NC2780AK001B033-EV

Synchronous 34V Input Buck Switching Regulator (Controller) Evaluation Board

No.EEV-AK001B033-250501

NC2780AK001B033-EV is the evaluation board for NC2780 which has the below features, benefits and specifications.

GENERAL DESCRIPTION

The NC2780 is a CMOS-based controller-type buck switching regulator that operates using external high-side and low-side NMOSFETs. Equipped with a PFM function, it achieves high efficiency even at light loads, enabling low consumption in the system. Also, the switching frequency can be adjusted in the range of 250 kHz to 1 MHz by an external resistor.

FEATURES

- Input Voltage (Maximum Rating): 4.0 V to 34 V (36V)
- Start-Up Voltage: 4.5 V
- Output Voltage: 3.3 V
- Feedback Voltage Tolerance: 0.64 V ± 1 %
- Quiescent Current: Typ. 15 µA (PFM at no load)
- Oscillation Frequency: 1 MHz(RRT: 33 kΩ)
- Soft-Start: 10 ms (When CSS is 33nF)
  Can be optimized with external capacitance.
- Minimum On-Time: Typ. 100 ns
- Minimum OFF-Time: Typ. 120 ns
- Duty-Over: Oscillation Frequency × 1 to 1 / 4
- Operating mode: Auto switch mode, Force PWM mode, PLL sync mode
- Operating Temperature Range: -40 °C to 105 °C
- SSCG (Spread Spectrum) ※Option
- Power-Good
- Anti-Phase Clock Output
- Under Voltage Lockout (UVLO) Function: V_{CC} = Typ. 3.3 V
- Overvoltage Detection (OVD), Undervoltage Detection (UVD)
- Thermal Shutdown: Typ. 160 °C
- Output Overcurrent Protection: Hiccup mode
- Short-Circuit Protection Function: SW to VIN or GND
- For more details on NC2780 IC, please refer to
  https://www.nisshinbo-microdevices.co.jp/en/products/dc-dc-switching-regulator/spec/?product=nc2780

PART NUMBER INFORMATION

Product Name	Package
NC2780AK001B033	HSOP-18-AK

Description of Configuration

Composition	Item	Description
AK	Package Code	Indicates the package. AK: HSOP-18-AK

Select the output voltage range and current limit threshold voltage.

	Output Voltage Range	Current Limit Threshold Voltage (Typ.)	Reverse Current Limit Threshold Voltage (Typ.)
001	3.15V < V_{OUT} ≤ 5.3V	50mV	-25mV

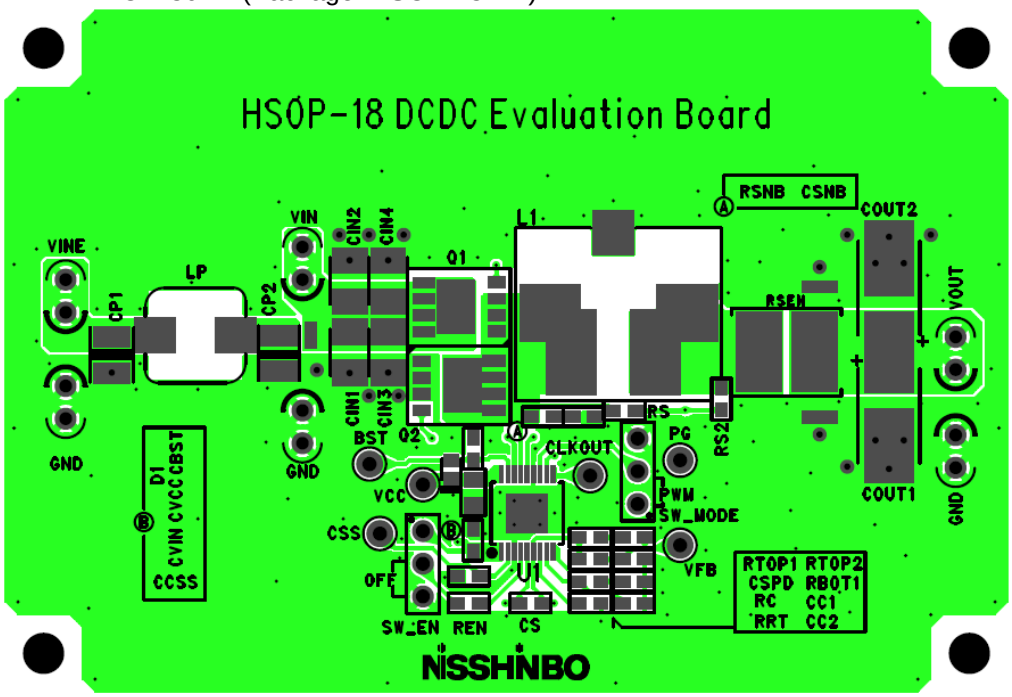
Select the Overcurrent Protection and SSCG.

