CHOPPER CONTROL BOARD

Each Merlin™ includes a variable frequency chopper drive and control board. This board controls the 75154 Open and 75152 Enclosed Chopper Heads, and uses the opto sensor on the heads for frequency stabilization. The advanced drive features rapid slew rate, fast settling time and extremely tight frequency control of the servo loop. Chopping frequencies to 1100 Hz are selectable from the menu. Synchronization to externally controlled choppers is possible using sync pulses from these choppers.

ANALOG SIGNAL PROCESSOR BOARD

This low noise board has an extremely wide dynamic range via a precision amplifier chain. The Smart Ranging™ feature does not require switching of amplifier stages. Merlin™ monitors all amplifiers all of the time, checking for optimal gain. There is no time or signal information lost in hardware range switching.

DIGITAL SIGNAL PROCESSOR BOARD

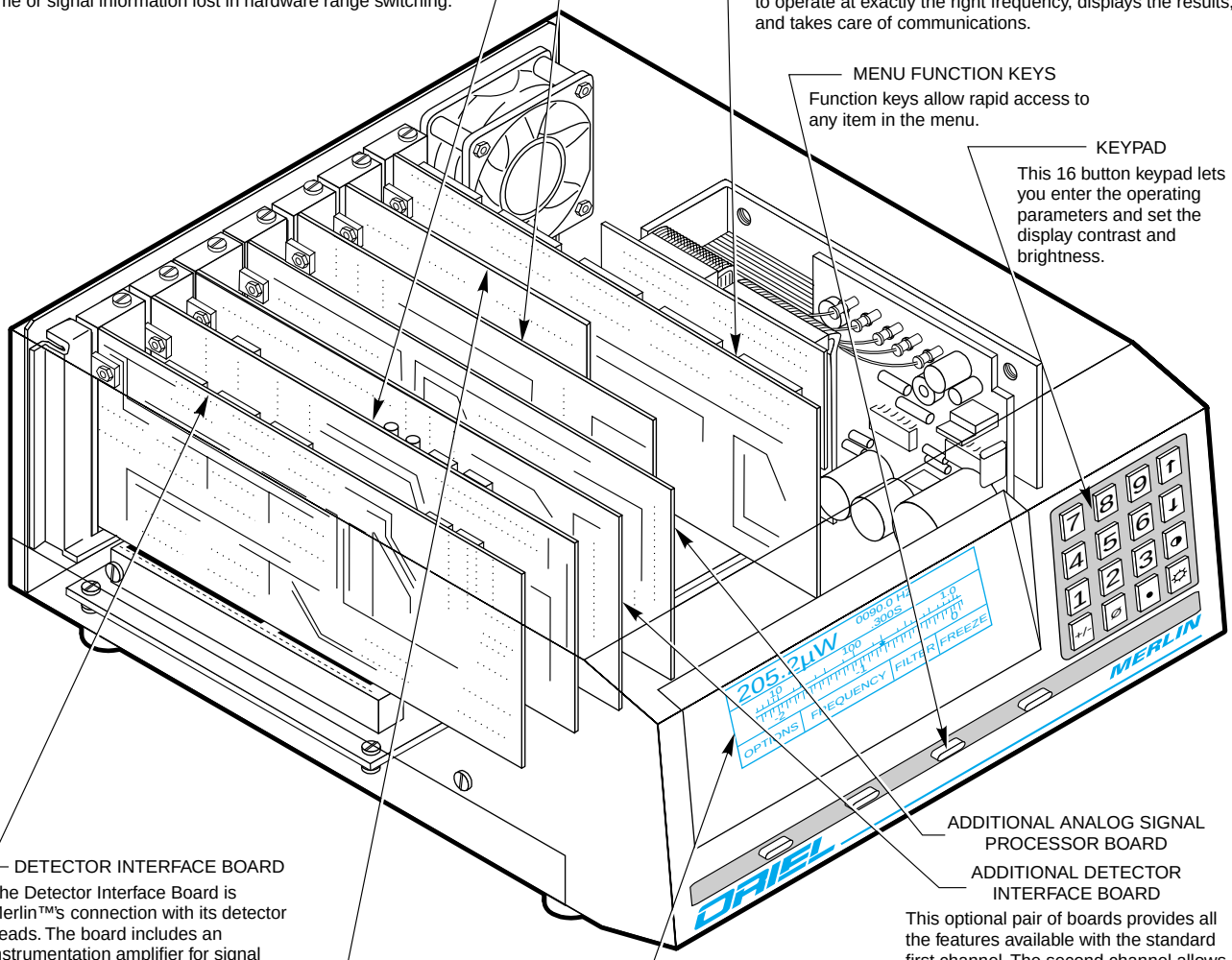
The digital signal processor board uses a digital signal processing microcomputer (DSP), optimized for high speed numerical computation. This new device gives orders of magnitude improvement in signal processing capability over conventional microprocessors. It operates at 10 mips (10 million instructions per second), creating an effective theoretical dynamic range of over 10^{12} using a 40 bit accumulator and registers. The powerful DSP architecture is required for the demanding signal processing involved in precise measurements of the input signal and conversion to meaningful units. The data is over sampled at rates approaching 100 kHz, before selection by the DSP. This then calculates the magnitude and phase, filters the data, converts to radiometric units or ratios as required. At the same time the processor controls the data taking, synchronizes the chopper to operate at exactly the right frequency, displays the results, and takes care of communications.

MENU FUNCTION KEYS

Function keys allow rapid access to any item in the menu.

KEYPAD

This 16 button keypad lets you enter the operating parameters and set the display contrast and brightness.



DETECTOR INTERFACE BOARD

The Detector Interface Board is Merlin™'s connection with its detector heads. The board includes an instrumentation amplifier for signal conditioning of both the main detector and reference detector channels. When a calibrated detector is connected, Merlin™ automatically accesses the identification and irradiance calibration information. Reference inputs are typically derived from a reference photodiode such as that on the 68950 Light Intensity Controller, or from control current or voltage reference on a laser, for example. Reference channel processing mimics that of the main signal to ensure appropriate referencing.

COMMUNICATIONS BOARD

This can be either RS-232 or IEEE-488. Both allow data downloading and calibration, and system parameter uploading from a host computer.

ADDITIONAL ANALOG SIGNAL PROCESSOR BOARD

ADDITIONAL DETECTOR INTERFACE BOARD

This optional pair of boards provides all the features available with the standard first channel. The second channel allows you to use a simple computer command or a few button pushes to change the channel selection and, therefore, to swap detectors without having to tear your system apart. This feature is especially attractive when you are working with the MS257™, Cornerstone™ 260, and MS260i™ 1/4 m monochromators and spectrographs with their two output ports.

LCD DISPLAY

The high resolution display is a Super Twist (Twisted Nematic) Liquid Crystal Display with 240 by 64 pixels and full dot matrix graphics capability. The clear 130 x 40 mm white on blue display field is backlit by a cold cathode fluorescent lamp for excellent visibility and long life. The backlighting is fully adjustable. The screen menus, along with calibration and set-up data are held in non-volatile memory.

Fig. 1 Merlin™ Control Unit.

