

1. Features

- Wide input AC range: 90Vac~264Vac
- Output power: 3W~5W
- Built-in power transistor
- Up to 80KHz operating frequency
- Adjustable cable compensation (3%~8%)
- Quasi-resonant turn on
- DoE(VI)/CoC tier2 compliant efficiency
- Less than 70mW standby power @230Vac
- Over temperature protection

- VCC over-voltage protection
- Output over-voltage protection
- Output short circuit protection
- Single fault protection

2. Applications

- Mobile phone chargers
- Cordless phone adapters
- LED driver
- Standby power supplies

3. Typical applications (5V/1A USB charger)

Parameter	Symbol	Value	Unit	Condition
AC supply	V_{AC}	90~264	V	
Output voltage	V_O	5	V	At cable end
Output voltage ripple	V_{RIPPLE}	<150	mV	At cable end
Output current	I_{OMAX}	1.08	A	
Switching frequency	f_{MAX}	50	KHz	At 5V/1.08A
Cable compensation	V_{cab}/V_O	3%		
No input load power	P_{NL}	<70	mW	Per energy star test method
Average efficiency	η	79%		At cable end
AC on time delay	T_{ON}	<3	S	At 90Vac

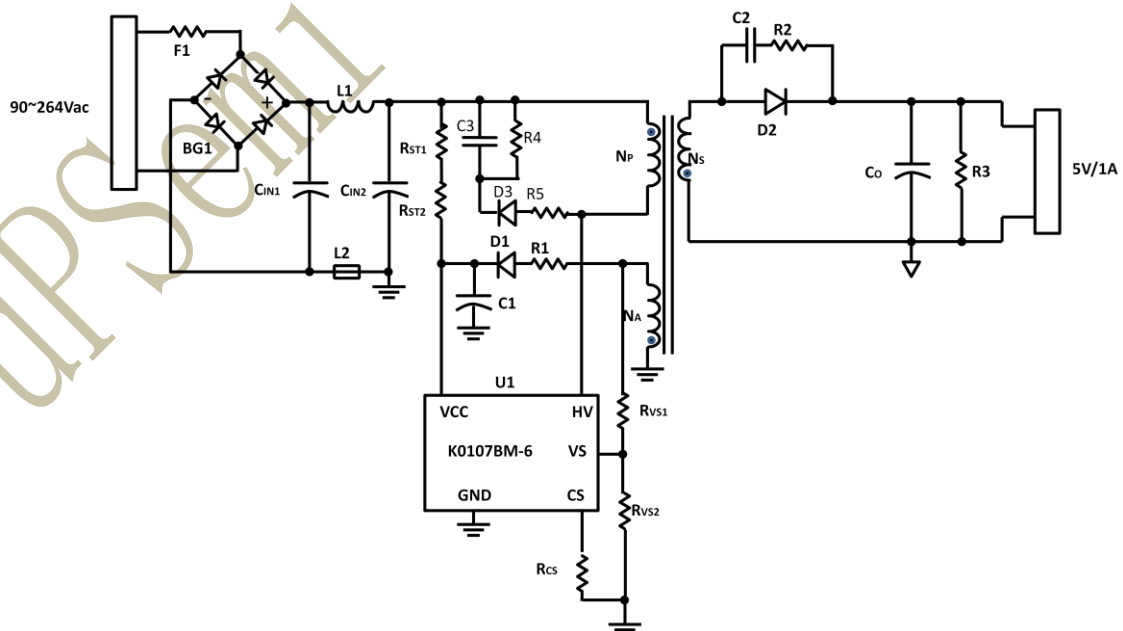


Fig.1 Application diagram

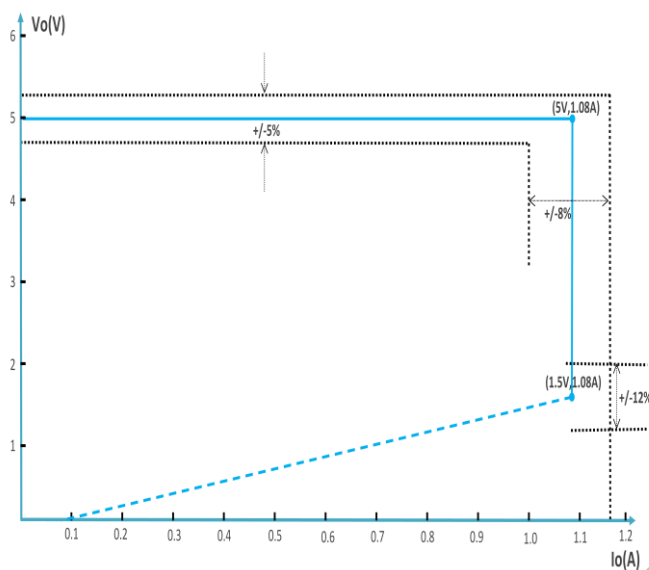
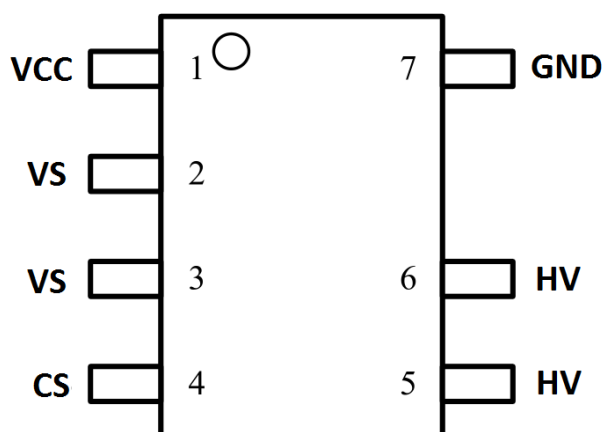


Fig.2 I-V curve of 5W USB charger

4. Pin definitions



K0107BM-6

Pin Name	Pin Type	Pinout	Pin Functions
VCC	Power	1	Supply of operating current of the controller
VS	Input	2	Voltage sense of secondary winding
VS	Input	3	Voltage sense of secondary winding
CS	Input	4	Current sense of BJT emitter current
GND	Ground	7	Ground
