

Clarifying SMA Connector Confusion

The HT (handi-talkie) is often the new HAMs first radio. It is affordable, compact, and a common sight among EmComm HAMs. Pictured below is what comes in the box of a Bao Feng UV5R radio. The short stubby “rubber duck” antenna is standard equipment. The antenna works but not all that well. Most HAMs soon buy a longer high gain whip antenna.



A Bao Feng UV5R fresh from the box.

[Note: A good rule of thumb for radio/antenna purchases is to get the best antenna you can afford. It is better to spend more on an excellent antenna used on a mediocre radio than to have an excellent radio with a mediocre antenna. After all, the best radio in the world will not be fully effective if the antenna limits the quality of the transmitted signal. In contrast, a mediocre radio may perform to its full potential thanks to an excellent antenna.]

Shopping for a better antenna for your radio involves some critical factors:

- 1) Knowledge of how and where you will be using your radio. This includes radio operating frequencies and TX power. Consider the terrain and distance as these affect overall radio system performance;
- 2) Technical knowledge about antenna performance measurement and assessment;
- 3) The type of antenna connector on your radio;
- 4) The type of connector on the antenna you want to buy;
- 5) The maximum TX power rating of the antenna you want to buy. It should be equal to or more than the maximum TX power of your radio.

This article will focus on the antenna connectors commonly used with HT radios. But first, a brief introduction to the HT antenna connector.

The SMA (Sub Miniature A) RF coaxial connector is designed for use from DC (0 Hz to 18 GHz). It is most commonly used for hand-held radios. It is rated at 50 Ω. The SMA connector is equipped with a #6 SAE hex nut (7.9 mm, 5/16 inch or 0.3125 inch) across opposite flats.

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FOOTPRINTS

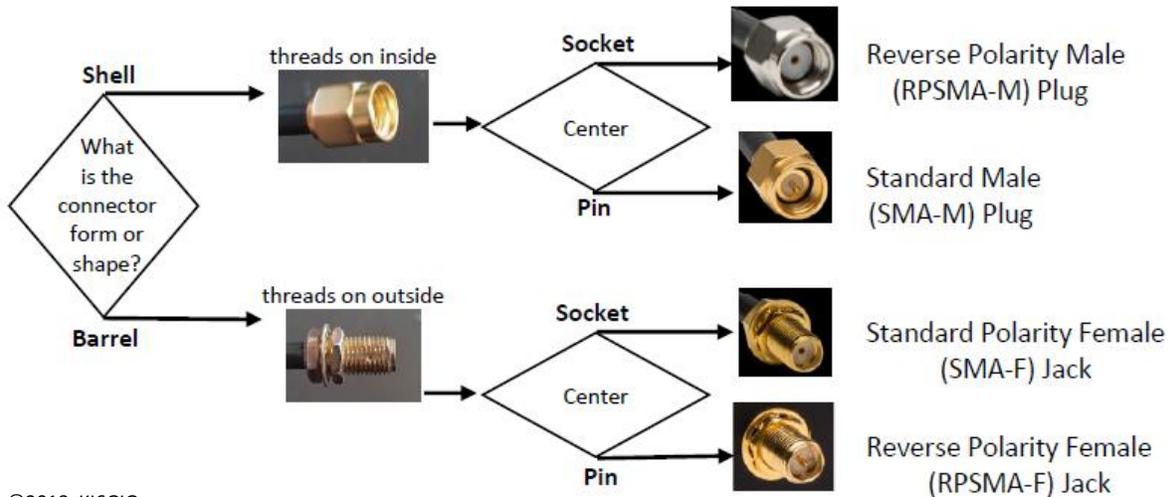
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It looks very similar to the slightly larger 75 Ω Type F connectors used for cable TV. These different connector types cannot be joined or used together. When mating an SMA 50 Ω plug and a jack, it is important to ensure they are the same polarity. For example, the plug and jack should **both** be standard SMA 50 Ω standard SMA connectors or RPSMA (Reverse Polarity SMA).

To tell the difference, use the following steps and refer to the chart below:

Step 1. Look at form or shape (shell or barrel) of the SMA housing and location of the threads (inside or outside).

Step 2. Look at the center and identify if it is a pin or a socket.



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The source of confusion lies in the fact the gender of the connector is commonly determined by the shape of the center conductor. A male connector (plug) is a pin that sticks up from the center of the connector's insulated surface. A female connector (jack) is a socket recessed into or below the center of the connector's insulated surface.

