# EV4601ES-00A

## Buck-Boost White LED Driver For TV Backlighting Applications

The Future of Analog IC Technology

## DESCRIPTION

The EV4601ES-00A Evaluation Board is designed to demonstrate the capabilities of MPS' MP4601ES for TV backlighting applications. MP4601 is an integrated Buck-Boost white LED driver which is suitable for TV and big panel backlighting applications with MPS patented pending technology.

With a 12V input VIN and a high voltage source $V_{INH}$, EV4601ES-00A can deliver a regulated voltage ($V_{INH}$ to $V_{INH}$+60V) to drive a LED string over 350V. The LED current is regulated to about 120mA. The EV4601ES-00A can be synchronized. Several EV4601ES-00As can be used together to drive a TV panel

## FEATURES

- Novel Power Leverage Control Technology
- Negative Output Buck-Boost Operation
- Switching Frequency Synchronization
- Analog and PWM Dimming Control
- Programmable Cycle-by-Cycle Over Current Protection
- Thermal Shutdown Protection
- LED Short and Open Protection
- Fault Output for Short LED Protection
- Output Short Circuit Protection

## APPLICATIONS

- TV Backlighting
- Large LCD Panels Backlighting

## ELECTRICAL SPECIFICATION

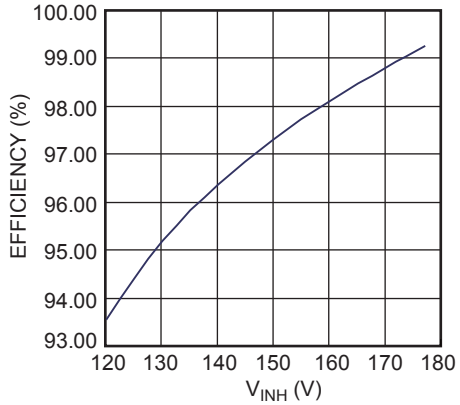
| Parameter | Symbol | Value | Units |
|---|---|---|---|
| Input Voltage | VIN | 12±10% | V |
| Enable | EN | 5±10% | V |
| Dimming | DIM | 5±10% | V |
| LED Current | $I_{LED}$ | 120±5% | mA |
| Switching Frequency | fs | 300 | kHz |
| Over Voltage Protection | $V_{LED-Max}$ | -63 | V |

## EV4601ES-00A EVALUATION BOARD

**(L x W x H) 5cm x 4.6cm x 4.5mm**

| Board Number | MPS IC Number |
|---|---|
| EV4601ES-00A | MP4601ES |

**Efficiency vs. $V_{INH}$**

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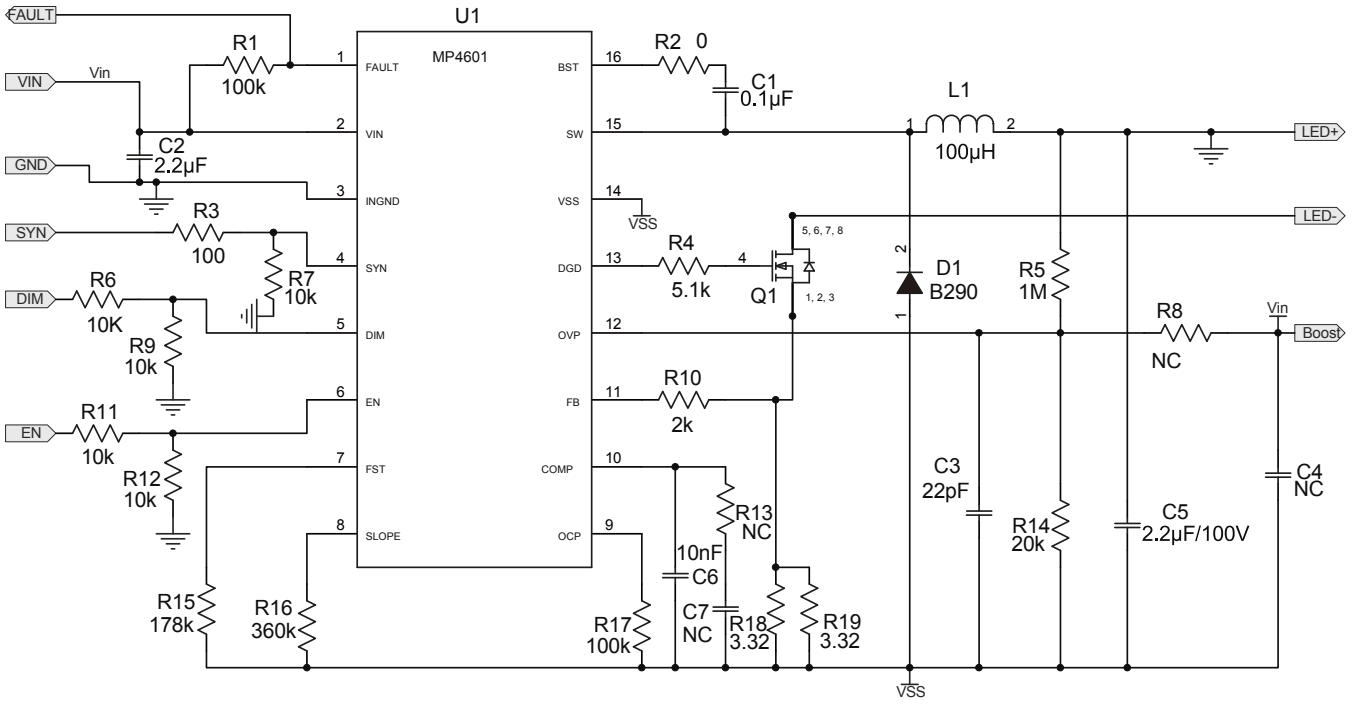
## EVALUATION BOARD SCHEMATIC




