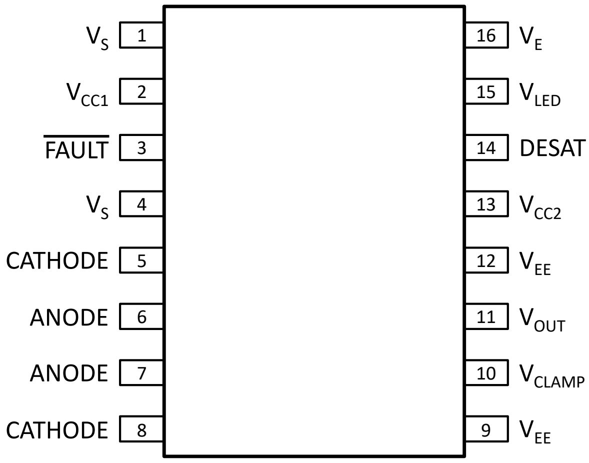
ICPL332J

DESCRIPTION

The ICPL332J is an advanced 5.0 A output current, easy-to-use, intelligent gate driver which makes IGBT V_{CE} fault protection compact, affordable, and easy-to implement. Features such as integrated V_{CE} detection, under voltage lockout (UVLO), "soft" IGBT turn-off, isolated open collector fault feedback and active Miller clamping provide maximum design flexibility and circuit protection.

The ICPL332J contains an AlGaAs LED. The LED is optically coupled to an integrated circuit with a power output stage. ICPL332J is ideally suited for driving power IGBTs and MOSFET used in motor control inverter applications. For IGBTs with higher ratings, the ICPL332J can be used to drive a discrete power stage which drives the IGBTs gate.

ICPL332J is supplied in SO16 package.



1	V_S	Input Ground
2	V_{CC1}	Positive Input Supply Voltage
3	$\overline{FAULT}$	Fault Output
4	V_S	Input Ground
5	CATHODE	Cathode
6	ANODE	Anode
7	ANODE	Anode
8	CATHODE	Cathode
9	V_{EE}	Output Supply Voltage
10	V_{CLAMP}	Miller Clamp
11	V_{OUT}	Gate Drive Voltage Output
12	V_{EE}	Output Supply Voltage
13	V_{CC2}	Positive Output Supply Voltage
14	DESAT	Desaturation Voltage Input
15	V_{LED}	LED Anode
16	V_E	Common Output Supply Voltage (IGBT Emitter)

FEATURES

- 5.0A maximum Peak Output Current
- 4.0A minimum Peak Output Current
- Under Voltage Lock Out (UVLO) Protection with Hysteresis
- Desaturation Detection
- 1.7A Miller Clamping
  Clamp pin short to V_{EE} if not used
- Open Collector Isolated Fault Feedback
- "Soft" IGBT Turn-Off
- Fault Reset by next LED Turn-On (Low to High) after Fault Mute period
- 200ns maximum Propagation Delay
- 100ns maximum Pulse Width Distortion (PWD)
- 4.5mA maximum Supply Current I_{CC}
- Guaranteed performance over Temperature range −40°C to +105°C
- High Common Mode Rejection (CMR) 50kV/µs minimum at V_{CM} 1500V
- RoHS Compliant
- UL File E91231

APPLICATIONS

- Isolated IGBT / MOSFET Gate Drive
- Industrial Inverters
- Uninterruptible Power Supply (UPS)
- AC and Brushless DC Motor Drives

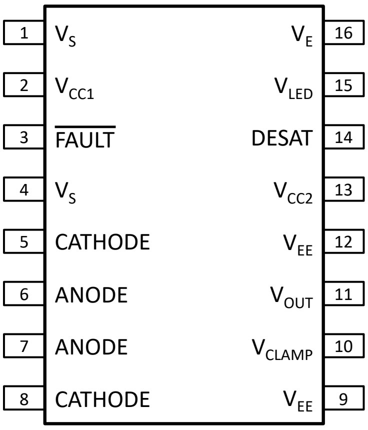
ORDER INFORMATION

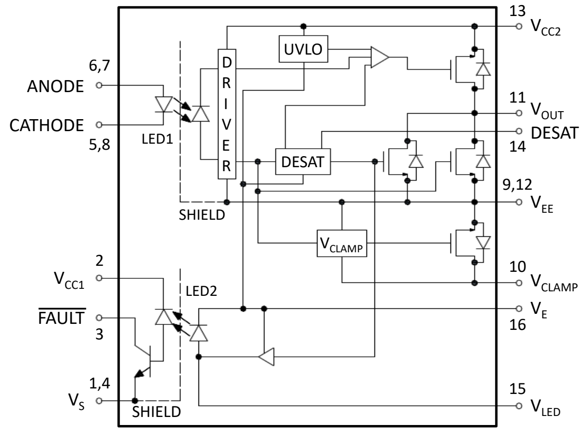
- Supplied in Tape and Reel

ISOCOM COMPONENTS 2004 LTD
Unit 25B, Park View Road West, Park View Industrial Estate
Hartlepool, Cleveland, TS25 1PE, United Kingdom
Tel : +44 (0)1429 863 609 Fax : +44 (0)1429 863 581
e-mail : sales@isocom.co.uk
http://www.isocom.com

ISOCOM COMPONENTS ASIA LTD
Hong Kong Office
Block A, 8/F, Wah Hing Industrial Mansions
36 Tai Yau Street, San Po Kong, Kowloon, Hong Kong
Tel : +852 2995 9217 Fax : +852 8161 6292
e-mail : sales@isocom.com.hk

ICPL332J





1	V_S	Input Ground
2	V_{CC1}	Positive Input Supply Voltage (3.3V to 5.5V)
3	$\overline{\text{FAULT}}$	Fault Output $\overline{\text{FAULT}}$ changes from a high impedance state to a logic low output within 5µs of the voltage on the DESAT pin exceeding an internal reference voltage of 6.7V. $\overline{\text{FAULT}}$ output is an open collector which allows the $\overline{\text{FAULT}}$ outputs from all ICPL332J in a circuit to be connected together in a "wired OR" forming a single fault bus for interfacing directly to the micro-controller.
4	V_S	Input Ground
5	CATHODE	Cathode
6	ANODE	Anode
7	ANODE	Anode
8	CATHODE	Cathode
9	V_{EE}	Output Supply Voltage
10	V_{CLAMP}	Miller Clamp
11	V_{OUT}	Gate Drive Voltage Output
12	V_{EE}	Output Supply Voltage
13	V_{CC2}	Positive Output Supply Voltage
14	DESAT	Desaturation Voltage Input When the voltage on DESAT exceeds an internal reference voltage of 6.7V while the IGBT is on, $\overline{\text{FAULT}}$ output is changed from a high impedance state to a logic low state within 5µs.
15	V_{LED}	LED Anode This pin must be left unconnected for guaranteed data sheet performance. (For Optical Coupling Testing only)
16	V_E	Common Output Supply Voltage (IGBT Emitter)

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http://www.isocom.com

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Hong Kong Office
Block A, 8/F, Wah Hing Industrial Mansions
36 Tai Yau Street, San Po Kong, Kowloon, Hong Kong
Tel : +852 2995 9217 Fax : +852 8161 6292
e-mail : sales@isocom.com.hk

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C)

Stresses exceeding the absolute maximum ratings can cause permanent damage to the device. Exposure to absolute maximum ratings for long periods of time can adversely affect reliability.

INPUT LED		
Average Input Current	I_F	25mA
Peak Transient Input Current	$I_{F(TRAN)}$	1A
Reverse Input Voltage	V_R	5V
Power Dissipation	P_I	150mW
$\overline{\text{FAULT}}$		
Positive Input Supply Voltage	V_{CC1}	−0.5V to 7V
$\overline{\text{FAULT}}$ Output Current	$I_{\overline{FAULT}}$	8mA
$\overline{\text{FAULT}}$ Pin Voltage	$V_{\overline{FAULT}}$	−0.5V to V_{CC1}
OUTPUT		
"High" Peak Output Current	$I_{OH(PEAK)}$	5A
"Low" Peak Output Current	$I_{OL(PEAK)}$	5A
Total Output Supply Voltage	$V_{CC2} - V_{EE}$	−0.5V to 35V
Positive Output Supply Voltage	$V_{CC2} - V_E$	−0.5V to 35V−(V_E−V_{EE})
Negative Output Supply Voltage	$V_E - V_{EE}$	−0.5V to 15V
Output Voltage	$V_{O(PEAK)}$	−0.5V to 35V
Peak Clamping Sinking Current	I_{Clamp}	1.7A
Miller Clamping Pin Voltage	V_{Clamp}	−0.5V to V_{CC2}
DESAT Voltage	V_{DESAT}	V_E to V_E+10V
Power Dissipation	P_O	600mW
Junction Temperature	T_J	125°C
TOTAL PACKAGE		
Isolation Voltage	V_{ISO}	5000V_{RMS}
Operating Temperature	T_{OP}	−40 to 105°C
Storage Temperature	T_S	−55 to 125°C
Lead Soldering Temperature (10s)		260°C

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Recommended Operating Conditions

Parameter	Symbol	Min	Max	Unit
Operating Temperature	T_A	−40	105	°C
Total Output Supply Voltage	$V_{CC2} - V_{EE}$	15	30	V
Positive Output Supply Voltage	$V_{CC2} - V_E$	15 (−0.5)	30 − (V_E−V_{EE})	V
Negative Output Supply Voltage	$V_E - V_{EE}$	0 (−0.5)	15	V
Input Current (ON)	$I_{FL(ON)}$	8	12	mA
Input Voltage (OFF)	$V_{F(OFF)}$	−3.6 (0)	0.8	V

Negative Output Supply Voltage ($V_E - V_{EE}$) : This supply is optional. Required only when negative gate drive is implemented.

