

ROHDE & SCHWARZ

Manual

**BASIC SOFTWARE
FOR CONTROL OF SMFP2
WITH PUC
SMFP2 - K1**

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Hints for the use of Software SMFP2-K11. Software Structure

The Basic Software SMFP2-K1 consists of a number of subroutines for controlling the Mobile Tester SMFP2, the Programmable Power Supply NGPU and the Printer PUD from the Process Controller PUC.

The following groups of routines are included:

- Initialization of IEC (GPIB) interface bus and instruments;
entry of test-item data with storage in the PUC.
- Settings on the SMFP2 and NGPU.
- Measurements with the SMFP.
- Transmitter measurement routines.
- Receiver measurement routines.
- Routines for presenting instructions on the screen of the PPC,
for visualizing adjustments and for generating output on the printer.

The basic software occupies program lines 8998⁶ to 16500.

The user program will normally be written using lines 100 to 8900.

The basic software uses the following variables:

X, X(-)
Y, Y1...Y9, Y\$, Y\$()
R
Y1\$...Y9\$, YS\$, YSZ
YA, YB, YC, YD, YE, YF, YG, YH
Z(-), ZC, ZP

These variables should not be used in the user program. All other variables may be used as required. If arrays are to be used, these must be dimensioned in the user program.

2. Calling up the Individual Routines

Routines are called up in general using a three-part procedure:

- Definition of parameters needed in the routine.
- Jump to the corresponding part of the program.
- Output of the result generated by the routine.

Example: Measurement of receiver sensitivity for 20-dB SINAD.

500	Y = 20	- Definition:	20 dB SINAD
510	R = 67 : GOSUB 9000	- Jump:	} routine 67, jump to line 9000
520	PRINT Y	- Output on screen:	} sensitivity in μV

Not all routines require this full procedure. Thus simple settings do not require an output instruction and measurements are usually possible without any prior parameter definition.

3. Preparation of the User Program

3.1 Initialization

The initialization routine (routine 1) should always be used at the start of a test program.

```
100 Y1$ = "SMFP2"
110 R = 1 : GOSUB 9000
```

3.2 Entry of Test-item Data

Routines 2 through 7 are used to store the essential data of the radio to be tested as variables in the PPC. Examples:

```
110 Y = 75.275      } - Receive frequency
120 R = 2 : GOSUB 9000 }
130 Y = 9800       } - Upper/lower band spacing
140 R = 4 : GOSUB 9000 }
.
.
.
.
190 Y = 4          } - Maximum permissible deviation
200 R = 7 : GOSUB 9000 }
```

etc.

3.3 Instrument Settings

This section covers settings on the power supply, basic modulation settings etc. By using the rear-panel control outputs of the SMFP it is also possible to set the radio under test to the correct mode, channel etc.

```
300 Y = 1          } - CCITT filter on
310 R = 18 : GOSUB 9000 }
320 Y = 4          } - NGPU current limit
330 R = 23 : GOSUB 9000 }
340 Y = 12.0       } - NGPU voltage setting
350 R = 24 : GOSUB 9000 }
```

3.4 Measurements

The SMFP2 is switched to the appropriate measuring mode before performing the measurement.

Attention should be paid to the conditions which must be fulfilled before certain test routines can be executed. These preconditions are described in detail in the routine definitions. Error-free operation of the routines can be ensured only if all stated conditions have been realised.

If an error occurs in a routine in the course of the program caused, for example, by an automatic search routine demanding an impossible parameter value or because the SMFP2 responds with a measurement other than that commanded, the error is signalled on the PUC screen. When a button is pressed on the PUC the program continues to run.

The error message states the number of the routine in which the error occurred and the number of the previously used routine.

Settings on the test item which are to be carried out manually can be displayed on the screen with routine 87.

When the setting is completed it is acknowledged using the keyboard on the PUC and the program continues.

400	Y\$	= "SWITCH TO RECEIVE MODE"	}	Instruction on screen
410	R	= 87 : GOSUB 9000		
420	R	= 62 : GOSUB 9000		Receiver test
430	Y	= 20	}	Sensitivity of receiver for 20 dB SINAD and storage in Z(1)
440	R	= 67 : GOSUB 9000		
450	Z(1)	= Y		

3.5 Output of Results

Test results can be output on the screen of the PUC or on the printer PUD. The normal PRINT instructions are used for output on the PUC screen.

A number of routines in the software SMFP2-K1 provide output on the printer PUD. Routine 89 produces a formatted line of print containing text and result. Routine 90 additionally performs a comparison of the measured result with previously stated tolerance limits.

In order to produce titles and other text on the printer use can be made of routine 88.

Output can be generated following each measurement or at the end of the complete test. In the latter case it will be necessary to store the results in the PUC for later use as illustrated in program line 450 above.

Variable arrays must be dimensioned within the user program.

```
500 Y$ = "RECEIVER MEASUREMENTS":R=88:Y=2:GOSUB 9000
510 Y$ = "SENSITIVITY FOR 20 DB SINAD (MICROVOLT)"
520 Y = Z(1)
530 R = 89:GOSUB 9000
```

	Routine No.	Routine	Input parameter	Output parameter
System data	1	Start	SMFP2 - firmware version Y1\$ = "SMFP" Y1\$ = "SMFP2"	---
	2	RF frequency (= receive frequency)	Y in MHz	X(1) in MHz
	3	Channel spacing	Y = in MHz Y1 = channel number Y2 = in kHz	X(1) in MHz X(2) X(3) in kHz
	4	Upper band/lower band spacing	Y in MHz, positive for rec. freq. > transm. freq.	X(4) in MHz X(6) in MHz
	5	IF	Y = in MHz, positive for osc. freq. > input frequency	X(5) = in MHz
	6	Modulation AM, FM, ϕ M	Y = 1, 2 or 3	X(7) = type of mod.
	7	Maximum permissible modulation	Y = modulation in %, kHz or rad	X(8) = mod.
Instrument settings	8	RF frequency setting (signal generator)	Y in MHz	---
	9	RF level setting (signal generator)	Y in μ V	---
	10	RF generator output on/off	Y = 1 or \emptyset	---
	11	RF level (continuous variation ± 0.1 dB)	Y = +1 or -1	---
	12	Modulation setting (int.)	Y in %, kHz or rad	---
	13	Modulation setting (ext.)	Y in %, kHz or rad	---
	14	Internal modulation on/off	Y = 1 or \emptyset	---
	15	---		