MERLIN™ DIGITAL LOCK-IN RADIOMETRY SYSTEM

70100 Merlin™ Control Unit.

- **A complete UV-IR detection instrument; it's more than a lock-in**
- **Superior accuracy and stability from DSP lock-in amplifier**
- **Seamless gain switching for maximum dynamic range and fastest readings**
- **One or two channels each accommodating signal and reference detectors**
- **RS-232 and IEEE-488 (GPIB) capabilities**

Measure UV to IR optical radiation with the Merlin™ Digital Lock-in Radiometry System and its family of calibrated detectors. Merlin™ uses digital signal processing for highest accuracy and stability. 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 Merlin™ instruments; each channel includes a reference capability. A broad selection of calibrated detectors which have preamplifiers matched to Merlin™, are available (see page 6-33 for selection).

Merlin™ works with chopped radiation, repetition rates from 8 to 1100 Hz. An external chopper wheel is required (see page 6-32 for choices); power and control is provided by the chopper control board inside Merlin™.

WHY MERLIN™?

Superior performance and ease of use make Merlin™ the best measuring system for demanding applications. Take a look at the benefits:

- Lock-in detection improves S/N and insulates you from ambient radiation
- Usable from 180 nm to 40 µm, with interchangeable detectors
- Calibrated measurements
- Reference input corrects your measurement channel to compensate for source drift
- Dual signal channel option lets you take measurements over a very broad spectral range without manually changing detectors
- Smart Ranging™; a seamless gain switching feature - always ensures the best amplification range
- Display measurement in W, W cm^{-2}, dBm or V

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 downloads the calibration information.

Optical Chopper

The chopper modulates the radiation to be measured. We offer an open and an enclosed version, models 75154 and 75152, respectively, 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.

Detector

Page 6-33 introduces the large selection of Merlin™ optimized UV-IR detectors.

Merlin™ Control Unit with DSP Power

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 the system. It is shown in Fig. 1 on the previous page. 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 Merlin™s. The dual channel models support two detectors, but only one operates at a time. A dual channel system complements our **new** line of Cornerstone™ Scanning Monochromators (pages 4-17 and 4-24).

SMART RANGING™

Merlin's™ Smart Ranging™ feature simplifies measurements. The gain setting is automatically and seamlessly selected. Merlin™'s wide dynamic range, multi-stage, very low noise amplifier chain is sequentially sampled at each stage many times during each cycle and the highest, nonsaturated voltage is utilized for analog to digital conversion, A/D. This means you are ensured of maximum utilization of the A/D system resolution for every reading. The 40 bit accumulator and registers of the DSP board create an effective theoretical dynamic range of 10^{12}, but noise levels bring it down to 10^{7}.

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 the **new** Cornerstone™ 260 1/4 m Monochromator make an excellent combination since the Cornerstone™ has two output ports. The optional TRACQ32™ Software will control both instruments, acquire, process and display the data. See page 4-24 for details on Cornerstone™ 1/4 m and 4-51 for TRACQ32™.

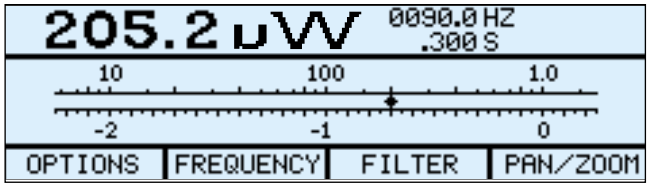


Fig. 2 A real time meter displays the signal reading. The scale can be expanded to better view the active range.

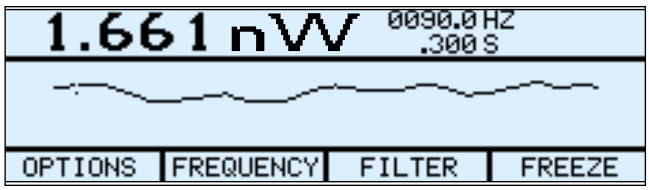


Fig. 3 The oscilloscope-like display helps you monitor trends.

INTERNAL SOFTWARE DOES THE WORK

Merlin™'s electronics provide you with full control of the system's parameters; Merlin™'s internal software allows you to plug in the detector and take basic measurements with minimal set-up. This combination of ease and versatility comes from our user interface.

You can control Merlin™ from a menu structure accessed via the instrument's front panel. Four function keys and a keypad give you complete control of all the options. The LCD displays your data in W, W cm^{-2}, dBm or V. To look for a peak signal you can use the display's analog bar scale or scope display (Fig. 2 and 3) with rapid update.

TECH NOTE

The core of Merlin™ technology is its digital signal processing (DSP) board. The powerful processor gives Merlin™ its accuracy and speed, and offers key capabilities such as single and dual phase demodulation. Dual phase demodulation is the ultimate in hands-off signal readout. Single phase demodulation allows advanced thermal measurements. The processor also takes care of Merlin™'s built-in referencing capabilities. Any lock-in provides background rejection as a result of synchronizing with the chop cycle, but Merlin™'s DSP also analyzes the reference detector and corrects your measurement, to compensate for source drift. The large inherent dynamic range, exceptional signal to noise ratio, and rapid processing are based upon the capabilities of our DSP.

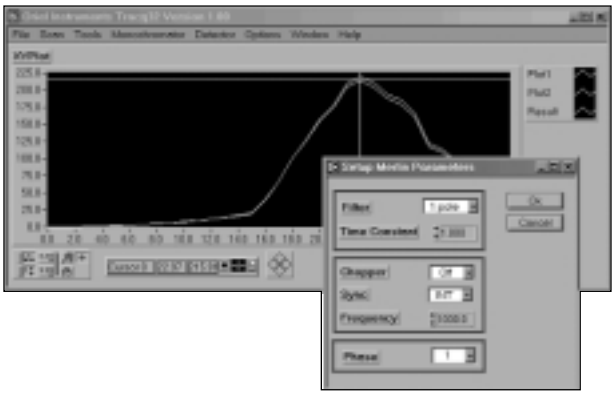


Fig. 4 TRACQ 32™ set-up screen for Merlin™ Radiometry system.

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 TRACQ32™, our **new** Data Acquisition and Radiometry Software. TRACQ32™ controls the instruments, acquires, processes and displays your data, in real time. It runs under Windows™ '95, '98 and NT. See page 4-51 for details on TRACQ32™.

For those who wish to integrate Merlin™ with other laboratory instruments, we supply LabView™ VIs. With these development tools you can write your own application.

CHOPPER

Modulate your source with one of the these choppers:

75152 Enclosed Chopper

- Safer operation
- Mounts directly to Oriel Light Sources

75154 Open Chopper

- Low cost
- Chops multiple beams simultaneously

Your choice of chopper wheel (not included with the 75152 or 75154) depends upon your desired chopping frequency; read ***TECH NOTE***, below. The chopper wheels are listed on page 6-42.

TECH NOTES

CHOOSING YOUR CHOPPING FREQUENCY

Often, it is enough to simply chop the optical beam; chopping frequency is not important (provided it is below the 1100 Hz limit of Merlin™ DSP). However, there are certain factors that may suggest particular chop frequencies for optimizing your system. One common practice, removing power line generated noise from the system, requires chopping at an odd multiple of ½ the line frequency in your geographic region. For example, in the United States, 90 Hz is routinely used because it is the third multiple of 30 Hz, one half the 60 Hz line. You will need to use higher chopping frequencies to follow faster changing signals.

