Ordering number : ENA1849

SANYO Semiconductors
DATA SHEET

An ON Semiconductor Company

# LV5990M — Bi-CMOS IC Low power consumption and high efficiency Step-down Switching Regulator

## Overview

LV5990M is 1ch DC-DC converter with built-in power Pch MOS transistor. The recommended operating range is 4.5V to 18V. The maximum current is 3A. The operating current is about 90μA, and low power consumption is achieved.

## Functions

- 1ch SBD rectification DC-DC converter IC with built-in power Pch MOS transistor
- Maximum value of light load mode current is 90μA.
- Built-in OCP circuit with P-by-P method
- When P-by-P is generated continuously, it shifts to the HICCUP operation.
- If connect C-HICCUP to GND pin, then latch-off when over current.
- The oscillatory frequency is 360kHz.
- UVLO and built-in TSD

## Specifications

### Maximum Ratings at Ta = 25°C

| Parameter | Symbol | Conditions | Ratings | Unit |
|---|---|---|---|---|
| Input voltage | $V_{IN}$-max | | 22 | V |
| Allowable pin voltage | SW | | 30 | V |
| | EN, PG | | $V_{IN}$ | V |
| | PDR | | $V_{IN}$ -6 | V |
| | REF | | 6 | V |
| | SS,FB,COMP C-HICCUP | | REF | V |
| Allowable power dissipation | Pd max | specified substrate * | 1.05 | W |
| Operating temperature | Topr | | -40 to 85 | °C |
| Storage temperature | Tstg | | -55 to 150 | °C |

* Specified board: 40.0mm × 30.0mm ×1.6mm, glass epoxy.


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## Recommended Operating Conditions at Ta = 25°C

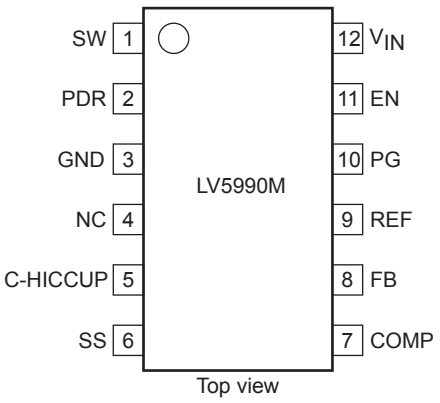
| Parameter | Symbol | Conditions | Ratings | Unit |
|---|---|---|---|---|
| Input voltage renge | $V_{IN}$ | | 4.5 to 18 | V |

## Electrical Characteristics at Ta = 25°C, $V_{IN}$ = 15V

| Parameter | Symbol | Conditions | Ratings | | | Unit |
|---|---|---|---|---|---|---|
| | | | min | typ | max | |
| **Reference voltage** | | | | | | |
| Internal reference voltage | VREF | | 1.235 | 1.260 | 1.285 | V |
| Pch drive voltage | VPDR | $I_{OUT}$=0 to -5mA | $V_{CC}$-5.5 | $V_{CC}$-5.0 | $V_{CC}$-4.5 | V |
| **Saw wave oscillator** | | | | | | |
| Oscillatory frequency | $F_{OSC}$ | | 300 | 360 | 420 | kHz |
| **ON/OFF circuit** | | | | | | |
| IC startup voltage (EN pin) | $V_{CNT_ON}$ | | 1.5 | | $V_{IN}$ | V |
| Disable voltage (EN pin) | $V_{CNT_OFF}$ | | | | 0.3 | V |
| **Soft start circuit** | | | | | | |
| Soft start source current | $I_{SS_SC}$ | EN>1.5V | 1.3 | 2 | 3 | μA |
| Soft start sink current | $I_{SS_SK}$ | EN<0.3V, SS=0.4V | 120 | 150 | 180 | μA |
| **UVLO circuit** | | | | | | |
| UVLO release voltage | $V_{UVLO}$N | FB=COMP | 3.0 | 3.4 | 3.8 | V |
| UVLO lock voltage | $V_{UVLO}$F | FB=COMP | 2.5 | 2.9 | 3.3 | V |
| **Error amplifier** | | | | | | |
| Input bias current | $I_{EA_IN}$ | | -100 | -50 | 100 | nA |
| Error amplifier gain | $G_{EA}$ | | 100 | 250 | 400 | μA/V |
| Output sink current | $I_{EA_OSK}$ | FB=1.75V | -40 | -20 | -10 | μA |
| Output source current | $I_{EA_OSC}$ | FB=0.75V | 10 | 20 | 40 | μA |
| **Over current limit circuit** | | | | | | |
| Current limit peak | $I_{CL}$ | | 3.2 | 4.7 | 6.2 | A |
| HICCUP timer start-up cycle | $N_{LCYCLES}$ | | | 15 | | cycle |
| HICCUP comparator threshold voltage | $V_{tHIC}$ | | 1.20 | 1.26 | 1.32 | V |
| HICCUP timer charge current | IHIC | | 1 | 2 | 3 | μA |
| **PWM comparator** | | | | | | |
| Maximum on-duty | $D_{MAX}$ | | 95 | | | % |
| **Logic output** | | | | | | |
| Power good “L” sink current | $I_{pwrgd_L}$ | PG=5V | 4 | 5 | 6 | mA |
| Power good “H” leakage current | $I_{pwrgd_H}$ | PG=5V | | | 1 | μA |
| Power good threshold FB voltage | $V_{tPG}$ | | 1.0 | 1.1 | 1.2 | V |
| Power good hysteresis | $V_{PG_H}$ | | 40 | 50 | 60 | mV |
| Power good impedance | $R_{PG}$ | | | 1 | | kΩ |
| **Output** | | | | | | |
| Output on-resistance | $R_{ON}$ | $I_O$=1A | | 150 | | mΩ |
| **The entire device** | | | | | | |
| Standby current | $I_{CCS}$ | EN<0.3V | | | 1 | μA |
| Light load mode consumption current | $I_{sleep1}$ | EN>1.5V, $I_{LOAD}$=0, No oscillatory -20°C≤Ta≤70°C * | 50 | 70 | 90 | μA |
| Thermal shutdown | TSD | * | | 170 | | °C |

