

SWITCHING REGULATOR CONTROL IC

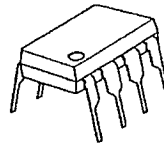
■ GENERAL DESCRIPTION

The NJM2377 is high speed switching regulator control IC which can operate at low voltage.

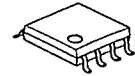
The NJM2377 consists of low power oscillation circuit, high precision reference, wide band error amplifier, under voltage lockout circuit, and a totem pole output circuit; which can drive an external Bipolar transistor directly.

The NJM2377 is suitable for any portable system, TFT panel to note PC and especially power supply at video CD.

■ PACKAGE OUTLINE



NJM2377D



NJM2377M

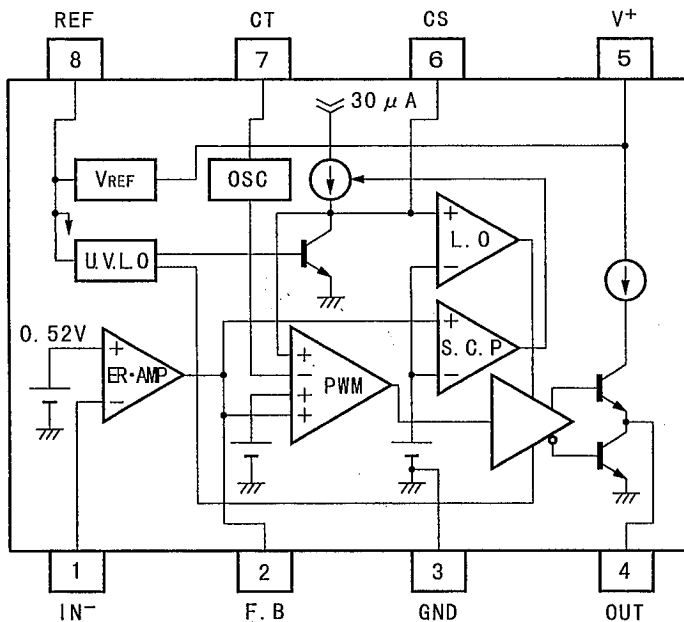


NJM2377V

■ FEATURES

- PWM Type Switching Regulator Control
- Operating Voltage (2.7~18V)
- Wide Oscillator Range (10~500kHz)
- ON/OFF Maximum Duty Cycle (Ton:Toff=9:1)
- Totem Pole Output
- Soft-Start Function
- Under Voltage Lockouts (U. V. L. O.)
- Bipolar Technology
- Package Outline DIP8, DMP8, SSOP8

■ 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

■ ABSOLUTE MAXIMUM RATINGS (Ta=25°C)

| PARAMETER                   | SYMBOL           | RATINGS                                 | UNIT |
|-----------------------------|------------------|---|------|
| Input Voltage               | V <sup>+</sup>   | 18                                      | V    |
| Reference Output Current    | I <sub>o</sub>   | ±50                                     | mA   |
| Power Dissipation           | P <sub>D</sub>   | (DIP8) 700<br>(DMP8) 300<br>(SSOP8) 250 | mW   |
| Operating Temperature Range | T <sub>OPR</sub> | -40~+85                                 | °C   |
| Storage Temperature Range   | T <sub>STG</sub> | -50~+150                                | °C   |

■ RECOMMENDED OPERATING CONDITIONS (V<sup>+</sup>=3V, Ta=25°C)

| PARAMETER                   | SYMBOL           | MIN. | MAX.   | UNIT  |
|-----------------------------|------------------|------|--------|-------|
| Operating Voltage           | V <sup>+</sup>   | 2.7  | 18     | V     |
| Feed Back Resistor          | R <sub>NF</sub>  | 100  | —      | k Ω   |
| Oscillator Timing Capacitor | C <sub>T</sub>   | 220  | 22,000 | p F   |
| Oscillator Timing Resistor  | R <sub>T</sub>   | 5    | 100    | k Ω   |
| Oscillation Frequency       | f <sub>osc</sub> | 10   | 500    | k H z |

