

### DESCRIPTION

The EV4423H-Q-00A is an evaluation board for the MP4423H/MPQ4423H, a high-frequency, synchronous, rectified, step-down, switch-mode converter with build-in power MOSFETs. It offers a very compact solution to achieve a 3A continuous output current with excellent load and line regulation over a wide input supply range. The MP4423H/MPQ4423H has synchronous mode operation for higher efficiency over the output current load range.

Current-mode operation provides fast transient response and eases loop stabilization.

Full protection features include over-current protection and thermal shut down.

The EV4423H-Q-00A uses a minimal number of readily-available standard components, and is assembled and tested in space-saving QFN-8(3mmx3mm) package.

### ELECTRICAL SPECIFICATIONS

| Parameter      | Symbol           | Value | Units |
|----------------|------------------|-------|-------|
| Input Voltage  | V <sub>IN</sub>  | 4-36  | V     |
| Output Voltage | V <sub>OUT</sub> | 3.3   | V     |
| Output Current | I <sub>OUT</sub> | 3     | A     |

### FEATURES

- Wide 4V to 36V Continuous Operating Input Range
- 85mΩ/55mΩ Low RDS(ON) Internal Power MOSFETs
- High-Efficiency Synchronous Mode Operation
- Default 410kHz Switching Frequency
- Synchronizes to a 200kHz to 2.2MHz External Clock
- High Duty Cycle for Automotive Cold-crank
- Power-Save Mode
- Internal Soft-Start
- Power Good
- OCP Protection and Hiccup
- Thermal Shutdown
- Output Adjustable from 0.8V
- Available in an QFN-8 (3mmx3mm) package
- Fully assembled and tested

### APPLICATIONS

- Automotive
- Industrial Control System
- Distributed Power Systems

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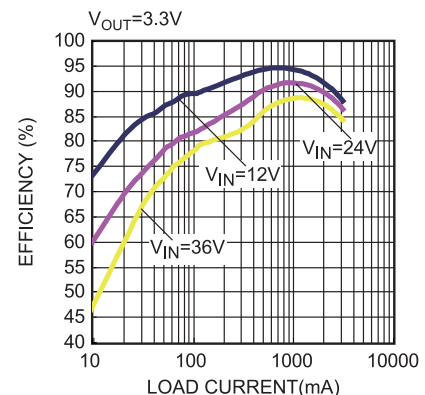
## EV4423H-Q-00A EVALUATION BOARD



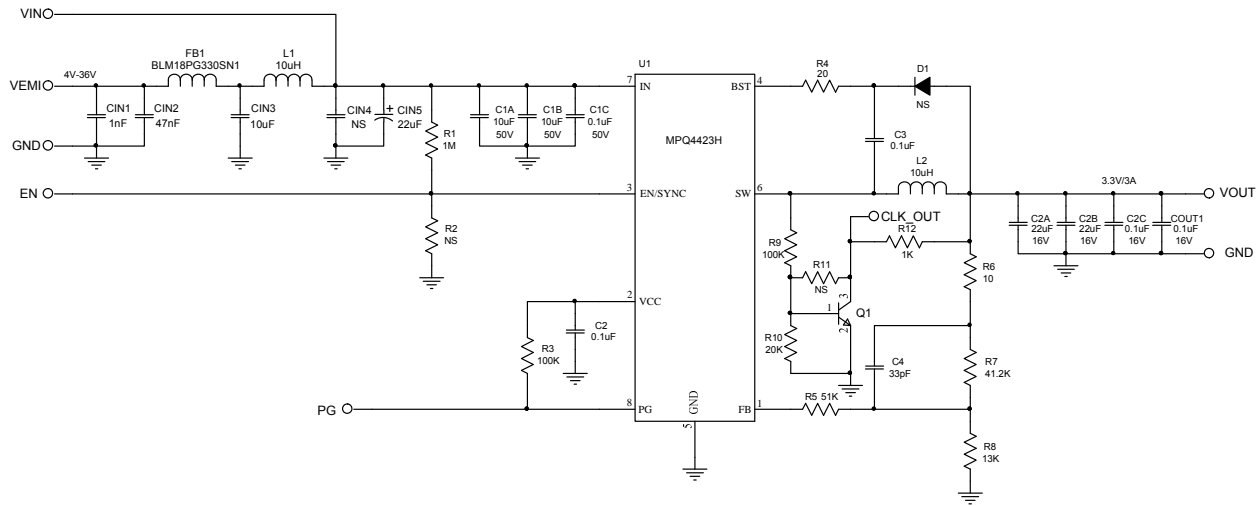
(L x W x H) 2.5" x 2.5" x 0.2"  
(6.35cm x 6.35cm x 0.5cm)

| Board Number  | MPS IC Number |
|---------------|---------------|
| EV4423H-Q-00A | MPQ4423HGQ    |

