



ABN 43 064 478 842

➤ 231 osborne avenue clayton south, vic 3169
PO box 1548, clayton south, vic 3169
t 03 9265 7400 f 03 9558 0875
freecall 1800 680 680
www.tmgtestequipment.com.au

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ROHDE & SCHWARZ

Test and Measurement
Division

Release Notes

Firmware Version 3.52

for ZVR/ZVRE/ZVRL/ZVC/ZVCE/ZVM/ZVK

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General Information

Manual for ZVR Family

The analyzers of the ZVR family are supplied with the following manual:

"Operating Manual – Vector Network Analyzer" ZVR/E/L, ZVC/E, ZVM, ZVK

Order No. 1127.8700.xx-03-

where xx	11	(German)
	12	(English)
	13	(French)
	19	(English, US letter format)

Update Procedure

The update instructions given in section 1 of this release note are to the latest state; any deviating instructions in the operating manual are to be ignored.

If you have received this document together with a new analyzer, you can skip section 1.

If you have received the document together with a firmware update kit or as a download together with a self-extracting archive file, you should read section 1.

Initial Steps

If you work with a ZVR analyzer for the first time, it is recommended to read the operating manual to familiarize yourself with the unit.

If you are already familiar with the instrument, this document informs you about new features.

Documentation of Firmware Modifications

This document covers firmware modifications that are not part of the current operating manual.

1 Firmware Update

System Requirements

None

Preparations for Update

No preparations are required.

Contents of Firmware Update Kit

The update kit comprises the following:

- Five 3.5"/1.44 Mbyte disks labelled as follows:
 - Disk 1 : „V3.52 DISK 1“
 - Disk 2 : „V3.52 DISK 2“
 - Disk 3 : „V3.52 DISK 3“
 - Disk 4 : „V3.52 DISK 4“
 - Disk 5 : „V3.52 DISK 5“
- This document

Update Procedure

1. If you have received a self-extracting archive file per e-mail or as a download

a set of disks must first be created from the archive file.

Proceed as follows:

- Check if you have received all files.
 - disk1.bin self extracting ZIP file, used to generate update disk 1
 - data2.cab packed contents of disk 2, automatically unpacked during FW update
 - data3.cab packed contents of disk 3, automatically unpacked during FW update
 - data4.cab packed contents of disk 4, automatically unpacked during FW update
 - data5.cab packed contents of disk 5, automatically unpacked during FW update
 - disk_d.bin this document packed
- Keep five DOS-formatted 3.5" / 1.44 Mbyte disks ready.
- Label disks as follows:
 - V3.52 DISK 1
 - V3.52 DISK 2
 - V3.52 DISK 3
 - V3.52 DISK 4
 - V3.52 DISK 5
- Create a temporary directory on your PC (e.g. ZVRTEMP on C:\). For this you require about 3 Mbytes of free memory on your hard disk.
- Copy file disk1.bin to this temporary directory.
- Rename file disk1.bin to disk1.exe.

- Execute disk1.exe, e.g. by using the following command sequence for Windows95/NT:
<CTRL><ESC> - RUN – C:\ZVRTEMP \DISK1 - <ENTER> (English version) or
<CTRL><ESC> - AUSFÜHREN – C:\ZVRTEMP \DISK1 - <ENTER> (German version).

The files are extracted.

- Delete file disk1.exe in the temporary directory.
The temporary directory should contain the following files:

inst32i.ex	_isdel.exe	_setup.dll	_sys1.cab	_user1.cab
data.tag	data1.cab	lang.dat	layout.bin	os.dat
readme.txt	setup.exe	setup.ini	setup.ins	setup.lid

- Copy all files to update disk 1 (V3.52 DISK 1).
Check if all files are on the disk with their correct names. In particular, the underscores ("_" as in "_inst32iex_") are essential for a successful update.
- The contents of the other 4 disks are already in the format needed for the update. Files data2.cab,..., data5.cab must be copied to the corresponding disks DISK2, ..., DISK5.

The disks are now ready, and you can continue with section 2 "If you have received a firmware update kit on a disk ...".

Notes: *If any error messages are output during creation of a disk, the installation process for the disk in question must be repeated. Before re-creating the disk, check if the write protection of the disk has been removed.*

File disk_d.bin contains this document in pdf format. To unpack the document proceed as follows:

- *Copy disk_d.bin to the temporary directory.*
- *Rename the file to disk_d.exe.*
- *Execute disk_d.exe, e.g. by using the following command sequence for Windows95/NT:*
 <CTRL><ESC> - RUN – C:\ZVRTEMP \DISK_D - <ENTER> (English version)
 or <CTRL><ESC> - AUSFÜHREN – C:\ZVRTEMP \DISK_D - <ENTER> (German version)

2. If you have received a firmware update kit on a disk ...

You can load the firmware directly from the disk to your network analyzer.

- Insert the disk DISK 1 into the drive.
- Press the **SETUP** key and change to the side menu by pressing \Rightarrow key.
- Press the **FIRMWARE UPDATE** softkey.
- Start the update by pressing the **UPDATE** softkey and follow the instructions on the analyzer display.

First, the contents of the update disks are copied to the hard disk of the instrument. Then the files are extracted and copied in the directories accordingly. After the extraction, the instrument is rebooted.

The firmware update is complete.

The previous firmware version may be restored using softkey **RESTORE**.

3. If problems occur during the firmware update ...

The new firmware can if necessary also be loaded under NT. This should be done only with an external keyboard and a mouse. Log-in has to be made using the ADMINISTRATOR function, and the device firmware closed.

Log in as administrator.

- Press key combination ALT SYSREQ to switch to NT screen if not yet displayed.
- Call up the NT task bar START – SHUT DOWN.
- Select 'Close all programs and logon as different user'.
- Hold the SHIFT key down and press the OK key to leave the input window until the login window appears.
- Release the SHIFT key as soon as the login window appears.
- Now enter administrator as user name and 894129 as password.

Close the device firmware:

- Press the keys **CTRL ALT DEL** on the external keyboard simultaneously.
- Select the Task Manager.
- Select the Application **Rohde&Schwarz ZVR NT Interface** and terminate it with **End Task**.

Now the new firmware can be loaded:

- Insert **DISK 1** into drive A:
- Start the installation with **START RUN A:SETUP**. You will be prompted to insert the remaining disks one after the other.

After loading the software, the operating system is rebooted. Then change back from **administrator** to instrument (password instrument) for the login. This is done in the same way as changing of login to administrator.

