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FIBRE-OPTICS MONITOR

A Unique Instrument for Optical Testing

The Fibre-Optics Monitor is a versatile, portable product that has been designed for fibre-optics and general optics measurement applications, and for use in **training and education**. A high radiance I.e.d. in the transmitter provides a very stable optical output and ensures a good measurement performance for all types of multimode optical fibres, including **50µm core graded index** fibre. The Monitor is fitted with **SMA** connector housings as standard and consists of the following items:

OPTICAL TRANSMITTER, with high radiance infra-red I.e.d. in connector receptacle, un-housed infra-red I.e.d., highly stable optical output, variable output control; variable frequency square wave generator; both digital and analogue inputs. Power is from an internal battery, or single external d.c. power supply (9V to 15V) for which a mains adaptor socket is provided.

OPTICAL RECEIVER, with loudspeaker analogue output, low impedance analogue output, and variable analogue gain; mean power monitor output; silicon p-i-n diode mounted in connector receptacle. Power is from an internal battery, or single external d.c. power supply (9V to 15V) for which a mains adaptor socket is provided.

ACCESSORIES, including instruction manual, various electrical connectors, microphone, batteries, and robust carrying case.

Both the transmitter and receiver units are housed in strong aluminium boxes.

Equipment Designed and Manufactured in the U.K.

FIBRE-OPTICS MONITOR APPLICATIONS

The Fibre-Optics Monitor transmitter and receiver units form useful pieces of portable test equipment for training and education, and also in a fibre-optics or general optics laboratory, production facility, or at an installation site. The Monitor may be used for numerous applications, including:

TRAINING AND EDUCATION

OPTICAL CABLE/FIBRE CONTINUITY TESTING

DETECTING PRESENCE OF INFRA-RED RADIATION

ANALOGUE AUDIO TRANSMISSION

OPTICAL CABLE ATTENUATION MEASUREMENTS

TESTING OUT OPTICAL RECEIVERS AND TRANSMITTERS

An outline of each of these applications is given below:

TRAINING AND EDUCATION

The many applications of the Fibre-Optics Monitor make it ideal for use as training equipment for courses on fibre-optics, general optics, or telecommunications, in industry, universities, technical colleges, and technology training centres. For training purposes, the Fibre-Optics Monitor, which is designed to be used with all types of multimode fibres, is a complementary piece of equipment to the Ellmax Fibre-Optics Educator, which is a training aid for the teaching of the basic principles of fibre-optics, and which incorporates a visible I.e.d. and is designed for use with 1mm plastic fibre. The Ellmax Fibre-Optics Power Meter, which includes a pointer scale with dBm and µW readings, may also be used in conjunction with the Fibre-Optics Monitor in training and education courses.

Optical Cable/Fibre Continuity Testing

The receiver's loudspeaker output together with the transmitter's variable frequency generator make the Monitor an easy to use piece of equipment for testing the continuity of optical fibres. Continuity is detected by listening to the transmitted tone at the receiver, and so the equipment can be viewed as the optical equivalent of the well-known "buzzer" apparatus for electrical continuity testing.

The product is suitable for measuring all varieties of multimode fibres terminated in the chosen connector option, including 50µm core graded index, and all step index types. Due to the very high radiance I.e.d. in the transmitter, and the high sensitivity of the receiver, routes of over 40dB loss in a 50µm graded index cable may be tested.

Also, an unhoused I.e.d. is incorporated in the transmitter for testing out the continuity of bare, unterminated fibres. Minimal preparation of the fibre ends are necessary, and the fibres are simply held in front of the transmitting and receiving diodes to provide the signal path. This application is particularly suited for larger core fibres.

Detecting presence of Infra-red Radiation

The Monitor receiver may be used to give an audible indication of the presence of infra-red radiation at locations such as the remote ends of optical links, cable breaks, bad joints and "lossy" optical coupling arrangements, if audio tones, such as those produced by the transmitter, are present in the signal. The receiver circuitry is very sensitive, being able to detect optical levels below 100pW.

Unmodulated optical radiation may also be detected by connecting a DVM (set to d.c.) to the MEAN POWER MONITOR socket of the receiver.

Analogue Audio Transmission

Analogue audio signals in the bandwidth of 25Hz to 20kHz may be transmitted over optical fibres with the Monitor units. The transmission range is greater than 35dB even when 50µm diameter graded index fibre is being used. A major application of the audio transmission system is communicating verbal instructions during cable jointing operations, using spare fibres in the cable to carry the voice signals. These fibres may be connected to each Monitor unit by a temporary joint to a short length of similar fibre already terminated in the appropriate Monitor connector. A loudspeaker is incorporated into the receiver for directly listening to the received signal, and a microphone, for connecting to the transmitter, is included as an accessory.

