

## SWITCHING REGULATOR CONTROL IC FOR FLYBACK WITH CURRENT SENSE AMPLIFIER

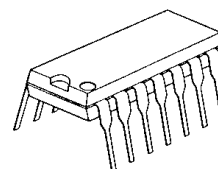
### ■GENERAL DESCRIPTION

The **NJM2381** is a low voltage operation DC/DC converter control IC.

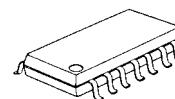
It features totem pole output directly driving external bipolar transistor and operates at high switching frequency which improves transient response.

It is suitable for LCD back light, and other portable applications.

### ■PACKAGE OUTLINE



**NJM2381D**



**NJM2381M**

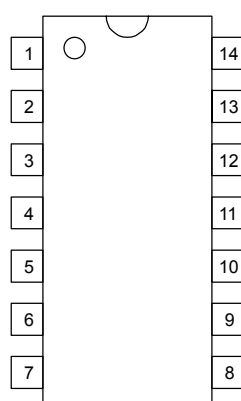


**NJM2381V**

### ■FEATURES

- PWM switching control
- Operating Voltage (3.6 to 32V)
- Wide Oscillator Range (5 to 350 kHz)
- Current Sensing Amplifier
- Soft-Start Function
- UVLO(Under Voltage Lockouts)
- Bipolar Technology
- Package Outline DIP14, DMP14, SSOP10

### ■PIN CONFIGURATION

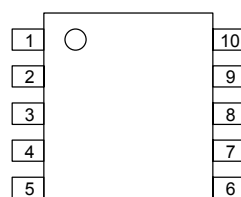


**NJM2381D**

**NJM2381M**

#### PIN FUNCTION

|                     |                    |
|---------------------|--------------------|
| 1.NC                | 8.NC               |
| 2.IN <sup>-</sup> 1 | 9. V <sup>+</sup>  |
| 3.IN <sup>-</sup> 2 | 10.CS              |
| 4.F.B               | 11.CT              |
| 5.GND               | 12.REF             |
| 6.OUT               | 13.IN <sup>+</sup> |
| 7.NC                | 14.NC              |



