# SWITCHING REGULATOR CONTROL IC

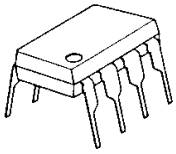
## ■GENERAL DESCRIPTION

The **NJM2377** is a high speed low voltage operation switching regulator control IC.

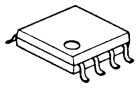
It features a totem pole driver circuit that can directly drive an external Bipolar transistor.

The **NJM2377** is suitable for potable applications, including TFT panel supply with fly-back configuration.

## ■PACKAGE OUTLINE



**NJM2377D**



**NJM2377M**

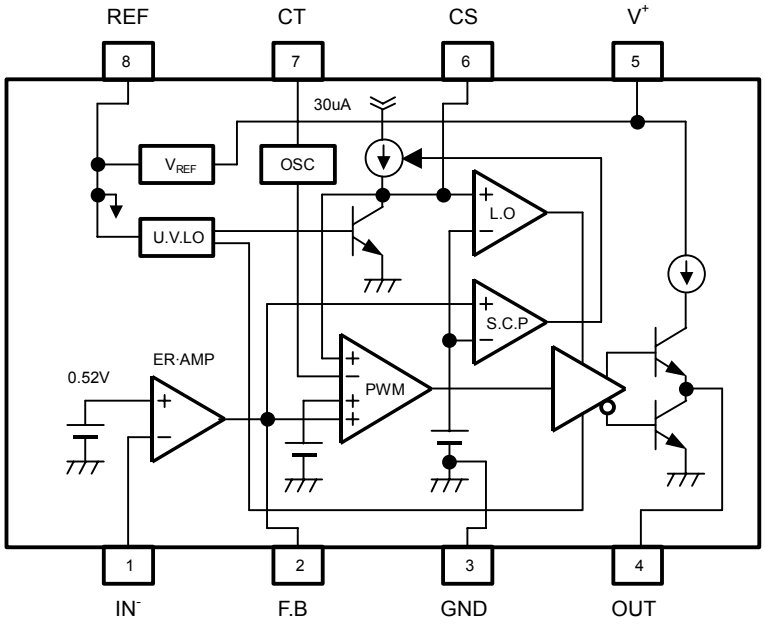
**NJM2377V**

**NJM2377R**

## ■FEATURES

- PWM switching control
- Operating Voltage (2.7 to 18V)
- Wide Oscillator Range (10 to 500 kHz)
- ON/OFF Maximum Duty Cycle (Ton:Toff = 9:1)
- Totem Pole Output
- Soft-Start Function
- UVLO (Under Voltage Lockout)
- Bipolar Technology
- Package Outline DIP8, DMP8, SSOP8, VSP8

## ■BLOCK DIAGRAM




PIN FUNCTION

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

■ABSOLUTE MAXIMUM RATINGS (Ta=25°C)

| PARAMETER | SYMBOL | MAXIMUM RATINGS | UNIT |
|---|---|---|---|
| Input Voltage | $V^+$ | 18 | V |
| Output Current | $I_O$ | ±50 | mA |
| Power Dissipation | $P_D$ | (DIP 8) 700<br>(DMP 8) 300<br>(SSOP 8) 250<br>(VSP 8) 320 | mW |
| Operating Temperature Range | $T_{OPR}$ | -40 ~ +85 | °C |
| Storage Temperature Range | $T_{STG}$ | -50 ~ +125 | °C |

■RECOMEND OPERATING CONDITIONS ($V^+$=3V, Ta=25°C)

| PARAMETER | SYMBOL | MIN. | MAX. | UNIT |
|---|---|---|---|---|
| Operating Voltage | $V^+$ | 2.7 | 18 | V |
| Feed Back Resistor | $R_{NF}$ | 100 | – | kΩ |
| Oscillator Timing Capacitor | $C_T$ | 220 | 22,000 | pF |
| Oscillator Timing Resistor | $R_T$ | 5 | 100 | kΩ |
| Oscillation Frequency | $f_{OSC}$ | 10 | 500 | kHz |

■ELECTRICAL CHARACTERISTICS ($V^+$=3V,$R_T$=39kΩ,$C_T$=470pF,Ta=25°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 ~ 18V, $I_{OR}$=1mA | – | 3.8 | 11.5 | mV |
| Load Regulation | $\Delta V_O$-$I_O$ | $I_{OR}$=0.1 ~ 5.0mA | – | 5 | 30 | mV |

