COMMUNICATIONS CIRCUITS READY-REFERENCE

JOHN MARKUS

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Preface

Communications Circuits Ready-Reference is one of five books in the Ready-Reference series. These books are the product of cover-to-cover searching of back issues of U.S. and foreign electronics periodicals, the published literature of electronics manufacturers, and recent electronics books, together filling well over 100 feet of shelving. This same search would take weeks or even months at a large engineering library, plus the time required to write for manufacturer literature and locate elusive sources.

Each circuit has type numbers or values of all significant components, an identifying title, a concise description, performance data, and suggested applications. At the end of each description is a citation giving the title of the original article or book, its author, and the exact location of the circuit in the original source.

To find a desired circuit quickly, start with the alphabetically arranged table of contents at the front of the book. Note the chapters most likely to contain the desired type of circuit, and look in these first. If a quick scan does not locate the exact circuit desired, use the index at the back of the book. Here the circuits are indexed in depth under the different names by which they may be known. Cross-references in the index aid searching. The author index will often help find related circuits after one potentially useful circuit is found, because authors tend to specialize in certain circuits.

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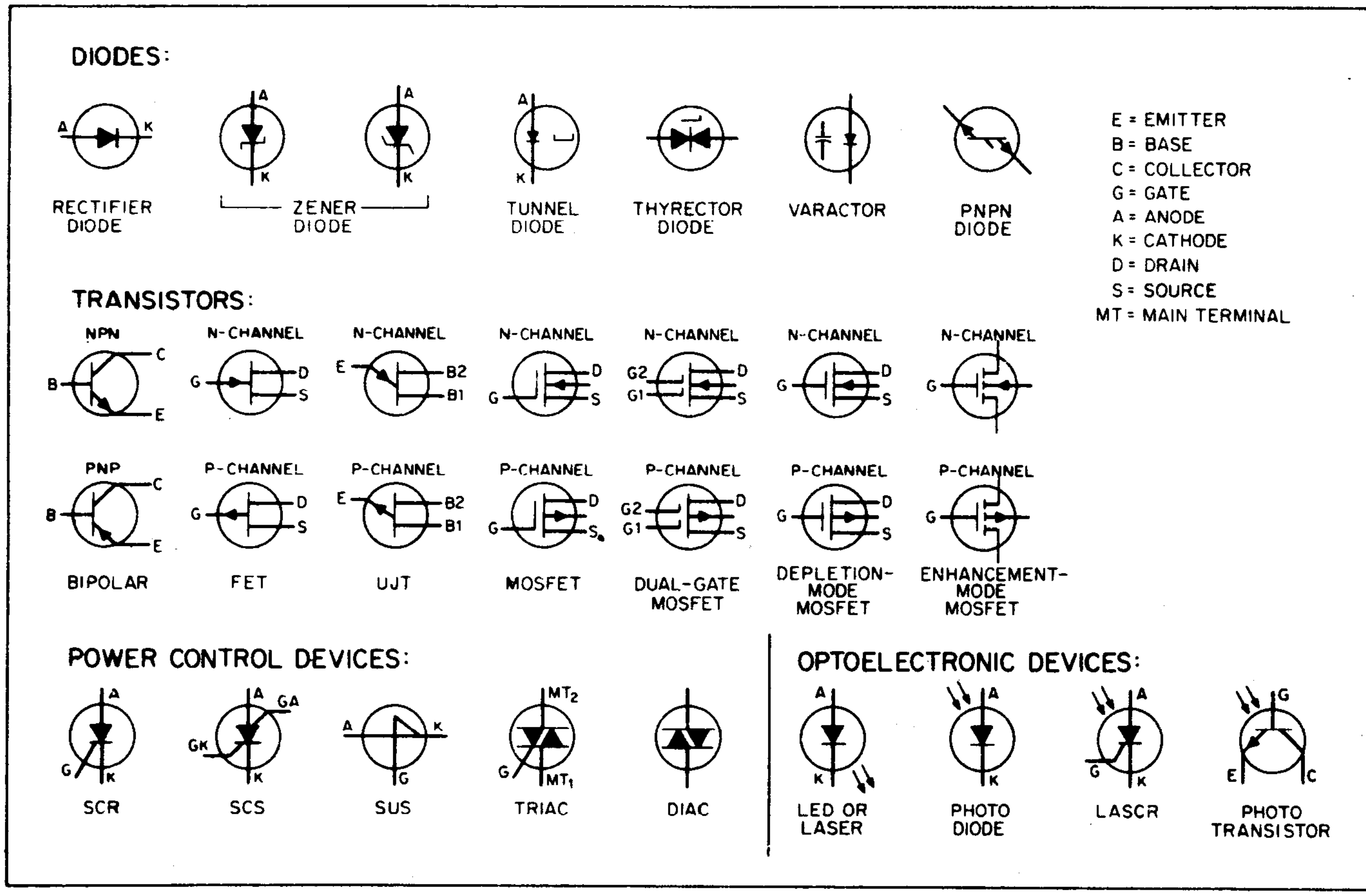
Semiconductor Symbols Used



The commonest forms of the basic semiconductor symbols are shown here. Leads are identified where appropriate, for convenient reference. Minor variations in symbols, particularly those from foreign sources, can be recognized by comparing with these symbols while noting positions and directions of solid arrows with respect to other symbol elements.

Omission of the circle around a symbol has no significance. Arrows are sometimes drawn open instead of solid. Thicker lines and open rectangles in some symbols on diagrams have no significance. Orientation of symbols is unimportant; artists choose the position that is most convenient for making connections to other parts of the circuit. Arrow lines outside optoelectronic symbols indicate the direction of light rays.

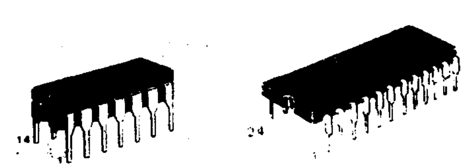
On some European diagrams, the position of the letter k gives the location of the decimal point for a resistor value in kilohms. Thus, 2k2 is 2.2K or 2,200 ohms. Similarly, a resistance of 1R5 is 1.5 ohms, 1M2 is 1.2 megohms, and 3n3 is 3.3 nanofarads.

Substitutions can often be made for semiconductor and IC types specified on diagrams. Newer components, not available when the original source article was published, may actually improve the performance of a particular circuit. Electrical characteristics, terminal connections, and such critical ratings as voltage, current, frequency, and duty cycle, must of course be taken into account if experimenting without referring to substitution guides.

Semiconductor, integrated-circuit, and tube substitution guides can usually be purchased at electronic parts supply stores.

Not all circuits give power connections and pin locations for ICs, but this information can be obtained from manufacturer data sheets. Alternatively, browsing through other circuits may turn up another circuit on which the desired connections are shown for the same IC.

When looking down at the top of an actual IC, numbering normally starts with 1 for the first pin *counterclockwise* from the notched or otherwise marked end and continues sequentially. The highest number is therefore next to the notch on the other side of the IC, as illustrated in the sketches below. (*Actual positions* of pins are rarely shown on schematic diagrams.)



