2 - phase Boost Converter Switching Regulator IC

■ GENERAL DESCRIPTION

The **NJW4141** is a 2-phase boost converter switching regulator IC that operates wide input range from 3V to 40V.

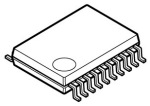
It can optimize applications by external phase compensation and voltage mode control.

The digital phase shifter adds 180 degree phase shift signal to the PWM signal and controls boost circuit by 2-phase operation. The 2-phase operation reduces an input ripple current and realizes large output current applications.

It has a pulse-by-pulse over current protection circuit that limits an output current at over load. When recovering from abnormal load condition, switching operation restarts automatically.

The **NJW4141** suitable for large output current application such as a boost power supply of audio amplifier and a boost application from battery unit.

■ PACKAGE OUTLINE

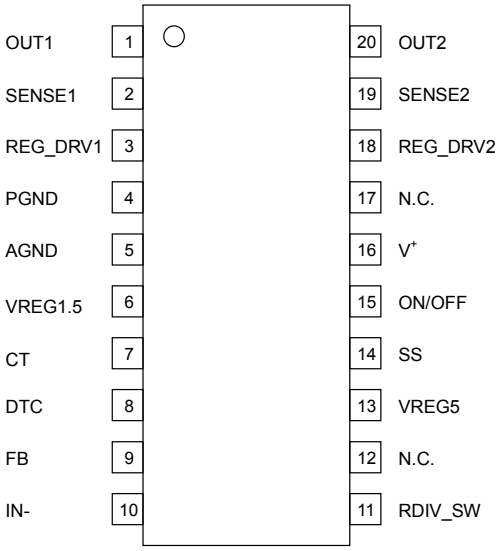


NJW4141VC3-T1

■ FEATURES

- 2-phase Boost Converter Application
- Correspond to Operating Temperature 125°C
- Nch MOSFET Driving — Driving Voltage 5.1V typ.
- Wide Operating Voltage Range — 3V to 40V
- PWM Control
- Wide Oscillating Frequency — 50kHz to 500kHz
- Adjustable Soft Start Function
- Dead Time Control
- UVLO (Under Voltage Lockout)
- Over Current Protection
- Standby Function
- Package Outline — NJW4141VC3-T1 : SSOP20-C3

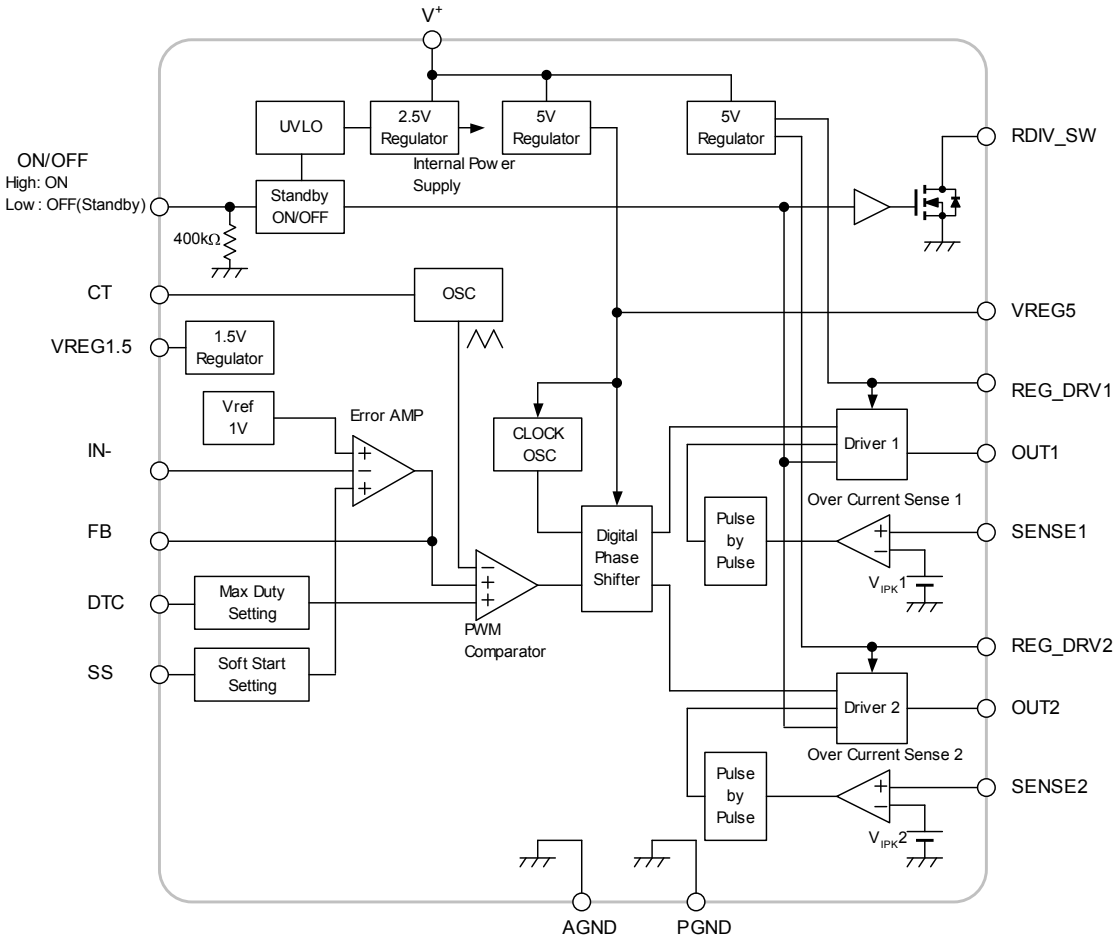
■ PIN CONFIGURATION



(Top View)

