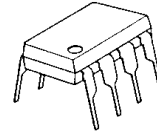


SWITCHING REGULATOR CONTROL IC FOR FLYBACK

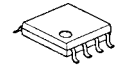
■GENERAL DESCRIPTION

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.

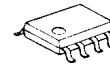
■PACKAGE OUTLINE



NJM2368D



NJM2368M



NJM2368E

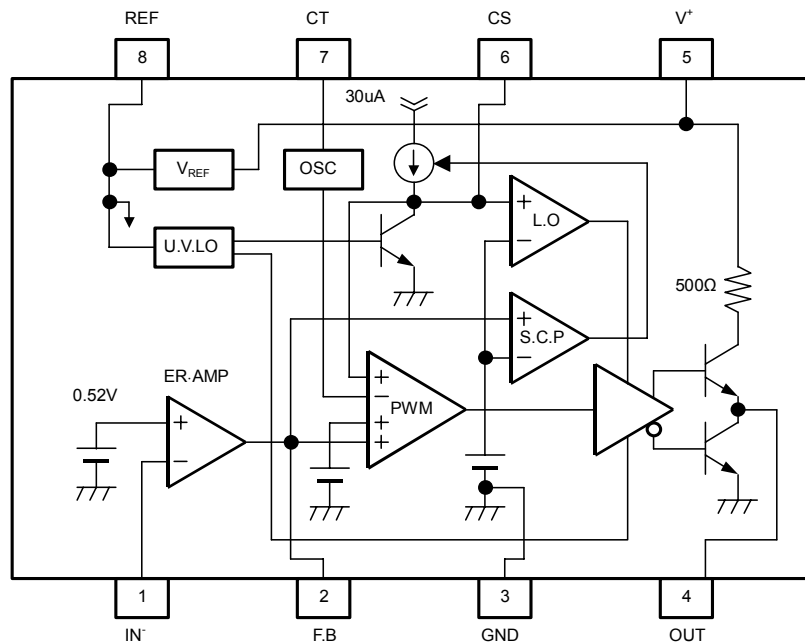


NJM2368V

■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, EMP8, SSOP8

■BLOCK DIAGRAM



PIN FUNCTION

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

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 (EMP 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		10	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	αM	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	μA
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

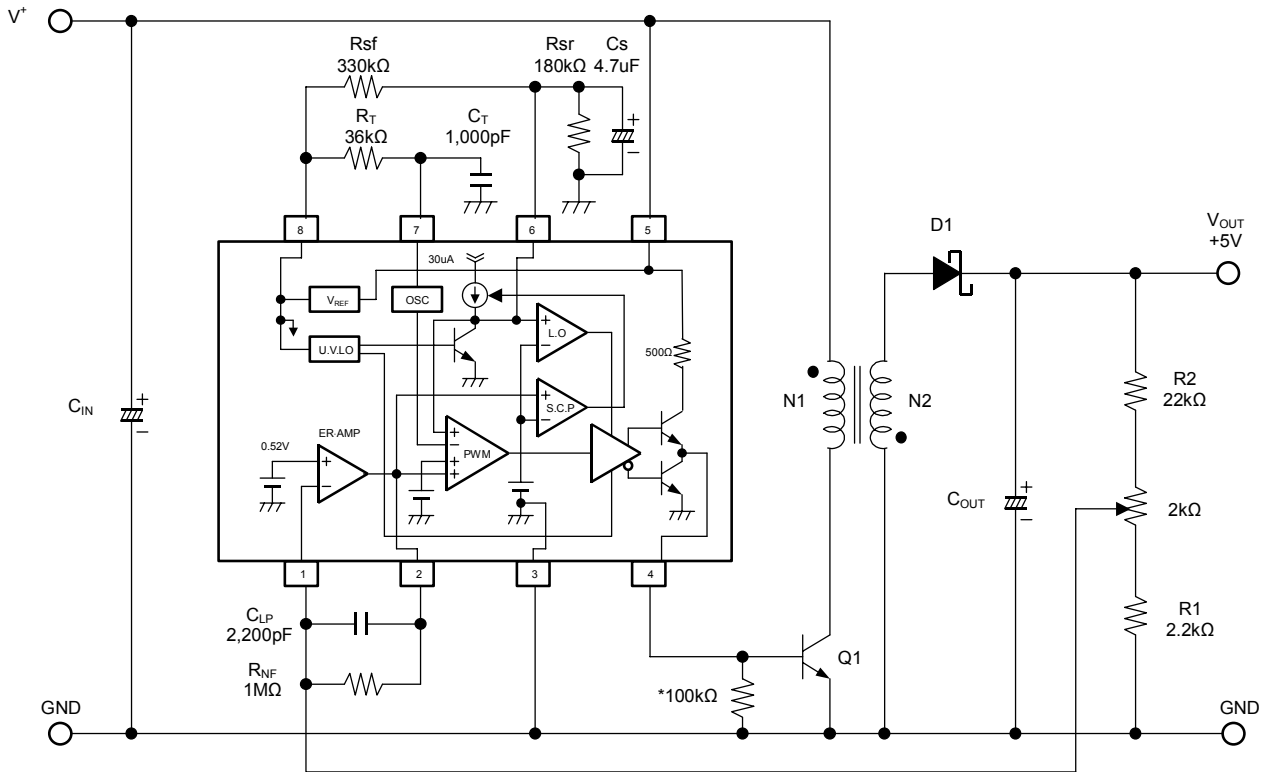
PARAMETER	SYMBOL	RATINGS	MIN.	TYP.	MAX.	UNIT
H-Output Voltage (OUT Pin)	V_{OH}	$R_L=10k\Omega$	3.50	4.00	–	V
L-Output Voltage (OUT Pin)	V_{OL}	Output Sink Current =20mA	–	0.25	0.65	V
Output Source Current (OUT Pin)	I_{SOURCE}	OUT Pin=0V	8	11	–	mA

