Boost Converter & Controller Solutions
New products/reference design update

BCS / BMC, TI
2Q 2020
BCS Terminology Definition

Boost Converter

Boost Controller

Buck-Boost Controller
Boost can also be used as Flyback and SEPIC
Boost converter $V_{\text{IN}} < 40V$
Buck-boost converter $V_{\text{IN}} < 40V$

- **Low-Power Buck-Boost (< 20V/IN)**
  - **VIN < 40V (MV)**
    - **TPS63070**
      - 2A, QFN, 16V $V_{\text{IN}}$
      - RTM 2016
    - **TPS630702 (Mosel)**
      - 2A, QFN, Discharge Function
      - RTM Mar 19
  - **VIN < 7V (LV)**
    - **TPS63030**
      - 500mA, QFN
      - RTM 2008
    - **TPS63024/25/27**
      - 2A, WCSP
      - RTM 2014/2016
    - **TPS6305 (Bourbon WCSP)**
      - 2A WCSP, 1µA IQ
      - RTM 4Q19

- **TPS55288**
  - Sampling
  - 36Vin, 16A, Sync, int boost side FET
  - Sampling, RTM in 2020

- **TPS6381x (Talisker)**
  - 2.5A, WCSP, PC
  - RTM 4Q19

- **TPS63806 (Kentucky Bourbon)**
  - 2.5A, WCSP, optimized transient
  - RTM 3Q19

- **TPS63802 (Bourbon HR)**
  - 2A, QFN, 1µA IQ
  - RTM 4Q19

- **TPS63900 (Glenfiddich)**
  - 400mA, QFN, <200nA $I_{Q}$
  - APL 2Q20

**Sampling**
Boost and buck-boost $V_{IN} > 40V$

- **LM3481** – Q1
  - 40Vin, non-sync, 1MHz
  - November, 2007

- **LM5175** – Q1
  - 42Vin, 55Vout, 4-switch sync
  - April 22, 2016

- **LM5176**
  - 55Vin, 55Vout, 4-switch sync
  - June 23, 2017

- **LM34935**
  - 30Vin, 24Vout, 4-switch sync
  - August 1, 2016

- **LM34936**
  - 30Vin, 30Vout, 4-switch sync
  - August 31, 2018

- **LM5127** – Q1
  - 65Vin, 2MHz, boost + 2 buck CTRLR+LDO
  - Sampling, RTM in Q2 2020

- **LM5156**
  - 60Vin, 2MHz, non-Sync, low EMI
  - RTM Q2 2020

- **LM5121/2**
  - 65Vin, 100Vout, sync
  - September, 2013

- **LM51501**
  - 65Vin, 2.2MHz, Low Iq, non-sync
  - May 29, 2018

- **LM5155**
  - 50Vin, 2MHz, Low Iq, non-sync
  - -Q version RTM in Q2 2019

- **LM3478** – Q1
  - 40Vin, non-sync
  - July, 2000

- **TPS43060/1**
  - 30Vin, sync, 1MHz
  - July, 2012

<table>
<thead>
<tr>
<th>Year</th>
<th>Products</th>
</tr>
</thead>
<tbody>
<tr>
<td>2020</td>
<td><strong>LM34936</strong>, <strong>LM5127</strong>, <strong>LM5156</strong></td>
</tr>
</tbody>
</table>
TPS61023
5V, 3A boost converter with input voltage down to 0.5V

**FEATURES**
- Input voltage range: 0.5V to 5.5V, Startup voltage: 1.8V
- Output voltage range: 2.2V to 5.5V
- Typical 100nA shutdown current from Vin and SW; 200nA Max. (room temp).
- Typical 20μA quiescent current from Vout
- Pass-through when Vin > Vout
- Valley current limit: 3A min.
- Rdson: 47mΩ low side and 68mΩ high side
- PFM mode in light load;
- True disconnection during shutdown
- 1 MHz switching frequency when Vin > 1.5V
- 0.6 MHz switching frequency when Vin < 1.0V
- Available in 1.6mm x 1.2mm SOT563 (DRL) package

**BENEFITS**
- Low input voltage support down to 0.5V Vin (1.8V for rising)
- Large output current: support 5W (5V/1A) from single cell Li+ battery
- Low shutdown current to support longer life cycle
- Low Rdson (L:47mΩ /H:68mΩ ) enable higher efficiency
- Support pass through mode when Vin > Vout