## EV4601ES-00A BILL OF MATERIALS

| Qty | Ref | Value | Description | Package | Manufacturer | Part Number |
|---|---|---|---|---|---|---|
| 1 | C1 | 0.1µF | Ceramic Capacitor;50V;X7R;0603 | 0603 | muRata | GRM188R71H104KA93D |
| 1 | C2 | 2.2µF | Ceramic Capacitor;100V;X7R;1210 | 1210 | muRata | GRM32ER72A225KA35L |
| 1 | C3 | 22pF | Ceramic Capacitor;50V;NPO;0603 | 0603 | LION | 0603N220J500T |
| 1 | C4 | NC | | | | |
| 1 | C5 | 2.2µF/100V | Ceramic Capacitor;100V;X7R;1210 | 1210 | muRata | GRM32ER72A225KA35L |
| 1 | C6 | 10nF | Ceramic Capacitor;50V;X7R;0603 | 0603 | muRata | GRM188R71H103KA01D |
| 1 | C7 | NC | Ceramic Capacitor;25V;C0G;0603 | 0603 | muRata | |
| 1 | D1 | B290 | Schottky Diode;90V;2A | SMB | Diodes | B290-F |
| 1 | L1 | 100µH | Inductor;100uH;255mOhm;1.2A | SMD | Wurth | 744066101 |
| 1 | Q1 | SMK0260D | N-Channel Mosfet;600V, 2A | DPAK (TO-252) | AUK | SMK0260D |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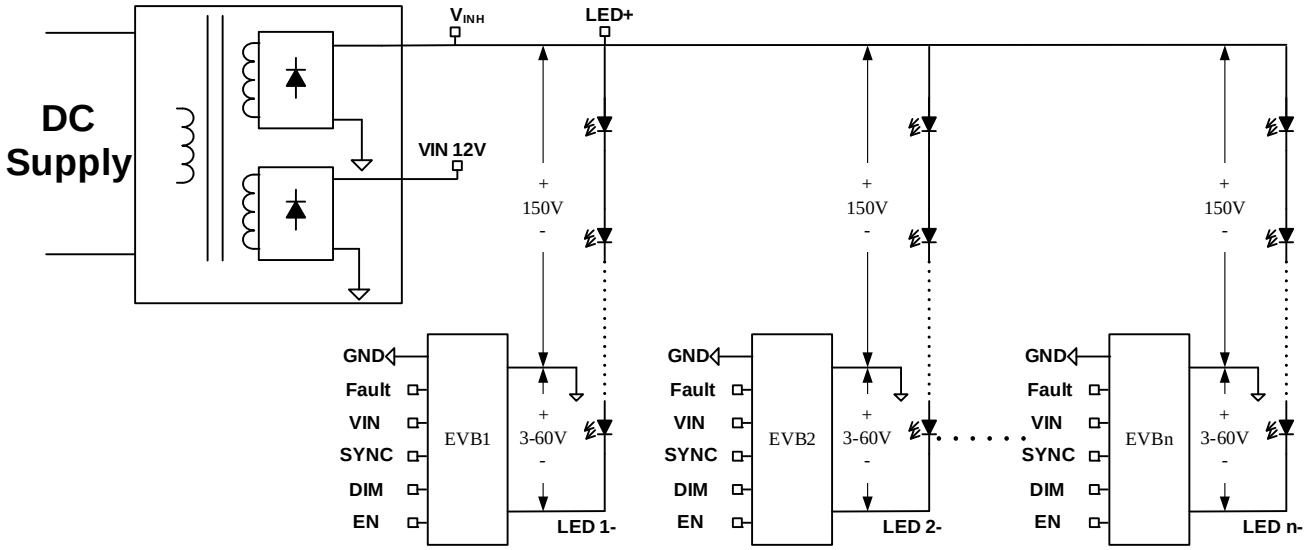
## EV4601ES-00A BILL OF MATERIALS *(continued)*