	Routine No.	Routine	Input parameter	Output parameter
Instrument settings	16	AF frequency setting	Y in kHz	----
	17	AF output level setting	Y in mV	---
	18	CCITT filter on/off	Y = 1 or \emptyset	---
	19	Tone sequences to ZVEI, CCIR	Y\$ = "Z" for ZVEI Y\$ = "C" for CCIR	----
	20	Control lines on/off	Y1 = relay number Y = \emptyset or 1	----
	21	BCD lines	Y\$ = 3-digit decimal number	---
	22	Channel setting (transceiver)	Y = channel number	X(1) Rx freq. X(2) channel no. X(3) Tx freq.
	23	Current limiting (NGPU)	Y = in A	---
	24	Voltage setting (NGPU)	Y = in V	---
	25	---	---	---
	26	---	---	---
AF and DC measurements	27	AF frequency (ext.)	YE = \emptyset for 1 Hz resol. YE = 1 for 0.1 Hz res. for adjustment: Y1 = min. Y2 = max. Y3 = 2	Y in Hz
	28	AF level (ext.)	for adjustment: Y1 = min. Y2 = max. Y3 = 2	Y in mV
	29	For internal use only		
	30	Distortion	YE = 1 for 300 Hz YE = 2 for 500 Hz YE = 3 for 1 kHz for adjustment: Y1 = min. Y2 = max. Y3 = 2	Y = k in %

	Routine No.	Routine	Input parameter	Output parameter
AF and DC measurements	31	RF voltage (via RF millivoltmeter)	YE = 1 for mV YE = 2 for dBm for adjustment: Y1 = min. Y2 = max. Y3 = 2	Y in mV or dBm
	32	AF frequency response	Y\$ = test frequencies in kHz	Y9 = number of freq. Y(1)...Y(n) in dB X(21)...X(20+Y9) = test freq. in kHz
	33	Multitone sequence generation (setting evaluation facility)	Y\$ = "...", code (up to 3 figures successively (YE = 1 (for acknow- ledge signal)	Y\$ = "..." (with call acknow- ledge facility only)
	34	Multitone sequence decoding	---	Y\$ = decoded tones
	35	DC voltage	for adjustment: Y1 = min. Y2 = max. Y3 = 2	Y in V
	36	DC current	for adjustment: Y1 = min. Y2 = max. Y3 = 2	Y in A
	37	NGPU current (using SMFP2 voltmeter)	---	Y in A
	38	---	---	---
	39	Universal adjustment	Y0 = nominal value Y1 = tolerance in % Y2 = test routine Y4 = setting routine Y5 = step size Y6 = start	Y = last value measured Y1 = last setting

	Routine No.	Routine	Input parameter	Output parameter
Transmitter measurements	40	Transmitter test	X(6) in MHz	---
	41	RF power	for adjustment: Y1 = min. Y2 = max. Y3 = 2	Y in W
	42	RF frequency offset	X(6) in MHz	Y in Hz
	43	Positive modulation	for adjustment: Y1 = min. Y2 = max. Y3 = 2	Y in %, kHz or rad
	44	Negative modulation	for adjustment: Y1 = min. Y2 = max. Y3 = 2	Y in %, kHz or rad
	45	---	---	---
	46	---	---	---
	47	Residual modulation	---	Y in %, kHz or rad
	48	Modulation sensitivity	YA = mod.freq. in kHz Y = nominal modulation in % of max. mod.	Y in mV
	49	Modulation frequency response (referred to 1 kHz)	Y\$ = "test freq. in kHz"	Y(1)...Y(n) levels in dB Y9 = number of freq. X(21)...X(20+Y9) = test freq. in kHz
	50	---	---	---
	51	Modulation distortion	Y = % of max. modulation YE = 1 for 300 Hz YE = 2 for 500 Hz YE = 3 for 1 kHz	Y in %
	52	For internal use only	---	---
53	S/N ratio	---	Y in dB	

	Routine No.	Routine	Input parameter	Output parameter
Transmitter measurements	54	RF frequency (via FREQ. METER or HF-RF input)	YE = 1 FREQ. METER YE = 2 HF-RF	Y in MHz
	55	Demodulated frequency	for adjustment: Y1 = min. Y2 = max. Y3 = 2 YE = 0 resolution 1 Hz YE = 1 resolution 0.1 Hz	Y in Hz
	56	Beat frequency (via FREQ. METER or HF-RF input)	Y \emptyset = comp. freq. in MHz YE = 1 FREQ. METER YE = 2 HF-RF	Y in Hz with polarity sign
	57	---	---	---
	58	Adjacent-channel power ratio	Y = +1 upper channel Y = -1 lower channel	Y in dB
	59	Adjacent-channel power	Y = +1 upper channel Y = -1 lower channel	Y in μ W
	60	---	---	---
	61	---	---	---
Receiver measurements	62	Receiver test	X(1) = in MHz	---
	63	---	---	---
	64	S/N ratio (at 1 kHz)	Y = % of max. modulation	Y in dB
	65	SINAD measurement (at 1 kHz)	Y = % of max. modulation	Y in dB
	66	Sensitivity for given S/N ratio	Y = S/N in dB	Y in μ V
	67	Sensitivity for given SINAD	Y = SINAD in dB YE = \emptyset threshold 2 dB YE = 1 threshold 1 dB	Y in μ V
	68	Quieting sensitivity	---	Y in μ V
	69	6-dB bandwidth + centre-frequency offset	X(1) = channel freq.	Y = in kHz Y1 = centre freq. offset in kHz

