MEDI’s two-phase inter-leaved switching MPPT

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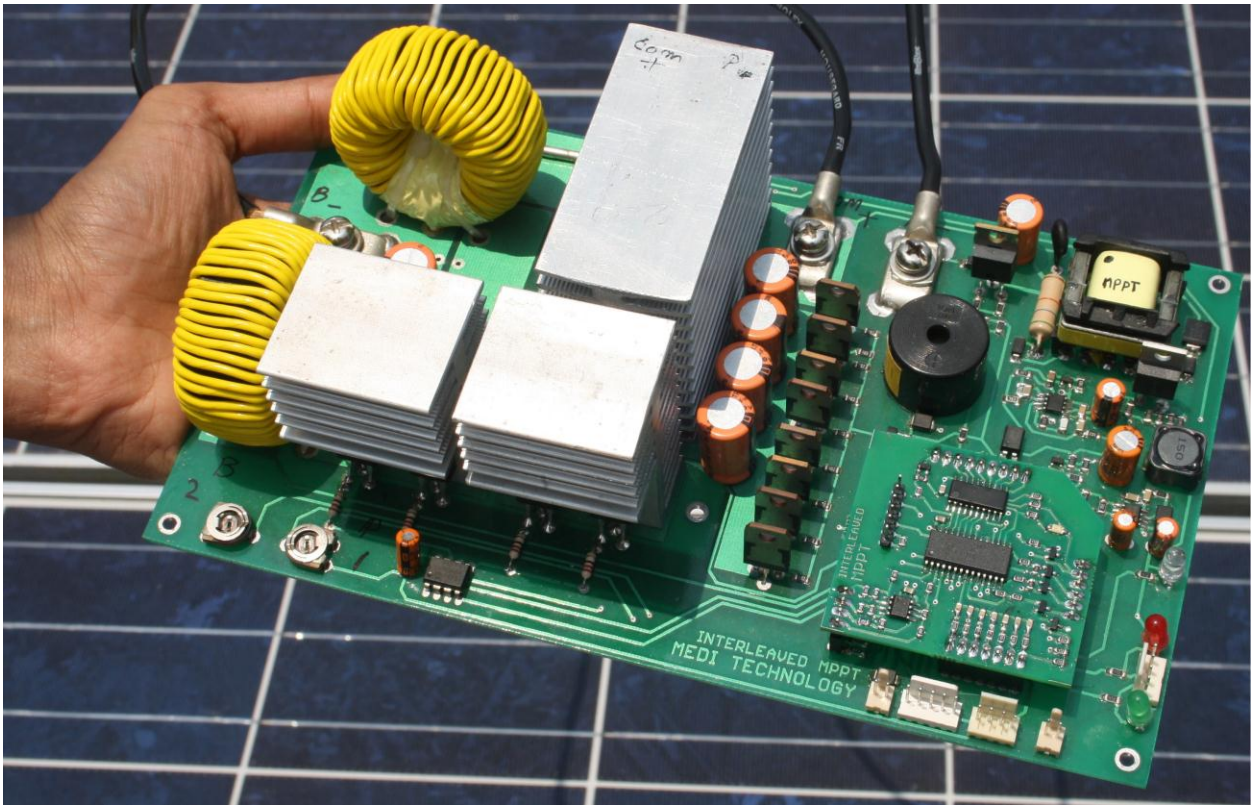
The power delivered by solar panels depend upon the current drawn, environmental conditions like temperature, solar radiation etc. Maximum Power Point Tracking (MPPT) is a method of extracting maximum available power from Solar Panel to load, batteries or devices like inverters etc.



2 Phase Interleaved MPPT PCB with SMD components

How it works?

Let us consider in a solar panel if we do not draw any current (i.e I = 0A), the voltage across the panel will be 22V. If we short circuit this panel, the current will be 10A and voltage across the panel will become 0V. In both the cases, we will get 0W from the panel.

i.e, 22V × 0A = 0W
and 0V × 10A = 0W

Note - The following values are not actual, these values are given only for understanding the principle of MPPT.

If we draw 0A from the panel, the panel voltage will be 22V. Output = 0W

If we draw 1A from the panel, the panel voltage will drop to 20V. Output = 20W

If we draw 2A from the panel, the panel voltage will drop to 18V. Output = 36W

If we draw 5A from the panel, the panel voltage will drop to 17V. Output = 85W

If we draw 8A from the panel, the panel voltage will drop to 16V. Output = 128W

If we draw 8.5A from the panel, the panel voltage will drop to 12V. Output = 102W

If we draw 9A from the panel, the panel voltage will drop to 2V. Output = 18W

If we short circuit the panel, current will be 10A and the panel voltage will drop to 0V.

