# SWITCHING REGULATOR CONTROL IC FOR FLYBACK

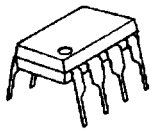
## ■ GENERAL DESCRIPTION

The NJM2369 is a high speed switching regulator control IC which can operate at low voltage.

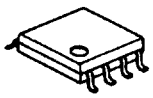
It uses a totempole output circuit , so that it can drive an external power MOS-FET directly.

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

## ■ PACKAGE OUTLINE



NJM2369D



NJM2369M

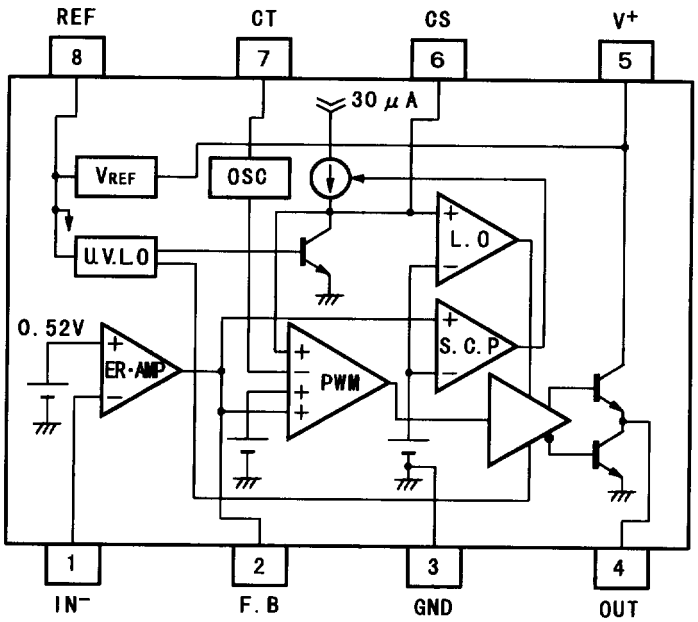
NJM2369E

NJM2369V

## ■ 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

## ■ BLOCK DIAGRAM




PIN FUNCTION

1. IN⁻
2. F. B
3. GND
4. OUT
5. V⁺
6. CS
7. CT
8. REF

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■ ABSOLUTE MAXIMUM RATINGS (Ta=25℃)

| PARAMETER | SYMBOL | MAXIMUM RATINGS | UNIT |
|---|---|---|---|
| Input Voltage | $V^+$ | 36 | V |
| Reference Output Current | $I_{OR}$ | 10 | mA |
| Power Dissipation | $P_D$ | (DIP8) 700<br>(DMP8) 300<br>(EMP8) 300<br>(SSOP8) 250 | mW |
| Operating Temperature Range | $T_{OPR}$ | -40～+85 | ℃ |
| Storage Temperature Range | $T_{STG}$ | -50～+125 | ℃ |

■ RECOMMENDED OPERATING CONDITIONS ($V^+$=6V, Ta=25℃)

| PARAMETER | SYMBOL | RATINGS | MIN. | MAX. | UNIT |
|---|---|---|---|---|---|
| Operating Voltage | $V^+$ | | 3.6 | 32 | V |
| Feed Back Resistor | $R_{NF}$ | | 100 | — | kΩ |
| Oscillator Timing Capacitor | $C_T$ | | 220 | 22000 | pF |
| Oscillator Timing Resistor | $R_T$ | | 10 | 100 | kΩ |
| Oscillate | $f_{OSC}$ | | 5 | 350 | kHz |

■ ELECTRICAL CHARACTERISTICS

($V^+$=6V, $R_T$=33kΩ, $C_T$=1000pF, Ta=25℃)

REFERENCE VOLTAGE BLOCK

| PARAMETER | SYMBOL | RATINGS | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| Output Voltage | $V_{REF}$ | $I_{OR}$=1mA | 2.45 | 2.50 | 2.55 | V |
| Line Regulation | $L_{INE}$ | $V^+$=3.6～32V, $I_{OR}$=1mA | — | 6.8 | 20.7 | mV |
| Load Regulation | $L_{OAD}$ | $I_{OR}$=0.1～5.0mA | — | 5 | 30 | mV |

OSCILLATOR BLOCK

| PARAMETER | SYMBOL | RATINGS | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| Oscillate | $f_{OSC}$ | $C_T$=1000pF, $R_T$=33kΩ | 85 | 105 | 125 | kHz |
| Oscillate Fluctuations1 (Line Fluctuations) | $f_{dv}$ | $V^+$=3.6～32V | — | 1 | — | % |
| Oscillate Fluctuations2 (Temp Fluctuations) | $f_{dt}$ | Ta=-40～+85℃ | — | 5 | — | % |

