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WARNING:

This instrument radiates electromagnetic energy (see transmitter specifications). Do not use near critical care medical instruments or instruments susceptible to interference.

Do not use on or near subjects who are using a pacemaker.
OVERVIEW

MT8 Biomedical Telemetry System

The MT8 Biomedical Telemetry System from MIE Medical Research Ltd is an eight channel instrument utilising the latest technology to provide the opportunity of remotely monitoring physiological or mechanical variables with the maximum versatility and the minimum of inconvenience. Although conceived as an EMG or ECG monitor, it may be used with any transducer or combination of transducers that will operate from a battery and provide an analogue output.

Transmitter Unit

The transmitter unit is fitted to a belt worn around the waist and is small and lightweight, with consequent negligible inertial effect. This is of importance in biomechanics where fast activities are being studied. The unit is especially suitable for those applications where trailing wires would be an encumbrance to both subject and investigator. As each of the eight channels is independent from all others, a combination of transducers may be used, for example EMG, ECG, electrogoniometers, accelerometers and foot switches. The usable range of the transmitter is over 100 metres, but this may be increased by using Yagi or dipole directional aerials on the receiver. The transmitter runs from a rechargeable 9V battery.

Receiver Unit

The receiver unit is mains operated and decodes the multiplexed signals from the transmitter. The output from the decoded signals can be seen individually on the LCD display on the front panel of the receiver unit or on a personal computer via the 25 pin D connector on the rear of the unit. A further 25 pin D connector provides enveloped EMG signals to drive either a pen recorder or UV galvanometer recorder.

Each channel has offset controls, fixed gain settings and a push button AC/DC switch to provide optimum baseline stability.

The receiver also incorporates a constant current battery charger, which is used to recharge the spare battery for the transmitter unit.

Preamplifiers

The system comes complete with a set of sub miniature preamplifiers which are light enough to mount directly onto the earth electrode. This propinquity reduces interference and artefact to a minimum, resulting in a high signal to noise ratio and stable baseline.
MTT8 Transmitter Unit

The transmitter unit has the following connections and controls:

- The power switch on the left side of the transmitter unit.

- A power indicator adjacent to the switch. This glows green when the power switch is set to the on position and the battery is fully charged. The light will change to red when the battery level is too low for reliable data transmission.

- A BNC aerial socket at the top of the transmitter, facing away from the belt. Use the stubby ‘rubber duck’ antenna supplied.

- A battery compartment on the top of the transmitter. Open the battery compartment by inserting a thumbnail into the slot at the back of the compartment lid, and gently prising it in the direction of the arrow. The transmitter uses a single PP3 rechargeable battery, which should not need to be removed from the plastic insert tray.
NOTE
During normal usage, the battery need never be removed from the plastic tray insert and this ensures that the correct polarity is maintained at all times

WARNING Use only rechargeable NiCd batteries. Use of alkaline manganese batteries may damage the transmitter unit and obviate the guarantee.

- Input sockets for channels 1, 2, 3 and 4 are on the right side of the transmitter unit and input sockets for channels 5, 6, 7 and 8 are on the left side of the transmitter unit. These input sockets are four pin Lemo sockets which lock together to prevent accidental disconnection as a result of any strain on the cable.
  - To insert the plug into the socket, hold the knurled barrel of the plug, align the red dots on the plug and socket and gently push the two together.
  - To remove the plug from the socket, hold the knurled barrel of the plug and pull gently. Pulling on any other part of the plug or cable will not release the plug and may cause damage.

Any combination of up to eight transducers may be connected to the transmitter unit at once. There are no restrictions as to which input sockets any particular type of transducer may be connected.
MTR8 Receiver Unit

The receiver unit comprises the following constituent parts:

**Power Supply**

- **Mains input socket**, located at the rear of the receiver unit. Before plugging in the mains power lead, supplied with the telemetry system, check that the power requirements printed beneath the mains input socket are appropriate for the mains supply available.

- **Input fuses**, located above mains input socket. The fuse rating is printed below the fuse holder. This unit complies with medical electrical safety regulations and therefore incorporates a double fuse, both of which must be intact in order for the system to function. Never replace the fuses with ones of a different rating.

