

Power Divider/Combiner Types and Functionality

By JFW Industries, Inc.

JFW manufactures both resistive type and reactive type power divider/combiners. Both types can be used to fan-in or fan-out RF signals. However, both types distribute RF signals in a different fashion. The below questions will help you determine a divider/combiner type for your application. JFW does provides direct access to our engineering team. If you would like a recommendation for your setup, please email our engineering team (jfwengr@jfwindustries.com).



Resistive Type Symmetrical layout Star configuration All paths have equal loss No isolation paths



Reactive Type

Non-symmetrical layout Common port design Fan-in or fan-out functionality Isolation between combiner ports

• What is the function of the power divider/combiner?

• (Will operate as a hub to connect multiple Tx/Rx devices to each other) Use resistive type

• (Will be used to fan-in or fan-out RF signals) Use reactive type

What is the low end of your frequency band of operation?

- (DC)

Do you need to pass DC or split the DC signal?

- Passing DC) Use Wilkinson reactive type
- (Splitting DC) Use resistive type

• (Less than 400MHz)

Is your frequency band narrow or wideband?

- —
 • (Narrow band) Use Wilkinson reactive type
- Wideband) Use Reactive toroidal type

(Greater than 400MHz)

• Are there size constraints?

- -• (Yes) Reactive toroidal types are significantly smaller than Wilkinson types
- —
 • (No) Wilkinson reactive types have better RF performance than toroidal types
- Is upper end of frequency band of operation > 2000MHz?
 - (Yes) Wilkinson reactive types operate with good RF performance into the GHz bands
 - (No) Toroidal reactive types operate with good RF performance up to 2000MHz

Construction



Resistive Power Divider/Combiners

The construction is a star configuration. All ports are symmetrical. There is no common port with this type design. A signal into port 1 will be divided up equally to ports 2, 3, 4, 5. This type of functionality makes resistive type power divider/combiners ideal for connecting multiple radios (Tx/Rx devices) together in a network. All radios connected to the resistive divider/ combiner have equal loss from radio-to-radio.



Reactive Power Divider/Combiners

The construction is non-symmetrical. A signal into the divider port (port 5) is divided up to all of the combiner ports (ports 1, 2, 3, 4). Signals into ports 1, 2, 3, 4 will all be combined together at port 5. The loss from divider port to a combiner port is equal for all paths. However, the loss between combiner ports is typically >20dB regardless of configuration (i.e. 1X2, 1X4, 1X8). The loss between combiner ports is referred to as isolation. The fact that the combiner ports are isolated from each other at >20dB typical makes reactive divider/combiners useful to fan-out a signal to multiple devices or fan-in signals from multiple devices.

Through Path Loss

There is a significant difference in through path loss between resistive and reactive type power divider/ combiners. A resistive model has twice the through path loss compared to the corresponding reactive model. Below is a chart showing the through path loss differences for common configurations. The losses shown are the calculated theoretical split losses for each configuration.

Configuration	Resistive Type	Reactive Type
2-Way (1X2)	-6.02dB	-3dB
4-Way (1X4)	-12.04dB	-6dB
8-Way (1X8)	-18.06dB	-9dB
16-Way (1X16)	-24.08dB	-12dB

Two Different Reactive Types

JFW manufactures two different types of reactive power divider combiners: Wilkinson type, Toroidal type. Each type has different RF benefits that make it better for certain applications. Typically Wilkinson models have better RF performance than their corresponding toroidal models.

Wilkinson Models

- Low end frequency typically >= 500MHz
- Wideband models at 500-6000MHz
- Below 400MHz only narrowband models
- Lower loss than corresponding toroidal model
- Wideband isolation >22dB typical

Toroidal Models

- Low end frequency typically >= 10MHz
- Wideband models at 20-3000MHz
- No models available for > 3000MHz
- Higher loss than corresponding Wilkinson model
- Wideband isolation >16dB typical

Size Differences

Because the power divider/combiner types are constructed differently, the enclosure sizes for each type differ from each other. If your application has strict size requirements, then selection of resistive type might be required. Typically the resistive type is the smallest enclosure size and the Wilkinson reactive type is the largest package size. Below are example pictures of three different types of 1X4 divider/combiners with similar frequency operation bands.



DC Passing Models

Some applications require the passing of a DC signal through the divider/combiner to power a device that is connected to the power divider/combiner. Standard resistive and standard toroidal designs do not pass DC. The standard Wilkinson design will pass DC without attenuating the DC signal level. Including DC blocks on the Wilkinson PCB layout will keep the DC Voltage on only the ports that require the DC Voltage.



Conclusions

The two types of power divider/combiners have distinctly different functionality. The required frequency range and size requirements will greatly influence your selection of divider/combiner type. If you would like a recommendation for your application, please contact our engineering team (jfwengr@jfwindustries.com). JFW does not charge NRE fees. If you have a unique request or need a custom rack mounted assembly, we will email you an ROM quote in 1-2 days. Our custom model pricing is in-line with our catalog model pricing.

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