NJW4141VC3-T1

■ BLOCK DIAGRAM



■ ABSOLUTE MAXIMUM RATINGS (Ta=25°C)

PARAMETER	SYMBOL	MAXIMUM RATINGS	UNIT
Supply Voltage	V^+	+45	V
OUT pin Voltage (*1)	V_{OUT}	-0.3 to +5.95 (*2)	V
REG_DRV pin Voltage (*1)	V_{REG_DRV}	-0.3 to +5.95 (*2)	V
VREG1.5 pin Voltage	$V_{REG1.5}$	+1.8 (*2)	V
VREG5 pin Voltage	V_{REG5}	+5.7 (*2)	V
IN- pin Voltage	V_{IN-}	+2.8 (*2)	V
DTC pin Voltage	V_{DTC}	+2.8 (*2)	V
SENSE pin Voltage (*1)	V_{SENSE}	+2.8 (*2)	V
CT pin Voltage	V_{CT}	+2.8 (*2)	V
SS pin Voltage	V_{SS}	+2.8 (*2)	V
ON/OFF pin Voltage	$V_{ON/OFF}$	+45	V
RDIV_SW pin Voltage	V_{RDIV_SW}	+45	V
OUT pin Peak Current (1*)	I_{O_PEAK+} I_{O_PEAK-}	1,000 (Source) 900 (Sink)	mA
Power Dissipation	P_D	1,000 (*3) 1,500 (*4)	mW
Operating Temperature Range	T_{opr}	-40 to +125	°C
Storage Temperature Range	T_{stg}	-40 to +150	°C

(*1): Common to each channel.

(*2): When Supply voltage is less than each absolute maximum voltage, the absolute maximum voltage is equal to the Supply voltage.

(*3): Mounted on glass epoxy board. (76.2×114.3×1.6mm:based on EIA/JDEC standard, 2Layers)

(*4): Mounted on glass epoxy board. (76.2×114.3×1.6mm:based on EIA/JDEC standard, 4Layers),
internal Cu area: 74.2×74.2mm

■ RECOMMENDED OPERATING CONDITIONS (Ta= -40°C to +125°C)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V^+	3	—	40	V
Timing Capacitor	C_T	270	—	3,300	pF
Oscillating Frequency	f_{OSC}	50	—	500	kHz

■ ELECTRICAL CHARACTERISTICS (Unless otherwise noted, $V^+=V_{ON/OFF}$=12V, C_T=470pF, Ta=25°C)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Under Voltage Lockout Block						
ON Threshold Voltage	V_{T_ON}	V^+= L → H	2.65	2.8	2.95	V
		V^+= L → H, Ta= -40°C to +125°C	2.65	–	2.95	
OFF Threshold Voltage	V_{T_OFF}	V^+= H → L	2.4	2.55	2.7	V
		V^+= H → L, Ta= -40°C to +125°C	2.35	–	2.8	
Oscillator Block						
Oscillating Frequency1	f_{OSC1}	C_T=470pF	270	300	330	kHz
		C_T=470pF, Ta= -40°C to +125°C	260	–	330	
Oscillating Frequency2	f_{OSC2}	C_T=1,500pF	90	100	110	kHz
		C_T=1,500pF, Ta= -40°C to +125°C	80	–	120	
Charge Current	I_{chg}		150	200	250	μA
		Ta= -40°C to +125°C	140	–	260	
Discharge Current	I_{dis}		150	200	250	μA
		Ta= -40°C to +125°C	140	–	260	
Voltage amplitude	V_{OSC}		–	0.7	–	V
Oscillating Frequency deviation (Supply voltage)	f_{DV}	V^+=3V to 40V	–	3	–	%
Soft Start Block						
Charge Current (SS pin)	I_{chg_SS}		1.6	2	2.4	μA
		Ta= -40°C to +125°C	1.6	–	2.4	
Threshold Voltage (SS pin)	V_{THSS0}	Duty1,2=0%	0.41	0.49	0.57	V
		Duty1,2=0%, Ta= -40°C to +125°C	0.39	–	0.59	
Threshold Voltage (SS pin)	V_{THSS85}	Duty1,2=80%	0.92	1.1	1.28	V
		Duty1,2=80%, Ta= -40°C to +125°C	0.87	–	1.33	
Error Amplifier Block						
Reference Voltage	V_B		-1.0%	1.00	+1.0%	V
		Ta= -40°C to +125°C	-2.0%	–	+2.0%	
Input Bias Current	I_B		-0.1	–	0.1	μA
		Ta= -40°C to +125°C	-0.1	–	0.1	
Open Loop Gain	A_V		–	80	–	dB
Gain Bandwidth	G_B		–	1.5	–	MHz
Output Source Current	I_{OM+}	V_{FB}=1V, V_{IN-}=0.9V	40	90	140	μA
		V_{FB}=1V, V_{IN-}=0.9V, Ta= -40°C to +125°C	40	–	140	
Output Sink Current	I_{OM-}	V_{FB}=1V, V_{IN-}=1.1V	2	4	6	mA
		V_{FB}=1V, V_{IN-}=1.1V, Ta= -40°C to +125°C	2	–	8	