	Routine No.	Routine	Input parameter	Output parameter
Receiver measurements	70	---	---	---
	71	Modulation acceptance bandwidth	---	Y = in kHz
	72	Upper and lower squelch thresholds and hysteresis	---	Y(1) = lower threshold in μV Y(2) = upper threshold in μV Y = in dB
	73	---	---	---
	74	---	---	---
	75	---	---	---
	76	AF frequency response (at 1 kHz)	Y\$ = test frequencies in kHz	Y9 = number of freq. Y(1)...Y(n)=levels in dB X(21)...X(20+Y9) = test freq. in kHz
	77	Duplexer test	---	Y = in dB
	78	Image frequency rejection	---	Y in dB
Output	79	---	---	---
	80	---	---	---
	81	---	---	---
	82	---	---	---
	83	---	---	---
	84	---	---	---
	85	---	---	---

	Routine No.	Routine	Input parameter	Output parameter
Output	86	Adjustment with analog indication	Y = measured value Y1 = min. Y2 = max. Y\$ = "text"	Y3 = 1 continue Y3 = \emptyset stop
	87	Text (instruction on screen)	Y\$ = "text"	---
	88	Text (on printer)	Y = \emptyset (normal) Y = 1 (underlined) Y = 2 (expanded) Y\$ = "text"	----
	89	Printer output	Y\$ = "text" Y = measured value	----
	90	Printer output with nominal/actual comparison	Y = measured value Y1 = min. Y2 = max. Y\$ = "text"	----
	91	Screen output with nominal/actual comparison	Y = measured value Y1 = min. Y2 = max. Y\$ = "text"	---
	92	Frequency-response	Y9 = number of freq. X(21)...X(20+n) = test freq. in kHz Y(1)...Y(n) = levels in dB	----
	93	Hard copy	----	---
	94	---	---	---
	95	---	---	---
	96	---	---	---
	97	---	---	---
	98	---	---	---
99	---	---	---	
100	Error signal (int.)	---	---	

Start routine

Routine No. 1

Function

Produces a defined initial condition.

Should be used at the start of every test program.

Dimensions arrays X () for input data and
Y () for test results.

Includes definition of IEC-bus addresses and message
delimiter declaration.

For distinguishing the different measurement capabilities
of SMFP and SMFP2, the type of instrument with which the
software is used is assigned to variable Y1\$. If this
variable is not defined prior to calling up a routine
SMFP will be used automatically.

Variables

INPUT Y1\$ = "SMFP2" when using SMFP2
Y1\$ = "SMFP" when using SMFP

OUTPUT none

Preconditions none

Routines used none

RF frequency

Routine No. 2

Function

Stores the receiver frequency.

Value is used later during receiver test or for transmitter-frequency offset measurement.

Routine should be used for single-channel radios and for each channel of units with various different channel frequencies. A separate routine is provided for multi-channel equipment (R3).

Variables

INPUT Y = RF frequency in MHz

OUTPUT X (1) = RF frequency

Preconditions

none

Routines used

none

Channel spacingFunction

Stores the entered values of receiver frequency, channel number and channel spacing. Values are used later for multi-channel measurements.

Variables

INPUT Y = receive frequency of channel Y1 in MHz
Y1 = channel number (frequency Y)
Y2 = channel spacing in kHz (positive for frequency increasing with increasing channel number, negative for frequency decreasing with increasing channel number)

OUTPUT X (1) = RF frequency
X (2) = channel number
X (3) = channel spacing

Preconditions

none

Routines used

none

Upper-band/lower-band spacing

Function Stores the upper-band/lower-band spacing for duplex equipment.

Variables INPUT Y = upper-band/lower-band spacing in MHz:
positive for rec. freq. > trans. freq.
negative for rec. freq. < trans. freq.
For simplex equipment the routine can be omitted.

X (4) is then set to 0 in the initialization routine.

OUTPUT X (4) = band spacing in MHz
X (6) = X (1) - X (4)
calculated nominal value of trans. frequency.

Preconditions RF frequency R2

Routines used none

Type of modulation

Routine No. 6

Function Stores the type of modulation and sets the SMFP2 accordingly.

		INTERNAL MODULATION	EXTERNAL MODULATION	
<u>Variables</u>	INPUT Y = type of mod.	AM	FM	Y = 1
		FM	ϕ M	Y = 2
		ϕ M	AM	Y = 3
	OUTPUT X (7) = type of mod.			

Preconditions none

Routines used R100 (error signal)

Maximum permissible modulation

Routine No. 7

Function Stores the maximum permissible modulation. Value is used later for settings and adjustments and as reference value for the calculation of spurious modulation ratios.

Variables: INPUT Y = maximum permissible modulation in accordance with type of mod.:

- for AM in %
- for FM in kHz
- for ϕM in rad

(permissible range 0 to 100)

OUTPUT X (8) = maximum permissible modulation

Preconditions none

Routines used R100 (error signal)

RF level setting on signal generator

Routine No. 9

<u>Function</u>	Level setting in μV . Coarse setting using step attenuator; interpolation (< 2 dB) using electronic fine variation.
<u>Variables</u>	INPUT Y = RF level in μV (permissible range 0.032 to 1000000) OUTPUT none
<u>Preconditions</u>	none
<u>Routines used</u>	R100 (error signal)

RF generator output on/off

Routine No. 10

Function Switches the RF output of the signal generator on or off without affecting the frequency, level setting or modulation.

Variables INPUT Y = 0 off
= 1 on

OUTPUT none

Preconditions none

Routines used R100 (error signal)

RF level (continuous variation)

Routine No. 11

Function

Continuous variation of RF level using the electronic attenuator.

The RF level must first be set to an initial value using routine 9. Starting from this value it is possible to increase the attenuation by up to 10 dB without causing an interruption of the RF signal.

If variation is continued beyond this range the coarse step attenuator will switch, causing a brief interruption of the RF signal.

Each time the routine is executed the level is changed by the smallest possible step of 0.1 dB. Larger steps are produced by repeating the routine.

Variables

INPUT Y = 1 Increase level by 0.1 dB
 = -1 Decrease level by 0.1 dB

OUTPUT none

Preconditions

Coarse level setting R9

Routines used

R100 (error signal)

Modulation setting, int.

