High Efficiency Synchronous Step-Down switching regulator IC

■ GENERAL DESCRIPTION

The **NJU7690** is a high efficiency synchronous step-down switching regulator control IC. It offers high efficiency power supply circuits in applications by synchronous rectification. The NJU7690 also has a soft-start function, dead time control and timer latch for short circuit protection and their times are all adjustable with external parts. It is available in a small and thin 10-lead MSOP (TVSP) package. It is suitable for battery powered applications.

■ PACKAGE OUTLINE

NJU7690RB2
(MSOP10 (TVSP10))

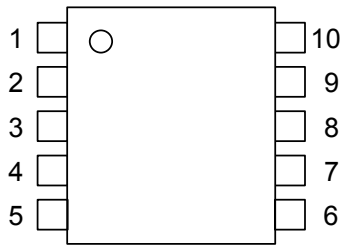
■ FEATURES

- Synchronous Rectification
- PWM switching control
- Standby Function
- Operating Voltage 2.2V to 8V
- Wide Oscillator Range 300kHz to 1MHz
- Maximum Duty Cycle 100%
- Quiescent Current Operating :800μA typ.
  Standby :1μA max.
- Soft-Start Function Internal : 16ms typ. or adjustable
- Dead Time Control
- Timer Latch for Short Circuit Protection
- C-MOS Technology
- Package Outline NJU7690RB2 : TVSP10

■ PRODUCT VARIATION

NJU7690
↑ Synchronous rectification
NJU7631
↑ PWM/PFM Light Load to Efficiency
NJU7630
PWM Control

