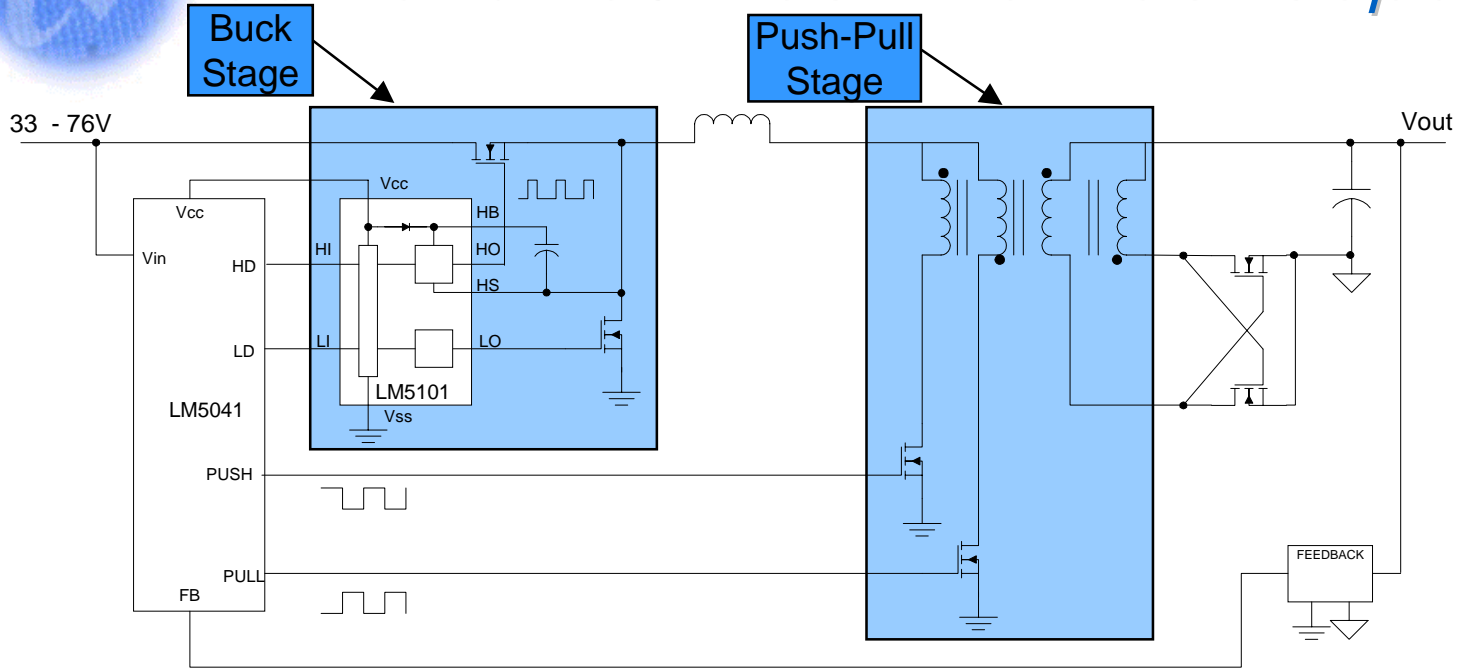




***LM5041 Application DC – DC
Converter
Featuring the Cascaded
Power Converter Topology***



Current Fed Push-Pull Concept



- Push and Pull outputs operate continuously, alternating with a slight overlap.
- Output voltage is controlled by the Buck stage which operates at 2X the Push-Pull frequency.
- Continuous output current from the Push-Pull stage requires minimal filtering.
- High Efficiency achieved with low Push-Pull switching losses and matched Sync rectifier loading.
- Favorable topology for multi-output converters.



