

## R2M scalar network analyzers

### Features

- Wide frequency range: 10 MHz to 4/20/40 GHz
- Wide output power level range: -90 dBm<sup>1</sup> to +15 dBm
- High stability of frequency and output signal power
- Operation in several coaxial paths
- Simultaneous operation with three measurement ports
- Measurement of gain, reflection and VSWR, group delay time, dynamic characteristics, frequency transformation device parameters, device measurements in pulse mode, measurements with reference channel



### Description

R2M scalar network analyzers (hereinafter, R2M analyzers) are designed to measure transmission coefficient modulus (TC modulus), reflection coefficient modulus (RC modulus), voltage standing-wave ratio (VSWR), power level, and generate continuous harmonic signals. Additional R2M operation modes<sup>2</sup> allow you to monitor dynamic characteristics, group delay time, characteristics of frequency conversion devices and pulse mode characteristics of devices.

R2M analyzers are used for analyzing, tuning, testing and monitoring during the manufacturing of high-frequency and microwave devices used in radio electronics, communications, radars, measuring equipment.

R2M analyzers detect high-frequency electromagnetic waves (incident wave, wave passed through DUT (device under test), and waves reflected from the DUT inputs), convert them to low-frequency voltages that are proportional to the wave's power level, measure voltages, and calculate TC and RC modulus as well as VSWR. Electromagnetic waves are detected and converted to low-frequency voltage with detectors and SWR sensors.

There are three types of R2M analyzers with different frequency ranges:

- R2M-04A: 10 MHz to 4 GHz;

- R2M-18A: 10 MHz to 20 GHz;
- R2M-40: 10 MHz to 40 GHz.

R2M analyzer is computer-controlled with the Graphit R2M software installed. The software processes the measured data and displays the obtained results. The R2M analyzer and PC are connected via Ethernet.

R2M program interface is IVI-COM compatible, which allows to control R2M analyzer with third-party software.

Various R2M analyzer versions are available with a certain set of options.

<sup>1</sup> With ATA/70 option

<sup>2</sup> Measurement errors of R2M analyzers are not standardized for additional operation modes.

## Analyzer features and options

### Output microwave connector type

Following R2M options define the type of output connector of frequency synthesizer modules:

- 01R option — type III connector (female);
- 11R option — type N connector (female);
- 03R option — type IX connector, ver. 3 (female);
- 13R option — 3.5 mm connector (female);
- 05R option — 2.4 mm connector (female).

### Extended dynamic range (ATA/70 option)

ATA/70 is a hardware option. A 0...70 dB electromechanical step attenuator with 10 dB step is placed at analyzer's output, extending the range of output power level adjustment and measurement range.

### Frequency synthesizer

R2M analyzer is used as a frequency synthesizer and generates frequency- and power-stabilized continuous harmonic signals with low phase noise in wide frequency and power range

in the following modes:

- fixed frequency and power;
- frequency sweep with fixed step;
- frequency list sweep;
- power sweep with fixed step;

In addition, external pulse modulator and clock oscillator built-in into R2M can generate pulse modulated signal with pulse duration between 20 ns and 4 sec, pulse period between 30 ns and 4 sec, and pulse envelope front/tail less than 10 ns. MI1 series external pulse modulator is a recommended external pulse modulator (for detailed information see respective section of Test and Measurement Equipment catalogue).

### Power measurement

R2M analyzer may be used as three-channel power meter.

### Dynamic measurement

R2M analyzer provides measurement of DUT dynamic characteristics — output power level vs. input power level.

### Frequency conversion device measurements

R2M analyzer allows to measure TC modulus of frequency conversion devices: converters, mixers, frequency multipliers and dividers. When measuring mixers, an external heterodyne signal source is required, such as a second R2M analyzer, G7M frequency synthesizer or PLG portable signal generators. Mixers may be measured with fixed heterodyne frequency or synchronous tuning of heterodyne and signal frequency.

### Group delay time measurement

The R2M analyzer has a function of group delay time measurement that characterizes the linearity of DUT phase frequency response. A relation of amplitude-response modulus logarithm vs. phase-response with Hilbert transformation, used to determine group time delay, allows to measure group delay time for minimum-phase networks only with zeros and poles within a unit circle of Z-plane.

### Measurement of device characteristics in pulse mode

R2M analyzer allows to measure TC and RC modulus as well as VSWR in pulse mode. Minimum duration of a measured radio pulse may vary between 138 and 22655  $\mu$ sec, depending on averaging degree. The pulse sampling option is pulse-in-point. Depending on tested device type, the pulse signal may be generated in the two following ways:

- power on/off control of analyzed device;
- generation of pulse modulated probing signal with external pulse modulator.

