CubicMOS

Low Input Voltage Boost DC/DC Converter With PWM Control & Built in LDO CM7213/A

General Description

CM7213/A is a compact step-up DC/DC conveter, with built-in current mode PWM control loop, to provide a stable and high efficient operation over a wide range of load current. It operates in both continuous and discontinuous current modes in stable waveforms.
The start-up voltage from 0.9V, output current 200mA, which is suitable for battery cell application. The 100KHz high switching rate minimized the size of external compenent. Two external resistors is needed for set the output voltage from 2.4V to 6V. Both 2A switch and driver for driving external power devices (NMOS or NPN)(CM7213)
CM7213A has built in a compensation pin to provide Low Noise switching for those application less than 200mA.
Built in a 100mA LDO, operate at 1.8V to 5V output voltage as a secondary low noise output as well as a output current stop in shutdown mode.

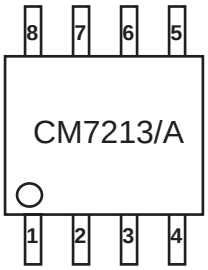
Feature

- ♦ 0.9V Low start-up Input Voltage
- ♦ Adjustable Output Voltage Range : 2.4V ~ 6V
- ♦ Built In Ramp Circuit for reduce output ripple
- ♦ High Supply Capability to Deliver 3.3V 200mA Output With 1.5V Input Voltage
- ♦ Provide Flexibility For Using External or Internal Power Switches
- ♦ Built in 100mA LDO
- ♦ Built in Current mode PWM Loop control

Applications

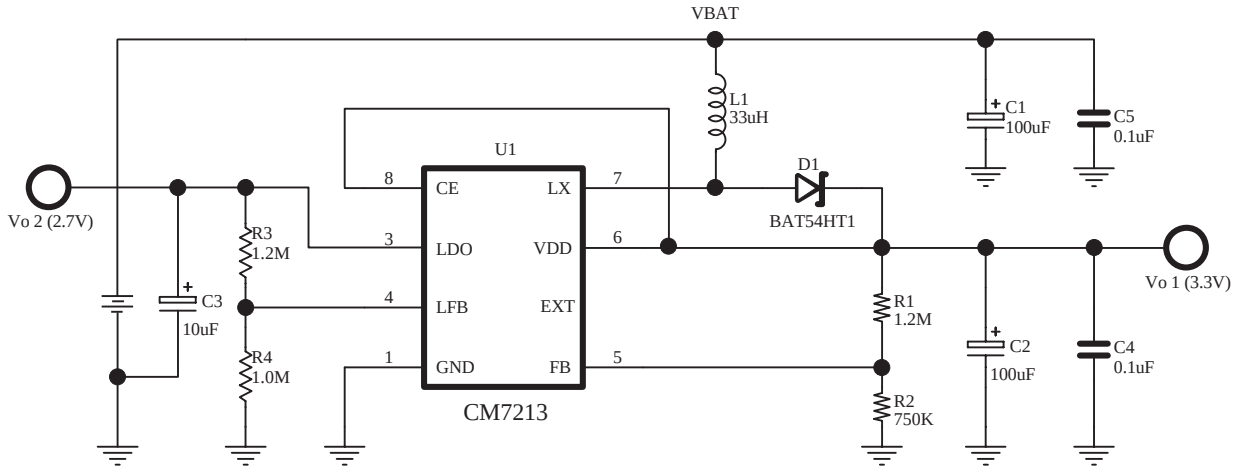
- ♦ All Single Cell or Dual Cell Battery Operated Products
- ♦ PDA
- ♦ Portable Equitment
- ♦ MP-3 Player