| Qty | Ref | Value | Description | Package | Manufacturer | Part Number |
|---|---|---|---|---|---|---|
| 2 | R1,R17 | 100k | Film Resistor;1% | 0603 | Yageo | RC0603FR-07100KL |
| 1 | R2 | 0 | Film Resistor;5% | 0603 | Yageo | RC0603JR-070RL |
| 1 | R3 | 100 | Film Resistor;1% | 0603 | Yageo | RC0603FR-07100RL |
| 1 | R4 | 5.1k | Film Resistor;1% | 0603 | Yageo | RC0603FR-075K1L |
| 1 | R5 | 1M | Film Resistor;1% | 0603 | Yageo | RC0603FR-071ML |
| 5 | R6, R7, R9, R11, R12 | 10k | Film Resistor;1% | 0603 | Yageo | RC0603FR-0710KL |
| 2 | R8, R13 | NC | | | | |
| 1 | R10 | 2k | Film Resistor;1% | 0603 | Yageo | RC0603FR-072KL |
| 1 | R14 | 20k | Film Resistor;1% | 0603 | Yageo | RC0603FR-0720KL |
| 1 | R15 | 178k | Film Resistor;1% | 0603 | Yageo | RC0603FR-07178KL |
| 1 | R16 | 360k | Film Resistor;1% | 0603 | Yageo | RC0603FR-07360KL |
| 2 | R18, R19 | 3.32 | Film Resistor;1% | 0603 | Yageo | RC0603FR-073R32L |
| 1 | U1 | MP4601ES | MP4601ES | SOIC16 | MPS | |

## EXAMPLE OF TV BACKLIGHT DRIVE WITH SEVERAL EV4601ES-00A





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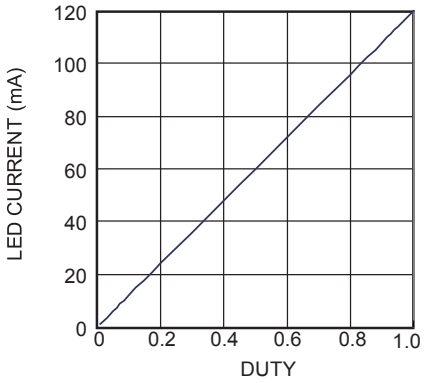
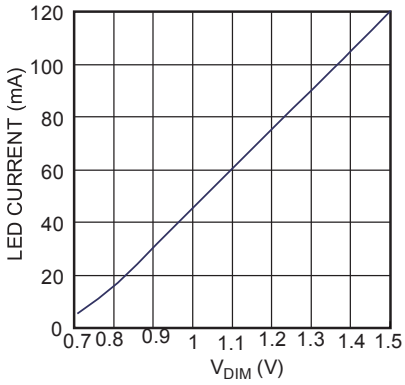
# EVB TEST RESULTS

**Performance waveforms are tested on the evaluation board.**
**VIN = 12V, $V_{INH}$=150V, VLED=180V, ILED = 120mA, $T_A$ = 20ºC, unless otherwise noted.**

