
CUSTOMER MANUAL

ECCS-450-470-4-4-1TB

**450-470MHz Compact Combining System, 4
Channels, 50W, Duplexed, Field Tunable**



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PRODUCT DESCRIPTION

ECCS-450-470-50-4-4-1TB field tunable compact combining system allow four transmitters and four receivers operating in 450-470MHz share one Tx/Rx antenna.

- Built-in tunable duplexer accessible by removing the cover on the bottom of the chassis.
- Tune the duplexer without disconnecting the interconnection cables.
- Gain adjustment switches on the rear panel.

Major Tuning Parameters	Typical Tuning Range
Tx Band	Low Band
Rx Band	High Band
Tx-Rx End-End Separation, Non-tunable	5MHz
Tx Tuning Range	450-470MHz
Tx Pass Bandwidth, Non-tunable	2MHz
Rx Tuning Range	450-470MHz
Rx Pass Bandwidth, Non-tunable	2MHz



Warning Message:

- Attempt to tune and operate the unit beyond the tuning range specified in the above table may damage the unit and violate the warranty.
- Please follow the instruction to connect the network analyzer and tune the duplexer.

Electrical Specifications	Typical Tuning Target
Insertion Loss (maximum): Tx-ANT Ports	8.2dB (including duplexer insertion loss)
Isolation (minimum): Tx-Rx Ports	85dB
Isolation (minimum): Tx-Tx Ports	75dB
Isolation (minimum): ANT-Tx Ports	55dB
VSWR @ Tx/Rx Ports	1.25:1
VSWR @ Antenna Port	1.4:1

TUNING INSTRUCTION

Tuning Tools

- L-shaped Tuning Socket Wrench (Supplied, as shown in the image)
- Screw Driver(Supplied)
- 2-Ports Vector Network Analyzer (VNA)

Fig.1 Use of tuning screw driver and wrench



Tuning Rods

3 different type of tuning rods are identified in Fig.2 with digital numbers, letters and combinations of the two, and colored in blue, yellow and green respectively.

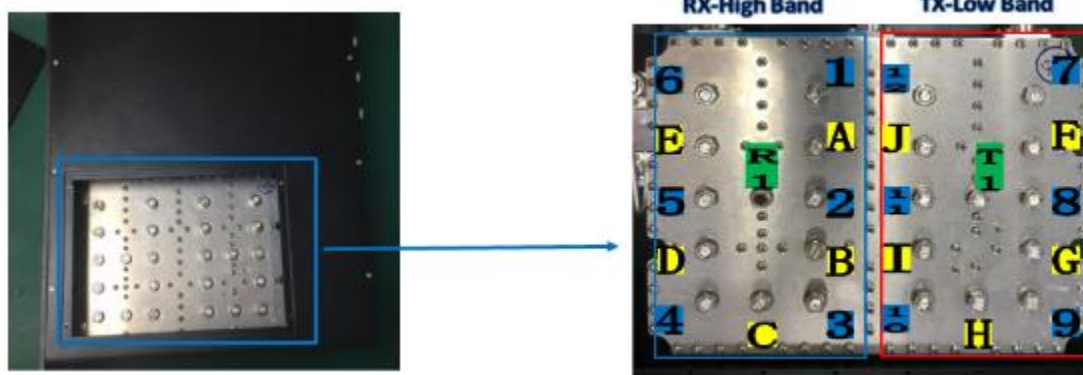


Fig.2 Duplexer Tuning Rods

- Tuning Rods identified by digital numbers 1-6 in blue: High band Rx band adjustment
- Tuning Rods identified by digital numbers 7-12 in blue: Low band Tx band adjustment
- Tuning Rods identified by letters A-E in Yellow: High band Rx bandwidth adjustment
- Tuning Rods identified by letters F-J in Yellow: Low band Tx bandwidth adjustment
- Tuning Rods identified by R1 and T1 in Green: Rejection (Tx/Rx isolation) adjustment

Network Analyzer Connection

Configuration and Connection for Rx Band Tuning

1. Connect VNA port1 to the product (**ECCS**) antenna port, and VNA port2 to ECCS port RX1, plug in ECCS power supply, and terminate other Rx ports with 50 Ohm loads.
2. Set VNA output power to -20dBm and markers for the interested Rx and Tx frequency ranges.
3. Adjust the gain switches on the rear panel to set the gain (S21) to 0-2dB.
4. Move the Rx tuning rods to adjust the Rx frequency range and bandwidth following the instruction given in the next section.