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



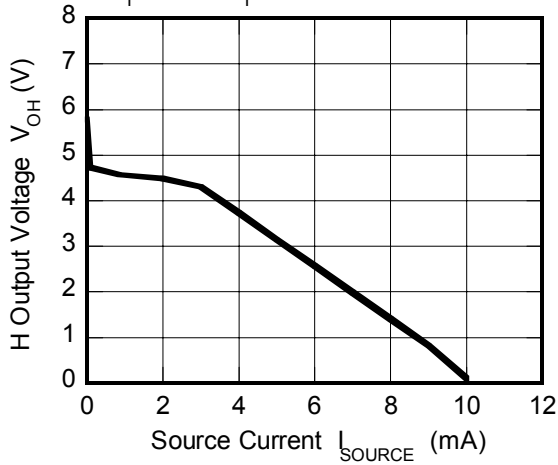
When Short Circuit Protection (SCP) is activated, Output terminal (Pin 4) becomes high impedance and the external switching transistor (Q1) is turned off.

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.

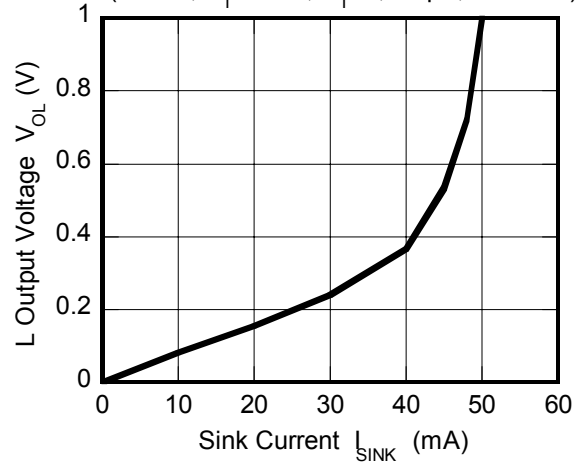
To avoid this issue, insert a 100kΩ resistor between the Gate and the Source of the external transistor.

