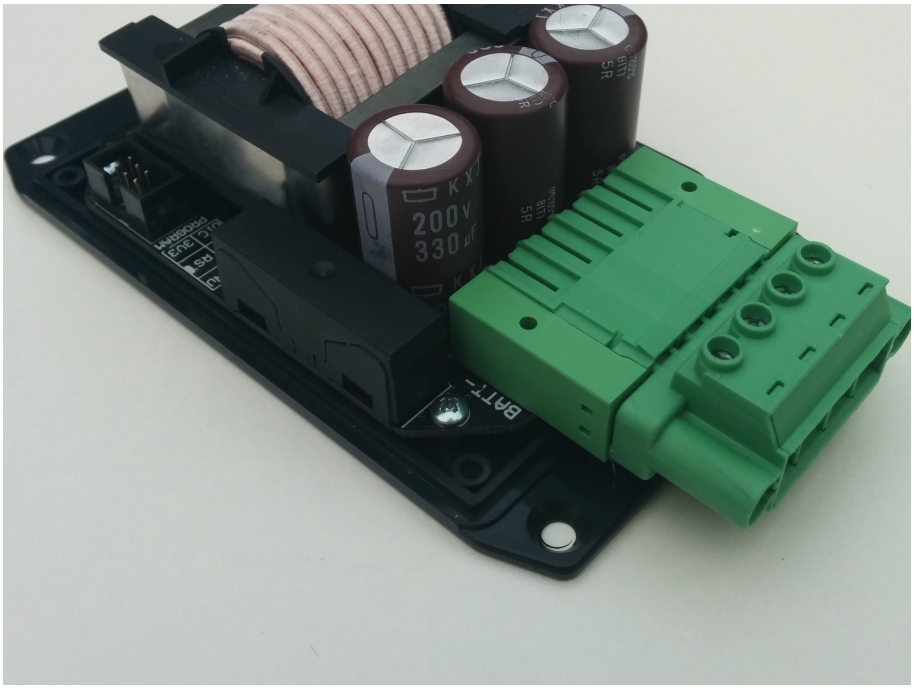
Elmar Solar MPPT Datasheet

March 1, 2019



1 Introduction

This document describes the specifications, performance and properties of the Elmar Solar MPPT. With it's record breaking 99.6% peak efficiency it is currently the most efficient MPPT available for solar car racing teams.

Different versions of the MPPT are available to accompany for lower current Multi-junction solar arrays and Lower voltage battery systems. This document describes the default configuration of the MPPT optimized for SunPower C60 silicon solar cells and a $100Vli-ionbattery$.

