

**TUNING INSTRUCTIONS  
"TC" SERIES  
TRANSMITTER COMBINERS  
CM-1005**

**ENCLOSURES**

The following instructions include the tuning instructions for the "TC" series transmitter combiners and associated Isolators, Hybrid Couplers and Harmonic Filters.

"TC" Series .....	CI-1028-1031
Isolators .....	CI-1025-1027
Hybrid Couplers.....	CI-1032-1034
Harmonic Filters.....	CI-1035
Applications .....	CI-1036

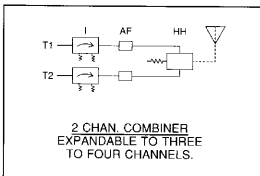
## "TC" SERIES TRANSMITTER COMBINERS 66-960 MHZ

### DESCRIPTION

This series of transmitter combiners are used in systems which require extremely close frequency separations. They utilize Sinclair manufactured Isolators, Hybrids and Harmonic Filters.

**STANDARD CONFIGURATIONS** allow combining up to four transmitters into one antenna. The tuning instructions which follow in this manual apply to two to four channel systems in the 125-150 watt power ratings, although up to five channels and higher power rated versions are available and the same tuning instructions apply.

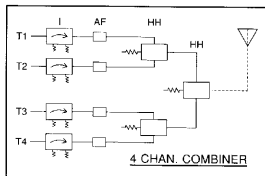
### SYSTEM DIAGRAMS



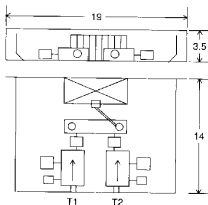
I- Dual or Single Stage Isolator  
(Dual Shown)

AF- Harmonic Filter

HH- Hybrid Coupler



NOTE: Dual Stage Isolators Shown With 15 & 30 Watt Loads And 125 Watt Loads At The Hybrid Couplers



### OUTLINE DETAIL

Typical outline drawing of Model TC-3212, two channel combiner shown in the 406-512 MHz Band.

Refer to page CI-1029 for electrical and mechanical specifications for other models.

## "TC" SERIES TRANSMITTER COMBINERS

### ELECTRICAL SPECIFICATIONS

	TC-2212	TC-2214	TC-3212	TC-3214	TC-4212	TC-4214
No. of Chan's	2	4	2	4	2	4
Freq. Range MHZ	132 - 174		406 - 512		806 - 960	
Freq. Separation MHZ	0-3		0 - 9		0 - 10	
Insertion Loss, Typ. dB	4.2	7.5	4.1	7.3	3.8	7.1
Isolation, Typ db	100					
TX - TX						
ANT-TX	55	58	55	58	53	53
Power Rating: Watts	150 Input Each Channel					
Terminations	Type "N" Female					

- The above electrical specifications are for transmitter combiners in the 132-960 MHz range with Dual Isolators and typical values shown for insertion loss and isolation values.
- For single stage isolators the values for insertion loss is reduced by 0.3-0.5 dB, and the values for isolation are reduced by 30 dB.
- Consult Sinclair Catalog or Sales Department for other frequency ranges and additional channels available.
- All models have VSWR specification of 1.25:1 referenced to 50 OHMS.

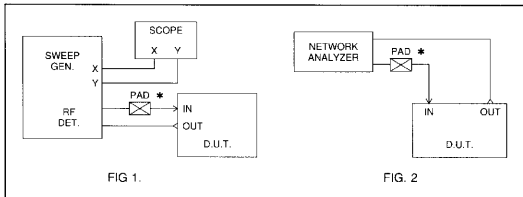
### MECHANICAL SPECIFICATIONS

	TC-2212	TC-2214	TC-3212	TC-3214	TC-4212	TC-4214
Height In.	3.5	10.5	3.5	10.5	3.5	10.5
Width In.	19 Rack Mount					
Depth In.	14					

The above mechanical specifications are for models which use either single or dual stage isolators.

## "TC" SERIES TRANSMITTER COMBINERS RETUNING INSTRUCTIONS

### TYPICAL TEST EQUIPMENT SET UPS:



Typical test equipment setups are shown in Figures 1 or 2.

