

## SWITCHING REGULATOR CONTROL IC FOR FLYBACK

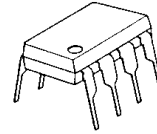
### ■GENERAL DESCRIPTION

The **NJM2368** 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 Bipolar Transistor directly.  
 It is suitable for applications of flyback type switching regulation of up to 10W.

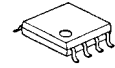
### ■FEATURES

- Operating Voltage (3.6V ~ 32V)
- Wide Oscillator Range (5kHz ~ 350 kHz)
- Soft-Start function.
- Under Voltage Lockouts (U.V.L.O.)
- Bipolar Technology
- Package Outline  
 DIP8, DMP8, SOP8 JEDEC 150mil, SSOP8

### ■PACKAGE OUTLINE



**NJM2368D**  
(DIP8)



**NJM2368M**  
(DMP8)

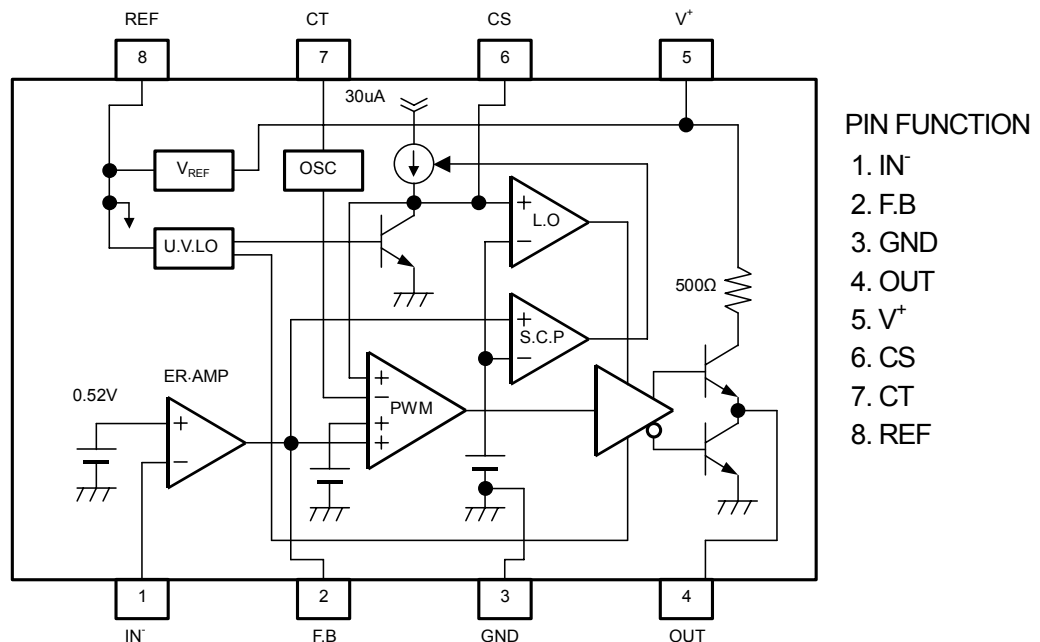


**NJM2368E**  
(SOP8)



**NJM2368V**  
(SSOP8)

### ■BLOCK DIAGRAM



# NJM2368

## ■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
Power Dissipation	$P_D$	(DIP 8) 700 (DMP 8) 300 (SOP 8) 300 (SSOP 8) 250	mW
Operating Temperature Range	$T_{OPR}$	-40 ~ +85	°C
Storage Temperature Range	$T_{STG}$	-50 ~ 125	°C

## ■RECOMMENDED OPERATING CONDITIONS ( $V^+=6V$ , Ta=25°C)

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	22,000	pF
Oscillator Timing Resistor	$R_T$		22	100	kΩ
Oscillate	$f_{OSC}$		5	350	kHz

## ■ELECTRICAL CHARACTERISTICS ( $V^+=6V$ , $R_T=33k\Omega$ , $C_T=1,000pF$ , Ta=25°C)

### 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	$L_{LINE}$	$V^+=3.6V \sim 32V$ , $I_{OR}=1mA$	–	6.8	20.7	mV
Load Regulation	$L_{LOAD}$	$I_{OR}=0.1mA \sim 5.0mA$	–	5	30	mV

