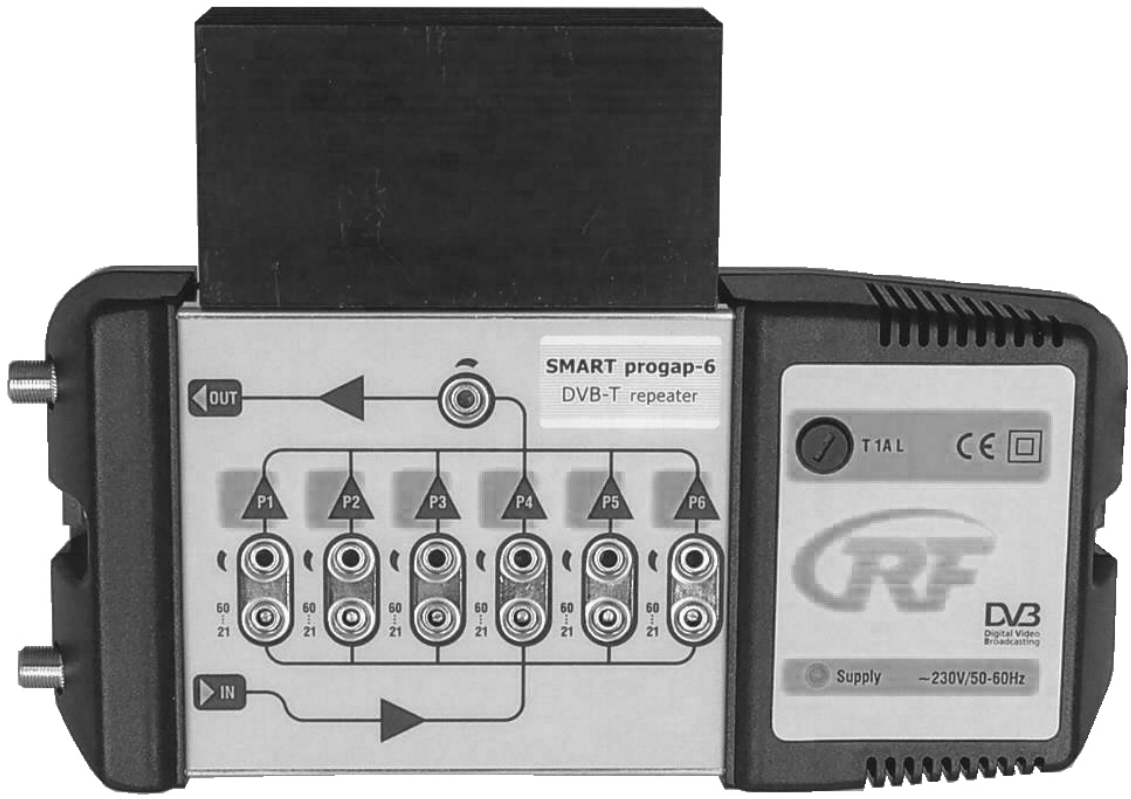
SMART progap-6

Repeater/gapfiller for DVB-T and DVB-H signals

USER MANUAL



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I. Purpose of use

SMART progap-6 is a low-power DVB-T/H gapfiller designed for implementation of wireless digital TV networks for any type of buildings and residences.
A wireless digital TV network is realized easily with **SMART progap-6** by connecting it with an ordinary roof-top receiving TV antenna and a small transmitting antenna, typically located in a staircase of the building, thus making the reception of DVB-T programs possible in all positions in the building with a simple indoor antenna.

The basic structure of a wireless system is presented below in Figure 1.

