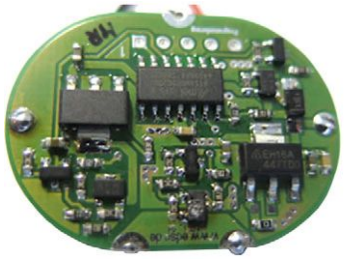
Embedded Charger for 196 HVC ENYCAP™ Capacitor Constant Voltage Charger With Intermittent Charging Technique

By Gerald Tatschl

MAL219699002E3
196 HVC ENYCAP™ - EMBEDDED CHARGER



This version is optimized for a 196 HVC in a 90 F, 8.4 V configuration. Basically, it is a voltage converter and switch logic in one, which adjusts to a wide input voltage range. It provides the correct charging voltage and protects against deep discharge.

INTRODUCTION

The 196 HVC 90 F series is a real hybrid system combining electrostatic and faradaic energy storage. It has more power density than a battery and more energy density than an ultra capacitor. Therefore, it is possible to charge HVCs faster than a battery.

For applications that require a constantly high charge state of the energy storage device, e.g. backup systems, an intermittent (pulsed) charging method is recommended. The idea behind intermittent charging is to compensate for self-discharge, while avoiding regular overcharge, in order to improve the service life of the hybrid system.

The recommended and simplest way to implement intermittent charging is a constant voltage source controlled by a timer.

An initial charge ensures enough energy for the next application, while maintenance charge pulses compensate for the self-discharge of the capacitor.

Typical steps:

1. Check for available energy via an open circuit voltage (OCV) measurement, and provide initial charging if necessary
2. After initiation, regular operation begins. Maintain the charge state and monitor the state of health (SOH)
3. Discharge scenario (backup) → 1.

For detailed product information, please check the 196 HVC product specification (www.vishay.com/doc?28409). All relevant parameters concerning the 196 HVC are explained within this document.

For details on the recommended charging method, refer to the Vishay application note “Power Management Solution: Constant Voltage (CV) Pulse Charging of Hybrid Capacitors” (www.vishay.com/doc?28427).

TECHNICAL NOTE

For technical questions, contact: hybridstorage@vishay.com

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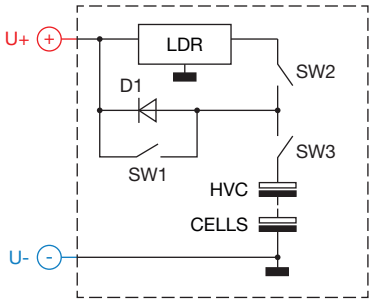
GENERAL INFORMATION

The embedded 196 HVC charger is a product for demonstrating the recommended charging technique (intermittent charging = pulsed charging). This version is designed for an HVC in the 90 F, 8.4 V configuration.

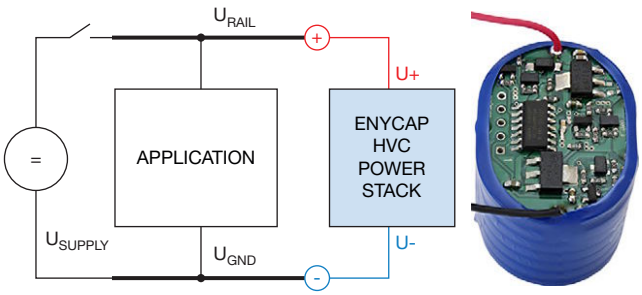
Basically, it is a voltage converter (LDR) that adjusts a wide input voltage range to the correct charging voltage. It can be powered directly, e.g. by the 12 V power of a PCI slot.

SCHEMATIC

ENYCAP HVC Power Stack



APPLICATION



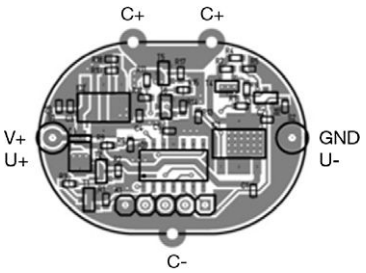
LAYOUT AND CONNECTION

The embedded charger is designed to be connected directly with the pins of a 196 HVC 90 F stack.

