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BROADCOM®

Data Sheet

ASSR-1410, ASSR-1411 and ASSR-1420

General-Purpose, Form A, Solid State Relay (Photo MOSFET) (60V/0.6A/1Ω)

Description

The Broadcom® ASSR-14XX Series consists of an AlGaAs infrared light-emitting diode (LED) input stage optically coupled to a high-voltage output detector circuit. The detector consists of a high-speed photovoltaic diode array and driver circuitry to switch on/off two discrete high-voltage MOSFETs. The relay turns on (contact closes) with a minimum input current of 3 mA through the input LED. The relay turns off (contact opens) with an input voltage of 0.8V or less.

The single-channel configurations, ASSR-1410 and ASSR-1411, are equivalent to 1 Form A Electromechanical Relays (EMR), and the dual-channel configuration, ASSR-1420, is equivalent to 2 Form A EMR. They are available in 4-pin SO, 6-pin DIP, 8-pin DIP and Gull Wing Surface Mount for DIP packages. Their electrical and switching characteristics are specified over the temperature range of –40°C to +85°C. They are used for general-purpose switching of signals and low-power AC/DC loads.

ASSR-1411 enables AC/DC and DC-only output connections. For DC-only connection, the output current, I_O, increases to 1.2A and the on-resistance, $R_{(ON)}$ reduces to 0.5Ω.

CAUTION! It is advised that normal static precautions be taken in handling and assembly of this component to prevent damage and/or degradation which may be induced by ESD.

Features

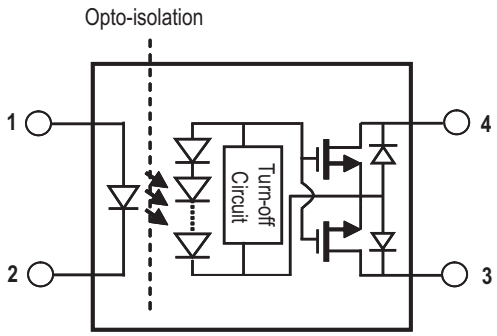
- Compact solid-state bidirectional signal switch
- Single and dual channel normally-off Single-Pole-Single-Throw (SPST) relay
- 60V output withstand voltage
- 0.6A or 1.2A current rating (See schematic for ASSR-1411 connections A and B.)
- Low input current: CMOS compatibility
- Low on-resistance:
  - 0.2Ω typical for DC-only
  - 0.7Ω typical for AC/DC
- High speed switching:
  - 0.1 ms (T_{ON}), 0.02 ms (T_{OFF}) typical
- High transient immunity: >1 kV/µs
- High input-to-output insulation voltage (safety and regulatory approvals)
  - 3750 Vrms for 1 min per UL1577
  - CSA component acceptance

Applications

- Telecommunication switching
- Data communications
- Industrial controls
- Medical
- Security
- EMR/Reed Relay replacement

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Functional Diagram



Single Channel, SPST Relay,
1 Form A in 4-Pin SO Package

Truth Table

LED	Output
Off	Open
On	Close

Ordering Information

ASSR-xxxx is UL Recognized with 3750 Vrms for 1 minute per UL1577 and is approved under CSA Component Acceptance Notice #5.

Part Number	Option RoHS Compliant	Package	Surface Mount	Gull Wing	Tape & Reel	Quantity
ASSR-1410	-003E	SO-4	X			100 units per tube
	-503E		X		X	1500 units per reel
ASSR-1411	-001E	300-mil DIP-6				50 units per tube
	-301E		X	X		50 units per tube
	-501E		X	X	X	1000 units per reel
ASSR-1420	-002E	300-mil DIP-8				50 units per tube
	-302E		X	X		50 units per tube
	-502E		X	X	X	1000 units per reel

To order, choose a part number from the part number column and combine with the desired option from the option column to form an order entry.

Example 1:

ASSR-1411-501E to order product of 300-mil DIP-6 Gull Wing Surface Mount package in Tape and Reel packaging and RoHS Compliant.

Example 2:

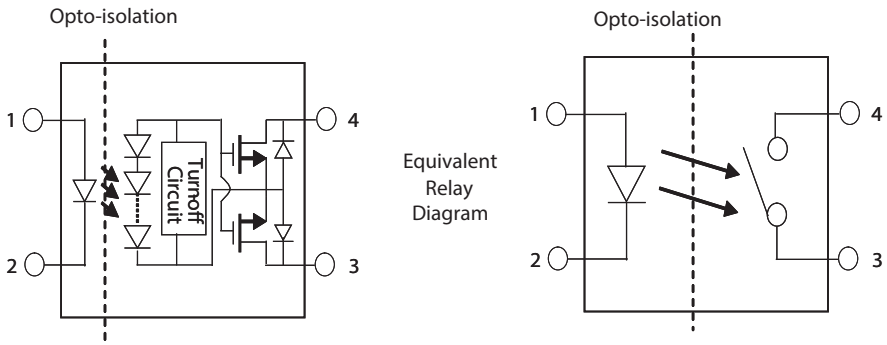
ASSR-1420-002E to order product of 300-mil DIP-8 package in tube packaging and RoHS Compliant.

Option data sheets are available. Contact your Broadcom sales representative or authorized distributor for information.

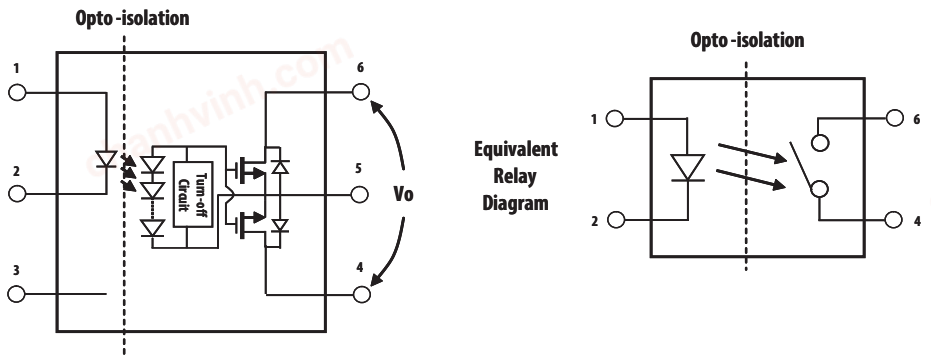
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Schematic

