# ELM95xxD CMOS PWM step-up DC/DC converter

## ■General description

ELM95xxD series is CMOS PWM step-up DC/DC converter which consists of reference voltage source, error amplifier, oscillation circuit, start-up circuit, PWM control circuit, switch transistor and output voltage setting resistor. For external parts, coil, diode and capacitor are possible choices; with external parts, ELM95 series can acquire constant output voltage higher than input voltage. The standard output voltages are 2.7V,3.0V,3.3V and 5.0V; ELM95 series can also be designed as semi-custom IC within the range of 2.5V to 5.5V by 0.1V step. With newly-developed PWM control circuit, ELM95 series is able to modulate switching time smoothly with constant frequency and consequently generates stable output with small ripples.

## ■Features

- Output voltage range         : 2.5V to 5.5V (by 0.1V)
- Low voltage operation        : Vin≥0.98V (RL=30kΩ)
- Low power operation          : 35μW (Typ. ELM9530D)
- High efficiency              : Typ. 85%
- High output voltage accuracy : ±2.5%
- Output current (e.g.)        : 10mA (When Vin=1.5V, Vout=3.0V)
- Constant output frequency    : Typ. 55kHz
- Small ripples
- Package                      : SOT-89

## ■Application

- Constant voltage source for battery-operated devices
- Constant voltage source for cameras
- Portable communication equipments
- Local regulator

## ■Maximum absolute ratings

| Parameter | Symbol | Limit | Unit |
|---|---|---|---|
| Apply voltage to LX pin | Vlx | 12 | V |
| Apply voltage to VOUT pin | Vout | 12 | V |
| Output current of LX pin | Ilx | 200 | mA |
| Power dissipation | Pd | 300 | mW |
| Operating temperature | Top | -40 to +85 | °C |
| Storage temperature | Tstg | -55 to +125 | °C |

## ■Selection guide

### ELM95xxD-x

| Symbol | | |
|---|---|---|
| a, b | Output voltage | e.g.:<br>27: Vout=2.7V<br>30: Vout=3.0V<br>33: Vout=3.3V<br>50: Vout=5.0V |
| c | Product version | D |
| d | Taping direction | S : Refer to PKG file<br>N : Refer to PKG file |

ELM95 x x D - x
↑ ↑ ↑ ↑
a b c d

ELM
TECHNOLOGY
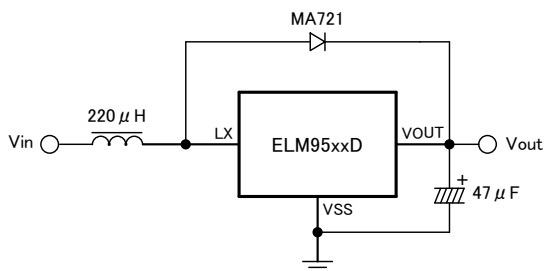
# ELM95xxD CMOS PWM step-up DC/DC converter
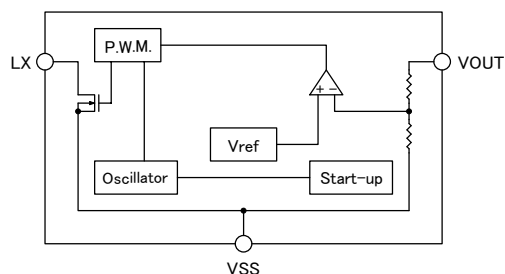
## ■Pin configuration

SOT-89 (TOP VIEW)
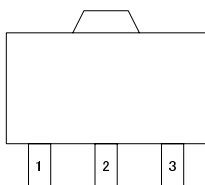
| Pin No. | Pin name |
|---------|----------|
| 1 | VSS |
| 2 | VOUT |
| 3 | LX |

## ■Standard circuit



## ■Block diagram



## ■Electrical characteristics

Vout=2.7V (ELM9527D)    L=220μH, D=MA721, C=47μF, Vss=0V, Top=25°C

| Parameter | Symbol | Condition | Min. | Typ. | Max. | Unit |
|-----------|--------|-----------|------|------|------|------|
| Input voltage | Vin | | | | 10 | V |
| Starting voltage | Vst | RL=27kΩ | | | 0.98 | V |
| Holding voltage | Vhold | Iout=1mA | | | 0.7 | V |
| Current consumption | Iss | Vin=1.5V | | 9.0 | 18.0 | μA |
| Output voltage | Vout | Iout=1mA, Vin=1.5V | 2.63 | 2.70 | 2.77 | V |
| Output current of LX pin | Ilx | Vout=2.6V, Vlx=0.4V | 70 | | | mA |
| Leakage current of LX pin | Ilxl | Vout=Vlx=10V | | | 1.0 | μA |
| Oscillating frequency | Fosc | Vout=2.6V | 35 | 55 | 75 | kHz |
| Maximum duty ratio | Duty | Vout=2.6V | 45 | 60 | 75 | % |

