MAGSTIM®
200²
P/N 3001-23-04

OPERATING MANUAL

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GUARANTEE

Equipment manufactured by the Magstim Company Limited is fully guaranteed covering materials and workmanship for a period of one year from the date of shipment. The capacitor is guaranteed for one year, or 200,000 discharges, which ever comes first. The Magstim Company Limited reserves the right to perform guarantee services in its factory, at an authorised repair station, or at the customer's installation.

The Magstim Company's obligations under this guarantee are limited to repairs or, at the company's option, replacement of any defective parts of our equipment, except batteries, without charge if said defects occur during normal service.

Claims for damages during shipment must be filed promptly with the transportation company. All correspondence concerning the equipment must specify both model name and/ or number and serial number, as it appears on the invoice for said equipment.

Improper use, mishandling, tampering with, or operation of the equipment without following specific operating instructions will void this guarantee and release the Magstim Company from any further guarantee obligations.

The Magstim Company will only accept responsibility for the effects on safety, reliability and performance of the equipment if:

i modifications or repairs are carried out by persons authorised by The Magstim Company.

ii the electrical installation of the relevant room complies with local regulations, and

iii the equipment is used in accordance with the instructions for use.

SECTION 1: DESCRIPTION

1.1 INTRODUCTION

This manual is written for users of the Magstim 200^2, an instrument used in the magnetic stimulation of neuromuscular tissue.

The Magstim 200^2 is a device capable of stimulating neuromuscular tissue by inducing small currents in the tissue using a brief pulse of electromagnetic energy.

This method of stimulation enables deep, and otherwise inaccessible, nerves to be stimulated easily and relatively painlessly. In addition, no skin preparation is required and stimulation can be achieved through clothing.

INDICATIONS FOR USE

The Magstim 200^2 is a magnetic nerve stimulator intended for the stimulation of neuromuscular tissue. The Magstim 200² system is for use by, or under the supervision of a medical practitioner only.

CAUTION

Federal law restricts this device to sale by or on the order of a practitioner licensed by the law of the State in which he/she practices to use or order the use of the device.

CONTRAINDICATIONS

Magstim 200^2 and its accessories should not be used on or in the vicinity of patients or users with cardiac demand pacemakers, implanted defibrillators and/or implanted neurostimulators.

SECTION 2: WARNINGS AND PRECAUTIONS

USA Only	**CAUTION:** Magnetic Stimulators have not been cleared by the FDA for cortical stimulation. Investigational human uses require that the user complies with the FDA regulations regarding Investigational Devices. Please visit www.fda.gov/cdrh or www.magstim-us.com for more information. **CAUTION:** In the USA, Federal Law restricts this device to sale by or on the order of a practitioner licensed by the law of the State in which he/ she practices to use or order the use of the device.

Attention: Consult accompanying documentation before using the Magstim 200².

CAUTION: The Magstim 200² and its stimulating coils must not be used on, or in the vicinity of, patients or subjects with cardiac demand pacemakers, implanted defibrillators, or other electronic implants.

The Magstim 200², its coils and accessories generate high intensity magnetic pulses. The induced eddy current is of sufficient magnitude to stimulate nerves and muscle.

The strong magnetic pulses generated by stimulating coils induce eddy currents in any conductive medium such as the human body, nearby metallic objects or electronic devices.

NB Particular care must be taken to ensure that leads connected directly to the patient, or other equipment, are not in a position where the stimulating coil can couple resulting in currents being induced in them.

Do not discharge the Magstim with the stimulating coil in the vicinity of metallic objects or these may be projected, moved and/or damaged.

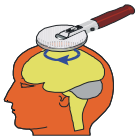
The Magstim 200² must not be used in an explosive atmosphere or in the presence of flammable anaesthetics.

When the magnetic pulse is delivered, a discharge click is produced by the Magstim 200² and its stimulating coil. This discharge click may startle.

Where possible avoid the use of the stimulating coil near the ears. The use of ear plugs is recommended.

High voltages are present within this instrument. Do not remove covers. Refer servicing to qualified personnel.

The Magstim 200^2, its stimulating coil and accessories must not be used if there are any signs of external damage or if any parts are damp or wet.



Cortical magnetic stimulation runs the risk of inducing seizures.

Do not discharge the Stimulating Coil in the vicinity of objects sensitive to magnetic fields. Examples are credit cards, floppy disks and computer screens.

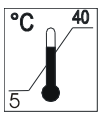
Trigger input/output – only equipment that meets EN 60601-1 (IEC 601-1), and configured in compliance with EN 60601-1-1, should be connected to this input.

Protection circuits in the Magstim Magnetic Stimulator disable the equipment if the surface temperature of the Coil exceeds to set limit. The 90mm Coil is intended for transient use, the surface temperature limits for which, being 50°C. If it is intended that the coil be used for more prolonged contact, the proposed protocol must be run, prior to its application on a patient, to ensure that the surface temperature does not rise above 41°C during operation.

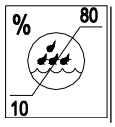
Coils must not be immersed in water, put in an ice bucket, or refrigerated. Not even if placed within a plastic bag. The coils do not have any specialised protection against the ingress of liquids, therefore conditions where ingress of liquid, or the forming of condensation within the coil, can occur must be avoided as the electrical insulation will be compromised. Cooling must only be performed by using a flow of cool air from a fan or air conditioning unit.

Due to thermal lag, the surface temperature of the Stimulating Coil will continue to rise following the coil over-temp activating and forcing the main unit into a standby condition. Therefore, the Coil must be removed from the patient as soon as the replace coil symbol is illuminated.

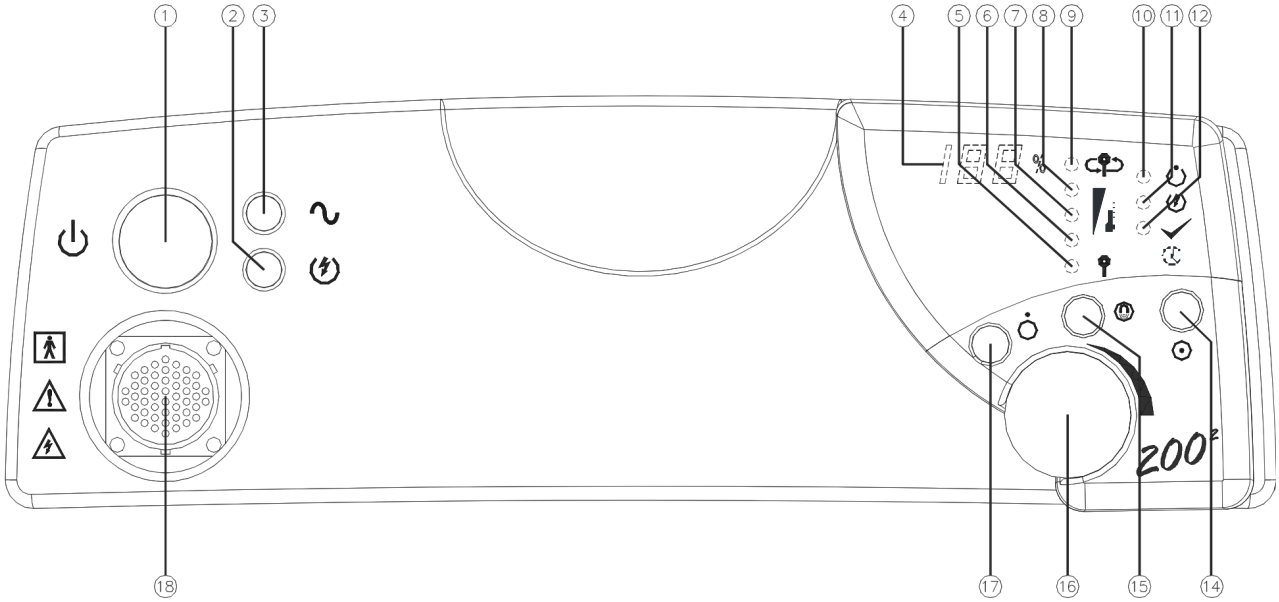
There are currently few medical papers available regarding the effects of magnetic stimulation on the unborn child/ foetus or the expectant mother. As a result of this, we are unable to verify the safety of the Coil's use on, or by, pregnant women. We recommend that anyone wishing to use the Coil on a pregnant woman, or use it whilst pregnant, should contact the Magstim Company Ltd. for more information as new medical papers become available.