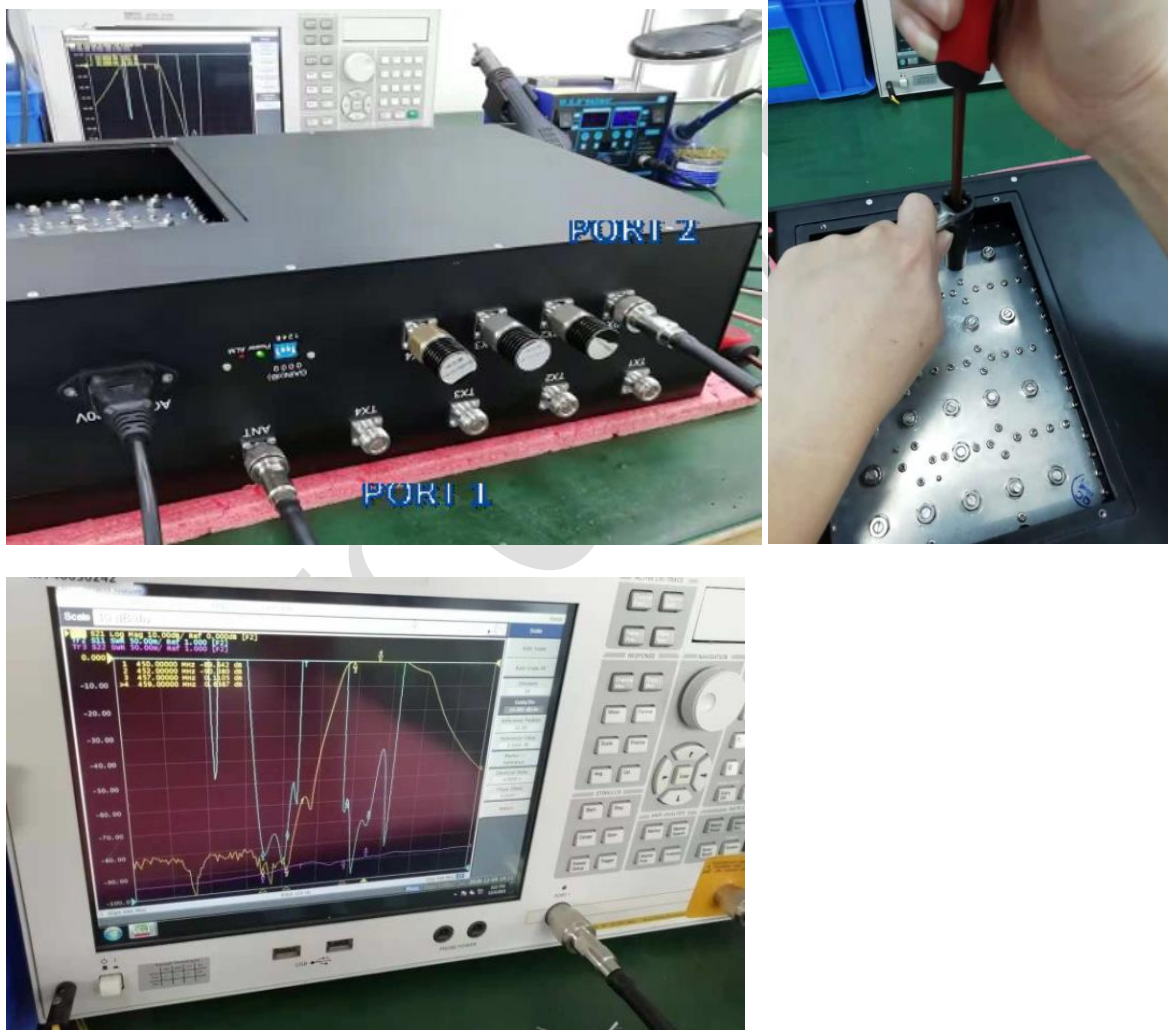


Fig.3 VNA Connection for Rx band tuning

Gain switches

- Up-On
- Down-Off

When all gain switches are off, the maximum output gain is 10 ± 1 dB. When a switch is on, the gain will drop corresponding to the number indicated by the switch. For example, if the 4 dB switch is on, then the gain will be $10 \pm 1 - 4 = 6 \pm 1$ dB. When more than one switches are on, the gain will drop corresponding to the summation of the numbers indicated by the switches.