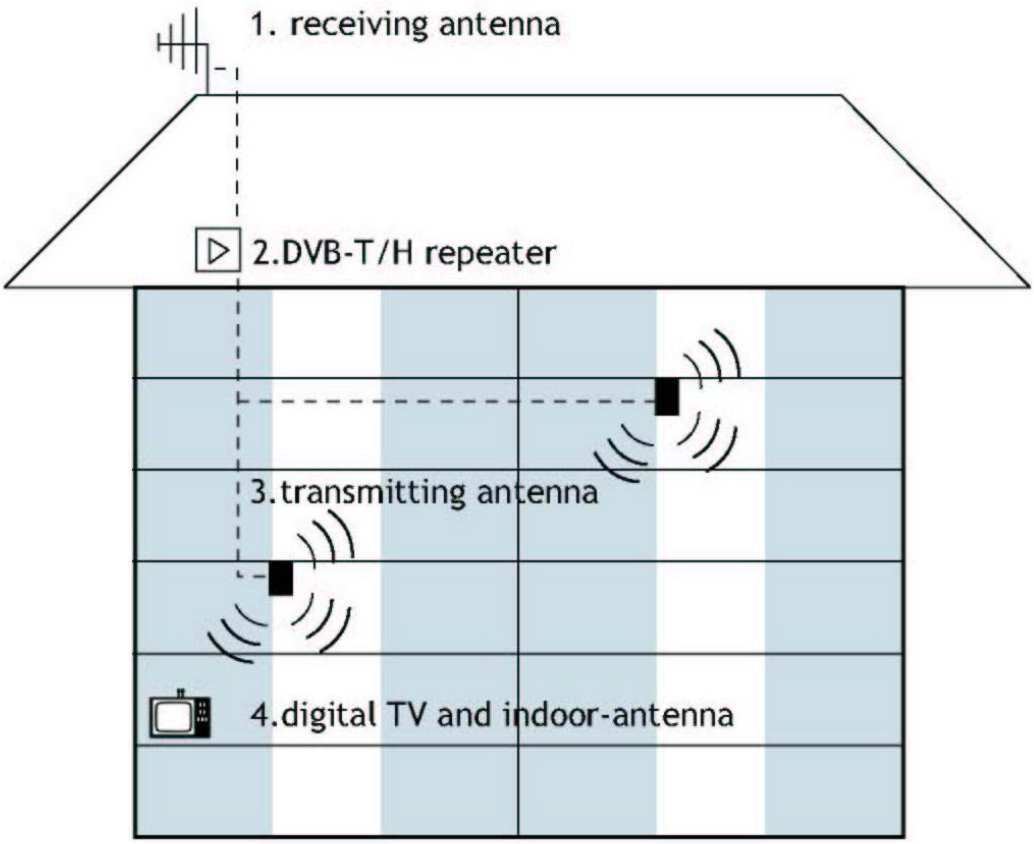

FIG. 1. Structure of the wireless DVB-T/H system

II. Operating principle

SMART progap-6 is a selective high-gain UHF TV-band amplifier with high (200 mW) output level.
It contains a low-noise pre-amplifier stage followed by six (6) separate selective UHF channel amplifiers.
Each of these amplifiers has independent operating frequency and gain adjustment.
The final stage of the gapfiller is a common output amplifier equipped with automatic gain control (AGC).
This function ensures the constant output level of the gapfiller, regardless of variations in input signal levels.

III. Installation and adjustment

The implementation of the wireless DVB-T/H system contains some matters differing from a typical MATV amplifier installation. These facts should be understood and taken into account.

The gapfiller is a device that receives, amplifies, and re-transmits the DVB-T/H signals at the original frequency. Therefore it is possible that in some undesired situations the whole wireless system might start to oscillate and generate strong interference in the neighborhood. This can be avoided by following the instructions given below.

1. Receiving antenna and required minimum input level

In order to operate as designed, the **SMART progap-6** requires an input signal level from the receiving antenna of **no less than 60 dBµV.**
Therefore the gain of the receiving antenna must be sufficient. The location of receiving antenna must also be carefully examined to ensure the performance of the whole wireless system. A **SMART pre2** pre-amplifier can be used in weak receiving conditions.

2. Transmitting antenna

SMART Digit is a wide-band transmitting antenna designed for use together with **SMART progap-6**. The radiation pattern of the antenna is relatively wide, in order to fulfill the needs of the wireless DVB-T/H system. The nominal impedance of the antenna is 75 ohms.
In a typical apartment building installation, a transmitting antenna is installed in each the staircase. In very large buildings several antennas may be needed. The antenna can be installed on the wall or ceiling directly or by using a suitable stand. Do not install any transmitting antenna closer than three meters from the **SMART progap-6**.

Fig. 2. Wall-mounted **SMART Digit** transmitting antenna

3. Antenna isolation

An essential point in the operation of a gapfiller is to get sufficient isolation between receiving and transmitting antennas, so that the maximum available transmitting power can be used without signal degradation and to avoid self-oscillation of the system in a fault situation.
This isolation is strongly dependent on the placement of the receiving and transmitting antennas.
A rule of thumb is that the required isolation is 20 dB greater than the actual gain of the gapfiller.

