Omicron Matrix SPM Control System Version T1.0–7 Release Notes

March 2006

This document describes changes to the software; installation, upgrade, and compatibility information; new and existing software problems and restrictions; and software corrections.

Revision/Update Information: This is a new manual

System Version: Omicron Matrix SPM Control System Version T1.0–7

Omicron NanoTechnology

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1 Introduction

This document contains the release notes of the Omicron Matrix SPM Control System version T1.0–7.
The new release supersedes version T1.0–6 and its variants. Major changes in this version are the addition of support for adjusting scan parameters by manipulating displayed images by mouse, the introduction of force-distance curve acquisition support, and the addition of the “Dual Mode” scanning and drift compensation facilities. In addition, version T1.0–7 corrects several problems and lifts some restrictions imposed by previous versions.

As with most releases, Matrix version T1.0–7 incorporates some changes that required modification of the experiment and Omicron SPM equipment descriptions shipped with the Matrix kit. Thus, experiment and equipment descriptions provided as part of previous Matrix versions are *not compatible* with version T1.0–7. Please read chapter 3 of this manual carefully before installing the Matrix version T1.0–7 kit.

This manual contains release notes introduced in the current release and notes from previous Matrix versions that still apply to the new release. A margin note indicates the version of origin when an old note was last updated.
Notes from previous releases are published when the information in the release note has not been documented in any of the Matrix manuals and the note is still pertinent.

Note that although the hardware and software is fully operable, there are still several known problems and restrictions that impact on the use of the system. Omicron will release maintenance updates frequently in order to overcome these limitations; all relevant information regarding current problems is detailed below.

1.1 Document Structure

Besides the introduction sections, this manual contains the following chapters.

- Chapter 2 summarises the new features introduced in version T1.0–7 of the Matrix system.
- Chapter 3 describes upgrade, re-installation, and removal procedures for Matrix version T1.0–7. In addition, changes to the Installer program and post-installation tasks are outlined in this chapter. Finally, a special section pertains to computer resource prerequisites required for running the Matrix software.
- Chapter 4 discusses some important application aspects of Matrix version T1.0–7.
- Chapter 5 details new features, known problems and restrictions, and software corrections that are of interest to all users of the Matrix system.
- Chapter 6 contains release notes specific to the administration of a Matrix system.

1.2 Abbreviations

The following abbreviations are used throughout this document.

ADC	**A**nalogue-to-**D**igital **C**onverter
CPU	**C**entral **P**rocessing **U**nit
CRTC	**C**entral **R**eal-**T**ime **C**ontroller
DRB	**D**igital **R**egulator **B**oard
GUI	**G**raphical **U**ser **I**nterface
CD	**C**ompact **D**isk
CU	**C**ontrol **U**nit
OCB	**O**scillator **C**ounter **B**oard
OPD	**O**scillator **P**hase **D**etector
PC	**P**ersonal **C**omputer
PDC6	**P**iezo **D**river **C**ard
RAM	**R**andom **A**ccess **M**emory
RSGB	**R**aster **S**can **G**enerator **B**oard
SP	**S**ervice **P**ack
SPM-AAB	**SPM**-bus **A**nalogue **A**dapter **B**oard
SPR	**S**ystem **P**erformance **R**eport
STM-SCB	**S**canning **T**unnelling **M**icroscopy **S**ignal **C**onversion **B**oard
STS	**S**canning **T**unnelling **S**pectroscopy
TFTP	**T**rivial **F**ile **T**ransfer **P**rotocol
UI	**U**ser **I**nterface
U-SCB	**U**niversal **S**ignal **C**onversion **B**oard
XML	E**x**tensible **M**ark-up **L**anguage

1.3 Reporting Problems

If you experience problems while running the Matrix system, and you have reason to believe that the problems are caused by a hardware or software failure, please submit a System Performance Report (SPR). SPRs can be generated from within the Matrix software by choosing “Help → System Performance Report…” if the software is still operable, or by launching the “SPR.exe” application available in the “bin” folder located in the Matrix software installation folder chosen during installation. (The application is also available on the Windows XP “Start” menu by choosing “Programs → Omicron NanoTechnology → Matrix → Support → System Performance Report”.
Fill in the form displayed by the software, attach log files and/or screenshots that might be helpful for Omicron to reproduce the problem, and finally choose “Save”. The software will generate an XML form from the data you provided; please supply this file to the Omicron service organisation.

Please refer to the Matrix application manual (chapter “Reporting a Problem”) for additional information on problem reporting.

The Omicron service organisation can be reached by e-mail through service@omicron.de, or by phone: +49 (0) 61 28 / 987 – 230.

2
Summary of New Features

Table 2-1 summarises the new features of version T1.0–7 of the Matrix SPM Control System.

Table 2-1 Summary of new Features

Feature	Description (Section Reference)
Experiments	▪ Support for AFM Needle sensor experiments has been added. (5.2.4) ▪ Support for Dual Mode experiments has been added. (5.2.1) ▪ The new drift compensation facility allows setting up correction vectors for automatically compensating sample drift effects. (5.2.3) ▪ Auto-Approach delay times are now experiment-specific. (5.2.30) ▪ Controls for the signals V_{Mod}, V_{Ext} and Z_{Ext} have been added to all experiments. (5.2.13)
Equipment Support	Support for the Omicron NANOPROBE instrument hardware has been added. (5.1.1)
AFM Support	▪ The AFM Non-Contact “Auto Δ f → 0” functionality is now supported. (5.2.5) ▪ The acquisition of force-distance curve data for the AFM contact-mode imaging experiment is now supported. (5.2.6) ▪ AFM adjustment and measurement operations can run simultaneously now. (5.2.8)
Spectroscopy	▪ Raster spectroscopy operations can now be disabled for a particular scan direction. (5.2.10) ▪ For V-spectroscopy operations, an additional *Z*-offset can now be specified. (5.2.11) ▪ The regulator feedback loop can now either be disabled or enabled during spectroscopy operations. (5.2.6) ▪ The slew rate-restricted spectroscopy parameter adjustment can be disabled now. (5.2.18) ▪ A new strategy variation for spectroscopy parameter correction is available. (5.2.12)
User Interface	▪ Covered windows can now be brought to front easily. (5.3.4)

	▪ Several scan parameters can now be adjusted by direct graphical manipulation. (5.3.2) ▪ The image-mode display now supports content magnification and panning. (5.3.1) ▪ Some usability aspects of the “Favourites Gallery” facility have been improved. (5.3.5) ▪ The graphical scan area representation now supports visualisation and manipulation of the “Zoom” parameter. (5.3.7) ▪ The image-mode display now supports dedicated anti-aliasing/smoothing of displayed content. (5.3.8)
SPIP image processing package	▪ New version 4.2.3 shipped. (5.4.1) ▪ SPIP now supports loading of data resulting from single point spectroscopy operations. (5.4.2) ▪ Matrix force-distance curve data can now be analysed. (5.4.4) ▪ Matrix CITS data can now be exported in SCALA PRO format. (5.4.8) ▪ The ImageMetrology Explorer software is now able to process Matrix result files. (5.4.5) ▪ The scan constraints “Line” and “Point” are supported now. (5.4.3)
Installer	▪ The installation routines now support the automatic preparation of user accounts. (3.3) ▪ Updating an existing Matrix installation without the need to uninstall an old version first is now supported. (3.3) ▪ The Installer software now also allows uninstalling the Matrix software. (3.3)

3
Installation and Upgrade Notes

This chapter contains important information you need to know for upgrading and (re-) installing the Matrix software. Also, you will find information on set-up options and PC hardware and software prerequisites in the subsequent sections.

3.1 Upgrading a Matrix Installation

The term “upgrade” refers to a process that replaces an existing Matrix software installation by a new version. Upgrading an existing Matrix software is an automated process requiring very few manual tasks only. The subsequent sections outline the upgrade process.

Note

Section 3.1.3 “Post-Installation Tasks” provides important information regarding tasks that you might have to perform after successful installation of the Matrix kit. Be sure that you have read the section carefully before using Matrix version T1.0–7.

3.1.1 User Data from Previous Versions

Matrix will store user data in the Microsoft Windows XP “home directory” of each user account. These directories are named according to the user account and can be found in directory “C:\Documents and Settings”. (For example, the Matrix user standard account named *Matrix* is located at “C:\Documents and Settings\Matrix”.) Within the “home directory” there is a Windows XP folder named “Application Data” which in turn stores the Matrix user base directory named “Omicron NanoTechnology”. During a session, the Matrix software will place all user-specific data (Project and experiment descriptions, experiment parameters, and the like) within this base directory.

Note

By default, the Microsoft Windows XP operating system “hides” the “Application Data” folder. In order to view it, choose “Folder Options” from the Windows XP Explorer’s “Tools” menu. Afterwards, click on the “View” tab, and select the option “Show hidden files and folders” of the “Hidden files and folders” tab entry.

Most often, new versions of the Matrix software come with improved and enhanced experiment and instrument descriptions. As a result, user data from previous versions must be replaced. If the installation routines discover Matrix user data folders during an upgrade operation, they will offer to backup this data automatically. Selecting this option will cause the installation process to save copies of all user data folders first, and clean up all obsolete information afterwards.

Note

The installation routines will also offer an option to ignore existing user data, however, you must then clean up data from previous Matrix versions manually. Omicron therefore recommends to choose the “Backup stored data” option always.

Matrix users launching the software for the first time after an upgrade will be informed that no resource data could be found. (The actual message is “Cannot find the default user account. The user account "default" will be created”) By confirming the message, the software is directed to copy the new experiment and instrument descriptions automatically.

3.1.2 Performing the Upgrade

To upgrade the Matrix system, log in to a privileged account (e.g. the Matrix administration account *Omicron*) first and run the Installer software provided on the distribution CD by double-clicking the file “setup.exe”. (If you have downloaded the Matrix kit from the Omicron service FTP site, you’ll find “setup.exe” within the ZIP archive “Matrix_T1.0_7.zip” that you must unpack to an empty directory first.) The installation routines will detect that a previous version of the Matrix software is already installed and offer to upgrade the installation automatically. Confirm the question dialogue regarding the upgrade by clicking “Yes”, the Installer will then guide you through the upgrade process.

The Installer software actually consists of several parts each of which provides a specific section of the Matrix software (e.g. control unit firmware, experiments, the SPIP package, the TFTP server software, etc.) Please note that during the upgrade process each part of the installation routines will separately request you to confirm the upgrade operation.

Note

You should explicitly log into a privileged account for installing Matrix kits instead of utilising the Windows XP “Run As” feature. Using “Run As” can cause the installation routines to fail under certain circumstances.

3.1.3 Post-Installation Tasks

Generally, the only explicit task required after installing the Matrix T1.0–7 kit is rebooting your Matrix CU in order to apply firmware changes.

If you are upgrading an existing Matrix installation, and you have modified hardware or software resources, some additional actions might be required before you can actually use Matrix version T1.0–7:

- If you have previously received supplemental instrument description and calibration information from Omicron, and you wish to continue to use this information, you will have to add a revised version of the instrument description and calibration data to the system instrument description set after installing the Matrix version T1.0–7 kit. If your Matrix installation is affected, please contact the Omicron service organisation for assistance.
- If you have previously applied modifications to instrument calibration data, all modified data will be substituted by the original versions after upgrading the Matrix system and launching the upgraded software. Thus, you must re-apply any modification to calibration data after starting the Matrix software for the first time after the upgrade.

An additional task must be accomplished if all of the below criteria are met:

- You are using an Omicron instrument based on a *p*-type scanner
- You are upgrading from a Matrix version earlier than T1.0–6
- The PDC6 piezo driver board jumper settings have been changed in order to achieve correct *Z*-axis deflection

Because Matrix version T1.0–7 supports a mechanism that will adjust the *Z*-axis information with respect to the scanner equipment chosen, the PDC6 jumper settings must not be changed any longer. Thus, if you have previously changed the PDC6 jumper settings in order to utilise a *p*-type scanner, you *must* revert to the factory default jumper settings before using Matrix version T1.0–7.

3.2 Removing and Re-Installing the Matrix Software

There are two options for removing a Matrix software installation from a computer:

- From the Microsoft Windows XP “Start” menu, choose “Settings → Control Panel” and double-click the item “Add or Remove Programs” in the control panel window. Windows XP will display a list of installed software products; from this list, select the item *Matrix T1.0 – SPM Control System* and click on the “Change/Remove” button.
- Double-click the “setup.exe” program from the Matrix distribution CD. (If you have downloaded the Matrix kit from the Omicron service FTP site, you’ll find “setup.exe” within the ZIP archive “Matrix_T1.0_7.zip” that you must unpack to an empty directory first.)

In either case, the Matrix Installer software will present a list of packages that you can choose to keep or uninstall. After selecting the packages to be uninstalled, the software will issue a couple of confirmation dialogues, and remove the selected packages from the computer.

Note

The removal process does not affect Matrix user directories and their contents.

To re-install the Matrix software system, launch the Installer software by double-clicking the file “setup.exe” from the Matrix distribution CD (or the ZIP archive “Matrix_T1.0_7.zip”, respectively). This will start the installation process, which supplies the firmware for the Matrix CU boards, the Matrix PC software, and the SPIP image processing software.