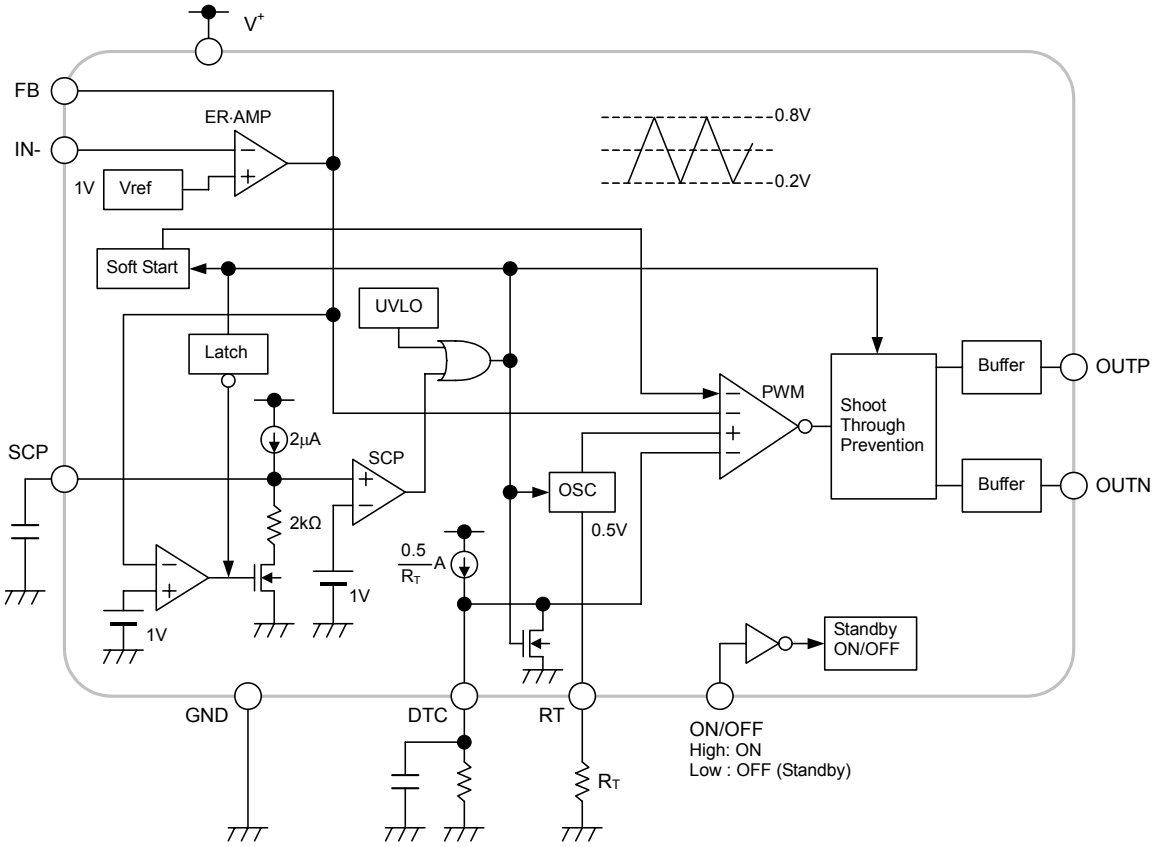
■ PIN CONFIGURATION



NJU7690RB2

PIN FUNCTION
1. OUTP
2. V^+
3. FB
4. IN-
5. SCP
6. ON/OFF
7. DTC
8. RT
9. GND
10. OUTN

■ BLOCK DIAGRAM



■ ABSOLUTE MAXIMUM RATINGS

(Ta=25°C)

PARAMETER	SYMBOL	MAXIMUM RATINGS	UNIT
Supply Voltage	V^+	+9	V
Output Pin Current	I_O	±50	mA
Power Dissipation	P_D	MSOP8 (TVSP8) :320	mW
Operating Temperature Range	T_{OPR}	-40 to +85	°C
Storage Temperature Range	T_{STG}	-40 to +125	°C

■ RECOMMENDED OPERATING CONDITIONS

(Ta=25°C)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT
Operating Voltage	V^+	2.2	–	8	V
Oscillator Timing Resistor	R_T	30	47	120	kΩ
Oscillation Frequency	f_{OSC}	300	700	1,000	kHz

■ ELECTRICAL CHARACTERISTICS

(V^+= $V_{ON/OFF}$=3.3V, R_T=47kΩ, Ta=25°C)

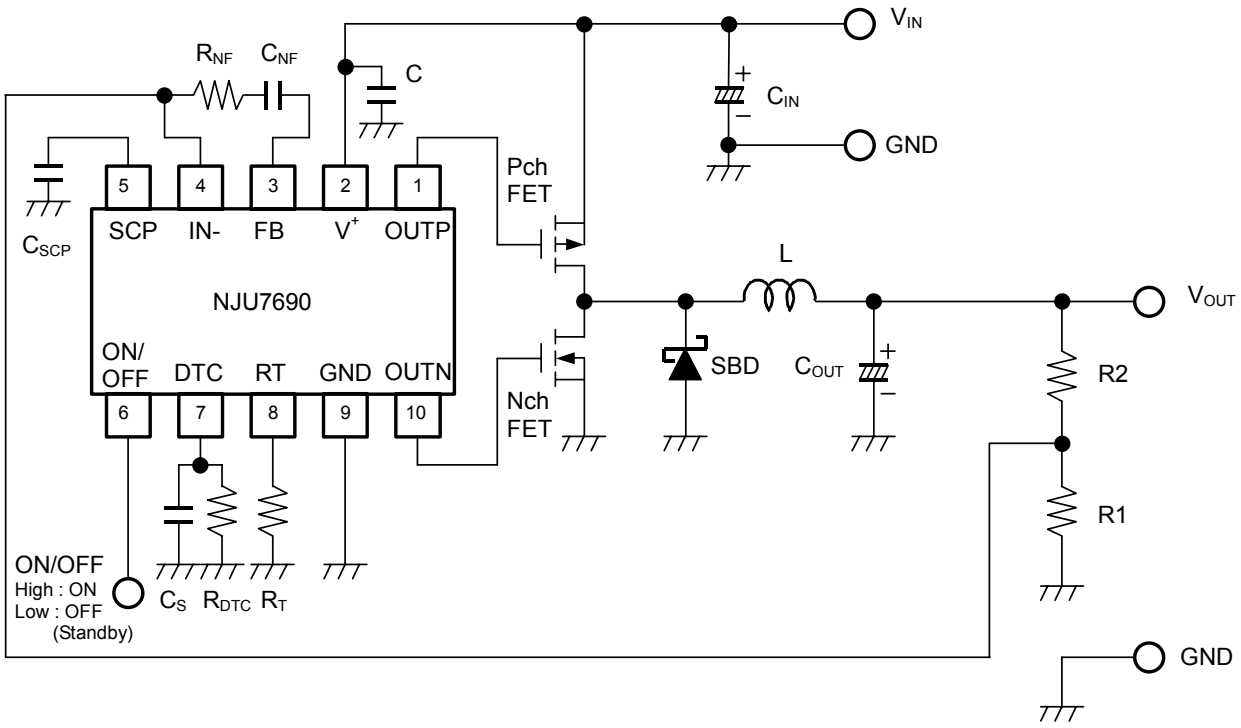
PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Under Voltage Lockout Block						
ON Threshold Voltage	V_{T_ON}	V^+= L → H	1.9	2.0	2.1	V
OFF Threshold Voltage	V_{T_OFF}	V^+= H → L	1.8	1.9	2.0	V
Hysteresis Voltage	V_{HYS}		60	100	–	mV
Soft Start Block						
Soft Start Time	T_{SS}	V_{T_ON} → Duty=80%	8	16	24	ms
Short Circuit Protection Block						
Input Threshold Voltage	V_{T_PC}	FB Pin	0.95	1.00	1.05	V
Charge Current	I_{CHG}	V_{SCP}=0V	1.5	2	2.5	μA
Latch Mode ON Threshold Voltage	V_{T_LA}	SCP Pin	0.95	1.00	1.05	V
Latch Mode OFF Threshold Voltage	V_{T_LAOFF}	SCP Pin	0.20	0.45	0.70	V
Oscillator Block						
RT Pin Voltage	V_{RT}		-10%	0.5	+10%	V
Oscillation Frequency	f_{OSC}		630	700	770	kHz
Oscillate Supply Voltage Fluctuations	f_{DV}	V^+=2.2V to 8V	–	1	–	%
Oscillate Temperature Fluctuations	f_{DT}	Ta=-40°C to +85°C	–	3	–	%