L: 33 mm

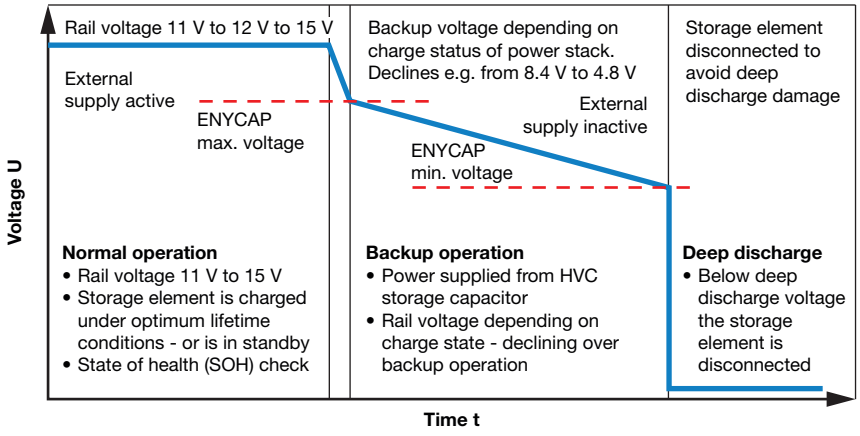
W: 25 mm

H: 3 mm



The arrangement of the cells is flexible. Usually, the firmware of the board is programmed specifically for a 196 HVC in the standard 90 F, 8.4 V configuration. Reprogram the controller for other voltages.

FUNCTIONS



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It is a constant voltage charger. As soon as it is powered, it will charge the HVC power caps pack for five minutes (CCCV - 8.7 V). After that, for regular stand-by operation in a backup application, it will apply a charge pulse of one minute (CCCV 8.7 V) every 12 hours. This is sufficient to compensate for self-discharge, which occurs over long periods of time. These parameters are not adjustable for the customer.

CHARGING PARAMETERS		
PARAMETER	**MIN.**	**UNITS**
Input voltage	10 to 13	V
Charging voltage	8.7	V
Timer initial charge	300	s
Timer pulse charge	60	s
Timer pause (OCV)	12	h

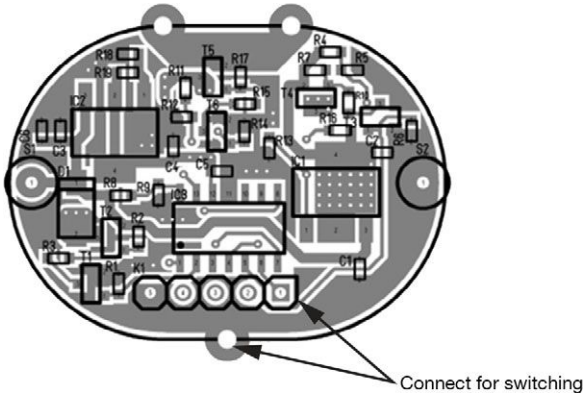
The power supply voltage for the embedded charger can be between 10 V and 13 V.

If the power supply fails, the charger switches to a discharge circuit and enables the power caps to become a power supply, e.g. for data backup.

The 196 HVC pack is separated from the electronic circuit by a high resistivity MOSFET. This allows a so-called sleep mode. As soon as a power supply is detected, the MOSFET is switched off and the charger leaves the sleep mode.

There are three options for reactivating from sleep mode:

1. Discharge below 4.8 V → the MOSFET will switch in order to protect the HVC power caps from deep discharge
2. 30 minutes after the power supply is disconnected, the MOSFET will switch in order to protect the HVC power caps from deep discharge
3. Connect the following pins to manually switch the MOSFET



As soon as a power supply is detected, the sleep mode is terminated.