### OSCILLATOR BLOCK

PARAMETER	SYMBOL	RATINGS	MIN.	TYP.	MAX.	UNIT
Oscillate	$f_{osc}$	$C_T=1,000pF$ , $R_T=33k\Omega$	85	105	125	kHz
Oscillate Fluctuations1 (Line Fluctuations)	$f_{dv}$	$V^+=3.6V \sim 32V$	–	1	–	%
Oscillate Fluctuations2 (Temp Fluctuations)	$f_{dt}$	Ta=-40°C ~ +85°C	–	5	–	%

### 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 (F.B Pin)	$V_{OM+}$	$R_{NF}=100k\Omega$	$V_{REF}-0.2$	–	–	V
	$V_{OM-}$	$R_{NF}=100k\Omega$	–	–	200	mV
Output Source Current (F.B Pin)	$I_{OM+}$	$V_{OM}=1V$	40	85	200	uA

■ELECTRICAL CHARACTERISTICS ( $V^+=6V$ ,  $R_T=33k\Omega$ ,  $C_T=1,000pF$ ,  $T_a=25^\circ C$ )

### PWM COMPARATE BLOCK

PARAMETER	SYMBOL	RATINGS	MIN.	TYP.	MAX.	UNIT
Input Threshold Voltage (F.B Pin)	$V_{TH0}$	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	$\alpha M$	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	$\mu A$
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

### OUTPUT

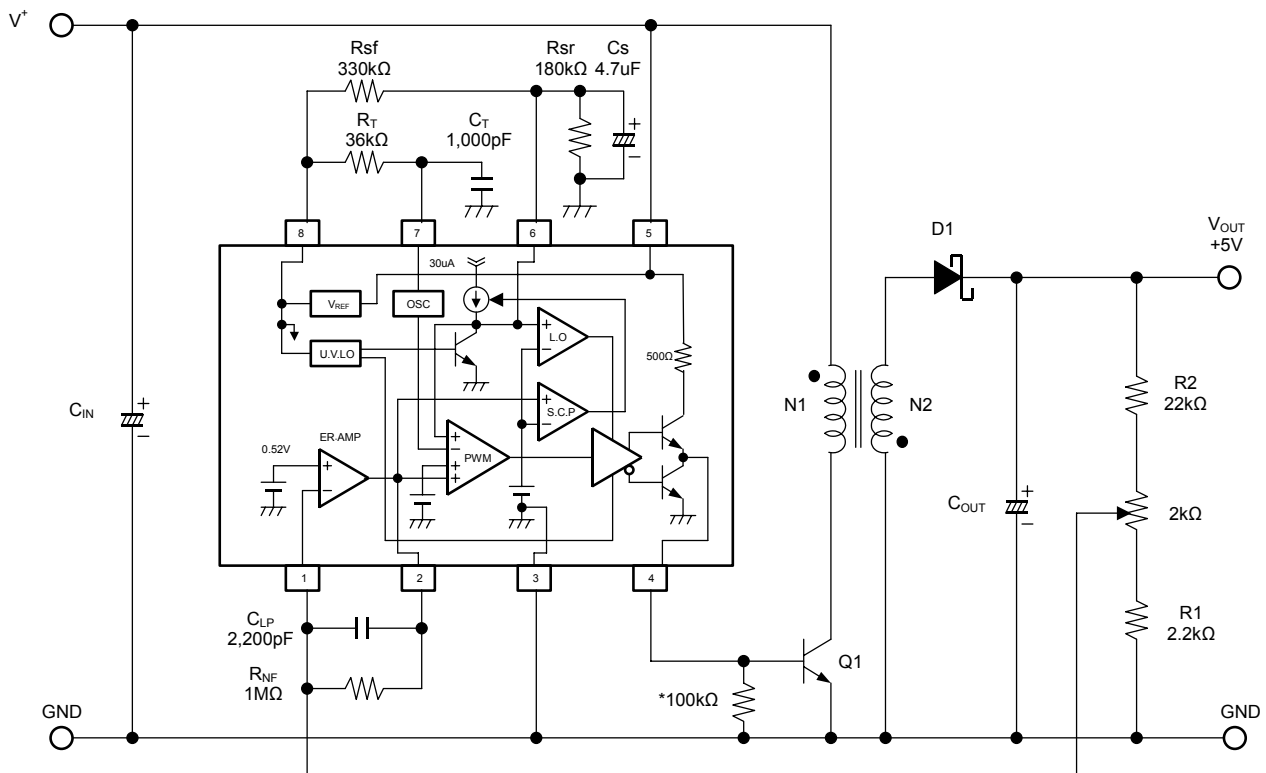
PARAMETER	SYMBOL	RATINGS	MIN.	TYP.	MAX.	UNIT
H-Output Voltage (OUT Pin)	$V_{OH}$	$R_L=10k\Omega$	3.50	4.00	–	V
L-Output Voltage (OUT Pin)	$V_{OL}$	Output Sink Current =20mA	–	0.25	0.65	V
Output Source Current (OUT Pin)	$I_{SOURCE}$	OUT Pin=0V	8	11	–	mA

