



SWITCHING REGULATOR CONTROL IC FOR FLYBACK

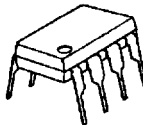
■ GENERAL DESCRIPTION

The NJM2368 is a high speed switching regulator control IC which can operate at low voltage.

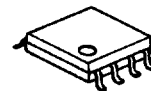
It uses a totempole output circuit, so that it can drive an external Bipolar Transistor directly.

It is suitable for applications of flyback type switching regulation of up to 10W.

■ PACKAGE OUTLINE



NJM2368D



NJM2368M

■ FEATURES

- Operating Voltage (3.6~32V)
- Wide Oscillator Range (5~350 kHz)
- Soft-Start Function.
- Under Voltage Lockouts (U.V.L.O.)
- Bipolar Technology
- Package Outline DIP8, DMP8, EMP8, SSOP8

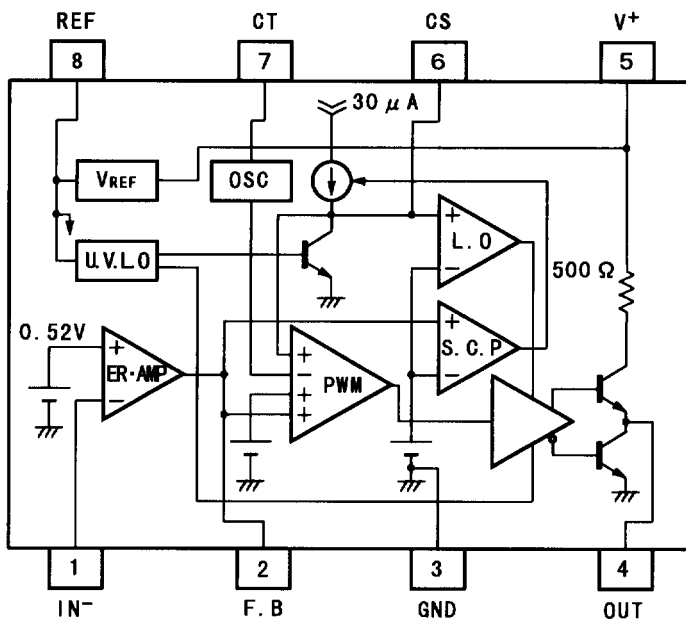


NJM2368E



NJM2368V

■ BLOCK DIAGRAM



PIN FUNCTION

1. IN<sup>-</sup>
2. F. B
3. GND
4. OUT
5. V<sup>+</sup>
6. CS
7. CT
8. REF

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■ ABSOLUTE MAXIMUM RATINGS (T<sub>a</sub> = 25°C)

| PARAMETER                   | SYMBOL           | MAXIMUM RATINGS                                       | UNIT |
|-----------------------------|------------------|---|------|
| Input Voltage               | V <sup>+</sup>   | 36  | V    |
| Reference Output Current    | I <sub>OR</sub>  | 10  | mA   |
| Output Current              | I <sub>O</sub>   | ±50   | mA   |
| Power Dissipation           | P <sub>D</sub>   | (DIP8) 700<br>(DMP8) 300<br>(EMP8) 300<br>(SSOP8) 250 | mW   |
| Operating Temperature Range | T <sub>OPR</sub> | -40~+85   | °C   |
| Storage Temperature Range   | T <sub>STG</sub> | -50~+125  | °C   |

■ RECOMMENDED OPERATING CONDITIONS (V<sup>+</sup> = 6V, T<sub>a</sub> = 25°C)

| PARAMETER                   | SYMBOL           | RATINGS | MIN. | MAX.  | UNIT |
|-----------------------------|------------------|---------|------|-------|------|
| Operating Voltage           | V <sup>+</sup>   |         | 3.6  | 32    | V    |
| Feed Back Resistor          | R <sub>NF</sub>  |         | 100  | —     | kΩ   |
| Oscillator Timing Capacitor | C <sub>T</sub>   |         | 220  | 22000 | pF   |
| Oscillator Timing Resistor  | R <sub>T</sub>   |         | 10   | 100   | kΩ   |
| Oscillate                   | f <sub>OSC</sub> |         | 5    | 350   | kHz  |