■ **ELECTRICAL CHARACTERISTICS** (V^+= $V_{ON/OFF}$=3.3V, R_T=47kΩ, Ta=25°C)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Error Amplifier Block						
Reference Voltage	V_B		-1.0%	1.00	+1.0%	V
Input Bias Current	I_B		-0.1	–	0.1	μA
Open Loop Gain	A_V		–	80	–	dB
Gain Bandwidth Product	G_B		–	1	–	MHz
Output Source Current	I_{OM+_1}	V_{FB}=1V, V_{IN-}=0.9V	12	40	70	mA
	I_{OM+_2}	V_{FB}=1V, V_{IN-}=0.9V, V^+=2.2V	2.5	9	16	mA
Output Sink Current	I_{OM-}	V_{FB}=1V, V_{IN-}=1.1V	0.10	0.16	0.22	mA
PWM Comparate Block						
Input Threshold Voltage	V_{T_0}	Duty=0%	0.10	0.16	0.22	V
	V_{T_50}	Duty=50%	0.4	0.5	0.6	V
Maximum Duty Cycle	$M_{AX}D_{UTY\_1}$	V_{FB}=0.9V	100	–	–	%
	$M_{AX}D_{UTY\_2}$	V_{FB}=0.9V, R_{DTC}=47kΩ	35	50	65	%
Output Block						
OUTP Output High Level ON Resistance	R_{OPH}	I_O=-20mA	–	10	20	Ω
OUTP Output Low Level ON Resistance	R_{OPL}	I_O=+20mA	–	5	10	Ω
OUTN Output High Level ON Resistance	R_{ONH}	I_O=-20mA	–	10	20	Ω
OUTN Output Low Level ON Resistance	R_{ONL}	I_O=+20mA	–	5	10	Ω
OUTP-OUTN Rise Dead Time	t_{dr}		55	85	120	ns
OUTN-OUTP Fall Dead Time	t_{df}		45	75	110	ns
ON/OFF Block						
ON Control Voltage	V_{ON}	$V_{ON/OFF}$= L → H	1.6	–	V^+	V
OFF Control Voltage	V_{OFF}	$V_{ON/OFF}$= H → L	0	–	0.3	V
General Characteristics						
Quiescent Current	I_{DD}	R_L=Non Load	–	800	1200	μA
Standby Current	I_{DD_STB}	$V_{ON/OFF}$=0V	–	–	1.0	μA

