ROHDE&SCHWARZ

Geschäftsbereich
Meßtechnik

APPLICATION NOTE

ALC for Propagation and EMC Measurements

Products:

Power meters

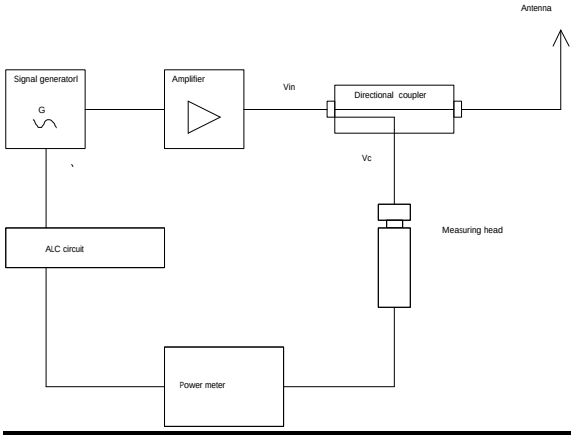
Signal generators

1G06-02-1193-e

1 ALC

A problem associated with EMC and propagation measurements is that the generated field strength must remain constant during the measurement so that reproducible results can be obtained. In computer-controlled systems, level adjustments can be made via the process controller but in simpler systems, which are mostly manually controlled, there is no ALC. ALC would be of advantage though, as the output power of an amplifier connected to a signal source may vary as a function of temperature or frequency. The aim of ALC is to keep the set value constant within certain limits.
In addition to the applications mentioned above, terminated power measurements, level measurements on coaxial lines, attenuation measurements, directional power measurements as well as reflection measurements using a directional coupler can be carried out.

2 Block Diagram of Test Transmitter System



Particularly for propagation measurements, field strength and frequency of specific transmitters are to be measured frequently or continually over a longer period of time. ALC is of great advantage in this case and improves the accuracy of field-strength measurements and reproducibility. In the above example the level can be kept constant within certain limits.

3 ALC Circuit Description

The level at the DC output of a power meter is compared to an internal 1.5-V reference voltage and applied to a subsequent integrator. The output level of 1.5 V is obtained because the level meter outputs an 1.5-V DC voltage when the deviation from the nominal value is 0 dB. The time constant is selected to give a stable control for the required settings. The output of the circuit is connected to the AM input of the signal generator. The output voltage of the integrator may vary between 0 and 3 V. This determines the control range of the circuit depending on the input and output voltage range of the signal generator in the AM mode.

4 System Description

The output power of the signal generator is amplified and transmitted via an antenna. The directional coupler couples out part of the power fed to the antenna.
The coupled out voltage is applied to a power meter. The coupling is entered as a correction value so that the true power applied to the antenna is indicated on the meter. The correction value is entered directly in dB. For highly accurate power measurements, the coupling factor may be individually calibrated.
Relative indication in dB is selected on the analog display of the power meter and the required nominal power is entered as a reference value. The difference to the entered nominal power is displayed and produces a DC voltage at the output of the power meter. This DC voltage is applied to the ALC circuit. The output signal of the ALC circuit controls AM of the signal generator thus compensating for deviations from the nominal value.

5 ALC Adjustment

The transmitter system consists of a signal generator, an amplifier, a directional coupler, a power meter and the ALC circuit.

The adjustment will be explained with the aid of two instruments: signal generator SME 02 and power meter NRVS.

First, the required nominal level has to be entered as a reference value on the power meter. This can be done only if the power meter has a facility to take the attenuation connected ahead into account. In this case, enter the attenuation of the directional coupler on the meter. Otherwise the reference value to be entered has to be reduced by the attenuation of the directional coupler. The selected filter for the meter should be switched off in both cases. By selecting the relative display in dB on the meter a DC voltage between 0 and 3 V is obtained at the DC output of the power meter, which is directly proportional to the value indicated on the analog display. With a level difference of 0 dB, a DC voltage of 1.5 V is present at the output. This level is applied to an integrator with a reference voltage of 1.5 V. Any deviation of the input signal from this reference voltage causes the output power of the signal generator to be adjusted. The voltage provided by the ALC is thus used as an external modulation signal for the signal generator. With the aid of this voltage the output level is amplitude-modulated.
One of the two scale ranges below may be selected on the power meter:

a) -3 to 3 dB
b) -6 to 6 dB

Considering that the control range for the amplitude modulation is limited by the permissible input level, range b) is recommended only when the nominal level is less than half the permissible transmitter output level.