Note

For installing or removing the Matrix software a privileged user account is required. You should explicitly log into such a privileged account for installing Matrix kits instead of utilising the Windows XP “Run As” feature. Using “Run As” can cause the installation routines to fail under certain circumstances.

Note also that Omicron recommends to use a non-privileged account for operating the Matrix system.

3.3 Installer Modifications

The installation routines now support the automatic backup of Matrix user data during an installation. Thus, manually backing-up and deleting user-specific Matrix folders (which was required previously before installing a Matrix update) is no longer necessary.

In addition, various smaller improvements have been made; in particular, Matrix uninstall and re-installation support has been added.

3.4 Remedial Kits Included

The following remedial kits released earlier as add-ons to the Matrix version T1.0–6 software are included in the version T1.0–7 kit:

- MTRX837_v054301 (Offline mode support)
- MTRX687_v054501 (Needle sensor support, SPIP 4.1.5)
- MTRX113_v054801 (Force/distance curve support, SPIP 4.1.5)
- MTRX410_v060201 (Software failure correction)

3.5 PC Configuration Requirements

For using the Matrix system, the minimum PC hardware and software requirements listed in Table 3-1 should be met.

Table 3-1 Minimum System Requirements

Hardware	**CPU**	Pentium 4, 2.8 GHz
	Memory	DDR, 512 MB
	Interfaces	1 x Ethernet 10/100/1000 MBit
		1 x Ethernet 10/100 MBit
	Disk	Serial ATA 120 GB
	Graphics	nVIDIA GeForce FX 5200 128 MB
Software	**Operating System**	Microsoft Windows XP, Service Pack 1
	Graphics	OpenGL V1.2

4
Application Notes

The subsequent sections provide information on some application aspects of the Matrix SPM Control System, version T1.0–7.

4.1 Using Channel Oversampling

T1.0–6 Experiment Elements of type “Channel” (Catalogue “SPMBasic”) support Matrix CU-based oversampling and filtering during data acquisition. When oversampling, a channel will actually acquire several samples when it is triggered. It will then filter the acquired data by running a simple averaging algorithm on the sampled values. The result of this filtering operation will be delivered by the channel as outcome of the sample process. Note that both oversampling and filtering will be executed by a Matrix CU, i.e. the processes are completely transparent to the Matrix PC software.

The oversampling and filtering process is controlled by four parameters supported by the Experiment Element “Channel”:

- `Sample_Rate` — Determines the data acquisition rate, measured in Hertz (actually samples per second). The sample rate can range between 1 kHz and 200 kHz.
- `Sample_Count` — Specifies the number of sample operations that take place when a channel is triggered. Minimum number is 1, i.e. a single sample will be acquired.
- `Delay_Time` — Specified in seconds, the parameter value determines the initial delay time before the sample operation(s) are started.
- `Auto_Oversampling` — Determines whether the Experiment Element should compute the oversampling rate on the basis of the specified sample rate, delay time, and raster time automatically. The parameter is of type *Boolean* and must be set to “false” if the Experiment Element should use the parameters as specified, i.e. without computing values itself.

By default, oversampling is activated for spectroscopy channels and force-distance curve data acquisition only. However, you might want to enable oversampling also for other specific channels in order to benefit from multiple data item acquisition in certain scenarios.

To enable oversampling for a channel, follow the procedure described below:

1. Locate the channel parameter file of the respective experiment. For example, the AFM cantilever contact-mode imaging experiment “AFM_Contact_Basic” uses the channel parameter file “AFM_Contact_Basic_Channel.expp”. (Experiment parameter files are located in folder “Experiments” of the Matrix file tree in your “Documents and Settings” directory. For the pre-installed Matrix user account “Matrix”, the file tree can be found at “C:\Document and Settings\Matrix\Omicron NanoTechnology\Matrix\default”).

2. In the parameter file, locate the channel that you like to oversample, for example, “Z_Channel”.
3. Choose a sample rate, and set the parameter `Sample_Rate` accordingly. The value must be specified in Hertz and can currently range between 1 kHz and 200 kHz.
4. Choose an initial delay time to be used and set the parameter `Delay_Time` accordingly. The value must be specified in seconds and can range between 10 microseconds and 1.8 seconds. It is important to consider the minimum raster time that you intend to use, as the initial delay time must always be smaller than the raster time used.
5. Set parameter `Auto_Oversampling` to “true” in order to direct the Matrix software to automatically adapt the sample count to the raster time, sample rate, and initial delay time chosen.
6. Optionally, you can choose to add panel “FilterControl” to the graphical user interface (GUI) of an experiment. This panel will allow you to specify the oversampling parameters described above by means of the GUI. For example, to add this panel for channel “Z_Channel” of experiment “AFM_Contact_Basic”, follow the below procedure:

   6a. Locate the experiment description file for the experiment; in this case “AFM_Contact_Basic.expd”.

   6b. Locate the description of a suitable window to add the panel to, i.e. “AFM_Z_Channel_Fwd” for the data display of the “forward” part of a scan line.

   6c. Add the following code to the end of the window description, i.e. right before the `</Window>` XML tag:

```
<Panel name="Z_Channel_Oversampling"
       experimentElementInstanceName="Z_Channel"
       panelType="FilterControl">
  <LayoutInfo>
    <SizePolicy horizontal="preferred"
                vertical="preferred"/>
    <Alignment horizontal="auto" vertical="auto"/>
    <GridPosition col="-12 row="-1"/>
  </LayoutInfo>
</Panel>
```

It is important to notice that the Matrix CU data acquisition resources are currently limited, thus oversampling *must not* be enabled for all channels supported by a single experiment simultaneously. As a rule of thumb, you should restrict oversampling to at most two channels at a time.

4.2 Inaccurate Timing Behaviours of the Spectroscopy Axis

T1.0–5 In a spectroscopy experiment, either the gap voltage (*V*) or the sample-tip distance (*Z*) is systematically varied, and a number of associated data channels are simultaneously triggered. In case of the Matrix system, the initialisation phase of each spectroscopy measurement process as well as the exit phase back into the normal spatial scan progress can precisely be controlled via the parameters T1 through T4. The delay times T1 and T2 are used before the spectroscopy axis starts while T3 and T4 control the timing behaviour within the exit phase and the return into the normal scan process. The use of these parameters is explained in greater detail in the spectroscopy sections of the Matrix manuals.

Regarding the actual timing behaviour, there are currently three known issues.

First, due to the current status of the Matrix-internal clock generation, the delay time T2 (i.e. the time after approaching the start value of the spectroscopy axis) appears to be extended by a time interval exactly equal to the currently chosen raster time of the spectroscopy axis. Thus, this extra time interval appears only once per spectroscopy curve.

It is understood that this timing behaviour differs from the intended behaviour. Omicron will solve the problem in a future software release; however, significant effort is required for a thorough solution.

Considering the practical consequences of the above deficiency, two aspects appear to be important:

- Typically, a spectroscopy curve consists of at least 20 points. In this case, the additional delay after T2 increases the total measurement time per spectroscopy curve by less than 5%. For a larger number of spectroscopy points, the impact of the increased delay is reduced even further.
- The interval between approaching the start value of the spectroscopy axis and the initiation of the data acquisition at the first spectroscopy point is defined by the sum of T2 and the raster time. In case of a *I(V)* spectroscopy, a typical figure for T2 ranges between 200 and 400 µs. However, a typical value for the raster time of the spectroscopy axis is within the same range. Thus, one can at least partially compensate the extra time interval by a reduced value for T2. Nevertheless, this procedure is obviously not applicable for long-time spectroscopy experiments where the selected raster time is large against the value of T2. In the latter case, the total measurement time per spectroscopy curve might become considerable long (depending on the number of points) and therefore the time extension is presumably acceptable.

The second timing issue affects the delay time after the last spectroscopy data item has been acquired, but before the system returns into the spatial scan process. This delay time is actually the raster time set for spectroscopy operations, however, for short raster times (below approx. 70 microseconds) you will notice a significant extra time (e.g. 200 microseconds instead of 40). Although this behaviour is incorrect and will be addressed in a future release of the Matrix system, it does not cause any negative side effects.

Finally, very long raster times (> 1 second) can cause a Matrix CU to defer the actual experiment termination for the duration of one raster time period after the user has stopped an ongoing spectroscopy experiment. However, as the deferred experiment termination will not be reflected by the user interface of the Matrix software, you could re-start the respective spectroscopy experiment while the termination process has actually not been finished. In this case, the start value used for initialising the spectroscopy axis (i.e. the initial *V*- or *Z*-value) might become invalid.

Omicron will address the above issues in a future release of the Matrix software.

4.3 Spectrum Acquisition Points Differ Between Scan Directions

T1.0–5 When setting up an acquisition point grid for spectroscopy operations, the actual data acquisition point positions utilised by the Matrix system will differ between the forward and backward (or up and down) scan directions. As a result, a spectrum that has been acquired at some position during a forward (or up) scan will not be re-acquired at the same scan position when scanning in backward (or down, respectively) direction, but at a position close to the original location. This issue is caused by the pseudo-triangular scan function utilised for forward/backward and up/down scans.

Omicron will lift this restriction in a future version of the Matrix system.

4.4 Short Raster Times Can Cause Temporary Data Loss

Reducing the scanner raster time to a value smaller than 10 microseconds can currently cause temporary loss of data under certain circumstances. The symptom is that data displays will not be updated at regular intervals, or even stop to become updated. The underlying problem is an overload situation affecting various Matrix subsystems; this overload is in turn caused by high workload resulting from impacts of the short raster time.

Note that in order to reduce the risk of accidentally reducing the raster time to a value below 10 microseconds, the lower bound of the scanner raster time has been limited in version T1.0–7 of the Matrix software. As a result, you cannot set the raster time to less than 10 microseconds by using the value slider or by means of the numerical value control spin buttons; typing in a value below the 10 microseconds limit will yield a warning message.

Omicron will re-visit this restriction in a future release of the Matrix system.

4.5 Gap Voltage Cannot Be Changed During Running V-Spectroscopy Experiment

T1.0–5 Currently, when running a *V*-spectroscopy experiment, it is not possible to modify the gap voltage while a spectroscopy operation is active. If the gap voltage is nevertheless changed during an ongoing *V*-spectroscopy operation, the new gap voltage will take effect only for a period that is shorter or equal to the raster time chosen for the spectroscopy axis. Afterwards, the gap voltage will be reset to its original value, i.e. the value before the modification. In addition, using the gap voltage sign toggle control while a raster spectroscopy operation is progressing can cause invalid voltage ramps to be generated. Due to the above problems, Omicron recommends changing the gap voltage only in case the respective experiment has been stopped or does not perform spectroscopy operations. Note that the restrictions affect only experiments that use V_{gap} as the spectroscopy parameter.

This restriction will be lifted in a future release of the Matrix software.

4.6 Needle Sensor Operation

T1.0–6U1 The following notes pertain to operating a Needle sensor controlled by a Matrix system.

- *Automatic change of polarity for negative slopes yet missing* — After a “single sweep” operation has been completed, the phase value *Phi-2* (actually parameter `Phi2` of Experiment Element “NeedleAdjust”) is automatically set to the correct value, thus yielding zero output at the phase detector. However, for a negative slope (this is indicated by a negative value in the “Control” area of the “Needle Adjustment” window) the algorithm does not work properly. In this case, a manual change of the sign (default is ‘ – ‘) is required; you can determine the sign by means of the “Polarity” control of the “Needle Adjustment” window. Note that after a change of the sign, a new “single sweep” operation must be initiated.
- *Working around noisy signals when utilising bad sensors and/or small excitation amplitudes* — If the Needle sensor produces only a weak signal (e.g. due to a low Q-factor or an excitation amplitude being too low), the resonance curve of the sensor can appear to be very noisy. In such situations, a second “single sweep” operation (with

parameter *Phi-2* automatically adjusted to the correct value) or an increase of the excitation amplitude for the sweep can remedy the situation.

- *Needle sensor Auto-Approach restriction* — Auto-Approach operations are performed in closed loop state, the speed of the *Z*-ramp of the sensor depends on the actual loop gain and setpoint settings. The Auto-Approach mechanism will stop if the setpoint is reached, however, there is a 15 seconds time limit after each start of the *Z*-ramp during the approach. After this time has expired, a coarse step will be performed if no setpoint could be detected; this also happens if the scanner is not fully extended. If due to the settings of the regulator parameters the resulting speed of the *Z*-ramp causes the 15 seconds time-out period to become exceeded (and the scanner is not fully extended), a tip crash will very likely occur.
- *Wrong Units for "Dphi" in measurements* — The units given for *Dphi* values in the line displays and measurement data is currently Volts. Values can be converted to degrees by multiplying the voltage displayed by a factor of 10; the conversion is actually 0.1 Volt per degree.
- *Feedback loop gain control parameters behave different than their SCALA counterparts* — Since the distance regulation of the Needle sensor is performed fully digital, the values for I– and P-gain differ from the values SCALA users are used to. As a rule of thumb, the I-gain value has to be approximately half of the value one would have chosen in a SCALA environment; the P-gain value can be twice or three times the value SCALA users would have utilised.

