

# Supplement A to Operating Manual Spectrum Analyzer FSEA20/30, FSEB20/30, FSEM20/21/30/31, FSEK20/21/30/31

(Firmware Version 3.30 and higher (for instruments without controller function or with DOS controller function))

(Firmware Version 4.30 and higher (for instruments with Windows NT controller function))

## Dear Customer,

your spectrum analyzer is equipped with a new firmware version. The new firmware offers a number of extensions and improvements which are not yet described in the operating manual. They are explained on the following pages. The new functions concern:

- Selection of trace averaging method
- Extended functionality for external mixer (option FSE-B21)
- Extended functionality for operating modes GSM BTS ANALYZER (FSE-K11) and GSM MS ANALYZER (FSE-K10).
- New operating mode EDGE Mobile Tests (application firmware FSE-K20).
- New operating mode EDGE Base Station Tests (application firmware FSE-K21).
- New application firmware extension FSE-K30: 850 MHz GSM band for FSE-K10 and FSE-K20
- New application firmware extension FSE-K31: 850 MHz GSM band for FSE-K11 and FSE-K21
- Extended functionality for operating mode vector signal analysis (option FSE-B7)
- Trace export in vector analyzer mode
- Additional IEEE/IEC-bus commands



### Caution:

*Instruments FSEM and FSEK equipped with a RF module of model index 20 and higher should not be operated by a firmware version below 3.01 or 4.01 (instruments with Windows NT controller).*

## Selection of Trace Averaging Method

Section "Trace Selection and Setup" of the operating manual was extended to include the selection of the trace averaging method.

TRACE 1 right side menu:



The *AVERAGE LIN/LOG* softkey switches between linear and logarithmic averaging in case of logarithmic level display.

In case of logarithmic averaging, the dB values of the display voltage are averaged, in case of linear averaging the level values in dB are converted into linear voltages or powers prior to averaging. These voltages or powers are averaged and then again converted into level values.

For stationary sinewave signals the two averaging methods yield the same result.

Logarithmic averaging is recommended if sinewave signals are to clearly stand out against the noise since, with this averaging, noise suppression is greater while the sinewave signals remain unchanged.

IEC/IEEE command : [SENSE<1 | 2> : ]AVERAge:TYPE VIDEo | LINear

This softkey is also available for GSM application firmware FSE-K10/K11 in Power vs Time and Carrier Power measurements.

## External Mixer option FSE-B21 extended

The permissible setting range of parameter *HARMONIC NUMBER* under *BAND LOCK OFF* was increased from 40 to 62.

## New Application Firmware FSE-K20/21, EDGE Mobile Tests and EDGE Base Station Tests.

Firmware application FSE-K20 (order no. 1106.4086.02) extends option FSE-K10 and firmware application FSE-K21 (order no.1106.4186.02) extends option FSE-K11 by the analysis of 8-PSK modulated EDGE signals according to the standard.

In this way, the functions of firmware applications FSE-K10 and FSE-K11 is also available for EDGE signals.

The functions of the options are described in the following manuals:

*Operating Manual EDGE Mobile Tests FSE-K20, Order No. 1106.4105.xx-01*

where xx = 41 (German)  
42 (English)  
49 (English, US letter format)

*Operating Manual EDGE Base Station Tests FSE-K21, Order No. 1106.4205.xx-01*

where xx = 41 (German)  
42 (English)  
49 (English, US letter format)

## New Application Firmware Extensions FSE-K30 and FSE-K31 for Operating Modes GSM and EDGE Mobile and Base Station Tests

FW extension FSE-K30/FSE-K31 provides measurements in the new 850 MHz GSM band for firmware applications FSE-K10/FSE-K20 or FSE-K11/FSE-K21.

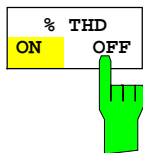
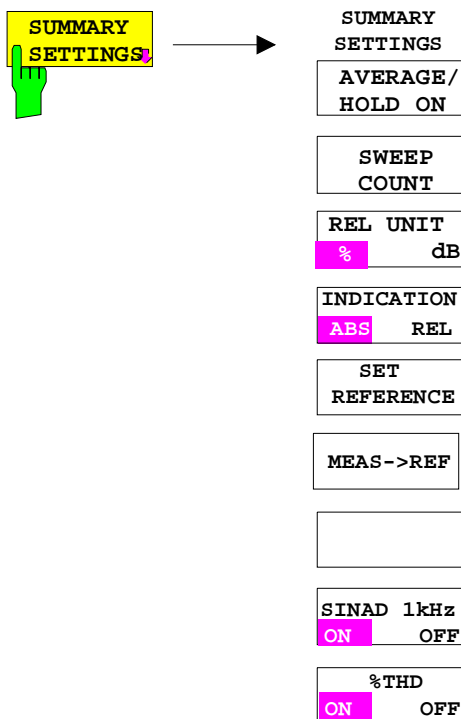
## Extended Functionality for Vector Analyzer Operating Mode (Option FSE-B7)

