



NEX8080 series

Wide V_{CC} range multi-mode flyback controller

Rev. 1 — 30 September 2024

Product data sheet

1. General description

The NEX8080 device series (NEX8080x) are intelligent multi-mode PWM controller implemented with peak current mode control. As the load changes, it automatically switches between Continuous Conduction Mode (CCM), Quasi-Resonant (QR) mode, Discontinuous Conduction Mode (DCM) and Pulse Frequency Modulation (PFM) Mode to maintain a high efficiency across the entire load range. To achieve an ultralow standby power, Burst Mode (BM) is implemented in very light load or no-load condition.

The wide 10 V to 83 V V_{CC} range makes NEX8080x devices suitable for wide output voltage range application, such as USB PD/PPS which require an output range between 3.3 V to 21 V.

The NEX8080x offers comprehensive protection including output OV/UV, V_{CC} OV/UV, OPP, OCP, line voltage BROWN-IN/OUT, secondary SR short, CS open/short, internal/external OTP, etc.

Furthermore, the spread spectrum and smart driving function can minimize noise and improve EMI performance.

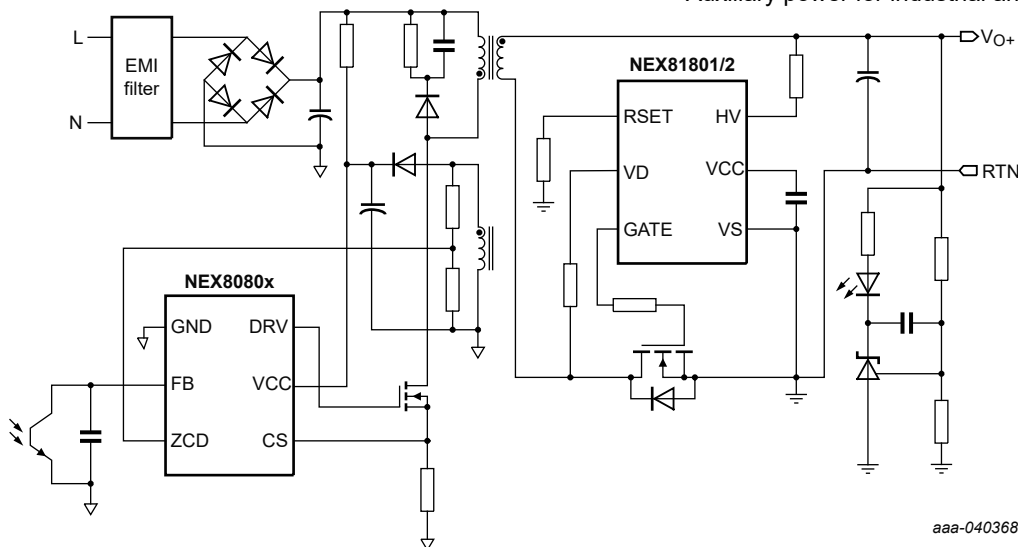
The NEX8080x device series comes in a cost-effective TSOT23-6 package.

2. Features and benefits

- Wide V_{CC} range (10 V to 83 V) supports PD/PPS
- Multimode support CCM/QR/DCM/PFM
- Peak Load Mode (NEX80805)
- Valley switching operation in QR/DCM/PFM
- Burst mode with ultra-low operation current under light load and no load
- 65 kHz or 85 kHz maximum frequency options
- Internal soft start (SST)
- Output over voltage protection (OVP)
- Spread spectrum for better EMI
- Internal over temperature protection (OTP)
- External OTP by NTC resistor
- V_{CC} over/under voltage protection (V_{CC} OV/UV)
- Line voltage brown-in, brown-out (BNI/BNO)
- Output short circuit protection (SCP)
- CS open/short protection
- Secondary rectifier short protection (SRSP)
- Overload protection (OLP)
- Overpower protection (OPP) to meet LPS
- TSOT23-6 package

3. Applications

- USB PD/QC chargers
- AC/DC adapters for portable devices
- Auxiliary power for industrial and home equipment



4. Ordering information

Table 1. Ordering information

Type number	Package			
	Temperature range	Name	Description	Version
NEX80801DA	-40 °C to +125 °C	TSOT23-6FC	Plastic, surface-mounted package; 6 leads	SOT8061-1
NEX80805DA	-40 °C to +125 °C	TSOT23-6FC	Plastic, surface-mounted package; 6 leads	SOT8061-1
NEX80808DA	-40 °C to +125 °C	TSOT23-6FC	Plastic, surface-mounted package; 6 leads	SOT8061-1
NEX80809DA	-40 °C to +125 °C	TSOT23-6FC	Plastic, surface-mounted package; 6 leads	SOT8061-1

5. Marking

Table 2. Marking code

Type number	Marking code
NEX80801DA	NTE
NEX80805DA	NTF
NEX80808DA	NTH
NEX80809DA	NTJ

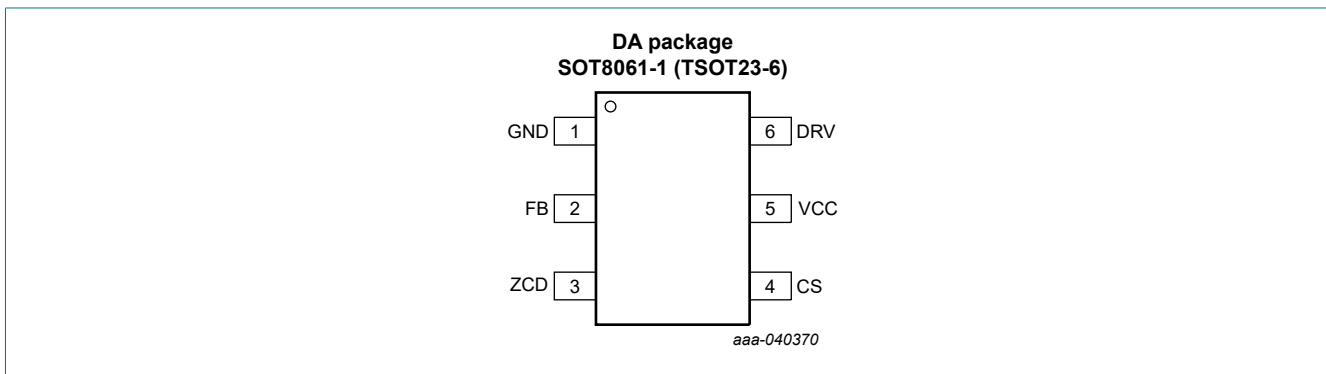
6. Device comparison

Table 3. Device comparison

Type number	F _{SW_MAX} (kHz)	Peak load mode	I _{out} limited by	Optimized application
NEX80801DA	65	No	OPP	65 W PD
NEX80805DA	65	Yes	OCP	65 W PD
NEX80808DA	65	No	OPP	33 W PD
NEX80809DA	85	No	OPP	33 W PD

