INSTRUCTION MANUAL

Description and tuning instructions

for transmitter diplexing filters

Power : 300 W, 1 kW and 3 kW

Description of a star-point diplexer

A star-point diplexer is made by parallel circuiting two band pass filters having different pass bands. Care must be taken, however, to ensure that the impedance transformed by the one band pass filter at the junction point does not affect the pass band of the other filter.

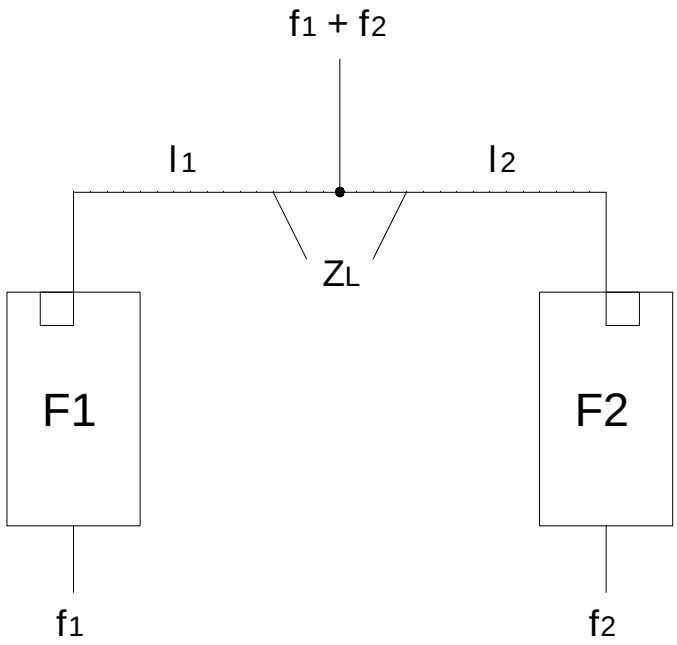


Fig. 1

In the diplexer illustrated in Fig.1, filter F1 permits frequency f_1 to pass, whereas filter F2 cuts it off. In relation to frequency f_1, filter F2 presents a short circuit at its inputs. Via an electrically effective cable length of $\lambda/4$ (made up of l_1 and the length of the input coupling loop), this shorting circuit is transformed into a very high impedance Rp at the junction point. In contrast, due to the matching of its input impedance for a frequency of f_1, filter F1 presents impedance Z_L at this point. The filter F2 functions in the analog manner in relation to frequency f_2.

Summary:

The diplexing filter, consisting of two filters and a junction point with defined cable lengths, has two narrow band inputs corresponding to the pass band characteristics of the filters.

Description of 2-way directional filter

This functional description is made with reference to the block schematic circuit diagram. The assumption is made that input 1 will be fed with a series of frequencies lying within the operating frequency range of the 3 dB couplers. The energy of these individual frequencies will be distributed in the ratio 1 : 1 to the coupler outputs and passed to the identically tuned filters 1 and 2. Frequencies failing in the pass band of the filters are fed on, but that in. the stop bands are reflected. While the phase relationship resulting from the reflection and the characteristics of the 3 dB coupler cancel the reflected energy component at input 1, they sum up at the diagonally opposite connection; in this case linked to an absorber.

The result is thus that at input 1 no energy can be reflected for frequencies lying within the operation band of the 3 dB coupler so that broad band matching is achieved. This presupposes that filters 1 and 2 are identically tuned and terminated in their own characteristic impedance. This matched termination and the proper phase relationed addition of the energy fed to the output (antenna)is carried out by the second 3 dB-coupler.

All frequencies injected into input 2 are fed by the coupler to filters 1 and 2 from whence, with the exception of components lying in the filters pass band, they are reflected. The reflected energy components are directed by the coupler to the connection positioned diagonally opposite to input 2 and marked “Antenna”. The frequencies falling in the pass band of the filters are fed to the absorber.

Summary

The diplexing filter, comprising two 3 dB couplers and two identically tuned band—pass filters, has a narrow band input (input 1) corresponding to the filters pass curve, and a broad band input which conducts all frequencies not within the filters pass band to a common output. The impedance of both inputs is frequency-independent and corresponds to the characteristic impedance of the filters and the couplers.

Practical results:

1. Since the filters and couplers do not function ideally, a residual ripple remains at input 1; it is maintained as small as possible by suitable adjustment in the operating channel. Since the couplers suffer practically no loss, the insertion loss between, input 1 and the output (antenna) corresponds to the pass band attenuation of the filter.