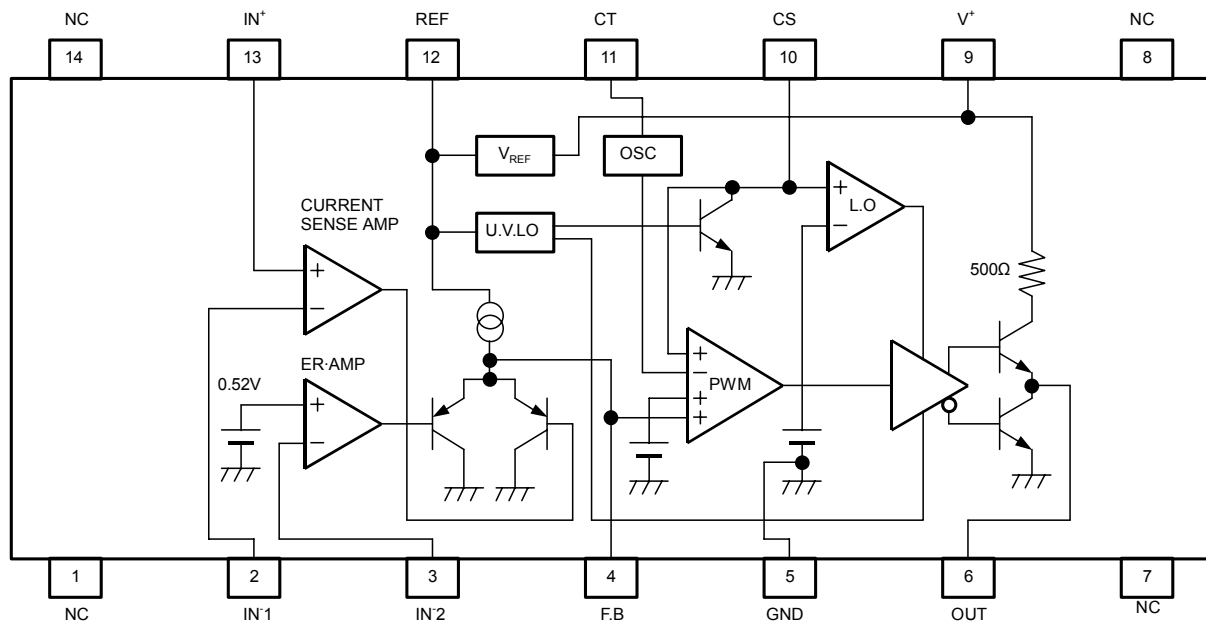
**NJM2381V**

#### PIN FUNCTION

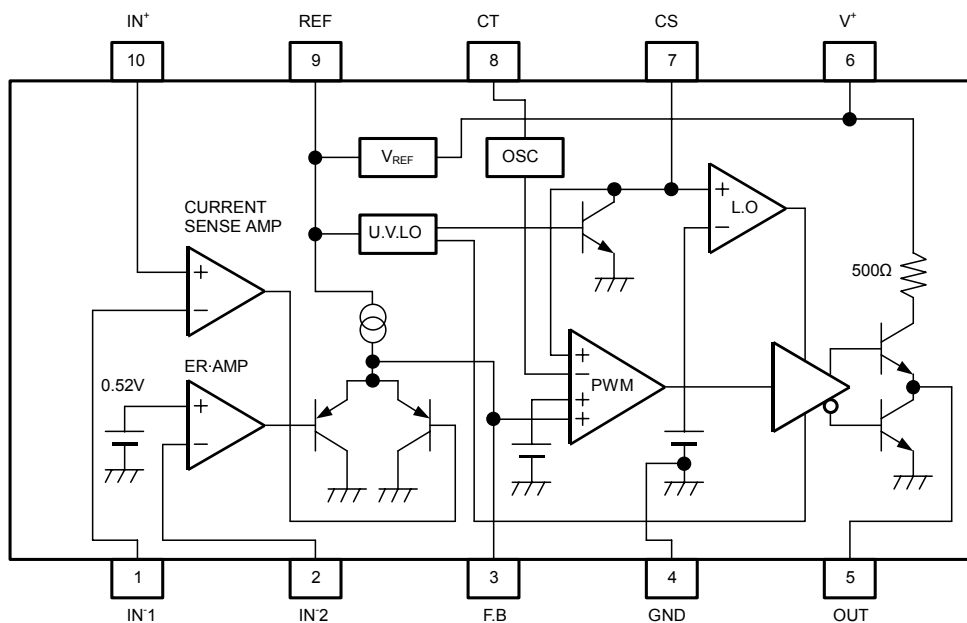
|                     |                    |
|---------------------|--------------------|
| 1.IN <sup>-</sup> 1 | 6. V <sup>+</sup>  |
| 2.IN <sup>-</sup> 2 | 7.CS               |
| 3.F.B               | 8.CT               |
| 4.GND               | 9.REF              |
| 5.OUT               | 10.IN <sup>+</sup> |

# NJM2381

## ■BLOCK DIAGRAM



(Package: DIP14, DMP14)



(Package: SSOP10)

## ■ABSOLUTE MAXIMUM RATINGS (Ta=25°C )

| PARAMETER                   | SYMBOL    | MAXIMUM RATINGS                               | UNIT |
|-----------------------------|-----------|-----------------------------------------------|------|
| Input Voltage               | $V^+$     | 36                                            | V    |
| Reference Output Current    | $I_{OR}$  | 10                                            | mA   |
| Output Current              | $I_O$     | ±50                                           | mA   |
| Differential Input Voltage  | $V_{ID}$  | 2.5                                           | V    |
| Common Mode Input Voltage   | $V_{IC}$  | -0.3 ~ 2.5                                    | V    |
| Power Dissipation           | $P_D$     | (DIP 14) 700<br>(DMP 14) 300<br>(SSOP 10) 250 | mW   |
| Operating Temperature Range | $T_{OPR}$ | -40 ~ +85                                     | °C   |
| Storage Temperature Range   | $T_{STG}$ | -50 ~ +125                                    | °C   |