Abbreviations Used

A	ampere
AC	alternating current
AC/DC	AC or DC
A/D	analog-to-digital
ADC	analog-to-digital converter
A/D, D/A	analog-to-digital, or digital-to-analog
ADP	automatic data processing
AF	audio frequency
AFC	automatic frequency control
AFSK	audio frequency-shift keying
AFT	automatic fine tuning
AGC	automatic gain control
Ah	ampere-hour
ALU	arithmetic-logic unit
AM	amplitude modulation
AM/FM	AM or FM
AND	type of logic circuit
AVC	automatic volume control
b	bit
BCD	binary-coded decimal
BFO	beat-frequency oscillator
b/s	bit per second
C	capacitance; capacitor
°C	degree Celsius; degree Centigrade
CATV	cable television
CB	citizens band
CCD	charge-coupled device
CCTV	closed-circuit television
cm	centimeter
CML	current-mode logic
CMOS	complementary MOS
CMR	common-mode rejection
CMRR	common-mode rejection ratio
cm^2	square centimeter
coax	coaxial cable
COHO	coherent oscillator
COR	carrier-operated relay
COS/MOS	complementary-symmetry MOS (same as CMOS)
CPU	central processing unit
CR	cathode ray
CRO	cathode-ray oscilloscope
CROM	control and read-only memory
CRT	cathode-ray tube
CT	center tap
CW	continuous wave
D/A	digital-to-analog
DAC	digital-to-analog converter
dB	decibel
dBC	C-scale sound level in decibels
dBm	decibels above 1 mW
dBV	decibels above 1 V
DC	direct current
DC/DC	DC to DC
DCTL	direct-coupled transistor logic
diac	diode AC switch
DIP	dual in-line package
DMA	direct memory access
DMM	digital multimeter
DPDT	double-pole double-throw
DPM	digital panel meter
DPST	double-pole single-throw
DSB	double sideband
DTL	diode-transistor logic
DTL/TTL	DTL or TTL
DUT	device under test
DVM	digital voltmeter
DX	distance reception; distant
EAROM	electrically alterable ROM
EBCDIC	extended binary-coded decimal interchange code
ECG	electrocardiograph
ECL	emitter-coupled logic
EDP	electronic data processing
EKG	electrocardiograph
EMF	electromotive force
EMI	electromagnetic interference
EPROM	erasable PROM
ERP	effective radiated power
ETV	educational television
eV	electronvolt
EVR	electronic video recording
EXCLUSIVE-OR	type of logic circuit
EXCLUSIVE-NOR	type of logic circuit
F	farad
°F	degree Fahrenheit
FET	field-effect transistor
FIFO	first-in first-out
FM	frequency modulation
4PDT	four-pole double-throw
4PST	four-pole single-throw
FS	full scale
FSK	frequency-shift keying
ft	foot
ft/min	foot per minute
ft/s	foot per second
ft^2	square foot
F/V	frequency-to-voltage
F/V, V/F	frequency-to-voltage, or voltage-to-frequency
G	giga- (10^9)
GHz	gigahertz
G-M tube	Geiger-Mueller tube
h	hour
H	henry
HF	high frequency
HFO	high-frequency oscillator
hp	horsepower
Hz	hertz
IC	integrated circuit
IF	intermediate frequency
IGFET	insulated-gate FET
IMD	intermodulation distortion
IMPATT	impact avalanche transit time
in	inch
in/s	inch per second
in^2	square inch
I/O	input/output
IR	infrared
JFET	junction FET
k	kilo- (10^3)
K	kilohm (1,000 ohms); kelvin
kA	kiloampere
kb	kilobit
keV	kiloelectronvolt
kH	kilohenry
kHz	kilohertz
km	kilometer
kV	kilovolt
kVA	kilovoltampere
kW	kilowatt
kWh	kilowatthour
L	inductance; inductor
LASCR	light-activated SCR

LASCS	light-activated SCS
LC	inductance-capacitance
LCD	liquid crystal display
LDR	light-dependent resistor
LED	light-emitting diode
LF	low frequency
LIFO	last-in first-out
lm	lumen
LO	local oscillator
logamp	logarithmic amplifier
LP	long play
LSB	least significant bit
LSI	large-scale integration
m	meter; milli- (10^{-3})
M	mega- (10^{6}); meter (instrument); motor
mA	milliampere
Mb	megabit
MF	medium frequency
mH	millihenry
MHD	magnetohydrodynamics
MHz	megahertz
mi	mile
mike	microphone
min	minute
mm	millimeter
modem	modulator-demodulator
mono	monostable
MOS	metal-oxide semiconductor
MOSFET	metal-oxide semiconductor FET
MOST	metal-oxide semiconductor transistor
MPU	microprocessing unit
ms	millisecond
MSB	most significant bit
MSI	medium-scale integration
m^2	square meter
μ	micro- (10^{-6})
μA	microampere
μF	microfarad
μH	microhenry
μm	micrometer
μP	microprocessor
μs	microsecond
μV	microvolt
μW	microwatt
mV	millivolt
MVBR	multivibrator
mW	milliwatt
n	nano- (10^{-9})
N	negative
nA	nanoampere
NAB	National Association of Broadcasters
NAND	type of logic circuit
nF	nanofarad
nH	nanohenry
NMOS	N-channel MOS
NOR	type of logic circuit
NPN	negative-positive-negative
NPNP	negative-positive-negative-positive
NRZ	nonreturn-to-zero
NRZI	nonreturn-to-zero-inverted
ns	nanosecond
NTSC	National Television System Committee
nV	nanovolt
nW	nanowatt
OEM	original equipment manufacturer
opamp	operational amplifier
OR	type of logic circuit
p	pico- (10^{-12})
P	peak; positive
pA	picoampere
PA	public address
PAL	phase-alternation line
PAM	pulse-amplitude modulation
PC	printed circuit
PCM	pulse-code modulation
PDM	pulse-duration modulation
PEP	peak envelope power
pF	picofarad
PF	power factor
phono	phonograph
PIN	positive-intrinsic-negative
PIV	peak inverse voltage
PLL	phase-locked loop
PM	permanent magnet; phase modulation
PMOS	P-channel MOS
PN	positive-negative
PNP	positive-negative-positive
PNPN	positive-negative-positive-negative
pot	potentiometer
P-P	peak-to-peak
PPI	plan-position indicator
PPM	parts per million; pulse-position modulation
preamp	preamplifier
PRF	pulse repetition frequency
PROM	programmable ROM
PRR	pulse repetition rate
ps	picosecond
PSK	phase-shift keying
PTT	push to talk
PUT	programmable UJT
pW	picowatt
PWM	pulse-width modulation
Q	quality factor
QRP	low-power amateur radio
R	resistance; resistor
RAM	random-access memory
RC	resistance-capacitance
RF	radio frequency
RFI	radio-frequency interference
RGB	red/green/blue
RIAA	Recording Industry Association of America
RLC	resistance-inductance-capacitance
RMS	root-mean-square
ROM	read-only memory
rpm	revolution per minute
RTL	resistor-transistor logic
RTTY	radioteletype
RZ	return-to-zero
s	second
SAR	successive-approximation register
SAW	surface acoustic wave
SCA	Subsidiary Communications Authorization
scope	oscilloscope
SCR	silicon controlled rectifier
SCS	silicon controlled switch
S-meter	signal-strength meter
S/N	signal-to-noise
SNR	signal-to-noise ratio
SPDT	single-pole double-throw
SPST	single-pole single-throw
SSB	single sideband
SSI	small-scale integration
SSTV	slow-scan television
SW	shortwave
SWL	shortwave listener
SWR	standing-wave ratio
sync	synchronizing
T	tera- (10^{12})
TC	temperature coefficient
THD	total harmonic distortion
TR	transmit-receive
TRF	tuned radio frequency
triac	triode AC semiconductor switch
TTL	transistor-transistor logic

TTY	teletypewriter
TV	television
TVI	television interference
TVT	television typewriter
TWX	teletypewriter exchange service
UART	universal asynchronous receiver-transmitter
UHF	ultrahigh frequency
UJT	unijunction transistor
UPC	universal product code
UPS	uninterruptible power system
V	volt
VA	voltampere
VAC	volts AC
VCO	voltage-controlled oscillator
VDC	volts DC
V/F	voltage-to-frequency
VFO	variable-frequency oscillator
VHF	very high frequency
VLF	very low frequency
VMOS	vertical metal-oxide semiconductor
VOM	volt-ohm-milliammeter
VOX	voice-operated transmission
VRMS	volts RMS
VSWR	voltage standing-wave ratio
VTR	videotape recording
VTVM	vacuum-tube voltmeter
VU	volume unit
VVC	voltage-variable capacitor
VXO	variable-frequency crystal oscillator
W	watt
Wh	watthour
WPM	words per minute
WRMS	watts RMS
Ws	wattsecond
Z	impedance

Abbreviations on Diagrams. Some foreign publications, including *Wireless World,* shorten the abbreviations for units of measure on diagrams. Thus, μ after a capacitor value represents μF, n is nF, and p is pF. With resistor values, k is thousand ohms, M is megohms, and absence of a unit of measure is ohms. For a decimal value, the letter for the unit of measure is sometimes placed at the location of the decimal point. Thus, 3k3 is 3.3 kilohms or 3,300 ohms, 2M2 is 2.2 megohms, 4μ7 is 4.7 μF, 0μ1 is 0.1 μF, and 4n7 is 4.7 nF.

