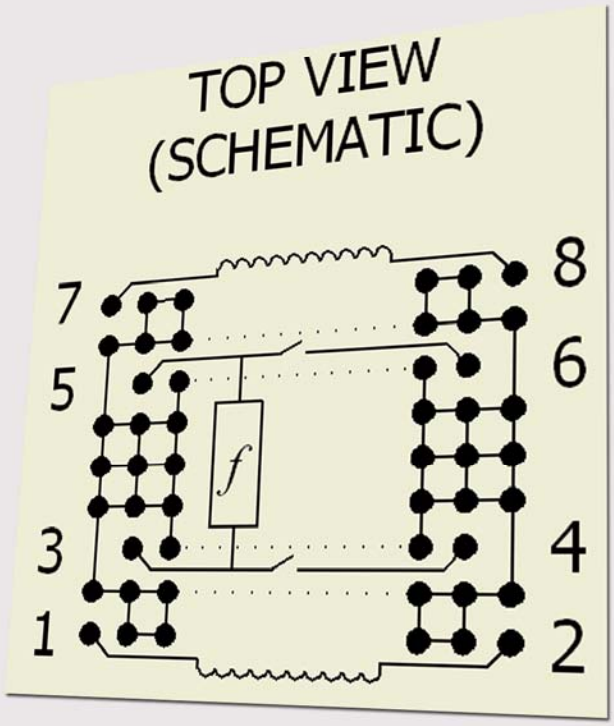
B21C
High Frequency
Form C Relay



Applications Note

B21C Relay Specification Data

TEST PARAMETERS		*CONDITIONS*[1,2]	*MIN*	*NOM*	*MAX*	*UNITS*
COIL SPECIFICATIONS						
COIL RESISTANCE		5.0VDC COIL	140.0	155.0	170.0	Ω
NOMINAL VOLTAGE				5.0	6.0	VOLT
MUST OPERATE					3.8	VOLT
MUST RELEASE			0.4			VOLT
CONTACT RATINGS						
SWITCHING VOLTAGE		MAX VDC/PEAK AC			100.0	VOLT
SWITCHING CURRENT					0.25	AMP
CARRY CURRENT (CONTINUOUS)		SWITCH & SHIELD			0.5	AMP
CONTACT RATING (RESISTIVE LOAD)		RESISTIVE LOAD			3.0	WATT
LIFE EXPECTANCY	SIGNAL SWITCHING[3]	1 VDC/10mA		1000		10^6 OPS
LIFE EXPECTANCY	RESISTIVE LOAD[3]	12VDC/10mA		1.0		10^6 OPS
LIFE EXPECTANCY	OTHER LOAD CONDITIONS[3]	CONSULT FACTORY				
RELAY SPECIFICATIONS						
STATIC CONTACT RESISTANCE	(INITIAL)	0.05VDC/50mA @ 100 Hz, 1.5ms			0.150	Ω
DYNAMIC CONTACT RESISTANCE	(INITIAL)	0.05VDC/10mA			0.200	Ω
INSULATION RESISTANCE	ALL ISOLATED PINS	100VDC	10^{10}	10^{12}		Ω
CAPACITANCE	ACROSS CONTACTS	SHIELD GUARDING		0.2		pF
CAPACITANCE	OPEN CONTACTS TO COIL	SHIELD GUARDING		0.5		pF
CAPACITANCE	CLOSED CONTACT TO COIL	SHIELD GUARDING		1.0		pF
DIELECTRIC STRENGTH	ACROSS CONTACTS	100µA	150			V(DC/PEAK AC)
DIELECTRIC STRENGTH	CONTACT TO COIL	100µA	500			V(DC/PEAK AC)
DIELECTRIC STRENGTH	CONTACT TO SHIELD	100µA	500			V(DC/PEAK AC)
OPERATE TIME	(INCLUDING BOUNCE)	NOMINAL VOLTAGE COIL DRIVE @ 30Hz, SQUARE WAVE		100	200	µs
RELEASE TIME	(Si DIODE DAMPED)			30	50	µs
RF INSERTION LOSS[4]		-3dB ROLL-OFF FREQUENCY	12.0			GHz
SIGNAL RISE TIME	(10%-90%)	CORRECTED FOR MEASUREMENT SYSTEM RESPONSE TIME			22	ps

NOTES:

[1] ALL PARAMETERS SPECIFIED PER EIA/NARM STANDARDS FOR DRY REED RELAYS, #RS-421 & RS-436, IF A SUITABLE PARAMETRIC STANDARD EXISTS