The Reverse Polarity SMA (RPSMA) connector reverses the form of the center conductor. Most of us reflexively think a pin in a connector automatically makes it a male connector. This is **NOT** true when dealing with RPSMA connectors. A RPSMA male is a socket housed in a shell (see the illustrations below). The ***"reverse polarity" means the form of the male/female center connector is reversed NOT the polarity of the signal.***

Standard SMA Connectors		Reverse Polarity SMA Connectors	
	Standard Polarity plug (SMA-M) male has a center pin	Shell threads on inside	 Reverse Polarity plug (RPSMA-M) male has a center socket
	Standard Polarity jack (SMA-F) female has a center socket	Barrel threads on outside	 Reverse Polarity jack (RPSMA-F) female has a center pin.

The HTs in the GECO radio inventory include:

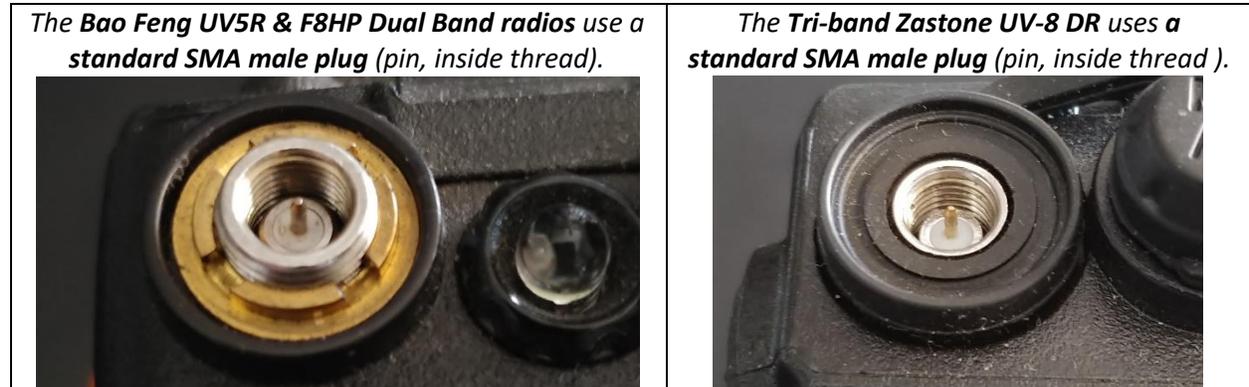
- Bao Feng UV5R Dual band (136-174/400-480 MHz); TX 1-4W; Duty cycle 3/3/54 (TX, RX, Standby); Dual band rubber duck.

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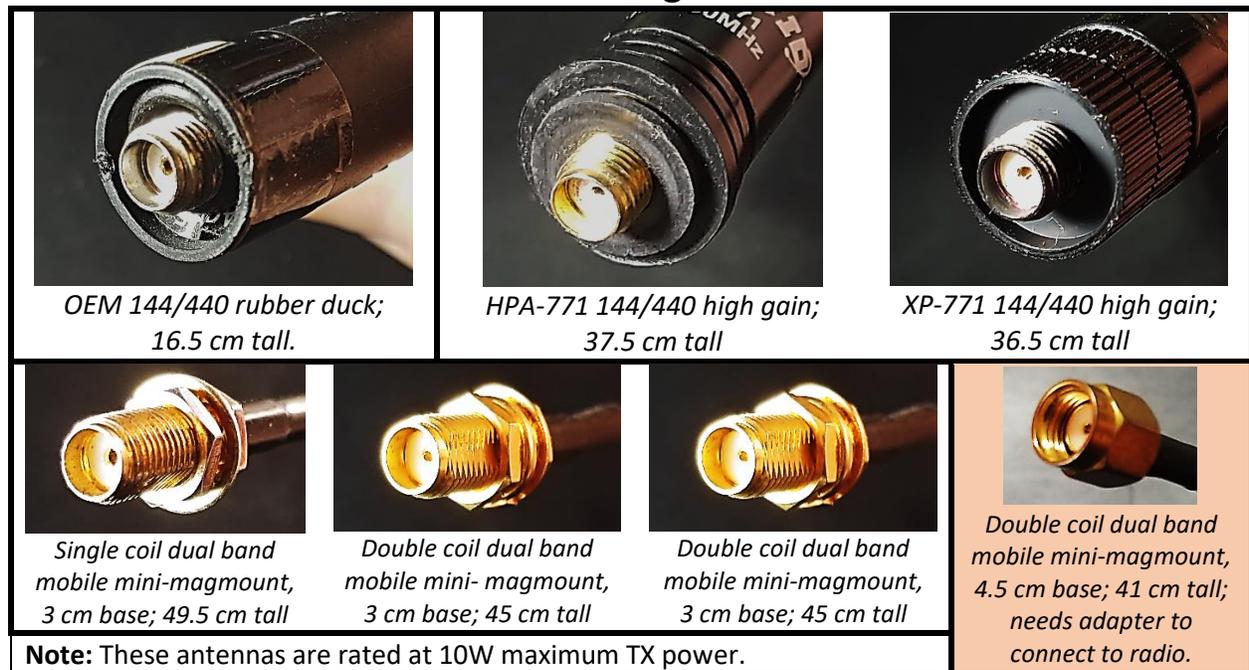
- Bao Feng F8hP Dual band (136-174/400-520 MHz); RX only 65-108 MHz; TX Low 1W, Mid 4 W, High 8 VHF, 7 UHF; Duty cycle 3/3/54 (TX, RX, Standby); Dual band rubber duck.
- Zastone UV8DR Tri-band (136-174/240-260/400-520 MHz); TX 2-5W; Duty cycle 3/3/54 (TX, RX, Standby); Dual band 144/440 rubber duck; mono band 220 rubber duck.

