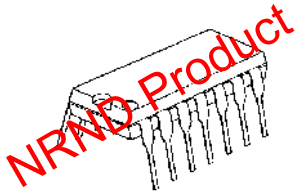
# DC/DC CONVERTER CONTROL IC
# WITH CURRENT SENSE AMPLIFIER

## ■GENERAL DESCRIPTION

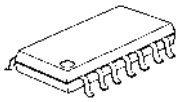
The **NJM2384** is a low voltage operation DC/DC converter control IC featuring high side current protection and soft start functions.

It is suitable for battery charger, power module application and on-board regulators.

## ■PACKAGE OUTLINE




**NJM2384D**

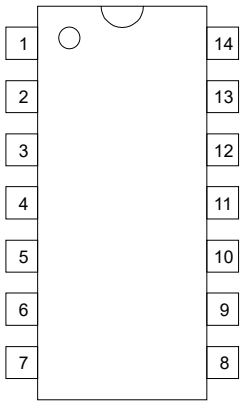


**NJM2384M**

## ■FEATURES

- PWM switching control
- Operating Voltage (3.6V to 32V)
- Wide Oscillator Range (5kHz to 500kHz)
- Current Sensing Amplifier
- Soft-Start Function
- UVLO (Under Voltage Lockouts)
- Bipolar Technology
- Package Outline DIP14, DMP14