Vout=3.0V (ELM9530D)    L=220μH, D=MA721, C=47μF, Vss=0V, Top=25°C

| Parameter | Symbol | Condition | Min. | Typ. | Max. | Unit |
|-----------|--------|-----------|------|------|------|------|
| Input voltage | Vin | | | | 10 | V |
| Starting voltage | Vst | RL=30kΩ | | | 0.98 | V |
| Holding voltage | Vhold | Iout=1mA | | | 0.7 | V |
| Current consumption | Iss | Vin=1.5V | | 12.0 | 20.0 | μA |
| Output voltage | Vout | Iout=1mA, Vin=1.5V | 2.92 | 3.00 | 3.08 | V |
| Output current of LX pin | Ilx | Vout=2.9V, Vlx=0.4V | 80 | | | mA |
| Leakage current of LX pin | Ilxl | Vout=Vlx=10V | | | 1.0 | μA |
| Oscillating frequency | Fosc | Vout=2.9V | 35 | 55 | 75 | kHz |
| Maximum duty ratio | Duty | Vout=2.9V | 45 | 60 | 75 | % |

ELM
TECHNOLOGY

# ELM95xxD CMOS PWM step-up DC/DC converter

Vout=3.3V (ELM9533D)  L=220μH, D=MA721, C=47μF, Vss=0V, Top=25°C

| Parameter | Symbol | Condition | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| Input voltage | Vin | | | | 10 | V |
| Starting voltage | Vst | RL=33kΩ | | | 0.98 | V |
| Holding voltage | Vhold | Iout=1mA | | | 0.7 | V |
| Current consumption | Iss | Vin=1.5V | | 14.0 | 23.0 | μA |
| Output voltage | Vout | Iout=1mA, Vin=1.5V | 3.21 | 3.30 | 3.39 | V |
| Output current of LX pin | Ilx | Vout=3.2V, Vlx=0.4V | 80 | | | mA |
| Leakage current of LX pin | Ilxl | Vout=Vlx=10V | | | 1.0 | μA |
| Oscillating frequency | Fosc | Vout=3.2V | 35 | 55 | 75 | kHz |
| Maximum duty ratio | Duty | Vout=3.2V | 45 | 60 | 75 | % |

Vout=5.0V (ELM9550D)  L=220μH, D=MA721, C=47μF, Vss=0V, Top=25°C

| Parameter | Symbol | Condition | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| Input voltage | Vin | | | | 10 | V |
| Starting voltage | Vst | RL=50kΩ | | | 0.98 | V |
| Holding voltage | Vhold | Iout=1mA | | | 0.9 | V |
| Current consumption | Iss | Vin=3V | | 30.0 | 45.0 | μA |
| Output voltage | Vout | Iout=1mA, Vin=3V | 4.87 | 5.00 | 5.13 | V |
| Output current of LX pin | Ilx | Vout=4.8V, Vlx=0.4V | 110 | | | mA |
| Leakage current of LX pin | Ilxl | Vout=Vlx=10V | | | 1.0 | μA |
| Oscillating frequency | Fosc | Vout=4.8V | 35 | 55 | 75 | kHz |
| Maximum duty ratio | Duty | Vout=4.8V | 45 | 60 | 75 | % |

■Marking

SOT-89
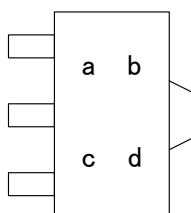
a : the integer digit of the output voltage

| Mark | Vout | Mark | Vout |
|---|---|---|---|
| 2 | 2.*V | 4 | 4.*V |
| 3 | 3.*V | 5 | 5.*V |

b : the decimal digit of the output voltage

| Mark | Vout | Mark | Vout |
|---|---|---|---|
| 0 | *.0V | 5 | *.5V |
| 1 | *.1V | 6 | *.6V |
| 2 | *.2V | 7 | *.7V |
| 3 | *.3V | 8 | *.8V |
| 4 | *.4V | 9 | *.9V |

c : Assembly lot No. ———
   A to Z (excepted I, O, X)

d : Assembly lot No. ———
   0 to 9

ELM
TECHNOLOGY

# ELM95xxD CMOS PWM step-up DC/DC converter

## ■External parts

To design DC/DC converter with ELM95 series, coil, diode, and capacitor are necessary.
(Refer to standard circuit configuration.)

### 1) Coil

When choosing choke coil, please select that whose core is not magnetically saturated, DC resistance is low, and which has sufficient margin for rated current.

For ELM95 series, ELM recommends following coil.

