MARAN Ultra
Installation Guide

MARAN Ultra Installation Guide
v2.3 April 2006

Note: It is recommended that users access the CD-ROM supplied with the instrument for the latest version of this manual.

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Chapter 1 Introduction

The aim of the MARAN Ultra Installation Guide is to describe the basic processes involved in installing and servicing MARAN Ultra instruments and accessories. This manual contains information for installation engineers and users who wish to perform basic servicing, such as changing fuses and cleaning air filters.

The MARAN Ultra Installation Guide does not attempt to:

i) Educate the non-expert user in the basic theory of low resolution NMR. For information of NMR theory, consult the appropriate basic introduction documents available from OIMBL.

ii) Provide information regarding software installation. Information on how to install software should be found in the appropriate manuals related to OIMBL software.

Chapter 2 Unpacking and Overview

2.1 Introduction

All MARAN Ultra instruments are composed of three main units:- the magnet box, power supply and computer.

2.2 Environmental Requirements

- The MARAN Ultra instrument is designed to operate indoors in normal laboratory conditions.
- A bench area of 2m x 1m is required.
- The instrument should be sited in a vibration-free area away from draughts and out of direct sunlight on a non-metallic bench capable of supporting a weight of up to 120kg.
- The average surrounding air temperature should be between 20ºC and 30ºC and should not vary by more than ±3ºC during any 24-hour period. Ideally the instrument should be sited in an air-conditioned room.

2.3 Electrical Requirements

- The MARAN Ultra is designed to operate from a voltage supply of between 95-240V.
- The instrument has a current rating of 6.3A and the power supply should be connected to an electrical outlet, meeting this requirement with an earth connection.

2.4 Positioning of Units

- Open all the shipping crates, check for transit damage and identify the contents of each crate. Lift the magnet box onto the bench.
- The MARAN Ultra magnet box is very heavy (up to 70kg for the standard benchtop versions). Use mechanical lifting gear if available and observe local health and safety guidelines for lifting heavy objects.
- All ferromagnetic objects must be kept at a safe distance away from the magnet box.
- The power supply can be positioned anywhere within 2m of the magnet box in a well ventilated location.
- Unpack the PC (if supplied). Connect the VGA cable, monitor power lead and keyboard into the main PC unit as described in the computer's installation instructions.

2.5 The Magnet Box

- Ferromagnetic objects must never be placed near the magnet access hole or between the magnet poles.
- The MARAN Ultra magnet generates a strong but localised magnetic field. Do not place magnetic media in close proximity to the magnet box.
- The MARAN Ultra magnet box contains the permanent magnet, RF coil and amplifier and associated electronics for performing NMR experiments. The magnet box may weigh up to 70kg and should be sited on a sturdy non-metallic bench away from strong drafts, direct sunlight and vibrations.

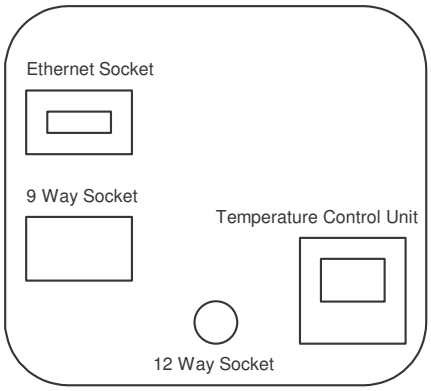

Figure 1.1 – This diagram represents the rear panel of the magnet box showing the Ethernet connection, the 9-way D-type connector, the 12-way power supply socket and the temperature control unit

