Comparator-based RF Switch

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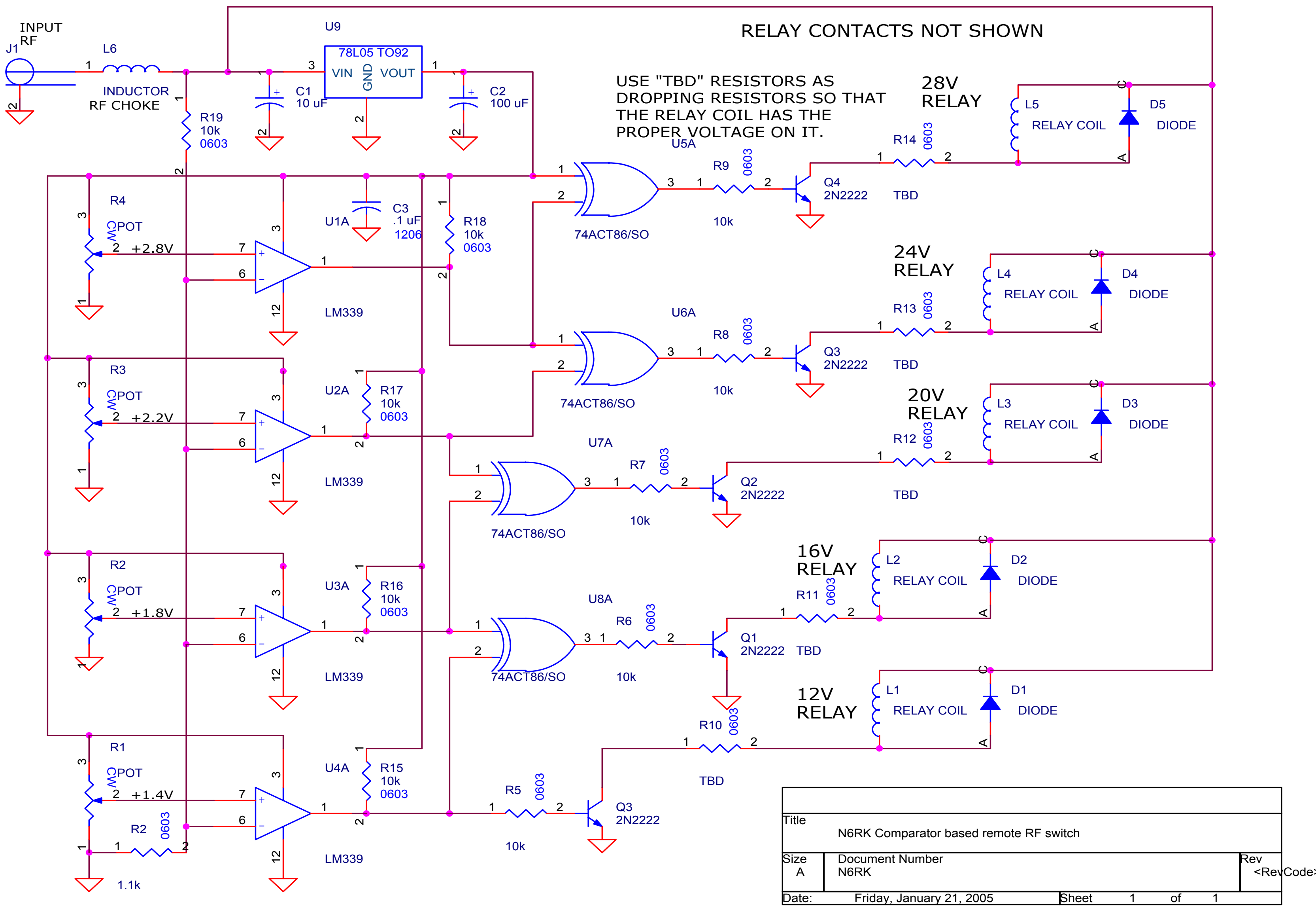
This is a concept paper, not a constuction article. There are too many variables to propose a one size fits all design. However, this paper should give you the basic idea how to do it. There are, of course, many variations on how this could be done, so do what makes sense in your own situation. Lots of comparators will work, and lots of gates and transistors will work, so don't feel that you must copy me.