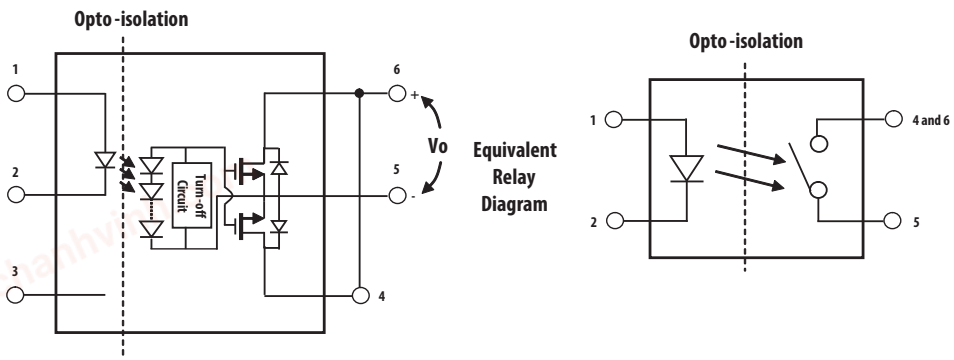
ASSR-1410



ASSR-1411 Connection A

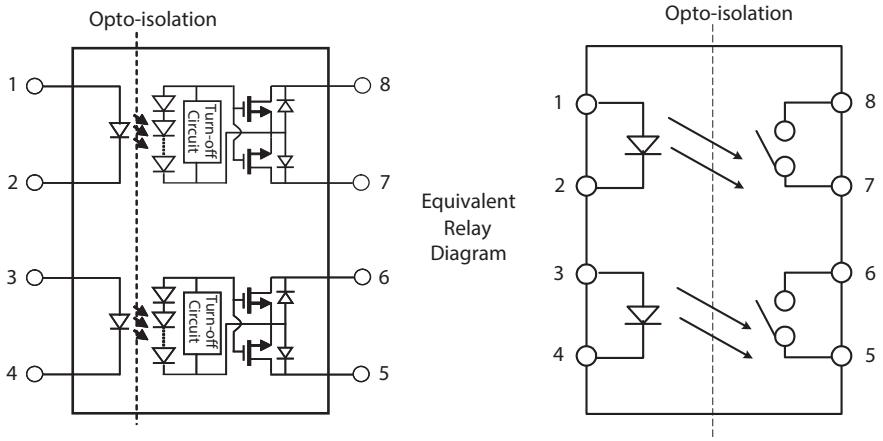


ASSR-1411 Connection B



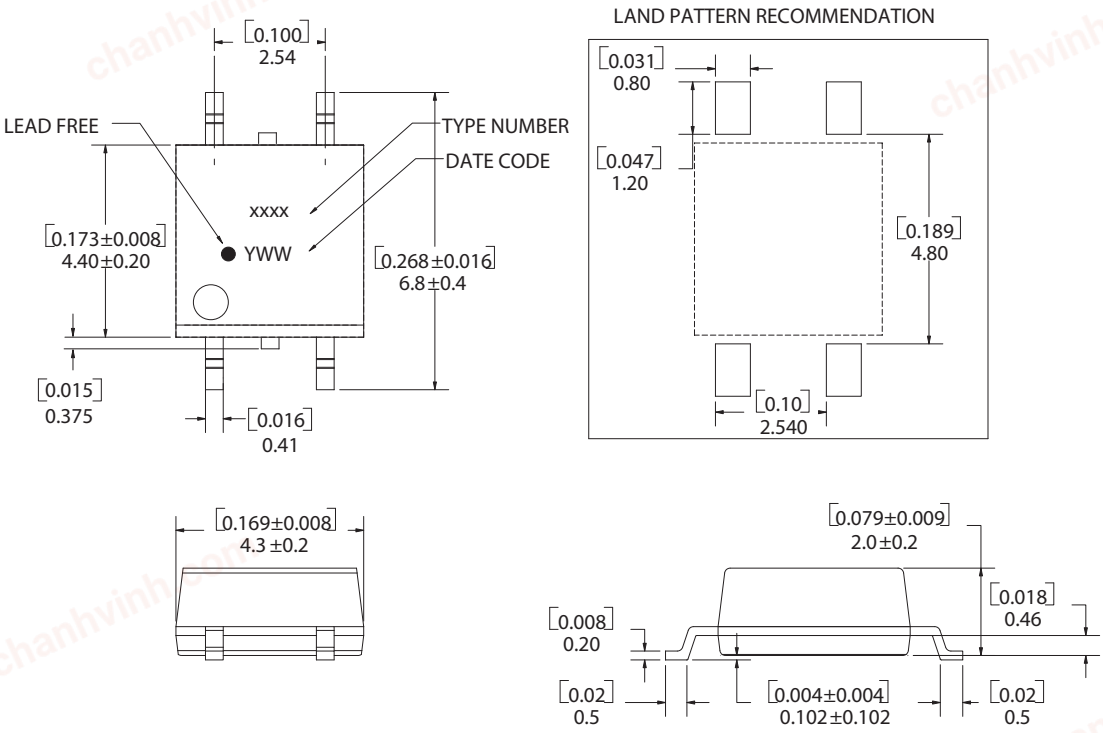
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ASSR-1420