On no account must the Magstim 200^2 and its accessories be used in environmental conditions outside those specified in this operating manual.



SECTION 3: FRONT PANEL DESCRIPTION



NOTE

1. All operating functions described in this section assume that the mains power switch, located on the rear panel, is in the ON position.

2. For the Magstim 200^2 - 3006-00, which is supplied without the control unit shown in the above diagram, functions 4 to 17 are implemented on the remote control coils. For details of the remote control coils see Magstim Remote Control Coils Operating Manual – 3179-23.

ON/OFF (Standby) Button (1)

This switch toggles the operational state of the Magstim 200^2. On initial application of mains power, the Magstim 200^2 enters its **Standby** state. This is indicated by the Power State indicator (3) flashing. Pushing the **ON/OFF** switch when the unit is in its **Standby** state will set the Magstim 200^2 into its operational state. This is indicated by the Power State indicator (3) being continuously illuminated. All LEDs and symbols will illuminate within a period of 5 seconds. At the end of 5 seconds the **OUTPUT % DISPLAY** will default to 30%, and the inactive default condition indicator (10) will illuminate. At the end of the session the Magstim 200^2 can be returned to its Standby condition by pushing the **ON/OFF** switch.

ARMED Indicator (2)

This LED is illuminated when the unit is in an armed condition. This indicates that there is high voltage present inside the unit. On power-up the armed indicator on the main unit flashes three times as part of a self-test programme.

Unit Power Status Indicator (3)

Condition 1. – While the Magstim 200^2 is in the Standby state, as controlled by the Mains Power switch (1), this LED flashes at approximately 0.5Hz, indicating that the unit is in a standby condition.

Condition 2. – While the Magstim 200^2 is in the Operational state, as controlled by ON/ OFF (Standby) button (2), this LED is continuously lit, indicating that the unit is in the Operational state.

OUTPUT % DISPLAY Indicator (4)

This display is used to show the following:

1. The set power output as a percentage of maximum. After turning the unit on using the **ON/OFF** button (1) the **OUTPUT % DISPLAY** will display 30%. The **OUTPUT CONTROL** knob (16) can then be used to change the output level in 1% steps. **Note:** The **OUTPUT % DISPLAY** only shows the level the Magstim 200^2 is actually charged to if the **READY** symbol (12) is illuminated.

2. The system status codes. These are detailed in Section 6 – System Status Codes.

COIL IN Indicator (5)

This green LED will illuminate if there is a coil detected as being connected correctly to the Magstim 200^2.

COIL TEMPERATURE Indicators (6, 7 & 8)

These LED's represent the surface temperature of the coil. The LED's illuminate sequentially as the coil temperature rises, beginning with the bottom green LED and ending with the amber LED. When the amber LED is lit, it means that the coil is getting close to its maximum operating temperature. As soon as it reaches its maximum operating temperature, the replace coil indicator will illuminate and the M200^2 will put itself into a safe default mode and discharge internally.
NB If the temperature of the coil is below 5^{o}C, the system will not operate. The Magstim 200^2 will remain in its inactive default condition until it detects that the coil temperature has risen above 5^{o}C.

REPLACE COIL Indicator (9)

This red LED will illuminate if any of the following conditions are present:

1. The Coil connected is not compatible with the Magstim 200^2.
2. The surface temperature of the connected Coil has risen above its set limit.
3. The connected Coil is faulty.
4. There is no Coil connected.

If this LED is illuminated the Magstim 200^2 will be put into its safe inactive default condition.

DEFAULT CONDITION Indicator (10)

This LED is illuminated when the Magstim 200^2 has been put into its safe inactive default condition.

ARMED Indicator (11)

This LED is illuminated when the unit is in an armed condition. This indicates that there is high voltage present inside the unit.

READY Indicator (12)

This LED is illuminated when the Magstim 200^2 is charged and ready to be triggered. A magnetic pulse can be produced by depressing one of the Trigger Enable switches at the base of the stimulating coil and depressing the **TRIGGER** button (15), or by depressing the footswitch, or by applying a Trigger Input to the **TRIGGER INPUT** connector on the rear panel.

Note: If the instrument has not been triggered for over 1 minute after the **READY** symbol is illuminated the unit will automatically select the default mode and discharge internally.

The function represented by this symbol is not implemented on the Magstim 200^2.

RUN Button (14)

The Magstim 200^2 can be put into the **ARMED** mode by momentarily pushing the **RUN** button. This can only be achieved if the stimulating coil is connected to the **COIL OUTPUT** socket (18) and the **REPLACE COIL** symbol (9) is not illuminated. In the **ARMED** mode the **ARMED** symbol (11) will illuminate and the instrument will charge to the level displayed on the **OUTPUT % DISPLAY** (4)**.**

TRIGGER Button (15)

The Magstim 200^2 can be triggered, and a magnetic pulse produced, by pushing the **TRIGGER** button when the **READY** symbol (12) is illuminated and one of the safety buttons at the base of the stimulating coil is activated. The instrument will continuously charge and discharge if the **TRIGGER** button is pressed and held.

OUTPUT CONTROL (16)

The output level setting as shown on the **OUTPUT % DISPLAY** (4) can be increased, or decreased, by rotating the control clockwise or anti-clockwise respectively. Each complete 360º rotation changes the output level by approximately 20%.

SYSTEM STOP Button (17)

The Magstim 200^2 can be put into the safe inactive default mode by momentarily pushing the STOP button. In this mode the **DEFAULT CONDITION** indicator (10) will illuminate and the instrument will discharge internally.

Note: The default mode is automatically selected if the coil is disconnected, becomes faulty, the surface temperature of the connected Coil has risen above its set limit, the **SYSTEM STOP** button is activated, the instrument detects an internal fault, or if the **READY** symbol has been illuminated for over 1 minute without the instrument having been triggered.