7. Pinning information

7.1. Pinning



7.2. Pin description

Pin		I/O	Description
Name	Number		
GND	1	PWR	Ground
FB	2	IN	Secondary side voltage feedback pin. Connect to the collector of the opto-coupler.
ZCD	3	IN	Auxiliary voltage sense, brown-in/-out and quasi-resonant valley detection.
CS	4	IN	Current sense pin, connect to the sense resistor of the MOSFET.
V _{CC}	5	PWR	Supply input terminal
DRV	6	OUT	Gate drive output to drive the external MOSFET

8. Product specifications

8.1. Limiting values

Table 4. Limiting values

Symbol	Parameter	Conditions	Min	Max	Unit
V _{CC}	supply voltage		-0.3	100	V
DRV	gate drive voltage		-0.3	V _{DRV_H}	V
CS, FB, ZCD	CS, FB, ZCD voltage		-0.3	5.5	V
T _J	operating junction temperature		-40	T _{SD}	°C
ESD					
V _{ESD}	ESD voltage	HBM: ANSI/ESDA/JEDEC JS-001 class 2, all pins except CS	-2000	+2000	V
		HBM: ANSI/ESDA/JEDEC JS-001 class 1C, CS pin only	-1500	+1500	V
		CDM: ANSI/ESDA/JEDEC JS-001 class C2a	-500	+500	V

8.2. Thermal characteristics

Table 5. Thermal characteristics

Symbol	Parameter	TSOT23	Unit
R _{ΘJA}	junction-to-ambient thermal resistance	127	C/W

8.3. Recommended operating conditions

Table 6. Recommended operating conditions

Symbol	Parameter	Conditions	Min	Max	Unit
V _{CC}	supply voltage		10	V _{CC_OVP}	V
CS, ZCD	CS, ZCD voltage		0	5	V
T _J	operating junction temperature		-40	125	°C

8.4. Electrical characteristics

Table 7. Electrical characteristics

Where V_{CC} = 10 V to 90 V; T_J = -40 °C to 125 °C; typical values are measured at V_{CC} = 20 V, T_J = 25 °C (unless otherwise noted).

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Supply (V_{CC} pin)						
V _{CC_ON}	V _{CC} on threshold voltage		-	17	18	V
V _{CC_OFF}	V _{CC} off threshold voltage		-	8.4	-	V
V _{CC_HOLD}	V _{CC} hold threshold voltage		-	9	9.4	V
V _{CC_OVP}	V _{CC} OVP threshold voltage		83.5	89	93	V
V _{CC_DIS}	V _{CC} discharge threshold voltage		-	94	99	V
V _{CC_DIS_HYS}	V _{CC} discharge threshold hysteresis voltage		-	5	-	V
I _{DISCHARGE}	V _{CC} discharge current		-	5	-	mA
I _{STARTUP}	V _{CC} startup current		-	5	8	μA
I _{NORMAL}	V _{CC} normal operating current	NEX80801, NEX80805, NEX80808 F _{SW} = 65 kHz, V _{CC} = 20 V, 1 nF at DRV pin	-	1.25	1.75	mA
		NEX80809 F _{SW} = 85 kHz, V _{CC} = 20 V, 1 nF at DRV pin	-	1.6	2.24	mA
I _{BURST}	V _{CC} current in burst mode		-	270	350	μA
Feedback input (FB pin)						
V _{FB_OPEN}	FB pin open-circuit voltage		-	5	-	V
R _{FB}	FB internal pull-up resistor		-	28	-	kΩ
V _{FB_BURST_OFF}	FB voltage when DRV pulse is skipped		-	0.3	-	V
V _{FB_BURST_ON}	FB voltage when DRV pulse is resumed		-	0.35	-	V
V _{FB_OLP}	overload protection threshold voltage		-	3.5	-	V
t _{D_OLP}	overload protection deglitch time		-	50	-	ms
K _{FB}	divider ratio from FB to CS		-	5	-	V/V
t _{SS}	soft start time	0 V to 0.4 V V _{CS}	-	4.3	-	ms
Current sense input (CS pin)						
t _{LEB_PWM}	leading edge blanking for PWM comparator		-	320	-	ns
V _{CS_PWM_MAX}	maximum current limit threshold for PWM comparator		0.365	0.4	0.43	V
t _{LEB_OCF}	leading edge blanking for OC fault protection		-	90	-	ns
V _{CS_OCF}	secondary rectifier (SR) short-circuit fault protection		0.61	0.65	0.7	V
t _{D_OCF}	SR short-circuit fault deglitch cycles		-	3	-	cycles
V _{CS_SHORT}	CS pin short detection threshold		-	0.04	-	V
t _{BLK_CS_SHORT}	CS pin short detection blanking time	I _{line} = 90 μA	-	4.5	-	μs
t _{D_CS_SHORT}	CS pin short fault deglitch cycles		-	3	-	cycles

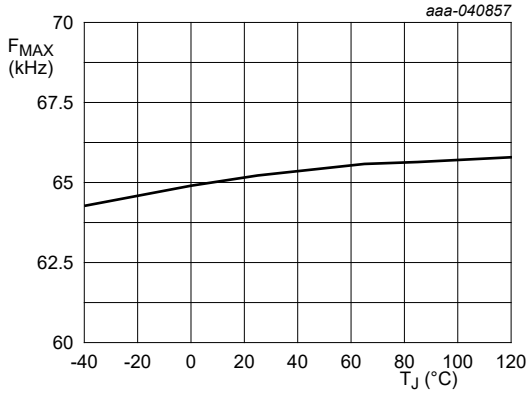
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Zero current detection (ZCD pin)						
I _{ZCD_VALLEY}	valley detection threshold		-	9	-	μA
t _{W_VALLEY}	valley window time	NEX80801, NEX80805, NEX80808	-	3	-	μs
		NEX80809	-	2.5	-	μs
I _{BNI}	brown-in detection threshold	T _J = 25 °C	-	91	96	μA
I _{BNO}	brown-out detection threshold	[1]	79	85	91	μA
t _{D_BNO}	brown-out deglitch time		-	50	-	ms
V _{ZCD_OVP}	ZCD OVP threshold		3.3	3.6	3.8	V
t _{D_ZCD_OVP}	ZCD OVP deglitch time		-	7	-	cycles
V _{ZCD_SCP}	output short-circuit protection threshold		-	0.3	-	V
t _{D_ZCD_SCP}	output short-circuit protection deglitch time		-	7	-	cycles
t _{BLK_UVP}	UVP/SCP blanking time during soft start		-	20	-	ms
Gate Drive (DRV pin)						
V _{DRV_L}	DRV low level		-	-	0.2	V
V _{DRV_H}	DRV high level	V _{CC} = 12 V	8	-	-	V
	DRV high level clamp voltage	V _{CC} ≥ 15 V	-	11.5	-	V
t _r	DRV rising time	C _{load} = 1 nF	-	250	-	ns
t _f	DRV falling time	C _{load} = 1 nF	-	30	-	ns
Control law						
F _{MAX}	maximum switching frequency	NEX80801, NEX80805, NEX80808	60	65	70	kHz
		NEX80809	76	85	91	kHz
F _{MIN}	minimum switching frequency		20	25	30	kHz
F _{PEAK}	maximum switching frequency in peak load mode	NEX80805	117	130	143	kHz
D _{MAX}	maximum duty cycle		-	78	-	%
Over temperature protection						
T _{SD}	internal thermal shutdown threshold		-	155	-	°C
T _{SD_HYS}	internal thermal shutdown hysteresis		-	30	-	°C
V _{CS_OTP}	external OTP trigger voltage		-	V _{ZCD} /7	-	V
t _{D_OTP}	external OTP deglitch time		-	1.5	-	ms

[1] Guaranteed by design.