**APPLICATIONS**
- Electrical Shelf Label
- Tracker
- Video Doorbell
- RF Smart Remote Control

1.6mm x 1.2mm SOT563 (DRL)
**Features**

- **Wide input range**: 3.5V~60V (Abs Max 65V)
  (2.97V~16V when BIAS=VCC, 1.5V~60V when VCC≥2.97V)
- **Programmable frequency**: 100kHz to 2.2MHz with clock synchronization
- **Shutdown I\(_Q\) ≤ 3uA**
- **Non-switching I\(_Q\) ≤ 480uA**
- **Support internal spread spectrum**
- **1.5A peak gate driver**
- **100mV current limit threshold with optional hiccup mode protection**
- **1.0V +/-1% reference**
- **Adjustable slope compensation**
- **Programmable line UVLO**
- **Adjustable soft-start**
- **PGOOD indicator**
- **OVP protection, Thermal shutdown protection**
- **12pin-WSON package (3mm x 2mm)**

**Applications**

- **Flyback, LED Bias supply**
- **48V Flyback POE PD Application**
- **Solar Panel Optimizer**
- **Amplifier Bias**

**Benefits**

- **Boost/Seip/Flyback (Non-isolated/isolated) configurable**
- **Wide VIN supports POE application and 24V battery**
- **Switching frequency out of AM band**
- **Reduced EMI using spread spectrum**
- **Small solution size at 2.2MHz**
- **Low shutdown I\(_Q\) reduces battery drain in battery-powered application**
- **Low current limit threshold minimizes power loss**
- **Optional hiccup mode for sustained overload / short-circuit protection**
- **Allows high step-up ratio using SYNC**

![Hiccup mode protection](image)

<table>
<thead>
<tr>
<th>Hiccup mode protection</th>
<th>Disabled</th>
<th>Enabled</th>
</tr>
</thead>
<tbody>
<tr>
<td>LM5156</td>
<td>LM51561</td>
<td></td>
</tr>
</tbody>
</table>
What is Dual Random Spread Spectrum (DRSS)?

- DRSS is a digital spread spectrum technique that spreads energy in multiple bands of interest using two random frequency generators.

<table>
<thead>
<tr>
<th>Freq. Band</th>
<th>ARSS</th>
<th>PRSS</th>
<th>DRSS</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;30MHz</td>
<td>Good</td>
<td>Bad</td>
<td>Good</td>
</tr>
<tr>
<td>&gt;30MHz</td>
<td>Not bad</td>
<td>Good</td>
<td>Good</td>
</tr>
</tbody>
</table>
Spread spectrum (TI-patented DRSS)

2.2MHz $F_{SW}$ – Full Range

- 9 kHz RBW (10-15dB reduction)
- 120 kHz RBW (5-7dB reduction)

AM Radio

Energy (dB µV)

Frequency (MHz)

CISPR-25 Peak Limit
Conducted Emissions (No SS)
Conducted Emissions (DRSS)
TPS63900 (Glenfiddich)
400-mA buck-boost converter with 200-nA operating $I_Q$

**FEATURES**
- Input voltage 1.8 V to 5.5 V
- Output voltage 1.8 V to 5 V ±1.5% (100-mV steps, 32 settings)
- Output current up to 400 mA (typ. 1.9 A peak current limit)
- Operating Quiescent current: 200nA typical
- Shutdown current: 60nA typical
- >90% efficiency at 10uA load
- <50mV Load transient response
- 2-level dynamic voltage scaling (DVS)
- Programmable input current limit (1mA to 100mA & unlimited)
- Device enable pin
- Short-circuit protection, thermal shutdown

**APPLICATIONS**
- IoT
- Smart Gas- and Water meters and sensor nodes
- Fitness trackers, smart watches and patient monitors
- Thermostats, Door locks

**BENEFITS**
- Input current limit maximizes capacity of primary batteries like LiSOCl2
- DVS allows for optimizing output voltages for heavy and light load operation which reduces the total system power consumption
- Output current supports commonly-used RF standards like sub-1-GHz, BLE, LoRa, wM-Bus & NB-IoT
- High efficiency over wide load range prolongs battery life

![Schematic Diagram](image-url)
A practical example for DVS…

<table>
<thead>
<tr>
<th>Duration</th>
<th>% of time</th>
<th>Load</th>
<th>Comment</th>
<th>% Energy</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 h</td>
<td>99.98</td>
<td>11 uA</td>
<td>sleep</td>
<td>68</td>
</tr>
<tr>
<td>384 ms</td>
<td>0.0018</td>
<td>250 mA</td>
<td>RF TX/RX</td>
<td>28</td>
</tr>
<tr>
<td>3.8 s</td>
<td>0.0018</td>
<td>4 mA</td>
<td>RF RX</td>
<td>4</td>
</tr>
</tbody>
</table>
What about operating time…?

50% Battery life extended vs non-DVS solution.

