

# 4-channel switching regulator controller

## BA9737KV

The BA9737KV is a 4-channel controller that includes all of the circuits required to construct a switching regulator. The circuits on the chip include a triangular-wave oscillator, a reference voltage circuit, an error amplifier, a PWM comparator, a pseudo-totem-pole driver, and a short-circuit protection circuit.

### ●Applications

Camcoders and digital still cameras etc.

### ●Features

- 1) The totem-pole driver can directly drive power transistors, and the on current can be set to the rating current using an external resistor. For the off current, the peak current can be set using an external capacitor.
- 2) Output cutoff circuit (timer latch type) for overload protection.
- 3) Channels 2 and 3 are supplied using the internal reference voltage, and use a positive voltage only. Channels 1 and 4 are general-purpose channels, and all inputs are externally available.
- 4) Channels can be switched off individually or all together (STB and STB1 to STB4).
- 5) Dead-time control is provided for all channels, and duty limits can be used.

### ●Absolute maximum ratings (Ta = 25°C)

| Parameter             | Symbol           | Limits   | Unit |
|-----------------------|------------------|----------|------|
| Power supply voltage  | V <sub>cc</sub>  | 12.5     | V    |
| Power dissipation     | P <sub>d</sub>   | 400*     | mW   |
| Operating temperature | T <sub>opr</sub> | -25~+85  | °C   |
| Storage temperature   | T <sub>stg</sub> | -55~+125 | °C   |

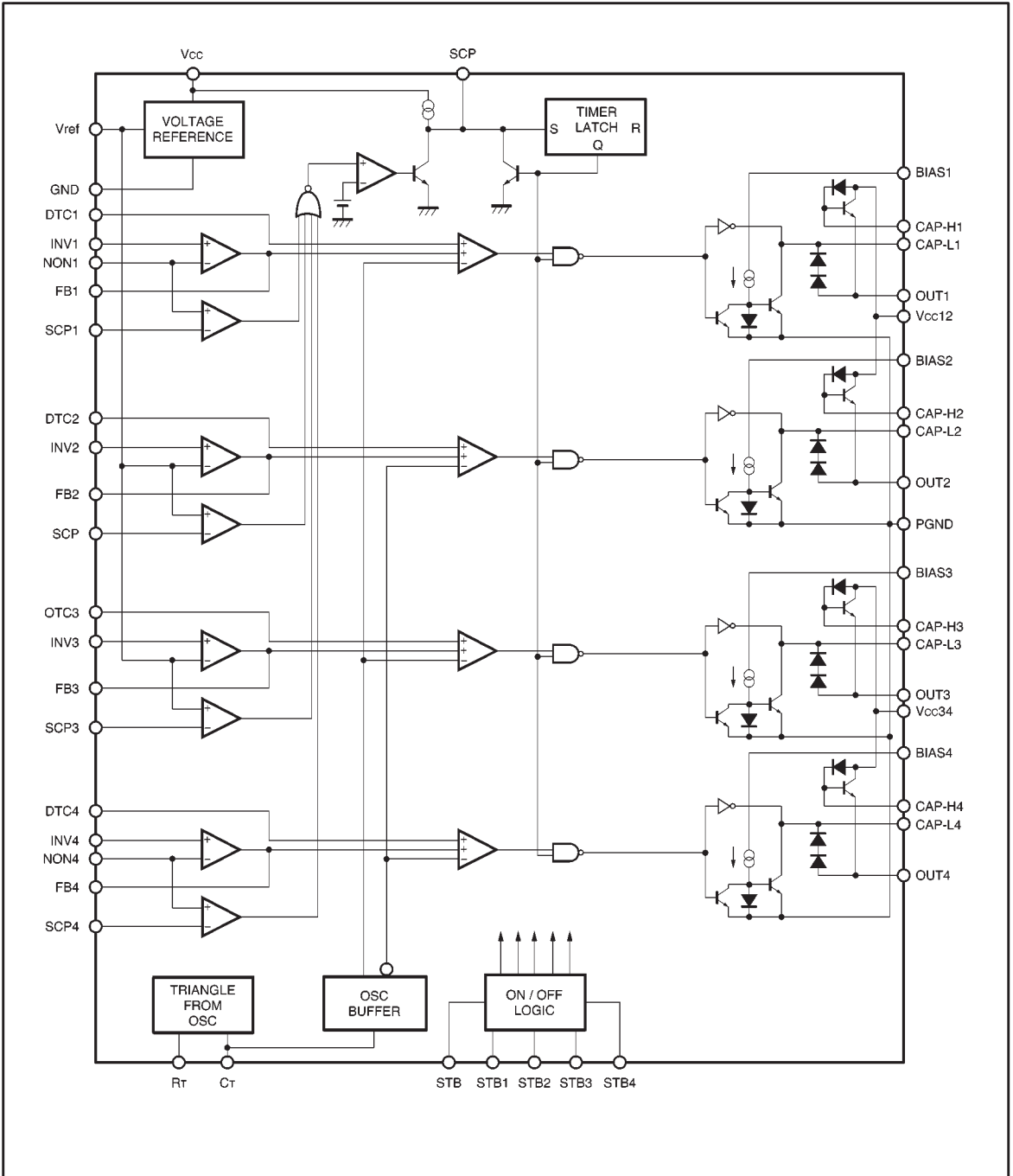
\*1 Reduced by 4.0mW for each increase in Ta of 1°C over 25°C.

