

General Description

The AGD8156A / AGD8256A are 600V 6-channel gate drivers 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)



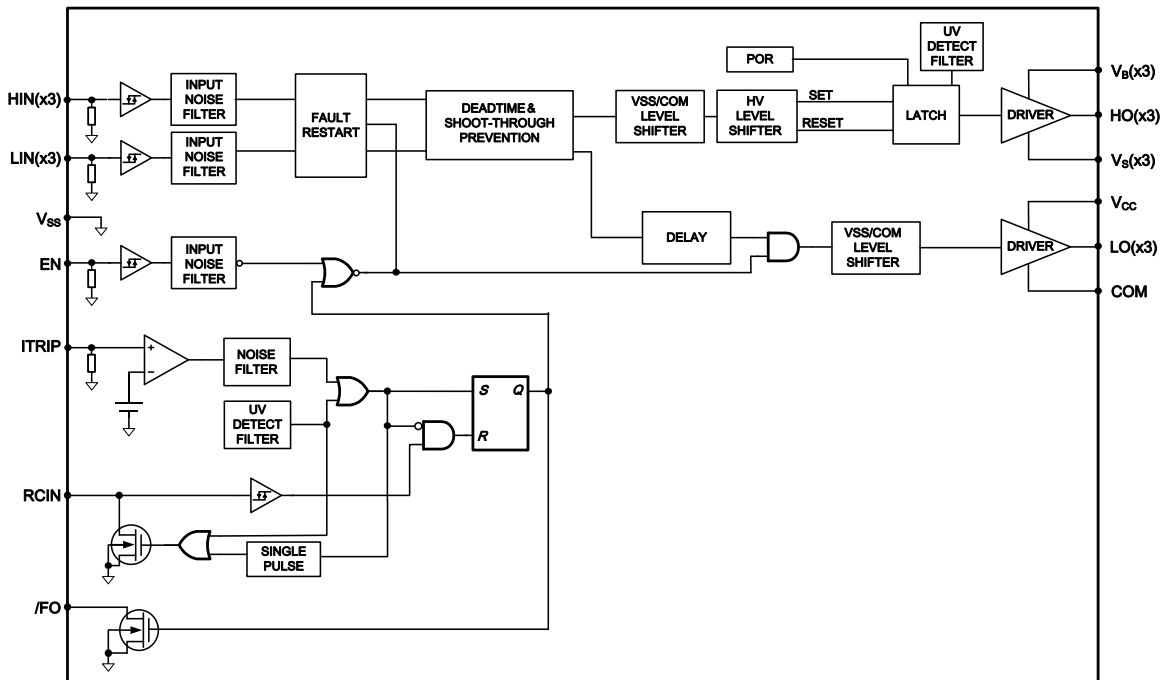
Features

- 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 inputs logic compatible
- Input logic: Schmitt trigger receiver circuit (Active high)