Package Outline Drawings

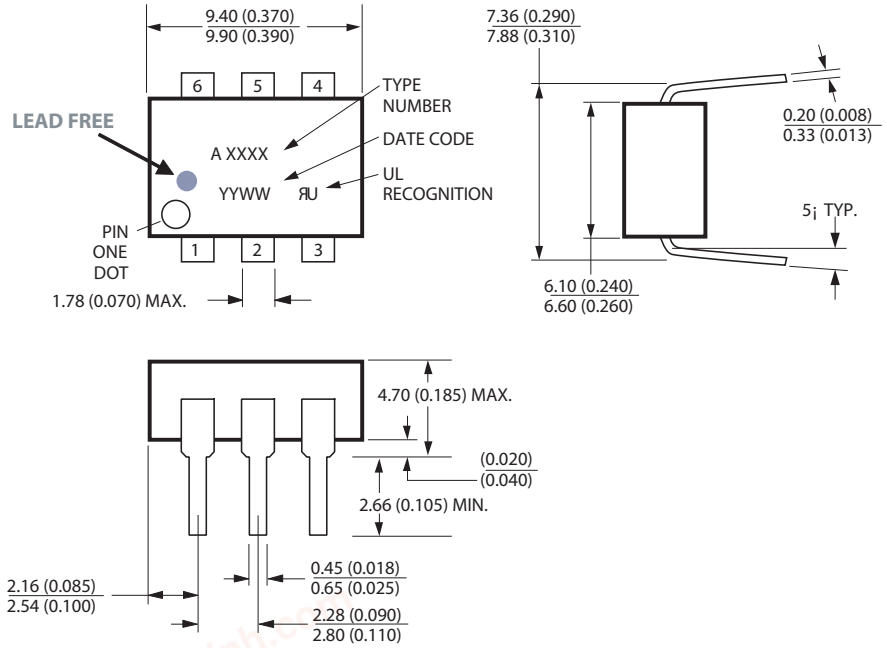
ASSR-1410 4-Pin Small Outline Package



DIMENSIONS IN MILLIMETERS AND [INCHES]
OPTION NUMBER 500 AND UL RECOGNITION NOT MARKED

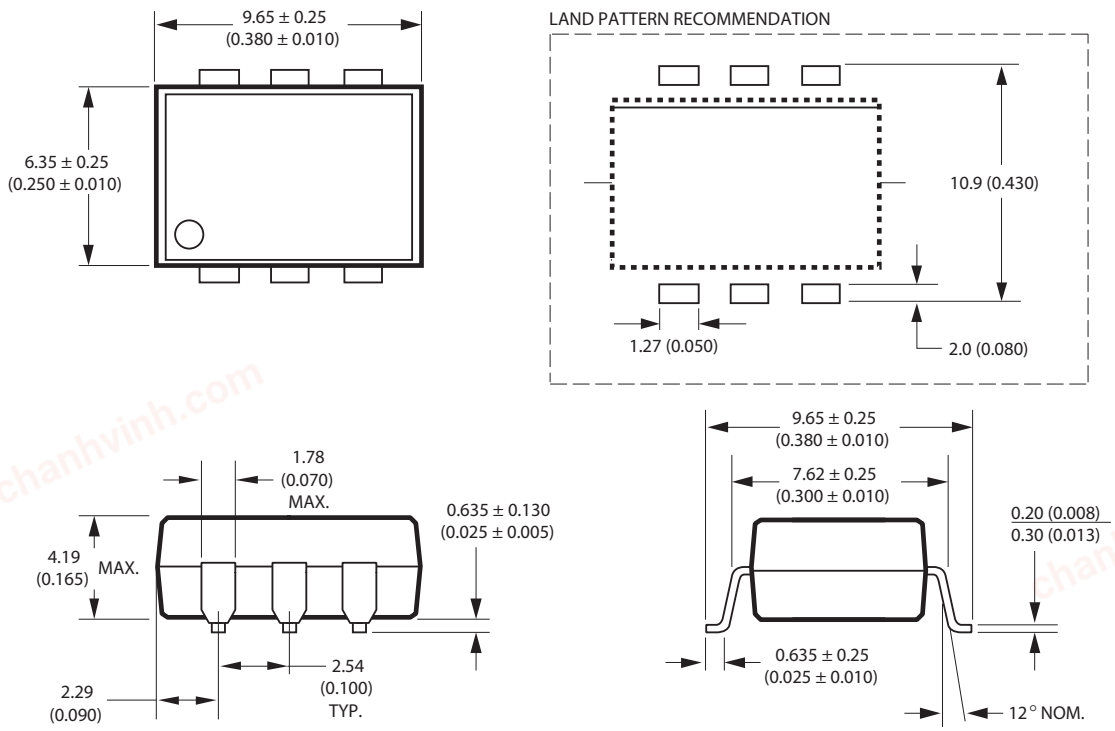
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ASSR-1411 6-Pin DIP Package



DIMENSIONS IN MILLIMETERS AND (INCHES).

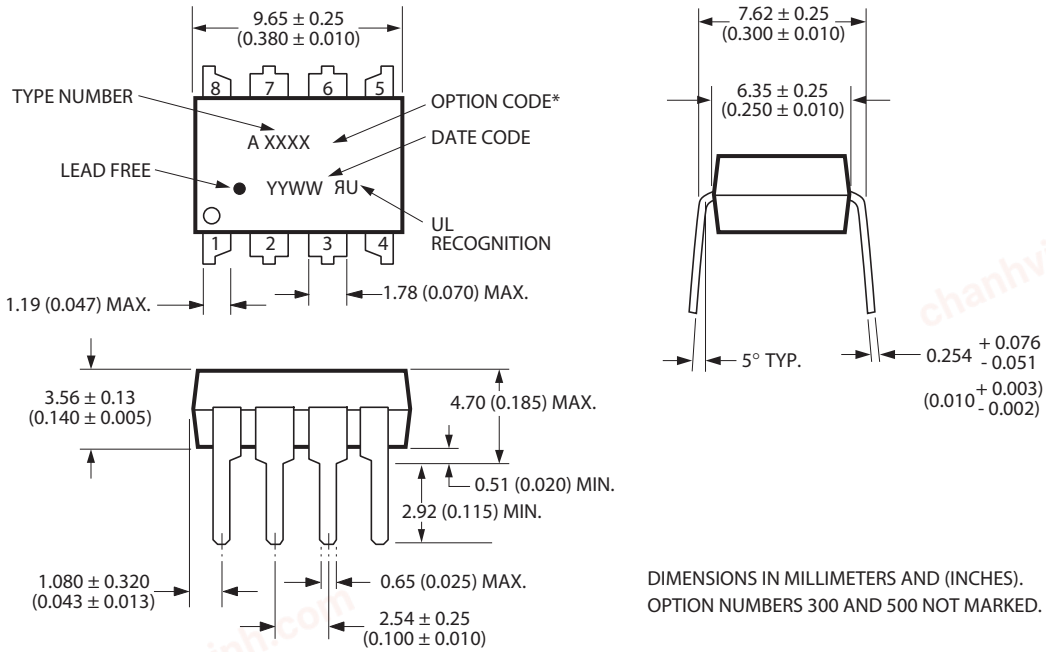
ASSR-1411 6-Pin DIP Package with Gull Wing Surface Mount Option 300



NOTE: FLOATING LEAD PROTRUSION IS 0.25 mm (10 mils) MAX.

