

## Features

- Fully operational to +650V
- Tolerant of negative transient voltages
- dV/dt immune (50V/ns)
- Latch-up protected over entire operating range
- Fault-current shutdown for all drive outputs
- User selectable delay or latching function for clearing of the FAULT signal, independent user controlled clearing of the FAULT signal is also available
- UVLO protection for all drive outputs
- Enable signal capable of disabling all driver outputs
- 3 half-bridge driver pairs (independent)
- 3.3V logic compatible
- Cross-conduction prevention logic, 220 ns - 360ns Phase leg deadtime
- Peak output current: 600mA Pull-up/Source, 600mA Pull-down/Sink
- Wide operating supply voltage range: 8.0V to 35V
- Capacitive load drive capability: 1250pF in < 100ns
- Matched, low propagation delay times
- Low supply current
- Monolithic construction
- Fault monitoring is accompanied by a FLT signal indication, with programmable reset or user selectable latched protection
- Target package power dissipation capability is 2.0W.
- Full level of function available from -55°C to + 125°C
- Available in 48-Lead 7mm x 7mm MLP Quad package and 44-Lead PLCC package

## General Description

The IXA531 is a monolithic, 3-phase, MOSFET/IGBT gate driver consisting of three independent, high and low side output channels. In addition to the six inputs, which are CMOS/TTL Compatible, for the three corresponding high side and three low side outputs, there are dedicated lines for FAULT, ENABLE and RESET. Overload/Short Circuit protection is implemented by sensing a voltage across a shunt or low value resistor which carries load current. Upon Overload/Short Circuit detection, all outputs are disabled. Likewise ENABLE (EN) pin, when LOW under abnormal operating conditions, affords soft shut down of outputs. FAULT (FLT) signal's status indicates that shut down has occurred either due to Overload/Short Circuit in driven MOSFET/IGBT or Under Voltage on  $V_{CL}$ . Clearing of FAULT (FLT) signal and restoration of normal operation ensue automatically after a programmed delay using an RC Network wired at RST (RESET) pin. Matched propagation delays ensure proper operation even at very high switching frequencies. Absence of cross conduction in output stages removes possibility of shoot through in driven power MOSFETs or IGBTs.

