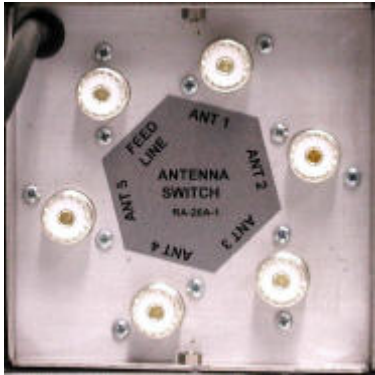


RA-20A-1 Remote Antenna Switch

RA-20A-1 Remote Antenna Switch



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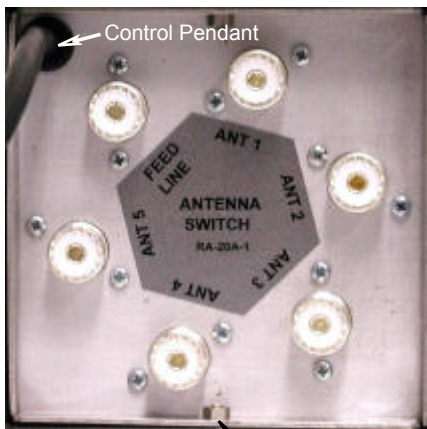
RA-20A-1 Remote Antenna Switch

Applications

- The RA-20A-1 is designed to remotely switch five 50Ω unbalanced antenna ports to a single RF feed line using a weather resistant, tower mounted assembly.
- Port five is connected to the RF feed line by default and a control signal must be present to disconnect it. This ensures the antenna connected to port five is available even if all communication is lost between the remote switch and the control assembly.
- Control cable requires 7 low current conductors, such as CAT 5 computer cable.
- Control signals are current limited to prevent wiring or equipment damage.
- Port to port isolation and insertion loss are excellent up through 150 MHz.
- Control assembly includes an HF (five port switch) as well as a VHF/UHF (two port switch) to operate a single 2M and 70 CM relay that is not included in the remote assembly.
- Power handling exceeds 800 W as designed but could operate at 2 KW with ceramic relays.
- Power requirement from the station power supply is 12 VDC at 0.25 Amp.
- Green LED indicates power present and non-shortened control lines. 20 Watt 12V halogen lamp provides current limit and visual indication of shorted control lines.

Installation - Remote Assembly

Mount the RA20A101 Remote Assembly on the tower at a convenient point to feed the various antennas that are to be switched. Drill into the outdoor enclosure **only below** the connector plate, if required, for tower mounting.



Drill into this lip (any side) using the hex inserts as a guide

RA20A101 Remote Assembly

Ensure the Remote Assembly is mounted with the SO-239 connectors pointed **down** to prevent water entry. Note the control cable extends from the assembly as a pendant and must be connected

externally. While this pendant can be hard wired, a connector protected with electrical tape will make future maintenance easier.

All RF cables should be connected with properly installed PL-259 RF connectors and should run vertically down at least several inches to reduce water migration. Do **not** use the connectors to support the weight of coax longer than a few feet.

The feed line should be weather resistant non-contaminating 50Ω coax with a loss and power handling capability compatible with the distance to the station and highest operating frequency of interest - see table below for selected cables.¹

Cable Loss for selected coax types							
(Nominal characteristics for matched coax - not specific to any manufacturer)							
Cable	Cent. Cond.	Diel. Type	Cable OD (in)	Loss (dB/100 ft) vs Frequency			
				1.0 MHz	10.0 MHz	100 MHz	1 GHz
RG-8	#10S	FPE	0.405	0.1	0.4	1.2	4.0
RG-8	#9.5 F	FPE	0.405	0.2	0.6	1.8	5.3
RG-8X	#16F	FPE	0.242	0.3	0.9	2.8	8.4
RG-58A	#20F	PE	0.192	0.4	1.5	5.4	22.8
RG-213	#13F	PE	0.405	0.2	0.6	1.9	8.0