[2] UNLESS OTHERWISE NOTED, ALL PARAMETERS ARE SPECIFIED AT 25 DEGREES CELSIUS AND 40% RELATIVE HUMIDITY

[3] LIFE EXPECTANCY BASED ON MCBF CALCULATED FROM THE 2-PARAMETER WEIBULL DISTRIBUTION.
CONTACT RESISTANCE >2.0Ω DEFINES END OF LIFE

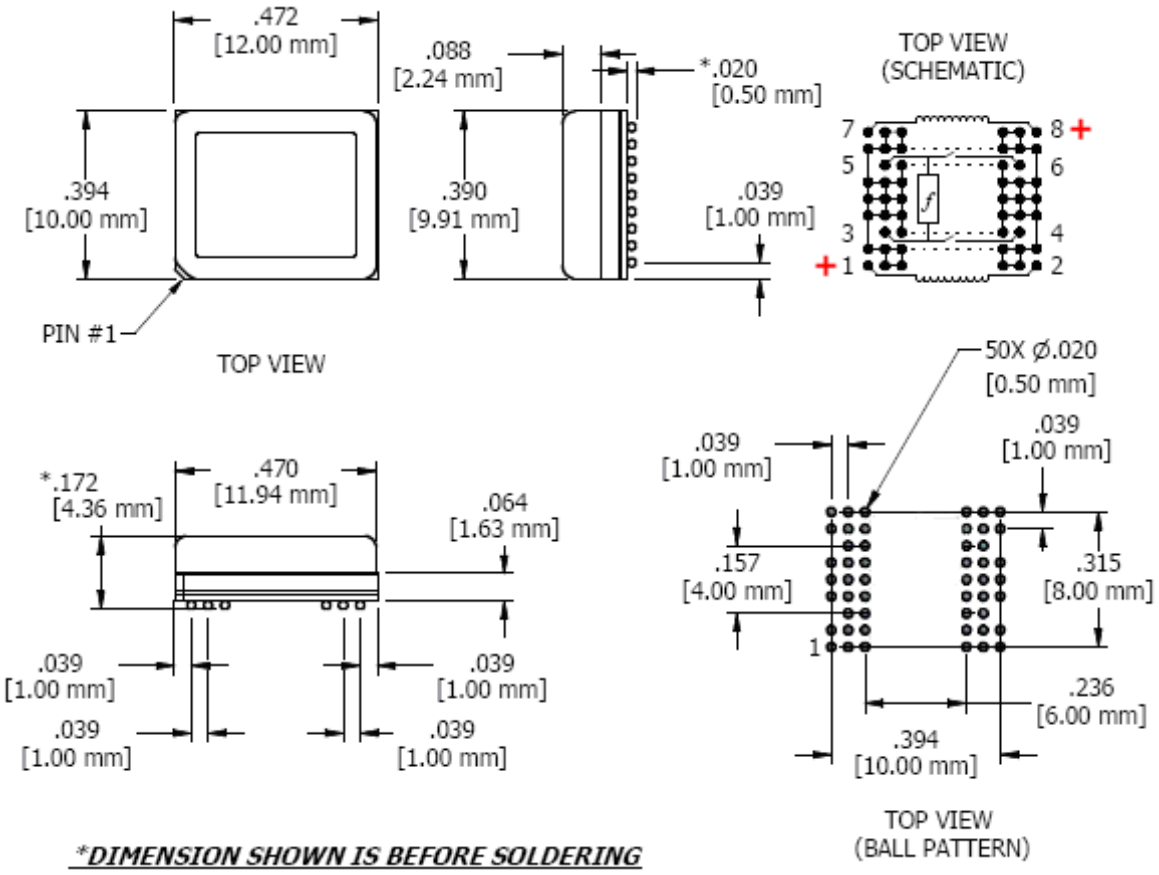
[4] FREQUENCY AT WHICH THE DIFFERENCE BETWEEN OUTPUT AND INPUT SIGNAL AMPLITUDE EXCEEDS -3 dB.