8.5. Typical characteristics

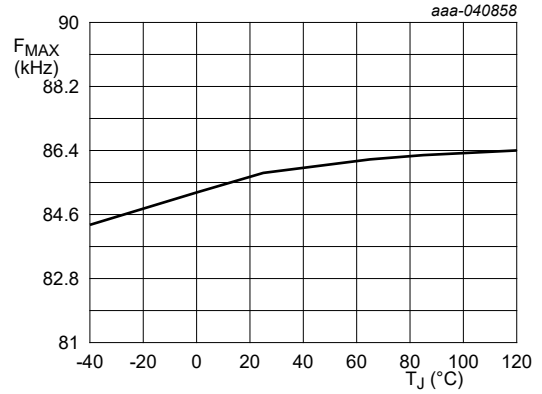
Table 8. Typical characteristics

<p>Fig. 1. V_{CC_ON} vs. junction temperature</p>	<p>Fig. 2. V_{CC_OFF} vs. junction temperature</p>
<p>Fig. 3. V_{CC_HOLD} vs. junction temperature</p>	<p>Fig. 4. V_{CC_OVP} vs. junction temperature</p>
<p>Fig. 5. I_{STARTUP} vs. junction temperature</p> <p>V_{CC} = 16 V</p>	<p>Fig. 6. I_{BURST} vs. junction temperature</p> <p>V_{CC} = 20 V</p>



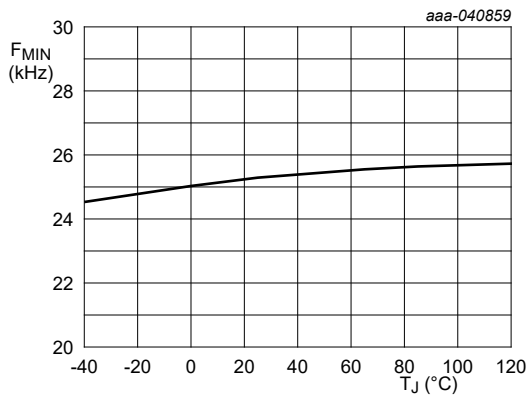
For NEX80801, NEX80805, NEX80808
V_{CC} = 20 V