4.7 Z-Axis Offset Impacts on Force-Distance Curve Acquisition

When utilising the new AFM force-distance curve acquisition mechanism (refer to section 5.2.6 for more information) Matrix users should be aware of a potential interference between the *Z*-axis offset and the force-distance data acquisition procedure. The *Z*-axis offset is usually controlled by means of the Experiment Element "ZControl" (Catalogue "SPMBasic") which is referenced by all Omicron-supplied experiments. This element allows specifying a *Z*-axis offset when the regulator feedback is disabled; enabling the feedback loop will cause the "ZControl" element to revoke the offset automatically.

The acquisition of force-distance curve data is a process that involves implicit manipulation of the regulator feedback loop state. As a result, any *Z*-axis offset that has been established will be revoked after a force-distance data acquisition procedure has finished successfully. Hence, initiating two subsequent force-distance data acquisition procedures may cause different results because a *Z*-axis offset could be active during the first procedure but is not during the second.

If *Z*-axis offsets should be maintained, the regulator feedback loop must be disabled manually after a force-distance data acquisition procedure has been finished, and the respective offset value has to be re-established by using the "ZControl" element.

4.8 Last Point on Force-Distance Curve can be Invalid

Due to a known problem, the last data point on a force-distance curve can be acquired at an invalid interval, i.e. an interval significantly shorter than the acquisition time chosen. As a result, the scanner will be retracted too early, causing the associated data point to become invalid. The actual interval used for acquisition is random.

Omicron will address this issue in a future release of the Matrix system.

4.9 Gap Voltage Range Changes in Dual Mode

The new Dual Mode functionality supports utilising different gap voltage pre-amplification ranges for the “forward” and “backward” sections of a line scan. (Note, however, that it is not recommended by Omicron to change the gap voltage range by means of the Dual Mode. See section 5.2.1 for details.) Due to a current Matrix software restriction, different gap voltage ranges during a line scan can impact on the system performance if all of the below conditions are met:

- The Dual Mode is enabled for the gap voltage range control of Experiment Element “GapVoltage”.
- Different gap voltage ranges have been set up for the forward and backward sections of a line scan.
- A *V*-spectroscopy experiment is run in any mode.

The symptom of the problem is that the performance of the system decreases dramatically. Hence, Omicron strongly recommends not to change the gap voltage range in Dual Mode in case *V*-spectroscopy experiments are run.

If the gap voltage range is changed manually during ongoing spectroscopy operations, the problem described above does not occur. However, in case the spectroscopy curves are acquired in both scan directions, i.e. during “forward” and “backward” scanner movement, users might encounter a restriction regarding the data analysis: The SPIP data analysis software will treat the spectroscopy ramps used during the “forward” and “backward” sections of the scan as being identical, although they could be actually different. In other words, the abscissa of a spectroscopy diagram associated with the “forward” section will be identical to its “backward” section counterpart, although this is incorrect.

Omicron will re-visit these issues in a future version of the Matrix system.

4.10 Invalid Gap Voltage Ranges During Spectroscopy Operations in Dual Mode

As stated in section 5.2.1, the Dual Mode is not yet available for spectroscopy operations. This restriction imposes a potential problem when the gap voltage pre-amplification range differs between the “forward” and “backward” sections of a line scan, as the different ranges will not be considered when a *V*-spectroscopy operation is initiated. As a result, the voltage ramp used for the spectroscopy operation can consist of values being either ten times higher or ten times lower than expected, depending on the preamplifier range.

The problem can only manifest itself if different gap voltage ranges are utilised in Dual Mode; Omicron will address this issue in a future version of the Matrix software.

4.11 Cantilever Calibration Caveat

Starting with Matrix version T1.0–7, the AFM sensor alignment mechanism supports a means to specify calibration parameters for the lateral and normal force parameters (F_n and F_l) so that cantilever characteristics can be taken into account during the measurement processes (see section 5.2.50 also). However, when adjusting the calibration parameters, users should be aware that changing the calibration also impacts on the regulator setpoint in AFM contact-mode. Depending on the calibration parameters chosen, an abrupt change of the setpoint can occur, which in turn can result in sensor damage. Omicron therefore recommends to retract the tip before actually changing the cantilever calibration parameters.

5
General User Release Notes

This chapter provides information about new features and software modifications, existing problems and their impact on system operation, and problem corrections. The release notes in this chapter are of interest to all users of the Matrix system.

5.1 Instrument Release Notes

The release notes in this section pertain to the microscopy instrument and electronics support provided by Matrix version T1.0–7.

5.1.1 Supported Environments

Matrix version T1.0–7 has been qualified for use with the Omicron SPM instruments and stages listed in Table 5-1.

Table 5-1 Instrument Compliance Matrix

	Preamplifier			Scanner	
	SPM PRE 4	SPM PRE	VT PRE	n-type	p-type
LT STM	✕	✕		✕	
VT AFM	✕		✕	✕	
VT STM	✕		✕	✕	
LS AFM	✕	✕	✕	✕	
LS STM	✕	✕	✕	✕	
UHV AFM/STM		✕		✕	
STM 1 (TS1 / TS2)		✕		✕	✕
MULTISCAN STM	✕			✕	
Cryogenic STM	✕	✕		✕	
NANOPROBE	✕			✕	

Please note that support for the Omicron NANOPROBE instrument hardware (initially introduced in the hardware support release T1.0–6NP1 of the Matrix software) has been included in version T1.0–7. The respective parameter sets are "*NANOPROBE Standard*" and "*NANOPROBE Stack Piezo*".

Matrix version T1.0–7 supports STM, AFM contact, and AFM non-contact measurement experiments; the AFM non-contact mode can be used with cantilever/beam deflection sensors, the Omicron Needle sensor option (see section 5.2.4 for details), and the QPlus experimental sensor implementation by Omicron.

Standard calibration data sets for the SPM instruments and methods mentioned above are shipped as part of the Matrix installation kit. Note that Omicron will extend the range of supported instruments continuously in forthcoming releases of the Matrix system.

5.1.2 SPM PRE 4 Preamplifier Gap Voltage Sign – Problem Corrected

In all previous releases of the Matrix software, the calibration data sets for instruments intended to be used with the SPM PRE 4 preamplifier established an invalid gap voltage conversion. As a result, wrong potential differences have been established.

The calibration data sets shipped as part of the version T1.0–7 Matrix kit solve this problem.

5.1.3 VT PRE Preamplifier Support not Functional – Problem Corrected

A last-minute bug in Matrix version T1.0–6 restricted the parameter space for the linear transfer function parameter “neutral factor” to positive values. As a result, the VT PRE preamplifier support ceased to function; hence, selecting any parameter set from the calibration data set “*STM for VT PRE*”, “*STM/AFM for VT PRE*”, “*AFM KelvinProbe for VT PRE*”, or “*STM/AFM NonContact for VT PRE*” caused an abrupt software termination.

This bug has been fixed.

5.1.4 Invalid Tunnelling Current Range Handling – Problem Corrected

Previously, the tunnelling current range calibration data was incorrect for the following calibration data sets:

- *STM for VT PRE*
- *STM/AFM Contact for VT PRE*
- *STM/AFM NonContact for VT PRE*
- *AFM KelvinProbe for VT PRE*
- *STM for SPM PRE*
- *STM/AFM Contact for SPM PRE*
- *STM/AFM NonContact for SPM PRE*
- *AFM KelvinProbe for SPM PRE*

The symptom was that an invalid range for the tunnelling current regulator feedback loop setpoint was displayed (0 to 495 pA instead of 0 to 4.95 nA). In addition, the actual setpoint applied was increased by a factor of 10 compared to the value one had selected.

This problem has been corrected.

5.1.5 Support for LS STM Instrument Completed

Previously, the LS STM instrument hardware was supported for AFM needle sensor non-contact experiments only in case the SPM PRE 4 or VT PRE preamplifiers were utilised. Matrix version T1.0–7 extends the AFM support to the older SPM PRE preamplifier, i.e. the calibration data sets “*AFM KelvinProbe for SPM PRE*”, or “*STM/AFM NonContact for SPM PRE*”.

5.2 Experiment Release Notes

The subsequent release notes provide information related to the supported STM and AFM experiments.

5.2.1 Introduction of Dual Mode Support

Starting with Matrix version T1.0–7, certain parameters of an experiment can vary with the scan direction; this functionality is traditionally referred to as *Dual Mode*. In Dual Mode, certain Experiment Elements will apply a particular set of parameter values while the scanner is moving “forward”, and a different set while moving “backward”. However, as most Experiment Elements are not aware of scan directions, the respective parameter sets are called “*Standard*” and “*Alternate*”.

“Standard” parameter values will be used during the “forward” section of a line scan, and if the scanner has been configured for unidirectional scans†. In contrast, “alternate” parameter values will be used during the “backward” section of a line scan. Table 5-1 lists the parameters and Experiment Elements being Dual Mode-enabled in version T1.0–7 of the Matrix software.

Table 5-1 Dual Mode-capable Parameters

Parameter	“Backward” Section Counterpart	Experiment Elements
`Feedback_Set`	`Feedback_Set_Alternate`	Regulator (SPMBasic)
`Loop_Gain`	`Loop_Gain_Alternate`	Regulator (SPMBasic, AFMHybrid)
`Feedback_Set_Contact`	`Feedback_Set_Contact_Alternate`	Regulator (AFMHybrid)
`Feedback_Set_NonContact`	`Feedback_Set_NonContact_Alternate`	Regulator (AFMHybrid)
`Feedback_Set_qPlus`	`Feedback_Set_qPlus_Alternate`	Regulator (AFMHybrid)
`Feedback_Set_Needle`	`Feedback_Set_Needle_Alternate`	NeedleRegulator (AFMHybrid)
`Loop_Gain_I`	`Loop_Gain_I_Alternate`	NeedleRegulator (AFMHybrid)
`Loop_Gain_P`	`Loop_Gain_P_Alternate`	NeedleRegulator (AFMHybrid)
`Set_Vgap`	`Set_Vgap_Alternate`	GapVoltage (STM)
`Preamp_Gain_x10`	`Preamp_Gain_x10_Alternate`	GapVoltage (STM)

Caution

Modifying the preamplifier gap voltage range (represented by parameter `Preamp_Gain_x10`) requires a relay switch operation. Using different ranges in Dual Mode can thus result in an excessive amount of relay state switching during scanning, and is thus not recommended. Note that there is also a performance issue affecting *V*-spectroscopy experiments; see section 4.9 for more information.

All Dual Mode-capable Experiment Elements provide dedicated graphical user interface controls for specifying the “standard” as well as the “alternate” parameter value. For this purpose, the affected parameter controls now offer “mode switch” buttons supporting to toggle between the “standard” and the “alternate” parameter setting.

Note that you can enable or disable the Dual Mode support separately for each parameter; right-clicking the “mode switch” controls of a Dual Mode-capable parameter will display a context menu offering a single entry “Dual Mode”. Using this entry, one can enable or disable the “alternate” value support for the respective parameter. If Dual Mode support has been disabled for a particular parameter, the value specified for the “standard” setting will be used, regardless of the scan direction.

The Experiment Element “XYScanner” supports Dual Mode operations by two new parameters; these parameters can be utilised to specify dedicated delays the scanner should utilise when the beginning and end of a scan line is reached. (See section 5.2.2 also.)

† Unidirectional scanning (“forward only”, “up only”) will be supported by one of the next releases of the Matrix software.

Note

The Dual Mode support is currently not available for the Experiment Element "Spectroscopy" of Catalogue "SPMBasic". As a result, the spectroscopy parameters (e.g. spectroscopy ramp start value, end value, raster time, etc.) cannot be set differently for the "forward" and "backward" scan directions.

To change the value of a Dual Mode-capable parameter directly during a progressing scan, you can change both the "standard" or the "alternate" setting of the respective parameter to the desired value. This value will then take effect immediately, however, with no respect to the current scan direction. As of version T1.0–7 of the Matrix system, it is not possible to direct the software to change a value immediately only if the scanner is currently moving in a specific direction.

The scan constraint "Point" (causing the scanner to keep the probe at the scan origin point while sampling) does currently *not* support Dual Mode parameter sets. As a result, the "standard" settings will be used during "Point"-mode scan operations.

5.2.2 Delaying Scan Direction Reversal – Changes

During spatial scan operations, the move direction of the probe will be reversed at the end of each scan line, and after the region of interest has been scanned completely. When in "forward/backward" scan mode, the *X*-axis scan direction will thus be reversed immediately when the last raster point of the "forward" and "backward" scan sections has been reached. In version T1.0–6 of the Matrix system, a new scanner parameter `Reversal_Delay` was introduced; this parameter could be used for specifying a delay time being applied each time the scanner reverses the move direction of a spatial scan axis.

Version T1.0–7 of the Matrix software replaces parameter `Reversal_Delay` by the new parameters `Forward_Delay` and `Backward_Delay`. Also, these parameters can now be changed by means of the graphical user interface of Experiment Elements of type "XYScanner"; for this purpose, a new panel "LineDelay" has been added to the set of panels supported by these elements.

5.2.3 Introduction of Automatic Drift Compensation

Version T1.0–7 of the Matrix software introduces a drift compensation facility supporting the compensation of thermal drift effects by applying a linear correction vector to the scan movement. The drift compensation support can be configured by either entering drift compensation vector information numerically, or graphically.

The convenient way of setting up a drift compensation vector is marking a surface feature rendered by an image-mode display in succeeding scan cycles, using the mouse. A new mouse tool supports this method of determining the actual drift characteristics. Alternatively, users can also enter the drift compensation vector in a numerical way by means of a dedicated user interface panel.