The signal may also be taken electrically (apart from using the loudspeaker) at the receiver, where the output impedance is less than 1Ω. As well as communicating over optical fibres, the Monitor can also transmit a short distance over **free space** using the unhoused infra-red I.e.d., and this distance may be increased to over 100 metres if lenses are used.

The Fibre-Optics Monitor is ideal for utilising or assessing the benefits of fibre-optics links over conventional transmission systems. These advantages include:

- immunity to electrical interference
- complete electrical isolation
- secure transmission, with no radiated waves from the cable
- no earth loops.

Optical Cable Attenuation Measurements

The Fibre-Optics Monitor, in conjunction with a voltmeter, can be used to measure with a high degree of accuracy the attenuation of an optical route to a range of 45dB. Due to the **high stability** of both the transmitter and receiver circuitry with changes in supply voltage and temperature, the insertion loss of a route may be monitored over a long period of time in order to determine any **long-term** fluctuations in the route's loss.

Cables terminated with SMA connectors can directly interface to the Monitor units, and cables terminated with other types of connectors can also be tested by using appropriate interface cables.

Testing out Optical Receivers and Transmitters

The Monitor transmitter may be used as a versatile optical source for testing out both digital and analogue optical receivers. By connecting an external signal generator, any data train up to a rate of 0.5MBit/s and any audio analogue signal may be produced at the transmitter. In both the digital and analogue configurations, the output power control, which has a range of approximately 20dB, provides a useful feature for sensitivity testing. The Monitor receiver may correspondingly be used for testing out audio frequency analogue optical transmitters.

As well as interfacing the Monitor to equipment under test with SMA-terminated cables, the un-housed I.e.d. may be utilised to launch light into bare, unterminated fibres or directly into a receiving diode for receiver testing.

Other Applications

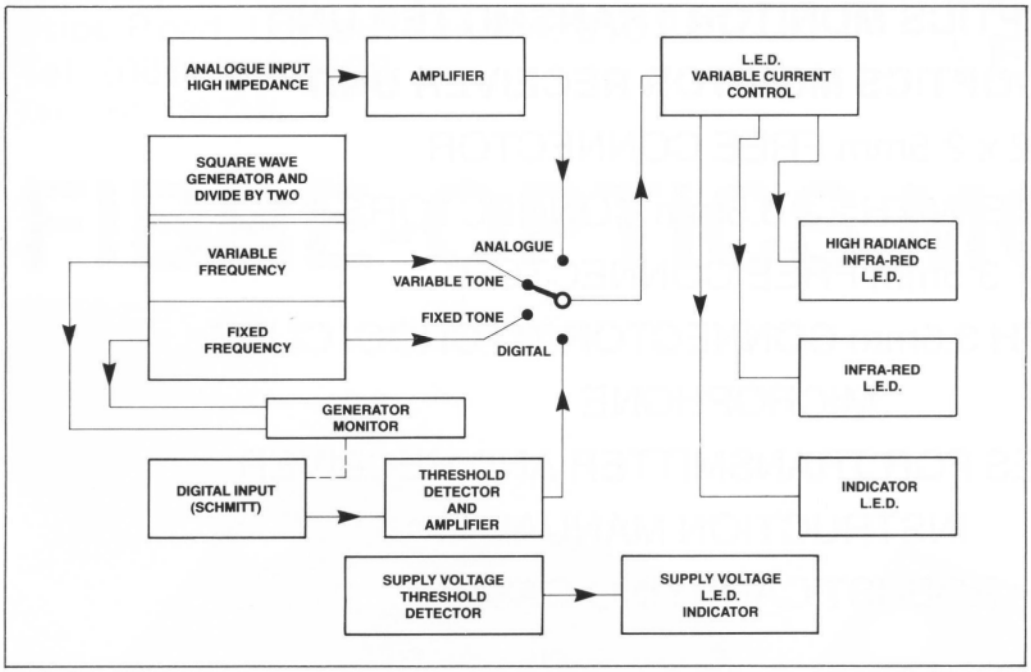
The Fibre-Optics Monitor transmitter may be used in conjunction with an optical power meter designed to measure modulated optical signal levels (as opposed to d.c. signals). In this application, the transmitter acts as a convenient, portable and stable power source, with a fixed or variable output frequency. It is advantageous to measure modulated signals while filtering out d.c. and low frequency levels, since extraneous contributions to the received signal from ambient light sources are normally contained in these lower frequency parts of the spectrum (typically below 300Hz).