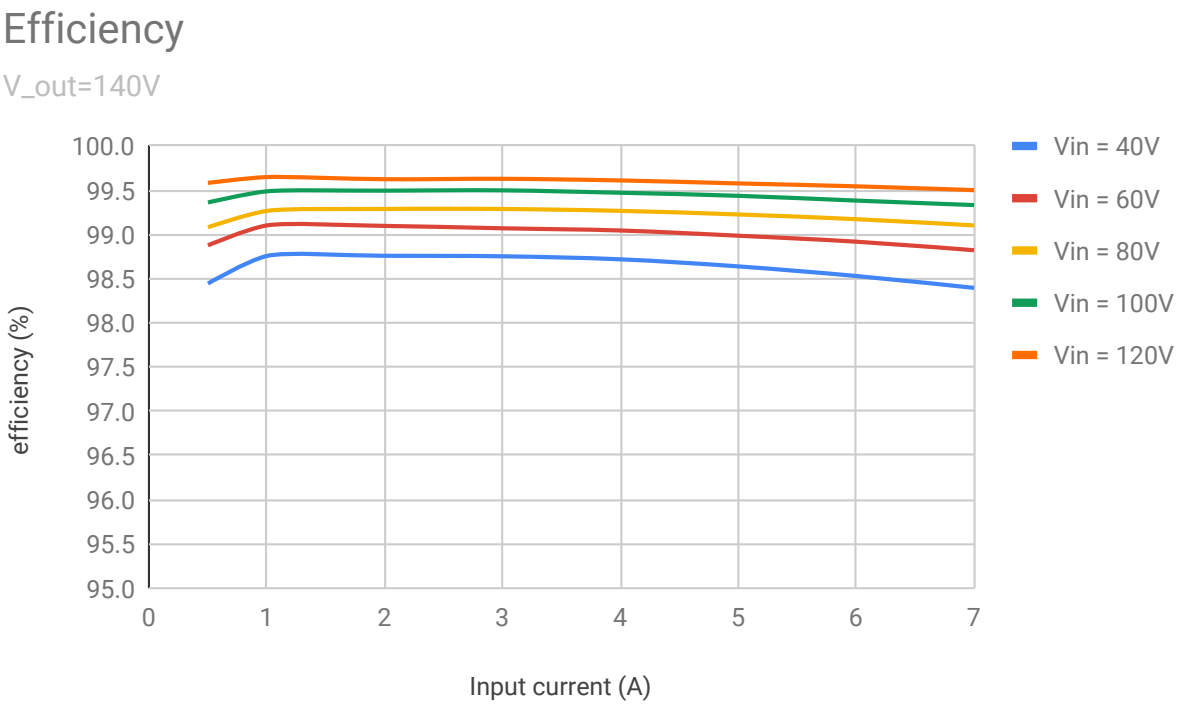
2 Features

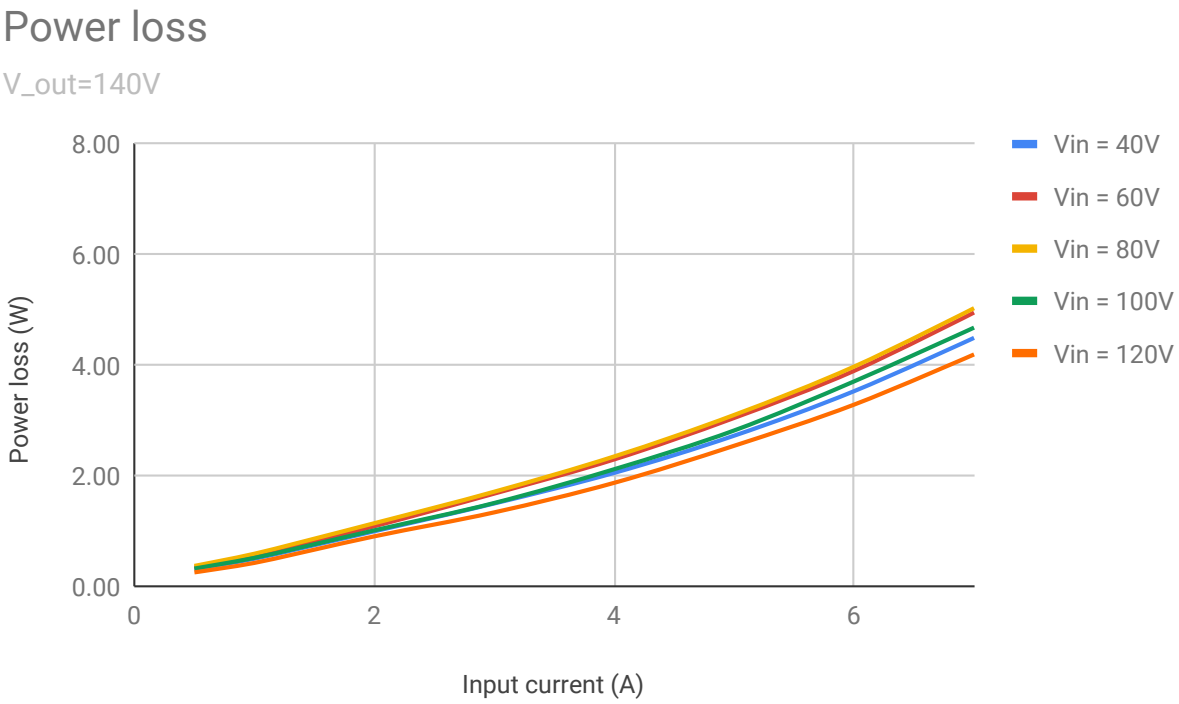
- Extremely high conversion efficiency up to 99.6%
- MPPT algorithm optimized for solar cars
- Data transmission via CAN Bus
- End of charge current control
- ABS enclosure for added protection