The Matrix version T1.0–7 implementation of the drift compensation facility lacks dedicated support for visualising the progress of the compensation process. Thus, users can currently not determine where the effective scan area resides with respect to the maximum positioning area. Hence, trying to apply an offset vector to the scan area or rotating the scan area could result in an overflow condition in case the drift compensation facility has already moved the scan area close to the maximum positioning area boundaries. Although the software will ensure that attempts to move or rotate the scan area will not cause negative effects in such a scenario, it is felt that dedicated user feedback is required. Omicron will thus lift this restriction in a future version of the Matrix system.

Enabling the drift compensation facility results in continuous shifting of the configured scan area. If this process causes the scan area to move close to the boundaries of the maximum scan area, the Matrix software will disable the drift compensation facility automatically and issue a warning message.

For utilising the graphical drift compensation vector determination in a specific display, the new Controller `XYScanner_Drift` must be configured for the View entity that is attached to that display. For the pre-defined experiments shipped as part of the Matrix kit, the respective controllers have already been configured. The drift compensation control panel “DriftCompensation” is part of the Experiment Element “XYScanner” (Catalogues “AFMHybrid” and “SPMBasic”).

5.2.4 AFM Non-Contact Needle Sensor Experiment Added

Version T1.0–7 of the Matrix system adds support for the Omicron Needle sensor STM/AFM option. The implementation comprises the following entities:

- Two new Experiment Elements (“NeedleAdjust” and “NeedleRegulator”, both from Catalogue “AFMHybrid”) that utilise the Omicron Oscillator Phase Detector (OPD) electronics for interfacing with the Needle sensor equipment.
- A set of equipment descriptions and calibration information for the Needle-enabled Omicron instruments VT STM and LS STM.
- A new imaging experiment “AFM_Needle_Basic” (currently being part of the Project “AFM_NonContact”).

In contrast to other AFM-mode experiments, the Needle sensor experiment support does neither require an AFM-CU nor an U-SCB, however, the basic implementation does not support additional channels for data acquisition. If you need to utilise additional channels (e.g. for measuring the tunnelling current, or for acquiring data from external signal sources), please contact Omicron for information on upgrade packages.

Note that for using Needle sensor equipment in AFM mode an additional Oscillator Phase Detector board (OPD) revision V4/N_6 and dedicated cabling is required.

See section 4.6 for application notes pertaining to Needle sensor operation.

Please note also that parts of this solution were previously made available via remedial kit MTRX687_v054501, however, the kit did not provide all required sanity checks. In particular, changing the excitation frequency or amplitude, or initiating a “single sweep” operation, while the Needle sensor was in feedback with a sample (or a scan was in progress) could have resulted in a tip crash. The Needle sensor implementation of Matrix version T1.0–7 has been enhanced to perform dedicated checks, thus avoiding potential tip crash scenarios.

5.2.5 AFM Non-Contact “Auto Δ f → 0” Functionality now Supported

When running AFM non-contact experiments utilising cantilever-based sensors, the required adjustment procedures include the determination of the reference frequency (*f-ref*) in a way the Δ f signal turns to zero. With previous releases of the Matrix software, this adjustment procedure had to be carried out manually. Matrix version T1.0–7 adds support for a dedicated “Auto Δ f → 0” functionality that automatically adjusts the reference frequency to yield Δ f = zero.

You can initiate the adjustment process by clicking the “Auto: df -> 0” button on panel “DeltaF” of Experiment Element “NonContactAdjust” (Catalogue “AFMHybrid”).

The detection algorithm has a maximum sensitivity of less than 1 Hz; note that up to 50 seconds can be required for determining the reference frequency.

5.2.6 Introduction of AFM Force-Distance Curve Support

Matrix version T1.0–7 introduces force-distance curve measurement support to the set of AFM-mode functionality. Thus, users can now determine the behaviour of the interaction force between the tip and the surface with varying distance. Measuring a force-distance curve before actually starting an AFM contact-mode experiment can also be helpful for determining the cantilever characteristics and for discovering the region of reliable force setpoints.

Specifically, the force-distance curve support comprises:

- A new Experiment Element “ForceDistance” that has been added to Catalogue “AFMHybrid”
- An extension of the Experiment Element “Channel” (Catalogue “SPMBasic”)
- Some additions to the experiment *AFM_Contact_Basic*
- Enhancements to the ImageMetrology SPIP package

The new Experiment Element “ForceDistance” controls the set-up and execution of a force-distance curve measurement operation and offers a panel for setting the minimum and maximum *Z*-distance, the number of *Z*-steps, and other parameters. The AFM contact-mode imaging experiment description provides an additional window containing the control panel of the Experiment Element “ForceDistance”, a line-mode data display for visualising the acquired curve, and the oversampling/filter controls of the force-distance channel.

Note that the minimum SPIP software version required for analysing force-distance curve data generated by Matrix is 4.1.5; the Matrix version T1.0–7 kit ships SPIP 4.2.3 which also includes support for analysing force-distance curve data generated by Matrix.

See sections 4.7 and 4.8 for information on potential restrictions when acquiring force-distance curve data, and the “Matrix Application Manual” for more information on force-distance measurement operations in general.

Please note also that parts of this functionality were previously made available via remedial kit MTRX113_v054801 (Matrix version T1.0–6U2), however, the Matrix version T1.0–7 software provides several improvements over the remedial kit solution:

- Version T1.0–6U2 of Matrix did not provide all required sanity checks. In particular, initiating a force-distance curve acquisition operation while a scan was in progress, or starting a scanning experiment while a force-distance measurement was still active could have resulted in a software failure. The force-distance curve acquisition mechanisms of Matrix version T1.0–7 have been enhanced to perform dedicated checks, thus avoiding potential failures.

- Setting the number of data points to be acquired to a value larger than 2047 would have caused the Experiment Element “ForceCurve” to hang. The Matrix software had to be exited, and the Matrix CU had to be re-booted in this scenario. Matrix version T1.0–7 limits the number of data points that users can enter to the supported maximum of 2047 now.

- When loading force-distance curve data generated by Matrix version T1.0–6U2 into the SPIP software analysis package, the forward and backward sections of the curve were displayed in separate windows. In addition, the force-distance curve data analysis features of SPIP were not available. Matrix version T1.0–7 now adds dedicated information to result files allowing SPIP to recognise force-distance data properly.

- The *Y*-axis of the “ForceCurve” display was always labelled “Data Unit 0” instead of “Fn”. In addition, no valid unit information was displayed for the *Y*-axis.

- Users could have set the parameter “Delay Time” for specifying the initial delay being applied before a force curve data item is acquired to be identical to the acquisition time (determined by parameter “Time”.) However, choosing these values to be identical causes the sample rate to drop down to 1, which in turn can cause Matrix to fail to acquire a force-distance curve at all. Version T1.0–7 of the Matrix system now limits the minimum raster time to 20 microseconds, and the maximum initial delay time to 90% of the raster time, which circumvents this problem.

5.2.7 Force-Distance Curve Acquisition not Supported in Spectroscopy Experiments – Known Restriction

Currently, the AFM $F_n(Z)$ contact-mode spectroscopy experiment does not support the acquisition of force-distance curves due to a known restriction. Omicron will address this issue in one of the next Matrix software releases.

5.2.8 AFM Adjustment and Measurement Operations no Longer Mutually Exclusive

The Matrix AFM cantilever/beam deflection experiments support mechanisms for adjusting the laser device (contact and non-contact modes) and the excitation mechanism (non-contact mode). However, in previous versions of the Matrix software, one had to disable all adjustment features by setting the respective control buttons to their “off” state before starting an experiment. If both the experiment and the adjustment options were active, confusing data would have been displayed by the active line profile and image displays.

This issue has been resolved, the adjustment mechanisms can remain active without restrictions now.

Note that due to the above modification the adjustment state controls (“On” buttons) have eventually become obsolete and were thus removed from the respective adjustment panels. However, it is still possible to gain access to the state control buttons as these have been placed on separate panels now; the name of the respective panels is “OnOff”.

5.2.9 Introduction of Feedback Loop Control Support for Spectroscopy Experiments

Matrix version T1.0–7 adds support for controlling the state of the feedback loop during spectroscopy operations. While in previous versions of the Matrix software the feedback loop was always disabled before starting a spectroscopy operation and re-enabled after the operation had finished, you can now also choose to keep the feedback loop enabled during the spectroscopy operation.

The actual behaviour of an experiment is controlled by the new Boolean-type parameter `Feedback_Loop_Enabled` of Experiment Element “Spectroscopy” (Catalogue “SPMBasic”). Setting this parameter to “true” will keep the feedback loop enabled during spectroscopy operations; the default value is “false”. The state of this parameter can also be controlled by means of the graphical user interface.

5.2.10 Raster Spectroscopy Operations can be Bound to Scan Direction

With the advent of Matrix version T1.0–7, raster spectroscopy operations can be restricted with respect to the scan direction. The Experiment Element “Spectroscopy” now allows configuring spectroscopy operations for only the “forward”, the “backward”, or both scan directions. Thus, users can now enable or disable spectroscopy operations for a particular scan direction.

5.2.11 Z-Axis Offset for V-Spectroscopy Operations

The Experiment Element “Spectroscopy” has been enhanced to support a fixed *Z*-axis offset for *V*-spectroscopy operations with disabled feedback loop. The respective numerical value entry field is not available for *Z*-spectroscopy operations. The *Z*-axis offset entered will be established between the delays *T1* and *T2*, after disabling the regulator feedback loop.

5.2.12 New Parameter Correction Mode

The spectroscopy parameter correction facility of the Matrix software enforces equidistant steps between the gap voltage (*V*) or the sample-tip distance (*Z*) values utilised during a spectroscopy operation. Also, the facility ensures that the number of data points chosen can actually be mapped onto the range between the start and end values of the spectroscopy ramp. The correction algorithms will modify the start or end value of the ramp if the number of data points chosen prevent an equidistant distribution, or the absolute number of data points is too large. As a result, users who want to maximise the number of data points while keeping the start and end values of the spectroscopy ramp unchanged have found it difficult to prevent the correction facility from modifying the start or end values while trying to determine a suitable number of data points.

Matrix version T1.0–7 adds support for a variation of the correction strategies that will keep the start and end values entered, and maximise the number of data points in case the number entered is actually too large. Thus, in order to map the largest possible number of data points to a given spectroscopy ramp, users can now enter the start and end values of the spectroscopy ramp, and set the number of data points to the maximum (currently 2047) afterwards. This will cause the new strategy to maximise the number of data points instead of correcting the spectroscopy ramp limits.

To enable the variation (and to disable the default behaviour, which is modification of the ramp limits in case the number of data points exceeds the allowed range), the parameter `Autocorrect_Axis_Points` of the Experiment Element “Spectroscopy” (Catalogue “SPMBasic”) must be set to “true”. To set the parameter, locate the spectroscopy element parameter description file of the respective experiment and edit the parameter description.

For example, for experiment “STM_Spectroscopy”, the respective parameter description file is “STM_Spec_Spectroscopy.expp” in folder “Experiments” of the Matrix file tree. This file contains the following declaration:

```
<Parameter name="Autocorrect_Axis_Points" monitored="false">
  <Boolean> false </Boolean>
</Parameter>
```

Change the parameter value from “false” to “true” in order to enable the new parameter correction mode.

Note

You must exit and restart the Matrix software for the change to take effect.

5.2.13 Long Spectroscopy Raster Times Cause Regulator Failures – Problem Corrected

In previous versions of the Matrix system, configuring spectroscopy axis raster times larger than 1 second could cause a regulator failure when stopping an experiment. As a result, spectroscopy experiments utilising long raster times could have resulted in a tip crash when getting stopped. This problem was caused by a deficiency that prevented the regulator feedback loop from getting enabled after an ongoing spectroscopy operation was terminated by the experiment stop incident.

The problem has been corrected.

5.2.14 Stopping Spectroscopy Operations Left Parameters in Unpredictable State – Problem Corrected

Previously, when stopping a spectroscopy experiment, the slew rate limitation of the spectroscopy parameter and also the parameter value were occasionally not set correctly. As a result, the *Z*-axis or V_{gap} parameter values could be incorrect after the experiment completed the stop operation; in addition, the slew rate limitation of these parameters could erroneously be still active.

This problem has been corrected.

5.2.15 System Hangs on Experiment Stop – Problem Corrected

Under rare circumstances, previous releases of the Matrix software could hang after a running experiment was directed to stop. The symptom was that after pressing the "Stop" experiment state control button, the software appeared to be "frozen" (often without being able to refresh its window contents, resulting in an all-white Project window interior). In such situations, the Matrix software had to be terminated by means of the Windows XP task management facilities, and the Matrix CU had to be rebooted.

This problem has been corrected.

5.2.16 Scan Bias Exceeding Supported Range – Known Problem

The scan bias generated by the Raster Scan Generation Board (RSGB) can exceed the range supported by the piezo driver hardware (PDC6) by ±4.7 V in scenarios similar to the following:

- A large offset (e.g. *X* = –4000 nm, *Y* = –4000 nm) has been applied to a small scan area.
- The scan area is enlarged significantly (e.g. to 2000 x 2000 nm), and the offset is reduced.

In such a case, the probe relocation operation can cause the scan bias to reach ±14 V, thus exceeding the maximum PDC6 input voltage of ±9.3 V.