### GENERAL CHARACTERISTIC

PARAMETER	SYMBOL	RATINGS	MIN.	TYP.	MAX.	UNIT
Quiescent Current	$I_{CCLA}$	Latch Mode	–	1.6	2.2	mA
Average Quiescent Current	$I_{CCAV}$	$R_L=\infty$ , duty cycle=50%	–	3.5	4.8	mA

# NJM2368

## ■ TYPICAL APPLICATIONS

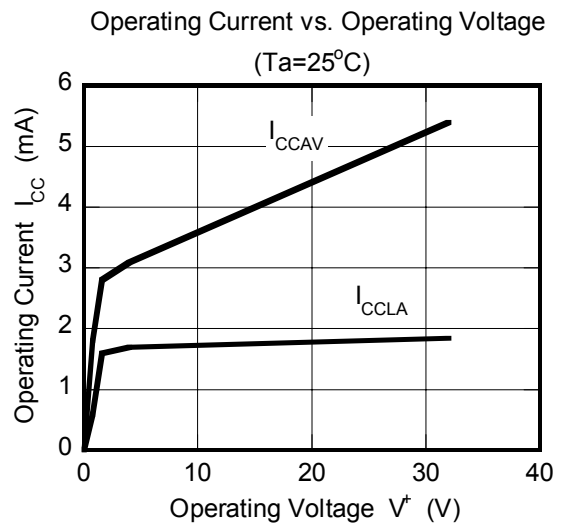
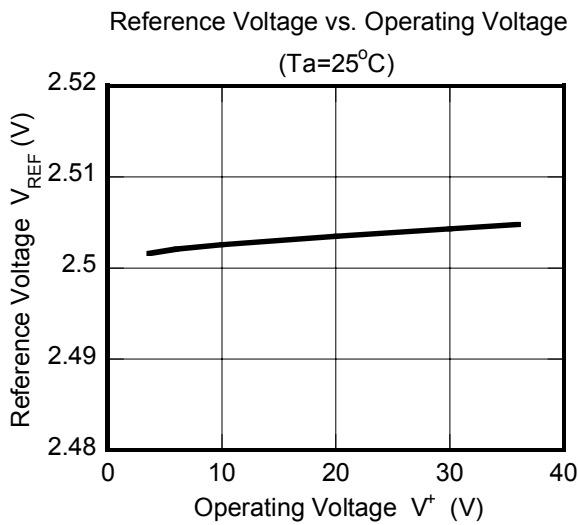
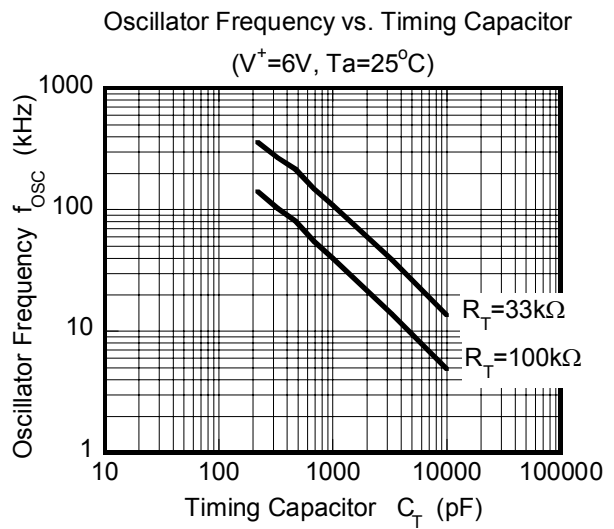
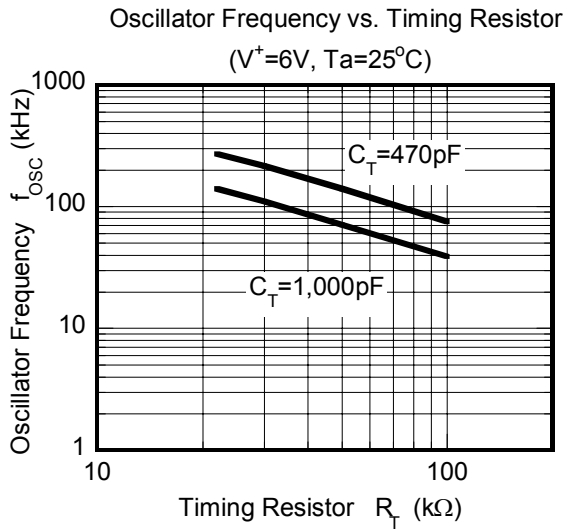
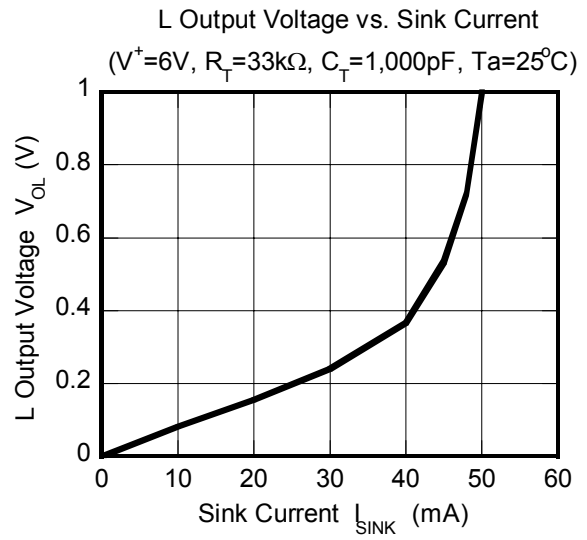
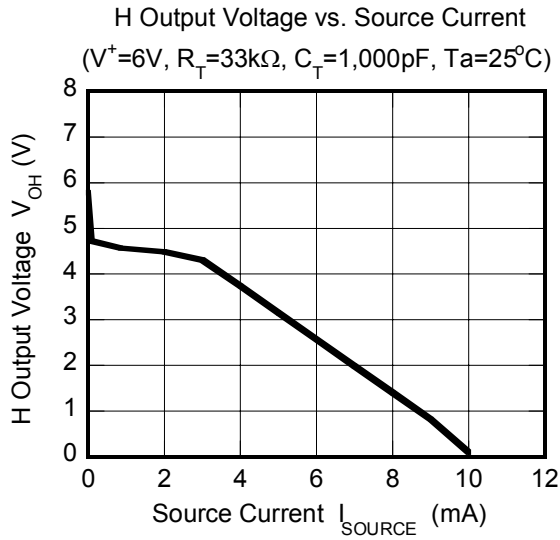


When Short Circuit Protection (SCP) is activated, Output terminal (Pin 4) becomes high impedance and the external switching transistor (Q1) is turned off.

However, small leak current from Output terminal at high ambient temperature may turn on the external switching transistor causing malfunction of the SCP particularly when FET is used as a switching device.

To avoid this issue, insert a 100kΩ resistor between the Gate and the Source of the external transistor.

