

# STREAMLINING SOLUTION SIZE AND COST WITH CUTTING EDGE BUCK CONVERTERS

## New Product Update

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– Systems Engineer

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# Agenda

- Product overview:
  - LMR36502 (65 V, 150 mA)
- Benefits of the Buck Converter
  - Efficiency and thermal performance
  - Low quiescent current ( $I_Q$ )
  - Scalable solution
  - Small size

Please feel free to “chat” with Harrison, Systems Engineer, who is available to answer any questions you have throughout this presentation.

# Product overview

# LMR36501/2 | Cooper Lite | 100mA/150mA

## Easiest-to-Use 65V, 100mA/150mA Synchronous Step-Down DC-DC Converters

### Features

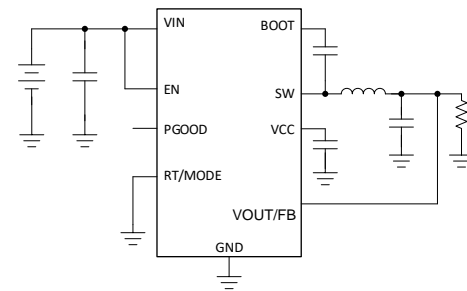
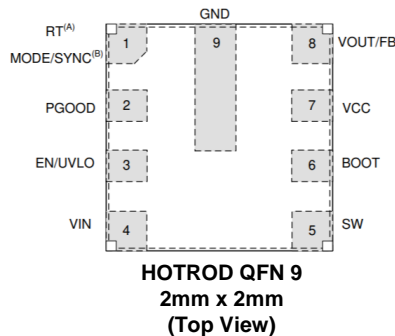
- **2 mm x 2 mm HotRod™ QFN**; -40C to **150C** T<sub>J</sub> operation
- **High Low Load Efficiency**
- **Wide VIN range: 3.4 V – 65 V** (Abs. Max = 70V)
  - VIN UVLO Falling = 3V
- **Design for Low EMI**
  - **HotRod™ QFN** with Wettable Flanks (Auto grade only)
  - **Spread Spectrum** with Pseudo Random
  - **Adjustable F<sub>SW</sub>** from 200kHz to 2.2 MHz with RT pin variant
    - Forced PWM / PFM factory setting
  - **MODE/SYNC** with MODE/SYNC pin variant [Automotive only]
    - & FPWM external selection (Continuous conduction mode at light load)
    - & PFM external selection (Diode emulation for light load efficiency)
- **Precision EN/UVLO and PGOOD with delay**
- **4μA Standby I<sub>q</sub>** with **Fixed VOUT/ BIAS** option
- **3.3V Fixed/Adj. and 5V Fixed/Adj.** options available