■ ELECTRICAL CHARACTERISTICS ( $V^+=3V$ ,  $R_T=39k\Omega$ ,  $C_T=470pF$ ,  $T_a=25^\circ C$ )

REFERENCE VOLTAGE BLOCK

| PARAMETER       | SYMBOL                | TEST CONDITION                   | MIN. | TYP. | MAX. | UNIT |
|-----------------|-----------------------|----------------------------------|------|------|------|------|
| Output Voltage  | $V_{REF}$             | $I_{OR}=1mA$                     | 1.47 | 1.50 | 1.53 | V    |
| Line Regulation | $\Delta V_o - V_{IN}$ | $V^+=2.7\sim 18V$ , $I_{OR}=1mA$ | —    | 3.8  | 11.5 | mV   |
| Load Regulation | $\Delta V_o - I_o$    | $I_{OR}=0.1\sim 5.0mA$           | —    | 5    | 30   | mA   |

OSCILLATOR BLOCK

| PARAMETER                                       | SYMBOL    | TEST CONDITION                   | MIN. | TYP. | MAX. | UNIT |
|---|-----------|----------------------------------|------|------|------|------|
| Oscillation Frequency                           | $f_{osc}$ | $C_T=470pA$ , $R_T=39k\Omega$    | 80   | 100  | 120  | kHz  |
| Oscillate Fluctuations1<br>(Line Fluctuations)  | $f_{dv}$  | $V^+=2.7\sim 18V$ , $I_{OR}=1mA$ | —    | 1    | —    | %    |
| Oscillate Fluctuations2<br>(Temp. Fluctuations) | $f_{dt}$  | $T_a=-40\sim +85^\circ C$        | —    | 5    | —    | %    |

ERROR AMPLIFIER BLOCK

| PARAMETER                            | SYMBOL    | TEST CONDITION                        | 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              | $G_B$     |                                       | —    | 1.0  | —    | MHz     |
| Maximum Output Voltage<br>(F. B Pin) | $V_{OM+}$ | $R_{NF}=100k\Omega$ , $I_{N-} Pin=0V$ | 1.9  | 2.2  | 2.4  | V       |
|                                      | $V_{OM-}$ | $R_{NF}=100k\Omega$ , $I_{N-} Pin=1V$ | —    | —    | 200  | mA      |
| Output Source Current<br>(F. B Pin)  | $I_{OM+}$ | $V_{OM}=1V$ , $I_{N-} Pin=0V$         | 40   | 85   | 200  | $\mu A$ |

PWM COMPARABLE BLOCK

| PARAMETER                             | SYMBOL     | TEST CONDITION                                 | MIN. | TYP. | MAX. | UNIT |
|---------------------------------------|------------|--|------|------|------|------|
| Input Bias Voltage<br>(F. B Pin)      | $V_{TH0}$  | duty·cycle=0%                                  | —    | 0.45 | 0.55 | V    |
| Input Threshold Voltage<br>(F. B Pin) | $V_{TH80}$ | duty·cycle=80%                                 | —    | 1.05 | —    | V    |
| Maximum Duty Cycle                    | $\alpha M$ | F. B Pin=1.2V<br>$C_T=470pF$ , $R_T=39k\Omega$ | 80   | 90   | —    | %    |

SOFT START CIRCUIT BLOCK

| PARAMETER                           | SYMBOL       | TEST CONDITION                  | MIN. | TYP. | MAX. | UNIT |
|-------------------------------------|--------------|---------------------------------|------|------|------|------|
| Input Bias Current<br>(GS Pin)      | $I_{BCS}$    |                                 | —    | 250  | 650  | nA   |
| Input Threshold Voltage<br>(GS Pin) | $V_{THCS0}$  | duty·cycle=0%<br>F. B Pin=1.2V  | —    | 0.25 | 0.35 | V    |
| Input Threshold Voltage<br>(GS Pin) | $V_{THCS80}$ | duty·cycle=80%<br>F. B Pin=1.2V | —    | 0.79 | —    | V    |

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■ ELECTRICAL CHARACTERISTICS ( $V^+=3V$ ,  $R_T=39k\Omega$ ,  $C_T=470pF$ ,  $T_a=25^\circ C$ )

