



Choosing a Feedline Choke

Feed line chokes/line isolators for coax fed dipoles, verticals, beams, slopers, loops, windom, OCF, and yagi antennas

Definition

Many companies often call the same item different names to confuse you or make it difficult to compare the same item between companies. So let's set the record straight and avoid the confusion with product names. A feed line choke is also called a common mode choke, a 1:1 balun, a 1:1 unun, a current balun/unun, a line isolator, a feed line current choke, and a 1:1 Guanilla balun/unun/choke. All these names are for the same item: a common mode current suppression device that works to suppress common mode current on the outside braid of your antenna feed line.

Note: There are also common mode current chokes for other types of lines including AC/DC cables, and device interconnect wires or cables (for example).

Purpose

The purpose of the common mode choke is to suppress or reduce the common mode current shared by all the wires in a cable of one or more wires. In the case of coax feed line, the center wire and inside of the coaxial braid carry the RF signal current and the outside of the braid can carry common mode current if it is not choked at the antenna feed point. In general, a higher choking impedance will suppress the common mode current more than a lower choking impedance. (Remember Ohm's law? For a fixed driving voltage E , a higher resistive impedance ($R + j$) will give a lower current, $I (I=E/R)$).

As you increase E (higher power into the coax), you will need to increase the choking impedance to reduce the common mode current to the same value present with the lower power. That is the reason that you may have little RFI with a 100 watt output transmitter, but add a linear amplifier at 1000-1500 watts without a choke and the antenna feed line acts as a vertical antenna coupling into the AC line, phone line or cable TV/computer DSL line inducing common mode current which you hear or see on the devices attached to these lines. If you add an amplifier, you will generally need to get a higher Z feed line choke.

A simple cure for transmitter RFI is to add a common mode choke, with sufficient choking impedance, at the antenna feed point to keep the RF signal on the antenna and off the feed line.

In addition to the antenna feed point choke, it is prudent to add another choke at the radio station end to choke off the common mode noise current picked up by the outside braid of the coax between the feed point and the station receiver. This common mode noise current gets on the coax braid from neighborhood noise sources including plasma TVs, computers, routers, etc. You “see/hear” the common mode noise as a high noise level on your receiver. Using high choking impedance chokes, it is possible to significantly reduce the receiver common mode noise levels. Unfortunately common mode noise usually takes multiple paths, but choking the feed line is usually a good first step to reduce neighborhood noise. To further reduce the noise to an acceptable level, you may also have to add common mode chokes to all wires/cables entering the radio station including computer interconnects between the receiver and the computer (includes internet connections too).

Typical Choke Placement

- Antenna Feed point place at the feed point or directly below any impedance transformers (2:1, 4:1, 9:1, etc that connect to the antenna feed point. Use as short a connection as possible since any length of coax between the feed point and transformer can act as a small antenna causing potential RFI problems.
- Station Receiver – place a feed line choke between the receiver or transceiver and the amplifier or antenna tuner in a low impedance line. DO NOT put the feed line choke at the high impedance point of the antenna tuner (antenna tuner output).
- Along Feed Line – for instances of persistent RFI, put an inline feed line choke every 1/4 electrical wavelength (physical wavelength x velocity factor of the coax feed line). In extreme cases you may also have to ground the outside braid along the feed line at the 1/4 wavelength points also.

Specifications

- Bandwidth Frequency Range – For single band antennas, a simple air wound coax choke may be sufficient if it has enough choking impedance at the frequency of operation. Most air wound coax chokes are only useful over narrow frequency ranges and generally have less choking impedance than ferrite based feed line chokes. For multi-band antennas, the most useful chokes are ferrite based because they are broadband with sufficient choking over a large frequency range or have very high choking over a narrow range (160-80-40 meter antennas for example). Whichever choke you choose investigate the frequency range and choking impedance at the frequencies you plan to operate. By the way, iron powder based chokes usually DO NOT have sufficient choking at any frequency due to their low permeability requiring long transmission lines on the toroids drastically affecting high frequency response).
- Power Requirements – A feed line choke passes the RF current through the choke and only has to choke the much lower common mode current that is present on the braid. (Typically < 5% of the RF current depending on the choking impedance). If a coax sleeve balun is chosen, the power requirements are solely dependent on the coax size (will it handle the RF current/voltage). The coax size is chosen to handle the RF current/voltage and the ferrite sleeve choke is chosen to physically fit the coax snugly or with appropriate shims. For toroid based chokes, you must choose a wire conductor size that will handle the RF current/voltage breakdown and provide sufficient choking at your frequency of interest.