## ■PIN CONFIGURATION

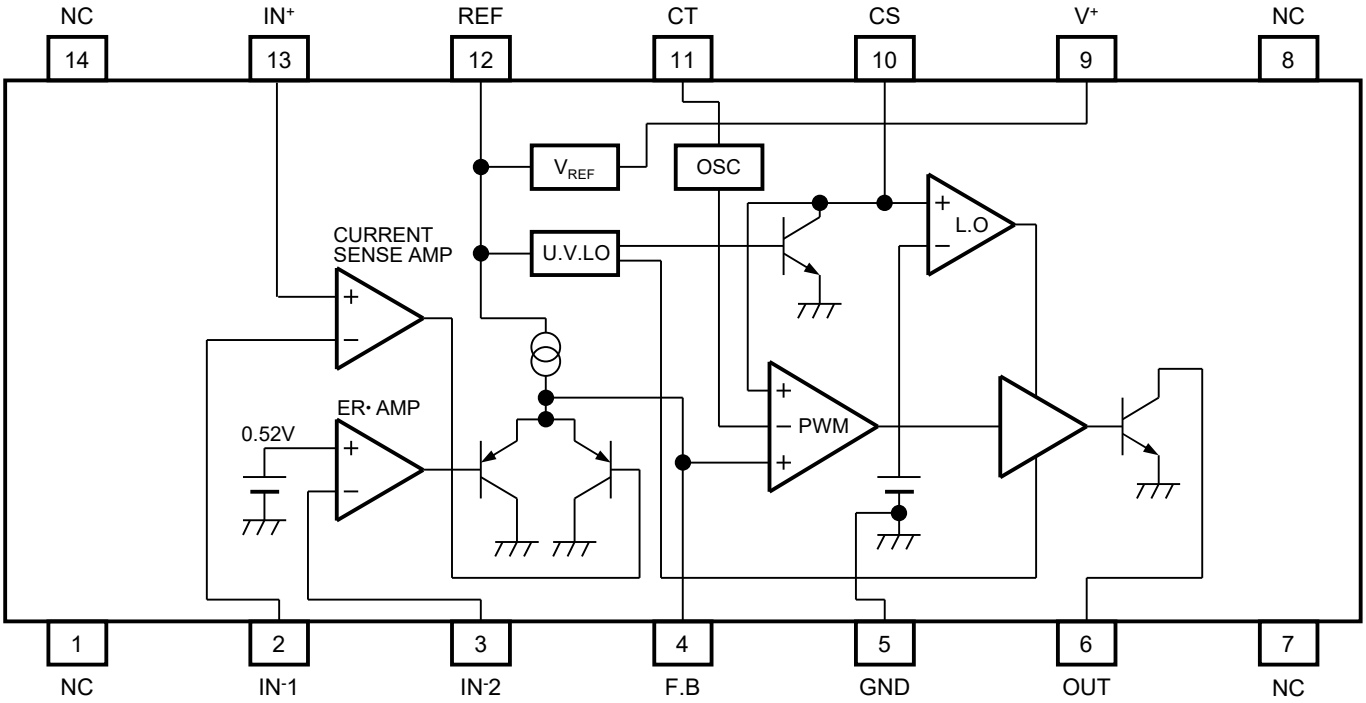



**NJM2384D**
**NJM2384M**

PIN FUNCTION

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

■BLOCK DIAGRAM



■ABSOLUTE MAXIMUM RATINGS (Ta=25°C)

| PARAMETER | SYMBOL | MAXIMUM RATINGS | UNIT |
|---|---|---|---|
| Input Voltage | $V^+$ | 36 | V |
| Reference Output Current | $I_{OR}$ | 10 | mA |
| Output Sink Current | $I_{SINK}$ | 200 | mA |
| Differential Input Voltage | $V_{ID}$ | 2.5 | V |
| Common Mode Input Voltage | $V_{IC}$ | −0.3 to 2.5 | V |
| Power Dissipation | $P_D$ | (DIP 14) 700<br>(DMP 14) 300 | mW |
| Operating Temperature Range | $T_{OPR}$ | −40 to 85 | °C |
| Storage Temperature Range | $T_{STG}$ | −50 to 150 | °C |

■ELECTRICAL CHARACTERISTICS ($V^+$=6V, $R_T$=33kΩ, $C_T$=1000pF, Ta=25°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 | $L_{INE}$ | $V^+$=3.6V to 32V, $I_{OR}$=1mA | - | 6.8 | 20.7 | mV |
| Load Regulation | $L_{OAD}$ | $I_{OR}$=0.1mA to 5.0mA | - | 5 | 30 | mV |

OSCILLATOR BLOCK

| PARAMETER | SYMBOL | TEST CONDITION | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| Oscillation Frequency | $f_{OSC}$ | $R_T$=33kΩ, $C_T$=1000pF | 85 | 105 | 125 | kHz |
| Oscillate Fluctuations1 (Line Fluctuations) | $f_{dV}$ | $V^+$=3.6V to 32V | - | 1 | - | % |
| Oscillate Fluctuations2 (Temp Fluctuations) | $f_{dT}$ | Ta=−40°C to 85°C | - | 5 | - | % |

CURRENT SENSE AMPLIFIER BLOCK

| PARAMETER | SYMBOL | TEST CONDITION | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| Input Offset Voltage1 | $V_{IO}1$ | | - | 2 | 7 | mV |
| Input Offset Current1 | $I_{IO}1$ | | - | 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 Voltage Ratio1 | $V_{ICM}1$ | | - | 0 to $V_{REF}$−0.8 | - | V |
| Maximum Output Voltage1 (F.B Pin) | $V_{OM-}1$ | $R_{NF}$=100kΩ | - | - | 1 | V |
| Maximum Source Current1 (F.B Pin) | $I_{OM+}1$ | $V_{OM}$=0.5V | 40 | 85 | 200 | μA |

■ELECTRICAL CHARACTERISTICS ($V^+$=6V, $R_T$=33kΩ, $C_T$=1000pF, Ta=25°C)

ERROR AMPLIFIER BLOCK

| PARAMETER | SYMBOL | TEST CONDITION | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| Reference Voltage2 | $V_B2$ | | 0.51 | 0.52 | 0.53 | V |
| Input Bias Current2 | $I_B2$ | | - | 5 | 100 | nA |
| Open Loop Gain2 | $A_V2$ | | - | 90 | - | dB |
| Gain Bandwidth Product2 | $G_B2$ | | - | 0.6 | - | MHz |
| Maximum Output Voltage2 (F.B Pin) | $V_{OM-}2$ | $R_{NF}$=100kΩ | - | - | 1 | V |
| Maximum Source Current2 (F.B Pin) | $I_{OM+}2$ | $V_{OM}$=0.5V | 40 | 85 | 200 | μA |