3 Specifications

Parameter	**Minimal**	**Nominal**	**Maximal**	**Unit**
Array Voltage	20		150	Volt
Array Current			7.0	Ampere
Output Voltage	22		165	Volt
Output Shutdown Voltage			175	Volt
Boost ratio	1.1		8	
Efficiency		99.2	99.6	%
Off state current draw ($V_{out} = 140V$)		84		uA
Operating Temperature	0		55	Celsius
CAN Interface Specification				
Supply Voltage	10.8	12	13.2	Volt
Supply Current		20		mA
Transmission rate	125	125	500	kB/s
Dimensions				
Length		136		mm
Width		82		mm
Height		44		mm
Weight incl. enclosure		395		gram
Weight excl. enclosure		285		gram

4 Electrical conversion





5 Operation

5.1 Off mode

The MPPT is in OFF mode whenver the Canbus supply voltage drops below 10.8V.
In Off mode:

- Output current draw 84uA
- MPPT acts at a diode from V_{in} to V_{out}
- Canbus communication is not possible

5.2 Standby Mode

The MPPT enters standby mode whenever supply voltage is available at the Can interface and the requirements for active mode are not satisfied. In Standby mode:

- Output current draw 84uA
- MPPT acts at a diode from V_{in} to V_{out}
- Canbus communication is possible and all measurements are performed

5.3 Active Mode

In order for the MPPT to enter active mode all of the following requirements need to be met:

- Canbus Supply voltage $> 10.8V$
- $V_{in} > 20V$
- $V_{in} > V_{out}/8$
- $I_{set} > 0$
- $T_{mosfet} < 70$ degree Celsius

In order for the MPPT to return to standby mode one of the following requirements need to be met:

- 12V not available
- $V_{in} < 10V$
- $V_{in} < V_{out}/8$
- I_{set}=0
- $T_{mosfet} > 70$ degree Celsius

In active mode:

- MPPT performs maximum power point tracking
- Canbus communication is possible and all measurements are performed

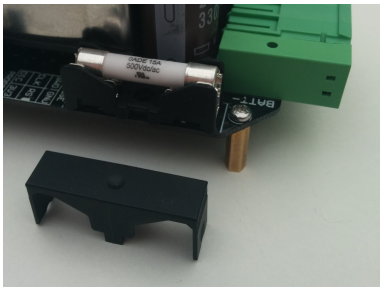
6 Fusing

6.1 CAN

The 12V Can supply voltage rail is protected with a resettable 200mA PTC fuse of the type Bourns MF-MSMF020-2 mounted on the PCB of the MPPT.

6.2 Power

The $V_{out}+$ voltage rail is protected with a fuse of the type Bel Fuse 0ADEC9150-BE mounted mounted on the PCB of the MPPT. This fuse is user replaceable, however it is recommended to send in the MPPT for service whenever this fuse is blown as there is a very high change of damage to the MPPT.



7 Precharge

7.1 Output

The Elmar Solar MPPT has 660uF of low-impedance capacitance across the DC bus output connections. Destructive high currents can flow when connecting capacitors or low impedance sources like a battery with different voltages in parallel. An external precharge circuit is mandatory when connecting the MPPT output to a battery.

When the MPPT is in off state there is still a diode from the input to the output connection, allowing the array to charge the output capacitors of the MPPT. Whenever connecting the output of MPPT's in parallel or paralleling the MPPT output to other devices such as a motor controller special care has to be taken to discharge all capacitors prior to making connections to avoid damage.

7.2 Intput

The Elmar Solar MPPT has 660uF of low-impedance capacitance across the DC bus output connections. A solar array is current limited and thereby a precharge circuit on the input is not necessary when connecting solar arrays that have a short circuit current of less than 8A.