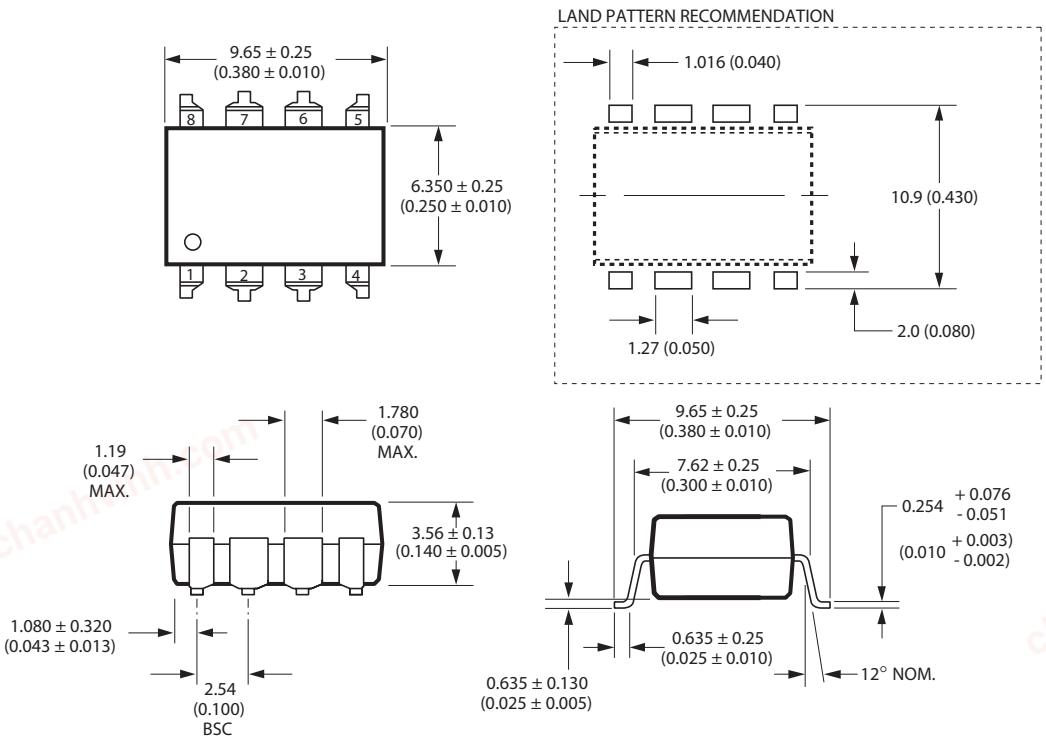
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ASSR-1420 8-Pin DIP Package



DIMENSIONS IN MILLIMETERS AND (INCHES).
OPTION NUMBERS 300 AND 500 NOT MARKED.

ASSR-1420 8-Pin DIP Package with Gull Wing Surface Mount Option 300

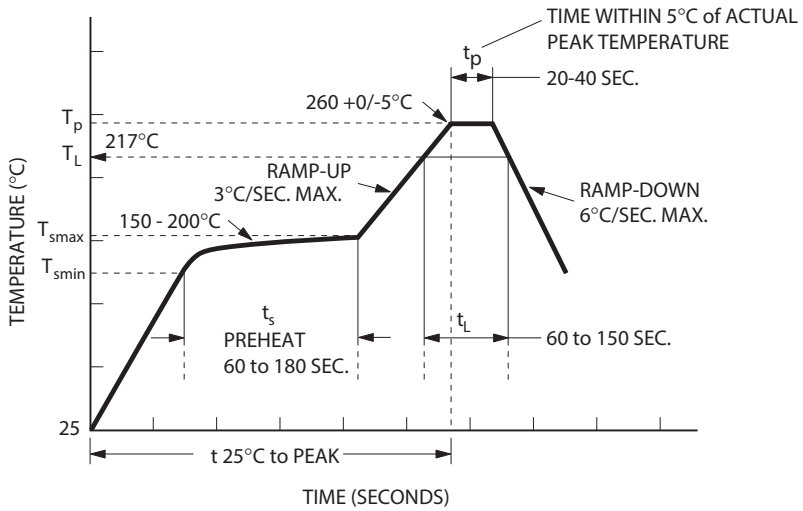


DIMENSIONS IN MILLIMETERS (INCHES).
LEAD COPLANARITY = 0.10 mm (0.004 INCHES).

NOTE: FLOATING LEAD PROTRUSION IS 0.25 mm (10 mils) MAX.

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Lead Free IR Profile



NOTES:
THE TIME FROM 25°C to PEAK TEMPERATURE = 8 MINUTES MAX.
T_{smax} = 200°C, T_{smin} = 150°C

Non-halide flux should be used.

Regulatory Information

The ASSR-1410, ASSR-1411, and ASSR-1420 are approved by the following organizations:

UL

Approved under UL 1577, component recognition program up to V_{ISO} = 3750 Vrms.

CSA

Approved under CSA Component Acceptance Notice #5.

Insulation and Safety Related Specifications

Parameter	Symbol	ASSR-1410	ASSR-1411 ASSR-1420	Unit	Conditions
Minimum External Air Gap (Clearance)	L(101)	4.9	7.1	mm	Measured from input terminals to output terminals, shortest distance through air.
Minimum External Tracking (Creepage)	L(102)	4.9	7.4	mm	Measured from input terminals to output terminals, shortest distance path along body.
Minimum Internal Plastic Gap (Internal Clearance)		0.08	0.08	mm	Through insulation distance conductor to conductor, usually the straight line distance thickness between the emitter and detector.
Tracking Resistance (Comparative Tracking Index)	CTI	175	175	V	DIN IEC 112/VDE 0303 Part 1.
Isolation Group (DIN VDE0109)		IIIa	IIIa		Material Group (DIN VDE 0109).

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Absolute Maximum Ratings

Parameter		Symbol	Min.	Max.	Unit	Note
Storage Temperature		T_S	–55	125	°C	
Operating Temperature		T_A	–40	85	°C	
Junction Temperature		T_J	—	125	°C	
Lead Soldering Cycle	Temperature		—	260	°C	
	Time		—	10	s	
Input Current	Average	I_F	—	25	mA	
	Surge		—	50		
	Transient		—	1000		
Reversed Input Voltage		V_R	—	5	V	
Input Power Dissipation	ASSR-1410	P_{IN}	—	40	mW	
	ASSR-1411	P_{IN}	—	40	mW	
	ASSR-1420	P_{IN}	—	80	mW	
Output Power Dissipation	ASSR-1410	P_O	—	360	mW	
	ASSR-1411	P_O	—	720	mW	
	ASSR-1420	P_O	—	720	mW	
Average Output Current (T_A = 25°C, T_C ≤ 100°C)		I_O	—	0.6	A	a
	ASSR-1411 Connection B	I_O	—	1.2	A	
Output Voltage (T_A = 25°C)		V_O	–60	60	V	b
	ASSR-1411 Connection B	V_O	0	60	V	
Solder Reflow Temperature Profile		See Lead Free IR Profile.				

a. For derating, refer to Figure 1, Figure 2, Figure 3, and Figure 4.

b. The voltage across the output terminals of the relay should not exceed this rated withstand voltage. Overvoltage protection circuits should be added in some applications to protect against overvoltage transients.

Recommended Operating Conditions

Parameter	Symbol	Min.	Max.	Unit	Note
Input Current (ON)	$I_{F(ON)}$	3	20	mA	a
Input Voltage (OFF)	$V_{F(OFF)}$	0	0.8	V	
Operating Temperature	T_A	–40	+85	°C	

a. Threshold to switch device is I_F ≥ 0.5 mA; however, for qualified device performance over temperature range, it is recommended to operate at I_F = 5 mA.

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Package Characteristics

Unless otherwise specified, T_A = 25°C.