COIL OUTPUT SOCKET (18)

This socket is used to connect the stimulating coil to the Magstim 200^2. Note that the unit cannot be armed and triggered unless the stimulating coil is connected to this output. Ensure that the locating spot on the coil plug is correctly lined up with the coil output socket before inserting the plug. When the coil plug is fully engaged in the socket, lock the plug in place by turning the black locking ring clockwise.

HIGH VOLTAGE Symbol

This sign warns that voltages in excess of 1500V are present within the instrument (see also Section 2).

ATTENTION Symbol

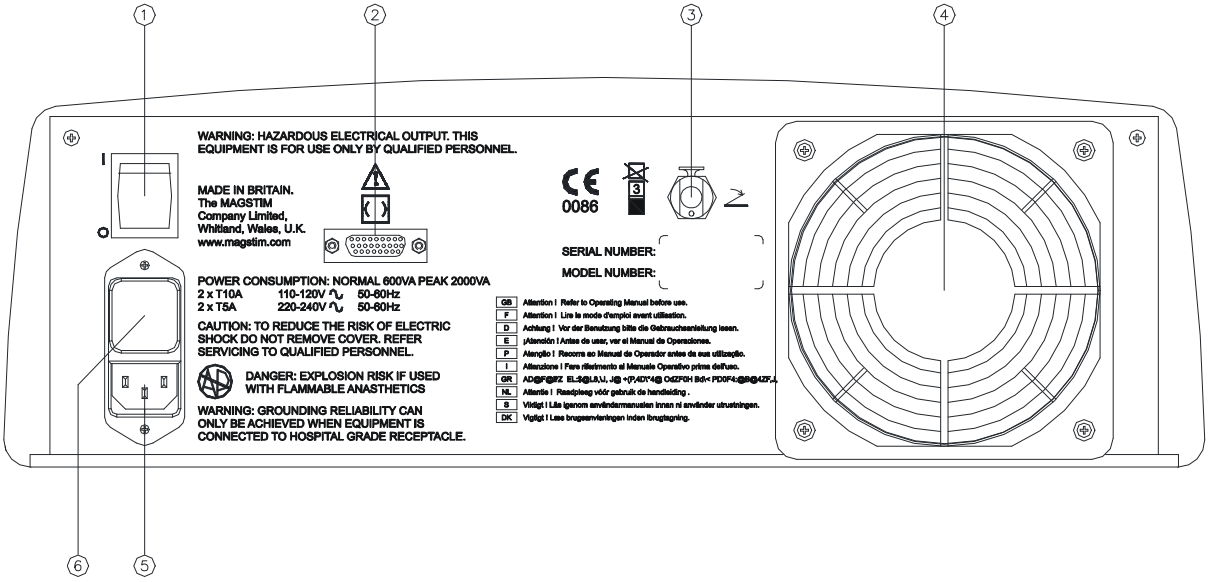
See warnings in Section 2 regarding the use of the Magstim 200^2.

APPLIED PART Symbol

BF Type Applied Part.

The applied part of this device, namely the stimulating coil, is electrically isolated from the other parts of the equipment as required by safety standards of BSEN60601-1.

SECTION 4: REAR PANEL DESCRIPTION



MAINS POWER Switch (1)

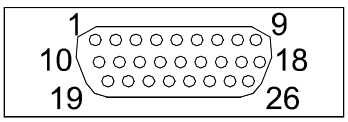
To connect the mains supply to the Magstim 200^2 set the mains power switch the **ON** (I) position. To disconnect the mains supply, the mains switch on the rear panel of the unit must be set to the OFF (0) position.

ISOLATED INTERFACE (RS232/ trigger) Port (2)

WARNING

(Only equipment complying with EN 60601-1, and configured in compliance with EN 60601-1-1, should be connected to this interface port)
(Unless otherwise indicated, signal levels are 5V CMOS Logic)

Pin Connections (26D)



1. Aux GND	10. Aux. +5V	19. Aux GND
2. *	11. Aux. GND	20. *
3. Tout – O/C	12. Rx (RS232 Level)	21. *
4.*	13. Tx (RS232 Level)	22. *
5. +ve Trigger In	14. *	23. *
6. -ve Trigger In	15. *	24. †Trigger Edge/ Level
7. +ve Trigger Out	16. *	25. *
8. -ve Trigger Out	17. *	26. *
9. *	18. *	

* **Factory Use Only – DO NOT CONNECT**

† **No Connection – Edge Trigger**
Connect Pin 24 to Pin 19 – LEVEL Trigger

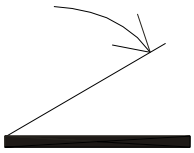
TRIGGER INPUT/ OUTPUT

The **trigger input** is used to synchronise the Magstim 200^2 to an external trigger input. Application of a 5V CMOS Logic Level to this input will result in the instrument being triggered, provided the **READY** symbol (12) is illuminated and one of the safety buttons at the base of the stimulating coil is activated. This signal must be active for at least 10µs.

In most instances the Magstim 200^2 will be used in conjunction with a recording instrument supplied by various manufacturers. In these cases the Magstim and the recording instrument will have to be synchronised so that the magnetic pulse produced by the Magstim occurs exactly at the start of the recording sweep of the recording instrument. Almost all recording instruments have some means of accepting an external trigger signal via either a dedicated input port or via the foot switch trigger input. The **trigger output** supplies a synchronisation signal to the external recording instrument. A 100µs 5V CMOS Logic Level pulse of either polarity is provided at this output whenever the Magstim is discharged.

Attention: Consult accompanying documentation before using the Magstim 200^2.

FOOT SWITCH Pneumatic Socket (3)



This socket is used to connect the supplied pneumatic **FOOT SWITCH** to the Magstim 200^2. The **FOOT SWITCH** can be used to trigger the instrument when one of the safety switches at the base of the stimulating coil is activated and the **READY** symbol on the front panel is illuminated.

COOLING FAN OUTLET (4)

With the Magstim 200^2 turned on, air is drawn through slots at the bottom of the instrument and expelled through the **FAN OUTLET**. Since it is important to allow unrestricted air flow, the instrument must be placed on a hard surface. In addition, there should be no obstructions placed closer than 50mm to the **FAN OUTLET**.

POWER ENTRY MODULE (5)

FUSE ACCESS & VOLTAGE SELECTOR (6)

See Section 9 of this operating manual for instructions on how to replace the fuses. **NB** The fuses should only be replaced with those specified in this operating manual.

SECTION 5: PREPARATIONS FOR USE

IMPORTANT

To avoid interference problems the Magstim 200^2, and its accessories, should not be used in the vicinity of any equipment that does not comply with EMC Standard EN 60601-1-2.

Before using the instrument, ensure that the correct fuses are fitted and that the voltage selector is set to suit the supply voltage (see Section 9). Check the Magstim 200^2 and its accessories for any signs of damage. If the Magstim 200^2, or any of its accessories, are damaged in any way they must not be used.

If a number of Magstim 200^2 units are being used, or the Magstim 200^2 is part of a BiStim system, it may be desirable for the units to be stacked on top of each other. The Magstim 200^2 enclosure has been designed such that the units may be safely stacked on top of each other. **The maximum number of units that can be safely stacked on top of the base Magstim 200^2 is 3.** Attempts to exceed this limit could result in crush damage to the base Magstim 200^2. In addition, the stacked units could become unstable and overbalance, causing injury to the patient, or user, and damage to the Magstim units.