	Overcurrent Protection	SSCG
B	Non-Latch Type Hiccup Mode	Disable

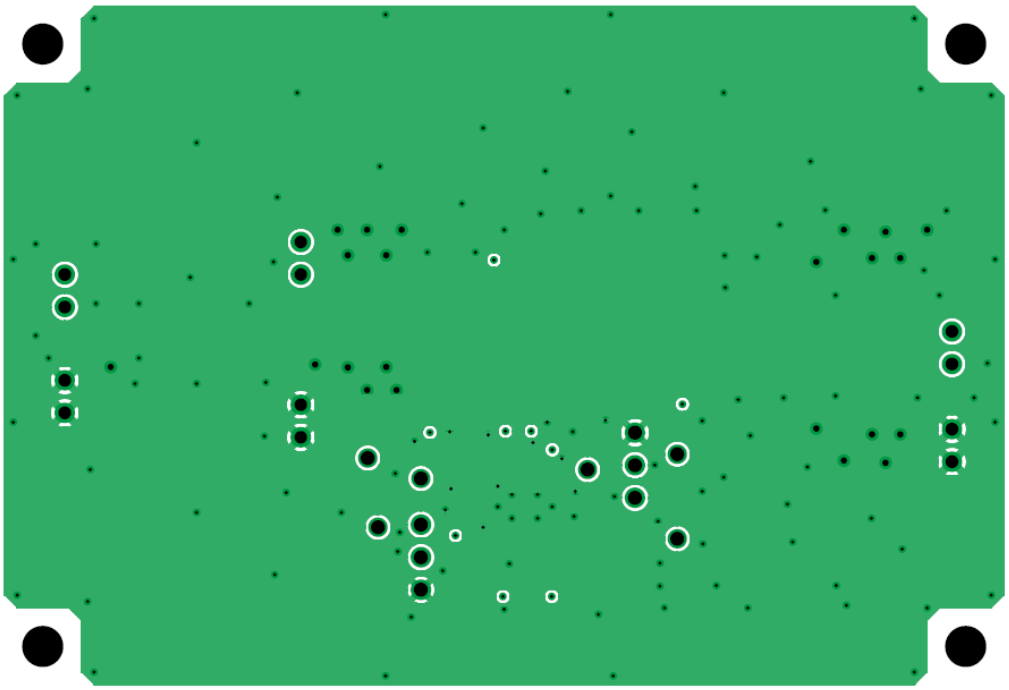
033: 3.3V, Output Voltage

PCB LAYOUT

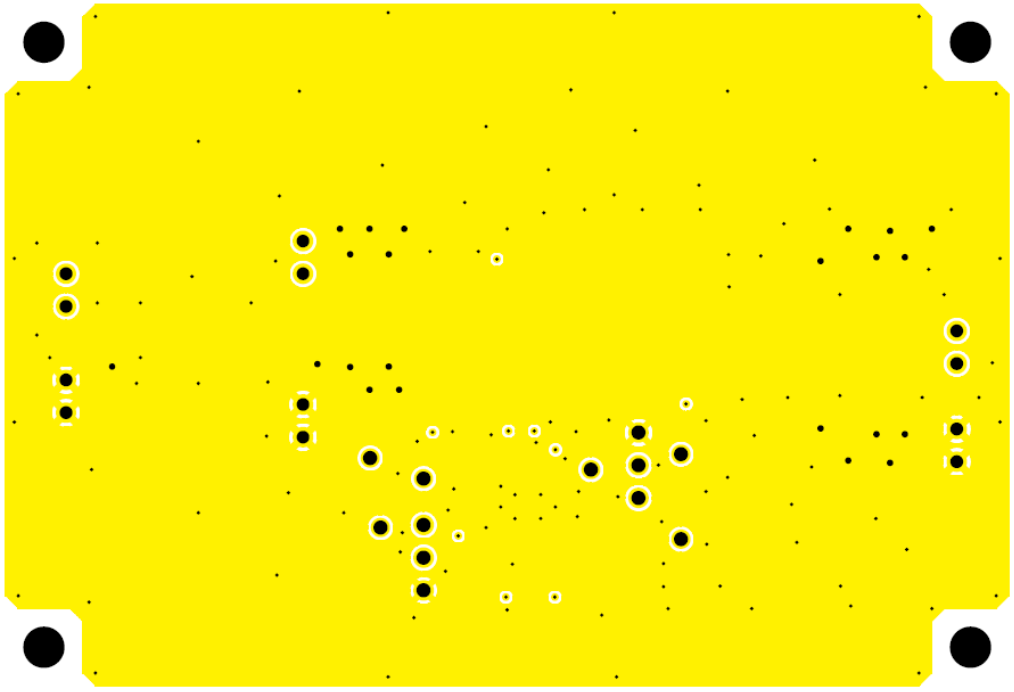
Evaluation board of NC2780AK (Package: HSOP-18-AK)