OSCILLATOR BLOCK

| PARAMETER | SYMBOL | TEST CONDITION | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| Oscillation Frequency | $f_{OSC}$ | $R_T$=39kΩ, $C_T$=470pF | 80 | 100 | 120 | kHz |
| Oscillate Fluctuations1 (Line Fluctuations) | $f_{dV}$ | $V^+$=2.7 ~ 18V | – | 1 | – | % |
| Oscillate Fluctuations2 (Temp Fluctuations) | $f_{dT}$ | Ta=-40°C ~ +85°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 Bandwidth Product | $G_B$ | | – | 1.0 | – | MHz |
| Maximum Output Voltage (F.B Pin) | $V_{OM+}$ | $R_{NF}$=100kΩ, $IN^-$ Pin=0V | 1.9 | 2.2 | 2.4 | V |
| | $V_{OM-}$ | $R_{NF}$=100kΩ, $IN^-$ Pin=0V | – | – | 200 | mV |
| Output Source Current (F.B Pin) | $I_{OM+}$ | $V_{OM}$=1V, $IN^-$ Pin=0V | 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% | – | 0.45 | 0.65 | V |
| Input Threshold Voltage (F.B Pin) | $V_{TH80}$ | duty·cycle=80% | – | 1.05 | – | V |
| Maximum Duty Cycle | αM | F.B Pin=1.2V<br>$R_T$=39kΩ, $C_T$=470pF | 80 | 90 | – | % |

SOFT START CIRCUIT BLOCK

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

■ELECTRICAL CHARACTERISTICS ($V^+$=3V,$R_T$=39kΩ,$C_T$=470pF,Ta=25°C)

SHORT CIRCUIT PROTECTION

| PARAMETER | SYMBOL | TEST CONDITION | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| Input Threshold Voltage (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 | μA |
| Latch Mode Threshold 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 |