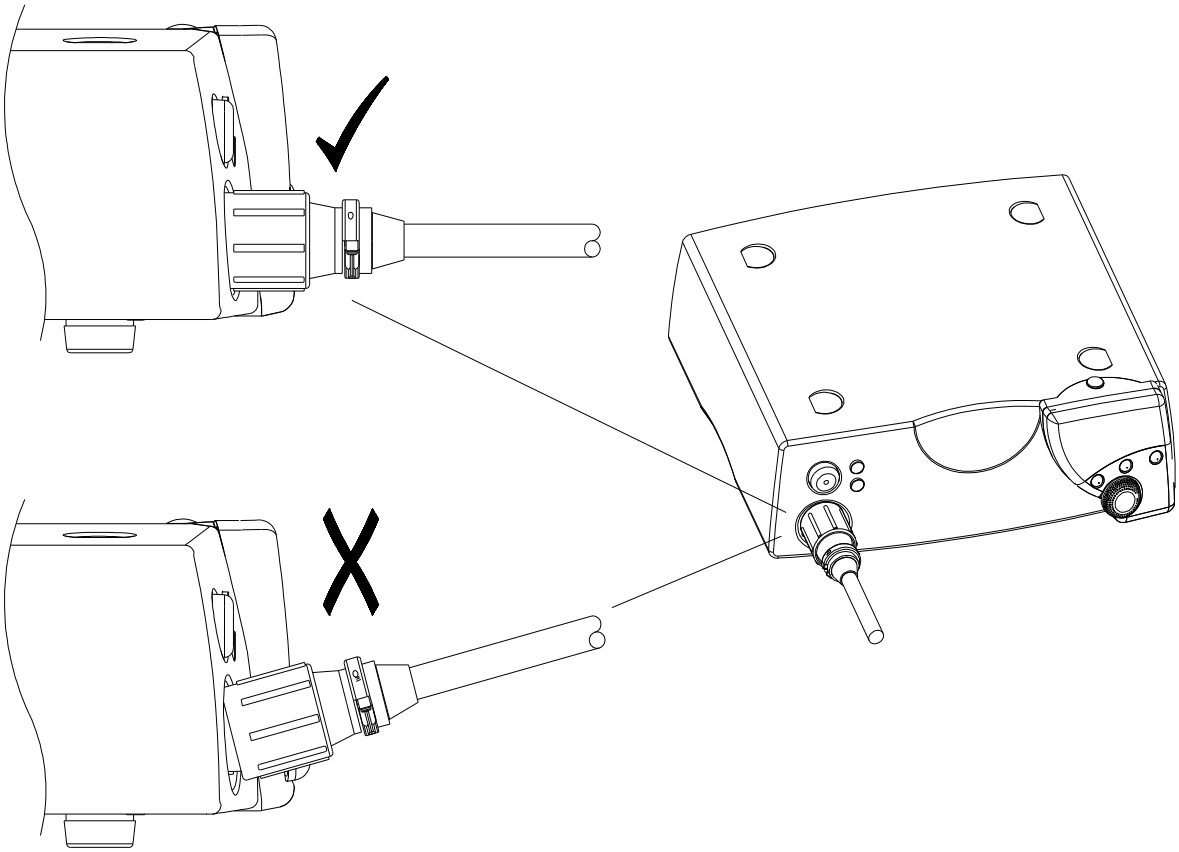
1. Insert the pneumatic connector of the foot switch to the rear panel **FOOTSWITCH** socket on the Magstim 200^2.

2. If a recording device is being used, synchronise the Magstim with the recording instrument by following the instructions in Section 4 – **ISOLATED TRIGGER I/O Port**.

3. Ensure that the locating spot on the coil plug is correctly lined up with the **COIL OUTPUT SOCKET,** located on the front panel of the Magstim 200^2. Insert the connector of the stimulating coil into the output socket. When the coil plug is fully engaged in the socket, lock the plug in place by turning the black locking ring clockwise until it clicks into place.

COIL

Please note: it is important that the coil is connected correctly. If the coil appears to be misaligned, remove and re-connect the coil. Do not use if the coil appears misaligned.



4. Set the **MAINS POWER** switch on the rear of the unit to the **ON** (I) position. The Unit Power Status Indicator LED will flash at approximately 0.5Hz, indicating that the unit is in a standby condition.

5. Push the **ON/OFF** button on the front panel of the unit. The Unit Power Status Indicator LED will be continuously lit, indicating that the unit is operational and is in its safe inactive default condition.

6. All LEDs and symbols will illuminate within a period of 5 seconds. At the end of the 5 second period, the **OUTPUT % DISPLAY** will indicate an output power level of 30%, and the **DEFAULT CONDITION** indicator will remain illuminated.

7. Ensure that all indicator LEDs are functioning properly before proceeding; if not, contact The Magstim Company Service Department.

8. Press the **RUN** button. The **ARMED** indicator will illuminate and when the instrument is charged to 30% the **READY** indicator will also illuminate. This indicates that the instrument is ready for use.

Note: If the instrument has not been triggered for over 1 minute after the **READY** symbol is illuminated the unit will automatically select the default mode and discharge internally.

9. Hold the stimulating coil and press one of the Trigger Enable switches located on either side of the coil handle. Press and hold the **TRIGGER** key on the front panel, or depress and hold the footswitch. There should be a clicking noise emanating from both the stimulating coil and the Magstim, each time the Magstim is discharged, indicating that a magnetic pulse is being produced.

Note: When using a standard 2nd Generation Coil, pressing one, or both, of the safety switches at the base of the stimulating coil will enable the armed M200², allowing it to be triggered either via the trigger button on the unit – item 15 in Section 3 (front panel description) of this operating manual, or the footswitch – item 3 in Section 4 (rear panel description) of this operating manual. If a Remote Control Coil is being used, depression of one of the safety switches will cause the system to arm, depression of the second switch will trigger the system.

On no account must the trigger enable buttons on the stimulating coil be permanently activated, by taping down, or any other method of fixing. They are designed as a safety interlock, to disable them could result in a serious injury as a result of an inadvertent discharge of the coil.

Ensure the instrument is functioning properly before proceeding.

Note: The Magstim 200² can also be triggered by applying a signal to the **TRIGGER INPUT** Port, located on the rear panel of the unit.

Completion of Session:
During prolonged use, the temperature of some of the internal components of the Magstim 200² will tend to rise. During operation this is regulated by the operation of the cooling fan. However, when the unit is switched off, the cooling operation is terminated. Therefore, it is recommended that, if the Magstim 200² has been subject to prolonged use, the unit is left switched on for approximately ten minutes after the last session has been completed, to allow the fan to cool the unit.

SECTION 6: SYSTEM STATUS CODES

BASE Controller Error Codes produced by the User Interface.

Error Codes	Description
U24	POWERDOWN
U25	Stack underflow
U26	Stack overflow
U27	RTS overrun
U28	Watchdog Timeout
U29	ROM Checksum Incorrect
U30	Unexpected RESET
U31	Unknown serial interrupt
U32	CSIO overrun
U33	Debug error
U34	No serial communications
U35	Loss of communication
U36	Bad NVRAM Checksum

Error codes produced by Coil.