### Applications

- Appliance
- Building automation
- Factory automation

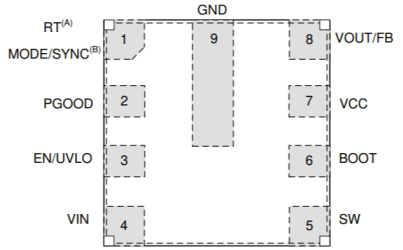
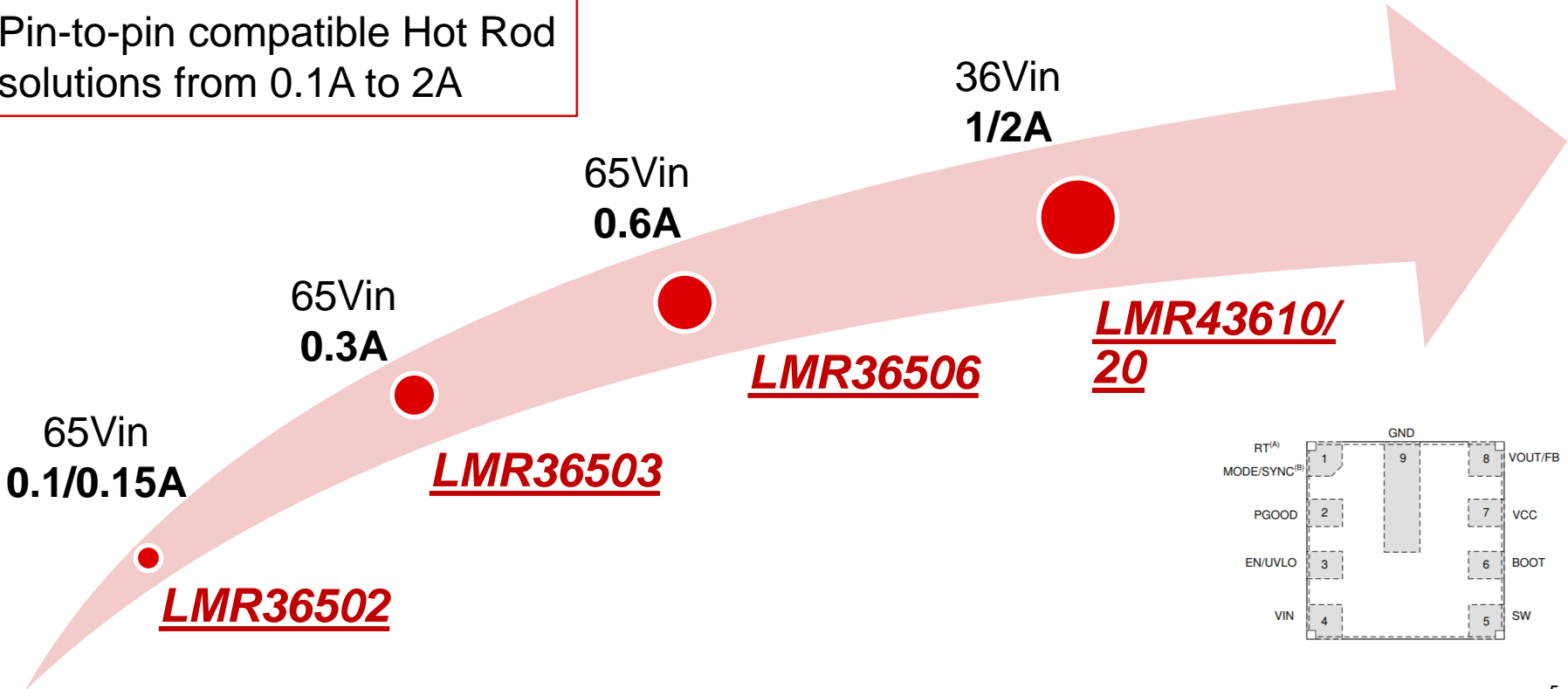
### Benefits

- **Smallest Wide-V<sub>IN</sub> package** and reduced solution size suitable for space constrained sensor applications
  - Capable of handling wide **input transients up to 70V**
- **Fixed frequency** (with adjustable option) and ultra low ripple over entire load range
- Best in class Wide-V<sub>IN</sub> TI solution for low load efficiency
  - **Typ. Automotive (82% @12VIN, 3.3VOUT @ 100mA, 2.2MHz, T<sub>A</sub>=25°C)**
  - **Typ. Industrial (80% @24VIN, 3.3VOUT @ 80mA, 1MHz, T<sub>A</sub>=25°C)**



# Scalable Buck Solution

Pin-to-pin compatible Hot Rod solutions from 0.1A to 2A

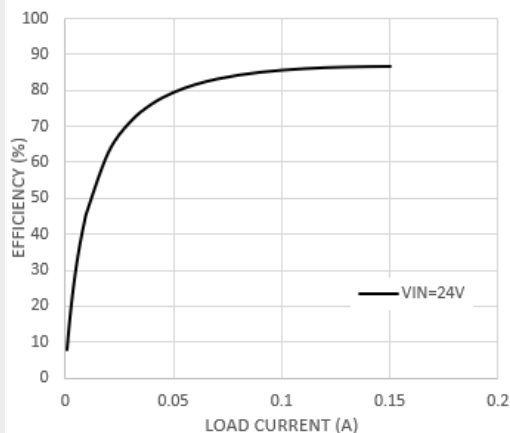


# LMR36501/2 Benefits Overview

## Efficiency & Thermal

### High efficiency and good thermal performance

- Low  $I_Q$ : 6 $\mu$ A switching  $I_Q$  (AUTO)
- 7°C temperature rise at full load
- 86% Peak Efficiency 24Vin, 5Vout, 1MHz

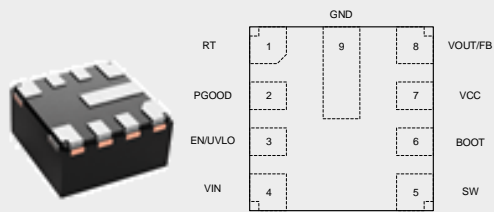


LMR36502EVM

## Scalable Solution

### Pin to pin compatible family of devices supporting currents from 0.1A to 2A

- LMR36501/2 (65V, 100mA/150mA)
- LMR36503/6 (65V, 300mA/600mA)
- LMR4361/20 (36V, 1A/2A)
- These devices also have module equivalents



HOTROD QFN 9  
2mm x 2mm  
(Top View)