■ ELECTRICAL CHARACTERISTICS (Unless otherwise noted, $V^+=V_{ON/OFF}$=12V, C_T=470pF, Ta=25°C)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
PWM Comparate Block						
Maximum Duty Cycle	$M_{AX}D_{UTY90}$	Duty1,2 , V_{FB}=1.2V, R_{DTC}=100kΩ	80	90	95	%
		Duty1,2 , V_{FB}=1.2V, R_{DTC}=100kΩ, Ta= -40°C to +125°C	80	–	95	
	$M_{AX}D_{UTY50}$	Duty1,2 , V_{FB}=1.2V, V_{DTC}=0.715V	40	50	60	%
		Duty1,2 , V_{FB}=1.2V, V_{DTC}=0.715V, Ta= -40°C to +125°C	40	–	60	
	$M_{AX}D_{UTY0}$	Duty1,2 , V_{FB}=1.2V, V_{DTC}=0.3V	–	–	0	%
		Duty1,2 , V_{FB}=1.2V, V_{DTC}=0.3V, Ta= -40°C to +125°C	–	–	0	
Phase Shift Block						
Shift Time Ratio	Rt_{shift}	V_{FB}=0.7V, C_T=1,500pF, [Definition: $t_{shift}/(t_{OSC}/2)$]	-5.0%	1	+5.0%	–
		V_{FB}=0.7V, C_T=1,500pF, [Definition: $t_{shift}/(t_{OSC}/2)$] Ta= -40°C to +125°C	-7.0%	–	+7.0%	
VREG5 pin Voltage	V_{REG5}		4.8	5.1	5.4	V
		Ta= -40°C to +125°C	4.7	–	5.5	
VREG Block						
VREG1.5 pin Voltage	$V_{REG1.5}$	$I_{REG1.5}$=300μA	-2.0%	1.5	+2.0%	V
		$I_{REG1.5}$=300μA, Ta= -40°C to +125°C	-4.0%	–	+4.0%	
Current Limit Detection Block (common to SENSE1 and SENSE2)						
Current Limit Detection Voltage	V_{IPK}		90	110	130	mV
		Ta= -40°C to +125°C	90	–	130	
Delay Time	t_{DELAY}	$\Delta V_{SENSE1}=\Delta V_{SENSE2}$=300mV	–	190	–	ns
Output Block (common to OUT1 and OUT2)						
Output High Level ON Resistance	R_{OH}	$I_{O1,2}$= -50mA	–	2.0	3.0	Ω
		$I_{O1,2}$= -50mA, Ta= -40°C to +125°C		–	4.0	
Output Low Level ON Resistance	R_{OL}	$I_{O1,2}$= +50mA	–	3.0	4.0	Ω
		$I_{O1,2}$= +50mA, Ta= -40°C to +125°C		–	5.0	
Output Source Current	I_{OH}	OUT1,2 pin=4.5V	45	70	105	mA
		OUT1,2 pin=4.5V, Ta= -40°C to +125°C	40	–	105	
REG_DRV pin Voltage	V_{REG_DRV}		5	5.3	5.6	V
		Ta= -40°C to +125°C	5	–	5.75	

■ ELECTRICAL CHARACTERISTICS (Unless otherwise noted, $V^+=V_{ON/OFF}=12V$, $C_T=470pF$, Ta=25°C)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Output Division Resistor Switch						
Low Level Output Voltage	V_{OL_RDIV}	$V_{ON/OFF}$=12V, I_{O_RDIV}=+0.5mA	–	0.1	0.25	V
		$V_{ON/OFF}$=12V, I_{O_RDIV}=+0.5mA, Ta= -40°C to +125°C	–	–	0.25	
Leak Current	I_{LEAK_RDIV}	$V_{ON/OFF}$=0V, V_{O_RDIV}=40V	–	–	1	μA
		$V_{ON/OFF}$=0V, V_{O_RDIV}=40V, Ta= -40°C to +125°C	–	–	1	
ON/OFF Control Block						
ON Control Voltage	V_{ON}	$V_{ON/OFF}$= L → H	1.5	–	V^+	V
		$V_{ON/OFF}$= L → H, Ta= -40°C to +125°C	1.5	–	V^+	
OFF Control Voltage	V_{OFF}	$V_{ON/OFF}$= H → L	0	–	0.6	V
		$V_{ON/OFF}$= H → L, Ta= -40°C to +125°C	0	–	0.6	
ON/OFF pin Pull-down Resistance	$R_{ON/OFF}$		–	400	–	kΩ
General Characteristics						
Quiescent Current 1	I_{DD1}	R_L=no load, V_{IN-}=0.7V, C_T=470pF	–	3.6	4.2	mA
		R_L=no load, V_{IN-}=0.7V, C_T=470pF, Ta= -40°C to +125°C	–	–	4.7	
Quiescent Current 2	I_{DD2}	R_L=no load, V_{IN-}=0.7V, C_T=1,500pF	–	3.2	3.8	mA
		R_L=no load, V_{IN-}=0.7V, C_T=1,500pF, Ta= -40°C to +125°C	–	–	4.5	
Standby Current	I_{DD_STB}	$V_{ON/OFF}$=0V	–	2.5	6	μA
		$V_{ON/OFF}$=0V, Ta= -40°C to +125°C	–	–	8	