■ ELECTRICAL CHARACTERISTICS

(V<sup>+</sup> = 6V, R<sub>T</sub> = 33kΩ, C<sub>T</sub> = 1000pF, T<sub>a</sub> = 25°C)

REFERENCE VOLTAGE BLOCK

| PARAMETER       | SYMBOL            | RATINGS   | MIN. | TYP. | MAX. | UNIT |
|-----------------|-------------------|---|------|------|------|------|
| Output Voltage  | V <sub>REF</sub>  | I <sub>OR</sub> = 1mA                           | 2.45 | 2.50 | 2.55 | V    |
| Line Regulation | L <sub>LINE</sub> | V <sup>+</sup> = 3.6~32V, I <sub>OR</sub> = 1mA | —    | 6.8  | 20.7 | mV   |
| Load Regulation | L <sub>LOAD</sub> | I <sub>OR</sub> = 0.1~5.0mA                     | —    | 5    | 30   | mV   |

OSCILLATOR BLOCK

| PARAMETER                                      | SYMBOL           | RATINGS  | MIN. | TYP. | MAX. | UNIT |
|--|------------------|--|------|------|------|------|
| Oscillate                                      | f <sub>OSC</sub> | C <sub>T</sub> = 1000pF, R <sub>T</sub> = 33kΩ | 85   | 105  | 125  | kHz  |
| Oscillate Fluctuations1<br>(Line Fluctuations) | f <sub>dv</sub>  | V <sup>+</sup> = 3.6~32V                       | —    | 1    | —    | %    |
| Oscillate Fluctuations2<br>(Temp Fluctuations) | f <sub>dt</sub>  | T <sub>a</sub> = -40~+85°C                     | —    | 5    | —    | %    |

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## ELECTRICAL CHARACTERISTICS

( $V^+ = 6V$ ,  $R_T = 33k\Omega$ ,  $C_T = 1000pF$ ,  $T_a = 25^\circ C$ )

### ERROR AMPLIFIER BLOCK

| PARAMETER               | SYMBOL    | RATINGS             | MIN.          | TYP. | MAX. | UNIT    |
|-------------------------|-----------|---------------------|---------------|------|------|---------|
| Reference Voltage       | $V_B$     |                     | 0.51          | 0.52 | 0.53 | V       |
| Input Bias Current      | $I_B$     |                     | —             | 5    | 100  | nA      |
| Open Loop Gain          | $A_V$     |                     | —             | 90   | —    | dB      |
| Gain Band width Product | $G_B$     |                     | —             | 0.6  | —    | MHz     |
| Maximum Output Voltage  | $V_{OM+}$ | $R_{NF}=100k\Omega$ | $V_{REF}-0.2$ | —    | —    | V       |
| (F.B Pin)               | $V_{OM-}$ | $R_{NF}=100k\Omega$ | —             | —    | 200  | mV      |
| Output Source Current   | $I_{OM+}$ | $V_{OM}=1V$         | 40            | 85   | 200  | $\mu A$ |
| (F.B Pin)               |           |                     |               |      |      |         |

### PWM COMPARE BLOCK

| PARAMETER               | SYMBOL     | RATINGS        | MIN. | TYP. | MAX. | UNIT |
|-------------------------|------------|----------------|------|------|------|------|
| Input Bias Voltage      | $V_{TH0}$  | duty·cycle=0%  | —    | 0.55 | 0.65 | V    |
| (F.B Pin)               |            |                |      |      |      |      |
| Input Threshold Voltage | $V_{TH50}$ | duty·cycle=50% | —    | 0.87 | —    | V    |
| (F.B Pin)               |            |                |      |      |      |      |
| Maximum Duty Cycle      | $\alpha M$ | F.B Pin=1.2V   | 55   | 64   | 85   | %    |