- The magnet box should be connected to the PC's Ethernet port via the supplied Ethernet lead. Users should note that two Ethernet cables are supplied, one crossover cable, which is used to connect the MARAN Ultra directly to a PC and a straight through cable which can be used to connect the MARAN Ultra to a network port (enabling the MARAN Ultra to be operated remotely over the Ethernet).
- Users should also ensure that the correct Ethernet cable is used to connect the MARAN Ultra to the PC/network port. Note that the MARAN Ultra will not function correctly unless the correct Ethernet cable is used.
- Finally, connect the power supply to the magnet box via the 12-way power supply lead and the 9-way D-type connector to a spare 9-way D-type connector on the PC. Note that the 9-way D-type lead is supplied for diagnostic purposes only and does not need to be connected.
- The magnet box should be left for approximately 12 hours after being switched on to allow the magnet box temperature to stabilise. If the magnet box is switched off during a power cut (power outage), electrical safety test or during maintenance it must be allowed to re-stabilise before new measurements can take place.
- The magnet box has a temperature control unit located on the rear of the magnet box (Figure 1.2). The temperature control unit is automatically activated when the magnet box is switched on. More information on setting the magnet box temperature may be found in Chapter 3. Operators should ensure that no metallic objects are placed in close proximity to the magnet box. Computer disks, videotapes and other magnetic media should be kept at least 30cm away from the magnet box.
- The magnet box contains no user serviceable parts or air filters. Under no circumstances should the magnet box cover be removed without first contacting OIMBL for advice.

2.6 The Power Supply

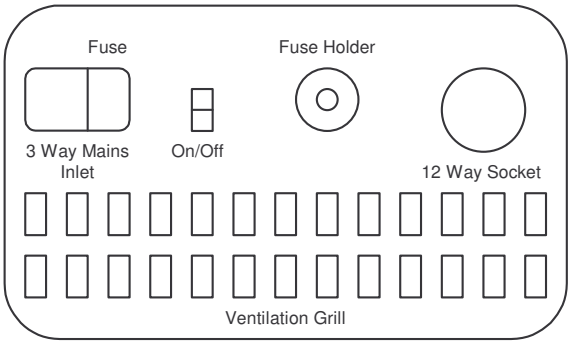

Figure 1.2 – Diagram representing the rear panel of the power supply, showing the fuse holder, 3-way IEC mains inlet connector (fused) and 12-way magnet power supply socket

- The power supply transforms the local power supply into a format compatible with the MARAN Ultra.
- The power supply weighs approximately 3kg and should be sited in a well-ventilated area within 2m of the magnet box.
- A diagram of the rear panel of the power supply may be found in Figure 1.2. The power supply is connected to the mains via the supplied 3-way IEC mains lead. The power cable is factory fitted with a 13A fuse (UK only). The 3-way mains inlet connector is also fused with a 6.3A anti surge fuse (OI part number 57-FU1011). During operation the power supply must be earthed via the 3-way IEC mains lead at all times.
- The 12-way magnet power supply lead (the lead has gold 12-way connectors) should be connected from the rear panel of the power supply (Figure 1.1) to the rear of the magnet box (Figure 1.2). The power supply is turned on via the switch located next to the 3-way IEC mains inlet connector.
- The power supply has a single filter for the cooling fan mounted on the front panel. The filter must be cleaned periodically (once every 6 months) or sooner if it becomes clogged. The cleaning procedure is particularly important when the MARAN Ultra is being operated in harsh environmental conditions. The filter may be snapped off by hand and cleaned with a soft wire brush.

- The power supply should be tested periodically (to observe local standards) for electrical safety using a portable appliance tester. The fuse holder (Figure 1.1) contains a 3.15A fast blow fuse (OI part number 57-FU1010).
- The power supply contains no user serviceable parts. Under no circumstances should the power supply cover be removed. If in any doubt please contact OIMBL for advice.

2.7 The MARAN Ultra PC

- The PC supplied with the MARAN Ultra instrument is already loaded with the necessary software.
- The PC should be regarded as an integral part of the MARAN Ultra instrument and not as a normal laboratory PC available for other tasks.

2.8 MARAN Ultra's Supplied Without a PC

- The MARAN Ultra may be supplied for use with an existing PC.
- In this case it is necessary to install an Ethernet card in the PC (one is supplied with the MARAN Ultra instrument if a PC is not included).
- Please refer to the RINMR User Manual for more information on installing Ethernet cards and configuring MS Windows for use with the MARAN Ultra.

