Application Note

Levelling Applications with the ML2400A Power Meter

ML2400A Series
Power Meters

Understand how to set up and use the Power Meter for external levelling

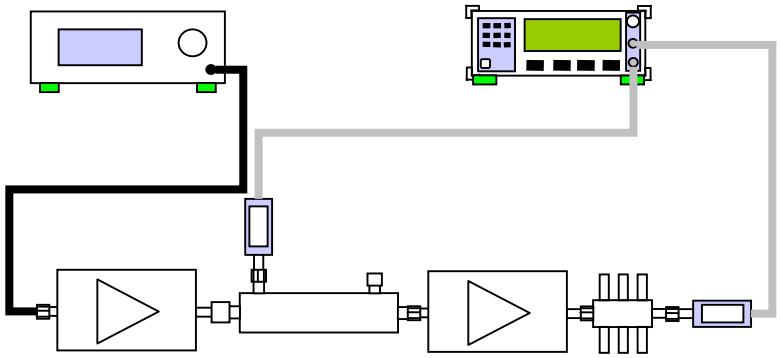
How to use the ML24XXA series Power meters for Levelling Applications

When testing high power amplifiers and systems, it sometimes necessary to use amplifiers and other components to boost the output from the signal generator to a level suitable for the test. The advantage of this approach is that the signal levels are now at the right level. The disadvantage of this approach is that the extra components have added extra uncertainty into the system for the following reasons.

- The frequency response of the extra components may not be flat over the range of interest,
- The amplifier gain may not be linear at the operating power level,
- The amplifier may drift with time and temperature
- The output match of the amplifier may be lower than the signal generator introducing an extra mismatch uncertainty into the measurement.

amplifier characteristics change, then the ratio technique still gives the correct gain. Another advantage is that the effective source match of the booster amplifier is improved by the use of the ratio technique. Actual results depend upon the effective directivity of the splitter or coupler.

The ratio technique is very useful and in many cases is sufficient to make accurate power measurements on amplifiers. The dual channel ML2438A or ML2408A is ideally suited for these applications. The user can display the ratio of the powers to obtain the gain, and can also enter user offset tables to take into account the frequency response of the couplers and attenuators in the system. A range of sensors and measurement modes enables the power amplifier to be measured under the actual application conditions. For example the MA2472B



A typical Amplifier Ratio Measurement Setup using an external amplifier to increase the power from the test source

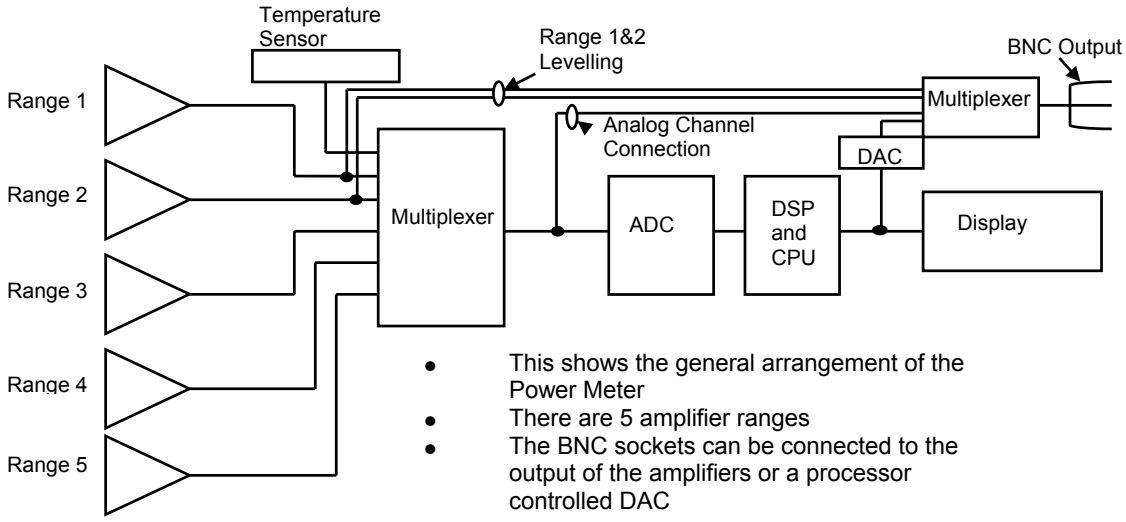
There are two ways to overcome these problems. One way is to use the technique of ratio measurements. In ratio measurements the input signal to the amplifier under test is sampled using a splitter or coupler. The output power and gain can then be measured. If the booster