SHORT CIRCUIT PROTECTION

| PARAMETER                                | SYMBOL     | TEST CONDITION        | MIN. | TYP. | MAX. | UNIT    |
|--|------------|-----------------------|------|------|------|---------|
| Input Threshold Voltage<br>(F.B Pin)     | $V_{THPC}$ |                       | 1.30 | 1.50 | 1.80 | V       |
| Charge Current (CS Pin)                  | $I_{CHG}$  | CS Pin=0V, F.B Pin=2V | 10   | 30   | 50   | $\mu A$ |
| Latch mode Threshold<br>Voltage (CS Pin) | $V_{THLA}$ |                       | 1.20 | 1.50 | 1.80 | V       |

UNDER VOLTAGE LOCKOUT

| PARAMETER             | SYMBOL      | TEST CONDITION | MIN. | TYP. | MAX. | UNIT |
|-----------------------|-------------|----------------|------|------|------|------|
| ON Threshold Voltage  | $V_{THON}$  |                | —    | 1.95 | —    | V    |
| OFF Threshold Voltage | $V_{THOFF}$ |                | —    | 1.78 | —    | V    |
| Hysteresis Voltage    | $V_{HYS}$   |                | 60   | 170  | —    | mV   |

OUTPUT BLOCK

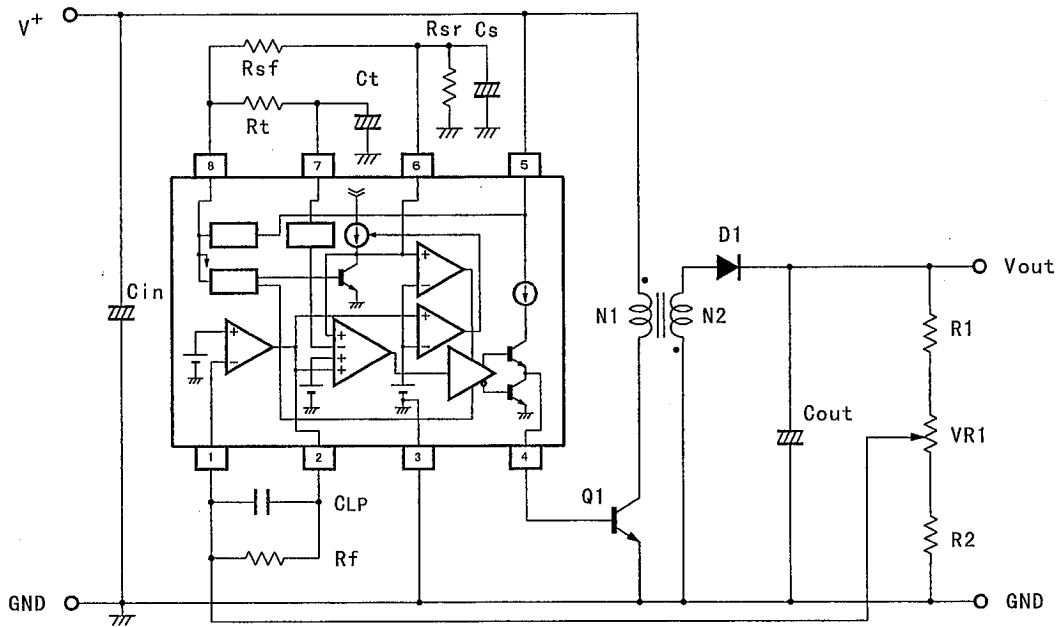
| PARAMETER                          | SYMBOL       | TEST CONDITION           | MIN. | TYP. | MAX. | UNIT |
|------------------------------------|--------------|--------------------------|------|------|------|------|
| H-Output Voltage (OUT Pin)         | $V_{OH}$     | $R_L=10k\Omega$          | 1.7  | 2.0  | —    | V    |
| L-Output Voltage (OUT Pin)         | $V_{OL}$     | Output Sink Current=20mA | —    | 0.25 | 0.65 | V    |
| Output Source Current<br>(OUT Pin) | $I_{SOURCE}$ | OUT Pin=0V               | 23   | 35   | —    | mA   |