- **Mains power switch**, located on the far right of the front panel of the receiver unit. The switch will glow green when the power is on.
Front panel controls

- **LCD oscilloscope** to assist in setting up procedure. This feature is designed to give the operator an indication of the correct functioning of the transducers during application to the subject. It does not have the resolution to be used for any analytical purposes.

- **Rotary channel select switch**, located to the left of the LCD display. This switch allows the operator to select the channel to be displayed on the LCD screen or external oscilloscope connected to the BNC connector on the back panel. Selecting position C causes the composite signal of all 8 channels to be displayed.

- **Five LCD control buttons** immediately to the right of the LCD display are used to control the LCD display settings. The centre button selects the function, whereas the buttons above and below correspondingly increase and decrease the values of the selected function. The display is factory set so that you can immediately use the upper and lower buttons to change the voltage values and the left and right buttons to change the time-base. When you switch off the receiver unit, the last settings are stored and used the next time the unit is switched on again. Do not use these controls to adjust offset as it may cause errors when using the individual offset controls on the front panel (see below).

- **Red charge button**, under the channel select switch, switches on the trickle charger used to recharge the transmitter NiCd battery. The charger incorporates a timer so that after approximately 14 hours, the charger will automatically turn itself off. To start charging press the red button. During charging the button will flash on and off. When charging is complete, the button light will go out. To start charging a second battery, switch off the button and switch on again.

**NOTE:** Overcharging considerably shortens the life of NiCd batteries. Ensure that batteries are completely discharged before recharging. The timer will be reset to zero if the receiver is switched off, or the mains lead removed. In these circumstances, it will not be possible to determine for how long a battery has been charged. The batteries should be periodically checked to see if they are maintaining their charge and replaced if necessary.

- **Yellow ac/dc coupling buttons** are provided for each channel. The buttons are in the dc mode when the lights are out and in the ac mode when lit.
  DC coupling should be used where the transducer on a particular channel is operating at low frequencies, e.g. 0 -2 Hz. Typical transducers which are operating at these frequencies are electrogoniometers, foot switches and accelerometers.
  AC coupling may be used where the transducer is measuring frequencies above 2 Hz, e.g. EMG, ECG. AC coupling will generally give improved baseline stability over time than DC coupling.
Gain controls, located directly beneath the ac/dc coupling switches, are provided for each channel. Each gain control has fixed gains of unity (x1), x2 and x5. Overall system gain can also be altered by using alternative gain preamplifiers or alternative settings in the Myo-Dat software (optional extra).

Offset controls, located directly beneath the gain control switches, are provided for each channel. When adjusting the LCD display, it is better to use these offset controls to restore the baseline than the LCD controls.

Rear Panel

The rear panel has the following features:

- **Aerial socket.** The BNC aerial socket is used to connect either the 16cm whip antenna or an external antenna, such as a dipole or Yagi directional antenna used for improved transmitter range.

- **Monitor socket.** This is used to connect the system to an external oscilloscope. Channel selection is via the rotary channel select switch on the front panel.

- **Battery charger.** The battery charger tray can be removed by inserting a fingernail into the slot and lifting the tray upward. When replacing a discharged transmitter battery, exchange the whole battery and plastic tray together. If, for any reason, you need to remove the battery from the tray, ensure that the battery polarity is correct. The battery tray and tray receptacle is designed to ensure that the battery polarity is correct.

- **Analogue output.** The receiver output is via a 25 pin D connector. The analogue output is normally for use with an A to D converter. The system is supplied with a suitable A to D converter for use with an IBM compatible AT/PC.

- **Envelope output.** This output is provided for those who only wish to monitor the enveloped EMG signal on a pen or chart recorder.
Preamplifiers

MIE Medical Research offers a range of preamplifiers and electrode leads to suit most users’ needs. Preamplifiers are available as sub-miniature and are available in three gain settings of x1000, x4000 and x8600.

The sub-miniature preamplifiers should be attached on the skin adjacent to the electrode site by using a paediatric ECG pre-gelled self adhesive electrode as supplied in the electrode kit.

The sub miniature preamplifiers are designed to be placed on top of the earth electrode utilising the in-built press-stud.

Electrode leads are attached to the preamplifier via the terminal screws. The bipolar pickup leads are at the opposite ends of the amplifier cable.