CONNECTOR

Molex 87439-0400 connector

1. + (Red) Positive rail
2. - (Black) Negative rail
3. (White) Temperature
4. (Blue) Temperature

REMARKS

There are some features for backup operations that should be controlled by an external logic:

1. If the voltage drops below < 1.29 V per cell (< 7.74 V for a HVC 90 F, 8.4 V), an initial charge pulse should be applied
2. Backup operation is finished, but the power supply is still off → an external signal should activate sleep mode
3. SOH tracking (= ESR(DC) determination)

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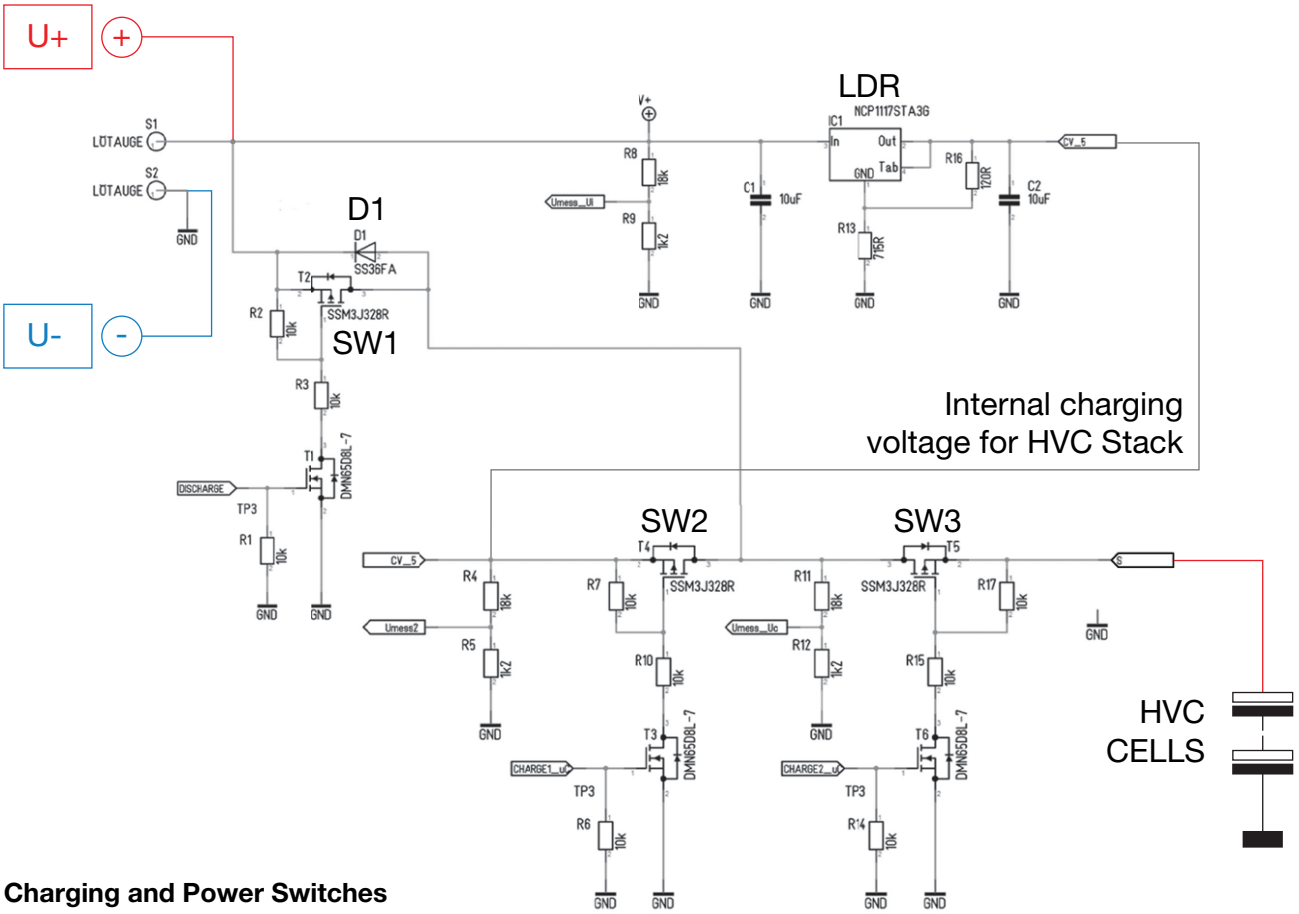
CIRCUIT

