Functional description

and

integration instructions

for Repeater using

band modules with

variable bandwidth.

Contents

1 Functional description

The band module with variable bandwidth can be set to a desired centre frequency and to a desired bandwidth.

The explanation how it works is made with reference to the following figures and exemplary values for frequencies, bandwidths and levels.

There are two filters in one link (UL or DL) in series in the band module which can be set to a defined centre frequency. In the example we have two filters with a bandwidth of 25 MHz each and for demonstration purposes the frequency range is 870 to 940 MHz.

In Fig. 1 we see that filter 1 and filter 2 are both set to a centre frequency (CF) of 900 MHz. The resulting overall response of the module is thus a 25 MHz band with a centre frequency of 900 MHz ($\Rightarrow$ frequency range from 887.5 MHz to 912.5 MHz). The attenuation in the stop band of one filter was assumed to be 40 dB. Thus, the overall attenuation of the module is 80 dB.
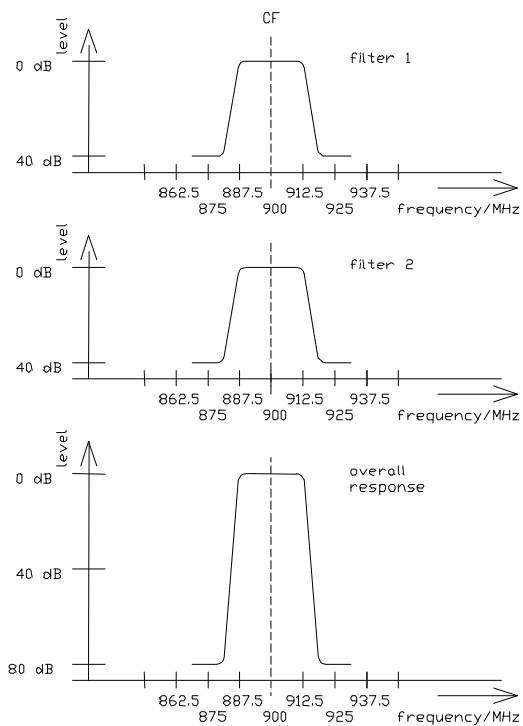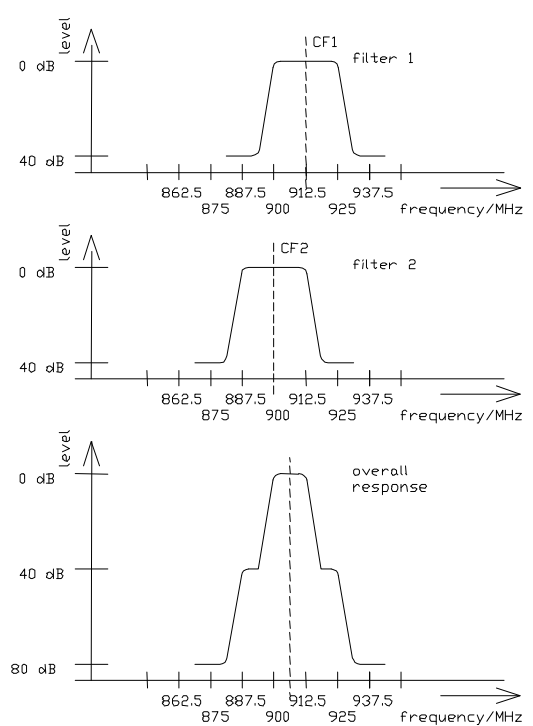
Fig. 1

Fig. 2

In Fig. 2 we have the same filters but this time with different centre frequencies. The centre frequency of filter 1 is this time 912.5 MHz and the centre frequency of filter 2 is again 900 MHz. Consequently, we get another overall response of the module as can be seen in fig. 2. Filter 1 limits the frequency range towards lower frequencies and filter 2 towards higher frequencies. The resulting response is thus an attenuation of 80 dB up to 881.25 MHz, 40 dB up to 893.25 MHz, 3 dB bandwidth is 12.5 MHz from 900 MHz to 912 MHz, 40 dB attenuation from 918.75 MHz and 80 dB from 931.25 MHz. (Values exemplary!)

It is shown in the following how the centre frequency and the bandwidth of the module can be set to desired values.