GENERAL CHARACTERISTIC

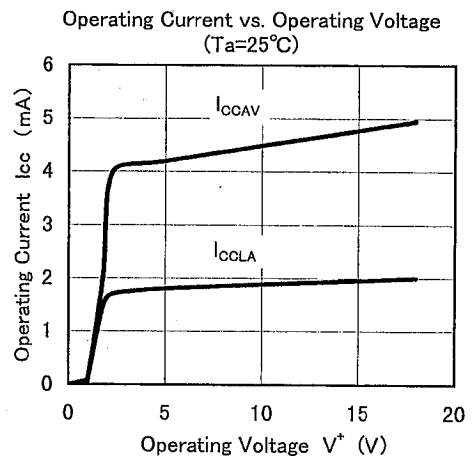
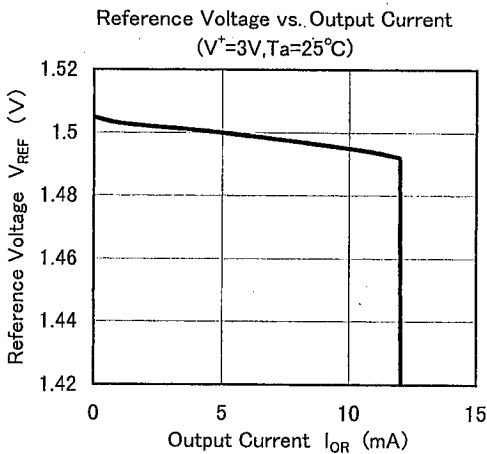
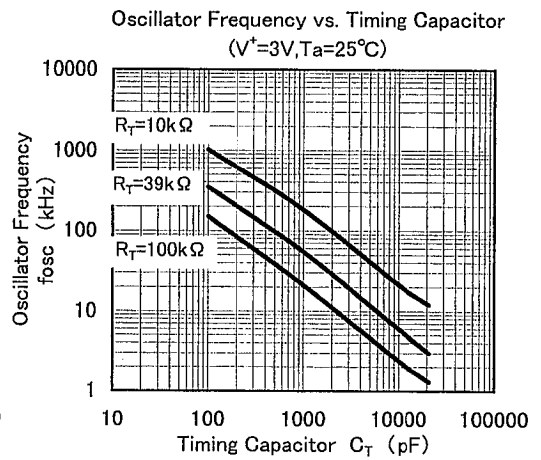
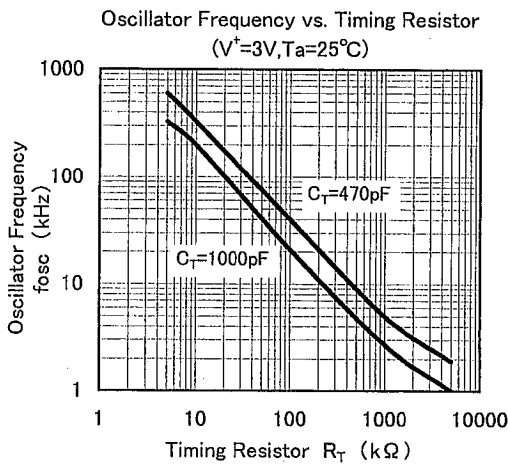
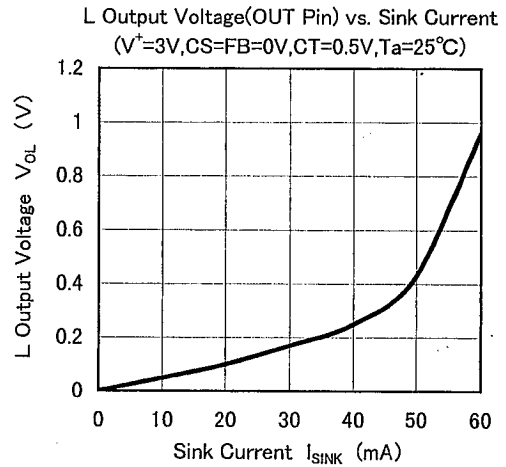
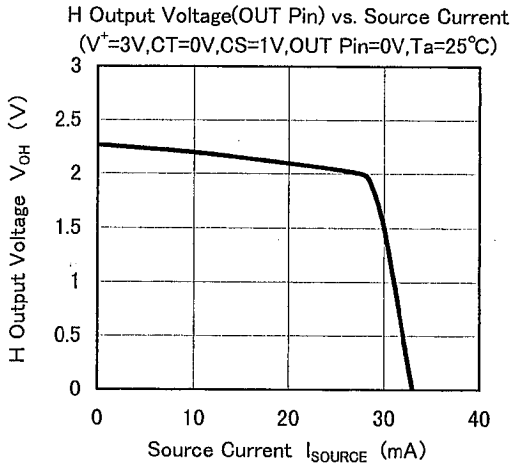
| PARAMETER                 | SYMBOL     | TEST CONDITION                | MIN. | TYP. | MAX. | UNIT |
|---------------------------|------------|-------------------------------|------|------|------|------|
| Quiescent Current         | $I_{CCLA}$ | Latch Mode, CS Pin=1.8V       | —    | 1.7  | 2.4  | mA   |
| Average Quiescent Current | $I_{CCAV}$ | $R_L=\infty$ , duty-cycle=50% | —    | 5.0  | 6.8  | mA   |