### Adaptation for EDGE - measurement with receiver filter

The EDGE measurement with a receiver filter and the EVM calculation are performed according to ETSI-TDOC **SMG2 829/99** / ANNEX H. This specified filter is effective in all display and measurement modes. Since it is a lowpass filter intersymbol-interference-free (ISI-free) points no longer occur in the display modes such as constellation diagram and vector diagram. In addition, the sync sequences provided in the unit were adapted by inverting the bits.

**Note:** If measurements are to be performed without a receiver filter, deactivate digital standard EDGE (e.g. by switching from modulation parameter, meas filter from edge\_mes to egde\_ref and back to edge\_mes).

### Analog Demodulation - THD Measurement



#### **REAL TIME ON** only.

The **%THD ON/OFF** softkey activates the %THD measurement (= similar to SINAD measurement, but result displayed in %) for the main modulation signal.

Irrespective of the signal applied, the main modulation signal is compared with the main modulation signal which is filtered by a 1-kHz notch filter. The display unit is %.

When a signal modulated with 1 kHz is applied, the %THD value is thus displayed correctly.

Default setting is **%THD OFF**.

With **REAL TIME OFF** (no real-time demodulation) no **%THD** measurement is possible, the softkey cannot be operated.

IEC/IEEE-bus command: :CALC:MARK:FUNC:ADEM:SIN:THD[:STAT] ON  
:CALC:MARK:FUNC:ADEM:SIN:RES?

## Trace Export for VECTOR ANALYZER Mode

Section "Measurement Function Selection – TRACE 1 to 4 Key" has been extended for the function ASCII EXPORT.



In vector analyzer mode, the *ASCII EXPORT* softkey stores the corresponding trace in a file with ASCII format. For measurement results that are output in written text in tables (Symbol Table, Error Summary, Modulation Summary), this function is not available.

Upon pressing the ASCII EXPORT softkey, a file name can be entered. The default name is TRACE.DAT. Then the measured data of the trace are stored.

The function can be configured in the *ASCII CONFIG* submenu (see trace export for analyzer mode)

### Structure of the ASCII file:

The file consists of the header containing important measurement and scaling parameters and a data section containing the trace data.

The data of the file header consist of three columns, each separated by a semicolon:

parameter name; numeric value; basic unit

The data section starts with the keyword " Trace <n> " (<n> = number of stored trace), followed by the measured data in one or several columns (depending on measurement) which are also separated by a semicolon.

This format can be read in from spreadsheet calculation programs, e.g. MS-Excel. It is necessary to define ';' as a separator.

### 1) Format for digital demodulation

	Content of file	Description
File header	Type;FSEA 30;	Instrument model
	Version;3.10;	Firmware version
	Date;01.Oct 2000;	Date of data set storage
	Comment;Test 1;	Comment
	Mode;digital demodulation;	Instrument mode
	Signal;Meas Signal;	Signal: Measurement, reference or error signal
	Measurement;PHASE;	Selected measurement
	Digital Standard;GSM;	Selected digital standard
	Demodulator;DMSK;	Selected demodulation type
	Center Freq;1930200000;Hz	Center frequency
	Freq Offset;0;Hz	Frequency offset
	Ref.Level;-30;dBm	Reference level
	Level Offset;0;dB	Level offset
	RF Att;20;dB	Input attenuator
	Symbol Rate;270833.33;Hz	Symbol rate
	Meas Filter;NONE;	Input filter
	Ref Filter;gauss;	Filter for ideal reference signal
	Alpha BT;0.3000000;	Roll Off factor or product of bandwidth/symbol duration
	Result Length;148;Symbols	Number of indicated symbols
	Frame Length;400;Symbols	Number of evaluated symbols
	Points per Symbol;4;	Points per symbol
	Memory Size;16384;	Memory size
	x-Axis Start;0.0;Symbols;	Start value of x axis
	x-Axis Stop;147.75;Symbols;	Stop value of x axis
	y per div;45.0;deg;	Y axis scaling, per division
	Ref Value y-Axis;0.0;deg;	y axis scaling, reference value
Ref Value Position;50.0;%;	y axis scaling, position of reference value	
Sweep Count;20;	Number of sweeps	
Trace Mode;CLR/WRITE	Trace mode: CLR/WRITE,AVERAGE,MAXHOLD,MINHOLD	