PWM COMPARATE BLOCK

| PARAMETER | SYMBOL | TEST CONDITION | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| Input Threshold Voltage (F.B Pin) | $V_{TH0}$ | duty·cycle=0% (note) | - | 1.65 | 1.75 | V |
| Input Threshold Voltage (F.B Pin) | $V_{TH100}$ | duty·cycle=100% (note) | - | 2.10 | - | V |

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 (CS Pin) | $V_{THCS0}$ | duty·cycle=0% (note) | - | 0.25 | 0.35 | V |
| Input Threshold Voltage (CS Pin) | $V_{THCS50}$ | duty·cycle=100% (note) | - | 0.7 | - | 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 |
|---|---|---|---|---|---|---|
| L-Output Voltage (OUT Pin) | $V_{OL}$ | Output Sink Current=100mA | - | 0.25 | 0.65 | V |

GENERAL CHARACTERISTICS

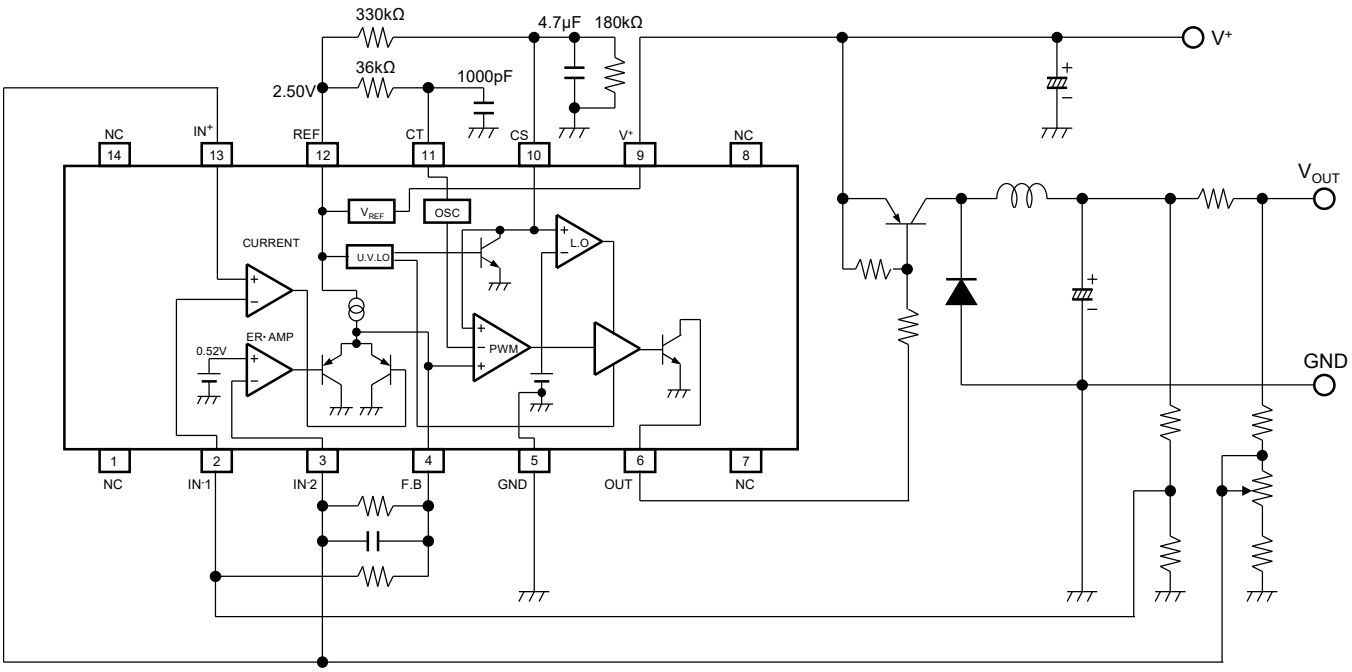
| PARAMETER | SYMBOL | TEST CONDITION | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| Latch Mode Threshold Voltage (CS Pin) | $V_{THLA}$ | | 1.2 | 1.5 | 1.8 | V |
| Quiescent Current | $I_{CCLA}$ | Latch Mode | - | 1.6 | 2.2 | mA |
| Average Quiescent Current | $I_{CCAV}$ | $R_L$= ∞ , duty·cycle=50% | - | 5.5 | 10 | mA |

(note) Duty·Cycle is defined as follows:

Duty·Cycle=0%: IC output transistor is OFF.

