

## High Voltage Ring Generator

### Ordering Information

Operating Voltage	Package Options
$V_{PP1}-V_{NN1}$	SOW-20
325V	HV430WG

### Features

- 105Vrms ring signal
- Output over current protection
- 5.0V CMOS logic control
- Logic enable/disable to save power
- Adjustable deadband in single-control mode
- Power-on reset
- Fault output for problem detection

### Applications

- Line access cards
- Set-top/Street box

### Absolute Maximum Ratings

$V_{PP1} - V_{NN1}$ , power supply voltage	+340V
$V_{PP1}$ , positive high voltage supply	+220V
$V_{PP2}$ , positive gate voltage supply	+220V
$V_{NN1}$ , negative high voltage supply	-220V
$V_{NN2}$ , negative gate voltage supply	-220V
$V_{DD}$ , logic supply	+7.5V
Storage temperature	-65°C to +150°C
Power dissipation	600mW

### General Description

The Supertex HV430 is a high voltage PWM ring generator integrated circuit. The high voltage outputs,  $V_{PGATE}$  and  $V_{NGATE}$ , are used to drive the gates of external high voltage P-channel and N-channel MOSFETs in a push-pull configuration. Over current protection is implemented for both the P-channel and N-channel MOSFETs. External sense resistors set the over-current trip point.

The RESET input functions as a power-on reset when connected to an external capacitor.

The FAULT output indicates an over-current condition and is cleared after 4 consecutive cycles with no overcurrent condition. A logic low on RESET or ENABLE clears the FAULT output. It is active-low and open-drain to allow wire OR'ing of multiple drivers.

$P_{gate}$  and  $N_{gate}$  are controlled independently by logic inputs  $P_{IN}$  and  $N_{IN}$  when the MODE pin is at logic high. A logic high on  $P_{IN}$  will turn on the external P-channel MOSFET. Similarly, a logic high on  $N_{IN}$  will turn on the external N-channel MOSFET. Lockout circuitry prevents the N and P switches from turning on simultaneously. A pulse width limiter restricts pulse widths to no less than 100-200ns.

For applications where a single control input is desired, the MODE pin should be connected to SGND. The PWM control signal is then input to the  $N_{IN}$  pin. A user-adjustable deadband in the control logic ensures break-before-make on the outputs, thus avoiding cross conduction on the high voltage output during switching. A logic high on  $N_{IN}$  will turn the external P-Channel MOSFET on and the N-Channel off, and vice versa. The IC can be powered down by applying a logic low on the ENABLE pin, placing both external MOSFETs in the off state.

## Electrical Characteristics

(Over operating supply voltage unless otherwise specified,  $T_A = -40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ .)

### External Supplies

Symbol	Parameter	Min	Typ	Max	Unit	Conditions
$V_{PP1}$	High voltage positive supply	50		200	V	
$I_{PP1Q}$	$V_{PP}$ quiescent current		250	500	$\mu\text{A}$	$P_{IN}=N_{IN}=0\text{V}$
$I_{PP1}$	$V_{PP}$ operating current			2.0	mA	No load $V_{OUTP}$ and $V_{OUTN}$ switching at 100kHz
$V_{NN1}$	High voltage negative supply	$V_{PP1}-325$		-50	V	
$I_{NN1Q}$	$V_{NN1}$ quiescent current		250	500	$\mu\text{A}$	$P_{IN}=N_{IN}=0\text{V}$ , $R_{DB}=18\text{k}\Omega$
$I_{NN1}$	$V_{NN1}$ operating current			1.0	mA	No load $V_{OUTP}$ and $V_{OUTN}$ switching at 100kHz
$V_{DD}$	Logic supply voltage	4.50		5.50	V	
$I_{DDQ}$	$V_{DD}$ quiescent current		300	400	$\mu\text{A}$	$P_{IN}=N_{IN}=0\text{V}$ , $R_{DB}=18\text{k}\Omega$
$I_{DD}$	$V_{DD}$ operating current			1.0	mA	$P_{IN}=N_{IN}=100\text{kHz}$ , $R_{DB}=18\text{k}\Omega$

### Internal Supplies

Symbol	Parameter	Min	Typ	Max	Unit	Conditions
$V_{PP2}$	Positive linear regulator output voltage	$V_{PP1}-16$		$V_{PP1}-10$	V	
$V_{NN2}$	Negative linear regulator output voltage	$V_{NN1}+10$		$V_{NN1}+14$	V	