Example:

Minimum isolation = 20 dB + output level [dBµV] – input level to gapfiller [dBµV]

- output level 50 mW (per channel) = 126 dBµV
- input to gapfiller = 60 dBµV

Required isolation is: 20 + 126 – 60 **= 86 dB**

The antenna isolation can be measured as follows:

1. Connect an antenna level meter or spectrum analyzer to the receiving antenna and find one empty and interference-free TV channel (noise level < 20 dBµV) near every used DVB-T/H channel.
2. Connect a UHF signal generator to the transmitting antenna. (Our **TM-8** TV modulator can be used as a low-priced test generator.)
3. Set the test generator on lowest test frequency and set the output level to 110 dBµV.
4. Measure the test signal level coming from the receiving antenna.
5. In case the test signal is too low to be measured, the isolation is positively sufficient.
6. The antenna isolation value is: 110 dBµV – measured test signal level.
7. Repeat the same test at other test frequencies.

4. Gapfiller adjustments

SMART progap-6 has six channel amplifiers marked **P1–P6.** Each amplifier has two adjustments. The lower, marked **"21–69"**, is a multi-turn operating frequency adjustment, and above it is the gain adjustment. The uppermost, marked with a **"⌒"** symbol, is the output level adjustment.
The AGC voltage is the output from a small sized connector, located at the bottom of the gapfiller.
The placement of the connectors and adjustments are shown in the figure below.

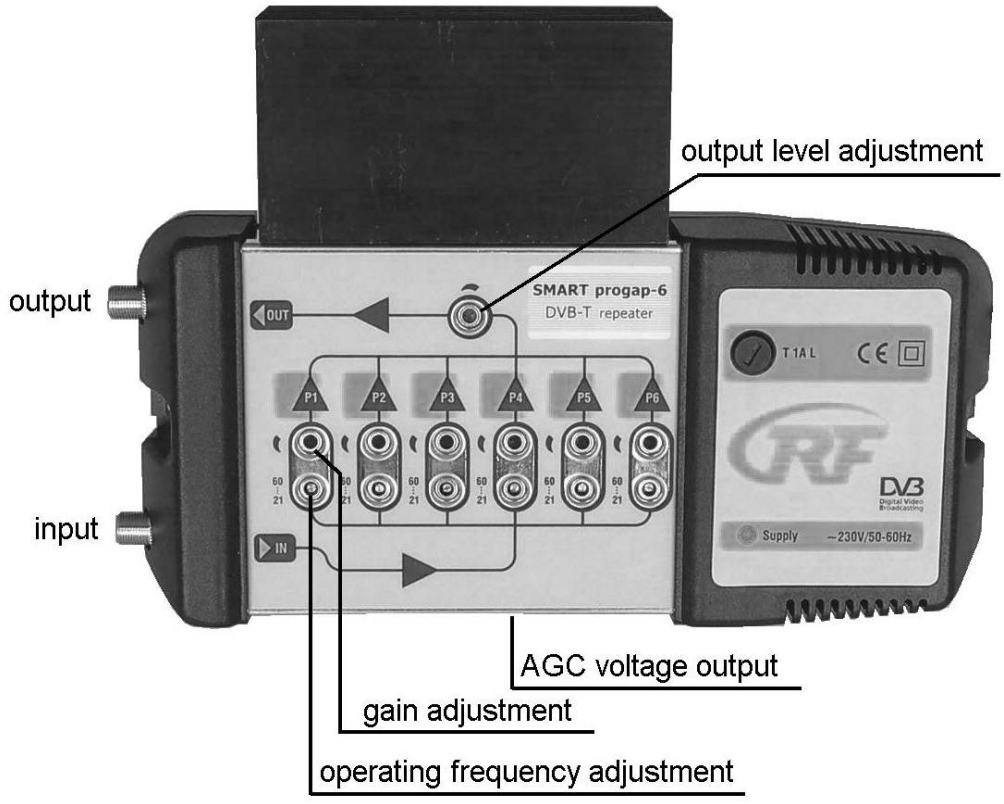

FIG. 3. Location of connectors and adjustments

The adjustments of the gapfiller can be started after 15 minutes of warm-up.