Chapter 3 Installing and Switching on the Instrument

3.1 Introduction

Once the instrument has been connected according to the instructions provided in Chapter 2, the MARAN Ultra and PC may be switched on. Once the magnet box has been switched on, the temperature controller display on the rear of the magnet box will illuminate, displaying the current temperature of the magnet box. If this display fails to illuminate, check that the power leads are connected correctly. If the problem persists, contact OIMBL for advice.

3.2 Magnet Box Temperature Control

- A temperature controller mounted on the rear panel of the magnet box controls the magnet temperature. The current magnet box temperature is displayed in green figures. Magnets are normally factory set to an operating temperature of 40ºC.
- To view the set temperature, press either the up or down arrow key once on the temperature controller. The set temperature is displayed for a few seconds before the display reverts back to the current magnet box temperature.
- To change the value of the set temperature, press and hold either the up or down arrow key. The current set temperature will be displayed and will begin to increase/decrease. Using the up and down arrow keys set the required operating temperature. After a few moments the display will revert back to displaying the current operating temperature, which will gradually increase/decrease to match the new set point.
- Note that although the operating temperature may reach the new set value quickly, the temperature sensor reads the temperature of the air inside the magnet box, not the temperature of the magnet itself. The magnet contains a large mass of metal that has a considerable thermal inertia and will take up to 24 hours to reach its new operating temperature.
- Do not press any other keys on the temperature controller or it may not function correctly.
- There must be at least a 5ºC difference between the set temperature and the outside air temperature for the temperature controller to function correctly.

3.3 Checking for PC-MARAN Ultra

3.3.1 Communications

To check that the PC is communicating with the MARAN Ultra electronics, run RINMR from the MS Windows Start menu.

- If the above message box appears, the MARAN Ultra electronics are not communicating correctly with the PC. Check the connections, particularly the Ethernet connection between the rear of the magnet box and the PC. If the problem persists, contact OIMBL for advice.
- User's configuring their own PC's for use with the MARAN Ultra electronics should refer to the RINMR User Manual, where additional information on installing Ethernet cards for use with the MARAN Ultra may be found.

Chapter 4 Safety and User Maintenance

4.1 Introduction

This chapter provides information regarding basic user safety testing and maintenance of the MARAN Ultra instrument. Users should be aware that MARAN Ultra instruments contain no user serviceable parts inside. If in doubt about any aspect of user servicing, users should contact OIMBL or the local distributor for advice. A copy of user warranty terms and conditions is available on request. Extended warranty contracts may be arranged by contacting the local distributor or OIMBL.

4.2 Fuses

The MARAN Ultra has two fuses located on the power supply:

- Power supply 3-way IEC mains inlet connector 6.3A (OI part number 57-FU1011).
- Power supply fuse holder 3.15A (OI part number 57-FU1010).

A full description of the location of these fuses may be found in Chapter 2.

4.3 Other Safety Points

The instrument must not be exposed to rain, moisture excessive dust or high temperatures as these may cause risk of shock or fire. High voltages are present inside the units. The instrument must be switched off and disconnected from the mains before any of the covers are removed and it must never be operated with any of the covers off. Please contact OIMBL for advice before removing the magnet box cover.

In normal use of the MARAN Ultra instrument, the sample is subjected to short, intense pulses of radio frequency electromagnetic radiation. Samples which may be damaged by this process, or which may cause sparking or other electrical effects, should not be placed in the instrument. This included metallic or magnetic samples. Volatile or flammable samples should also not be placed in the instrument.

If any of the following occurs, the instrument should be switched off and disconnected from the mains supply and OIMBL should be contacted:

1. Liquid is spilled on to into any part of the instrument.
2. Any part of the instrument is dropped.
3. Small metal objects fall into the sample access hole.
4. Fuses continually blow out.
5. Any of the mains leads are damaged or frayed.
6. The instrument exhibits any marked change in performance that might indicate the need for servicing.

4.4 Cleaning

The exterior panels of the instrument may be wiped if necessary with a damp (not wet) cloth.