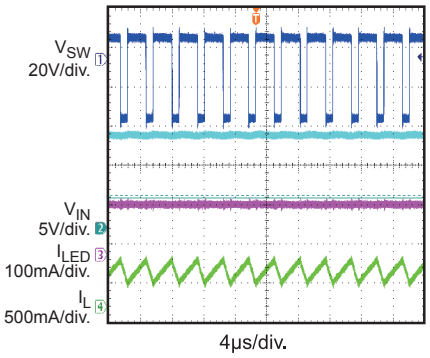
### PWM Dimming Curve



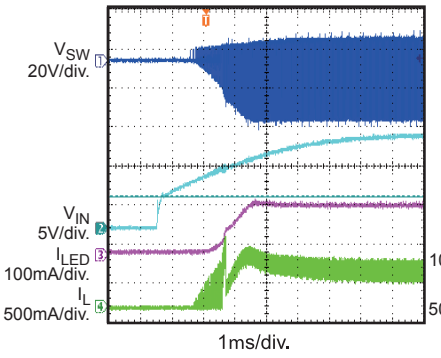

### Analog Dimming Curve



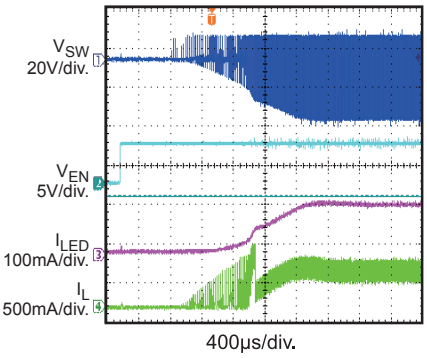

### Steady State




### VIN Start

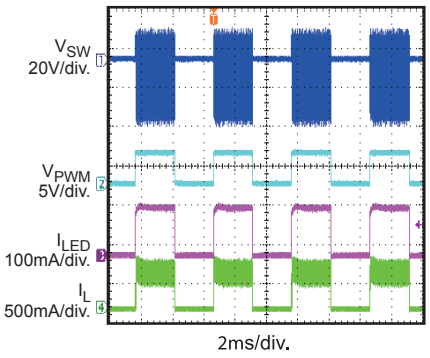



### EN Start



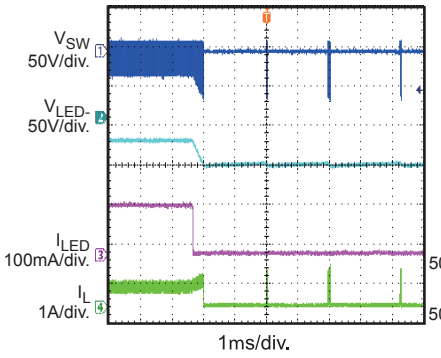

### PWM Dimming

$f_{PWM}$ = 200Hz, DUTY = 50%

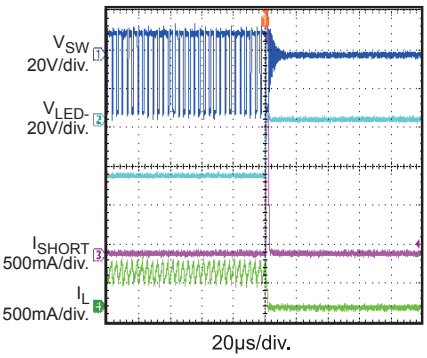



### OVP@Working

OVP Point = 63V




### Short LED- to GND@Working





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## PRINTED CIRCUIT BOARD LAYOUT