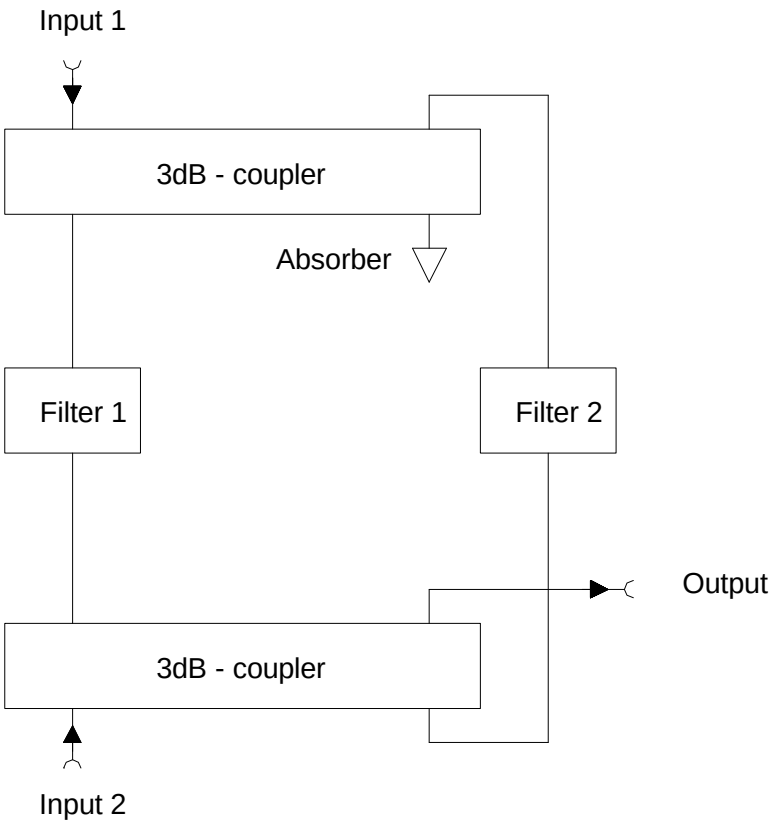
2. Coupling attenuation between inputs 1 and 2 corresponds to the sum of the pass band attenuation and the symmetrical attenuation of the 3 dB couplers connected to input 2. Assuming careful assembly, this latter Is in the order of 20- 30 dB.

3. Due to the constant input impedance and the broad band nature of input 2, this type of diplexing filter can easily be cascaded. It is even possible to connect a simple star point diplexer to input 2. This in turn means easy expansion of the network from 2 to 3 or more inputs.

4. Since refection on the filters in their stop band is bow loss, the insertion loss between input 2 and the output is exceptionally small; less than 1/10 dB.

5. The symmetrical attenuation of the 3 dB coupler on input 2 remains to provide coupling attenuation for the frequencies in the filters pass band between inputs 1 and 2.

Block schematic circuit diagram (2 way directional filter)



Input 1 = Narrow band input
Input 2 = Broad band input
Filter 1 and filter 2 are 3-circuit band-pass filters

Construction of multiplexing filters with more than 2 inputs.

1. It is possible to construct a type of triplexer (triple transmitter combining filter) by combination of a directional filter and a star-point diplexer; each with two inputs. The output of the star-point diplexer is fed to the broadband input of the directional filter. Thus, the result is three narrow band inputs. Function can be understood from the block diagrams together with the description of the directional filter and the star-point diplexing filter.
   Example: Refer to block schematic circuit diagram of the VHF transmitter combining filter

   The increased outlay far one filter and two 3 dB-couplers provide the following advantages in comparison with a triple star-point filter:

1.1 The length of the connecting cable between the two units is not critical and so allows unrestricted construction.

1.2 The two filters in the directional coupling network are only subjected to half the transmission output, giving either cooler operation for the same size or a reduction in the size of the components.

1.3 In the case of the filters in the star-paint diplexer, the required attenuation need only be achieved at double the required minimum frequency separation of the triplexer.

   Due to the additional decoupling of the 3 dB-coupler, the directional filter can be easily designed to give higher attenuation.