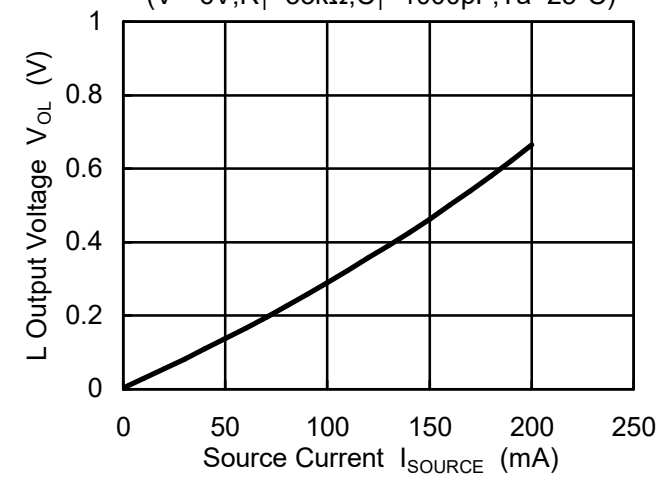
Duty·Cycle=100%: IC output transistor is ON.

■ TYPICAL APPLICATIONS

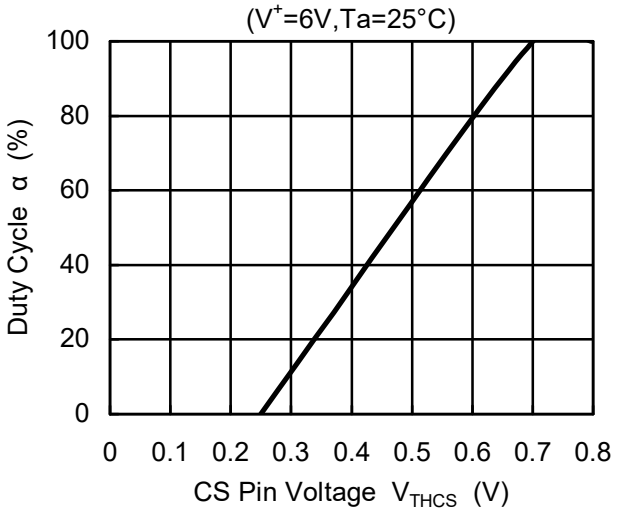


■TYPICAL CHARACTERISTICS

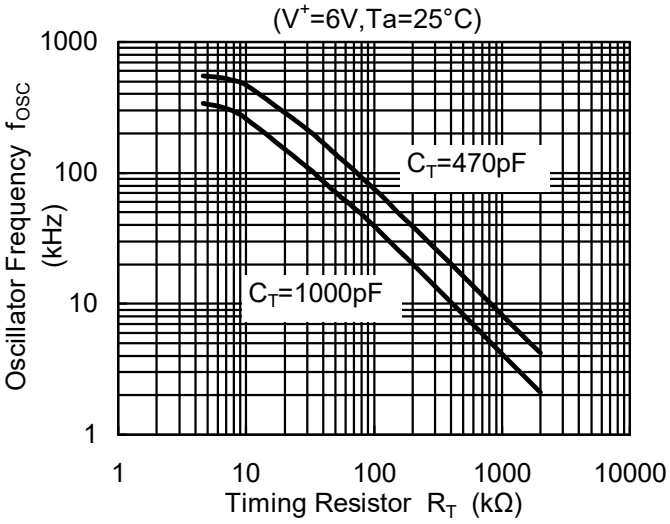
L Output Voltage vs. Source Current
($V^+$=6V,$R_T$=33kΩ,$C_T$=1000pF,Ta=25°C)