### Efficiency vs. Load Current



## EVALUATION BOARD SCHEMATIC



## EV4423H-Q-00A BILL OF MATERIALS

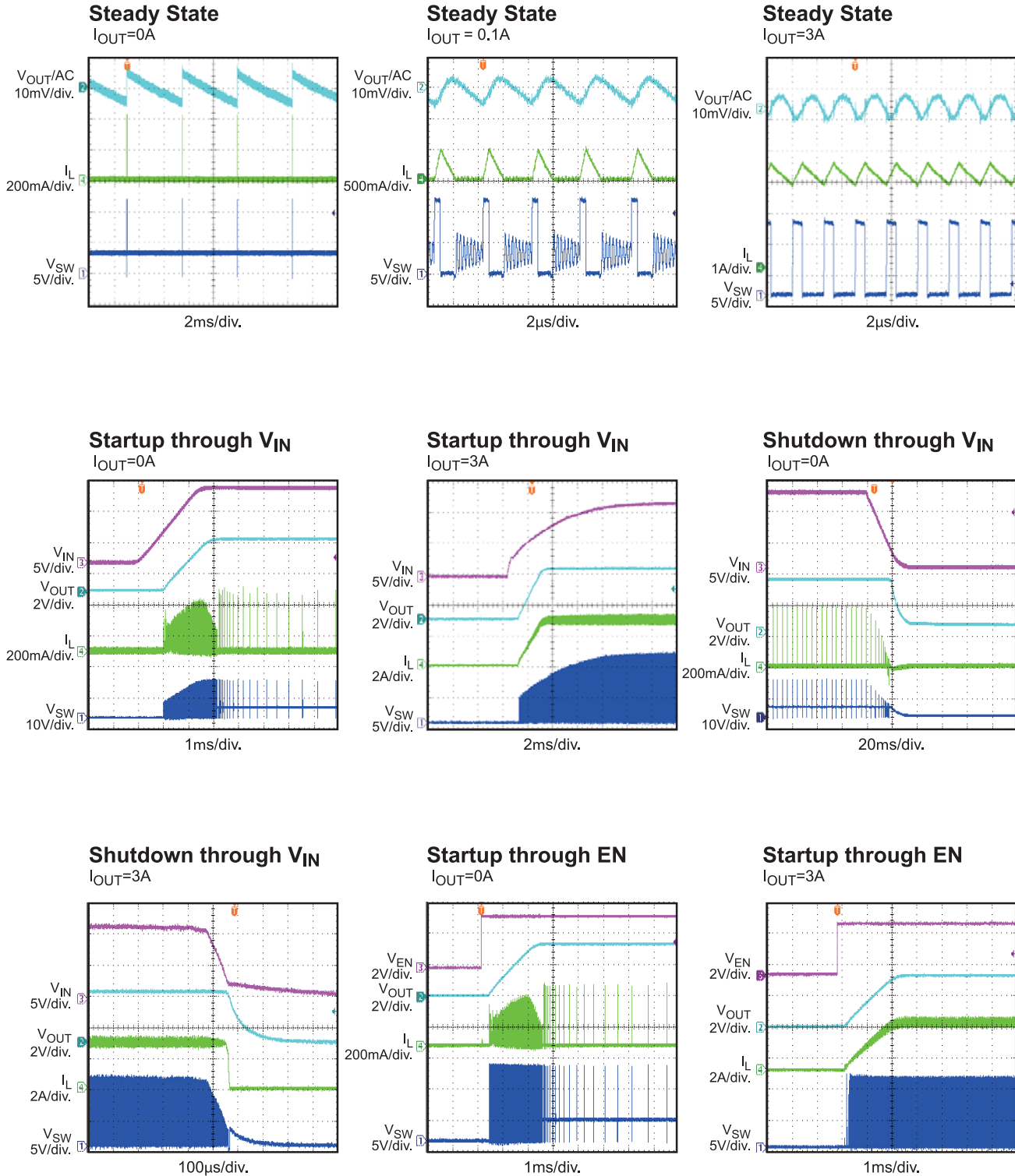
| Qty | Ref                     | Value       | Description                     | Package | Manufacturer | Manufacturer_P/N   |
|-----|-------------------------|-------------|---------------------------------|---------|--------------|--------------------|
| 3   | C1A,C1B<br>,CIN3        | 10 $\mu$ F  | Ceramic Cap.,<br>50V, X7R       | 1210    | muRata       | GRM32ER71H106KA12L |
| 1   | C1C                     | 0.1 $\mu$ F | Ceramic Cap.,<br>50V, X7R       | 0603    | muRata       | GRM188R71H104KA93D |
| 2   | C2A,C2B                 | 22 $\mu$ F  | Ceramic Cap.,<br>16V, X7R       | 1210    | muRata       | GRM32ER71C226KE79  |
| 4   | C2,C2C,<br>C3,COU<br>T1 | 0.1 $\mu$ F | Ceramic Cap.,<br>16V, X7R       | 0603    | muRata       | GRM188R71C104KA01D |
| 1   | C4                      | 33pF        | Ceramic Cap.,<br>50V, C0G       | 0603    | muRata       | GRM1885C1H330JA01D |
| 1   | CIN1                    | 1nF         | Ceramic Cap.,<br>50V, X7R       | 0603    | muRata       | GRM188R71H102KA01D |
| 1   | CIN2                    | 47nF        | Ceramic Cap.,<br>50V, X7R       | 0603    | muRata       | GRM188R71H473KA61D |
| 1   | CIN5                    | 22 $\mu$ F  | Electrolytic Cap.               | SMD     | Jianghai     | VTD-63V22          |
| 2   | CIN4,CO<br>UT1          | NS          |                                 |         |              |                    |
| 1   | D1                      | NS          |                                 |         |              |                    |
| 1   | FB1                     |             | Magnetic Bead, 3A               | 0603    | muRata       | BLM18PG330SN1      |
| 2   | L1,L2                   | 10 $\mu$ H  | Inductor, 40.9mOhm<br>DCR, 4.9A | SMD     | Coilcraft    | XAL5050-103ME      |
| 1   | R1                      | 1M          | Film Res., 5%                   | 0603    | Yageo        | RC0603JR-071ML     |
| 2   | R3,R9                   | 100k        | Film Res., 1%                   | 0603    | Yageo        | RC0603FR-07100KL   |
| 1   | R4                      | 20          | Film Res., 1%                   | 0603    | Yageo        | RC0603FR-0720RL    |
| 1   | R5                      | 51k         | Film Res., 1%                   | 0603    | Yageo        | RC0603FR-0751KL    |
| 1   | R6                      | 10          | Film Res., 1%                   | 0603    | Yageo        | RC0603FR-0710RL    |