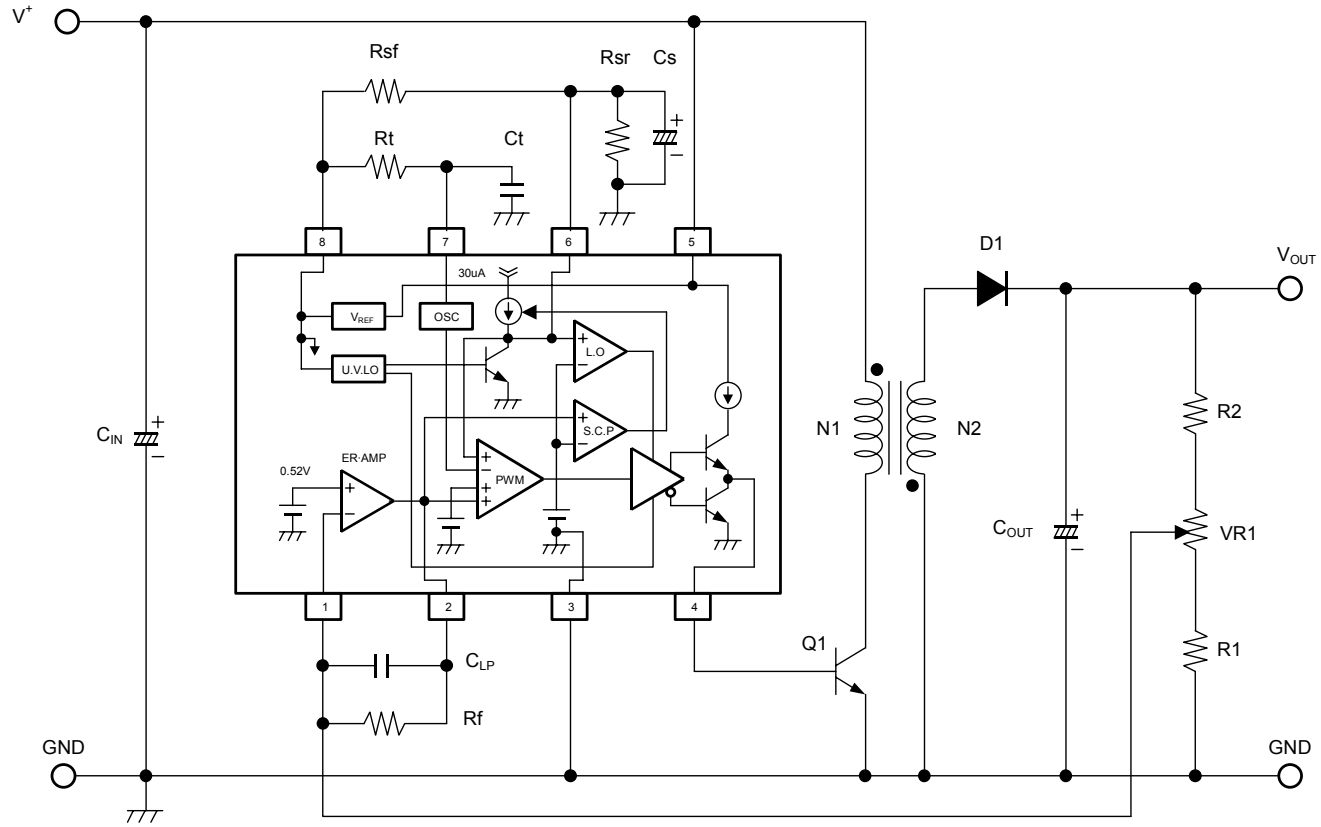
OUTPUT BLOCK

| PARAMETER | SYMBOL | TEST CONDITION | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| H-Output Voltage (OUT Pin) | $V_{OH}$ | $R_L$=10kΩ | 1.7 | 2.0 | – | 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 | 23 | 35 | – | mA |

GENERAL CHARACTERISTICS

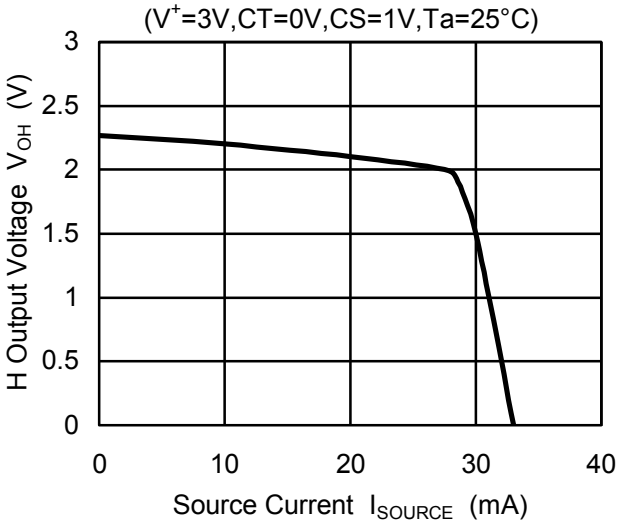
| PARAMETER | SYMBOL | TEST CONDITION | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| Quiescent Current | $I_{CCLA}$ | Latch Mode, CS Pin=1.8V | – | 1.7 | 2.4 | mA |
| Average Quiescent Current | $I_{CCAV}$ | $R_L$= ∞ , duty·cycle=50% | – | 5.0 | 6.8 | mA |