2 Integrating a conversion module and programming communication bus address

2.1 What you have to know of your system before the setting

Prerequisite for the adjustment is to know the bandwidth of the filters used in the module. (Can be gained using the VER command.) With this bandwidth and the desired values the start frequency and stop frequency (and thus the bandwidth and centre frequency) of the band can be set. The following formula shows how to calculate the values that have to be entered.

$$CF1 = f_{Start} + \frac{BW_{filter}}{2} \qquad CF2 = f_{Stop} - \frac{BW_{filter}}{2} \; ;$$
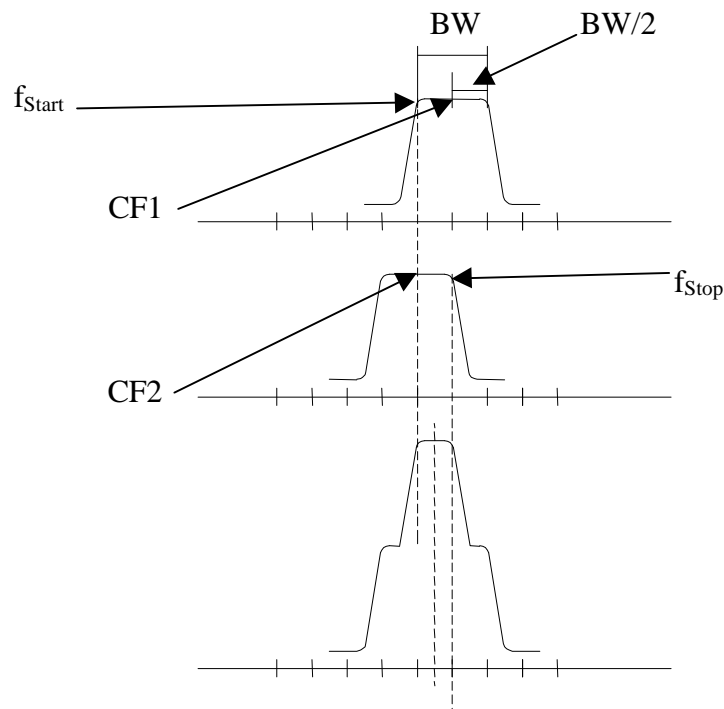
where
CF1 is the centre frequency of the first filter (to be entered)
CF2 is the centre frequency of the second filter (to be entered)
f_{Stop} is the stop frequency of the desired band (upper frequency)
f_{Start} is the start frequency of the desired band (lower frequency)
BW_{filter} is the bandwidth of the two filters of the module (can be gained with VER command)

2.2 Setting the bus address of the module

Another thing to know is the allocation of the filters to the respective links. Each filter is allocated to a link and a filter number by means of hex-coded rotary switches. Each rotary switch can be set to positions from 0 to F (16 positions) by means of a small screw driver.

This adjustment is important if you want to insert a module into a Main Unit or Extension Unit as the hex-coded rotary switches have to be set according to the Unit. If the module was inserted in the factory you don't have to care about that.

The following figure shows where the hex-coded rotary switches are located and the table shows the allocation.

back side
of the module
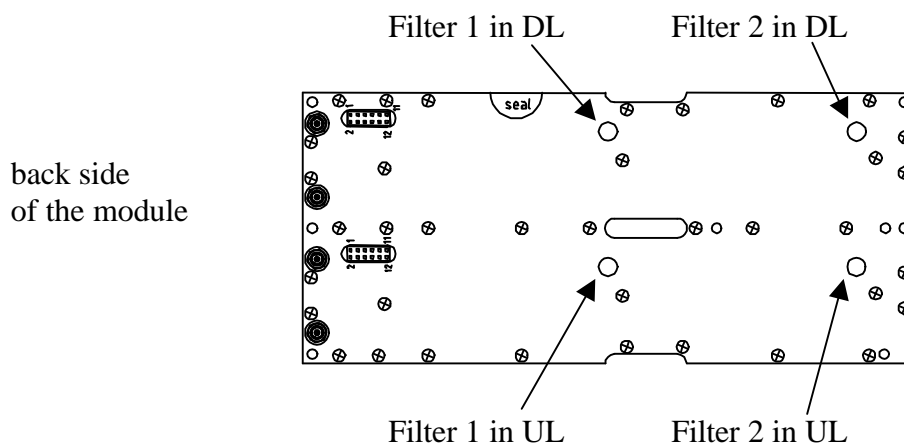
Rotary switch positions:

	Filter 1		Filter 2	
	UL	DL	UL	DL
Main Unit	0	1	2	3
Extension Unit 1	4	5	6	7
Extension Unit 2	8	9	A	B
Extension Unit 3	C	D	E	F

Example: Rotary switch for filter 2 UL (right hand side at the bottom) in Extension Unit 2 has to be set to A.