- It is recommended to use a 6-10 dB pad in the input lines in order to reduce VSWR reflections which may be introduced in the test equipment being used.

Each sub-assembly of the transmitter combiner (the Isolator, Harmonic Filter, and the Hybrid Couplers) can be returned to the new frequencies of the 4% bandwidth BUT final tuning should be performed through the complete system. As stated on page CI-1031 the system should not be retuned under full transmitter power as damage may result to the Isolators and other components in the system.

Refer to the following pages for tuning of each sub-assembly associated with this transmitter combiner series.

## "TC" SERIES

### GENERAL INFORMATION

All "TC" series transmitter combiners are shipped factory tuned to specific frequencies as specified by the customer. The following tuning instructions apply if minor frequency changes are required in the field.

### RETUNING PROCEDURE

Refer to page CI-1030 for typical test equipment setups. The "TC" series consist of single or dual stage Isolators, Hybrid Couplers, Harmonic Filters and all required 50 OHM loads.

The system can be retuned in the field to new frequencies to within 4% of the existing transmit frequencies, which are determined by the bandwidth of the Isolators in the system.

If extreme changes in frequency are required, it is recommended to consult Sinclair sales or the system should be returned to the factory for retuning.

Retuning to new frequencies consist of tuning each sub-assembly-Isolators, Hybrid Couplers and Harmonic Filters either individually or through the complete system depending upon the equipment available.

Individual tuning of each sub-assembly is detailed in the following pages:

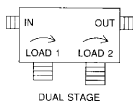
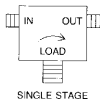
Isolators.....	CI-1025-1027
Hybrid Couplers.....	CI-1032-1034
Harmonic Filters .....	CI-1035

**NOTE:** Under no circumstances should the system be retuned under full transmitter power as damage may result to the Isolators in the system.

## ISOLATORS/CIRCULATORS

INSTALLATION AND TUNING INSTRUCTIONS

When used as isolators, both single and dual models are available with a variety of load terminations for the isolated ports. Retuning of these units may be performed in the field in the 2-4 MHz bandwidth by following the instructions in CI-1026-1027.

**TABLE 1 - ELECTRICAL SPECIFICATIONS**

	Freq. Band (MHz)	Insertion Loss (-cb)		Isolation (-db)	
		TYP	MAX	TYP	MIN
SINGLE STAGE	132-174	0.4	0.6	35	25
	406-512	0.3	0.6	35	25
	806-960	0.3	0.4	35	25
DUAL STAGE	132-174	0.7	1.0	75	50
	406-512	0.6	1.1	75	50
	806-960	0.55	0.7	75	50

VSWR: In/out (all units) (23 db+) 1.25:1 max.

**NOTE:**

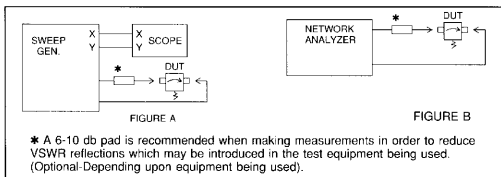
Ferrite isolators are subject to certain non-linearities and may conduct or generate a weak signal harmonic. For proper IM protection a low pass 2nd harmonic filter is often used between the isolator and antenna to suppress the 2nd and 3rd harmonic energy of the transmitter. The SRL AF series 2nd harmonic filters are available for this purpose.

All isolators/circulators are factory adjusted and tuned to specifications and the exact frequency as requested by the customer and have a 2-4 MHz bandwidth.

These units can be retuned within this bandwidth specification by adjusting tuning capacitors located at the front and rear of the units. Retuning beyond the bandwidth specification is not recommended in the field as this may require a readjustment of magnets located internally to the units.

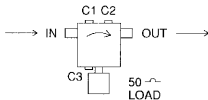
The isolators can be retuned using test setups as in Figures A & B or other equipment capable of measuring isolation, insertion loss, and reflected power (VSWR).

A signal source with a maximum output level of 100 MW (+20 dbm or less) is recommended. Under no circumstances should a transmitter be used to tune as isolator.



#### SINGLE STAGE ISOLATORS:

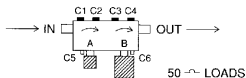
1. Connect the signal source to the input port of the isolator and monitor the output port. (The 50 Ohm load used in the system must be terminated at the isolator load port).
2. Adjust capacitors C1 and C2 for minimum insertion loss at  $f_0$ .