Routine No. 12

Function

Setting the modulation of the RF signal generator.
In accordance with the selected type of modulation
the setting will be in % (AM), kHz (FM) or rad (ϕ M).

Variables

INPUT Y = modulation in %, kHz or rad
Range: 0.1 to 100 for AM, FM
0.1 to 12 for ϕ M

OUTPUT none

Preconditions

Type of modulation R6

Routines used

R100 (error signal)

Routine No. 14

Modulation, int. ON/OFF

Function Switches the internal modulation on and off without changing the set AF frequency or modulation.

Variables INPUT Y = 0 off
= 1 on

OUTPUT none

Preconditions none

Routines used none

CCITT filter on/off

Function Switches the CCITT weighting filter on or off.
When the filter is on both measurements on externally applied signals and measurements on internally demodulated signals are passed through the weighting filter.

Variables INPUT Y = 1 filter on
= 0 filter off

OUTPUT none

Preconditions none

Routines used R100 (error signal)

Tone sequences to ZVEI, CCIR

Routine No. 19

Function Generation and decoding of 5-tone sequences to ZVEI or CCIR.
The defined tone sequence is generated or decoded in routines
33 and 34.

Variables INPUT Y\$ = "Z" ZVEI
 "C" CCIR

 OUTPUT none

Precondition none

Routines used R100 (error signal)

Control lines on/off

Routine No. 20

Function Controls the relay matrix built into the SMFP2. The relays may be used for controlling the radio being tested or for switching test signals.

Relay 1 cannot be switched with this routine.

Relay 1 is closed by calling up R40 (transmitter test) and opened by calling up R62 (receiver test).

The relay contacts are brought out at the control sockets BU401 and BU402 on the rear panel. Contact occupancy:

Relais	1	2	3	4	5	6	7	8	9
Contacts	14+15	1+2	3+4	5+6	7+8	9+10	11+12	13+15	14+15
Socket	BU401	BU402							

Contact 15 of BU402 is common to relays 8 and 9

Variables INPUT Y1 = number of relay
(permissible range see table above)

Y = 0 contacts open
= 1 contacts closed

OUTPUT none

Preconditions none

Routines used R100 (error signal)

BCD lines

Routine No. 21

Function

The data contained in the string Y\$ are brought out at the pins of socket BU401 on the rear of the SMFP2.

Pin allocation:

	Hundreds				Tens				Units			
Contact	┌───────────┐				┌───────────┐				┌───────────┐			
Socket	9	10	11	12	5	6	7	8	1	2	3	4
BU401	MSB		LSB		MSB		LSB		MSB		LSB	

Four bit hexadecimal bytes (decimal 10 to 15) can also be produced by using the appropriate ASCII characters (: ; < = > ?)

Variables

INPUT Y\$ = decimal value to be generated
 (always enter 3 characters)
 permissible characters 0 to 9 and : ; < = > ?

OUTPUT none

Preconditions

none

Routines used

R100 (error signal)

Channel setting on transceiver

Routine No. 22

Function

Receive and transmit frequencies are calculated from the channel number entered. These are then stored in X (1) and X (6).

The channel number is output on the BCD lines of socket BU401 (occupancy see routine no. 21).

Variables

INPUT Y = channel number
(permissible range 0...999)

OUTPUT X (1) = receive frequency in MHz
X (2) = channel number
X (6) = transmit frequency

Precondition

channel spacing R3

Routines used

R4 Upper-band/lower-band spacing
R21 BCD lines

AF frequency measurement (external signal)

Routine No. 27

Function

Measures the frequency of a signal applied at the AF input socket.

For adjustments, the measurement can be displayed in analog form on the screen by setting Y3 = 2.

See routine 86.

Variables

INPUT YE = 0 resolution of measured value 1 Hz
1 resolution of measured value .1Hz

Optional for adjustment

Y3 = 2

Y1 = lower limit in Hz

Y2 = upper limit in Hz

OUTPUT Y = frequency in Hz

Preconditions

Selection of firmware version (SMFP/SMFP2) R1

Routines used

R100 (error signal)

Distortion measurement

Routine No. 30

Function

Measures the harmonic distortion of a 300-Hz, 500-Hz or 1-kHz signal applied at the AF input.

For adjustments, the measurement can be displayed in analog form on the screen by setting Y3 = 2.

See routine 86.

Variables

INPUT YE = 1 for 300 Hz
 YE = 2 for 500 Hz
 YE = 3 for 1 kHz

Optional for adjustment

Y3 = 2
Y1 = lower limit
Y2 = upper limit

OUTPUT Y = distortion in %

Preconditions

AF frequency setting (externally or with R16)
Selection of firmware version (SMFP/SMFP2) R1.

Routines used

R100 (error signal)

AF frequency response

Routine No. 32

Function

- AF frequencies contained in string and separated by commas are allocated to distinct variables.
- Set 1 kHz modulation frequency and measure reference value.
- Measure at test frequencies and compute frequency-response values in dB.
- Reset frequency to 1 kHz.

Variables

INPUT Y\$ = string containing input data separated by commas

OUTPUT Y9 = number of data elements

Y (0) = AF level at 1 kHz (reference) in mV

X (21)	}	test frequencies in kHz
.		
X (20 + Y9)		
Y (1)	}	frequency response values in dB ordered as in input string Y\$
.		
.		
Y (Y9)		

Preconditions AF output level setting R17

Routines used

R16 AF frequency setting

R28 AF level measurement

Multitone sequence generation

Routine No. 33

Function

Generates up to 8 tones to CCIR or ZVEI which are available at the MOD. GEN. output or which modulate the AF output signal.

The tone-sequence decoder is reset prior to the tone output.

Selection of CCIR or ZVEI in R19.

Level setting in R17, modulation setting in R42.

For radio sets with call acknowledge facility, setting YE = 1 causes the acknowledge signal to be detected and decoded.

Variables

INPUT Y\$ = "-----"

(up to 8 figures from 0 to 9,
successively without separator)

YE = 1 for acknowledge signal

OUTPUT Y\$ = "----" acknowledge signal (with call
acknowledge facility only)

Preconditions

Tone sequence to ZVEI/CCIR R19,

AF output level setting R17 or modulation setting R12

RF level setting R9, R66, R67, R68

Continuous tone R16

(frequency = 0, suppresses the continuous tone).