■ TYPICAL CHARACTERISTICS

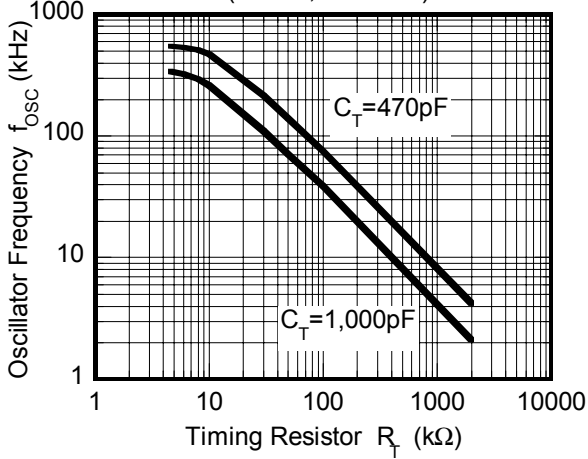
H Output Voltage vs. Source Current
 ($V^+=6V$, $R_T=33k\Omega$, $C_T=1,000pF$, OUT Pin=0V, $T_a=25^\circ C$)



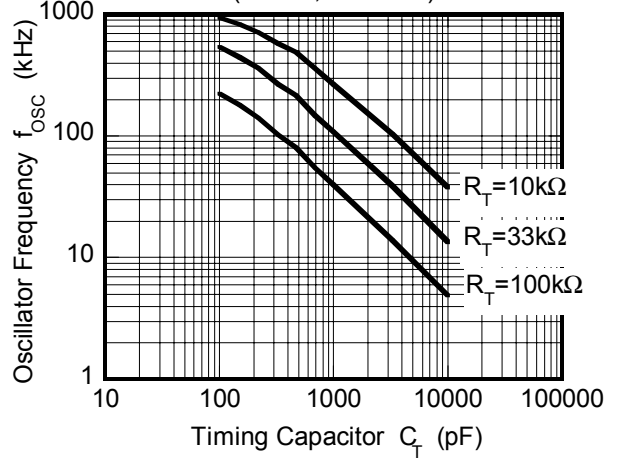
L Output Voltage vs. Sink Current
 ($V^+=6V$, $R_T=33k\Omega$, $C_T=1,000pF$, $T_a=25^\circ C$)



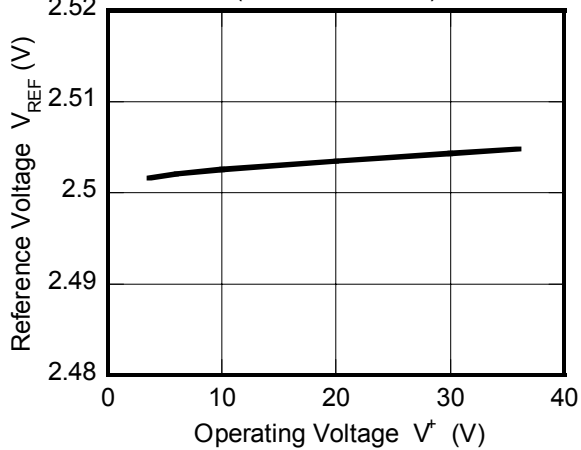
Oscillator Frequency vs. Timing Resistor
 ($V^+=6V$, $T_a=25^\circ C$)



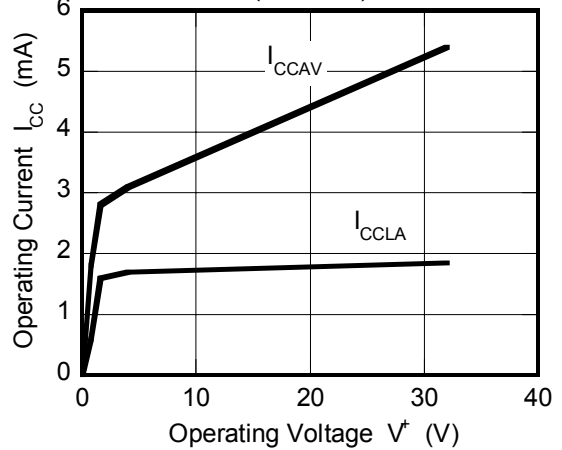
Oscillator Frequency vs. Timing Capacitor
 ($V^+=6V$, $T_a=25^\circ C$)



Reference Voltage vs. Operating Voltage
 ($V^+=6V$, $T_a=25^\circ C$)

