Relays Part 2 Larry Weinstein KONA

A Solid State Transceiver Except:

- Panel buttons
- Relays
 - Band switching filters
 - Transmit and receive switching
 - Push to talk is the safest
 - Typically no power on SSB till you start to talk
 - VOX one may have reasonable power to switch
 - May have some power
 - CW key down is full power!
 - If timing is not correct SWR is infinite at full power!

How Fast Do Relays Need to Be?

- At 20 wpm a dot is about 50ms long
 At contest speeds of 40 wpm it is 25ms
- Reed and vacuum relays normally take sub 10 ms to operate
 - As a reference: 60 cycle is 16.66 ms per cycle
- Larger mechanical relays ie the Drake L4b take 15 to 30 ms to operate with normal voltages
- This problem occurs every time you start to transmit

Overexcite a Relay

- A common way to increase the speed of a relay is to over excite it
 - A higher than normal voltage is applied for a short time to close the relay
 - Close times can be halved
 - Release times are not affected
 - Typically not critical
- A simple circuit is a capacitive input half wave rectifier
 - The capacitor charges to 1.4X the supply voltage
 - The resistance in the ac supply then limits the relay voltage after closed
 - Resistors before the diode can limit steady state voltage

Modifying the Drake L4b

- The T/R relay was going bad
 - Dirty contacts not going back to receive
 - Arcing sometimes in transmit
- Decided to modify it to full QSK
 - Use vacuum relays even though they are expensive

Drake L4b



L4b

- Needed a 3 pole double through relay
 None available
- Used 3 spdt vacuum relays
 - Because of the expense I bought 3 used ones
 - Worked good for a while!
 - Bought a few more swapping out the output relay

Additional Research

- Input and bias could be switched with small inexpensive relays
 - 100W at 50 ohms:
 - 70 volts
 - 1.4 amps
- Had a supply of Omron G5V-2-H1s in the shack



General-purpose, Low-cost, **Two-pole Relays for Signal Circults**

- · General-purpose DIL terminal lavout.
- 2 amp contacts Fully-sealed type Relays standardized with bifurcated crossbar contacts. Highly reliable in addition to its high environment resistance
- Wide switching power of 10 µA to 2 A.

 - Conforms to FCC Part 68 (impulse withstand voltage of 1,500 V for 10 x 160 µs between coil and contacts and between contacts of the same polarity).
 - · High dielectric strength at 1,000 VAC between coil and contacts, and 750 VAC between contacts of the same polarity.
 - · UL and CSA standard approved.

RoHS Compliant

Model Number Legend

G5V-□-□ 2 1

1. Number of Poles/ Contact form 2: 2-pole/DPDT (2c)

2. Classification None: Standard H1: High-sensitivity

Application Examples

- Telecommunication equipment
- · Security equipment

Characteristics

Item	Classification	Standard	High-sensitivity	
Contact resistance *1		50 mΩ max.	100 mΩ max.	
Operate time		7 ms max.		
Release tim	ne	3 ms max.		
Insulation n	esistance *2	1,000 MΩ min. (at 500 VDC)		
Dielectric strength	Between coil and contacts	1,000 VAC, 5	i0/60 Hz for 1 min	
	Between contacts of the same polarity	750 VAC, 50/60 Hz for 1 min	500 VAC, 50/60 Hz for 1 min	
	Between contacts of different polarity	1,000 VAC, 50/60 Hz for 1 min		
Impulse withstand voltage	Between coil and contacts	1,500 V (10 x 160 µs)		
	Between contacts of the same polarity	1,500 V (10 x 160 µs)		
	Between contacts of different polarity	1,500 V (10 x 160 μs)		
Vibration	Destruction	10 to 55 to 10 Hz, 0.75 mm single amplitude (1.5 mm double amplitude)		
resistance	Malfunction	10 to 55 to 10 Hz, 0.75 mm single amplitude (1.5 mm double amplitude)		
Shock	Destruction	1,000 m/s ²		
resistance	Malfunction	200 m/s ²	100 m/s ²	
Durability	Mechanical	15,000,000 operations min. (at 36,000 operations/hr)		
	Electrical	100,000 operations min. (at 1,800 operations/hr)	AC: 100,000 operations min., DC: 300,000 operations min. (at 1,800 operations/hr)	
Failure rate (P level) (reference value) *3		10 µA at 10 m VDC		
Ambient operating temperature		-25°C to 65°C (with no icing or condensation)	-25°C to 70°C (with no icing or condensation)	
Ambient operating humidity		5% to 85%		
Weight		Approx. 5 g		

Note: The above values are initial values.