8 Led signaling

A single LED indicator is available next to the canbus connectors. Use CAN to get more detailed information about the MPPT state.

Led color	**state**
Off	off-state
orange	standby-state
green	active-state
red	error-state

9 Can Bus Interface

The canbus van be used to monitor the operation of the MPPT and to limit the input current of the MPPT. The use of CAN communication is recommended but optional, the 12V can supply is required for the MPPT to turn on.

9.1 Galvanic isolation

A galvanic isolation barrier is present between the CAN circuitry and the power circuit.

Parameter	**Value**
Isolation Voltage	1kVDC
Isolation Resistance	10GOhm
Isolation Capacitance	20-75pF
Insulation Grade	Basic

9.2 CAN Bus Speed

The general device identifier is hard coded into the device and can be specified when ordering the MPPT. Available options are 125kB/s, 250kB/s and 500kB/s, by default it is set to 125 kB/s.

9.3 Identifier

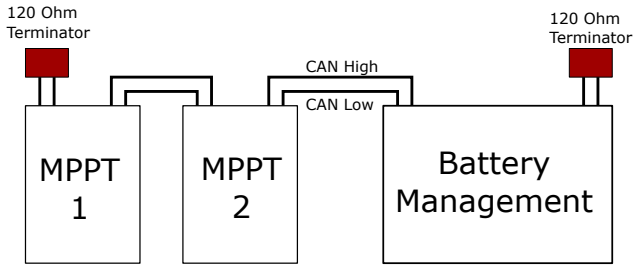
The identifier field has been split in three sections for Elmar Solar MPPT's. Bits 10-8 contain the general device identifier, bits 7-4 contain the specific device identifier and bits 3-0 contain the message identifier.

The general device identifier is hard coded into the device and can be specified when ordering the MPPT, by default it is set to 0x600. The specific device identifier can be selected using the rotary encoder on the MPPT and is equal to the number displayed on the rotary switch multiplied by 0x010.

With the default setting for the general device identifier of 0x600, and the rotary switch on position A, the MPPT base address becomes 0x6A0, with the rotary switch positioned on 3 the MPPT base address becomes 0x630.

9.4 CAN Termination

The CAN bus is structured as a linear network. The CAN bus data lines must be terminated at each end of the main bus with 120 ohm resistors between the CAN-H and CAN-L signals.



9.5 CAN broadcast Messages

9.5.1 Input measurements

ID: MPPT base Address + 0

Variable	Bits	Type	Unit
Input Voltage	63 .. 32	FLOAT	Volt
Input Current	31 .. 0	FLOAT	Ampere

9.5.2 Output measurements

ID: MPPT base Address + 1

Variable	Bits	Type	Unit
Output Voltage	63 .. 32	FLOAT	Volt
Output Current	31 .. 0	FLOAT	Ampere

9.5.3 Temperature

ID: MPPT base Address + 2

Variable	Bits	Type	Unit
Mosfet Temperature	63 .. 32	FLOAT	Degree Celsius
Controller Temperature	31 .. 0	FLOAT	Degree Celsius

9.5.4 12V supply and status flags

ID: MPPT base Address + 3

Variable	Bits	Type	Unit
12V Can Bus Voltage	63 .. 32	FLOAT	Volt
Serial Number	31 .. 16	UINT16	
Firmware version	15 .. 8	UINT8	
PWM limit	7	bit	
Input current limit	6	bit	
Output voltage limit	5	bit	
Mosfet temperature limit	4	bit	
Input undervoltage	3	bit	
Canbus error	2	bit	
12V undervoltage	1	bit	
Mode	0	bit	0=standby 1=active

