



General Description

The AGD8136A / AGD8236A are 600V 6-channel gate driver ICs to control IGBTs and power MOS-transistors in 3-phase inverter systems. Due to specially designed common mode filter, it has an excellent ruggedness on transient voltage variation.



SOP-28L

(Body: 18 x 7.5 x 2.5 mm)



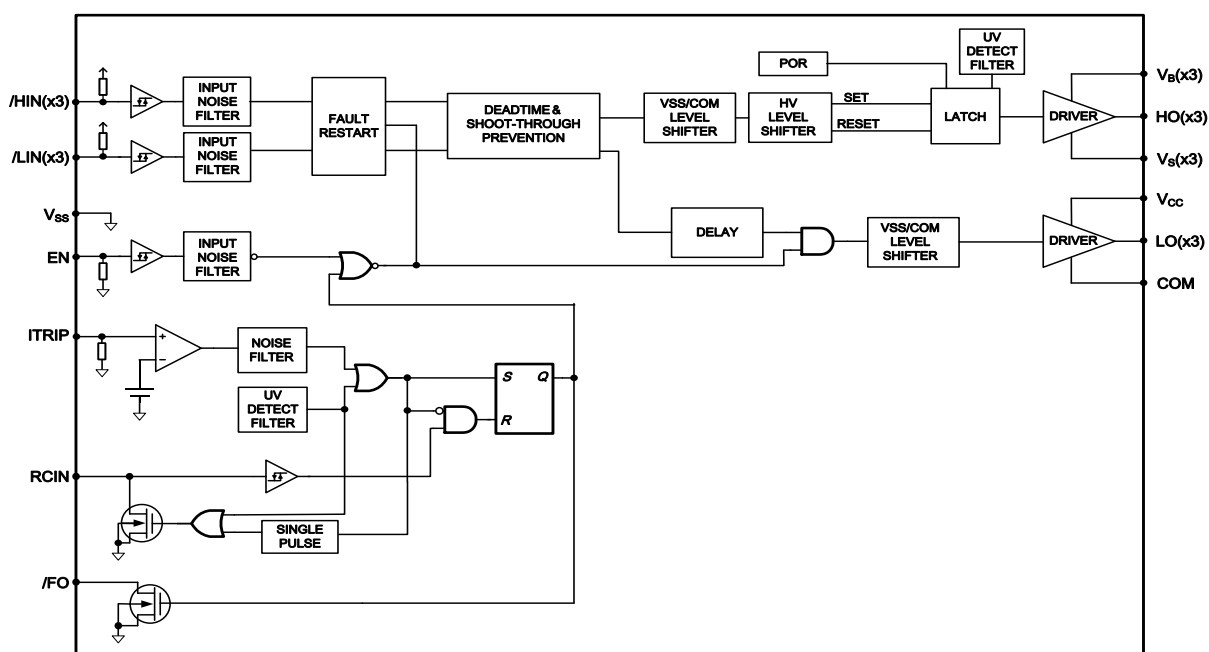
Features

- Maximum blocking voltage +600V
- Output current: +200mA / -350mA (Typ.)
- Matched propagation delay for all channels
- Shoot-through (cross-conduction) protection
- Under-voltage lockout protection (UVLO)
- Over-current protection (OCP)
- Fault output corresponding to UV (Vcc supply) and OCP
- Shut-down of all channels during fault conditions
- Adjustable fault output duration time
- 3.3V / 5V CMOS and TTL input logic compatible
- Input logic: Schmitt trigger receiver circuit (Active Low)

Applications

- 3-phase motor drives
- Home appliances
- IGBT and power MOS gate drivers for general purpose