ELECTRICAL CHARACTERISTICS (Over Recommended Operating Conditions unless Otherwise Specified. All Typical Values at $V_{CC} - V_{EE}$ = 30V, $V_E - V_{EE}$ = 0V, T_A = 25°C unless Otherwise specified.)

INPUT LED

Parameter	Symbol	Test Condition	Min	Typ.	Max	Unit
Forward Voltage	V_F	$I_F = 10mA$	1.2	1.37	1.8	V
Forward Voltage Temperature Coefficient	$\Delta V_F/\Delta T$	$I_F = 10mA$		−1.237		mV/°C
Reverse Voltage	BV_R	$I_R = 10\mu A$	5			V
Input Threshold Current (Low to High)	I_{FLH}	$I_O = 0A, V_O > 5V$		2.5	6	mA
Input Threshold Voltage (High to Low)	V_{FHL}		0.8	1.26		V
Input Capacitance	C_{IN}	$f = 1MHz, V_F = 0V$		33		pF

$\overline{\text{FAULT}}$

Parameter	Symbol	Test Condition	Min	Typ.	Max	Unit
Logic Low Output Voltage	$V_{\overline{FAULT}}$	$I_{\overline{FAULT}} = 1.1mA, V_{CC1} = 5.5V$			0.4	V
		$I_{\overline{FAULT}} = 1.1mA, V_{CC1} = 3.3V$			0.4	
Logic High Output Current	$I_{\overline{FAULT}}$	$V_{\overline{FAULT}} = 5.5V, V_{CC1} = 5.5V$			0.5	µA
		$V_{\overline{FAULT}} = 3.3V, V_{CC1} = 3.3V$			0.3	

ELECTRICAL CHARACTERISTICS (Over Recommended Operating Conditions unless Otherwise Specified. All Typical Values at $V_{CC} - V_{EE}$ = 30V, $V_E - V_{EE}$ = 0V, T_A = 25°C unless Otherwise specified.)

OUTPUT

Parameter	Symbol	Test Condition	Min	Typ.	Max	Unit
High Level Supply Current	I_{CC2H}	I_F = 7 to 16mA Output Open		2.4	4.5	mA
Low Level Supply Current	I_{CC2L}	V_F = 0 to 0.8V Output Open		2.5	4.5	mA
High Level Output Current	I_{OH}	$V_O = V_{CC2} - 3V$ Pulse Width 50μs max			−2.0	A
		$V_O = V_{CC2} - 7V$ Pulse Width 10μs max (Note 1)			−5.0	
Low Level Output Current	I_{OL}	$V_O = V_{EE} + 2V$ Pulse Width 50μs max	2.0	1.5		A
		$V_O = V_{EE} + 6V$ Pulse Width 10μs max (Note 1)	5.0			
High Level Output Voltage	V_{OH}	I_O = −100mA, I_F = 10mA (Notes 2, 3, 4)	$V_{CC} - 1.2$	$V_{CC} - 1.0$		V
Low Level Output Voltage	V_{OL}	I_O = 100mA, I_F = 0mA		$V_{EE} + 0.1$	$V_{EE}+0.25$	V
Clamp Low Level Sinking Current	I_{CL}	$V_O = V_{EE} + 2.5V$	0.5	4.0		A
Blanking Capacitor Charging Current	I_{CHG}	V_{DESAT} = 2V	−0.13	−0.24	−0.33	mA
Blanking Capacitor Discharge Current	I_{DSCHG}	V_{DESAT} = 7V	10	30		mA
DESAT Threshold	V_{DESAT}	$V_{CC2} - V_E > V_{UVLO-}$	6	6.5	7.5	V
Clamp Pin Threshold Voltage	V_{tClamp}			2.0		V
UVLO Threshold	$V_{UVLO}+$	V_O > 5V, I_F = 10mA	10.5	11.6	12.5	V
	$V_{UVLO}-$	V_O < 5V, I_F = 10mA	9.2	10.3	11.1	
UVLO Hysteresis	$UVLO_{HYS}$	$V_{UVLO+} - V_{UVLO-}$		1.3		V

ELECTRICAL CHARACTERISTICS (Over Recommended Operating Conditions unless Otherwise Specified. All Typical Values at $V_{CC} - V_{EE}$ = 30V, $V_E - V_{EE}$ = 0V, T_A = 25°C unless Otherwise specified.)

SWITCHING

Parameter	Symbol	Test Condition	Min	Typ.	Max	Unit
Propagation Delay Time to High Output Level	t_{PLH}	R_g = 10Ω, C_g = 10nF, f = 10kHz, Duty Cycle = 50% I_F = 10mA V_{CC2} = 30V	50		200	ns
Propagation Delay Time to Low Output Level	t_{PHL}		50		200	
Pulse Width Distortion $\lvert t_{PHL} - t_{PLH}\rvert$ for any given Device	PWD		-80		80	
Propagation Delay Difference ($t_{PHL} - t_{PLH}$) between any two Devices under same test conditions	PDD		−100		100	
Output Rise Time (10% to 90%)	t_r			50		
Output Fall time (90% to 10%)	t_f			50		
DESAT Sense to 90% V_O Delay	$t_{DESAT(90\%)}$	C_{DESAT} = 100pF R_g = 10Ω C_g = 10nF		0.25	0.5	µs
DESAT Sense to 10% V_O Delay	$t_{DESAT(10\%)}$			2	3	
DESAT Sense to Low Level $\overline{\text{FAULT}}$ Signal Delay	$t_{DESAT(\overline{FAULT})}$	C_{DESAT} = 100pF R_F = 2.1kΩ, C_F = 1nF R_g = 10Ω, C_g = 10nF		0.25	0.5	
DESAT Sense to DESAT Low Propagation Delay	$t_{DESAT(LOW)}$	C_{DESAT} = 100pF R_F = 2.1kΩ R_g = 10Ω, C_g = 10nF		0.25		
DESAT input Mute	$t_{DESAT(MUTE)}$		5			
$\overline{\text{RESET}}$ to High Level $\overline{\text{FAULT}}$ Signal Delay	$t_{(RESET(\overline{FAULT})}$	C_{DESAT} = 100pF R_F = 2.1kΩ R_g = 10Ω, C_g = 10nF	0.2	1	2	

ELECTRICAL CHARACTERISTICS (Over Recommended Operating Conditions unless Otherwise Specified. All Typical Values at $V_{CC} - V_{EE}$ = 30V, $V_E - V_{EE}$ = 0V, T_A = 25°C unless Otherwise specified.)

SWITCHING

Parameter	Symbol	Test Condition	Min	Typ.	Max	Unit
Common Mode Transient Immunity at High Level Output	CM_H	I_F = 10mA R_F = 2.1kΩ, C_F = 15pF V_{CM} = 1500V V_{CC2} = 30V T_A = 25°C Split Resistors Network with Ratio 1:1 at Input LED1	15			kV/µs
		I_F = 10mA R_F = 2.1kΩ, C_F = 1nF V_{CM} = 1500V V_{CC2} = 30V T_A = 25°C Split Resistors Network with Ratio 1:1 at Input LED1	50			
Common Mode Transient Immunity at Low Level Output	CM_L	V_F = 0V R_F = 2.1kΩ, C_F = 15pF V_{CM} = 1500V V_{CC2} = 30V	15			
		V_F = 0V R_F = 2.1kΩ, C_F = 1nF V_{CM} = 1500V V_{CC2} = 30V	50			

ISOLATION

Parameter	Symbol	Test Condition	Min	Typ.	Max	Unit
Isolation Voltage	V_{ISO}	R.H. ≤ 40% – 60% T_A = 25°C t = 1 min	5000			V
Input - Output Resistance	R_{I-O}	V_{I-O} = 500VDC		10^9		Ω
Input - Output Capacitance	C_{I-O}	f = 1MHz, T_A = 25°C		1.3		pF

Device is considered a two terminal device : pins 1 to 8 are shorted together and pins 9 to 16 are shorted together

Notes :

1. Output Current at Maximum Pulse Width 10us : This value is intended to allow for component tolerances for designs with I_O peak minimum 4.0A. Derate linearly from 5.0A to 2.5A at +105°C. This compensates for increased I_O PEAK due to changes in V_{OL} over temperature.