Output = 0W

So, if you draw less current the panel voltage will be more and if you draw more current the panel voltage will be less. But the product (panel voltage × panel current) is more at a certain point. This point is called Maximum Power Point. This point will vary according to the intensity of the sunlight and the type of the panel.

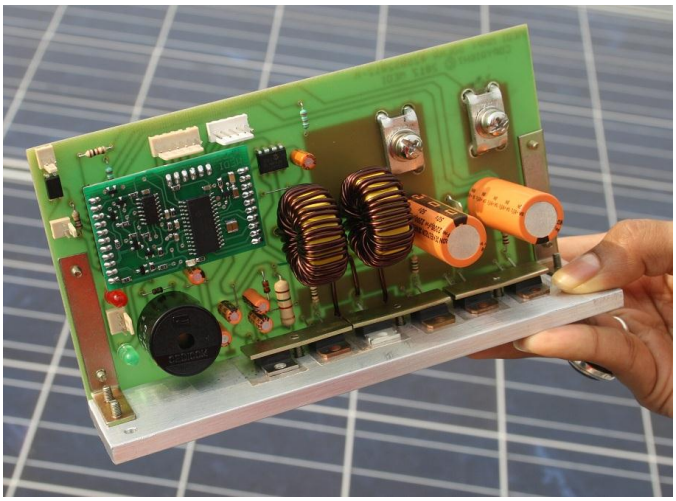
MEDI's MPPT topology

MPPT action in MEDI's two phase interleaved MPPT solar charger is done by shifted phase modulation in interleaved switching. The DSP will vary PWM duty cycle of interleave switching for obtaining the Maximum Power Point. The DSP will continuously multiply voltage and current from the panel while varying the duty cycle of interleave switching. At a particular duty cycle the maximum wattage (V × I) is obtained. The DSP will track this point continuously and ensures the working of MPPT Charger is always at this Maximum Power Point.

Since it is two-phase interleave switching, the Maximum Power Point Tracking will be more efficient than the conventional switching MPPT chargers.

The circuit is based on DSP. The DSP will intelligently calculate at what impedance the maximum power is transferred from the panel to the battery. The DSP will scan the impedance (i.e transformation ratio between the panel and battery) of the circuit from maximum to minimum and find out at which point the maximum power is delivered. Then the DSP fixes the impedance at that point.

With this method we get 20 – 30 % extra energy than the panel directly connected to the battery.



2 Phase interleaved MPPT PCB with through-hole components

Specification

Panel / Battery Voltage Range	
Total input voltage range	16V to 88V
Total output voltage range	10V to 60V
One Panel One Battery	
Panel voltage VMP	16V to 17.5; VOC : 22V
Battery voltage	12V
Charging current	60A Maximum
Battery full charge cut-off	Settable
Two Panels One/Two Batteries	
Panel voltage VMP	32V to 35; VOC : 44V
Battery voltage	12V or 24V
Charging current	50A Maximum
Battery full charge cut-off	settable
Three Panels Two / Three Batteries	
Panel voltage VMP	48V to 52.5; VOC : 66V
Battery voltage	24V or 36V
Charging current	40A Maximum
Battery full charge cut-off	settable
Four Panels Three / Four Batteries	
Panel voltage VMP	64V to 70; VOC : 88V
Battery voltage	36V or 48V
Charging current	40A Maximum
Battery full charge cut-off	settable

Features

- DSP based two phased interleaved switching.
- Control device – DSP
- Power topology – two phased interleaved switching
- Switching element – MOSFETs
- Charging algorithm – Four-level charge with MC, CV, Release and Trickle.
- Isolation - No isolation, positive is common
- Switching frequency in each phase is 18KHz, resultant switching frequency in the final output 36KHz.
- Low ripple current in input and output due to inter-leaved switching.

Protections

- Panel reverse protection
- Battery full charge cut-off
- Lightning protection
- Battery reverse protection (optional)
- Power consumption from battery during night (when no panel voltage available) < 0.02W

Technical know-how cost – Rs.1,50,000
Assembled and programmed DSP module – Rs.850
BOM of 24V 40A MPPT = Rs.2000 including DSP module of Rs.850.