### Positive High Voltage Output

Symbol	Parameter	Min	Typ	Max	Unit	Conditions
$V_{Pgate}$	Output voltage swing	$V_{PP2}$		$V_{PP1}$	V	No load on $V_{Pgate}$
$R_{sourceP}$	$V_{Pgate}$ source resistance			12.5	$\Omega$	$I_{OUT}=80\text{mA}$
$R_{sinkP}$	$V_{Pgate}$ sink resistance			12.5	$\Omega$	$I_{OUT}=-80\text{mA}$
$t_{riseP}$	$V_{Pgate}$ rise time			50	ns	$C_{load}=1.4\text{nF}$
$t_{fallP}$	$V_{Pgate}$ fall time			50	ns	$C_{load}=1.4\text{nF}$
$t_{pwp(min)}$	$V_{Pgate}$ minimum pulse width (internally limited)	100	150	200	ns	
$t_{delayP}$	$P_{IN}$ to $P_{gate}$ delay time			300	ns	mode=1
$V_{Psen}$	$V_{Pgate}$ current sense voltage	$V_{PP1}-0.85$	$V_{PP1}-1.0$	$V_{PP1}-1.15$	V	
$t_{shortP}$	$V_{Pgate}$ current sense off time			150	ns	

## Negative High Voltage Output

Symbol	Parameter	Min	Typ	Max	Unit	Conditions
$V_{Ngate}$	Output voltage swing	$V_{NN2}$		$V_{NN1}$	V	No load on $V_{Ngate}$
$R_{sourceN}$	$V_{Ngate}$ source resistance			15.0	$\Omega$	$I_{OUT}=80mA$
$R_{sinkN}$	$V_{Ngate}$ sink resistance			15.0	$\Omega$	$I_{OUT}=-80mA$
$t_{riseN}$	$V_{Ngate}$ rise time			50	ns	$C_{load}=1.0nF$
$t_{fallN}$	$V_{Ngate}$ fall time			50	ns	$C_{load}=1.0nF$
$t_{pwn(min)}$	$V_{Ngate}$ minimum pulse width (internally limited)	100	150	200	ns	
$t_{delayN}$	$N_{IN}$ to $V_{Ngate}$ delay time			300	ns	mode=1
$V_{Nsen}$	$V_{Ngate}$ current sense voltage	$V_{NN1}+0.85$	$V_{NN1}+1.0$	$V_{NN1}+1.15$	V	
$t_{shortN}$	$V_{Ngate}$ current sense OFF time			150	ns	