Fig. 7. F_{MAX} vs. junction temperature



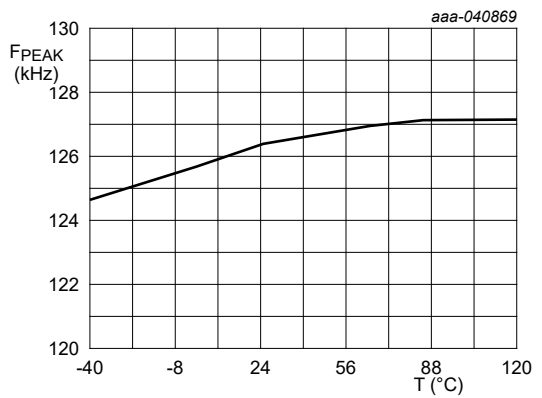
For NEX80809
V_{CC} = 20 V

Fig. 8. F_{MAX} vs. junction temperature



V_{CC} = 20 V

Fig. 9. F_{MIN} vs. junction temperature



For NEX80805
V_{CC} = 20 V

Fig. 10. F_{PEAK} vs. junction temperature

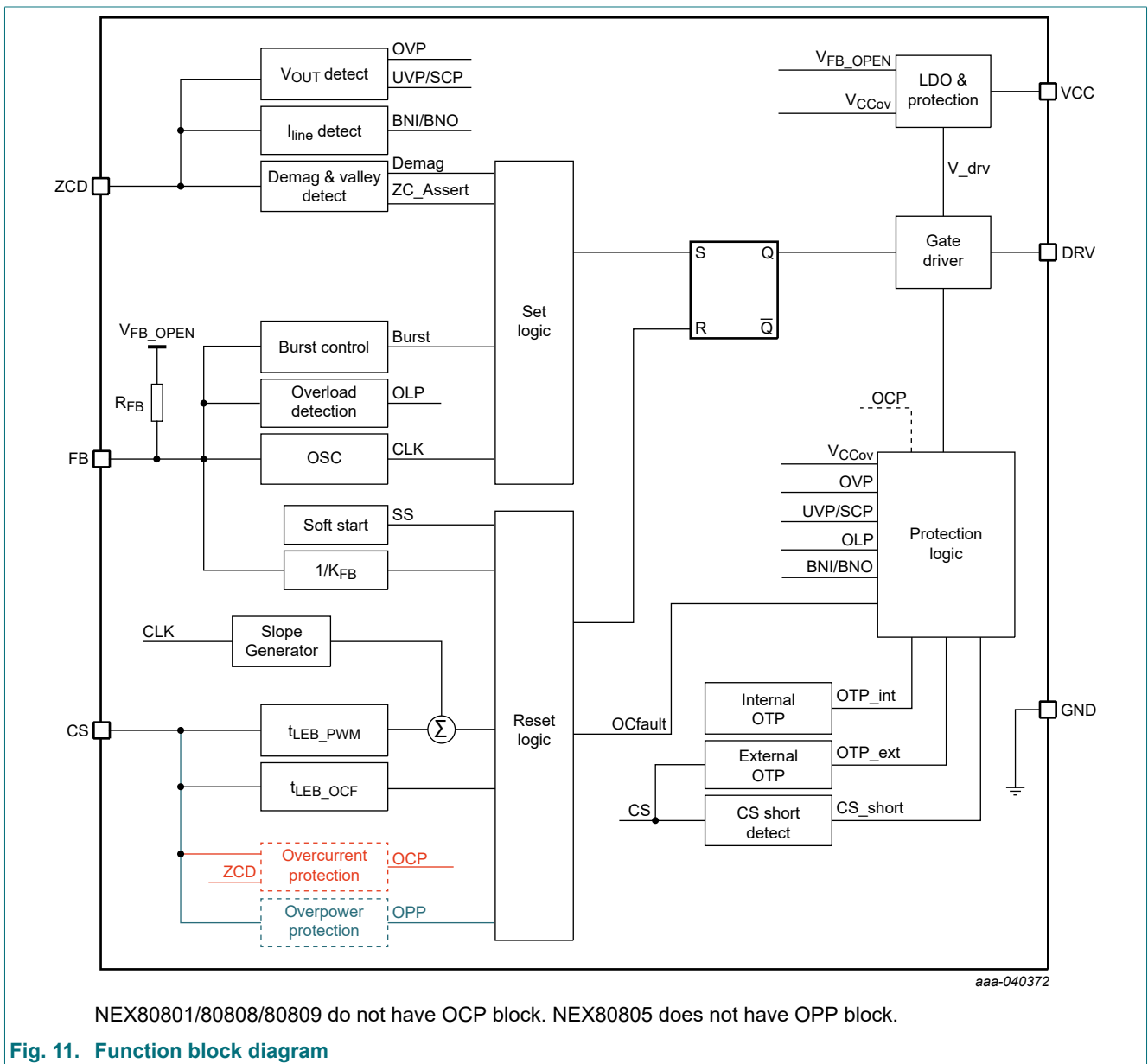
9. Detailed Description

9.1. Overview

The NEX8080x is an intelligent multi-mode PWM controller implemented with peak current mode control. Under conditions of low input line voltage and heavy load, the NEX8080x works in Continuous Conduction Mode (CCM) to reduce conduction loss. As the input voltage increases, or the load current decreases, it enters Quasi-Resonant (QR) mode or Discontinuous Conduction Mode (DCM) with valley switching to reduce the switching loss. As the load current further decreases, it enters Pulse Frequency Modulation (PFM) mode with frequency foldback to maintain a high efficiency across the entire load range. To achieve an ultralow standby power, Burst Mode (BM) is implemented under very light load or no-load conditions, while the minimum switching frequency is fixed at 25 kHz to avoid audible noise.

9.2. Functional block diagram

The functional block diagram for the NEX8080 series of products is shown in Fig. 11.



9.3. Feature description

9.3.1. Startup

The NEX8080x devices are enabled when V_{CC} voltage is higher than the turn-on threshold V_{CC_ON}, and disabled when it drops below the turn-off threshold V_{CC_OFF}. The voltage dips during startup; a hysteresis is built in to avoid shutdown during this process. As the AC input voltage is supplied, the voltage across the input bulk capacitor will charge the V_{CC} capacitor through the startup resistor R_{START} as shown in Fig. 12. Before being enabled, the VCC pin consumes only I_{STARTUP} which is typically 5 µA. Thus, a relatively larger value can be chosen for R_{START} to reduce the power consumption. However, too large of a resistance for R_{START} will increase the startup time. Nexperia recommends using two 1.5 MΩ resistors with 1206 package in series for R_{START}.

Once V_{CC} voltage is higher than V_{CC_ON} threshold, the NEX8080x is enabled and the DRV pulse is generated to drive the external MOS. The current consumption at the VCC pin will increase to I_{NORMAL}, which is much higher than the current from startup resistor. Then the V_{CC} voltage decreases. It is important that the auxiliary winding voltage increases enough to take over and maintain the V_{CC} voltage in the normal range before it drops below V_{CC_OFF}. The capacitance of the V_{CC} capacitor should be carefully sized to meet this requirement. A 4.7 µF electrolytic capacitor is normally used here. The timing sequence of startup is shown in Fig. 13

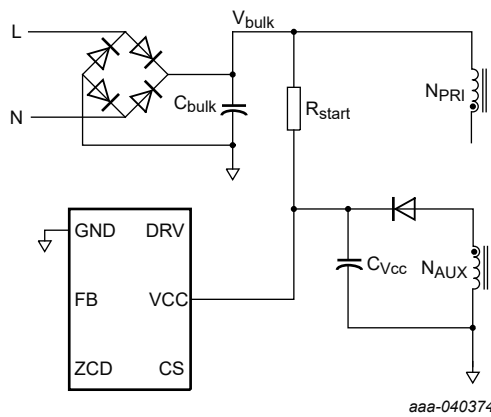


Fig. 12. Typical startup circuit

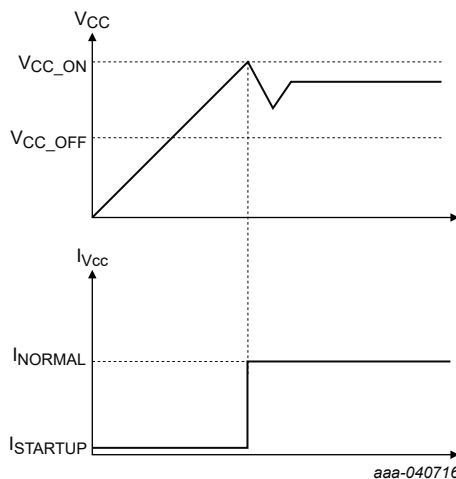


Fig. 13. Timing sequence of startup

9.3.2. Brown-in/brown-out

In addition to the detection of V_{CC} voltage, the input line voltage is also checked before the soft start is initiated. When the primary MOS is turned on, the induced auxiliary winding voltage is negative, generating a current flowing out from the ZCD pin. See Fig. 14 for reference.

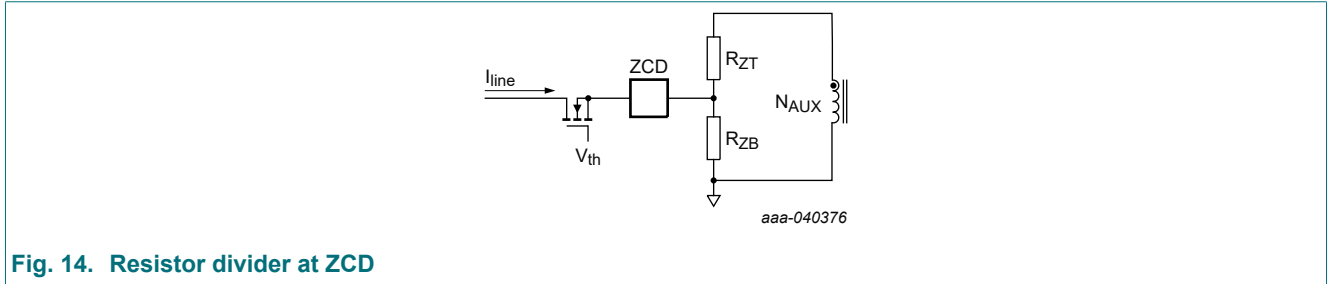


Fig. 14. Resistor divider at ZCD

Since the ZCD voltage is clamped at ~0 V by an internal circuit, this current is proportional to input voltage and can be calculated as shown in Equation 1:

$$I_{line} = \frac{V_{BULK} \times N_{AUX}}{N_{PRI} \times R_{ZT}} \tag{1}$$

where N_{PRI} and N_{AUX} are the number of turns of primary winding and auxiliary winding respectively, and R_{ZT} is the top side resistor of the divider from auxiliary winding to ZCD pin.

Each time V_{CC} is higher than V_{CC_ON}, the NEX8080x will send out several narrow pulses to turn on the primary MOS, and then detect I_{line}. If I_{line} > I_{BNI} (brown-in threshold current), the NEX8080x will initiate soft start process. Otherwise it will restart.

During the normal working period, I_{line} is always checked when the primary MOS is turned on. If I_{line} drops below I_{BNO} (brown-out threshold current) for a continuous period larger than t_{D_BNO} (~50 ms), NEX8080x will restart. The timing sequence of brown-out is shown in Fig. 15.