■ ELECTRICAL CHARACTERISTICS

($V^+$=6V, $R_T$=33kΩ, $C_T$=1000pF, Ta=25℃)

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 | $V_{OM+}$ | $R_{NF}$=100kΩ | $V_{REF}$-0.2 | — | — | V |
| (F.B Pin) | $V_{OM-}$ | $R_{NF}$=100kΩ | — | — | 200 | mV |
| Output Source Current (F.B Pin) | $I_{OM+}$ | $V_{OM}$=1V | 40 | 85 | 200 | μA |

PWM COMPARATE BLOCK

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

SOFT START CIRCUIT BLOCK

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

SHORT CIRCUIT PROTECTION

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

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, $R_T$=33kΩ, $C_T$=1000pF, Ta=25℃)

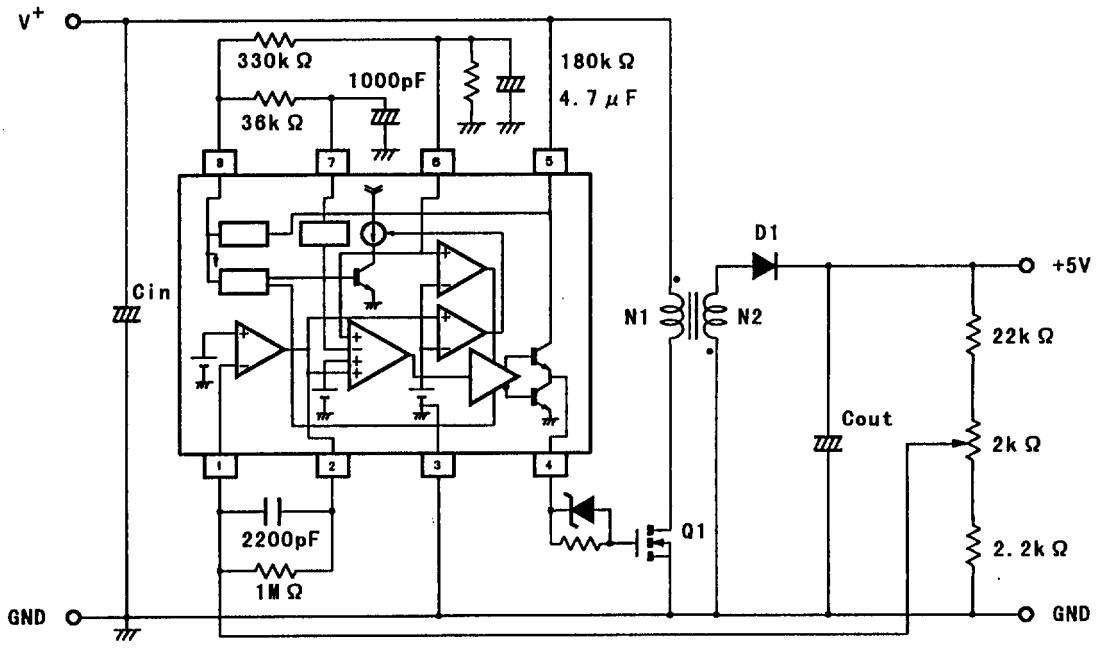
OUTPUT

| PARAMETER | SYMBOL | RATINGS | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| H-Output Voltage(OUT Pin) | $V_{OH}$ | $R_L$=10kΩ | 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 | — | 35 | — | mA |

GENERAL CHARACTERISTIC

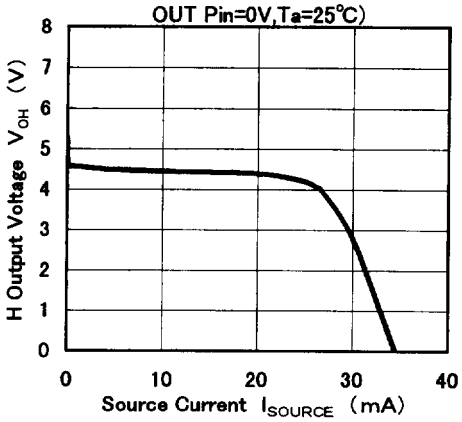
| PARAMETER | SYMBOL | RATINGS | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| Quiescent Current | $I_{CCLA}$ | Latch | — | 1.6 | 2.2 | mA |
| Average Quiescent Current | $I_{CCAV}$ | $R_L$=∞, duty·cycle=50% | — | 5.2 | 10.0 | mA |