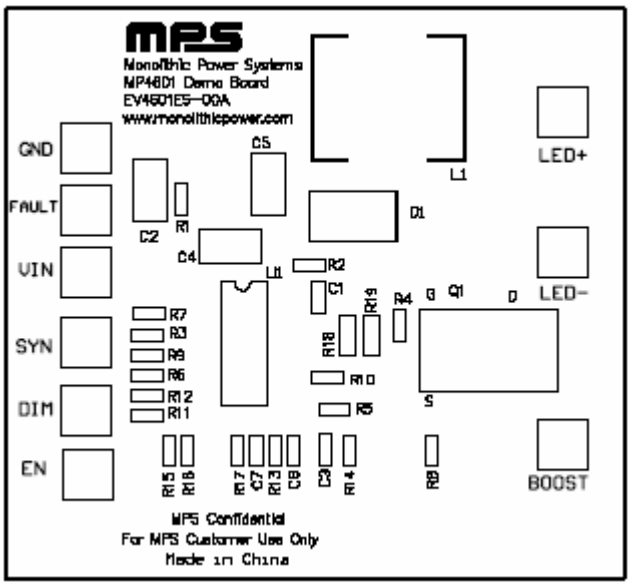


**Figure 1—Top Silk Layer**

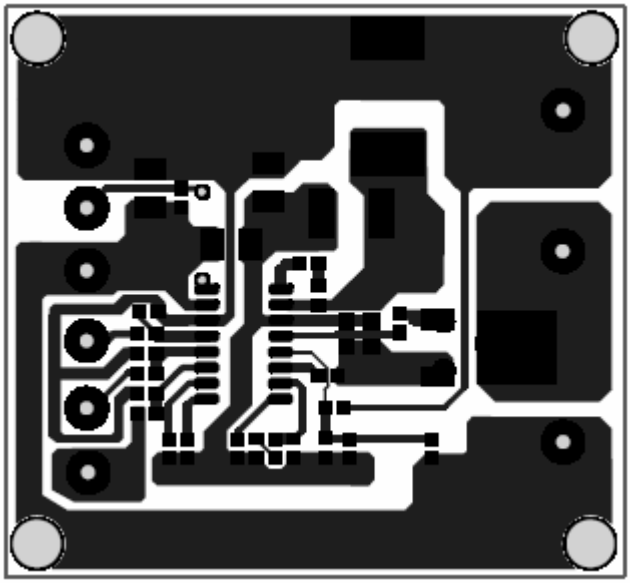

**Figure 2—Top Layer**

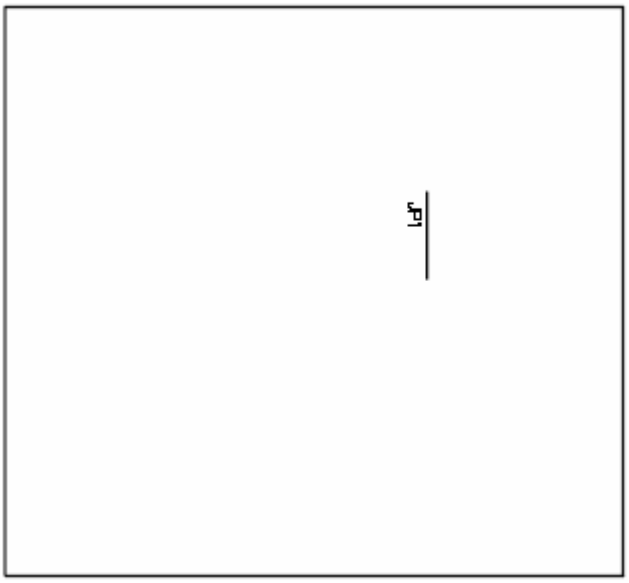


**Figure 3—Bottom Silk Layer**

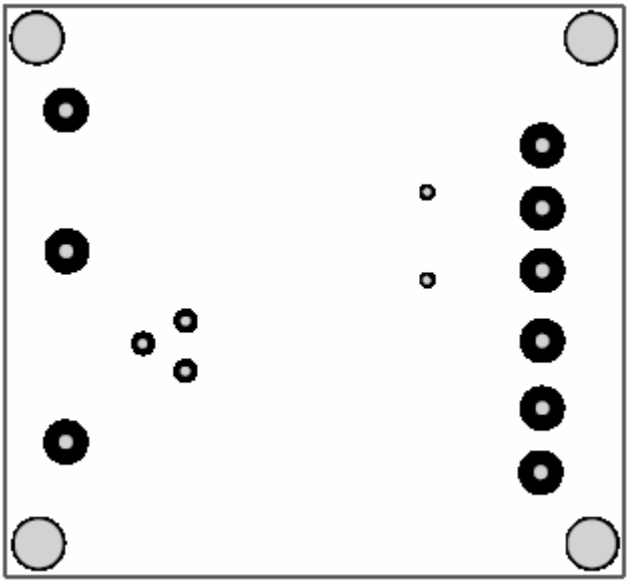

**Figure 4—Bottom Layer**


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## QUICK START GUIDE

1. Check the LED string voltage and preset the high voltage power supply's output. For example, 60 LED string needs 180V. Set the high voltage power supply output $V_{INH}$ as 150V.
2. Set a second power supply VIN to 12V as the input of all the EVBs. Set a third power supply to 5V as the EN input to all the EVBs, Set a fourth power supply to 5V as the DIM input of all EVBs.
3. Turn-off all power supplies.
4. Connect the positive terminal of the high voltage power supply to all the anodes of the LED strings, and the negative terminal to all the EVB GND connector.
5. Connect each LED string cathode to the LED- connector on one EVB individually (one EVB for one LED string).
6. Connect VIN (12V) the positive terminal to all the EVB VIN connectors and the negative terminal to all the EVB GND connectors.
7. Connect the 5V DIM power supply positive terminal to all the EVB DIM connectors, and negative terminal to all the EVB GND connectors.
8. Connect the 5V EN power supply positive terminal to all the EVB EN connectors, and negative terminal to all the EVB GND connectors.
9. Connect all SYNC pin of all EVBs together for synchronization if necessary.
10. Turn on the high voltage power supply.
11. Turn on the 12V power supply.
12. Turn on the 5V DIM power supply.
13. Turn on the 5V EN power supply. All the LED strings should be lighted.
14. To demo the dimming function: replace the 5V power supply with a function generator. Set the PWM signal amplitude to 5V and the frequency within 100Hz to 20kHz range. For analog dimming, adjust the power supply on DIM connector from 1.4V to 3V

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