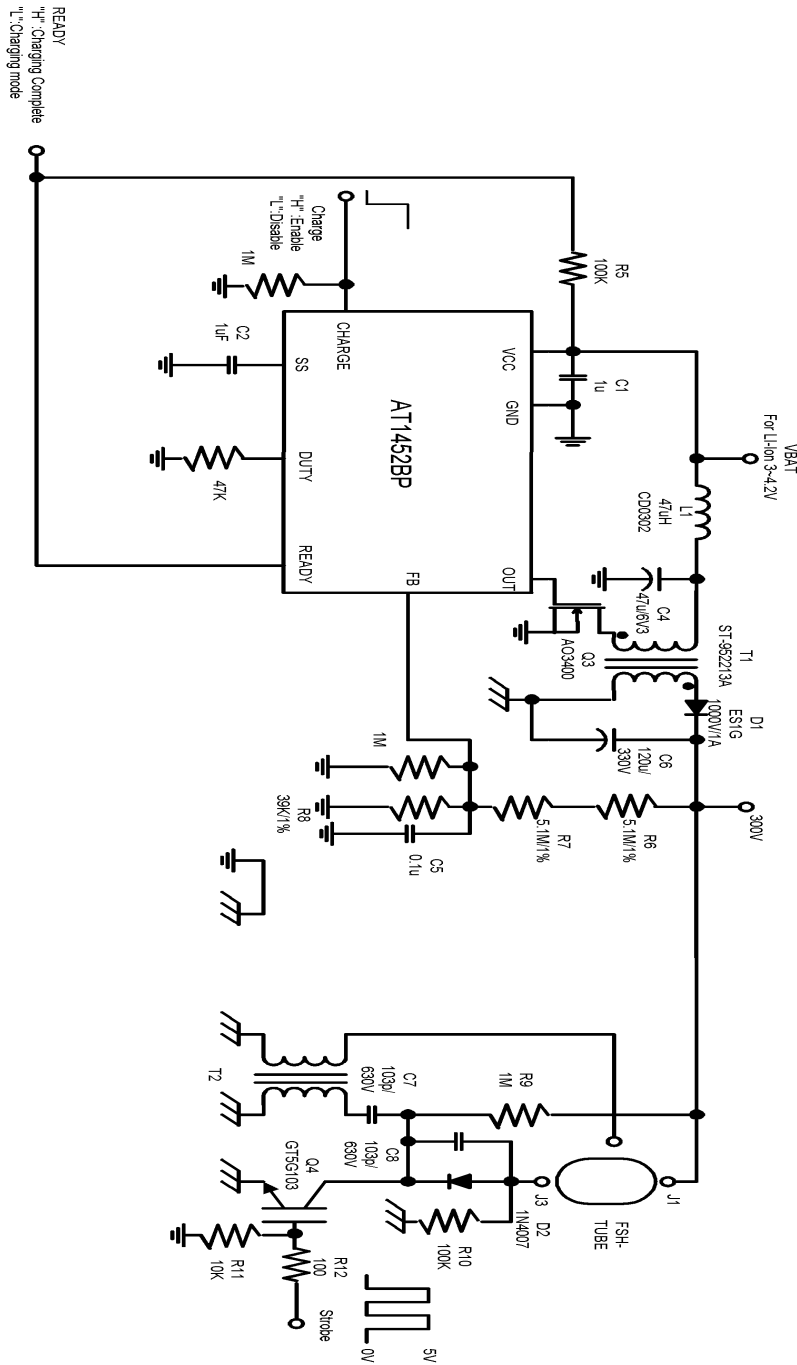








**(C) Li-Ion Application**



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CH1:CHARGE CH2:READY CH3:V<sub>OUT</sub>(300V) CH4:IBAT