## ■ELECTRICAL CHARACTERISTICS ( $V^+=6V, R_T=33k\Omega, C_T=1000pF, Ta=25^\circ C$ )

### REFERENCE VOLTAGE BLOCK

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

### OSCILLATOR BLOCK

| PARAMETER                                      | SYMBOL    | TEST CONDITION              | MIN. | TYP. | MAX. | UNIT |
|------------------------------------------------|-----------|-----------------------------|------|------|------|------|
| Oscillation Frequency                          | $f_{OSC}$ | $R_T=33k\Omega, C_T=1000pF$ | 85   | 105  | 125  | kHz  |
| Oscillate Fluctuations1<br>(Line Fluctuations) | $f_{dV}$  | $V^+=3.6 \sim 32V$          | —    | 1    | —    | %    |
| Oscillate Fluctuations2<br>(Temp Fluctuations) | $f_{dT}$  | $Ta=-40 \sim 85^\circ C$    | —    | 5    | —    | %    |

### CURRENT SENSE AMPLIFIER BLOCK

| PARAMETER                            | SYMBOL     | TEST CONDITION      | MIN. | TYP.                 | MAX. | UNIT |
|--------------------------------------|------------|---------------------|------|----------------------|------|------|
| Input Offset Voltage1                | $V_{IO1}$  |                     | —    | 2                    | 7    | mV   |
| Input Offset Current1                | $I_{IO1}$  |                     | —    | 5                    | 50   | nA   |
| Input Bias Current1                  | $I_{B1}$   |                     | —    | 5                    | 100  | nA   |
| Open Loop Gain1                      | $A_{V1}$   |                     | —    | 90                   | —    | dB   |
| Gain Bandwidth Product1              | $G_{B1}$   |                     | —    | 0.6                  | —    | MHz  |
| Input Common Mode<br>Voltage Ratio1  | $V_{ICM1}$ |                     | —    | 0 ~<br>$V_{REF}-0.8$ | —    | V    |
| Maximum Output Voltage1<br>(F.B Pin) | $V_{OM-1}$ | $R_{NF}=100k\Omega$ | —    | —                    | 1    | V    |
| Maximum Source Current1<br>(F.B Pin) | $I_{OM+1}$ | $V_{OM}=0.5V$       | 40   | 85                   | 200  | μA   |

# NJM2381

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

## ERROR AMPLIFIER BLOCK

| PARAMETER                                        | SYMBOL     | TEST CONDITION      | MIN. | TYP. | MAX. | UNIT    |
|--------------------------------------------------|------------|---------------------|------|------|------|---------|
| Reference Voltage <sub>2</sub>                   | $V_{B2}$   |                     | 0.51 | 0.52 | 0.53 | V       |
| Input Bias Voltage <sub>2</sub>                  | $I_{B2}$   |                     | –    | 5    | 100  | nA      |
| Open Loop Gain <sub>2</sub>                      | $A_{v2}$   |                     | –    | 90   | –    | dB      |
| Gain Bandwidth Product <sub>2</sub>              | $G_{B2}$   |                     | –    | 0.6  | –    | MHz     |
| Maximum Output Voltage <sub>2</sub><br>(F.B Pin) | $V_{OM-2}$ | $R_{NF}=100k\Omega$ | –    | –    | 1    | V       |
| Maximum Source Current <sub>2</sub><br>(F.B Pin) | $I_{OM+2}$ | $V_{OM}=0.5V$       | 40   | 85   | 200  | $\mu A$ |

## PWM COMPARE BLOCK

| PARAMETER                            | SYMBOL     | TEST CONDITION                                          | MIN. | TYP. | MAX. | UNIT |
|--------------------------------------|------------|---------------------------------------------------------|------|------|------|------|
| Input Threshold Voltage<br>(F.B Pin) | $V_{TH0}$  | duty·cycle=0%                                           | –    | 1.65 | 1.75 | V    |
| Input Threshold Voltage<br>(F.B Pin) | $V_{TH50}$ | duty·cycle=50%                                          | –    | 1.88 | –    | V    |
| Maximum Duty Cycle                   | $\alpha M$ | Current Sense Amp.=HIGH<br>Error Amp.=HIGH ,CS Pin=1.2V | 55   | 64   | 85   | %    |