■ APPLICATION

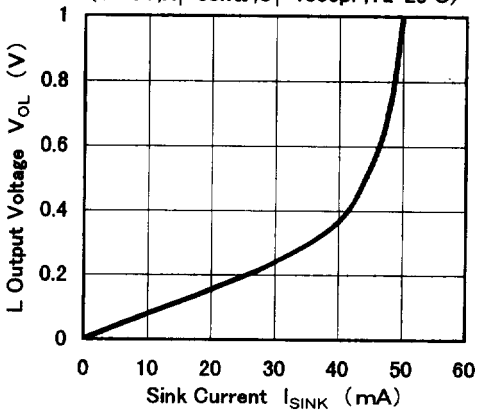


■ TYPICAL CHARACTERISTICS

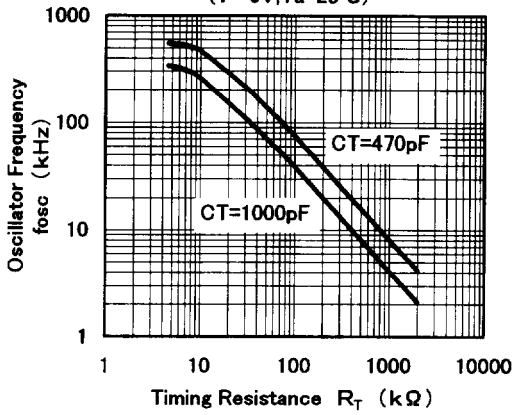
H Output Voltage vs. Source Current
($V^+$=6V,$R_T$=33kΩ,$C_T$=1000pF,
OUT Pin=0V,Ta=25°C)



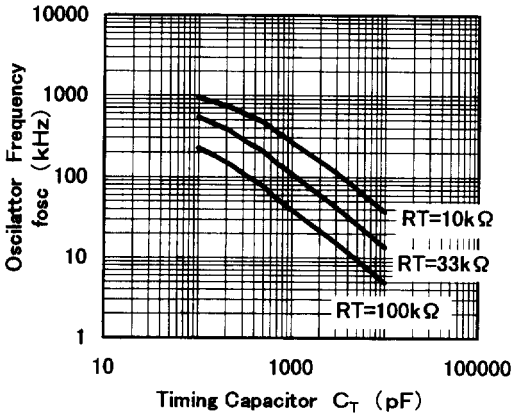

L Output Voltage vs. Sink Current
($V^+$=6V,$R_T$=33kΩ,$C_T$=1000pF,Ta=25°C)



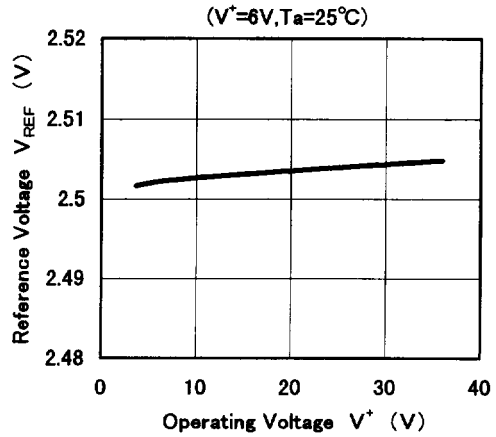

Oscillator Frequency vs. Timing Resistor
($V^+$=6V,Ta=25°C)



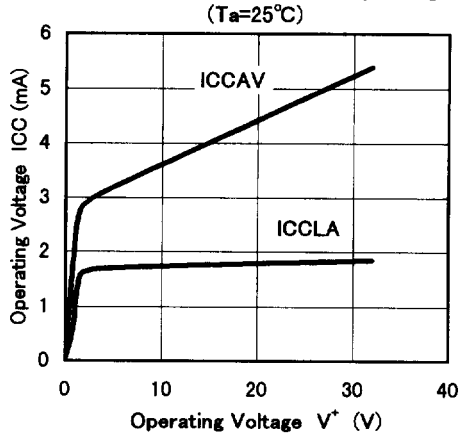

Oscillator Frequency vs. Timing Capacitor
($V^+$=6V,Ta=25°C)




Reference Voltage vs. Operating Voltage
($V^+$=6V,Ta=25°C)




Operating Current vs. Operating Voltage
(Ta=25°C)