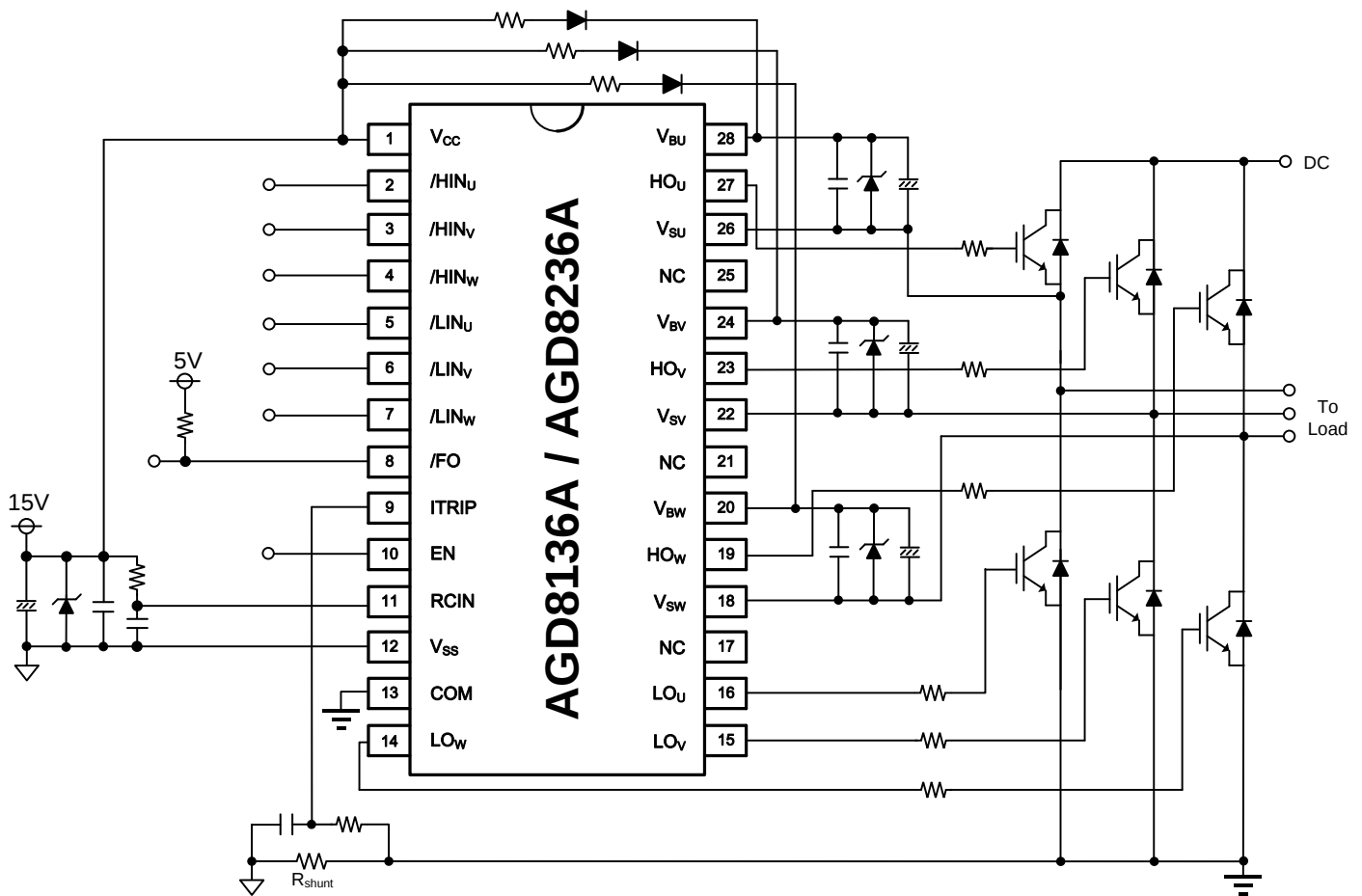
Internal Block Diagram



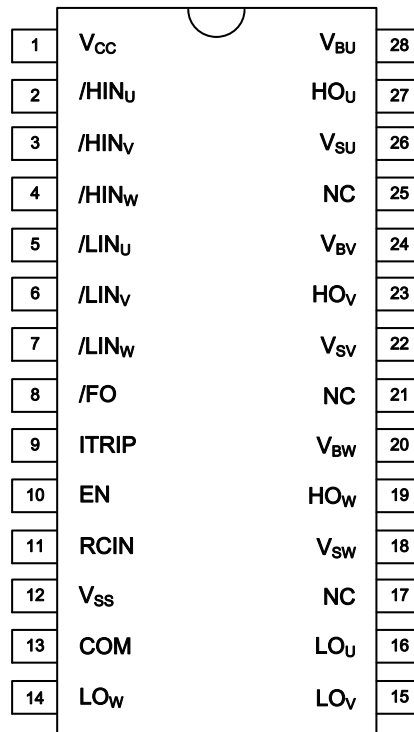
Ordering Information

Part Number	Temperature Range	Package
AGD8136A	-40°C to 125°C	SOP-28L
AGD8236A	-40°C to 125°C	SOP-28L

Typical Application Circuit



Pin Configuration



SOP-28L
(Top View)

Pin Description

Pin Number	Pin Name	Pin Function
1	V _{CC}	Low-Side Supply Voltage
2	/HIN _U	High-Side Logic Input (U-Phase)
3	/HIN _V	High-Side Logic Input (V-Phase)
4	/HIN _W	High-Side Logic Input (W-Phase)
5	/LIN _U	Low-Side Logic Input (U-Phase)
6	/LIN _V	Low-Side Logic Input (V-Phase)
7	/LIN _W	Low-Side Logic Input (W-Phase)
8	/FO	Fault Output with Open Drain (Indicates Over-Current and V _{CC} UVLO)
9	ITRIP	Analog Input for Over-Current Shutdown
10	EN	Enable I/O Functionality (Positive Logic)
11	RCIN	External RC-Network Input used to define Fault Output Duration Time
12	V _{SS}	Logic Ground
13	COM	Power Ground
14	LOW	Low-Side Driver Output (W-Phase)
15	LO _V	Low-Side Driver Output (V-Phase)
16	LO _U	Low-Side Driver Output (U-Phase)

Pin Description (*continued*)

Pin Number	Pin Name	Pin Function
17	NC	No Connection
18	V _{SW}	High-Side Floating Supply Offset Voltage (W-Phase)
19	HO _W	High-Side Driver Output (W-Phase)
20	V _{BW}	High-Side Floating Supply Voltage (W-Phase)
21	NC	No Connection
22	V _{SV}	High-Side Floating Supply Offset Voltage (V-Phase)
23	HO _V	High-Side Driver Output (V-Phase)
24	V _{BV}	High-Side Floating Supply Voltage (V-Phase)
25	NC	No Connection
26	V _{SU}	High-Side Floating Supply Offset Voltage (U-Phase)
27	HO _U	High-Side Driver Output (U-Phase)
28	V _{BU}	High-Side Floating Supply Voltage (U-Phase)

Absolute Maximum Ratings

Absolute maximum ratings indicate sustained limits beyond which damage to the device may occur. All voltage parameters are absolute values referenced to V_{SS} unless otherwise stated in the table.