■ TYPICAL APPLICATIONS

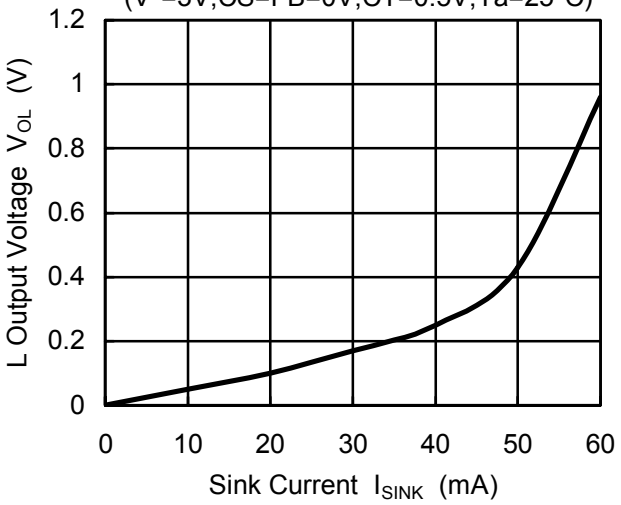


■TIPICAL CHARACTERISTICS

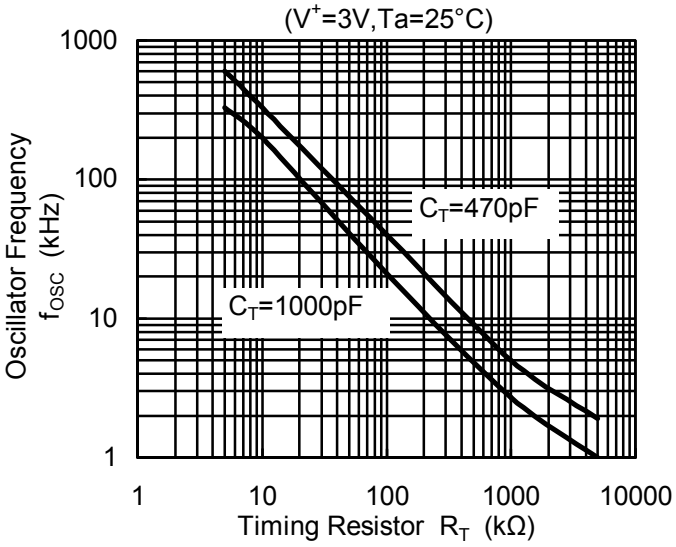
H Output Voltage(OUT Pin) vs. Source Current
($V^+$=3V,CT=0V,CS=1V,Ta=25°C)



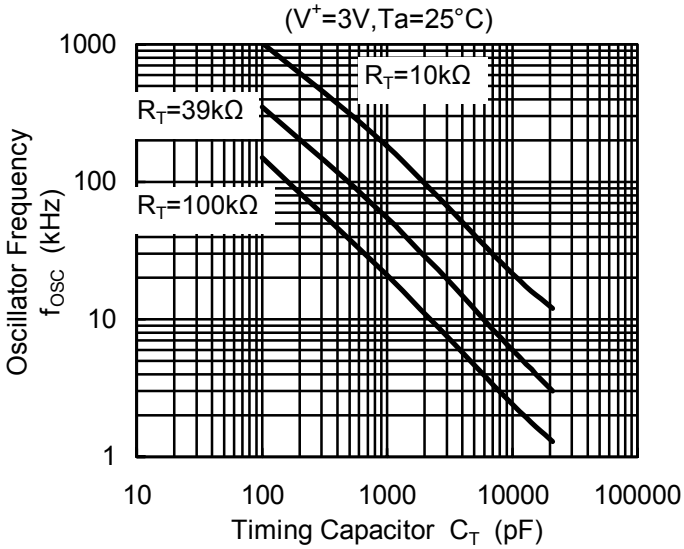

L Output Voltage(OUT Pin) vs. Sink Current
($V^+$=3V,CS=FB=0V,CT=0.5V,Ta=25°C)



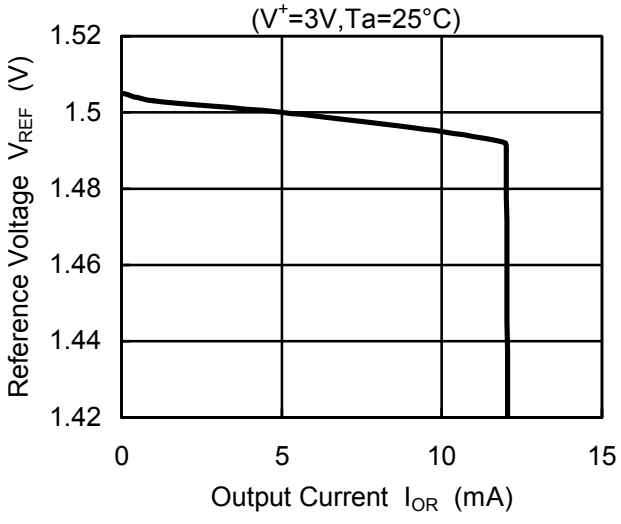

Oscillator Frequency vs. Timing Resistor
($V^+$=3V,Ta=25°C)