	Content of file	Description
<b>Data section of the file</b>	Trace 1:	Selected trace
	x-Unit;Symbols;	Unit of x values:
	y-Unit;deg;	Unit of y values:
	Values;592;	Number of test points
		Measured values:
		<x value>,, <y1>, <y2>
		<y2> being only available with Polar Vector or Polar Constellation.
	0.00;44.919303894;	
	0.25;35.109680176;	
	0.50;31.512094498;	
0.75;36.470279694;		
1.00;49.823390961;		
...;...;		

### Example 1a: GSM Phase Measurement

```
Type;FSEA 30;
Version;3.10;
Date;13.Jul 2001;
Comment;PCS BTS;
Mode;digital demodulation;
Signal;Meas Signal;
Measurement;PHASE;
Digital Standard;GSM;
Demodulator;DMSK;
Center Freq;1930200000.000000;Hz;
Freq Offset;0.000000;Hz;
Ref. Level;-10.000000;dBm;
Level Offset;0.000000;dB;
RF Att;20.000000;dB;
Symbol Rate;270833.333330;Hz;
Meas Filter;NONE;
Ref Filter;gauss;
Alpha BT;0.300000;
Result Length;148;Symbols;
Frame Length;400;Symbols;
Points per Symbol;4;
Memory Size;16384;
x-Axis Start;0.000000;Symbols;
x-Axis Stop;147.750000;Symbols;
y per div;45.000000000;deg;
Ref Value y-Axis;0.000000;deg;
Ref Value Position;50.000000;%;
Sweep Count;0;
Trace Mode;CLR/WRITE;
TRACE 1:
x-Unit;Symbols;
y-Unit;deg;
Values;592;
0.000000;44.919303894;
0.250000;35.109680176;
0.500000;31.512094498;
0.750000;36.470279694;
1.000000;49.823390961;
```

...

### Example 1b: Polar Vector Measurement

```
Type;FSEA 30;
Version;3.10;
Date;13.Jul 2001;
Comment;;
Mode;digital demodulation;
Signal;Error Signal;
Measurement;IQ POLAR VECTOR;
Digital Standard;None;
Demodulator;DMSK;
Center Freq;1930200000.000000;Hz;
Freq Offset;0.000000;Hz;
Ref. Level;-10.000000;dBm;
Level Offset;0.000000;dB;
RF Att;20.000000;dB;
Symbol Rate;270833.333330;Hz;
Meas Filter;NONE;
Ref Filter;raised cos;
Alpha BT;0.300000;
Result Length;148;Symbols;
Frame Length;400;Symbols;
Points per Symbol;4;
Memory Size;16384;
x-Axis Start;-12.500000;NONE;
x-Axis Stop;12.500000;NONE;
y per div;2.0000000000;%;
Ref Value y-Axis;0.000000;%;
Ref Value Position;50.000000;%;
Sweep Count;0;
Trace Mode;CLR/WRITE;
TRACE 1:
x-Unit;NONE;
y-Unit;%;
Values;592;
0.000000;-1.167166233;0.299441814;
0.250000;7.433214664;5.665826797;
0.500000;16.573915482;9.026193619;
0.750000;22.309810638;12.612837791;
1.000000;19.233440399;17.377298355;
...
```