### SOFT START CIRCUIT BLOCK

| PARAMETER               | SYMBOL       | RATINGS        | MIN. | TYP. | MAX. | UNIT |
|-------------------------|--------------|----------------|------|------|------|------|
| Input Bias Current      | $I_{BCS}$    |                | —    | 250  | 650  | nA   |
| (CS Pin)                |              |                |      |      |      |      |
| Input Threshold Voltage | $V_{THCS0}$  | duty·cycle=0%  | —    | 0.25 | 0.35 | V    |
| (CS Pin)                |              |                |      |      |      |      |
| Input Threshold Voltage | $V_{THCS50}$ | duty·cycle=50% | —    | 0.52 | —    | V    |
| (CS Pin)                |              |                |      |      |      |      |

### SHORT CIRCUIT PROTECTION

| PARAMETER                    | SYMBOL     | RATINGS               | MIN. | TYP. | MAX. | UNIT    |
|------------------------------|------------|-----------------------|------|------|------|---------|
| Input Threshold Voltage      | $V_{THPC}$ |                       | 1.20 | 1.50 | 1.80 | V       |
| (F.B Pin)                    |            |                       |      |      |      |         |
| Charge Current               | $I_{CHG}$  | CS Pin=0V, F.B Pin=2V | 10   | 30   | 50   | $\mu A$ |
| (CS Pin)                     |            |                       |      |      |      |         |
| Latch mode Threshold Voltage | $V_{THLA}$ |                       | 1.20 | 1.50 | 1.80 | V       |
| (CS Pin)                     |            |                       |      |      |      |         |

### UNDER VOLTAGE LOCKOUT

| PARAMETER             | SYMBOL      | RATINGS | MIN. | TYP. | MAX. | UNIT |
|-----------------------|-------------|---------|------|------|------|------|
| ON Threshold Voltage  | $V_{THON}$  |         | —    | 2.70 | —    | V    |
| OFF Threshold Voltage | $V_{THOFF}$ |         | —    | 2.52 | —    | V    |
| Hysteresis Voltage    | $V_{HYS}$   |         | 60   | 180  | —    | mV   |



■ ELECTRICAL CHARACTERISTICS

( $V^+ = 6V$ ,  $R_T = 33k\Omega$ ,  $C_T = 1000pF$ ,  $T_a = 25^\circ C$ )

