Small Hybrid DC/DC Converter Controller
Based on Innovative Rad-Hard PWM IC
AMICSA 2021

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Power Management Products

Modular Secondary Power Distribution

POWER CONDITIONING UNIT

12V DC/DC

12V DC/DC

12V DC/DC

3.3V Module

1.1V Module

Module

Module

Module

PWM

DC/DC Controller

Hi-POL

V-Clamp

Cooperation with

ARC POWER

POL

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SPACE IC
Power Management Products

Modular Secondary Power Distribution

- 12V DC/DC
- 3.3V Module
- 1.1V Module
- 5V Module

Cooperation with

DC/DC Controller

V-Clamp

Hi-POL

PWM
Redundancy DOES NOT necessarily ”resolve” propagating failures!

Integrated DC/DC Converter Controller is desired

- Integrated power switch
- Integrated start-up from power bus
- Integrated protections: OV, UV, OC, OT
- Protections independent from PWM control
- Integrated regulation for non-isolated feedback
DC/DC Hybrid

European DC/DC converter controller with integrated power switch
- Isolated and non-isolated converter topologies
- Up to 15W output power from 18V - 105V input power bus
- DC/DC converter design effort limited to magnetic components, diodes and passives
- SPACE IC SPPWM120RH inside - cooperation project with ARC POWER, Switzerland
Example: Oscillator

Traditional Implementation

Proposed Implementation
Example: Oscillator
**Gate Driver Polarity**

**Low-Side Active Clamp:**

**Toggling:**

![Diagram of Gate Driver Polarity](image-url)
### PWM IC Integration

#### SPPWM120RH

![SPPWM120RH Circuit Diagram]

<table>
<thead>
<tr>
<th>Pin Name</th>
<th>Pin Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>VCC_P</td>
<td>Protection Supply and Reference Voltage Source</td>
</tr>
<tr>
<td>AUX_P</td>
<td>Protection Supply and Reference Voltage Source</td>
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<tr>
<td>EN</td>
<td>Enable Pin</td>
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<tr>
<td>CLK</td>
<td>Clock Pin</td>
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<tr>
<td>ERROR</td>
<td>Error Pin</td>
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<tr>
<td>STATUS</td>
<td>Status Pin</td>
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<tr>
<td>OSC</td>
<td>Oscillator</td>
</tr>
<tr>
<td>TON</td>
<td>Timing Pin</td>
</tr>
<tr>
<td>TOFF</td>
<td>Timing Pin</td>
</tr>
<tr>
<td>TEMP</td>
<td>Temperature Sensor</td>
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<tr>
<td>GATE</td>
<td>Gate Driver</td>
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<tr>
<td>GM</td>
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<td>PWM</td>
<td>PWM Output</td>
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<td>Reference Voltage Source</td>
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<td>Primary Input Control</td>
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<tr>
<td>PVIN</td>
<td>Primary Input</td>
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<tr>
<td>GND</td>
<td>Ground Pin</td>
</tr>
</tbody>
</table>

#### PWM Control

- **PWM SEQUENCING**
  - **PWM CONTROL**
  - **PREREGULATOR**
  - **BANDGAP**

#### Current Limit

- **0.9V**
- **0.8V**
- **+12V (semi-regulated)**
- **-12V (semi-regulated)**
- **+5V (regulated)**

#### Protection Logic

- **SET_STATUS**
- **SET_ERROR**
- **SW_STATUS**
- **ERROR**
- **ERROR***

#### Oscillator

- **TON, MIN**
- **TOFF, MIN**
- **TOSC**

#### Magnetic Feedback

- **TEMP_SENSE**
- **VREF_MONITORING**
- **TEMP**

#### Other Components

- **STARTUP CIRCUITRY**
- **INTERNAL SUPPLY**
- **REFERENCE AND PRIMARY HOUSEKEEPING**
- **AUX**
- **PVIN**
- **AUX_P**
- **AUX_P_INTERNAL**
- **SS**
- **SS_P**
- **OUTSEL / RDEL**
- **GND**
- **GND_P**
- **SYNC**
- **SYNC* IN**
- **SYNC**
- **SYNC* IN**

#### Additional Features

- **Double Trench Barrier**
- **PWM ENABLE**
- **VREF P**
- **CURRENT LIMIT**
- **PREREGULATOR**
- **BANDGAP**
- **VCC**
- **ERROR**
- **ERROR***
- **SW_STATUS**
- **ERROR**
- **ERROR***
- **SW_STATUS**

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**Notes:**

- The circuit diagram shows the internal connections and interfaces of the SPPWM120RH PWM IC.
- The PWM IC integrates various components to control power switching and monitoring functions.

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**Figure:**

- Schematic diagram of the SPPWM120RH PWM IC showing internal circuitry and external connections.
DC/DC Converter Controller is designed:

- Easy applicable and versatile
- Robust parameters
- Simple parameter settings inside hybrid
- Separated protection on die
- Small footprint
- Test results will follow
Special thanks to ESA, the co-authors and other contributors to

ESA Activity No. 4000126082
Thank you for your attention!

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