## 2) Format for analog demodulation

	Content of file	Description
<b>File header</b>	Type;FSEA 30; Version;3.10; Date;13.Jul 2001; Comment;Test 1; Mode;analog demodulation; Signal;AF Signal; Measurement;AM Signal; Coupling;AC COUPLING; Real Time;OFF; Center Freq;930200000;Hz; Freq Offset;0.000000;Hz; Ref. Level;-10.000000;dBm; Level Offset;0.000000;dB; RF Att;20.000000;dB; Demod BW;100000.000000;Hz; x-Axis Start;0.000000;s; x-Axis Stop;0.005000000;s; y per div;50.0;%; Ref Value y-Axis;0.0;%; Ref Value Position;50.0;%; Sweep Count;0; Trace Mode;CLR/WRITE;	Instrument model Firmware version Date of data set storage Comment Instrument mode AF mode Type of demodulation (AM, FM, PM) AC or DC coupling Real time demodulation (on/off) Center frequency Frequency offset Reference level Level offset Input attenuation Demodulation bandwidth Start value of x axis Stop value of x axis Y axis scaling, per division Y axis scaling, reference value Y axis scaling, position of reference value Number of sweeps set Trace mode: CLR/WRITE,AVERAGE,MAXHOLD,MINHOLD
<b>Data section of the file</b>	Trace 1: x-Unit;s; y-Unit;%; Values;625;  0.0;-28.4; 0.008e-003;-28.4; 0.016e-003;-28.5; 0.024e-003;-28.5; 0.032e-003;-28.4; ...;...;	Selected trace Unit of x values Unit of y values Number of test points Measured values: <x value>; <y value>;

## Example 2: Analog Demodulation

```
Type;FSEA 30;
Version;3.10;
Date;13.Jul 2001;
Comment;Test 1;
Mode;analog demodulation;
Signal;AF Signal;
Measurement;AM Signal;
Coupling;AC COUPLING;
Real Time;OFF;
Center Freq;1930200000.000000;Hz;
Freq Offset;0.000000;Hz;
Ref. Level;-10.000000;dBm;
Level Offset;0.000000;dB;
RF Att;20.000000;dB;
Demod BW;100000.000000;Hz;
x-Axis Start;0.000000;s;
x-Axis Stop;0.005000000;s;
y per div;50.000000000;%;
Ref Value y-Axis;0.000000;%;
Ref Value Position;50.000000;%;
Sweep Count;0;
Trace Mode;CLR/WRITE;
TRACE 1:
x-Unit;s;
y-Unit;%;
Values;625;
0.000000;-28.418941498;
0.008012821e-003;-28.434963226;
0.016025641e-003;-28.550777435;
0.024038462e-003;-28.536586761;
0.032051282e-003;-28.461055756;
```



## Extended Functionality for GSM BTS ANALYZER and GSM MS ANALYZER Operating Modes

Functions for the GSM BTS ANALYZER and GSM MS ANALYZER modes have been considerably extended:

- Additional power class P1 for GSM BTS Analyzer. The new power class P1 for Pico BTS is supported.
- Extended settings range of output power for GSM BTS Analyzer  
The settings range of output power now includes the gap between the power classes 8 and M1. Settings in this range are indicated by a question mark "?" in the table of power classes.
- Trace averaging mode selectable (see description above for Analyzer mode).

### Note for Option FSE-K10:

The measurement MODULATION SPECTRUM - RX BAND as specified in GSM-11.10, chapter 13.4.4, section d)

*d) The resolution and video bandwidth on the spectrum analyzer are adjusted to 100 kHz and the measurements are made at the following frequencies:*

*on every ARFCN from 1 800 kHz offset from the carrier to the edge of the relevant transmit band for each measurement over 50 bursts.*

*at 200 kHz intervals over the 2 MHz either side of the relevant transmit band for each measurement over 50 bursts.*

*at 200 kHz intervals over the band 925 - 960 MHz for each measurement over 50 bursts.*

*at 200 kHz intervals over the band 1805 - 1880 MHz for each measurement over 50 bursts.*

covers also for the P-GSM the E-GSM RX band.

For firmware release 3.10 / 4.10 and above, the measurement covers the following bands:

Selected standard	Modulation RX bands
P-GSM	925 – 960 MHz (instead of 935 to 960 MHz as before)
E-GSM	925 – 960 MHz
For RGSM the extended range from 921 MHz is used.	
R-GSM	921 – 960 MHz

## New IEEE-Bus Commands

The new firmware was extended by the following IEEE-bus commands:

- %THD measurement (FSE-B7, analog demodulation).
- Query for currently used limits in operating modes GSM BTS ANALYZER (FSE-K11) and GSM MS ANALYZER (FSE-K10), Phase Frequency Error measurement.
- Query for currently used limits in FSE-K20/K21 Modulation Accuracy measurement.
- Trace averaging method selectable.

New or extended commands for option FSE-B7 and firmware applications FSE-K10, FSE-K11, FSE-K20, FSE-K21, FSE-K30 and FSE-K31 are included in the updated FSE operating manual and therefore not described in this supplement.