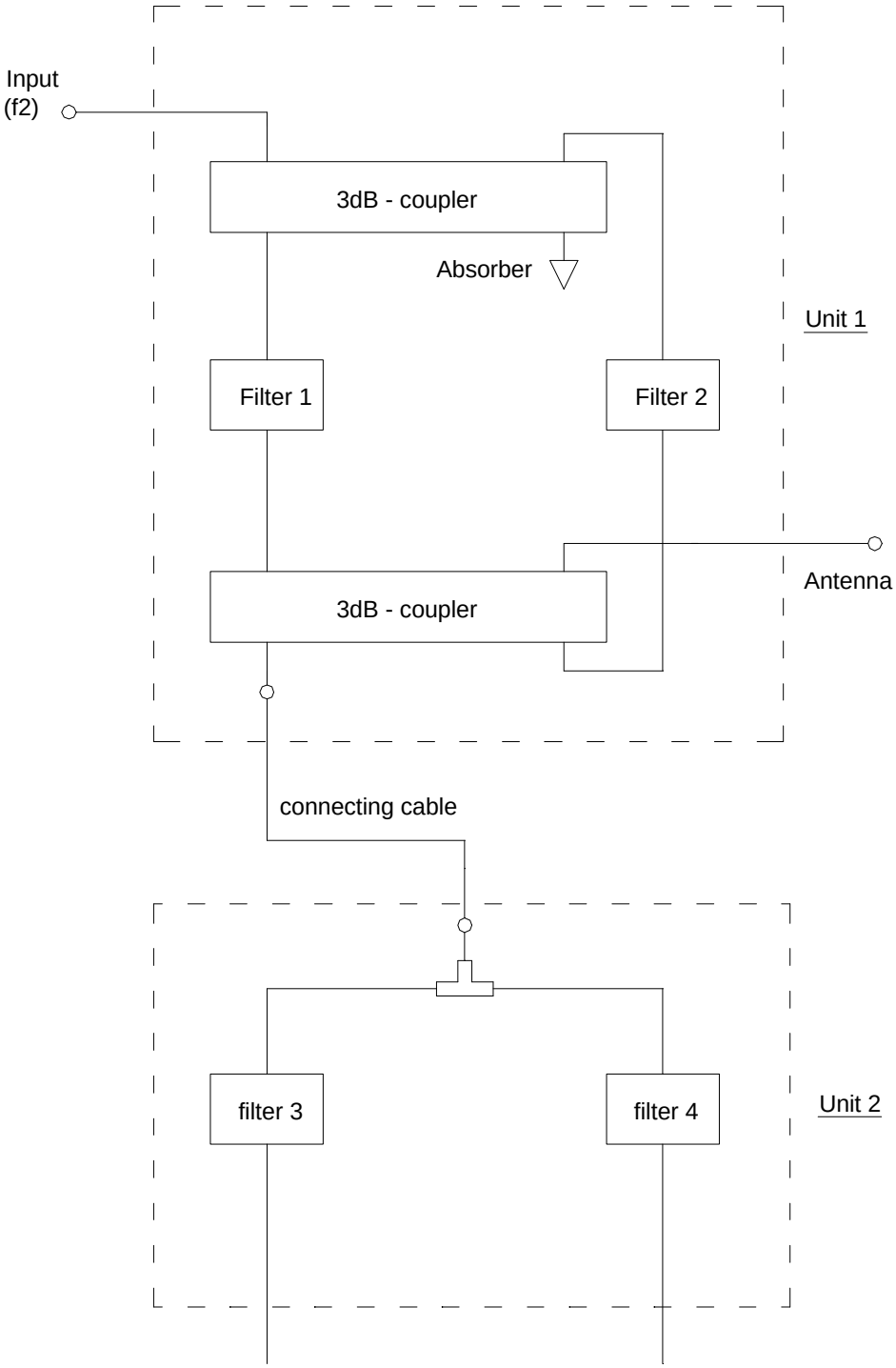
2. A star-point triplexer is created by connecting three filters in parallel.