2. 15V is the recommended minimum operating positive supply voltage ($V_{CC2} - V_E$) to ensure adequate margin in excess of the maximum $V_{UVLO}+$ threshold of 12.5V. For High Level Output Voltage testing, V_{OH} is measured with a DC load current. When driving capacitive loads, V_{OH} will approach V_{CC} as I_{OH} approaches zero units.

3. Maximum Pulse Width 1.0ms.

4. To clamp the output voltage at V_{CC} - 1 V, a pull-down resistor between the output and V_{EE} is recommended to sink a static current of 100mA while the output is high.

5. Once V_O of the ICPL332J is allowed to go high ($V_{CC2} - V_E > V_{UVLO}+$), the DESAT detection feature of the ICPL332J will be the primary source of IGBT protection. UVLO is needed to ensure DESAT is functional. Once V_{CC2} is increased from 0V to above $V_{UVLO}+$, DESAT will remain functional until V_{CC2} is decreased below $V_{UVLO}-$. Thus, the DESAT detection and UVLO features of the ICPL332J work in conjunction to ensure constant IGBT protection.

6. $V_{UVLO}+$: This is the “Increasing” (i.e. turn-on or “Positive going” direction) of $V_{CC2} - V_E$.

7. $V_{UVLO}-$: This is the “Decreasing” (i.e. turn-off or “Negative going” direction) of $V_{CC2} - V_E$.

8. Switching Time Test Load condition approximates the gate load of a 1200 V/150A IGBT.

9. PWD and PDD measured from ANODE, CATHODE of LED to V_{OUT}.

10. DESAT Sense to Low Level $\overline{\text{FAULT}}$ Signal Delay : This is the amount of time from when the DESAT threshold is exceeded, until the $\overline{\text{FAULT}}$ output goes low.

11. DESAT Sense to DESAT Low Propagation Delay : This is the amount of time the DESAT threshold must be exceeded before V_{OUT} begins to go low, and the $\overline{\text{FAULT}}$ output to go low. This is supply voltage dependent.

12. Auto Reset: This is the amount of time (DESAT Input Mute) when V_{OUT} will be asserted low after DESAT threshold is exceeded.

13. Common Mode Transient Immunity in High state is the maximum tolerable negative dV_{CM}/dt on the trailing edge of the common mode impulse signal, V_{CM}, to assure that the output will remain in High state (V_O > 15V or $\overline{\text{FAULT}}$ > 2V). Split resistors network with a ratio of 1:1 is needed at input LED1.

14. Common Mode Transient Immunity in Low state is the maximum tolerable positive dV_{CM}/dt on the leading edge of the common mode impulse signal, V_{CM}, to assure that the output will remain Low state (V_O < 1V or $\overline{\text{FAULT}}$ < 0.8V).