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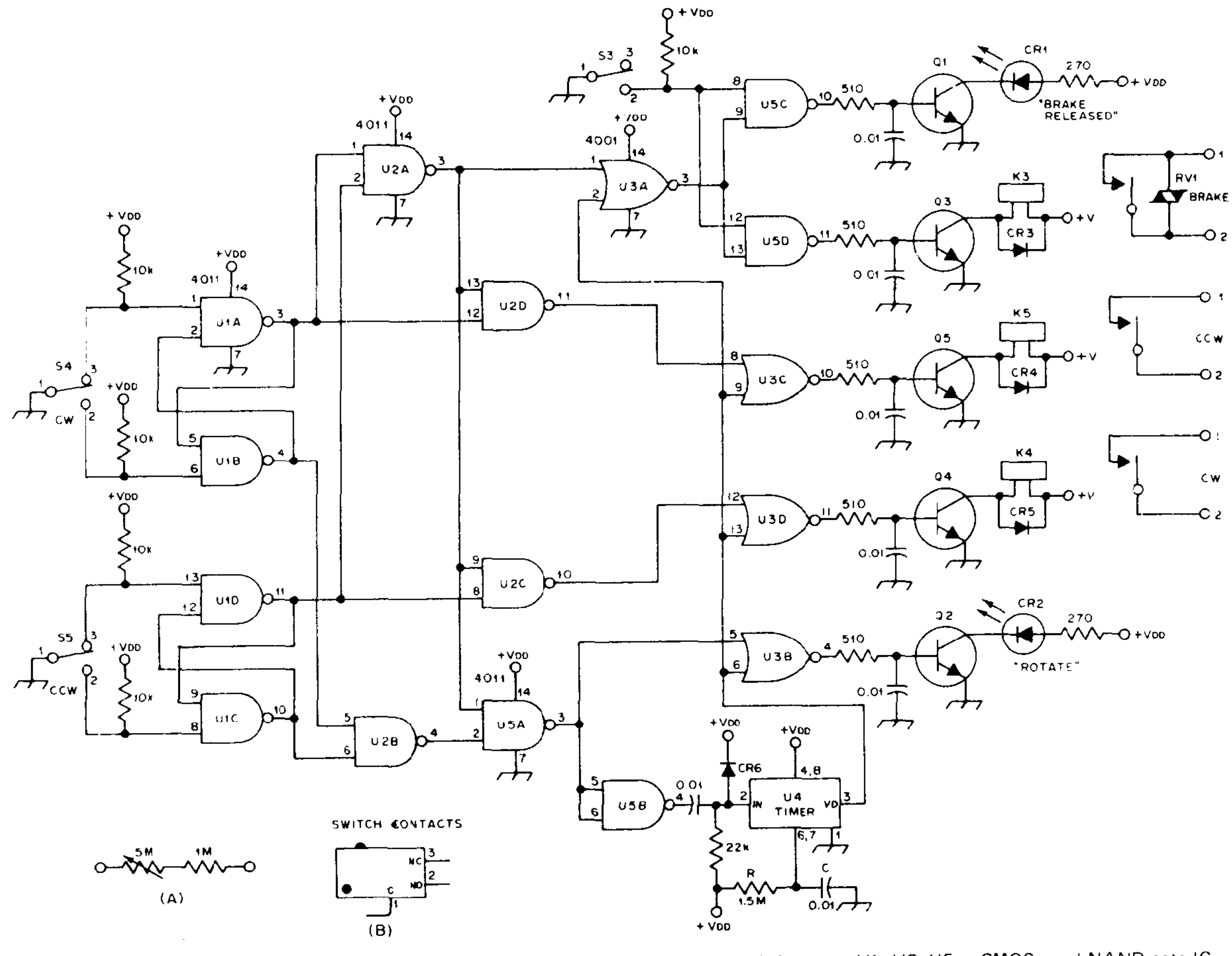
Contents

CHAPTER 1
Antenna Circuits

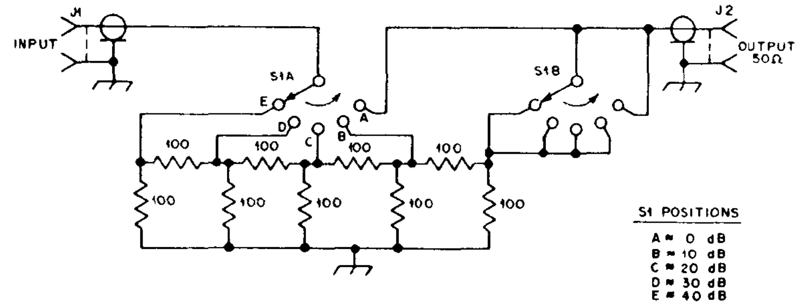
Includes circuits for measuring and adjusting VSWR, field strength, earth conductivity for grounds, and impedance, as well as antenna motor controls, radio direction finders, sferics receiver, active antennas, RF attenuators, remote antenna switching systems, RF magnetometer, and far-field signal sources for tuning beam antennas. See also Receiver, Transceiver, and Transmitter chapters.

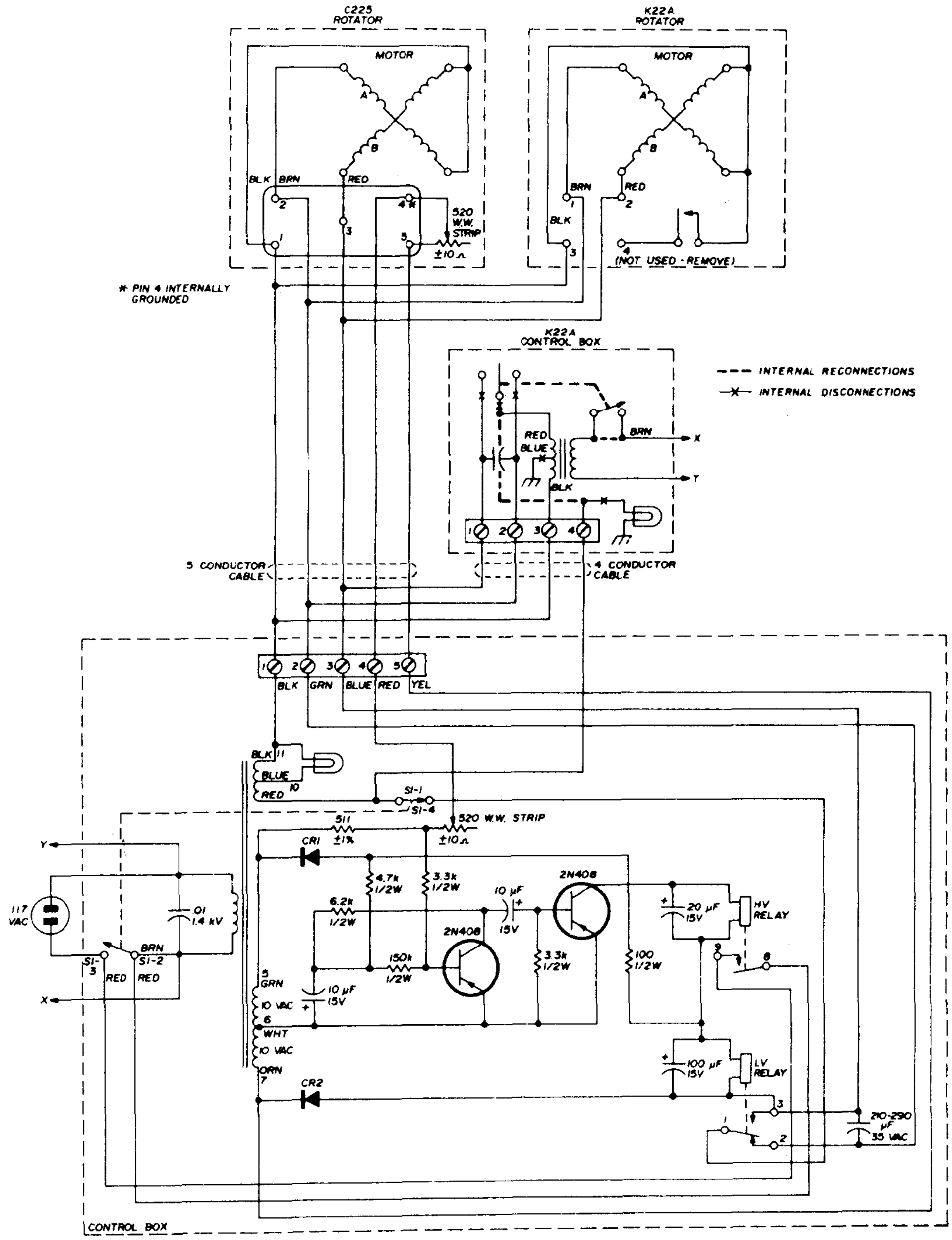


CR1, CR2 – Light-emitting diode, Motorola type MLED600 or equiv.
CR3-CR6, incl. – Silicon signal diode, 1N914 or equiv.
K3-K5, incl. – Switching relay, 12 V dc, 1200 ohms, 10 mA; contact rating 1 A; 125 V ac; Radio Shack 275-003 or equiv.
Q1-Q5, incl. – Silicon npn transistor, 2N3904 or equiv.
RV1 – Varistor, GE 750 or equiv.
U1, U2, U5 – CMOS quad NAND-gate IC, RCA CD-4011A or equiv.
U3 – CMOS quad NOR-gate IC, RCA CD-4001A, or equiv.
U4 – Timer IC, 555 or equiv.