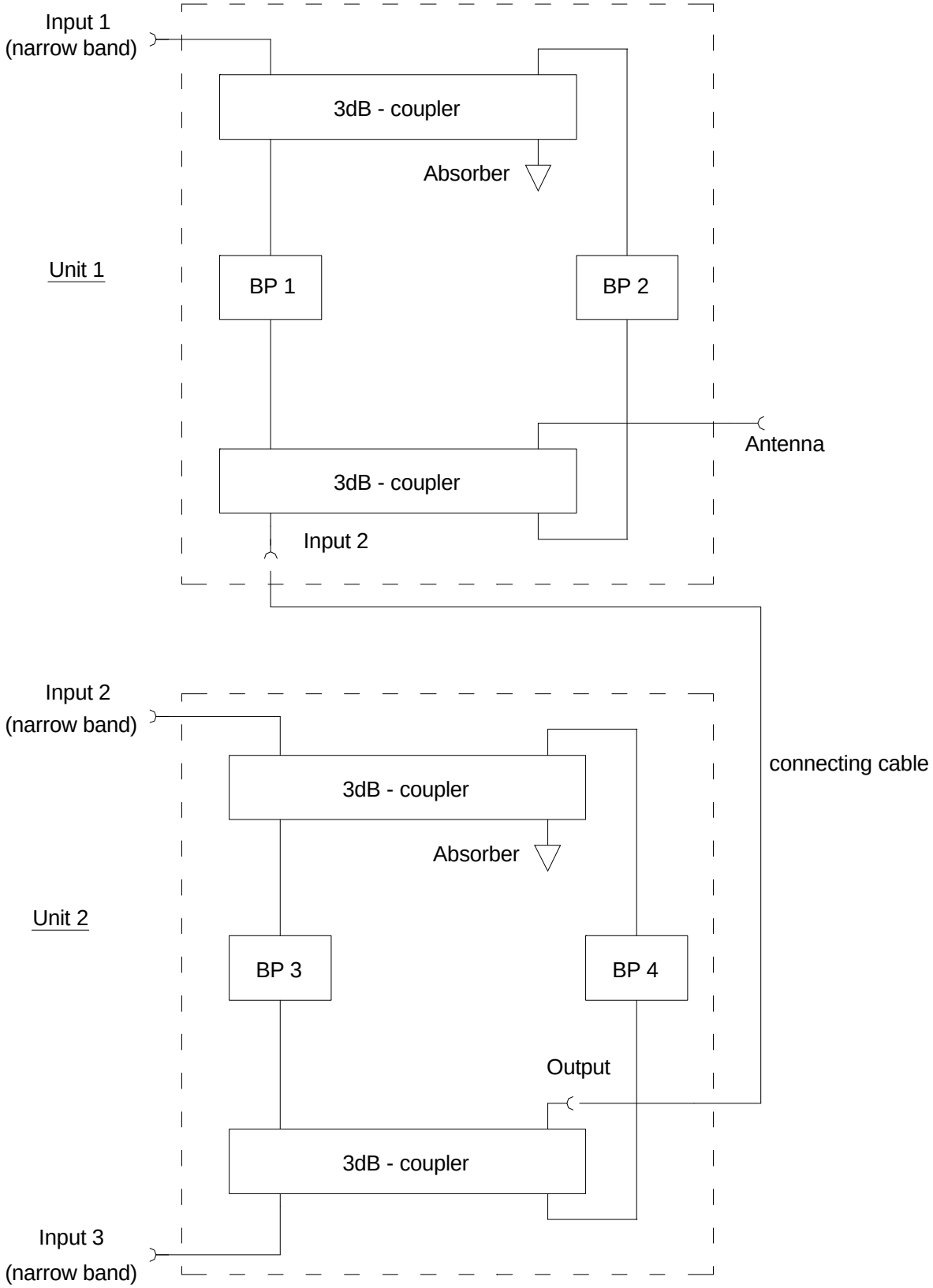
3. Triplexing filters can also be constructed by cascading two directional filters. In this case the output of the second cascade is fed to the broad band input of the first diplexer. The result is two narrow band inputs and one broad band input.

   Example: Block schematic circuit diagram

$f_1 \leq f_2 - 2\ MHz$

$f_3 \geq f_2 + 2\ MHz$




Input 1
(narrow band)
3dB - coupler
Absorber
Unit 1
BP 1
BP 2
Antenna
3dB - coupler
Input 2
Input 2
(narrow band)
connecting cable
3dB - coupler
Absorber
Unit 2
BP 3
BP 4
Output
3dB - coupler
Input 3
(narrow band)

Scope for expansion:

Two possibilities are open if an already available triplexer is to be converted into a multiplexer with additional inputs:

1. Extension of the twin star-point diplexing filter to three or more inputs. This method is always to be recommended if the frequency separation between the new transmitter and that already in use is considerably greater than the specified minimum separation. Since it is highly unlikely that 4 or more transmitters, each with very low frequency separation, are grouped together, it is nearly always possible to employ this circuit.

2. If the frequency separation of an additional transmitter is relatively low in relation to other transmitters, a further selective coupling filter must be connected ahead of it with the output of the triplexer fed into the broad band input of the new directional filter.
   If other extensions are contemplated, please consult us.

The transmitter combining filters are factory-tuned to the specified operating channels. Re-tuning can be carried out on site in accordance with the following tuning instructions.

The 3-resonator filter has 7 tuning devices:

- input coupling
- output coupling
- two interstage couplings
- the frequency setting facility far each of the 3 individual resonators -- coarse and fine adjustment.