HV	I/O	5,6	Collector of the power BJT

5. Absolute maximum ratings (Note 1)

Parameter	Name	Range	Unit
Voltage range	HV	-0.5 to 800	V
Voltage range	VCC	-0.5 to 30	V
Voltage range	VS	-30 to 7	V
Voltage range	CS	-0.5 to 7	V
Voltage range(K)	OUT	-0.5 to 7	V
Maximum junction temperature	T _{JMAX}	150	°C
Lead temperature	T _{LEAD}	260	°C
Storage temperature	T _{STG}	-55 to 150	°C
ESD rating per ANSI/STM5.1-2001	HBM	2000	V
ESD rating per JEDEC JESD22-C101F	CDM	1000	V
Latchup test per JEDEC 78D		+/-200	mA

Note1: Stresses over those listed under “Absolute maximum ratings” may cause permanent damages to the device. These are stress ratings only. Functional operation beyond those under “Recommended operating conditions” is not implied.

6. Thermal parameter

Junction to ambient thermal resistance	θ_{JA}	140	°C/W
Over temperature protection	T _{OTP} *	160	°C

*Typical, guarantee by design

7. Electrical parameter

T_a=25 °C, unless otherwise specified

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Power supply(VCC pin)						
VCC overvoltage protection	VCC _{OVp}		35	37	39	V
Quiescent current	I _{CC}	VCC=12V	260	350	440	μA
Startup voltage	V _{ST}		12.75	15	17.25	V
Minimum operating voltage	V _{UVLO}		3.5	4.2	4.9	V
Startup current	I _{ST}	VCC=V _{st} -0.5V		0.4	0.6	μA
Constant voltage control (VS pin)						
VS regulation voltage	V _{FB}		4.05	4.1	4.15	V
Cable compensation current	I _{CAB}	At no load		50		μA
Sampling instant/T _{ONS}	T _{SAM} /T _{ONS}	@V _{CSMAX}		66		%