Environmental Specifications

RoHS compliant

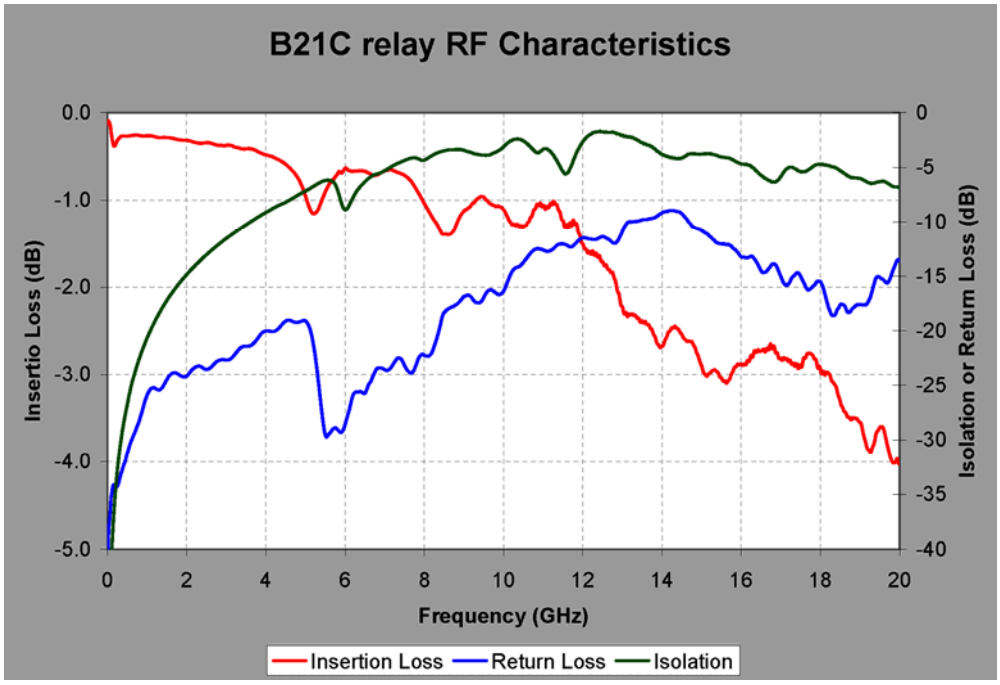
ENVIRONMENTAL RATINGS
STORAGE TEMPERATURE: -35 TO 100 DEGREES CELSIUS
OPERATING TEMPERATURE: -20 TO 85 DEGREES CELSIUS
VIBRATION: SINUSOIDAL VIBRATION WITH AN AMPLITUDE OF 10G OVER A 10Hz TO 2000Hz FREQUENCY RANGE SHALL NOT CAUSE
A CLOSED CHANNEL ACTIVATED AT THE NOMINAL COIL VOLTAGE TO OPEN, NOR AN OPEN CHANNEL TO CLOSE
MAX SOLDERING TEMPERATURE: 260 DEGREES CELSIUS FOR 1 MINUTE DWELL TIME, MEASURED AT RELAY BALL TERMINATION
MOISTURE SENSITIVITY LEVEL: HANDLE AS J-STD-020B LEVEL 5A