Routines used

R100 (error signal)

R40 Transmitter test

R16 AF frequency setting

R8 RF frequency setting on signal generator

R41 RF power of transmitter

R62 Receiver test

R14 Modulation, int. ON/OFF

R10 RF generator output on/off

R28 AF level measurement

Multitone sequence decoding

Routine No. 34

Function

Decodes 5-tone sequences to ZVEI or CCIR.

The tone sequence is applied either to the external AF-AC input or derived from a demodulated transmitter signal. First carry out R33 (with Y\$ = " ") to clear the decoder store.

Variables

INPUT none

OUTPUT Y\$ = ordinal numbers of decoded tones
(hexadecimal 0 to 9, A,B,C,D,E,F)

Preconditions

Tone sequence to ZVEI/CCIR R19

Decoding of demodulated signal:

Transmitter modulation R43, R44.

Decoding of AF-AC signal:

AF level measurement (ext.) R28

(level > 100 mV)

Resetting the decoder by output of a sound sequence R33

Routines used

R100 (error signal)

DC voltage measurement

Routine No. 35

Function

Measurement of the DC voltage applied at the DC test sockets. If the voltage is applied with the wrong polarity the result will be 0.

For adjustments, the measurement can be displayed in analog form on the screen by setting Y3 = 2.

See routine 86.

Variables

INPUT optional for adjustment

Y3 = 2

Y1 = lower limit

Y2 = upper limit

OUTPUT Y = DC voltage in V

Preconditions

none

Routines used

R100 (error signal)

DC current measurement

Routine No. 36

Function

Measurement of the DC current flowing between one of the pairs of test sockets. If the polarity is wrong the result will be \emptyset .

For adjustments, the measurement can be displayed in analog form on the screen by setting Y3 = 2.

See routine 86.

Variables

INPUT optional for adjustment

Y3 = 2

Y1 = lower limit

Y2 = upper limit

OUTPUT Y = current in A

Preconditions

none

Routines used

R100 (error signal)

Routine No. 37

NGPU current measurement using
sensing resistor and SMFP voltmeter

Function

Measurement of the current drawn from the NGPU by measuring the voltage drop across the sensing resistor in the NGPU using the DC voltmeter of the SMFP2.

100 mV is produced at the maximum current in each range of the current limiting. (If the NGPU 70/20 is used the result must be further multiplied by 2).

Variables

INPUT none

OUTPUT Y = DC current in A

Preconditions

none

Routines used

R35 DC voltage measurement

Universal adjustment routine

Routine No. 39

Function One routine is used for measurements and another for setting. The set parameter is varied automatically until the measurement reaches the nominal value within the given tolerance.

The direction of variation is determined automatically by the routine. The initial step size should be chosen to produce a change in the measured result by a factor of 2.

If the required adjustment cannot be made, the routine stops and outputs the measured value reached or the set parameter.

Variables

INPUT Y0 = nominal value
Y1 = tolerance in %
Y2 = number of measurement routine
Y4 = number of setting routine
Y5 = initial step size
Y6 = initial value for setting routine

OUTPUT Y = measured value at end of adjustment
Y1 = last value of setting parameter

Preconditions

none

Routines used

Routines specified with Y4 and Y5

Transmitter test

Routine No. 40

Function

Switches the SMFP2 to the transmitter test mode.
Transceiver is switched to transmit by closing the
control relay no. 1 (contacts 14 and 15 of socket BU401).

Variables

INPUT X (6) = nominal transmitter frequency in MHz
OUTPUT none

Preconditions

Receiver frequency R2 or R3
Band spacing R4 if required

Routines used

R12 Modulation setting
R20 Relay control

Routine No. 41

RF power of transmitterFunction Measurement of RF transmitter powerVariables INPUT optional for adjustment

Y3 = 2

Y1 = lower limit

Y2 = upper limit

OUTPUT Y = measured power in W

Preconditions noneRoutines used R100 (error signal)

RF frequency offset of transmitter

Routine No. 42

Function Measurement of transmitter frequency and calculation
of the offset from the nominal frequency X (6).

Variables INPUT X (6) = transmitter nominal frequency
OUTPUT Y = frequency offset in Hz

Preconditions Receiver frequency R2 or R3
Band spacing R4 if required

Routines used R100 (error signal)

Positive modulation of transmitter

Routine No. 43

Function Measurement of the positive modulation in %, kHz or rad.
Switches off SMFP2 generator modulation.

Variables INPUT optional for adjustment

Y3 = 2
Y1 = lower limit
Y2 = upper limit

OUTPUT Y = modulation in %, kHz or
rad positive values

Preconditions Type of modulation R6
Transmitter modulation R16 + R17
Transmitter test R40

Routines used R100 (error signal)

Negative modulation of transmitter

Routine No. 44

Function Measurement of the negative modulation in %, kHz or rad.
Switches off SMFP2 generator modulation.

Variables INPUT optional for adjustment
Y3 = 2
Y1 = lower limit
Y2 = upper limit
OUTPUT Y = modulation in %, kHz or
rad. negative values

Preconditions Type of modulation R6
Transmitter modulation R16 + R17
Transmitter test R40

Routines used R100 (error signal)

Routine No. 47

Residual modulationFunction

→ Switch off AF signal

→ Measure modulation

Variables

INPUT none

OUTPUT Y = residual modulation in %, kHz or rad

Preconditions

Transmitter test R40

Type of modulation R6

Routines used

R17 AF output level setting

R43 Positive modulation

Modulation sensitivity of transmitter

Routine No. 48

Function

- Sets modulation generator
- Measures modulation and automatically sets AF generator level until the given modulation is reached within 5%.
The modulation is to be specified as % of maximum permissible modulation.

Variables

INPUT YA = modulation generator frequency in kHz
Y = test modulation as % of max. perm. mod.