Note: Extension Unit 1 can also be the second module in an 8K cabinet.
Extension Unit 2 can also be the third module in an 8K cabinet.
Extension Unit 3 can also be the fourth module in an 8K cabinet.

2.3 Which CF to set?

When setting the centre frequency the software queries for a band module (1-8). This number has to be considered carefully because the band module with variable bandwidth contains two filters that can be shifted independently whereas in the standard band module only one centre frequency can be shifted. That means that one band module with variable bandwidth requires two band module numbers to be set. The following schematic figure and the table shall explain what band module number has to be entered.

band module with variable bandwidth
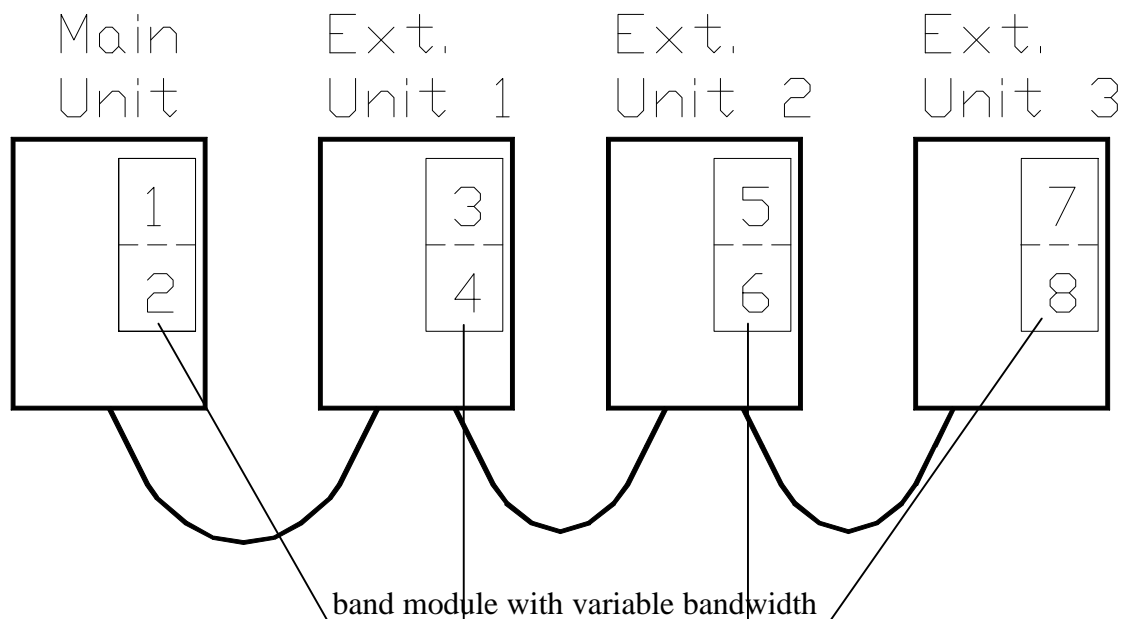
Band module number:

	Main Unit	Ext. Unit 1	Ext. Unit 2	Ext. Unit 3
Filter 1	1	3	5	7
Filter 2	2	4	6	8

Example: Band module number of filter 1 in Extension Unit 2 is 5 and number of filter 2 in Extension Unit 2 is 6.

Note: Extension Unit 1 can also be the second module in an 8K cabinet.
Extension Unit 2 can also be the third module in an 8K cabinet.
Extension Unit 3 can also be the fourth module in an 8K cabinet.

2.4   Attenuation setting

One band module with variable bandwidth needs to be addressed as if there were two modules (see also chapter 2.2).

This means for the attenuation setting that, theoretically, there are two different attenuations that can be set in one module. This is, however, wrong. Only one attenuation setting can be done. This setting has always to be done in the even module number (Filter 2). Thus, attenuation settings can only be done in module numbers 2, 4, 6 and 8.

If settings on the odd module numbers are executed the software will show dummy values but these values are not valid. This attenuation is not really set.

Example: If you want to set the attenuation of the band module with variable bandwidth in the Extension Unit 2 you have to set the attenuation via software in the band module 6. See also table in chapter 2.3.

Note: Extension Unit 1 can also be the second module in an 8K cabinet.
        Extension Unit 2 can also be the third module in an 8K cabinet.
        Extension Unit 3 can also be the fourth module in an 8K cabinet.