Note: *If the firmware is installed in this way, the previous version cannot be restored.*

2 New Features, Improvements and Modifications

New Features

- Support of waveguide calibration:
For this purpose, two new softkeys were added to the menu CAL → CAL KITS → right side menu:
WAVEGUIDE (position 6) and CUTOFF FREQUENCY (position 7)
- Deinstallation of calibration kits:
A new softkey is available in the menu CAL → CAL KITS:
UNINSTALL KITS (position 10)
- New SCPI commands:
 - Reading out and modification of system error calibration and power calibration
 - Support of waveguide calibration
 - Query of electrical length, mechanical length and phase delay
- Support of additional, external devices:
 - Generator SML (Rohde & Schwarz)
 - Generator SMR30, SMR50, SMR60, SMR30B11, SMR50B11, SMR60B11 (Rohde & Schwarz)
 - Generator HP8648 A/B/C/D (Agilent)
 - Generator HP83650A (Agilent)
 - Power Meter NRP (Rohde & Schwarz)
 - Power Meter ML2438A (Anritsu)
 - Power Meter E4417A (Agilent)
 - Power Meter EPM-441A (Agilent)

Improvements

- When reading and writing system error correction data and level correction data in the REAL64 format, an error message is output.
Affected IEC/IEEE bus commands:
SENSe[1..4]:CORRection:DATA
SENSe[1..4]:CORRection:POWer:DATA
SOURce[1..4]:POWer:CORRection:DATA
- If a waveguide calibration (WAVEGUIDE = ON) is performed via IEC/IEEE bus with a CUTOFF FREQUENCY that is higher than the START FREQUENCY, an error message is now output because this action is not permitted.
- Omission of unnecessary level calibration interpolation (improves performance especially during operation via the IEC/IEEE bus).
- The CALC:MARK:FUNC:RES? IEC/IEEE bus query now yields 10 significant marker points (previously only 6).
- Improvement of signal quality of R&S SMR generators (SMR20/27/30/40/50/60, SMR20/27/30/40/50/60B11) in TTL mode.
(This requires an SMR firmware version ≥ 1.26 .)
- Generators currently not used are switched to RF OFF. This prevents erroneous measurements and avoids disconnecting any cables.

Examples:

- During power calibration of the internal generator, any external generators connected to the instrument and set to REMOTE are switched to RF OFF.
- This applies analogously to the calibration of an external generator. In this case, the internal generator (and, if available, a second external generator connected and set to REMOTE) is switched to RF OFF.
- When a COMP/SOI/TOI, arbitrary or mixer measurement is switched off, the external generators used in the measurement are set to RF OFF.

Modifications

- New softkeys or softkeys shifted to another position in menu CAL → CAL KITS:
 - Softkey USER CONN NAME now at position 9 of right side menu
 - Softkey USER CONN IMPEDANCE now at position 10 of right side menu
 - New softkey UNINSTALL KITS at position 10 of main menu
 - New softkey WAVEGUIDE at position 6 of right side menu
 - New softkey CUTOFF FREQUENCY at position 7 of right side menu

3 Bug Fixes

- In the ACTIVE xx STANDARDS table, the entries for the OPEN standards are again available when a calibration is performed.
- System error correction data sets generated with a version <3.50 can now be recalled again (RECALL).
- The power correction function has been improved:
 - External power calibration is reliably activated with COMP/SOI/TOI measurements.
 - An existing power calibration can be used again in power sweeps and in time sweeps.
- The normal user (logged on under the name "INSTRUMENT") has write access again to the directory AUTOKAL, so the AutoCal function works again.
- Commanding the OFFSET SHORT standards (SENSe[1..4]:CORRection:COLLect:ACQuire:OSHORT1 or OSHORT2) in case of waveguide calibration (WAVEGUIDE = ON) is possible again.
- Errors were corrected in the following SCPI commands:
 - SENS:FUNC?
 - SOURce:POWer:[LEVel]:[IMMediate]:CAMPlitude
- Softkeys that were not visible are now available again:
 - Menu MEAS → USER DEF'D S-PARAMS: softkeys USER DEF'D S-PARAMS and USER DEF ACTIVE
 - Menu CAL → START NEW CAL → FULL ONE PORT → BOTH PORTS: softkey 2.92 mm FEMALE
 - Menu MEAS → WAVE QANTITY: softkey DRIVE PORT

4 Extensions to Operating Manual

Characteristics of Calibration Standards (Re section 2.15.1.3)

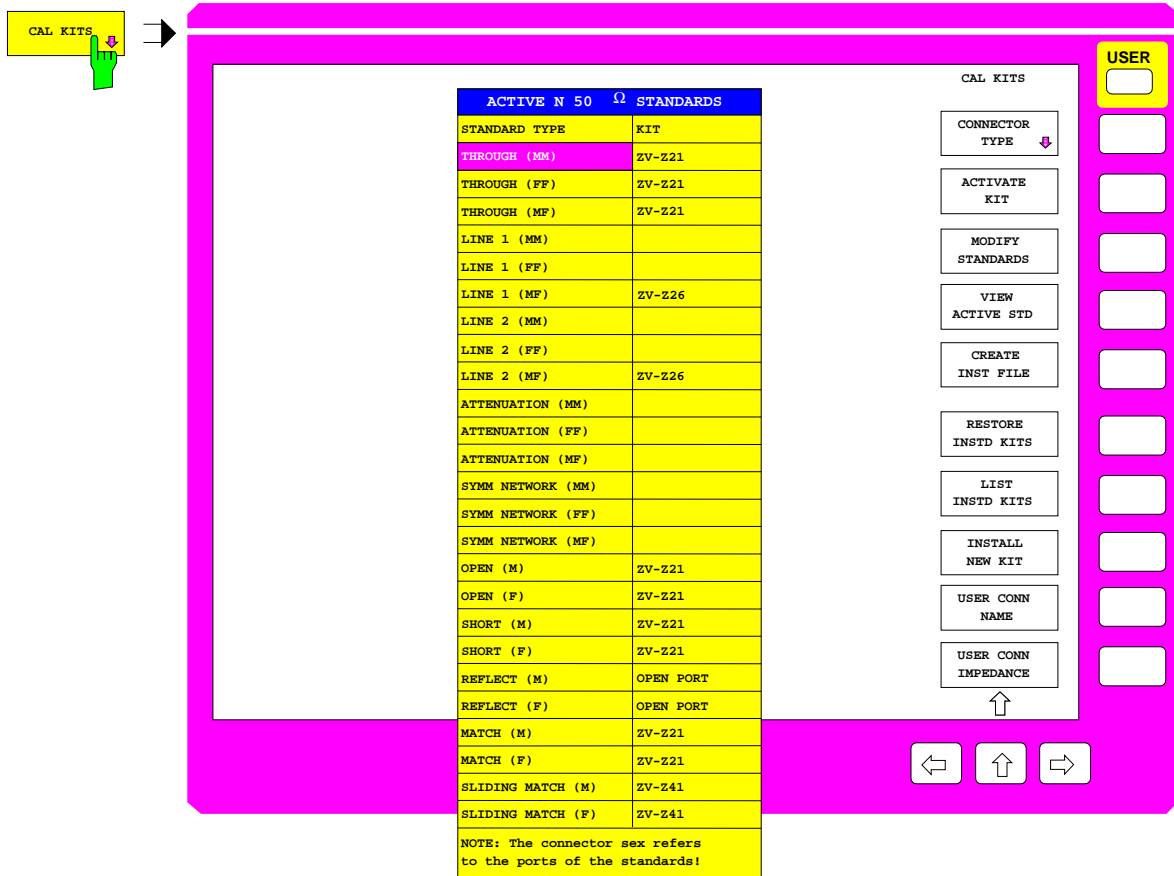
The *MODIFY CAL KIT* softkey opens a menu for the management of calibration kits for the individual connector families.