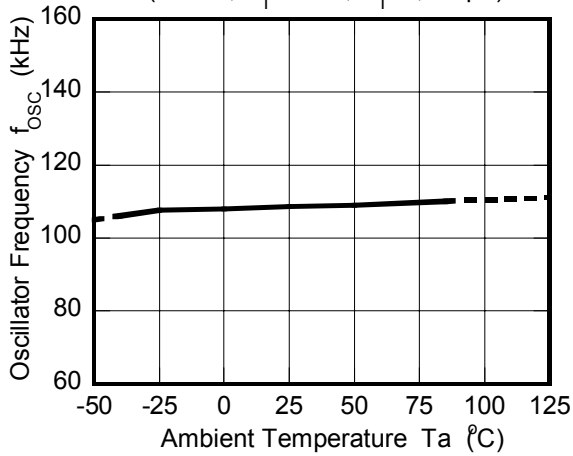
## ■ TYPICAL CHARACTERISTICS



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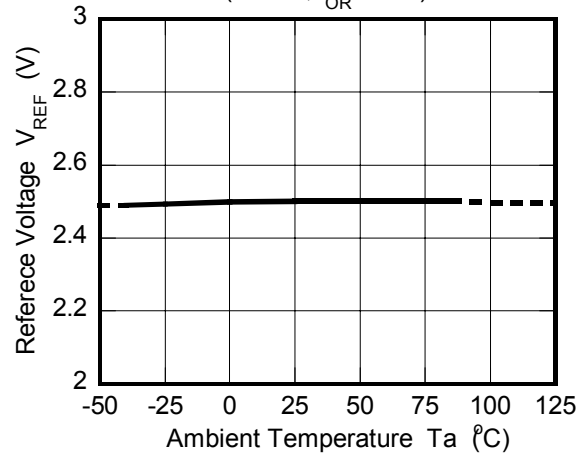
Oscillator Frequency vs. Temperature

( $V^+=6V$ ,  $R_T=33k\Omega$ ,  $C_T=1,000pF$ )



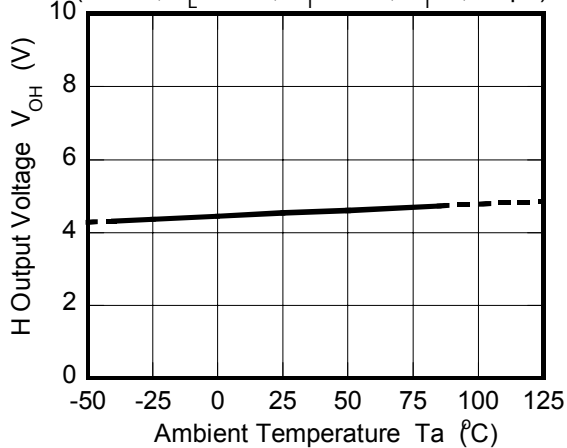
Reference Voltage vs. Temperature

( $V^+=6V$ ,  $I_{OR}=1mA$ )



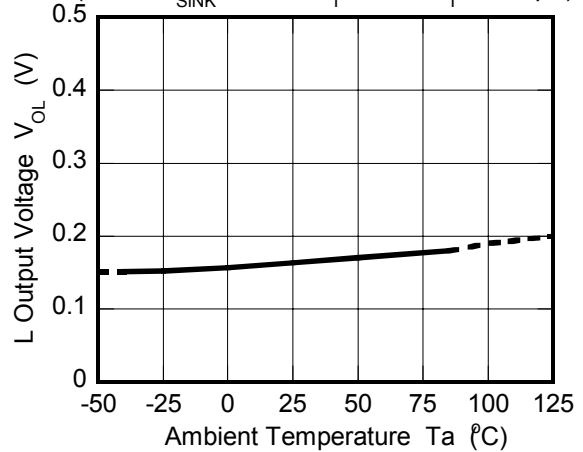
H Output Voltage vs. Temperature

( $V^+=6V$ ,  $R_L=10k\Omega$ ,  $R_T=33k\Omega$ ,  $C_T=1,000pF$ )



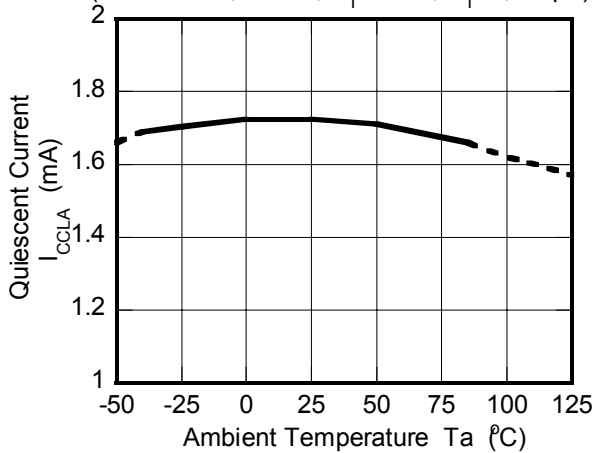
L Output Voltage vs. Temperature

( $V^+=6V$ ,  $I_{SINK}=20mA$ ,  $R_T=33k\Omega$ ,  $C_T=1,000pF$ )



