TEC103 Solar Phone Charger

Step-Up Converter and Charge Controlling from Solar cell to Li-Ion/Li-Pol cell

Features

- **Ultra-low-voltage DC-DC synchronous boost controller & Li-ion charge controller in a single chip**
- **Highest power conversion efficiency, up to 85%, from a single solar cell (~0.45v) to a Li-Ion cell**
- Real-time variable charge current proportional to collected solar power
- Photo voltaic cell is used at or close to the optimal power-point
- Ultra low standby current consumption of **12uA**, when no solar power available
- LED indication of solar charging
- **Circuit is automatically turned on only when solar cell can produce enough current**
- Circuit is automatically turned off when output current is low (< 1 mA)

Description

The TEC103 Solar Phone Charger is a synchronous boost controller and Li-Ion charge controller based on Techtium's TEC103 single-chip. It converts power with highest efficiency of up-to 85% from low level input voltages of a photo-voltaic (solar) cell (~0.45v) to a higher voltage output such as a portable device powered by one Li-Ion cell.

Applications

The TEC103 Solar Phone Charger circuit is designed to work best in **applications with PV cells that typically outputs more than 100mW** like:

- **Mobile Phones** with Solar charging
- **Li-Ion / Li-Pol power-pack** with Solar charging
- **Netbooks** with Solar charging
- **DSC & DVC** with Solar charging
- **MP4 & MP3** with Solar charging

Typical Application

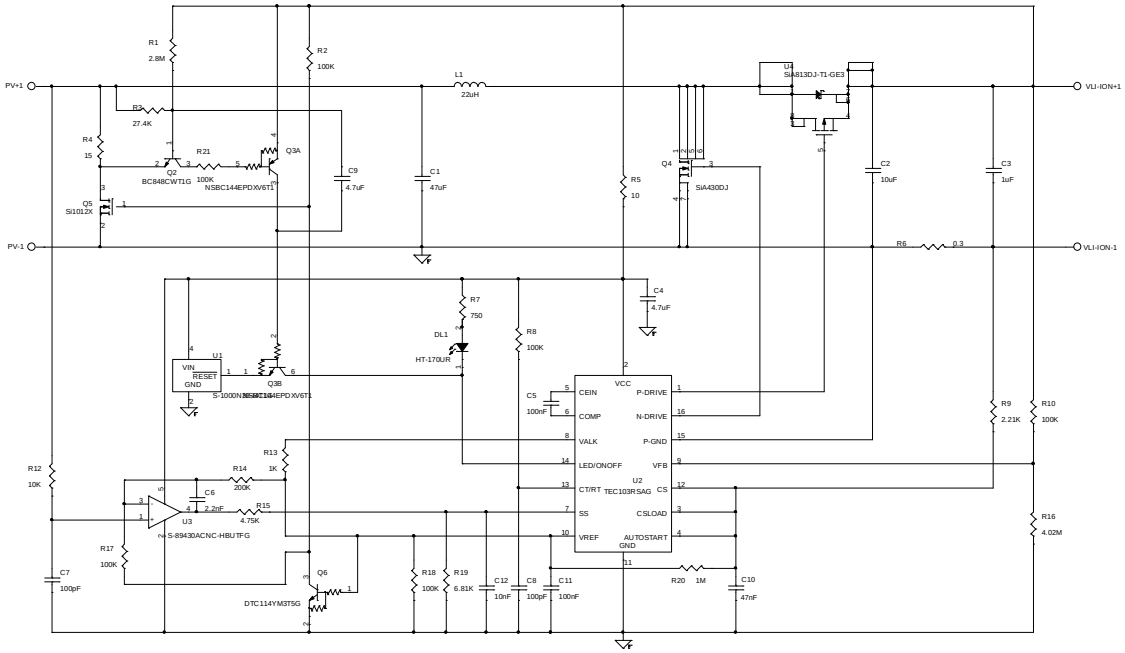
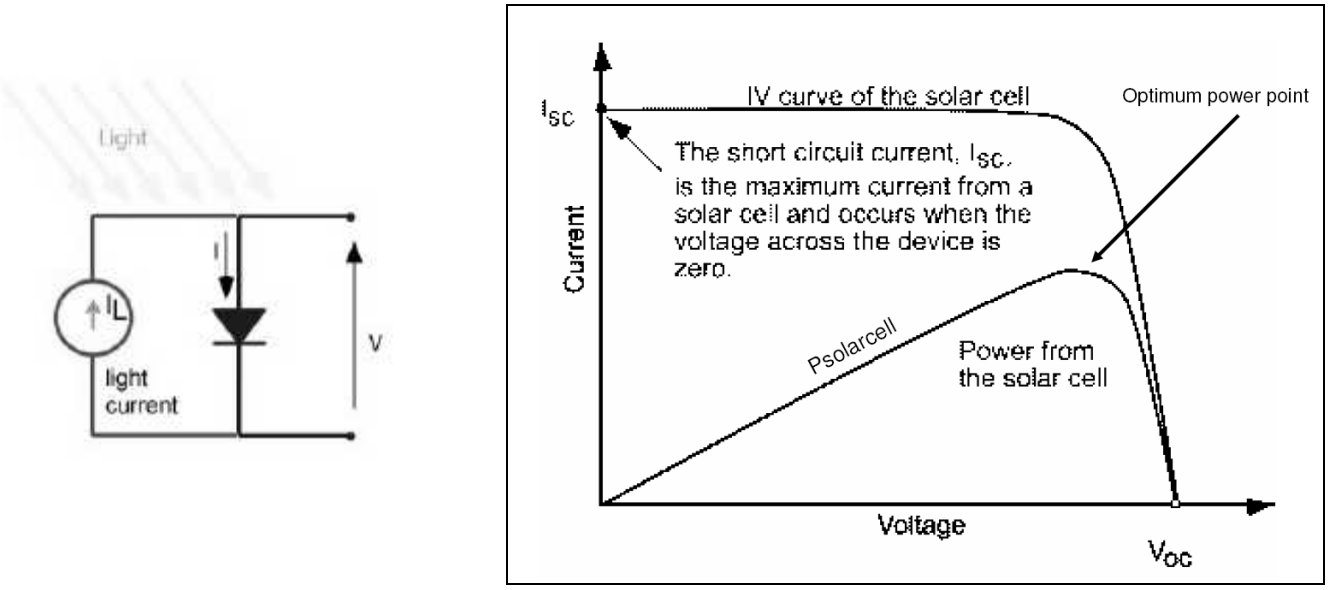