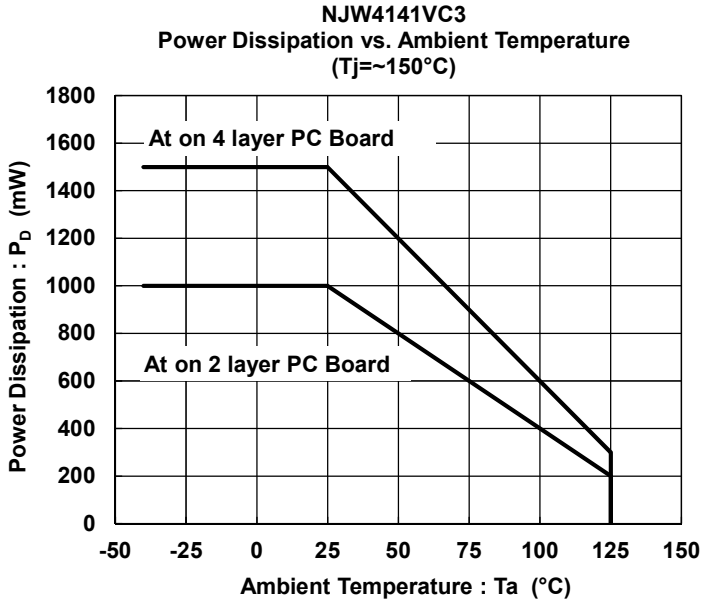
■ THERMAL CHARACTERISTICS

PARAMETER	SYMBOL	VALUE	UNIT
Junction-to-ambient thermal resistance	θja	125 (*5) 83 (*6)	°C/W
Junction-to-Top of package characterization parameter	ψjt	13 (*5) 9 (*6)	°C/W

(*5): Mounted on glass epoxy board. (76.2×114.3×1.6mm:based on EIA/JDEC standard, 2Layers)

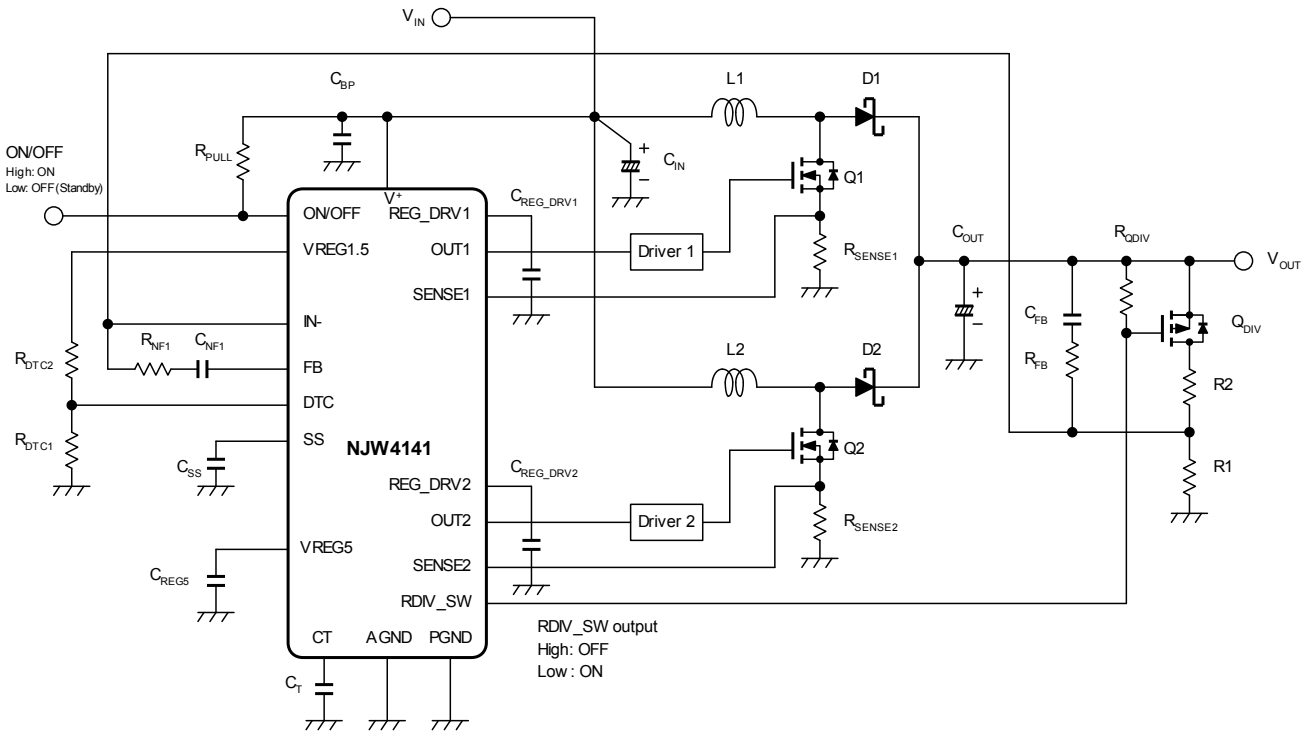
(*6): Mounted on glass epoxy board. (76.2×114.3×1.6mm:based on EIA/JDEC standard, 4Layers),
internal Cu area: 74.2×74.2mm