Error Codes	Description
C01	ROM Checksum Incorrect.
C02	EEPROM Checksum Incorrect.
C03	Invalid coil Category.
C04	Invalid Power Identification .
C05	Temperature sensor circuit failure.
C06	Bad Serial command or received data checksum.
C07	Internal Software Error.
C08	Invalid Coil Temperature ID.
C09	Invalid temperature algorithm coefficient.
C10	Coil controller malfunction.
C21	Coil Disconnected/ Coil Under Temperature.
C22	Brown Out Detected.
C23	No serial Communications.
C24	Bad Serial command of received data checksum (outside TRIGGATE).
C25	EMC Detected (Coil adapter only).
C26	Invalid Coil Power Identification (Coil adapter only).
C27	Hardware Stop activated.
C28	Watchdog Timeout.
C29	Temperature Interlock 3 activation.
C30	Coil stop line fault.

Error codes produced by base system.

Error Codes	Description
E61	Power fail
E62	Stack underflow
E63	Stack overflow
E64	RTS overrun
E65	WD Timeout
E66	Unexpected reset
E67	Bad checksum
E68	SYS debug error
E70	Coil under temperature
E71	Coil max difference
E72	Stack over temperature
E73	Stack under temperature
E74	Stack max difference
E75	HVCAP over temperature
E76	HV Transformer over temperature
E77	Charge threshold failure
E78	VREF check failure
E79	HVCAP voltage comparison failure
E80	Charging fault
E81	HV over voltage
E82	Invalid system configuration
E83	Stop line fault
E84	Base coil stop line fault
E85	UI stop line fault
E86	Dump system fault **WARNING** – high voltage may be present up to 20 minutes after use on internal high voltage capacitor.
E87	Invalid coil category for current system configuration.
E88	Invalid NVRAM Checksum.
E89	Faulty charging relay detected
E90	Base arm LED drive failure

SECTION 7: USING THE MAGSTIM 200²

7.1 DESCRIPTION OF THE COIL – Standard 90mm Coil – 3193-00

Magnetic nerve stimulation can be achieved by discharging the Magstim 200² with the Stimulating Coil in the vicinity of neuromuscular tissue. Current flows from the instrument through the coil in only one direction. However, depending upon which side of the coil (labelled A or B) is facing up, the direction of the current flow relative to the stimulated tissue will change.

Standard 90mm Stimulating Coil - 3193-00

With **Side A** visible and **Side B** facing the area to be stimulated, coil current flows in the anti-clockwise direction and the induced tissue current flows in the clockwise direction during the stimulating phase. With **Side B** visible and **Side A** facing the area to be stimulated, coil current will flow in the clockwise direction and induced tissue current flows in the anti-clockwise direction. The convention used above is that, in the coil, current flows from positive to negative. In the tissue current flow refers to ionic (+) movement.

7.2 COIL POSITIONING

Correct coil positioning is essential to allow accurate measurements of the important parameters such as conduction latency, threshold of stimulation, response size and waveform morphology.

The MAGSTIM 200² is supplied as standard with the Standard 90mm Coil (P/N 3193-00), which is designed for the purposes of deep nerve stimulation stimulation. Stimulating the motor cortex using the Standard 90mm Coil produces responses which can be recorded from the majority

of muscles in the body allowing for the functional assessment of motor pathways. In the case of the MAGSTIM the discharge current in the stimulating coil and the resulting magnetic pulse is mono-phasic allowing for mono-hemispheric stimulation.

To record the best responses from muscles in the right side of the body always place the coil such that **Side A** is visible to the operator and **Side B** is touching the subject. To record the best response from the left side of the body always place the coil such that **Side B** is visible to the operator. The above rules should be observed when stimulating the motor cortex or the spinal nerve roots.

The induced stimulating current flows clockwise under the coil winding when viewing **Side A** and counter-clockwise when viewing **Side B**. Since the motor cortex is more sensitive to current flowing from posterior to anterior, clockwise induced current primarily stimulates the left motor cortex and counter-clockwise induced current stimulates the right motor cortex.

When recording from muscles in the arms and hands position the Standard 90mm Coil centrally on the vertex. In the case of circular coils

Stimulation takes place under the winding and not under the coil centre. When recording from muscles in the lower limbs move the Standard 90mm Coil forward from the vertex and contra lateral to the target muscle by approximately 5cms (2 inches) each way such that part of the coil winding lies over the central fissure.

7.3 DISCHARGING THE MAGSTIM

1. Check that the Magstim 200^2 is in the default condition. If the default condition indicator is not illuminated, follow the instructions detailed in Section 5 – Preparations for Use.

2. Set the output level on the instrument by rotating the **OUTPUT CONTROL** knob until the desired level is displayed on the **OUTPUT % DISPLAY**. It is recommended that 30% be used as a starting point, gradually increasing, in 10% steps, until a response is indicated.

3. Press the **RUN** key and the **ARMED** indicator will illuminate.

4. When the **READY** LED illuminates, it indicates that the instrument is ready to discharge a magnetic pulse.

5. Hold the stimulating coil over the area to be stimulated. When using a standard 2nd Generation Coil, pressing one, or both, of the safety switches at the base of the stimulating coil will enable the armed M200^2, allowing it to be triggered either via the trigger button on the unit – item 15 in Section 3 (front panel description) of this operating manual, or the footswitch – item 3 in Section 4 (rear panel description) of this operating manual. If a Remote Control Coil is being used, depression of one of the safety switches will cause the system to arm, depression of the second switch will trigger the system.

6. A magnetic pulse can then be produced by depressing the **TRIGGER** button (15), by depressing the footswitch, or by applying a Trigger Input to the **TRIGGER INPUT** connector on the rear panel. An internal click will sound and the **READY** LED will extinguish, indicating that the Magstim has discharged. When the Magstim has recharged to the set output power level the **READY** LED will illuminate and the system is ready to be re-triggered.

   The instrument will continuously discharge and recharge if the **TRIGGER** key or foot switch is pressed and held, and the safety switch on the coil is depressed.

7.4 RECORDING OF EVOKED RESPONSES

In general the electrophysiological responses to magnetic stimulation can be recorded using the same methods as for conventional electrical stimulation. The recording instrument can be triggered from the **TRIGGER OUTPUT** socket on the rear panel of the Magstim 200^2. Alternatively, the Magstim can be triggered by the recording equipment via the **TRIGGER INPUT** socket on the rear panel of the Magstim.

To avoid excessive stimulus artefact occurring on the recordings the following practices are recommended:

1. Artifact is reduced by keeping the length of loose individual leads to a minimum, to avoid them forming loops. This is best done by keeping all recording leads (active electrodes and the reference) running next to each other. Twisting or taping the leads together will prove helpful.

2. The recording and reference leads, and the amplifier, should be kept a minimum of 0.5m away from the magnetic stimulator and the stimulator coil and its cable whenever possible.

3. The use of a larger reference electrode is recommended to reduce impedance. For your information, The Magstim Company Limited also supplies a special EMG Lead Kit (Part Number 9831-00) designed for use with magnetic stimulators to help reduce artifact.

4. Ensure that the recording electrodes make good electrical contact with the patient and that standard practices for preparing the skin have been carried out.