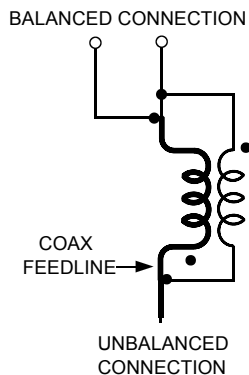
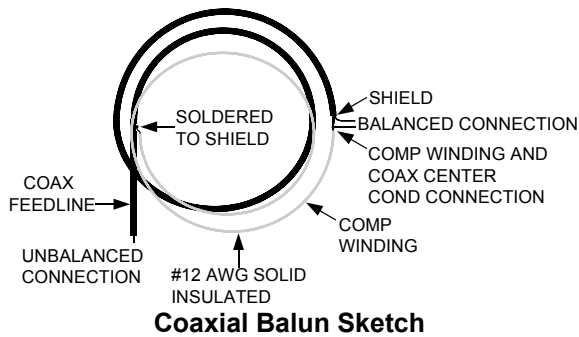
Notes:

Cent. Cond. is center conductor AWG wire size and type (S = solid, F = Flex or stranded).
 Diel. Type is dielectric, PE = polyethylene, FPE = Foamed polyethylene.
 O.D. is outside diameter of coax jacket.
 For additional coax types see "The ARRL Handbook". For accurate loss data refer to specific cable manufacturer's specifications.

Coax connections to the various antenna systems should be made through properly con-

RA-20A-1 Remote Antenna Switch

structured coax baluns designed for the particular operating frequency.



Good coaxial baluns reduce or eliminate RF currents on the coax shield, reduce the unbalanced feed line effects on balanced antenna radiation patterns and offer an easy and **permanent** path to shunt static electricity to ground.

Coaxial chokes or ferrite-core baluns can also be used, but the suitability and design of a particular balun is beyond the scope of this document. Refer to good technical literature sources for guidance.²

The control cable connection is not critical in any regard. Care should be used to prevent physical damage and water entry at the control cable entrance, but otherwise it is a low voltage and current limited circuit. The use of a multi-pin connector is recommended to facilitate removing the Remote Assembly from the tower. Unshielded multi-conductor cable (e.g. CAT 5 computer cable) will suffice to connect the Remote Assembly to the Control Assembly located in the station - see *specifications* for additional details and the schematic for details to connect the station control cable to a stand alone VHF/UHF tower mounted relay switch. Be sure the exposed cable is protected from the sun's UV rays.

Installation - Control Assembly

The Control Assembly can be located almost anywhere in the station desired. It requires connection to a 13.8 VDC source and to the control cable that connects to the tower mounted remote assembly.



RA20A100 Control Assembly

The faceplate containing the HF antenna names is held in place by a single control nut under the switch knob. It can be easily removed to change the antenna descriptions as needed.

Theory of Operation

Refer to the schematic for a better understanding of the following description. The HF ANTENNA switch is a single pole 6 position rotary. For antenna selections 1, 2, 3 and 4 it provides 12 VDC to the appropriate control wire and to K105 control wire. This energizes both the selected relay and K105 which in turn will disconnect antenna 5 and connect the selected antenna.

This feature ensures that antenna 5 will be connected to the feed line if all power and/or control is lost to the remote assembly. If antenna 5 is selected by the control assembly then all relays are de-energized. To disconnect all antenna ports, power is supplied to only K105.

A 20 Watt, 12 V halogen bulb provides current limiting. The filament's cold resistance is very low and causes very little voltage drop due to the relay currents. However, for a short on one of the control lines it will light and the hot filament current will be less than 1.75 Amps.

The green power LED is normally pure green in color. If the halogen bulb lights it will actually

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shine through the LED resin body as a bright washed-out green.

A VHF/UHF switch is also included on the control assembly that allows a separate remote relay switch to select one of two antenna systems for a low-loss feed line. This switch is labeled on the front panel and if not appropriate for the application will require self-adhesive labels be used to cover the markings.

The Remote Assembly contains five DPDT power relays that are modified to function as contactors. Refer to the schematic to see a representation of this function. The non-selected relays have a minimum connection to the common feed line point since the normal relay movable contact is not used, but rather just one fixed

contact is connected. The moveable contact of one section is connected to the other via a low loss conductor and the normally open contact is grounded to improve port to port isolation. Note K105 is connected using the normally closed contacts.

The relays are not specified for RF operation, but the materials and construction are reasonable for such use. If higher power and or frequency of operation is required a similar relay with ceramic contact mounting would be more appropriate.

Each relay has a clamp diode and RF bypass capacitor. The capacitors improve the port to control cable RF isolation.