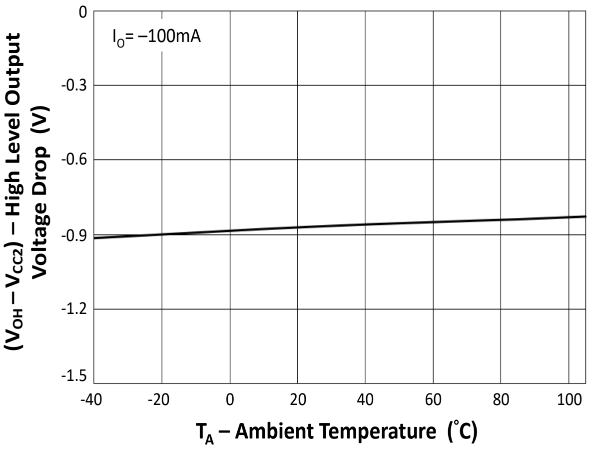


Fig 1 High Level Output Voltage Drop vs Ambient Temperature

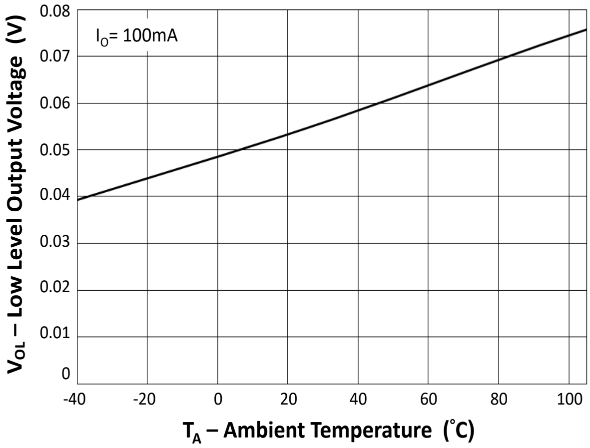


Fig 2 Low Level Output Voltage vs Ambient Temperature

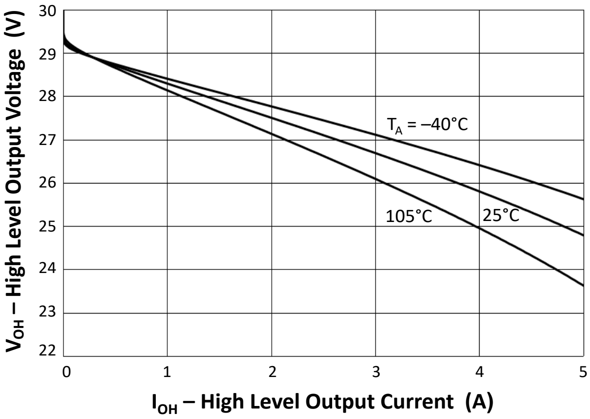


Fig 3 High Level Output Voltage vs High Level Output Current

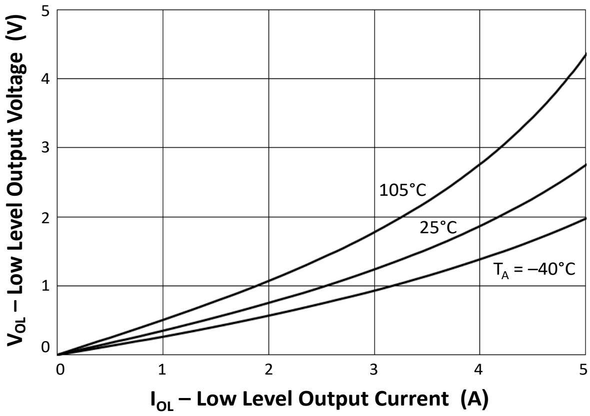


Fig 4 Low Level Output Voltage vs Low Level Output Current

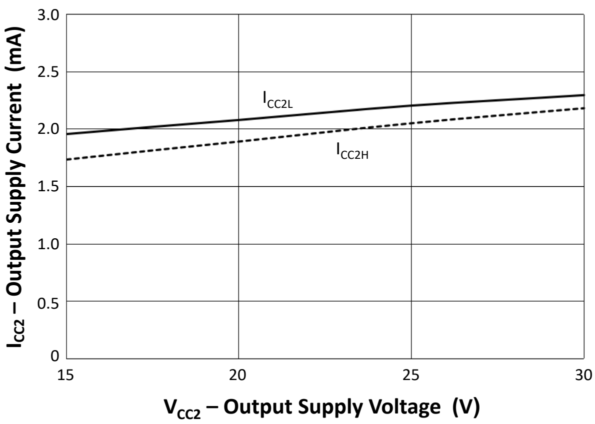


Fig 5 I_{CC2} Output Supply Current vs V_{CC2} Output Supply Voltage

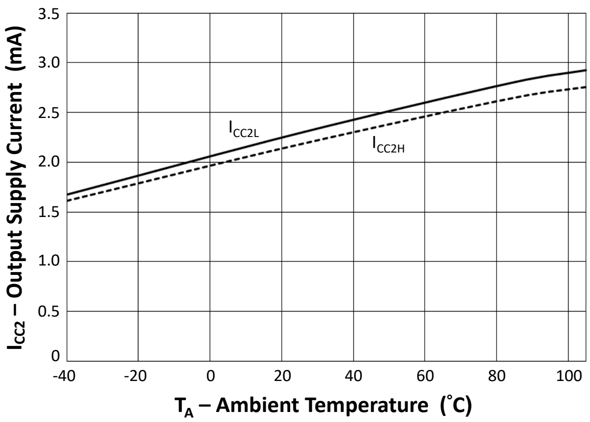


Fig 6 I_{CC2} Output Supply Current vs Ambient Temperature

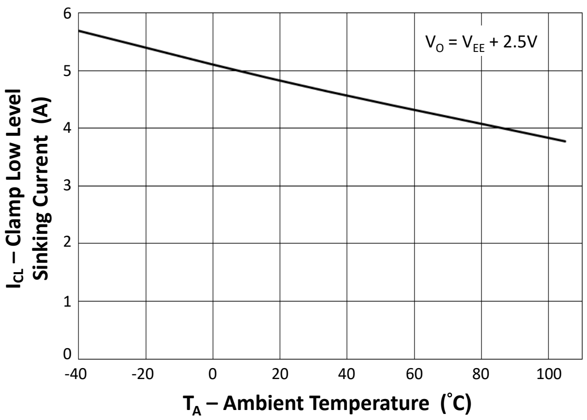


Fig 7 Clamp Low Level Sinking Current vs Ambient Temperature

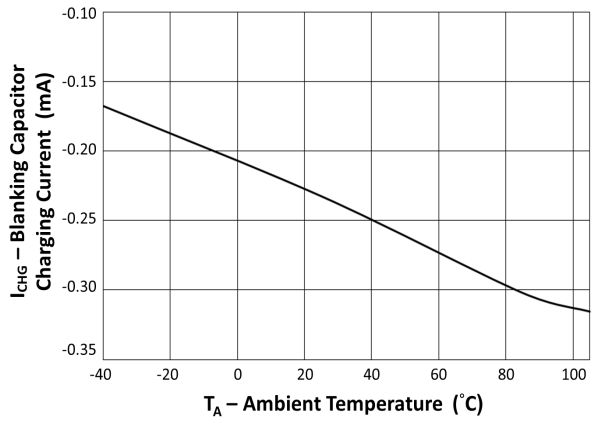


Fig 8 Blanking Capacitor Charging Current vs Ambient Temperature

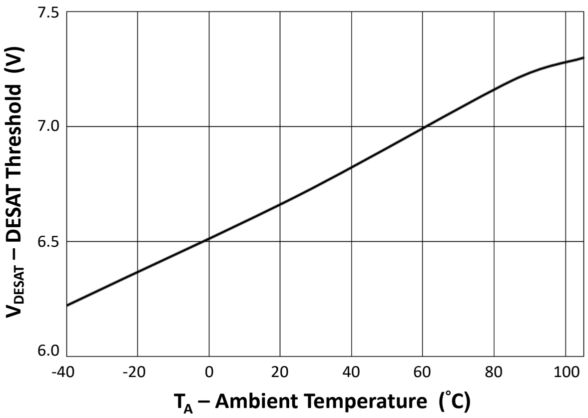


Fig 9 DESAT Threshold Voltage vs Ambient Temperature

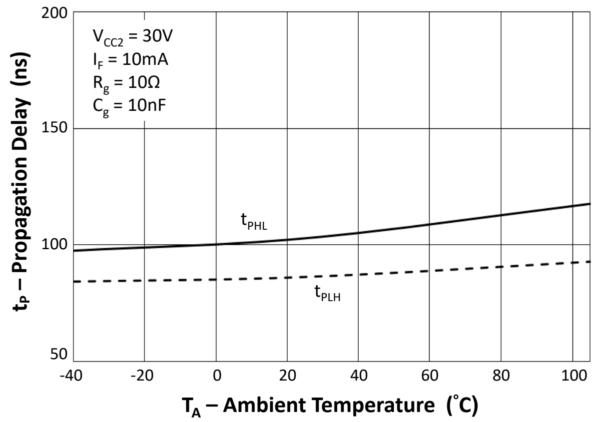


Fig 10 Propagation Delay vs Ambient Temperature

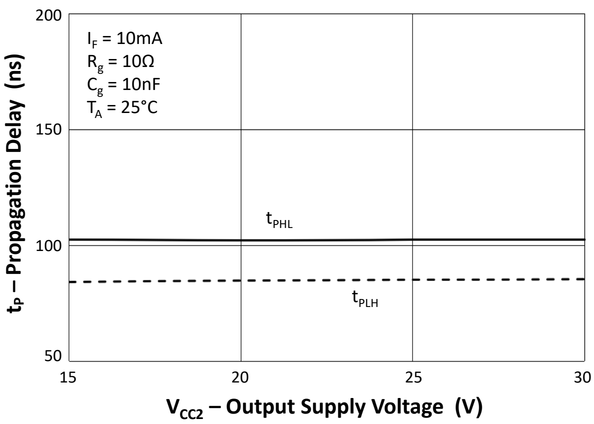


Fig 11 Propagation Delay vs Output Supply Voltage

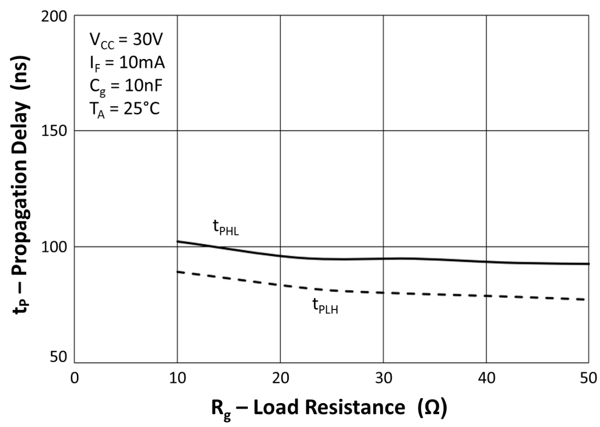


Fig 12 Propagation Delay vs Load Resistance

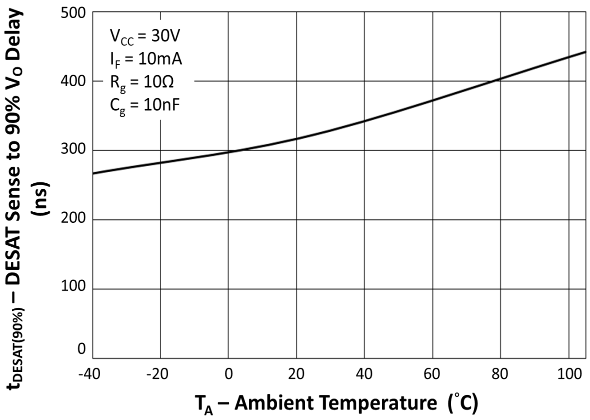


Fig 13 DESAT Sense to 90% Output Voltage Delay vs Ambient Temperature

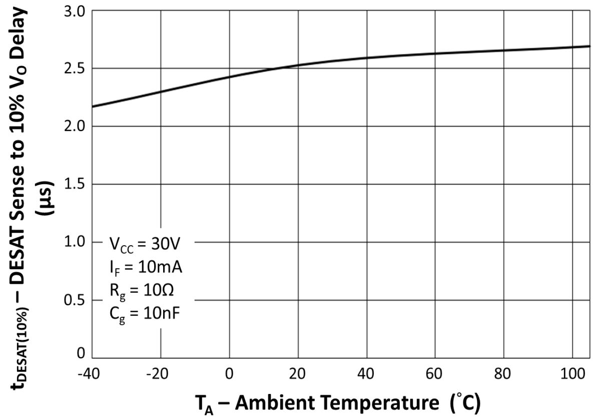


Fig 14 DESAT Sense to 10% Output Voltage Delay vs Ambient Temperature

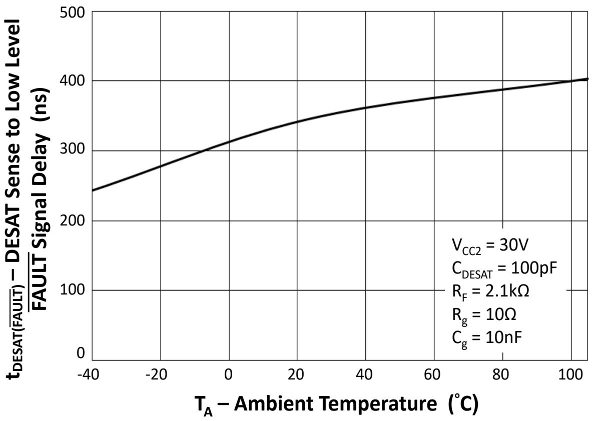


Fig 15 DESAT Sense to Low Level $\overline{\text{FAULT}}$ Signal Delay vs Ambient Temperature

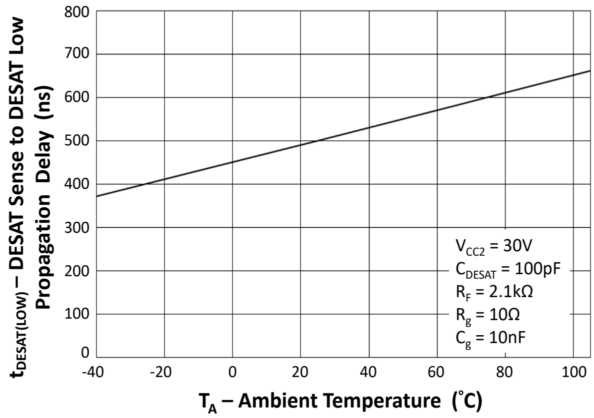


Fig 16 DESAT Sense to DESAT Low vs Ambient Temperature

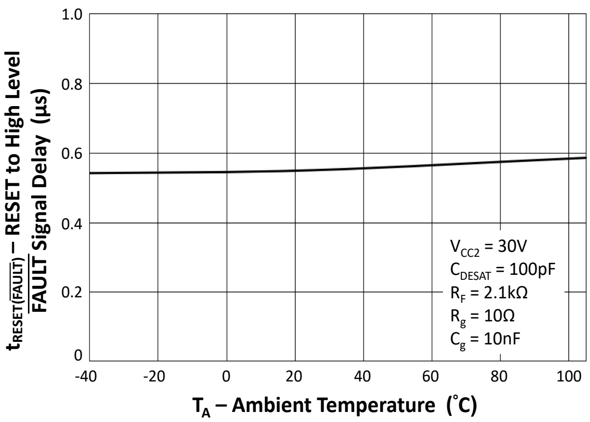


Fig 17 RESET to High Level $\overline{\text{FAULT}}$ Signal Delay vs Ambient Temperature