***Fig 1**: Solar application based on TEC103*

Doc. Number: **SB1-GEN2-PAN-11**

Solar Optimal Power Point



(a) *(b)*

***Fig. 2**: (a) photovoltaic cell model (b) IV curve and power from solar cell*

The application of Figure 1 is keeping the photovoltaic cell at a fixed voltage at which it will deliver maximum power. Figure 2 is showing the model and power curve of a photovoltaic cell. At no load, all light generated current (I_L) will go through the diode and the voltage will be Voc. The power Psolarcell will be zero (fig 2b) as no current delivered to the output. When the PVcell is shorted, the current is at maximum (Isc) and the delivered power (Psolarcell) is again zero, as the output voltage this time is 0V. Between this short- and open-PVcell there is a power-optimum. Typically Voc is diode voltage and about 0.5-0.6V. The optimum power point can be found at about 0.43V (@60 deg C).

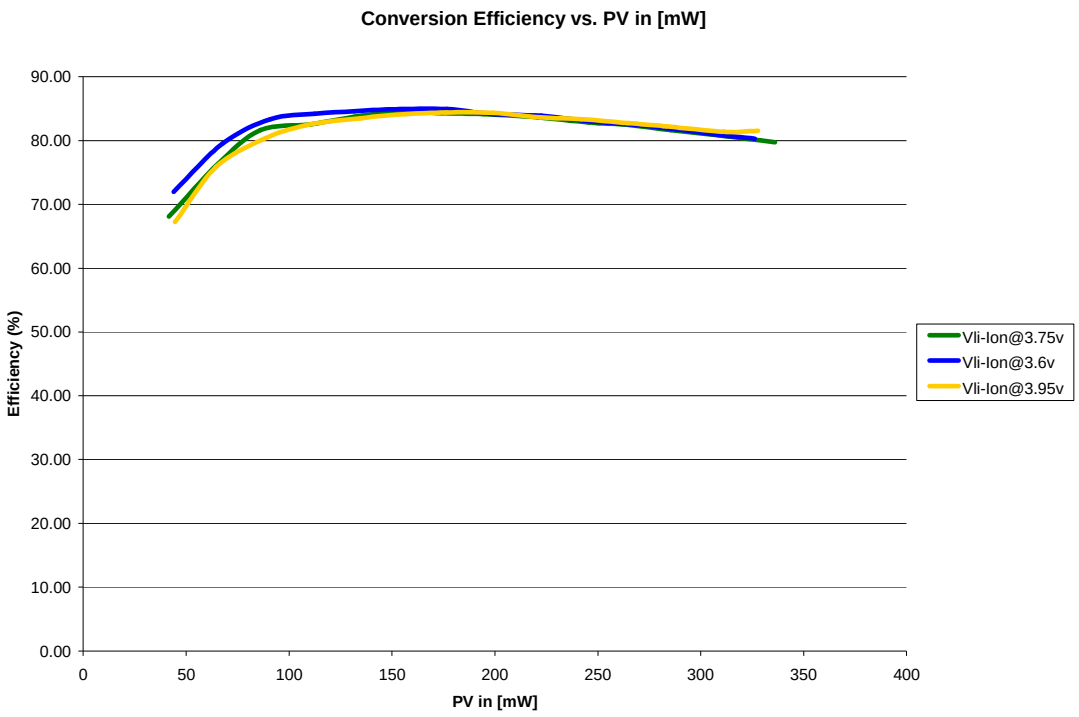
Technical Specification

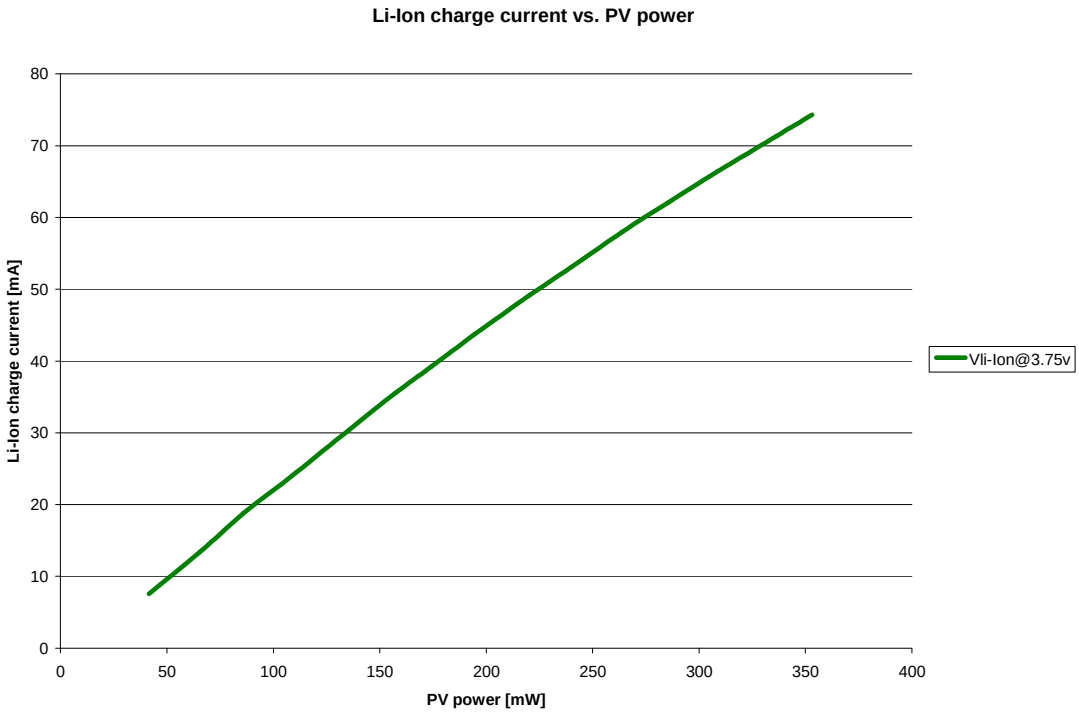
Parameter	NOTE	Test Conditions	Limits			Units
			Min	Typ.	Max	
PV input voltage	4			430		mV
Circuit output voltage	2,4		2.6		4.2	V
Circuit output current	1,4		0		220	mA
Circuit standby current consumption		Vli-Ion = 3.9v		12		uA
Circuit active current consumption		Vli-Ion = 3.9v		3		mA
Conversion efficiency				80		%
Auto-start conditions	4	PV voltage above VLi-Ion Above Vli-Ion Below Input Power Above		550 2.6 4.1 13		mV V V mW
Auto-stop conditions	4	Output Current below		1		mA
Maximum output voltage	2,3	VLi-Ion	4.175	4.2	4.225	V

Notes:

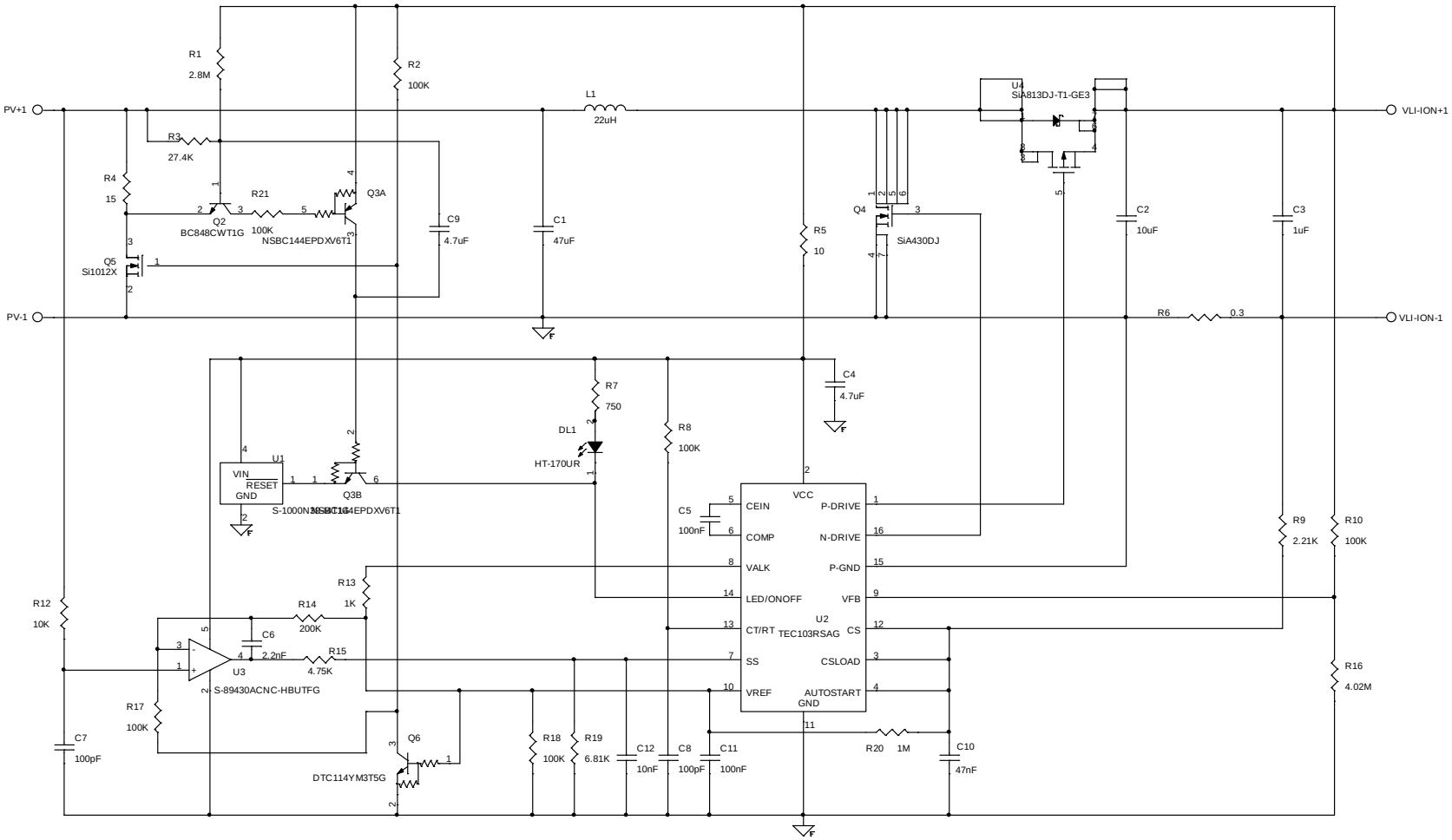
1) Proportional to collected power from the Solar cell
   For PV of 18cm^2; 15.8% power efficiency; Li-Ion voltage 3.3V and 25°C the maximum current is 68mA
   For PV of 18cm^2; 17.5% power efficiency; Li-Ion voltage 3.3V and 25°C the maximum current is 76mA
2) Output designed for proper Li-Ion voltage & current charging
3) Accurate End of Charge by Li-Ion voltage and current according to battery manufacturer recommendations.
4) All Parameters can be adjusted by component choice