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■ TYPICAL APPLICATION

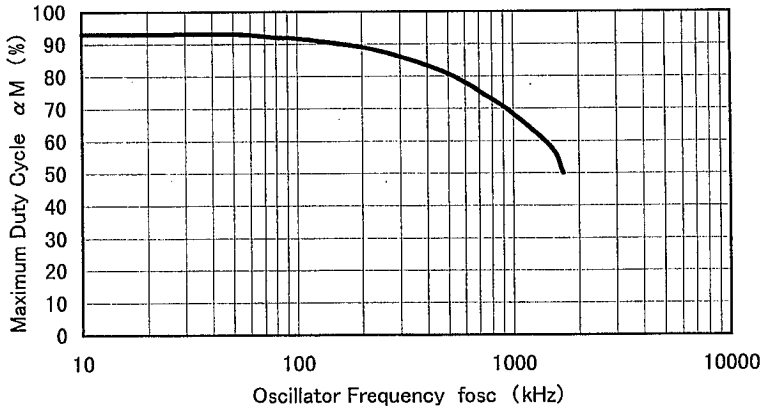


## TYPICAL CHARACTERISTICS

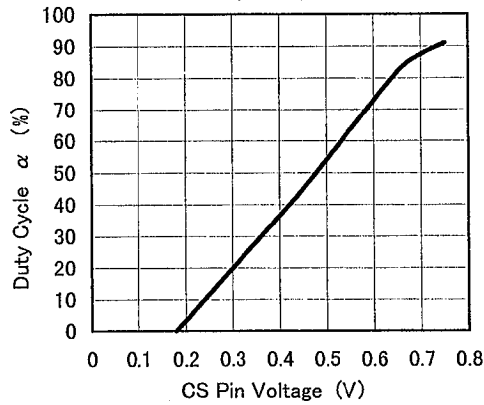


■ TYPICAL CHARACTERISTICS

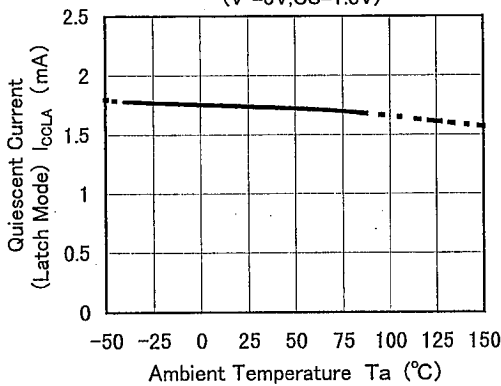
Maximum Duty Cycle vs. Oscillator Frequency  
( $V^+ = 3V$ )