CASCADED CURRENT FED BENEFITS

- A Current-Fed Push-Pull Converter is a Buck type converter consisting of a Buck Regulation stage followed by (cascaded by) a Push-Pull Isolation Stage
- The Buck Stage Capacitor and the Output Stage Inductor have been eliminated from the Voltage-Fed
- Reduced switching loss in PP stage
- The Push-Pull Stage voltage stresses are reduced to $V_{out} * N * 2$ over all line conditions, similar to Voltage-Fed
- The output rectification can be easily optimized, similar to Cascaded Voltage-Fed



Current-Fed Waveforms

12-Nov-02
10:02:52

Trace 1: Push_Pull XFR Side A

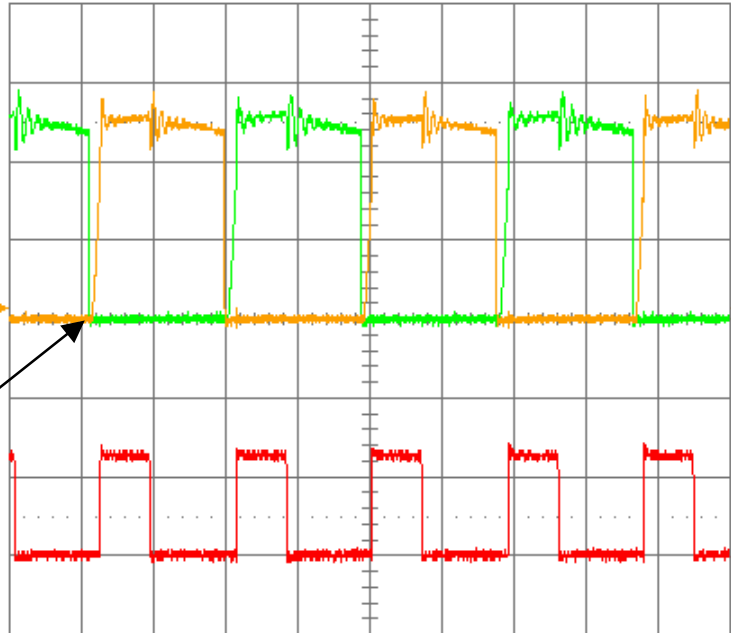
Trace 2: Push_Pull XFR Side B

Trace 3: Buck Stage Switching Node

1
2 μs
20.0 V

2
2 μs
20.0 V

3
2 μs
50 V



$V_{in} = 60V$
 $V_{out} = 2.5V$
 $I_{out} = 20A$

Note; There is an overlap time where both the Push and the Pull switches are ON.

This is required to maintain the inductor current path

2 μs
1 2 V DC $\times 10$
2 2 V DC $\times 10$
3 5 V DC $\times 10$
4 20 mV 500 $\times 100$

1 DC 2.8 V

500 MS/s

AUTO



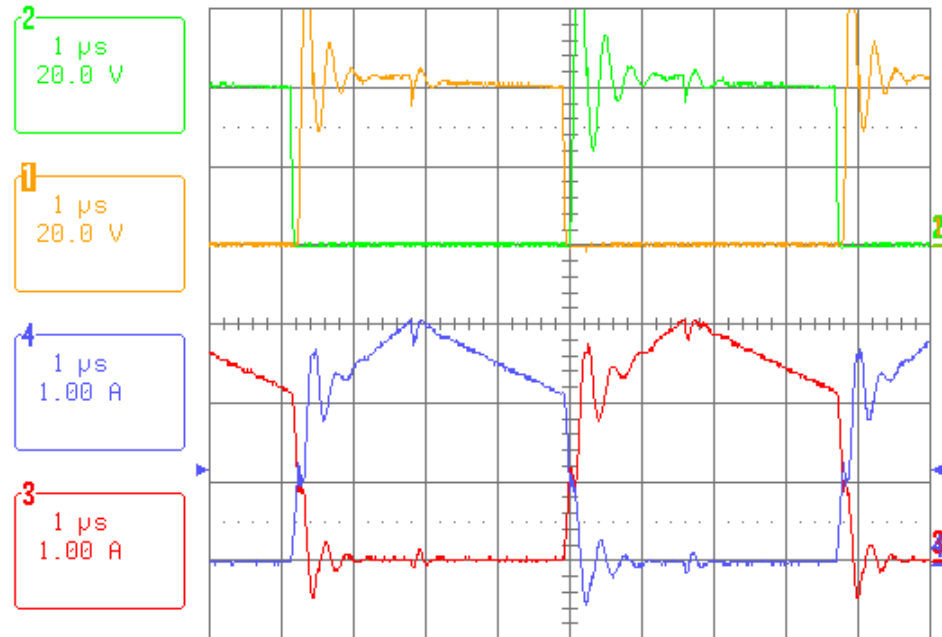
Current-Fed Waveforms

15-Nov-02
13:27:22

Ch 1,2 Push-Pull Vds

Ch 3,4 Push-Pull Ids

$V_{in} = 48V$
 $V_{out} = 2.5V$
 $I_{out} = 20A$



	1 μs	BWL
1	2 V	DC $\times 10$
2	2 V	DC $\times 10$
3	.1 V	DC $\times 10$
4	.1 V	DC $\times 10$