- Choking Impedance (Z) – Common mode chokes have choking impedance which varies with frequency. The general rule of thumb is to have a choking impedance of a minimum of 10 times the coax line impedance. For 50 ohm coax, that would mean a minimum of 500 ohms of choking. The manufacturer should label the choking impedance on the choke at various frequencies or at least have a table of choking values verses frequency so you can check the effectiveness at your frequency. Make sure you have enough choking at the frequency you are using. If the choke you are purchasing does not have choking impedance specified at the frequency you intend to operate, avoid the choke as it may be useless at your frequency. (E.g. 28 MHz radio operators will get little use out of chokes designed or optimized for 1.8-10 MHz). All broadband chokes usually have a min/max frequency range where the choking impedance is greater than 10 x the line impedance. The Palomar feed line chokes usually have a choking impedance chart for reference to check your frequency and the expected choking impedance.

Topology Alternatives

Feed line chokes are manufactured in a variety of sizes and shapes (topology) to make them physically useful for various applications.

Sleeve Chokes

For simple (< 2000 ohm choking) choking requirements, the coax sleeve chokes (either slip on if the coax connector is NOT on the cable) or Snap On (connector already on cable) are used on coax feeding all antenna types. They are simple to install and if additional choking is required after initial installation, then another choke can simply be added in series with the first to increase the choking. Sleeve chokes are available with inside hole diameters from 1/4" up to 1.5" suitable for a variety of cable sizes. For customers with power requirements which can be served with 1/2" cable size, the sleeve chokes are available with PL-259 male connectors and either 5, 10 or 15 bead versions for additional choking at lower frequencies. Sleeve chokes can be used on all antenna types.

Coaxial – Air Wound

Available in single bands for 1.8- 160 MHz at power levels dependent on coax cable size

Coaxial Ferrite Enhanced

The ferrite enhanced chokes are called Super Chokers (TM) and consist of several models for specific band ranges or broader frequency ranges (but less overall choking). They consist of several turns of coax thru various mixes of ferrite cores used to fine tune the frequency bandwidth of the chokes. The chokes are typically used at the antenna feed point, along the feed line, and at the receiver end of the coax. They are particularly good at handling high power from amplifiers.

CUBE™ Chokes

Common Unun and Balun Enclosure (CUBE)™ feed line chokes are ferrite based chokes available in higher choking impedances and broader frequency ranges than sleeve or coaxial chokes. They are also available with SO-239 or N connector inputs and either SO-239 or N connector or stud/wing nut outputs



to suit a variety of antenna connection types of either balanced or unbalanced feed points. Various power ranges, frequency ranges and connections options exist for these chokes. A special case is the 4:1 off center fed impedance transformer which incorporates a feed line choke in a CUBE™ enclosure saving space and money at the same time without giving up any performance. You should choose CUBE™ chokes when you need specific connectors or frequency ranges or higher choking impedances for difficult RFI issues.

Toroid Kit Chokes

Toroid kit chokes are intended for do it yourself customers who have a particular enclosure they want to use or wish to fine tune the number of turns on the toroid choke for a particular frequency range. The kits come with an input connector, winding wire or cable and instructions to make the choke. When completed the chokes can be used on all types of antennas. The kits are cost effective, offer various models to cover the frequency spectrum of 1.8-160 MHz and are available in power ranges up to 1500 watts PEP.

Palomar Feed Line Choke Alternatives

Click on picture for product info

Example Product	Choke Type	Frequency Range	Choking Z (ohms)	General Use	Relative Cost
 <p>BA-8 on RG-213 Cable</p>	Slip On Chokes (BA-8 for 1/2" cable), BA-58 for 1/4" cable), BA-103 (3/4" cable), BA-200 (1" cable)	1-150 MHz	200-2200	antenna feed point, Station entrance, all antenna types, broadband	\$10 – \$95
	FC1, FC2, FC3 – assembled BA8 chokes	1-150 MHz	200-1700	antenna feed point, Station entrance, all antenna types, broadband	\$35 – \$65



Snap On
Chokes

1-150
MHz

200-
1700

antenna
feed point,
Station
entrance, \$15-
all antenna \$50
types,
broadband

Kit 105 Installed on RG-58 Cable



Super
choker

1.8 – 30
MHz

300 –
9000

antenna
feed point,
Station
entrance, \$50-75
all antenna
types,
broadband

Super choker 4010 – 40-10 meters



FSB-1 –
Big Clamp
on = 1" hole

1.8 – 150
MHz

500 –
4000

antenna
feed point, \$18-55
broadband

Super Choker with 3 FSB-1 with 3 turns each on feed line



Cube Balun	1 – 160 MHz	700 – 8000	antenna feed point, Station entrance, all antenna types, broadband	\$50- 150
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CUBE Balun – 1:1 SO239 or Stud output



Coax Wound ("Badger") Balun	1.8-160 MHz	500 – 3000	antenna feed point, Station entrance, all antenna types but band specific	\$20-95
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Toroid Choke Kits	1- 160 MHz	500 – 6500	antenna feed point, Station entrance, all antenna types, broadband	\$15 – \$55
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Balun Kits 1:1 4:1 9:1

For additional help in choosing the correct feedline choke for your application call Palomar Engineers at 760-747-3343 or drop us an email at Sales@Palomar-Engineers.com

See website for latest product info and specifications and examples of actual customer use.