Another consideration is detector sensitivity to chop frequency. Pyroelectric and PbS detectors, for example, work better at low frequencies, preferably below 200 Hz. On the other hand, PbSe detectors have a better response at higher chopping frequencies.

The best way to determine the correct chop rate is to connect your system and optimize according to your particular conditions. In addition to the "½ Line Law" use this rule of thumb to get started: use the highest chop frequency and lowest corresponding time constant that will give you an adequate signal to noise ratio; this will speed your data collection rate.

BEAM SIZE AND CALIBRATION

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 from Oriel, 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.

MERLIN™ SPECIFICATIONS

Detector Channel(s)

Max. frequency:	1100 Hz
Dynamic range:	10^7:1
Gain:	instantaneous auto selection
Sensitivity:	
LSB on A/D:	0.15 µV r.m.s.
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

Max. frequency:	1100 Hz
Dynamic range:	3 x 10^4
Gain:	1, 2, 4, 8, 16
Sensitivity:	
LSB on A/D:	61 µV r.m.s.
Full scale:	4 V r.m.s.
Input:	differential, grounded or floating
Common mode rejection ratio:	95 dB
Input noise:	12 µV pk. to pk. in 3 kHz BW

Internal Frequency Reference

Mode:	fundamental
Phase drift:	none
Orthogonality:	90° exactly
Synchronizing source:	internal or external

Chopper Control (Oriel Choppers)

Frequency range:	8 - 1100 Hz
Control:	closed loop servo
Phase error:	zero
Max. slew time:	5 s

Single/dual Phase Demodulator

Operating method:	input signal multiplied by digitally synthesized sine and cosine waves
Signal output:	single phase (Rcos θ) 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
Amplifier output:	±15 V x 20 mA

General

Power requirements:	95 - 130 VAC, 50/60 Hz 190 - 260 VAC, 50/60 Hz (user selectable)
Weight:	14 lbs. (6.5 kg)

A wide selection of room temperature and cooled detectors is available for Merlin™, covering the wavelength range from 160 nm to over 40 µm. These are described on the following pages. Use Fig. 5 during the detector selection process. The detectors are ranked by nominal peak detectivity with the group having the highest D*, PMTs, at the top. Many performance factors, such as: element size, specific wavelength of operation, effects of cooling and bias, and window type, as well as convenience and price must be considered. The data on the following pages provide more detailed information on the performance and use of the specific detectors. If you have any questions or need validation of your selection, call an Applications Engineer.

Turn to the following pages for details:

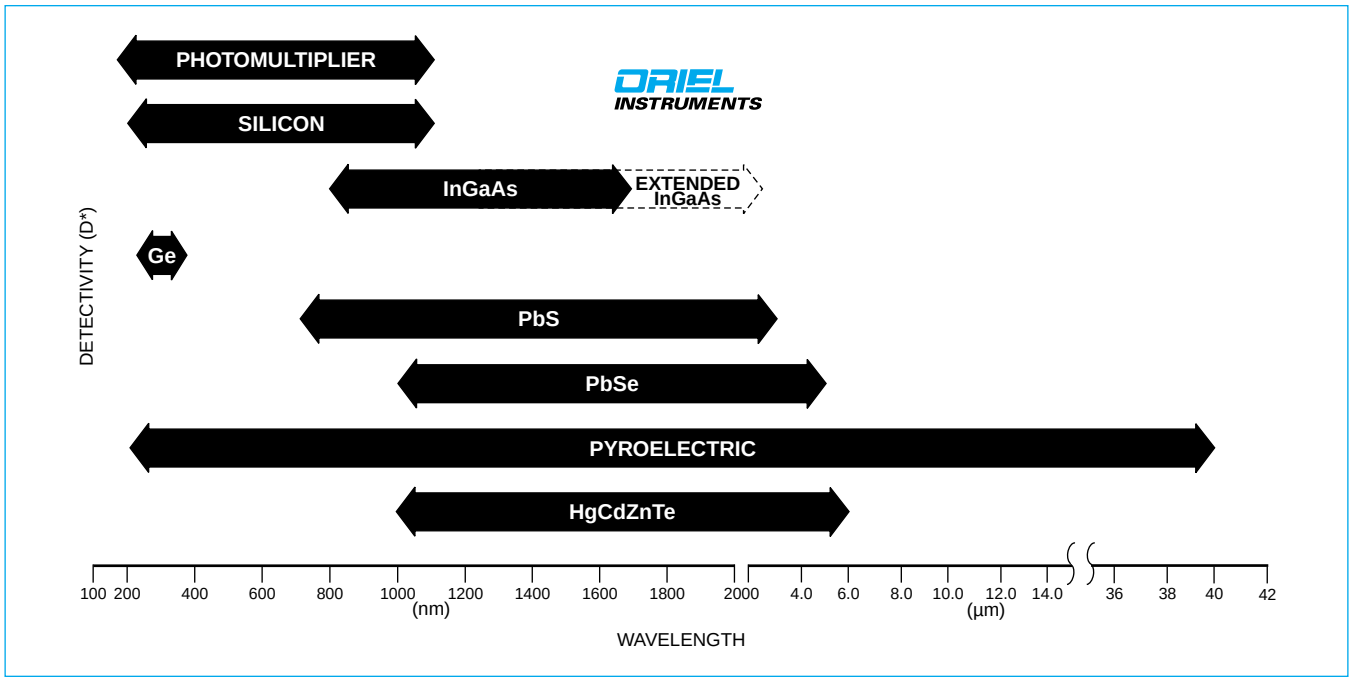


Fig. 5 Usable wavelength ranges of Merlin™ Detectors.

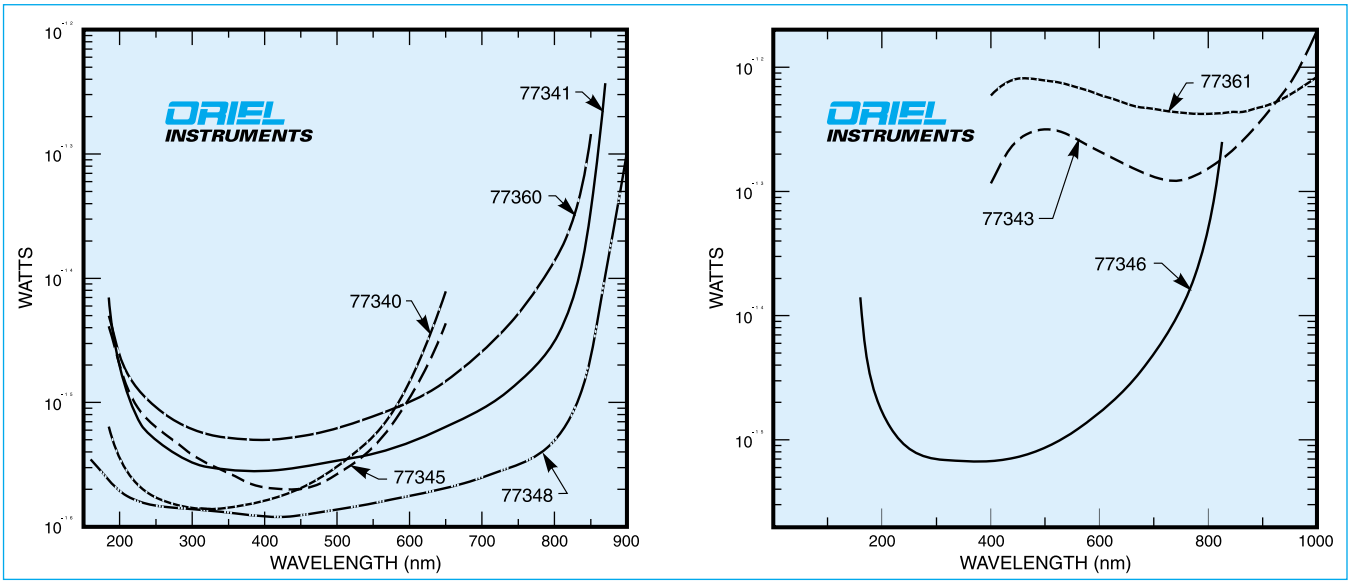


Fig. 6 Minimum measurable power levels of photomultiplier tubes, operated by Merlin™.