Pin Assignmant

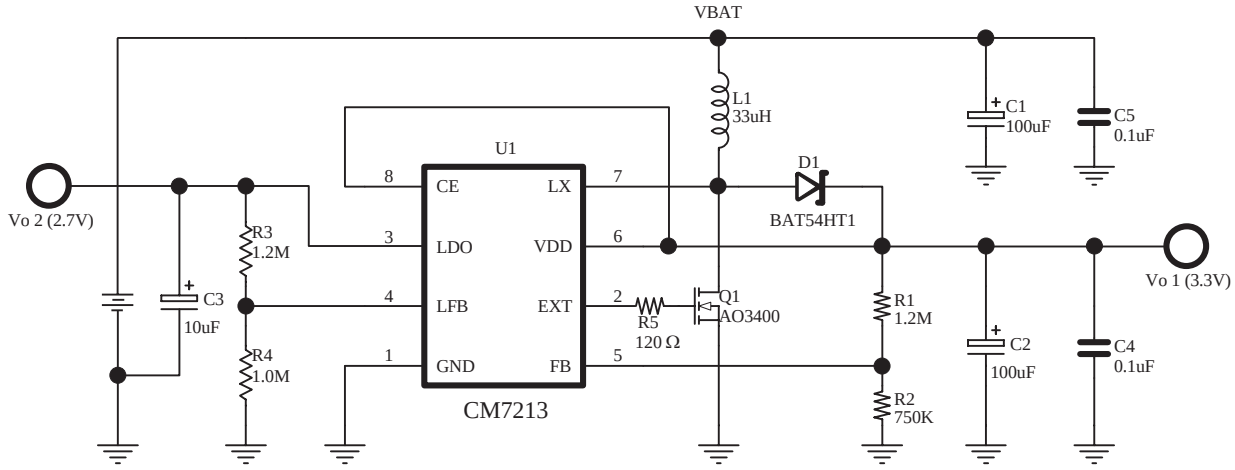


Pin No.	CM7213	CM7213A
1	GND	GND
2	EXT	COMP
3	LFB	LFB
4	LDO	LDO
5	FB	FB
6	VDD	VDD
7	LX	LX
8	CE	CE

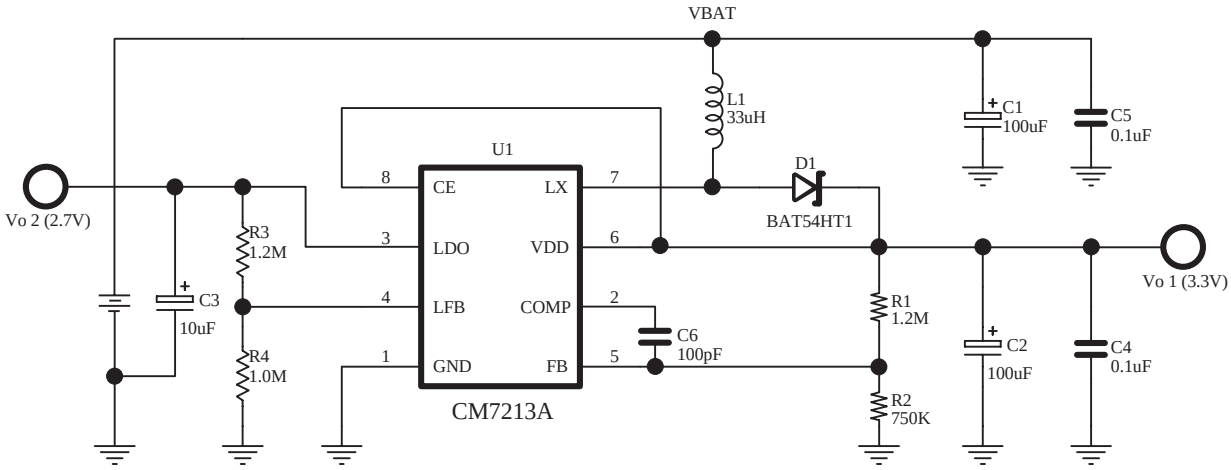
Application Circuit



(Fig. 1 Typical Application Circuit of CM7213)



(Fig. 2 Typical Application Circuit of CM7213 for more than 200mA output current)



(Fig. 3 Typical Application Circuit of CM7213A)

Pin Description

Pin No.	Pin Name	Description
1	GND	Ground
2	EXT (CM7213)	Output pin for driving external NMOS or NPN When driving a NPN, should added a resistor to limiting the based current
	COMP (CM7213A)	Compensation Pin of Error Amplifier for stabilize the switching activity
3	LFB	Feed back pin of LDO
4	LDO	Voltage output pin of LDO
5	FB	Feed back input pinI
6	VDD	Input Power (Positive)
7	LX	Switching pin
8	CE	Chip Enable

Electrical Characteristics

(VIN = 1.5V, VDD set to 3.3V, Load Current = 0, TA = 25 C)