The search for alternative antennas to the OEM rubber duck antennas begins with knowing the type of SMA connector on your radio. The Bao Feng and the Zastone radios use standard SMA plugs on the radios. This means any additional antennas we get can attach directly to all GECO HT radios if the antennas have standard SMA female connectors on them.



Currently the following Dual Band antennas in the GECO inventory are intended to be directly attached to the radios. All these antennas have standard SMA female jacks on their bases. This first set of antennas are primarily allocated for use with the Bao Feng radios.

Dual Band Antennas for the Bao Feng Radios



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Tri-Band Antennas for the Zastone UV8DR Radios

These are the GECO Tri-band antennas available for the Zastone UV8DR radios. All antennas are 50 Ω impedance. If needed, the tri-band antennas can be used with the Bao Feng radios for dual band 144/440 MHz operations. All antennas are rated at 10 W maximum except the JT-776SMA.

 <i>OEM 144/440 rubber duck; 14.7 cm tall</i>	 <i>RD-301 144/220/440 high gain; 19.5 cm tall</i>	 <i>220 monoband, mini-magmount; 3 cm base; 34 cm tall</i>	 <i>JT-776SMA 144 / 220 / 440; 2.15 dBi; 20 W; 42.5 cm tall</i>
 <i>OEM Mono band (220) rubber duck; 14.7 cm tall</i>	 <i>RD-371 144/220/440 high gain; 37.8 cm tall</i>	 <i>220; mini-magmount, 4 cm base; 32 cm tall; adapter required</i>	 <i>Mini-magmount 5.5 cm base</i>
		<p>Note: Using the 5.5 cm magmount requires two different RPSMA connectors: (one for the antenna to the mount; one for the coax to the radio.)</p>	
		 <i>Mini-magmount coax connector</i>	

RG174 Extension Cable

Sometimes elevating the antenna can improve its overall performance. It is an easy thing to do with this 2 m long RG174 extension cable. It has an RPSMA-M connector on one end. This accepts all GECO antennas that attach directly to all GECO HTs. A standard SMA-F connector is at the other end of the extension cable which connects directly to the HT. In an emergency, the JT-776 SMA tri-band whip antenna can be attached via an SMA-F to SMA-F connector.

<ul style="list-style-type: none"> • OEM 144/440 rubber duck • HPA-771 144/440 • XP-771 144/440 • OEM 220 rubber duck • RD-301 144 / 220 / 440 • RD-371 144/220/440 	 <i>Extension End SMA-M</i>	 <i>RG174 extension cable (2m long)</i>	 <i>Extension End SMA-F</i>	 <i>HT radio SMA-M</i>
<ul style="list-style-type: none"> • JT-776SMA 144 / 220 / 440 	 <i>SMA-F to SMA-F</i>			

Remember:

- A **standard polarity jack** (female) has a socket; a **reverse polarity jack** (female) has a pin.
- A **standard polarity plug** (male) has a pin, a **reverse polarity plug** (male) has a socket.
- Use the minimum number of connectors between your antenna and radio.

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Selected SMA Adapters

Joe N6WZK donated several antennas to GECO. One was a dual band mobile mini-magmount antenna with coax terminating in a RPSMA plug connector. [Note: Anytime a connector/adaptor is used it adds impedance to the radio/antenna system. This can reduce overall performance. GECO prefers to set up its radio/antenna systems with minimal connectors between the antenna and the radio.]