■ POWER DISSIPATION vs. AMBIENT TEMPERATURE



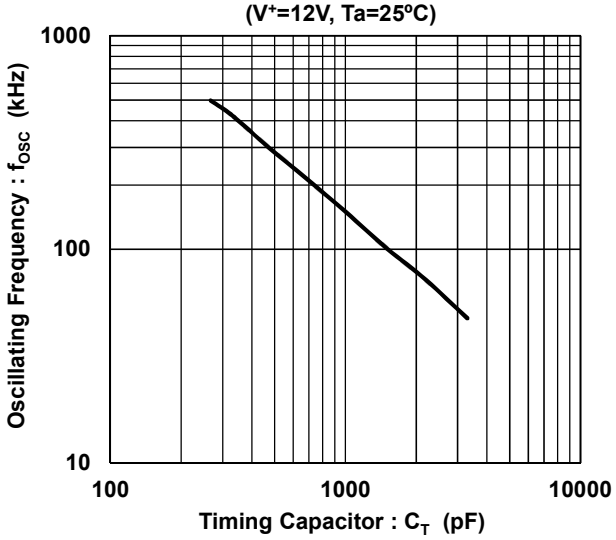
■ TYPICAL APPLICATIONS

2 Phase Boost Applications

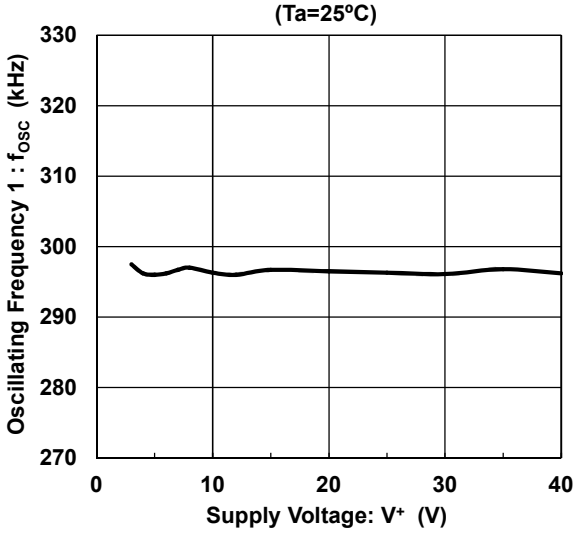


■ TYPICAL CHARACTERISTICS

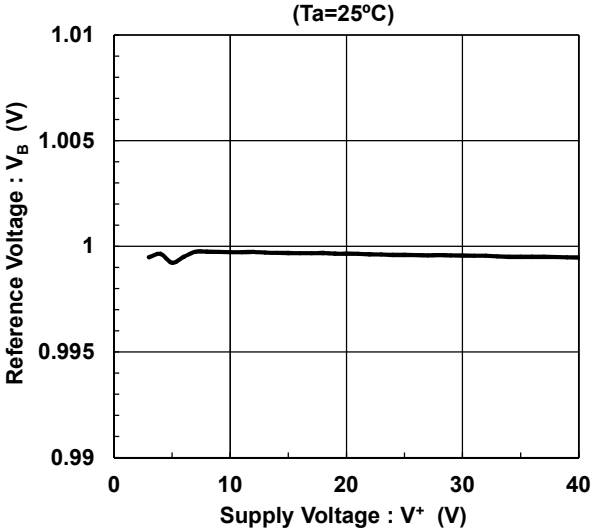
Oscillating Frequency vs. Timing Capacitor
(V^+=12V, Ta=25ºC)



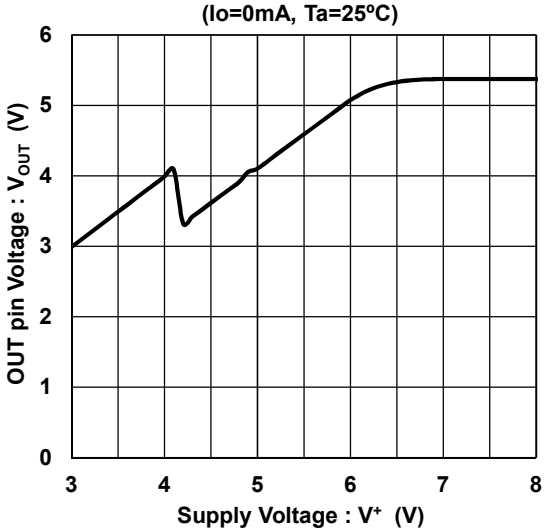
Oscillating Frequency 1 vs. Supply Voltage
(Ta=25ºC)



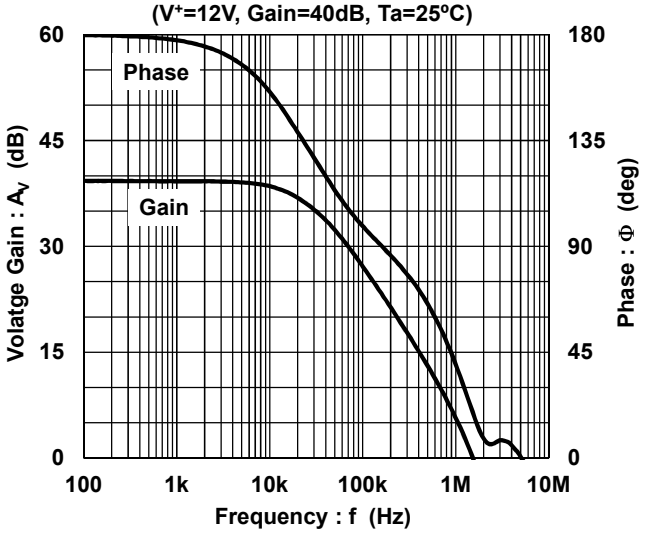
Reference Voltage vs. Supply Voltage
(Ta=25ºC)



OUT pin Voltage vs. Supply Voltage
(Io=0mA, Ta=25ºC)

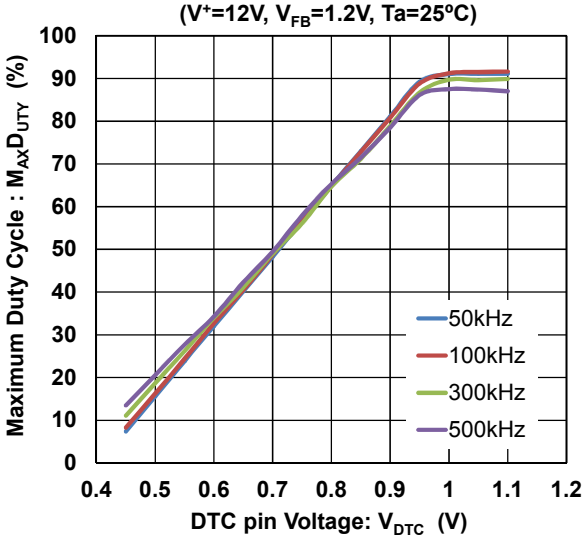


Error Amplifire Block
Voltage Gain, Phase vs. Frequency
(V^+=12V, Gain=40dB, Ta=25ºC)