Parameter	Sym.	Min.	Typ.	Max.	Unit	Conditions	Note
Input-Output Momentary Withstand Voltage	V_{ISO}	3750	—	—	Vrms	RH ≤ 50%, t = 1 min	a, b
Input-Output Resistance	R_{I-O}	—	10^{12}	—	Ω	V_{I-O} = 500 Vdc	
Input-Output Capacitance							a
ASSR-1410	C_{I-O}	—	0.4	—	pF	f = 1 MHz; V_{I-O} = 0 Vdc	
ASSR-1411	C_{I-O}	—	0.5	—	pF	f = 1 MHz; V_{I-O} = 0 Vdc	
ASSR-1420	C_{I-O}	—	0.8	—	pF	f = 1 MHz; V_{I-O} = 0 Vdc	

a. Device is considered a two-terminal device:
ASSR-1410 — pin 1, 2 shorted and pin 3, 4 shorted.
ASSR-1411 — pin 1, 2, 3 shorted and pin 4, 5, 6 shorted.
ASSR-1420 — pin 1, 2, 3, 4 shorted and pin 5, 6, 7, 8 shorted.

b. The Input-Output Momentary Withstand Voltage is a dielectric voltage rating that should not be interpreted as an input-output continuous voltage rating. For the continuous voltage rating, refer to the IEC/EN/DIN EN 60747-5-2 Insulation Characteristics Table (if applicable), your equipment level safety specification, or Broadcom Application Note 1074, *Optocoupler Input-Output Endurance Voltage*.

Electrical Specifications (DC)

Over recommended operating T_A = –40°C to 85°C, I_F = 5 mA to 10 mA, unless otherwise specified.

Parameter	Sym.	Min.	Typ.	Max.	Unit	Conditions	Fig.	Note
Output Withstand Voltage	$\|V_{O(OFF)}\|$	60	65	—	V	V_F = 0.8V, I_O = 250 µA, T_A = 25°C		
		55	—	—	V	V_F = 0.8V, I_O = 250 µA	5	
Output Leakage Current	$I_{O(OFF)}$	—	0.5	100	nA	V_F = 0.8V, V_O = 60V, T_A = 25°C		
		—	—	1	µA	V_F = 0.8V, V_O = 60V	6	
Output Offset Voltage	$\|V_{(OS)}\|$	—	1	—	µV	I_F = 5 mA, I_O = 0 mA		
Input Reverse Breakdown Voltage	V_R	5	—	—	V	I_R = 10 µA		
Input Forward Voltage	V_F	1.1	1.3	1.65	V	I_F = 5 mA	7, 8	
Output On-Resistance	$R_{(ON)}$	—	0.7	1	Ω	I_F = 5 mA, I_O = 600 mA, Pulse ≤ 30 ms, T_A = 25°C	9, 10	a
ASSR-1411 Connection B	$R_{(ON)}$	—	0.2	0.5	Ω	I_F = 5 mA, I_O = 1.2A, Pulse ≤ 30 ms, T_A = 25°C		

a. During the pulsed $R_{(ON)}$ measurement (I_O duration ≤ 30 ms), ambient (T_A) and case temperature (T_C) are equal.

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Switching Specifications (AC)

Over recommended operating T_A = –40°C to 85°C, I_F = 5 mA to 10 mA, unless otherwise specified.

Parameter	Sym.	Min.	Typ.	Max.	Unit	Conditions	Fig.	Note
Turn On Time	T_{ON}	—	0.25	0.5	ms	I_F = 5 mA, I_O = 600 mA, T_A = 25°C	11, 15	
		—	—	1.0	ms	I_F = 5 mA, I_O = 600 mA	12	
		—	0.1	0.25	ms	I_F = 10 mA, I_O = 600 mA, T_A = 25°C		
		—	—	0.5	ms	I_F = 10 mA, I_O = 600 mA		
Turn Off Time	T_{OFF}	—	0.02	0.2	ms	I_F = 5 mA, I_O = 600 mA, T_A = 25°C	13, 15	
		—	—	0.5	ms	I_F = 5 mA, I_O = 600 mA	14	
		—	0.02	0.15	ms	I_F = 10 mA, I_O = 600 mA, T_A = 25°C		
		—	—	0.2	ms	I_F = 10 mA, I_O = 600 mA		
Output Transient Rejection	dV_O/dt	1	7	—	kV/µs	ΔV_O = 60V, T_A = 25°C	16	
Input-Output Transient Rejection	dV_{I-O}/dt	1	≥10	—	kV/µs	ΔV_{I-O}= 1000V, T_A = 25°C	17	

Applications Information

On-Resistance and Derating Curves

The Output On-Resistance, $R_{(ON)}$, specified in this data sheet, is the resistance measured across the output contact when a pulsed current signal (I_O = 0.6A) is applied to the output pins. The use of a pulsed signal (≤30 ms) implies that each junction temperature is equal to the ambient and case temperatures. The steady-state resistance, Rss, on the other hand, is the value of the resistance measured across the output contact when a DC current signal is applied to the output pins for a duration sufficient to reach thermal equilibrium. Rss includes the effects of the temperature rise in the device.

Derating curves are shown in Figure 1, Figure 2, Figure 3, and Figure 4, specifying the maximum output current allowable for a given ambient temperature. The maximum allowable output current and power dissipation are related by the expression Rss = Po(max)/(Io(max))^2 from which Rss can be calculated. Staying within the safe area ensures that the steady-state MOSFET junction temperature remains less than 125°C.

Turn On Time and Turn Off Time Variation

The ASSR-14xx Series exhibits a very fast turn on and turn off time. Both the turn on and turn off time can be adjusted by choosing proper forward current as depicted in Figure 11 and Figure 13. The changes of the turn on and turn off time with ambient temperature are also shown in Figure 12 and Figure 14.

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Figure 1: Maximum Output Current Rating vs Ambient Temperature (ASSR-1410-003E)

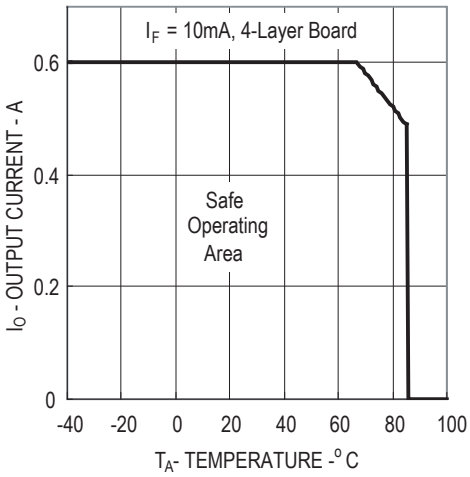


Figure 2: Maximum Output Current Rating vs Ambient Temperature (ASSR-1411-001E)