## Control Circuitry

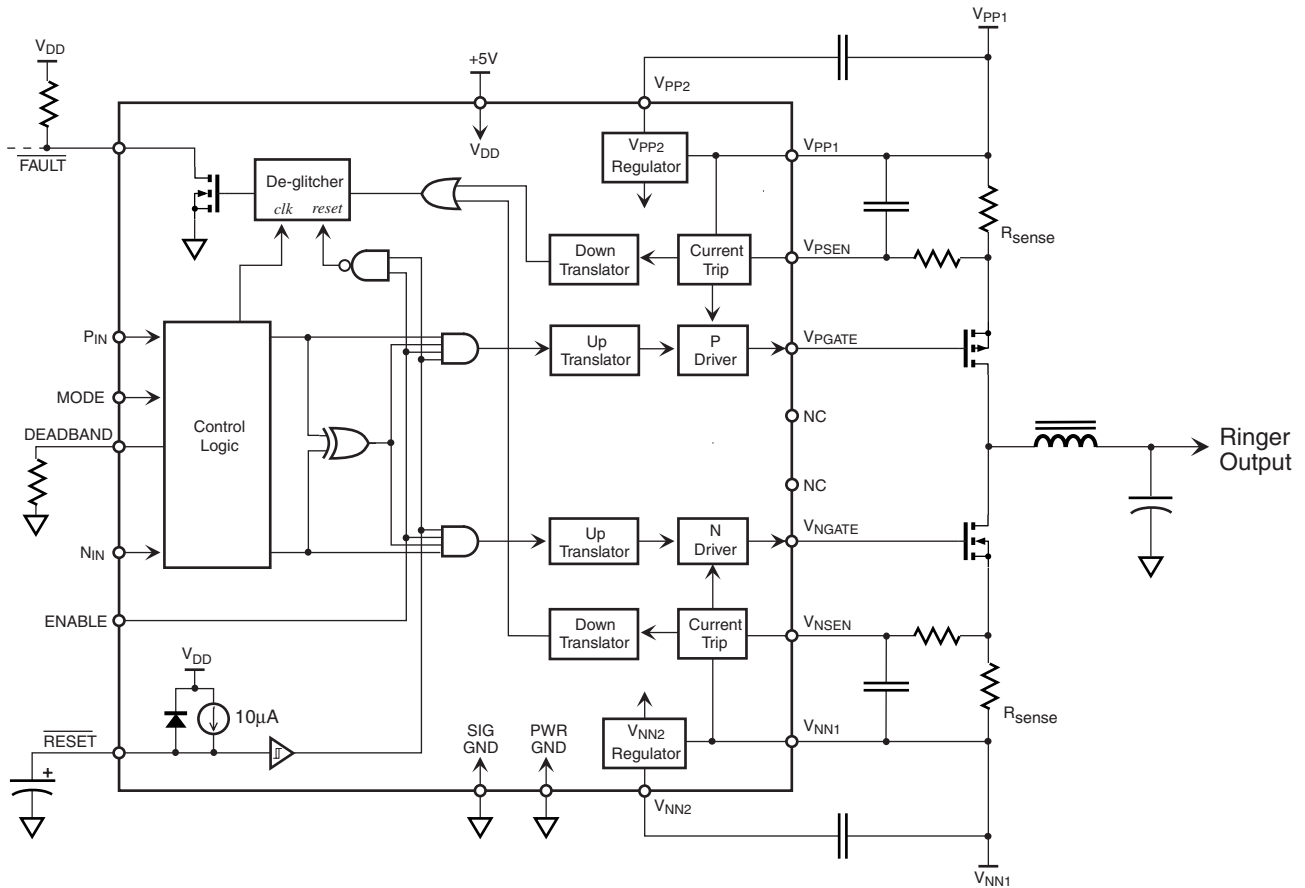
Symbol	Parameter	Min	Typ	Max	Unit	Conditions
$V_{IL}$	Logic input low voltage	0		0.60	V	$V_{DD}=5.0V$
$V_{IH}$	Logic input high voltage	2.7		5.0	V	$V_{DD}=5.0V$
$I_{INdn}$	Input pull-down current	0.5	1	5	$\mu A$	$P_{IN}, N_{IN}, ENABLE$
$R_{up}$	Input pull-up resistance	100	200	300	$k\Omega$	MODE
$V_{OL}$	Logic output low voltage			0.50	V	$V_{DD}=5.0V, I_{OUT}=-0.5mA$
$V_{OH}$	Logic output high voltage	4.50			V	$V_{DD}=5.0V, I_{OUT}=0.5mA$
$V_{RST(OFF)}$	Reset voltage, device off	3.2		3.5	V	$V_{DD}=5.0V$
$V_{RST(ON)}$	Reset voltage, device on	3.7		4.0	V	$V_{DD}=5.0V$
$V_{RST(HYS)}$	Reset hysteresis voltage	0.3			V	$V_{DD}=5.0V$
$I_{reset}$	Reset pull-up current	7	10	13	$\mu A$	$V_{RESET}=0-4.5V$
$t_{RST(ON)}$	RESET on delay			1.0	$\mu s$	
$t_{RST(OFF)}$	RESET off delay			1.0	$\mu s$	
$t_{EN(ON)}$	ENABLE on delay	50	100	150	$\mu s$	
$t_{EN(OFF)}$	ENABLE off delay			1.0	$\mu s$	
$t_{FLT(HOLD)}$	FAULT hold time		4		$N_{IN}/P_{IN}$ cycles	ENABLE=1
$t_{DB}$	Deadband time	35	50	70	ns	Mode=0, Rdb=5.6k $\Omega$
		105	140	175	ns	Mode=0, Rdb=18k $\Omega$
$t_{delay(N-P)}$	N-off to P-on transistion delay			300	ns	Mode=0, Rdb<27k $\Omega$
$t_{delay(P-N)}$	P-off to N-on transistion delay			300	ns	Mode=0, Rdb<27k $\Omega$
$\Delta t_{delay(N-P)}$	Delay difference $t_{delayN(off)} - t_{delayP(on)}$	-80	0	80	ns	Mode=1
$\Delta t_{delay(P-N)}$	Delay difference $t_{delayP(off)} - t_{delayN(on)}$	-80	0	80	ns	Mode=1