2.5 Required software commands

The software command to set the centre frequency (CF1 and CF2) of the filters and the attenuation is given in the following.

With the SET CF command the centre frequency of a filter can be set with an accuracy of 10 kHz in GSM900 and 100kHz in GSM1800. The SET CFO (centre frequency offset) command is for correction purposes only and should be avoided if possible. SET CFO can be set in steps of 10 kHz from – 1000 kHz to + 1000 kHz. (See also software manual for more details.)

SET CF

```
        Syntax:      SET CF ↵
                     ENTER BAND MODULE (1-8): ↵
                     ENTER CF UL <MHz>: ↵
                     ENTER CF DL <MHz>: ↵
```

SET CFO

```
        Syntax:      SET CFO ↵
                     ENTER BAND MODULE (1-8): ↵
                     ENTER CFO UL <kHz>: ↵
                     ENTER CFO DL <kHz>: ↵
```

SET ATT

```
        Syntax:      (ENTER Repeater Number (1-4): ↵) *
                     ENTER BAND MODULE ( 1-8 ): ↵
                     ENTER MODE ( UL or DL): ↵
                     ENTER ATTENUATION: ↵
```

                        * (This is only valid in some earlier software versions!)

Band module number can be found in table "Band module number".

3 Example

An example shall demonstrate the above statements.

For further details how to perform certain actions please refer also to the Repeater manual.

Assumed we want to replace a module with variable bandwidth in an Extension Unit 2. The desired bandwidth is 16.2 MHz and the desired centre frequency in the UL is 902.5 MHz and in the DL 947.5 MHz. The attenuation in UL has to be set to 16 dB and 22 dB in the DL.

First thing is to check whether the rotary switches of the module are in the correct position. The rotary switch for filter 1 in UL has to be in position 8, for filter 1 in DL in position 9, for filter 2 in UL in position A and for filter 2 in DL in position B. (See table "Rotary switch position".)

The module has to be inserted and if the bandwidth of the filters in the module is not known it can be gained with the VER command. Entering the VER command will be responded by (amongst others) the hardware of the Repeater including the bandwidth of the filters. The response for example of the software in a MR301A with 25 MHz filters would be: `MR301A-25`, where 25 shows the bandwidth in MHz.

Next thing to do is to calculate the centre frequencies that have to be entered. With the above given formula we get:

UL:

$$CF1 = f_{Start} + \frac{BW_{filter}}{2} = (902.5 - 8.1)\ \text{MHz} + 12.5\ \text{MHz} = 906.9\ \text{MHz}$$

$$CF2 = f_{Stop} - \frac{BW_{filter}}{2} = (902.5 + 8.1)\ \text{MHz} - 12.5\ \text{MHz} = 898.1\ \text{MHz}$$

DL:

CF1 = (947.5 – 8.1) MHz + 12.5 MHz = 951.9 MHz

CF2 = (947.5 + 8.1) MHz – 12.5 MHz = 943.1 MHz

Having all the values the centre frequencies can be set with the SET CF commands as follows: (Band module number can be found in table "Band module number".)

```
SET CF ↵
     ENTER BAND MODULE (1-8): 5↵
     ENTER CF UL <MHz>: 906.9↵
     ENTER CF DL <MHz>: 951.9↵

SET CF ↵
     ENTER BAND MODULE (1-8): 6↵
     ENTER CF UL <MHz>: 898.1↵
     ENTER CF DL <MHz>: 943.1↵
```

And the attenuation can be set as follows:

```
SET ATT
     ENTER BAND MODULE ( 1-8 ): 6↵
     ENTER MODE ( UL or DL): UL↵
     ENTER ATTENUATION: 16↵

SET ATT
     ENTER BAND MODULE ( 1-8 ): 6↵
     ENTER MODE ( UL or DL): DL↵
     ENTER ATTENUATION: 22↵
```

4 Quick reference for experienced users

4.1 Frequency adjustment in UL and DL in module 1

Setting lower band edge:

SET CF
1

$$\text{Lower band edge} + (\frac{\text{filter bandwidth}}{2})$$

Setting lower band edge:

SET CF
2

$$\text{Upper band edge} - (\frac{\text{filter bandwidth}}{2})$$

4.2 Frequency adjustment in UL and DL in modules 2/3/4

Same as above with 3 and 4 / 5 and 6 / 7 and 8.

4.3 Attenuation

SET ATT
2/4/6/8 (for module 1/2/3/4)
Attenuation value