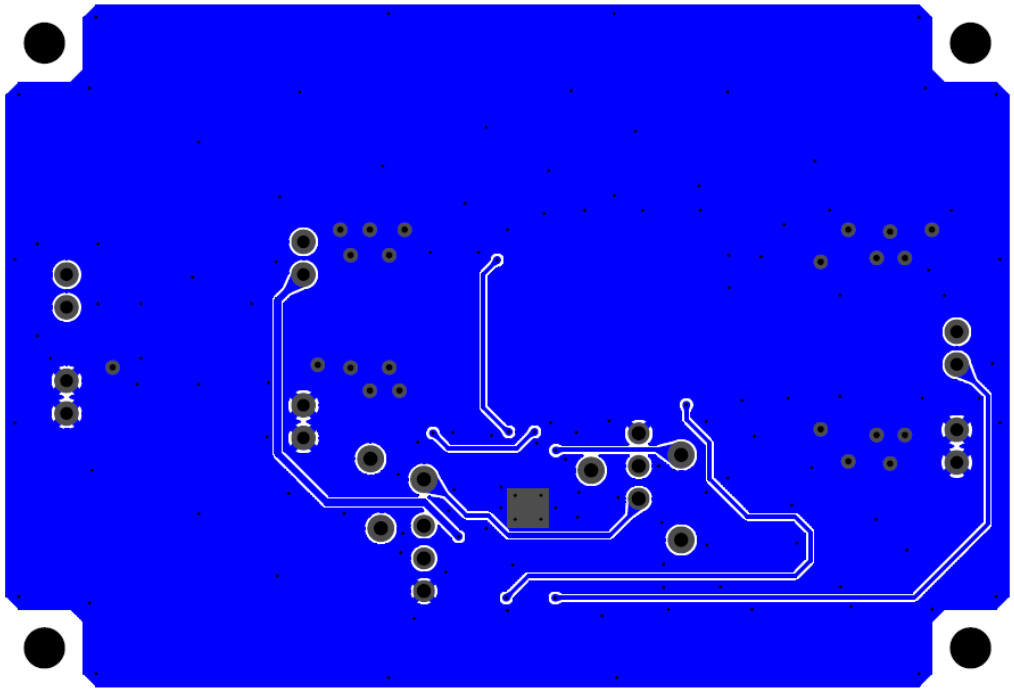
PCB Layout - 1st Layer (Top Layer)



PCB Layout - 2nd Layer

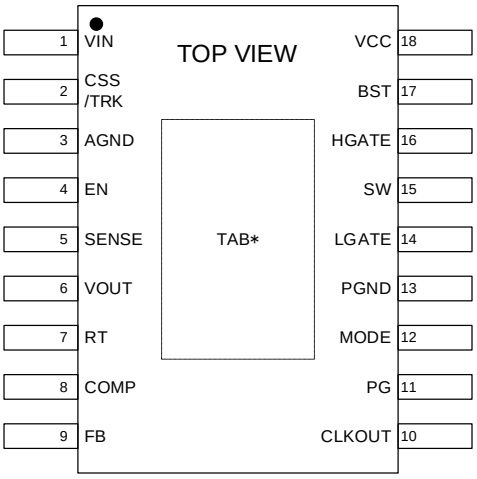


PCB Layout - 3rd Layer



PCB Layout - 4th Layer (Bottom Layer)

PIN DESCRIPTIONS



NC2780 Pin Configuration

*1 The tab on the bottom of the package must be electrically connected to GND (substrate level) when mounted on the board.