## SOFT START CIRCUIT BLOCK

| PARAMETER                           | SYMBOL       | TEST CONDITION | MIN. | TYP. | MAX. | UNIT |
|-------------------------------------|--------------|----------------|------|------|------|------|
| Input Bias Current (CS Pin)         | $I_{BCS}$    | CS Pin=1.8V    | –    | 250  | 650  | nA   |
| Input Threshold Voltage<br>(CS Pin) | $V_{THCS0}$  | duty·cycle=0%  | –    | 0.25 | 0.35 | V    |
| Input Threshold Voltage<br>(CS Pin) | $V_{THCS50}$ | duty·cycle=50% | –    | 0.52 | –    | V    |

## UNDER VOLTAGE LOCKOUT BLOCK

| PARAMETER             | SYMBOL      | TEST CONDITION | 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   |

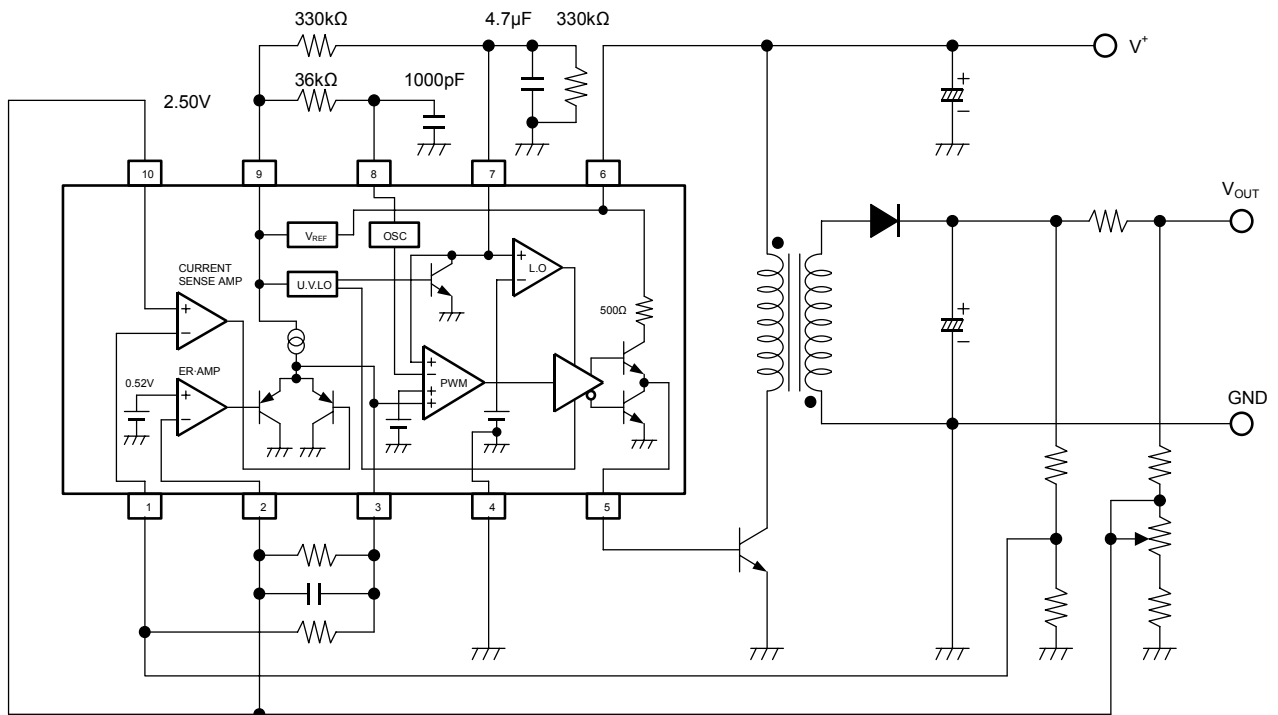
## OUTPUT BLOCK

| PARAMETER                          | SYMBOL       | TEST CONDITION           | 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<br>(OUT Pin) | $I_{SOURCE}$ | OUT Pin=0V               | 8    | 11   | –    | mA   |