5. If practical, keep the reference electrode within 5cm of the active recording electrodes.

SECTION 8: SAFETY FEATURES

8.1 COIL TEMPERATURE PROTECTION

1. An indication of the coil temperature is given by the Coil Temperature LEDs located on the User Interface Controller – see section 3, items 6 - 8.

2. If the coil surface temperature reaches its set limit, the **REPLACE COIL** indicator will illuminate and the Magstim 200^2 will be put into its safe inactive default condition. The default condition indicator will illuminate.

   The normal operation of the equipment can then be resumed by allowing the coil to cool, or alternatively, by replacing the coil with a cool one.

8.2 COIL DISCONNECTION

Do not remove the coil until the system has discharged.
If the coil is disconnected from the unit while the unit is charged, the **REPLACE COIL** indicator will illuminate and the unit will automatically select the default mode and discharge internally.

The **ARMED** indicator will extinguish, indicating that the unit is discharged.

8.3 OTHER SAFETY MEASURES

- If the instrument has not been triggered for over 1 minute after the **READY** symbol is illuminated the unit will automatically select the default mode and discharge internally

- Power charge up or charge down responds instantly to the **OUTPUT CONTROL**, minimising the waiting period or accidental discharge at a setting higher than required.

- The Magstim 200^2 is capable of recognising automatically the type of stimulating coil being used, and adjusts its maximum output power accordingly.

- High quality pneumatic foot switch.

SECTION 9: MAINTENANCE AND SERVICING

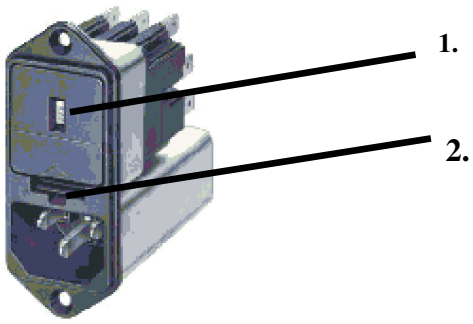
9.1 VOLTAGE SELECTION AND FUSE RATING

The Magstim Model 200 may be operated from supplies in the range 110-120V and 220-240V. The voltage selector on the rear panel and the adjacent fuses must correspond to the supply voltage as indicated in the table below:

Supply Voltage	Set Voltage Selector To	Qty	Fuses Rating
110-120V ~	**120V**	**2**	**10A (t) ***
220-240V ~	**240V**	**2**	**5A (t) ***

* (t) denotes Timed, or Antisurge, fuse. The use of fast acting fuses is not recommended.

Voltage Selection Instructions



- **IMPORTANT –**Ensure that the Magstim 200^2 is disconnected from the mains supply before changing the fuse, or setting the voltage selector.
- Insert the tip of a small blade screwdriver, or similar tool, into slot no. 2, shown in diagram above. Gently lever up the retaining lip of the fuse holder. The fuse holder will then slide out.
- Using a pair of narrow nosed pliers, grip the voltage selector unit on one of the metal connection plates and remove it from the Power Entry Module.
- Orient the voltage selector unit, such that the desired voltage is facing out from the Power Entry Module.
- Re-insert the voltage selector unit into the Power Entry Module.
- Replace the fuse holder, ensuring that the retaining lip is properly home, and verify that the voltage window (1) displays the correct voltage value.

Changing Fuse Type

- Insert the tip of a small blade screwdriver, or similar tool, into slot no. 2, shown in diagram on previous page. Gently lever up the retaining lip of the fuse holder. The fuse holder will then slide out.

- Replace damaged fuse(s) with a suitable replacement – see Section 10 for Power Input Fuse Ratings.

- Replace the fuse holder, ensuring that the retaining lip is properly home.

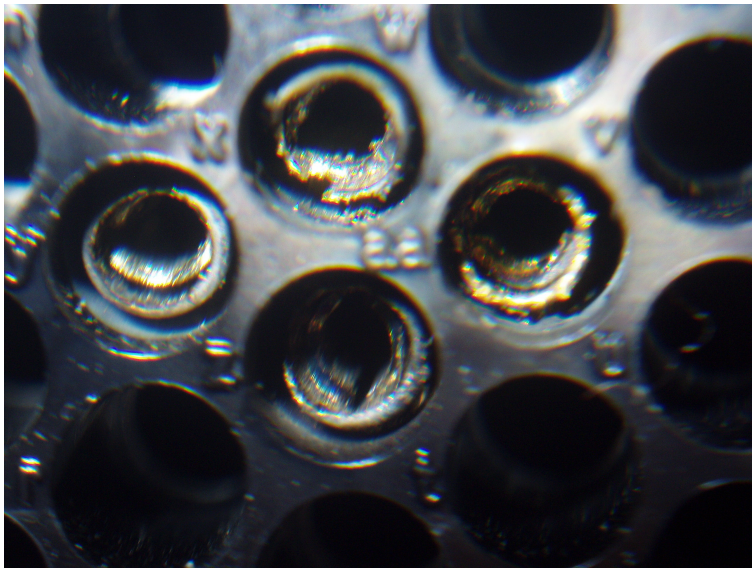
9.2 USER MAINTENANCE

At the start of each session the Operator must check the Magstim 200^2 and the stimulating coil for any signs of damage, paying particular attention to the plastic casing. If there are any signs of physical damage to the Magnetic Stimulator, or the stimulating coil, they must not be used.

9.3 TECHNICAL MAINTENANCE

The coil pins should be checked carefully after every 100 shots for any signs of pitting, or burning, as under conditions of exceptionally hard use at high energy levels, it is possible for the localised heating to manifest itself in the form of micro-welds. Continued used in this condition will eventually result in the coil pins/sockets becoming totally eroded and open circuit.

Note: The pin burning is communicable - any coil with good pins that is used on a stimulator with burned socket pins will have its pins damaged immediately. The reverse is also true, a socket with good pins that has a coil with burnt pins connected to it will have its pins damaged immediately. If damage is noticed on any coil connector or stimulator coil socket the complete system must not be used until all pins and sockets are carefully examined for any damage. If any contacts show damage, even if slight, they will need to be changed. If this is not done thoroughly there is the risk that the cycle of contact damage will continue.



As contact repair is a specialised procedure, it is recommended that contact replacement is undertaken by the Magstim Company, or one of its authorised service centres. If additional advice or information is required, please contact The Magstim Company.

9.4 CLEANING AND DISINFECTING

The stimulating coil, exterior of main unit and foot switch may be cleaned using an isopropyl alcohol moistened cloth. Ensure that the stimulating coil has thoroughly dried before use.

Note: This coil cannot be sterilised. Do not allow the coil to become contaminated with bodily fluids.

9.5 SERVICING

All servicing must be carried out by the Magstim Company Ltd, or one of its authorised service centres.

It is recommended that an annual PAT (Portable Appliance Test) test be carried out on the Magstim 200^2.

For further information or service contact:

The Magstim Company Limited
Spring Gardens
Whitland
Carmarthenshire
SA34 0HR
Wales
United Kingdom
Tel: +44 (0) 1994 242900
Fax: +44 (0) 1994 242910
email: service@magstim.com
Website: www.magstim.com

Important: Un-authorised persons must not remove the screws securing the covers of the Magstim 200^2 or the guarantee will be void.