Exact knowledge of the calibration standards is a prerequisite for a accurate system-error calibration. More precisely, the calibration is based on the knowledge of those S-parameters of the standards which are assumed to be known for the applied calibration method. These S-parameters are derived from physical models which contain one or more parameters (such as the electrical length) depending on the type of standard.

In addition to these physical parameters, there are three description fields for each standard listing the assignment of the standard and further information for the user.

1. Standard type: The type depends on the kind of standard (e.g. open circuit, short circuit, through-connection) and the sex of the connectors. Example: *THROUGH (MF)* denotes a through-connection with a plug at one and a socket at the other port. The standard type determines the physical description model and therefore the parameters which can be edited. Up to four individual standards with different parameters can be defined for one standard type. Only one of them can be selected (active) at one time.
2. Calibration kit (*KIT*): A calibration kit is an assembly of real, physical calibration standards. Calibration kits are supplied by Rohde & Schwarz as an accessory for network analyzers. The parameters of the standards in a calibration kit are stored on a floppy disk which can be read in via the *INSTALL NEW KIT* softkey. Kits for coaxial connector families usually do not contain all possible standard types of these families but only a subset comprising the types which are most frequently used in coaxial technology. Calibration kits can be user-defined as well. Using the *ACTIVATE KIT* softkey, the standards of a calibration kit can be selected altogether by just one keystroke.
3. Serial number (*SERIAL #*): All standards of a calibration kit are factory-labelled with the same serial number so they can be assigned unambiguously to this kit. The serial number helps to avoid confusion between standards of the same type from different calibration kits which might have different physical parameters.

CAL CAL - CAL KITS submenu:



Selecting the connector families

After pressing the *CAL KITS* softkey, the *ACTIVE XX STANDARDS* selection table is displayed, where *XX* denotes the connector family selected. By default, the connector family of the test set ports is selected. The table gives an overview of the active standards of the connector family:

- The **STANDARD TYPE** column lists all standard types which are required for the calibration procedures of the respective type of instrument.
- The **KIT** column indicates to which calibration kit the currently selected physical standard belongs. By default, for standard types contained in the calibration kits offered by Rohde & Schwarz, the designation of the corresponding kit is also displayed. Although typical parameter values are pre-defined for these standards, the individual parameters for each calibration kit, which are supplied on a floppy, should be read in for the sake of maximum accuracy (see *INSTALL NEW KIT* softkey). The predefined standards without calibration kit assignment are assumed to be ideal.

The cursor can be used to select the standard type the softkeys *MODIFY STANDARDS* and *VIEW ACTIVE STD* refer to.

For polarized connector families, three types exist for each two-port standard, namely male/male (MM), female/female (FF), and male/female (MF). One-port standards are provided as male (M) and female (F). For non-polarized connectors, such as PC 7, all standards are contained only once in the table.

If a calibration method requires to measure two standards with the same polarity simultaneously, their characteristics are assumed to be identical. This applies, e.g., to the TOM-X calibration method if the *OPEN BOTH PORTS* measurement is performed.

The following types of standards are provided for the various types of network analyzers. Due to the restricted calibration facilities of the ZVRE, ZVCE and ZVRL compared to the ZVR, ZVC, ZVK and ZVM, a reduced set of standards is required only.

Table: Standard types for the network analyzers

ZVR, ZVC, ZVK, ZVM	ZVRE, ZVCE, ZVRL	
THROUGH	THROUGH	through-connection
LINE 1		line 1 for TRL calibration procedure
LINE 2		line 2 for TRL calibration procedure
ATTENUATION		unknown matched attenuator
SYMMETRIC NETWORK		unknown mismatched reflection-symmetric two-port standard
OPEN	OPEN	open circuit
SHORT	SHORT	short circuit
OFFSET SHORT	OFFSET SHORT	additional short circuit for waveguide calibration
REFLECT		unknown mismatched one-port standard
MATCH	MATCH	broadband termination
SLIDING MATCH	SLIDING MATCH	sliding load

CAL CAL - MODIFY CAL KIT - SELECT KIT submenu:

CAL KITS	CONNECTOR TYPE
CONNECTOR TYPE	N 50 Ω
ACTIVATE KIT	N 75 Ω
MODIFY STANDARDS	
VIEW ACTIVE STD	PC 7
RESTORE INSTD KITS	SMA
LIST INSTD KITS	PC 3.5
INSTALL NEW KIT	
USER CONN NAME	SEXLESS USR CONN 1
USER CONN IMPEDANCE	USR CONN 2

The *CONNECTOR TYPE* softkey calls a menu for selecting the connector family shown in the *ACTIVE XX STANDARDS* table.

The type and order of the connectors shown in this menu are different for the different models of the ZVx family. The connector types used for the instrument test ports always come at the uppermost position. This is also the default setting.

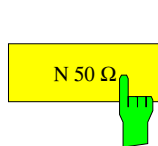
The following connector families are provided:

- N 50 Ω ,
- N 75 Ω ,
- PC 7,
- SMA,
- PC 3.5,
- 2.92 mm.

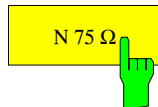
In addition two connector families can be arbitrarily defined, namely:

- SEXLESS USR CONN 1
- USR CONN 2

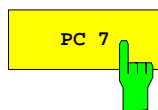
Only the two user-defined connector families can be configured for waveguide calibration.



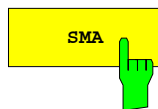
The *N 50 Ω* softkey displays the table *ACTIVE N 50 Ω STANDARD*.