**EV4423H-Q-00A BILL OF MATERIALS (continued)**

| Qty | Ref                                    | Value | Description           | Package  | Manufacturer     | Manufactuer_P/N  |
|-----|--|-------|-----------------------|----------|------------------|------------------|
| 1   | R7                                     | 41.2k | Film Res., 1%         | 0603     | Yageo            | RC0603FR-0741K2L |
| 1   | R8                                     | 13k   | Film Res., 1%         | 0603     | Yageo            | RC0603FR-0713KL  |
| 1   | R10                                    | 20k   | Film Res., 1%         | 0603     | Yageo            | RC0603FR-0720KL  |
| 1   | R12                                    | 1k    | Film Res., 1%         | 0603     | Yageo            | RC0603FR-071KL   |
| 2   | R2,R11                                 | NS    |                       |          |                  |                  |
| 1   | Q1                                     |       | Transistor, 40V, 0.2A | SOT-23   | ON Semiconductor | MMBT3904LT1      |
| 1   | U1                                     |       | Step-Down Regulator   | QFN3X3-8 | MPS              | MPQ4423HGQ       |
| 5   | VIN,<br>VEMI,<br>GND,<br>VOUT,<br>GND  |       | 2.0 Golden Pin        |          | HZ               |                  |
| 5   | EN/SYNC<br>,GND,PG,<br>GND,CLK<br>_OUT |       | 1.0 Golden Pin        |          | HZ               |                  |

## EVB TEST RESULTS

$V_{IN} = 12V$ ,  $V_{OUT} = 3.3V$ ,  $C_{OUT} = 2 \times 22\mu F$ ,  $L = 10\mu H$ ,  $T_A = +25^\circ C$ , unless otherwise noted.



## EVB TEST RESULTS *(continued)*

$V_{IN} = 12V$ ,  $V_{OUT} = 3.3V$ ,  $C_{OUT} = 2 \times 22\mu F$ ,  $L = 10\mu H$ ,  $T_A = +25^\circ C$ , unless otherwise noted.