9.5.5 reserved

ID: MPPT base Address + 4..7

9.6 CAN receive Messages

9.6.1 Power level

ID: MPPT base Address + 8

Variable	Bits	Type	Unit
Power level	63 .. 56	UINT8	0-100

9.6.2 reserved

ID: MPPT base Address + 9..15

10 Connectors

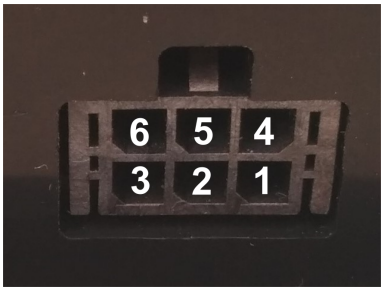
10.1 Can Bus

All 6 pins on the two canbus connectors are interconnected, pin 1 is connected to pin 1, pin 2 is connected to pin 2 etc. The connector used for the canbus on the MPPT is Wurth Electronics 66200621022.

Mating parts for this connector can be either:

- Wurth Electronics 662006113322
- Micro-Fit 3.0 430250600 / 430250608 / 430250610

1	+12V	Can Supply voltage, 10.8-13.2V
2	GND	Can Ground
3	NC	Not connected
4	CAN-H	Can Low
5	CAN-L	Can High
6	NC	Not connected



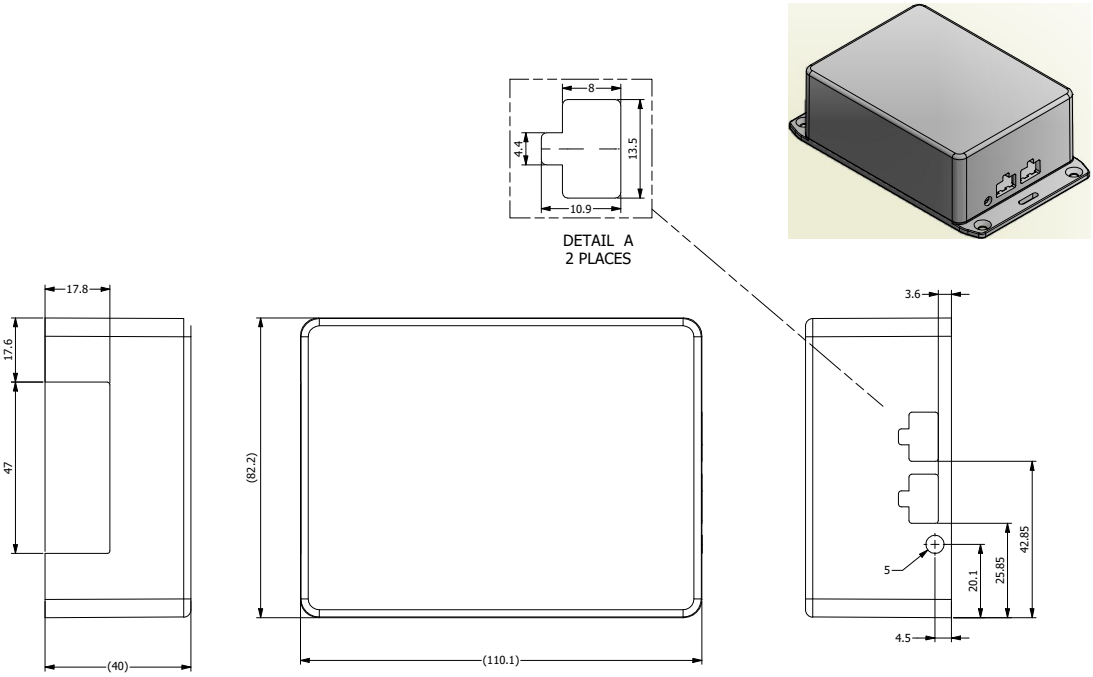
10.2 Power

The Power connector used on the MPPT is Phoenix 1720819 (PC 5/4-GF-7,62). The recommended mating part for this connector is Phoenix contact 1777859 (PC 5/ 4-STF1-7,62). The connector is also backwards compatible with the older PC 4 counterparts commonly used in solar cars.

1	$V_{in}-$	Array -
2	$V_{in}+$	Array +
3	$V_{out}+$	Battery +
4	$V_{out}-$	Battery -

11 Dimensions

11.1 Top cover



11.2 Base plate