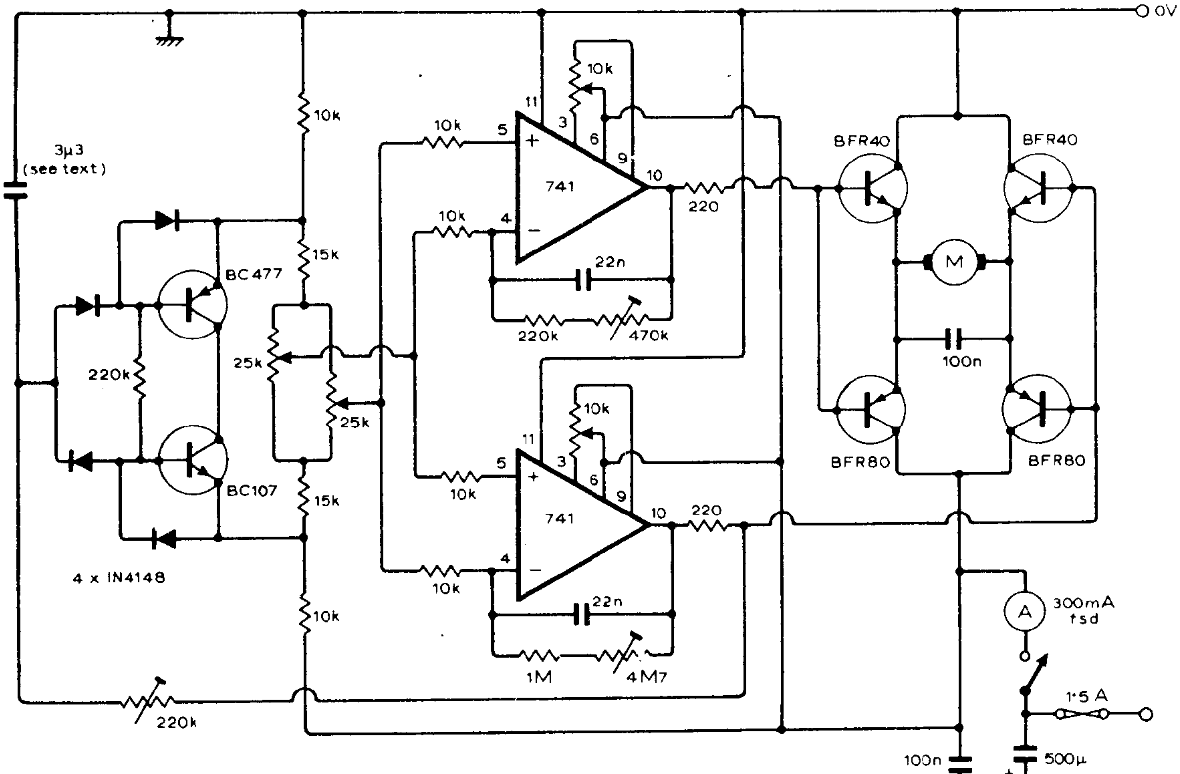
DELAYED BRAKE—Protects antenna rotator on high tower from damage by delaying brake action automatically after rotation and by disabling direction-selector switches so antenna system coasts to stop before rotation can begin in other direction. For about 3-s delay in timer U4, use 2.2 megohms for R and 1 μF for C instead of values shown. RV1 is commonly listed as V150LA20A by GE. S3-S5 are original brake release and direction switches in CDE Ham-II rotor system. Article covers construction and installation, including modifications needed in control unit.—A. B. White, A Delayed Brake Release for the Ham-II, *QST*, Aug. 1977, p 14–16.

LADDER ATTENUATOR—Inserted in series with receiving antenna to provide 5 steps of attenuation for comparing performance of antennas or preamps. Resistors are ¼-W composition with 5% tolerance.—D. DeMaw, What Does My S-Meter Tell Me?, *QST*, June 1977, p 40–42.

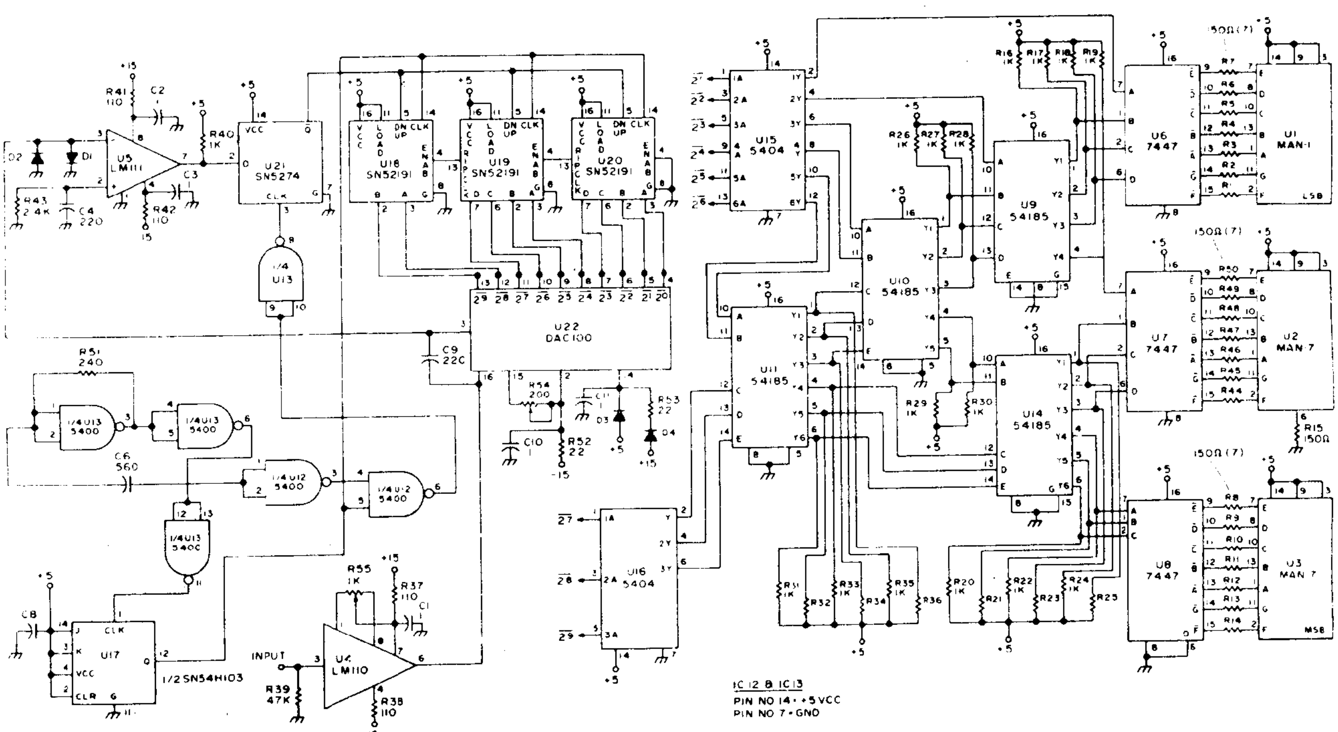




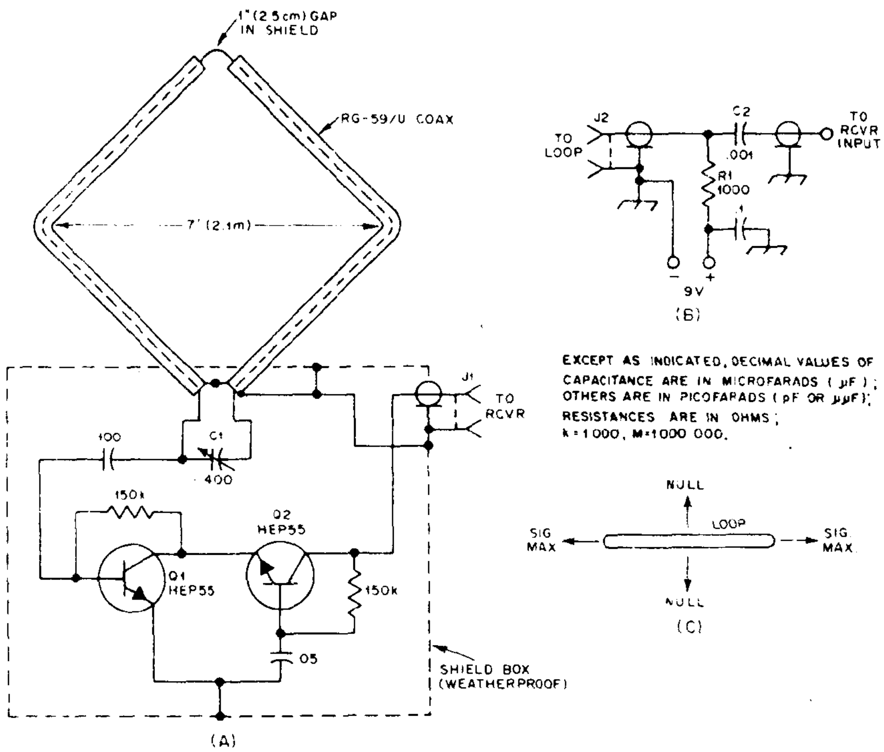
TWO-ROTATOR CONTROL—Low-cost Alliance C-225 TV antenna rotator and Alliance K22A rotator with control box are used with single transistorized-bridge control circuit. Rotators operate in tandem on same shaft to provide double torque for handling medium-size 20-meter amateur radio antennas. One arm of bridge is 520-ohm wirewound pot in which wiper position is proportional to heading. Article covers wiring and bench-testing of rotators.—F. E. Gehrke, Antenna Rotator for Medium-Sized Beams, *Ham Radio*, May 1976, p 48–51.