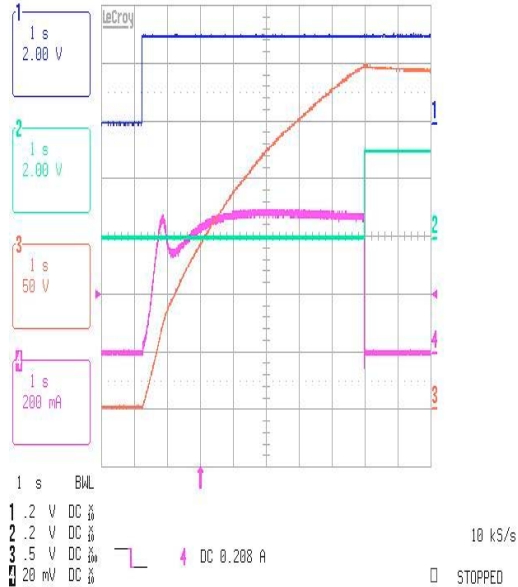


Fig 1. VBAT=3.0V

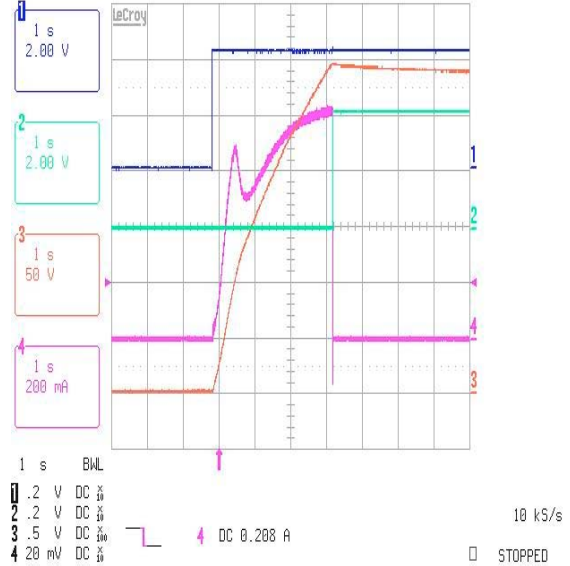


Fig 3. VBAT=4.2V

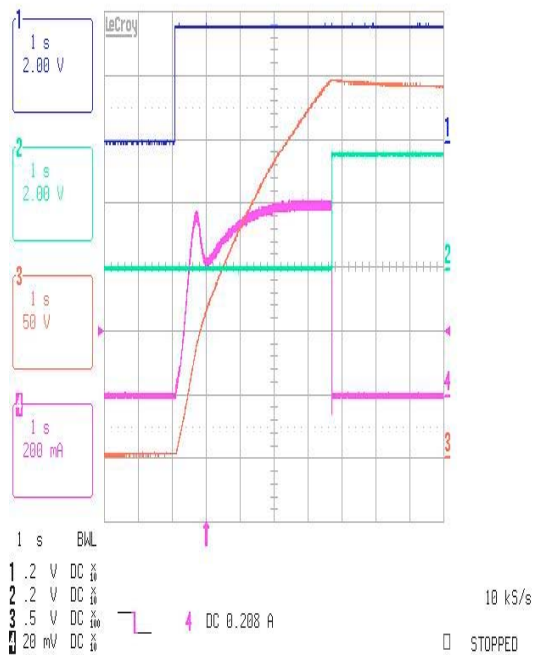
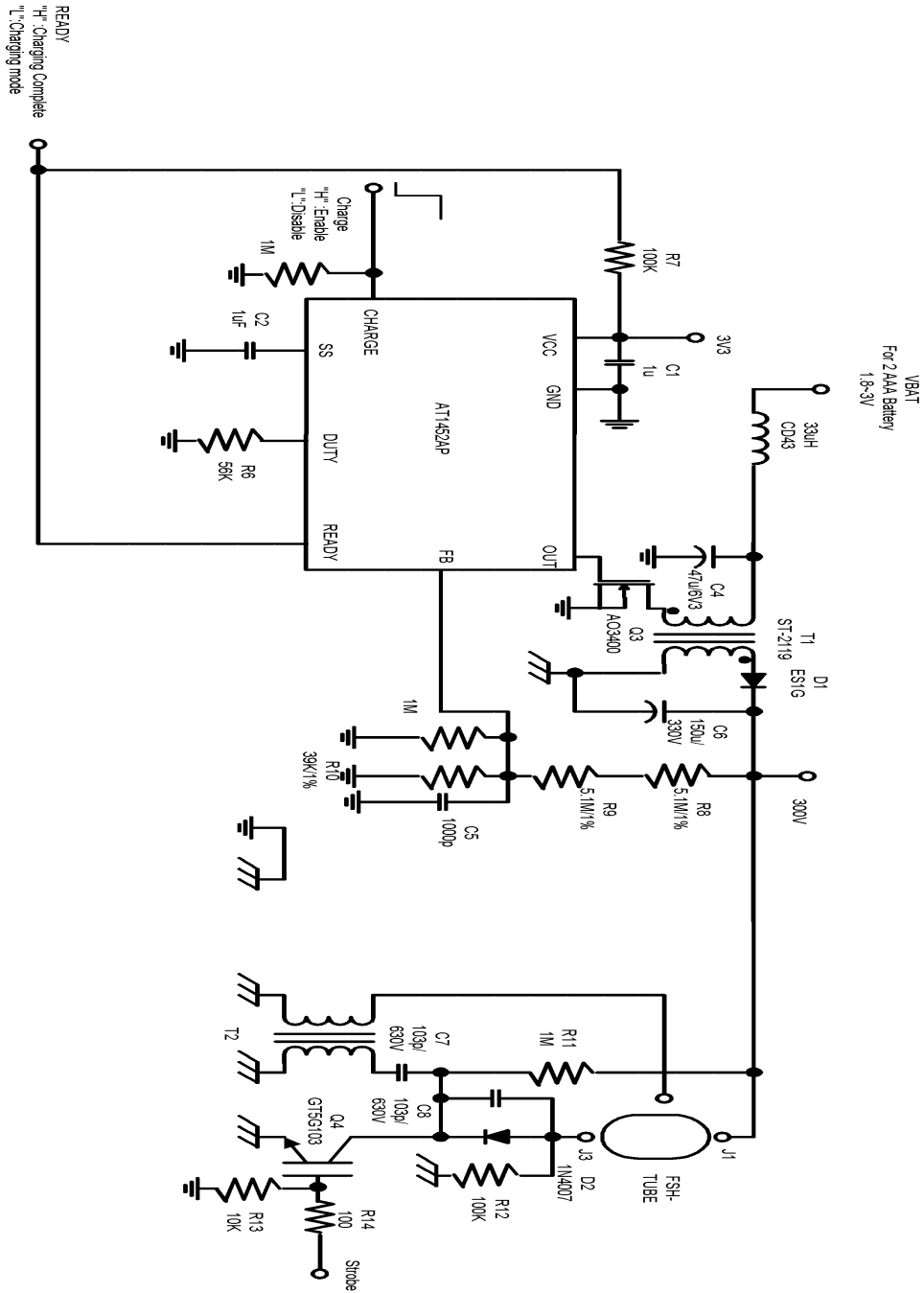