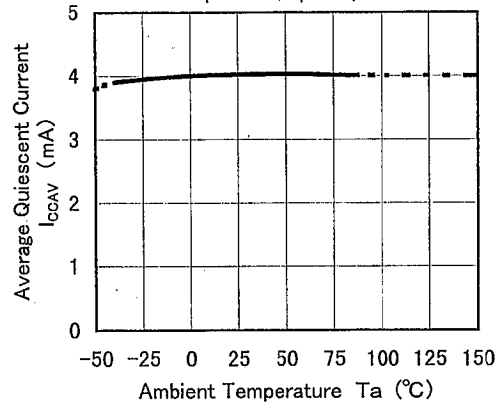
Duty Cycle vs. CS Pin Voltage  
( $V^+ = 3V$ )



Quiescent Current (Latch Mode) vs. Temperature  
( $V^+ = 3V, CS = 1.8V$ )

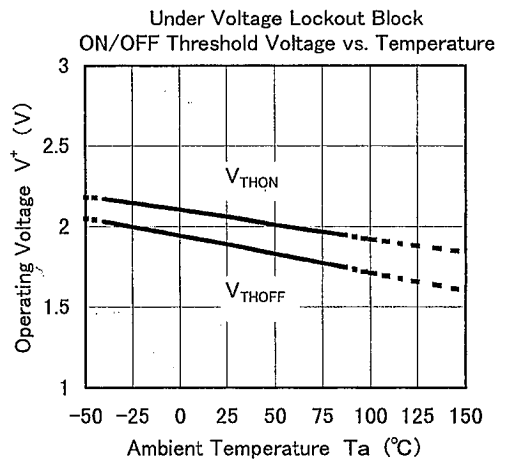
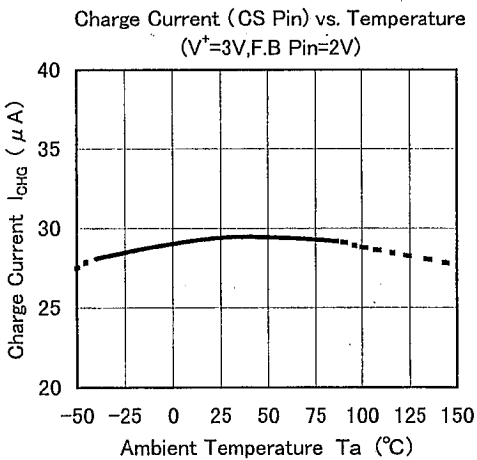
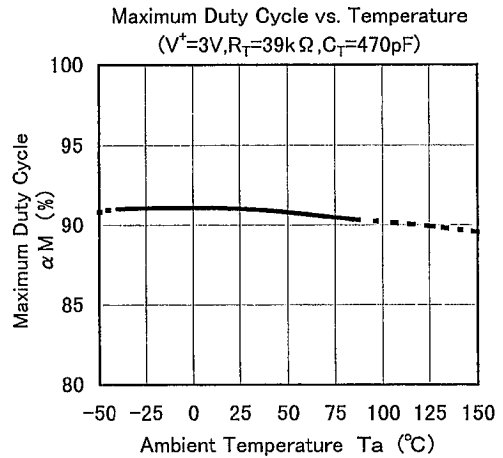
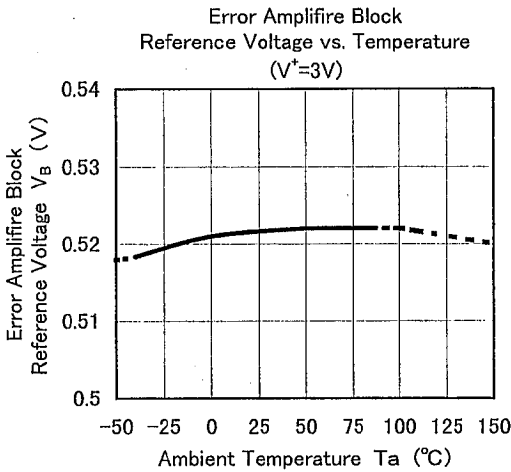
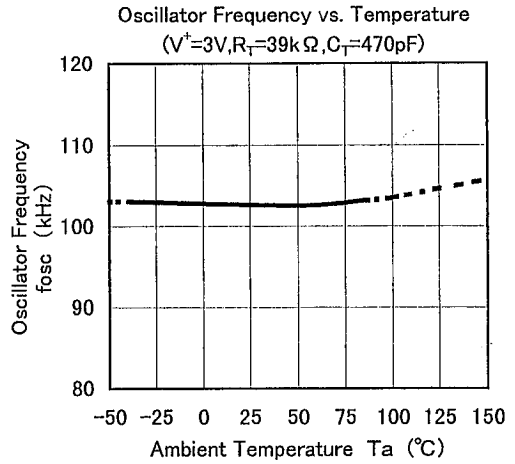
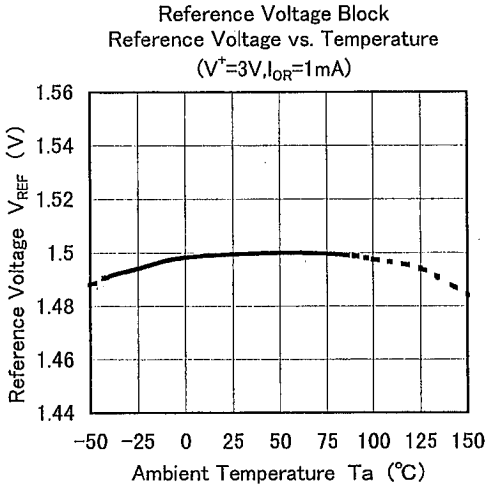