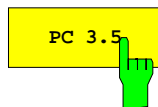
The *N 75 Ω* softkey displays the table *ACTIVE N 75 Ω STANDARDS*.



The *PC 7* softkey displays the table *ACTIVE PC 7 STANDARDS*.



The *SMA* softkey displays the table *ACTIVE SMA STANDARDS*.



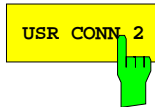
The *PC 3.5* softkey displays the table *ACTIVE PC 3.5 STANDARDS*.



The *SEXLESS USR CONN 1* softkey displays the table *ACTIVE USER CONN 1 STANDARDS*. The connector family *SEXLESS USR CONN 1* which can be user-defined is not polarized (similar to PC 7) and particularly suited for non-coaxial cable systems such as microstrip.

The two user-defined connector families *SEXLESS USR CONN 1* and *USR CONN 2* can also be used for waveguide calibration (refer to *WAVEGUIDE* softkey description). As waveguides are as a rule not polarized, *SEXLESS USR CONN 1* is to be preferred to *USR CONN 2*.

The name of this connector family (*USR CONN 1* by default) can be modified via the *USER CONN NAME* softkey.



The *USR CONN 2* softkey displays the table *ACTIVE USER CONN 2 STANDARDS*. Unlike *SEXLESS USR CONN 1*, this user-defined connector family is polarized and therefore suited for the coaxial connectors that are not pre-defined in the *CONNECTOR TYPE* menu. The connector family *USR CONN 2* can also be used for waveguide calibration.

The name of this connector family (*USR CONN 2* by default) can be modified via the *USER CONN NAME* softkey.

CAL CAL - CAL KITS submenu:



The *ACTIVATE KIT* softkey displays the selection table *ACTIVATE KIT*.

ACTIVATE KIT
OPEN PORT
ZCAN
✓ ZV-Z21
ZV-Z26
ZV-Z28
ZV-Z41

This table lists all calibration kit names defined for the connector family currently selected. All standards including the ones that are currently not active are considered.

The cursor keys move the cursor within the table. A kit is selected via the units prefix key. A checkmark displayed for a short time indicates that a kit has been selected.

All standards with the selected kit name are set active.

MODIFY N 50 Ω THROUGH (MM) STANDARDS		
ACTIVE	✓	
KIT	ZV-Z21	ZCAN
SERIAL #		
MIN FREQ	0 Hz	0 Hz
MAX FREQ	18 GHz	4 GHz
LENGTH	46.1 mm	48.97 mm
LOSS	0.01 dB/GHz ^{1/2}	0.012 dB/GHz ^{1/2}
ACTIVE		
KIT		
SERIAL #		
MIN FREQ	0 Hz	0 Hz
MAX FREQ	18 GHz	18 GHz
LENGTH	0 m	0 m
LOSS	0 dB/GHz ^{1/2}	0 dB/GHz ^{1/2}

CLR returns to the ACTIVE STANDARDS table

Modifying the standards

The *MODIFY STANDARDS* softkey calls the *MODIFY XX YY STANDARDS* table.

In the four quadrants of this table, the parameters of the four individual standards of a single type are displayed. The type is selected in the *ACTIVE XX STANDARDS* table. The parameters describe the physical model of this standard type. All displayed parameters can be edited, even if the corresponding standard is currently not set. The upper five parameters are available for all standard types, the remaining ones depend on the kind of model applied.

If a parameter in this table is changed, an asterisk (*) is appended to the calibration kit name (*KIT*) of the corresponding standard.

ACTIVE Standard active

A checkmark in the table row *ACTIVE* indicates which one of the individual standards is currently active. If a definite standard type, e.g. an OPEN (F), is measured in a calibration, the calibration algorithm uses the parameters of the active individual standard of this type.

KIT Designation of the calibration kit

The calibration kit name can be entered here. It comprises a maximum of 10 characters and appears in the *ACTIVE XX STANDARDS* table if the standard activated.

Some softkey functions access the calibration kit name as well. The standards with the same kit name can be activated altogether via *ACTIVATE KIT*. The softkey *RESTORE INSTD KITS* restores the original parameters of the calibration data sets which were installed from floppy disk. *LIST INSTD KITS* list all calibration data of a connector type installed from floppy disk.

An asterisk (*) as the last character of the kit name indicates that the preset values or the values installed from floppy of one or several parameters of the corresponding individual standard were changed. If an attempt is made to enter a calibration kit name which is already present twice (e.g. once in the original form and once labelled as user-defined, i.e. with an asterisk), an exclamation mark and an asterisk will be appended to the name.

SERIAL # Serial number of the standard

Besides the calibration kit name, the serial number (max. 15-digit) is a further individual attribute for the standards. It is used especially to distinguish standards from calibration kits of the same type. For the calibration kits offered by Rohde & Schwarz, the same serial number is used throughout the whole kit. This number is assigned to every single standard when the kit is installed. Standards purchased later as spare parts have another serial number of course.

MIN FREQ – minimum frequency of the standard

The sliding load, e.g., is a standard with minimum frequency since it can be used above 2 GHz only.

MAX FREQ – maximum frequency of the standard

For each standard, a maximum frequency is defined. The physical model described by the subsequent parameters is valid up to this maximum frequency.

LENGTH – electrical length of the standard

The electrical length of the standard can be entered for *OPEN*, *SHORT*, *OFFSET SHORT (short with length offset)*, *REFLECT*, *THROUGH*, *LINE 1* and *LINE 2* and *SYMMETRIC NETWORK*. The default unit of the electrical length is mm. For *REFLECT* and *SYMMETRIC NETWORK*, the electrical length must be specified only if it causes a phase deviation of more than 90° from the assumed approximation (*APPROX* field) in the frequency range to be calibrated.

Note: For one-port standards, only the single length (length offset) is to be entered, too.

LOSS – losses

The losses of the standard are entered in this field. It is assumed that they are resistive line losses whose value (in dB) increases proportionally with the root of the frequency due to the skin effect. The attenuation is thus entered in units of dB/GHz. Losses are indicated only for *OPEN*, *SHORT*, *OFFSET SHORT (short with length offset)*, *THROUGH* and *LINE*. For one-port standards, the total loss, i.e., the return loss must be entered.

C0... C3 – polynomial coefficients for parasitic capacitance

For *OPEN*, as well as for *REFLECT* and *SYMMETRIC NETWORK* with *APPROX = OPEN* selected, the parasitic capacitance at the open end of the line can be described by a third-order frequency polynomial. C0 denotes the constant part, C1 to C3 the polynomial coefficients of the corresponding powers of the frequency. The unit of the coefficient Cn is thus fF/GHzⁿ (n=0,..., 3).