# Truth Table

Logic Inputs*					Output	
N <sub>IN</sub>	P <sub>IN</sub>	mode	EN	RESET	External N-Channel MOSFET	External P-Channel MOSFET
L	L	H	H	$> V_{reset(on)}$	OFF	OFF
L	H	H	H	$> V_{reset(on)}$	OFF	ON
H	L	H	H	$> V_{reset(on)}$	ON	OFF
H	H	H	H	$> V_{reset(on)}$	OFF	OFF
H	X	L	H	$> V_{reset(on)}$	OFF	ON
L	X	L	H	$> V_{reset(on)}$	ON	OFF
X	X	X	L	X	OFF	OFF
X	X	X	X	$< V_{reset(off)}$	OFF	OFF

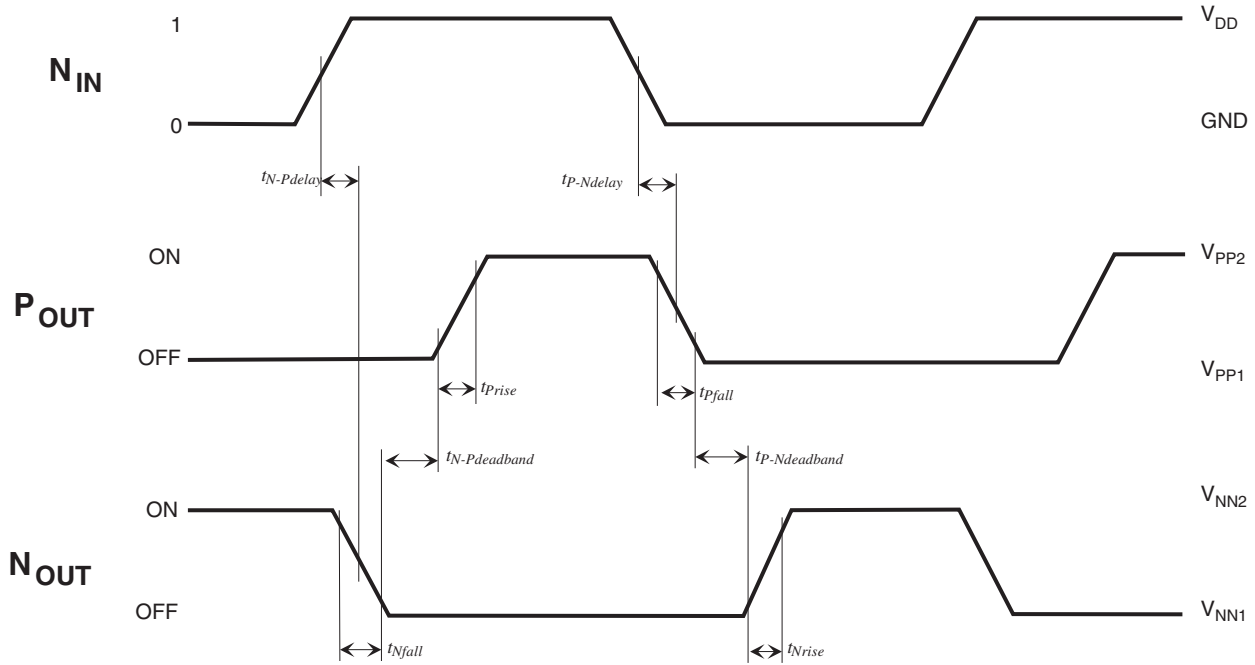
\* Unused logic inputs should be connected to V<sub>DD</sub> or GND.