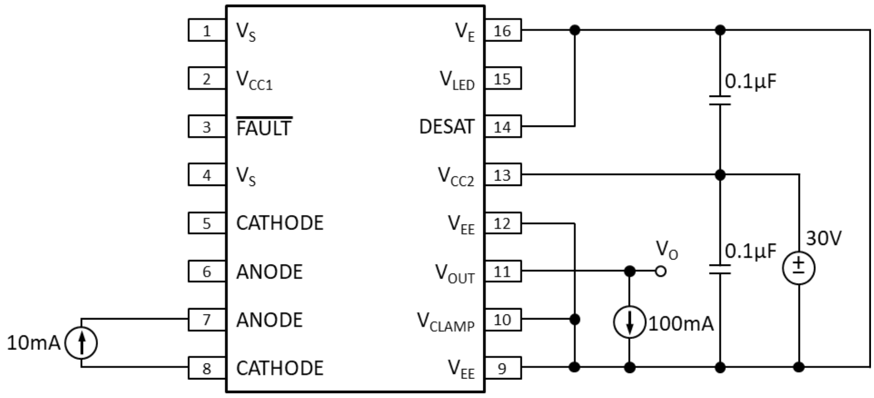


Fig 18 V_{OH} Test Circuit

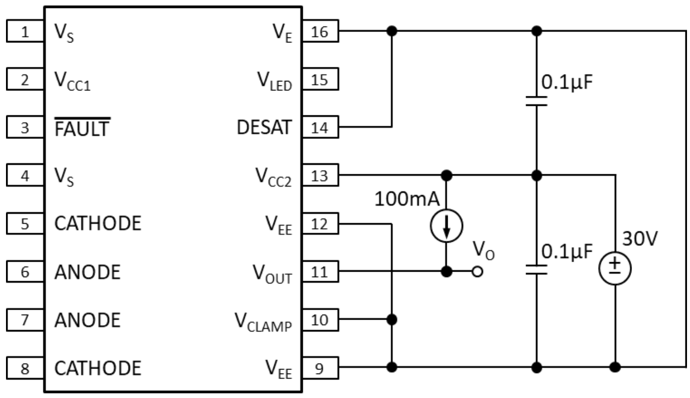


Fig 19 V_{OL} Test Circuit

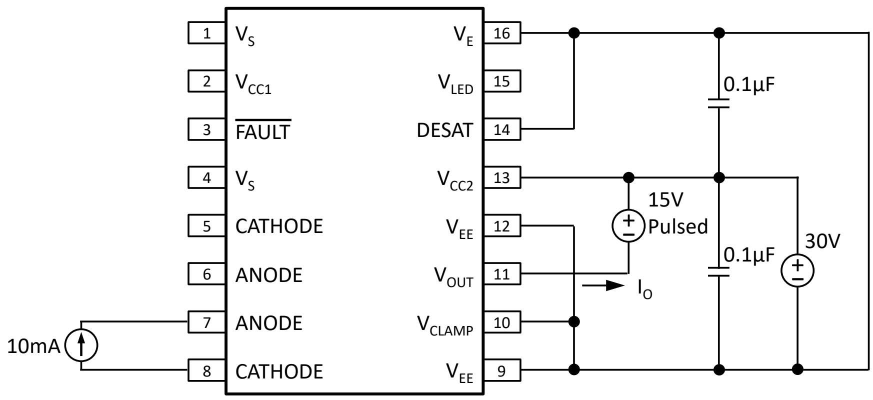


Fig 20 I_{OH} Test Circuit

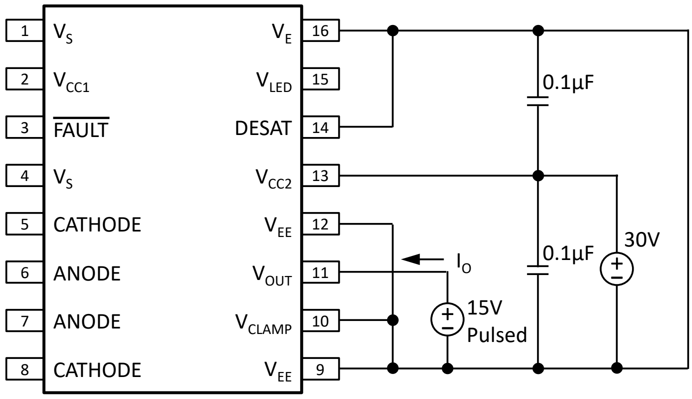


Fig 21 I_{OL} Test Circuit

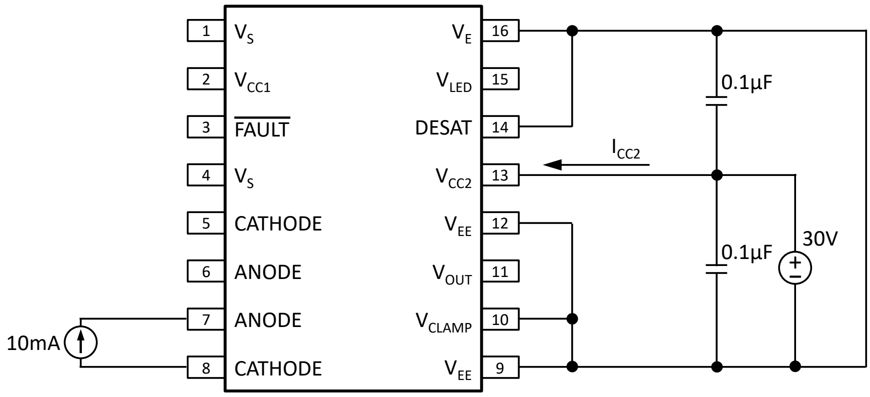


Fig 22 I_{CC2H} Test Circuit

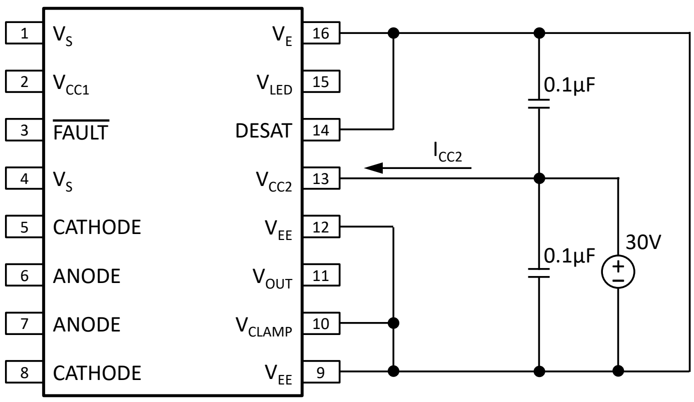


Fig 23 I_{CC2L} Test Circuit

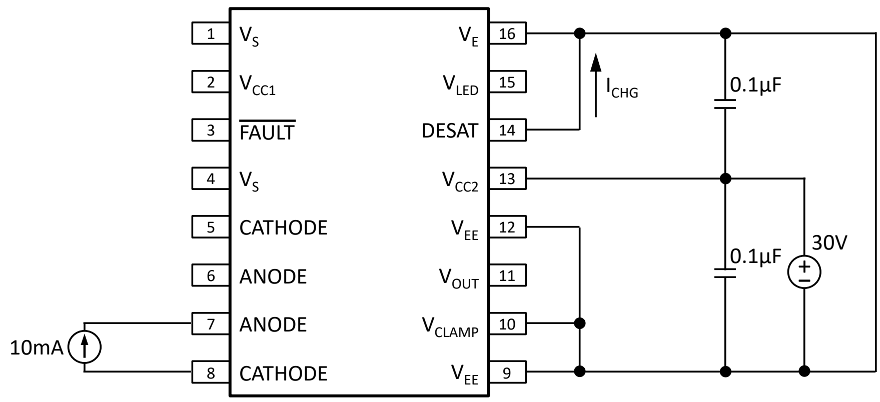