PHOTOMULTIPLIER SYSTEMS FOR MERLIN™

PMTs are the most sensitive single channel detector we offer. We describe their principles and benefits on page 6-65. Here, we show their performance with a Merlin™ Lock-in.

Fig. 6 represents not the "once-in-a-lifetime" results, but performance levels that are fairly typical of our systems. The responsivity and dark current values of PMTs can vary by as much as a factor of 5 each, under identical bias and temperature conditions. Therefore, there may be a few tubes which will not reach these typical results.

We offer room temperature end-on and side-on PMTs to cover the 160 to 1100 nm range.

NON-CALIBRATED DETECTORS

We do not usually calibrate PMTs, since the long term stability is not adequate for this purpose. You can calibrate Merlin™ PMT systems with a standard lamp, or transfer calibration from a silicon detector (following page), providing care is taken in selecting the operating conditions.

CHOPPING FREQUENCY

Use any chopping frequency between the 8 and 1100 Hz limits of the Merlin™ Lock-in. The PMTs will comfortably follow any signal within these limits, transimpedance amplifier bandwidth allowing.

Let the noise levels and the desired speed of data collection guide your chopping frequency and time constant selections. We find that frequencies equal to 1.5 or 1.75 times the line frequency and 0.3 to 3 second time constants work very well for low light levels.

DETECTION SYSTEMS

We offer two PMT packages for Merlin™. The 70143 uses an end-on PMT, and the 70107 uses a side-on PMT. See page 6-65 for a technical discussion of the differences between end-on and side-on PMTs. Because we carry so many photomultiplier tubes with different responsivities and usable wavelength ranges, we do not include the tube in the system.

Each package includes:

- 77265 End-on or 70680 Side-on PMT Housing
- 70710 Transimpedance Amplifier
- All necessary interconnecting cables

You must order the following, separately:

- Photomultiplier Tube from the list below
- 70705 Power Supply described on page 6-68 (or provide your own source of high voltage bias)
- Merlin™ Control Unit
- Chopper

Table 1 Photomultiplier Tubes*

Wavelength Range (nm)	Peak Wavelength (nm)	Cathode Responsivity** (mA/W)	NEP** (W Hz$^{-1/2}$)	Supply Voltage (V)	Model No.
Side-on Photomultipliers					
185-650	340	48	1.4 x 10^{-16}	1000	**77340**
185-870	330	40	2.8 x 10^{-16}	1000	**77341**
400-1000	730	1.9	1.2 x 10^{-13}	1250	**77343**
160-900	400	68	1.2 x 10^{-16}	1000	**77348**
185-850	420	70	5.0 x 10^{-16}	1000	**77360**
End-on Photomultipliers					
185-650	420	85	2.0 x 10^{-16}	1000	**77345**
185-850	420	64	6.6 x 10^{-16}	1000	**77346**
400-1100	800	1.9	4.2 x 10^{-13}	1250	**77361**

*** See page 6-66 for other specifications.**
**** Typical values at the supply voltage listed.**

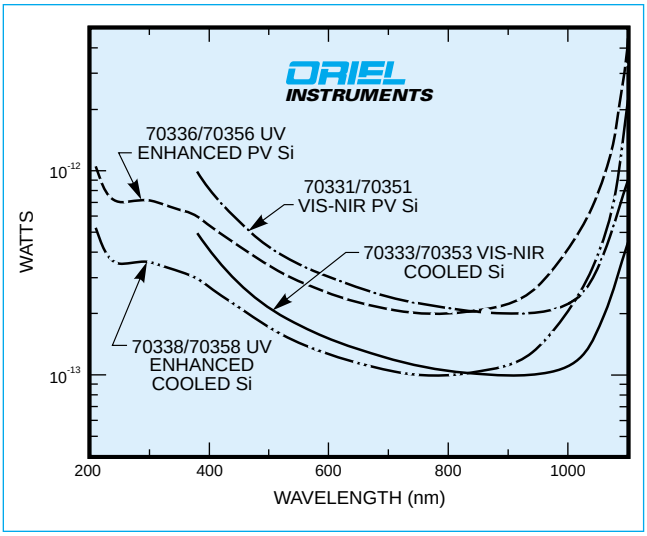


Fig. 7 Lowest measurable powers of Silicon Based Detectors operated by Merlin™.

SILICON DETECTORS FOR MERLIN™

These versatile and ultrasensitive detectors reach NEP levels surpassed only by PMTs (see Fig. 7). The linearity range is unmatched by any other detector type. They have excellent long term stability, especially the UV enhanced models. These withstand high intermittent and cumulative levels of UV without significant change of response.

The TE stabilized units overcome the small temperature dependence of silicon responsivity for even better performance. This is especially critical in the near infrared spectral region, >1 µm, in the vicinity of the band gap.

COOLED OR ROOM TEMPERATURE PHOTOVOLTAIC MODE DETECTORS

These photovoltaic, unbiased mode detectors provide the lowest noise and highest linearity operation. We offer:

- 5 mm diameter area, single stage TE cooled/stabilized detectors
- 10 mm^2 area, room temperature detectors

Switch selectable transimpedance gain and bandwidth control are provided by the built-in amplifiers.

MEASURABLE POWER

The built-in transimpedance amplifiers allow gains between 10^4 V/A and 10^9 V/A to match the output of the detectors to the input range of Merlin™, 0.15 µV to 4 V, RMS.

The phase sensitive detection of Merlin™ allows measurement of low signal power even in the presence of background radiation. We have used the 10 mm^2 detectors to measure 200 fW at 700 nm, at signal to noise ratios of better than 2:1.

CALIBRATION

We offer calibrated and standard versions of these detectors. The standard models are shipped with a single point calibration at 633 nm. You can enter that value into Merlin™ for a calibrated measurement. Because of the spectral variation in response, the displayed value is only correct for 633 nm. You can approximately correct the power reading using relative responsivity curves, if you know the spectral content of the incident radiation.

For absolute measurement at different wavelengths, choose a calibrated detector. Please take a look at the ***TECH NOTE*** on page 6-32 for a discussion on calibration and beam size issues.