Pin No.	Pin Name	I/O	Description
1	VIN	I	Power Supply Input Pin
2	CSS/TRK	I	Soft-Start Adjustment Pin
3	AGND	-	Analog GND pin of internal circuit Be sure to connect it to the PGND pin on the board.
4	EN	I	Enable Pin Input "Low" to this pin shuts down the IC. Input "High" to this pin enables the IC.
5	SENSE	I	Sense pin for inductor current Set the current value for current limit and reverse current limit by connecting a sense resistor.
6	VOUT	I	Power supply input pin for internal circuit / output voltage sense pin
7	RT	I	Timing Resistor pin to Program the Oscillator Frequency Connecting a resistor between the GND pin and this pin sets the switching frequency. Switching frequency range is from 250 kHz to 1 MHz.
8	COMP	O	Error Amplifier Phase Compensation Pin Connect a resistor and a capacitor for phase compensation.
9	FB	I	Feedback Input Pin Set the output voltage by connecting an external resistor.
10	CLKOUT	O	Clock Output Pin Outputs a pulse signal (Duty typ. 50%) whose phase is 180° different from the switching control signal inside the IC during PWM operation.
11	PG	O	Power-Good Output Pin NMOS open drain pin.
12	MODE	I	Mode Control Pin and External Clock Synchronization Input pin High: Forced PWM Control, Low: PWM/PFM Auto Switching Control, Clock input: PLL synchronization mode.
13	PGND	-	Power GND pin Be sure to connect it to the AGND pin on the board.
14	LGATE	O	Gate Drive pin for Bottom(low-side) Synchronous N-Channel MOSFET.
15	SW	I	Switching Pin Connect the high-side MOSFET source, low-side MOSFET drain, and inductor.
16	HGATE	O	Gate Drive pin for Top(high-side) N-Channel MOSFET
17	BST	O	Bootstrapped Pin By connecting a capacitor (C_{BST}) between the BST and SW pin, the voltage between the BST and SW pin is controlled to Typ.5V. C_{BST} is charged from VCC.
18	VCC	O	Output pin of Internal 5V linear Regulator The control circuits of drive external MOSFETs are powered from this voltage source.

For details, refer to " *TYPICAL APPLICATION CIRCUIT* " and " *THEORY OF OPERATION* ".

ABSOLUTE MAXIMUM RATINGS

	Symbol	Ratings	Unit
VIN Pin Voltage	V_{IN}	-0.3 to 36	V
EN Pin Input Voltage	V_{EN}	-0.3 to V_{IN} + 0.3 ≤ 36	V
CSS/TRK Pin Voltage	$V_{CSS/TRK}$	-0.3 to V_{IN} + 0.3 ≤ 3	V
VOUT Pin Voltage	V_{OUT}	-0.3 to 6	V
SENSE Pin Voltage	V_{SENSE}	-0.3 to 6	V
RT Pin Voltage	V_{RT}	-0.3 to 3	V
COMP Pin Voltage	V_{COMP}	-0.3 to V_{CC} + 0.3 ≤ 6	V
FB Pin Voltage	V_{FB}	-0.3 to 3	V
VCC Pin Voltage	V_{CC}	-0.3 to 6	V
Output Current for VCC Pin		Internally limited	mA
BST Pin Voltage	V_{BST}	SW - 0.3 to SW + 6	V
HGATE Pin Voltage	V_{HGATE}	SW - 0.3 to BST	V
SW Pin Voltage	V_{SW}	-0.3 to V_{IN} + 0.3 ≤ 36	V
LGATE Pin Voltage	V_{LGATE}	-0.3 to 6	V
MODE Pin Voltage	V_{MODE}	-0.3 to 6	V
PG Pin Voltage	V_{PG}	-0.3 to 6	V
CLKOUT Pin Voltage	V_{CLKOUT}	-0.3 to V_{CC} + 0.3 ≤ 6	V
Junction Temperature Range [*1]	T_j	-40 to 125	°C
Storage Temperature Range	T_{stg}	-55 to 125	°C

ABSOLUTE MAXIMUM RATINGS

Electronic and mechanical stress momentarily exceeded absolute maximum ratings may cause permanent damage and may degrade the lifetime and safety for both device and system using the device in the field. The functional operation at or over these absolute maximum ratings is not assured.