4 DC 1.22 A

500 MS/s

AUTO



Current-Fed Waveforms Expanded Scale

Note, Switches only switch
 $\frac{1}{2}$ current

Ch 1,2 Push-Pull V_{DS}

Ch 3,4 Push-Pull I_{DS}

$V_{in} = 48V$
 $V_{out} = 2.5V$
 $I_{out} = 20A$

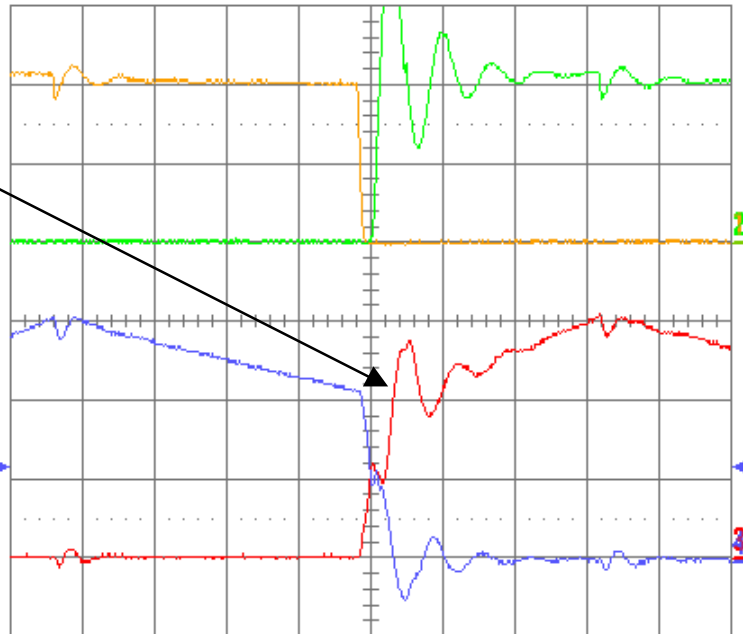
15-Nov-02
13:24:39

2
.5 μs
20.0 V

1
.5 μs
20.0 V

4
.5 μs
1.00 A

3
.5 μs
1.00 A



				BWL
1	2	V	DC	$\times 10$
2	2	V	DC	$\times 10$
3	.1	V	DC	$\times 10$
4	.1	V	DC	$\times 10$



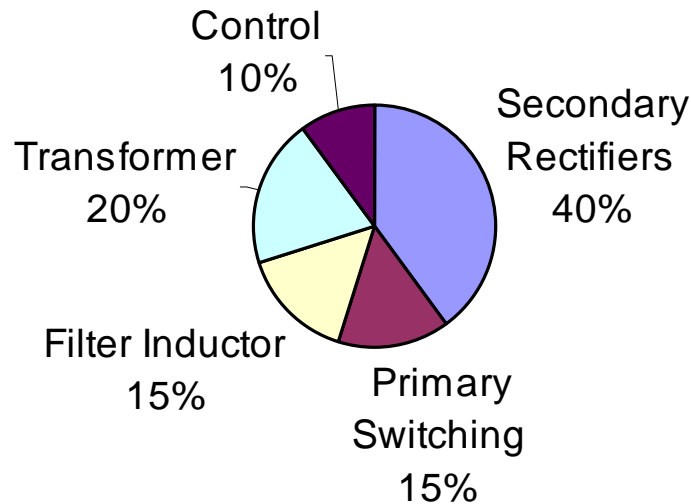
4 DC 1.22 A

500 MS/s

AUTO



Why is Reducing Secondary Rectification Losses Important?