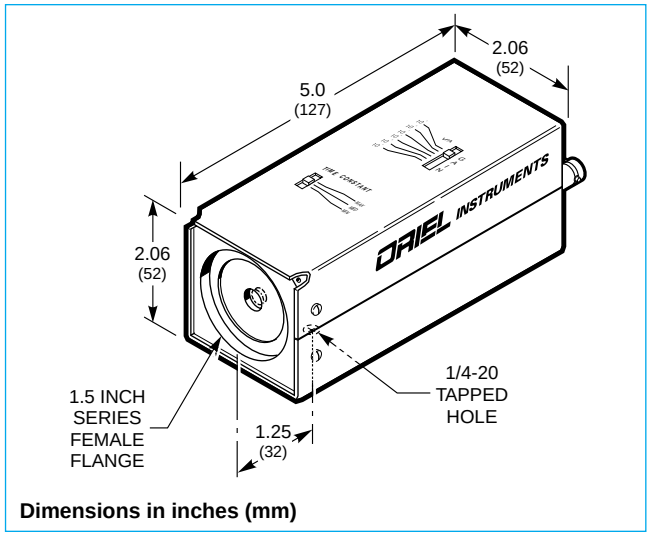
DETECTOR SYSTEMS

All the detector packages listed in Table 2 include:

- Silicon detector element
- Detector housing with built-in preamplifier
- All necessary interconnecting cables

You will also need to order:

- 77057 (110 V) or 77058 (220 V) Cooler Controller for the cooled systems
- Merlin™ Control Unit
- Chopper



Dimensions in inches (mm)

Fig. 8 Dimensional diagram of Silicon Detectors.

FOR ORDERING INFOMATION...

Ordering information for these, and all other Merlin™ Detectors, is on page 6-42.

Table 2 Silicon Detector Packages

Wavelength Range (nm)	Detector Type	Detector Size	Model No.	
			Standard	Calibrated
400 - 1100	Room Temperature	10 x 10 mm	**70331**	**70351***
400 - 1100	TE Cooled	5 mm diameter	**70333**	**70353***
185 - 1100	Room Temperature	10 x 10 mm	**70336**	**70356****
185 - 1100	TE Cooled	5 mm diameter	**70338**	**70358****

*** Calibrated for 400 - 1100 nm spectral range.**
**** Calibrated for 200 - 1100 nm spectral range.**

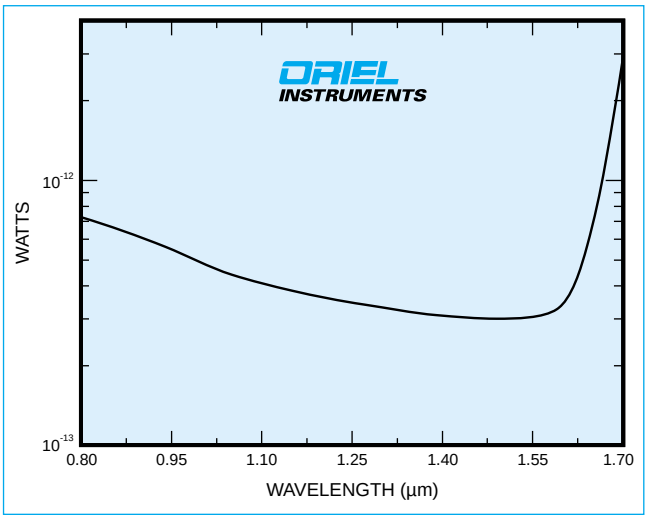


Fig. 9 Measurable power of the TE cooled 70348 Detector, operated by Merlin™.

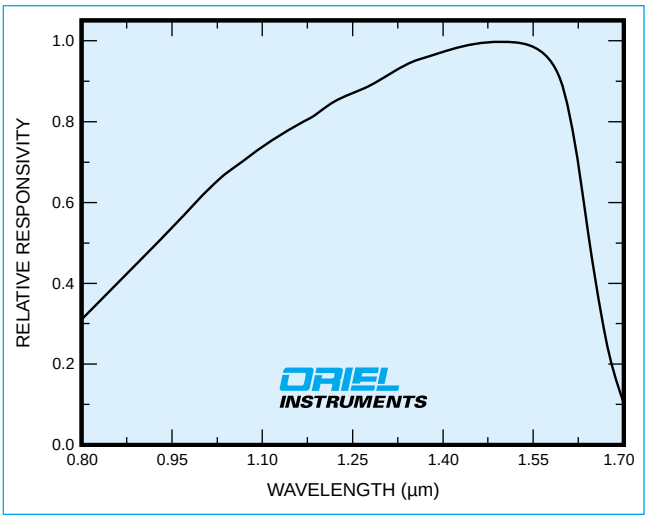


Fig. 10 Relative responsivity of 70348 InGaAs Detector.

InGaAs DETECTORS FOR MERLIN™

These direct gap semiconductor devices have excellent speed of response and linearity. They are a little bit noisier than silicon detectors, due to the smaller band gap, and therefore we offer one with two-stage TE cooling for radiometric applications. The 1.3 µm and 1.55 µm wavelengths, so important to the telecommunications industry, lie within the 0.8 to 1.7 µm detection range. Transmission and loss measurements can be done most accurately with these extremely stable and sensitive detectors.

ROOM TEMPERATURE vs COOLED

We achieve excellent stability of response with the TE cooled detectors as a result of the inherent qualities of the diode and thermal stabilization at temperatures down to -20 °C. The room temperature detectors will serve you well if you don't work too close to the extremes of their spectral range, especially at 1.7 µm.

CALIBRATION

The stability and linearity of response of our InGaAs Detectors makes them excellent candidates for calibrated measurements. We ship the standard models with a single point calibration at 1.55 µm. Use the typical responsivity curve shown in Fig. 9 to approximate responsivity at other wavelengths.

For highest accuracy, we offer calibrated models with NIST traceable calibrated responsivity factors for the 0.8 to 1.7 µm range. Please take a look at the ***TECH NOTE*** on page 6-32 for a discussion of calibration and beam size issues.

TECH NOTE

We talk about the 3 mm diameter of the InGaAs detectors as a large area, based on the ease of coupling rather than actual physical size. We selected this size based on a price to benefit trade off analysis. Larger InGaAs elements increase in price quite drastically due to limited yields of high quality detector grade material with uniform properties.

DETECTOR SYSTEMS

Each InGaAs Detector Package includes:

- InGaAs Detector element
- Detector housing with built-in preamplifier
- All necessary interconnecting cables

You will also need:

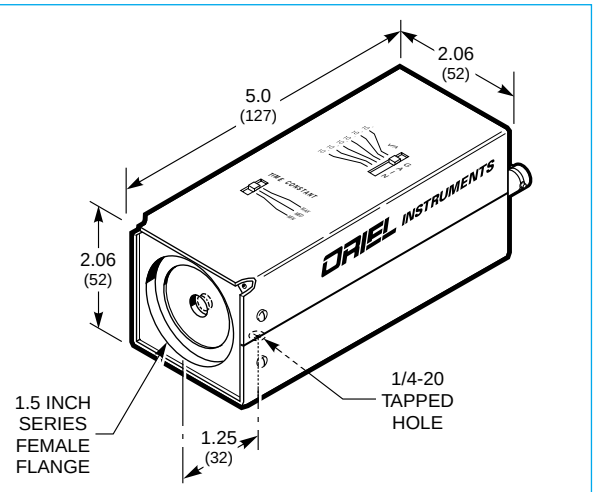
- 77057 (110 V) or 77058 (220 V) Cooler Controller for TE cooled models
- Merlin™ Control Unit
- Chopper

Table 3 InGaAs Detector Packages

Wavelength Range (nm)	Detector Type	Detector Size	Model No.	
			Standard	Calibrated
800 - 1700	Room Temp.	3 mm dia.	**70347**	**70367**
800 - 1700	TE Cooled	3 mm dia.	**70348**	**70368**

FOR ORDERING INFORMATION...