[*1] Please refer to "*THERMAL CHARACTERISTICS*" for the thermal resistance under our measurement board conditions.

RECOMMENDED OPERATING CONDITIONS

	Symbol	Ratings	Unit
Input Voltage	V_{IN}	4.0 to 34	V
Operating Temperature Range	T_a	−40 to 105	°C
Output Voltage Range	V_{OUT}	0.7 to 5.3	V

RECOMMENDED OPERATING CONDITIONS

All of electronic equipment should be designed that the mounted semiconductor devices operate within the recommended operating conditions. The semiconductor devices cannot operate normally over the recommended operating conditions, even if when they are used over such conditions by momentary electronic noise or surge. And the semiconductor devices may receive serious damage when they continue to operate over the recommended operating conditions.

ELECTRICAL CHARACTERISTICS

V_{IN} = 12 V, V_{EN} = V_{IN} unless otherwise specified.
For parameter that does not describe the temperature condition, the MIN / MAX value under the condition of −40 °C ≤ T_a ≤ 105 °C is described.

Parameter		Symbol	Conditions	MIN	TYP	MAX	Unit
Start-Up Voltage		V_{START}		-	-	4.5	V
VCC Pin Voltage (VCC - AGND)		V_{CC}	V_{FB} = 0.672 V	4.9	5.1	5.3	V
Shutdown Current		I_{SD}	V_{IN} = 34 V, V_{EN} = 0 V	-	3	21	µA
Quiescent Current 1 at Switching Stop in PWM Mode	NC2780AK0xxx	I_{Q1}	V_{FB} = 0.672 V, V_{MODE} = 5 V, V_{OUT} = V_{SENSE} = V_{SW} = 5 V	-	1.0	1.5	mA
	NC2780AK1xxx		V_{FB} = 0.672 V, V_{MODE} = 5 V, V_{OUT} = V_{SENSE} = V_{SW} = 1.5 V	-	1.6	2.1	
Quiescent Current 2 at Switching Stop in PFM Mode	NC2780AK0xxx	I_{Q2}	V_{FB} = 0.672 V, V_{MODE} = 0 V, V_{OUT} = V_{SENSE} = V_{SW} = 5 V	-	15	75	µA
	NC2780AK1xxx		V_{FB} = 0.672 V, V_{MODE} = 0 V, V_{OUT} = V_{SENSE} = V_{SW} = 1.5 V	-	45	145	
UVLO Release Voltage		$V_{UVLOREL}$	V_{CC} Rising	3.85	4.0	4.2	V
UVLO Detection Voltage		$V_{UVLODET}$	V_{CC} Falling	3.1	3.3	3.4	V
FB Pin Voltage		V_{FB}	T_a = 25 °C	0.6336	0.64	0.6464	V
			-40 °C ≤ T_a ≤ 105 °C	0.6272		0.6528	V
Oscillation Frequency 0		f_{OSC0}	R_{RT} = 135 kΩ	225	250	275	kHz
Oscillation Frequency 1		f_{OSC1}	R_{RT} = 32 kΩ	900	1000	1100	kHz
Minimum OFF Time		t_{OFF}	V_{IN} = 5 V, V_{OUT} = 5 V	-	120	190	ns
Minimum ON Time		t_{ON}	V_{IN} = 5 V, V_{OUT} = 0.7 V	-	100	120	ns
Synchronizing Frequency		f_{SYNC}	f_{OSC} as the reference	f_{osc}×0.5	-	f_{osc}×1.5	kHz
				250	-	1000	kHz
Soft-Start Time 1		t_{SS1}	CSS/TRK = OPEN	0.4	-	0.75	ms
Soft-Start Time 2		t_{SS2}	C_{SS} = 4.7 nF	1.4	-	2.0	ms
Charge Current for Soft-Start Pin		I_{TSS}	$V_{CSS/TRK}$ = 0 V	1.8	2	2.2	µA
CSS/TRK Pin Voltage at End of Soft-Start		V_{SSEND}		V_{FB}	V_{FB} + 0.03	V_{FB} + 0.06	V
Discharge Resistance for CSS/TRK Pin		R_{ONDIS_CSS}	V_{IN} = 4.5 V, V_{EN} = 0 V, $V_{CSS/TRK}$ = 3 V	2.0	3.0	5.0	kΩ