■ TYPICAL APPLICATIONS

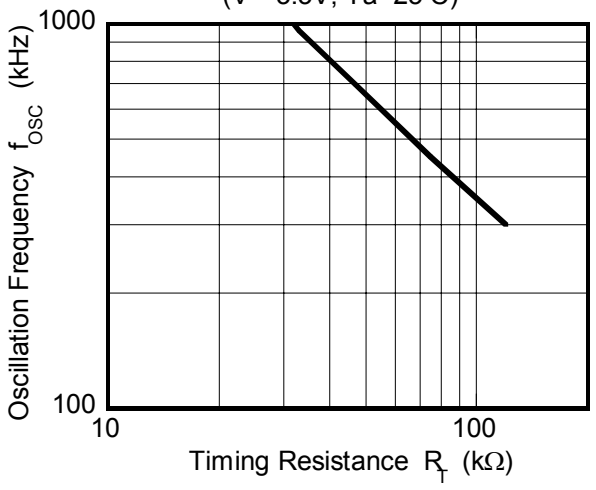
Step-Down Converter



■ TYPICAL CHARACTERISTICS

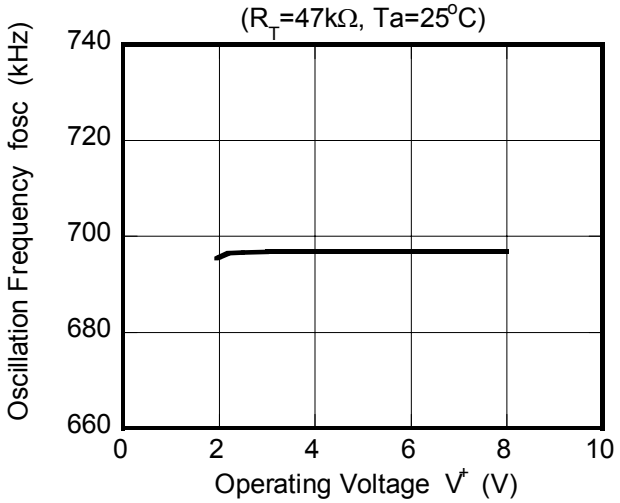
Oscillation Frequency vs. Timing Resistance

(V^+=3.3V, Ta=25°C)



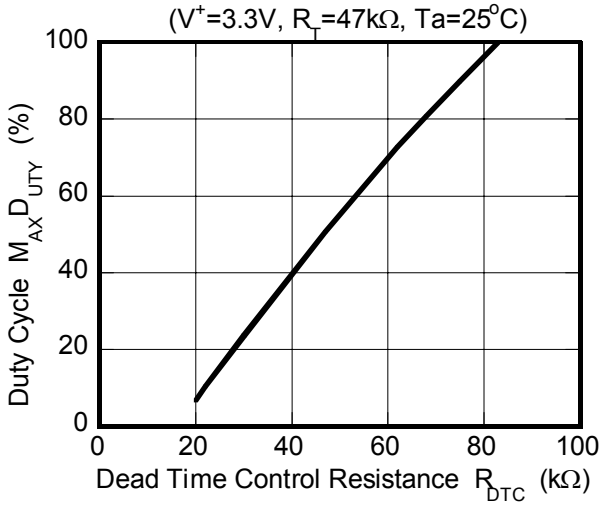
Oscillation Frequency vs. Operating Voltage

(R_T=47kΩ, Ta=25°C)



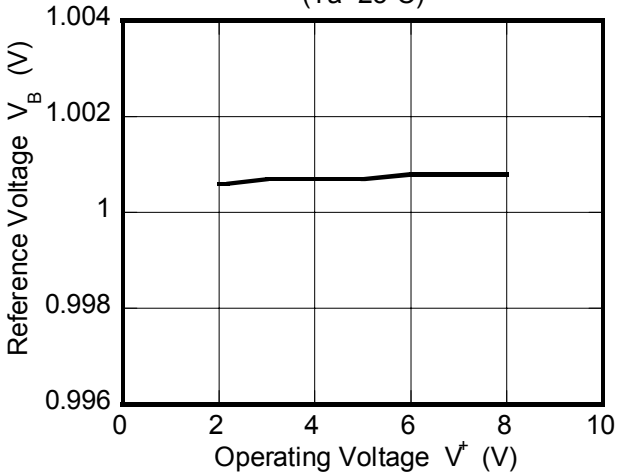
Duty Cycle vs. R_{DTC}

(V^+=3.3V, R_T=47kΩ, Ta=25°C)