For *REFLECT* and *SYMMETRIC NETWORK*, specification of the coefficients is required only if the latter cause a phase deviation of more than 90° from the assumed *OPEN* approximation in the frequency range to be calibrated.

L0... L3 – polynomial coefficients for parasitic inductance

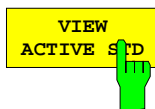
For *OPEN*, as well as for *REFLECT* and *SYMMETRIC NETWORK* with *APPROX = SHORT* selected, the parasitic inductance can be described by a third-order frequency polynomial. L0 denotes the constant part, L1 to L3 the polynomial coefficients of the corresponding powers of the frequency. The unit of the coefficient Ln is thus pH/GHzⁿ (n=0,..., 3).

For *REFLECT* and *SYMMETRIC NETWORK*, specification of the coefficients is required only if the latter cause a phase deviation of more than 90° from the assumed *SHORT* approximation in the frequency range to be calibrated.

APPROX – approximate modelling

When a reflection standard (*REFLECT*) or a reflection-symmetric network (*SYMMETRIC NETWORK*) is selected, it must be indicated, whether the unknown reflection coefficient can be approximately modelled as a short or an open circuit.

This information is required only to exclude a sign ambiguity when the reflection coefficient is determined implicitly. If the length offset or parasitic reactances cause a rotation of the phase of the unknown reflection coefficient of more than 90° with respect to the approximate phase (0° for *APPROX = OPEN*, 180° for *SHORT*), these parameters must be specified as well.



The *VIEW ACTIVE STD* softkey displays the *ACTIVE XX YY* table, where XX denotes the connector family and YY the standard type, e.g. ACTIVE N 50 Ω OPEN (F).

This table can not be edited. It shows the parameters of the currently active individual standard of the type that was selected in the *ACTIVE XX STANDARDS* table. If a certain standard type, e.g. an OPEN (F) is measured during a calibration, the calibration algorithm uses the parameters of the active individual standard of this type. For a description of the table rows refer to softkey *MODIFY STANDARDS*.



The *CREATE INST FILE* softkey creates an installation file for a calibration kit. This function is useful, e.g., if an updated installation file for the entire calibration kit is needed after exchange of an individual calibration standard, or if calibration kit data entered via *MODIFY STANDARDS* are to be transferred to other instruments. The *SELECT KIT* table shows all calibration kits of the connector type currently selected.

Once the desired kit has been selected and confirmed via the ENTER key, an input field for the path and name of the installation file is displayed. The default entries correspond to the current path for *SAVE / EDIT* and the name of the selected calibration kit with the extension *.chk. Upon entering the name the installation file is written to the specified directory.

To create an updated installation file for the entire calibration kit after exchanging an individual calibration standard, the file supplied with the replacement standard is installed first. During installation, only the data pertaining to this standard are overwritten in the corresponding calibration kit file. Afterwards, the desired file for the entire kit can be created via *CREATE INST FILE*.

To create an installation file for calibration kits from other manufacturers, the data describing the different standards is entered via *MODIFY STANDARDS*; the entire data is assigned to the same calibration kit. Afterwards, *CREATE INST FILE* is used to create the installation file.



The *RESTORE INSTD KITS* softkey resets the parameters of all standards to the values defined in the instrument firmware. Exceptions are calibration kits installed from floppy disk (or from another storage medium). Those are reset to their original state after the installation.

The softkey also activates the same standards which were active in the preset state. Besides that, the default values of the name and reference impedance of the connector families which can be user-defined (*SEXLESS USR CONN 1* and *USR CONN 2*) are restored. This function is used to cancel all user entries, especially the ones made by mistake.



The *LIST INSTD KITS* softkey displays the *INSTALLED CAL KITS* table.

This table can not be edited. It shows all calibration kits which were installed from floppy disk (or from another storage medium) or which were generated by modifying an originally installed calibration kit. Preinstalled kits or kits generated by modification of an originally preinstalled kit are not listed.

INSTALLED CAL KITS		
CONNECTOR	KIT	SERIAL #
N50Ω	ZV-Z21	123456/001

CONNECTOR Connector family

The CONNECTOR column shows the connector family of the calibration kit.

The meaning of the two columns *KIT* and *SERIAL #* is as explained under softkey *MODIFY STANDARDS*. If the standards of a kit have different serial numbers *VARIOUS* is indicated in the *SERIAL #* column.



The *INSTALL NEW KIT* softkey allows the user to install calibration kits from a floppy disk or another storage medium.

If a floppy containing a single calibration kit file (this applies to all floppies provided with the calibration kits from Rohde & Schwarz) is inserted into the disk drive a message window indicating the connector type and the kit designation is displayed after a short time. In this window, installation of the new kit must be confirmed. The calibration kit is read in and a new message indicates that the installation was successfully completed.

If several calibration kit files (file extension *.ck) are stored on the floppy, or if no floppy is in the disk drive, the input field *EDIT CAL KIT PATH* is invoked where the path and file name of the desired calibration kit file can be entered. The further procedure is as described above.



The *UNINSTALL KITS* softkey allows the user to delete the user-installed calibration kits for a connector family.

User-installed calibration kits are meant to include calibration kits read in from a storage medium by means of the *INSTALL NEW KIT* function. They do not mean to include the preinstalled kits contained in the instrument firmware. Please note that this function deletes **all** user-installed calibration kits for the connector family selected in the *CONNECTOR TYPE* menu (e.g. PC 3.5).

To preserve particular user-installed calibration kits, they must first be saved by means of the *CREATE INST FILE* function.



The connector families *SEXLESS USR CONN 1* and *USR CONN 2* can also be configured for waveguide calibration by means of the *WAVEGUIDE* softkey. If this softkey is activated, the instrument takes into account the nonlinear relationship between the phase of the S-parameters and the frequency, which prevails in waveguides. This effect is also known as dispersion.

At the frequency f , the transmission phase φ , e.g. of a *THROUGH* or a *LINE* standard of the length l , is not governed by the relationship

$$\varphi = \frac{2\pi f}{c} \cdot l \quad \text{but by}$$

$$\varphi = \frac{2\pi f}{c} \cdot l \cdot \sqrt{1 - \left(\frac{f_c}{f}\right)^2},$$

where f_c is the cutoff frequency of the waveguide mode used (normally the basic mode).

When the *WAVEGUIDE* softkey is activated, the *CUTOFF FREQUENCY* softkey for entering the cutoff frequency is available too.