Omicron will modify the scan generation algorithms to prevent such situations in a future release of the Matrix software.

5.2.17 Pausing Single Point Spectroscopy Operations – Problem Corrected

Pressing the "Pause" experiment state control button during an ongoing single point spectroscopy operation could previously result in incorrect experiment behaviour. Although the experiment state changed from "Running" to "Paused", the experiment continued scanning.

This problem has been corrected.

5.2.18 Slew Rate Limitation can be Disabled During Spectroscopy Operations

To avoid overshooting effects, the start and end values of a spectroscopy ramp are approached at a specific slew rate you can determine via the "Extra Settings" panel of the Experiment Element "Spectroscopy". For certain experiments, however, the additional delay caused by the slew rate might not be acceptable.

Starting with Matrix version T1.0–7 users can now disable the slew rate limitation completely; the start and end values of the spectroscopy ramp will then be approached at the maximum speed the affected electronics supports.

5.2.19 Invalid Slew Rate Handling – Problem Corrected

Under certain circumstances, including small slew rates (such as 0.03 V/s) were chosen for establishing the start and end values of a spectroscopy operation, the actual ramp used for approaching these values was significantly less steep than specified by the slew rate parameter.

This problem has been corrected.

5.2.20 Slew Rate Limitation Erroneously Enabled – Problem Corrected

Previously, the Matrix software erroneously enabled the slew rate limitation for gap voltage changes in spectroscopy experiments not only during an ongoing spectroscopy operation, but also for spatial scanning (including scan processes in spectroscopy modes “Single Point” and “Off”.) As a result, changing the gap voltage manually has caused the software to approach the new voltage value by utilising a ramp function instead of establishing this value immediately. Also, pressing the gap voltage sign toggle control button would often result in a tip crash, as this operation was also performed with slew rate limitation enabled. Finally, using the sign toggle control button could result in a situation where the sign of the gap voltage was not returned to its original state after releasing the toggle button.

Matrix version T1.0–7 corrects the problems described above.

5.2.21 Signal Controls Added to Experiments

A set of GUI elements for controlling the input signals V_{Mod}, V_{Ext}, and Z_{Ext} has been added to all experiments supported by Matrix version T1.0–7. By utilising these elements, users can enable or disable the V_{Mod} and V_{Ext}, input signals, and control the low-pass filter settings for the Z_{Ext} input signal.

The control elements can be found in the new window “External Inputs”.

5.2.22 Certain Parameter Ranges not Updated After Calibration Change – Restriction Lifted

The gap voltage and tunnelling current setpoint parameters (supported by the Experiment Elements “GapVoltage” of Catalogue “STM”, and “Regulator” of Catalogue “SPMBasic”, respectively) are both associated with a preamplification range selector. Starting with version T1.0–5 of the Matrix software, the actual gap voltage and tunnelling current ranges established by the two different selector states have been displayed by the selector control, however, when changing the calibration data set to a different preamplifier, the ranges displayed were not updated although affected by the change.

Version T1.0–7 of the Matrix system lifts this restriction, the parameter range displays will be updated correctly now.

5.2.23 Software Failure after Preamplifier Range Change – Problem Corrected

After loading and starting an STM spectroscopy experiment in single point-mode, changing the preamplifier tunnelling current range has resulted in an ‘Access violation’ condition so far. After confirming the respective message dialogue, the Matrix software was slowed down significantly; stopping the affected experiment often resulted in a system hang in this scenario.

The above problem has been corrected.

5.2.24 Software Failure after Calibration Data Change – Problem Corrected

In previous versions of the Matrix software, changing the calibration data set by means of the “Experiment Options” dialogue could have resulted in an abrupt software termination if the respective experiment was at least started once before the attempted calibration change. If the experiment was not started, the calibration change was applied correctly.

This problem has been corrected.

5.2.25 Decreasing Raster Time Online Impacts on Channel Oversampling – Problem Corrected

Previously, when channel oversampling was enabled (see section 4.1 for more information on oversampling support) decreasing the raster time utilised by the scanner during an executing experiment could cause the scan process and the data acquisition process to fall out of synch. As a result, the images produced by the system appeared distorted after decreasing the raster time. The phenomenon disappeared when increasing the raster time slightly immediately after decreasing it.

This problem has been corrected.

5.2.26 Spectroscopy Mode Stored Permanently now

In previous versions, the spectroscopy experiment descriptions shipped as part of the Matrix kit did not include the parameter `Location_Mode` of Experiment Element “Spectroscopy” (Catalogue “SPMBasic”) in their active parameter groups. As a result, the spectroscopy mode (raster-oriented spectroscopy operations, “Single Point” spectroscopy operations, or spectroscopy operations disabled) was not stored when saving the status of an experiment to disk.

The Matrix version T1.0–7 experiment descriptions solve this issue, the spectroscopy mode chosen will be saved correctly now. In addition, the default spectroscopy mode used will now be “Off” (spectroscopy operations disabled), instead of “Raster” (raster-oriented spectroscopy operations).

5.2.27 Single Point Spectroscopy and Raster Time Modification Interference Issues – Problem Corrected

Previously, when running a spectroscopy experiment in mode “Single Point”, any modification of the scanner raster time (in either state of the experiment) could have caused a significant delay in spectra delivery. For example, after modifying the raster time, and depending on the spectroscopy settings, it could require up to 15 single point spectroscopy operations until the first spectrum was actually displayed by the software. Note that the spectroscopy operations, however, were correctly executed.

This problem has been corrected.

5.2.28 Default State of Regulator Feedback Loop Changed

The default state of the regulator feedback loop (Experiment Element “Regulator”) has been changed from “disabled” to “enabled” in version T1.0–7 of the Matrix software.

5.2.29 Single-Point Spectroscopy now Enabled for “Backward” Displays

Previously, the Matrix software did not support initiating single point spectroscopy operations in “backward”-image displays. (From the technical perspective, controllers of type `XYScanner_SPS` could not be configured for data Views of type `2DforwardBackward` if these were set to direction “backward”.)

Matrix version T1.0–7 lifts this restriction, the respective controllers can now be associated also with “backward”-image displays. Note that the spectroscopy experiment descriptions shipped as part of the Matrix version T1.0–7 kit have been modified to include single point spectroscopy controllers with all displays.

5.2.30 Introduction of Experiment-Specific Auto-Approach Delay Times

During an Auto-Approach operation, the Matrix system will adjust the probe/sample distance by a number of consecutive “coarse steps”. Between each of these steps, the system will attempt to detect a suitable working point automatically; if a working point has been determined, the Auto-Approach operation is complete. The maximum time allowed for detecting a working point is actually determined by the delay time between two coarse steps. If this delay time is exceeded, the Matrix system will first cancel the detection procedure, perform a coarse step, and then restart the working point detection mechanism.

Previous releases of the Matrix system did support a fixed maximum delay time between two coarse steps only, however, the maximum time that must be allowed for detecting a suitable working point is actually sensor-specific. To circumvent the problem, previous versions of the Matrix software have used delay times suitable for sensors that require long working point detection periods. Hence, the coarse positioning subsystem remained active for too long when utilising sensors that require relatively short working point detection times (as it is true for STM and AFM cantilever sensors.) As the activated coarse positioning subsystem can impact on the quality of data acquisition under certain circumstances, version T1.0–7 of the Matrix system introduces a mechanism for specifying the maximum delay time with respect to the experiment being used.

The Experiment Elements “Regulator” and “NeedleRegulator” from Catalogue “AFMHybrid” support a new parameter, `Auto_Approach_Delay`, that can be used to adjust the maximum Auto-Approach delay time. The parameter is of type “double-precision floating point” and expects the delay time in seconds. Note that the Needle sensor and the preliminary QPlus experiments utilise the `Auto_Approach_Delay` parameter to configure the specific delay times required by these sensors. For the STM and AFM cantilever/beam deflection experiments, the maximum delay time has been decreased to approx. 6 seconds, which is also the time utilised up to version T1.0–FT3 of the Matrix software.

5.2.31 Maximum Number of Raster Scan Points Temporarily Reduced

T1.0–6 Setting the maximum number of raster scan points per line to the maximum value of 2048, or setting the maximum number of scan lines to the maximum value of 2048, currently causes a problem with the scan clock generation. As a workaround, Omicron has temporarily limited the maximum number of raster points per line, and the maximum number of scan lines, to 2047.

The underlying problem will be addressed in a future version of the Matrix system.

5.2.32 Switching Between Experiments – Known Problem

After unloading an experiment, a Matrix CU can currently fail to operate correctly if another experiment gets uploaded. Symptoms vary, but the experiment usually expose invalid behaviour when started, stops to function after a short time, or does not load at all.

This problem is caused by a known re-initialisation failure and will be addressed in a future version of the Matrix system. The only workaround currently known is to exit the Matrix software, power cycle the Matrix CU, and to restart the Matrix software afterwards.

5.2.33 Memory Requirements for Raster Spectroscopy Operations – Restriction Enforced

Depending on the parameters chosen, raster spectroscopy experiments require a considerable amount of memory. In fact, it is possible to exceed the memory resources of the computer system by far in certain scenarios.

The Matrix software will allocate memory for the spectroscopy operations configured for exactly one scan cycle. For example, if you have set up a scan grid of 500 x 500 points, the number of data elements resulting from the spatial forward/backward up/down scan is actually 1,000,000 (500 + 500 = 1000 data elements for each scan line). If you would run a spectroscopy axis of 1000 raster points on every node of the scan grid, the resulting number of data elements would be actually 1000 x 1,000,000 = 1,000,000,000 (one billion) elements, yielding memory requirements of several gigabytes, and thus exceeding the addressable memory of the computer system considerably.

Previous releases of the Matrix software terminated abruptly during the start-up process of a spectroscopy experiment if the memory resources of the computer system were depleted due to invalid spectroscopy parameter settings. Starting with version T1.0–7, the Experiment Element “Spectroscopy” (Catalogue “SPMBasic”) will check all relevant parameters in order to prevent situations where the memory resources become exhausted. If the element detects a critical parameter value constellation it will first reduce the number of spectroscopy points per operation. If, however, the spectroscopy point count drops below 5 points, the element will also enlarge the spectroscopy raster, thus reducing the number of spectroscopy operations per scan line.

Note

As the memory required for data acquisition operations will initially be allocated during the start-up phase of an experiment, you will notice a significantly longer time before an experiment changes to state “Running” from state “Stopped” if the spectroscopy experiment parameters result in utilisation of large data buffers. This delay is actually caused by the operating system and cannot be circumvented.

In general, utilising large numbers of scan points and/or lines will cause Matrix to allocate considerable amounts of memory. For example, a 1000 points x 1000 lines scan (without spectroscopy operations) will consume approximately 65 Mbytes RAM in case four data channels are in use. As a result, the time required by an experiment to change from state “Stopped” to state “Running” also depends on the number of scan points and lines, as the Windows XP operating system requires more time to allocate larger amounts of memory. In extreme situations, it can take several minutes to launch an experiment run; this can happen if the operating system is forced to swap out memory contents to the system disk. If you frequently utilise large numbers of scan points and lines, Omicron recommends to extend the memory of your Matrix PC to 2 Gbytes.

5.2.34 Regulator Low-Pass Filter Setting “Ground” has been Removed

Several experiments offer access to low-pass filters supported in certain signal paths, e.g. the tunnelling current I_{Treg} signal path, or the gap voltage output signal path. In previous releases of the Matrix software, some of the low-pass filter controls (e.g. the control for the I_{Treg} signal low-pass filter) offered a special setting “Ground” besides various filter frequencies. However, if the “Ground” setting for regulator low-pass filters are activated with feedback loop turned on, this immediately caused a tip crash. As the “Ground” setting could have easily been selected accidentally when another filter frequency was actually intended to be chosen, it has been removed.

5.2.35 Increased Performance when Changing Regulator Parameters

In previous versions of the Matrix system, changing the regulator parameters feedback loop gain and feedback setpoint required several seconds to complete due to some internal restrictions. These restrictions have been lifted now, users will thus notice a significant increase in performance when modifying loop gain or setpoint values.

5.2.36 Increased Performance when Changing Scan Zoom Factor and Rotation Angle

The Matrix system will respond to modifications of the scanner parameters “Zoom” and “Angle” significantly faster than in previous versions.

5.2.37 Modifying Scan Area Offset while Scanning – Problem Corrected

Due to a current restriction, the Matrix software must limit the maximum scan area offset in *X*- and *Y*-direction that can be applied while a scanning experiment is executing. However, this limit was not properly guarded in previous releases of the Matrix software. Thus, trying to move the scan area by an amount exceeding the limit could result in a system hang or a significant decrease in response time.

This problem has been corrected.

5.2.38 Data Loss on Raster Time Change – Problems Corrected

In previous versions of the Matrix software, modifying the scanner raster time while a scanning experiment was progressing could have resulted in a temporary loss of data. The amount of data items lost was usually quite small (most often, only a fraction of one scan line could not be acquired correctly), moreover, the online data display facilities corrected the problem automatically in most cases. As a result, data loss incidents were probably not noted by users. However, in contrast to the online data displays, the result data management mechanism failed to handle data loss incidents properly. Thus, when analysing acquired data by means of the SPIP package, users might have encountered corrupted images. (Most often, the images of an affected scan cycle appeared to be “shifted”; subsequent images, however, did not show such corruption then.)

