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Merlin™ Digital Lock-in Radiometry System

ORIEL INSTRUMENTS
A Newport Corporation Brand



70100 Merlin™ Control Unit

Measure UV to IR optical radiation with the Merlin™ Digital Lock-in Radiometry System and its family of calibrated detectors. The unique Smart Ranging™ feature gives you seamless gain switching. Over seven decades of input signal values, sub-microvolts to volts, are easily accommodated without electrical transients. We offer single and dual channel RS-232 and GPIB-488 Merlin instruments; each channel includes a reference capability. A broad selection of calibrated detectors, which have preamplifiers matched to Merlin, are available (see page 1266 to page 1272). Merlin™ works with chopped radiation, repetition rates from 8 to 1100 Hz. An external chopper wheel is required; Merlin provides power and control for the chopper.

What makes up a Merlin Digital Lock-in System?

Typically three components make up a Merlin System:

- Merlin Control Unit
- Detector(s) with preamplifier
- Optical Chopper

These three components were designed to work together as a system. When you plug the detector into the Merlin Control Unit, Merlin identifies the detector and, if you are using a calibrated detector(s), downloads the calibration information.

Merlin Control Unit

Merlin is a true digital lock-in. A powerful signal processing computer performs the demodulation and filtering. This allows greater flexibility and fidelity than available from analog lock-ins. Select single or dual phase operation and single or double time constant (one of two pole filtering), as needed. The impressive computational capability allows immediate signal ratioing and conversion, and forms the basis for Smart Ranging™.

The Merlin Control Unit is the heart of a Merlin Radiometry System. The Control Unit drives the chopper and acts as a lock-in amplifier to retrieve the signal and reject unmodulated background radiation. It then computes the signal value using previously loaded calibration data. The signal value is displayed in selected units. We offer single channel and dual channel Merlins. The dual channel models support two detectors, but only one operates at a time.

Optical Chopper

The chopper modulates the radiation to be measured. We offer an open and two enclosed versions, with a selection of chopper blades. You don't need a separate chopper controller (or power source); it's built into the Merlin Control Unit. Use the sync input if your signal is modulated by other means. Your choice of chopper wheel (not included with any of the Chopper Heads) depends upon your desired chopping frequency.

The 75154 Open Chopper is the most economical choice if you don't require an enclosed beam path. The 75151 and 75152 are both enclosed chopper heads. Choose the 75151 if you are going to flange mount the chopper to other Oriel instruments; choose the 75152 if you are rod mounting the chopper head or hard mounting to an optical table.

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Merlin calculates the 1st harmonic content of the chopped signal and this provides the RMS value. Relation of this RMS value to the peak-to peak value of the signal varies depending on the ratio of the beam size to the chopper wheel aperture size. For a very small beam, i.e. a HeNe laser beam passing through a 5 aperture wheel, the signal is almost a square wave, and the resulting ratio of the measured RMS voltage to peak-to-peak voltage is 0.4502. When the enclosed chopper wheel is illuminated by a totally uniform beam, a triangular wave shape results, and the resulting RMS is 0.3113 of the peak-to-peak value. Other illumination conditions produce intermediate values of the RMS factor. When you order a calibrated Merlin detector, you will receive data based on the square wave, small beam, experiment set-up. If your measurement conditions are different, you will need to modify the calibration factor to reflect the change in RMS multiplier.

Detector

We offer the following detectors; please refer to the individual pages for complete details.

Table 1 Detectors for Merlin™

Detector Type	Usable Wavelength Range	Reference Page
Photomultipliers	160 to 1100 nm	see page 1272
Silicon	185 to 1100 nm	see page 1275
InGaAs	800 to 1700 nm	see page 1267
Ge	700 to 1800 nm	see page 1265
PbS	0.7 to 3 μm	see page 1271
PbSe	1 to 5 μm	see page 1271
Pyroelectric	200 nm to 40 μm	see page 1274
HgCdZnTe	3.0 to 6 μm	see page 1266

Full Capability Second Channel

Automation is much easier with a dual channel Merlin Control Unit. The second channel allows you to switch to another detector automatically so you can cover a much broader wavelength range. All the same features that are accessible on your first channel are available on the second. A dual channel Merlin and Cornerstone™ 260 1/4 m Monochromator make an excellent combination since the Cornerstone™ has two output ports. The optional TRACQ™ Software will control both instruments, acquire, process and display the data.