When connecting the bipolar electrode leads to the preamplifier, it is advisable to connect the leads so that they sweep backwards as shown in the diagram below so as to minimise any strain due to skin movement. This will greatly reduce any movement artefacts.

In high activity conditions, the pre-amp and leads should be taped to the skin using micropore tape.
Application of EMG electrodes

The biological/electronic interface is often the major source of unreliable results during EMG recordings. This section of the manual gives a basic guide to the application of electrodes.

When using surface electrodes, a number of problems occur. First, the system is trying to detect very small signals amongst a lot of electrical noise, both on the skin of the subject and in the environment around it. Typically, an EMG signal may be as small as a few µV on the skin surface whereas the noise may be several volts. This means that the noise can be a thousand of times greater than the signal. However, by following a few simple procedures, the effect of noise can be greatly reduced.

The primary aim of EMG electrode application is to reduce the electrical resistance throughout the system. The major sources of high resistance are dirty contacts or thick callused skin (generally speaking, elderly subjects will exhibit a higher skin resistance since their skin quality is poorer). For reasonable results, the resistance between the electrodes and the skin should be less than 10,000 ohms.

The average skin resistance of a healthy adult is normally about 100 times greater than this.

To reduce the skin resistance the following procedure is advised:

1) Shave the area using the razor provided with the electrode kit, if the subject is particularly hairy.

2) The outer layer of the skin is a poor conductor, so the outer layer of dead cells should be removed by gentle abrasion. Several passes with the abrasive paper supplied with the kit should suffice. A residue on the abrasive paper indicates that the dead cells have been removed. Blood should never been drawn as this causes a risk to infection and is very uncomfortable for the subject. In most cases, it is unnecessary to abrade the subject at all.

3) Use some cotton wool dipped in acetone to remove any natural skin oils from the site of application. Do not use alcohol wipes as these often leave a white film on the skin that increases skin resistance.

When using self-adhesive electrodes, you need only follow steps 1 and 3. When using small reusable disc electrodes, then it is essential to follow the complete procedure described above.

4) Having located the site of the muscle and prepared the skin, place the two pickup electrodes. Attach the electrode leads to your chosen amplifier. It is advised that the leads are attached so that they naturally face away from the front of the amplifier. Place double sided tape on the underside of the preamplifier and attach adjacent to the electrodes. Now curve the leads forward and attach the crocodile clips to the electrode tabs (see illustration on previous page).
5) Finally, attach the earth electrode and place wherever convenient. It is not essential to place the earth electrode in any particular place. If required, further secure the preamplifier to the body with micropore or some other suitable tape.

![Image of setup](image)

To attach the sub miniature preamplifiers, place the earth electrode onto the skin first. Then attach the preamplifier to the electrode’s press-stud and then place the two pickup electrodes. Try to ensure that the electrode leads are fixed similarly to that previously described.
IMPORTANT NOTE: Use only fresh electrodes whose electrode gel are clean and not dried out. The quality of the signal depends very strongly on the skin-electrode interface.

CHECK THE “USE BY” DATE WRITTEN ON THE PACKAGE

Electrodes should be kept in a sealed plastic bag and stored in a cool place or refrigerator to maximise shelf life.

WARNING

Some electrode gels can cause severe reactions that are slow to heal and may lead to permanent scarring. Electrode gels are often excellent growth mediums for bacteria and may promote infection.

After the electrodes have been removed from the subject, clean the skin with warm soapy water to remove any excess electrode gel. Long term attachment of electrode gel may irritate the skin due to the salt content of the gel.

If you reduce the size of the electrodes by cutting them down, then the noise levels will increase and so skin preparation is more important.

Replacement electrodes and other sundries are available from MIE or your local MIE distributor.

WARNING

Do not attach electrode leads to the pre-amplifier with the screwdriver, whist the amp is attached to the subject. You may slip and injure the subject.

Always attach the electrode leads prior to fixing the pre-amp to the subject
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<td>illuminated.</td>
<td>Fuses blown: Replace.</td>
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<tr>
<td>Radio contact not established.</td>
<td>Transmitter not switched on.</td>
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<td></td>
<td>Aerials not fitted correctly.</td>
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<td></td>
<td>Transmitter too far from receiver.</td>
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<td></td>
<td>Transmitter battery low.</td>
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<tr>
<td>Battery will not hold charge.</td>
<td>Battery worn out through use or improper charging.</td>
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<tr>
<td>No muscle activity observed when muscle is contracted.</td>
<td>Wrong muscle being contracted.</td>
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<tr>
<td></td>
<td>Electrodes placed on a tendon, not a muscle.</td>
</tr>
<tr>
<td></td>
<td>Electrodes or connectors have come loose.</td>
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<td>Old, dried out electrodes.</td>
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<td>High skin resistance.</td>
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</table>
Technical specifications

This instrument is classified as a Class 1 with a measuring function, Type B applied Part.