Applications

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

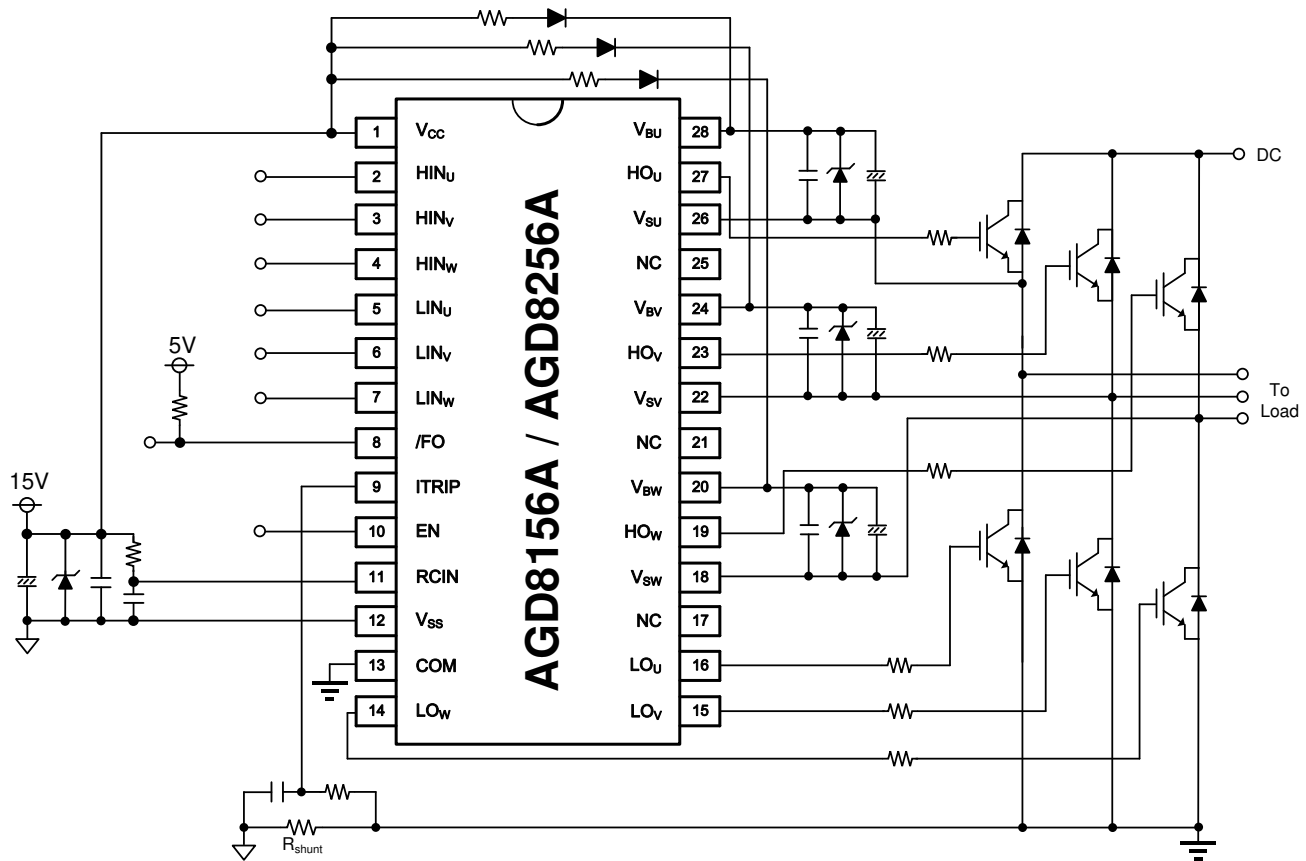
Internal Block Diagram



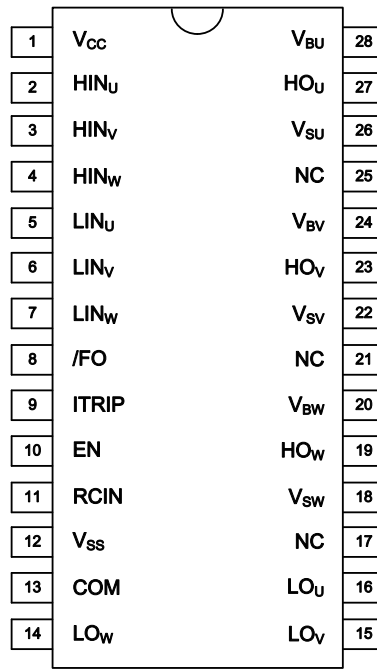
Ordering Information

Part Number	Temperature Range	Package
AGD8156A	-40°C to 125°C	SOP-28L
AGD8256A	-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	LO _W	Low-Side Driver Output (W-Phase)
15	LO _V	Low-Side Driver Output (V-Phase)
16	LO _U	Low-Side Driver Output (U-Phase)
17	NC	No Connection
18	V _{SW}	High-Side Floating Supply Offset Voltage (W-Phase)
19	HO _W	High-Side Driver Output (W-Phase)

Pin Description (continued)

Pin Number	Pin Name	Pin Function
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)	$V_{SS}-0.3$	$V_{CC}+0.3$	
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	$^\circ\text{C}/\text{W}$
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

Notes:

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

Recommended Operating Ratings

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 $(V_{CC} - COM) = (V_B - V_S) = 15V$.

Symbol	Parameter	Min.	Max.	Units	
V_{CC}	Low-Side Supply Voltage	AGD8156A	10	20	V
		AGD8256A	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	AGD8156A	V_S+10	V_S+20	
		AGD8256A	$V_S+13.2$	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	

Notes:

- 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} - 50V with a 50ns pulse width, which is guaranteed by design.