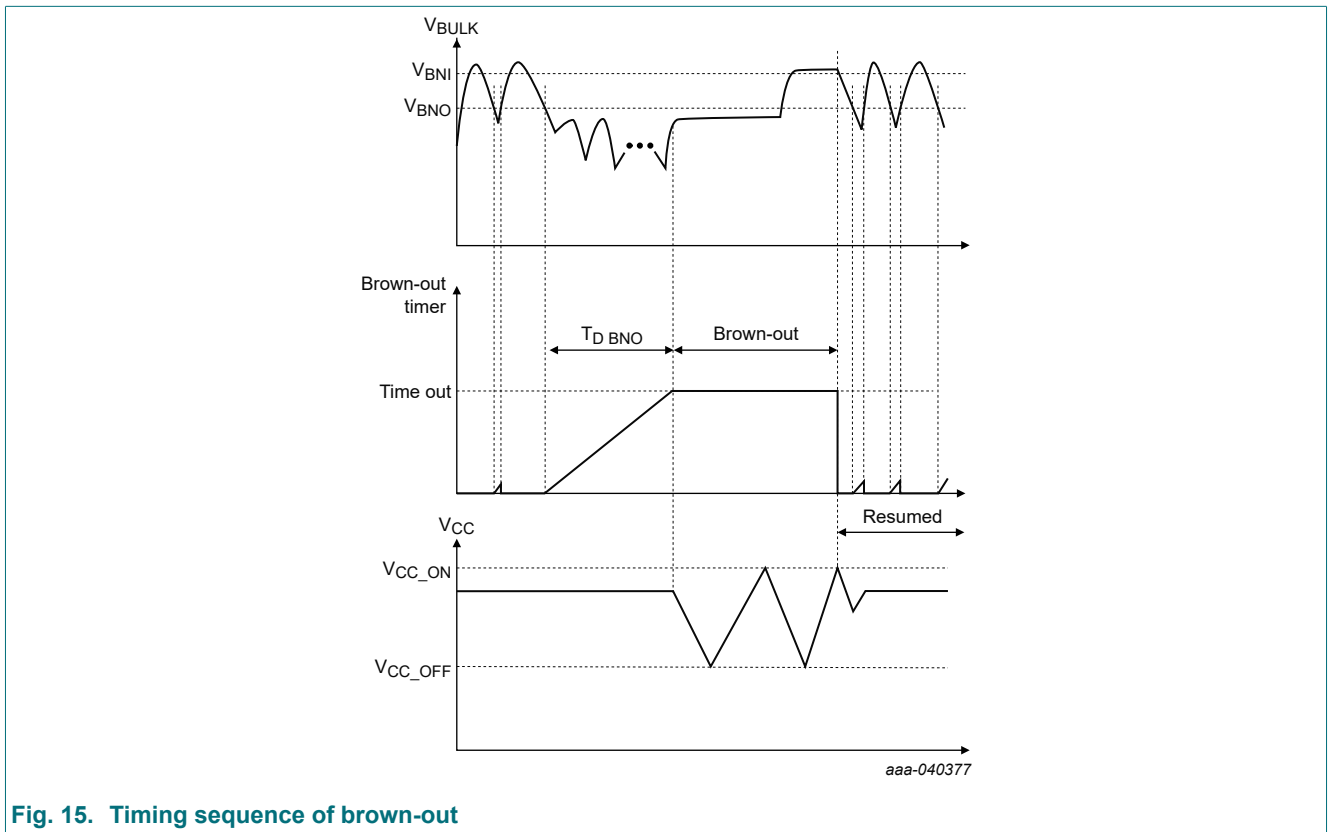


Fig. 15. Timing sequence of brown-out

9.3.3. V_{CC} holding mode

In very light load conditions, the NEX8080x may stay in the burst off-state for a long time when the output voltage is higher than the target. V_{CC} voltage may drop below V_{CC_OFF} since there is no driving pulse. This triggers the restart. To avoid this, the NEX8080x will send out the driving pulse once V_{CC} is below V_{CC_HOLD}, which is slightly higher than V_{CC_OFF}. The NEX8080x will stop the driving pulse when V_{CC} returns to V_{CC_HOLD} plus hysteresis. This is called V_{CC} Holding Mode.

For wide output voltage range applications, the turn ratio of auxiliary winding and secondary winding should be properly selected to make sure the V_{CC} Holding Mode will not be triggered at the minimum output voltage condition, since V_{CC} Holding Mode will override the normal output voltage regulation.

9.3.4. Current sense and peak current control

To implement peak current mode control, the sense resistor (R_S) is connected between the source of the primary MOS and GND to sense the primary current. The sense voltage across R_S is feedback to the CS pin, which is compared to the peak-control voltage to determine the duty cycle of the primary MOS. The peak-control voltage is generated from FB voltage divided by K_{FB} (typically 5), where the FB voltage is commanded by the voltage control loop to regulate the output voltage, see Fig. 16. The maximum peak-control voltage is clamped at V_{CS_PWM_MAX} (~400 mV) internally. The maximum transformer primary current can be obtained using Equation 2:

$$I_{\text{Peak_max}} = \frac{V_{\text{CS_PWM_MAX}}}{R_S} \quad (2)$$

Due to the parasitic capacitance of the primary MOS and transformer, a large voltage spike often appears on the CS pin at the turn-on moment. To prevent this spike from falsely triggering the current sense comparator, a leading-edge-blanking (LEB) time t_{LEB_PWM} (~320 ns) is included in the input of CS pin. If this internal LEB time is not long enough, an external R-C filter can be added between the sense resistor and CS pin.

For peak current mode control, during CCM, there may be subharmonic oscillation issues when duty cycle is higher than 50%. The NEX8080x has internal slope compensation to address this problem.

To improve the reliability, the NEX8080x limits the maximum duty of primary MOS at D_{MAX} (~78%).

9.3.5. Soft start

The soft start process is initiated when V_{CC} is higher than V_{CC_ON} threshold, and the input voltage is higher than the brown-in threshold. During this period, the peak voltage on the CS pin is limited by the SS signals, which ramps up from 0 mV to 400 mV within t_{SS} which is typically 4.3 ms. This means the primary peak current increases slowly in the soft start period.

A proprietary method is implemented to prevent the device from working in CCM during the soft start period. The output voltage can ramp up without overshoot, and the voltage/current stress of secondary rectifier is minimized.

9.3.6. Voltage control loop

The output voltage is sensed by a resistor divider and provides feedback to an error amplifier (usually TL431 is used). The output of the error amplifier drives an opto-coupler to generate the command voltage at the FB pin. The FB voltage, combined with the internal current loop, controls the output voltage. The typical circuit of voltage control loop is shown in Fig. 16.