Version T1.0-7 of the Matrix software corrects both problems: Modifying the scanner raster time during a progressing scan will not result in data loss incidents any longer; in addition, the result data management software is now capable of handling any potential data loss incident correctly.

Note that due to a current restriction, reducing the raster time to a value less than 10 microseconds will still cause data loss incidents. (See section 4.4 also.) In addition, data “dropouts” can currently also occur when certain parameters are changed while scanning fast (e.g. utilising a raster time of 12 microseconds). Omicron will address these issues in a future version of the Matrix system.

5.2.39 Raster Time Modification in State “Pause” Caused System Failure – Problem Corrected

In previous versions of the Matrix software, changing the raster time while an experiment was in state “Paused” caused a system failure. The symptom was that immediately after modifying the raster time the input field “Raster time” changed to a weird (sometimes even negative) value, and the system hang for several seconds. Although the software seemed to recover from this state it was actually unusable afterwards.

This problem has been corrected.

5.2.40 Decreased Accuracy of Spectroscopy Ramp Information – Problem Corrected

The Matrix software stores information about various characteristics of a spectroscopy ramp as part of a result file; this information will be used by data analysis software (i.e. the SPIP package) for determining certain properties of data displays, such as scales, labels, etc. However, in previous releases of the Matrix software, the information produced could become inaccurate under certain circumstances. As a result, the SPIP data analysis software would have rendered spectroscopy curve diagrams with a slightly incorrect end value for the abscissa.

This problem has been corrected.

5.2.41 Abrupt Software Termination When Toggling Spectroscopy Modes – Problems Corrected

The Matrix software terminated abruptly while a spectroscopy experiment was loaded when the spectroscopy mode was changed from “Raster” to “Single Point” under certain circumstances, including that the experiment was first unloaded and then reloaded. The same problem has occurred if the mode was toggled frequently and quickly.

The above problems have been corrected.

5.2.42 Spectroscopy Mode Change Failures – Problems Corrected

T1.0–6U1 In previous versions of the Matrix software, the system could have exposed invalid behaviour in the following scenarios:

- After opening one of the spectroscopy experiments, the default spectroscopy mode “Raster” was changed to either “Off” or “Single Point” *before* the respective experiment was uploaded to a Matrix CU.
- In spectroscopy mode “Off” or “Single Point”, the number of scan lines and/or scan points was changed, and the respective experiment was re-started afterwards.
- The parameter `Location_Mode` was added to the XML description of the active parameters of Experiment Element “Spectroscopy”.

Observed symptoms were complete experiment malfunction (no scan progress, no data acquisition, no spectroscopy operations), and spontaneous spectroscopy operations at arbitrary positions during scanning with spectroscopy mode set to either “Off” or “Single Point”.

The above problems have been corrected.

5.2.43 Spectroscopy Ramp Limit Auto-Correction – Problems Corrected

The Experiment Element “Spectroscopy” provides a correction facility for the start and end values of the spectroscopy ramp; this facility ensures that the ramp function can actually be configured as specified and the intervals between the ramp points are equidistant. However, in previous versions of the Matrix software, the correction facility could have modified the end value of the ramp immediately after the user had entered a new value. As a result, the spin buttons for increasing and decreasing the end value could have appeared to be non-functional. In addition, the facility could have produced incorrect limit modifications if the spectroscopy experiment varied the sample-tip distance instead of the gap voltage.

The above problems have been corrected.

5.2.44 Toggling V_{gap} Sign Immediately After Zooming Causes Failure – Problem Corrected

Previously, toggling the gap voltage sign by utilising the respective control immediately after the scan area zoom factor has been modified resulted in an abrupt software termination. The workaround was to wait for a couple of seconds between these operations.

This problem has been corrected.

5.2.45 Toggling V_{gap} Sign in Low Preamplifier Range Could Fail in Borderline Cases – Problem Corrected

Previously, if the gap voltage was set to 1V in the lower range of a supported preamplifier, the voltage sign toggle control could cease to function, i.e. the polarity was not changed when clicking (and holding) the respective button.

This problem has been corrected.

5.2.46 Maximum Value for AFM Non-Contact Vibration Amplitude has been Limited

The maximum vibration amplitude (parameter `Vibration_Amplitude` of Experiment Element “NonContactAdjust”) has been limited to 1V. This change was made as beyond the 1V limit the amplitude gain fails to output the setpoint, causing an inconsistency between displayed value and true amplitude.

5.2.47 Misleading Cantilever Oscillation Amplitude Displayed – Problem Corrected

Previously, the “Amplitude” value display of the window “NonContact Adjust” has shown a value of approx. 0.7 V instead of the actual cantilever oscillation amplitude. Although the value was technically correct, it has often misled users.

The algorithm for computing the value displayed by “Amplitude” has now been changed to remedy the situation.

5.2.48 Software Failure during Experiment Start

T1.0–6U3 All previous releases of the Matrix system could sporadically report a “lost connection to control unit” failure during the launch phase of an experiment. Afterwards, the Matrix software had to be exited, and the Matrix control unit had to be power-cycled.

This problem has been corrected.

5.2.49 Wrong Units Used for Certain Signals – Restriction Lifted

Previously, the AFM-related signals F_n (unit N), F_l (unit N), and df (unit Hz) were displayed as voltages. This restriction has been lifted, the above signals will utilise correct units now.

5.2.50 Cantilever Calibration not Functional – Restriction Lifted

The AFM sensor alignment mechanism (provided by Experiment Element “QuadAdjust” of Catalogue “AFMHybrid”) offers a means to specify calibration parameters for the lateral and normal force parameters (F_n and F_l) so that cantilever characteristics can be taken into account during AFM contact-mode measurement processes. However, in previous versions of the Matrix software, this feature was actually not available although supported by the GUI.

In version T1.0–7 of the Matrix system, this restriction has been lifted.

5.2.51 Damping Meter Graphics Showed Invalid Value – Problem Corrected

In all previous versions of the Matrix software, the graphical representation of the damping signal meter used by the AFM non-contact mode experiments did not reflect the numerical value correctly under all circumstances. For example, the maximum value visualised was approximately 8.8V while the actual maximum value was 10V.

This problem has been corrected.

5.2.52 Frozen Damping Meter – Problem Corrected

Also in all previous versions of the Matrix software, the damping signal meter utilised by AFM non-contact mode experiments could appear to be frozen although the excitation was enabled. The workaround was to slightly vary the vibration amplitude which caused the damping signal meter to become active.

This problem has been corrected.

5.2.53 Stopping an Experiment in State "Paused" Has Temporarily Re-Started Scanning – Problem Corrected

In all previous versions of the Matrix system, stopping an experiment that had been paused caused a temporary restart. Thus, scanning resumed for a short period of time before the experiment was actually stopped.

This problem has been corrected.

5.2.54 Changing Calibration Parameter Set Could Cause Invalid Image Scaling – Problem Corrected

Under certain circumstances, when changing the calibration parameter set of an experiment in state "Stopped" e.g. from "LT STM LHe" to "LT STM LN2", the Matrix software could expose invalid image scaling after starting the respective experiment.

This problem has been corrected.

5.2.55 Light Spot Indicator not Updated Correctly – Known Problem

T1.0–5 Under certain circumstances, the Sensor Alignment window (actually the panel "QuadDetector" of Experiment Element "QuadAdjustment") can fail to display the light spot indicator correctly. This behaviour results from a rapid change of the F_n signal from any "normal" voltage level to more than 12V. The light spot indicator will rest at the last measured "normal" value in such a case.

Omicron will address this problem in a future release of the Matrix system.

5.2.56 Monitoring the I_{Treg} Signal – Known Restriction

T1.0–FT2 The I_{Treg} signal represents the I_T (tunnelling current) signal for the digital regulator for all STM experiments. The device representing the I_{Treg} signal is named `IT_Regulator` and can theoretically be used as a sensor device for a data acquisition channel. However, it is strongly discouraged to monitor this signal by assigning the device `IT_Regulator` to a channel, as due to a problem with the Experiment Analysis software of the Matrix CU the hardware resource requirements for measuring this signal will be computed invalidly. As a result, the resulting images will show artefacts. Thus, the I_T signal (being represented by the device `IT_Image`) should be used instead of the I_{Treg} signal. Note that all predefined experiments have been configured correctly so no dedicated actions are required.

Omicron considers to lift this restriction in a future version of the Matrix system.

5.2.57 Incorrect Initialisation of AFM Experiment – Problem Corrected

In all previous versions of the Matrix software one could observe a problem affecting the initialisation of an AFM non-contact experiment after transfer to a Matrix CU. The symptom was that the cantilever oscillation could not be excited because the amplitude regulation was not set up correctly. The workaround was to enter a slightly different vibration amplitude value in panel “Excitation” of Experiment Element “NonContactAdjust”; afterwards, the oscillation could be excited correctly.

This problem has been corrected.

5.2.58 Certain Parameters not Restored Correctly – Problem Corrected

Under certain circumstances, the Matrix software could have failed to restore the value of the parameters `Axis_Points` (number of data points on a spectroscopy ramp) of Experiment Element “Spectroscopy”, and `Sample_Rate` (sample rate for oversampling operations) of Experiment Element “Channel” after the experiment parameter state was saved and the Matrix software was restarted.

This (weird) problem has been corrected.

5.2.59 Software Failure when Changing Light Source Parameters – Problem Corrected

Previous versions of the Matrix software could terminate abruptly if the AFM beam-deflection light source was switched on or off (or varied in intensity) immediately after manipulating certain other experiment parameters. For example, enabling a previously disabled data channel and switching the light source on immediately afterwards would have exposed the problem.

This bug has been fixed.

5.2.60 Scanner Movement not Allowed in Certain Experiment States – Restriction Enforced

In previous versions of the Matrix software, the scanner could have reacted to modifications of the scanner parameters “Zoom”, “x-Position”, “y-Position” and “Angle” immediately even if the experiment was in state “Stopped” or “Paused”. However, as tip movements are only allowed during a starting or progressing experiment, modifying scanner parameters in states “Stopped” or “Paused” will now take effect when (re-)starting an experiment.

5.3 User Environment Release Notes

The subsequent release notes pertain to the Matrix user environment software, i.e. to functionality that is not specific to a particular experiment or application.

5.3.1 Introduction of Display Content Magnification and Panning

Matrix version T1.0–7 introduces support for interactive magnification (scaling) of the current contents of a data display in image-mode, and for moving around such contents (the latter is also referred to as “panning”). The magnification and panning operations are bound to the scroll wheel of the mouse device:

- Scrolling upwards will magnify the display contents; the magnification factor will be displayed online during the operation.
- Scrolling downwards will shrink the display contents; the magnification factor will be displayed online during the operation.

- Pressing and holding down the scroll wheel while moving the mouse allows moving the display contents around; the corresponding offset values will also be displayed online during the operation.

Note that magnification and panning operations do not affect the scan parameters but only the display contents; however, you can also apply the established magnification factor and offset values to the scanner parameter set. (See section 5.3.2 below for details.)

All magnification and panning operations can be reset by right-clicking the affected image-mode display and choosing "Reset Zoom/Pan" from the context menu.

5.3.2 Graphical Modification of Scan Parameters

In Matrix version T1.0–7, support for modifying the scan area parameters "Zoom", "Rotation Angle", and "Position/Offset" by manipulating the contents of displays in image-mode has been added. Users can rotate the image by utilising a new mouse tool, the rotation applied to the image will then be used to determine a new value for the scanner parameter `Frame_Angle`. This new value will be computed such that the position of the image chosen will result from scan operations.
The zoom factor and the position of the scan area can also be determined graphically by utilising the new display content magnification and panning facility (see section 5.3.1 also). Once you have selected zoom factor and/or image position, clicking the new "Apply Zoom/Pan" button to the right of an image display will adjust the scanner parameters according to the display detail you have selected.

Note that the Matrix software applies a WYSIWYG(What-you-see-is-what-you-get) -style of operation when modifying scan parameters graphically: Rotating or shifting the display contents by mouse will cause the Matrix software to establish scan parameters producing the results reflected by the manipulated display contents. In other words, the system will *not* translate mouse movements into equivalent scan area manipulations but establish scan parameters that will cause the generation of an image with the orientation, location and zoom factor chosen. As a result, shifting the image contents e.g. to the right will actually cause the scan area to move left, because the display (not the display contents) represents the scan area. Also, rotating the display contents clockwise will result in counterclockwise rotation of the scan area for the same reason. If you need to manipulate the scan area directly, Omicron recommends to utilise the scan area representation control instead of the display-based parameter modification facilities.

The "Zoom" function can be used for increasing the zoom factor as well as for decreasing it. Note, however, that you can graphically zoom out of an image that has been measured at a zoom factor of 1; attempting to adjust the scanner parameters by clicking the "Apply Zoom/Pan" button accordingly will then yield no effect. Note also that the "Zoom" feature supported by the Experiment Elements "XYScanner" only allows zoom factors ranging from 1 to 100. However, the display contents magnification function operates on a level of granularity that is considerably finer. Hence, when applying the established magnification to the scanner parameter `Zoom`, the resulting scan area can differ significantly if the resulting factor is quite low (e.g. 2 or 3). Note that Omicron considers to lift this restriction in a future release of the Matrix system.