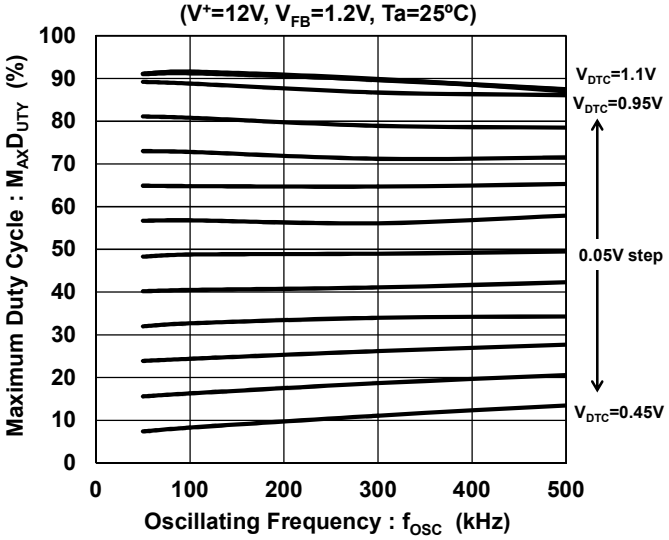


■ TYPICAL CHARACTERISTICS

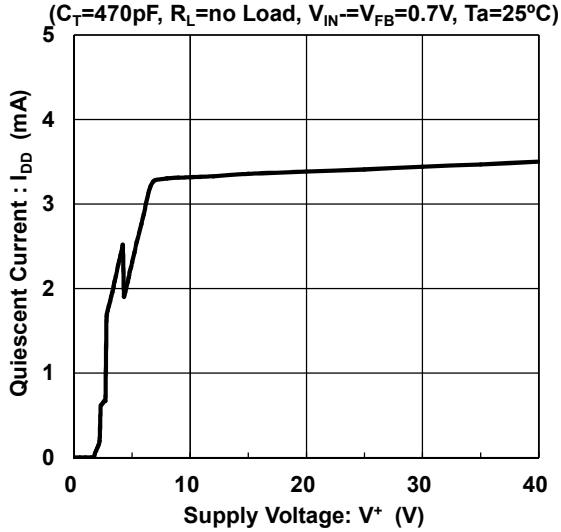
Maximum Duty Cycle vs. DTC pin Voltage
(V^+=12V, V_{FB}=1.2V, Ta=25ºC)



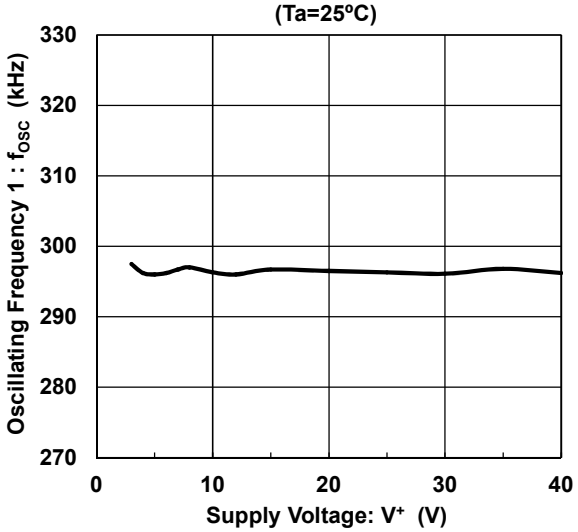
Maximum Duty Cycle vs. Oscillating Frequency
(V^+=12V, V_{FB}=1.2V, Ta=25ºC)



Quiescent Current vs. Supply Voltage
(C_T=470pF, R_L=no Load, V_{IN}-=V_{FB}=0.7V, Ta=25ºC)

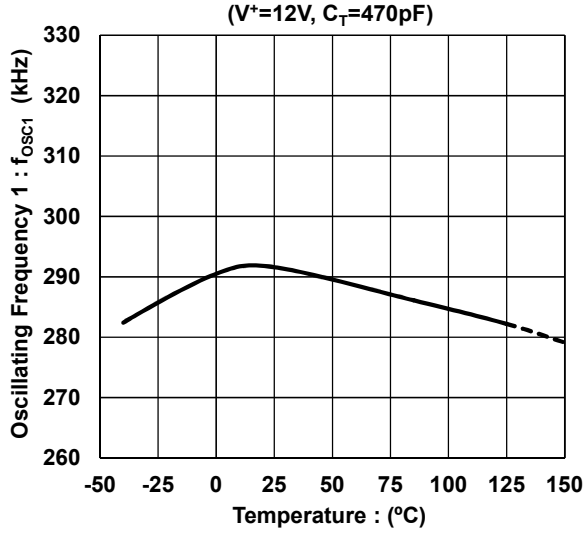


Oscillating Frequency 1 vs. Supply Voltage
(Ta=25ºC)