ANTENNA ROTATOR—Two-opamp Wheatstone bridge provides positive and negative error signals to give proportional control for 24-VDC motor used for remote positioning of antenna. Circuit will operate with supply ranging from 15 to 28 VDC. Offset null controls for opamps use 10K pots. Article describes operation and adjustment of circuit in detail. —D. J. Telfer, An Aerial Rotator Servo, *Wireless World*, April 1975, p 177–181.

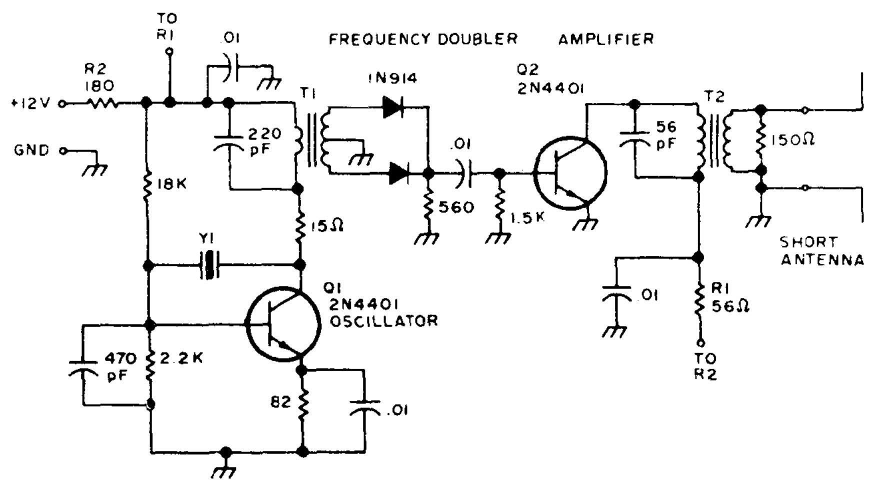


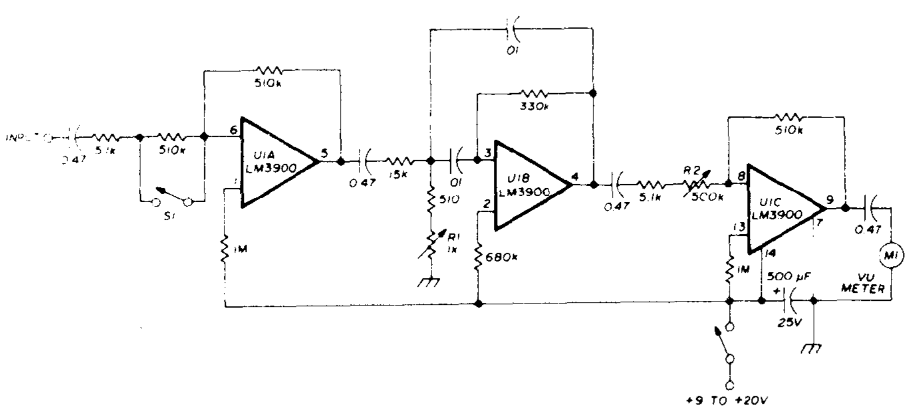
DVM FOR SWR—Converts voltage output from analog computer to drive for 3-digit LED display of standing-wave ratio. Circuit uses Precision Monolithics D/A converter A1MDAC-100CC-Q1. Requires regulated 5-VDC logic supply at 1 A for digital display, along with ±15 V supplies for logic. Article gives alignment procedure. Accuracy of digital reading is better than 0.1% over 0-8 V range.—T. Mayhugh, The Automatic SWR Computer, *73 Magazine*, Dec. 1974, p 86–87.



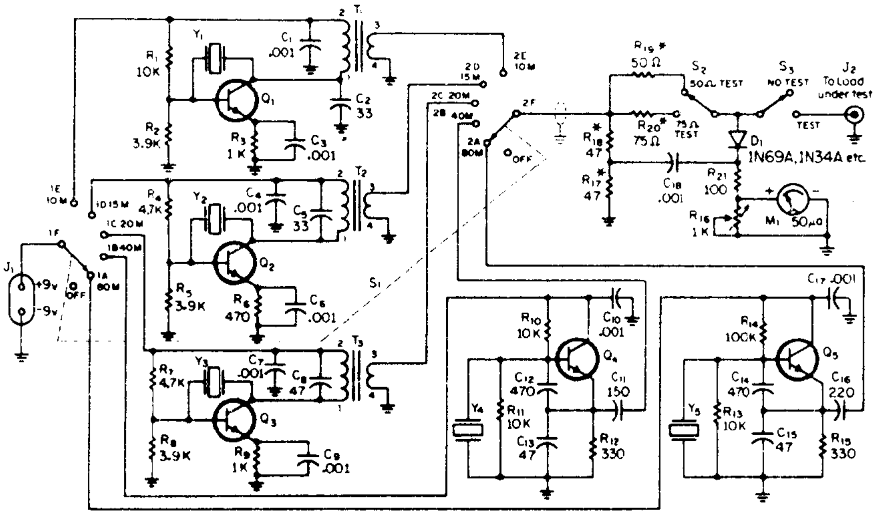
160-METER LOOP-PREAMP—Shielded 5-foot square loop and single preamp pull signals out of noise when propagation conditions make other antennas unsatisfactory. Operating voltage is supplied through coax feeder. R1 isolates signal energy from ground, and C2 keeps DC voltage out of receiver input. Nulls are off broad side of loop.—B. Boothe, Weak-Signal Reception on 160—Some Antenna Notes, *QST,* June 1977, p 35–39.

FAR-FIELD TRANSMITTER—Provides far-field signal source for tuning Yagi and other beam antennas used on amateur radio frequencies. Q1 is Pierce oscillator operating in fundamental mode of 7.06-MHz crystal to permit field-strength measurements at 14.12, 21.18, and 28.24 MHz for 20-, 15-, and 10-meter bands. Antenna uses two 5-foot lengths of wire connected as dipole. T1 is Amidon core T50-2 with 22 turns on primary and 20 turns center-tapped on secondary. T2 is same core with 22-turn primary and 5-turn secondary.—G. Hinkle, Closed Loop Antenna Tuning, *73 Magazine,* May 1976, p 32–33.