I designed this comparator based RF switch to control an array of 12 Beverage antennas. I didn't want to deal with control cables, so I send DC down the coax. The DC powers the switching relays, and the control logic. In the shack, a switch selects from a bunch of 3 terminal regulators and sends, for example, 12, 16, 20, 24 or 28V down the coax to select one of five relays respectively. The coax voltage comes in through an RF choke (L6) and a 5V regulator IC (U9). Thus the control logic runs on constant 5V, no matter what voltage is sent down the line. R19 and R2 attenuate the coax voltage by a factor of 10 and drive all the inverting comparator inputs on U1-U4. Pots R1, R2, R3, and R4 are set at 1.4, 1.8, 2.2, and 2.6 volts respectively, and drive the non-inverting inputs on U1, U2, U3, and U4 respectively. When the coax voltage is less than 14 volts, U1-4 are all "off" meaning the output current is zero and the output voltage is 5V. When the voltage is between 14 and 18 volts, U1 only is on. From 18 to 22 volts, U1 and U2 are on. From 22 to 26 volts, U1-U3 are on. Above 26 volts, U1-4 are all on. The structure described so far is a classical flash A/D converter front end. The output voltages of U1-4 form a so-called "thermometer code". At most, one of the exclusive OR gates will have differing inputs, and only it will go high. This will turn on one of the relays L2 through L5. Below 14 volts, none of the gates will be high, but U1 will be high, and turn on L1. Since the relays are running directly from the coax voltage, you need to put dropping resistors (denoted "TBD") in series with the coils so that the relay coil has the correct voltage when it is energized. For example, if the relays have 12 volt coils with 1K resistance, the "TBD" resistors would be R10=0, R11=333 ohms, R12 = 667 ohms, R13= 1000 ohms, and R14=1333 ohms. You need a lot of guard band voltage, in this case +/- 2V, to allow for the voltage drop through the coax. In particular installations, this may be overkill, or may be insufficient.

I have also cascaded these boxes; ie I pass through the DC coax voltage to another piece of coax that continues on pass the initial control box. There are lots of possibilities depending on your individual situation.



RELAY CONTACTS NOT SHOWN
USE "TBD" RESISTORS AS DROPPING RESISTORS SO THAT THE RELAY COIL HAS THE PROPER VOLTAGE ON IT.
INPUT RF
J1
L6
INDUCTOR RF CHOKE
U9
78L05 TO92
VIN
GND
VOUT
C1 10 uF
C2 100 uF
R19 10k 0603
C3 .1 uF 1206
R18 10k 0603
R17 10k 0603
R16 10k 0603
R15 10k 0603
R4 POT CW +2.8V
R3 POT CW +2.2V
R2 POT CW +1.8V
R1 POT CW +1.4V
R2 0603 1.1k
U1A LM339
U2A LM339
U3A LM339
U4A LM339
U5A 74ACT86/SO
U6A 74ACT86/SO
U7A 74ACT86/SO
U8A 74ACT86/SO
R9 0603 10k
R8 0603 10k
R7 0603 10k
R6 0603 10k
R5 0603 10k
Q4 2N2222
Q3 2N2222
Q2 2N2222
Q1 2N2222
Q3 2N2222
R14 0603 TBD
R13 0603 TBD
R12 0603 TBD
R11 0603 TBD
R10 0603 TBD
28V RELAY
24V RELAY
20V RELAY
16V RELAY
12V RELAY
L5 RELAY COIL
L4 RELAY COIL
L3 RELAY COIL
L2 RELAY COIL
L1 RELAY COIL
D5 DIODE
D4 DIODE
D3 DIODE
D2 DIODE
D1 DIODE
Title
N6RK Comparator based remote RF switch
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