Reference Voltage vs. Operating Voltage

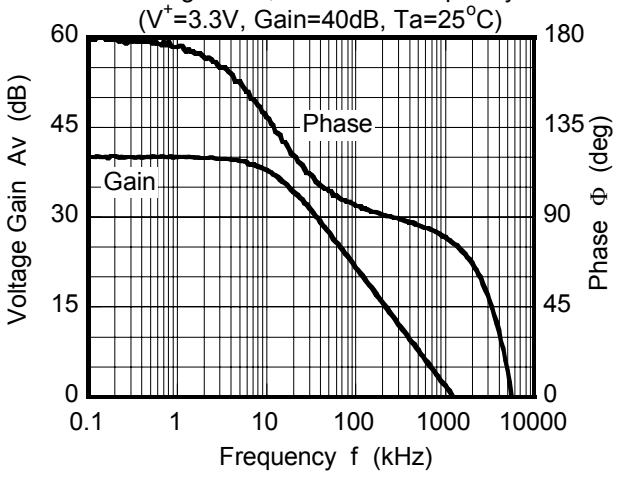
(Ta=25°C)



Error Amplifier Block

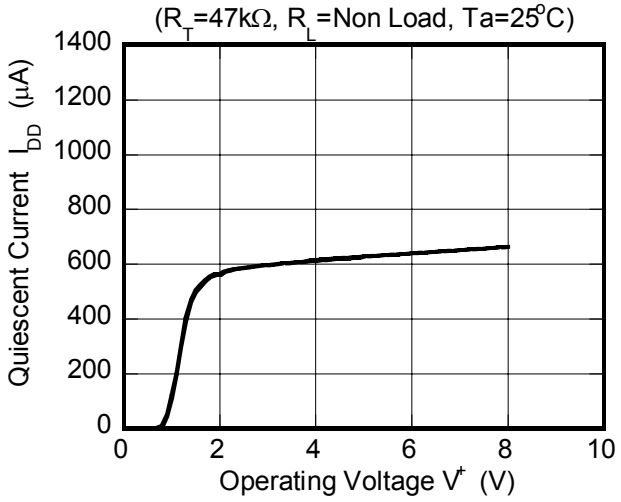
Voltage Gain, Phase vs. Frequency

(V^+=3.3V, Gain=40dB, Ta=25°C)