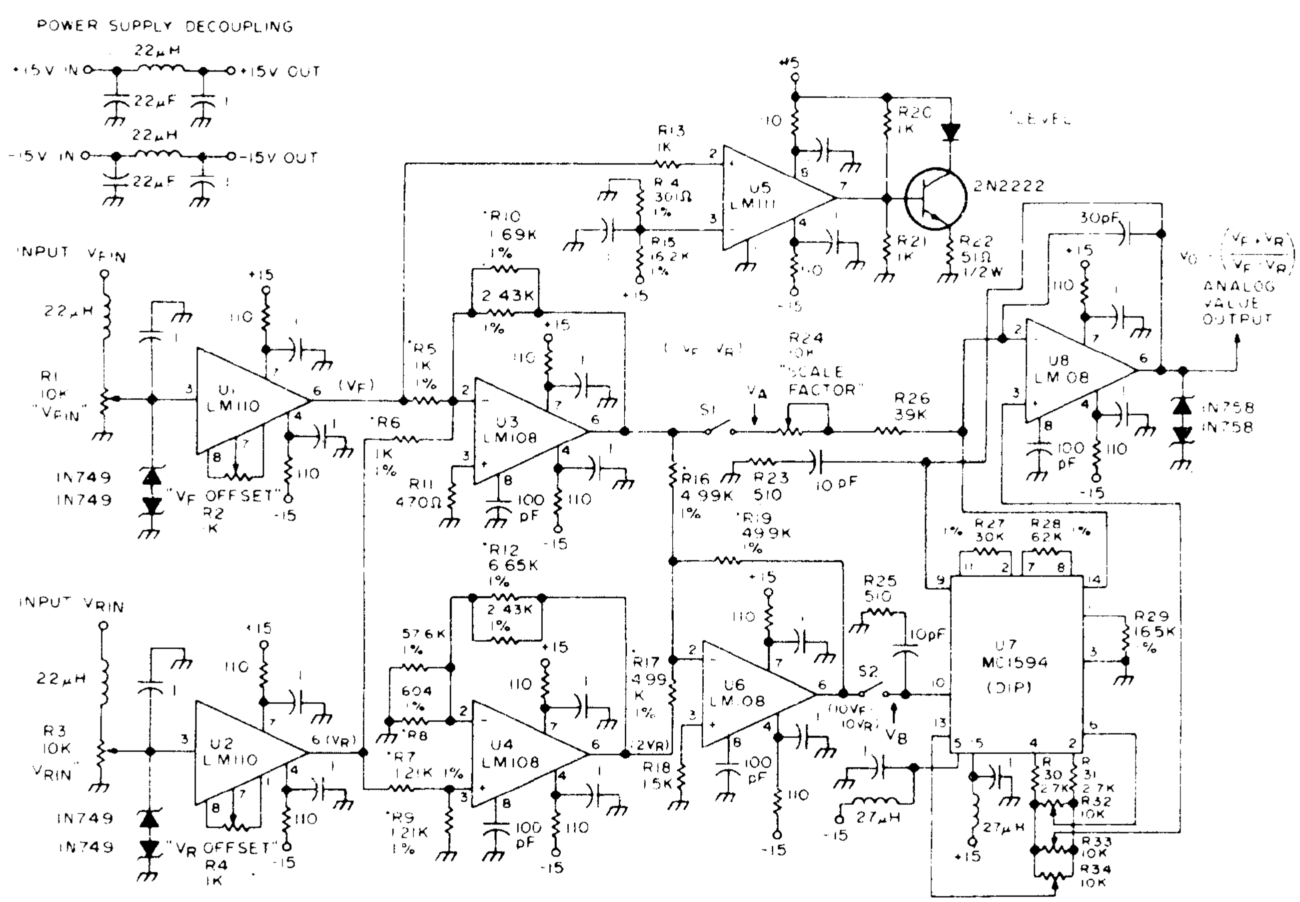


VSWR METER—Simple, easily transported VSWR meter consists of high-gain amplifier, narrow-bandwidth (100-Hz) selective amplifier tuned to 1000 Hz, and variable-gain output amplifier driving low-cost VU meter. Ideal for nulling-type VSWR measurements. Draws only about 6 mA from 9-V transistor battery. Closing S1 increases gain about 100 times for low-level readings. R1 sets U1B to 1000 Hz, while R2 sets reference on VU meter.—J. Reisert, Matching Techniques for VHF/UHF Antennas, *Ham Radio,* July 1976, p 50–56.

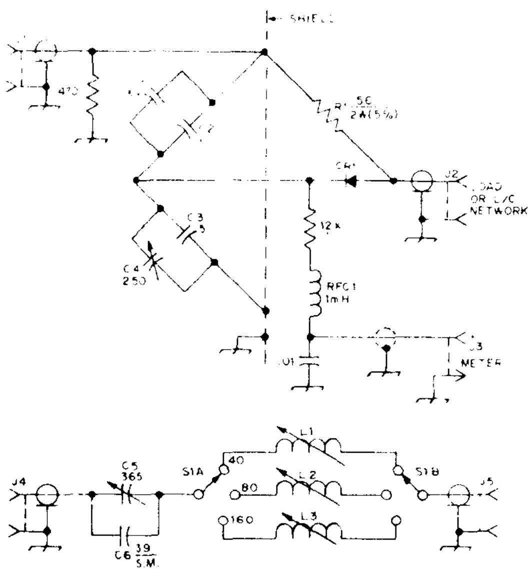


SELF-EXCITED SWR BRIDGE—Portable bridge has built-in signal sources for each band from 80 through 10 meters, for tuning antenna on tower before transmission line is connected. Oscillators are crystal controlled at desired antenna tune-up frequencies. Separate oscillators for each band simplify switching problems, so only supply voltage from J_1 and oscillator outputs to meter circuit need be switched. Current drain from 9-V battery is maximum of 12 mA. R_{17} and R_{18} should be closely matched, while R_{19} and R_{20} should have 5% tolerance.—T. P. Hulick, An S.W.R. Bridge with a Built-In 80 Through 10 Meter Signal Source, *CQ*, June 1971, p 64–66, 68, and 99.

Q_1-Q_5—RCA 40245.
S_1—2 pole 6 position subminiature rotary switch. (Centerlab PA-2005).
S_2—S.p.d.t. slide switch.
S_3—S.p.s.t. slide switch.
T_1—Pri.: 11 t. #36 e. Sec.: 3 t. #36 e. on Indiana General CF-101 Q2 toroid.
T_2—Pri.: 16 t. #36 e. Sec.: 4 t. #36 e. Same core as T_1.
T_3—Pri.: 20 t. #36 e. Sec.: 5 t. #36 e. Same core as T_1.
Y_1, Y_2, Y_3—Overtone crystals for 10, 15 and 20 meter bands respectively. HC-6U holders.
Y_4, Y_5—40 and 80 meter crystals respectively in HC-6U holders.

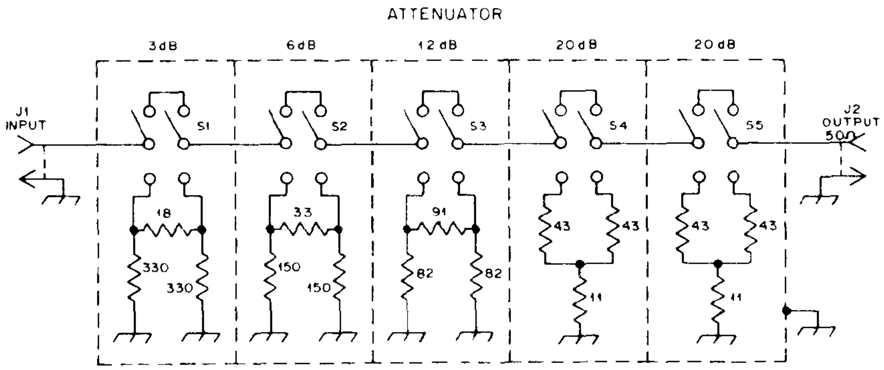


SWR COMPUTER—Automatically computes standing-wave ratio in 50-ohm coax feeding antenna and delivers analog voltage for driving meter or digital display. Inputs are forward (V_{FIN}) and reverse (V_{RIN}) voltages as conventionally measured for SWR checks. Requires regulated ±15 VDC supply at 40 mA. Article gives construction details and covers adjustment of critical resistors during alignment.—T. Mayhugh, A Digital SWR Computer!, *73 Magazine*, Nov. 1974, p 80–82, 84, and 86.

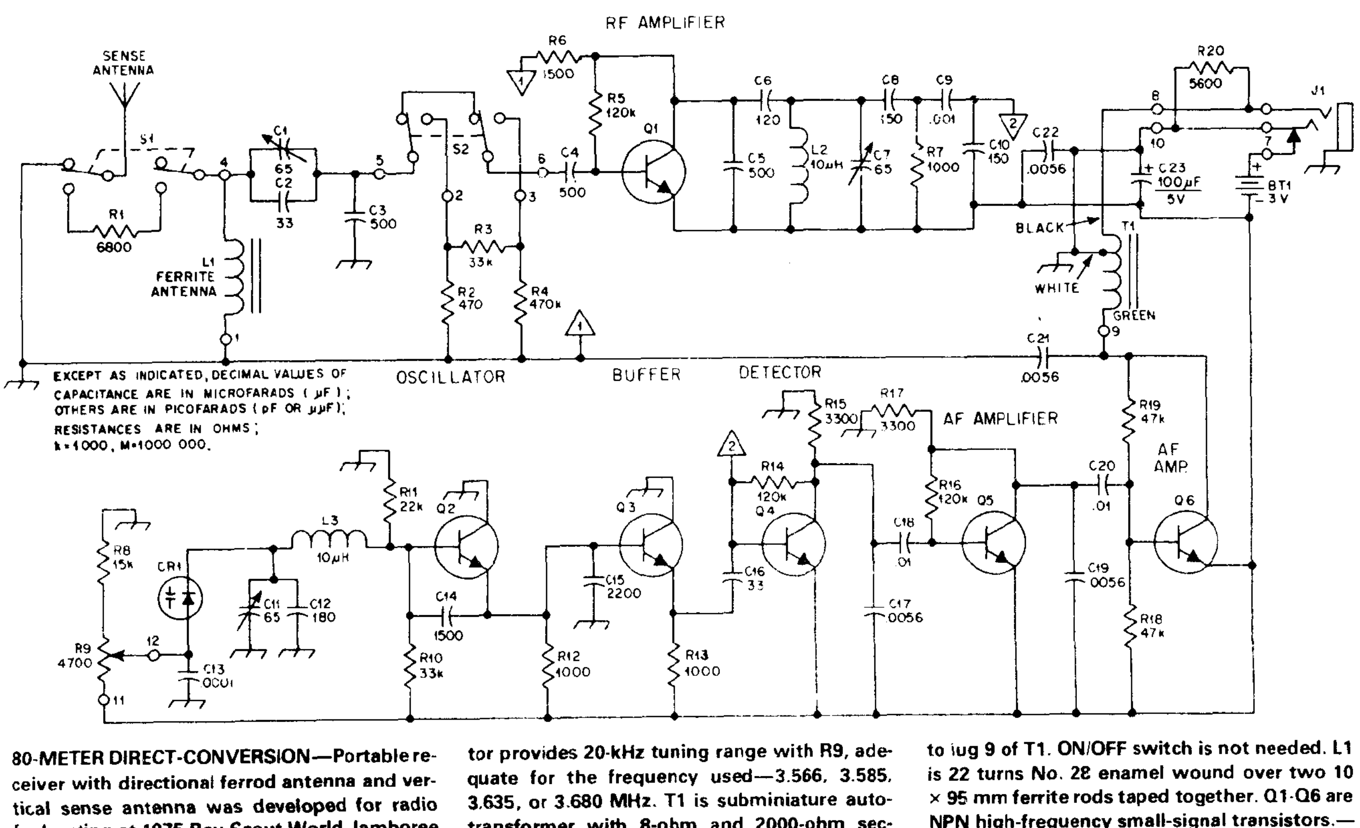


C1, C2 — 39- and 10-pF silver micas in parallel.
C3 — 5-pF silver mica.
C4 — 250-pF straight-line-wavelength variable (Hammarlund MC-250M).
C5 — 365-pF miniature variable (Archer-Allied 695-1000).
CR1 — Germanium diode.
J1, J2, J4, J5 — Coaxial receptacle.
J3 — Phono jack.
L1 — 15 turns No. 24 enamel close-wound on Miller 66A022-6 form (purple slug).
L2 — 30 turns like L1.
L3 — 63 turns like L1, but scramble-wound.
S1 — 2-pole 3-position wafer switch.