sensors can be used in profile mode to make measurements on GSM systems and the MA2481B Universal Sensor can be used to make measurements on WCDMA amplifiers.

However the ratio technique does not keep the power constant at the input of the device under test. For large signal devices where it is important to keep the test signal at a constant level, the technique of using the power meter to control the level of the test source can be used instead.

This application note looks at how the power meter works and how to use it in conjunction with a signal source such as the ANRITSU MG3690A or 68C/69B microwave synthesizers to produce an externally levelled system.

How the Analogue Port works



- This shows the general arrangement of the Power Meter
- There are 5 amplifier ranges
- The BNC sockets can be connected to the output of the amplifiers or a processor controlled DAC

A functional view of the power meter

The power meter has 5 amplifier ranges. Range 1 has the lowest gain and Range 5 the highest gain. Ranges 3-5 are AC amplifiers used for low level signals, and use a chopper located in the sensor. Ranges 1 and 2 are DC amplifiers and the ones suitable for levelling output purposes. For a standard diode sensor, ranges 1 & 2 cover the power input range of approximately –30dBm to +20dBm. The analogue port can be set up for three different modes of operation.

Signal Channel A (or B).

In this mode the output to the rear panel comes from the multiplexer that has selected the range amplifier. Only ranges 1 and 2 have DC operation and the DC voltage output is affected by the selection of the range. Range Hold needs to be set otherwise the voltage output will change if the range is changed. If range 1 is held, then the output will correspond to the gain for range 1, if range 2 is held then the output will correspond to the gain settings for range 2. Ranges 3-5 work in chopped mode, so the output is not DC.

As there is no correction the voltage out is simply the uncorrected amplified voltage from the sensor. Settling time is dependent upon the sensor selected. Sensor A is connected to output 1, sensor B is connected to output 2. It is not possible to switch them over.

In this mode the multiplexer reads the temperature sensor approximately every 500ms and so there is a brief change in

voltage on the output which corresponds to the internal temperature sensor.

Levelling A (or B)

In this mode the output from either range 1 or range 2 can be directly connected to the BNC output. As the amplifiers are active all the time, the output is available continuously and is unaffected by the range setting in the sensor mode. There is no correction; the voltage out is simply the uncorrected amplified voltage from the sensor. Settling time is dependent upon the sensor selected. Like the Signal channel mode, Sensor A is connected to Output 1, and Sensor B is connected to Output 2.

Analog OUT

This comes from a DAC written to by the main processor. It has a scaled, fully corrected output of either channel 1 or channel 2. The analog scaling can be selected in the menu. The samples are produced approximately every 4ms so this option is not as fast as the levelled option, but has the advantage of being relatively precise. This output can be routed to either output 1 or output 2 on the rear panel. The output can also be scaled within the range +/-5V.

Output 1 Sensor A | Output 2 Sensor B

Rear Panel of ML24XXA

How to set up the Port

- To select the BNC output port press
  - System
  - more
  - more
  - Rear Panel
  - BNC