It is possible to accurately measure optical absorption or reflection properties of various materials at the wavelengths of the emitting devices using procedures similar to the cable attenuation measurements.

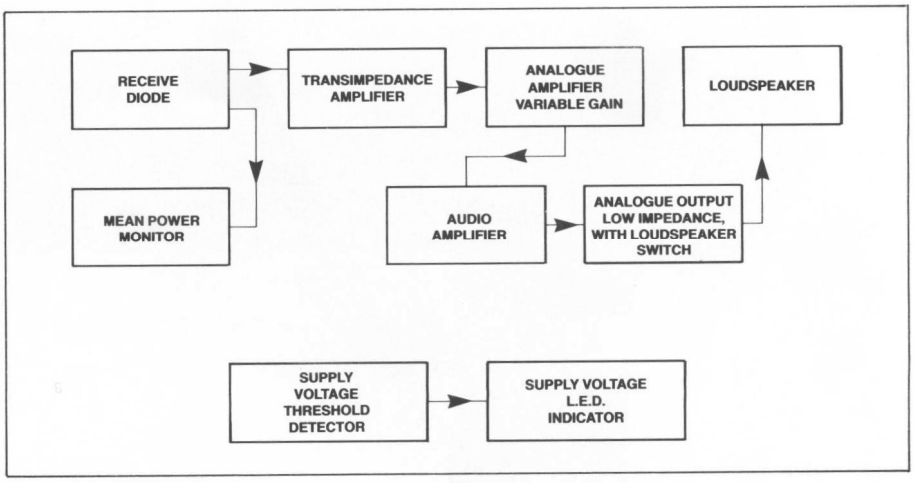
Another application is "listening" directly to light sources, since any audio modulation of detected light will be converted into sound by the Monitor receiver.

By connecting a frequency meter to the receiver's analogue output, it is also possible to measure the frequency of a rotating disc or a vibrating object using light reflection or transmission.

The following diagrams show the functions of the transmitter and receiver units in simplified form:



FIBRE-OPTICS MONITOR TRANSMITTER BLOCK DIAGRAM



FIBRE-OPTICS MONITOR RECEIVER BLOCK DIAGRAM

Brief Specifications of Fibre-Optics Monitor

a) Transmitter/Receiver Combination

Attenuation measurement range:
Standard method: 30dB (±0.2dB accuracy)
High loss method: 45dB (±0.5dB accuracy)
Temperature dependence of above accuracy figures: 0.01dB/°C typical

Analogue bandwidth: 25Hz to 20kHz (3dB points)

Range for analogue transmission (better than 40dB S.N.R.): 25dB (This range is for a fibre link, with the high radiance I.e.d. being used to launch light into a graded index fibre, core diameter 50µm, N.A. 0.21)

Operating Temperature Range: 0°C to 70°C.

b) Transmitter

Typical power launched from I.e.d. in connector receptacle into 50µm graded index fibre, N.A. 0.21: 5µW peak (at maximum setting)

Typical output power from unhoused I.e.d.: 3mW (at maximum setting)

Variable I.e.d. drive control: 20dB range (±3dB)

Peak Output Wavelength/Spectral Width:
I.e.d. in connector housing: 820nm/35nm
unhoused I.e.d: 880nm/80nm

Tone generator frequency (typical):
fixed: 400Hz
variable: 100Hz to 5kHz

Tone generator output:
square wave, 50:50 mark:space ratio to within 1%

Maximum transmitted digital data rate for less than 15% pulse width distortion: 0.5MBit/s

c) Receiver

Photodiode type: Silicon p-i-n

Minimum optical power for 40dB Signal to Noise Ratio: 12nWpp at 850nm

Typical response at 850nm at analogue output: 2.5V/µW to 82V/µW (over analogue gain range)

Typical response at 850nm at mean power monitor: 50mV/µW

d) Power supply

9V PP3-type battery for each unit

Optional external d.c. supply: +9V to +15V d.c. (current is 25mA typical at 9V)

e) Physical Characteristics

Dimensions: 128 x 97 x 75mm approx. for each unit

Weight: 500 gm approx. for each unit

The Fibre-Optics Monitor contains the following items:

FIBRE-OPTICS MONITOR TRANSMITTER UNIT
FIBRE-OPTICS MONITOR RECEIVER UNIT
2 x 2.5mm FREE CONNECTOR
CABLE WITH 2 x 3.5mm CONNECTORS
3.5mm FREE CONNECTOR
CABLE WITH 3.5mm CONNECTOR TO CROC. CLIPS
MICROPHONE
BATTERIES FOR TRANSMITTER AND RECEIVER
INSTRUCTION MANUAL
ROBUST CARRYING CASE

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