4.5 Regular Maintenance

- There are no user serviceable parts inside the MARAN Ultra instrument.
- Once per year, the electrical safety of the instrument should be checked according to local guidelines.
- The filter on the rear of the power supply should be cleaned periodically.

Chapter 5 MARAN Ultra Accessories

5.1 Introduction

This section contains information regarding the operation of supplementary MARAN Ultra equipment including gradients and the variable temperature (VT) controller.

5.2 The Variable Temperature (VT) Controller

5.2.1 Introduction

The MARAN Ultra VT controller may be used in conjunction with a MARAN Ultra instrument to conduct NMR experiments at difference temperatures. Sample temperatures between -50ºC and 150ºC may be achieved.

The VT controller has three main components:

1. A special RF probe with a vacuum-insulated glass dewar.
2. A PTFE gas flow rod that contains the gas heater and the temperature sensor.
3. A VT control unit with associated cables.

The VT controller works by forcing gas under pressure through the inlet pipe at the back of the magnet box. Inside the magnet the gas is heated through an electrical element before being blown out of a gas flow rod onto the base of the sample test tube that is located directly above it. The heated gas then passes around the side of the test tube and exhausts through the sample hole in the top of the magnet. The gas temperature is measured by a platinum temperature sensor situated in the gas flow rod just below the base of the sample test tube.

The source of the gas can be a compressed gas bottle, laboratory piped gas, the output from a liquid nitrogen evaporation unit or the output from a simple air compressor. The electrical heater and platinum temperature sensor inside the gas flow rod are both connected to the heater/controller unit. the VT control unit can supply sufficient power to increase the incoming gas temperature by about 150ºC. The temperature of the VT controller may be set using the RINMR data acquisition software using the VT command.

5.2.2 Connecting the VT Control Unit and Probe

These connections must be made:

- Connect the VT control unit to the magnet box via the supply lead.
- Insert the gas flow rod into the magnet box. To perform this operation, first remove the magnet box cover. Remove the current RF probes (see the Probes section in the MARAN Ultra Supplementary Equipment Manual on to remove and insert RF probes). In the base of the magnet box centred between the pole pieces there is a small inlet hole (the hole will be surrounded by black foam rubber insulation).
- Ensure that the gas flow rod is orientated correctly (the end which should be pushed into the gas inlet hole situated in the base of the magnet has a long lead with a connector attached to it). Drop the rod between the magnet pole pieces and push firmly into the inlet hole. Feed the lead under the rear magnet pole piece and connect it to the power supply connector (this is the spare MOLEX 4-way connector which is situated to the rear of the magnet box – only one of these connectors exists).
- Next gently place the VT RF probe into the magnet. DO NOT allow the probe to fall to the bottom of the magnet as it is inserted. This will cause the glass dewar in the probe to impact on the base of the magnet box and may cause the glass to break.
- Lower the VT RF probe carefully into position, ensuring that the gas flow rod passes through the centre of the RF probe. The VT RF probe should fit snugly over the gas flow rod.
- Gentle pressure may be required to push the VT RF probe over the rubber seals on the gas flow rod. Secure the VT RF probe using the bolt.
- Replace the magnet box cover and allow the magnet box temperature to stabilise.
- Note that RF VT probes are extremely delicate. Contact OIMBL for advice if required.
- Connect gas supply line to the inlet on the outside of the magnet box.

- Connect the RS232 line from the PC to the VT control unit (if remote control of the VT controller is required).
- Connect the power supply lead to the VT control unit.
- Switch on the gas flow. Note that it is essential to ensure that gas flow is present before the VT control unit is activated.
- Switch on the VT control unit using the switch mounted on the rear panel. When the unit is switched on for the first time the red button on the front panel should be illuminated. Press this button once. The light should go out. The VT control unit is now ready for use.