Min. operating frequency	f_{MIN}		71	83	95	Hz
Constant current control (CS pin)						
Max. shutdown voltage	V_{CSMAX}		500	525	550	mV
Min. shutdown voltage	V_{CSMIN}			300		mV
Leading edge blanking	T_{LEB}			360		nS
Maximum duty cycle	D_{SMAX}			0.5		
Protection functions						
Over temperature	T_{OTP}		130	160	190	°C
Output over voltage	V_{FBOVP}			5.3		V
Output short circuit voltage	$V_{FBHICUP}$			1		V

8. Functional block diagram

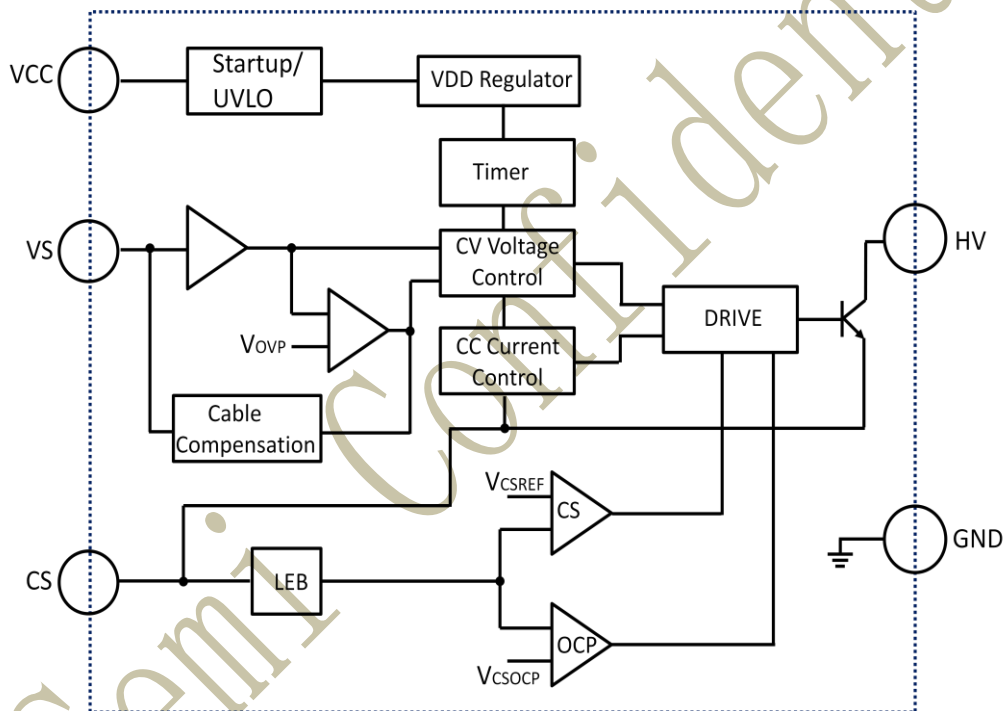


Fig.3, K0107BM-6 block diagram

9. Principle of operation

The K0107BM-6 is a high performance offline AC-DC switcher for charger and adapter applications up to 5W. The devices operate in Discontinuous Conduction Mode (DCM) with Primary Side Regulation (PSR) to achieve Constant Voltage (CV) and Constant Current (CC) in the whole load range.

9.1 Power up and power down sequences

Refer to Fig.2 and Fig.3, after AC power supply is applied to the converter, VCC capacitor C1 is charged via the startup resistors R_{ST1} and R_{ST2} . When VCC voltage reaches startup voltage V_{ST} , the switcher U1 starts to work. The built-in power transistor is turned on, and voltage on CS pin is

ramping up as the current through the primary winding generates voltage drop across the current sense resistor R_{CS} . When the CS pin voltage reaches V_{CSREF} after the Leading Edge Blanking (LEB) time T_{LEB} , the controller turns off the power transistor, then generates next turn on event according to the load conditions of the charger/adaptor. When the AC power is removed, there is no sufficient energy in the input capacitor C_{IN1} and C_{IN2} , the VCC voltage continues dropping. When VCC voltage drops below V_{UVLO} , the built-in power transistor is forbidden to be turn on, the controller waits for the VCC voltage to be higher than V_{ST} for a new round startup.