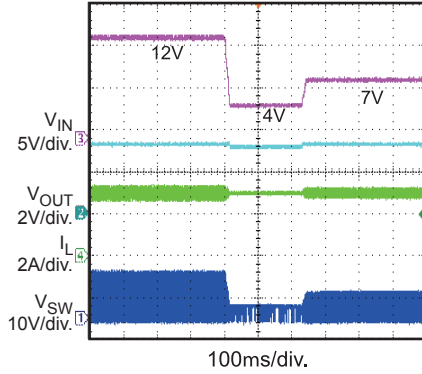


## EVB TEST RESULTS *(continued)*

$V_{IN} = 12V$ ,  $V_{OUT} = 3.3V$ ,  $C_{OUT} = 2x22\mu F$ ,  $L = 10\mu H$ ,  $T_A = +25^\circ C$ , unless otherwise noted.

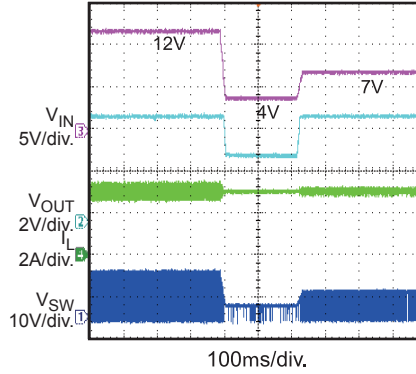
### Cold-Crank

$V_{OUT} = 3.3V$ ,  $I_{OUT} = 3A$



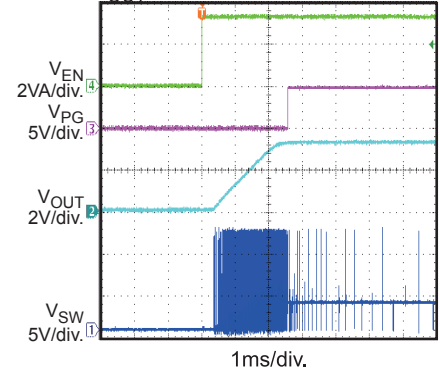
### Cold-Crank

$V_{OUT} = 5V$ ,  $I_{OUT} = 3A$



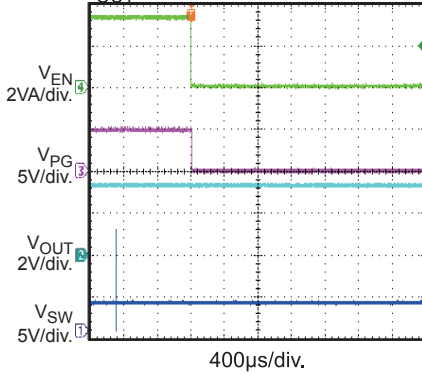
### Power Good through EN Start-Up

$I_{OUT} = 0A$



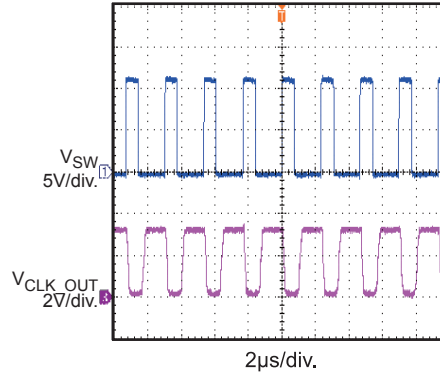
### Power Good through EN Shut-Down

$I_{OUT} = 0A$



### CLK\_OUT Inverted from SW

$I_{OUT} = 3A$



### PRINTED CIRCUIT LAYOUT

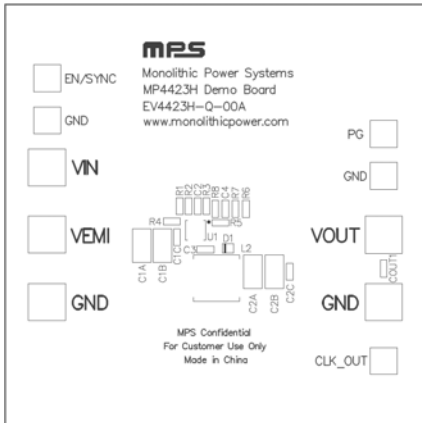


Figure1 – Top Silk Layer

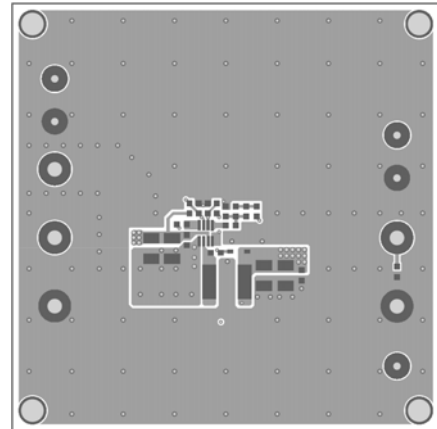


Figure 2 – Top Layer

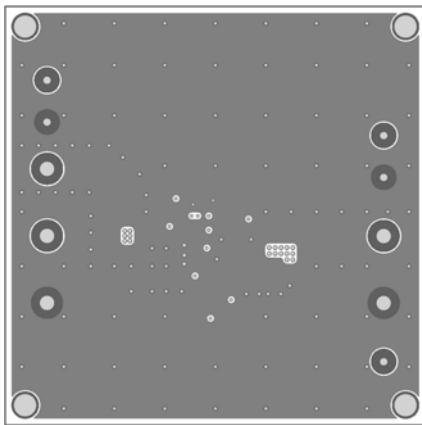


Figure3 – Inner Layer 1

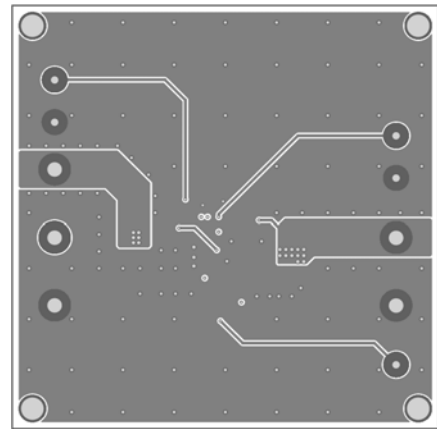


Figure 4 – Inner Layer 2

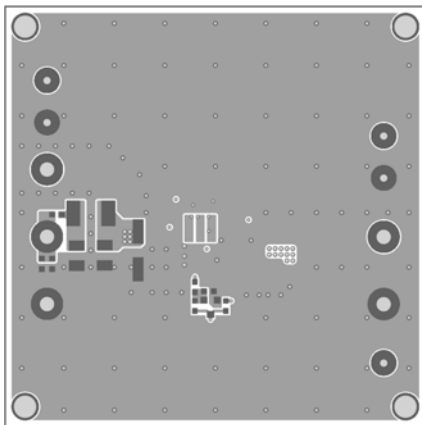


Figure5 – Bottom Layer

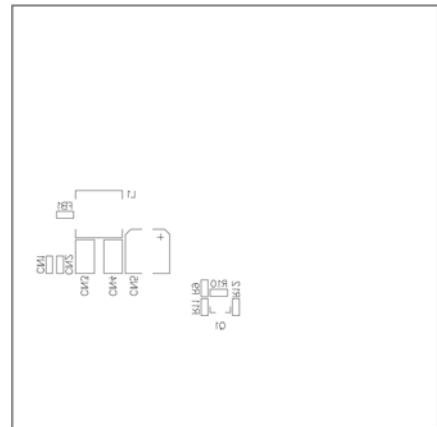


Figure 6 – Bottom Silk Layer

## QUICK START GUIDE

1. Connect the positive and negative terminals of the load to the VOUT and GND pins respectively.
2. Preset the power supply output to between 4V to 36V and then turn it off.
3. Connect the positive and negative terminals of the power supply output to the VIN and GND pins respectively.
4. Turn the power supply on. The MP4423H/MPQ4423H will automatically startup.