5.2.3 Operating Instructions and Requirements

- The VT control unit has two Omron fuzzy-logic temperature control modules.
- The one mounted on the left of the unit monitors and sets the sample temperature while the module on the right is used for over-temperature protection.
- There are no user adjustable parameters on the over-temperature control module and it should not be touched. All controls on the over-temperature control module have been disabled.
- A thin film Platinum resistance thermometer (class B) is used to measure sample temperature and is mounted directly in the gas flow rod close to the sample test tube.
- The VT controller requires a gas supply with flow control capable of providing a constant flow in the range of 3 -10 litres per minute.
- The gas must be clean, oil-free and below the dew-point of the lowest temperature it will reach.
- Either nitrogen gas or air can be used as the heat transfer medium, although nitrogen is preferred.
- The insulated inlet pipe to the variable temperature unit is supplied with an 8mm standpipe fitting.
- Connection to this should be made with a fitting capable of sealing at the expected temperature of the *incoming* gas.
- The maximum pressure in the inlet hose during normal operation should be no more than 0.5bar. Care must be exercised to ensure that the pressure is not taken above 2 bar (do not block the sample space or kink the inlet hose).

5.2.4 Sample Temperature Control

- The set point temperature is indicated by the green LED display and is marked as 'SV' (Set Value). The present value of the sample temperature is indicated by the larger red LED display and is marked as 'PV' (Present Value).
- Upper and lower limits of ±150ºC and -50ºC have been set within the VT control unit and are not adjustable by the user. The VT control unit can operate only to temperatures above the ambient temperature of the gas.
- Temperatures below ambient can be achieved by passing the incoming gas through heat exchange coils (available from OIMBL) which have been placed in a suitable refrigerated bath.
- Alternatively, a liquid nitrogen evaporation device may be used to cool the gas.
- The VT control unit is capable of heating gas by up to 150ºC at any flow rate with the range of 3-10 litres per minute.
- The indicated 'sample temperature' is measured at a point approximately 2cm below the actual sample test tube. Therefore a difference exists between the present value indicated on the left temperature controller and the actual sample test tube temperature. This offset will be constant for any given flow rate. The level of the offset can be reduced if the gas flow is increased, but this will increase the gas consumption and force the heater to work harder.
- If accurate knowledge of sample temperature is required, the user should carry out calibration tests using a temperature sensor embedded in the sample to establish precisely the offset between the gas temperature with the gas flow rod and the actual sample temperature.
- Do not insert any wires into the sample tube while the instrument is generating RF pulses.

5.2.5 Controlling the Temperature

The sample temperature controller is a sophisticated fuzzy-logic controlled device. It automatically adjusts its internal control to accommodate a given set point value and the system may over or under shoot a set point the first

time the value is used. On subsequent visits to this set point the unit will attain the temperature with very little or no overshoot. If however the gas flow is altered then the controller will have to refrain itself to the new flow rate.

5.2.6 Configuring RINMR for the VT Control Unit

RINMR must have two additional lines placed in its RINMR.ini file (usually located in the C:\Program Files\Resonance\RINMR\Bin\directory) in order to remotely operate the VT Control Unit.

Usually this RINMR.ini file is factory-configured for systems supplied with VT Controllers. However, systems not supplied with PC's or upgraded systems may require the RINMR.ini file to be modified.

The lines that should be added are as follows:

[HARDWARE]
…
TempPort=1
TempControl=OMRON

Note that the TempPort setting controls which serial port the VT Control Unit is operating from. If the PC has more than one serial port of the VT Control Unit not operating correctly it is possible that TempPort is not configured to the correct serial port. In this case try increasing the value of TempPort to 2 and restart RINMR.

5.2.7 Using RINMR to set the VT Control Unit

The description of the VT software facility can be found in the RINMR User Manual. Here is a basic description of the VT command:

- The VT Unit is controlled from the RINMR data acquisition software using the VT command.
- Type VT in the command history box to bring up the VT control window. Type the required temperature in the entry box and left click on the set button to change the sample temperature to the new value.
- The VT command may be used with the following command line arguments:- VT [n] + option [N], option [W].
- The command VT [n] sets the VT to (n)ºC and waits until the sample temperature monitor reaches (n)ºC before returning control to RINMR.
- VT [n] N (e.g. VT 100 N) – this command sets the VT to (n)ºC and returns control immediately to RINMR.
- VT W – this command writes the current value of the sample temperature monitor to screen and can be used in conjunction with a log file to monitor the sample temperature.