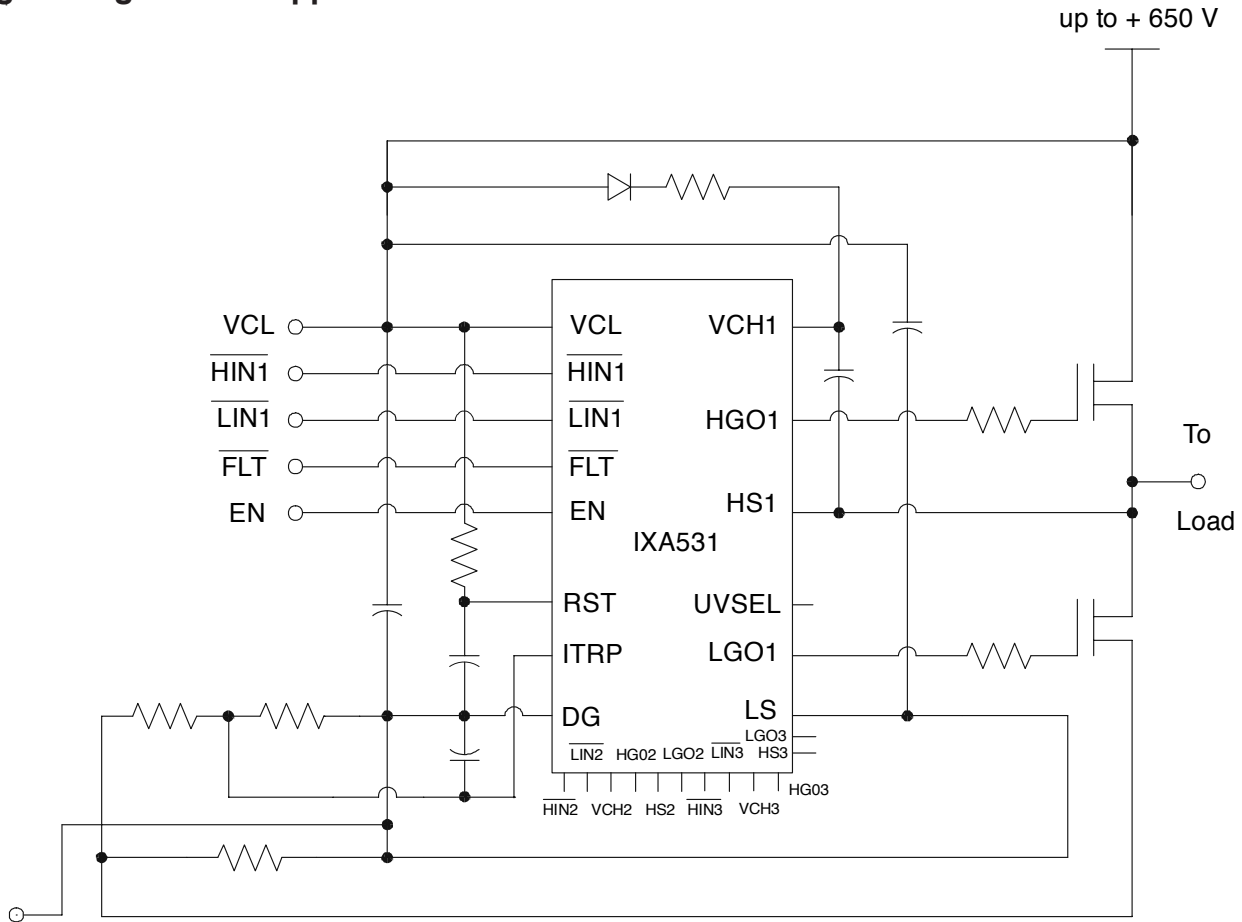
## Applications

- Driving MOSFETs and IGBTs in half-bridge circuits
- High voltage, high side and low side drivers
- Motor Controls
- Switch Mode Power Supplies (SMPS)
- DC to DC Converters
- Class D Switching Amplifiers

## Ordering Information

Part	Package
IXA531S10	48L - SSLGA
IXA531L4	44L - PLCC

**Warning: The IXA531 is ESD sensitive.**

**Fig. 1. Single Phase Application**


### Pin Description And Configuration

SYMBOL	FUNCTION	DESCRIPTION
$\overline{\text{HIN1,2,3}}$	HS Input	High side Input signal, TTL or CMOS compatible; HGO1,2,3 out of phase
$\overline{\text{LIN1,2,3}}$	LS Input	Low side Input signal, TTL or CMOS compatible; LGO1,2,3 out of phase
EN	Enable	Chip enable. When driven high, both outputs go low.
DG	Ground	Logic Reference Ground
VCH1,2,3	Supply Voltage	High Side Power Supply
HGO1,2,3	Output	High side driver output
HS1,2,3	Return	High side voltage return
VCL	Supply Voltage	Low side and Logic fixed power supply. This power supply provides power for all outputs. Voltage range is from 8.0 to 35V.
LGO1,2,3	Output	Low side driver output
LS	Low side return	Low side driver return
$\overline{\text{FLT}}$	Fault	Indicates Low-Side under voltage or Over Current Trip
ITRP	Trip	Input for over current shutdown
RST	Delay after trip	Externally connected RC network decide FAULT CLEAR delay.

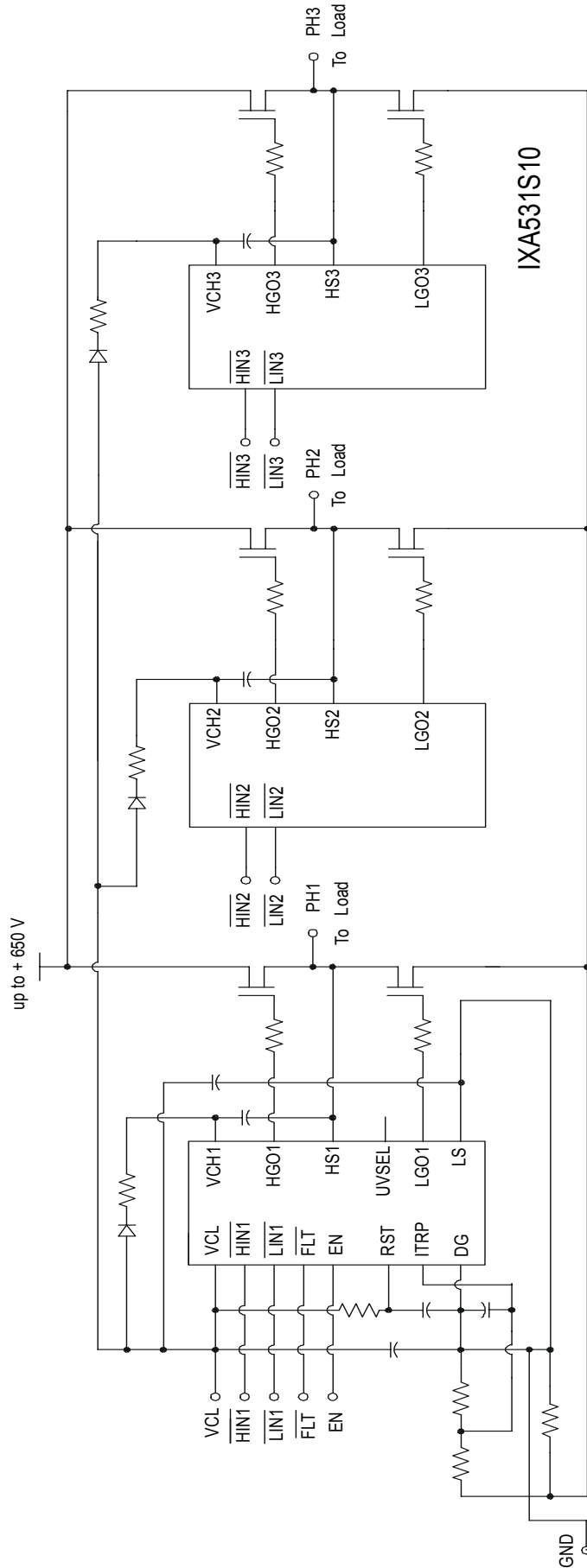


Fig. 2. 3-Phase Application for the IXA531.