The *OPEN* standard is unsuitable with waveguide calibration because in this case it does not provide total reflection but radiates like an antenna. Therefore, if the *WAVEGUIDE* softkey is switched on, the *OPEN* standards are replaced by *SHORTS* (for standards table see *CAL CAL - CAL KITS* submenu). The latter must have a length offset different from the existing *SHORTS* and are for this reason referred to as *OFFSET SHORTS*. At frequencies at which the length difference between the *SHORT* and the *OFFSET SHORT* equals a multiple of $\lambda/2$, singularities occur since the shorts have identical reflection coefficients in this case. To avoid this, the length offset of the *OFFSET SHORT* should be selected to obtain a length difference of $\lambda/4$ between the *SHORT* and the *OFFSET SHORT* in the middle of the measurement frequency range. The associated reflection coefficients are then exactly opposite in phase. As the frequency range is normally not larger than the single-mode range of the waveguide, i.e. max. one octave, singularities do not occur at the range limits either if the length offset is selected as described.

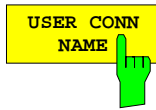
The *SHORT* of a waveguide calibration kit is usually in the form of a plate, i.e. it has no electrical length. The effects of attenuation and leakage inductance can be neglected in practice. The *OFFSET SHORT* is in most cases realized by a *SHORT* to which a piece of line ($\lambda/4$) (shim) is added. The electrical length of this added line is entered as the length offset for the *OFFSET SHORT*. The effects of attenuation and leakage inductance can usually also be neglected for the *OFFSET SHORT*.

*Note: The $\lambda/4$ line can also be used as a *LINE* standard, for example for *TRL* calibration.*



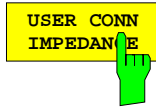
The *CUTOFF FREQUENCY* softkey opens an input field for entering the cutoff frequency for the waveguide mode for which calibration is to be made. This is usually the basic mode of the waveguide.

The waveguide mode cannot propagate below the cutoff frequency, which means that system error correction is not possible below this point. The cutoff frequency, therefore, represents the minimum start frequency for measurement and calibration. If the start frequency of the calibration range is lower than the entered cutoff frequency (e.g. after a *PRESET*), an error message is output.



The *USER CONN NAME* softkey activates the entry of a name comprising up to 11 characters for the connector families *SEXLESS USR CONN 1* and *USR CONN 2*. The name refers to the family selected in the *CONNECTOR TYPE* menu. In the title of the tables *ACTIVE XX STANDARDS*, *MODIFY XX YY STANDARDS* and *ACTIVE XX YY*, it replaces the character string *XX*. The name of the corresponding softkeys in the *CONNECTOR TYPE* submenu, however, can not be overwritten.

The default names are *USER CONN 1* and *USER CONN 2*.



The *USER CONN IMPEDANCE* softkey activates the entry of the reference impedance for the connector *SEXLESS USR CONN 1* or *USR CONN 2*. The impedance refers to the family selected in the *CONNECTOR TYPE* menu. The default value is 50 Ω .

Note: Only a constant reference impedance can be entered via this softkey. While the characteristic impedance of a waveguide is highly frequency-dependent, the conversion of reflection coefficients to impedances or the calculation of Z parameters in the waveguide are irrelevant in practice.

5 New IEEE-Bus Commands

CALCulate:MARKer Subsystem (Re section 3.6.3.5)

The CALCulate:MARKer subsystem controls the marker functions.

COMMAND	PARAMETER	UNIT	COMMENT
CALCulate<1..4>			
:MARKer<1...8>			
[[:STATe]	<Boolean>	--	
:AOFF			no query
:MODE	CONTInuous DISCrete	--	
:COUPled			
[[:STATe]	<Boolean>		
:X	<numeric_value>	HZ S DBM	
:MODE	ABS REL		
:Y?	--	--	query only
:FORMat	MLINear MDB PHASe REAL IMAGinary SWR GDElay MLPHase MDPHase COMPLex L C RLC	--	
:TRANSform			
:COMPLex	S SINV Z ZREL Y YREL		
:TRACe	CHDATA CHMEM		
:SEARch			
[[:IMMediate]	--	--	no query
:NEXT	--	--	no query
:RIGHT	--	--	no query
:LEFT	--	--	no query
:TRACKing	<Boolean>	--	--
:MAXimum	--	--	no query
:MINimum	--	--	no query
:FUNCTION			
[[:SELect]	MAXimum MINimum TARGet BFILter		
:BWIDth	<numeric_value>	DB	
:MODE	BPASSs BSTop	--	
:QFACtor	--	--	
:SFACtor	<numeric_value>, <numeric_value>	--	
:TARGet	<numeric_value>	DBM DB	
:RESULT?			query only
:EDElay	TIME DISTance ELENgth OFF		
:VALue?		--	query only
:DELTA			
:STATe	<Boolean>		
:REFERence	MARKER1 MARKER2 MARKER3 MARKER4 MARKER5 MARKER6 MARKER7 MARKER8 FIXed		

COMMAND	PARAMETER	UNIT	COMMENT
:RPOsition			
[:CARTesian]	<numeric_value>,<numeric_value>	HZ S DBM,DB	
POLar	<numeric_value>,<numeric_value>,<numeric_value>	HZ S DBM,DB, DB	
:PTPeak			
:STATe	<Boolean>	--	
:RESult?	[ALL]		query only
:CENTer			no query
:STARt			no query
:STOP			no query
:REFerence			no query

CALCulate[1...4]:MARKer[1...8]:FUNction:EDELay

This command switches on or off the display of the electrical or the mechanical length or the phase delay. The suffix of MARKer has no meaning. The parameter information means the following:

ELENgth = electrical length
DISTAnce = mechanical length
TIME = phase delay
OFF = display switched off

Syntax: CALCulate[1...4]:MARKer[1...8]:FUNCTION:EDELay TIME | DISTance | ELENgth | OFF

Example: "CALC:MARK:FUNC:EDEL TIME"

```

Features:      *RST   value: OFF
                  SCPI:   device-specific

```

CALCulate[1...4]:MARKer[1...8]:FUNctioN:EDELay:VALue?

This command queries the value of the electrical or the mechanical length or the phase delay. The format of the return value must be selected beforehand with CALC:MARK:FUNC:EDEL. The suffix of MARKer has no meaning.

Syntax: CALCulate[1...4]:MARKer[1...8]:FUNction:EDELay:VALue?

Example: "CALC:MARK:FUNC:EDEL:VAL?"

```

Features:      *RST value:  --
                  SCPI:      device-specific

```

This command is a query only and therefore has no *RST value.

SENSe:CORRection Subsystem (Re section 3.6.14.3)

The SENSe:CORRection subsystem controls the system error correction and the recording of the individual correction values.