Estimate for typical 3.3V Output, 35 – 80V Input



Comparison of Rectifier Stresses

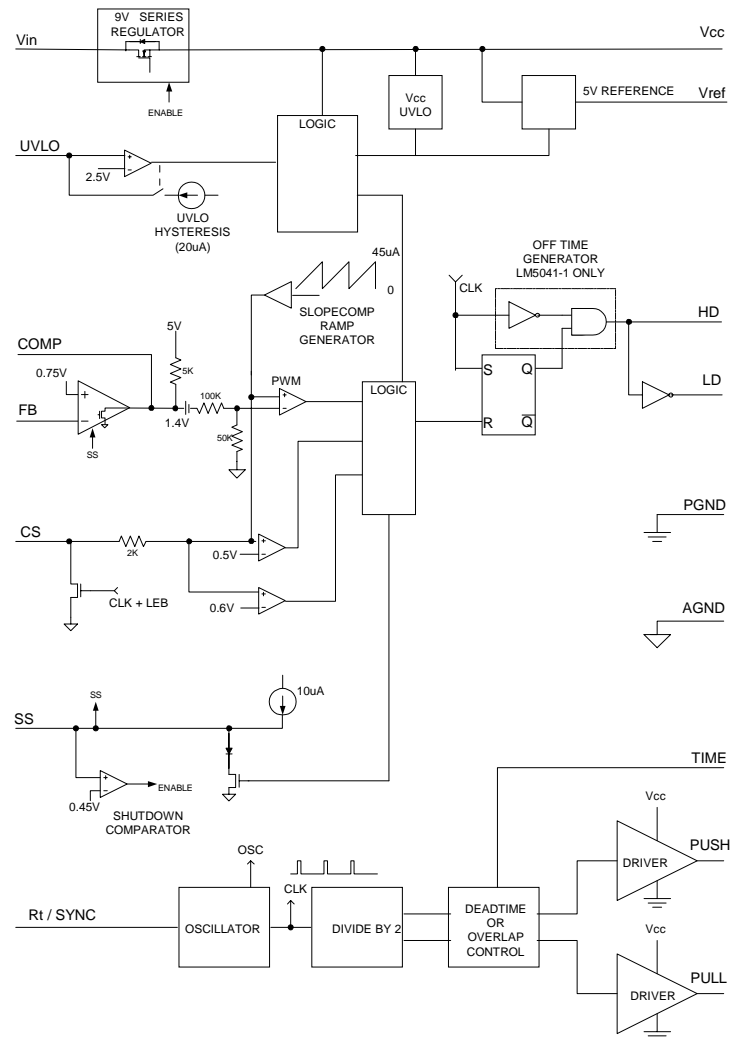
Topology	Rectifier Voltage Stresses	Example: 3.3V Out, 35 - 80V Input	Example: Assumptions
Forward	$V_{in} * (N_s/N_p)$	20V	High Line with XFR Ratio 4:1
Push-Pull	$V_{in} * (N_s/N_p) * 2$	26.7V	High Line with XFR Ratio 6:1
Cascaded PP	$V_{out} * 2$	6.6V	All Line conditions XFR Ratio 6:1
Topology	Rectifier Current Ratios	Example: 3.3V Out, 35 - 80V Input	Example: Assumptions
Forward	$I_{out} * D$ and $I_{out} * (1-D)$	16 / 84%	Ratio at High Line
Push-Pull	$50% * I_{out}$	50%	All line conditions
Cascaded PP	$50% * I_{out}$	50%	All line conditions

LM5041 Cascaded PWM Controller

Features

- Internal Start-up Bias Regulator
- Programmable Line Under Voltage Lockout with Adjustable Hysteresis
- Current Mode Control
- Internal Error Amplifier with Reference
- Dual Mode Over-Current Protection
- Programmable Push-Pull Overlap or Deadtime
- Internal Push-Pull Gate Drivers
- Programmable Soft-Start
- Programmable Oscillator with Sync Capability
- Precision Reference
- Thermal Shutdown (165°C)

Packages: TSSOP16 and
LLP16 (5 x 5 mm)