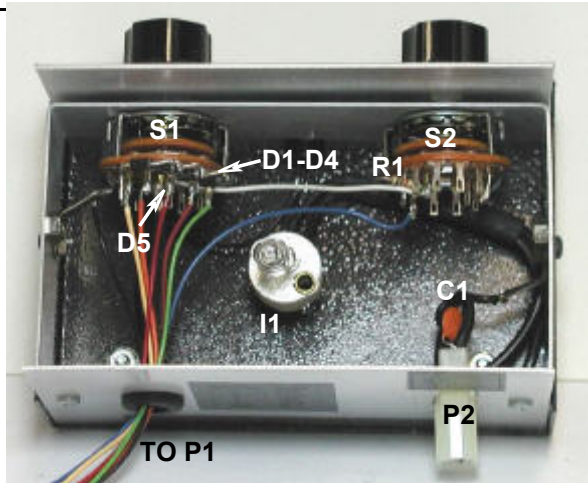
Specifications

Remote Switch Assembly		Control Assembly	
Control Inputs (per relay)	9.6 to 13.2 VDC @ 75 mA nominal		
Control cable (Note 1)	5 control wires plus ground (Relays are connected to chassis ground)		
Insertion loss	Frequency	Insertion loss	
	3.5 MHz	<0.03 dB	
	7.0 MHz	<0.03 dB	
	14 MHz	<0.03 dB	
Isolation (port-to-port)	28 MHz	0.07 dB	
	Frequency	Isolation	
	3.5 MHz	- 72 dB	
	7.0 MHz	- 68 dB	
port-to-control	14 MHz	- 63 dB	
	21 MHz	- 61 dB	
	28 MHz	- 60 dB	
	7.0 MHz	- 65 dB	
Environmental	Temperature	-40 °C to +55 °C	
	Humidity (non-condensating)	10% to 90%	
Enclosure	Weather tight cover (internal desiccant for humidity control)		
Relays (Note 2)	Contact material	Silver Alloy	
	Contact current	15A thermal limit	
	Mechanical life	10,000,000 operations	
	Dielectric	1500 V(rms)	
Power Requirement	10 to 15 VDC		
Input Current	<0.25 Amp @ 13.8 VDC		
Controls	6 Position HF switch (5 selections plus off) 2 Position VHF/UHF switch Green power-on LED		
Control cable (7 conductor) (Note 2)	With Remote Switch Assembly grounded to antenna system		
	Wire Size	Distance	
	24 AWG	400 ft	
	22 AWG	500 ft	
	20 AWG	1400 ft	

Notes:

- Control cable requires 7 conductors from the station, 6 are used to control the Remote Switch Assembly and one (plus ground) are used to control a separate VHF/UHF antenna switch.
- Antenna selection **must not** occur with transmit power applied to the Remote Switch Assembly.

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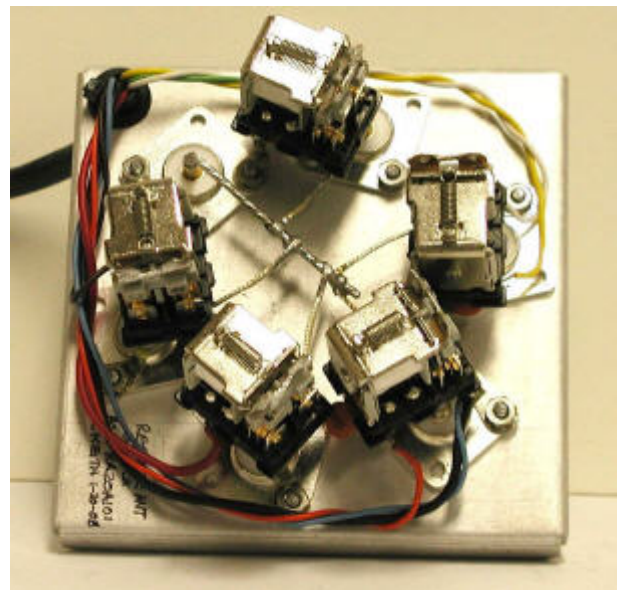
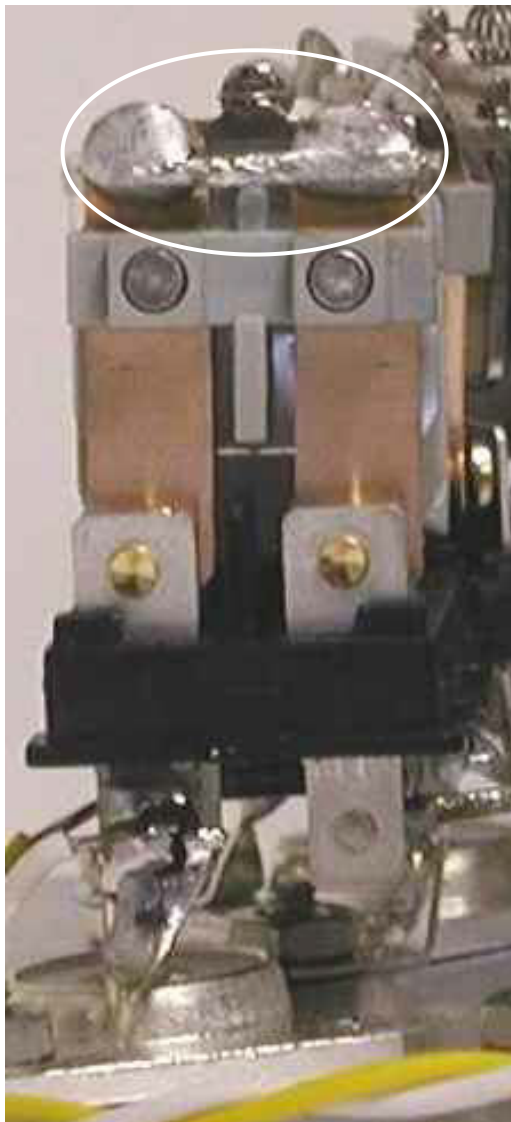
RA20A100 Control Assembly