5.2.8 Over-Temperature Projection and Troubleshooting

- Protection is provided against loss of gas flow and power supply over-temperature.
- In either case the system will cut the mains supply to the heater power unit.
- The red button map on the front panel will show to indicate that over-temperature protection has been activated.
- Once the cause of the failure has been established and rectified the button can be pressed to reset the VT control unit.
- The lamp will go out and the system will return to the set value.
- In the event of lost gas flow the heater will go full on until the set value of the over-temperature controller is reached. This temperature has been factory set and is not adjustable by the user.
- The heater output is fused with a 20mm, 3.15A time lag ceramic fuse. This should be checked in the case of the unit not reaching its set point.
- The heater power supply also has a 55ºC thermal switch fitted to its case. This is wired in series with the over-temperature protection circuit and is self re-setting. The red neon lamp will indicate that the over-temperature protection circuit has been activated.

5.2.9 Service Requirements

- The heater element is mounted inside the magnet box and contains no user serviceable parts.

- The heater power supply and control units do not contain user serviceable parts beyond replacement of the mains and heater output fuses.
- The cooling fan filter should be replaced or thoroughly cleaned every 12 months. More regular replacement may be necessary if the operating environment is particularly harsh.

5.3 Gradients

5.3.1 Introduction

Gradients may be used in conjunction with specific MARAN Ultra utilities to perform imaging and diffusion experiments. This section describes how to connect Crown Macrotech 5000VZ gradient amplifiers (supplied by OIMBL) to the MARAN Ultra system, how to connect RF gradient probes and how to conduct experiments using the gradient utilities. Here are a few recommendations:

- For more information on Crown Macrotech 5000VZ amplifiers, the user should refer to the Crown manuals supplied with the instrument.
- Users with systems operating with Techron 7780 gradient amplifiers should contact OIMBL for advice.
- Installation engineers should first familiarise themselves with the gradient amplifiers by reading the manuals supplied by Crown.
- The Crown Macrotech 5000VZ amplifiers supplied with the MARAN instrument are capable of generating lethal energy levels.
- Suitably qualified personnel only should be allowed to perform procedures involving gradients.
- Gradient amplifiers must remain disconnected from the mains supply throughout the installation procedure.
- If in any doubt, contact OIMBL for advice.

5.3.2 Installing Gradient Probes

- The gradient amplifiers and the magnet box must be disconnected from the mains power supply before the RF gradient probe is installed/removed.
- Gradient probes are installed in a similar manner to normal radio-frequency probes.
- Users should refer to the Probes section of this manual for instructions on how to install and remove RF probes.
- In addition to the two connectors for the transmitter and receiver RF lines, between 2 and 6 insulated copper wires are also present on gradient probes.
- These wires connect to the gradient plates that are situated in the outside of the probe body and should be attached to the 6-way terminal block that is mounted on the rear of the MARAN Ultra magnet frame.
- The gradient probe wires should be attached according to the gradient probe wiring information available from OIMBL.
- After installing the gradient probe replace the lid on the magnet box.
- Under no circumstances should the RF gradient probes be connected without reference to the wiring diagram supplied with the MARAN Ultra instrument. If in doubt, contact OIMBL for advice.

5.3.3 Other Gradient Types

For installation of other gradient types, users should refer to the additional documentation supplied with the MARAN Ultra instrument.

5.3.4 Connecting the Gradient Amplifiers

- Connect the gradient amplifiers to the inputs on the rear of the magnet box via the supplied SPEAKON leads (blue connectors).
- The leads and gradient amplifiers are labelled (X, Y, Z) and **must** be connected to the corresponding ports on the rear of the magnet box.
- Failure to do so with result in incorrect gradient mapping.
- Connect the gradient input signal leads between the MARAN RF unit and the rear of the gradient amplifiers.
- The leads are labelled and **must** be connected as indicated.

- Finally, plug the gradients into the mains power supply. Note that the gradient amplifier power supply should be rated at 20A.