Symbol	Parameter	Min.	Max.	Units
V_{CC}	Low-Side Supply Voltage	-0.3	20 ⁽¹⁾	V
V_{IN}	Logic Input Voltage (/LIN, /HIN)	$V_{SS}-0.3$	$V_{SS}+5.2$	
V_{ITRIP}	ITRIP Input Voltage	$V_{SS}-0.3$	$V_{SS}+5.2$	
V_{EN}	Enable Input Voltage	$V_{SS}-0.3$	$V_{SS}+5.2$	
V_{RCIN}	RCIN Input Voltage	$V_{SS}-0.3$	$V_{CC}+0.3$	
V_B	High-Side Floating Supply Voltage	-0.3	620	
V_S	High-Side Floating Supply Offset Voltage	V_B-20 ⁽¹⁾	$V_B+0.3$	
V_{HO}	High-Side Driver Output Voltage	$V_S-0.3$	$V_B+0.3$	
V_{LO}	Low-Side Driver Output Voltage	COM-0.3	$V_{CC}+0.3$	
V_{FO}	Fault Output Voltage	$V_{SS}-0.3$	$V_{CC}+0.3$	
COM	Power Ground	$V_{CC}-25$	$V_{CC}+0.3$	
dV_S/dt	V_S Offset Voltage Slew Rate ⁽²⁾	-	50	V/ns
PW_{HIN}	High-Side Input Pulse Width	500	-	ns
P_D	Package Power Dissipation @ $T_A \leq 25^\circ\text{C}$	-	1.6	W
$R_{th(j-a)}$	Thermal Resistance, Junction to Ambient	-	78	$^\circ\text{C/W}$
T_J	Junction Temperature	-	150	$^\circ\text{C}$
T_S	Storage Temperature	-55	150	
T_L	Lead Temperature (Soldering, 10 seconds)	-	300	
ESD	Human Body Model	2		kV

Note:

1. An internal 20V zener diode is integrated to clamp each supply voltage.
2. Not subject of production test, verified by characterization.

Recommended Operation Conditions

The device is not guaranteed to operate beyond the Recommended Operating Conditions. All voltage parameters are absolute voltages referenced to V_{SS} unless otherwise specified. The offset rating is tested with supplies of $(V_{CC} - COM) = (V_B - V_S) = 15\text{ V}$.

Symbol	Parameter		Min.	Max.	Units
V_{CC}	Low-Side Supply Voltage	AGD8136A	10	20	V
		AGD8236A	13.2	20	
V_{IN}	Logic Input Voltage (/LIN, /HIN)		V_{SS}	$V_{SS}+5$	
V_{EN}	Enable Input Voltage		V_{SS}	$V_{SS}+5$	
V_B	High-Side Floating Supply Voltage	AGD8136A	V_S+10	V_S+20	
		AGD8236A	$V_S+13.2$	V_S+20	
V_S	High-Side Floating Supply Offset Voltage ⁽³⁾		COM-6	600	
$V_S(t)$	Transient High-Side Floating Supply Voltage ⁽⁴⁾		-50	600	
V_{HO}	High-Side Driver Output Voltage		V_S	V_B	
V_{LO}	Low-Side Driver Output Voltage		COM	V_{CC}	
COM	Power Ground		-5	5	
V_{FO}	Fault Output Voltage		V_{SS}	V_{CC}	
V_{RCIN}	RCIN Input Voltage		V_{SS}	V_{CC}	
V_{ITRIP}	ITRIP Input Voltage		V_{SS}	$V_{SS}+5$	
T_A	Ambient Temperature		-40	125	°C

Note:

- Logic operation for V_S of -6V to 600V. Logic state held for V_S of -6V to $-V_{BS}$.
- Operational for transient negative V_S of $V_{SS}-50\text{V}$ with a 50ns pulse width, which is guaranteed by design.

Static Electrical Characteristics

$V_{CC} = V_{BS} = 15\text{V}$. $T_A = 25^\circ\text{C}$ unless otherwise specified.

Symbol	Parameter		Conditions	Min.	Typ.	Max.	Units
UV_{CC+}	V_{CC} Under-Voltage Positive Going Threshold	AGD8136A		8.0	8.9	9.8	V
		AGD8236A		10.8	11.9	13.0	
UV_{CC-}	V_{CC} Under-Voltage Negative Going Threshold	AGD8136A		7.4	8.2	9.0	
		AGD8236A		10.3	11.4	12.5	
UV_{CChys}	V_{CC} Under-Voltage Hysteresis	AGD8136A		-	0.7	-	
		AGD8236A		-	0.5	-	
UV_{BS+}	V_{BS} Under-Voltage Positive Going Threshold	AGD8136A		8.0	8.9	9.8	
		AGD8236A		10.0	11.0	12.0	
UV_{BS-}	V_{BS} Under-Voltage Negative Going Threshold	AGD8136A		7.4	8.2	9.0	
		AGD8236A		9.0	10.0	11.0	
UV_{BSHys}	V_{BS} Under-Voltage Hysteresis	AGD8136A		-	0.7	-	
		AGD8236A		-	1.0	-	
I_{LK}	High-Side Floating Supply Leakage Current (per 1-Phase)		$V_B = V_S = 600\text{V}$	-	-	50	μA