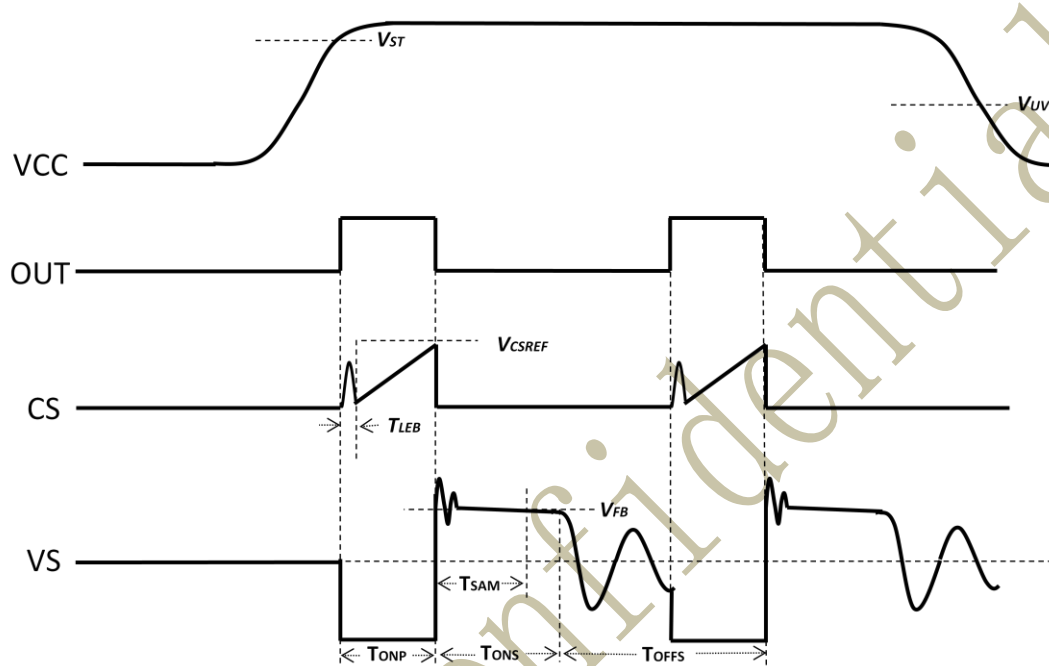


Fig.4, switching waveforms of typical application

9.2 Constant Voltage (CV) operation

Constant voltage operation occurs when the load is between no-load and full-load. Output voltage is sensed at the VS pin, which is connected to the auxiliary winding via resistors R_{VS1} and R_{VS2} . As shown in Fig.5, the VS waveform is sampled at T_{SAM} , around 2/3 duration of the secondary winding conduction time (T_{ONS}). The sampled voltage is regulated at V_{FB} by the voltage control loop. The CV output is determined by the resistors R_{VS1} , R_{VS2} and the turn ratio of secondary winding to auxiliary winding (N_s/N_A). Due to system ESD considerations, the sum of R_{VS1} and R_{VS2} is suggested in the range of $25K\Omega$ to $75K\Omega$. The VS pin sources a current which is inverse proportional to load current to generate cable compensation voltage. The cable compensation current at no load is I_{CAB} . The cable compensation voltage V_{CAB} can be adjusted by setting the R_{VS1} value. Neglecting the forward conduction voltage of the rectifier diode D2, the cable compensation voltage at full load is

$$V_{CAB} = I_{CAB} * R_{VS1} * (N_s/N_A)$$

The output voltage at cable end is approximately

$$V_O = V_{FB} * (1 + R_{VS1}/R_{VS2}) * (N_s/N_A) - V_D$$

The cable compensation percentage is approximately

$$V_{CAB}/V_O = I_{CAB} / [V_{FB} * (1/R_{VS1} + 1/R_{VS2})] = I_{CAB} * (R_{VS1}/R_{VS2}) / V_{FB} - 0.05$$

The 0.05 is to compensate the load regulation drop. In a typical 5V/1A charger system, $I_{CAB}=50\mu A$, $R_{VS1}=30K\Omega$, $R_{VS2}=25K\Omega$ generate about 5% cable compensation voltage at system output.

