



Products: Test Broadcast System R&S® SFU

# Seamless Level Setting on the R&S® SFU

## Application Note

The Rohde & Schwarz® SFU supports several modes of level setting. This Application Note describes the differences between these modes and especially describes a method to achieve a seamless transition without any impact to the output signal during a change of settings on an Rohde & Schwarz® SFU (Firmware > 1.30).



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## 1 Overview

The R&S® SFU is an integrated test system for the broadcasting industry. It offers a wide range for the level of the RF output signal with high accuracy and signal quality. This is achieved by combining the settings of switched attenuators and voltage controlled amplifiers according to users' preferences.

As the attenuators are switching whenever there is a change in the RF level, level setting is not seamless, but there is no decrease in signal quality regarding noise and intermodulation. Setting the gain of voltage controlled amplifiers is seamless, but due to limited linearity and noise figure the range for the gain is restricted. The R&S® SFU enables the customer to control these tradeoffs.

## 2 Controlling the level setting

In the R&S® SFU, there are 3 settings which influence the output level. These are "Modulator Level", "ALC Mode" and "Attenuator Mode".

### 2.1 Modulator Level

Depending on the level of noise simulation, an attenuator can be set to find the best tradeoff between high output level with worse noise floor or lower output level and high signal quality. With Default settings this is done automatically according to the settings of the noise simulator.

Tuning the C/N value may cause a switching of this attenuator with the lack of a short interruption of the output signal. If this is detrimental for a test setup, a fixed setup can be chosen.

There are 2 settings which are of interest to a user who desires a constant output level, irrespective of any changes to the

frequency or level setting. These 2 settings are related to the control of the RF output level from the instrument.

## 2.2 Automatic Level Control (ALC) Mode

When the ALC is set to OFF, the benefit offered is the best accuracy of the internal gain and this is independent from the kind of chosen modulation signal. However, the setback is the presence of interruption at any setting which influences the level of modulation signal like output level, level of noise, fading or interferer simulation.

When the ALC is set to ON, level settings within a range of 30dB without interruption (when Attenuator Mode = Fixed) is possible.

The ALC mode is available in the R&S<sup>®</sup> SFU to provide the user with the choice to automatically hold the level of the RF output signal. If the ALC is turned off, a sample and hold function is employed where for each frequency or level setting the system briefly switches to a defined signal, the ALC switches on briefly, the control voltage freezes and then the system switches back to the selected signal.

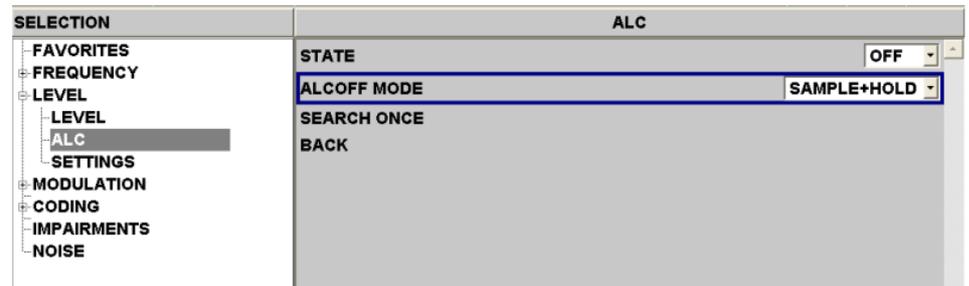


Figure 1 The ALC setting is displayed as part of the LEVEL menu

If you select **ALC** to **OFF** and **ALCOFF MODE** to **SAMPLE+HOLD**, a recalibration of the level takes place for each setting of the level or frequency. This involves briefly switching the ALC on for a defined signal. Then, the level adjustment is held at the value that was reached and the ALC is blocked. To avoid any errors that might occur, the OFF state of the ALC is activated whenever there is a selection from the user to generate I/Q impairments. In the ALC = AUTO position, the R&S<sup>®</sup> SFU automatically switches to sample & hold operation if the impairments are switched on. This applies to both MODULATOR IMPAIRMENTS (I/Q impairments) and BASEBAND IMPAIRMENTS.