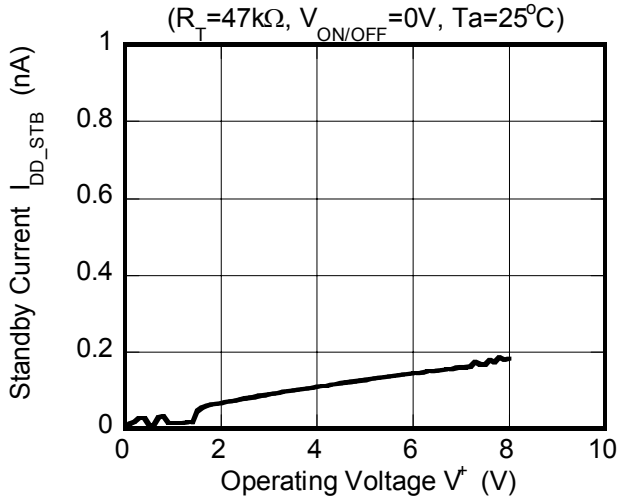


■ TYPICAL CHARACTERISTICS

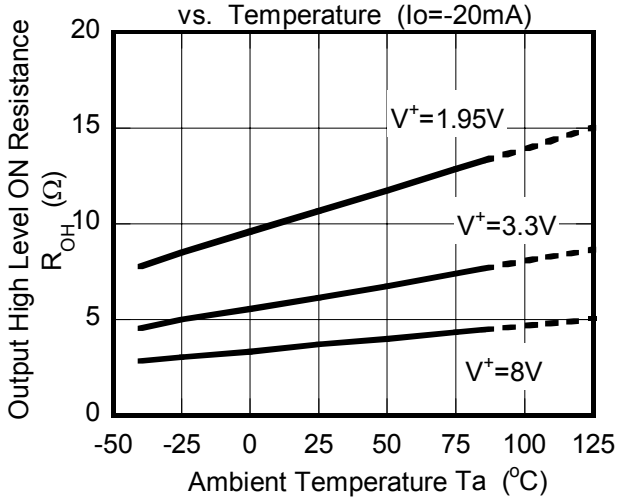
Quiescent Current vs. Operating Voltage
(R_T=47kΩ, R_L=Non Load, Ta=25°C)



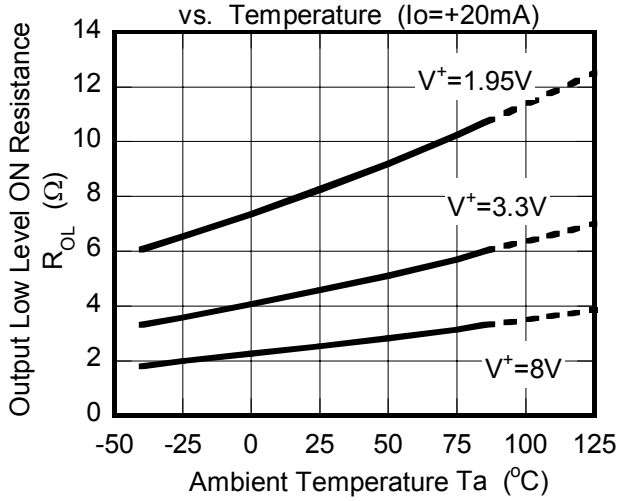
Standby Current vs. Operating Voltage
(R_T=47kΩ, $V_{ON/OFF}$=0V, Ta=25°C)



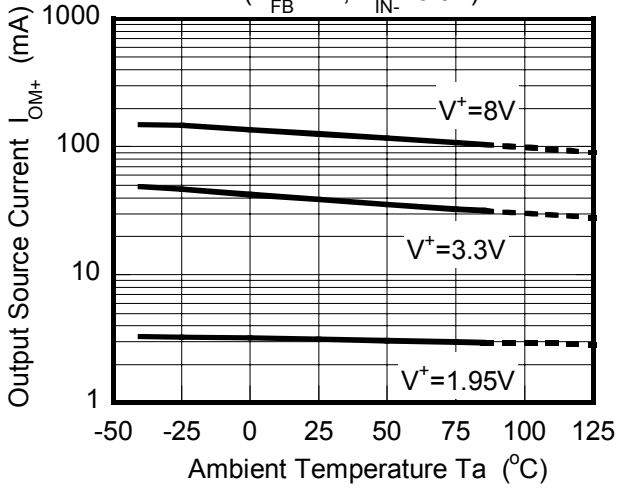
Output Block (P&N)
Output High Level ON Resistance
vs. Temperature (Io=-20mA)



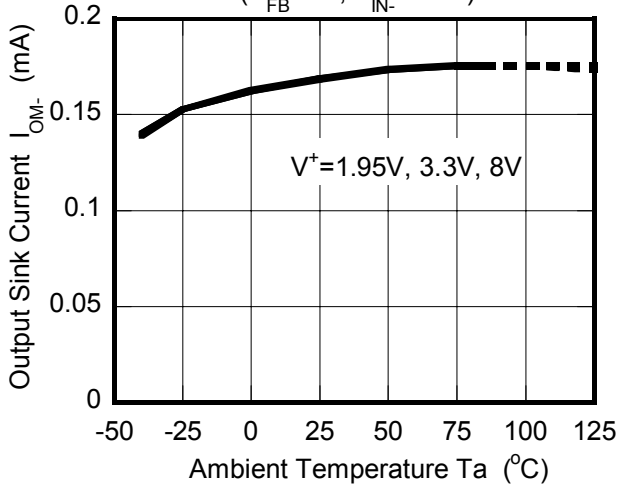
Output Block (P&N)
Output Low Level ON Resistance
vs. Temperature (Io=+20mA)



Error Amplifier Block
Output Source Current vs. Temperature
(V_{FB}=1V, V_{IN-}=0.9V)