Fig 24 I_{CHG} Test Circuit

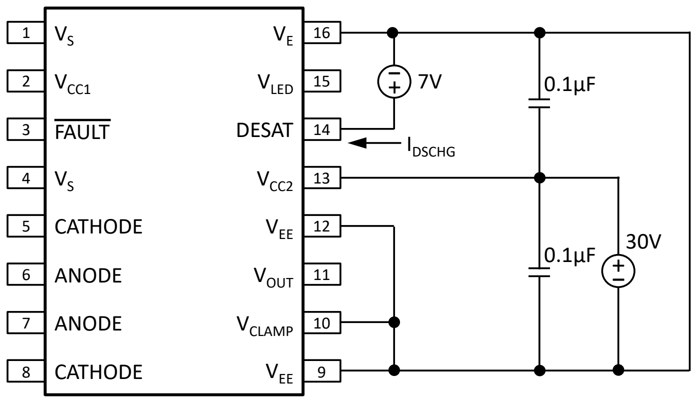


Fig 25 I_{DSCHG} Test Circuit

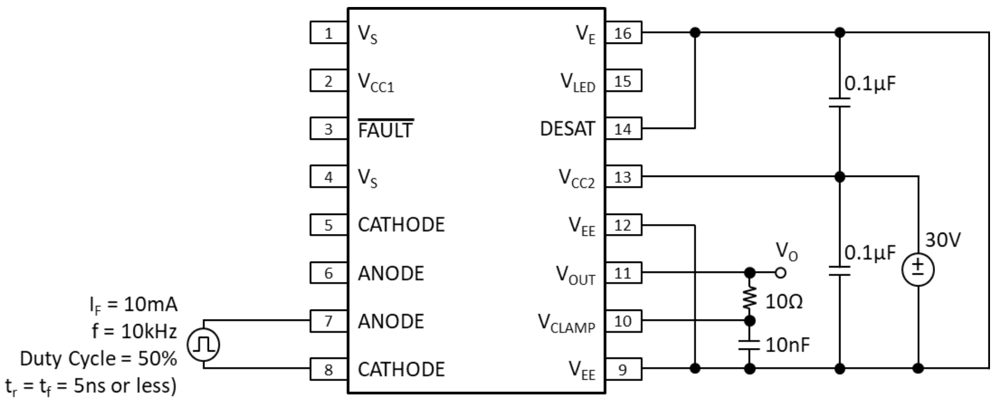
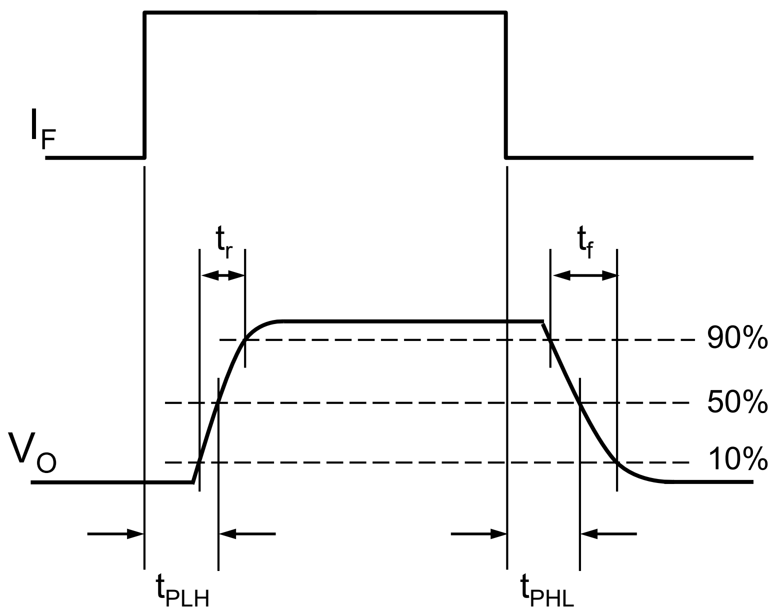


Fig 26 Propagation Delay (t_{PLH} and t_{PHL}), Rise Time (t_r) and Fall Time (t_f) Test Circuit



Propagation Delay (t_{PLH} and t_{PHL}), Rise Time (t_r) and Fall Time (t_f) Timing Waveforms

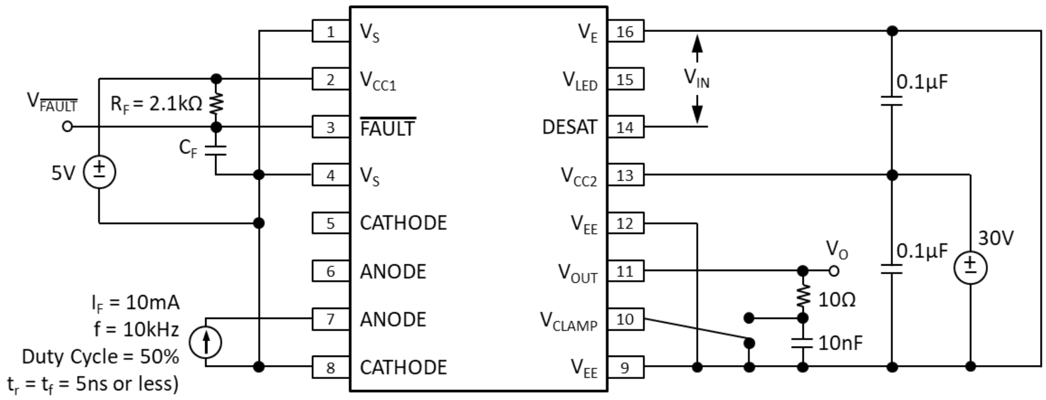
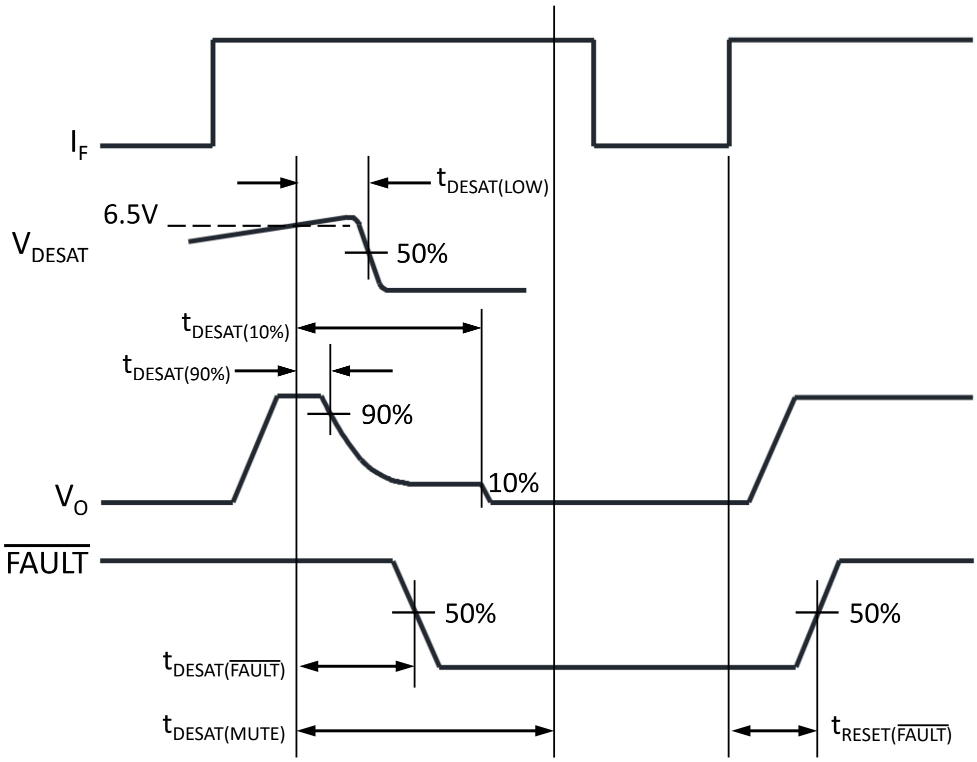