Inside view showing the location of several components. Note the rotary switches are mounted to an internal bracket that also secures the bottom and rear panels.



RA20A100 Control Assembly

Rear panel view - note the #4 screws that secure the rear panel to the internal wrap-around bracket.



RA20A101 Remote Assembly

Inside view showing the location of relays and connectors. Note the relay diodes and bypass capacitors are hidden under the relays. The relays solder directly to their respective SO-239 connectors. A ground lug completes the mechanical support and grounds the unused contacts.

Relay Details

Note the moveable contact wires are removed and a low Z strap installed across the DPDT moveable contacts.

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List of Material

Qty	Designator	Value/Type	Description	Part Number	Supplier ¹	Notes
6	C1, C101-105	5600 pF	50V, 10%, Y5P Ceramic disk	140-50P5-562K-RC	MOU	
9	D1-D4, D101-105	1N4007	1 KV, 1 AMP SI RECT	821-1N4007	MOU	
1	D5	P6KE18	14.5 V TVS DIODE	576-P6KE18	MOU	
1	D6	40 MCD	T-1 ¼ GRN LED	604-WP7113SGD	MOU	
1	I1	12 V / 20W	HALOGEN BI-PIN BASE			2
1	J101	9 PIN MOLEX	RECP/W MALE 0.062 PINS	538-03-06-1091 RECP 538-02-06-2132 M PINS	MOU	
5	K101-105	15A DPDT	MAGNECRAFT PWR RELAY	528-7880-7	MOU	
1	P1	9 PIN MOLEX	PLUG W/ FEMALE 0.062 PINS	538-03-06-2091 PLUG 538-02-06-1103 F PINS	MOU	
1	P2	2 PIN MOLEX	RECP W/ MALE PINS	538-03-09-1027 RECP 538-02-09-2118 M PINS	MOU	
1	R1	1K, 5%, ¼ W	CARBON FILM	291-1K-RC	MOU	
2	S1, S2	2P, 6POS	ROTARY SW	105-SR2511F-26RN	MOU	
6		SO-239	PANEL MTG UHF CONN			
4		FEET	SCRW MTG	5167-208	MOU	
2		KNOB	BLK POINTER 1" DIA, 1/4" SFT	45KN013-GRX	MOU	
1		LED HOLDER	PANEL MTG	593-CLP125	MOU	
1		T 1 ¼ LED	RETAINING RING	593-RNG234	MOU	
AR		4-40 X 0.25"	PHILLIPS PAN HEAD	67413641	MSC	
AR		4-40 X 0.375	PHILLIPS PAN HEAD	87913315	MSC	
AR		6-32 X 0.25"	PHILLIPS PAN HEAD	87913398	MSC	
AR		4-40	0.25" HEX NUT	31F2106	NEW	
AR		6-32	0.25" HEX NUT	31F2107	NEW	
AR		4-40	INT TOOTH LK WASHER	87920708	MSC	
AR		6-32	SWAGED STANDOFF	534-1620-2	MOU	

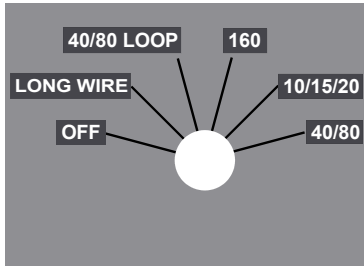
Notes:

- Supplier codes:
DK = Digikey.com
MOU = mouser.com
MSC = msdirect.com
NEW = newark.com
- Low voltage outdoor landscaping spot light bulb.