Typical Performance





Schematic


PV+1
PV-1
VLI-ION+1
VLI-ION-1
R1
2.8M
R2
100K
L1
22uH
U4
SIA813DJ-T1-GE3
R3
27.4K
R4
15
R21
100K
Q2
BC848CWT1G
Q3A
NSBC144EPDXV6T1
C9
4.7uF
C1
47uF
Q5
Si1012X
R5
10
Q4
SiA430DJ
C2
10uF
C3
1uF
R6
0.3
C4
4.7uF
R7
750
DL1
HT-170UR
R8
100K
U1
VIN
RESET
GND
S-1000N
Q3B
NSBC144EPDXV6T1
C5
100nF
VCC
CEIN
COMP
VALK
LED/ONOFF
CT/RT
SS
VREF
P-DRIVE
N-DRIVE
P-GND
VFB
CS
CSLOAD
AUTOSTART
GND
U2
TEC103RSAG
R9
2.21K
R10
100K
R12
10K
R13
R14
1K
200K
C6
2.2nF
R15
4.75K
U3
S-89430ACNC-HBUTFG
R16
4.02M
R17
100K
C7
100pF
Q6
DTC114YM3T5G
R18
100K
R19
6.81K
C12
10nF
C8
100pF
C11
100nF
R20
1M
C10
47nF

Component List

Reference	Qty	Description	Package	Part Number	Vendor
Ceramic Capacitors					
C1	1	Capacitor 47uF 6.3V X5R 20%	0805	JMK212BJ476MG-T	Taiyo-Yuden
C2	1	Capacitor 10uF 10V X5R 20%	0805	LMK212BJ106MG-T	Taiyo-Yuden
C3	1	Capacitor 1uF 10V X5R 20%	0402	LMK105BJ105MV-F	Taiyo-Yuden
C4,C9	2	Capacitor 4.7uF 10V X5R 20%	0603	LMK107BJ475MA-T	Taiyo-Yuden
C5,C11	2	Capacitor 100nF 10V X5R 20%	0402	LMK105BJ104MV-F	Taiyo-Yuden
C6	1	Capacitor 2.2nF 10V X5R 20%	0402		
C7,C8	2	Capacitor 100pF 10V X5R 20%	0402	LMK0402BJ101MC-F	Taiyo-Yuden
C10	1	Capacitor 47nF 10V X5R 20%	0402	LMK105BJ473MV-T	Taiyo-Yuden
C12	1	Capacitor 10nF 10V X5R 20%	0402	LMK105BJ103MV-T	Taiyo-Yuden
Diodes					
DL1	1	SMD Red LED	0805	HT-170UR	Harvatek
Inductor					
L1	1	INDUCTOR 22 µH, CORE 58240, N=20T, WIRE=0.315mm	13*13mm	58240	Magnetics
Resistors					
R1	1	Resistor 2.8M Ohm 1%	0402		
R2,R8,R17, R18,R21	5	Resistor 100K Ohm 1%	0402		
R3	1	Resistor 27.4K Ohm 1%	0402		
R4	1	Resistor 15 Ohm 1%	0402		
R5	1	Resistor 10 Ohm 1%	0402		
R6	1	Resistor 0.3 1%	0805	WSL0805 0.3 1% RT1	Vishay
R7	1	Resistor 750 Ohm 1%	0402		
R9	1	Resistor 2.21K Ohm 1%	0402		
R10,R14	2	Resistor 200K Ohm 1%	0402		
R12	1	Resistor 10K Ohm 1%	0402		
R13	1	Resistor 1K Ohm 1%	0402		
R15	1	Resistor 4.75K Ohm 1%	0402		
R16	1	Resistor 4.02M Ohm 1%	0402		
R19	1	Resistor 6.81K Ohm 1%	0402		
R20	1	Resistor 1M Ohm 1%	0402		
Transistors					
Q2	1	General Purpose NPN Transistor	SC70-3	BC847CWT1G	ON
Q3	1	Dual PNP, NPN transistors	SOT563-6	NSBC144EPDXV6T1	On
Q4	1	N-Channel 20-V (D-S) MOSFET	POWERPAK -SC70-6_S	SiA430DJ-T1-GE3	Vishay
Q5	1	N-Channel 1.8-V (G-S) MOSFET	SC89-3	Si1012X	Vishay
Q6	1	NPN digital transistor	SOT723-3	DTC114YM3T5G	On
Integrated Circuits					
U1	1	3.9V - Low Voltage Detector	SNT-4A	S-1000N39-I4T1G	Seiko Instruments
U2	1	DCDC up converter	QFN-16_4x4mm	TEC103RSAG	Techtium
U3	1	RtoR op amplifier	SC88-5	S-89430ACNC-HBUTFG	Seiko Instruments
U4	1	P-Channel 20-V (D-S) MOSFET with Schottky Diode	POWERPAK -SC70-6_P	SiA813DJ-T1-GE3	Vishay

Notes

The selected components provide best performance at input power range of up-to ~350mW.

For optimizing Techtium application circuit for higher input power please contact Techtium.

For lower input power applications (e.g. Bluetooth headsets), please refer to Techtium's TEC103 Solar Headset Charger application notes (SB1-GEN1-PAN-xx).

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