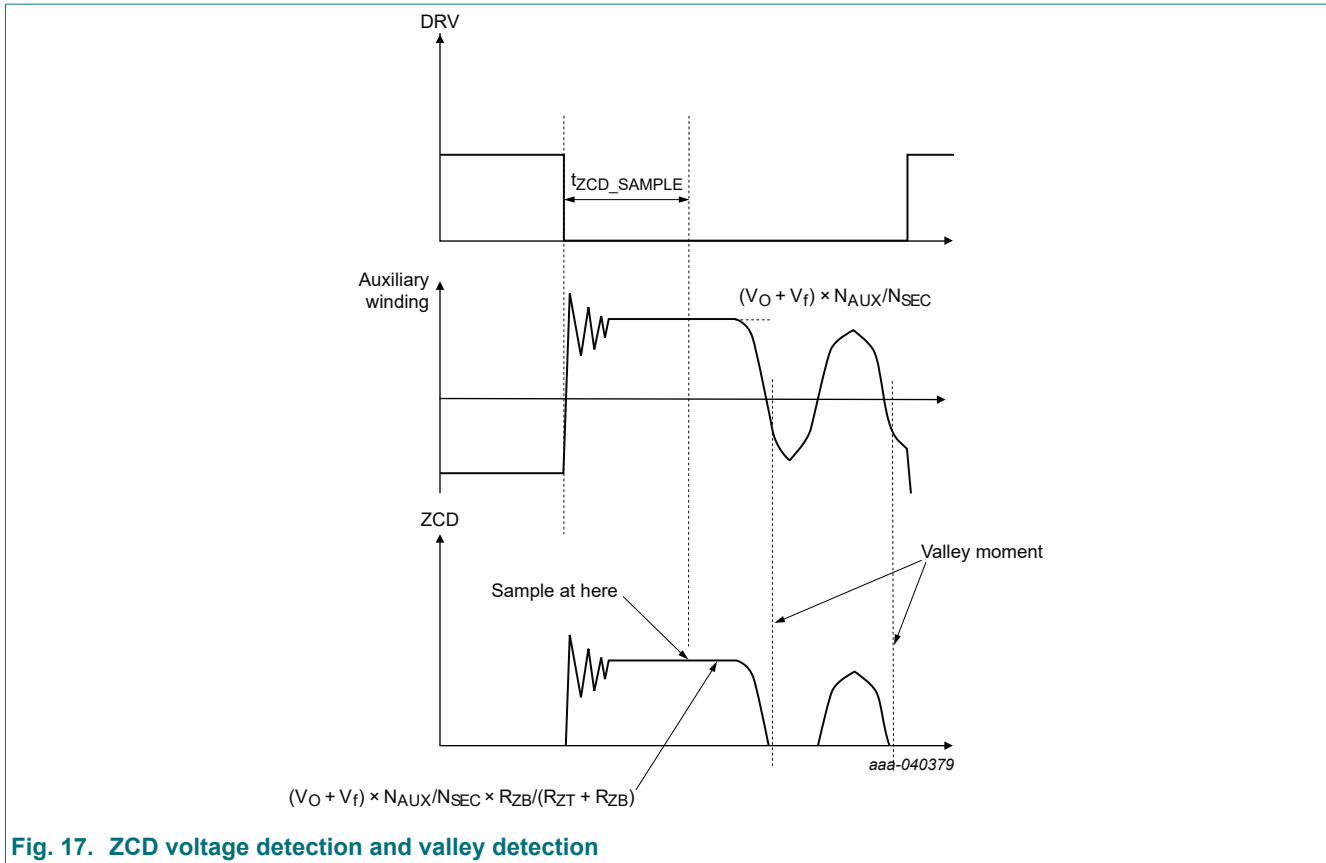


Fig. 17. ZCD voltage detection and valley detection

The output voltage OVP and UVP/SCP protection are implemented by comparing the sampled ZCD voltage with different threshold voltages.

The output voltage OVP protection is triggered if the sampled ZCD voltage is higher than OVP threshold for seven consecutive cycles.

The output voltage short-circuit protection (SCP) is triggered if the sampled ZCD voltage is lower than SCP threshold V_{ZCD_SCP} (typically 0.3 V) for seven consecutive cycles.

Since the output voltage need time to setup, the UVP/SCP protection is disabled for a t_{BLK_UVP} blanking time during soft start.

Due to the leakage inductance of the transformer, there is large ringing waveform at ZCD pin at the beginning of the flyback period. To avoid sampling at this ringing moment, a blanking time is added after the going-low of DRV signal. ZCD sampling is not allowed until this blanking window expires.

9.3.10. Valley switching

During QR/DCM/PFM mode, once the magnetizing current decreases to zero, the primary inductor begins oscillating with the parasitic capacitor of the primary MOS. It is ideal to turn on the primary MOS at the valley moment of oscillation to minimize the switching loss. As shown in Fig. 17, when the auxiliary winding voltage becomes negative, ZCD pin is clamped at ~ 0 V internally, and the current flowing out of ZCD pin is detected. Once the current is larger than I_{ZCD_VALLEY} ($\sim 9 \mu\text{A}$), that moment is identified as a valley moment. Several valley moments may be identified before CLK signal arrives. The valley moment just behind CLK is chosen as the moment to turn on the primary MOS.

9.3.11. Oscillator frequency

The NEX8080x is specially designed for wide output voltage range applications. To optimize the efficiency of each output voltage condition, the maximum switching frequency is adjusted according to the target output voltage, as derived by ZCD detection. Different frequency-vs-FB curves are used for different output voltage conditions.

As FB voltage decreases, the clamp frequency CLK will decrease until it arrives the minimum limit F_{MIN} (typically 25 kHz, to avoid audible noise), thus a relatively high efficiency is achieved in the whole load range.

To optimize the EMI performance, spread-spectrum function is implemented.

9.3.12. Peak load mode

Some applications require a much higher output current, normally double the full load current, in a short period (less than 200 ms normally). The output voltage must be basically stable during this short period (output voltage is allowed to drop ~10%).

For NEX8080x, the primary peak current reaches its maximum limit when the voltage on FB approaches ~2 V. The switching frequency is also at maximum frequency F_{MAX} (~65 kHz) at this moment. To further improve the capability of output power, NEX80805 implemented peak load mode by increasing frequency gradually from F_{MAX} to F_{Peak} (~130 kHz) as FB voltage approaches 3.2 V.

9.3.13. Driver

The typical high voltage on the DRV pin is maintained by an internal voltage clamp, which clamps the voltage at 11.5 V under normal conditions. For a normal 12 V V_{CC} supply, the DRV amplitude is guaranteed to be higher than 8 V. This gives enough voltage to fully turn on the high-voltage MOSFETs, while providing an adequate margin to avoid overvoltage damage of the gate, since most high-voltage MOSFETs have a maximum gate voltage rating of 20 V.

9.3.14. Restart

When the restart process is triggered, the DRV pulse is stopped. Then V_{CC} voltage declines, since there is no supply from auxiliary winding. Once V_{CC} drops below the V_{CC_OFF} threshold, the device is disabled and the V_{CC} current consumption drops to $I_{STARTUP}$ (typically 5 μ A), the V_{CC} capacitor will be charged up by the startup resistor. When V_{CC} voltage rises above V_{CC_ON} , a soft start process is initiated if the line voltage meets the brown-in requirement.

9.3.15. Overload protection (OLP)

If the load current is higher than the maximum allowed output current limit, the output voltage will decrease, and FB voltage will increase. If FB voltage is higher than V_{FB_OLP} (typically 3.5 V) for a period t_{D_OLP} , overload protection is triggered, and the device will restart.

9.3.16. Overpower protection (OPP)

To meet the Limited Power Source (LPS) requirements, the maximum output current of the power supply should be less than 8A, and the output power should not exceed 100 W under any condition. However, with a fixed primary peak current limit, the output current and output power will increase as input line voltage increase, so LPS is likely to be violated.