## Small Solution Size

### HOTROD QFN Package allows for minimal PCB area:

- 2-mm x 2-mm QFN Package
- 36mm<sup>2</sup> optimized solution size
- 6 external passives required



# Benefits of TI Buck Converter vs Competition

# Features Comparison

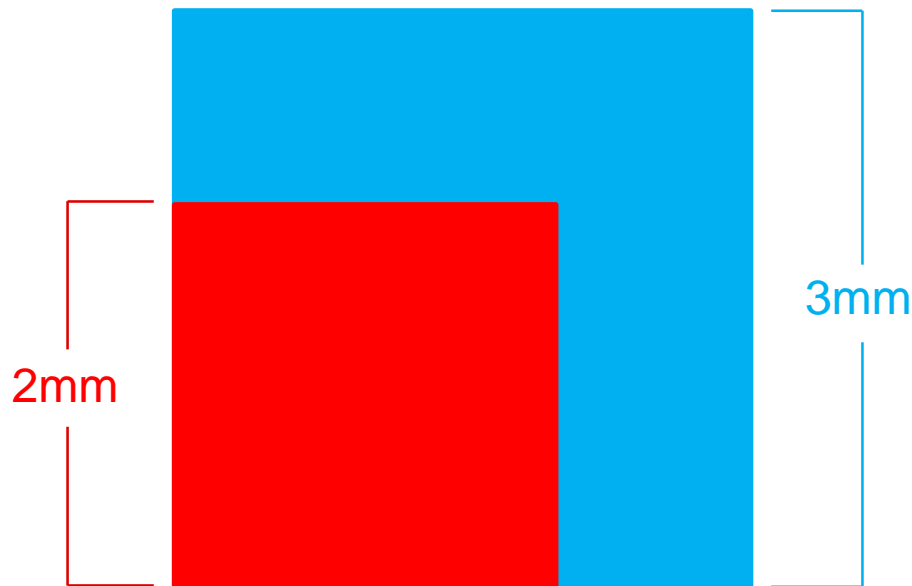
Manufacturer	Texas Instruments	Competitor A	Comment
Input Voltage Range	3 – 65 V	4 – 60 V	Smaller Vin Range
Load Current	150 mA	150 mA	Equal output load
Output Voltage Range	3.3 V	3.3 V	Equal output voltage
Shutdown Current (EN=0V)	1 $\mu$ A	2.5 $\mu$ A	Nominal values at 24V input. Greater shutdown Current
$I_Q$	4 $\mu$ A	70 $\mu$ A	In PFM
Switching Frequency	200kHz – 2.2MHz	200kHz – 2.2MHz	
Minimum On Time	57 ns	75 ns	Greater Min On Time
Rdson	2.2 / 1 $\Omega$	2.7 / 1.33 $\Omega$	Greater Rdson
Synchronous	✓	✓	Both parts synchronous
Internal Compensation	Yes	Yes	Both parts internally compensated
Operating $T_J$	-40°C to 150°C	-40°C to 150°C	
Board size	48cm <sup>2</sup>	25cm <sup>2</sup>	Smaller EVM board size as measured with calipers
Package	2-mm x 2-mm VQFN	3mm x 3mm TDFN	Larger package sizes

