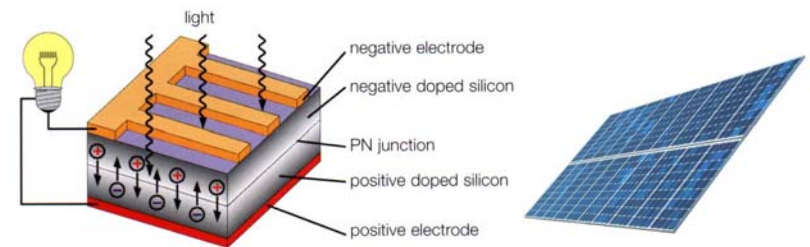


PV-Based Battery Charger Project

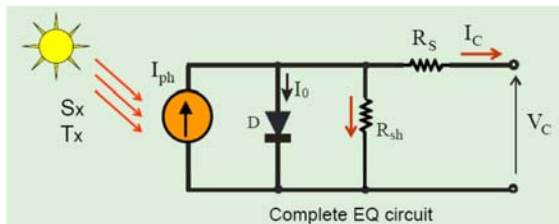
- Charger for a 12V lead-acid battery (max. 2A charging current, a BP7-12 VRLA battery manufactured by B. B. Battery will be provided) from a widely-variable dc input source (10V-24V? your decision) such as a solar panel
- (Non-isolated, i.e. no isolation is needed)
- Safe to use (no overheating, no explosion, sufficient protections... your design)
- Efficient
- Reliable
- Economical ...

Photovoltaic Cells

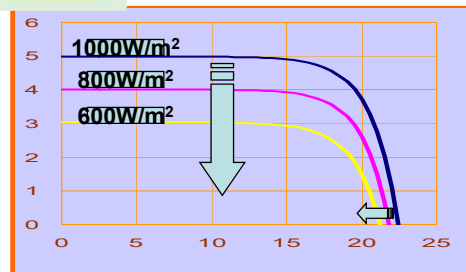
- Solar cell operation is based on the ability of semiconductors to convert sunlight directly into electricity. In the conversion process the incident energy of light creates mobile charged particles in the semiconductor, which are then separated by the device structure and produce electrical current.



Characteristics of PV Cells

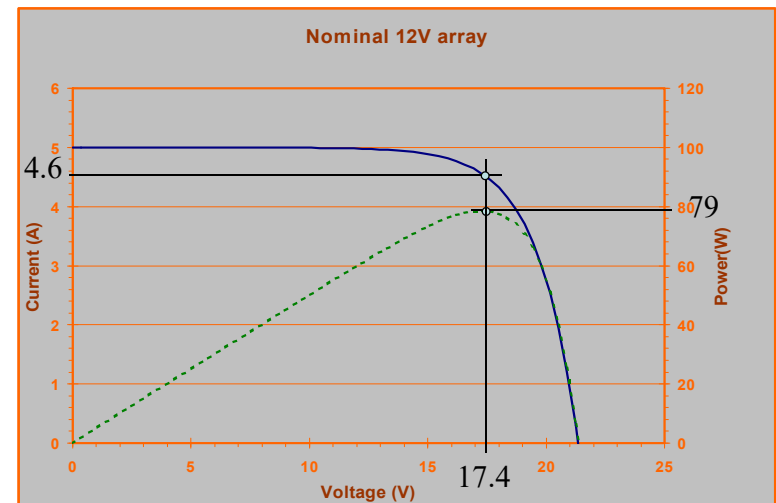


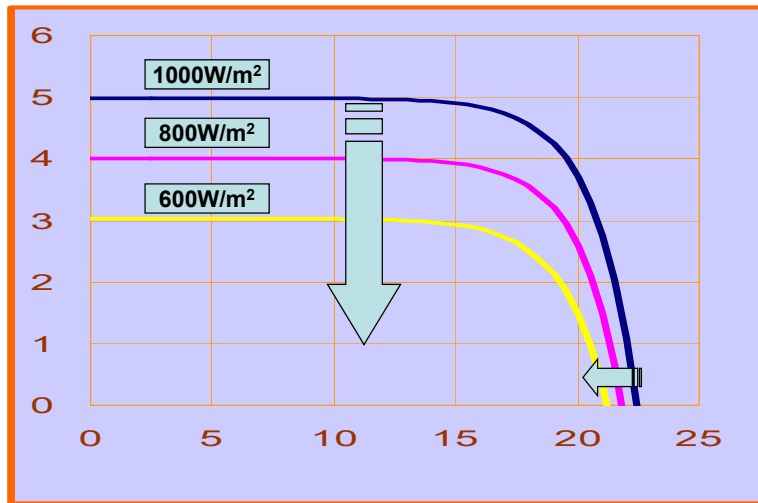
$$I_c = I_{ph} - I_0 \left\{ \exp \left[\frac{e}{kT_c} (V_c + R_s I_c) \right] - 1 \right\} - \frac{V_c + R_s I_c}{R_{sh}}$$