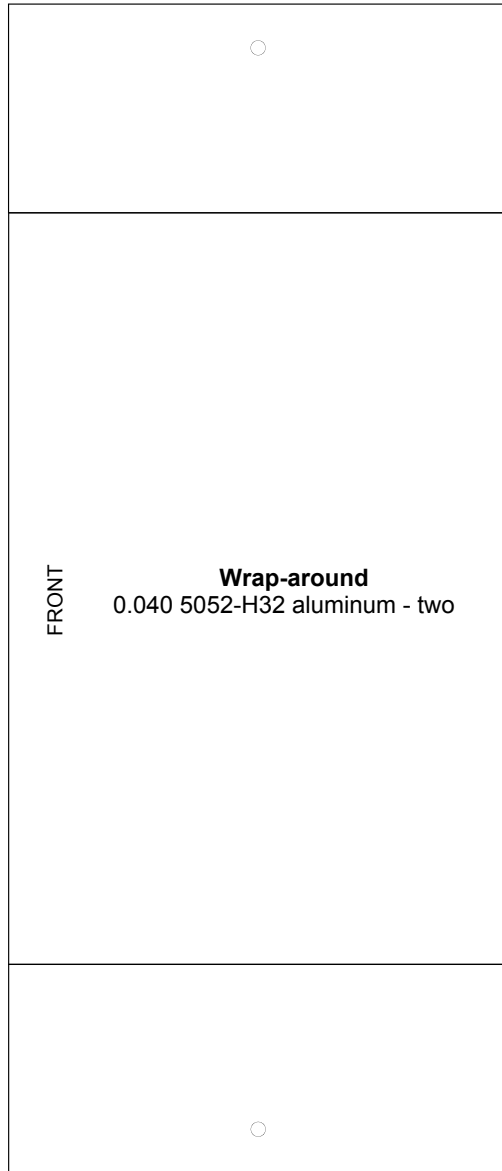
Footnotes:

- Coax cable types and specifications;
"The ARRL Handbook for Radio Communications"
coaxman.com
davisrf.com
- "Ham Radio" March 1980 - New Class of Coaxial-line Transformers

RA-20A-1 Remote Antenna Switch



HF Faceplate
0.040 5052-H32 aluminum plate



FRONT
Wrap-around
0.040 5052-H32 aluminum - two

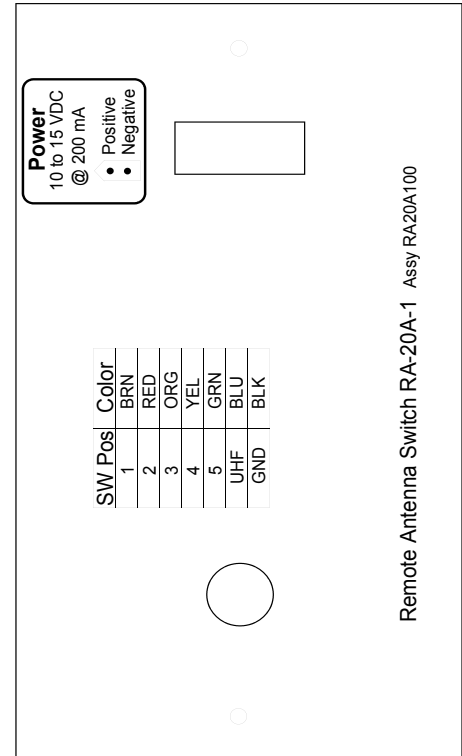
Internal Bracket
0.040 5052-H32 aluminum bracket to