Fig.4 Gain adjustment

Configuration and Connection for Tx Band Tuning

1. Connect VNA port1 to ECCS antenna port, VNA port2 to ECCS Tx1, plug in ECCS power supply, and terminate other ports with 50 Ohm loads.
2. Set VNA output power to -20 dBm and markers for the interested Rx and Tx frequency ranges.
3. Move the Tx tuning rods to adjust the Tx frequency range and bandwidth following the instruction given in the next section.

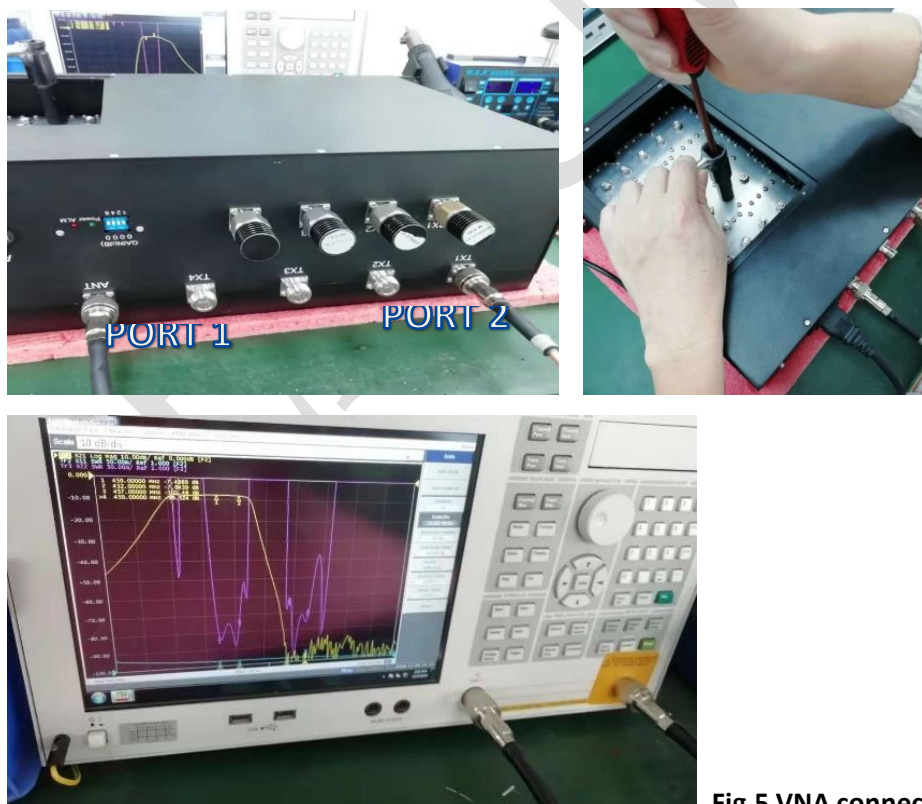


Fig.5 VNA connection for Tx tuning

Connection Check List

Measurement	VNA Connection and Configuration				
	Port1	Port2	Load	Measure	Output Power
Gain	ANT	RX1	TX	S21	-20dBm
VSWR(Rx1)	ANT	RX1	TX	S22	-20dBm
Out of Band Rejection (TX-RX)	ANT	RX1	TX	S21	-20dBm
Isolation (RX1-RX2)	RX2	RX1	ANT	S12	-20dBm
Insertion Loss (ANT-TX1)	ANT	TX1	RX	S12	
VSWR (ANT)	ANT	TX1	RX	S11	
VSWR (TX1)	ANT	TX1	RX	S22	
Isolation (ANT-TX1)	ANT	TX1	RX	S21	
Out of Band Rejection (RX-TX)	ANT	TX1	RX	S12	