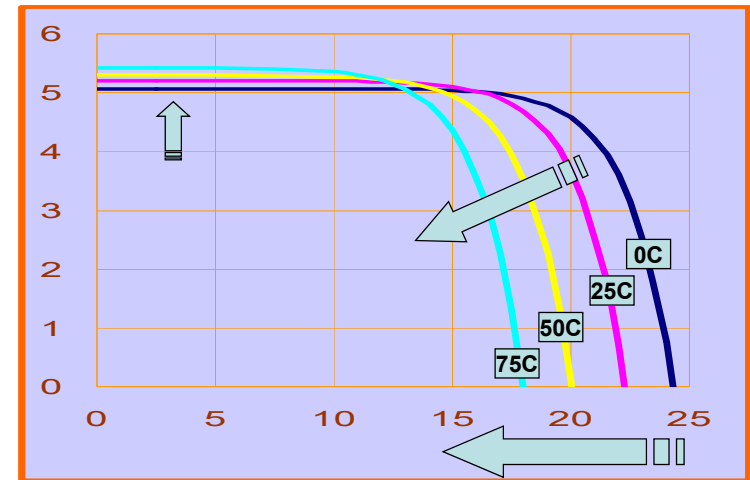
VI Characteristic Curve

- wide range of output voltage



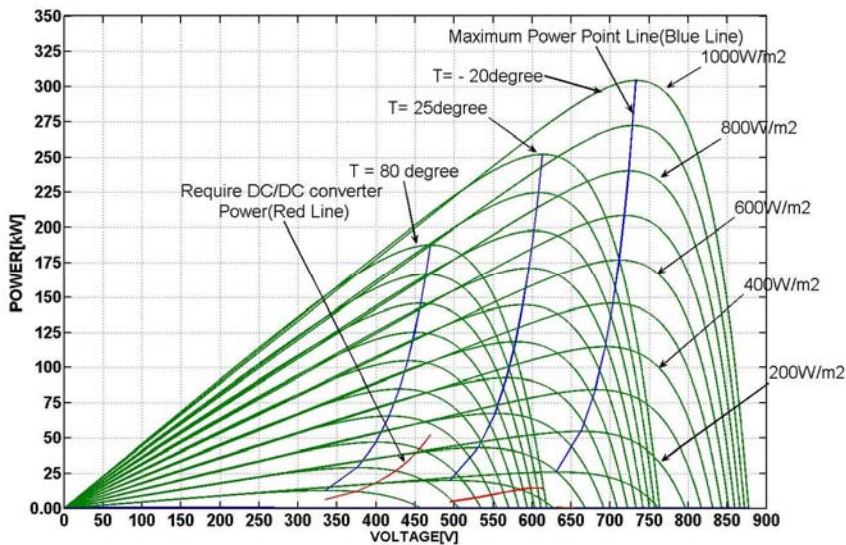


Effect of Temperature



This characteristic is important in determining the dc voltage window of grid connected inverters

Power – Voltage Curves of PV Plant



PV Modules Intended for ECE3031

EPOD-1

Thin Film Amorphous Laminate.



Technical data

Electrical data*

Initial nominal power ¹	16.5Wp
Specified minimum stable power ²	13.2W
Voltage open circuit [TYP]	24V
Voltage at nominal power	16.8V
Current at nominal power	0.8A
Max. DC system voltage	1000V

■ Although we intend to use PV as the input source for battery charging, we will use a variable dc power supply in our labs instead due to the low output of PV panels in a room.