Symbol	Parameter	Conditions	Min	Typical	Max	Units
V_{ST}	Start Up Voltage	I_L = 1mA	0.7	0.9		V
V_{DD}	Operating VDD Range	Start up to I_{DD1} > 250µA	0.7		6.0	V
I_{NOLOAD}	No Load Current (V_{IN})	V_{IN} = 1.5V, V_{OUT} = 3.3V		70		µA
$I_{SWITCH\ OFF}$	Switch Off Current (V_{DD})	V_{DD} = 3.3V		50		µA
I_{OFF}	Shutdown Current (V_{IN})	CE Pin = 0V, V_{IN} = 4.5V		0.1	1	µA
V_{REF}	Feedback Reference Voltage	Close Loop, V_{DD} = 3.3V	1.22	1.25	1.28	V
V_{REF}	Feedback Reference Voltage for LDO	Close Loop, V_{DD} = 3.3V	0.86	0.9	0.93	V
F_S	Switching Rate	V_{DD} = 3.3V	80	100	120	KHz
η	Efficiency	V_{DD} = 3.3V	90	92	94	%
I_{LIMIT}	Current Limit Setting	V_{DD} = 3.3V	1.5	2	3	A
ΔV_{LINE}	Line Regulation	V_{IN} = 1.5V, I_L = 10mA		5		mV/V
ΔV_{LOAD}	Load Regulation	V_{IN} = 2.5V, I_L = 1mA ~ 100mA		0.2		mV/mA
	LX ON Resistance			0.25	0.30	Ω
	EXT ON Resistance to $V_{DD\ (HI)}$	V_{DD} = 3.3V		50		Ω
	EXT ON Resistance to $G_{ND\ (LOW)}$	V_{DD} = 3.3V		40		Ω
	LDO PMOS ON Resistance	V_{DD} = 3.3V		3	4	Ω
V_{DROP}	LDO Drop Out Voltage	V_{DD} = 3.3V, I_L = 100mA		300	400	mV
	CE Pin Trip Level	V_{DD} = 3.3V		0.6	0.75	V
T_S	Temperature Stability for FB, LFB	Guaranteed by design		50		ppm/C
T_{SD}	Thermal Shutdown	Guaranteed by design	120	140	160	°C
ΔT_{SD}	Thermal Shutdown Hysterises	Guaranteed by design		10		°C

Application Note

Output Voltage Selection

The VOUT can be adjustable by connecting the FB pin to OUT due to internal resistor divider. In order to adjust the output voltage, a resistor divider is connected to VOUT , FB, GND Use the following equation to calculate:

R1 = R2(VOUT-VREF)/VREF
R2 = 50K ~ 1M

Where VREF = 1.25V and VOUT may range from 2.4V - 6.0V.

LDO Selection

The internal low-dropout linear regulator steps down the output from the step-up converter and reduces switching ripple. It is intended to power noise-sensitive analog circuitry, such as low-noise amplifiers and IF stages, and can deliver up to 100mA. However, in practice, the maximum output current is further limited by the current available from the boost converter and by the voltage differential between OUT and LDO. Use a 10µF capacitor with a low equivalent series resistance (ESR) at the output for stability. During power-up, the linear regulator remains off until the stepup converter goes into regulation for the first time.
Use the following equation to calculate :

R3 = R4(LDO-0.9)/0.9
R4 = 50K ~ 1M

Shutdown

The whole circuit is shutdown when CE is low. During shutdown mode, the current can flow from the battery to the output due to serial diode and inductor. VOUT falls to approximately Vin-0.35V and LX remains high impedance. The capacitance and load at OUT determine the rate at which VOUT decays Shutdown can be pulled as high as 6V. Regardless of the voltage at OUT.

Thermal Shutdown

The CM7213/A shut down when their die temperature reaches +140°C. Normal operationcontinues after the die cools by 10°C. This prevents damage if an excessive load is applied or the output is shorted to ground.

COMP

CM7213A has provide a compensation Pin for Error Amplifier. Connect a capacitor from COMP to FB. Startup time is set by the capacitance connected to this pin (0.833ms for each 100pF).