### Absolute Maximum Ratings

Absolute maximum ratings indicate sustained limits beyond which damage to the device may occur. All voltage parameters are absolute voltages referenced to LS. The thermal resistance and power dissipation ratings are measured under board mounted and still air conditions

Symbol	Definition	Min.	Max.	Units
V <sub>CH</sub>	High side floating supply voltage , (V <sub>CH1,2,3</sub> )	-200	650	V
V <sub>HS</sub>	High side floating supply offset voltage , (V <sub>HS1,2,3</sub> )	V <sub>CH1,2,3</sub> - 35	V <sub>CH1,2,3</sub> + 0.3	V
V <sub>HGO</sub>	High side floating output voltage , (V <sub>HGO1,2,3</sub> )	V <sub>HS1,2,3</sub> - 0.3	V <sub>CH1,2,3</sub> + 0.3	V
V <sub>CL</sub>	Low side and logic fixed supply voltage	8.0	35	V
V <sub>DG</sub>	Logic Supply offset voltage	V <sub>LS</sub> - 0.7	V <sub>LS</sub> + 0.7	V
V <sub>LGO</sub>	Low side output voltage	- 0.3	V <sub>CL</sub> + 0.3	V
V <sub>IN</sub>	Input voltage <u>HIN1,2,3</u> , <u>LIN1,2,3</u> , ITRP, RST , EN	V <sub>DG</sub> - 0.3	Lower of (V <sub>DG</sub> + 35) or (V <sub>CL</sub> + 0.3)	V
V <sub>FLT</sub>	FAULT output voltage	V <sub>DG</sub> - 0.3	V <sub>CL</sub> + 0.3	V
dV/dt	Allowable offset voltage slew rate		50	V/ns
P <sub>D</sub>	Package power dissipation@ T <sub>A</sub> ≤ +25°C		2.0	W
R <sub>thJA</sub>	Thermal resistance, junction to ambient		63	K/W
T <sub>J</sub>	Junction temperature		125	°C
T <sub>S</sub>	Storage temperature	-55	150	°C
T <sub>L</sub>	Lead temperature (soldering, 10 seconds)		300	°C

### Recommended Operating Conditions

\*For proper operation the device should be used within the recommended conditions. All voltage parameters are absolute values referenced to LS. The V<sub>HS</sub> offset rating is tested with all supplies biased at 15V differential.

Symbol	Definition	Min.	Max.	Units
V <sub>CH1,2,3</sub>	High side floating supply voltage	V <sub>HS1,2,3</sub> + 12	V <sub>HS1,2,3</sub> + 35	V
V <sub>HS1,2,3</sub>	High side floating supply offset voltage	- 200	650	V
V <sub>HGO1,2,3</sub>	High side floating output voltage	V <sub>HS1,2,3</sub>	V <sub>CH1,2,3</sub>	V
V <sub>LGO1,2,3</sub>	Low side output voltage	0	V <sub>CL</sub>	V
V <sub>CL</sub>	Low side and logic fixed supply voltage	12	35	V
V <sub>DG</sub>	Logic Supply offset voltage	V <sub>LS</sub> - 0.3	V <sub>LS</sub> + 0.3	V
V <sub>FLT</sub>	FAULT output voltage	V <sub>DG</sub>	V <sub>CL</sub>	V
V <sub>RST</sub>	RST input voltage	V <sub>DG</sub>	V <sub>CL</sub>	V
V <sub>ITRP</sub>	ITRP input voltage	V <sub>DG</sub>	V <sub>CL</sub>	V
V <sub>IN</sub>	Logic input voltage <u>HIN1,2,3</u> , <u>LIN1,2,3</u> , EN	V <sub>DG</sub> or V <sub>LS</sub>	V <sub>CL</sub>	V
T <sub>A</sub>	Ambient temperature	-40	125	°C

**Static Electrical Characteristics**

$V_{BIAS}$  ( $V_{CL}$ ,  $V_{CH1,2,3}$ ) = 15V unless otherwise specified. The  $V_{IN}$ ,  $V_{TH}$  and  $I_{IN}$  parameters are referenced to DG and are applicable to all six channels. The  $V_O$  and  $I_O$  parameters are referenced to LS and  $V_{HS1,2,3}$  and are applicable to the respective output leads:  $H_{GO1,2,3}$  and  $L_{GO1,2,3}$ .