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Units
I_{QBS}	Quiescent V_{BS} Supply Current (per 1-Phase)	$V_{IN}=5V$ (all inputs are in the off state)	-	70	120	
I_{QCC}	Quiescent V_{CC} Supply Current (per 1-Phase)		-	1	2	mA
V_{OH}	High Level Output Voltage Drop, $V_{BIAS} - V_O$	$I_O=20mA, V_{IN}=0V$	-	0.9	1.4	V
V_{OL}	Low Level Output Voltage Drop, V_O	$I_O=20mA, V_{IN}=5V$	-	0.4	0.6	
I_{O+}	Output High Current with Capacitive Load	$C_L=10nF$	120	200	-	mA
I_{Opk+}	Peak Output High Short Circuit Pulsed Current	$V_O=0V, PW \leq 10\mu s$ (Single Pulse)	-	220	-	
I_{O-}	Output Low Current with Capacitive Load	$C_L=10nF$	220	350	-	
I_{Opk-}	Peak Output Low Short Circuit Pulsed Current	$V_O=15V, PW \leq 10\mu s$ (Single Pulse)	-	375	-	
V_{IH}	High Level Input Voltage		2.5	-	-	V
V_{IL}	Low Level Input Voltage		-	-	0.8	
V_{CLAMP}	Input Clamp Voltage (/LIN, /HIN, ITRIP, EN)	$I_{IN}=100\mu A$	5.2	5.6	5.9	
I_{HIN+}	Input Bias Current	$V_{HIN}=5V$	-	110	150	μA
I_{HIN-}	Input Bias Current	$V_{HIN}=0V$	-	150	200	
I_{LIN+}	Input Bias Current	$V_{LIN}=5V$	-	110	150	
I_{LIN-}	Input Bias Current	$V_{LIN}=0V$	-	150	200	
$V_{RCIN,TH}$	RCIN Positive Going Threshold		-	8	-	V
I_{RCIN}	RCIN Input Bias Current	$V_{RCIN}=0V$ or $15V$	-	-	1	μA
$R_{RCIN,ON}$	RCIN Low On-Resistance	$I=1.5mA$	-	50	100	Ω
$V_{IT,TH+}$	ITRIP Positive Going Threshold		0.42	0.46	0.5	V
$V_{IT,TH-}$	ITRIP Negative Going Threshold		-	0.4	-	
$V_{IT,Hys}$	ITRIP Hysteresis		-	0.06	-	
I_{ITRIP+}	High ITRIP Input Bias Current	$V_{ITRIP}=4V$	-	5	40	μA
I_{ITRIP-}	Low ITRIP Input Bias Current	$V_{ITRIP}=0V$	-	-	1	
$V_{EN,TH+}$	EN Positive Going Threshold		-	-	2.5	V
$V_{EN,TH-}$	EN Negative Going Threshold		0.8	-	-	
I_{EN+}	High EN Input Bias Current	$V_{EN}=5V$	-	5	40	μA
I_{EN-}	Low EN Input Bias Current	$V_{EN}=0V$	-	-	1	
$R_{FO,ON}$	Fault Low On-Resistance	$I=1.5mA$	-	50	100	Ω

Dynamic Electrical Characteristics

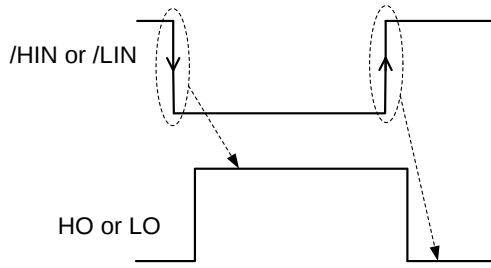
V_{BIAS} (V_{CC} or V_{BS}) = 15V, C_L = 1000pF and T_A = 25°C unless otherwise specified.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Units
t_{ON}	Turn-On Propagation Delay	$V_{IN}=0V$ or 5V	400	530	750	ns
t_{OFF}	Turn-Off Propagation Delay		400	530	750	
t_R	Turn-On Rise Time		-	125	190	
t_F	Turn-Off Fall Time		-	50	75	
$t_{IN,FLT}$	Input Filter Time (/LIN, /HIN) ⁽⁵⁾		200	350	510	
t_{EN}	EN Low to Output Shutdown Propagation Delay	$V_{IN}=0V$ $V_{EN}=5V \rightarrow 0V$	250	460	650	ms
$t_{EN,FLT}$	EN Input Filter Time		100	200	-	
t_{FOD}	Fault Output Duration Time (RCIN: C = 1nF, R = 2MΩ)	$V_{ITRIP}=1V$	1.3	1.65	-	ms
t_{ITRIP}	ITRIP to Output Shutdown Propagation Delay	Low Side	420	620	970	ns
		High Side	600	800	1150	
$t_{IT,FLT}$	ITRIP Filter Time	$V_{ITRIP}=5V$, $V_{IN}=0V$, $V_{FO}=5V$ (10kΩ pull-up)	-	400	-	
t_{FO}	ITRIP to FO Propagation Delay		400	600	950	
DT	Dead Time ⁽⁶⁾	$V_{IN}=0V$ or 5V without External Dead Time	100	275	420	ns
MT	Matching Delay Time (t_{ON} , t_{OFF}) ⁽⁷⁾	$ t_{ON(HO)} - t_{ON(LO)} $ or $ t_{OFF(HO)} - t_{OFF(LO)} $	-	-	100	
PM	Output Pulse Width Matching ⁽⁸⁾	Input Pulse Width=10μs	-	-	150	

Note:

- The minimum width of the input pulse is recommended to exceed 500ns to ensure the filtering time of the input filter.
- Please refer to 'Dead Time' definition of 'Function Diagram'.
- This parameter, MT and MDT applies to all of the channels.
- PM is defined as |(input pulse width) – (output pulse width)|.