Fig 2. VBAT=3.6V

VBAT	Charge Time	Charge Input Current
3.0V	6.79s	500mA
3.6V	4.62s	600mA
4.2V	3.36s	800mA

\* RDUTY can be change the Input Current.

**(D) 2-Cell Battery Application**



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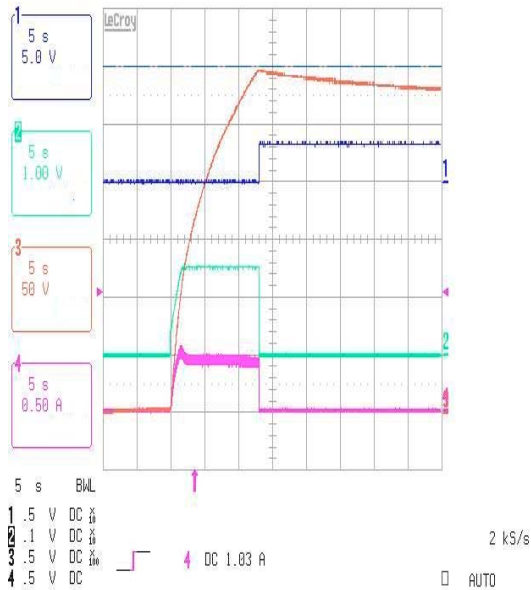
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CH1:READY CH2:SS CH3:VOUT(300V) CH4:IBAT



VBAT	Charge Time	Charge Input Current
3.0V	4.79s	800mA
2.0V	13.6s	500mA

\* RDUTY can be change the Input Current.

Fig 4. VBAT=2.0V

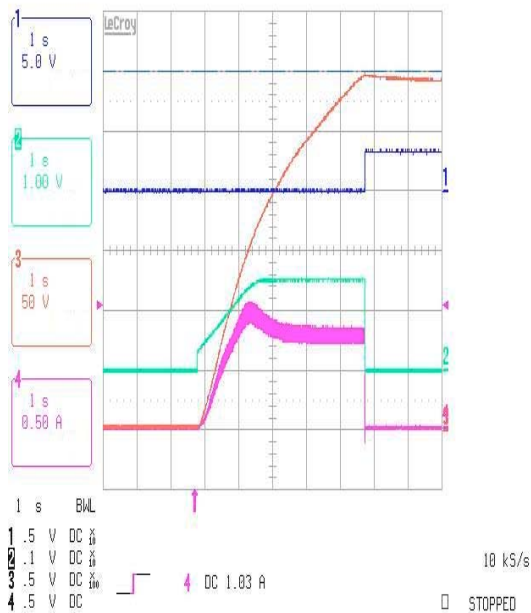


Fig 5. VBAT=3.0V

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**Application Information**

**Photoflash Capacitor Charger Charge Time:**

The energy stored in the output capacitor is:

$$E = \frac{C \times V^2}{2}$$

The output power required by the flyback converter to charge the capacitor in a period of time is:

$$P_{CAP} = \frac{E}{t} = \frac{C \times V^2}{2 \times t} = V_{IN} \times I_{AVG} \times D \times \eta$$