For utilising the "apply magnification and offset" function in a specific display, the new Controller `XYScanner_ZoomPosition` must be configured for the View entity that is attached to that display, the "rotate graphically" function requires the new Controller `XYScanner_Rotate` to be present at the respective View. For the pre-defined experiments shipped as part of the Matrix kit, the respective controllers have already been configured.

5.3.3 Result File Access During Experiment Execution now Supported

Previously, users occasionally experienced problems when trying to load a result file into the SPIP data analysis software when such an operation was attempted from within SPIP while the Matrix software was still active. The symptom was that SPIP displayed its "Heuristic File Importer" window and rendered corrupted images. The same result file, however, could be processed correctly by SPIP after exiting the Matrix software. Also, the result file contents could be successfully transferred to SPIP by means of the Matrix "Favourites Gallery" facility.

The underlying problem was a file locking conflict between the SPIP and Matrix software systems. This conflict prevented the SPIP software from accessing the result file contents correctly and caused the described phenomenon. In version T1.0–7 of the Matrix system, the file locking strategy has been revised significantly. As a result, the SPIP software is now able to access result file chains also when a Matrix instance is still active; result files can even be opened from within SPIP if the associated experiment is still executing, i.e. producing data.

In addition, starting with version T1.0–7, the Matrix software will generate significantly less result file links; in most cases the entire experiment log will now be placed in a single result file ("`*_0001.mtrx`").

5.3.4 New "Bring to Front" Function for Windows

An experiment window that is partially or completely covered can be brought to front so that it resides in front of all other windows by utilising a new user interface function: You can use the right mouse button to click on a window name shown on the "Window" menu now; doing so will place the associated window on top of the window stack. By left-clicking the window name you can still toggle the visibility of the respective window between the states "displayed" and "hidden".

5.3.5 Favourites Gallery Improvements

Version T1.0–7 of the Matrix software includes several enhancements to the "Favourites Gallery" facility that improve general usability aspects. In particular, each "thumbnail" image displayed by the "Favourites Gallery" will now be labelled with the run/scan cycle information of the respective image. Thus, locating the result data file storing the image data represented by a particular "thumbnail" is now straightforward. Moreover, placing the mouse cursor on a "thumbnail" image will cause the Matrix software to display a "tool tip" providing more detailed information on the respective image (name of the data channel used for image data acquisition, run and scan cycle identification, and scan direction information).

As the "Favourites Gallery" window may represent results from several experiments, the following modifications have been applied to the experiment selection controls:

- Starting with version T1.0–7, the "Favourites Gallery" window will only show an entry for experiments that have been opened by a user. In order to reduce the number of unused entries in the window, the Matrix software will no longer include experiments that have never been used.
- When a new experiment gets opened, the associated "tab" in the "Favourites Gallery" window will automatically become selected now.
- The "Add to Favourites" operation will now cause the "Favourites Gallery" to activate the "tab" representing the affected experiment automatically. Thus, the new or updated "thumbnail" image will be exposed without human intervention.

- The “Add to Favourites” context menu item will be disabled if acquired data will not be stored. This prevents accidental marking of images by means of the “Favourites Gallery” although no image data will be saved.

Please note that the user interface of the “Favourites Gallery” feature may still be subject to change.

5.3.6 Duplicated Displays now Support Favourites Gallery

In previous versions of the Matrix software, duplicated displays did not properly support the “Favourites Gallery” facility. As a result, the contents of a duplicated display could not be added to the gallery; instead, the “Add to Favourites” function had to be used on the “original” display.

Version T1.0–7 of the Matrix software lifts this restriction.

5.3.7 Improvements of the Graphical Scan Area Representation

Several user interface enhancements affect the graphical representation of the scan area (panel “Area” supported by the Experiment Elements “XYScanner”):

- The colour management has been improved to reflect scan constraints, scan area limits, scan area rotation, and other parameters in a more distinct way.
- Besides the scan area width and height set by the user, the effective region of interest after applying a zoom factor will now be visualised.
- The parameter `Zoom` can now also be changed in a graphical way by utilising the new “Zoom” tool of the graphical scan area representation.
- When modifying scan parameters by manipulating the scan field representation by mouse, an ongoing manipulation can now be aborted by pressing the escape key (“Esc”).
- Several help texts and on-screen labels have been enhanced or corrected.

5.3.8 Introduction of Image Display Content Anti-Aliasing/Smoothing

The property controls of a data display in image-mode now support to enable or disable a dedicated anti-aliasing/smoothing algorithm for the displayed image. At the cost of a slightly decreased update performance, enabling this new option can help to improve the quality of the displayed image significantly, in particular when using the new display contents magnification function. (See section 5.3.1 also.)

5.3.9 Graphically Changing Scanner Parameters not Supported During Experiment Run – Restriction Lifted

Previous versions of the Matrix software blocked the graphical representation of the scan area (panel “Area” of Experiment Element “XYScanner”) while an experiment was executing. As a result, both the scan offset and the scan area rotation angle could only be changed by entering numerical values while a scan was progressing.

Matrix version T1.0–7 lifts this restriction, both scan offset and rotation angle can now be changed graphically while an experiment is executing.

5.3.10 Experiment State Control Location can be Configured now

The experiment state control elements for uploading/unloading, starting, stopping and pausing an experiment will usually be placed below all other panels a window contains. However, some customers asked for an option to locate the state controls on top of all panels instead, as it was felt that the controls will otherwise be covered by overlapping windows frequently. While the default behaviour of Matrix version T1.0–7 remains unchanged regarding the location of the experiment state controls, users may now create the experimental Windows registry key `[HKEY_LOCAL_MACHINE\SOFTWARE\Omicron NanoTechnology\MATRIX\T1.0\Debug\Gui\Project\StateControllerTop` to change this behaviour. Assigning the value “true” to the above registry key will direct the Matrix software to change the location policy by placing the state controls on top of all panels.

Future versions of the Matrix software will presumably offer the state controls location policy to be used as an application option configurable via the GUI.

5.3.11 Duplicated Displays can Enable Useless Mouse Tools – Problem Corrected

Previously, when duplicating a display by using the “Duplicate” context menu item, the new display instance could expose useless mouse tool control buttons under certain circumstances. For example, duplicating an image display of a spectroscopy experiment would have enabled the single point spectroscopy location selection mouse tool button in the duplicated display even if the spectroscopy experiment was switched to “Grid spectroscopy”. Besides the fact that such mouse tools were actually not functional, no negative side effects are known.

This problem has been corrected.

5.3.12 Data Displays Could Cause Various System Failures – Problems Corrected

A number of issues regarding duplicated data displays and displays in line-mode has been observed with previous releases of the Matrix system. The symptoms varied, and included abrupt software terminations, incorrect window behaviour, display “freeze” effects (i.e. data displays stop to become updated), and system hangs.

Version T1.0–7 of the Matrix software introduces a significantly revised data display subsystem that fixes these problems; in particular, the line-mode display management has been improved substantially. In addition, the display performance has been improved significantly; more displays can be kept open simultaneously now, while overall CPU usage has been decreased.

5.3.13 Line-Mode Displays Could Cause Software Failure – Problem Corrected

Under certain circumstances, data displays in line-mode could have caused an abrupt software termination while redrawing their axis decoration. For example, the problem manifested itself in a Needle sensor experiment when configuring the lower and upper limits for a frequency sweep to certain values.

This problem has been corrected.

5.3.14 Spectroscopy Curve Display now Displays Correct Information Items

Under certain circumstances, the spectroscopy curve display introduced in version T1.0–6 of the Matrix software was not capable of displaying associated information items (run/scan cycle and spectroscopy data origin) correctly. Thus, both information items were disabled by default. The underlying problems have been corrected in this release of the Matrix software, hence both the run/scan cycle information as well as the pixel coordinate of the spectroscopy data origin will now appear in spectroscopy displays by default.

5.3.15 Spectroscopy Curve Displays can be Duplicated now

Previously, spectroscopy curve displays did not offer the “Duplicate” functionality because of some internal deficiencies. As Matrix version T1.0–7 corrects the underlying problems, the “Duplicate” controller has now also been enabled for spectroscopy curve displays.

5.3.16 Exiting the Matrix Software – Problems Corrected

A number of issues regarding the shutdown of the Matrix software has been corrected in this release. In particular, fixes for the following bugs have been included:

- The Matrix software frequently terminated abnormally if (a) one of the spectroscopy experiments had been used for some time and then was stopped, and (b) the software was exited by pressing the "window close" button in the upper right corner of the main window. Rebooting the Matrix CU was not required in this case.
- Exiting the Matrix software during a running experiment that utilised at least one data display in line-mode would have caused the software to hang; the application had to be terminated by means of the operating system then, also, the Matrix CU had to be rebooted.
- Attempting to close a Project window after an experiment associated with the respective Project had been uploaded to the Matrix CU would have caused an abrupt software termination if either the "Display Properties" or the "Favourites Gallery" dialogue was displayed.

5.3.17 Graphical User Interface Clean-Up

Version T1.0–7 of the Matrix system also provides some smaller improvements to the graphical user interface. Enhancements include:

- Several menu entry texts, including the low-pass filter menu entries, have been cleaned up.
- Some icons and dialogue layouts have been streamlined.
- The mouse cursor handling in some scenarios has been corrected.
- The scrollbar behaviour of the "Favourites Gallery" window has been corrected. Also, some missing tool tip help messages have been added to controls related to the "Favourites Gallery".
- Some dialogue elements have been changed; for example, the rather tiny check box for the regulator feedback loop status control has been replaced by a more eye-catching control element.
- The numerical value entry fields now support to restrict a selection to some digits of a value if the selection is performed by mouse.
- The increment of numerical value entry fields will now be reliably displayed by the tool tip help facility.
- The "Properties" dialogue associated with numerical value entry fields will not disappear any longer if an error message box gets displayed.
- The window layout of some experiments has been improved.
- Some of the textual information shown in displays will be suppressed if the respective information is not available.
- A couple of help texts have been enhanced and corrected.

5.3.18 Parameter Range Update Could be Incomplete when Changing Calibration Data – Problem Corrected

Previously, under certain circumstances, the Matrix software could have failed to update all parameter ranges after calibration data has been changed by means of the "Experiment Options" window. Most often, the problem manifested itself when selecting a parameter set from a different calibration data set, e.g. switching from "*VT AFM*" of "*STM for SPM PRE 4*" to "*VT AFM*" of "*STM/AFM Contact for SPM PRE 4*".

This problem has been corrected.

5.3.19 Scan Parameter Constraint Mechanism Could Sometimes Cause Software Failures – Problem Corrected

Using the scan parameter constraint mechanism in order to preserve the aspect ratio of the scan area when changing the size of the area could have resulted in an abrupt software termination under certain circumstances. The problem manifested itself when using certain values for the parameters `Width` and `Height` only; also, the scan area must have been rotated before.

This problem has been corrected.

5.3.20 Numerical Value Entry Inconsistencies – Problems Corrected

A number of inconsistencies and problems related to the numerical value entry mechanisms have been observed in previous releases of the Matrix software. The issues manifested themselves in different scenarios and caused several different effects including confusing and sometimes conflicting value displays (for example, values being out of the supported range of a particular parameter could nevertheless be entered under certain circumstances), and abrupt software terminations (for example, changing the unit of raster time parameters from “µsec” to “msec” and back could cause the software to exit). In addition, some problems regarding the parameter properties handling have been corrected. In particular, the Matrix software will not terminate abruptly any longer if one tries to configure incorrect bounds for the value slider. Finally, the slider facility can no longer erroneously produce floating point value entries for integer parameters.

5.3.21 Aspect Ratio Locking Could Cause Software Failures – Problem Corrected

When enabling the aspect ratio locking of the scan area by means of the “wedding rings” control for the scan parameters “Width” and “Height”, a parameter handling inconsistency could have caused software failures so far. Symptoms included system hangs, and the generation of weird values for one of the affected parameters.

This problem has been corrected.

5.3.22 Line-Mode Display Curve Colours Could not be Changed – Problem Corrected

In previous versions of the Matrix software, trying to change the colour of the curves rendered by displays in line-mode did not function properly. This problem has been corrected.

5.3.23 Window State “Closed” not Saved – Problem Corrected

Previously, when saving the Project state by choosing “Save All Projects” from the “File” menu of the Matrix main window (or by answering “Yes” to the “Do you want to save your project data before exiting?” question on program exit), the state of windows that have been closed was no saved correctly. As a result, such windows were re-opened when restarting the Matrix software while they should have been presented in state “iconified”.

This problem has been corrected.

5.3.24 Failed Operations Leave System in an Inconsistent State – Known Problem

T1.0–5 Under certain circumstances, the Matrix software can fail to upload an experiment to a Matrix CU. Possible scenarios include attempting to send an AFM contact or non-contact experiment to a Matrix CU without a connected AFM-CU, or using an incompatible calibration data set (such as "*STM for SPM PRE 4*" from the standard Instrument descriptions file for an AFM experiment.) In such situations, the software will alert the user by displaying appropriate message boxes, however, the system is in an inconsistent state afterwards. As a result, trying to continue the session will most likely cause software failures.

Omicron considers to lift this restriction in a future version of the Matrix system. The current workaround is to exit the Matrix software, to reboot the Matrix CU by switching it off and back on, and to restart the Matrix software.