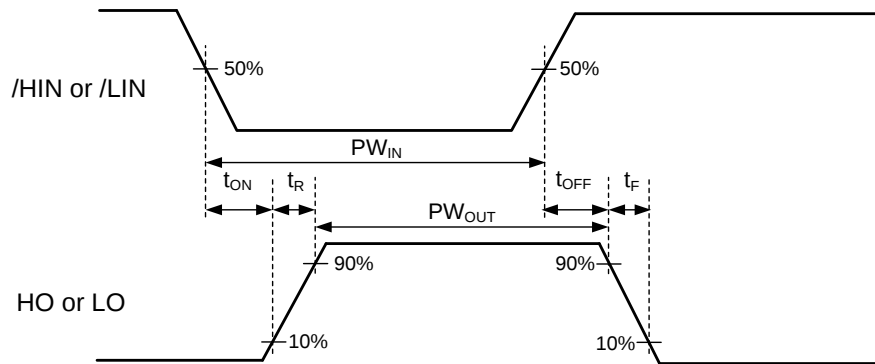
Output Activation



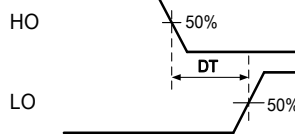
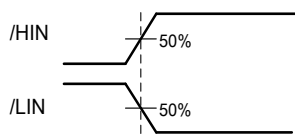
EN	$\overline{\text{HIN}}$	$\overline{\text{LIN}}$	HO	LO
L	L or H	L or H	L	L
H	H	L	L	H
	L	H	H	L

Note: Output signal (HO or LO) is triggered by the edge of input signal.

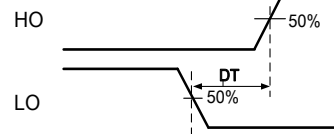
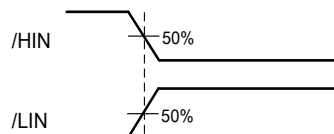
Input / Output Timing Diagram



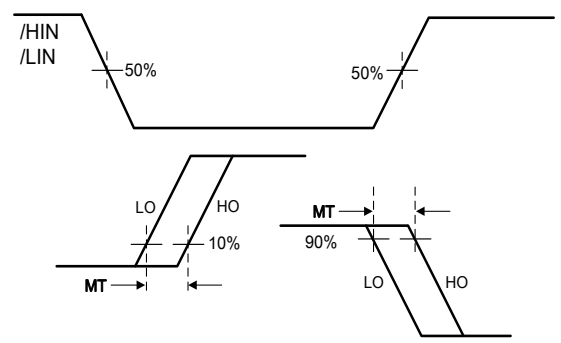
Dead Time Activation



< $\overline{\text{HIN}}$ off and $\overline{\text{LIN}}$ on>



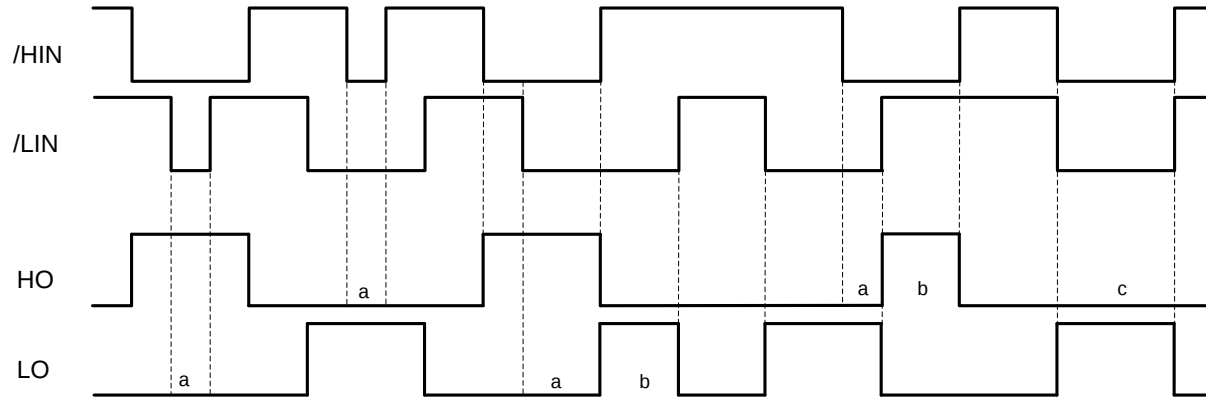
< $\overline{\text{HIN}}$ on and $\overline{\text{LIN}}$ off>