- The contact resistance was measured with 10 mA at 1 VDC with a voltage *1. drop method.
- *2. The insulation resistance was measured with a 500 VDC megohmmeter
- applied to the same parts as those used for checking the dielectric strength. This value was measured at a switching frequency of 120 operations/min *3. and the criterion of contact resistance is 50 \OM2. This value may vary
 - depending on the switching frequency and operating environment. Always double-check relay suitability under actual operating conditions.

Ordering Information

Classification	Enclosure rating	Contact form	Terminal shape	Model	Rated coil voltage	Minimum packing unit
	Fully sealed	DPDT (2c)	PCB terminals	G5V-2	3 VDC	25 pcs/tube
					5 VDC	
					6 VDC	
Standard					9 VDC	
					12 VDC	
					24 VDC	
					48 VDC	
				G5V-2-H1	5 VDC	
High-					12 VDC	
sensitivity					24 VDC	
					48 VDC	

Note: When ordering, add the rated coil voltage to the model number. Example: G5V-2 DC3.

T -Rated coil voltage

However, the notation of the coil voltage on the product case as well as on the packing will be marked as DD VDC.



G 5 Ň 2

■Characteristics

· · · · · ·

.

.

	Item	Classification	Standard	High-sensitivity	
	Contact res	istance *1	50 mΩ max.	100 mΩ max.	
	Operate time		7 ms max.		
	Release tin	ne	3 ms max.		
	Insulation r	esistance *2	1,000 MΩ m	nin. (at 500 VDC)	
		Between coil and contacts	1,000 VAC, 5	50/60 Hz for 1 min	
	Dielectric strength	Between contacts of the same polarity	750 VAC, 50/60 Hz for 1 min	500 VAC, 50/60 Hz for 1 min	
		Between contacts of different polarity	1,000 VAC, 5	60/60 Hz for 1 min	
		Between coil and contacts	1,500 V	(10 x 160 μs)	
	impulse withstand	Between contacts of the same polarity	1,500 V	(10 x 160 μs)	
	Vibration	Between contacts of different polarity	1,500 V (10 x 160 µs)		
		Destruction	10 to 55 to 10 Hz, 0.75 mm single amplitude (1.5 mm double amplitude)		
	resistance	Malfunction	10 to 55 to 10 Hz, 0.75 mm single amplitude (1.5 mm double amplitude)		
	Shock	Destruction	1,000 m/s ²		
	resistance	Malfunction	200 m/s ²	100 m/s ²	
		Mechanical	15,000,000 operations min. (at 36,000 operations/hr)		
	Durability	Electrical	100,000 operations min. (at 1,800 operations/hr)	AC: 100,000 operations min., DC: 300,000 operations min. (at 1,800 operations/hr)	
	Failure rate (P level) (reference value) *3 Ambient operating temperature Ambient operating humidity Weight		10 µA at 10 m VDC		
			-25°C to 65°C (with no icing or condensation)	-25°C to 70°C (with no icing or condensation)	
			5% to 85%		
			Approx. 5 g		

Vacuum Relays

- Used vacuum relays are typically not a good deal
- GigaVac has a ham radio discount
 - GH1 was about \$90
 - Working great in my new amplifier
 - At 2KW:
 - 316 Volts
 - 6.3 amps



FEATURES

- > Low stable contact resistance for high carry current and low voltage drop
- > Low loss in RF circuits
- > Mounting options in any axis
- > Solder or convenient threaded HV connections