RS-232 or IEEE-488 (GPIB) Communications

Collecting data is simple, with Merlin. The option of either the RS-232 or IEEE-488 (GPIB) communication boards covers most possibilities for fitting Merlin into your computer controlled system. Either of these interface boards allow you to upload system parameters, calibrate the signal, or download the collected data. If you're using an Oriel Cornerstone or MS257 Monochromator with a Merlin, you can command the entire system through TRACQ, our Data Acquisition and Radiometry Software.

Chopper Heads

Model	Description
75151	Enclosed Chopper Head
75152	Enclosed Chopper Head
75154	Open Chopper Head

Chopper Wheels

Model	Description
75162	Single Aperture Chopper Wheel, 2 Apertures, 32 mm Beam, 160 Hz Max. Chop Rate
75163	Single Aperture Chopper Wheel, 5 Apertures, 28 mm Beam, 400 Hz Max. Chop Rate
75166	Single Aperture Chopper Wheel, 12 Apertures, 13.7 mm Beam, 960 Hz Max. Chop Rate

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Specifications

Detector Channel(s)	
Maximum Frequency	1100 Hz
Dynamic Range	10^7:1
Gain	instantaneous auto selection
Sensitivity, LSB on A/D on A/D	0.15 μVr.m.s.
Sensitivity, Full Scale	4 V r.m.s.
Input	differential
Common Mode Rejection Ratio	110 dB
Input Noise	60 nV $Hz^{-1/2}$ at 1 kHz
Dynamic Reserve (for S/N = 100)	80 dB
Reference Channel	
Maximum Frequency	1100 Hz
Dynamic Range	3 x 10^4
Gain	1, 2, 4, 8, 16
Sensitivity, LSB on A/D	61 μ V rms V V
Sensitivity, Full Scale	4 V r.m.s.
Input	differential, ground or floating
Common Mode Rejection Ratio	95 dB
Input Noise	12 μV peak to peak in 3kHz B
Internal Frequency Reference	
Spatial Mode	fundamental
Phase Drift	none
Orthogonality	90° exactly
Synchronizing Source	internal or external
Chopper Control	
Frequency Range	8 - 1100 Hz
Control	closed loop servo
Phase Error	zero
Maximum Slew Time	5 s
Single/Dual Phase Demodulator	
Operating Method	input signal multiplied by digitally synthesized sine and cosine waves
Signal Output	single phase (Rcosθ) yields amplitude and phase, or two phase (vector) yields magnitude
Time Constant	from chop period to 100 s, single or two pole filter
Outputs	
Digital Panel Display	digital presentation of one or two signals, volts or radiometric units; chopping frequency, time constant, phase angle
Log Meter	shows signal level continuously
Analog Output	0 - 10 V; log (1 V/decade) or linear (programmable minimum and maximum)
Digital Output	RS-232C data rate to 9600 baud or IEEE-488
Synchronizing Output	TTL
Output Current Current	±15 V x 20mA
General	
Power Requirements	95 - 130 VAC 50/60Hz 190 - 260 VAC 50/60 Hz (user selectable)
Weight	14 lb (6.5 kg)

Ordering Information

Merlin Control Units

Model	Description
70100	Merlin™ Digital Lock-in Radiometry System, Single Channel, RS-232
70103	Merlin™ Digital Lock-in Radiometry System, Single Channel, GPIB
70104	Merlin™ Digital Lock-in Radiometry System, Dual Channel, RS-232
70105	Merlin™ Digital Lock-in Radiometry System, Dual Channel, GPIB

WEB *See our website for more info*

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