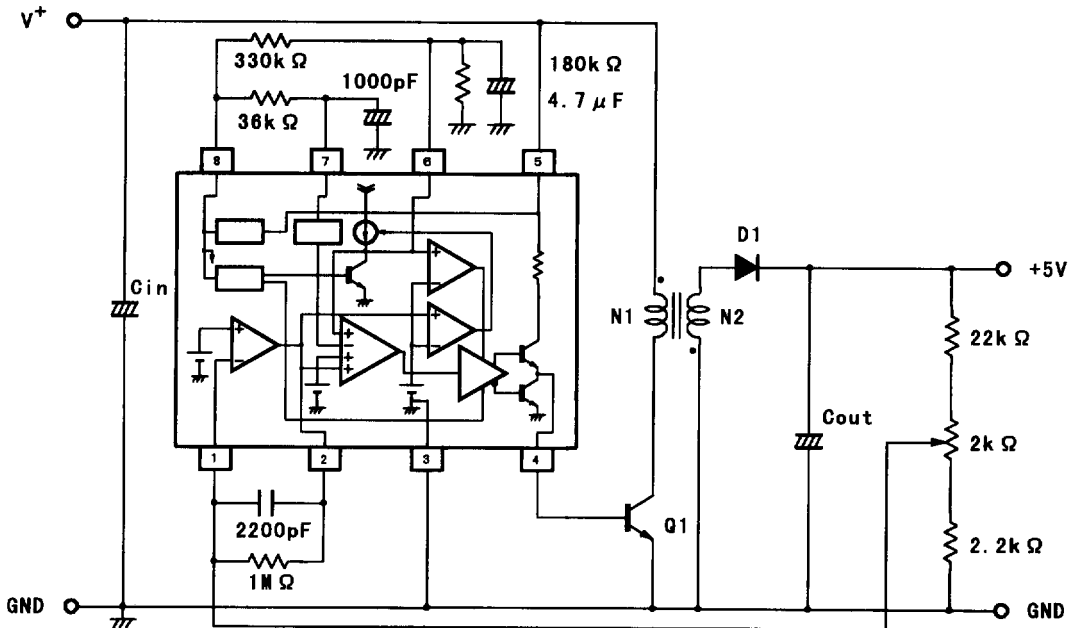
OUTPUT

| PARAMETER                       | SYMBOL       | RATINGS                  | MIN. | TYP. | MAX. | UNIT |
|---------------------------------|--------------|--------------------------|------|------|------|------|
| H-Output Voltage (OUT Pin)      | $V_{OH}$     | $R_L = 10k\Omega$        | 3.50 | 4.00 | —    | V    |
| L-Output Voltage (OUT Pin)      | $V_{OL}$     | Output Sink Current=20mA | —    | 0.25 | 0.65 | V    |
| Output Source Current (OUT Pin) | $I_{SOURCE}$ | OUT Pin=0V               | 8    | 11   | —    | mA   |

GENERAL CHARACTERISTIC

| PARAMETER                 | SYMBOL     | RATINGS                         | MIN. | TYP. | MAX. | UNIT |
|---------------------------|------------|---------------------------------|------|------|------|------|
| Quiescent Current         | $I_{CCLA}$ | Latch                           | —    | 1.6  | 2.2  | mA   |
| Average Quiescent Current | $I_{CCAV}$ | $R_L = \infty$ , duty cycle=50% | —    | 3.5  | 4.8  | mA   |