Dimensional Specifications

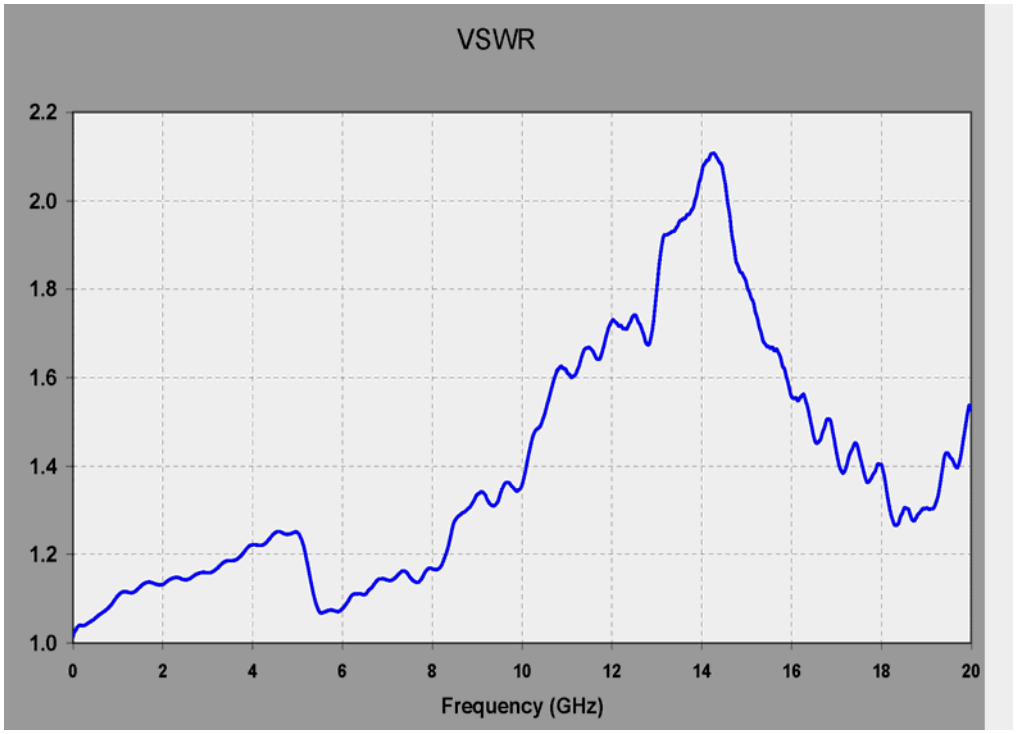


DIMENSION SHOWN IS BEFORE SOLDERING

RF Performance



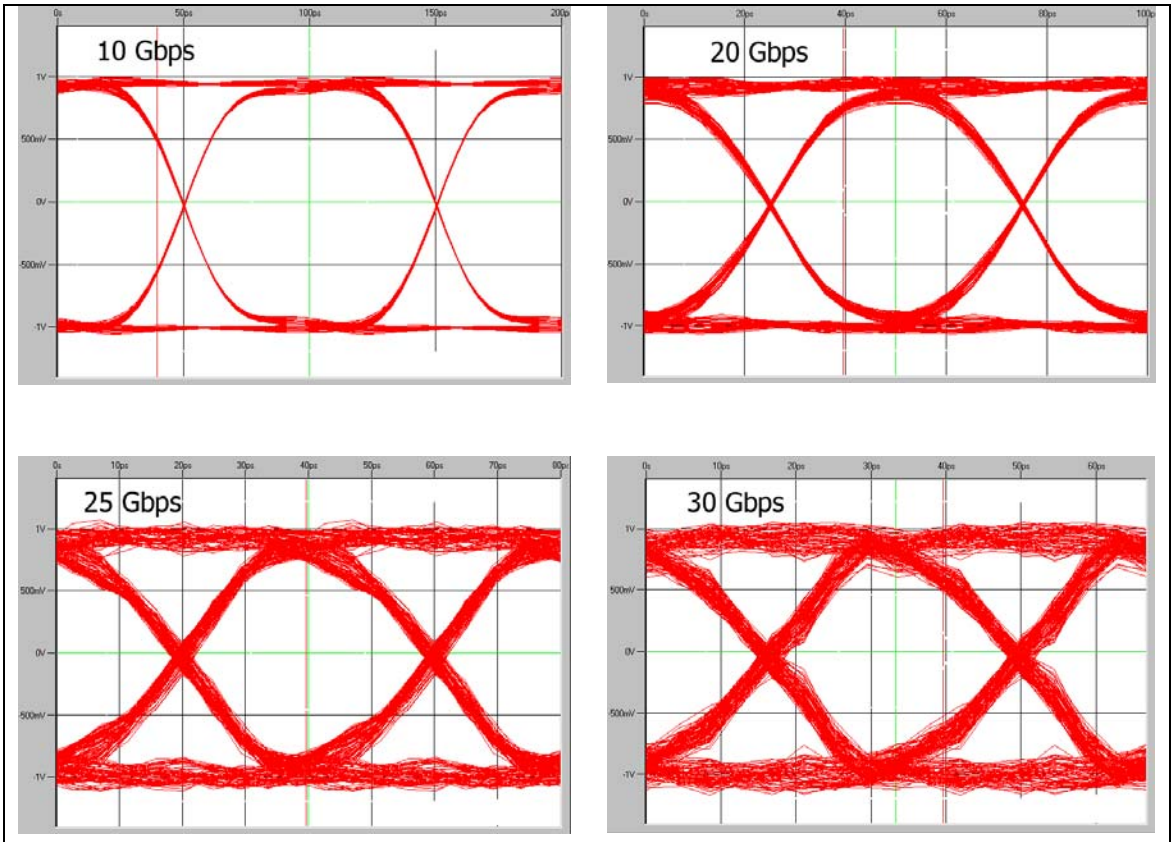
Notes: This RF data was acquired using microprobes applied directly to the relay signal ports. Isolation and return loss data are plotted against the right-hand axis of the plot, and insertion loss on the left hand axis.



Voltage Standing Wave Ratio (VSWR) Plot

Eye diagrams

Typical eye diagrams for the B21C relay are shown below. They were gathered at 10, 20, 25 and 30 Gbps using a digitizing oscilloscope with time domain reflection/transmission capability. The data was generated using a CJTPAT compliant jitter tolerance pattern.