Values displayed come from each part's datasheet unless otherwise stated

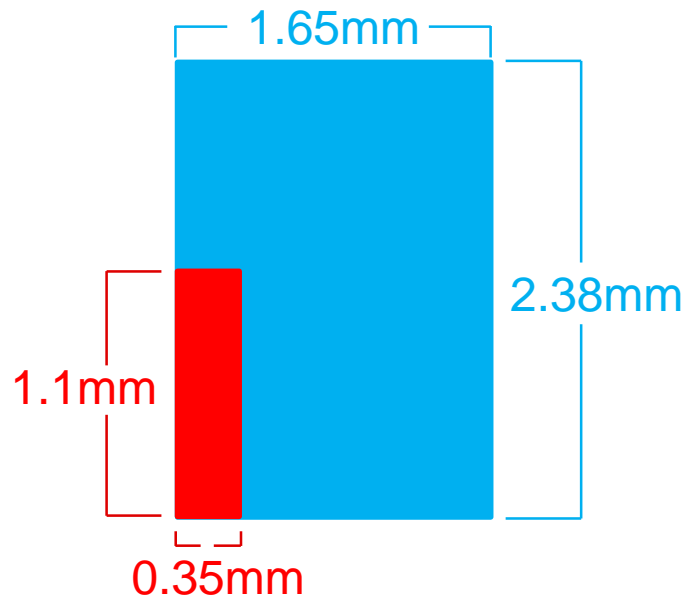


# Package Comparison

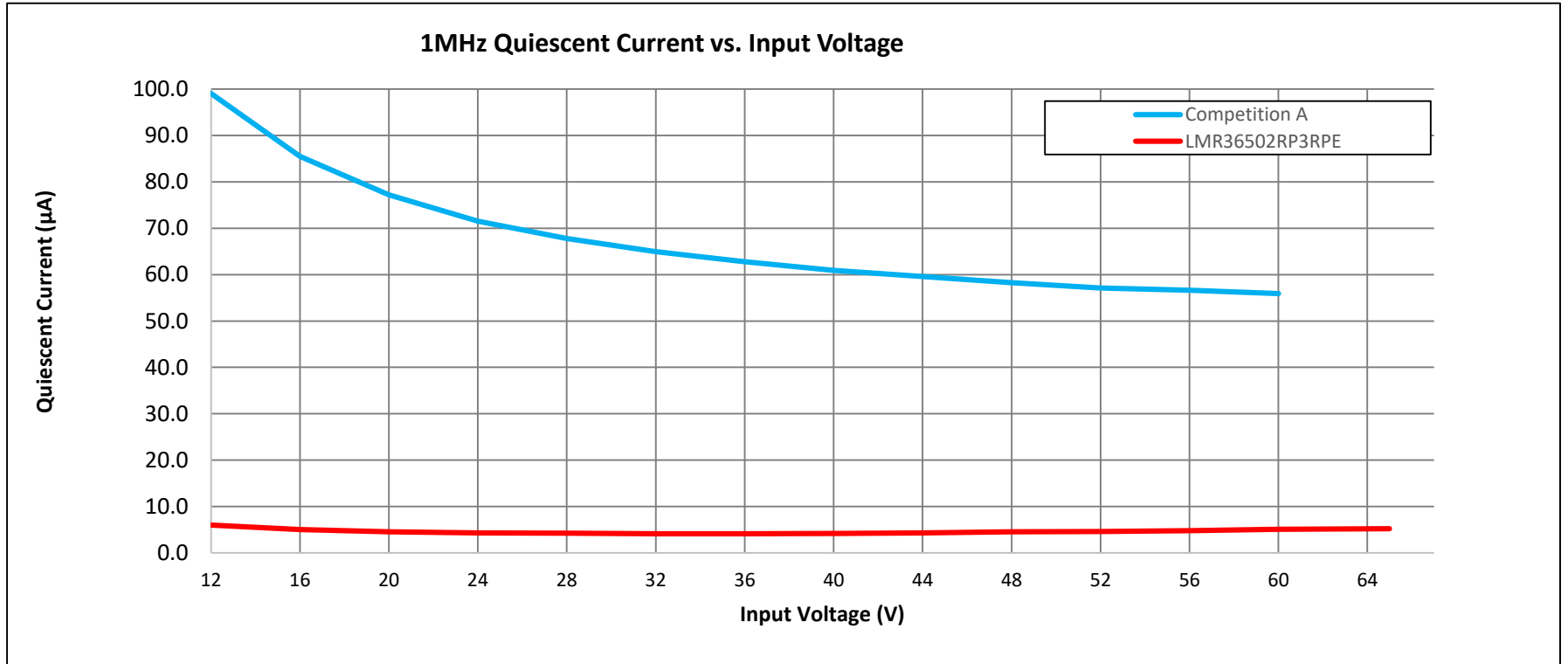
**LMR36502** and **Competitor A**  
package size



**LMR36502** and **Competitor A**  
ground pad size



# Quiescent Current Slide



# Getting Started with LMR36502

# Getting started with LMR36502

Table 9-3. Detailed Design Parameters

DESIGN PARAMETER	EXAMPLE VALUE
Input voltage	24 V (6 V to 65 V)
Output voltage	3.3 V
Maximum output current	0 A to 150 mA
Switching frequency	1000 kHz



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NEW

**LMR36502** ACTIVE

Notifications

3-V to 65-V, 150-mA ultra-small synchronous buck converter with 6  $\mu$ A IQ

[Order now](#)

DATA SHEET

[LMR3650x 3-V to 65-V, 100-mA and 150-mA Wide VIN Synchronous Buck Converter Optimized for Size and Light Load Efficiency datasheet \(Rev. A\)](#) [PDF](#) | [HTML](#)

# Getting started with LMR36502

## 9.2 Typical Application

Figure 9-1 shows a typical application circuit for the LMR36502. This device is designed to function over a wide range of external components and system parameters. However, the internal compensation is optimized for a certain range of external inductance and output capacitance. As a quick-start guide, Table 9-1 and Table 9-2 provide typical component values for a range of the most common output voltages.