Overview



Charging and Power Switches

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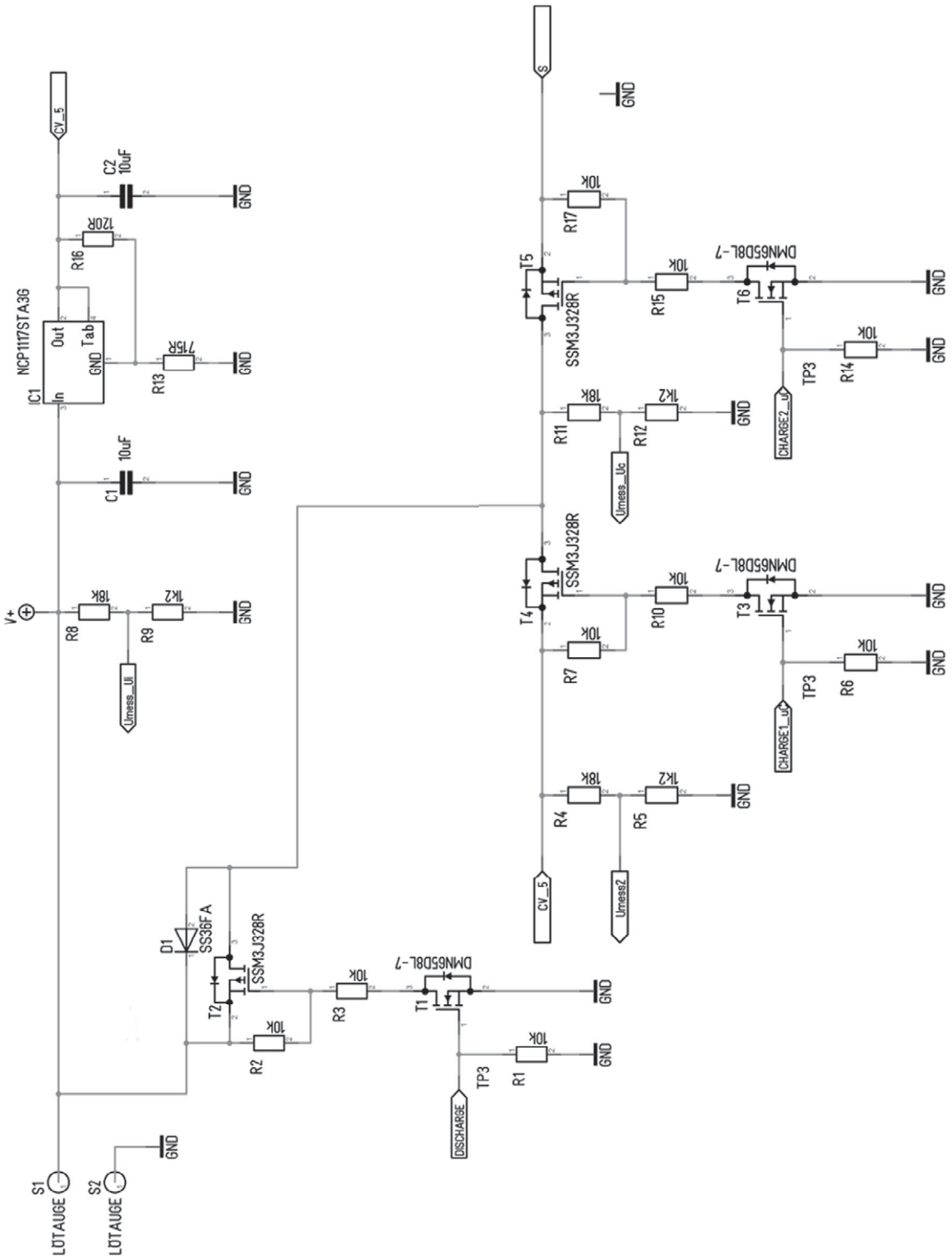
DETAIL