Set the generator as described below: level to approx. 70% of the power required at the antenna less the gain of the subsequent module. This ensures that positive and negative deviations are corrected within the same limits. This 70% level may be varied depending on the desired control range.
Set the signal generator to AM and external DC. (SME: select EXT1 in the AM SOURCE INDEX menu and DC in the AM EXT COUPLING menu).
The modulation depth to be entered depends on the scale selected on the power meter. Set a modulation depth of 50% for range a) and 100% for range b).

The time constant of the ALC circuit is selected so that the required level is kept constant under conditions where overshoots just fail to occur. Since different power meters have different time constants, ALC can be speeded up or optimized by selecting a suitable filter (0 to 5) on the power meter with the modulation depth set to 100%. A set modulation depth of 50% has to be increased to 80%, for instance. However, increasing the ALC speed leads to additional overshoots.

The list below summarizes the procedure described above:

1) Enter required level as a reference value on the power meter,
take the attenuation of the directional coupler into account or activate attenuation correction on the power meter.

2) Select relative level indication on the power meter.

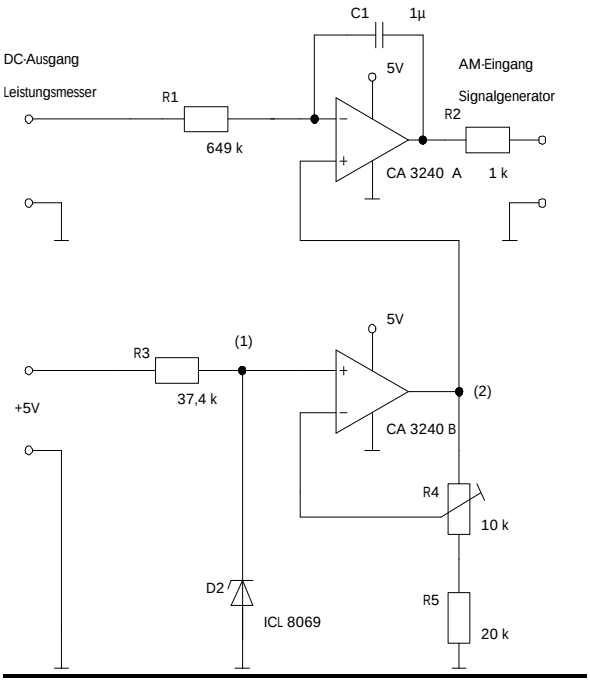
3) Select scale range on the power meter
a) -3 to 3 dB or
b) -6 to 6 dB

4) Set signal generator output level to approx. 70% of the required power less the gain of subsequent modules.

5) Set modulation depth to
a) 50%
b) 100%.

6) If required, speed up ALC for
a) by increasing the modulation depth, and for
b) by selecting one of the filter ranges 0 to 5 on the power meter.

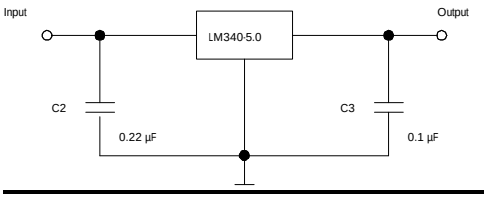
6 ALC Circuit



((DC-Ausgang = DC output
Leistungsmesser = Power meter
AM-Eingang = AM input
Signalgenerator = Signal generator))

7 Power Supply

A fixed-voltage regulator 7805 or LM340-5.0 may be used as a voltage source. Select an input voltage within 8 V and 25 V. Approx. 5 V will be available at the output. Use a bride rectifier for protection against reversed polarity.



8 Putting the Circuit into Operation

To ensure correct operation, a basic adjustment has to be made prior to using the circuit for the first time. Upon switching on, a voltage of approx. 1.2 V should be present at point (1). Use control R4 to adjust the voltage at point (2) to 1.5 V. The ALC circuit may now be switched into the test system.

9 Components Used

Resistors:	R1 649k
	R2 1k
	R3 37,4k
	R5 20k
Potentiometer:	R4 10k
Capacitors:	C1 1µ
	C2 0.22µ
	C3 0.1µF
Reference voltage source:	ICL 8069
Op amp:	CA 3240
Fixed-voltage regulator:	
	7805 or
	LM340-5.0
Bridge rectifier	B250 C800

Tilman Betz
1GPP