Service training courses are available on request. For further information contact the Magstim Company Service Manager – see above for contact details.

9.6 DEVICE LIFETIME

The lifetime of the Magstim 200^2 is defined as being 5 years from the date of shipment. The Magstim Company Ltd. will support the product for the duration of its lifetime.

9.7 DISPOSAL

When the Magstim 200^2 and stimulating coils reach the end of their serviceable life, the Magstim Company Limited should be contacted, at the above address, to arrange for their disposal in compliance with the appropriate environmental regulations.

SECTION 10: SPECIFICATIONS

GENERAL SPECIFICATIONS

This equipment is classified as Class 1, with type BF Applied Parts.

The system complies with the requirements of the Safety Standard EN60601-1 (90), including amendment 1 (91) and amendment 2 (95) and EMC Standard EN 60601-1-2.

Protection against ingress of liquids - The Magstim 200^2 and its accessories are classified as **IPXO (Not Protected)**, as there is **no** specialised protection provided against the ingress of liquids.

Protection against flammable anaesthetic mixtures – Not Protected.
Therefore, the Magstim 200^2 and its accessories are **not** suitable for use in the presence of a flammable anaesthetic mixture with air, oxygen or nitrous oxide.

Mode of Operation – Continuous

EMC General
The Magstim 200^2 should not be used adjacent to, or stacked with, other equipment and that if adjacent or stacked use is necessary, the equipment should be observed to verify normal operation in the configuration in which it will be used.

EMC Susceptibility
The Magstim 200^2 needs special precautions regarding EMC and needs to be installed and put into service according to the EMC information provided in Section 11 of this Operating Manual. To avoid interference problems the Magstim 200^2, and its accessories, should not be used in the vicinity of any equipment that does not comply with EMC Standard EN 60601-1-2, including portable and mobile RF communications equipment, such as mobile phones.

EMC Emissions
The use of accessories, transducers and cables other than those specified by the Magstim Company Ltd., may result in increased emissions, or decreased immunity, of the equipment. In order to ensure EMC compliance, the Magstim 200^2 must be used only with those parts specified by the Magstim Company Ltd. for use with the Magstim 200^2.

10.1 POWER

Voltage:	220-240V/110V-120Vac
Supply Frequency:	50-60Hz
Power Input Fuse Rating:	5A T x 2 (Europe; 220 – 240V) 10A T x 2 (USA; 110 – 120V)

Equipment should be used with the line cord provided. Where a fused line cord is used, it is recommended that a 7A or 15A fuse be fitted for 220 – 240V and 110 – 120V operation respectively.

Max Power Requirements:

Standby	100 VA
During discharge	2000VA peak, 600VA average

10.2 AMBIENT TEMPERATURE

Permissible Environment Conditions for Transport

Ambient Temperature Range:	-25ºC to 60ºC
Relative Humidity Range:	10% to 80% Non Condensing
Atmosphere Pressure Range:	50kPa to 106kPa

Storage and Operating Conditions:

Operating Temperature Range:	5ºC to 40ºC
Storage Temperature Range:	-25ºC to 60ºC
Coil Temperature Range:	5ºC to 40ºC

10.3 CAPACITOR LIFE EXPECTANCY

Life expectancy:

2×10^6 discharges at 70% power level
8×10^5 discharges at 80% power level
4×10^5 discharges at 90% power level
2×10^5 discharges at 100% power level

10.4 OUTPUT

Repetition rate of stimulus:

Once every 2 seconds at up to 0 - 49% power level
Once every 3 seconds at up to 50 - 79% power level
Once every 4 seconds at up to 80 - 100% power level

Magnetic Field:

The magnetic field produced by the Magstim 200² depends on the type of coil connected. Full details of the Magstim 2nd Generation Coils, and Remote Control Coils, are given in their operating manuals, P/N 3100-23 and 3179-23, respectively.

Maximum number of stimulations:

The maximum number of stimulations that can be achieved with a Magstim 200² at an ambient temperature of 20°C, with an interval between discharges of 4 seconds, before the coil exceeds its permitted operating temperature, depends on the type of coil connected. Details of the maximum number of stimulations possible for each of the Magstim 2nd Generation, and Remote Control, Coils are given in their operating manuals, P/N 3100-23 and 3179-23, respectively.

Pulse Characteristics:

100µs approximate rise time, 1ms duration

10.5 REAR PANEL

ISOLATED TRIGGER I/O Port (see Section 4).

The maximum non-destructive voltage range that can be applied to the external connections with respect to ground is: **- 0.3 – 5.3V**

Connection

	Logic Low	**Logic High**
Trigger Input	<0.8 V	>4V
Trigger Output	<0.8 V	>4V

10.6 GENERAL

Size:	Width	460 mm (18.1 inches)
	Height	160 mm (6.3 inches)
	Depth	375 mm (14.8 inches)
Weight	20.4 kg	

10.7 HANDLING

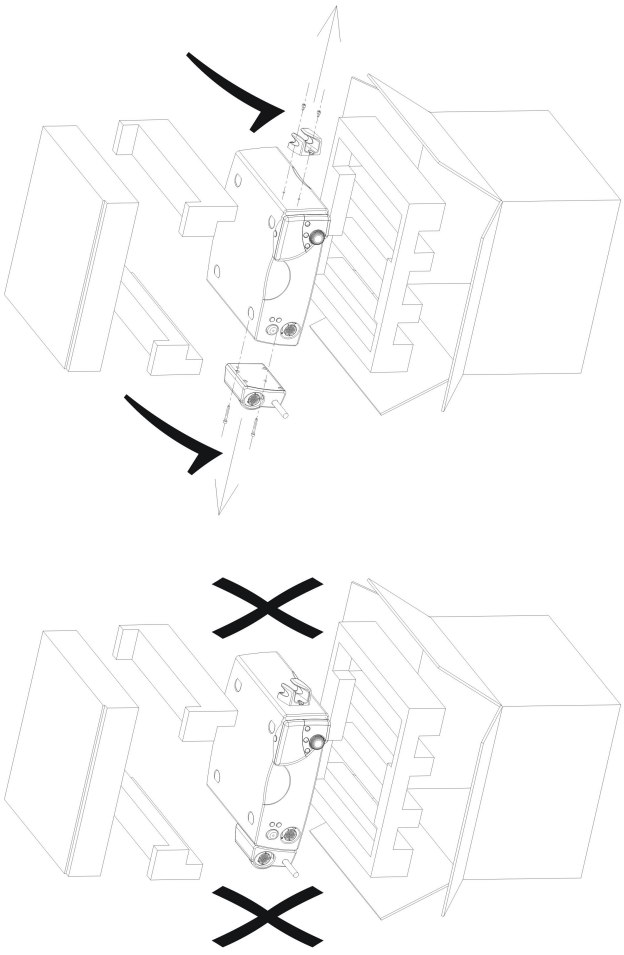
CAUTION
The Magstim 200² weighs in excess of 20kg. Therefore, if it is necessary to move the unit for any reason, the weight must be distributed between at least two persons.