Static Electrical Characteristics

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

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Units
UV_{CC+}	V_{CC} Under-Voltage Positive Going Threshold	AGD8156A	8.0	8.9	9.8	V
		AGD8256A	10.8	11.9	13.0	
UV_{CC-}	V_{CC} Under-Voltage Negative Going Threshold	AGD8156A	7.4	8.2	9.0	
		AGD8256A	10.3	11.4	12.5	
UV_{CChys}	V_{CC} Under-Voltage Hysteresis	AGD8156A	-	0.7	-	
		AGD8256A	-	0.5	-	
UV_{BS+}	V_{BS} Under-Voltage Positive Going Threshold	AGD8156A	8.0	8.9	9.8	
		AGD8256A	10.0	11.0	12.0	
UV_{BS-}	V_{BS} Under-Voltage Negative Going Threshold	AGD8156A	7.4	8.2	9.0	
		AGD8256A	9.0	10.0	11.0	
UV_{BSHys}	V_{BS} Under-Voltage Hysteresis	AGD8156A	-	0.7	-	
		AGD8256A	-	1.0	-	
I_{LK}	High Side Floating Supply Leakage Current (per 1-Phase)	$V_B = V_S = 600V$	-	-	50	μA

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Units
I _{QBS}	Quiescent V _{BS} Supply Current (per 1-Phase)	V _{IN} =0V	-	70	120	
I _{QCC}	Quiescent V _{CC} Supply Current (per 1phase)	(all inputs are in the off state)	-	0.3	1	mA
V _{OH}	High Level Output Voltage Drop, V _{BIAS} - V _O	I _O =20mA, V _{IN} =5V	-	0.9	1.4	V
V _{OL}	Low Level Output Voltage Drop, V _O	I _O =20mA, V _{IN} =0V	-	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≤10μs (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≤10μs (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} =100μA	5.2	5.6	
I _{HIN+}	Input Bias Current	V _{HIN} =5V	-	650	850	μA
I _{HIN-}	Input Bias Current	V _{HIN} =0V	-	-	1	
I _{LIN+}	Input Bias Current	V _{LIN} =5V	-	650	850	
I _{LIN-}	Input Bias Current	V _{LIN} =0V	-	-	1	
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

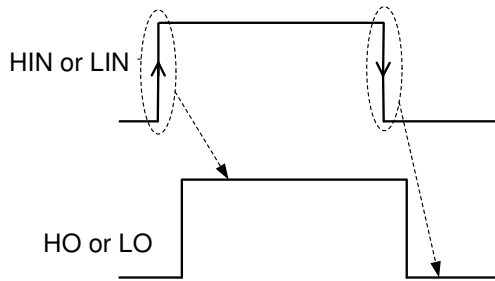
V_{BIAS} (V_{CC} or V_{BS}) = 15V, C_L = 1000pF and T_A = 25°C unless otherwise specified.

Symbol	Definition	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	$V_{IN}=5V$ $V_{EN}=5V \rightarrow 0V$	250	460	650	
$t_{EN,FLT}$	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	ns
$t_{IT,FLT}$	ITRIP Filter Time	$V_{ITRIP}=5V$, $V_{IN}=5V$, $V_{FO}=5V$ (10kΩ pull-up)	-	400	-	ns
t_{FO}	ITRIP to FO Propagation Delay		400	600	950	ns
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	

Notes:

- 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)|.