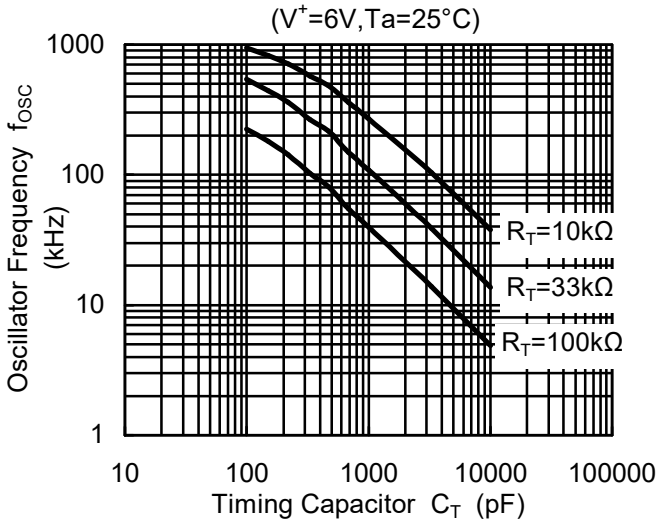

Duty Cycle vs. CS Pin Voltage
($V^+$=6V,Ta=25°C)



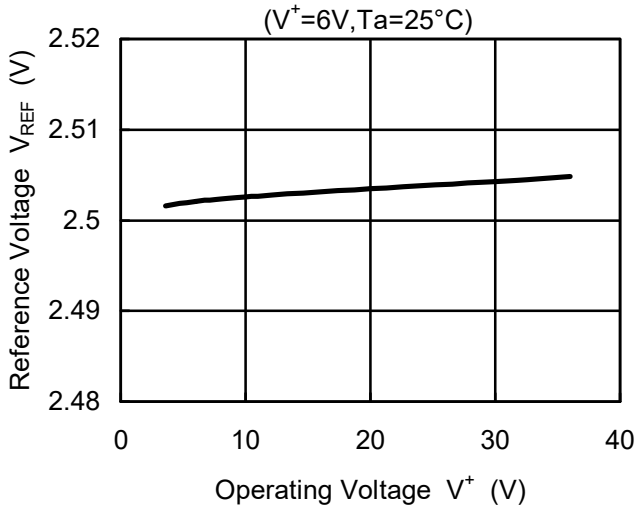

Oscillator Frequency vs. Timing Resistor
($V^+$=6V,Ta=25°C)



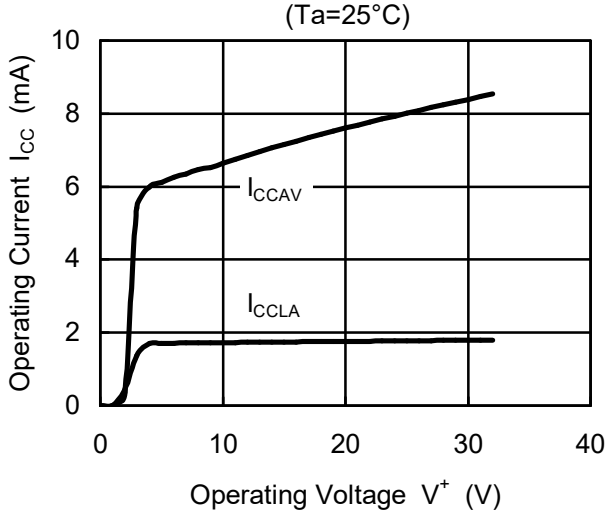

Oscillator Frequency vs. Timing Capacitor
($V^+$=6V,Ta=25°C)




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

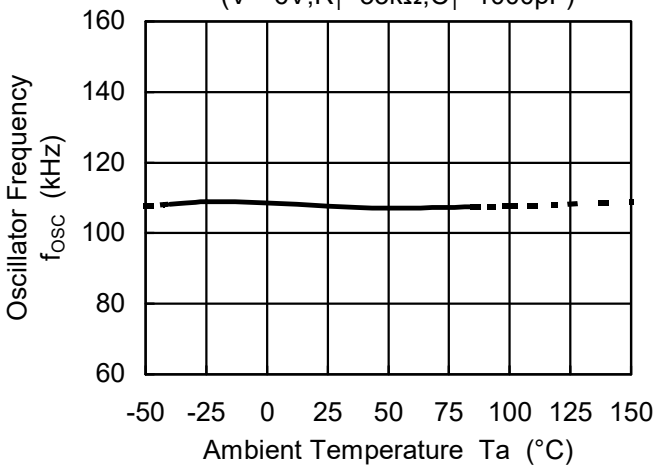



Operating Current vs. Operating Voltage
(Ta=25°C)