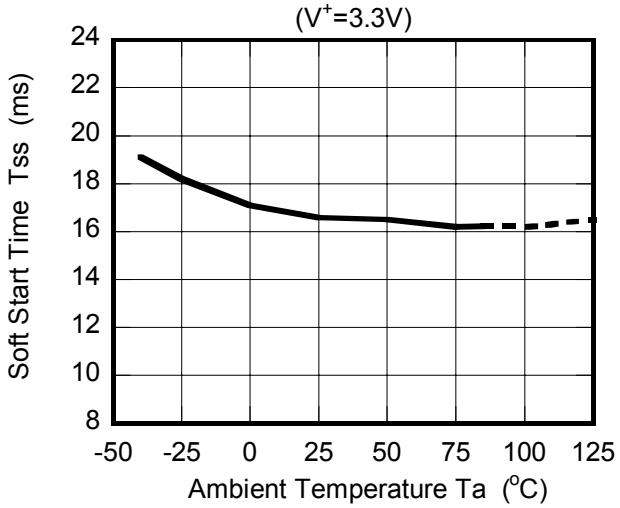


Error Amplifier Block
Output Sink Current vs. Temperature
(V_{FB}=1V, V_{IN-}=1.1V)

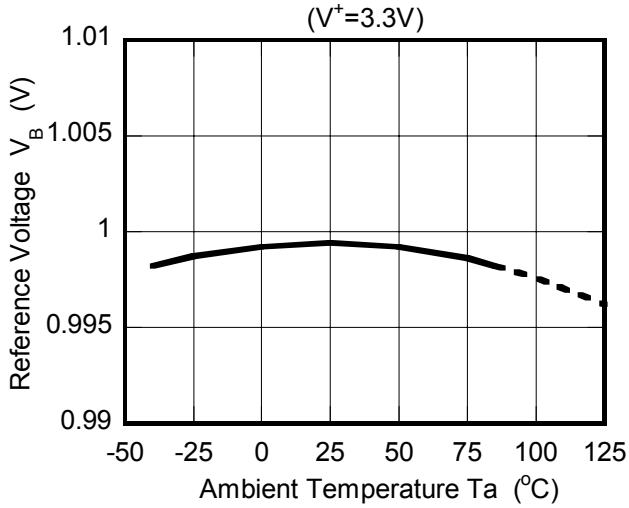


■ TYPICAL CHARACTERISTICS

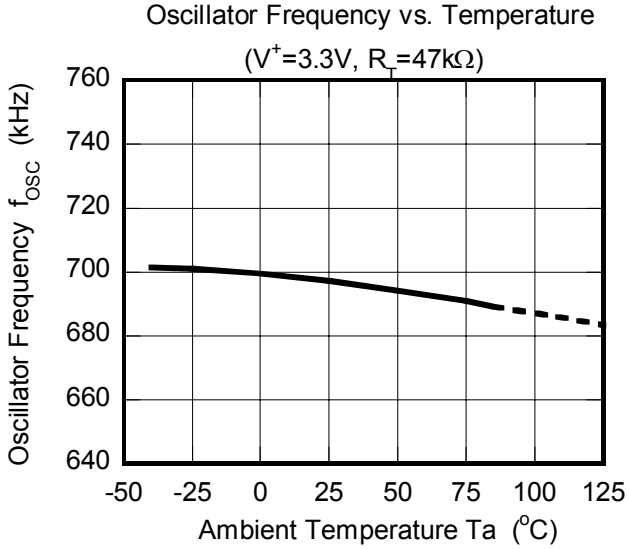
Soft Start Time vs. Temperature



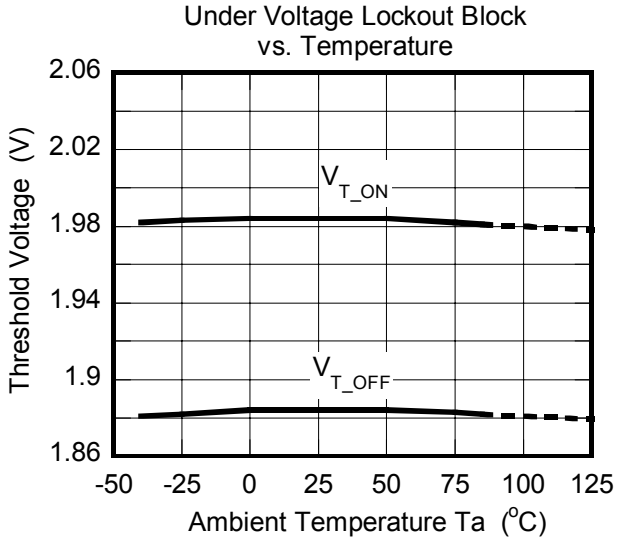
Reference Voltage vs. Temperature



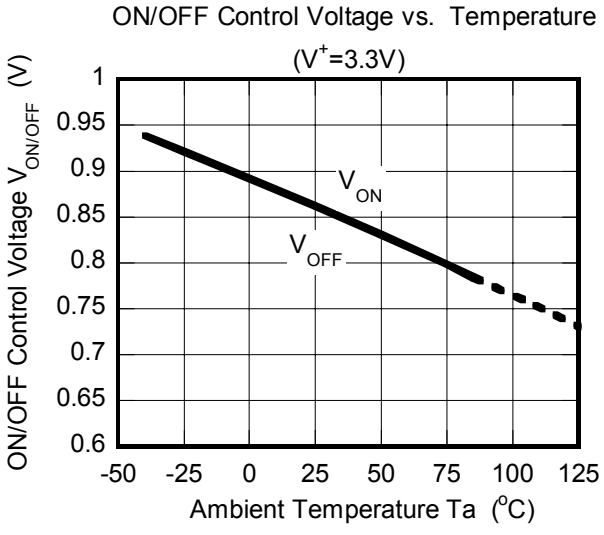
Oscillator Frequency vs. Temperature



Under Voltage Lockout Block vs. Temperature



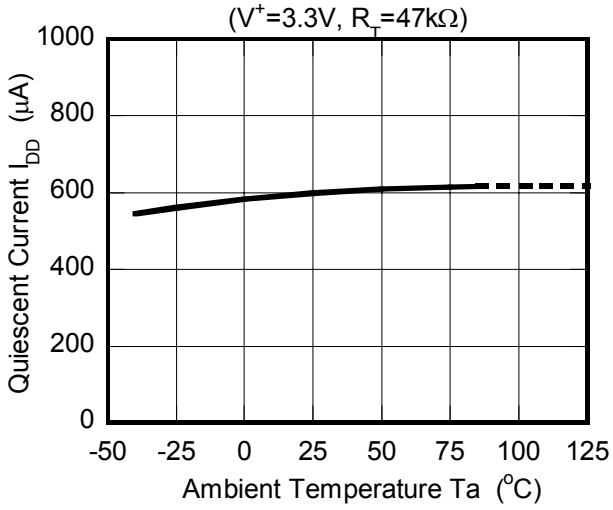
ON/OFF Control Voltage vs. Temperature



■ TYPICAL CHARACTERISTICS

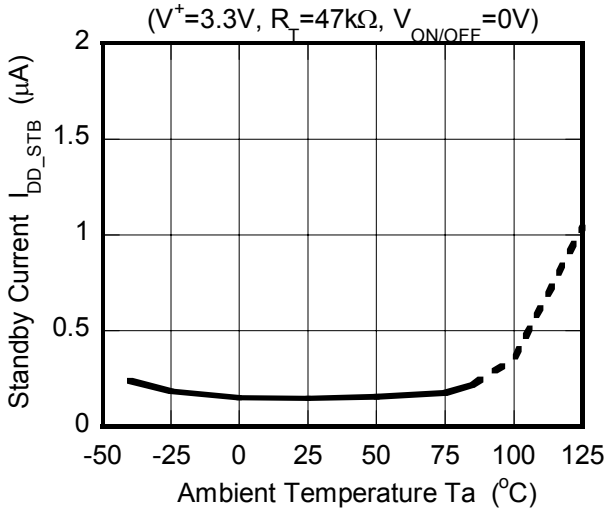
Quiescent Current vs. Temperature

(V^+=3.3V, R_T=47kΩ)



Standby Current vs. Temperature

(V^+=3.3V, R_T=47kΩ, $V_{ON/OFF}$=0V)



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