*: Design certification

## Pin Assignment

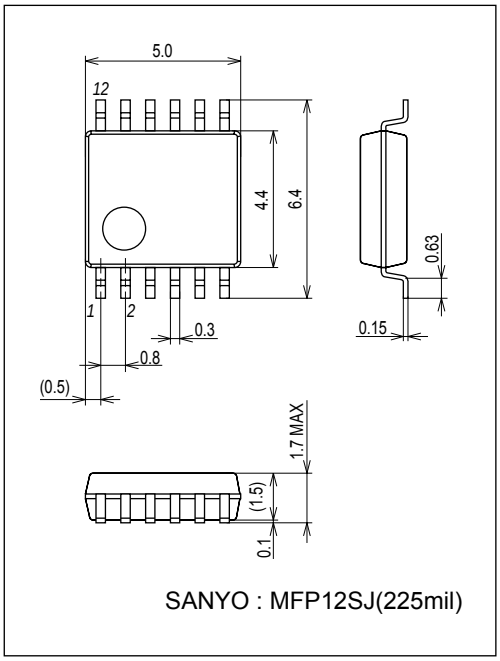


Top view

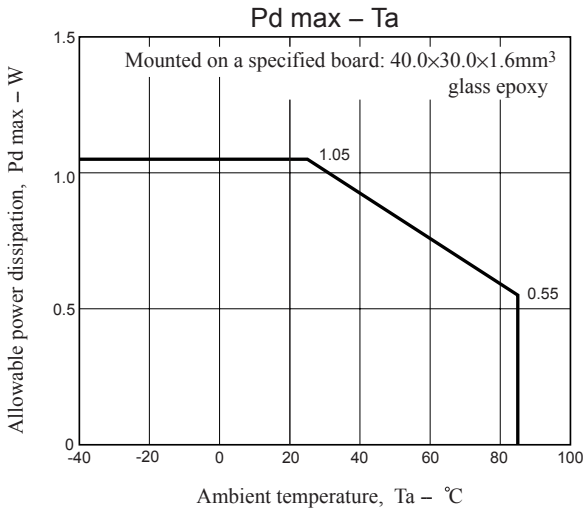
## Package Dimensions

unit : mm (typ)