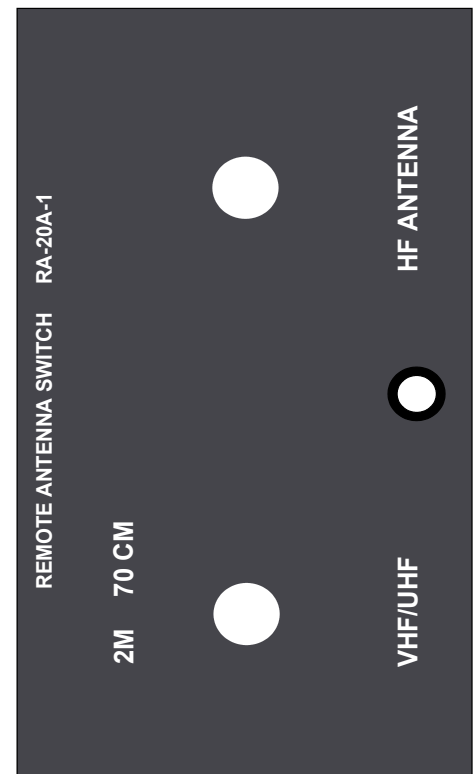
PANEL BRACKET 0.040 5052-H32 AL

REAR PANEL 0.040 5052-H32 AL

Fab Parts RA20A100 Control Assy
Shop built sheet metal parts for my prototype.
Design can be adapted to OEM sheet metal products if desired.



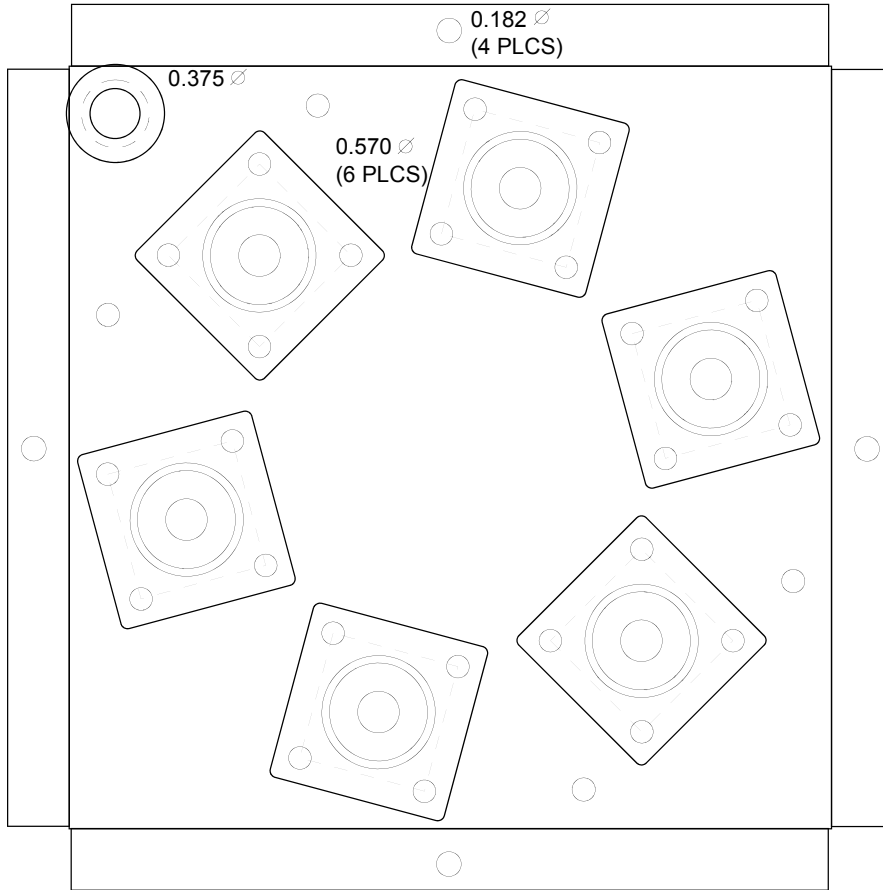
Remote Antenna Switch RA-20A-1 Assy RA20A100



RA-20A-1 Remote Antenna Switch

Fab Parts RA20A101 Remote Assy
 Shop built sheet metal parts for engineering prototype. Design can be adapted to OEM sheet metal products if desired.

CONNECTOR PLATE
 0.063 5052-H32 AL

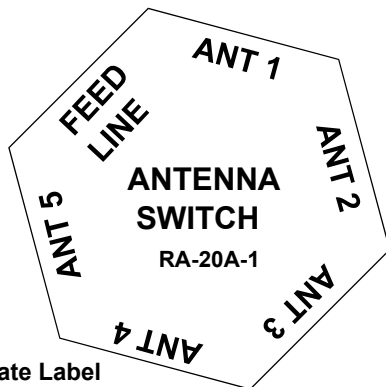


Connector Plate

0.063 5052-H32 aluminum - flanges mount downward (outside the surface the connectors mount to).