NOTE - The weight of the Magstim 200² is unevenly distributed – the right hand side of the unit being considerably heavier than the left hand side. Care should be taken when transporting the unit to ensure that this heavier side is adequately supported.

10.8 PACKING INSTRUCTIONS

If, for any reason, it is necessary to return your Magstim² System to either the Magstim Company, or local Distributor, for repair, or upgrade, care should be taken to ensure that the equipment is adequately packed to prevent transit damage. Ideally the equipment should be returned in its original packing. If this or an adequate replacement is not available, replacement shipping cartons can be obtained from the Magstim Company Service Department.

IMPORTANT
The Magstim 200² System must be completely disconnected before shipping, including removal of the coil holder on the side of the Magstim 200². Failure to do so is likely to result in transit damage to the casing.



SECTION 11: EMC EMISSIONS AND IMMUNITY

Guidance and Manufacturer's Declaration – Electromagnetic Emissions		
The Magstim 200² is intended for use in the electromagnetic environment specified below. The customer or the user of the equipment should assure that it is used in such an environment.		
Emissions Test	**Compliance**	**Electromagnetic environment - guidance**
RF emissions EN55011	Group 1	The Magstim 200² must emit electromagnetic energy in order to perform its intended function. Nearby electronic equipment may be affected.
RF emissions EN55011	Class B	The Magstim 200² is suitable for use in all establishments other than domestic and those directly connected to the public low-voltage power supply network that supplies buildings used for domestic purposes.
Harmonic Emissions IEC 61000-3-2	Class B (by equipment type)	
Voltage fluctuations/ flicker emissions IEC 61000-3-3	Complies	

Guidance and Manufacturer's Declaration – Electromagnetic Immunity			
The Magstim 200² is intended for use in an electromagnetic environment in which radiated RF disturbances are controlled. The customer or the user of the Magstim 200² can help prevent electromagnetic interference by maintaining a minimum distance between portable and mobile RF communications equipment (transmitters) and the Magstim 200² as recommended below, according to the maximum output power of the communications.			
Rated maximum output power of transmitter W	**Separation distance according to frequency of transmitter** m		
	150 kHz to 80 MHz $d = [\frac{3,5}{V_1}]\sqrt{P}$ Where $V_1 = 3$	**80 MHz to 800 MHz** $d = [\frac{3,5}{E_1}]\sqrt{P}$ Where $E_1 = 3$	**800 MHz to 2,5 GHz** $d = [\frac{7}{E_1}]\sqrt{P}$ Where $E_1 = 3$
0,01	0,117	0,117	0,233
0,1	0,369	0,369	0,738
1	1,167	1,167	2,333
10	3,689	3,689	7,379
100	11,667	11,667	23.333

For transmitters rated at a maximum output power not listed above, the recommended separation distance *d* in metres (m) can be estimated using the equation applicable to the frequency of the transmitter, where *P* is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer.
NOTE 1 At 80 MHz and 800 MHz, the separation distance for the higher frequency range applies.
NOTE 2 These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.

Guidance and Manufacturer's Declaration – Electromagnetic Immunity			
The Magstim 200² is intended for use in the electromagnetic environment specified below. The customer or the user of the equipment should assure that it is used in such an environment.			
Immunity Test	**IEC 60601 Test Level**	**Compliance Level**	**Electromagnetic environment - guidance**
Electrostatic discharge (ESD) IEC 61000-4-4	± 6 kV contact ± 8 kV air	Meets requirement	Floors should be wood, concrete or ceramic tile. If floors are covered with synthetic material, the relative humidity should be at least 30%.
Electrical fast Transient/ burst IEC 61000-4-11	± 2 kV for power supply lines ± 1 kV for input/ output lines	Meets requirement	Mains power quality should be that of a typical commercial or hospital environment.
Surge IEC 61000-4-5	± 1 kV differential mode ± 2 kV common mode	Meets requirement	Mains power quality should be that of a typical commercial or hospital environment.
Voltage dips, short interruptions and voltage variations on power supply input lines. IEC 61000-4-11	<5 % U_T (>95 % dip in U_T) for 0,5 cycle 40 % U_T (60 % dip in U_T) for 5 cycles 70 % U_T (30 % dip in U_T) for 25 cycles <5 % U_T (>95 % dip in U_T) for 5 sec	Meets requirement	Mains power quality should be that of a typical commercial or hospital environment. If the user of the Magstim 200² requires continued operation during power interruptions, it is recommended that the Magstim 200² be powered from an interruptible power supply.
Power Frequency (50/60Hz) Magnetic Field IEC 61000-4-8	3 A/m 50Hz	Meets requirement	Power frequency magnetic fields should be at levels characteristic of a typical location in a typical commercial or hospital environment
Radiated RF Immunity EN61000-4-3	80MHz – 2.5GHz 2Hz 80% amplitude modulation	Meets requirement	Equipment should only be used in the vicinity of other equipment compliant with EN60601-1-2.
Conducted RF Immunity EN61000-4-6	0.15MHz – 80MHz 2Hz 80% amplitude modulation	Meets requirement	Equipment should only be used in the vicinity of other equipment compliant with EN60601-1-2.
NOTE U_T is the a.c. mains voltage prior to application of the test level			

Guidance and Manufacturer's Declaration – Electromagnetic Immunity			
The Magstim 200² is intended for use in the electromagnetic environment specified below. The customer or the user of the equipment should assure that it is used in such an environment.			
Immunity Test	**IEC 60601 Test Level**	**Compliance Level**	**Electromagnetic environment - guidance**
Conducted RF IEC 61000-4-6	3 Vrms 150 kHz to 80 MHz	3 Vrms 150 kHz to 80 MHz	Portable and mobile RF communications equipment should be used no closer to any part of the Magstim 200², including cables, than the recommended separation distance calculated from the equation applicable to the frequency transmitter. **Recommended separation distance** $d = [\frac{3,5}{V_1}]\sqrt{P}$ $d = [\frac{3,5}{E_1}]\sqrt{P}$ 80 MHz to 800 MHz
Radiated RF IEC 61000-4-3	3 V/m 80 MHz to 2,5 GHz	3 V/m 80 MHz to 2,5 GHz	$d = [\frac{7}{E_1}]\sqrt{P}$ 800 MHz to 2,5 GHz Where P is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer and d is the recommended separation distance in metres (m). Field Strengths from fixed RF transmitters, as determined by an electromagnetic site survey, [a] should be less than the compliance level in each frequency range.[b] Interference may occur in the vicinity of equipment marked with the following symbol: 
NOTE 1 At 80 MHz and 800 MHz, the higher frequency range applies. **NOTE 2** These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.			
[a] Field strengths from fixed transmitters, such as base stations for radio (cellular/ cordless) telephones and land mobile radios, amateur radio, AM and FM radio broadcast and TV broadcast cannot be predicted theoretically with accuracy. To assess the electromagnetic environment due to fixed RF transmitters, an electromagnetic site survey should be considered. If the measured filed strength in the location in which the Magstim 200² is used exceeds the applicable RF compliance level above, the Magstim 200² should be observed to verify normal operation. If abnormal performance is observed, additional measures may be necessary, such as re-orienting or relocating the Magstim 200². [b] Over the frequency range 150 kHz to 80 MHz, field strengths should be less than [V_1] V/m.			