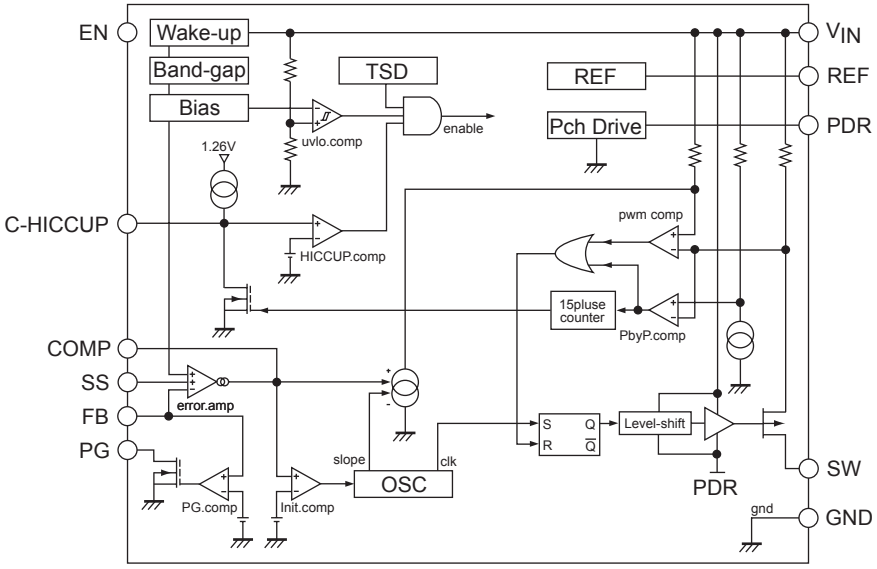
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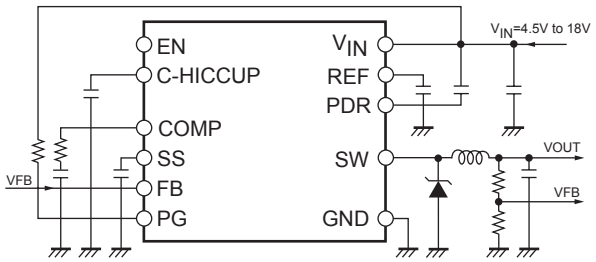
SANYO : MFP12SJ(225mil)



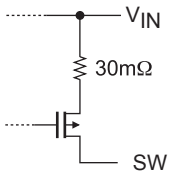
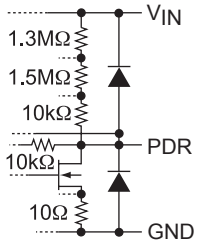
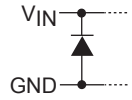
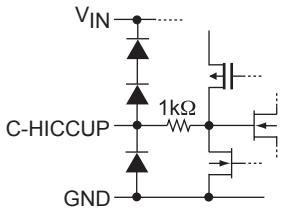
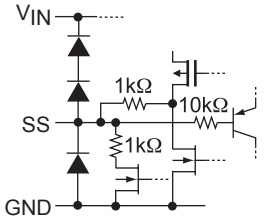
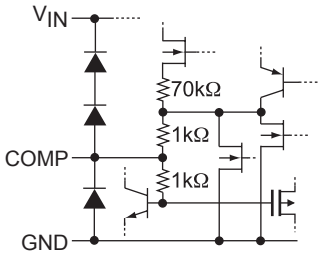
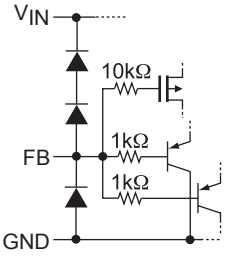
## Block Diagram




## Application Circuit

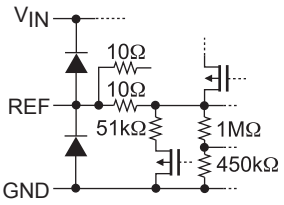
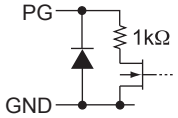
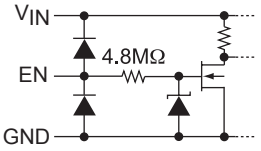


## Pin Function

| Pin No. | Pin name | Function | Equivalent circuit |
|---|---|---|---|
| 1 | SW | High-side Pch MOSFET drain pin |  |
| 2 | PDR | Pch MOSFET gate drive voltage<br>The bypass capacitor is necessarily connected between this pin and $V_{IN}$. |  |
| 3 | GND | Ground pin.<br>Ground pin voltage is reference voltage. |  |
| 12 | $V_{IN}$ | Supply voltage pin.<br>It is observed by the UVLO function. When its voltage becomes 3.4V or more. ICs startup in soft start. | |
| 5 | C-HICCUP | It is capacitor connection pin for setting re-startup cycle in HICCUP mode.<br>If connect it to GND pin, then latch-off when over current. |  |
| 6 | SS | Capacitor connection pin for soft start.<br>About 2μA current charges the soft start capacitor. |  |
| 7 | COMP | Error amplifier output pin.<br>The phase compensation network is connected between GND pin and COMP pin. |  |
| 8 | FB | Error amplifier reverse input pin.<br>ICs make its voltage keep 1.26V.<br>Output voltage is divided by external resistances and it across FB. |  |

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| Pin No. | Pin name | Function | Equivalent circuit |
|---|---|---|---|
| 9 | REF | Reference voltage |  |
| 10 | PG | Power good pin.<br>Connect to open drain of MOS-FET in ICs inside.<br>Setting output voltage to “L”, when FB voltage is 1.05V or less. |  |
| 11 | EN | ON/OFF pin. |  |


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