Transmitter Unit

- **Modulation**: FM time division multiplexed
- **Frequency**: 459 MHz; otherwise according to local regulations.
- **Bandwidth**: Wide band - 90KHz.
- **Deviation**: Wide band -18KHz.
- **Power**: Less than 10 mW
- **Switching frequency**: 2khz per channel
- **Channels**: 8
- **Channel bandwidth**: 1000Hz.
- **Modulation sensitivity**: 5V ptp, high impedance.
- **Range**: >100m line of sight.
- **Aerial**: Normal mode helix.
- **Input connectors**: Lemo™ ‘OB’ series (maximum non-destructive voltage 5V).
- **Power**: 1 x PP3 NiCd.
- **Battery life**: Approximately 2.5 hours (but dependent on transducers in use).
- **Dimensions**: 165 x 65 x 30mm.
- **Weight**: 550gm (including belt, battery and aerial).
- **Compliance**: Type approved ETS 300 220 and ETS 300 683

Receiver Unit

**Decoder**
- **Type**: Single conversion wide band
- **Decoder**: PLL multiplex
- **Sensitivity**: < 1µV
- **Aerial**: Normal mode helix.

**Signal Conditioning**

- **Outputs**: Analogue 25 pin ‘D’ connector ± 2.5V
- **(active detector, low pass filter, 6Hz cut-off frequency)**
- **BNC socket for external oscilloscope**
- **Integral LCD oscilloscope display**
- **Controls**: Individual fixed gain switches x1, x2, x5
- **Individual rotary offset controls**
- **Push button ac/dc coupling switches**
Ancillaries:
Battery charger: 11mA constant current and automatic shut down after 14 hours
Supply Voltage: 220 - 240V or 100V or 115V
Supply frequency: 50/60Hz
Supply type: Alternating current
Power consumption: 12W
Protection: Class I, Type B as defined in BS5724: Part 1: 1979

Preamplifiers
Input resistance: > 10^8 ohms
Maximum output: 5V ptp (1.768V rms)
Supply: 5V
Connector: Lemo® 'OB' series
Dimensions: Miniature - 33 x 21 x 9mm: Sub miniature - 30 x 17 x 6mm
Gains: x1000 or x4000 or x8600
Bandwidth: 15KHz (x1000) 32KHz (x4000) 32KHz(x8600)
Noise: -52dB(x1000) -36dB(x4000) -30dB(x8600)
CMRR: -102dB(x1000) -108dB(x4000) -114dB(x8600)

Maintenance
The transmitter unit may be cleaned after patient contact with a proprietary hospital approved hard surface disinfectant. The metal electrodes and optional skin resistance lead, may be cleaned by immersion in a cold liquid sterilising agent (eg Cidex). User maintenance is restricted to the recharging of the battery for the transmitter, as when required.

Once a year or as required, the alignment of the radio sections should be checked, either by returning the transmitter and receiver to the manufacturer or approved distributor.

Electromagnetic Radiation
This instrument radiates electromagnetic energy (see transmitter specifications above). Do not use near critical care medical instruments or instruments susceptible to interference including pacemakers.
If electromagnetic radiation from another source interferes with this instrument, remove the source before collecting data. Compliant to EN60601-1-1

Transportation
Transport using the original packaging. Remove all antennae and batteries. If returning to the manufacturer, please include all components for testing and calibration.

Storage:
Store in a dry place at a temperature between +5° and 45° C. Do not allow any ingress of water. Remove the batteries from the transmitter and charger if storing for long periods.
Exclusions:
Do not use in a sterile environment.
Do not use with flammable gases.
Ensure no ingress of water.
Do not operate this instrument near subjects who are using a pace maker.
Only connect this instrument to a computer port that complies with IEC60950

Accuracy ± 1% FSO