## GENERAL CHARACTERISTICS

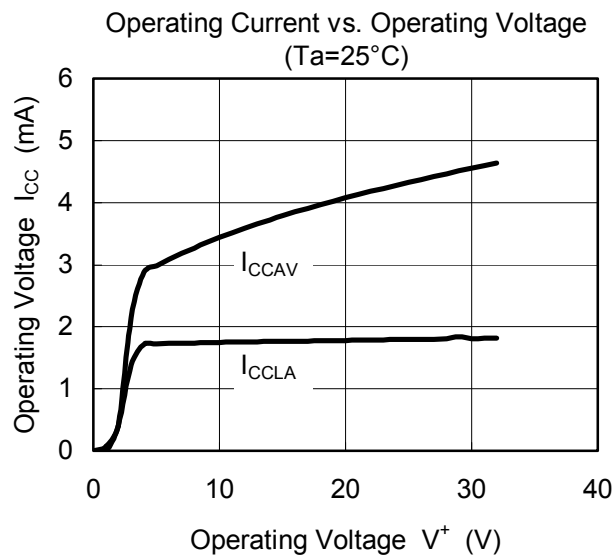
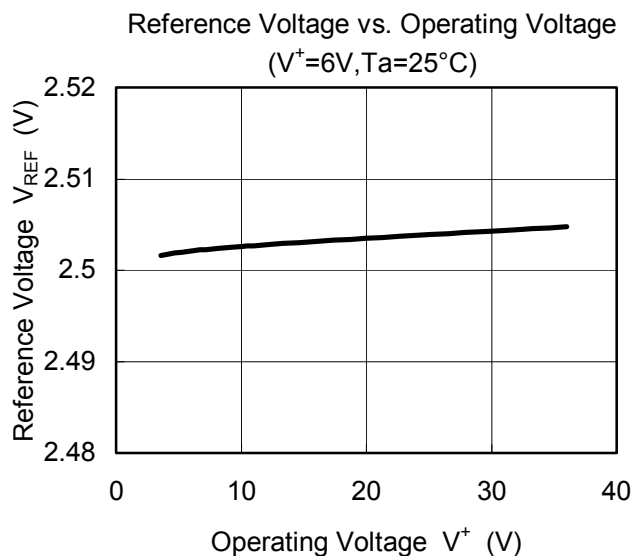
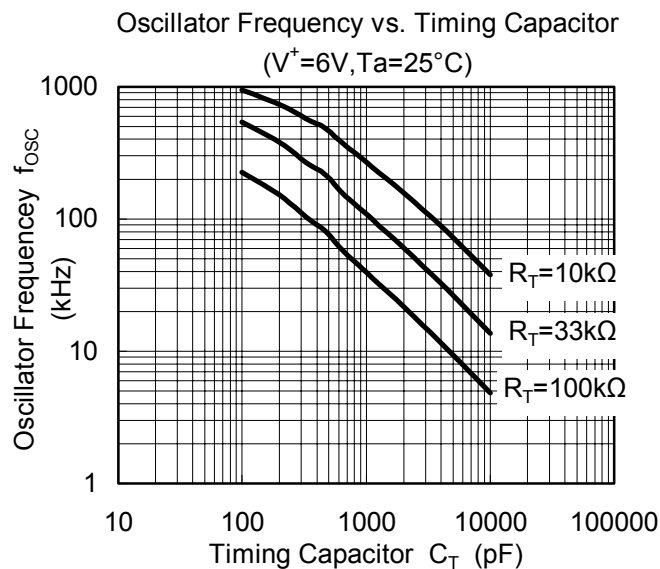
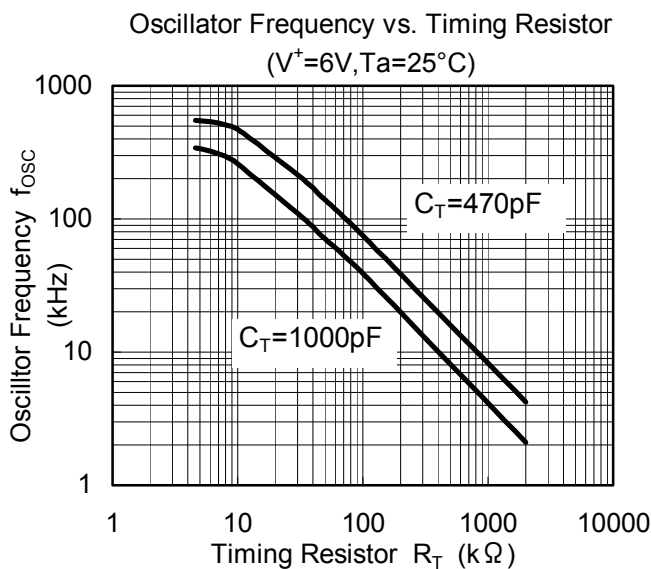
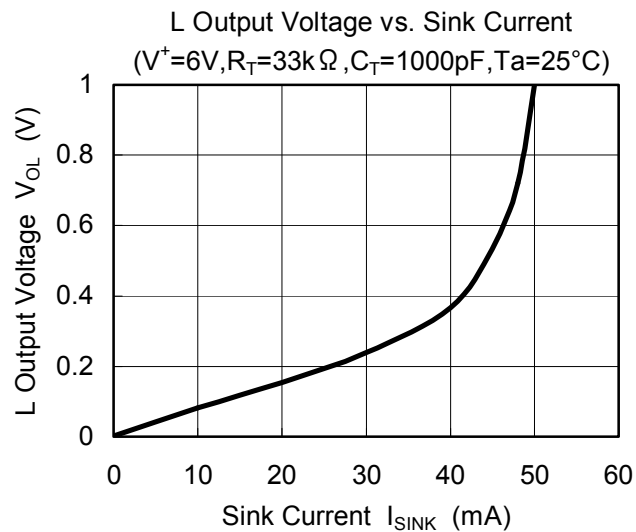
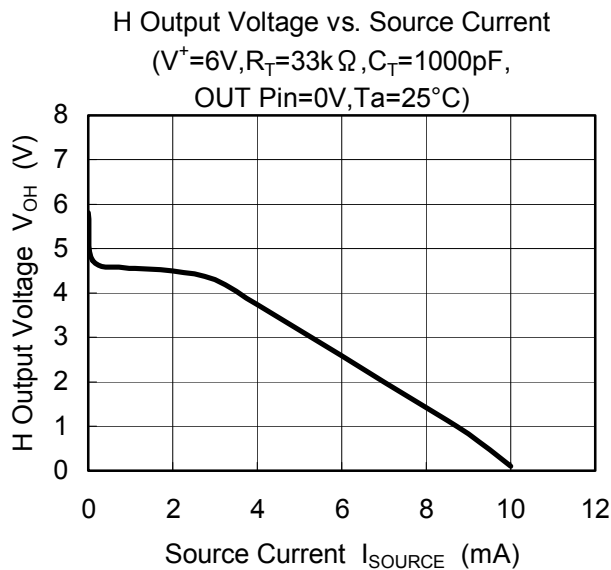
| PARAMETER                                | SYMBOL     | TEST CONDITION                 | MIN. | TYP. | MAX. | UNIT |
|------------------------------------------|------------|--------------------------------|------|------|------|------|
| Latch Mode<br>Threshold Voltage (CS Pin) | $V_{THLA}$ |                                | 1.2  | 1.5  | 1.8  | V    |
| Quiescent Current                        | $I_{CCLA}$ | Latch Mode                     | –    | 1.6  | 2.2  | mA   |
| Average Quiescent Current                | $I_{CCAV}$ | $RL = \infty$ , duty·cycle=50% | –    | 3.5  | 4.8  | mA   |