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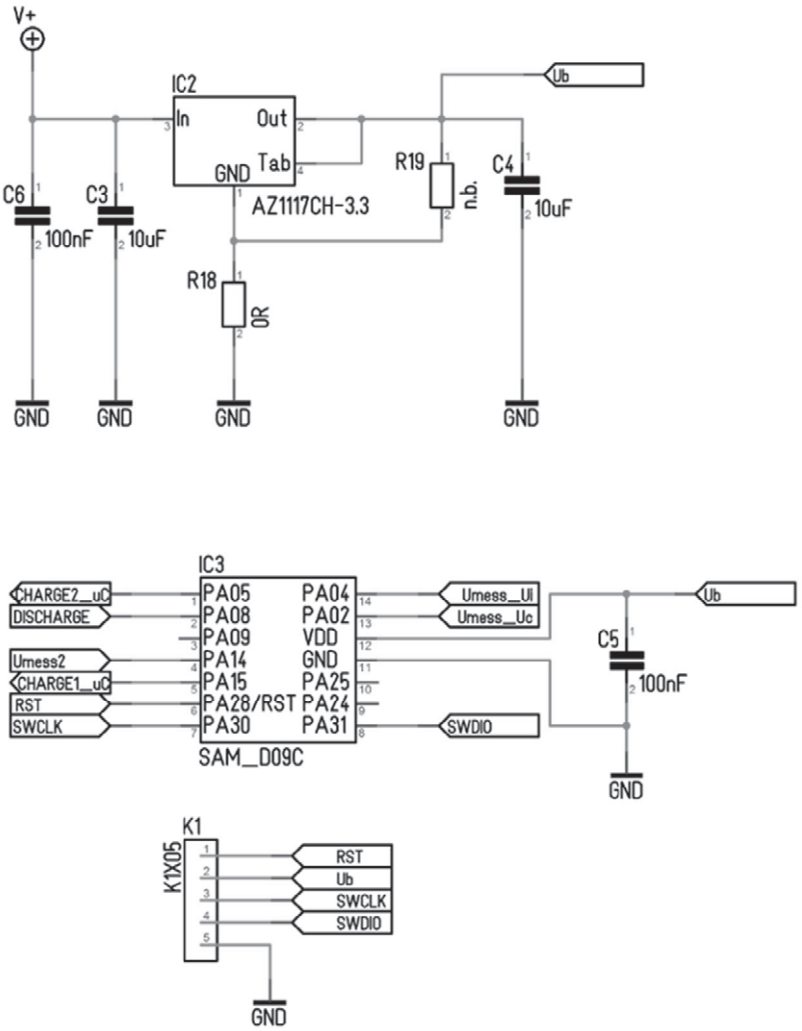

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PARTS			
NAME	**VALUE**	**SPECIFICATION**	**CHASSIS**
C1	10 µF	≥ 5 V 10 % X7R ceramic capacitor	603
C2	10 µF	≥ 5 V 10 % X7R ceramic capacitor	603
C3	10 µF	≥ 16 V	603
C4	10 µF	≥ 5 V	603
C5	100 nF	≥ 5 V	603
C6	100 nF	≥ 16 V	603
D1	SS36FA		SMA
IC1	NCP1117STA3G		SOT-223/1
IC2	AZ1117CH-3.3		SOT-223/1
IC3	ATSAMD09C		SOIC14_WB3.9_P1.2
R1	10 000	1 %	603
R2	10 000	1 %	603
R3	10 000	1 %	603
R4	18 000	1 %	603
R5	1200	1 %	603
R6	10 000	1 %	603
R7	10 000	1 %	603
R8	18 000	1 %	603
R9	1200	1 %	603
R10	10 000	1 %	603
R11	18 000	1 %	603
R12	1200	1 %	603
R13	715	1 %	603
R14	10 000	1 %	603
R15	10 000	1 %	603
R16	120	1 %	603
R17	10 000	1 %	603
R18	0	1 %	603
R19	n/a	1 %	603
T1	DMN65D8L-7		SOT-23/3
T2	SSM3J328R		SOT-23/3
T3	DMN65D8L-7		SOT-23/3
T4	SSM3J328R		SOT-23/3
T5	SSM3J328R		SOT-23/3
T6	DMN65D8L-7		SOT-23/3