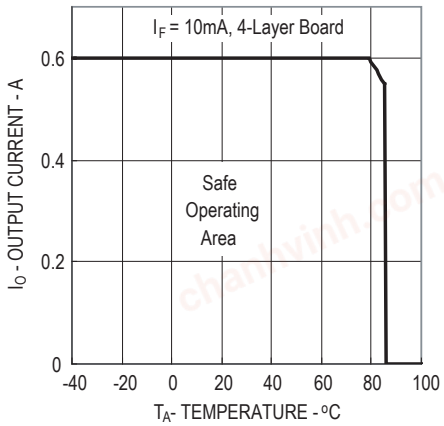


Figure 3: Maximum Output Current Rating vs Ambient Temperature (ASSR-1411-001E DC Connection)

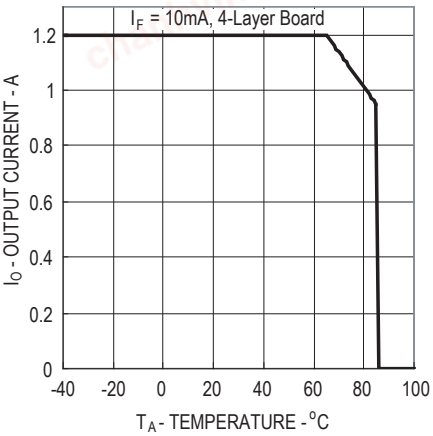


Figure 4: Maximum Output Current Rating vs Ambient Temperature (ASSR-1420-002E)

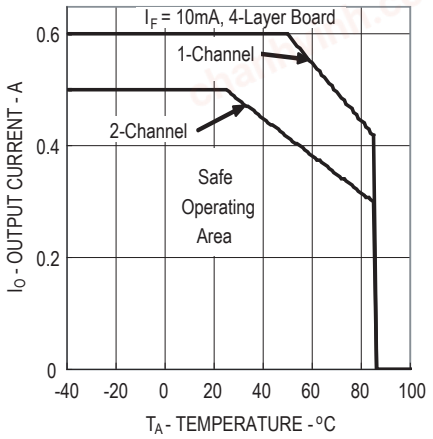


Figure 5: Normalized Typical Output Withstand Voltage vs. Temperature

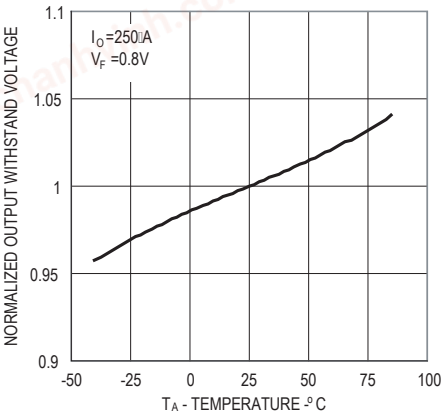
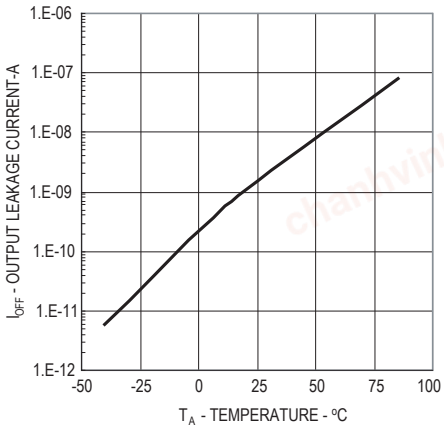


Figure 6: Typical Output Leakage Current vs. Temperature



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Figure 7: Typical Forward Voltage vs. Temperature

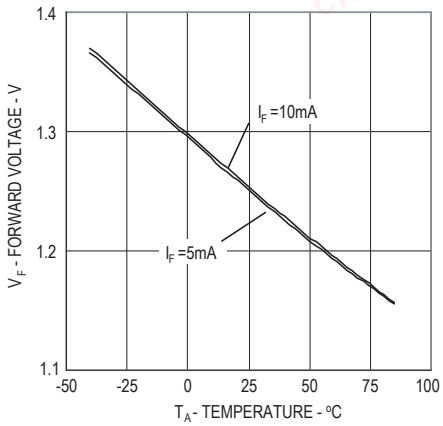


Figure 8: Typical Forward Current vs. Forward Voltage

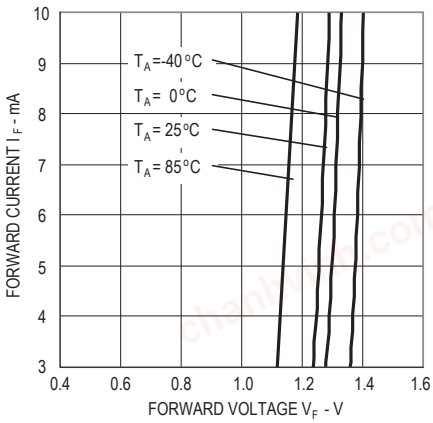


Figure 9: Typical On Resistance vs.Temperature

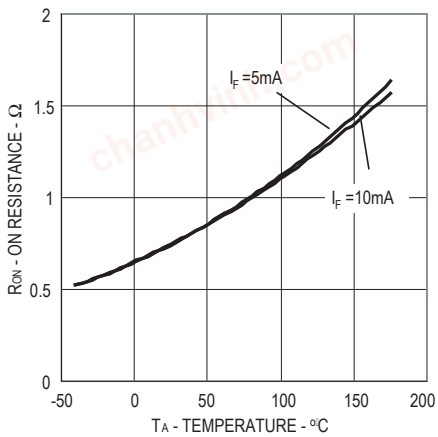


Figure 10: Typical Output Current vs. Output Voltage

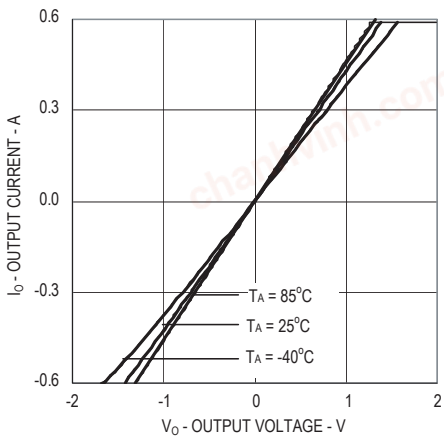


Figure 11: Typical Turn On Time vs. Input Current

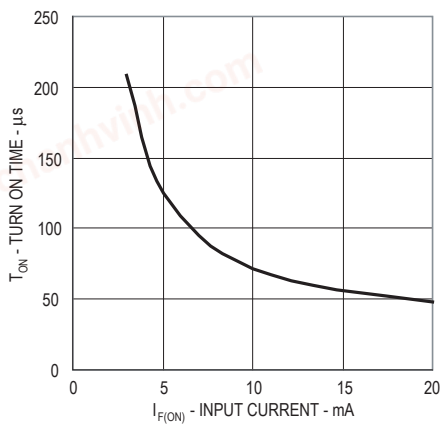
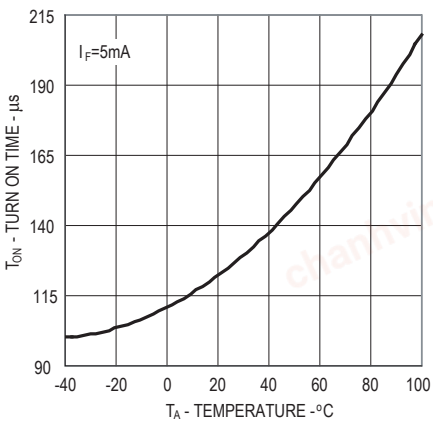