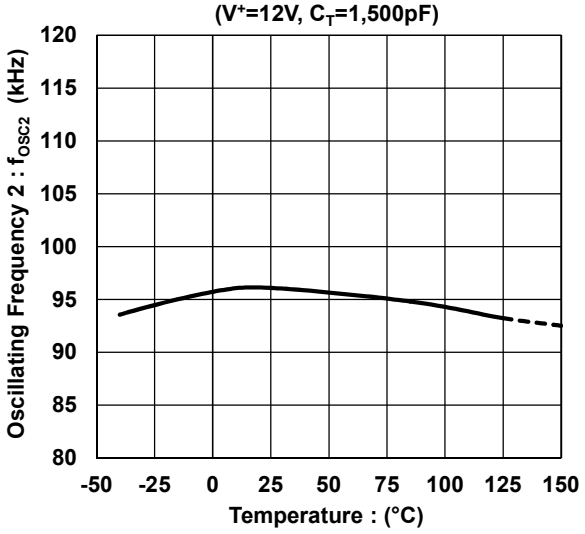


■ TYPICAL CHARACTERISTICS

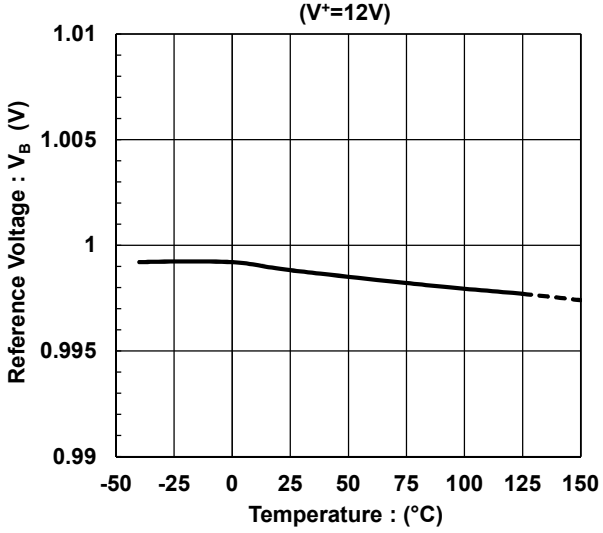
Oscillating Frequency 1 vs. Temperature
(V^+=12V, C_T=470pF)



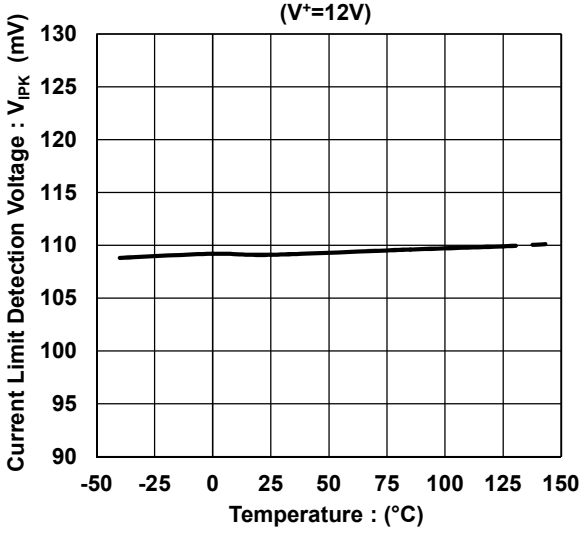
Oscillating Frequency 2 vs. Temperature
(V^+=12V, C_T=1,500pF)



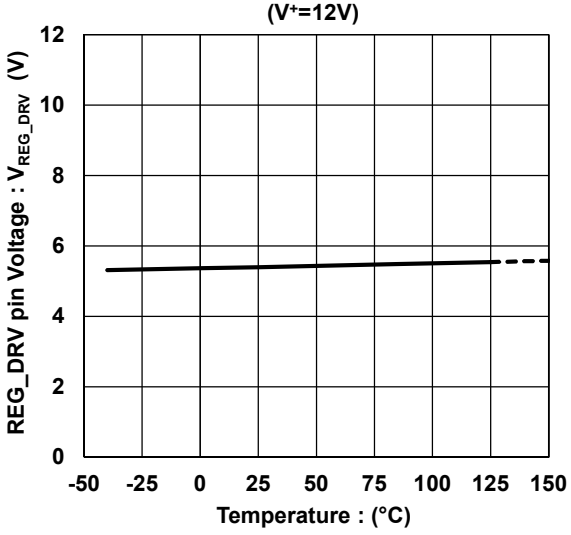
Reference Voltage vs. Temperature
(V^+=12V)



Current Limit Detection Voltage vs. Temperature
(V^+=12V)

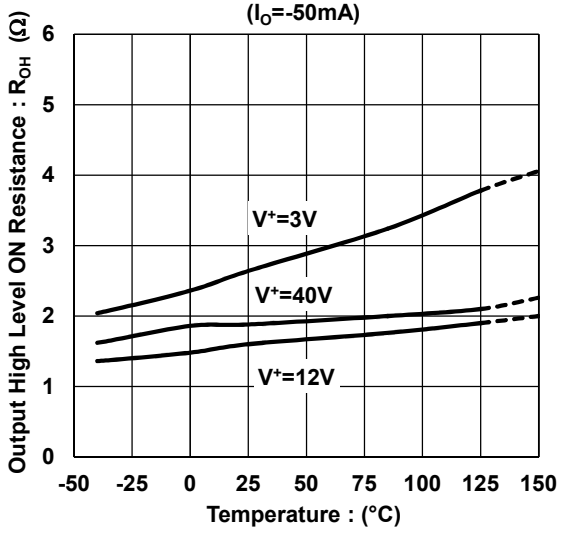


REG_DRV pin Voltage vs. Temperature
(V^+=12V)