# Block Diagram and Application Circuit

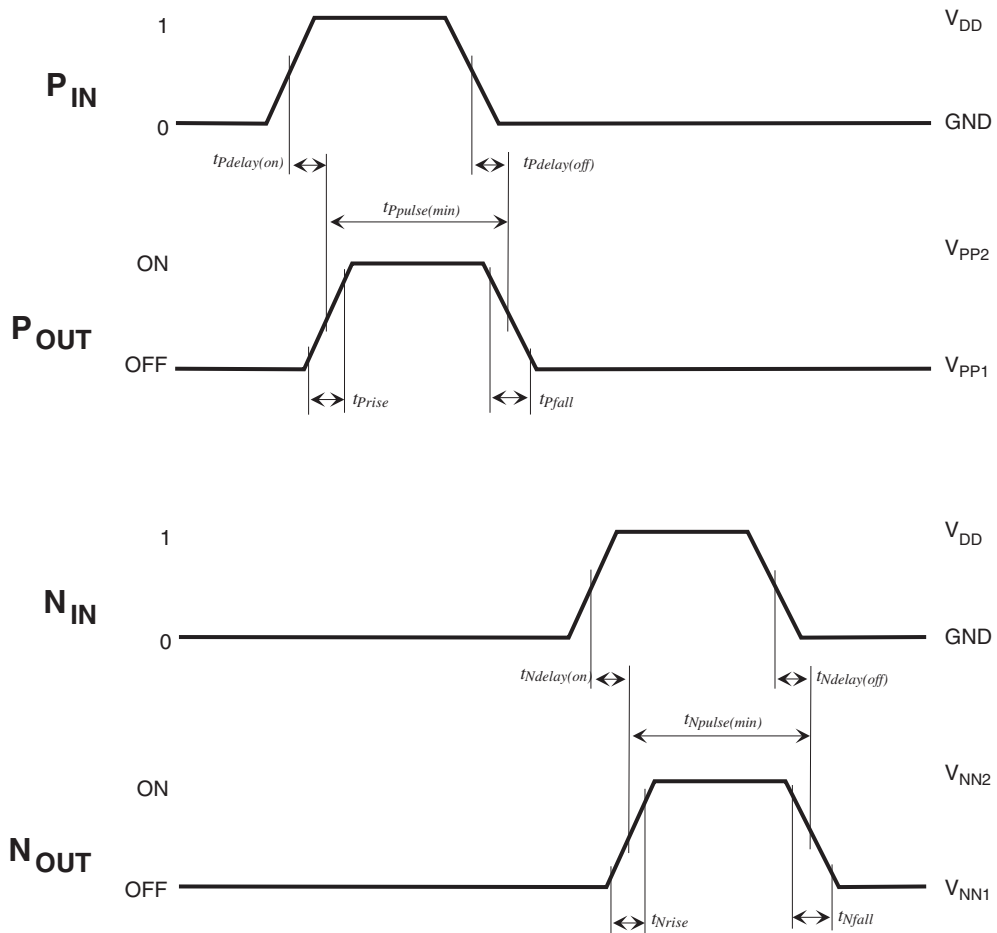


Note: P<sub>IN</sub>, N<sub>IN</sub>, and ENABLE are internally pulled low. MODE is internally pulled high. A Reset capacitor in the range of 1-10μF will yield a couple-second turn-on delay. Tantalum is recommended.