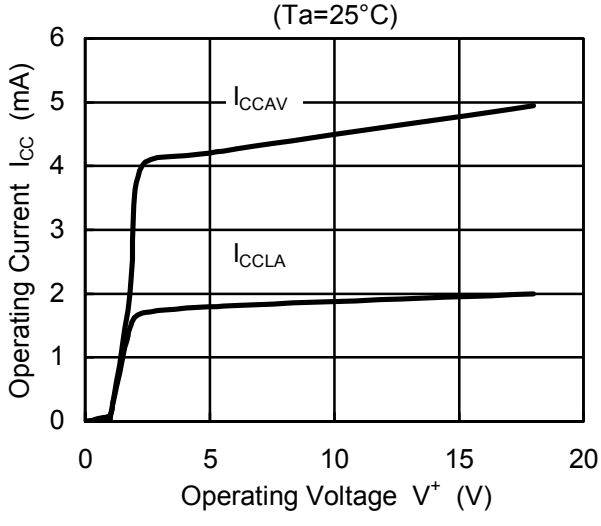

Oscillator Frequency vs. Timing Capacitor
($V^+$=3V,Ta=25°C)




Reference Voltage vs. Output Current
($V^+$=3V,Ta=25°C)

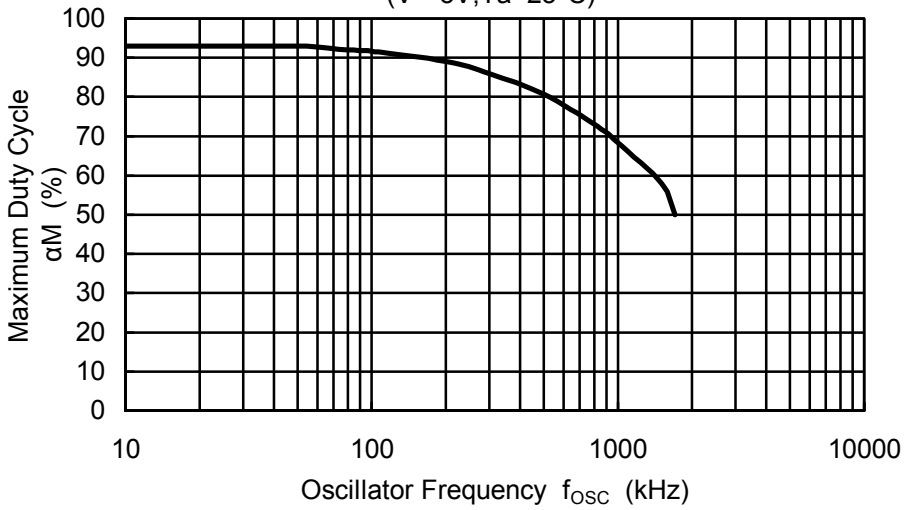



Operating Current vs. Operating Voltage
(Ta=25°C)

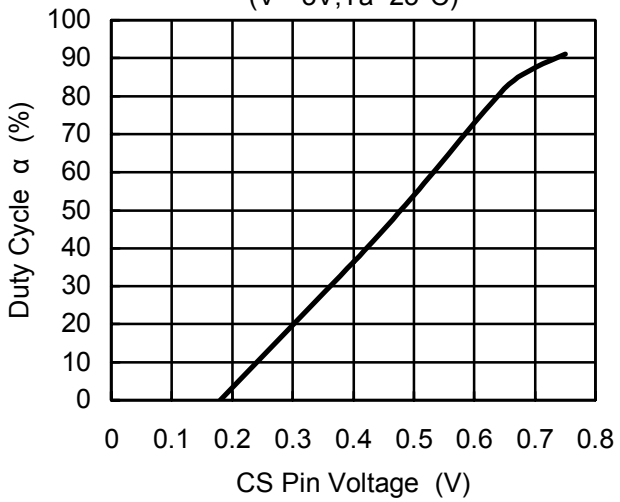


■TIPICAL CHARACTERISTICS

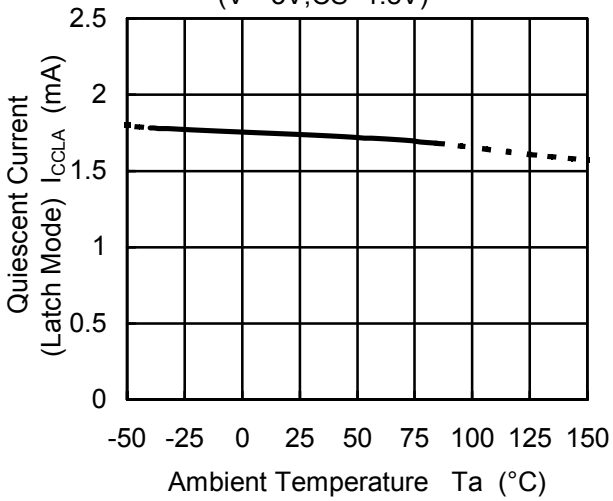
Maximum Duty Cycle vs. Oscillator Frequency
($V^+$=3V,Ta=25°C)