<Delay Matching Waveform Definition>

Function Timing Diagram

A. Illustration of Shoot-Through (Cross-Conduction) Protection Logic

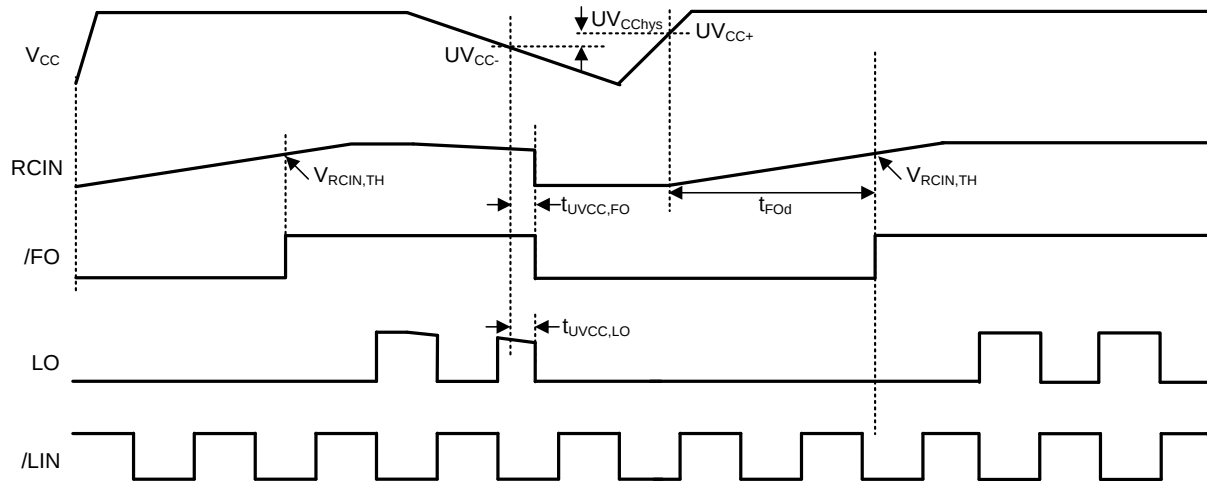


Note:

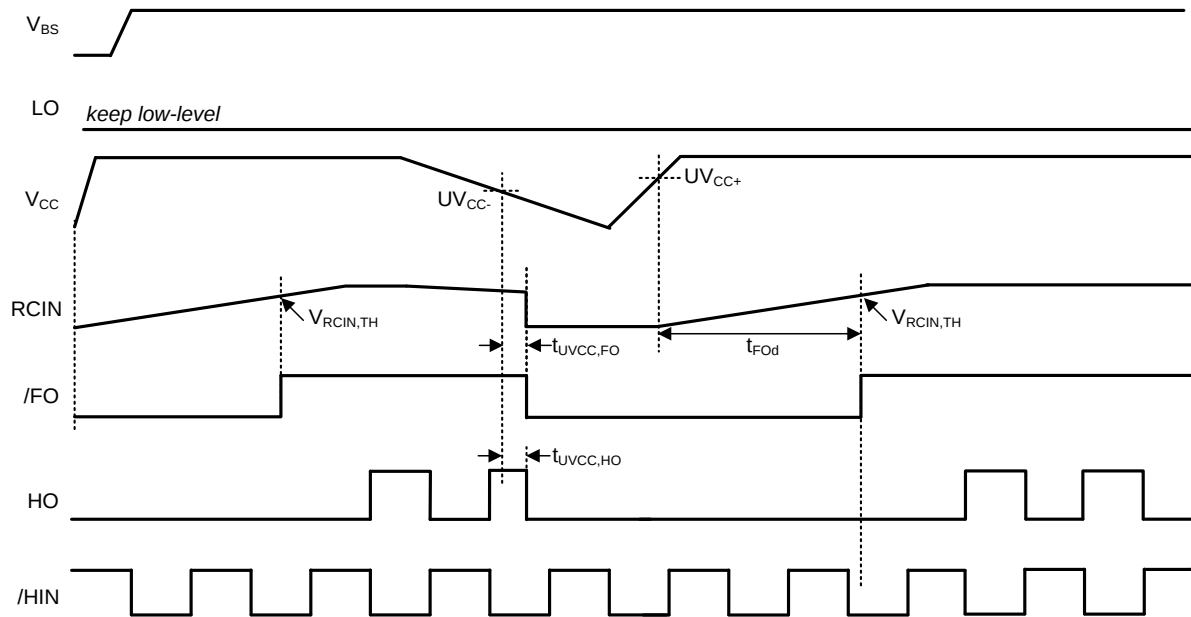
- When one output (high or low side) is turned on, the other side turn-on input is ignored.
- If both outputs are changed simultaneously, the turn-on activation is done by the internal dead time of 275ns typ. (For more information, please refer to below 'Dead Time' section.)
- When high-side (/HIN) and low-side (/LIN) have turn-on inputs at the same time, low-side (/LIN) has the priority.