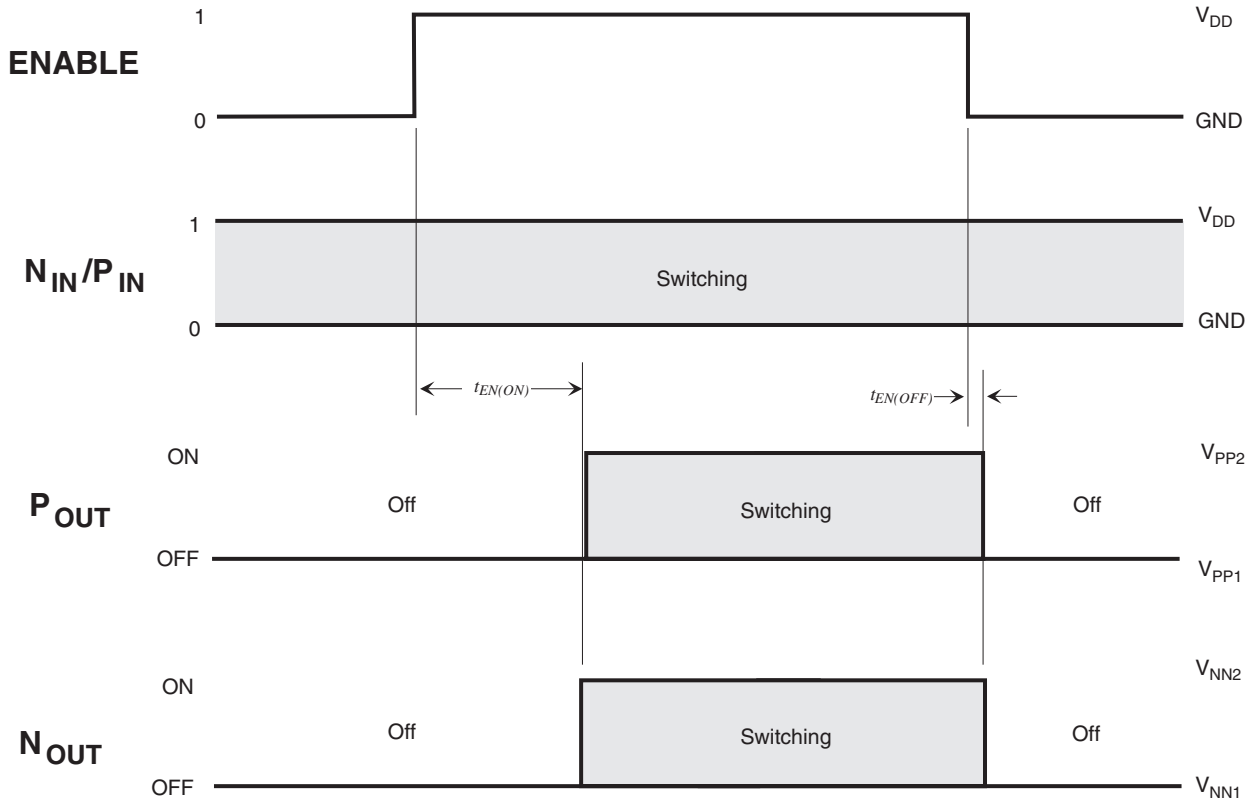
# Single-Control Mode Timing



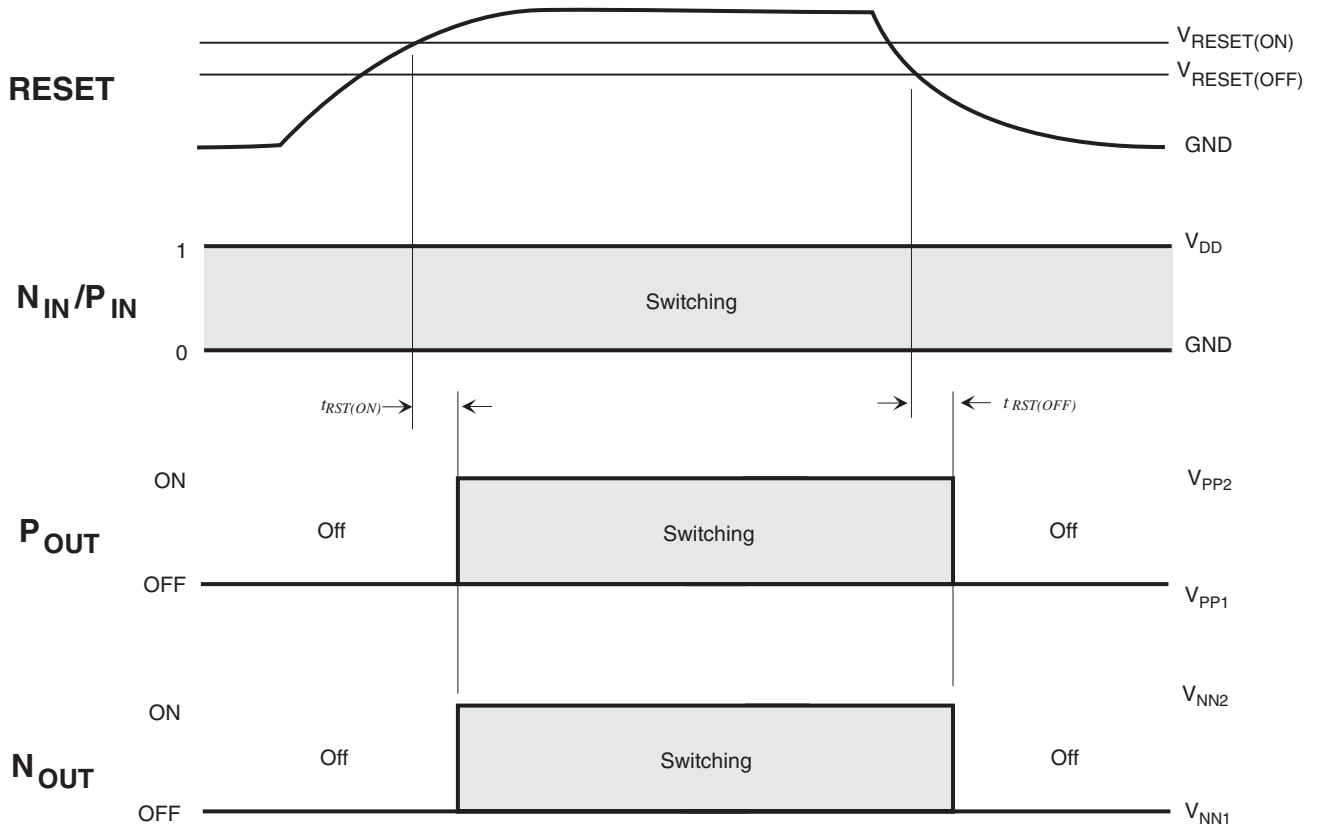
# Dual-Control Mode Timing



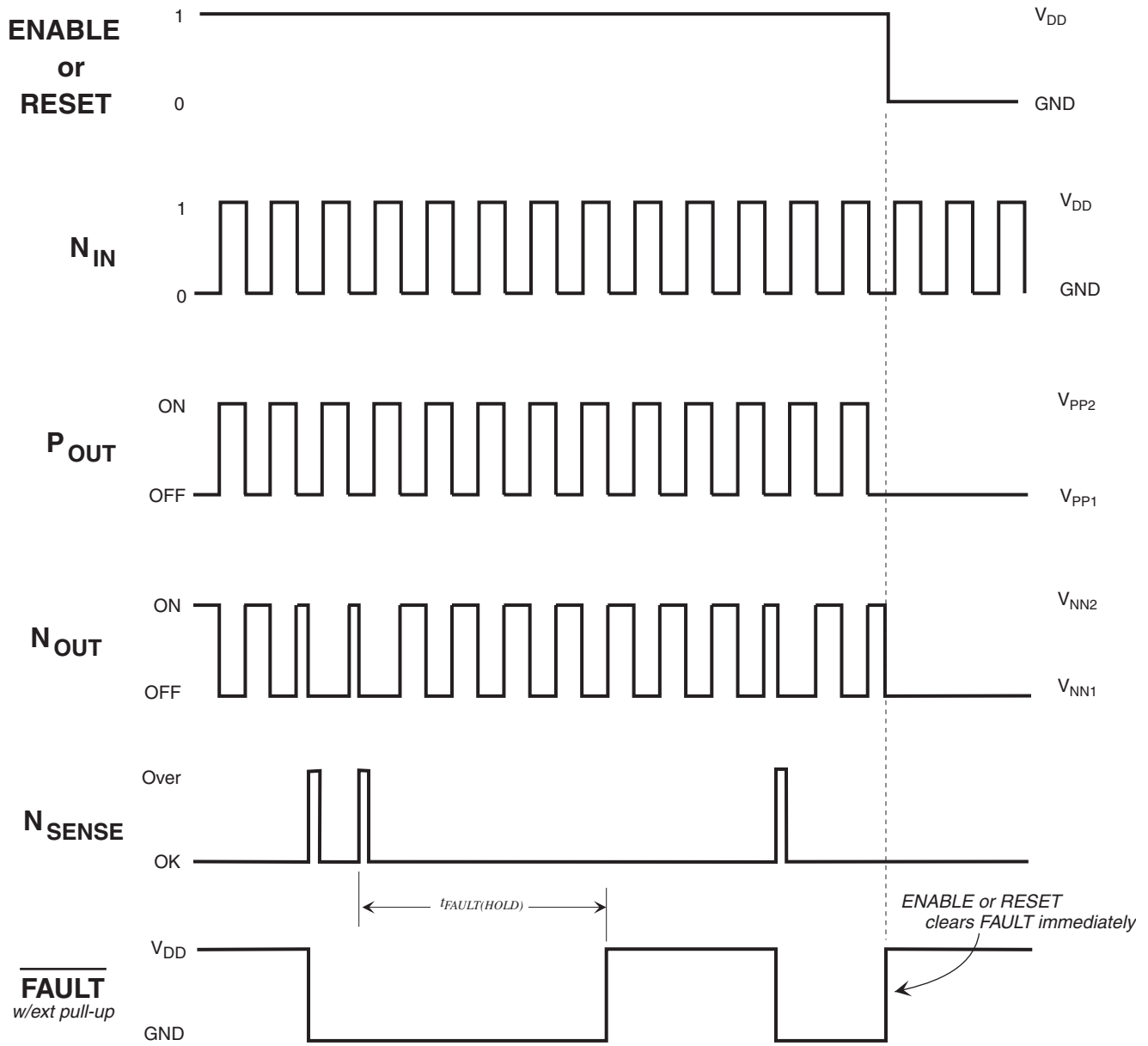
# ENABLE Timing



# RESET Timing



# FAULT Timing

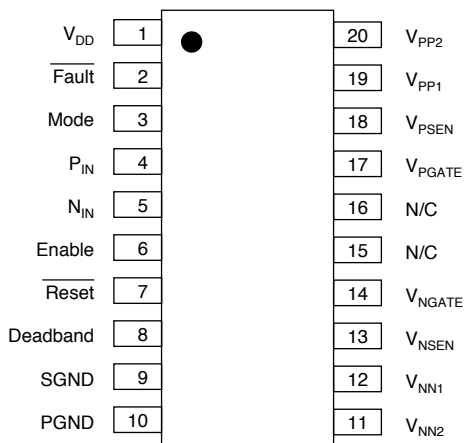


Note:  $N_{sense}$  overcurrent shown.  $P_{sense}$  operates identically.

## Pin Description

$V_{PP1}$	Positive high voltage supply.
$V_{PP2}$	Positive gate voltage supply. Generated by an internal linear regulator. A 25V, 100nF capacitor should be connected between $V_{PP2}$ and $V_{PP1}$ .
$V_{NN1}$	Negative high voltage supply.
$V_{NN2}$	Negative gate voltage supply. Generated by an internal linear regulator. A 25V, 100nF capacitor should be connected between $V_{NN2}$ and $V_{NN1}$ .
$V_{DD}$	Logic supply voltage.