The NEX80801/80808/80809 devices use the input line voltage information to compensate the primary peak current limit. The higher the input line voltage is, the lower the primary peak current limit is, thus a relatively constant output current/power limit can be achieved. A resistor, R_{SERIES} , between the current sense resistor and CS pin can be used to fine tune the primary peak current limit, see [Fig. 18](#). The resistance of R_{SERIES} is suggested to be less than 1k Ω . If the load current is higher than the output current limit, the output voltage will drop, FB voltage will increase. If FB voltage is higher than V_{FB_OLP} (typically 3.5 V) for a period t_{D_OLP} , overload protection is triggered, and the device will restart. This limits the maximum output power.

9.3.17. Over current protection (OCP)

To better meet LPS requirements, NEX80805 uses the OCP method. By detecting the valley and peak primary current, as well as the demagnetization duty, NEX80805 calculates the output current of the flyback circuit. If the calculated value is higher than the target current limit for a preset period, the OCP is triggered, and the device will restart.

9.3.18. Secondary rectifier short-circuit protection (SRSP)

In case the secondary rectifier is short-circuited, the primary MOS current increases very fast at the turn on moment, an immediate protection is needed here. A shorter blanking time t_{LEB_OCF} (~90 ns) is implemented to address this problem. Each time the primary MOS is turned on, once the blanking time t_{LEB_OCF} expires, the primary current is sampled and

feedback to CS pin. If it's higher than the SR short-circuit fault protection threshold V_{CS_OCF} (~650 mV), the primary MOS is turned off immediately. If this event happens for 3 consecutive cycles, the device will restart.

9.3.19. V_{CC} overvoltage protection (V_{CC} OVP)

Once V_{CC} voltage is higher than threshold V_{CC_OVP} (typically 89 V), V_{CC} OVP is triggered, and the device restarts. In some abnormal conditions, for example, when the startup resistance is too low, V_{CC} voltage is pulled up even though the device is in restart condition. If V_{CC} voltage is pulled higher than V_{CC_DIS} threshold (typically 94 V), a sink current $I_{DISCHARGE}$ (typically 5 mA) will discharge V_{CC} voltage until it is below 89 V. This prevents the VCC pin from being damaged by overvoltage in abnormal conditions.

9.3.20. Over temperature protection (OTP)

The junction temperature (T_J) of the device is monitored by an internal temperature sensor. Once the T_J exceeds the thermal shutdown threshold T_{SD} (typically 155 °C), the device shuts down and DRV pulse stops. The device temperature decreases; when T_J is below 125 °C, the device will restart.

Besides the internal OTP, the NEX8080x also has an external OTP function. By adding an NTC resistor at the key component of the power supply, that component can be protected from over temperature damage. This method is shown in Fig. 18.

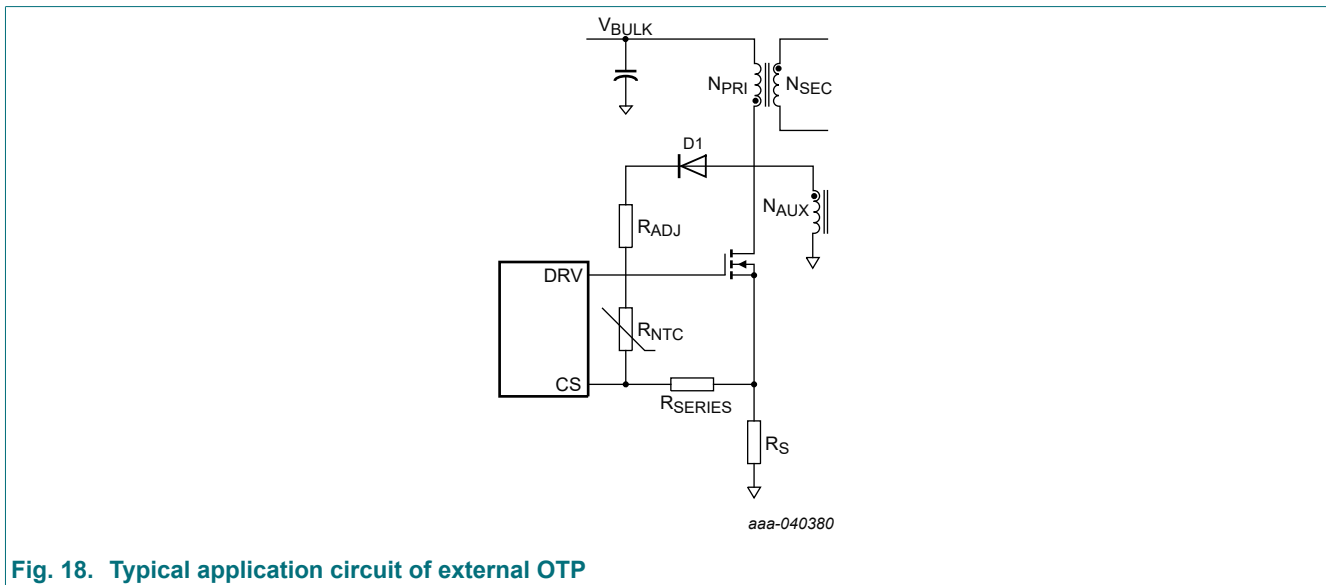


Fig. 18. Typical application circuit of external OTP

When the primary MOS is turned off, the auxiliary winding voltage is feedback to the CS pin by resistor divider. Under normal conditions, the NTC resistor R_{NTC} has a large resistance. This results in a very low voltage at the CS pin. For abnormal conditions, the NTC resistor temperature increases much higher due to the key component under protection, so the resistance of R_{NTC} decreases significantly, which leads to an increase in the divided voltage at the CS pin. If the voltage on the CS pin is higher than threshold V_{CS_OTP} for t_{D_OTP} (typically 1.5 ms), the external OTP is triggered, the device stops DRV pulse and restarts.

The resistance of R_{NTC} that triggering external OTP can be calculated in Equation 3:

$$R_{NTC(OTP)} = R_{series} \times \left(\frac{(N_{AUX} / N_{SEC}) \times V_O - V_d}{V_{CS_OTP}} - 1 \right) - R_{ADJ} \quad (3)$$

where, N_{AUX} and N_{SEC} are the turn numbers of auxiliary and secondary windings respectively. V_d is the forward voltage of D1. The resistor R_{ADJ} is used to fine tune the external OTP temperature at target threshold.

For wide output voltage range applications, to get a relatively constant external OTP temperature for different output voltage condition, the NEX8080x automatically adjusts the OTP threshold V_{CS_OTP} to be proportional to the output voltage.

9.3.21. CS pin short protection

In case the CS pin is shorted to GND, or the sense resistor R_S is shorted, the primary current will lose control. This is dangerous and must be prevented. Each time the primary MOS is turned on, a blanking timer $t_{BLK_CS_SHORT}$ starts. When it expires, if the MOS is not turned off yet, the CS pin voltage will be compared with V_{CS_SHORT} threshold (typically 40 mV). If the CS pin voltage lower than threshold, this indicates a CS short failure, and the primary MOS will be turned off immediately. If this event happens for three consecutive cycles, the NEX8080x will restart.