B. V_{CC} (V_{BS}) Supply Under-Voltage (UV) Lockout Timing Diagram

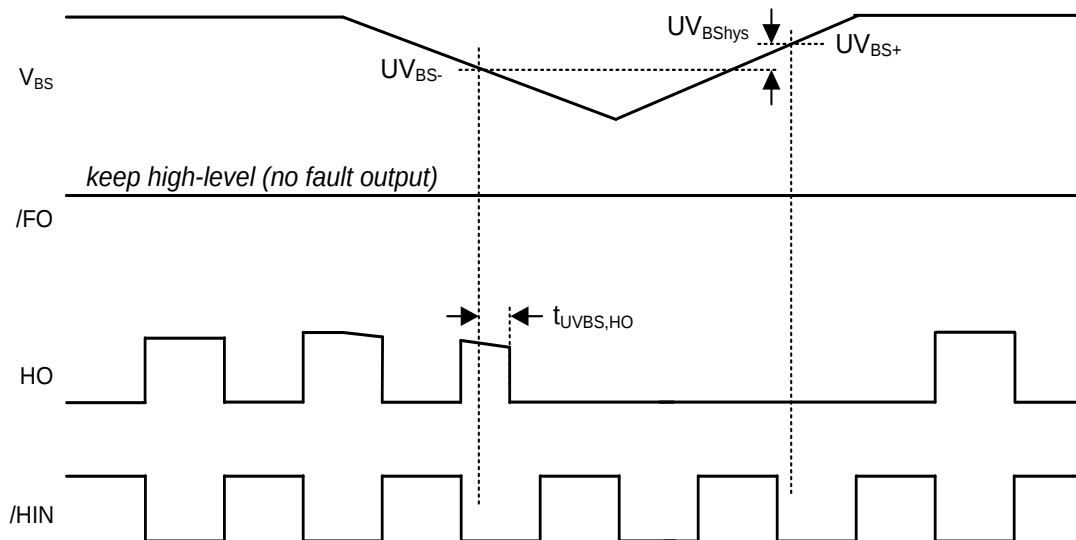
a. LO operation by V_{CC} under-voltage protection