5.3.25 "Store Measurement" Checkbox Might Show Wrong Status – Known Problem

T1.0–5 If the Matrix software runs out of disk space, it will disable the automatic storing of measurement data as soon as the remaining disk space reaches a critical level. However, the "Store Measurement" checkbox of the "Favourites Gallery" window will not reflect this change if the dialogue is open while the software disables the storage option.

Omicron will address this problem in a future release of the Matrix system.

5.3.26 Processor Changes not Reflected by Result File – Known Restriction

T1.0–FT2 Due to a known limitation, the Matrix software will currently not store modifications of processor parameters in the affected experiment's result file.

Omicron will lift this restriction in a future version of the Matrix system.

5.3.27 Parameter Change Handling Incomplete for Unloaded Experiment Elements – Known Restriction

T1.0–5 Experiment Elements in state "unloaded" (i.e. Experiment Elements utilised by experiments that have not been uploaded to a Matrix CU, or that have been removed from a Matrix CU) will currently not handle parameter changes completely. As a result, parameters that are associated with some other parameter might not be adapted when this parameter is changed. For example, changing the tunnelling voltage preamplifier range will have no effect on the tunnelling voltage displayed.

Omicron will lift this restriction in a future release of the Matrix system.

5.3.28 Invalid Calibration Data Can Cause System Failure – Restriction Enforced

T1.0–5 Under certain circumstances, older versions of the Matrix system could fail if a calibration data set being incompatible with a particular experiment got selected, and that experiment was uploaded to a Matrix CU afterwards. For example, the Matrix software would have exited abruptly if the STM calibration data set "*STM for SPM PRE 4*" was used for calibrating an AFM non-contact experiment.

Since the advent of version T1.0–5, the Matrix software will detect and report such situations, however, it still cannot remedy the underlying problem. Generally, if an incompatible calibration data set causes problems, the Matrix software will display an error dialogue displaying a message similar to the following:

The physical device **AFM_OffsetAdj** has not been defined for
calibration data set **STM for SPM PRE 4**.
Make sure that the correct Instrument and Experiment descriptions
are loaded, and the correct calibration data set is being selected.

Note

You have to restart both the Matrix CU and the Matrix software after a message similar to the above has been displayed.

Omicron will address this problem in a future release of the Matrix system.

5.3.29 Favourites Gallery not Usable for Fast Scan Operations – Known Problem

T1.0–6 During fast scan operations (e.g. utilising a raster time of 10 µsecs), the “Favourites Gallery” mechanism currently becomes unusable: When right-clicking an image display and selecting “Add to Favourites” from the context menu, the respective image will be transferred to the Favourites Gallery window, however, the green checkmark symbol indicating that the image data has been saved will presumably not appear (although the respective data has actually been stored). As a result, selecting one of the “Analyse” buttons will show no effect.

The underlying problem is a race condition between the graphical user interface and the result data storage mechanisms of Matrix.

Omicron will address this issue in a future release of the Matrix software.

5.4 Image Processing Release Notes

The release notes in this section provide information about the Matrix/SPIP integration.

5.4.1 SPIP Version Information

The Matrix version T1.0–7 kit ships SPIP 4.2.3 that has been qualified for use with the Matrix system. For information about changes incorporated into the SPIP package since version 4.0.7 (this version was part of the Matrix T1.0–6 kit) please visit the following web site: http://www.imagemet.com/index.php?main=products&sub=revisionhistory.

5.4.2 Single Point Spectroscopy Data Analysis now Supported

T1.0–6U1 The SPIP package does now provide support for analysing spectroscopy data that results from single point spectroscopy operations. Hence, SPIP is capable of analysing CITS images and spectroscopy curves from raster-oriented spectroscopy operations as well as curves resulting from single point spectroscopy operations.

Note that it is currently not possible to correlate spectroscopy curves resulting from single point spectroscopy operations with a particular position in a *Z*-image automatically.

5.4.3 Line and Point Scan Constraints now Supported

T1.0–6U1 The SPIP software is now able to read and analyse Matrix result files containing data resulting from scan operations utilising the constraints “Line” or “Point”.

5.4.4 Force Curve Analysis now Supported

The SPIP software is now able to read and analyse Matrix result files containing force-distance curve data generated during AFM contact-mode experiment runs. In contrast to SPIP 4.1.5 that was shipped as part of the Matrix T1.0–6U1 kit, SPIP will render the approach and retract sections of a force-distance curve in a single window now and also offer a set of dedicated analysis features.

5.4.5 ImageMet Explorer now Supports Matrix Result File Chains

T1.0–6U1 Users can use the file browsing facility “ImageMet Explorer” for viewing multi-image files and thus also Matrix result files.

The ImageMet Explorer will visualise result files by a folder symbol containing (at most) four thumbnails of the first four images described by a result file. In addition, the number of images stored by a file will also be displayed as part of the folder symbol. One can utilise the “Expand selected multi data file” and “Expand all multi data files” tool buttons in order to view the complete contents of a result file as a series of thumbnail images. Data files being referenced from within a result file chain (such files are generated since the advent of Matrix version T1.0–6) will be shown as separate “folders” by the ImageMet Explorer.

The ImageMet Explorer can also be used to transfer one or more images from a result file to SPIP for analysis, and to delete result files as well as data files.

5.4.6 Warning on Missing Result File Signatures can be Disabled now

T1.0–6U1 The Matrix software produces result files that are prepared for digital signature processes. Keeping digital signatures together with the result data ensures that the contents of a result file have not been manipulated after the file has been saved, thus enforcing data integrity.

Currently, however, the Matrix system does not sign result files. Hence, when loading result files into SPIP, the software will detect that the result data is actually “unprotected”; this situation will be reflected by displaying a warning message stating “The Omicron Matrix file is not signed”. Although this is the intended behaviour, the message box could have caused inconveniences when processing Matrix result files by means of the “batch processor” facility of SPIP, or when launching SPIP from the Matrix “Favourites Gallery”.

SPIP version 4.2.3 offers an option “Do not show this dialog again” as part of the warning message display; you can enable this option in order to suppress warnings about missing result file signatures.

5.4.7 Batch-Mode Conversion to SCALA PRO Format – Problem Corrected

The SPIP version 4.2.3 software supports conversion of images into the SCALA PRO format by means of the batch mode again.

5.4.8 Export of Spectroscopy “Volume Images” in SCALA PRO Format now Supported

Besides exporting images in SCALA PRO format, the SPIP software is now also capable to save spectroscopy curves from CITS “volume images” in a SCALA PRO-compatible way. Thus, user-written software or third party utilities that rely on the SCALA PRO format for CITS data can be used for processing Matrix result file contents after conversion with the SPIP software.

5.4.9 Run/Scan Cycle Information Displayed in Window Titles now

Up to now, the run/scan cycle information used by the Matrix software to construct the names of result files has been rendered by Matrix data displays only. Starting with SPIP version 4.2.3, the run and scan cycle will also be indicated by SPIP in the title bar of data display windows. Thus, windows showing data generated by Matrix use title bars indicating the following information:

Channel ScanDirection TimeStamp RunScanCycle ExperimentName ProjectName

For example:

Z RetraceUp Fri Mar 24 20.01.00 2006 [2-17] STM_Basic STM

The information given in square brackets is the run and scan cycle count.

5.4.10 Invalid Image Axis Scaling – Problem Corrected

Previously, the SPIP software could have failed to recognise the scan zoom factor of an image properly if either of the following conditions were met:

- A complete result file, referencing several image data files measured with different scan zoom factors was opened.
- A single image data file residing with other image files from the same experiment within a single folder was opened, and the images were measured with different scan zoom factors.

This problem has been corrected.

5.4.11 Invalid Image Scaling – Known Problem

T1.0–5 The SPIP software might render invalid image scales when you change the scan zoom factor within one scan cycle. For example, if the zoom factor is “1” during an “up” scan and gets changed to a different value during the corresponding “down” scan, then SPIP will treat the scales for the images resulting from the “up” and “down” scan identically. As a result, in such a situation, the scales for the image resulting from the “up” scan are actually incorrect. A similar problem will manifest itself if the preamplifier tunnelling current range is different between the “up” and the “down” scan cycle.

The error occurs because the SPIP package is currently unable to associate certain information from a Matrix result file with the actual image data; in addition, the Matrix software does currently not provide exact parameter change hints.

Omicron and ImageMetrology will provide a suitable solution for this issue in a future version of the Matrix system.

6
System Management Release Notes

This chapter provides information that is of interest to users who administer Matrix systems.

6.1 Dual Monitor Configurations Support

The Matrix PC and the Matrix software are generally prepared for supporting “Dual Head” configurations, i.e. users can connect a second monitor to the PC in order to enlarge the available screen workspace. However, using two monitors simultaneously can result in abnormal software behaviour. Basically, two different symptoms have been observed: Under certain circumstances, single displays in “image”-mode can stop to display data but render solid green areas instead. In this case, resizing the display solves the problem. The second symptom is an abrupt termination of the Matrix software during experiment start operations; this problem can only be circumvented by disconnecting the second monitor.

The problems described above have been caused by an interference between the Matrix display subsystem and the OpenGL software supplied by the PC graphics card manufacturer (currently NVIDIA Corporation). If you intend to utilise a dual monitor configuration, make sure that the NVIDIA ForceWare driver version 81.98 (release date: 7-Feb-2006) is installed on your system. To determine the driver version, you can use the following procedure:

- On the Windows XP desktop, right-click the “My Computer” icon and choose “Properties” from the context menu.
- Select the “Hardware” tab.
- Click the “Device Manager” button.
- Locate the “Display Adapters” entry in the device list being displayed, and open the entry. The only sub-entry shown should be “NVIDIA GeForce FX 5200”.
- Double-click the sub-entry “NVIDIA GeForce FX 5200”.
- From the window displayed, choose “Driver”.

If the driver version displayed is 8.1.9.8 (i.e. 81.98), the correct driver is installed. If the version number displayed is actually lower (e.g. 7.8.0.1, which identifies the driver as being version 78.01), you must upgrade to version 81.98 in order to use a dual monitor configuration.

Driver software can be downloaded from the NVIDIA Corporation internet site at http://www.nvidia.com. You may also contact the Omicron service organisation for further assistance.

6.2 Result File Writing Facility Improved

The result file writing facility of the Matrix software has been optimised to generate certain information only if required. As a result, the internal structure of a result file chain is streamlined; in addition, result files can be slightly smaller.

6.3 Qt Application Framework Update

The Qt application framework which is used by the Matrix software for GUI management purposes has been updated from version 3.3.4 to version 3.3.5.

6.4 Matrix System Start-up Procedure

T1.0–FT2 The Matrix CU requires a Trivial File Transfer Protocol (TFTP) server in order to bootstrap. Before using the system you must therefore follow the start-up sequence outlined below:

- Power on the Matrix CU.
- Log on to the Matrix PC.
- If not already started, launch the TFTP server by selecting “Programs → Omicron NanoTechnology → Matrix → TFTP → TFTP” from the Windows XP “Start” menu. (Note that the server will be started automatically if you log on to your Windows XP user account.)
- Wait for approx. one minute to allow the Matrix CU to finish its bootstrap procedure.
- Launch the Matrix software.

The Matrix software will wait for the Matrix CU to finish its start-up process before displaying its main and Project windows. If you launch the software while this process is still progressing, the initial “splash screen” shown by the program will display the message “Waiting for Control Units …” until the Matrix CU reports the successful start-up procedure termination.

6.5 Matrix Application Data and User Profile Restoring

T1.0–FT2 The Matrix software will keep Project and experiment descriptions, experiment structures, and other information in a folder hierarchy in the “Documents and Settings” directory. (The exact location of this folder hierarchy is determined by the `APPDATA` environment variable.) Because the “Documents and Settings” directory is actually part of the user profile maintained by the operating system, the data stored by Matrix is subject to user profile restore operations. As a result, on networked systems, the Matrix files might experience changes when the user profile information was not stored on the server properly (e.g. because the computer was switched off instead of shutdown orderly) but the networked profile is nevertheless being used on next login. In such a case, the more recent local user profile will be replaced by the older networked profile, thus destroying all changes to Matrix data that took place meanwhile.

One should take care that on a networked computer system the user profile information will be stored on the server correctly by using the logout and shutdown procedures of the Windows XP operating system only. If this is not possible (e.g. because the computer crashed or was accidentally switched off), you should always choose to use the more recent user profile stored locally instead of using the older profile data stored on the network server when the system prompts you to choose between the profiles. Otherwise, changes to Projects, experiments, and maybe also result data will be lost.

6.6 Using Serial CRTC Board Interconnection – Permanent Restriction

When using a serial connection between the CRTC board and the Matrix PC, you must make sure that the serial cable is always connected to both the Matrix CU and the PC. If the cable has been plugged into the CRTC but is not connected to the PC, the Matrix CU will fail to boot. Also, the serial cable has to be kept away from sources that might cause interference, e.g. power cables.

This is a permanent restriction.

Note

Using serial board interconnections is supported for dedicated diagnostic and maintenance purposes only and must *only* be used when advised by Omicron service or engineering.

6.7 Development Variant Shipped

T1.0–FT2 The installation kit of this release of the Matrix system ships development variants of all software modules in order to allow enabling of advanced tracing and monitoring options. As a result, an increased amount of disk space for installation is required; also, the run-time memory requirements are significantly higher then for regular deployment variants.