OUTPUT Y = AF generator voltage in mV for the given test modulation

Preconditions

Transmitter test R40
Type of modulation R6
Maximum permissible modulation R7

Routines used

R16 Modulation frequency
R17 AF output level setting
R43 Positive modulation

Modulation frequency response of transmitter

Routine No. 49

Function

- Stores the test frequencies as separate variables.
- Sets 20% of max. perm. modulation at 1 kHz.
- Measures modulation at the test frequencies.
- Calculates difference from value at 1 kHz in dB.
- Sets 20% of max. perm. mod. at 1 kHz.

Variables

INPUT Y\$ = list of test frequencies separated by commas

OUTPUT Y9 = number of test frequencies

Y (0) = modulation at 1 kHz (reference value)

Y (1)	}	levels in dB relative to value of modulation at 1 kHz, ordered as in input string Y\$
.		
.		
Y (9)		

X (21)	}	Test frequencies in kHz
.		
.		
X (20+Y9)		

Preconditions

Type of modulation R6

Max. perm. modulation R7

Transmitter test R40

Routines used

R43 Positive modulation

R48 Modulation sensitivity

R16 AF frequency setting

Modulation distortion of transmitter

Routine No. 51

Function

- Sets AF generator frequency
- Sets modulation to % of max. perm. mod.
- Measures harmonic distortion.

Variables

INPUT YE = 1 for 300 Hz
 2 for 500 Hz
 3 for 1 kHz
 Y = % of max. perm. mod.

OUTPUT Y = distortion in %

Preconditions

Type of modulation R6
Max. perm. modulation R7
SMFP/SMFP2 firmware level R1

Routines used

R16 AF frequency setting
R17 AF level setting
R43 Positive modulation
R30 Distortion measurement

Transmitter S/N ratio

Routine No. 53

Function

The AF output signal (modulation generator) is switched on and off, the modulation being measured in both cases. The ratio of the two modulation measurements is computed.

Variables

INPUT none

OUTPUT Y = S/N in dB

Preconditions

Transmitter test R40

Modulation sensitivity R48

or AF frequency and level setting R16 + R17

or AF level setting R17.

Routines used

R100 (error signal)

RF frequency

Routine No. 54

Function

Measurement of frequency either via HF-RF input/output
or FREQ. METER input

Variables

INPUT YE = 1 measurement via FREQ. METER input
 YE = 2 measurement via HF-RF input/output

OUTPUT Y = frequency in MHz

Preconditions

none

Routines used

R100 (error signal)

Measurement of demodulated frequency

Routine No. 55

Function Measurement of frequency of demodulated transmitter signal present at RF input.

For adjustment procedures, the measured value can be displayed directly as an analog value on the screen by setting Y3 = 2.

See routine 86.

Variables INPUT optional for adjustment

Y3 = 2

Y1 = lower limit

Y2 = upper limit

YE = 1 resolution 0.1 Hz

YE = 0 resolution 1 Hz

OUTPUT Y = frequency in Hz

Preconditions none

Routines used R100 (error signal)

Adjacent-channel power ratio

Routine No. 58

a) for SMFP

Function

- Checking for upper or lower adjacent channel
- Checking for permissible channel spacing
- Setting test modulation
 $f_{\text{mod}} = 1.25 \text{ kHz}$ 20 dB overmodulation
- Storing channel spacing
- Measuring adjacent-channel power ratio
- Setting nominal channel frequency on signal generator
- Resetting test modulation $f_{\text{mod}} = 1 \text{ kHz}$ without overmodulation.

Variables

INPUT	Y = (+)1	upper adjacent channel
	Y = -1	lower adjacent channel
OUTPUT	Y =	power ratio in dB

Preconditions

- Transmitter frequency R2 or R4
- Channel spacing R3
- Max. permissible modulation R7
- Selection of firmware version (SMFP/SMFP2) R1

Routines used

- R48 Modulation sensitivity
- R17 AF generator level
- R16 AF generator frequency
- R40 Basic setting for transmitter measurement

b) for SMFP2

Function

- Checking for upper or lower adjacent channel
- Setting test modulation .
 $f_{\text{mod}} = 1.25 \text{ kHz}$, 20 dB overmodulation
 (only with channel spacing 10; 12.5; 20; 25 kHz)
- Storing channel spacing
- Setting nominal channel frequency on signal generator
- Measuring adjacent-channel power ratio
- Resetting test modulation
 $f_{\text{mod}} = 1 \text{ kHz}$ without overmodulation.
 (only with channel spacing 10; 12.5; 20; 25 kHz)

Variables

INPUT Y = (+)1 upper adjacent channel
 Y = - 1 lower adjacent channel

YE = \emptyset Adjacent-channel power ratio
 measured at 4 kHz IF bandwidth

YE = 1 Adjacent-channel power ratio
 measured at 8 kHz IF bandwidth

OUTPUT Y = power ratio in dB

Preconditions

Transmitter frequency R2 or R4
 Channel spacing R3
 Max. permissible modulation R7
 Selection of firmware version (SMFP/SMFP2) R1

Routines used

R48 Modulation sensitivity
 R17 AF generator level
 R16 AF generator frequency
 R40 Basic setting for transmitter measurement

Adjacent-channel power

Routine No. 59

a) for SMFP

Function

- Checking for upper or lower adjacent channel
- Checking for permissible channel spacing
- Setting test modulation
 $f_{\text{mod}} = 1.25 \text{ kHz}$, 20 dB overmodulation
- Storing channel spacing
- Setting nominal channel frequency on signal generator
- Measuring adjacent-channel power
- Resetting test modulation $f_{\text{mod}} = 1 \text{ kHz}$ without overmodulation.

Variables

INPUT Y = (+)1 upper adjacent channel
 - 1 lower adjacent channel

OUTPUT Y = power in μW

Preconditions

Transmitter frequency R2 or R4
Channel spacing R3
Max. permissible modulation R7
Selection of firmware version (SMFP/SMFP2) R1.