- To select the various modes, press
  - Mode

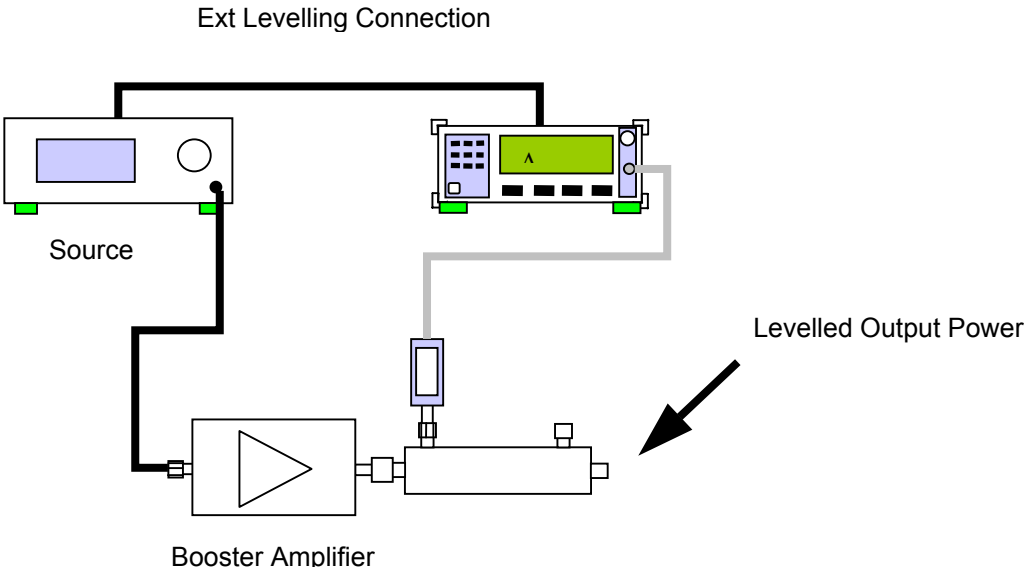
  This cycles between the following functions

  - Chan Analog Out (Scaled output from the processor DAC)
  - Chan pass/fail (digital pass fail limit output)
  - Signal Channel A (output from multiplexer, includes temperature sensor voltage)
  - Levelling A (1) (selects range 1 of the amplifier for output)
  - Levelling A (2) (selects range 2 of the amplifier for output)
  - AC mod output
  - Off

- To select the port on the back panel, press
  - Port

- To select Range Hold Press,
  - Sensor
  - Setup
  - more
  - HOLD (toggles between 1-2-3-4-5-Auto)

How to set up the Equipment



Connect the analog output port of the power meter to the external levelling socket on the synthesiser.

Select the appropriate range on the power meter using the range selection function.

Select the power meter levelling mode on the synthesiser.

The MG3690A series synthesisers and the 68000 and 69000 series of synthesisers have two external levelling modes. External detector and external power meter. The external levelling bandwidth of the synthesiser in power meter mode is 0.7Hz.

The output power level can be adjusted using the EXT ALC ADJ function on the synthesiser.

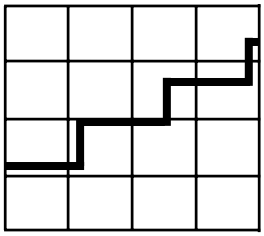
The desired output level can be easily monitored using the power meter. Use the offset function in the Sensor menu to add correction for the coupling factor of the coupler. Gain and output power can be measured using the dual channel versions of the power meter, the ML2438A or the ML2408A

The voltage out of the levelling port is the amplified sensor voltage and is not linearity corrected.

The response time of the channel depends upon the sensor used. The thermal sensors are slower than the diode sensors and the response time is 4ms. The response time of the diode sensor depends upon whether the readout mode or profile mode is selected. In readout mode a 17kHz Low pass filter is switched into the amplifier measurement channel.

In profile mode this filter is switched out and the bandwidth is limited by the diode response which typically might be 50kHz for a standard diode sensor.

In the scaled Analog output mode the response time is slower as the processor is calculating the linearity correction for each voltage out. The time per output sample is dependent upon the sensor and the averaging which has been set by the user. An output sample period of 4ms is typical. Voltage output in scaled mode can be set from -5 to +5v range.



The Scaled Analogue Channel output as seen on an oscilloscope.
Each section is approximately 4 ms long.
The averaging settings alter the response.

Further information on the products featured in this application note.

Power Meters

Anritsu offers two families of power meters, the ML2407/8A and the ML2437/8A and a range of sensors to suit all applications ranging from CW to WCDMA.