LM5100 / 1 High Voltage Buck Stage Gate Driver

Features

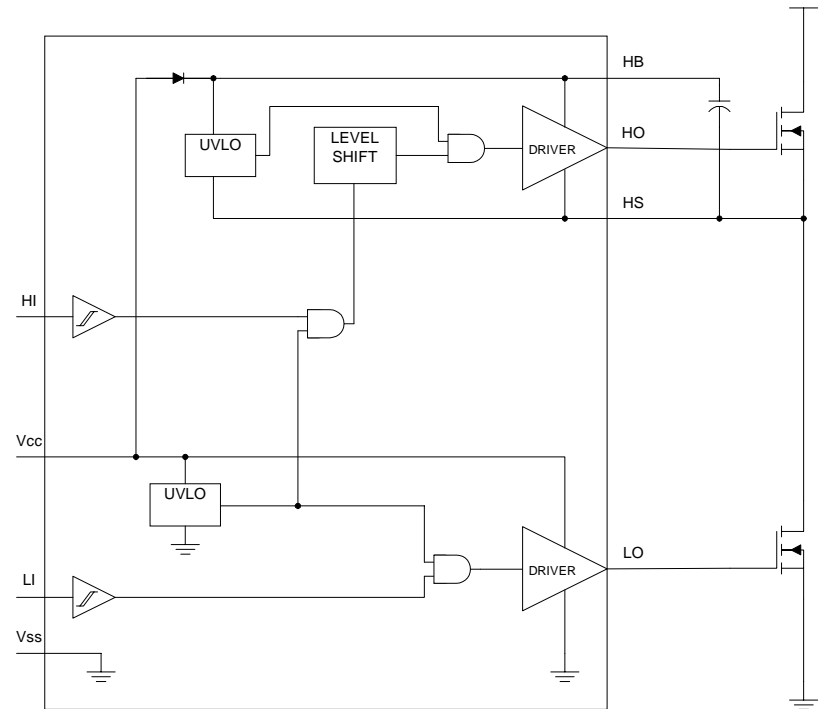
- Drives both a High Side and Low Side N-Channel MOSFET
- Independent Inputs (TTL for LM5101 or CMOS for LM5100)
- Bootstrap Supply Voltage to 116VDC
- Fast Propagation Times
- Drives 1000pF Loads with 10nS Rise and Fall Times
- Outputs Unaffected by Supply Glitching, HS Ringing Below Ground or HS High Slew Rates
- Supply Rail Under-voltage Lockout
- Low Power Consumption
- Pin for pin compatible with HIP2100/2101

Typical Applications

- Current Fed Push-Pull Power Converters
- Half Bridge Power Converters
- Full Bridge Power Converters
- Two Switch Forward Power Converters
- Active Clamp Forward Power Converters

Package

- SOIC – 8
- LLP - 10





Application Converter Performance

Input Range: 35 to 80V

Output Voltage: 2.5V

Output Current: 0 to 50A

Measured Efficiency:

89% @ 50A and 91% @20A

Board Size: 2.3 x 3.0 x 0.5

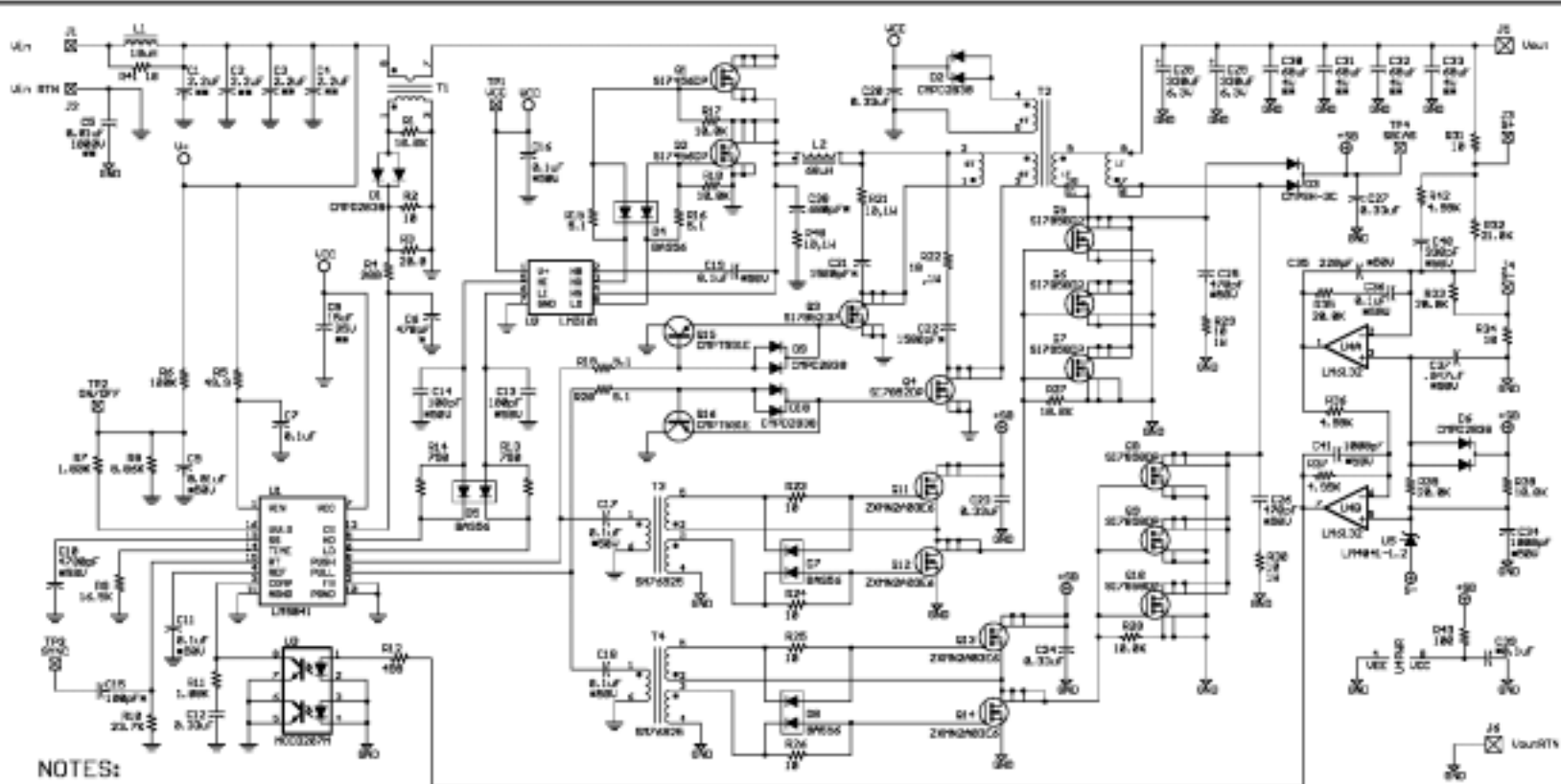
Load Regulation: 1%

Line Regulation: 0.1%

Line UVLO, Current Limit




LM5041 / LM5100 Demo Board 2.5V @ 50A Cascaded DC-DC Converter



NOTES:

- 1. ALL CAPACITORS IN MICROFARADS. ALL ARE 1206 Pkg., 50V, XPR, 100V UNLESS NOTED.
- 2. ALL RESISTORS ARE 1% 1206 Pkg. UNLESS NOTED.
- 3. 1 WATT RESISTORS ARE 2512 PACKAGE. * DENOTES 0805 PACKAGE, ** DENOTES 1002 PACKAGE.

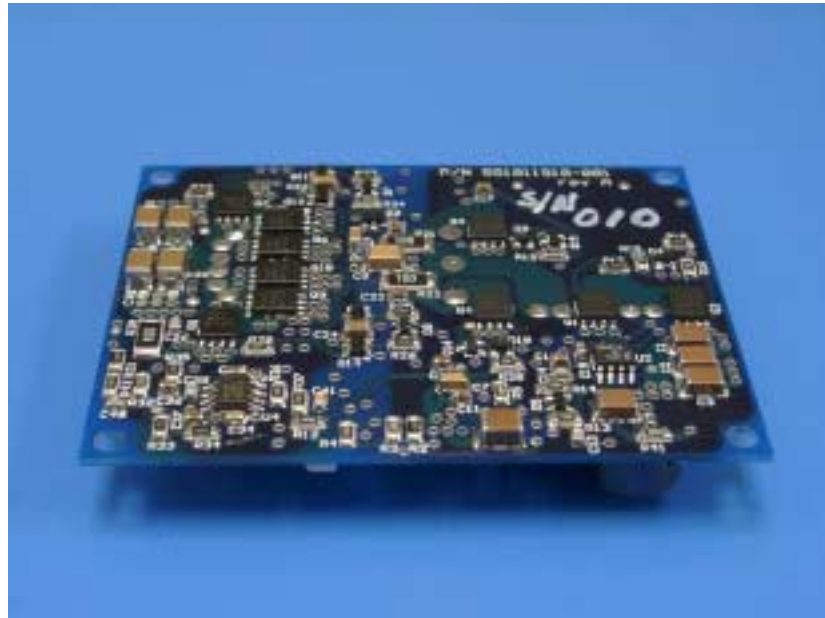
	TITLE:	LM5041_125WC
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		Sheet: 1/1



Demonstration Converter Photo



Top View



Bottom View