COMMAND	PARAMETER	UNIT	COMMENT
:CORRection			
[:STATe]	<Boolean>		
:DATA	<string>,<block> <numeric_value>...		
:DATE?			query only
:INTerpolate			
[:STATe]	<Boolean>		
:AKAL			
:SElect	<string>		
:EXPort	<string>		no query
:IMPort	<string>		no query
:CLEar	<string>		no query
:REName	<string>,<string>		no query
:COLlect			
[:ACQuire]	THROUGH OPEN1 OPEN2 OPEN12 SHORT1 SHORT2 MATCH1 MATCH2 MATCH12 NET ATT IMATCH12 REFL1 REFL2 SLIDE1 SLIDE2 SLIDE12 LINE1 LINE2 M1O2 O1M2 OSHORT1 OSHORT2 AKAL		no query
:METHod	FTRans RTRans FRTRans TOM TRM TRL TNA TOMX TOSM FUNDAMENTAL FOPORT1 FOPORT2 FOPORT12 FOPTport ROPTport REFL1 REFL2 REFL12 TPORT FTREF1 RTREF2		
:SAVE			no query
:CONNection<1 2>	N50FEMALE N50MALE N75FEMALE N75MALE PC7 SMAFEMALE SMAMALE PC35FEMALE PC35MALE PC292FEMALE PC292MALE UFEMALE1 UMALE1 UFEMALE2 UMALE2		
:CKIT	N50 N75 SMA PC7 PC35 PC292 USER1 USER2		
:INSTall	<string>		
:N<50 75>	MMTHrough MFTHrough FFTHrough MMLINE1 MFLINE1 FFLINE1 MMLINE2 MFLINE2 FFLINE2 MMATten MFATten FFATten MMSNetwork MFSNetwork FFSNetwork MOPen FOPen MSHort FSHort MREFlect FRElect MMTCh FMTCh MSMatch FSMATCH[,<string>]		
:SElect	<string>		
[SENSe<1...4>]			
:CORRection			
:CKIT			

COMMAND	PARAMETER	UNIT	COMMENT
:USER<1 2>	MMTHrough MFTThrough FFTHrough MMLINE1 MFLINE1 FFLINE1 MMLINE2 MFLINE2 FFLINE2 MMATten MFATten FFATten MMSNetwork MFSNetwork FFSNetwork MOPen FOPen MSHort FSHort OShort FOShort MOShort MREFlect FREFlect MMTCh FMTCh MSMatch FSMatch[,<string>]		
:SElect	<string>		
:IMPedance	<numeric_value>	OHM	
:WGUide			
[:STATe]	<Boolean>		
:CFRequency	<numeric_value>	HZ	
:MMTHrough	<string>, <string>, <numeric_value>, <numeric_value>, <numeric_value>, <numeric_value>	, , HZ, HZ, m,	
:MFTThrough	<string>, <string>, <numeric_value>, <numeric_value>, <numeric_value>, <numeric_value>	, , HZ, HZ, m,	
:FFTHrough	<string>, <string>, <numeric_value>, <numeric_value>, <numeric_value>, <numeric_value>	, , HZ, HZ, m,	
:MMLINE<1 2>	<string>, <string>, <numeric_value>, <numeric_value>, <numeric_value>, <numeric_value>	, , HZ, HZ, m,	
:MFLINE<1 2>	<string>, <string>, <numeric_value>, <numeric_value>, <numeric_value>, <numeric_value>	, , HZ, HZ, m,	
:FFLINE<1 2>	<string>, <string>, <numeric_value>, <numeric_value>, <numeric_value>, <numeric_value>	, , HZ, HZ, m,	
:MMATten	<string>, <string>, <numeric_value>, <numeric_value>	, , HZ, HZ	
:MFATten	<string>, <string>, <numeric_value>, <numeric_value>	, , HZ, HZ	
:FFATten	<string>, <string>, <numeric_value>, <numeric_value>	, , HZ, HZ	

[SENSe[1...4]:]CORRection:CKIT:USER<1|2>:WGUIde[:STATe]

This command switches on or off waveguide calibration for the respective calibration kit.
The suffix of SENSe has no meaning.

Syntax: [SENSe[1...4]:]CORRection:CKIT:USER<1|2>:WGUIde[:STATe] ON | OFF

Example: "CORR:CKIT:USER:WGU ON"

Features: *RST value: OFF
SCPI: device-specific

[SENSe[1...4]:]CORRection:CKIT:USER<1|2>:CFRequency

This command sets the cutoff frequency for the USER calibration kit.

Syntax: [SENSe[1...4]:]CORRection:CKIT:USER<1|2>:CFRequency <numeric_value>

Example: "CORR:CKIT:USER2:CFR 1 GHz"

Features: *RST value: 0 Hz
SCPI: device-specific

[SENSe[1...4]:]CORRection:DATA

This command is used for reading and writing system error correction values. The data set contains a complex value (real and imaginary component) for each test point. The data can be transmitted either in ASCII format, or in binary REAL32 format. Transmission in REAL64 format is not possible.

The <string> parameter may assume the following values:

"SCORR1"	Directivity, port 1
"SCORR2"	Source match, port 1
"SCORR3"	Reflection tracking, port 1
"SCORR4"	Forward isolation
"SCORR5"	Load match, port 1
"SCORR6"	Forward transmission tracking
"SCORR7"	Directivity, port 2
"SCORR8"	Source match, port 2
"SCORR9"	Reflection tracking, port 2
"SCORR10"	Reverse isolation
"SCORR11"	Load match, port 2
"SCORR12"	Reverse transmission tracking
"E11" to "E22"	Elements of E matrix (15-term method)
"G11" to "G22"	Elements of G matrix (7-term and 15-term methods)
"H11" to "H22"	Elements of H matrix (7-term and 15-term methods)
"F11", "F21", "F12"	Elements of F matrix (15-term method)

Syntax: [SENSe[1...4]:]CORRection:DATA <string>,<block> | <numeric_value>...