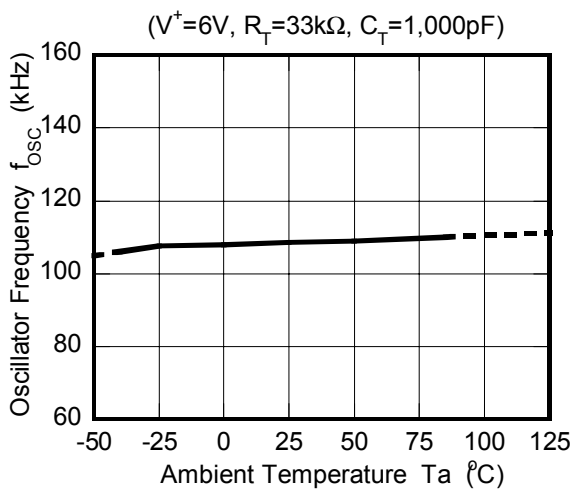


Operating Current vs. Operating Voltage
 ($T_a=25^\circ C$)

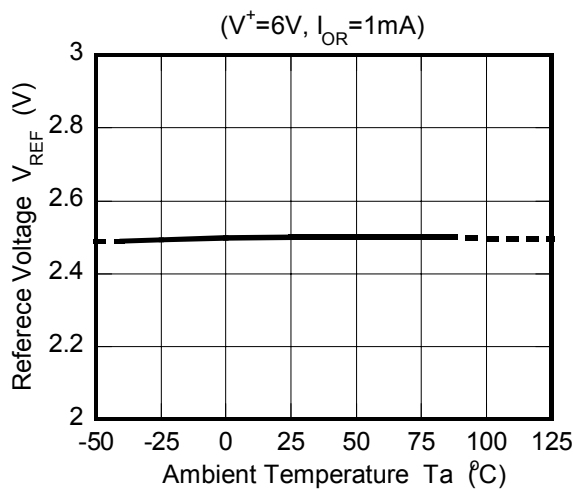


■ TYPICAL CHARACTERISTICS

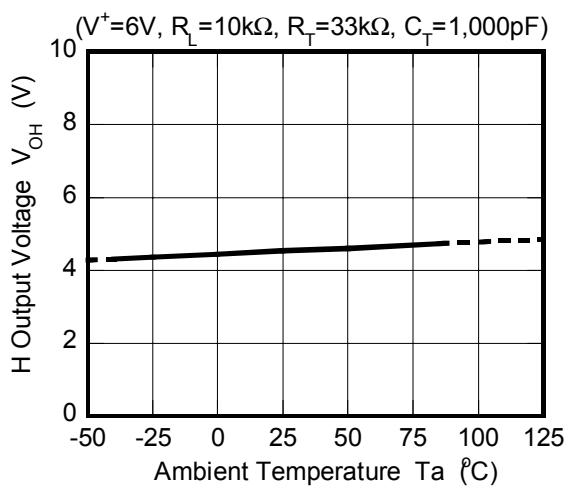
Oscillator Frequency vs. Temperature



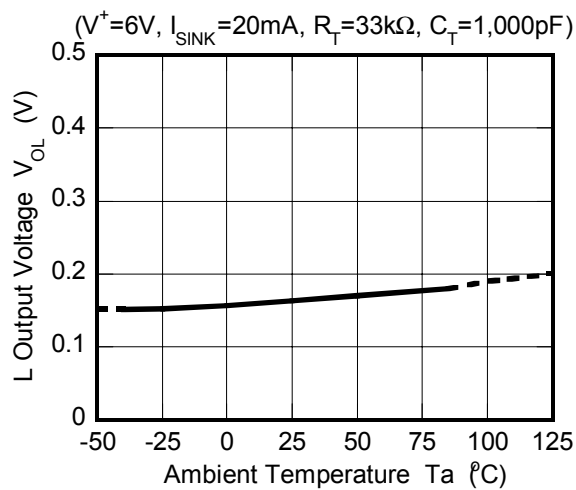
Reference Voltage vs. Temperature



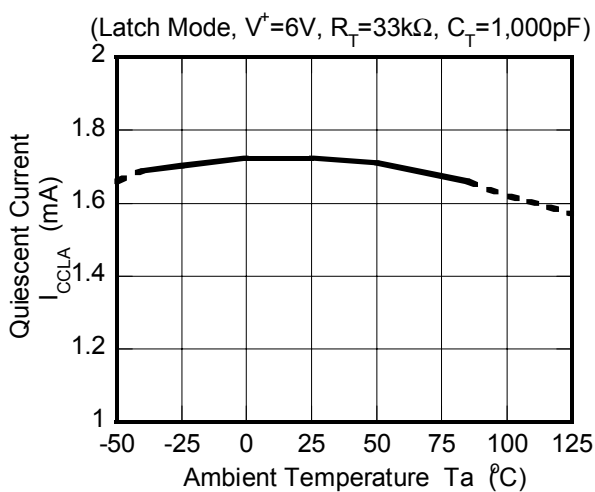