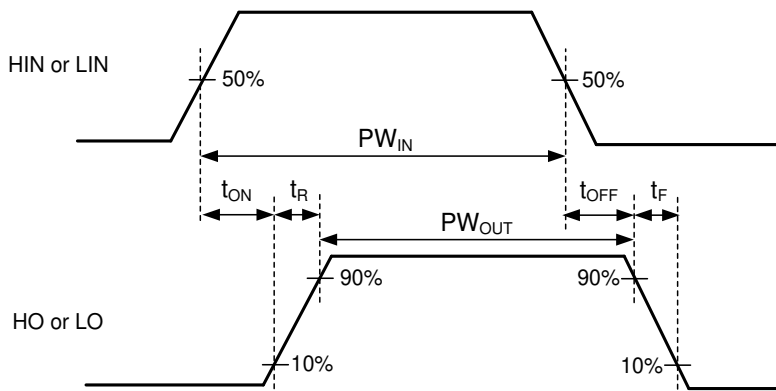
Output Activation



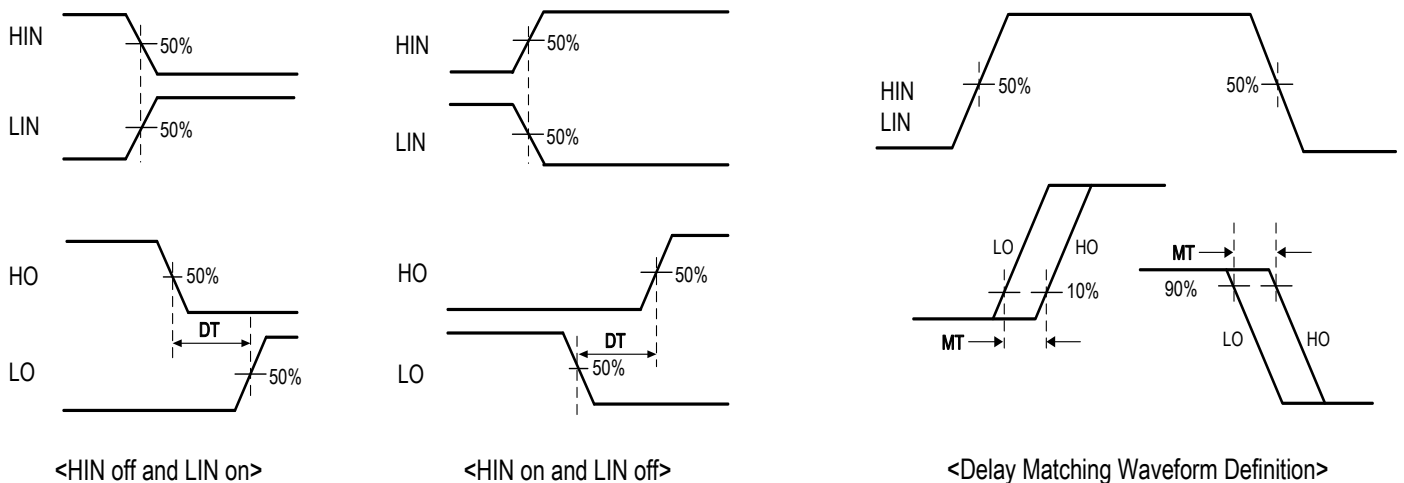
EN	HIN	LIN	HO	LO
L	L or H	L or H	L	L
H	H	L	H	L
	L	H	L	H