TLV61048
14V, 3.7A Non-sync Boost Converter in SOT23-6

**FEATURES**

- VIN = 2.65 V (Rising, 2.4V falling) to 5.5 V
- Support 1.2Vin to 12Vout with independent control supply
- VOUT = Up to 14V output voltage
- Switch current limit: 3.7A (typical)
- Switching frequency: 1 MHz / 600kHz Selectable
- Quiescent current: 100uA
- Shutdown current: 1uA
- Rdson (LS FET): 85mohm @3.3Vin (75mohm@5Vin)
- FB Accuracy: +/-2.5%
- Soft start time: 2ms
- PFM at light load
- SOT23-6 package

**APPLICATIONS**

- PLC Backup Power

**BENEFITS**

- Support lower input voltage
- Frequency selectable to balance the noise
- Pin to pin compatible with existing solution
TPS55288
36V, 16A buck-boost converter with PPS control

**FEATURES**

- Input voltage range: 2.7 V – 36 V (40V Absmax)
- Output voltage range: **0.8 V – 21.26 V**
- Synchronous buck-boost with ±1% output voltage accuracy
- Integrated Boost FETs with 7mΩ / 7mΩ Rdson
- Iq < 1mA when enabled (no switching, PFM mode)
- 10mA max shutdown Iq
- **Max. 16A average inductor current limit**
- >95% boost efficiency at 60W (VIN=5V, VOUT=20V/3A)
- I²C prog 0.8V to 21.26V output voltage in 20mV steps
- I²C prog output current limit up to 6A in 50mA steps (Prog Avg inductor I-limit to 16A)
- Pin selectable PFM and FPWM mode at light load
- Capacitor prog spread spectrum/ External sync clock
- I²C or Resistor prog Vout droop compensation
- Fixed 4ms soft start
- Output OVP, Hiccup mode SCP, OCP and thermal shutdown
- 150C operating Tj, TSD (175C, 20C hys)
- 3.5-mm x 4-mm WF Hotrod QFN-26

**APPLICATIONS**

- USB-PD
- Auto Infotainment/ADAS Regulated rail from Vbat

**BENEFITS**

- High power capability up to 100W (20V/5A) at > 9Vin
- High power conversion efficiency up to 97%
- Compact solution

**Selected Parts**

- GND
- VCC
- FC Address
- PFM/PWM

<table>
<thead>
<tr>
<th>RS</th>
<th>VCC</th>
<th>FC Address</th>
<th>PFM/PWM</th>
</tr>
</thead>
<tbody>
<tr>
<td>GND</td>
<td>Internal</td>
<td>74H</td>
<td>PWM</td>
</tr>
<tr>
<td>6.19k</td>
<td>Internal</td>
<td>74H</td>
<td>PFM</td>
</tr>
<tr>
<td>14.3k</td>
<td>Internal</td>
<td>75H</td>
<td>PWM</td>
</tr>
<tr>
<td>24.9k</td>
<td>Internal</td>
<td>75H</td>
<td>PFM</td>
</tr>
<tr>
<td>51.1k</td>
<td>External</td>
<td>74H</td>
<td>PWM</td>
</tr>
<tr>
<td>75.0k</td>
<td>External</td>
<td>74H</td>
<td>PFM</td>
</tr>
<tr>
<td>105k</td>
<td>External</td>
<td>75H</td>
<td>PWM</td>
</tr>
<tr>
<td>OPEN</td>
<td>External</td>
<td>75H</td>
<td>PFM</td>
</tr>
</tbody>
</table>

**Pin Configuration**

VIN = 2.7V to 36V
VOUT = 0.8V to 22V

**Diagram**

[Diagram of TPS55288 buck-boost converter]
Application note: USB type C power delivery source with TPS65987D and TPS55288

FEATURES

- Describes the necessary steps to implement a USB-PD source with four different voltage levels using TPS65987D as PD controller and TPS55288 as buckboost converter
- Provides support for 5V, 9V, 15V, and 20V levels
- Configure I2C master and binary indices
Welcome to our New Product Update webinar series! Join in every Thursday as we explore different industry trends and technologies across our diverse product portfolio. Our experts cover the latest analog and embedded processing topics for industrial applications.

**Thursday, 9:00 AM Central US Time**

**Click to join Webex meeting**

**How to join:**
- Meeting number: 356 235 123
- When joining the Webex, please click **Audio> Call Using Computer> Connect Audio.**
- **NOTE:** Webex Audio is used for this webinar series
## Upcoming new product updates

<table>
<thead>
<tr>
<th>Date</th>
<th>Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>6/18/2020</td>
<td>High Power Drivers</td>
</tr>
<tr>
<td>6/25/2020</td>
<td>Clock &amp; Timing Solutions</td>
</tr>
<tr>
<td>7/2/2020</td>
<td>Power Interface- USB</td>
</tr>
<tr>
<td>7/9/2020</td>
<td>Switching Regulators- Wide Vin &lt;100V</td>
</tr>
</tbody>
</table>