Typical eye diagrams using CJTPAT test pattern

Description

The B21C relay is a high-performance RF reed relay packaged with two separate fully shielded Form A channels. Form C changeover mode is available by activating the appropriate channel coil. Each channel transmits signals to 6 GHz at -1dB and 12 GHz at -3dB. The open switch isolation is -21dB at 1 GHz. A custom-designed internal bridge allows switching between low frequency sources such as parametric measurement units and high frequency digital test signals with minimal stub capacitance losses on the high frequency line. Power consumption is less than 160 mW per channel, and the mean contact life exceeds one billion cycles at a 10V 10mA hot-switched load. The BGA package footprint is 10 mm * 12 mm, with a height of 4.3 mm.

Introduction

Coto Technology's B21C Form C is designed principally for Automated Test Equipment (ATE) applications. The two 50-ohm impedance, independently controllable switching channels have less than 3 dB RF insertion loss from DC to 12 GHz. The internal filter bridge (shown in the schematic in Figure 1) provides a low impedance path between the two channels at low frequencies, while blocking high frequencies from leaking between the two channels. This custom-designed filter presents a very low capacitance to each switch channel, reducing stub capacitance losses and allowing each channel to maintain a high bandpass. Compared to using a bridge connection external to the relay to combine signals passing though each relay channel, the internal bridge greatly reduces high-frequency losses.

However, if an application requires a changeover between a low frequency analog signal source such a parametric measurement unit (PMU) and a high frequency source such as a Driver Comparator Load (DCL), the filter bridge serves two purposes: it prevents corruption of the PMU measurements by the potentially leaky DCL output stage, and it largely eliminates stub capacitance effects from pulling down the bandpass of the DCL channel. These effects can otherwise degrade the integrity of the bit stream passing to and from the DCL to the device under test (DUT).

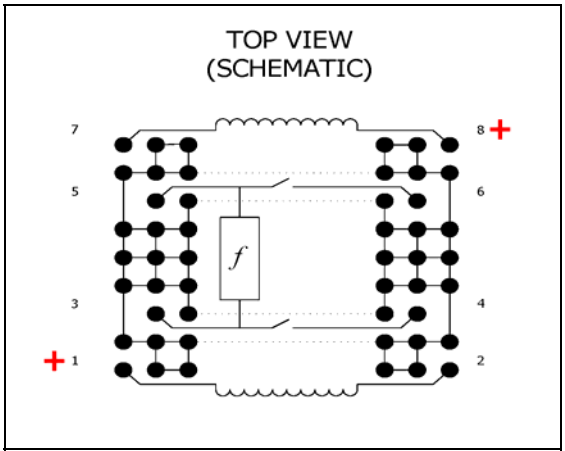


Fig. 1. Top view schematic of B21C relay showing the internal filter bridge

This application is shown in more detail in Figure 2. Because the two coils of the relay are independently addressable, Switch A can be closed while Switch B remains open, to connect the DCL to the DUT. The bridge filter isolates the DCL-DUT line from the capacitance of the section of the PMU running to Switch B. Alternatively, with switch B closed and Switch A open, the PMU can force and sense signals to and from the potentially leaky output stage

from the DUT without any corruption of the DCL. Should the application require it, channels A and B can both be used independently for high frequency signal transmission.