Symbol	Definition	Min.	Typ.	Max.	Units	Test Conditions
$V_{INL}$	Logic "0" input voltage $\overline{HIN1,2,3}$ ; $\overline{LIN1,2,3}$			0.8	V	
$V_{INH}$	Logic "1" input voltage $\overline{HIN1,2,3}$ ; $\overline{LIN1,2,3}$	3.0			V	
$V_{EN,TH+}$	EN positive going threshold			3.0	V	
$V_{EN,TH-}$	EN negative going threshold	0.8			V	
$V_{ITRP,TH+}$	ITRP positive going threshold	0.37	0.46	0.55	V	
$V_{ITRP,HYS}$	ITRP input hysteresis		.07		V	
$V_{RST,TH+}$	RST positive going threshold		8		V	
$V_{RST,HYS}$	RST input hysteresis		3		V	
$V_{OH1,2,3}$	High level output voltage, $V_{CH} - V_{HGO}$ or $V_{CL} - V_{LGO}$		0.9	1.4	V	$I_O=20mA$
$V_{OL1,2,3}$	Low level output voltage, $V_{HGO}$ or $V_{LGO}$		0.4	0.6	V	$I_O=20mA$
$V_{CLUV+}$	$V_{CL}$ supply under-voltage positive going threshold	10.6	11.1	11.6	V	
$V_{CHUV+}$	$V_{CH}$ supply under-voltage positive going threshold	10.6	11.1	11.6	V	
$V_{CLUV-}$	$V_{CL}$ supply under-voltage negative going threshold	10.4	10.9	11.4	V	
$V_{CHUV-}$	$V_{CH}$ supply under-voltage negative going threshold	10.4	10.9	11.4	V	
$V_{CLUVH}$	$V_{CL}$ supply under-voltage lockout hysteresis		0.2		V	
$V_{CHUVH}$	$V_{CH}$ supply under-voltage lockout hysteresis		0.2		V	
$I_{LK}$	Offset supply leakage current			50	$\mu A$	$V_{CH1,2,3}=V_{HS1,2,3}=600V$
$I_{QVCH}$	Quiescent $V_{CH}$ supply current		70	120	$\mu A$	$V_{IN}=0V$ or 5V
$I_{QVCL}$	Quiescent $V_{CL}$ supply current		1.6	2.3	mA	$V_{IN}=0V$ or 5V
$V_{IN}$	Input clamp voltage (HIN,LIN,ITRP,EN)		4.9		V	$I_{IN}=100\mu A$
$I_{LIN+or}I_{IN+}$	Logic "1" Input bias current for $LIN1,2,3$		200	300	$\mu A$	$V_{LIN}=5V$
$I_{LIN-or}I_{IN-}$	Logic "0" Input bias current for $LIN1,2,3$		100	220	$\mu A$	$V_{LIN}=0V$
$I_{HIN+or}I_{IN+}$	Logic "1" Input bias current for $HIN1,2,3$		200	300	$\mu A$	$V_{HIN}=5V$
$I_{HIN-or}I_{IN-}$	Logic "0" Input bias current for $HIN1,2,3$		100	220	$\mu A$	$V_{HIN}=0V$
$I_{ITRP+}$	"high" ITRP input bias current		30	100	$\mu A$	$V_{ITRP}=5V$
$I_{ITRP-}$	"low" ITRP input bias current		0	1	$\mu A$	$V_{ITRP}=0V$
$I_{EN+}$	"high" ENABLE input bias current		30	100	$\mu A$	$V_{EN}=5V$
$I_{EN-}$	"low" ENABLE input bias current		0	1	$\mu A$	$V_{EN}=0V$
$I_{RST}$	RST input bias current		0	1	$\mu A$	$V_{RST}=0V$ or 15V
$I_{GO+}$	Output high short circuit pulsed current		600		mA	$V_O=0V, PW<10\mu s$
$I_{GO-}$	Output low short circuit pulsed current		600		mA	$V_O=15V, PW<10\mu s$
$R_{ON,RST}$	RST low on resistance		50	100	$\Omega$	
$R_{ON,FLT}$	FLT low on resistance		50	100	$\Omega$	

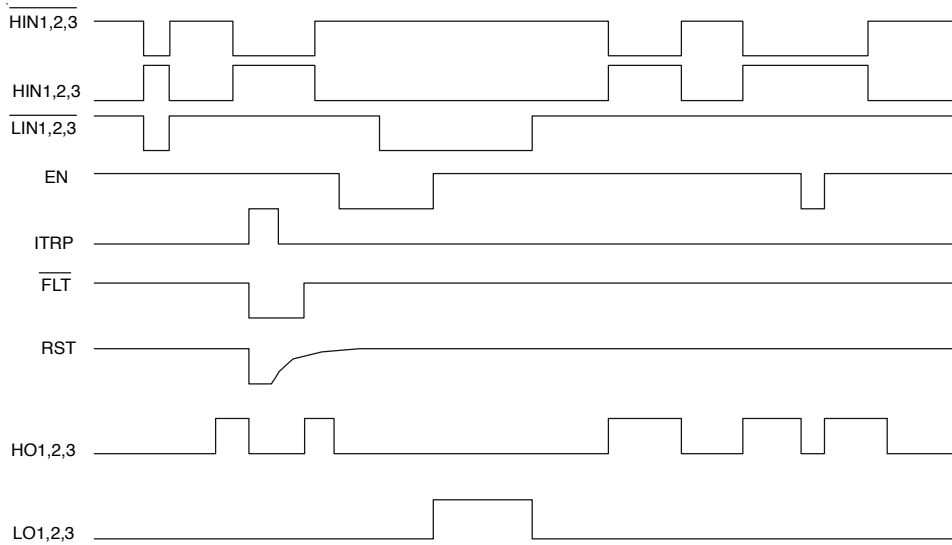
**Dynamic Electrical Characteristics**
 $V_{CL} = V_{CH} = V_{BIAS} = 15V, V_{HS1,2,3} = V_{DG} = V_{LS}, T_A = 25^\circ C$  and  $C_L = 1000pF$  unless otherwise specified.