The ML2430A Series Power Meters combine the advantages of thermal meter accuracy, diode meter speed and peak power meter display graphics. The result is a single instrument that achieves 90dB dynamic range with a single sensor. The ML2407/8A series has extended signal bandwidth ideal for IS95 and pulse measurement applications. The rugged housing and optional high-capacity NiMH battery bring laboratory quality accuracy to field service applications.

Features

· Speed and dynamic range
The 90 dB range MA2470 Series Power Sensors' high sensitivity reaches stable power readings to -70 dBm. High speed sample rates profile cellular,GSM, PCS and other pulsed signals. Modern connector technology achieves industry leading return loss for improved accuracy through 50 GHz.

· Wide Range of Sensors
Choose from five different sensor ranges to suit the application with versions available to 50GHz

· Standard Diode Sensors
Standard Diode Sensors with 90dB dynamic range.

· High Accuracy Diode Sensors
Sensors with additional matching circuitry.

· Universal Power Sensors
The Anritsu MA2480 series Universal Sensors will measure any modulated or multi-tone signal thanks to a patented sensor architecture with three diode pairs. RMS power measurements can be made on WCDMA signals.

· Fast Diode Sensors
Extended bandwidth sensors for IS95 and fast pulse applications when used with the ML2407/8 Power Meters

· Fast thermal sensors
Thermal sensors measure the true RMS power of any signal. Excellent VSWR through to 50GHz. The fabrication technique optimizes measuring speed to 4 ms rise and fall times.

· Burst profile graphics display
The ML2430A features random repetitive sampling for high resolution of fast signals. A time domain graphic display profiles pulsed signals over a power range of –40 dBm to +20 dBm. High speed sampling speed produces clear power profiles of cellular, and PCS signals including TDMA, PHS, GSM, and DCS-

1800. Pulse top power is easily and repeatably measured using between cursor averaging.

· Triggering controls
Data acquisition event arming and triggering functions traditionally found on expensive peak power meters are standard in the ML2430A series. Triggering delay and the sample integration time per reading can be directly controlled by the operator. Trigger sources include, continuous, internal, external TTL, and manual. Data acquisition can be optimally controlled for synchronization with other test equipment.

· Softkey menu control
Softkey menus simplify instrument control by making the user interface easier to understand. The numerical keypad simplifies the operator interface.

· GPIB speed
Industry leading speed is achieved under a variety of operating conditions including averaging settings, sensor control settings, triggering conditions, operating mode, sensor type, and GPIB interface manufacturer.

· GPIB emulation
With 99.9% emulation of older meters, the ML2430A series improves ATE system productivity. Typical test system speed improvement is 2 to 10 times faster system speed depending upon the number of measurements taken during the test, the minimal use of wait statements within the code, and the meter model emulated.

· Power vs. time graphics display
The power versus time mode is a strip chart style display for monitoring gain and output power variations over time/temperature, supply voltage or a component tolerance. In service applications, power versus time mode speeds trouble shooting of unusual conditions such as intermittent switches or abnormal power control in a mobile telephone. The power versus time mode provides a clear strip chart display of RF power variation.

· Parallel printer connector
A deskjet printer can be connected directly to the ML24XXA for fast documentation of performance on the bench or in the field. Meter calibration, triggering and averaging settings are listed with the display printout.

· Sensor EEPROM
All MA2400A series sensors are equipped with internal EEPROMs for storage of calibration factor data vs. frequency. This allows the power meter to interpolate and correct readings automatically, improving accuracy and convenience.

· High reliability
Rugged poly-carbonate chassis design handles drop shocks and rough field treatment. No vent holes are present, thus the meter is splash resistant. A front cover panel and softcase are optional for further environmental protection. Power sensors are also ruggedized for rough handling.

· Offset table for path loss correction
Compensating for the true frequency response of attenuators, couplers, cables, switches and other test setup devices improves measurement accuracy. For this reason, the ML2430A series can apply an offset table of attenuation-versus-frequency in addition to the traditional fixed dB offset capability.

· Battery
The optional NiMH “Smart” battery supports high charge density for a typical 8 hour day of operation.