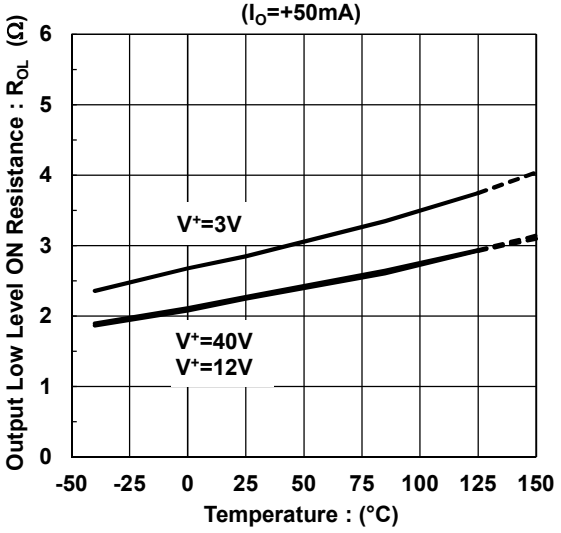


■ TYPICAL CHARACTERISTICS

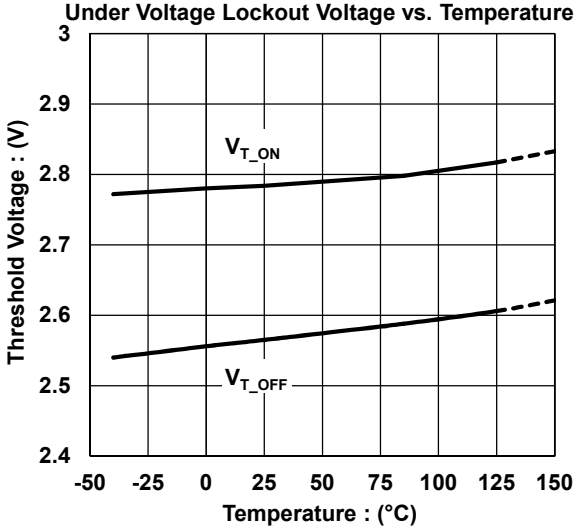
Output High Level ON Resistance vs. Temperature
(I_O=-50mA)



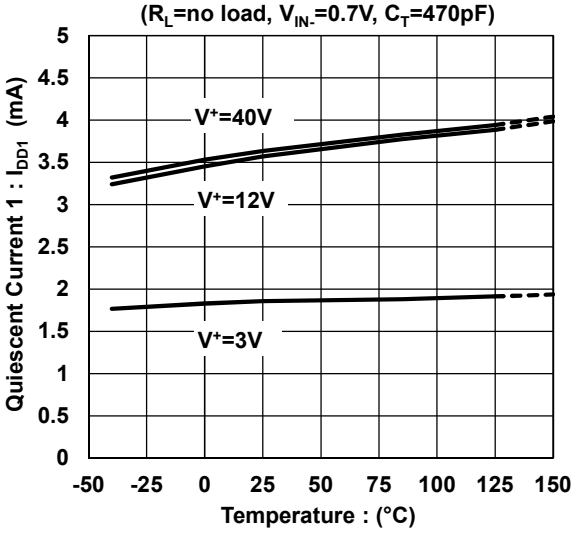
Output Low Level ON Resistance vs. Temperature
(I_O=+50mA)



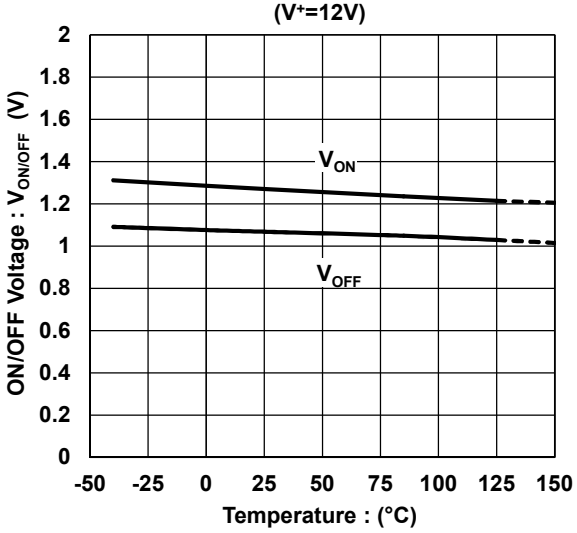
Under Voltage Lockout Voltage vs. Temperature



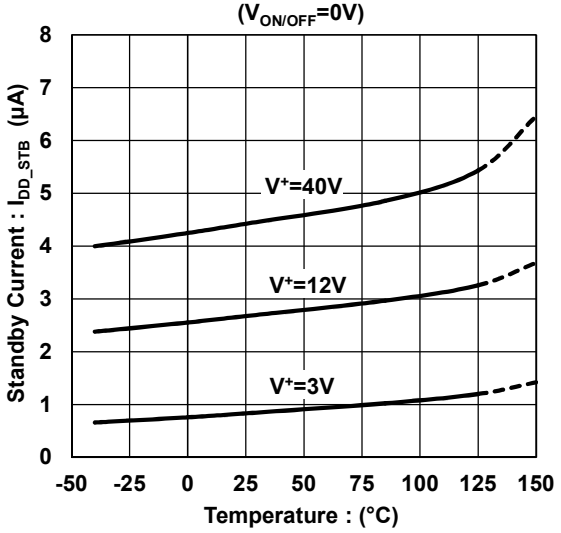
Quiescent Current 1 vs. Temperature
(R_L=no load, V_{IN-}=0.7V, C_T=470pF)



Enable Control ON/OFF Voltage vs. Temperature
(V^+=12V)



Standby Current vs. Temperature
($V_{ON/OFF}$=0V)



MEMO