## ■ TYPICAL APPLICATIONS

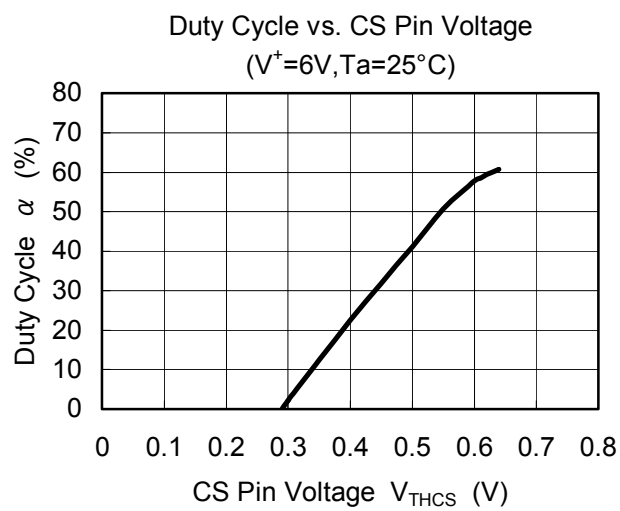
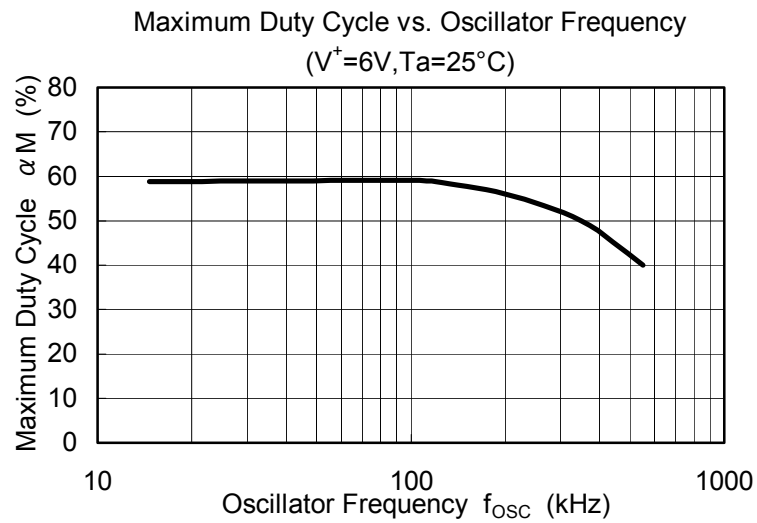


(Package:SSOP10)