The approximate charge time for the converter circuit is:

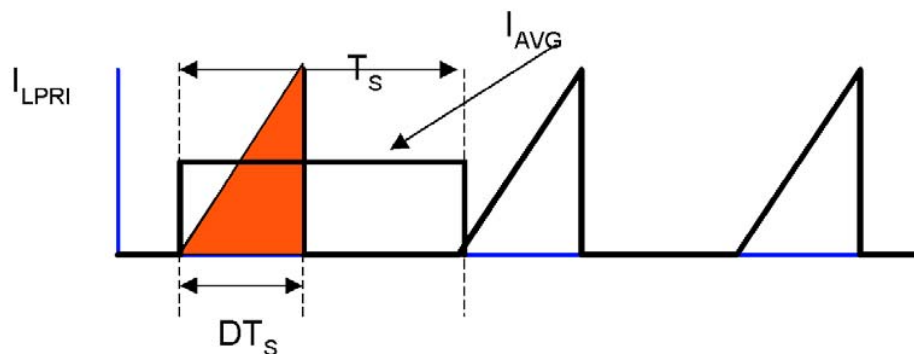
$$t = \frac{C_{OUT} \times V_{OUT}^2}{2 \times V_{IN} \times I_{AVG} \times D \times \eta}$$

Where:

- fs= Switching frequency
- D= Maximum Duty Cycle
- L<sub>PRI</sub>= Primary Inductance
- η= Efficiency

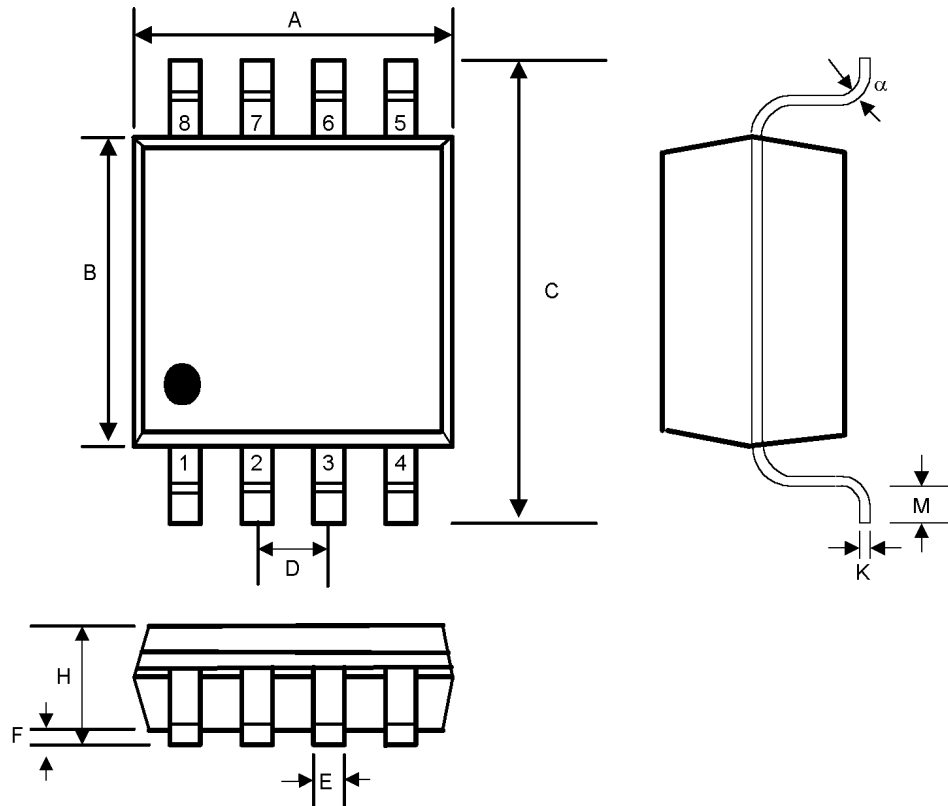
$$I_{AVG} = I_{BAT} = \frac{I_{PK} \times D}{2}$$

$$I_{PK} = \frac{V_{IN} \times D}{L_{PRI} \times f_s}$$





**Small Outline 8-pin TSSOP**



SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN	MAX	MIN	MAX	
A	0.114	0.122	2.90	3.10	-
B	0.169	0.177	4.30	4.50	-
C	0.244	0.260	6.20	6.60	-
D	0.026	BSC	0.65	BSC	-
E	0.010	0.012	0.25	0.30	-
F	0.002	0.006	0.05	0.15	-
H	0.041	0.047	1.05	1.20	-
K	0.005	BSC	0.127	BSC	-
M	0.020	0.028	0.50	0.70	-
$\alpha$	0°	8°	0°	8°	-

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