Figure 12: Typical Turn On Time vs. Temperature



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Figure 13: Typical Turn Off Time vs. Input Current

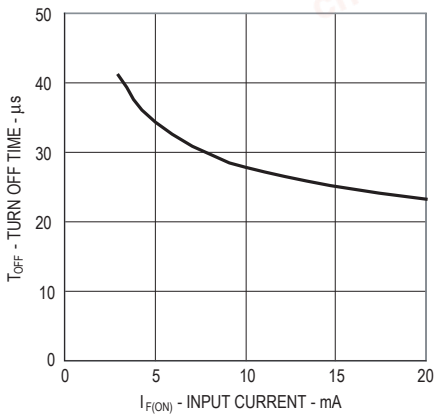


Figure 14: Typical Turn Off Time vs. Temperature

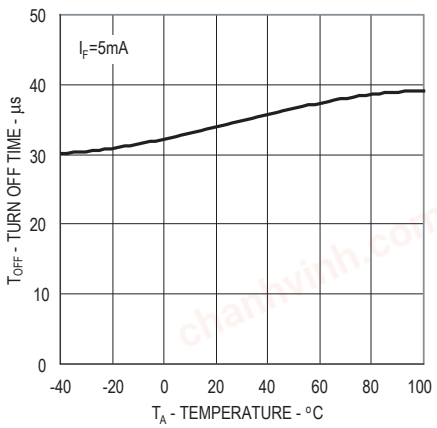
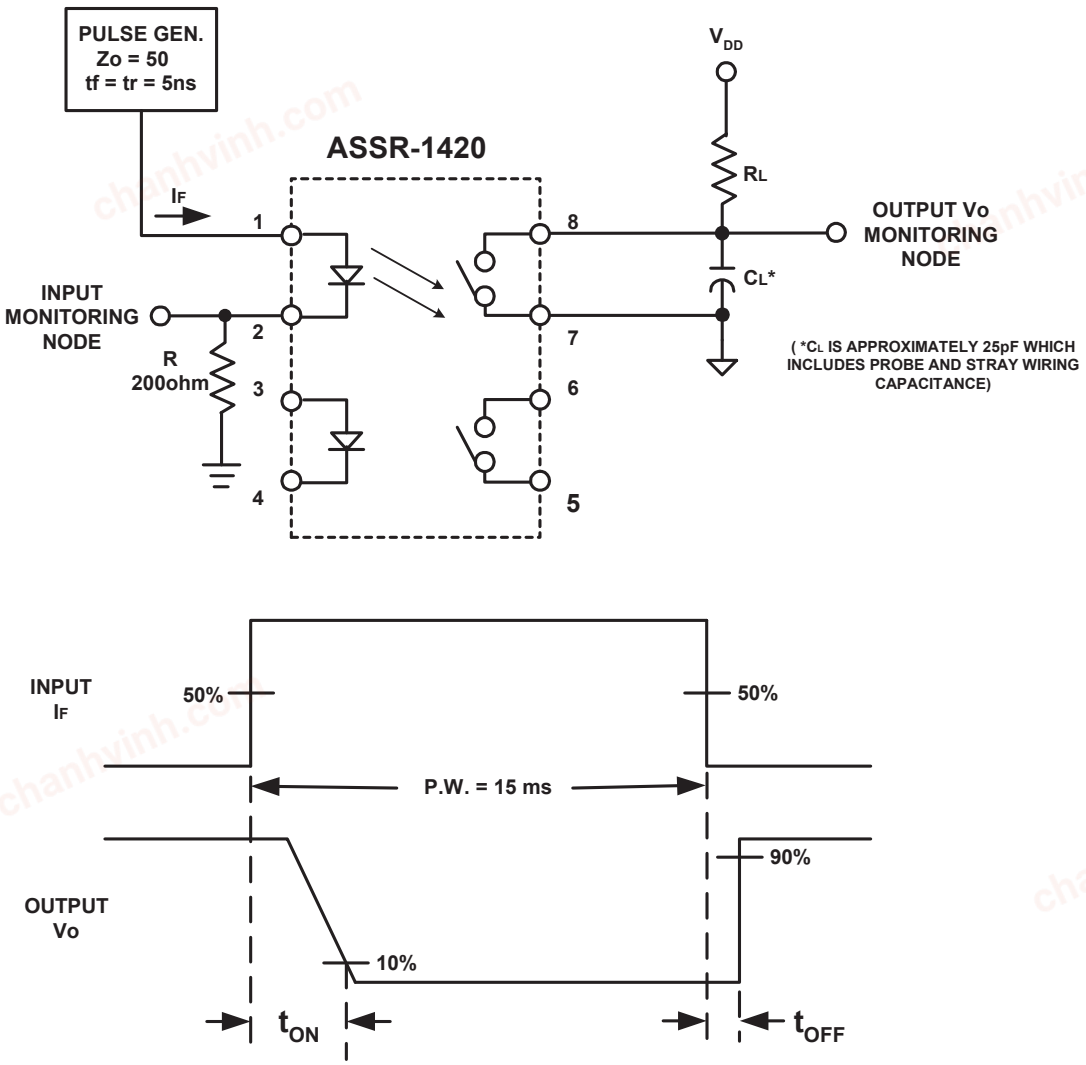
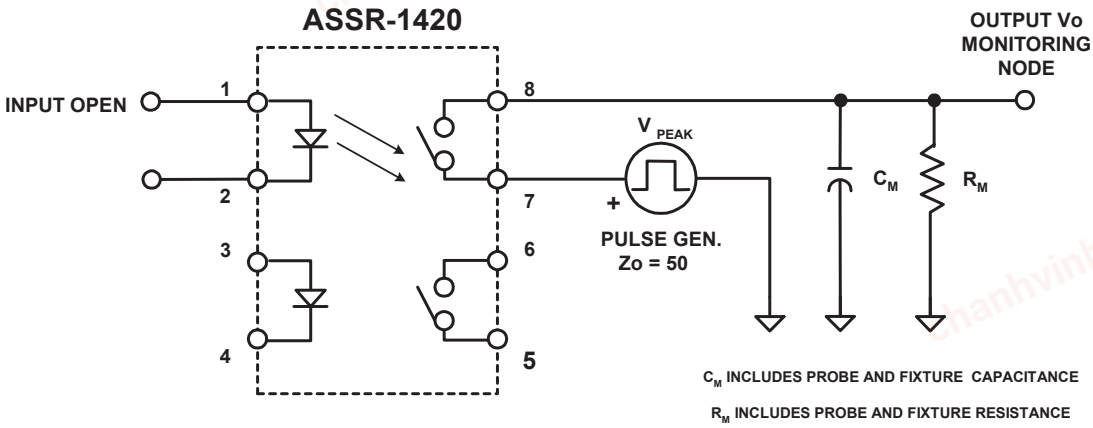