Example: "CORR:DATA "SCORR1" ,<block_data>"

Features: *RST value: -
SCPI: device-specific

The table below shows the correction terms available for the calibration methods:

Calibration Method	Available Correction Terms
Trans Norm Forward Trans Norm Reverse	SCORR6 SCORR12
Trans Norm both Directions	SCORR6, SCORR12
Refl Norm P1 Refl Norm P2	SCORR3 SCORR9
Refl Norm both Ports	SCORR3, SCORR9
Trans+Refl Norm Forward Trans+Refl Norm Reverse	SCORR3, SCORR6 SCORR9, SCORR12
Trans+Refl Norm both Ports	SCORR3, SCORR6, SCORR9, SCORR12
Full One Port P1 Full One Port P2	SCORR1 to SCORR3 SCORR7 to SCORR9
Full One Port both Ports	SCORR1 to SCORR3, SCORR7 to SCORR9
One Path Two Port Forward One Path Two Port Reverse	SCORR1 to SCORR3, SCORR6 SCORR7 to SCORR9, SCORR12
TOM, TRM, TNA, TRL	G11 to G22 and H11, H12, H22 (H21 = 1); Gxx is normalized to H21
TOSM	SCORR1 to SCORR12
TOM-X	E11 to E22, G11 to G22, H11 to H22, F11, F21, F12

[SENSe[1...4]:]CORRection:POWeR:DATA

This command is used for reading and writing power correction values for a receiver channel. The data can be transmitted either in ASCII format, or in binary REAL32 format. Transmission in REAL64 format is not possible.

The <string> parameter may assume the following values:

"B1"	Correction data for wave b1 at port 1
"INPUTB1"	Correction data for wave b1 at input b1
"B2"	Correction data for wave b2 at port 2
"INPUTB2"	Correction data for wave b2 at input b2
"IFREF"	Correction data for reference input a1 on rear panel
"A1REF"	Correction data for reference input a1 (ZVM and ZVK only)
"A2REF"	Correction data for reference input a2 (ZVM and ZVK only)

Syntax: [SENSe[1...4]:]CORRection:POWeR:DATA <string>,<block> | <numeric_value>...

Example: "CORR:POW:DATA "B1" ,<block>"

Features: *RST value: -
SCPI: device-specific

SOURce Subsystem (Re section 3.6.15)

COMMAND	PARAMETER	UNIT	COMMENT
SOURce<1...4>			
:POWer			
[:LEVel]			
[:IMMediate]			
[:AMPLitude]	<numeric_value>	DBM	
:CAMPlitude			
:A<1 2>	<numeric_value>	DBM	
:ESRC<1 2>	<numeric_value>	DBM	
:SLOPe	<numeric_value>	DB/GHZ	
:EXTeRnal<1 2>			
[:AMPLitude]	<numeric_value>	DBM	
:SLOPe	<numeric_value>	DB/GHZ	
:ALC			
[:STATe]	<Boolean>		
:NLINear			
:COMP			
:RANGe			
:UPPer	<numeric_value>	dBm	
:LOWer	<numeric_value>	dBm	
:SOI			
:RANGe			
:UPPer	<numeric_value>	dBm	
:LOWer	<numeric_value>	dBm	
:TOI			
:RANGe			
:UPPer	<numeric_value>	dBm	
:LOWer	<numeric_value>	dBm	
:CENTer	<numeric_value>	dBm	
:SPAN	<numeric_value>	dB	
:START	<numeric_value>	dBm	
:STOP	<numeric_value>	dBm	
:CORRection			
:DATA	<string>, <block> <numeric_value>...		
:EXT<1 2>			
:SWEep	<numeric_value>, <numeric_value>, <numeric_value>, LIN LOG	HZ, HZ, ,	
:NREadings	<numeric_value>		
[:ACQuire]	A1 A2 ESRC1 ESRC2		no query
:LLISt	<numeric_value>, <numeric_value>, <numeric_value> ...	, HZ, dB	
:STATE	<Boolean>		

COMMAND	PARAMETER	UNIT	COMMENT
:FREQuency			
[:CW]	<numeric_value>	HZ	
:FIXED	<numeric_value>	HZ	
:CONVersion			
:ARbitrary			
:IFRequency	<numeric_value>, <numeric_value>, <numeric_value>, CW FIXed SWEEp	, , HZ,	
:EFRequency<1 2>	<Boolean>, <numeric_value>, <numeric_value>, <numeric_value>, CW FIXed SWEEp	, , , HZ,	
:NLINear			
:COMP	INT ESRC1 ESRC2		
:SOI	IESRC1 IESRC2 ESRC12		
:OFFSet	<numeric_value>	HZ	
:TOI	IESRC1 IESRC2 ESRC12		
:OFFSet	<numeric_value>	HZ	

SOURce[1...4]:POWER:CORRection:DATA

This command is used for reading and writing power correction values for a generator channel. The data can be transmitted either in ASCII format, or in binary REAL32 format. Transmission in REAL64 format is not possible.

The <string> parameter is used for selecting the correction data set as follows:

"A1" Generator output a1
"A2" Generator output a2
"ESRC1" External generator 1
"ESRC2" External generator 2

Syntax: SOURce[1...4]:POWER:CORRection:DATA <string>,
 <block> | <numeric_value>...

Example: "SOUR:POW:CORR:DATA "A1" ,<block>"

Features: *RST value: -
 SCPI: device-specific

6 Special Features

The format of the system error calibration (SFK) files and the calibration kit (CalKit) files was changed for version 3.50. The files from older firmware versions are therefore converted to the new data format. The change concerns files with the extension "CAC", "CA1" to "CA4", "CK", "CKD" and "DAT". The old files are not deleted but renamed, i.e. an additional extension – ".BC350" – is appended. For example, "FACTORY.CAC" is renamed to "FACTORY.CAC.BC350".

Note:

There is no conversion if version 3.50 is updated to version 3.52.

The new data format cannot be processed by older firmware versions.

The following procedure should be adopted, therefore, when restoring a previous firmware version (e.g. V 3.40):

- Restore the old firmware version as usual by means of SETUP → FIRMWARE UPDATE → RESTORE.
- Terminate the firmware.
- In the Explorer, change to the "C:\R_S\INSTR\CAL" directory.
- Each file for which a file of identical name but with the additional extension ".BC350" exists, must be renamed, for example by appending the additional extension ".V350".
For example, "N50.CKD" must be renamed to "N50.CKD.V350".

Note:

If a file with the name "CK_INST.DAT" exists, it must in any case be renamed to "CK_INST.DAT.V350", no matter whether or not a file "CK_INST.DAT.BC350" exists.

- All files with the additional extension ".BC350" must be renamed, i.e. the extension has to be removed.
For example, "N50.CKD.BC350" has to be renamed to "N50.CKD".
- Start the firmware by means of START → START INSTRUMENT.
The SFK and CalKit files that were available prior to the update to version 3.50 or 3.52 are now fully available again. New files added through the version 3.50 or 3.52 update cannot be used however.

As an alternative to the above procedure, the complete "C:\R_S\INSTR\CAL" directory can be saved, for example under "C:\R_S\INSTR\CAL.BC350", before the update to version 3.50 or 3.52 is made. After restoring the old firmware version, this directory must be renamed to "C:\R_S\INSTR\CAL".