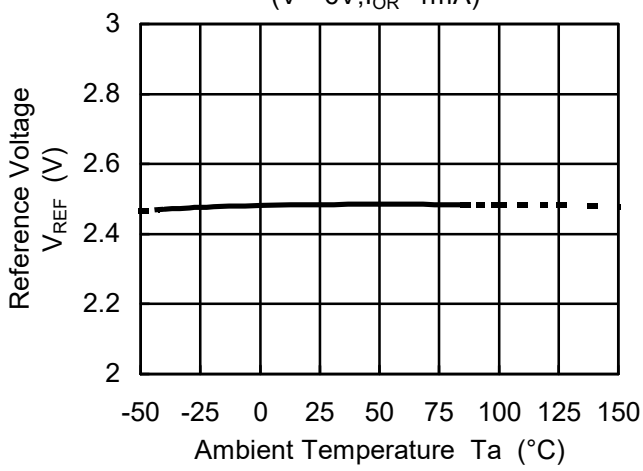


■TYPICAL CHARACTERISTICS

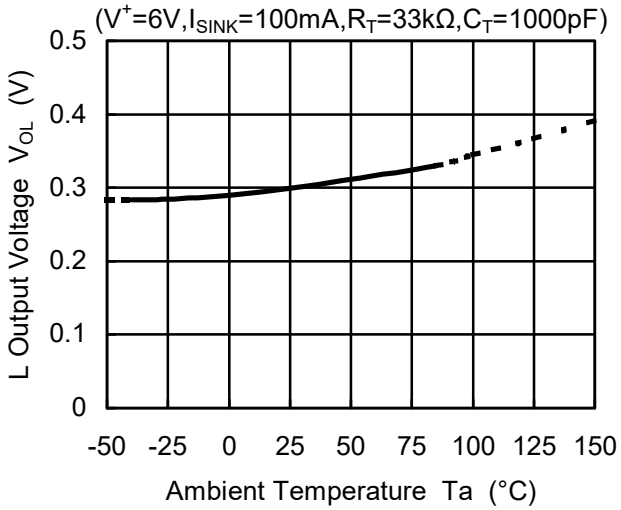
Oscillator Frequency vs. Temperature
($V^+$=6V,$R_T$=33kΩ,$C_T$=1000pF)



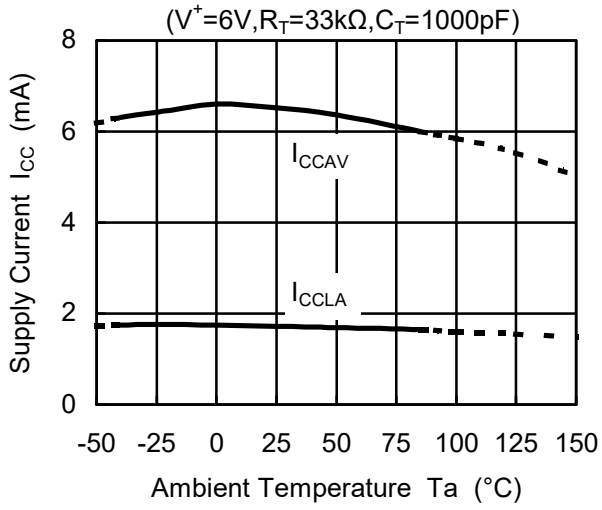

Reference Voltage vs. Temperature
($V^+$=6V,$I_{OR}$=1mA)




L Output Voltage vs. Temperature
($V^+$=6V,$I_{SINK}$=100mA,$R_T$=33kΩ,$C_T$=1000pF)




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



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