Ordering information for the entire Merlin™ Product Family is on page 6-42.



Dimensions in inches (mm)

Fig. 11 Responsivity of Germanium Detectors.

GERMANIUM DETECTORS FOR MERLIN™

These reliable detectors extend the detectivity range of Merlin™ photodiode detectors to 1.8 µm. They are stable and linear, and highly uniform in their responsivity.

The TE cooled units improve the low signal detectivity and stability, of the diode response.

COOLED OR ROOM TEMPERATURE PHOTOVOLTAIC MODE DETECTORS

These photovoltaic, unbiased mode detectors provide excellent performance in the 0.7 to 1.8 µm range. We offer 5 mm diameter devices in both cooled and room temperature models.

MEASURABLE POWER

Below picowatt powers can be measured using these germanium detectors. Built-in transimpedance amplifiers provide 10^4 V/A to 10^9 V/A gain and selectable electronic filter settings.

CALIBRATION

We offer calibrated and standard versions of these detectors. The standard models are shipped with a single point calibration at 1500 nm. Because of the spectral variation in response, the displayed value is only correct for 1500 nm. You can approximately correct the power reading (for other wavelengths) using relative responsivity curves, if you know the spectral content of the incident radiation.

For absolute measurements at different wavelengths, choose one of the NIST traceable calibrated models. See the ***TECH NOTE*** on page 6-32 for a discussion on the impact of beam size on calibration values.

DETECTOR SYSTEMS

All the detector packages listed in Table 4 include:

- Germanium detector element
- Detector housing with built-in preamplifier
- All necessary interconnecting cables

You will also need to order:

- 77057 (110 V) or 77058 (220 V) Cooler Controller for the cooled systems
- Merlin™ Control Unit
- Chopper

Table 4 Germanium Detector Packages

Wavelength Range (nm)	Detector Type	Detector Size	Model No.	
			Standard	Calibrated
700 - 1800	Room Temp.	5 mm Dia.	**70339**	**70359**
700 - 1800	TE Cooled	5 mm Dia.	**70340**	**70360**

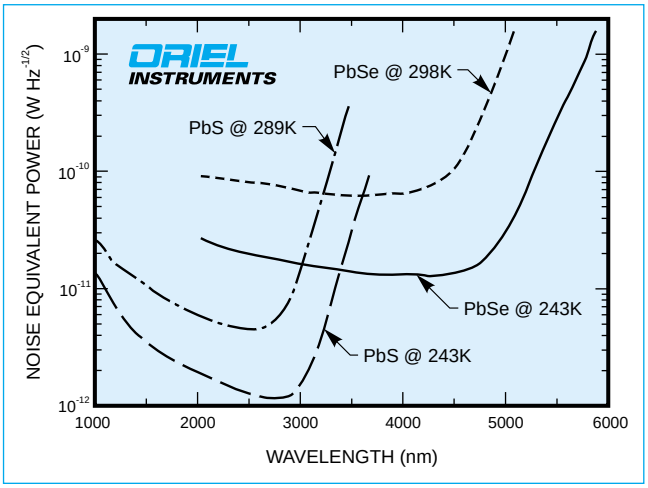


Fig. 12 NEP values of PbS and PbSe Detectors.

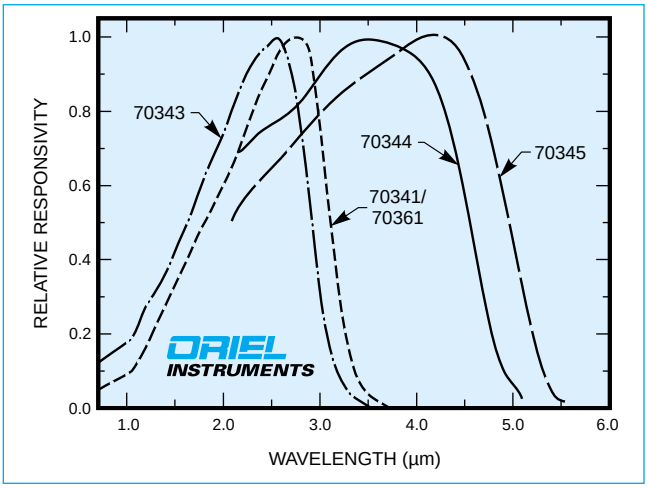


Fig. 13 Relative responsivities of PbS and PbSe detectors.

PbS AND PbSe DETECTORS FOR MERLIN™

These are classical photoconductive infrared detectors. PbS has a relatively high detectivity; PbSe extends the responsivity farther into the infrared. As with all infrared detectors, they benefit significantly from operating at lower temperatures. PbS and PbSe detectors are subject to 1/f noise due to bias current. We offer them for AC operation only.

STABILITY

Good stability of response is obtained with the TE cooled and stabilized detectors. Room temperature units show the usual drift with changing ambient conditions. Both PbS and PbSe are subject to a change of responsivity when exposed to blue to UV light. They usually recover but it may take days of dark storage before full recovery occurs.

These detectors require a bias voltage; a 100 V bias supply is built into the detector housings.

MEASURABLE POWER

Fig. 12 shows the typical minimum measurable power levels of our PbS and PbSe detectors. You will need an attenuator to measure power levels above approximately 0.1 mW (see page 10-18 for neutral density filters).

DETECTOR SYSTEMS

All PbS and PbSe detector packages for Merlin™include:

- Detector element
- Detector housing with built-in bias supply and preamplifier
- All necessary interconnecting cables

You will also need:

- 77057 (110 V) or 77058 (220 V) Cooler Controller for the TE cooled detectors
- Merlin™ Control Unit
- Chopper

Table 5 PbS and PbSe Detector Packages

Detector Type	Wavelength Range (µm)	Temperature	Detector Size	Model No.
PbS	0.7 to 3	Room Temperature	3 x 3 mm	**70343**
PbS	0.7 to 3	TE Cooled	1 x 3 mm	**70341**
PbSe	1 to 5	Room Temperature	3 x 3 mm	**70345**
PbSe	1 to 5	TE Cooled	1 x 3 mm	**70344**

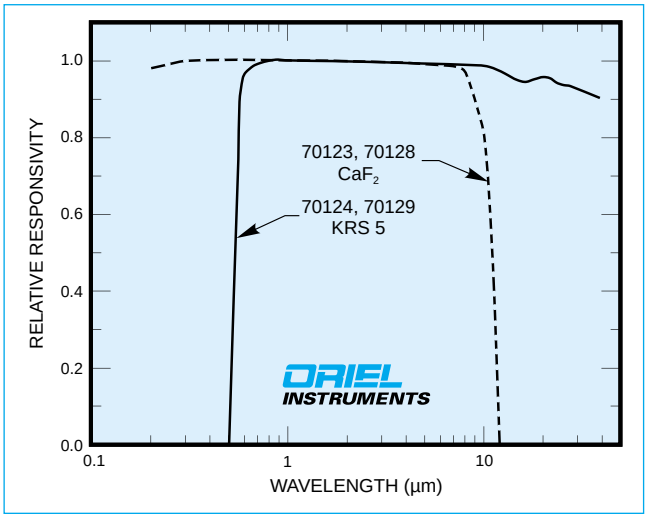


Fig. 14 Relative spectral response of Pyroelectric Detectors. The window material sets the useful limits.