Symbol	Definition	Min.	Typ.	Max.	Units	Test Conds.
$t_{on}$	Turn-on propagation delay	300	425	550	nS	$V_{IN}=0V$ & 5V
$t_{off}$	Turn-off propagation delay	250	400	550	nS	$V_{IN}=0V$ & 5V
$t_r$	Turn-on rise time		125	190	nS	----
$t_f$	Turn-on fall time		50	75	nS	----
$t_{EN}$	ENABLE low to output shutdown propagation delay	300	450	600	nS	$V_{IN}, V_{EN} = 0V$ or 5V
$t_{ITRP}$	ITRP to output shutdown propagation delay	500	750	1000	nS	$V_{ITRP}=5V$
$t_{bl}$	ITRP blanking time	100	150		nS	$V_{IN}=0V$ or 5V $V_{ITRP} = 5V$
$t_{FLT}$	ITRP to FAULT propagation delay	400	600	800	nS	$V_{IN} = 0V$ or 5V $V_{ITRP} = 5V$
$t_{FILIN}$	Input filter time (HIN, LIN, EN)	100	200		nS	$V_{IN} = 0V$ & 5V
$t_{FLCLR}$	FAULT clear time RST=2meg, C=1nF	1.3	1.65	2	mS	$V_{IN} = 0V$ or 5V $V_{ITRP}=0V$
DT	Dead time	220	290	360	nS	$V_{IN} = 0V$ & 5V
MT	Matching delay ON and OFF		40	75	nS	External Dead Time >400nsec
MDT	Matching delay, max ( $t_{on}, t_{off}$ ) - min ( $t_{on}, t_{off}$ ) ( $t_{on}, t_{off}$ are applicable to all 3 channels)		25	70	nS	
PM	Output pulse width matching, PWM <sub>IN</sub> -PWM <sub>OUT</sub>		40	75	nS	

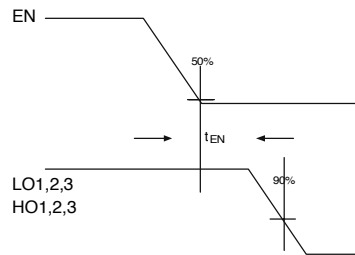
VCL	VCH	ITRP	ENABLE	FAULT	LGO1,2,3	HGO1,2,3
<UVCL	X	X	X	0(note 1)	0	0
15V	<UVCH	0V	15V	high imp	LIN1,2,3	0
15V	15V	0V	15V	high imp	LIN1,2,3	HIN1,2,3
15V	15V	>V <sub>ITRP</sub>	15V	0 (note 2)	0	0
15V	15V	0V	0V	high imp	0	0

**Notes:** A Cross Conduction logic prevents LGO1,2,3 and HGO1,2,3 for each channel from turning on simultaneously.

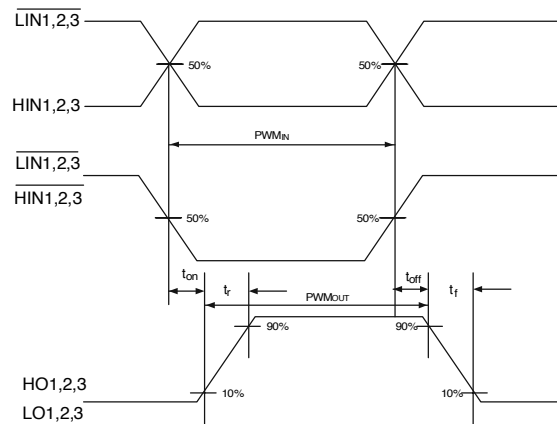
- UVCL is not latched, when  $VCL > UVCL$ , FAULT returns to high impedance.
- When  $ITRP < V_{ITRP}$ , FAULT returns to high-impedance after RST pin becomes greater than 8V (@VCL= 15V).