B21C Relay Applications

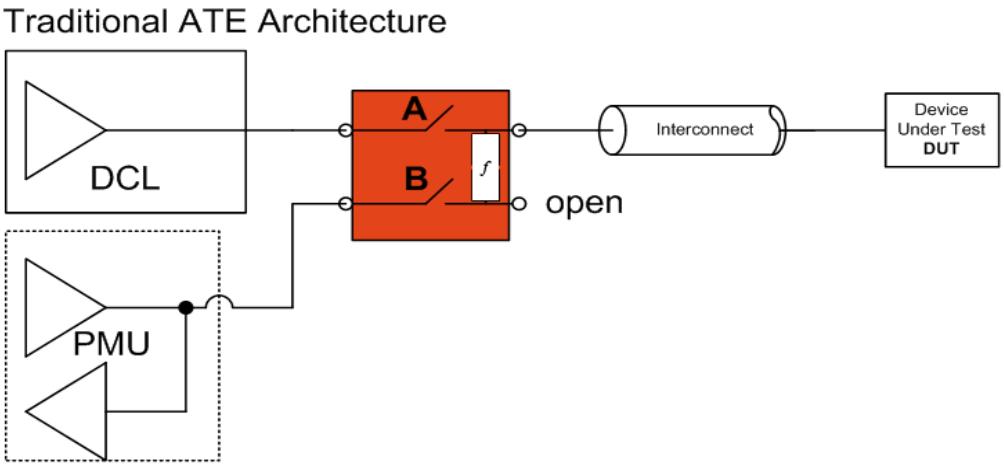


Fig. 2. Typical non-differential DCL-PMU switching architecture

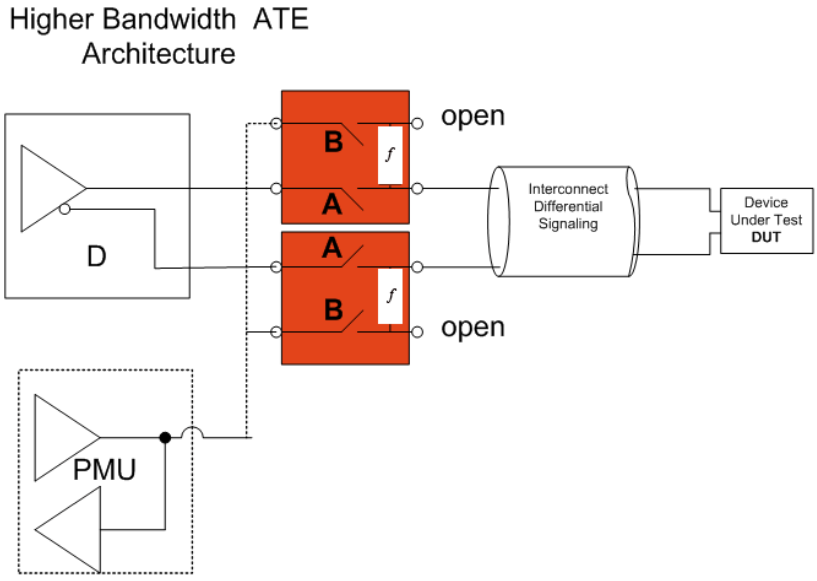


Fig. 3 Higher bandwidth DCL-PMU switching architecture using differential signaling

Test Data Storage and Retrieval

Each B21C shipped by Coto Technology is fully tested before shipment. Typical DC parametric measurements made on each channel include: operate and release voltage, static and dynamic contact resistance, contact resistance stability, and operate/release times. Relays are also individually tested for compliance with the high frequency specifications. All test data is archived for future reference. The relay has a unique serial number encoded in the product label in a two-dimensional bar code, which provides traceability of the date of manufacture, lot code and production test data to each individual B21C relay.

Fig. 4 Product label with bar code uniquely identifying each shipped relay

Notes

1) **RoHS Compliance**
The B21C is fully RoHS compliant, and will withstand typical RoHS component reflow attachment cycles for up to and including three cycles at a peak temperature of 260 degrees Celsius for a period of one minute.

2) **Reflow Attachment**
The B21C relay is provided with lead-free SAC (Tin/Silver/Copper) solder balls. The recommended reflow attachment profile is shown in Figure 5. Please note that this intended only a guide. The reflow profile may need to be adjusted based on other component sizes, their spacing and their thermal masses.

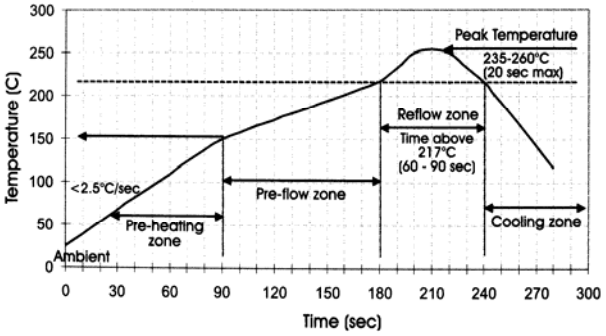
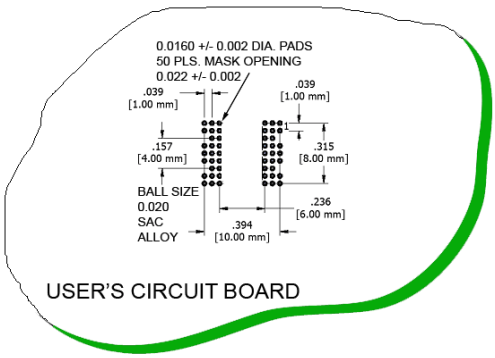


Fig 5 Recommended reflow attachment profile

3) **Recommended land pattern**



In order to maintain the best possible signal integrity, the lines leading to the relay's signal pins must be designed for 50 ohm impedance to ensure a clean signal transition in and out of the relay. Microstrip or coplanar waveguide transmission lines are recommended. Follow good design practices to minimize noise pickup, cross talk from adjacent signal lines, parasitic stubs and other design defects that can degrade the signal before or after it leaves the relay. See References 1 and 2 for further information.