Fig 27 t_{DESAT} Fault Test Circuit



DESAT FAULT Timing Waveforms

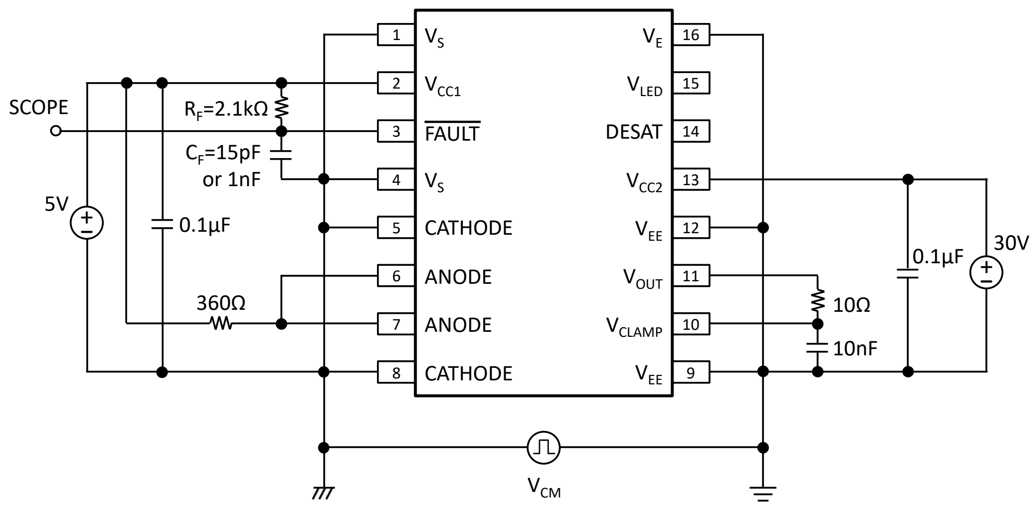


Fig 28 Common Mode Transient Immunity Test Circuit LED2 ON

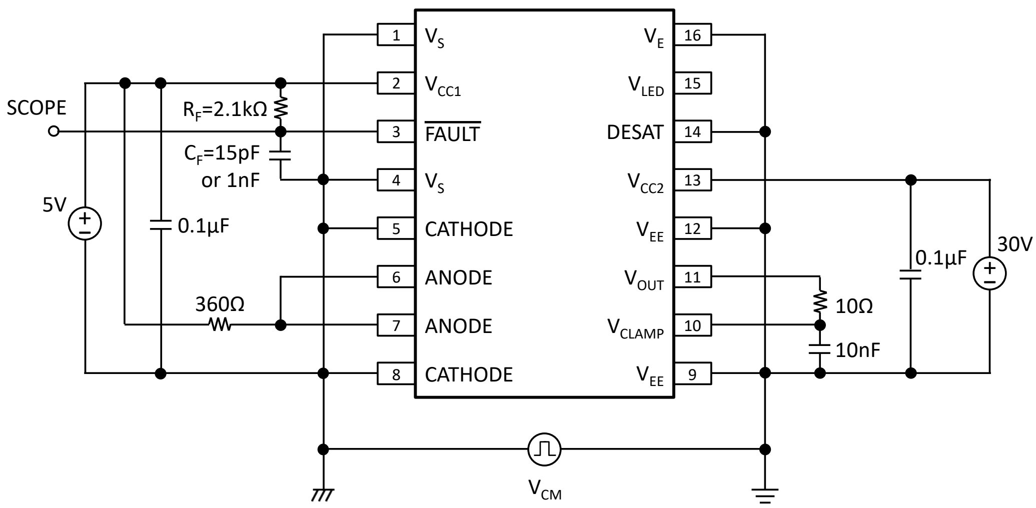


Fig 29 Common Mode Transient Immunity Test Circuit LED2 OFF

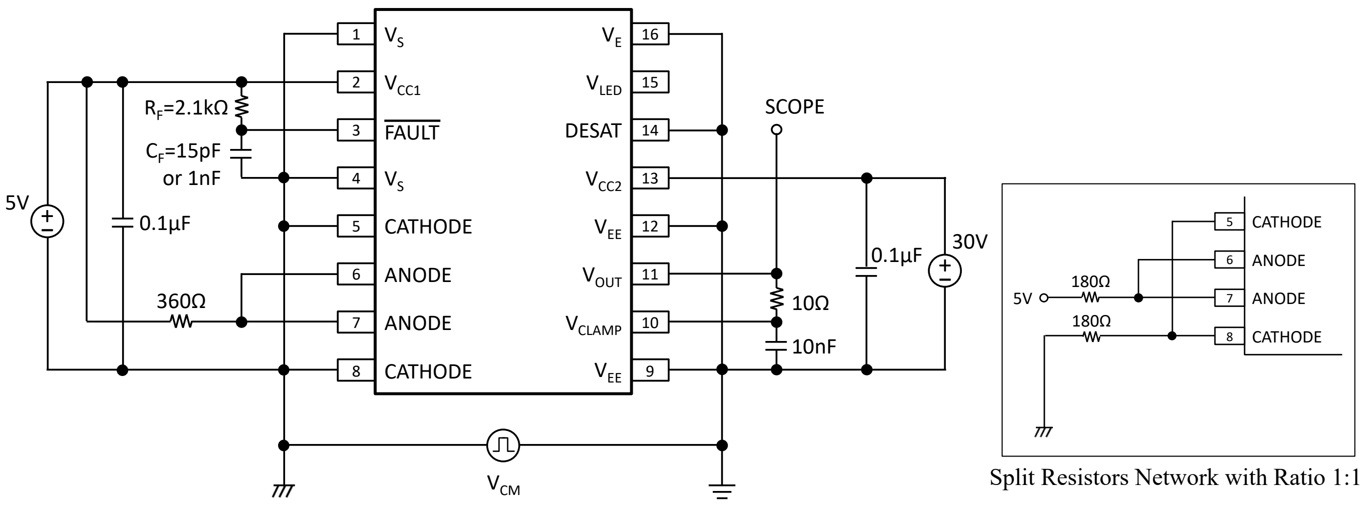


Fig 30 Common Mode Transient Immunity Test Circuit LED1 ON

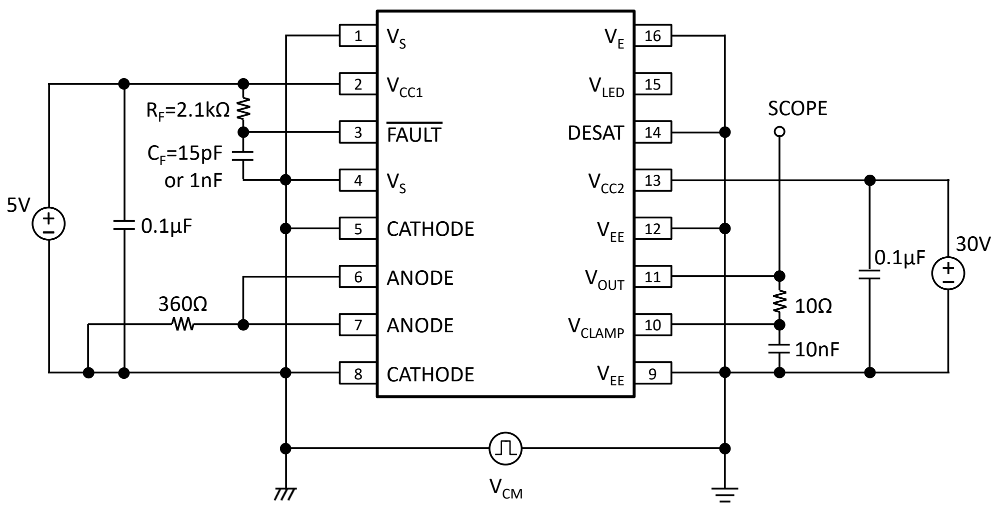
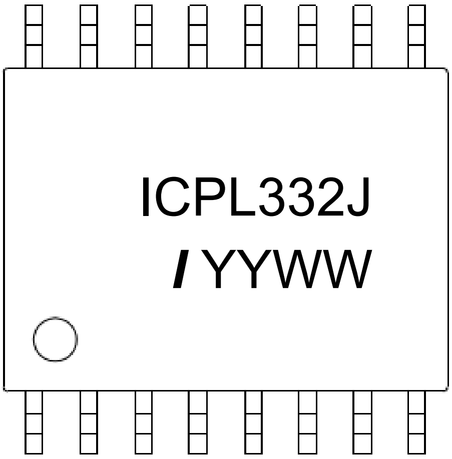