PYROELECTRIC DETECTORS FOR MERLIN™

Pyroelectric Detectors are sensitive over a broad spectral range. The responsivity varies very little from the ultraviolet to the infrared (see Fig. 14). We calibrate these detectors for response in V/W. The Merlin™ Control Unit can then display the reading in watts.

STABILITY

Because the responsivity of pyroelectric detectors is fairly temperature insensitive, you get good stability of response. The high absorptance of our durable coating has excellent long term stability.

MEASURABLE POWER

The noise equivalent power (NEP) of the 2 mm detector is 5 x 10^{-10} for a 1 Hz bandwidth. Since the NEP falls as bandwidth is reduced, you can, in principle, measure even lower powers if you are prepared to wait, and if all the noise is "well behaved." With reasonable electrical and acoustic shielding, we measure power levels down to a nW with a 1 s time constant at a 2:1 signal to noise ratio, in our laboratory. We regard this as a practical lower limit. The upper power limit for Merlin™, with a 2 mm pyroelectric detector, is 2 mW, based on the calibration factor of 2000 V/W. With an attenuator you can measure higher powers. The lower practical limit for the 5 mm unit is approximately 3 nW due to the noise associated with the large area of the detector element.

CALIBRATION

Each unit is calibrated at 633 nm. We do not offer detectors calibrated at more wavelengths, as the flatness of these detectors' response is quite unique and eliminates the need for more wavelength specific data. All the 2 mm units have their responsivity adjusted to 2000 V/W. The 5 mm units are shipped adjusted to 1000 V/W.

Please take a look at the ***TECH NOTE*** on page 6-32 for a discussion of calibration and beam size issues.

TECH NOTE

We compensate for the characteristic fall-off in responsivity with chopping frequency by including a gain boost in the amplifier circuit. This frees you to select any chopping frequency within the Merlin™ range (8 to 1100 Hz) with minor impact on the calibration. The signal remains constant but the signal to noise performance will deteriorate above 200 Hz due to the fundamental characteristics of the detector.

LITHIUM TANTALATE ELEMENTS

These detectors use lithium tantalate crystals for high responsivity, to minimize sensitivity to microphonics and for long term stability. The crystals have a proprietary black coating to enhance the responsivity and remove the sharp spectral variations beyond 10 µm due to crystal absorption bands. We offer these detectors with either CaF_2 or KRS 5 windows. This is done for detector protection and noise suppression, since these thermal detectors are very sensitive to air drafts.

DETECTOR SYSTEMS

We offer 2 mm and 5 mm diameter detectors. The smaller detectors are useful for many laser or focused beam applications; the 5 mm models are useful for monitoring the output of a monochromator or for applications where it is not possible to tightly focus the radiation.

Each system includes:

- Pyroelectric detector with window
- Detector housing with preamplifier
- All necessary interconnecting cables

Don't forget to also order:

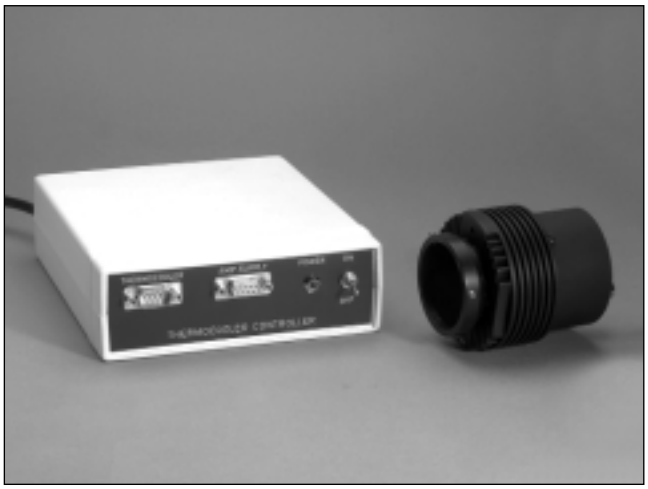
- Merlin™ Control Unit
- Chopper

Table 6 Pyroelectric Detector Packages

Detector Size	Window Material	Model No.
5 mm Dia.	CaF_2	**70362**
5 mm Dia.	KRS 5	**70363**
2 mm Dia.	CaF_2	**70364**
2 mm Dia.	KRS 5	**70365**

FOR ORDERING INFORMAION...

Ordering information for the entire Merlin™ Product Family is on page 6-42.



70373 TE Cooled HgCdZnTe Detector.

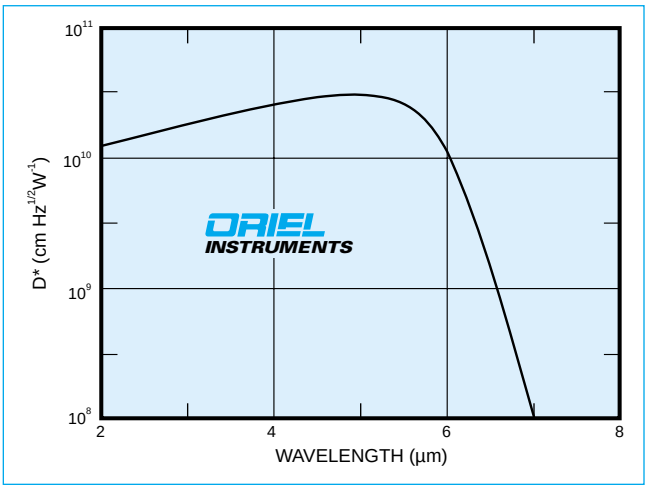


Fig. 15 Typical detectivity of 70373/4 HgCdZnTe Detectors.

TE COOLED HgCdZnTe DETECTORS FOR MERLIN™

We took our most popular HgCdZnTe detector, the 2 to 6 µm 70756 from page 6-77, and packaged it for use with Merlin™ and MIR 8000™ systems (page 5-20).

EASE OF USE

Unpack the detector, connect it to Merlin™, plug it into the mains and start using it. This all inclusive unit takes all the fuss out of working with high performance, cooled IR detectors.

The detector head contains a TE cooled detector element and a preamplifier. The power supply/controller box provides temperature control function and power for the preamplifier. We offer 110 and 230 V models.

PERFORMANCE

Monolithic optical immersion of these detectors provides unmatched performance. A 42° field of view (FOV) serves most applications well, and 1 x 1 mm optical size allows effective signal collection. Fig. 15 shows typical responsivity of this detector system (shown is DC responsivity; Merlin™ will read ~2.2 times lower voltage due to the RMS multiplier factor).

MOUNTING

The detector housings have a 1.5 Inch Series female flange for flange mounting, and M6 and 1/4-20 tapped holes for rod mounting.