Tuning Procedure

1. Flip over the unit, put it on a flat rubberized surface.
2. Remove the 4 screws for the cover on the bottom of the unit as show in Fig.6

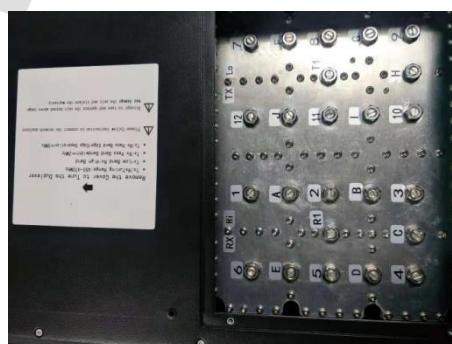


Fig.6 Remove the cover

3. Slightly loosen the nuts for tuning rods with the supplied socket wrench.

4. **Frequency band shift.** Gently move up and down the tuning rods with the screw driver to shift the band to desired new band then lock the nuts. Move the frequency tuning rods clockwise will lower the frequency, move the frequency tuning rods counter clockwise will increase the frequency. Move up and down the tuning rods smoothly and switch between each rod to maintain the shape of the VNA plots, as the example shown in Fig.7.

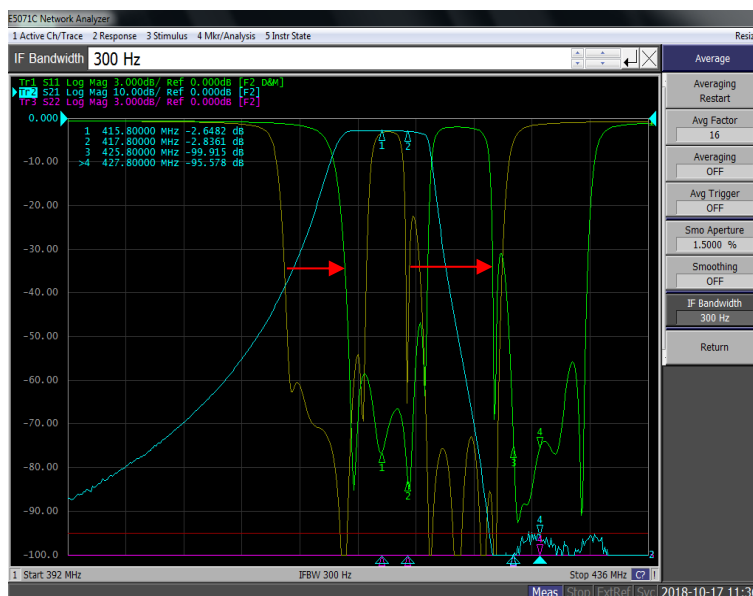


Fig.7 An example of 5MHz frequency shift by tuning
Yellow-The original frequency band Green-The retuned frequency band

5. **Bandwidth adjustment.** The bandwidth is pre-set at factory and not tunable except minor adjustable to compensate the effect of frequency band shift. Move the bandwidth tuning rods clockwise will widen the bandwidth, while counter clockwise will narrow the bandwidth.
6. **VSWR optimization.** The tuning in step-2 and step-3 may affect the VSWR, which can be compensated by the combined tuning between each rod. During the tuning process, if moving down a tuning rod will increase the VSWR, then move up the tuning rod to improve the VSWR and try to move other rods to achieve the attempted frequency shift or bandwidth adjustment.
7. **Rejection.** The Tx-Rx rejection is pre-set at factory and usually does not need tuning. In case it is needed, tuning rods T1 or R1 can be used to optimize the rejection.
8. **Verification.** Inspect all the parameters and ensure all meet the specification. Ensure each tuning rod screw is tightened and the performance is stable when pushing the tuning rods. Replace the cover and lock it by the screws.

Appendix: Sample Test Curves

Model Number: ECCS-450-470-4-4-1TB



Fig. 8 Tx band shifted from 450-452MHz shifted to 461-463MHz



Fig. 98 Rx band shifted from 457-459MHz to 468-470MHz