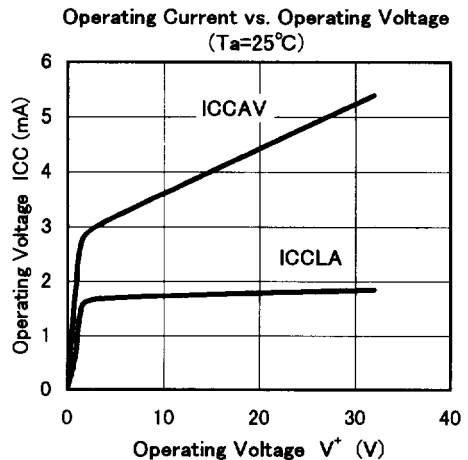
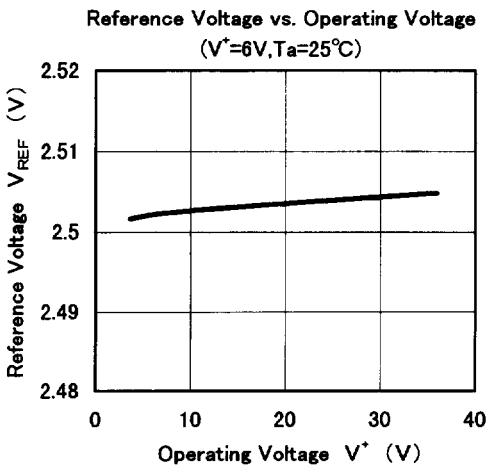
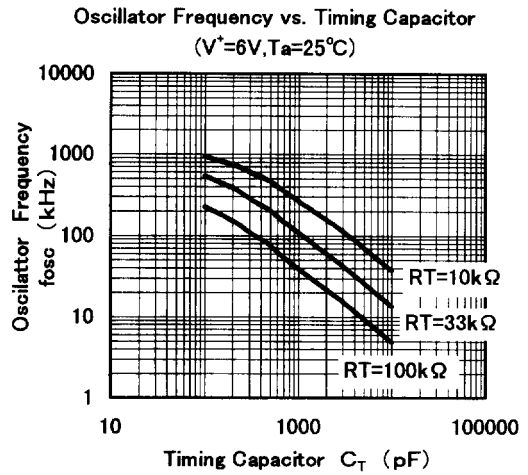
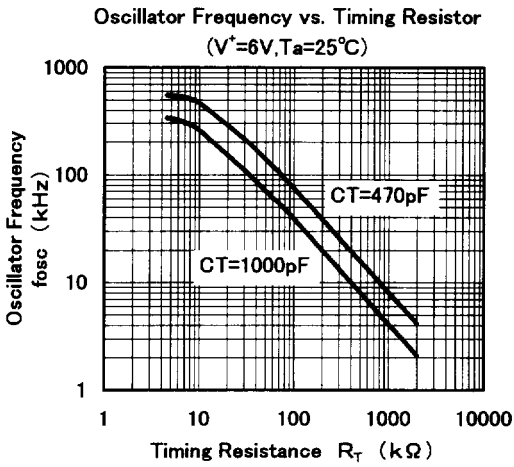
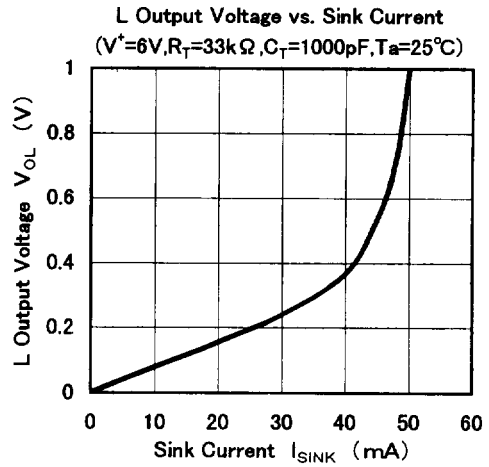
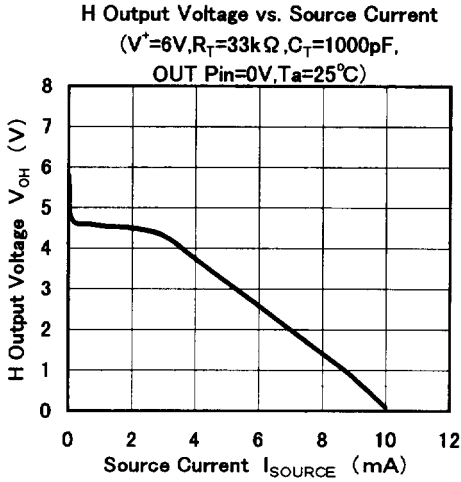
■ APPLICATION