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

Input / Output Timing Diagram

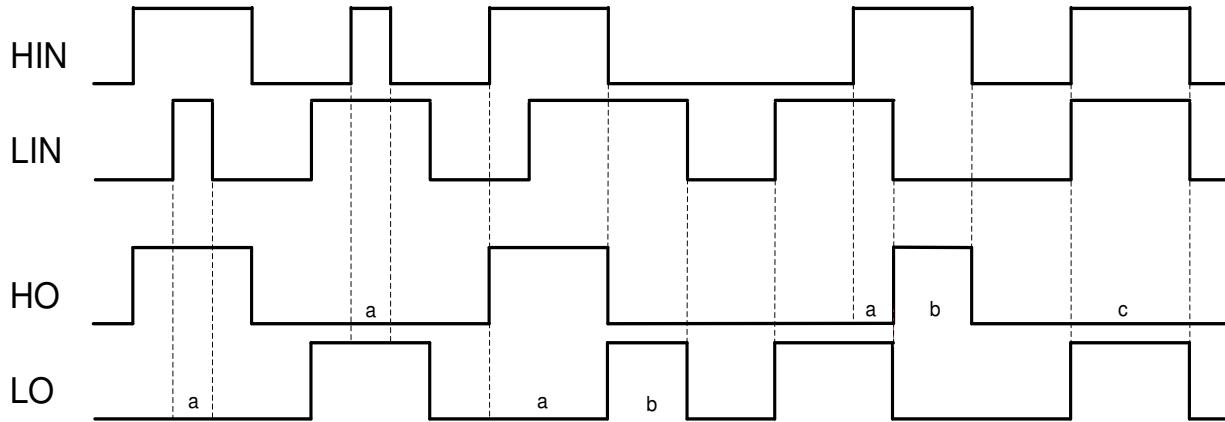


Dead Time Activation



Function Timing Diagram

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

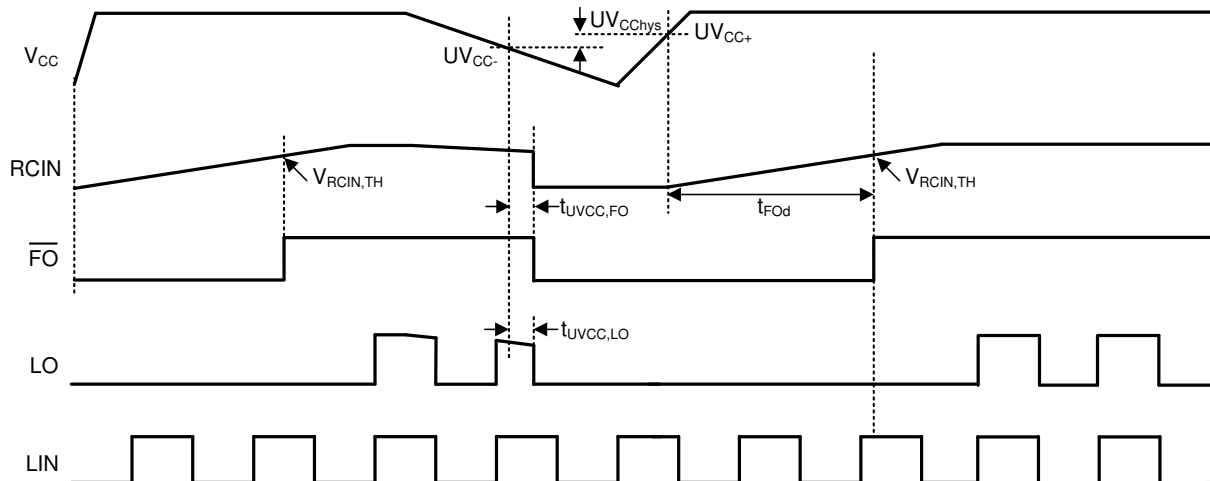


Note:

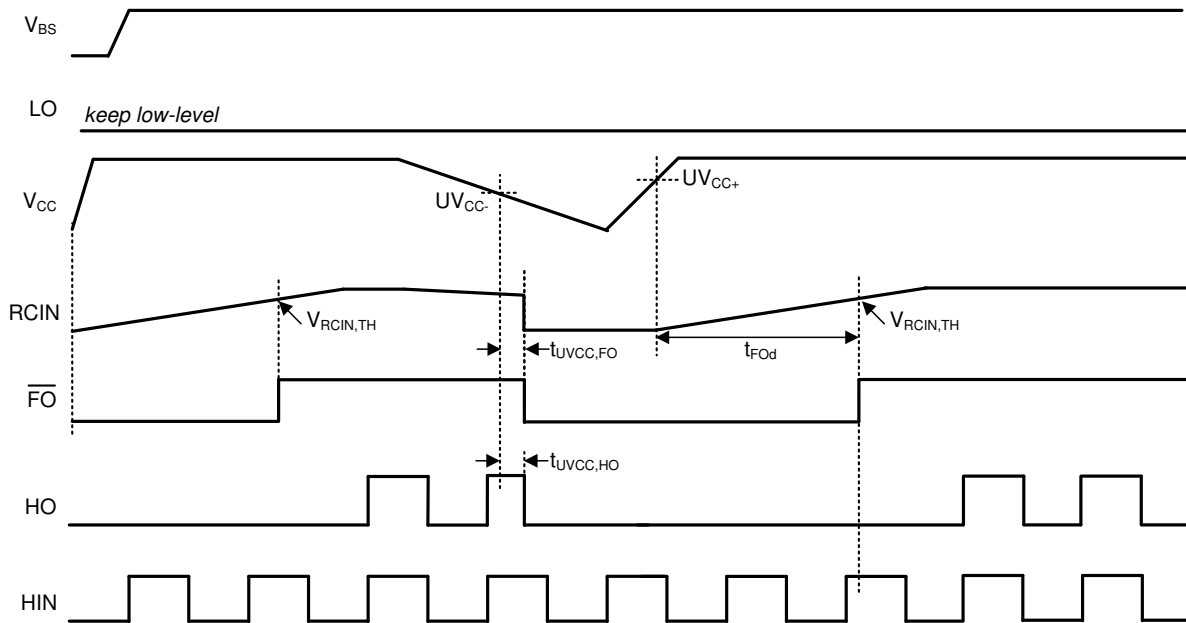
- When one output (high or low side) is turned on, the other side turn-on input is ignored.
- If both outputs are changed simultaneously, the turn-on activation is done by the internal dead time of 275ns typ. (For more information, please refer to below 'Dead Time' section.)
- When high-side (HIN) and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