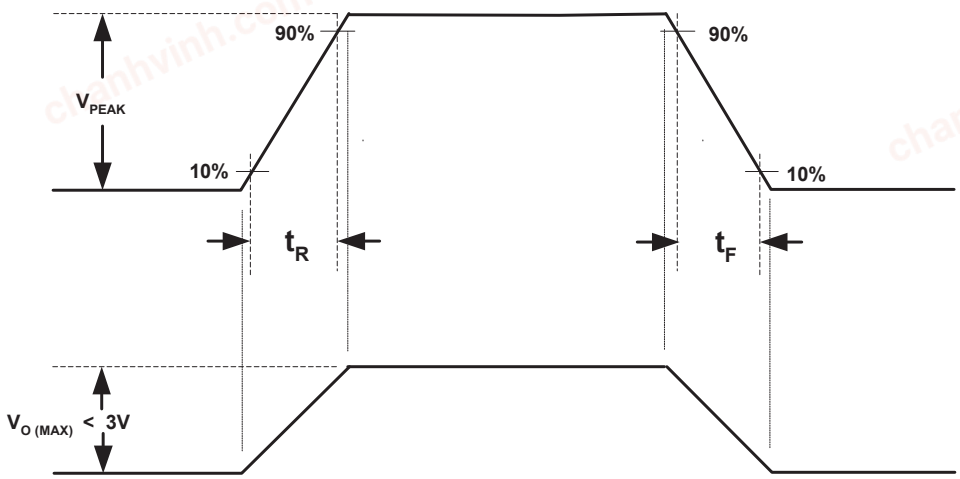
Figure 15: Switching Test Circuit for t_{ON}, t_{OFF}



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Figure 16: Output Transient Rejection Test Circuit



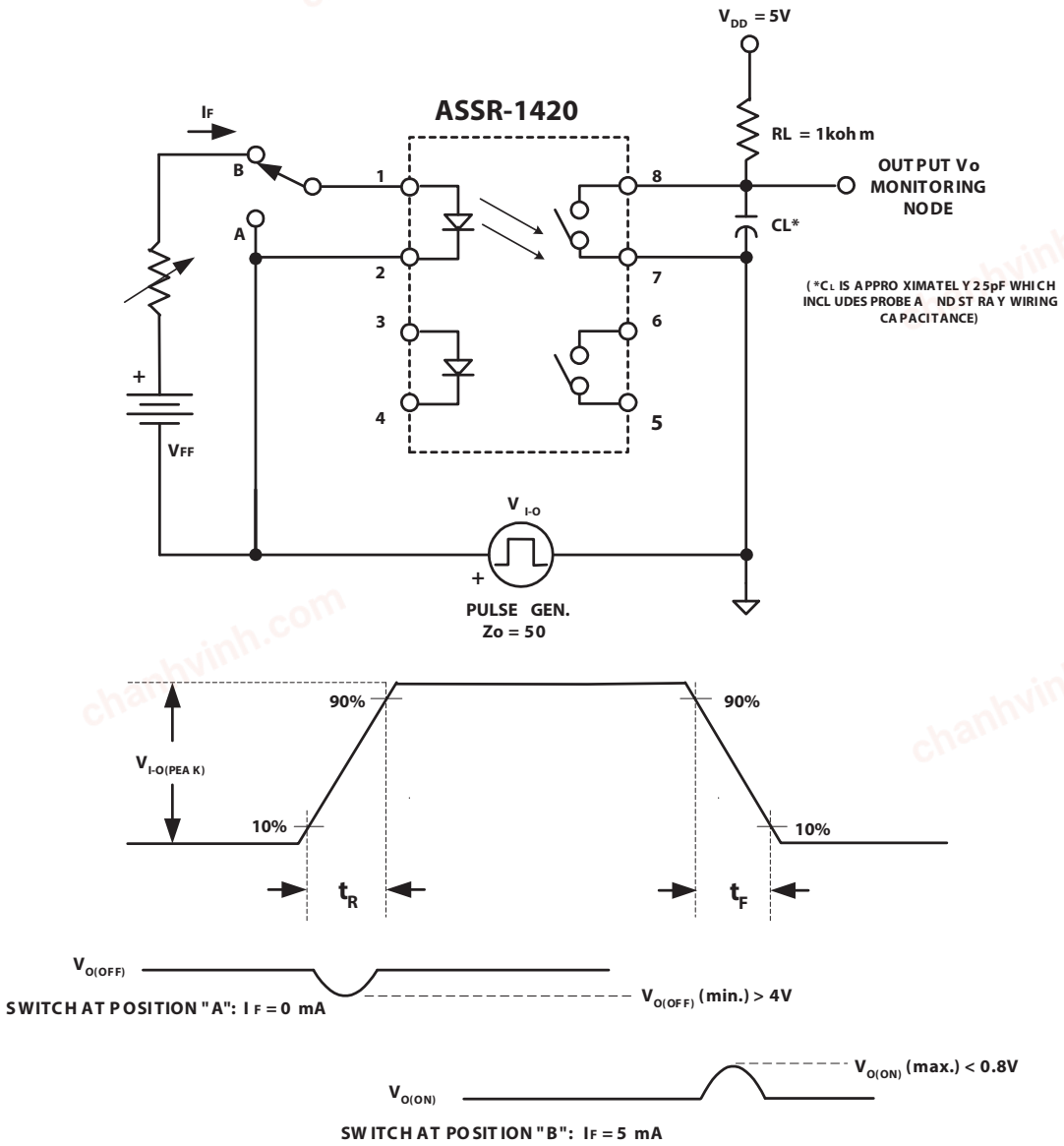


$$\frac{dV_0}{dt} = \frac{(0.8)V_{PEAK}}{t_R} \text{ OR } \frac{(0.8)V_{PEAK}}{t_F}$$

OVER SHOOT ON V_{PEAK} IS TO BE 10%

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Figure 17: Input-Output Transient Rejection Test Circuit



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