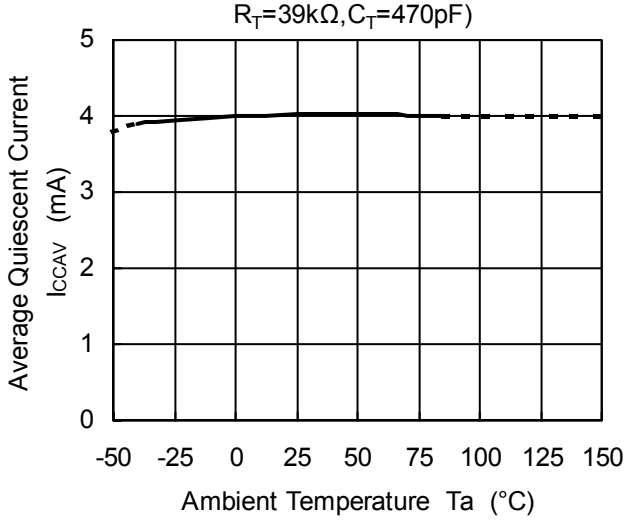

Duty Cycle vs. CS Pin Voltage
($V^+$=3V,Ta=25°C)




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

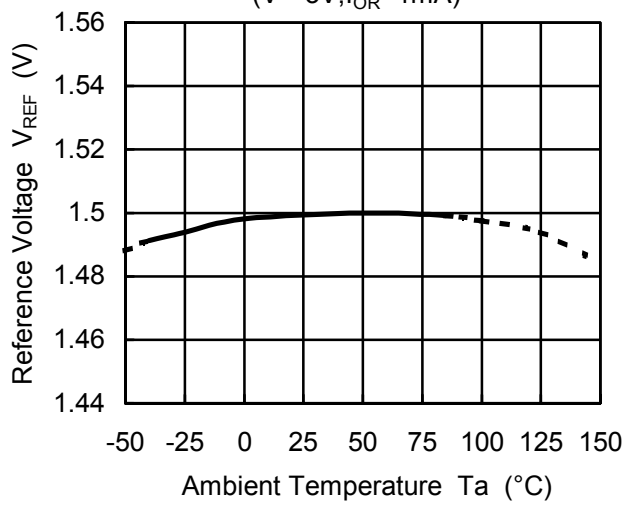



Average Quiescent Current vs. Temperature
($V^+$=3V,$R_L$= ∞ ,duty·cycle=50%
$R_T$=39kΩ,$C_T$=470pF)