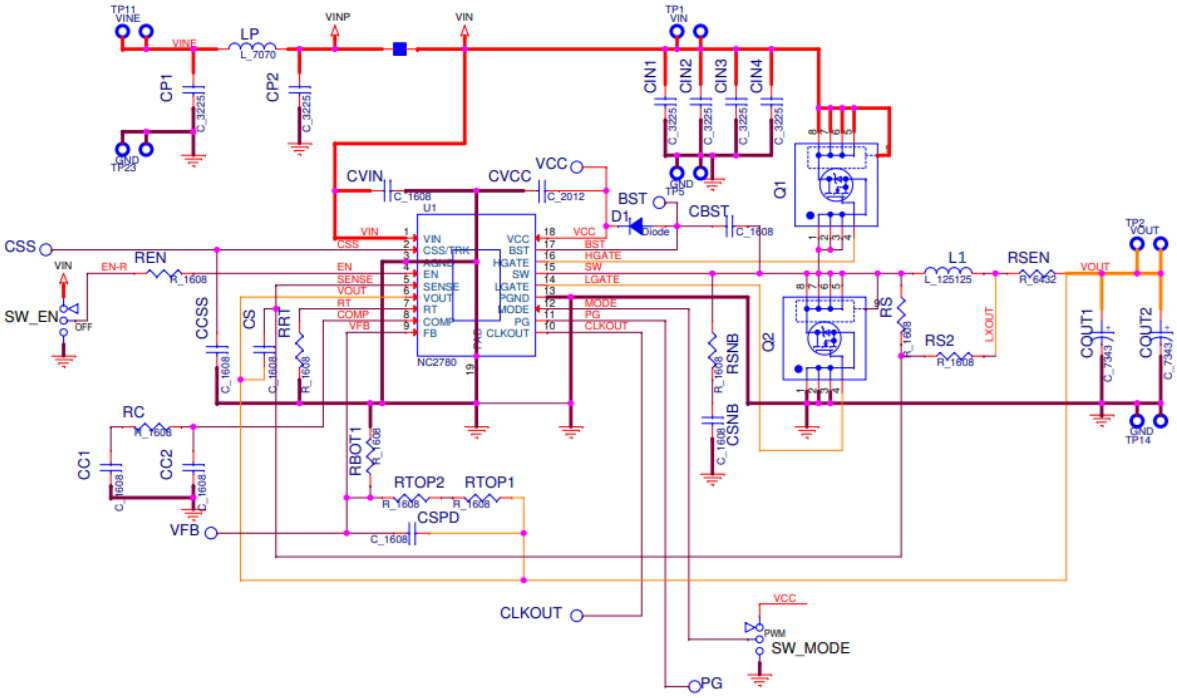
All electrical characteristic parameters that specify the minimum and maximum specifications are tested under the condition of $T_j \approx T_a$ = 25 °C .

V_{IN} = 12 V, V_{EN} = V_{IN} unless otherwise specified.
For parameter that do not describe the temperature condition, the MIN / MAX value under the condition of −40 °C ≤ T_a ≤ 105 °C is described.