SGnd	Low voltage logic ground.
PGnd	High voltage power ground.
$P_{IN}$	Logic control input. When mode is high, logic input high turns ON the external high voltage P-channel MOSFET. Internally pulled low.
$N_{IN}$	Logic control input. When mode is high, logic input high turns ON the external high voltage N-channel MOSFET. Internally pulled low.
ENABLE	Logic enable input. Logic high enables IC. Internally pulled low.
MODE	Logic mode input. 0=single-control; 1=dual-control. When MODE is high, $N_{IN}$ and $P_{IN}$ independently control $N_{OUT}$ and $P_{OUT}$ , respectively. When MODE is low, $N_{IN}$ controls both outputs in a complementary manner. (See Truth Table)
$\overline{FAULT}$	Logic output. Fault is at logic low when either current limit sense pin, $V_{Psen}$ or $V_{Nsen}$ , is activated. Remains active until overcurrent condition clears or $ENABLE=0$ or $RESET=0$ .
$\overline{RESET}$	Power-on reset. A capacitor connected between this pin and ground determines the delay time between application of $V_{DD}$ and when the device outputs are enabled. Low leakage tantalum recommended.
DEADBAND	A resistor between this pin and ground sets the 'break-before-make' time between output transitions. Applicable only in single-control mode. For minimum deadtime, a 5.6k $\Omega$ resistor to ground should be used. For dual-input mode, tie to Vdd.
$V_{Pgate}$	Gate drive for external P-channel MOSFET.
$V_{Ngate}$	Gate drive for external N-channel MOSFET.
$V_{Psen}$	Pulse by pulse over current sensing for P-Channel MOSFET.
$V_{Nsen}$	Pulse by pulse over current sensing for N-Channel MOSFET.

## Pin Configuration



top view  
SOW 20