Fig 31 Common Mode Transient Immunity Test Circuit LED1 OFF

ORDER INFORMATION

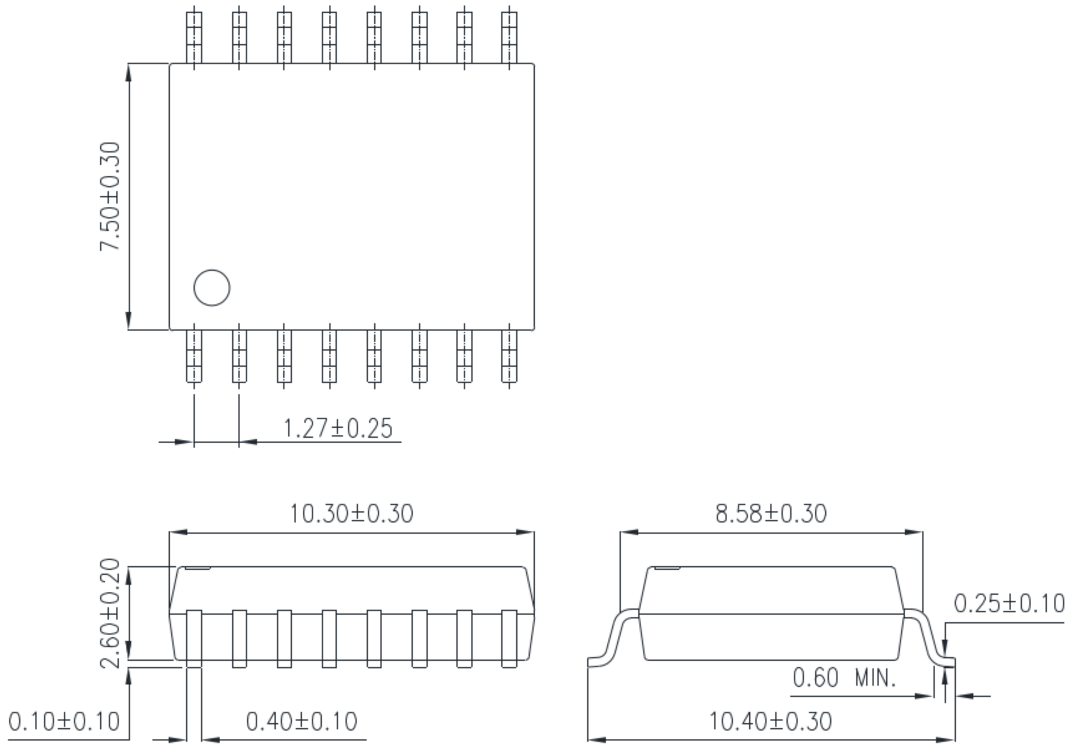
ICPL332J			
After PN	**PN**	**Description**	**Packing quantity**
None	ICPL332J	Surface Mount Tape & Reel	850 pcs per reel

DEVICE MARKING

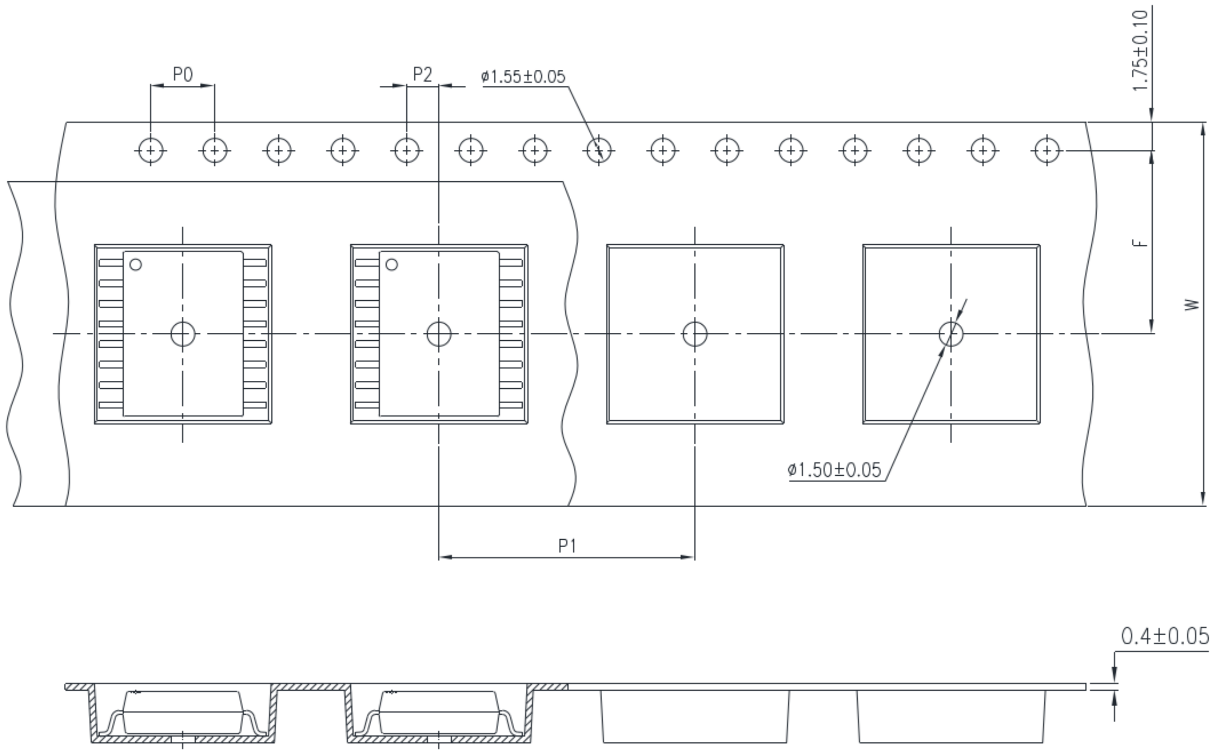


ICPL332J	Device Part Number
I	Isocom
YY	2 digit Year Code
WW	2 digit Week Code

PACKAGE DIMENSIONS in mm (inch)



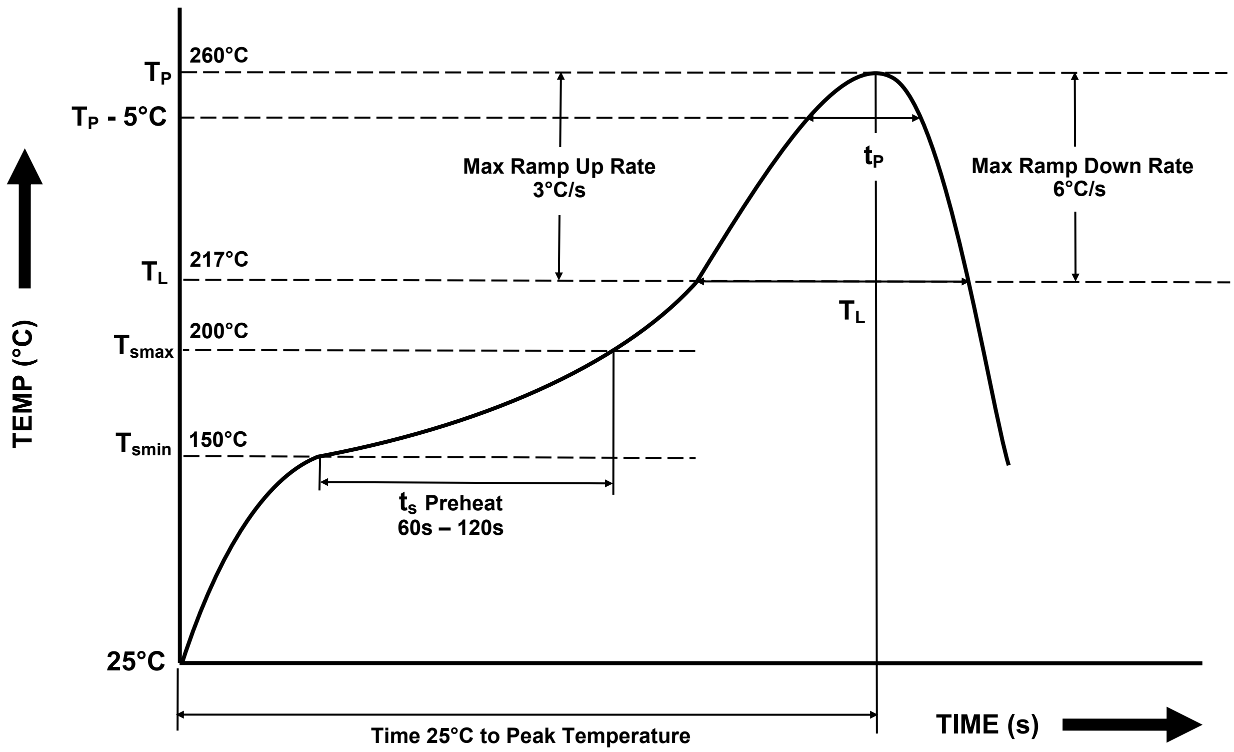
TAPE AND REEL PACKAGING



Description	**Symbol**	**Dimension mm (inch)**
Tape Width	W	24 ± 0.3 (0.94)
Pitch of Sprocket Holes	P_0	4 ± 0.1 (0.15)
Distance of Compartment to Sprocket Holes	F	11.5 ± 0.1 (0.452)
	P_2	2 ± 0.1 (0.079)
Distance of Compartment to Compartment	P_1	16 ± 0.1 (0.63)

IR REFLOW SOLDERING TEMPERATURE PROFILE

Note : One Time Reflow Soldering is Recommended.
Do Not Immerse Device Body in Solder Paste.



Profile Details	Conditions
Preheat - Min Temperature (T_{SMIN}) - Max Temperature (T_{SMAX}) - Time T_{SMIN} to T_{SMAX} (t_s)	 150°C 200°C 60s - 120s
Soldering Zone - Peak Temperature (T_P) - Time at Peak Temperature - Liquidous Temperature (T_L) - Time within 5°C of Actual Peak Temperature (T_P – 5°C) - Time maintained above T_L (t_L) - Ramp Up Rate (T_L to T_P) - Ramp Down Rate (T_P to T_L)	 260°C 10s max 217°C 30s max 60s - 100s 3°C/s max 6°C/s max
Average Ramp Up Rate (T_{smax} to T_P)	3°C/s max
Time 25°C to Peak Temperature	8 minutes max

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