4) **Cleaning**
PCB-attached relays may be cleaned by all normal PCB washing techniques with the exception of ultrasonic cleaning.

5) **Moisture Sensitivity Rating**
The B21C relay is a moisture sensitive component and should be handled as
J-STD-020B Level 5a

6) **Coil Connections**
Since internal coil kickback suppression diodes are not installed, the individual coils may be connected with either polarity. However, for most efficient operation we recommend using the opposite polarity for each coil as shown in Figure 1. Additionally, multiple relays should be mounted with the same orientation and coil polarity.

7) **Packaging**
B21C relays are supplied in Tape-and-Reel packaging. Contact Coto for details on reel and tape dimensions, and standard quantities per reel

8) **Patent Protection**
The B21C relay is protected by one or more of the following US Patents: 6025768, 6052045, 6294971, 6683518, RE38381, other Foreign patents, and patents pending.

References

[1] Johnson, Howard W. *High Speed Digital Design: A Handbook of Black Magic*, Prentice Hall, 1993

[2] Johnson, Howard W. *High Speed Signal Propagation: Advanced Black Magic*, Prentice Hall, 2003

Appendix

B21C Product Specification Sheet

PRELIMINARY PRINT FOR QUOTING AND REVIEW ONLY

COTO CONFIDENTIAL

TEST PARAMETERS		CONDITIONS[1,2]	MIN	NOM	MAX	UNITS
COIL SPECIFICATIONS						
COIL RESISTANCE		5.0VDC COIL	140.0	155.0	170.0	Ω
NOMINAL VOLTAGE				5.0	6.0	VOLT
MUST OPERATE					3.8	VOLT
MUST RELEASE			0.4			VOLT
CONTACT RATINGS						
SWITCHING VOLTAGE		MAX VDC/PEAK AC			100.0	VOLT
SWITCHING CURRENT					0.25	AMP
CARRY CURRENT (CONTINUOUS)		SWITCH & SHIELD			0.5	AMP
CONTACT RATING (RESISTIVE LOAD)		RESISTIVE LOAD			3.0	WATT
LIFE EXPECTANCY	SIGNAL SWITCHING[3]	1 VDC/10mA		1000		10^6 OPS
LIFE EXPECTANCY	RESISTIVE LOAD[3]	12VDC/10mA		1.0		10^6 OPS
LIFE EXPECTANCY	OTHER LOAD CONDITIONS[3]	CONSULT FACTORY				
RELAY SPECIFICATIONS						
STATIC CONTACT RESISTANCE	(INITIAL)	0.05VDC/50mA @ 100 Hz, 1.5ms			0.150	Ω
DYNAMIC CONTACT RESISTANCE	(INITIAL)	0.05VDC/10mA			0.200	Ω
INSULATION RESISTANCE	ALL ISOLATED PINS	100VDC	10^{10}	10^{12}		Ω
CAPACITANCE	ACROSS CONTACTS	SHIELD GUARDING		0.2		pF
CAPACITANCE	OPEN CONTACTS TO COIL	SHIELD GUARDING		0.5		pF
CAPACITANCE	CLOSED CONTACT TO COIL	SHIELD GUARDING		1.0		pF
DIELECTRIC STRENGTH	ACROSS CONTACTS	100µA	150			V(DC/PEAK AC)
DIELECTRIC STRENGTH	CONTACT TO COIL	100µA	500			V(DC/PEAK AC)
DIELECTRIC STRENGTH	CONTACT TO SHIELD	100µA	500			V(DC/PEAK AC)
OPERATE TIME	(INCLUDING BOUNCE)	NOMINAL VOLTAGE COIL DRIVE @		100	200	µs
RELEASE TIME	(SI DIODE DAMPED)	30Hz, SQUARE WAVE		30	50	µs
RF INSERTION LOSS[4]		-3dB ROLL-OFF FREQUENCY	16.0			GHz
SIGNAL RISE TIME	(10%-90%)	CORRECTED FOR MEASUREMENT SYSTEM RESPONSE TIME			22	ps

NOTES:

[1] ALL PARAMETERS SPECIFIED PER EIA/NARM STANDARDS FOR DRY REED RELAYS, #RS-421 & RS-436, IF A SUITABLE PARAMETRIC STANDARD EXISTS.

[2] UNLESS OTHERWISE NOTED, ALL PARAMETERS ARE SPECIFIED AT 25 DEGREES CELSIUS AND 40% RELATIVE HUMIDITY

[3] LIFE EXPECTANCY BASED ON CHARACTERISTIC LIFE (63.2% FAILURE) CALCULATED FROM THE 2-PARAMETER WEIBULL DISTRIBUTION.