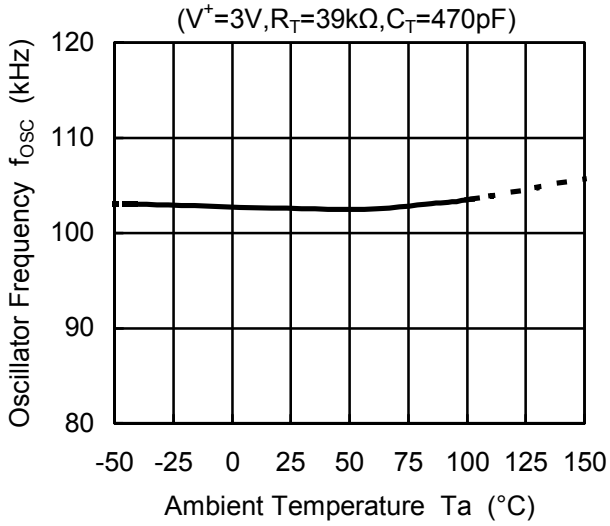


■TIPICAL CHARACTERISTICS

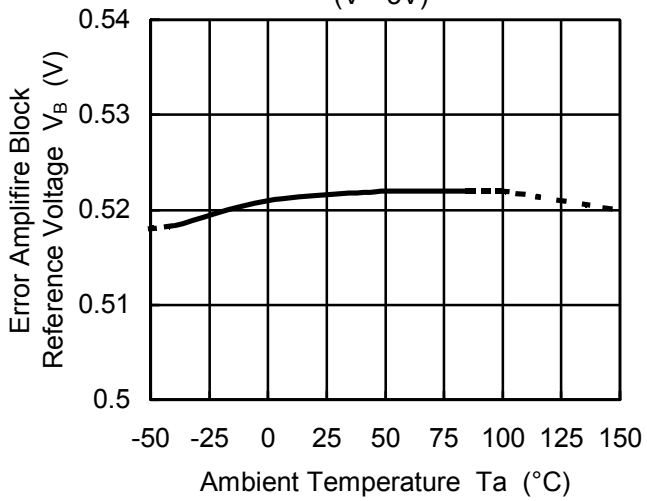
Reference Voltage Block
Reference Voltage vs. Temperature
($V^+$=3V,$I_{OR}$=1mA)



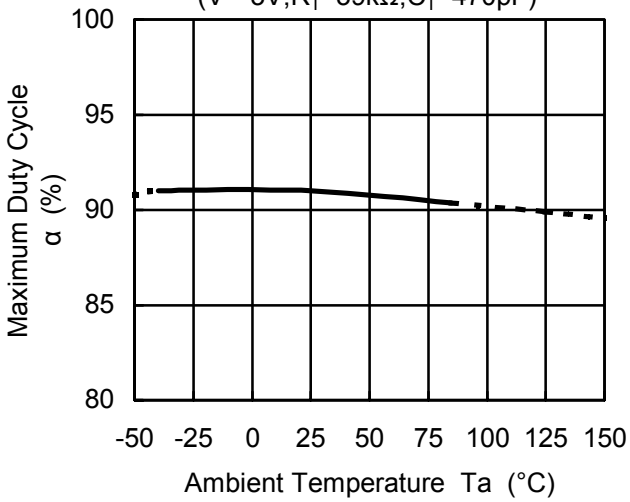

Oscillator Frequency vs. Temperature
($V^+$=3V,$R_T$=39kΩ,$C_T$=470pF)



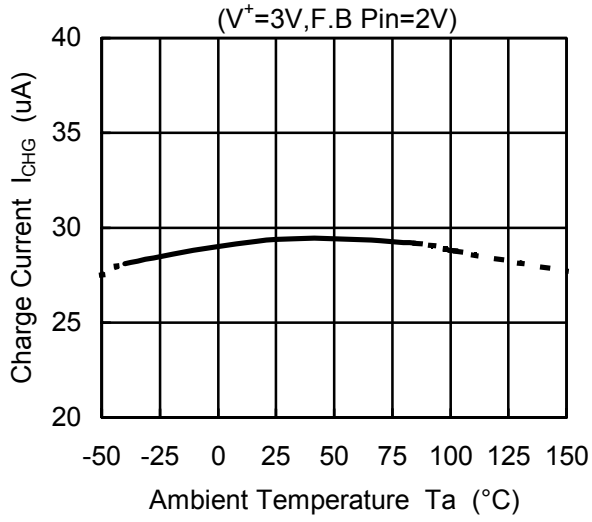

Error Amplifire Block
Reference Voltage vs. Temperaure
($V^+$=3V)



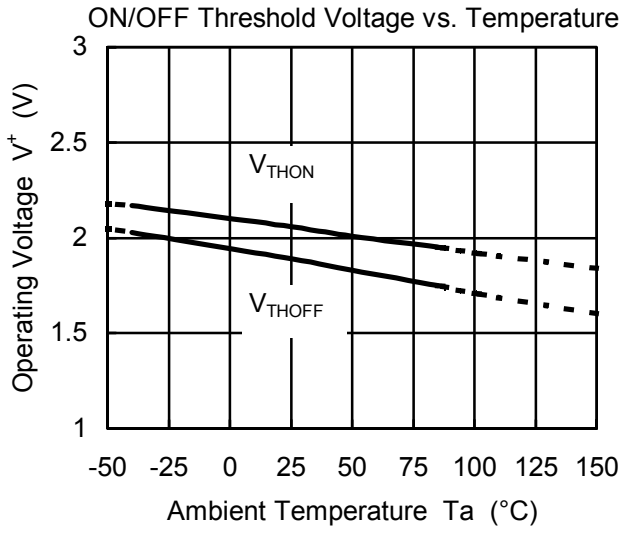

Maximum Duty Cycle vs. Temperature
($V^+$=3V,$R_T$=39kΩ,$C_T$=470pF)