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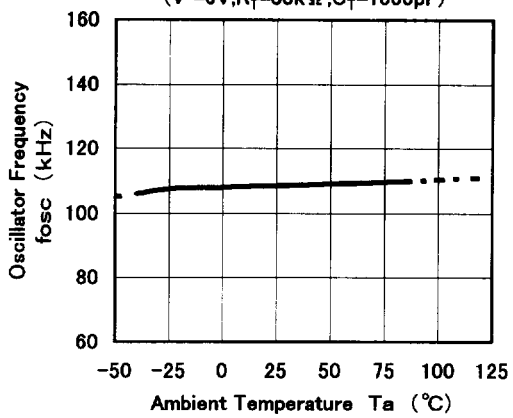
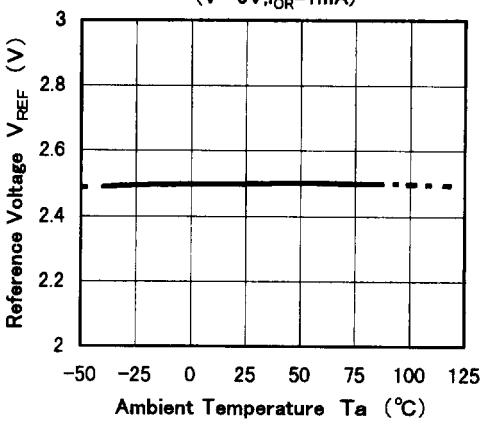
## ■ TYPICAL CHARACTERISTICS

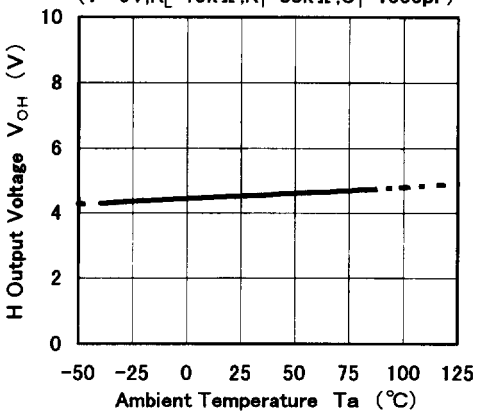
Oscillator Frequency vs. Temperature
($V^+$=6V,$R_T$=33kΩ,$C_T$=1000pF)



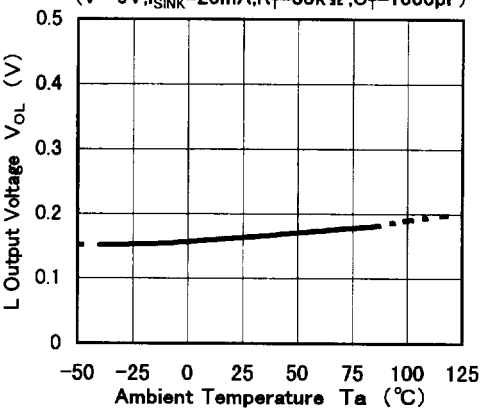

Reference Voltage vs. Temperature
($V^+$=6V,$I_{OR}$=1mA)



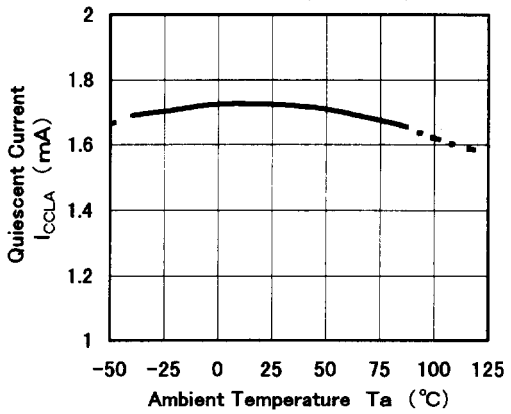

H Output Voltage vs. Temperature
($V^+$=6V,$R_L$=10kΩ,$R_T$=33kΩ,$C_T$=1000pF)




L Output Voltage vs. Temperature
($V^+$=6V,$I_{SINK}$=20mA,$R_T$=33kΩ,$C_T$=1000pF)




Quiescent Current vs. Temperature
(Latch Mode,$V^+$=6V,$R_T$=33kΩ,$C_T$=1000pF)




Average Quiescent Current vs. Temperature
($V^+$=6V,$R_L$=∞,duty・cycle=50%,
$R_T$=33kΩ,$C_T$=1000pF)