5. To use the Enable function, apply a digital input to the EN pin. Drive EN higher than 1.65V to turn on the regulator, drive EN less than 1.05V to turn it off.
6. Connect the EN input pin through a pull-up resistor to any voltage connected to the VIN pin. Make sure the pull-up resistor big enough to limit the EN input current to less than 150µA. For example, with 12V connected to VIN,  $R_{PULLUP} \geq (12V - 6.5V) \div 150\mu A = 36.7k\Omega$ .
7. Connect the EN pin directly to a voltage source without any pull-up resistor requires limiting voltage amplitude to  $\leq 6V$  to prevent damage to the Zener diode.
8. Connect the EN input pin with an external clock with a range of 200kHz to 2.2MHz after output voltage is set to synchronize the internal clock rising edge to the external clock rising edge. The pulse width of external clock signal should be less than 1.7µs.
9. Use R7 and R8 to set the output voltage with  $V_{FB}=0.792V$ . For R7=41.2kΩ, R8 can be determined by:

$$R8 = \frac{0.792 * 41.2}{V_{OUT} - 0.792} k\Omega$$

Follow the Application Information section in the device datasheet to recalculate the compensation, inductor and output capacitor values when output voltage is changed.

10. CLK\_OUT is a signal inverted to SW and can be used as other buck's sync signal to get 180 degree out of phase. The high voltage of CLK\_OUT is equal to the output voltage of the board, so make sure it is safe for the synchronized part when the output voltage setting value is high.

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