### ●Recommended operating conditions (Ta = 25°C)

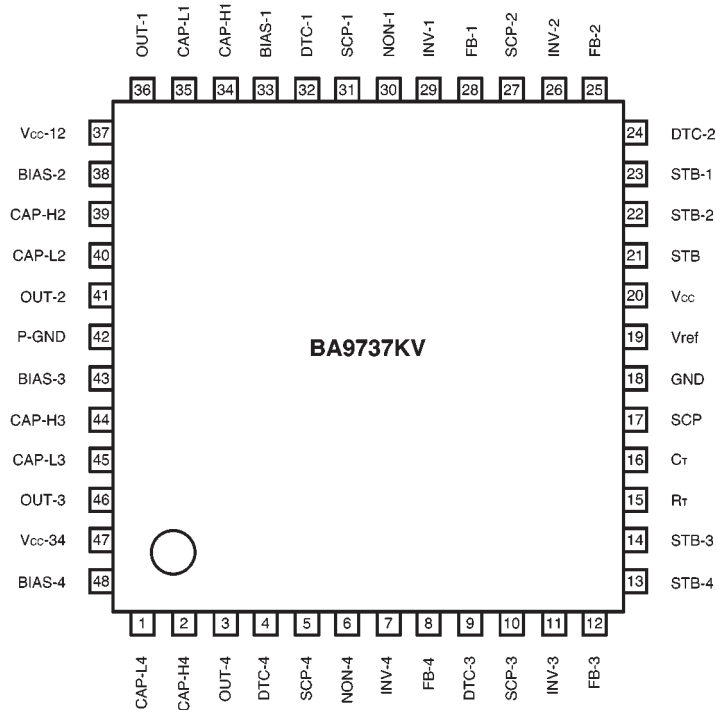
| Parameter            | Symbol           | Min. | Typ. | Max. | Unit. |
|----------------------|------------------|------|------|------|-------|
| Power supply voltage | V <sub>cc</sub>  | 2.5  | —    | 12   | V     |
| Oscillator frequency | f <sub>osc</sub> | 10.0 | —    | 700  | kHz   |
| Output current       | I <sub>out</sub> | —    | —    | 30   | mA    |



● Block diagram



## ● Pin assignments



## ● Pin descriptions

| Pin No.        | Pin name           | Function  |
|----------------|--------------------|---|
| 2, 34, 39, 44  | CAP-H4, 1, 2, 3    | H connection for off transistor current-setting capacitor |
| 1, 35, 40, 45  | CAP-L4, 1, 2, 3    | L connection for off transistor current-setting capacitor |
| 3, 36, 41, 46  | OUT-4, 1, 2, 3     | Power transistor base connection                          |
| 4, 9, 24, 32   | DTC-4, 3, 2, 1     | Dead time control   |
| 5, 10, 27, 31  | SCP-4, 3, 2, 1     | Output voltage monitor for channels 1 to 4 protection     |
| 6, 30          | NON-4, 1           | Non-inverting input for error amplifier                   |
| 7, 11, 26, 29  | INV-4, 3, 2, 1     | Inverting input for error amplifier                       |
| 8, 12, 25, 28  | FB-4, 3, 2, 1      | Error amplifier output                                    |
| 13, 14, 22, 23 | STB-4, 3, 2, 1     | Channel 1 to channel 4 on / off switches                  |
| 15             | R <sub>T</sub>     | Connection for resistor for triangular-wave timing        |
| 16             | C <sub>T</sub>     | Connection for capacitor for triangular-wave timing       |
| 17             | SCP                | Connection for capacitor for setting timing latch delay   |
| 18             | GND                | Ground  |
| 19             | V <sub>ref</sub>   | Reference voltage output                                  |
| 20             | V <sub>cc</sub>    | Power supply input  |
| 21             | STB                | All channel on / off switches                             |
| 33, 38, 43, 48 | BIAS-1, 2, 3, 4    | Output current setting                                    |
| 37             | V <sub>cc-12</sub> | Power supply input for channels 1 and 2 output stages     |
| 42             | P-GND              | Ground connection for all output stages                   |
| 47             | V <sub>cc-34</sub> | Power supply input for channels 3 and 4 output stages     |