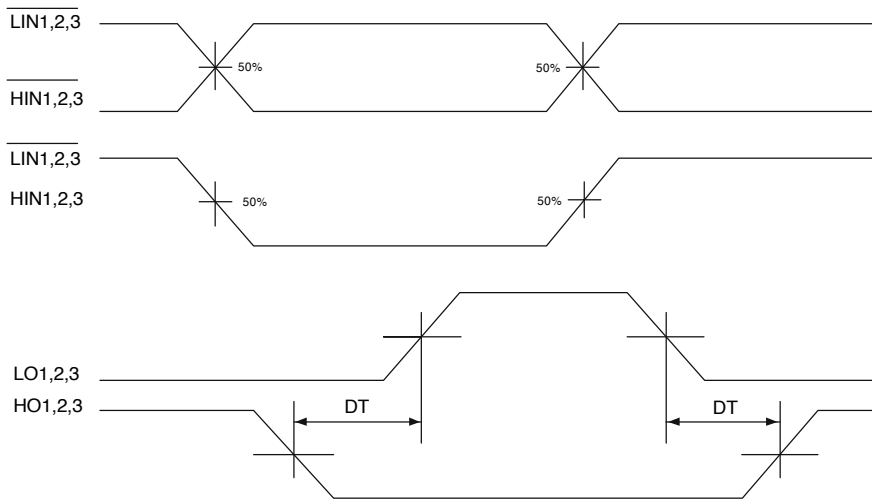
**Fig. 3. Timing Diagram**



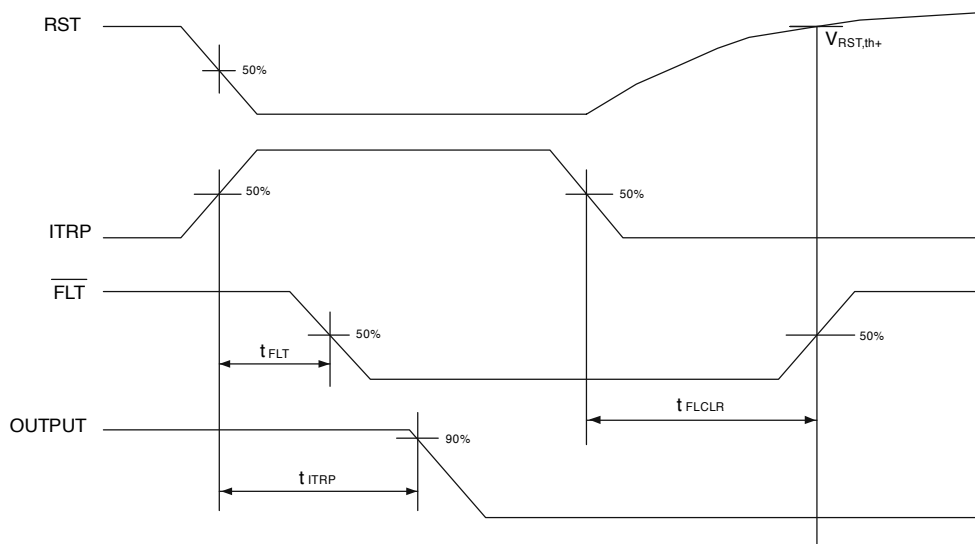
**Fig. 4. ENABLE Timing Waveforms**



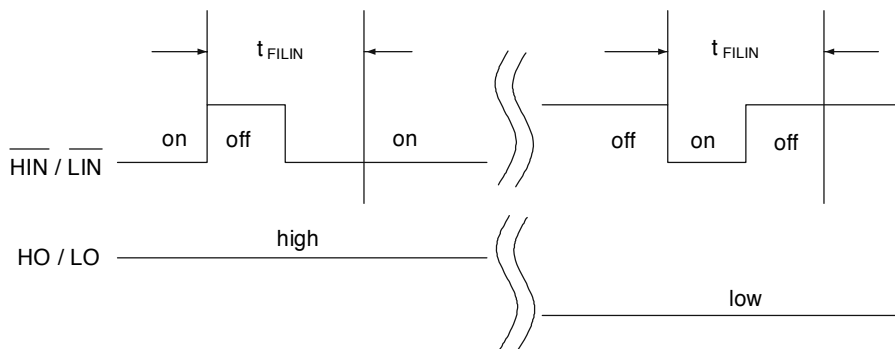
**Fig. 5. Switching Time Definitions**



**Fig. 6. Deadtime Waveforms**



**Fig. 7. ITRP / RST Waveforms**



**Fig. 8. ENABLE Timing Waveforms**



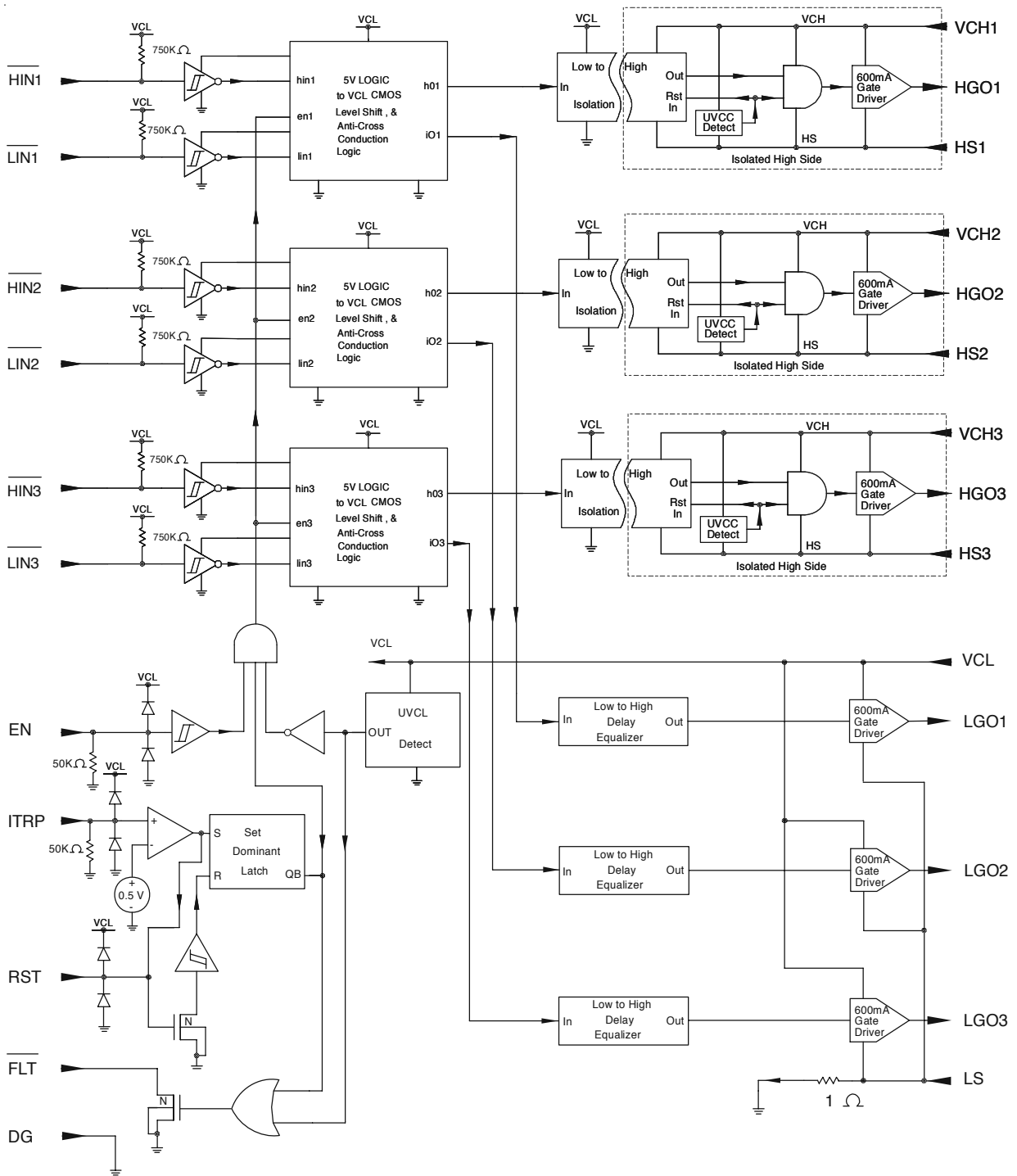


Fig. (9) IXA531 Block Diagram