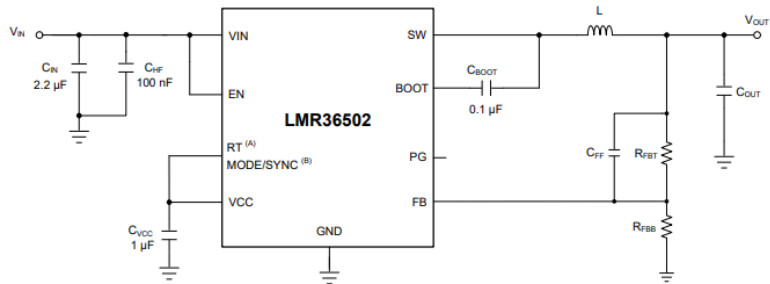


Table 9-1. Typical External Component Values for Adjustable Output LMR36502

$F_{sw}^{(1)(2)}$ (kHz)	$V_{out}$ (V)	L ( $\mu$ H)	NOMINAL $C_{out}$ (RATED CAPACITANCE)	MINIMUM $C_{out}$ (RATED CAPACITANCE)	$R_{FBT}$ ( $\Omega$ ) <sup>(3)</sup>	$R_{FBB}$ ( $\Omega$ )	$C_{in}$	$C_{BOOT}$	$C_{VCC}$
400	3.3	33	1 $\times$ 47 $\mu$ F	1 $\times$ 22 $\mu$ F	33.2 k	14.3 k	2.2 $\mu$ F + 1 $\times$ 100 nF	100 nF	1 $\mu$ F
1000	3.3	15	2 $\times$ 22 $\mu$ F	1 $\times$ 22 $\mu$ F	33.2 k	14.3 k	2.2 $\mu$ F + 1 $\times$ 100 nF	100 nF	1 $\mu$ F
400	5	47	1 $\times$ 47 $\mu$ F	1 $\times$ 22 $\mu$ F	49.9 k	12.4 k	2.2 $\mu$ F + 1 $\times$ 100 nF	100 nF	1 $\mu$ F
1000	5	22	2 $\times$ 22 $\mu$ F	1 $\times$ 22 $\mu$ F	49.9 k	12.4 k	2.2 $\mu$ F + 1 $\times$ 100 nF	100 nF	1 $\mu$ F

# Getting started with LMR36502



^ **Reference designs** →

Automotive  
Communications equipment  
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Personal electronics

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# Getting started with LMR36502

## Design & development

For additional terms or required resources, click any title below to view the detail page where available.

[All](#) [Hardware development](#) [Design tools & simulation](#) [CAD/CAE symbols](#)

### Hardware development



EVALUATION BOARD

**LMR36502EVM** – LMR36502 evaluation module for wide-input-voltage, 65-V 150-mA synchronous step-down converter

The LMR36502EVM evaluation module (EVM) helps designers evaluate the operation and performance of the LMR36502 wide-input buck regulator. The LMR36502 is an easy-to-use synchronous step-down DC/DC converter capable of driving up to 150 mA of load current from an input voltage of up to 65 V. The (...)

User guide: [PDF](#) | [HTML](#)

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\$70.00 (USD)

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### Design tools & simulation



SIMULATION MODEL

**LMR36502 PSPICE Model**

SNVMCB6.ZIP (633 KB) - PSpice Model

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# Getting started with LMR36502

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# Getting started

You can start evaluating this device leveraging the following:

Content type	Content title	Link to content or more details
Product folder	LMR36502 LMR36501	<a href="https://www.ti.com/product/LMR36502">https://www.ti.com/product/LMR36502</a> <a href="https://www.ti.com/product/LMR36501">https://www.ti.com/product/LMR36501</a>
Functional Safety Information	LMR36502 and LMR36501 Functional Safety FIT Rate, FMD and Pin FMA	<a href="https://www.ti.com/lit/fs/sffs553/sffs553.pdf">https://www.ti.com/lit/fs/sffs553/sffs553.pdf</a>
Selection and design tools and models	WEBENCH® circuit design and selection simulation services LMR36502 PSPICE Model	<a href="#">Webench design link</a> <a href="https://www.ti.com/product/LMR36502#design-development">https://www.ti.com/product/LMR36502#design-development</a>
Development tool or evaluation kit	LMR36502EVM	<a href="https://www.ti.com/tool/LMR36502EVM">https://www.ti.com/tool/LMR36502EVM</a>



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