- Electrical characteristics (unless otherwise noted, Ta = 25°C, Vcc = 6.0V, fosc = 0.45MHz, STB, STB1 to STB4 = 5V)

| Parameter                     | Symbol            | Min.         | Typ. | Max.  | Unit | Conditions                                  |
|-------------------------------|-------------------|--------------|------|-------|------|---|
| Standby current               | Ist               | –            | 1    | 10    | μA   | STB, STB1~4=0V                              |
| Circuit current               | Icc               | –            | 7.5  | 10.2  | mA   | –   |
| 〈Error amplifier〉             |                   |              |      |       |      |   |
| Output low level voltage      | Vol               | –            | –    | 0.2   | V    | VINV=2V                                     |
| Output high level voltage     | VOH               | Vref<br>–0.1 | –    | –     | V    | VINV=0V                                     |
| 〈PWM comparator〉              |                   |              |      |       |      |   |
| DTC input current             | I <sub>DT</sub>   | –            | –1   | –5    | μA   | VD=0V                                       |
| 0% DUTY threshold             | Vt0               | 0.38         | 0.48 | 0.58  | V    | V1 : DUTY0%                                 |
| 100% DUTY threshold           | Vt100             | 1.08         | 1.18 | 1.28  | V    | V1 : DUTY100%                               |
| 〈Output stage〉                |                   |              |      |       |      |   |
| Output sink current           | I <sub>OUT</sub>  | 4.0          | 5.8  | 7.5   | mA   | RBIAS=10kΩ                                  |
| 〈Reference voltage〉           |                   |              |      |       |      |   |
| Output voltage                | Vref              | 1.485        | 1.5  | 1.515 | V    | Iref=–1mA                                   |
| Line regulation               | DV <sub>LI</sub>  | –            | 2.0  | 12.5  | mV   | Vcc=2.5V~12V                                |
| Load regulation               | DV <sub>LC</sub>  | –            | 1.0  | 7.5   | mV   | Iref=–0.1mA~–1mA                            |
| Short-circuit output current  | I <sub>OS</sub>   | 4            | 26   | –     | mA   | Vref=0V                                     |
| 〈Overload cutoff〉             |                   |              |      |       |      |   |
| Channel 1 threshold           | V <sub>SC1</sub>  | 1.47         | 1.5  | 1.53  | V    | VS1=2V~1V                                   |
| Channel 2 threshold           | V <sub>SC2</sub>  | 1.47         | 1.5  | 1.53  | V    | VS2=2V~1V                                   |
| Channel 3 threshold           | V <sub>SC3</sub>  | 1.47         | 1.5  | 1.53  | V    | VS3=2V~1V                                   |
| Channel 4 threshold           | V <sub>SC4</sub>  | 1.47         | 1.5  | 1.53  | V    | VS4=2V~1V                                   |
| 〈Protection circuit〉          |                   |              |      |       |      |   |
| Input threshold               | V <sub>ISC</sub>  | 0.95         | 1.0  | 1.05  | V    | VSC=0V~1.5V                                 |
| Standby voltage               | V <sub>SSC</sub>  | –            | 120  | 170   | mV   | –   |
| Input source current          | I <sub>SCP</sub>  | –2           | –4   | –6    | μA   | VSC=0.1V                                    |
| 〈Triangular wave oscillator〉  |                   |              |      |       |      |   |
| Oscillation frequency (1)     | f <sub>OSC1</sub> | 0.385        | 0.45 | 0.475 | MHz  | R <sub>T</sub> =47kΩ, C <sub>T</sub> =100pF |
| Oscillation frequency (2)     | f <sub>OSC2</sub> | 0.63         | 0.70 | 0.77  | MHz  | R <sub>T</sub> =27kΩ, C <sub>T</sub> =100pF |
| Frequency deviation           | Df                | –            | 1    | 5     | %    | Vcc=2.5V→12V                                |
| RT voltage                    | V <sub>RT</sub>   | 0.35         | 0.45 | 0.55  | V    | –   |
| C <sub>T</sub> sink current   | I <sub>CSC</sub>  | 26.6         | 38   | 49.4  | μA   | VCT=1.7V                                    |
| C <sub>T</sub> source current | I <sub>CSI</sub>  | –26.6        | –38  | –49.4 | μA   | VCT=0.9V                                    |

## ● Operation notes

(1) Use short and wide wiring tracks for the power supply and ground to keep the mutual impedance as small as possible, and use inductors and capacitors to keep ripple to a minimum.

(2) Great care has been paid to the quality of this component. However, if the absolute maximum ratings for temperature and applied voltage are exceeded, the IC may be destroyed.

Since it is not possible to predict whether it will be in short mode or open mode if the IC is destroyed, if there is a chance that the maximum ratings of the IC will be exceeded, use appropriate physical protective measures (fuses etc.).

(3) Set the dead-time input voltage to 0.58V or more.

(4) This IC does not use an internal circuit to generate the output on peak current, so we recommend that you connect capacitors to each end of  $R_{BIAS}$  to externally generate the on peak current (after taking power dissipation and efficiency into consideration). In this case, there is a possibility that the output waveform may become unstable due to the current impedance, so we recommend that you connect resistors (of about  $100\Omega$  to  $500\Omega$ ) in series with the off peak capacitors.

## ● External dimensions (Units: mm)