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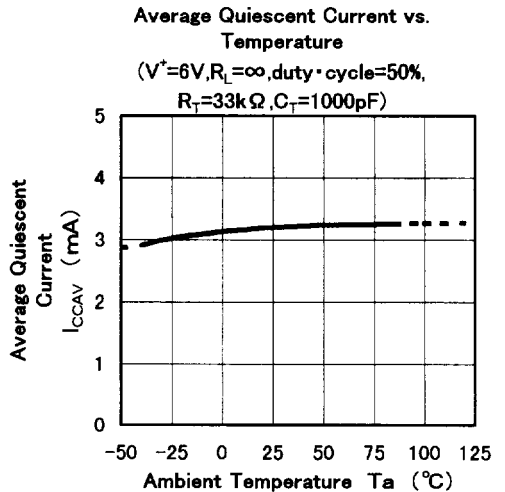
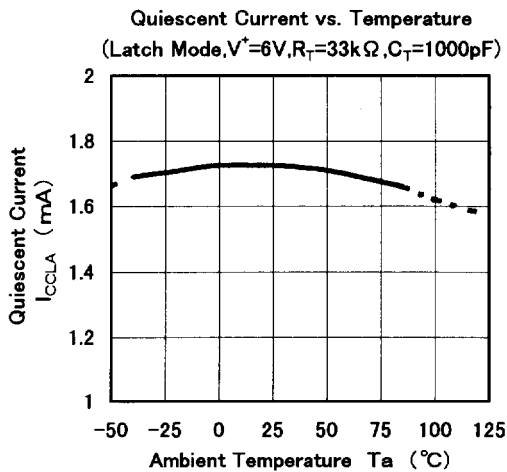
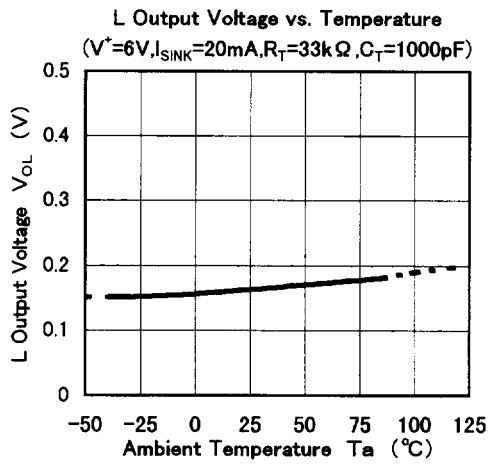
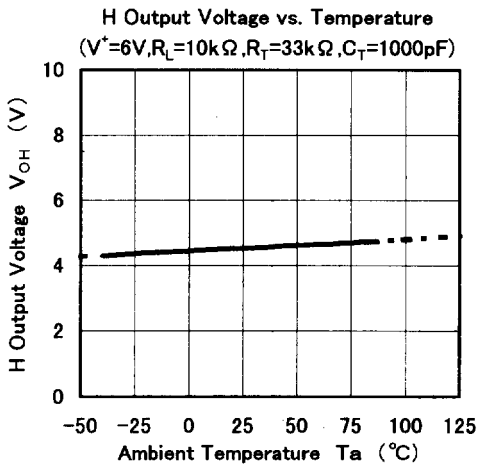
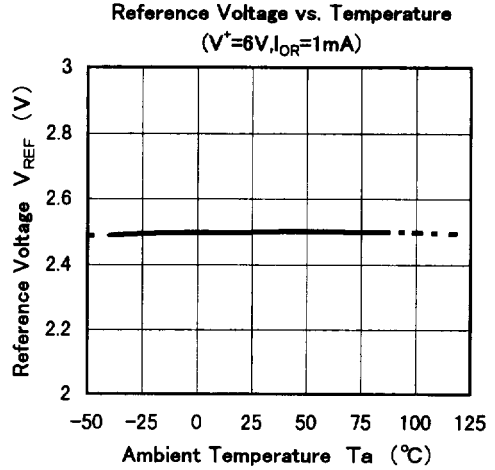
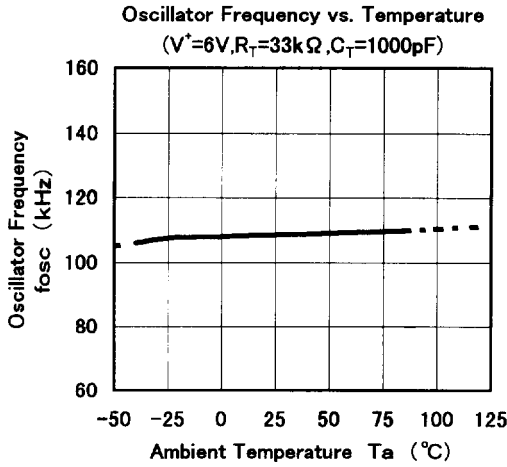


## TYPICAL CHARACTERISTICS





■ TYPICAL CHARACTERISTICS



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