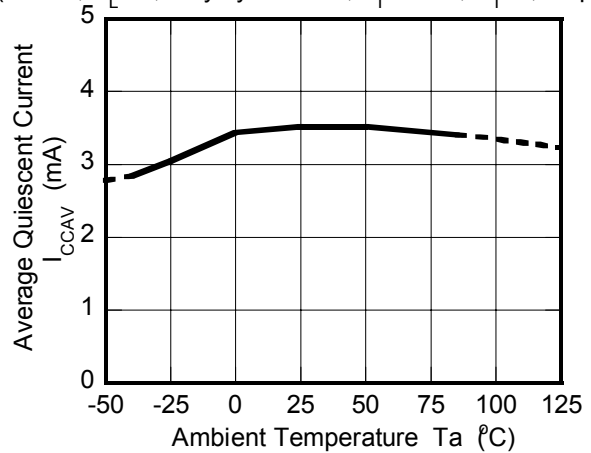
Quiescent Current vs. Temperature

(Latch Mode,  $V^+=6V$ ,  $R_T=33k\Omega$ ,  $C_T=1,000pF$ )

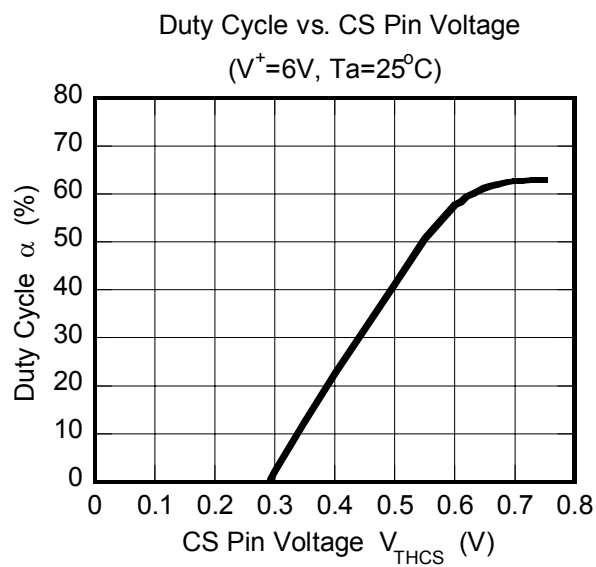
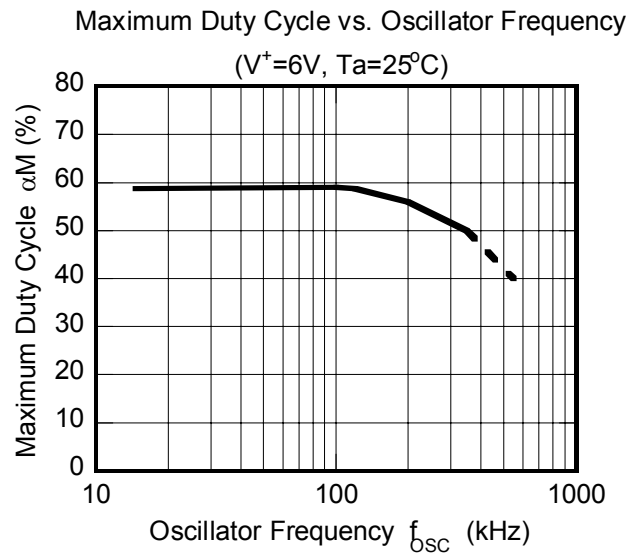


Average Quiescent Current vs. Temperature

( $V^+=6V$ ,  $R_L=$  , duty cycle=50%,  $R_T=33k\Omega$ ,  $C_T=1,000pF$ )



## ■ TYPICAL CHARACTERISTICS



**[CAUTION]**

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