9.3 Constant Current (CC) operation

Output current is limited by the maximum ratio of secondary winding conduction time (T_{ONS}) to the switching period (T_{sw}). So

$$I_{OMAX}=0.5*(V_{CSMAX}/R_{CS})*(N_p/N_s)*D_{SMAX}$$

Where $D_{SMAX}=T_{ONSMAX}/T_{sw}=0.5$.

During the constant current operation, if the output voltage is lower than a specified voltage V_{sc} for 64mS(typical), the output is regarded as shorted to ground, the controller will go into hiccup mode (startup then shutdown repeatedly) until the output voltage is higher than V_{sc} again.

$$V_{SC}=V_{FBHICCUP}*(1+R_{VS1}/R_{VS2})*(N_s/N_A)$$

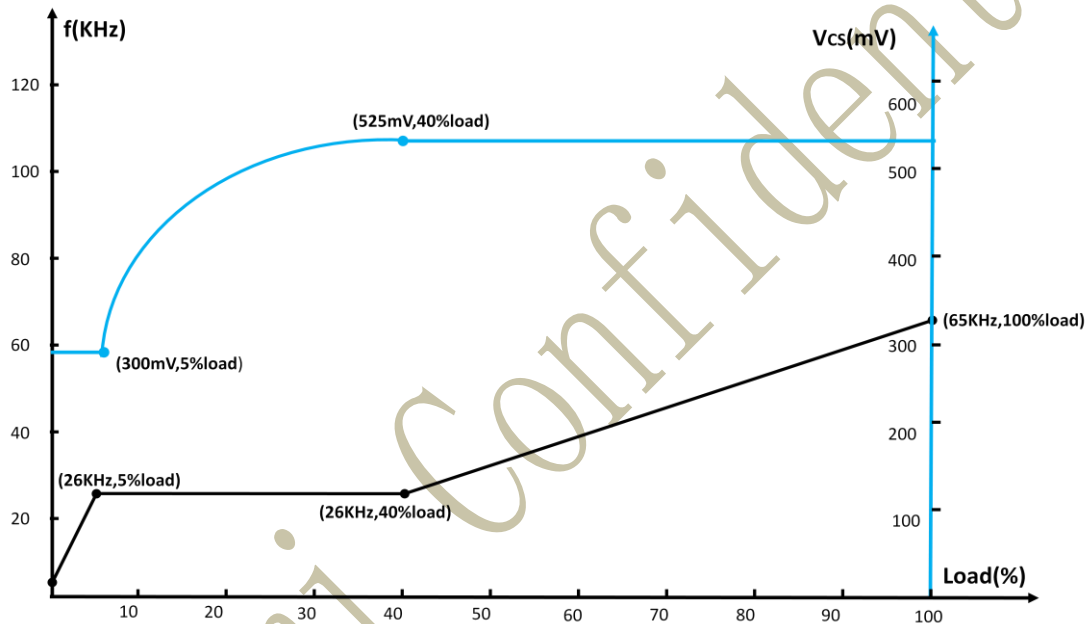


Fig.5, switching frequency and CS voltage vs. load current

9.4 Switching frequency control

The K0107BM-6 operates in Pulse Frequency Modulation (PFM) mode to control output voltage and current. As shown in Fig.6, the CS voltage (V_{cs}) at the power transistor turnoff instant varies from V_{CSMIN} to V_{CSMAX} when the load increases from no load to full load. Operating frequencies varies from around 100Hz at no load to 65KHz at full load, in the typical 5V/1A USB charger design. The power transistor turns on when the resonant ringing voltage is down to its valley (quasi-resonant switching). This can reduce turn on losses of the power transistor. It can also generate switching period jittering to reduce EMI.