• CM-5/CM-5N (Sumida Electric Co., Ltd.)

### 2) Diode

When choosing diode, please select that whose forward voltage is small, switching speed is high and which has sufficient margin for rated current. For ELM95 series, ELM recommends schottoky diodes.

### 3) Capacitor

When choosing capacitor, please select that whose capacity is comparatively large and voltage limit is at least three times larger than rated output voltage of used ELM95 series. For ELM95 series, ELM recommends to use "Aluminum electrolytic capacitor". When using capacitors such as "Tantalum capacitor" or "Laminated ceramic capacitor", there may be cases that few hundred hertz wave motion will happen in output voltage wave form. Under such circumstances, ELM recommends connecting resistance (1.0Ω approx.) to capacitor serially as following.
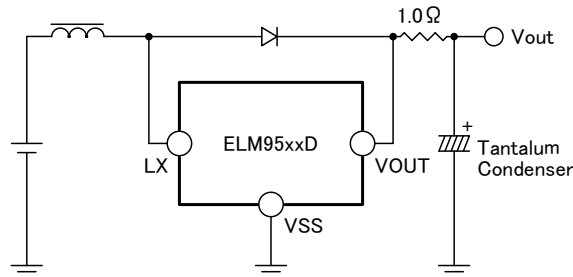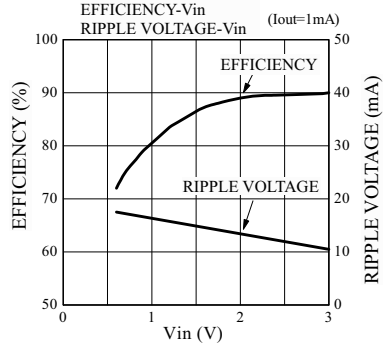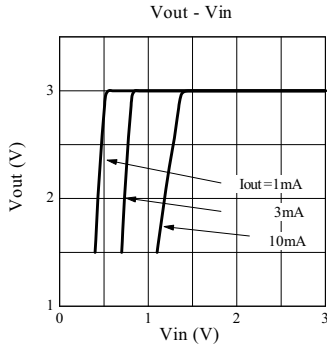


## ■Typical characteristics

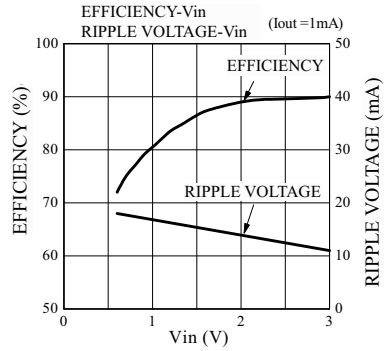• Vout=2.7V (ELM9527D)    (Top=25°C, L=220µH, D=MA721, C=47µF)
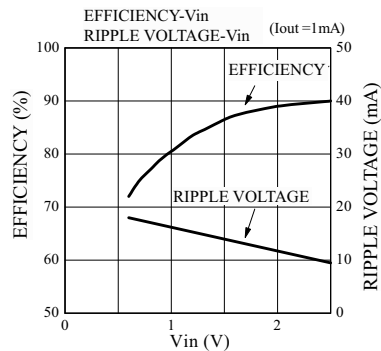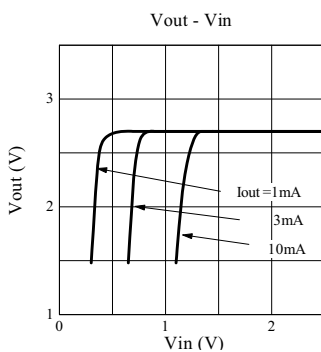
• Vout=3.0V (ELM9530D)    (Top=25°C, L=220μH, D=MA721, C=47μF)

Vout - Vin

EFFICIENCY-Vin
RIPPLE VOLTAGE-Vin    (Iout=1mA)

• Vout=3.3V (ELM9533D)    (Top=25°C, L=220μH, D=MA721, C=47μF)

Vout - Vin

EFFICIENCY-Vin
RIPPLE VOLTAGE-Vin    (Iout=1mA)
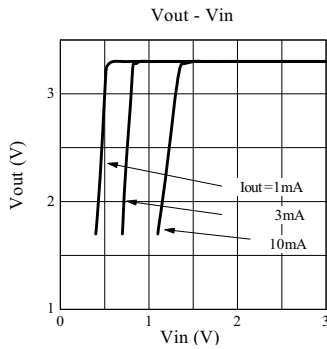
• Vout=5.0V (ELM9550D)    (Top=25°C, L=220μH, D=MA721, C=47μF)

Vout - Vin

EFFICIENCY-Vin
RIPPLE VOLTAGE-Vin    (Iout=1mA)