The commands are listed in alphabetical order. In the individual description, the complete notation of the command is given. An example for each command, the \*RST value and the SCPI information is written out at the end of the individual description. The modes for which a command can be used are indicated by the following abbreviations:

A	Spectrum analysis
A-F	Spectrum analysis - frequency domain only
A-Z	Spectrum analysis - time domain only (zero span)
VA	Vector signal analysis (option FSE-B7)
VA-D	Vector signal analysis - digital demodulation (option FSE-B7)
VA-A	Vector signal analysis - analog demodulation (option FSE-B7)
BTS	GSM BTS analysis (options FSE-K11, FSE-K21, FSE-K31)
MS	GSM MS analysis (options FSE-K10, FSE-K20, FSE-K30)

**Note:** *The spectrum analysis (analyzer) mode is implemented in the basic unit. For the other modes, the corresponding options are required.*

### :CALCulate<1|2>:MARKer<1...4>:FUNCTION:ADEMod:SINad:RESult?

This command queries the results of the SINAD or of the THD measurement. For SINAD the result is given in dB, for THD in percent.

**Example:** " :CALC:MARK:FUNC:ADEM:SIN:RES? "

**Features:** \*RST-Value: -  
SCPI: device-specific

**Mode:** VA-A

This command is only a query which is why it is not assigned an \*RST value.

### :CALCulate<1|2>:MARKer<1...4>:FUNCTION:ADEMod:SINad:THD[:STATe] ON | OFF

This command switches the THD measurement on or off. SINAD and THD can not be active at the same time. The result is queried with the same command as the result of the SINAD measurement (see above).

**Example:** " :CALC:MARK:FUNC:ADEM:SIN:THD ON "

**Features:** \*RST-Value: OFF  
SCPI: device-specific

**Mode:** VA-A

This command is valid only in the analog demodulation mode with Real Time ON.

## Modification of Commands for GSM/EDGE Applications:

**:CONFigure[:BTS]:LIMit:PPEak** <numeric\_value>

This command determines the phase error limits in degrees for the phase/frequency measurement (peak value).

**Example:** " :CONF:LIM:PPE 66 "

**Features:** \*RST value: depends on selected standard  
SCPI: device specific

**Mode:** BTS

For firmware 3.20/4.20 and higher, the query :CONFigure[:BTS]:LIMit:PPEak? reads out the error limits currently used in the measurement. I.e., if the standard limits are used, these limits are read out, and if the user limits are used, the set user limits are read out. For firmware versions < 3.20/4.20, always the user limits were read out even if the standards limits were used.

This modification also applies to the following commands:

:CONFigure[:BTS]:LIMit:PRMS

:CONFigure[:BTS]:LIMit:EVMRms

:CONFigure[:BTS]:LIMit:EVMPeak

:CONFigure[:BTS]:LIMit:OSUPpress

:CONFigure[:BTS]:LIMit:PERCentile

:CONFigure[:BTS]:LIMit:FREQuency

:CONFigure[:MS]:LIMit:PPEak

:CONFigure[:MS]:LIMit:PRMS

:CONFigure[:MS]:LIMit:EVMRms

:CONFigure[:MS]:LIMit:EVMPeak

:CONFigure[:MS]:LIMit:OSUPpress

:CONFigure[:MS]:LIMit:PERCentile

:CONFigure[:MS]:LIMit:FREQuency

## Correction of the Operating Manual:

For the following commands, the correct \*RST value is given below:

**:CONFigure[:BTS]:NETWork:PHASe**  
**:CONFigure[:MS]:NETWork:PHASe**

These commands select the phase of the standard according to which the base/mobile station will work.

**Example:** " :CONF:NETW:PHAS 2"

**Features:** \*RST value: 2 for PGSM, EGSM, GSM1800  
2,PLUS for RGSM  
for GSM850 and GSM1900 no phases are available  
SCPI: device-specific

**Mode:** BTS/MS

## Extended Functionality:

**:[SENSe<1|2>]:AVERAge:TYPE** MAXimum | MINimum | SCALar | VIDeo | LINear

This command selects the trace averaging method.

VIDeo Averaging of logarithmic level values.

LINear Averaging of linear power values prior to their conversion into level values.