10. Package outline

Plastic, surface-mounted package (TSOT23-6); 6 leads

SOT8061-1

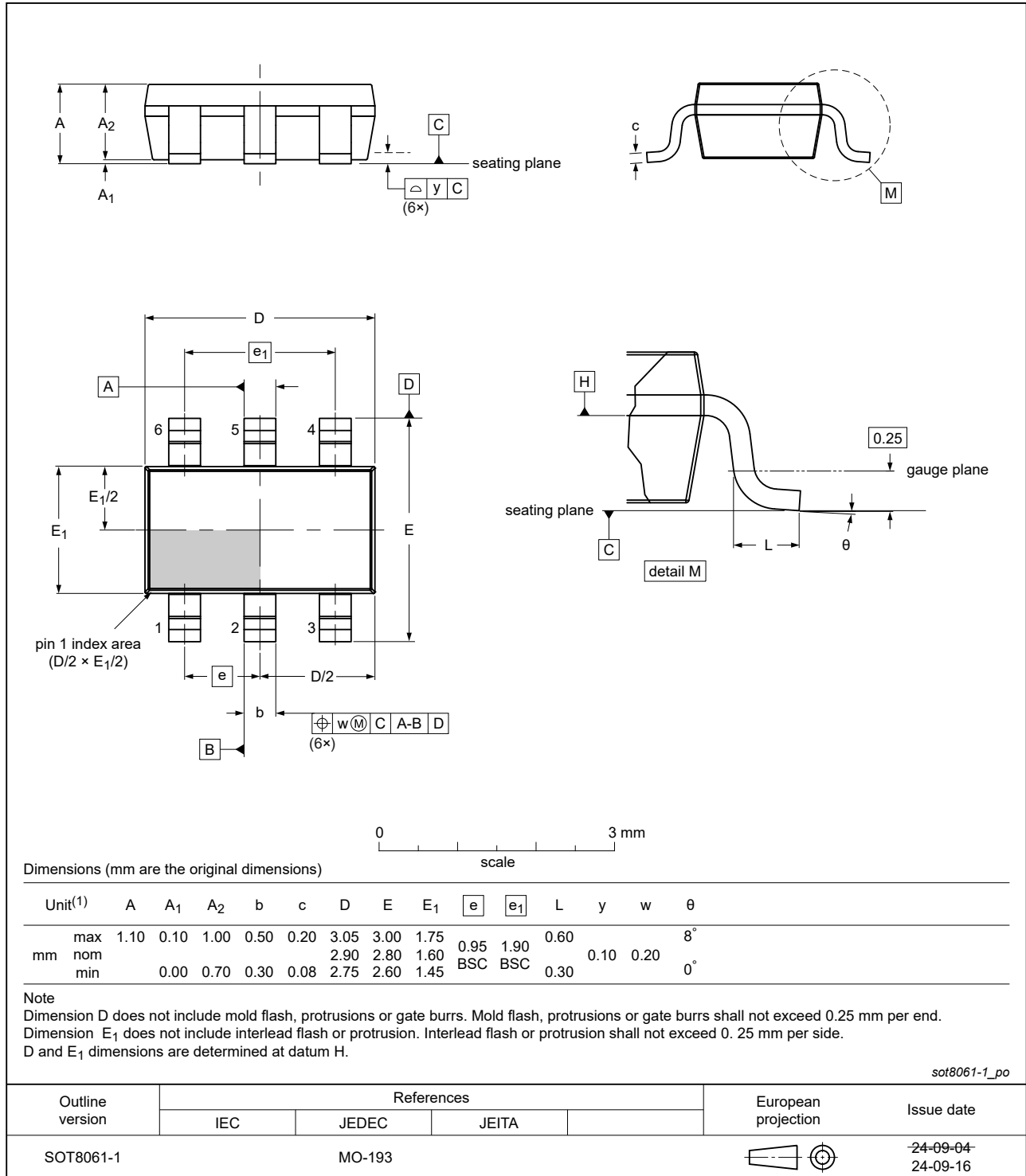


Fig. 19. Package outline SOT8061-1 (TSOT23-6)

11. Abbreviations

Table 9. Abbreviations

Acronym	Description
AC	Alternating Current
BM	Burst Mode
CCM	Continuous Conduction Mode
CDM	Charged Device Model
DC	Direct Current
DCM	Discontinuous Conduction Mode
DUT	Device Under Test
EMI	ElectroMagnetic Interference
ESD	ElectroStatic Discharge
HBM	Human Body Model
HV	High Voltage
IC	Integrated Circuit
JEDEC	Joint Electron Device Engineering Council
LPS	Limited Power Source
MOSFET	Metal-Oxide-Semiconductor Field-Effect Transistor
OCP	OverCurrent Protection
OLP	OverLoad Protection
OPP	OverPower Protection
OTP	OverTemperature Protection
OVP	OverVoltage Protection
PFM	Pulse Frequency Modulation
QR	Quasi-Resonant
SRSP	Synchronous Rectifier Short Protection
USB	Universal Serial Bus
UVLO	Under-Voltage LockOut

12. Revision history

Table 10. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
NEX8080_series v.1	20240930	Product data sheet	-	-

13. Legal information

Data sheet status

Document status [1][2]	Product status [3]	Definition
Objective [short] data sheet	Development	This document contains data from the objective specification for product development.
Preliminary [short] data sheet	Qualification	This document contains data from the preliminary specification.
Product [short] data sheet	Production	This document contains the product specification.

- [1] Please consult the most recently issued document before initiating or completing a design.
- [2] The term 'short data sheet' is explained in section "Definitions".
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Contents

1. General description	1
2. Features and benefits	1
3. Applications	1
4. Ordering information	2
5. Marking	2
6. Device comparison	2
7. Pinning information	2
7.1. Pinning	2
7.2. Pin description	3
8. Product specifications	3
8.1. Limiting values	3
8.2. Thermal characteristics	3
8.3. Recommended operating conditions	3
8.4. Electrical characteristics	4
8.5. Typical characteristics	6
9. Detailed Description	8
9.1. Overview	8
9.2. Functional block diagram	8
9.3. Feature description	9
9.3.1. Startup	9
9.3.2. Brown-in/brown-out	10
9.3.3. V _{CC} holding mode	11
9.3.4. Current sense and peak current control	11
9.3.5. Soft start	11
9.3.6. Voltage control loop	11
9.3.7. Multimode operation	12
9.3.8. Burst mode control	12
9.3.9. ZCD voltage detection	12
9.3.10. Valley switching	13
9.3.11. Oscillator frequency	13
9.3.12. Peak load mode	14
9.3.13. Driver	14
9.3.14. Restart	14
9.3.15. Overload protection (OLP)	14
9.3.16. Overpower protection (OPP)	14
9.3.17. Over current protection (OCP)	14
9.3.18. Secondary rectifier short-circuit protection (SRSP)	14
9.3.19. V _{CC} overvoltage protection (V _{CC} OVP)	15
9.3.20. Over temperature protection (OTP)	15
9.3.21. CS pin short protection	16
10. Package outline	17
11. Abbreviations	18
12. Revision history	19

13. Legal information	20
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