· Voltmeter
The ML2430A series also supports high speed voltage measurement. A rear panel BNC measures voltage or operates as V/GHz input supporting automated sensor calibration factor correction.

Synthesized CW Generator

Model: MG3690A Series
(MG3691A/92A/93A/94A/95A/96A)
0.1 Hz to 65 GHz

The new ergonomically designed MG3690A synthesizer is a CW generator that delivers superior value with exceptional performance at a reasonable cost. The MG3690A offers 6 basic models spanning 2 to 8.4 GHz (MG3691A), 20 GHz (MG3692A), 30 GHz (MG3693A), 40 GHz (MG3694A), 50 GHz (MG3695), or 65 GHz (MG3696A). These models are fully configurable to add lower frequency coverage, optional features, or added performance. RF frequency coverage may be added down to 10 MHz, or even down to an audio frequency of 0.1 Hz. External pulse modulation is available as an option. The MG3690A offers +17 dBm of leveled output power from 2-20 GHz as an option, while maintaining its superior harmonic spectral purity. Last but not least, the MG3690A offers the best SSB phase noise performance of any broadband microwave synthesizer. With the Ultra-Low Phase noise options added, the improved lock loops and the digital down-converter offer uncompromising RF and Microwave performance in one instrument.

Features

- Frequency coverage from 0.1 Hz to 65 GHz
- Uncompromising RF and Microwave performance
- CW Generator with digital step sweep
- +13 dBm power standard, +17 dBm optional
- Excellent Harmonic performance, even at +17 dBm
- Ultra-low SSB Phase Noise
- IF Up-conversion option for IQ modulation using an MG3681A
- Phase offset capability
- 0.01 Hz frequency resolution
- External Pulse Modulation
- Ergonomic Package, 3u height, 450 mm depth, 14 Kg
- 3 basic models, completely configurable and upgradeable
- IVI-COM driver for ease of ATE software development
- 3-year warranty standard

Synthesized Sweep/Signal Generator

Model: **68C/69B**
0.1 Hz to 110 GHz

Anritsu's El Toro microwave synthesizers present 28 models, providing you the right synthesizer for your component analysis, signal simulation, or A.T.E. applications. The 69B family, with the lowest Single Sideband (SSB) phase noise available, provides the ultimate performance at moderate cost, and includes models with unprecedented 0.1 Hz to 65 GHz frequency coverage in coax, and up to 110 GHz on banded waveguide.

Features

- 28 models for perfect fit to any application
- Ultra-low SSB phase noise; –107 dBc at 10 kHz offset from 10 GHz
- 0.1 Hz to 65 GHz frequency coverage in a single coaxial output
- Waveguide extensions to 110 GHz
- Economical upgrades
- +17 dBm maximum power, –125 dBm minimum power
- Internal AM, FM, øM, pulse modulation
- User down-loaded complex modulation

Swept measurements
The 69100A/68100B Synthesized Signal Generators feature 10 MHz to 65 GHz analog, step, and manual sweep capability. The 69100B/68100C also provide AM/FM/pulse modulation via external modulating signals. Output levels to +17 dBm, and optional 0.1 Hz resolution are available at prices comparable to CW only sources. To meet requirements that expand over time, economical upgrades are available to any higher performing model. Features, performance, and value combine to make the 69100B and 68100C the optimum sources for your network analysis and swept A.T.E. source applications.

Complete synthesized modulation and sweep capabilities for any signal requirement
The 69300B/68300C Synthesized High Performance Signal Generators provide all the capabilities of our CW generators and signal generators plus an internal AM/FM/pulse modulation generator in a single package. The internal generators offer 7 modulating wave forms, including Gaussian noise, as well as user-defined arbitrary waveforms. Pulse modulation parameters can be set externally or by the internal pulse generator. Doublet, triplet, or quadruplet pulses make RADAR blind spot testing easy. Simultaneous synchronized modulations let you set complex signal scenarios across the entire 10 MHz to 65 GHz frequency range. The 69300B is the highest performance universal synthesized signal generator available today

For more information on the range of products and services offered by Anritsu, please contact your local sales office.

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