CONTACT RESISTANCE >2.0Ω DEFINES END OF LIFE

[4] FREQUENCY AT WHICH THE DIFFERENCE BETWEEN OUTPUT AND INPUT SIGNAL AMPLITUDE EXCEEDS -3 dB.

(DIRECT WIRED USING 50Ω COAXIAL CABLE)

ENVIRONMENTAL RATINGS

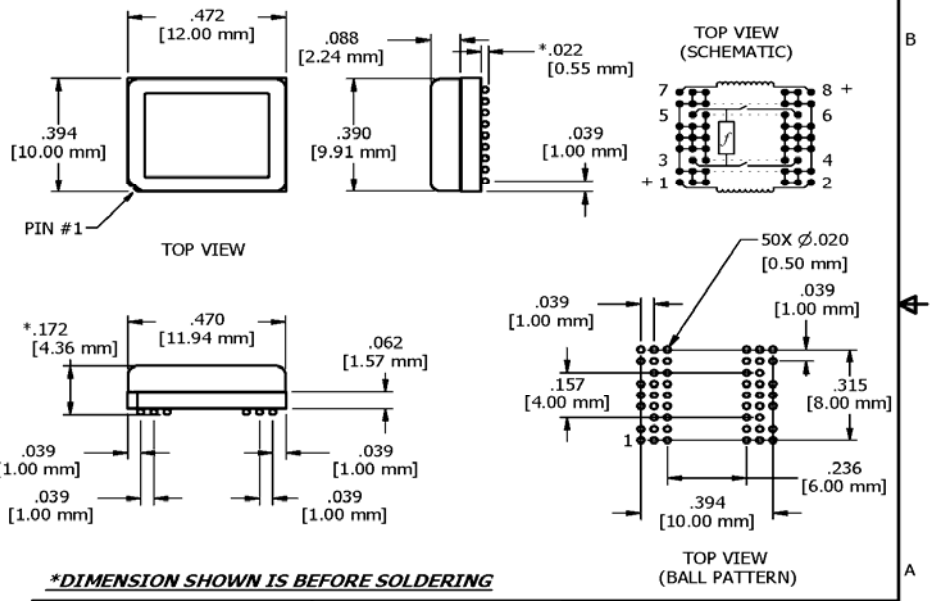
STORAGE TEMPERATURE: -35 TO 100 DEGREES CELSIUS

OPERATING TEMPERATURE: -20 TO 85 DEGREES CELSIUS

VIBRATION: SINUSOIDAL VIBRATION WITH AN AMPLITUDE OF 10G OVER A 10Hz TO 2000 Hz FREQUENCY RANGE SHALL NOT CAUSE A CLOSED CHANNEL ACTIVATED AT THE NOMINAL COIL VOLTAGE TO OPEN, NOR AN OPEN CHANNEL TO CLOSE.

MAX SOLDERING TEMPERATURE: 260 DEGREES CELSIUS FOR 1 MINUTE DWELL TIME, MEASURED AT RELAY BALL TERMINATION

MOISTURE SENSITIVITY LEVEL: HANDLE AS J-STD-020B LEVEL 5A



***DIMENSION SHOWN IS BEFORE SOLDERING**

ORDERING INFORMATION

B2XX-XXX

SERIES: B21C

NOM. COIL VOLTAGE: 050 = 5.0 VOLTS

SCALE 1 : 1

APPROVALS REQUIRED		UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES	171 SERVICE RD, SUITE301, BLDG2 WARWICK,RI 02886 USA PH:401.943.2686 www.COTORELAY.com
DRAWN BY: JWG	DATE: 5/26/2009	XX = ±.01 XXX = ±.005 XXXX = ±.001	COTO DWG NAME: BGA HF PSEUDO FORM C RELAY
CHECKED BY	DATE	FRACTIONS = 1/64 ANGLES = ±2°	COTO DWG#: B2XX-XX REV
QA APPROVAL BY	DATE	THIRD ANGLE PROJECTION	CUST./SUPL. NAME: COTO TECHNOLOGY CUST./SUPL. DWG#: B2XX-XX
MFG APPROVAL BY	DATE	DO NOT SCALE THIS DRAWING	SIZE: B SCALE: 3:1 FOR SERIES: BGA HF SHEETS: 1 OF 1
ENG APPROVAL BY: RLE	DATE		
MATERIAL: NA	FINISH: NA		

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