Charge Current (CS Pin) vs. Temperature
($V^+$=3V,F.B Pin=2V)

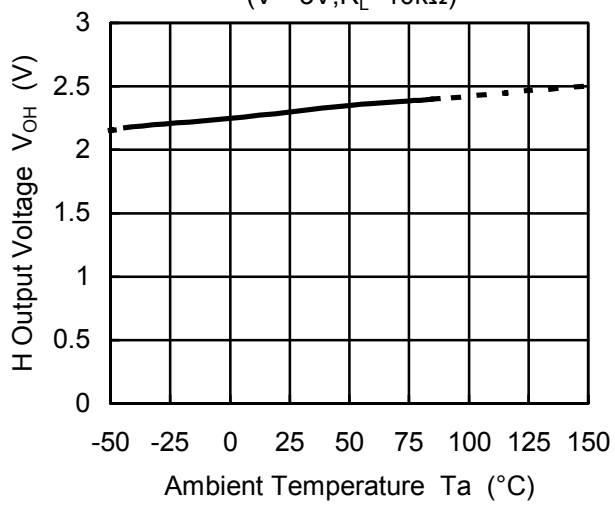



Under Voltage Lockout Block
ON/OFF Threshold Voltage vs. Temperature

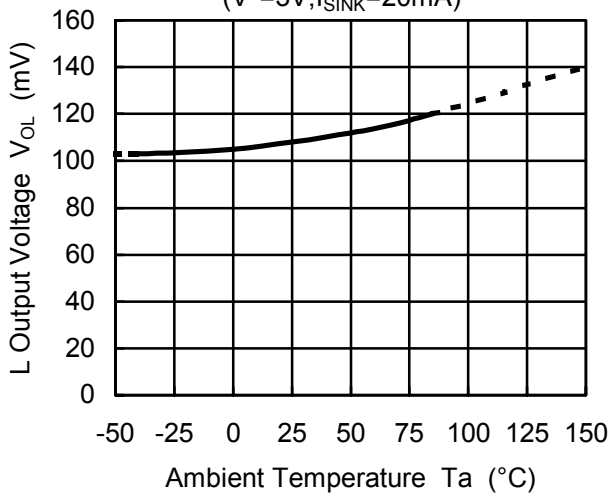


■TIPICAL CHARACTERISTICS

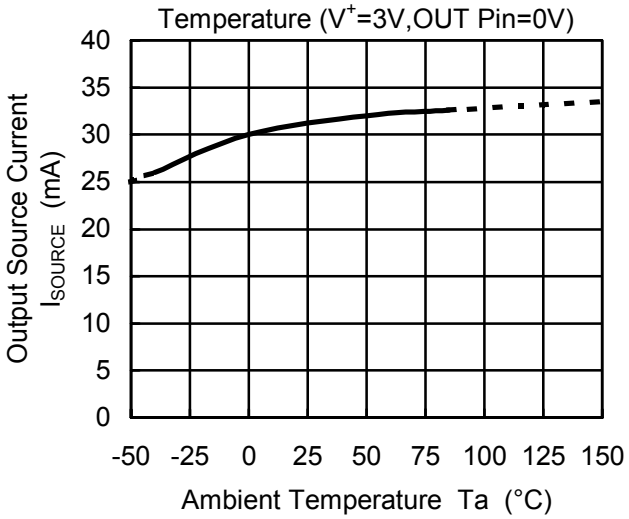
H Output Voltage (OUT Pin) vs. Temperature
($V^+$=3V,$R_L$=10kΩ)




L Output Voltage (OUT Pin) vs. Temperature
($V^+$=3V,$I_{SINK}$=20mA)




Output Source Current (OUT Pin) vs.
Temperature ($V^+$=3V,OUT Pin=0V)



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