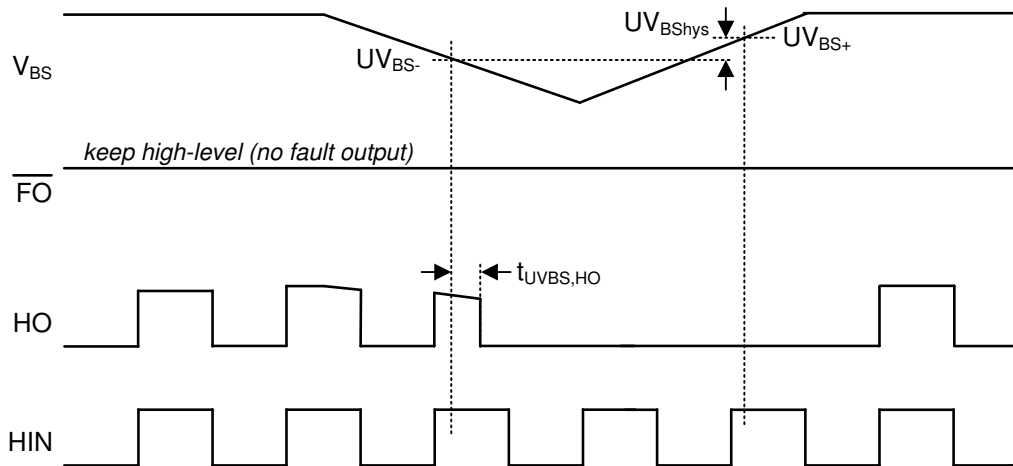
a. LO operation by V_{CC} under-voltage protection