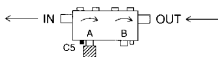
3. Reverse connections to the isolator in/out ports and adjust capacitor C3 to obtain typical isolation at  $f_0$  ( $\approx 35\text{dB}$ ).
4. Restore the connections as in step 1 and again adjust C1 and C2 for minimum insertion loss at  $f_0$ .
5. Check return loss (VSWR) at both input and output ports, the readings should agree with the specifications as shown in table 1 for single isolators. (Ref. page CI-1025)

**DUAL STAGE ISOLATORS:**

1. Connect the signal source to the input port of the isolator and monitor the output port. (The 50 Ohm loads used in the system must be terminated at the load ports).

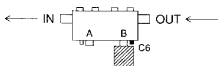


2. Adjust capacitors C1 thru C4 for minimum insertion loss at  $f_0$ .
3. Reverse the equipment in/out connections to the isolator and remove the 50 Ohm load from the isolator port B.



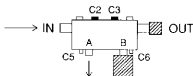
Adjust C5 to obtain maximum isolation at  $f_0$  ( $\approx 35$  db).

4. Remove the load from port A and connect the 50 Ohm load to port B.



Adjust C6 to obtain maximum isolation at  $f_0$  ( $\approx 35$  db).

5. Connect the signal source to the input port of the isolator and monitor the load port A. (Terminate the output port and port B with the 50 Ohm loads).



Adjust C2 and C3 for minimum insertion loss at  $f_0$  at load port A (This may require several minor back and forth adjustments of C2 and C3).

6. Restore all connections to step 1 and check insertion loss and isolation at  $f_0$ .
7. Check return loss (VSWR) at input and output ports.
8. Final minor optimized adjustments may be required by adjusting C2 and C3 only for insertion loss and C5 and C6 only for isolation.

The readings obtained should agree with the specifications as shown in table 1 for dual isolators. (Ref. PG CI-1025).



## "HH" SERIES HYBRID COUPLERS

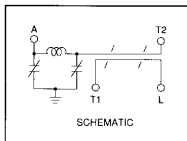
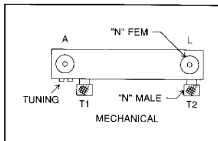
### DESCRIPTION

The basic hybrid coupler is a stripline device with a built-in LC matching network at its output port. The function of the hybrid is to couple two transmitters to a common load with as much isolation between the transmitters as possible.

In order that a 90 degree phase relationship is maintained and the hybrid directional properties remain valid, 1/2 or 3 dB of each transmitter's power must be dissipated. Thus, the attenuation of the desired signal is 3 dB plus approximately 0.2 dB for the through path and fitting loss.

An external resistive load capable of dissipating half the power of both transmitters must be connected to the hybrid load port. The antenna port has the tunable LC network which allows the hybrid to be matched to a slightly mismatched antenna system with a VSWR of up to 1.5:1.

With the hybrid properly matched to the antenna load characteristic, a minimum of 45 dB of isolation will be provided between the transmitters connected to the input ports, T1, T2.



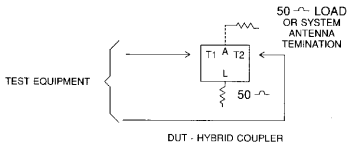
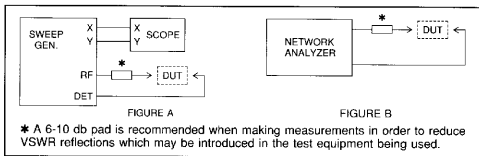
## Hybrid Couplers

### TUNING

All hybrid couplers are factory adjusted and tuned to the specifications and frequency as requested by the customer with all ports matched to 50 OHMS. If the VSWR of the antenna changes, the tuning capacitors may have to be adjusted slightly to compensate for this change.

These units can be retuned within their frequency range by adjusting the tuning capacitors located adjacent to the antenna port, using the test setup as follows or other equipment capable of measuring isolation, insertion loss, and reflected power (VSWR).

\* A 6-10 db pad is recommended when making measurements in order to reduce VSWR reflections which may be introduced in the test equipment being used.