H Output Voltage vs. Temperature



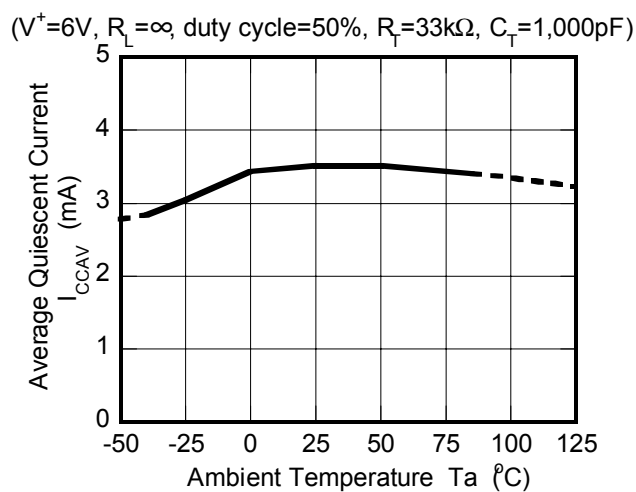
L Output Voltage vs. Temperature



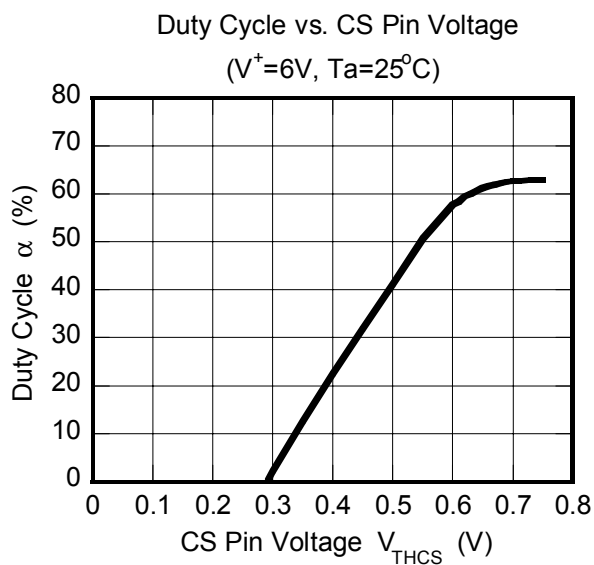
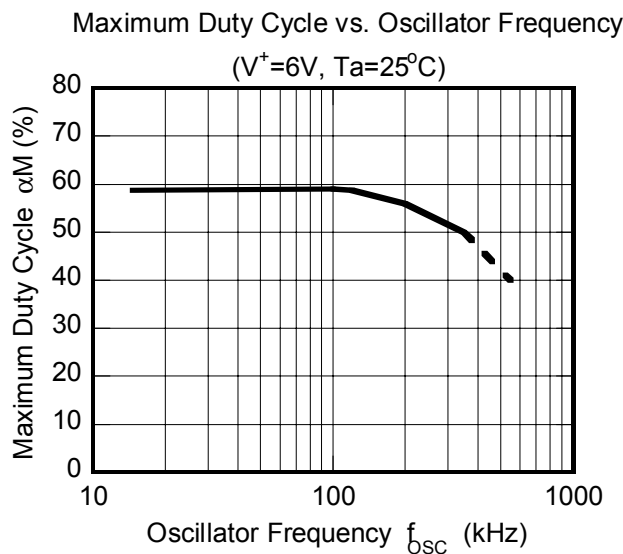
Quiescent Current vs. Temperature



Average Quiescent Current vs. Temperature



■ TYPICAL CHARACTERISTICS



[CAUTION]

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