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

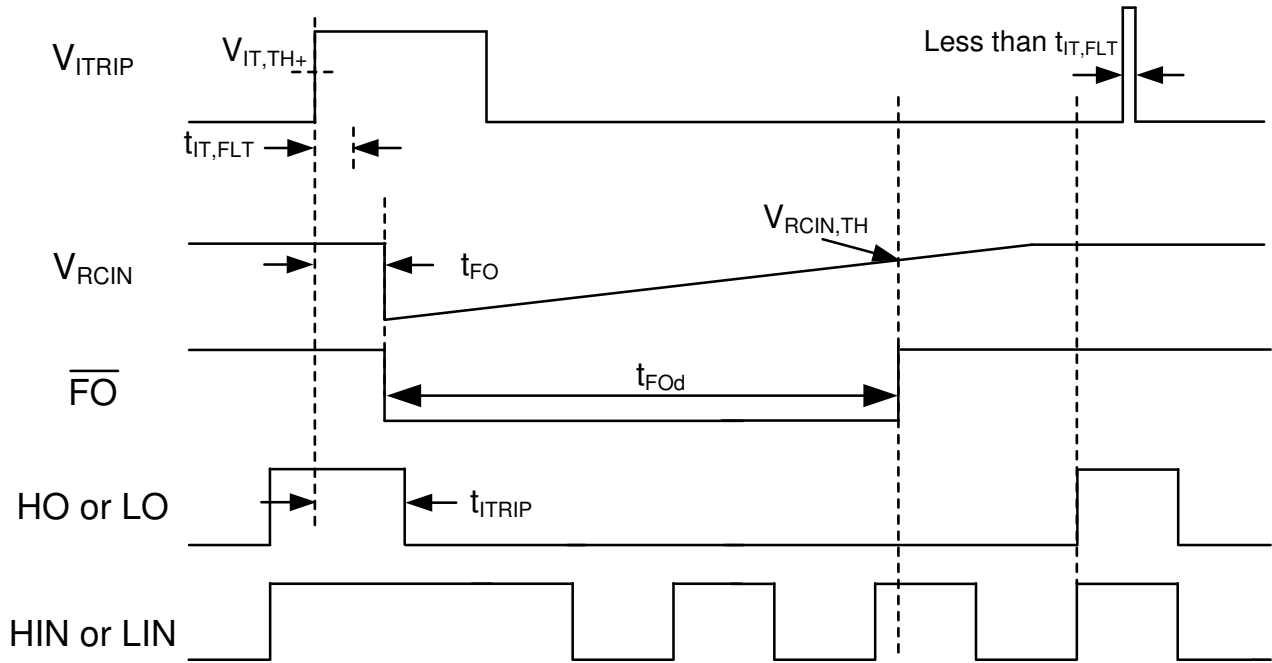


c. V_{BS} supply under-voltage (UV) lockout timing diagram

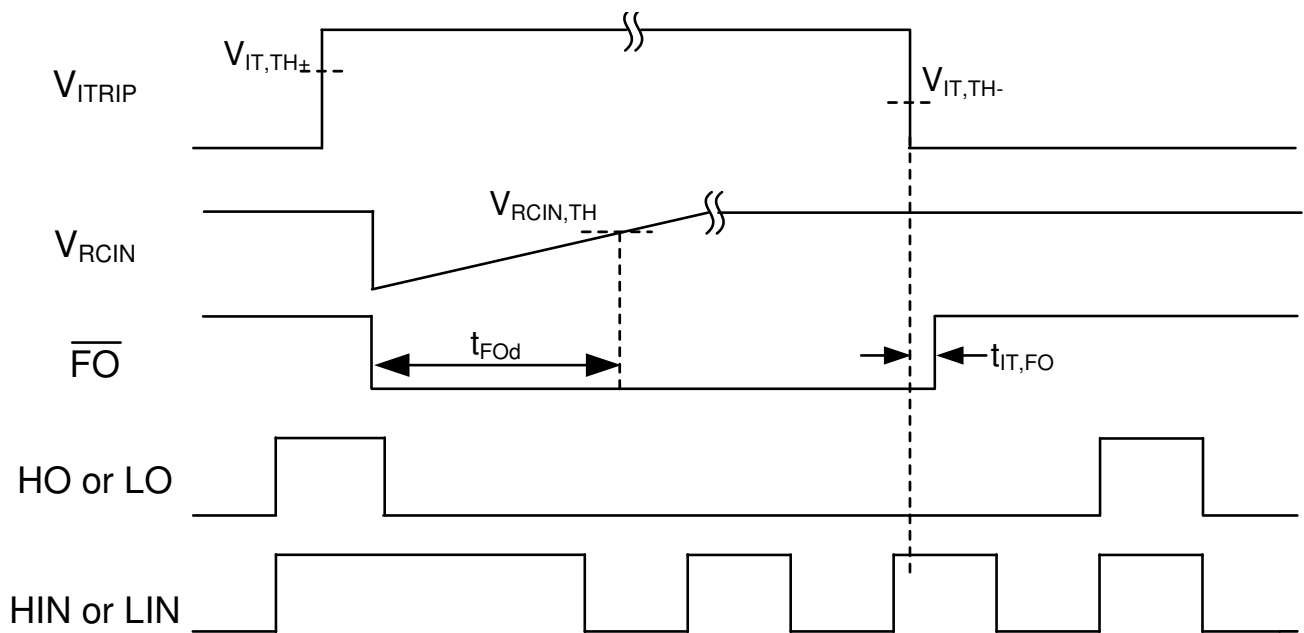


C. Over-Current Protection

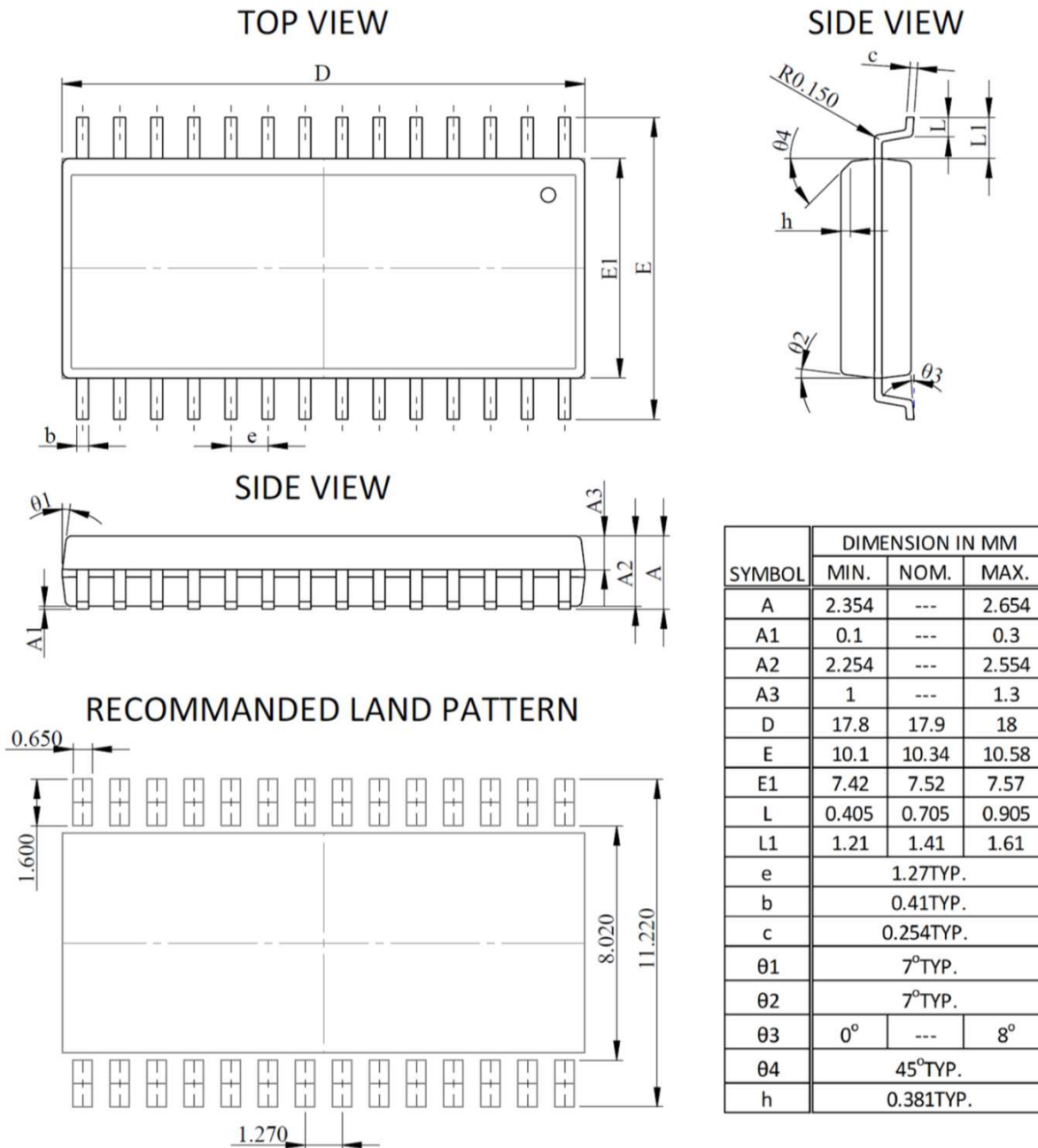
a. When ITRIP voltage rises higher than positive going threshold for $t < t_{FOd}$



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.

LEGAL DISCLAIMER

Alpha and Omega Semiconductor makes no representations or warranties with respect to the accuracy or completeness of the information provided herein and takes no liabilities for the consequences of use of such information or any product described herein. Alpha and Omega Semiconductor reserves the right to make changes to such information at any time without further notice. This document does not constitute the grant of any intellectual property rights or representation of non-infringement of any third party's intellectual property rights.

LIFE SUPPORT POLICY

ALPHA & OMEGA SEMICONDUCTOR PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS.

As used herein:

1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body or (b) support or sustain life, and (c) whose failure to perform when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury of the user.
2. A critical component in any component of a life support, device, or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.