**Example:** " :AVER:TYPE LIN"

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

**Mode:** A, VA, BTS, MS ("VIDeo" and "LINear" are not available in VA mode)

**Note:** *It is also possible to select the evaluation mode (MAXimum, MINimum, SCALar) for the trace with this command. However, it is recommended to use command DISPLAY[:WINDow<1|2>]:TRACe<1...4>:MODE for this purpose. The command AVERAge:TYPE should be used only to select the trace averaging method. Also, the query reads out the trace averaging mode only.*

*The following functions are defined but should not be used:*

MAXimum (MAX HOLD):  $AVG(n) = MAX(X_1...X_n)$

MINimum (MIN HOLD):  $AVG(n) = MIN(X_1...X_n)$

SCALar (AVERAGE):  $AVG(n) = \frac{1}{n} \times \sum_{i=1}^n x_i$

## Using user-defined limit lines via the remote-control interface with options GSM BTS ANALYZER and GSM MS ANALYZER, Options FSE-K10 and FSE-K11

If user-defined limit lines are to be remote-controlled in applications K10/K11, the following should be observed:

- Limit lines can be created with the commands of the basic unit (CALC:LIM subsystem). Lines created in such a way are available as limit line files in the unit and cannot be distinguished from the "normal" limit lines.
- A user-defined limit line should meet certain criteria (example: Frequency Domain should be selected for the transient spectrum measurement of K11) so that it can be used for a specific K10/K11 measurement. If an attempt is made to activate a non-compatible line, the unit returns the error message "-221, settings conflict".
- K10/K11 measurements require either no limit line or one (spurious, transient spectrum, modulation spectrum) or two limit lines (power vs time measurement). To ensure that measurements are performed as expected, select and activate at least the required number of limit lines (commands CALC1:LIM1:NAM and CALC1:LIM1:STATE) when using user-defined limit lines. It is not possible to activate a user-defined limit line, e.g. in the power vs time measurement, and then assume that the application will automatically select the second line to standard.
- Suffix 1 is always to be used for measurements with one line: CALC1:LIM1!
- For measurements with two lines, suffix 1 is to be used for lower limits and suffix 2 for upper limits.
- After selection and activation of the required number of limit lines, it is possible to activate the use of user-defined lines with command CONF:BTS:LIM:STAN OFF (K11) or CONF:MS:LIM:STAN OFF (K10).
- It is recommended not to use the names of lines for the limit line standard (e.g. DC\_BNL and DC\_BNU) as names of user-defined limit lines in order to make the query of limit line characteristics unambiguous.

### Programming Example:

A Comment line starts with </>

```
// Start FSE-K11 (e.g. GSM1800, Phase 1).
CONF:BTS:NETW GSM1800
CONF:BTS:NETW:PHAS 1

//Select Power vs. Time (PVT) measurement and perform measurement
//with standard limit lines; query results
CONF:BURS:PTEM
INIT:CONT OFF

INIT
*OPC?
CALC:LIM:BURS:PTEM?
```

```

//Create two limit lines and use them for measurement.

// Upper Limit for PVT

CALC1:LIM1:NAM 'K1PVTU'
CALC1:LIM1:DEL
CALC1:LIM1:UNIT DBM
CALC1:LIM1:CONT:DOM TIME
CALC1:LIM1:CONT:MODE REL
CALC1:LIM1:CONT -400e-6,-300e-6,-200e-6,-100e-6,100e-6,200e-6,300e-6,400e-6
CALC1:LIM1:UPPER -50,-40,-30,-20,-20,-30,-40,-50
CALC1:LIM1:UPPER:MODE ABS

// Lower Limit for PVT

CALC1:LIM1:NAM 'K1PVTL'
CALC1:LIM1:DEL
CALC1:LIM1:UNIT DBM
CALC1:LIM1:CONT:DOM TIME
CALC1:LIM1:CONT:MODE REL
CALC1:LIM1:CONT -400e-6,-300e-6,-200e-6,-100e-6,100e-6,200e-6,300e-6,400e-6
CALC1:LIM1:LOWER -60,-50,-40,-30,-30,-40,-50,-60
CALC1:LIM1:LOWER:MODE ABS

// Switch on and activate user defined limit lines
// The command for switching off the standard limit line is only available
// after the user defined limit lines are switched on

// Index 1 for Lower Limit !
CALC1:LIM1:NAM 'K1PVTL'
// Index 2 for Upper Limit !
CALC1:LIM2:NAM 'K1PVTU'
CALC1:LIM1:STATE ON
CALC1:LIM2:STATE ON
CONF:BTS:LIM:STAN OFF

// Start new measurement and query results
INIT
*OPC?
CALC:LIM:BURS:PTEM?

```