Fig. 10. Pin Diagram for the IXA531S10 48-Lead MLP Quad Package

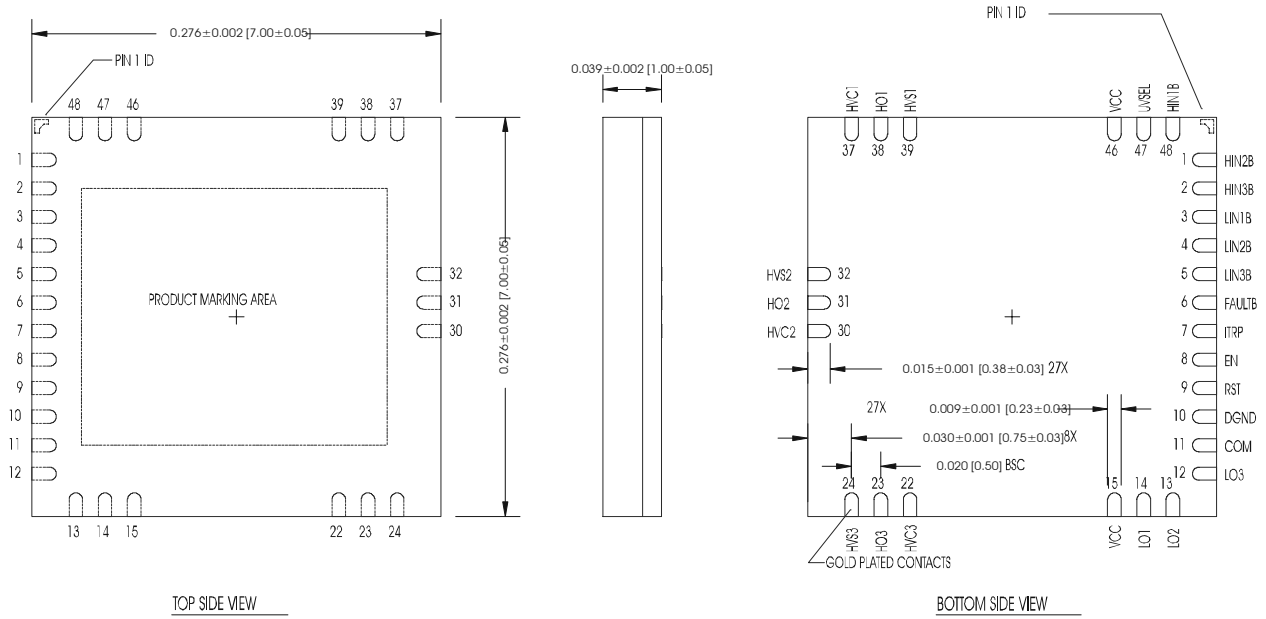


Fig. 11. Pin Diagram for the IXA531L4 44-Lead PLCC package

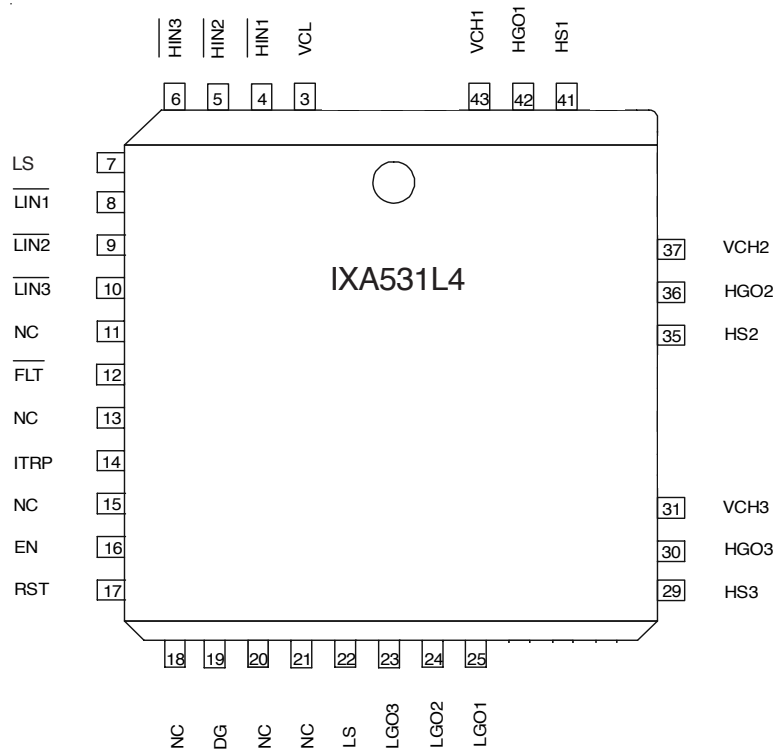
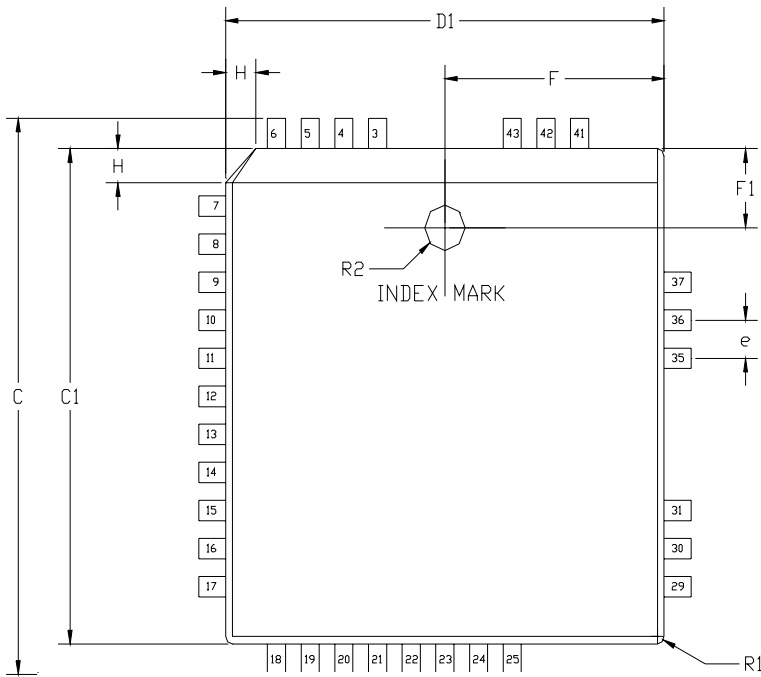


Fig. 12. 44-Lead PLCC Outline Diagram



DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.27	4.37	0.168	0.172
A1	3.63	3.73	0.143	0.147
A2	2.49	2.84	0.098	0.112
A3	0.58	0.69	0.023	0.027
B	0.41	0.51	0.016	0.020
B1	0.64	0.74	0.025	0.029
C	17.48	17.58	0.688	0.692
C1	16.48	16.59	0.649	0.653
D	17.48	17.58	0.688	0.692
D1	16.48	16.59	0.649	0.653
D2	15.44	15.54	0.608	0.612
e	1.27 BSC		0.050 BSC	
F	8.22	8.32	0.3235	0.3275
F1	2.58	2.68	0.1015	0.1055
H	1.09	1.19	0.043	0.047
R	0.76	1.02	0.030	0.040
R1	0.20	0.30	0.008	0.012
R2	1.47	1.57	0.058	0.062