The last stage which can affect the level of RF output is the attenuator is discussed next.

### 2.3 Attenuator Mode

When the Attenuator Mode is set to Auto, attenuation is varied in steps of 5dB. The gain control operates in the range of best linearity and accuracy with low noise. However, switching may cause signal discontinuity and transients.

When the Attenuator Mode is set to Fixed, level setting is seamless when ALC = ON. The range of the output level is restricted by the range for the gain of the ALC. The advantage is that the noise floor is constant for each signal level. However, high gain settings may slightly increase nonlinear effects

The attenuator is the final block of the output stage of the R&S® SFU which is responsible for ensuring the correct amount of RF power available at the RF connector. There are 2 modes available, AUTO and FIXED. Figure 2 shows the location of the mode setting. In the AUTO mode, the electronic attenuator switches in 5 dB increments at fixed points. In the FIXED mode, the electronic attenuator is held at the current settings and no switching occurs. There are 2 other modes, NORMAL and HIGH POWER which are available with option R&S® SFU-B90.

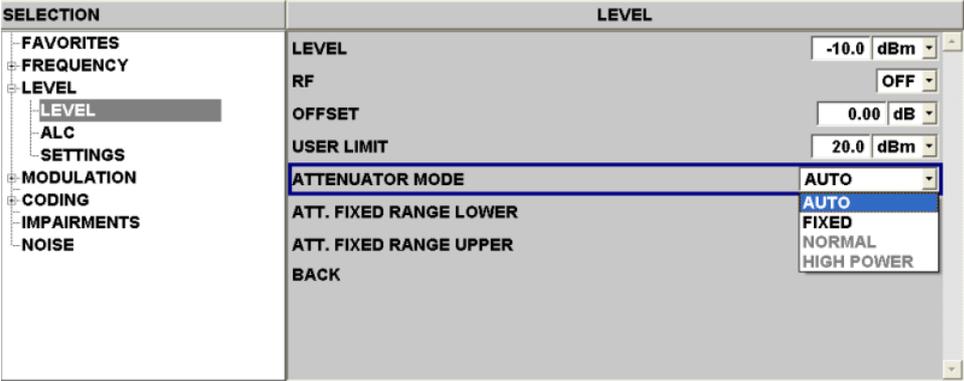


Figure 2 The ATTENUATOR MODE can be set to either “AUTO” or “FIXED” on the LEVEL menu of the R&S® SFU

### 3 Uninterrupted Output Measurement

To prevent any interruption to the output level, the settings of **ALC=ON** and **ATTENUATOR MODE = Fixed** is recommended. Hence, the output level is essentially being controlled by the ALC and there is no switching of the attenuator. This will eliminate the likelihood of a short transitional drop in the output signal level.

However, it must be stressed that that with these setting, there may be a 0.1 to 0.2 dB difference for a signal level with and without ambitious modulation signals. The more accurate reading comes from the settings of **ALC=OFF** and **ATTENUATOR MODE = AUTO**.

There are other situations where signal level interruption can also occur.

If we add NOISE with AWGN and tune C/N Setting, interruption will also occur.

Signal level interruption can also occur if the MODULATION LEVEL setting is set to "Auto". To avoid signal interruption, it is advisable to fix this MODULATION LEVEL setting. In Firmware version 1.30, this can be set to 4 fixed levels, "LOWEST NOISE" (+6 dB),"LOW NOISE" (+3 dB), "STANDARD" (0 dB) and "LOW DISTORTION" (-3 dB). The LOWEST NOISE option will produce the maximum level at the I/Q modulator while the LOW DISTORTION option will produce the lowest drive level.