Battery and Charger



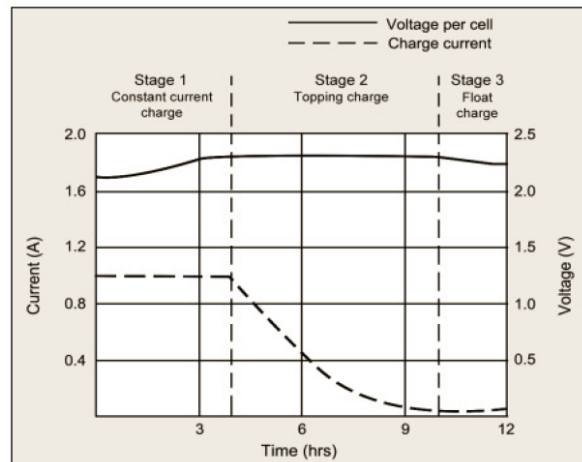
Battery Charging Strategy

- Getting the charge fast and safely
- Charging to full capacity
- Knowing when to terminate

General Lead-Acid Battery Charging Scheme -- Multi-Stage Charging

- Constant current (bulk charging) about half charging time, 70% capacity
- Constant voltage (topping charging) getting to full charge, current dropping
- Float charging (reduced voltage applied) obtain and maintain maximum capacity

Charging Stages of Lead Acid Batteries

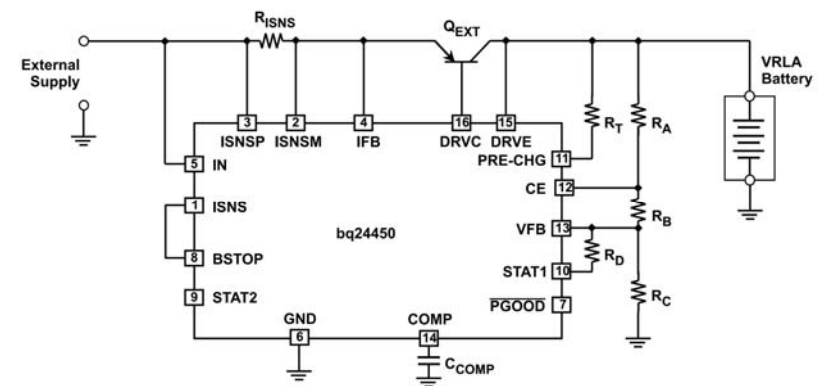


Stage 1: Voltage rises at constant current to V-peak.

Stage 2: Current drops; full charge is reached when current levels off

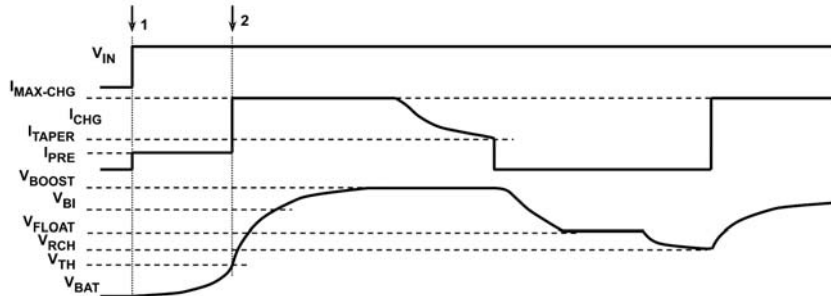
Stage 3: Voltage is lowered to float charge level

Charge Controller IC Example



- Optimum multi-stage charging, plus
- Pre-charge for deeply discharged batteries
- Temperature compensation

Typical Charging Cycle - managed by a charger



Direction of Improvement		Planning Matrix													
		Performance measures				Technical details									
Technical Requirements		Importance (1-5)	Meet Canadian Standards	Efficient	Weight and size	2A charging current	Number of solar panels	Our Product	PowerStream	Noco	Planned rating	Importance Factor	Sales point	Overall weighting percentage of total	
Customer Requirements	easy to use	3			△			4	4	3	4	1	1.1	3.3	8.3
	cost efficient	4	●		△	□		4	3	3	4	1	1.2	4.8	12
	storage	2			□	□		3	4	3	4	1.2	1.1	2.8	6.8
Performance	Lightweight	3			●		△	3	2	3	3	1	1.1	3.3	8.3
	Safe	5	●			△		4	4	3	5	1.2	1.2	7.2	18
	Robust	5		□				4	3	2	5	1.2	1.5	9	23
	One way current	4		●		●		4	3	4	5	1.2	1.5	7.2	18
	Appearance	2			□	□		1	2	2	2	1.2	1	2.4	6
Technical Priorities		54	123	54	62	34									
Percentage of total		17	37.59	17	19	10									
Technical	Our Product	Y	90	S	2	1									
	PowerStream	Y	85	S	1.5	0									
Benchmarking	Noco	Y	80	S	0.8	0									
	Design Targets	Y	90	S	2	1									

● = strong 9
□ = medium 3
△ = weak 1