b. HO operation by V_{CC} under-voltage protection

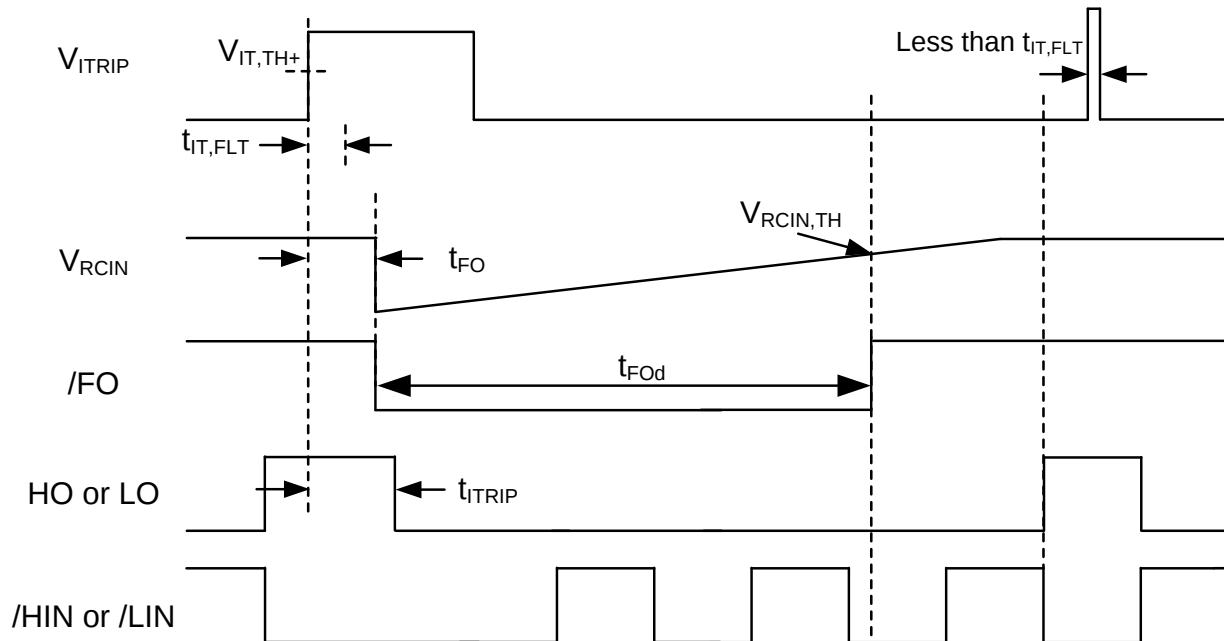


c. V_{BS} supply under-voltage (UV) lockout timing diagram

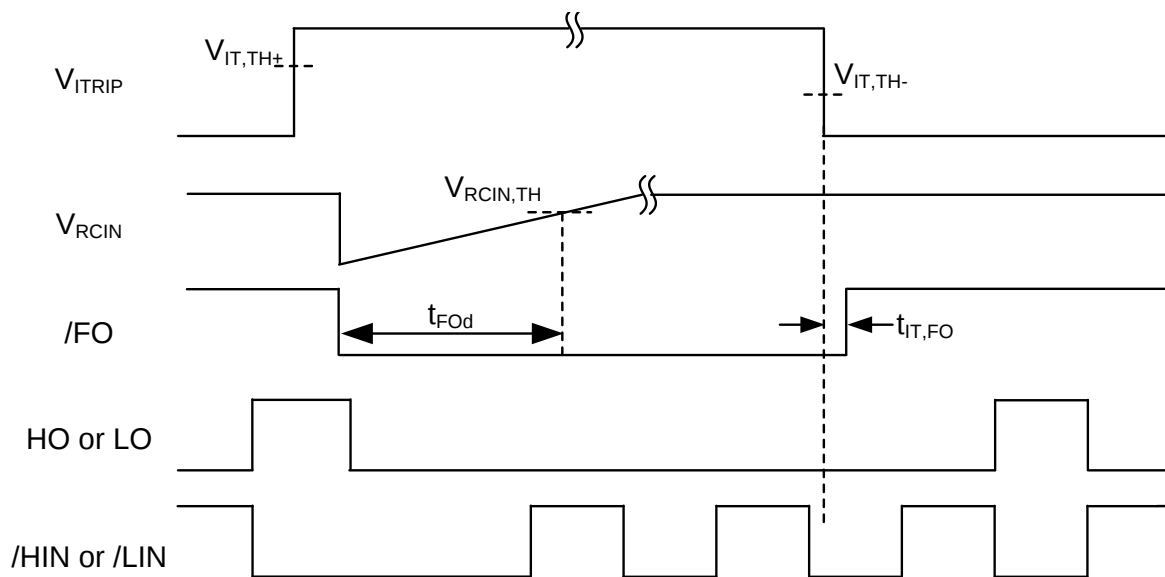


C. Over-Current Protection

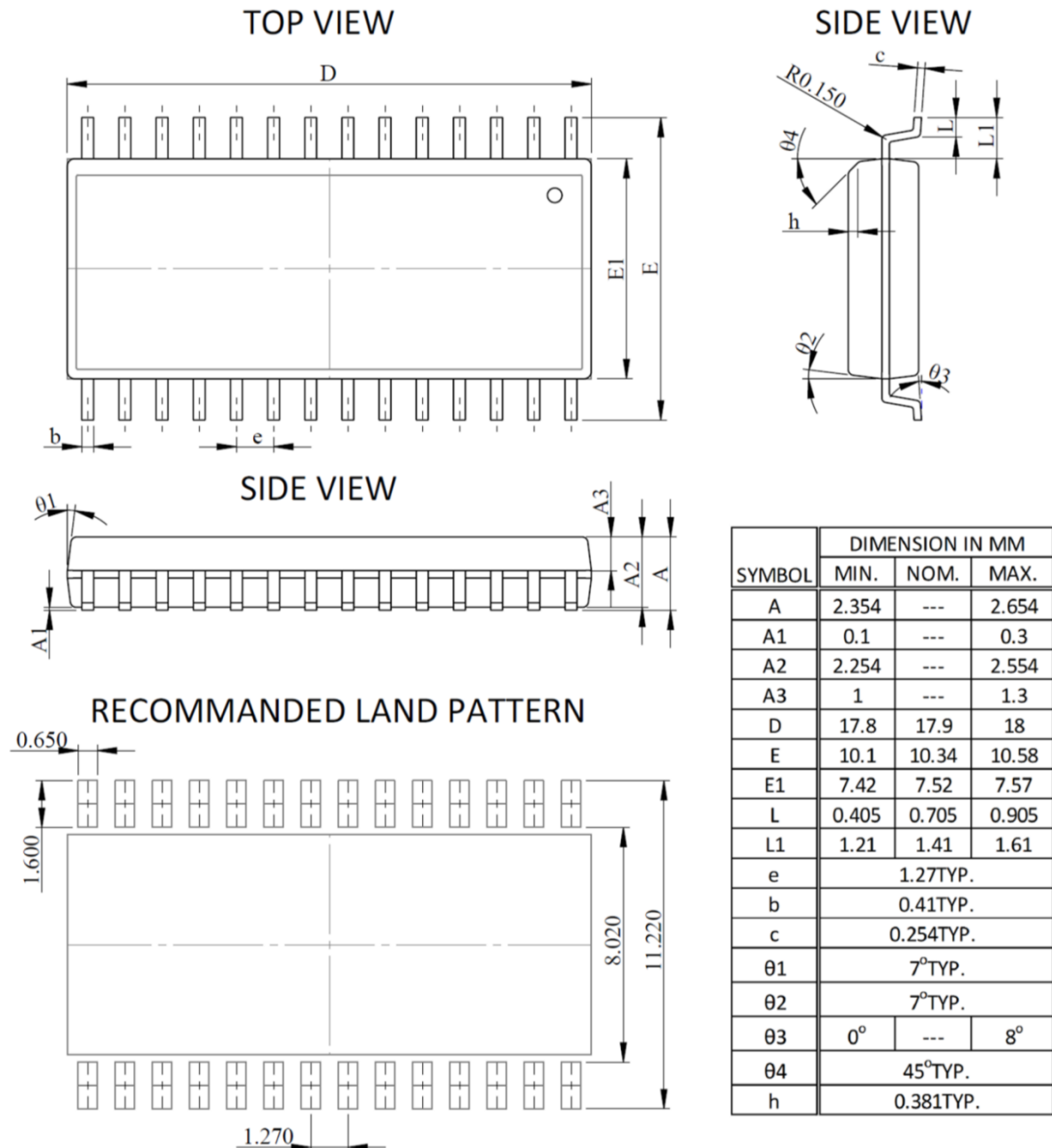
- a. When ITRIP voltage rises higher than positive going threshold for $t < t_{FOd}$



- b. When ITRIP voltage keeps longer than t_{FOd}



Package Dimensions, SOP-28L



NOTES

1. CONTROLLING DIMENSION : MM.
2. DIMENSIONS ARE INCLUSIVE OF PLATING.
3. PACKAGE BODY SIZES EXCLUDE MOLD FLASH AND GATE BURRS.
MOLD FLASH AT THE NON-LEAD SIDES SHOULD BE LESS THAN 6 MILS EACH.
4. DIMENSION L IS MEASURED IN GAUGE PLANE.

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