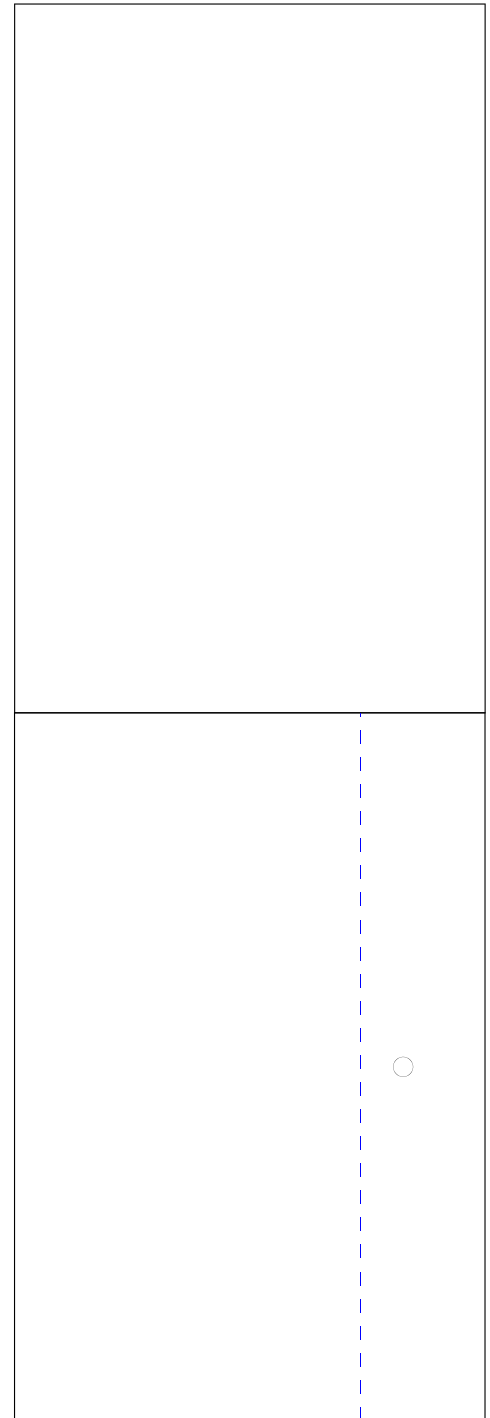
Wrap-around

0.040 5052-H32 aluminum - two identical parts form "clam-shell" en-

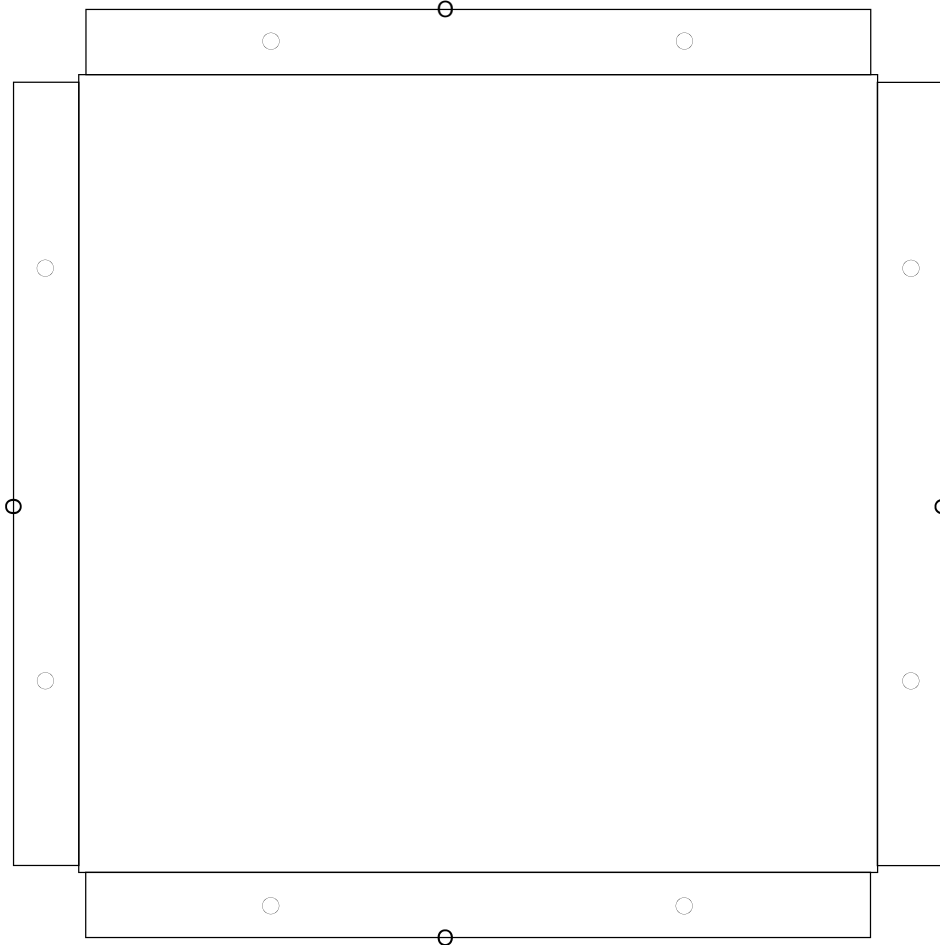


Connector Plate Label

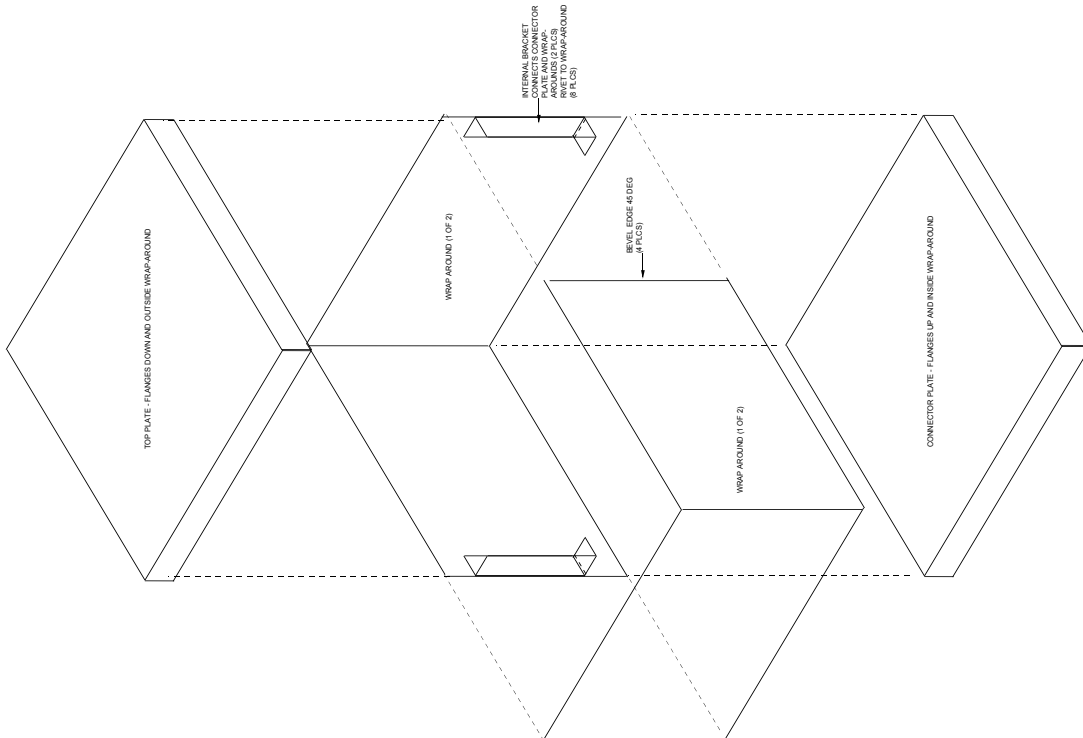
Printed on gray matte art stock and sealed with clear lacquer.



RA-20A-1 Remote Antenna Switch



Cover Plate
0.040 5052-H32 aluminum - flanges mount downward (outside the wrap-around).



Cover Plate and Wrap-around assembly
Cover plate mounts on the outside of wrap-around clam-shell. Connector plate mounts inside the wrap-

Fab Parts RA20A101 Remote Assy
Shop built sheet metal parts for engineering prototype. Design can be adapted to OEM sheet metal products if desired.