DETECTOR SYSTEMS

We offer two TE Cooled HgCdZnTe detector systems for Merlin™; the difference is the power. The 70373 is the choice for 115 V operation; the 70374 is for 230 V. We can also package any of the 70754 to 70762 detectors (page 6-77) into the same type of systems. Contact an Oriel Applications Engineer for price and delivery information.

Both detectors include:

- TE Cooled HgCdZnTe detector element
- Detector Housing with buit-in preamplifier
- Power supply and temperature controller
- All necessary interconnecting cables

You will also need to order:

- Merlin™ Control Unit
- Chopper

Table 7 TE Cooled HgCdZnTe Detector Packages

Wavelength Range* (µm)	Detector Size (mm)	Bandwidth	Model No.	
			115 V Operation	230 V Operation
2 to 6	1 x 1	100 Hz to 100 kHz	**70373**	**70374**

*** Other wavelength ranges (2 - 4 µm to 2 - 12 µm) are available; contact an Applications Engineer for details.**

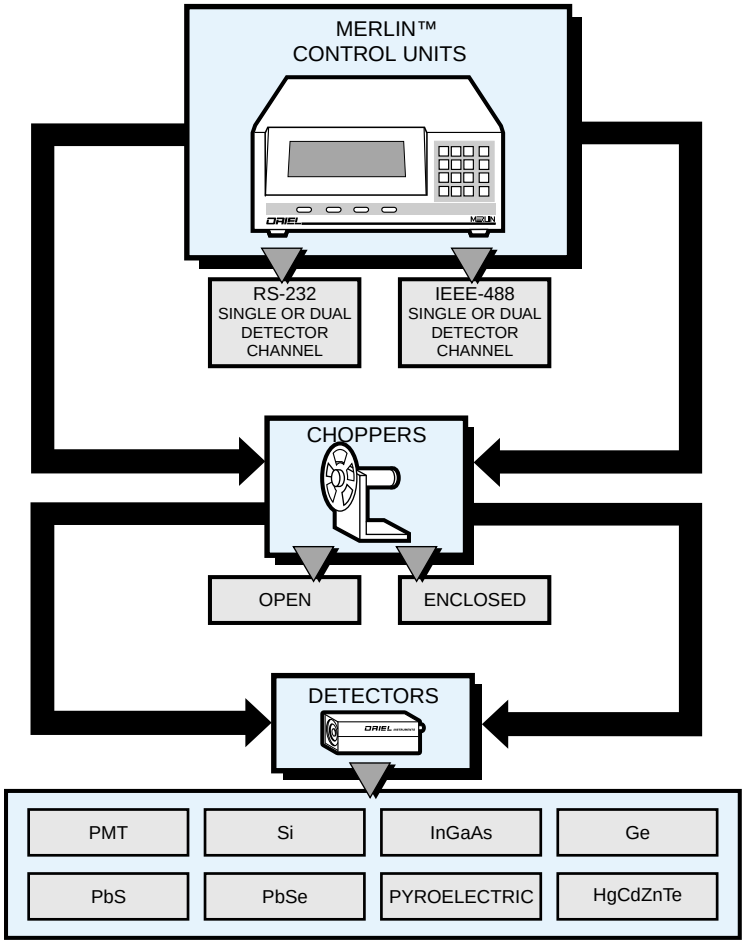


Fig. 16 To build a complete Merlin™ System, you need a Merlin™ Control Unit, a detector and a chopper. The choices are shown in this diagram.

Merlin™ Control Units and Software

Number of Channels	Computer Interface	Model No.	Price
Single	RS-232	**70100**	
Single	IEEE-488 (GPIB)	**70103**	
Dual	RS-232	**70104**	
Dual	IEEE-488 (GPIB)	**70105**	

70102 Additional Synchronous Detector Channel For 70100 or 70103 (Includes detector interface board with reference input and analog signal processor)

77888 TRACQ32™ Data Acquisition and Radiometry Software

Chopper Heads

75152 Enclosed Chopper Head
Order chopper wheel(s) separately

75154 Open Chopper Head
Order chopper wheel(s) separately

Chopper Wheels

Number of Apertures	Repetition Rate	Model No.	Price
2	8 - 200 Hz	**75162**	
5	20 - 500 Hz	**75163**	
12	60 - 1200 Hz	**75166**	

Photomultiplier Tube Systems

Packages include PMT Housing, Preamplifier and all necessary cables. Order PMT and 70705 Power Supply separately.

Housing Type	Model No.	Price
End-on	**70143**	
Side-on	**70107**	

PMTs

PMT Type	Wavelength Range (nm)	Model No.	Price
Side-on	185 - 650	**77340**	
Side-on	185 - 870	**77341**	
Side-on	400 - 1000	**77343**	
Side-on	160 - 900	**77348**	
Side-on	185 - 850	**77360**	
End-on	185 - 650	**77345**	
End-on	185 - 850	**77346**	
End-on	400 - 1100	**77361**	

70705 Bias Supply

InGaAs Detector Packages

Packages include detector, detector housing with built-in preamplifier, and all necessary interconnecting cables.

Detector Type	Standard		Calibrated	
	Model No.	Price	Model No.	Price
Room Temperature	**70347**		**70367**	
TE Cooled	**70348**		**70368**	

77057 Cooler Controller, 110 V
77058 Cooler Controller, 220 V

Germanium Detector Packages

Packages include detector, detector housing with built-in preamplifier, and all necessary interconnecting cables.

Detector Type	Standard		Calibrated	
	Model No.	Price	Model No.	Price
Room Temperature	**70339**		**70359**	
TE Cooled	**70340**		**70360**	

77057 Cooler Controller, 110 V
77058 Cooler Controller, 220 V

Silicon Detector Packages

Packages include detector, detector housing with built-in preamplifier, and all necessary interconnecting cables.

Detector Type	Wavelength Range (nm)	Standard		Calibrated	
		Model No.	Price	Model No.	Price
Room Temperature	400 - 1100	**70331**		**70351**	
TE Cooled	400 - 1100	**70333**		**70353**	
Room Temperature	185 - 1100	**70336**		**70356**	
TE Cooled	185 - 1100	**70338**		**70358**	

77057 Cooler Controller, 110 V **77058** Cooler Controller, 220 V

PbS and PbSe Detector Systems

Packages include detector, detector housing with built-in preamplifier and bias supply, and all necessary interconnecting cables.

Detector Type	Wavelength Range (µm)	Model No.	Price
PbS Room Temperature	0.7 - 3	**70343**	
PbS TE Cooled	0.7 - 3	**70341**	
PbSe Room Temperature	1 - 5	**70345**	
PbSe TE Cooled	1 - 5	**70344**	

77057 Cooler Controller, 110 V **77058** Cooler Controller, 220 V

Pyroelectric Detector Packages

Each package includes a calibrated detector with window, detector housing with preamplifier, and all necessary interconnecting cables.

Detector Size (mm)	Window Material	Model No.	Price
5	CaF_2	**70362**	
5	KRS 5	**70363**	
2	CaF_2	**70364**	
2	KRS 5	**70365**	

HgCdZnTe Detector Packages

Each package includes a TE cooled detector, detector housing with preamplifier, power supply and temperature controller and all necessary interconnecting cables.

Wavelength Range	Detector Size	115 V Operation		220 V Operation	
		Model No.	Price	Model No.	Price
2 - 6 µm	1 x 1 mm	**70373**		**70374**	