### Hybrid Couplers

Adjust the test equipment to the mean frequency between the T1, T2 frequencies for which the hybrid is to be tuned and a setting of up to 75 dB for isolation.

Adjust to two capacitors located on the hybrid coupler for maximum isolation between ports T1 and T2 with the load port "L" terminated in 50 OHMS and the output antenna port "A" terminated in its system configuration or an equivalent 50 OHM load. No further adjustments to the capacitors are required. The isolation value obtained from port T1-T2 should be a minimum of 45 dB with a typical value of 75 dB.

The insertion loss per port T1, T2 to antenna should be a maximum of 3.30 dB and a return loss (VSWR) of 1.25:1 maximum.

Electrical Specifications	HH-1140	HH-2140	HH-3140	HH-4140
Frequency Range: MHz	66-100	132-174	406-512	806-960
Insertion Loss (max): dB	3.3	3.25	3.3	
Isolation-T <sup>1</sup> to T <sup>2</sup> (min.) when Tuned to Load Z <sub>0</sub> dB	45			
VSWR T <sup>1</sup> and T <sup>2</sup> Ports	1.25:1			
Power Rating: watts	350			300
Terminations:				
T <sup>1</sup> and T <sup>2</sup> Inputs	Type "N" male			
Load and Antenna	Type "N" Female			

Note: (1) Isolation values given are minimum; typical values on factory tuned hybrids are 75dB.

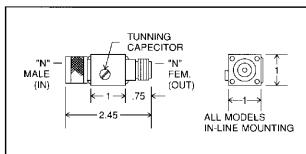
Mechanical Specifications	HH-1140	HH-2140	HH-3140	HH-4140
Height: in.	2			
Width: in.	17		7	4
Depth: in.	2			

## "AF" SERIES TUNABLE HARMONIC FILTERS

### DESCRIPTION

The tunable harmonic filters are used primarily in conjunction with ferrite type transmitter combiner systems. Ferrite isolators are subject to certain inherent non-linearities and may conduct or generate a weak second harmonic. This undesired weak signal will be at least 55 db below the carrier power, but can contribute to third order IM products.

Harmonic filters provide a minimum of 36 db of second harmonic attenuation - insuring that this component will be 90 db or more below carrier.

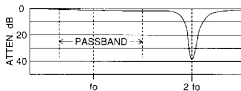


### TUNING

The units may be retuned to any frequency range within the specified bands of the model being used; by using a sweep generator and visual display or equivalent equipment to measure insertion loss, attenuation, and VSWR.

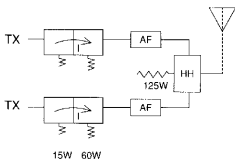
Each unit is composed of an LC type tuned circuit to pass the complete frequency band of the model being used. The only adjustment required is to tune the capacitor on the unit for maximum attenuation at the 2nd harmonic. Insertion loss and VSWR across the pass band should meet specifications without further adjustments. The specifications and typical response curve are as shown:

MODEL	FREQ. BAND
AF-2140	132-174 MHz
AF-3140	406-512 MHz
AF4140	806-960 MHz
AF-1140	66-100 MHz

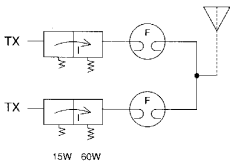


### All models:

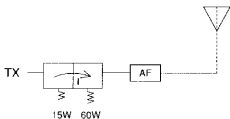
Insertion loss @  $f_0$  .....0.1 db max.  
 Attenuation @  $2 f_0$  .....36 db min.  
 Power rating .....300 Watts  
 VSWR (max) .....1.2:1  
 Impedance .....50 Ohms

**TYPICAL APPLICATIONS:**

"TC" Series  
Hybrid-Ferrite  
Transmitter combiner system for extremely close  
frequency separations



"TJ" Series  
Cavity-Ferrite  
Transmitter combiner system for moderate  
frequency separations



"PC" Series  
Combined isolator and 2nd harmonic filter for IM  
control in existing base stations

- I.....Single or Dual Isolators  
AF.....Harmonic Filters  
HH.....Hybrid Couplers  
F.....Bandpass Filters