9.5 Built-in output over voltage protection

When the output voltage is over a specified value V_{ovp} for 3 successive switching cycles, the internal output over voltage protection function works, power transistor will be turned off until a new startup event begins.

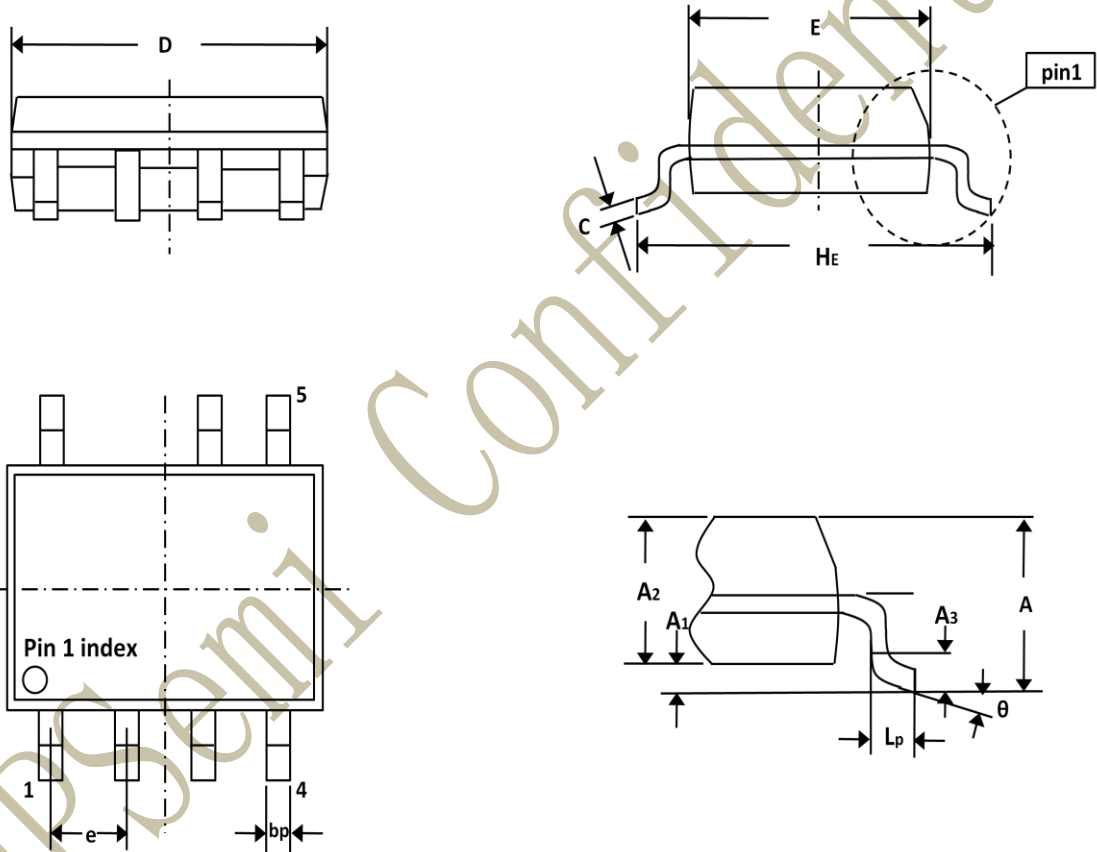
$$V_{OVP} = V_{FBOVP} * (1 + R_{VS1} / R_{VS2}) * (N_S / N_A)$$

10. Ordering information

Part number	Mark ID	Output power	Quantity per real	Package
K0107BM-6	0107BM-6	5W	4,000	SOP-7

11. Mechanical dimensions

SOP7



UNIT	A	A1	A2	A3	bp	c	D	E	e	HE	Lp	θ
mm	1.75	0.10/ 0.25	1.25/1.5	0.25	0.33/ 0.51	0.19/ 0.25	4.7/ 5.1	3.8/ 4.0	1.27	5.8/ 6.2	0.45/ 0.8	8°