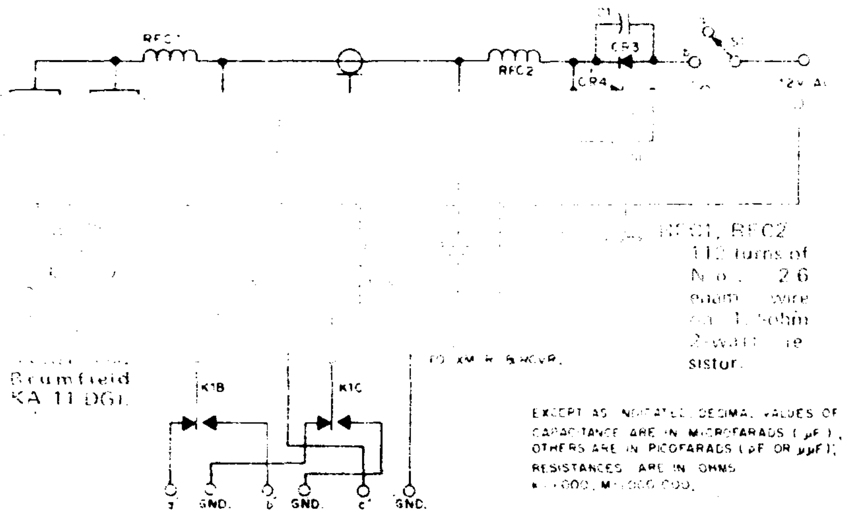
RF BRIDGE FOR COAX—Simplifies adjustment of vertical antenna for 40, 80, and 160 meters. S1 in add-on LC unit switches coil for desired band. Values of C1-C4 and standard resistor R1 give range of 10 to 150 ohms for measurement of radiation resistance. Meter can be from 50 to 200 μA full scale if 500 mW of power is available as signal source. For shorter-wavelength bands, change resistance in parallel with J1 to 5600 ohms and omit C6. L1 for 10 meters should then have 3½ turns No. 18 spaced to occupy ¼ inch on Miller 4200 coil form. L2 (15 meters) is 6 turns No. 16 enamel closewound on similar form. L3 (20 meters) is 11 turns No. 14 enamel on Miller 66A022-6 form.—J. Sevick, Simple RF Bridges, *QST*, April 1975, p 11–16 and 41.

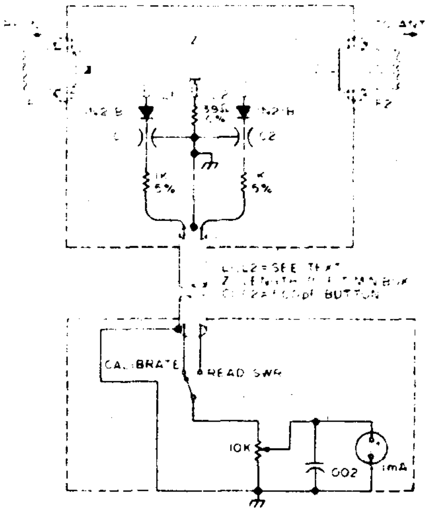


5-STEP ATTENUATOR—Applications include comparing performance of various receiving antennas and measuring gain of preamp used ahead of receiver. Dashed lines represent required shield partitions. All resistors are ¼-W composition with 5% tolerance.—D. DeMaw, What Does My S-Meter Tell Me?, *QST*, June 1977, p 40–42.



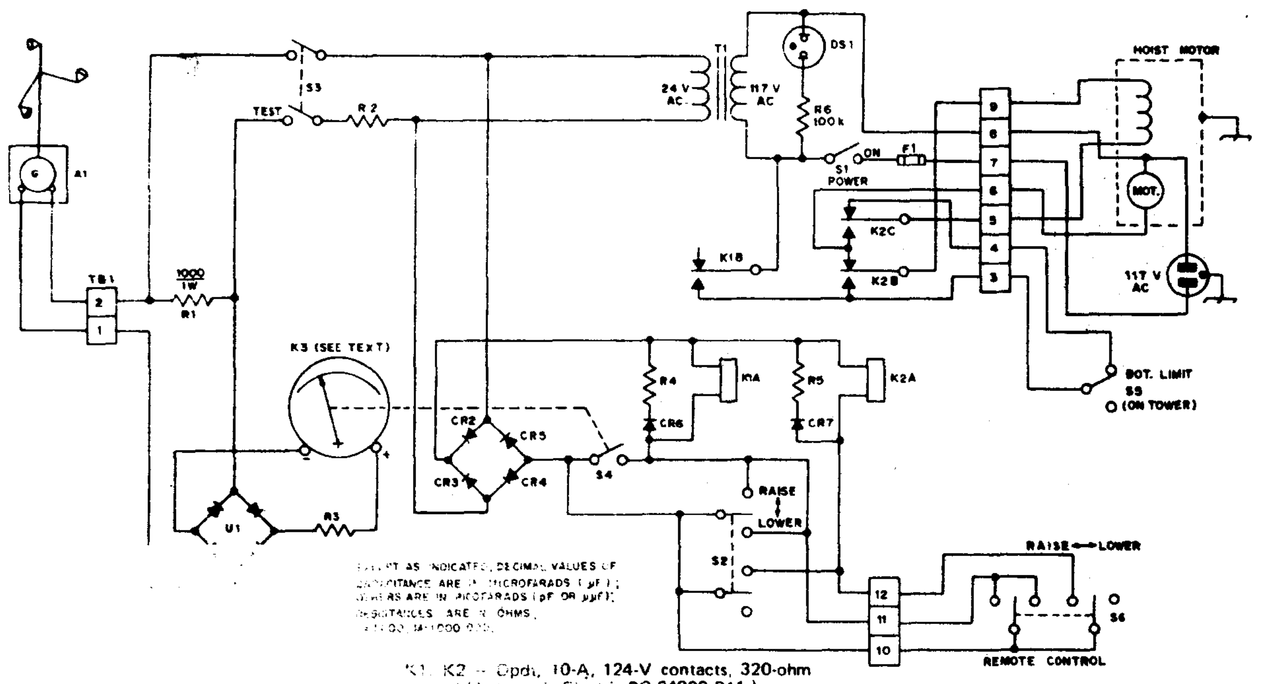
80-METER DIRECT-CONVERSION—Portable receiver with directional ferrod antenna and vertical sense antenna was developed for radio foxhunting at 1975 Boy Scout World Jamboree in Norway, in competitions for locating four low-power crystal-controlled transmitters hidden along 4-km course. Varactor-tuned oscillator provides 20-kHz tuning range with R9, adequate for the frequency used—3.566, 3.585, 3.635, or 3.680 MHz. T1 is subminiature autotransformer with 8-ohm and 2000-ohm sections, for 8-ohm headphones. For high-impedance headphones, connect headphone jack J1 to lug 9 of T1. ON/OFF switch is not needed. L1 is 22 turns No. 28 enamel wound over two 10 × 95 mm ferrite rods taped together. Q1-Q6 are NPN high-frequency small-signal transistors.—N. K. Holter, Radio Foxhunting in Europe, *QST*, Nov. 1976, p 43–46.