Routines used

R48 Modulation sensitivity
R17 AF generator level
R16 AF generator frequency
R40 Basic setting of transmitter measurement

b) for SMFP2

Function

- Checking for upper or lower adjacent channel
- Setting test modulation
 $f_{\text{mod}} = 1.25 \text{ kHz}$, 20 dB overmodulation
 (only with channel spacing 10; 12.5; 20; 25 kHz)
- Storing channel spacing
- Setting nominal channel frequency on signal generator
- Measuring adjacent-channel power
- Resetting test modulation
 $f_{\text{mod}} = 1 \text{ kHz}$ without overmodulation
 (only with channel spacing 10; 12.5; 20; 25 kHz)

Variables

INPUT Y = (+)1 upper adjacent channel
 - 1 lower adjacent channel

YE = \emptyset Adjacent-channel power
 measured at 4 kHz IF bandwidth

YE = 1 Adjacent-channel power
 measured at 8 kHz IF bandwidth

OUTPUT Y = power in μW

Preconditions

Transmitter frequency R2 or R4
 Channel spacing R3
 Max. permissible modulation R7
 Selection of firmware version (SMFP/SMFP2) R1

Routines used

R48 Modulation sensitivity
 R17 AF generator level
 R16 AF generator frequency
 R40 Basic setting of transmitter measurement

Receiver test

Routine No. 62

Function

- Switches the SMFP2 to receiver test mode.
- Switches transceiver transmitter off by opening control relay no. 1 (contacts 14 and 15 of socket BU401).
- Sets SMFP2 to receive frequency of transceiver.

Variables

INPUT X (1) = receiver frequency

OUTPUT none

Preconditions

Receive frequency R2

Routines used

R20 Control lines on/off

R8 RF generator frequency

S/N-ratio measurement, 1 kHz

Routine No. 64

Function

- Sets sig. gen. to % of max. perm. modulation
- Sets AF generator to 1 kHz
- First AF level measurement, switches modulation off
- Second AF level measurement, calculates S/N ratio in dB

Variables

INPUT Y = % of max. perm. modulation

OUTPUT Y = S/N ratio in dB

Preconditions

RF frequency setting R62 or R8

RF level setting R9

Max. perm. modulation R7

Type of modulation R6

Routines used

R12 Modulation setting

R16 AF frequency setting

R28 AF level measurement

SINAD measurement, 1 kHz

Routine No. 65

Function

- Sets sig. gen. to % of max. perm. mod.
- Sets AF generator to 1 kHz
- Measures SINAD

Variables

INPUT Y = % of max. perm. mod.

OUTPUT Y = SINAD in dB

Preconditions

RF frequency setting R8 or R62

RF level setting R9

Max. perm. modulation R7

Type of modulation R6

Routines used

R12 Modulation setting

R16 AF frequency setting

R100 (error signal)

Receiver sensitivity for given S/N ratio

Routine No. 66

Function

- Sets RF level to 1 μ V
- Measures S/N at 1 kHz with ^{Y1}60% of max. perm. mod. and compares with nominal value
- Corrects RF level setting and measures S/N until correct nominal value has been reached.

Variables

INPUT Y = nominal value of S/N ratio in dB
 $\gamma_1 = \frac{S}{N}$ of max. modulation

OUTPUT Y = sensitivity in μ V

Preconditions

RF frequency setting R8 or R62
 Type of modulation R6
 Max. perm. modulation R7

Routines used

R9 RF level setting
 R64 S/N ratio measurement

Receiver sensitivity for given SINAD

Routine No. 67

Function

- Sets RF level to 1 μ V
- Measures SINAD at 1 kHz with ⁴¹60% of max. perm. mod. and compares with nominal value.
- Corrects RF level setting and measures SINAD until nominal value has been reached.

Variables

INPUT Y = nominal value of SINAD in dB
41 = % of max. modulation
YE = 0 threshold at 2 dB
1 threshold at 1 dB

OUTPUT Y = sensitivity in μ V

Preconditions

RF frequency setting R62 or R8
Type of modulation R6
Max. perm. modulation R7

Routines used

R9 RF level setting
R65 SINAD measurement

Quieting sensitivity

Routine No. 68

Function

- RF off
- Measure AF level
- Apply unmodulated RF signal and increase RF level until AF level has dropped by 20 dB.

Variables

INPUT none

OUTPUT Y = 20 dB noise quieting sensitivity

Preconditions

RF frequency setting R62 or R8

Routines used

R10 RF generator on/off
R28 AF level measurement
R9 RF generator level setting

Receiver 6-dB bandwidth and centre-frequency offset

Routine No. 69

Function

- RF off, modulation off
- Measures AF noise level
- Switches on RF and increases level until noise falls by 10 dB (quieting).
- Increases RF level by further 6 dB and varies RF frequency to obtain same AF level again.
- Calculates bandwidth and offset from nominal channel frequency.
- Resets RF frequency to nominal channel frequency.

Variables

INPUT X (1) = channel frequency

OUTPUT Y = bandwidth in kHz

Y1 = centre-frequency offset in kHz

Preconditions

Receive frequency R2

Routines used

R10 RF generator output on/off

R28 AF level measurement

R9 RF level setting

R8 RF frequency setting

Routine No. 71

Modulation acceptance bandwidth

(to EIA)

Function

- Set modulation to 60% of max. permissible mod. at 1 kHz
- Adjust RF level for 12 dB SINAD
- Raise RF level by 6 dB
- Increase deviation until SINAD returns to 12 dB
(Measurement only possible with FM modulation).

Variables

INPUT none

OUTPUT Y = deviation in kHz

Preconditions

RF frequency setting R8 or R62

Type of modulation R6 (only FM possible)

Maximum permissible modulation R7

Routines used

R67 Receiver sensitivity for given SINAD

R9 RF level setting

R65 SINAD measurement

Squelch upper and lower thresholds and hysteresis

Routine No. 72

Function

- Sets low RF level and increases in coarse steps until squelch responds.
- Continuously reduces RF level until squelch closes again. (Level = Y1)
- Continuously raises RF level until squelch reopens (Level = Y2).
- Compute hysteresis in dB.