The source of modulation signal may be both internal and external. The MI1 series external pulse modulator is a recommended external pulse modulator (for detailed information is given in the corresponding section of this catalogue).

### Reference channel measurements

Reference channel measurements allow to enhance measurement quality by tracking power fluctuations caused by thermal instability of power and measuring path mismatch. Generally, reference channel measurements are used to:

- measure TC of low-loss devices, where input power fluctuations of DUT distort measurement results;
- compensate thermal drift of external amplifier gain that may be installed at R2M output to increase the power of probing signal;
- measure DUT transmission coefficient vs. DUT input power dependence for dynamic measurements.

### Change of probing direction

The R2M analyzer usage in conjunction with external PEM1 and PEM2 switches allows to change the probing direction while measuring parameters of two-port and three-port devices. This reduces measurement duration, eliminating the need for additional re-assembly of measuring circuit, which is especially needed for measuring unidirectional devices (isolators, circulators, etc.). Detailed information on PEM1 and PEM2 switches is given in the corresponding section of this catalogue.

### Waveguide path measurements<sup>1</sup>

Additional accessories (waveguide-to-coaxial adapters and waveguide directional couplers) allow to use the R2M analyzer for measuring device parameters in waveguide path.

### Power adjustment

Power adjustment feature allows to set the specified power level directly at DUT input, compensating for loss (or gain) introduced by microwave accessories that connect the DUT with R2M microwave output.

### Synchronization system

Output signal frequency stabilization of 1, 5 and 10 MHz external reference oscillator, external device frequency stabilization of 10 MHz internal reference oscillator and R2M's flexible digital synchronization system allows R2M to interact with external devices. This makes it possible to use R2M analyzers in various measuring circuits without developing additional software, e.g.:

- for mixers measurements;
- for measurement of devices in pulse mode;
- for pulse modulation in frequency synthesizer mode.

<sup>1</sup> parameter measurement errors in waveguide path are not regulated.

## Specifications

	R2M-04A	R2M-18A	R2M-40
Operating frequency range	10 MHz ... 4 GHz	10 MHz ... 20 GHz*	10 MHz ... 40 GHz
Output signal power setting range, dBm: without ATA/70 option with ATA/70 option	-20 ... +15 -90 ... +15	-20 ... +13 -90 ... +13	-20 ... +7 -90 ... +7
Transmission coefficient modulus measurement range, dB: without ATA/70 option with ATA/70 option	-70 ... +35 -70 ... +70	-65 ... +35 -65 ... +65	-60 ... +30 -60 ... +60
Power measurement range, dBm:	-55 ... +15	-55 ... +13	-55 ... +7
Output signal power setting error, dB: -20 ... +15 (+13) dBm -20 ... +7 dBm -55 ... -20 dBm	$\pm 1$ — $\pm 1.5$		— $\pm 1.5$ $\pm 2.5$
Transmission coefficient modulus measurement error**, dB:	$\pm(0.02 \times  A  + 0.2)$		$\pm(0.02 \times  A  + 0.3)$
Reflection coefficient modulus measurement error**	$\pm(0.09 \times \Gamma^2 + 0.02)$		$\pm(0.014 \times \Gamma^2 + 0.04)$
VSWR measurement error*** for $K_{ctU} \leq 2.0$ , %	$\pm(3 \times K_{ctU} + 1)$		$\pm(5 \times K_{ctU} + 3)$
Power measurement error, dB	$\pm 1$		$\pm 1.5$
Output signal power setting increment, Hz	1		
Relative frequency tuning error for operation with internal reference oscillator	$\pm 1 \times 10^{-6}$		
Output signal power setting increment, dB	0.1		
Reflection coefficient modulus measurement range	0 ... 1		
VSWR measurement range	1.02 ... 5		

\* Operating frequency range of R2M-18A with 01R, 11R options is from 10 MHz to 18 GHz.

\*\* A,  $\Gamma$ ,  $K_{ctU}$  are measured transmission coefficient modulus, reflection coefficient modulus and VSWR, accordingly.

\*\*\* When using measuring accessories, up to 20 GHz – error is  $\pm(3 \times K_{ctU} + 1)$  %, up to 40 GHz – error is  $\pm(5 \times K_{ctU} + 1)$  %.

## Measuring accessories

To operate with various coaxial path cross-sections with metric and inch -based threads, R2M analyzer can be supplied with different measuring accessories (detectors, SWR sensors, combined loads, microwave cables, coaxial adapters) with number and types specified in the order.