PRODUCT SPECIFICATIONS

Contact & Relay Ratings	Units	GH1
Contact Form		С
Contact Arrangement		SPDT
Contact Material (moveable/stationary)		molybdenum /copper
Dielectric	1	Vacuum
Voltage, Test Max., Contacts & to Base (15 µA Leakage Max.) dc or 60Hz	kV Peak	5
Voltage, Operating Max., Contacts & to Base (15 µA Leakage Max.)		
dc or 60 Hz	kV Peak	3.5
2.5 MHz	kV Peak	2.5
16 MHz	kV Peak	2
32 MHz	kV Peak	1.5
Current, Load Switching		Contact factory**
Current, Continuous Carry Max	1	
dc or 60 Hz	Amps	25
2.5 MHz	Amps	14
16 MHz	Amps	9
32 MHz	Amps	7
Coil Hi-Pot (V RMS, 60 Hz)	V	500
Capacitance	1	
Across Open Contacts	pF	2
Contacts to Ground	pF	2.5
Resistance, Contact Max @ 1A, 28 Vdc	ohms	0.01
Operate Time	ms	6
Release Time	ms	6
Life, Mechanical	cycles	2 million
Weight, Nominal	g (oz)	28 (1)
Vibration, Operating, Sine (55-500 Hz Peak)	G's	10
Shock, Operating, 1/2 Sine11ms (Peak)	G's	50
Temperature Ambient Operating	°C	-55 to +125

** Consult factory for load switching applications







COIL RATINGS

Nominal, Volts dc	12	26.5	115
Pick-up, Volts dc, Max.	8	16	80
Drop-Out, Volts dc	.5 - 5	1 - 10	5 - 50
Coil Resistance (Ohms ±10%)	80	335	6000

PART NUMBER SYSTEM

GH1	
High Voltage/Power Terminal Connections	
Coil Voltage*	Blank = 26.5 Vdc -12Vdc = 12Vdc -115Vdc = 115Vdc

* Order the relay with the coil unitage in the part number as shown

GigaVac detail

Voltage, Test Max., Contacts & to Base (15 µA Leakage Max.) dc or 60Hz	kV Peak	5	
Voltage, Operating Max., Contacts & to Base (15 µA Leakage Max.)			
dc or 60 Hz	kV Peak	3.5	
2.5 MHz	kV Peak	2.5	
16 MHz	kV Peak	2	
32 MHz	kV Peak	1.5	
Current, Load Switching		Contact factory**	← Note!
Current, Continuous Carry Max			1
dc or 60 Hz	Amps	25	
2.5 MHz	Amps	14	
 16 MHz	Amps	9	
32 MHz	Amps	7	
Coil Hi-Pot (V RMS, 60 Hz)	V	500	
Capacitance			
Across Open Contacts	pF	2	
Contacts to Ground	pF	2.5	
 Resistance, Contact Max @ 1A, 28 Vdc	ohms	0.01	
Operate Time	ms	6	
Release Time	ms	6	
Life, Mechanical	cycles	2 million	

Life Expectancy

- At 20 wpm and 50 ms on, 50 ms off
 - 2,000,000 operations minimum life
 - Equals 138 days of steady dots!
 - If properly designed you will not wear the relays out

Next Relay Project

- Single "on" button from the K3
 - Turning on the k3 will
 - Turn on the pan adapter
 - Connect the antenna
 - Turn off and ground the antenna when not in use
 - Turn on the amplifier
- Maximum current on the accessory out is 500ma
 - The plan is to use an automotive relay and power up a fuse block

Switching Inductive Loads

- All relay coils are inductive
 - Without a diode the relays in the amplifier wiped out the Arduino processor
 - Transient protection is a must in solid state circuits
- Switching DC loads can be difficult
 - DC is more difficult than AC
 - AC has a off time every 1/120 of a second
 - HF becomes more difficult because of the off time and capacitance.

Miscellaneous Relays

• Automotive

- 12v coils
- 30 amp SPDT contacts
- 40 amp SPST contacts
- I have used them in RF circuits
- Latching
 - Mechanical
 - Magnetic
 - A positive pulse latches the relay
 - A negative pulse unlatches the relay
- Time delay
 - Time delay on
 - Step start a tube amplifier
 - Time delay off
 - Cooling fan

Miscellaneous Relays

- Stepper relays
- Solid state optically isolated
 Typically AC only
- Motor starters
 - Designed for high contact current
 - Designed to break inductive loads
- Mercury wetted contacts

– Use for signal level switching

Questions?