On the R&S<sup>®</sup> SFU, any signal level output which is less than the lower bound setting will generate a warning message, "PEP VALUE LESS THAN DEFINED LOWER BOUND" and vice-versa. A note about the power level readings on the R&S<sup>®</sup> SFU is that the value displayed for the USER LIMIT, RANGE LOWER and RANGE UPPER is the Peak value and not the RMS value.

### 4 Summary

Depending on the requirements of the test setup, a user may prefer high accuracy for a wide setting range or seamless level setting. Obtaining a constant RF signal output is important in certain automated measurement setup. In the use of electronic attenuator in the R&S<sup>®</sup> SFU, this can be achieved by setting the ALC mode to AUTO and the Attenuator to FIXED mode.

## 5 Additional Information

Our application notes are updated from time to time. Please visit the Rohde & Schwarz website in order to download new versions.

Please send any comments or suggestions about this application note to [Broadcasting-TM-Applications@rohde-schwarz.com](mailto:Broadcasting-TM-Applications@rohde-schwarz.com).

## 6 Ordering information

BROADCAST TEST SYSTEM	R&S® SFU	2110.2500.02
DOCUMENTATION	R&S® SFU-DCV	2082.0490.30
EXTENSION BOARD 1	R&S® SFU-B1	2110.7424.02
MEMORY-ERWEITERUNG 1	R&S® SFU-B3	2110.7447.02
MEMORY-ERWEITERUNG 2	R&S® SFU-B4	2110.7453.02
USER I/O	R&S® SFU-B5	2110.7460.02
2nd HARDDISK	R&S® SFU-B6	2110.7501.02
EXTENSION BOARD 10	R&S® SFU-B10	2110.7747.02
ETI INPUT	R&S® SFU-B11	2110.7553.02
FADING SIMULATOR, 20 PATHS	R&S® SFU-B30	2110.7530.02
FADING SIMULATOR EXTENSION	R&S® SFU-B31	2110.7547.02
HIGHER OUTPUT POWER	R&S® SFU-B90	2110.8008.02
CODER DVB-T/H, 2K/4K/8K-COFDM	R&S® SFU-K1	2110.7301.02
CODER DVB-C	R&S® SFU-K2	2110.7324.02
CODER DVB-S/DVB-DSNG,	R&S® SFU-K3	2110.7330.02
CODER ATSC/8VSB	R&S® SFU-K4	2110.7353.02
CODER J.83B	R&S® SFU-K5	2110.7360.02
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TS-GENERATOR, SDTV TEST-	R&S® SFU-K20	2110.7476.02
TRP-RECORDER AND PLAYER	R&S® SFU-K21	2110.7482.02
TRP-PLAYER	R&S® SFU-K22	2110.7499.02
DYNAMICAL FADING UND ERHOEHTE	R&S® SFU-K30	2110.7560.02
ARB GENERATOR	R&S® SFU-K35	2110.7601.02
INTERFERER MANAGEMENT	R&S® SFU-K37	2110.7647.02
NOISE GENERATOR AWGN, DIGITAL	R&S® SFU-K40	2110.7653.02
PHASE NOISE	R&S® SFU-K41	2110.7660.02
IMPULSIVE NOISE	R&S® SFU-K42	2110.7676.02
MULTINOISE	R&S® SFU-K43	2110.7682.02
SW FOR POWER MEASUREMENT	R&S® SFU-K55	2110.7753.02
BER-MEASUREMENT	R&S® SFU-K60	2110.7782.02
EXTENDED ANALOG-I/Q IN	R&S® SFU-K80	2110.7953.02
REALTIME DISABLED	R&S® SFU-K81	2110.7960.02
REALTIME ENABLED	R&S® SFU-K82	2110.7976.02
CODER AMC	R&S® SFU-K108	2110.7418.02
MULTI ATV PREDEFINED	R&S® SFU-K199	2110.8089.02
T-DMB STREAMS	R&S® SFU-K221	2110.4348.02
T-DMB WAVEFORM	R&S® SFU-K351	2110.4277.02



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