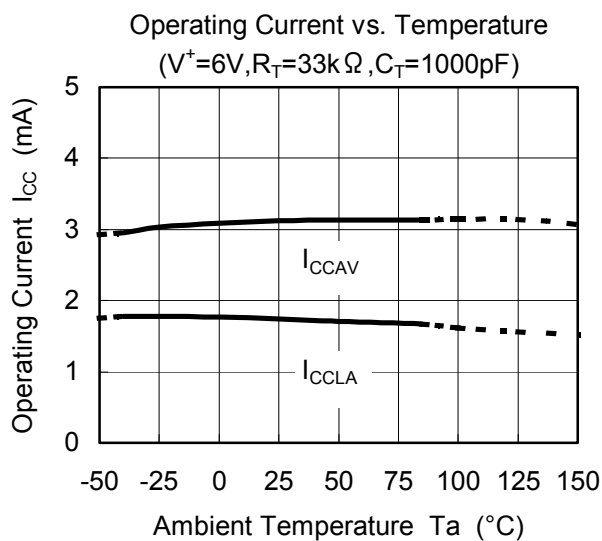
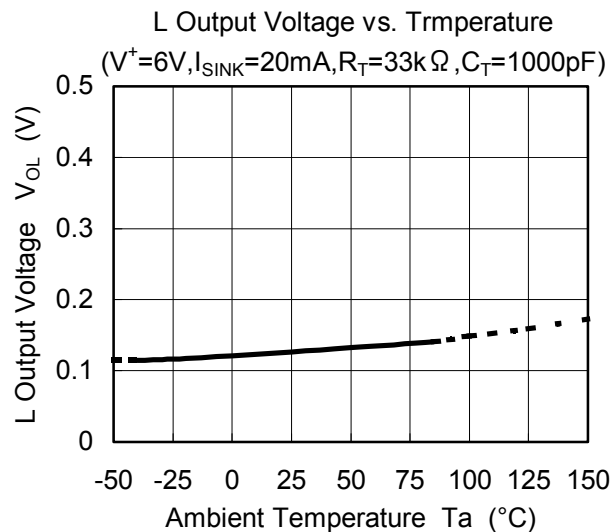
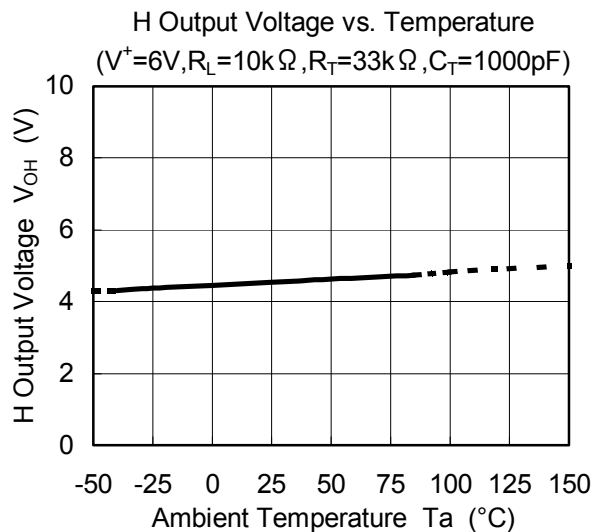
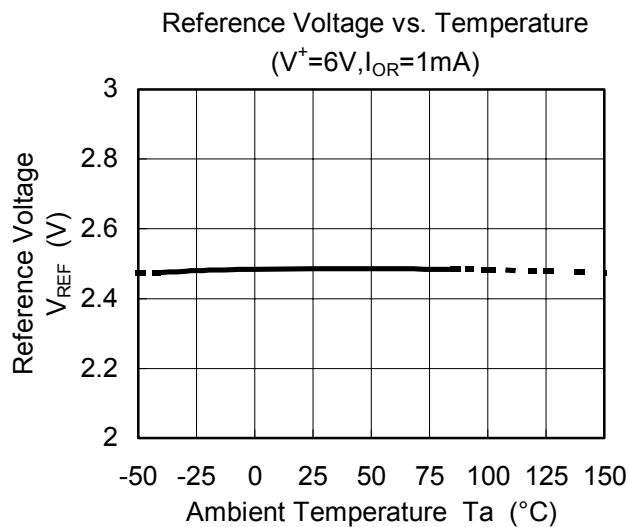
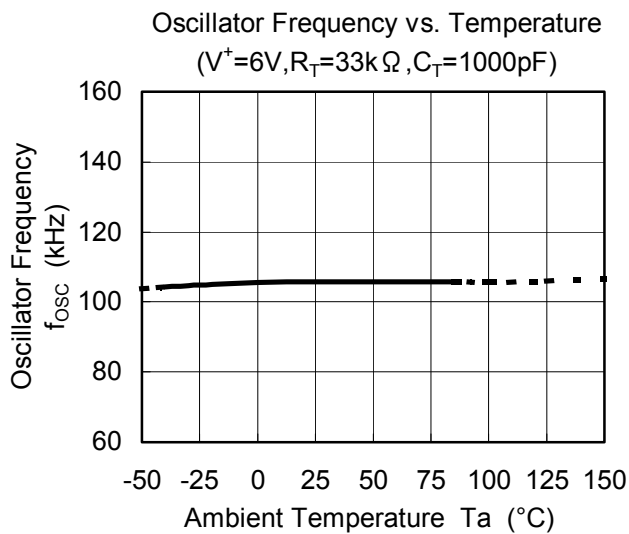
## TYPICAL CHARACTERISTICS



## ■TYPICAL CHARACTERISTICS



## TYPICAL CHARACTERISTICS



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