Average Quiescent Current vs. Temperature  
( $V^+ = 3V, R_L = \infty, \text{duty cycle} = 50\%$   
 $R_T = 39k\Omega, C_T = 470pF$ )



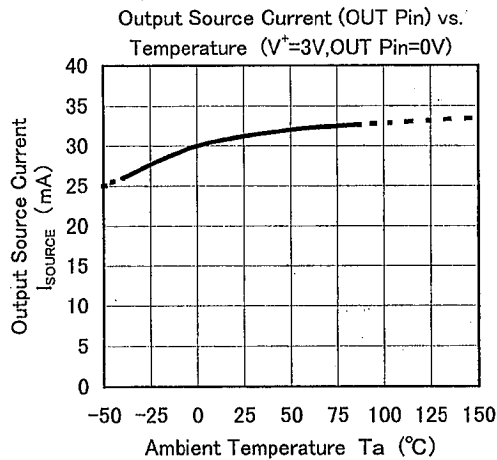
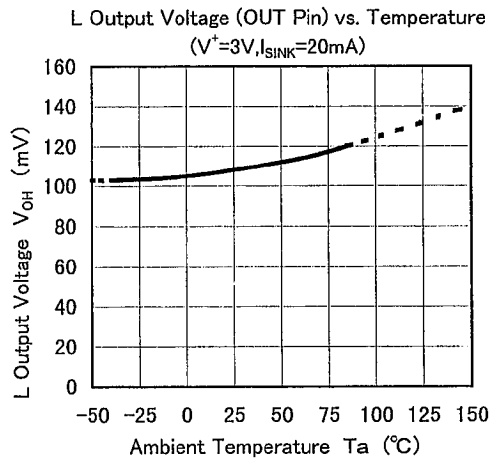
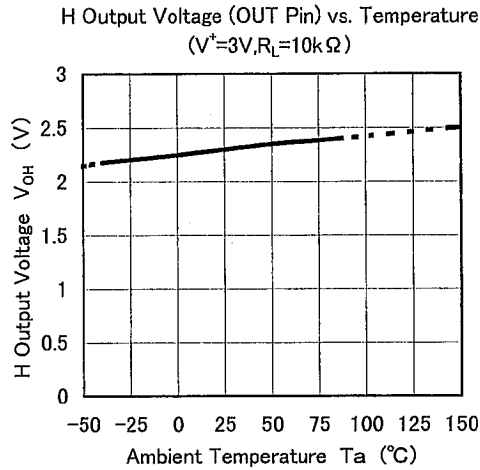
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## TYPICAL CHARACTERISTICS





■ TYPICAL CHARACTERISTICS



## MEMO

[CAUTION]

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