5.3.5 Gradient Amplifier Maintenance

- The user should refer to the manual supplied with the gradient amplifiers for instructions on routine maintenance.
- The filters on the front of the gradient amplifier should be cleaned on a regular basis.
- The gradient amplifier is fused by a single 10A fast blow fuse that is situated in a holder on the rear of the unit. This fuse may need replacing periodically.

5.3.6 Using Gradient Amplifiers

- Switch on the gradient amplifiers via the on/off switch on the front panel of the Crown amplifier.
- After a short pause, the amplifier will come out of standby (the twin green lights on the front panel marked SIGNAL/IOC will go out and the twin red lights marked ODEP will illuminate).
- At this point the gradient amplifier is read for use.
- Failure of the amplifier to come out of standby may indicate a blown fuse (see Gradient Amplifier Maintenance) or a wiring/connection error in the gradient circuits.

5.3.7 Recommended Safe Operating Conditions and Gradient Protection

- Gradients are hardware protected to prevent damage being caused by inappropriate usage.
- Users should note that the maximum safe gradient duty cycles vary depending on gradient set type and the type of cooling media and advice should be sought before undertaking aggressive gradient experiments with high duty cycles, such as CPMGGRAD.
- If in doubt, contact OIMBL for advice.

5.3.8 Using DEGAUSS

- Using magnetic field gradients leaves residual magnetism on the pole pieces of the MARAN Ultra magnet. The residual magnetism may be removed by running the Degauss utility.
- If the Degauss utility is not used after gradient experiments, the residual magnetisation may **severely** disrupt the homogeneity of the magnet and will significantly affect the results of further FID experiments.
- The Degauss utility must be used following gradient experiments to recover the magnet homogeneity.

5.3.9 Setting the Gradient Parameters in RINMR (for use with Crown Macrotech amplifiers)

The RINMR data acquisition software may be supplied with diffusion analysis software (RI Diffusion) and droplet size analysis software (RI Droplet). These programs automatically calculate diffusion coefficients from data acquired using the DIFF, DIFFA and DROPLET pulse sequences. More information on using RI Diffusion and RI Droplet may be found in the appropriate sections of this manual.

To function correctly, the RI Diffusion and RI Droplet analysis software requires information regarding the current setting on the gradient amplifiers and also the strength of the magnetic field gradients. This information is contained in the RINMR.ini file, which resides in the C:\Program Files\Resonance\RINMR\Bin directory.

The hardware section of the RINMR.ini file contains information relevant to the gradients:

```
[Hardware]
XMaxCurrent=35
YMaxCurrent=35
ZMaxCurrent=35
XGradStrength=0.0571
YGradStrength=0.0571
ZGradStrength=0.0571
```

- The maximum output current of each gradient amplifier (in amps) connected to the system (up to three amplifiers may be present on the X, Y and Z axes) is specified by the X, Y and Z MaxCurrent parameters.
- Users should note that the Crown Macrotech amplifiers have three current settings (corresponding to maximum currents of approximately 22, 35 and 55A). These are nominal maxima (i.e. the amplifiers usually output a slightly different maximum value of current than this).
- The gradient strength of each gradient axis is given by the X, Y and Z GradStrength parameters (in T/m/Amp). The value varies with probe geometry (gradients attached to RF coils with small diameters produce stronger magnetic fields), gradient orientation (Z gradients produce stronger magnetic field gradients per amp than X and Y gradients), magnet type and gradient amplifier (the maximum output current depends on the particular amplifier).

The following table provides a list of nominal gradient strengths and recommended gradient amplifier settings for a range of common gradient set types. Please contact OIMBL for advice if your gradient set is not listed.