Variables

INPUT none

OUTPUT Y1 = lower squelch threshold in μV
Y2 = upper squelch threshold in μV
Y = squelch hysteresis in dB

Preconditions

RF frequency setting R62 or R8
Modulation setting R12

Routines used

R9 RF level setting
R28 AF level measurement

Receiver AF frequency response

Routine No. 76

Function

- Stores test frequencies separately
- Measures AF output voltage at 1 kHz and at 20% of max. perm. modulation.
- Measures AF output voltage at test frequencies.
- Calculates difference from value at 1 kHz in dB.
- Sets AF frequency to 1 kHz.

Variables

INPUT Y\$ = "test frequencies in kHz separated by commas"

OUTPUT Y9 = number of test frequencies

Y (0) = AF level at 1 kHz (reference)

X (21)	}	test frequencies in kHz
.		
.		
X (20 + Y9)		
Y (1)	}	levels in dB relative to value at 1 kHz in same order as test frequencies
.		
.		
Y (9)		

Preconditions

RF frequency setting R62 or R8

Type of modulation R6

Max. perm. modulation R7

Routines used

R9 RF level setting

R28 AF level measurement

Duplexer test

Routine No. 77

Function

- Measures sensitivity for 12 dB SINAD
- Switches transmitter on (close relay no. 1)
- Measures sensitivity again for 12 dB SINAD
- Computes change in sensitivity in dB
- Switches off transmitter (open relay no. 1)

Variables

INPUT none

OUTPUT Y = change of receiver sensitivity in dB
when transmitter in operationPreconditions

RF generator frequency R62 or R8

Type of modulation R6

Max. perm. mod. R7

Routines used

Sensitivity for given SINAD R67

RF frequency setting R8

Transmitter test R40

Image frequency rejection

Routine No. 78

Function

- Measure in-channel 12 dB SINAD sensitivity
- Set RF generator to image frequency
- Repeat sensitivity measurement
- Compute rejection ratio in dB
- Reset RF frequency to channel frequency

Variables

INPUT none

OUTPUT Y = difference between sensitivities in channel
and at image frequency in dB

Preconditions

RF frequency setting R62 or R8

Enter IF R5

Type of mod. R6

Max. perm. mod. R7

Enter receiver frequency R2

Routines used

Sensitivity for given SINAD R67

RF generator frequency R8

Adjustment with analog indication

Routine No. 86

Function

Displays adjustment procedure on PUC screen.

An arrow indicates the position of the measured value relative to the given limits. The values of the current measurement and the limits are also shown digitally. Pressing any key on the PUC keyboard sets a variable which indicates whether the adjustment should be continued or stopped.

(This routine can also be used directly with various test routines. Before the routine is called set Y3 = 2, which makes it unnecessary to interrogate Y3 in the program.)

Variables

INPUT Y = measured value
Y1 = lower limit
Y2 = upper limit
Y\$ = text instruction (max. 39 characters)

OUTPUT Y3 = 1 when adjustment is to be continued
= 0 when adjustment is to be stopped

Preconditions

none

Routines used

none

Text instruction on screen

Routine No. 87

Function

Produces text on the screen of the PUC as an instruction to the operator. Text flashes at intervals of 0.5 s.

The routine can be stopped by pressing any key, which also causes the text to be cleared from the screen.

Variables

INPUT Y\$ = text (max. 39 characters)

OUTPUT none

Preconditions

none

Routines used

none

Text output on printer (PUD)

Routine No. 88

Function

The routine addresses the printer for the output of text such as titles on the printer. Various character types can be selected.

Variables

INPUT	Y	= 0	normal text
	Y	= 1	normal text underlined
	Y	= 2	expanded text
	Y	= 3	new line with no text in Y\$
	Y\$	= "Text!"	max. 72 characters normal max. 36 characters expanded

Preconditions

none

Routines used

R100 (error signal)

Printer output (PUD)

Routine No. 89

Function

The printer is addressed and the text printed.
The text appears at the lefthand margin and
the measured value in a column to the right of this.

Variables

INPUT Y = measured value
Y\$ = text (max. 48 characters)

OUTPUT none

Preconditions

none

Routines used

none

Printer output with nominal/actual comparison (PUD)

Routine No. 90

Function

The measured value is compared with a nominal value (upper and lower limits). Text and measured value are then printed. If the measured value lies outside the tolerance limits the measured value is printed one column further to the right and marked with an asterisk.

Variables

INPUT Y = value to be printed
Y1 = lower limit
Y2 = upper limit
Y\$ = text and physical unit to be printed
(max. 48 characters)

OUTPUT none

Preconditions

none

Routines used

R89 Printer output

Screen output with nominal/actual comparison

Routine No. 91

Function

The measured value is compared with a nominal value (upper/lower limits). Text and measured value are then output on screen. If the measured value lies outside the tolerance limits it is marked with an asterisk.

Variables

INPUT Y = measured value to be output
Y1 = lower limit
Y2 = upper limit
Y\$ = text and physical unit to be output
(max. 26 characters)

OUTPUT none

Preconditions

none

Routines used

none

Frequency-response diagram

Routine No. 92

Function

The routine produces a graphic representation of an AF frequency response measurement on the screen. The X-axis covers 0.1 to 10 kHz logarithmic. The Y-axis is scaled automatically. It shows the dB variation from the value at 1 kHz.

Variables

INPUT Y9 = number of test frequencies

X (21)	}	test frequencies in kHz
:		
X (20 + Y9)		
Y (1)	}	values to be displayed in dB relative to value at 1 kHz
:		
:		
Y (Y9)		

OUTPUT none

Preconditions

Frequency-response measurement R32, R49 or R76. These routines automatically supply the input data for the graphical display.

Routines used

none

Hard copy

Routine No. 93

Function

The routine produces a copy of the screen display on the printer PUD connected at the parallel interface. The printer is switched to no-space mode for the output and returned to normal mode after the output.

Variables

INPUT none

OUTPUT none

Preconditions

none

Routines used

none

Error signal

Routine No. 100

Function

Program jumps to this routine when an error is recognized in one of the measurement routines.

The number and function of the routine in which the error has been found is indicated. The program can be stopped using the STOP key or continued by pressing any other key.

Variables

INPUT Y = number of routine in which error has
 been found

OUTPUT none

Preconditions

none

Routines used

none