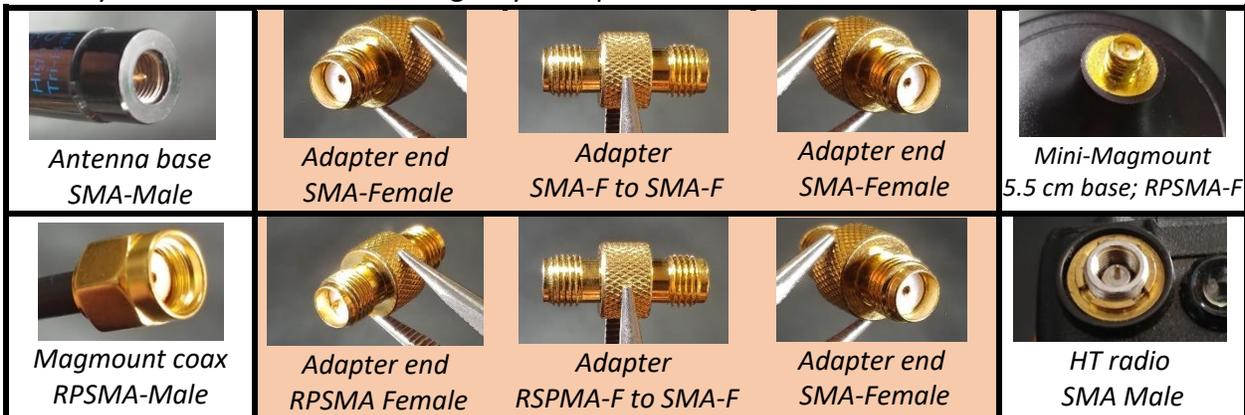
GECO purchased a monoband 220 MHz mini-magmount mobile antenna. The coax terminated in a BNC-Male connector. To use this antenna with the Zastone UV8DR, we needed a BNC-Male to SMA-Female adapter. [Note: This adapter works with our DBJ-2 antenna.]



GECO acquired the JT-776SMA Tri-band with a SMA-Male connector, we needed an SMA-F to SMA-F connector to use it with our HT radios.



To use the JT-776SMA Tri-band antenna on a mini-magmount for mobile operations, we need to use two additional connectors: 1) an SMA-F to SMA-F to connect the antenna to the Magmount base; 2) an RPSMA-F to SMA-F to connect the coax to the HT. This antenna option will only be considered as an emergency set up if no other antennas were not available. 🌱



Connecting GECO HTs to Mobile Antennas

GECO HT radio sets are equipped with high gain whips and mini-magmount mobile antennas. These are relatively compact and are an improvement over the OEM rubber duck antennas. GECO field options include mobile radio sets deployed in pedestrian mobile, bicycle mobile, and vehicular mobile modes. We could use HTs as well, but the priority is to use the higher TX power of the mobile radios. We use mobile whip antennas on magnetic base mounts and a variety of portable masts to raise the antennas to about 3-5 m AGL (above ground level).

We have adapters to connect our HTs to our base station and mobile antennas for emergencies. If a mobile radio is damaged, an HT can be used to bridge the gap. Being able to connect our HTs to our base station and mobile antennas is part of our commitment to flexibility, inter-operability and resilience. These larger antennas typically use RG58, RG8X, and RG8/U coax. The coax and antennas in the GECO inventory have PL259, SO239, and BNC connectors.



This jumper cable lets us connect an HT to all base station antennas and mobile magmount antennas. Access to the better antennas can improve overall HT performance. There are adapters that attach directly to the HT SMA-M fitting. We prefer to use a jumper cable. We feel this greatly reduces the strain on the radio connector from the weight of any length of RG58, RG8X and RG8/U coax. 🌱

GECO Base Station and Mobile Antennas

Loc	Antenna	Frequency	Ant. Conn.	Coax Conn	Connector to HT
Base Station	Diamond X3200A	144/220/440	SO239	Coax with PL259/PL259 connectors on both ends	SO239 to SMA-F
	Diamond X200a	144/440	SO239		
	Homebrew	144/220/440	SO239		
	Dual band Yagi	144/440	BNC		
	HHTX H-9000 Quad band	(2m/6m/10m/440)	PL259		
Mobile	N9TAX Slim Jim roll up RG58	(144/440)	SP239	BNC-F/PL259	BNC-F to SMA-F
	DBJ2 J-pole roll up RG174	(144/440)	BNC-M		
	TMS-1602 folding ant.	(144/430)	SO239	Magmnt/PL259	SO239 to SMA-F
	Comet SBB224	(146/220/446)	PL259	Magmnt/PL259	
	Larsen Kulrod (220B)	(220)	NMO	Magmnt/PL259	

Advisory Notes:

- 1) Just because you can find adapters and jumpers to connect a myriad of antennas / coax combinations to your radio doesn't necessarily mean you should. Strive to use the fewest number of connectors between the antenna and the radio for minimal impedance.
- 2) HT antennas often have a maximum TX power rating of 10 W. Be careful not to exceed those levels to prevent damaging equipment. 🌱