The purpose of the adjustments is:

- to select the desired DVB-T/H channels
- to equalize the output levels of all selected DVB-T/H signals
- to set the total output level
- to verify that the operating range of the AGC is correctly set.

1. Make sure that the input level of the desired channels is 60–80 dBµV. If not, use a **SMART pre2** pre-amplifier.

   Note: Any incoming UHF-band signal may not exceed 80 dBµV. Use a suitable attenuator if required.

2. Connect the receiving antenna to the gapfiller input marked **"IN"**.

3. Connect signal level meter or spectrum analyzer to the output connector marked **"OUT"**.
   Since this signal level is very high, use suitable attenuators at the test device input if necessary.

4. Set all frequency adjustments (**"21–69")** fully to clockwise direction.

5. Set the level adjustments of selected amplifiers to the middle position and unused to minimum position.

6. Adjust the operating frequency of selected amplifiers by monitoring the amplitude and shape of the wanted signal. If adjacent channels are to be used, select the channel amplifiers **P1–P6** so that the adjacent amplifiers will not be used in such situation.

7. Equalize the signal levels by using the gain adjustment of channel amplifiers. Ensure that the AGC voltage stays between 3 and 4.5 V. Note: due to the AGC, every gain adjustment has a minor effect on the levels of other channels.

8. Set the desired output level by using output level adjustment marked **"↷".** The maximum allowed output level can be observed by using a digital antenna analyzer with BER reading.
   If a spectrum analyzer is available, the visible "shoulders" will grow on both sides of DVB-T signal. At maximum output level, the "shoulders" must be at ≤ 40 dBc.

   This situation is shown in figure 3.

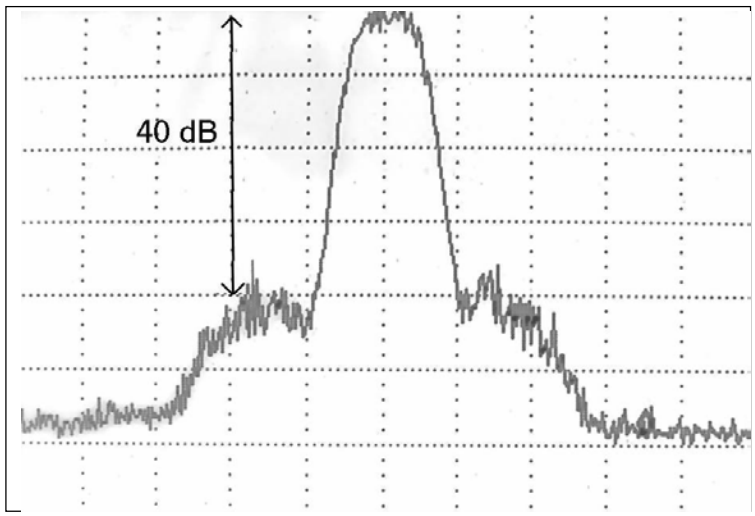

FIG 3. Spectrum of the DVB-T signal at maximum output level

9. Finally make sure that the AGC voltage still is between 3 and 4.5 V. If required, fine-tune the gain adjustments of selected channel amplifiers.

5. Other important matters

If the gapfiller is to be installed in a separate locker, ensure sufficient ventilation. This is essential, as the power consumption of the gapfiller is similar to that of a large wide-band amplifier.

Good ventilation typically requires about 50 cm2 ventilation holes at the top and bottom of the locker.

IV. Technical specification

Channel number			6	pcs
Output level			20–200	mW
Gain			70	dB
AGC operating range			35	dB
Bandwidth		- 3 dB	14	MHz
Adjacent channel attenuation		N + 2	17	dB
		N + 3	28	dB
Spurious output level		470–862 MHz	-36	dBc
		< 1 GHz	-36	dBm
		> 1 GHz	-30	dBm
Gain adjustment range		on each channel	15	dB
Maximum input level			80	dBµV
Minimum input level			60	dBµV
Operating frequency range			471- 860	MHz
Nominal impedance			75	ohm
EMC compatibility			According to EN 301 489-1	
Power consumption			15	W
Dimensions			230 x 160 x 50	mm
Weight			1	kg

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