Parameter		Symbol	Conditions	MIN	TYP	MAX	Unit
On-resistance of Pull-up MOSFET (HGATE Pin)		$R_{UPHGATE}$	(BST - SW) = 5 V	-	2.5	7.0	Ω
On-resistance of Pull-down MOSFET (HGATE Pin)		$R_{DOWNHGATE}$	(BST - SW) = 5 V	-	1.5	5.0	Ω
On-resistance of Pull-up MOSFET (LGATE Pin)		$R_{UPLGATE}$		-	4.0	8.5	Ω
On-resistance of Pull-down MOSFET (LGATE Pin)		$R_{DOWNLGATE}$		-	1.5	5.0	Ω
Current Limit Threshold Voltage (SENSE - VOUT)	NC2780AKx01x	V_{ILIMIT}	MODE = “High”	40	50	60	mV
	NC2780AKx02x			60	70	80	mV
	NC2780AKx03x			90	100	110	mV
Reverse Current Sense Threshold (SENSE - VOUT)	NC2780AKx01x	$V_{IREVLIMIT}$	MODE = “High”	-35	-25	-15	mV
	NC2780AKx02x			-45	-35	-25	mV
	NC2780AKx03x			-60	-50	-40	mV
SW Short to GND Detector Threshold Voltage (VIN - SW)		$V_{SWSHORTDET}$		0.325	0.43	0.525	V
SW Short to VCC Detector Threshold Voltage (SW - PGND)		$V_{SWSHORTDET}$		0.310	0.43	0.535	V
EN Pin “High” Input Voltage		V_{ENH}		1.3	-	-	V
EN Pin “Low” Input Voltage		V_{ENL}		-	-	1.1	V
EN Pin “High” Input Current		I_{ENH}	V_{IN} = 34 V, V_{EN} = 34 V	0.20	-	2.45	µA
EN Pin “Low” Input Current		I_{ENL}	V_{IN} = 34 V, V_{EN} = 0 V	-1.00	0	1.00	µA
FB Pin “High” Input Current		I_{FBH}	V_{IN} = 34 V, V_{FB} = 3 V	-0.1	0	0.1	µA
FB Pin “Low” Input Current		I_{FBL}	V_{IN} = 34 V, V_{FB} = 0 V	-0.1	0	0.1	µA
MODE “High” Input Voltage		V_{MODEH}		1.35	-	-	V
MODE “Low” Input Voltage		V_{MODEL}		-	-	0.74	V
MODE “High” Input Current		I_{MODEH}	V_{IN} = 34 V, V_{MODE} = 6 V	1.00	-	6.80	µA
MODE “Low” Input Current		I_{MODEL}	V_{IN} = 34 V, V_{MODE} = 0 V	-1.0	0	1.0	µA
CLKOUT Pin “High” Output Voltage		$V_{CLKOUTH}$	CLKOUT = Hi - Z	4.7	-	VCC	V
CLKOUT Pin “Low” Output Voltage		$V_{CLKOUTL}$	CLKOUT = Hi - Z	0	-	0.1	V
PG Pin “Low” Output Voltage		V_{PGOFF}	V_{IN} = 4.0 V, I_{PG} = 1 mA	-	0.26	0.54	V
PG Pin Leakage Current		I_{PGOFF}	V_{IN} = 34 V, V_{PG} = 6 V	-0.10	0	0.10	µA
FB Pin OVD Threshold Voltage		$V_{FBOVDDET}$	V_{FB} Rising	0.680	V_{FB}×1.10	0.740	V
		$V_{FBOVDREL}$	V_{FB} Falling	0.664	V_{FB}×1.07	0.712	V
FB Pin UVD Threshold Voltage		$V_{FBUVDDET}$	V_{FB} Falling	0.556	V_{FB}×0.90	0.604	V
		$V_{FBUVDREL}$	V_{FB} Rising	0.574	V_{FB}×0.93	0.628	V
Trans Conductance Amplifier		g_m (EA)	V_{COMP} = 1.5 V	0.35	1	1.55	mS

All electrical characteristic parameters that specify the minimum and maximum specifications are tested under the condition of $T_j \approx T_a$ = 25 °C .

TYPICAL APPLICATION CIRCUIT



NC2780AK Typical Application Circuit

Recommended values for components

Symbol	Value
CP1	OPEN
LP	OPEN
CP2	OPEN
CIN1,2,3,4	10μF * 3 set
COUT1,2	100μF
CBST	0.22μF
CVCC	2.2μF
L1	1.0μH
RSEN	3mΩ
CSPD	47pF
CC1	3.9nF
CC2	220pF
CCSS	33nF
CS	10nF
CVIN	OPEN
CSNB	OPEN
RSNB	OPEN
RS	OPEN
RCE	Short
RTOP1	91kΩ
RTOP2	430Ω
RBOT1	22kΩ
RRT	33kΩ
RC	4.7kΩ
RS2	1kΩ

TECHNICAL NOTES

The performance of power source circuits using this IC largely depends on peripheral circuits. When selecting the peripheral components, please consider the conditions of use. Do not allow each component, PCB pattern or the IC to exceed their respected rated values (voltage, current, and power) when designing the peripheral circuits.

- It is recommended to mount all the external components on the same layer as the IC on board. External components must be connected as close as possible to the Ics and make wiring as short as possible. Especially, the capacitor connected in between VIN pin and GND pin must be wiring the shortest. If their impedance is high, internal voltage of the IC may shift by the switching current, and the operating may be unstable. Make the power supply and GND lines sufficient.