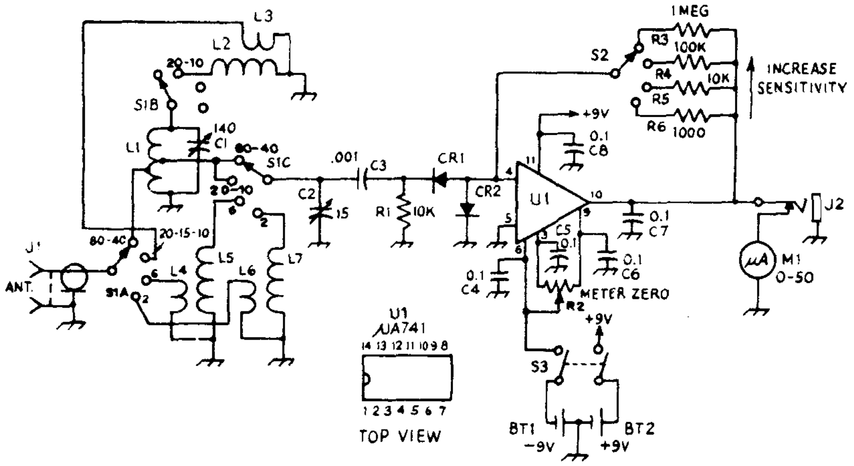
3-ANTENNA REMOTE SWITCHING—Single RF feed line serves for feeding transmitter power to tower and selecting desired one of three antennas. With S1 at a, neither K1 nor K2 is energized. RF energy then passes through cable to antenna terminals a' and GND. In position b, positive half-waves from 12-VAC supply operate relay K1 through CR1 and CR3, so antenna b' is energized. With S1 at c, K2 is energized through CR4 and CR2 for feeding c'.—U. H. Lammers, A Remote Antenna Switch, *QST*, Aug. 1974, p 41–43.

SWR TO 500 MHz—Permits measuring standing-wave ratio well above limits of many inexpensive indicators. For transmitters up to 2 W, coupling loop L1-L2 can be about 1 inch long. For high-power transmitters, loop length can be reduced to about ½ inch.—W. E. Parker, UHF SWR Indicator, *73 Magazine*, June 1977, p 68–70.



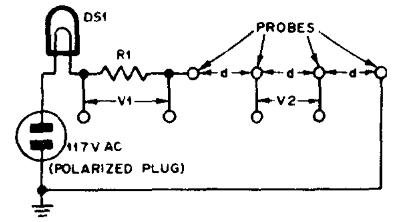
K1, K2 – Dpdt, 10-A, 124-V contacts, 320-ohm coil (Automatic Electric PG 24809-B11.)
K3 – Meter relay, 100 μA (Weston No. S46707).
R2, R3 – Approximately 12,000 ohm, 1-watt; see text.
S1 – Spst (JBT No. MS-35058-22).
S6 – Dpdt center off (JBT. No. 35059-27).
S2 – Dpdt normally off (JBT No. MS-35059-30).
S4 – Part of K3.
S5 – Spdt, bottom limit switch (Microswitch No. BZE6-2RN).
T1 – 117-V primary, 24-v secondary, 300 mA
U1 – Bridge rectifier assembly (Bradley Labs. No. CO14E4F).

WIND-ACTIVATED CONTROL—Anemometer feeding meter relay energizes control relay for antenna-tower hoist motor, to lower tower automatically when wind exceeds preset safe speed and raise it again when wind drops well below danger level. When only K1 is energized, motor rotates in tower-lowering direction. When K1 and motor-reversing relay K2 are both energized, motor reverses and raises tower.—J. Bernstein, The Tower-Guard System, *QST*, Dec. 1974, p 25–28.



C1 – 140-pF variable.
C2 – 15-pF variable.
CR1, CR2 – 1N914 or equiv.
L1 – 34 turns No. 24 enam. wound on an Amidon T-68-2 core, tapped 4 turns from ground end.
L2 – 12 turns No. 24 enam. wound on T-68-2 core.
L3 – 2 turns No. 24 wound at ground end of L2.
L4 – 1 turn No. 26 enam. wound at ground end of L5.
L5 – 12 turns No. 26 enam. wound on T-25-12 core.
L6 – 1 turn No. 26 enam.
L7 – 1 turn No. 18 enam. wound on T-25-12 core.
M1 – 50 or 100 µA dc.
R2 – 10,000-ohm control, linear taper.
S1 – Rotary switch, 3 poles, 5 positions, 3 sections.
S2 – Rotary switch, 1 pole, 4 positions.
S3 – Dpst Toggle.
U1 – µA741.

LINEAR FIELD-STRENGTH METER—Has sufficient sensitivity for checking antenna patterns and gain while positioned many wavelengths from antenna. Can be used remotely by connecting external meter at J2. L1 is tuned by C1 for 80 or 40 meters. For 20, 15, or 10 meters, L2 is switched in parallel with L1. L5 and C2 cover about 40 to 60 MHz, while L7 and C2 cover 130 to 180 MHz. Band-switched circuits avoid use of plug-in inductors. At most sensitive setting of S2, M1 will detect signals from pickup antenna as weak as 100 µV.—L. McCoy, A Linear Field-Strength Meter, *QST*, Jan. 1973, p 18–20 and 35.

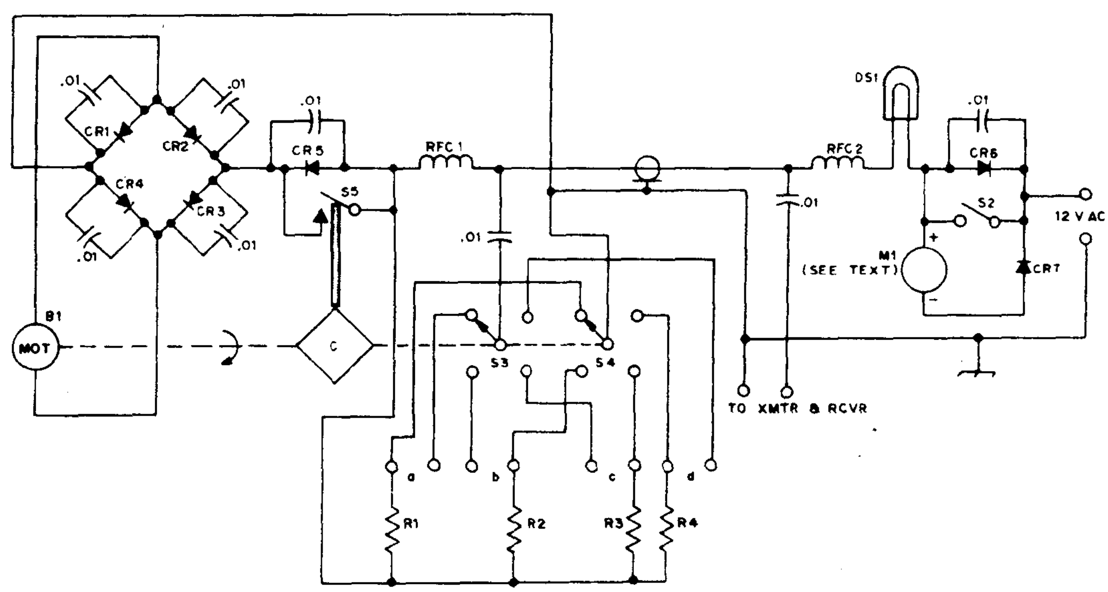


DS1 — 100-watt light bulb.
R1 — 14.6 ohms (5 watt).
Probes — 5/8-inch dia (iron or copper); spacing, d = 18 inches; penetration depth, D = 12 inches.

$$\text{Earth conductivity} = (21) \times \frac{V1}{V2}$$

(millimhos/meter).

EARTH CONDUCTIVITY—Simple AC measurement technique gives 25% accuracy, adequate for siting amateur radio antennas and designing radial ground systems. Measured values will range from 1 to 5 millimhos per meter for poor soil, 10–15 for average soil or fresh water, 100 for very good soil, and 5000 for salt water.—J. Sevick, Short Ground-Radial Systems for Short Verticals, *QST*, April 1978, p 30–33.



FOUR-POSITION MOTOR SWITCH—Single RF feed line also carries DC for 3-V permanent magnet DC motor B1 atop antenna tower, driving S3 and S4 for remote switching to antennas a, b, c, and d. Diagram shows switches set for feed to antenna a, with no drive applied to B1 since cam C has opened microswitch S5. CR5 and CR6 are now connected in series with opposite polarity, so neither positive nor negative half-waves from 12-VAC supply can drive motor. If S2 is closed, positive half-waves start B1. Once started, motor runs until cam opens S5; if S2 has not yet been released, motor continues running on positive and negative half-waves. Diode bridge CR1-CR4 makes motor rotate in only one direction for either drive polarity. If S2 is released, before S5 opens, motor stops. 6-V 1-A lamp DS1 comes on dimly when S2 is closed and brightens when S5 closes. If S2 is released now, B1 drives to next position and stops. If S2 is held down, switching continues. Meter M1 and CR7 identify position of switch. R1-R4, in range of 1K to 10K, are chosen to give ¼, ½, ¾, and full deflection of meter. Motor drives switch through 2860:1 reduction gears taken from alarm clock. All diodes are 50-PIV 1-A silicon such as 1N4001.—U. H. Lammers, A Remote Antenna Switch, *QST*, Aug. 1974, p 41–43.