Component Selection

Inductor

The appropriate inductor for a given application is calculated using the following equation :

$$L = \left(\frac{V_{OUT}-V_{IN(min)}+V_D}{I_{LIMIT}} \right) T_{OFF}$$

Where V_D is the schottky diode voltage, I_{CL} is the switch current limit, and T_{OFF} is the switch off time. When using this equation be sure to use the minimum input voltage for the application, such as for battery powered applications.

Diode

To maintain high efficiency, the average current rating of the schottky diode should be large than the peak inductor current, I_{PK}. Schottky diodes with a low forward drop and fast switching speeds are ideal for increasing efficiency in portable applications.

Capacitor

Choose low ESR capacitors for the output to minimize output voltage ripple. Multilayers ceramic capacitor are the best choice. For most applications, a 100uF Ceramic capacitor is sufficient. For some applications a reduction in output voltage ripple can be achieved by increasing the output capacitor.

Component Supplier in recommend application circuits

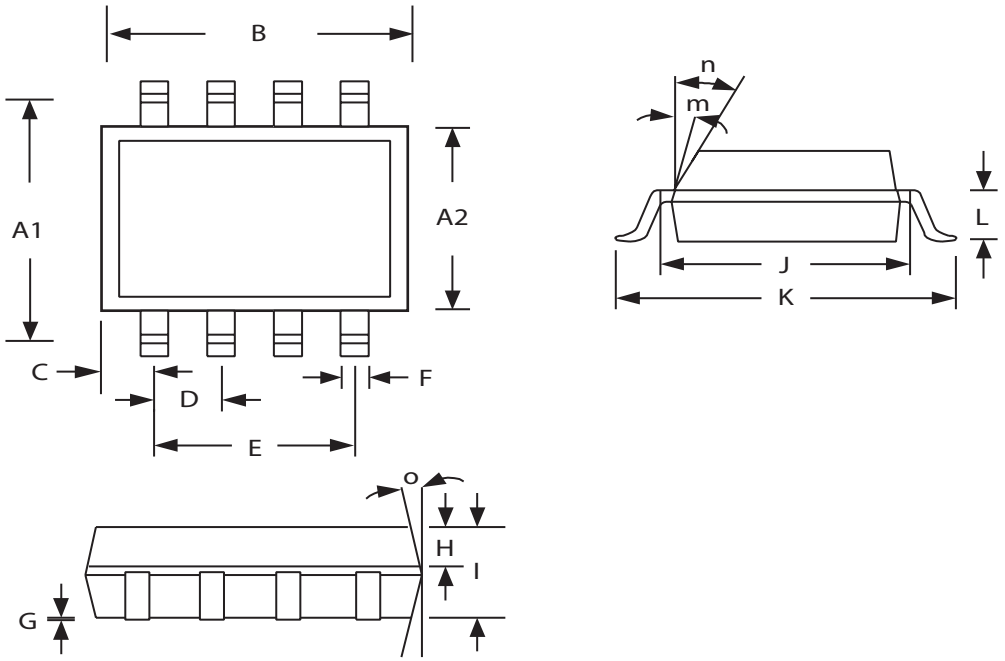
ITEM	SUPPLIER	PART NUMBER
L1	Cheng Yang (Taiwan) Taiyo Yuden (Japan)	BC73-330 LHLHL08TB330K
D1	ZOWIE (Taiwan)	BAT54HT1
C1, C2	Nichicon (Japan) Panasonic (Japan)	F931A107MCC EEJL0JC107R

Layout Considerations

Due to its high switching frequency and the high transient currents produced by the CM7213/A, careful board layout is necessary. A true ground plane and short connections to all capacitors will improve performance and ensure proper regulation under all conditions.

Package Dimension

SOP8



DIM	Millimeters		Inches	
	Min.	Max.	Min.	Max.
A1	4.80	5.00	0.190	0.200
A2	3.80	4.00	0.149	0.157
B	4.80	5.00	0.189	0.196
C	0.558		0.022	
D	1.2BSC		0.050BSC	
E	3.810		0.150	
F	0.33	0.51	0.013	0.069
G	0.152	0.202	0.006	0.008
H	0.406		0.016	
I	1.35	1.75	0.053	0.069
J	4.496	4.623	0.177	0.182
K	5.994	6.197	0.236	0.244
L	0.939		0.037	
m	7 °		7 °	
n	45 °		45 °	
o	8 °		8 °	