- Since the current loop of a switching regulator changes with each switching, the current changes significantly and high-frequency noise may be generated due to parasitic capacitance and inductance. Design the board layout so that the current loop length is as short as possible.

- AGND and PGND for the controller must be wired to the GND line at the low impedance point of the same layer with C_{IN} and C_{OUT}. Reduce the impedance between the AGND and PGND of IC.

- It is recommended that the C_{IN}, high-side, and low-side MOSFETs be placed on the same layer as the IC on PCB. If vias are used and placed on a different layer from the IC, the parasitic inductance of vias may affect the ringing of the SW pin voltage and increase noise.

- R_{TOP}, R_{BOT}, and C_{SPD} should be set close to the FB pin, but mount them away from the inductor, SW pin, and BST pin to avoid their noise.

- Place a capacitor (C_{BST}) as close as possible to the SW pin and the BST pin. If controlling slew rate for EMI, a resistor (R_{BST}) should be in series between the BST pin and the capacitor (C_{BST}), but not be in series to MOSFET for HGATE and LGATE pins. Because connecting the resistor in series to the MOSFET becomes a cause of a through-current.

- The tab on the bottom of the HSOP-18-AK package must be connected to GND when mounted on the board. To improve thermal dissipation on the multilayer board, set via to release the heat to the other layer in the connecting part of the tab on the bottom. Likewise, thermal dissipation for MOSFET is required.

- The MODE pin requires the “High” / “Low” voltages with the high stability when the forced PWM mode (MODE = “High”) or the PFM mode (MODE = “Low”) is enabled. If the voltage with the high stability cannot be applied, connection to the VCC pin as “High” level or the AGND pin as “Low” level is recommended. If connecting to the PGND pin as noisy, a malfunction may occur. Avoid the use of the MODE pin being “Open”.

- If V_{OUT} is a minus potential, the setup cannot occur.

- The power for the controller and for the high-side MOSFET must be used on the same power supply, since the internal slope compensation is applied as the power supply voltage of the high-side MOSFET is equal to the controller’s. If applying the other power supply voltage, the controller will become unstable owing to the inappropriate slope compensation.

- The thermal shutdown function prevents the IC from fuming and ignition but does not ensure the IC’s reliability or keep the IC below the absolute maximum ratings. The thermal shutdown function does not operate on the heat generated by other than the normal IC operation such as latch-up and overvoltage application.

- The thermal shutdown function operates in a state over the absolute maximum ratings, therefore the thermal shutdown function should not be used for a system design.

X-ON Electronics

Largest Supplier of Electrical and Electronic Components

Click to view similar products for Power Management IC Development Tools ***category:***

Click to view products by Nisshinbo ***manufacturer:***

Other Similar products are found below :

BQ24080EVM ISL91108IIA-EVZ DCD48AP480T320A50 HIP2103-4DEMO1Z NCP10671B05GEVB AP61100QZ6-EVM AP62250WU-EVM SAMPLEBOXILD8150TOBO1 AP63300WU-EVM AP62300Z6-EVM BTS7030-2EPA TLT807B0EPV 1944 EVALM7HVIGBTPFCINV4TOBO1 TDINV3000W50B-KIT NCP1681CCM1KWGEVB APEK89303KET-01-T NCP1681MM500WGEVB SI83401BAA-KIT SI83402BAA-KIT SI83411BAA-KIT SI83412BAA-KIT MIKROE-5294 APEK49406GES-01-T EVB81332 MIKROE-5019 BTG70902EPLDAUGHBRDTOBO1 TAB-48017 MIKROE-5510 PAM2423AECADJ-EVM EVAL6EDL04I065PRTOBO1 EVB81340-100W RTKA489EPRDK0010BU DC3107A EVL4248-QV-00A EVQ4371-V-1000-00A EVL28167-B-Q-00A NEVB-NID1100UL EV6631B-L-00A EVL1608C-TL-00A BD9E203FP4-EVK-001 EVALFFXMR20W2M1HXTOBO2 MOS7GENERICPOWBOARDTOBO1 EVAL7126G100VGANCTOBO1 EVAL7136U100VGANCTOBO1 EVALFFXMR20W2M1HXTOBO1 APEK49100KJP-A-03-T XC9291B12E0-EVB-01 APEK85000GEJ-01-T 1EDI3051EVALBOARDTOBO2