Specifications for Common Gradient Set Types (for use with Crown Macrotech amplifiers)

Gradient Type	Gradient Axis	Recommended Amplifier Settings (A/V)*	Nominal Gradient Strength (T/m/A)**	Nominal Gradient Strength (Max, G/cm)**	Cooling Option (Yes/No)
10mm	X, Y	4.4 (22A)	0.0909	200	No
10mm VT	X, Y	7 (35A)	0.0571	200	No
18mm	X, Y	7 (35A)	0.0571	200	No
18mm VT	X, Y	7 (35A)	0.0571	200	No
26mm (unshielded)	X, Y	7 (35A)	0.0571	200	No
26mm (shielded)	X, Y	11 (55A)	0.0182	100	Yes
40mm (shielded)	X, Y	11 (55A)	0.0045	25	Yes
51mm (shielded)	X, Y	11 (35A)	0.0083	25	Yes

* Crown Macrotech amplifiers have 3 current settings, 4.4A per volt, 7A per volt and 11A per volt. Input voltage is 0-5V so these settings correspond to maximum current outputs of 22, 35 and 55A respectively. Note that these are nominal amplifier outputs and that the true output of the amplifier may vary from these values.
** Gradient strength for unshielded gradients also varies depending on magnet type. These are nominal gradient strengths.

5.4 Radiofrequency Probes

5.4.1 Introduction

This section describes how to change over radio-frequency (RF) probes:

- MARAN Ultra instruments may be supplied with several types of radio frequency (RF) probe, including variable temperature (VT) probes, gradient probes, combinational probes (VT and gradient) and special nucleus probes (for looking at nuclei other than ^{1}H) including ^{19}F, ^{23}Na and ^{31}P.
- RF probes may be configured with a wide variety of diameters and coil lengths (absolute/ratio). Additional information on installing gradients, VT and combination RF probes may be found in the sections relevant to gradients and variable temperature controllers in this manual.

5.4.2 Changing RF Probes

- The magnet box must be disconnected form the mains supply before RF probes are installed or removed.
- Under no circumstances should magnetic material be placed between the magnetic pole pieces.
- To remove the existing RF probe, first turn off the power supply to the magnet box and remove the magnet box lid.
- Next unscrew the hexagonal securing bolt on top of the magnet frame using the key provided.
- Users removing VT probes should ensure that the RF probes does not drop and impact on the magnet base.

- The impact may shatter the glass dewar.
- If necessary, remove the VT gas flow rod using the tool provided.
- Next remove the probe gently from between the magnet pole pieces and disconnect the BNC cables.
- Theses are marked Tx and Rx.
- The new RF probe may not be inserted.
- First ensure that the sample positioning screw that ensures the sample is correctly positioned in the inside of the RF probe is set correctly (the centre of the coil in the RF probe is exactly halfway up the probe body).
- Connect the Tx and Rx cables inside the magnet box to the BNC connectors on the outside of the RF probe. Position the probe between the magnet pole pieces and secure the RF probe with the hexagonal bolt. Replace the magnet box cover and allow the magnet box to equilibrate in temperature before proceeding with NMR experiments.
- Remember to alter the SF parameter in the acquisition software if a non ^{1}H RF probe is being used.
- A script called PROBECHANGE has been written to facilitate swapping RF probes.
- The PROBECHANGE script automatically allows users to specify different probe parameters.
- Users should refer to the MARAN Pulse Sequence and Script Manual for more information on configuring and using the PROBECHANGE script.

Chapter 6 Additional Information

6.1 MARAN Ultra Specifications

- Mass (magnet box) usually less than 70kg (~45kg for standard MARAN Ultra-2 and ~70kg for MARAN Ultra-23)
- Dimensions (magnet box) approximately 45x40x30cm (LxWxH)
- Operating temperature (nominal) 40ºC
- Power supply 95-230V (1*13A sockets for magnet box + power supply)
- Note that these specifications do not include the PC that may vary in size, power requirement and configuration from instrument to instrument.

6.2 MARAN Ultra Fuses and Additional Parts

- 1*20mm 6.3A type T fuse (OI part number 57-FU1011).
- 1*20mm 3.15A type T fuse (OI part number 57-FU1010).
- Air filter for power supply (pack of 5).
- Fan/heater assembly
- Sample –in detector assembly.
- Ethernet crossover cable (MARAN Ultra to PC).
- 9-way D-type cable.
- Ethernet straight through cable (MARAN Ultra to network).

6.3 Additional Information

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