# Frequency synthesizer
SPS-20

2015

Application

SPS-20 is designed for using as a reference generator and a highly stable heterodyne in the wide frequency range 9 kHz…20 GHz for testing various electronic devices and systems during their research, development, operation and maintenance.

SPS-20 provides the specified harmonic signal of wide frequency range with output power control and different types of modulation.

Specification

– Dimensions: 178x85x25 mm
– Weight: 0,6 kg
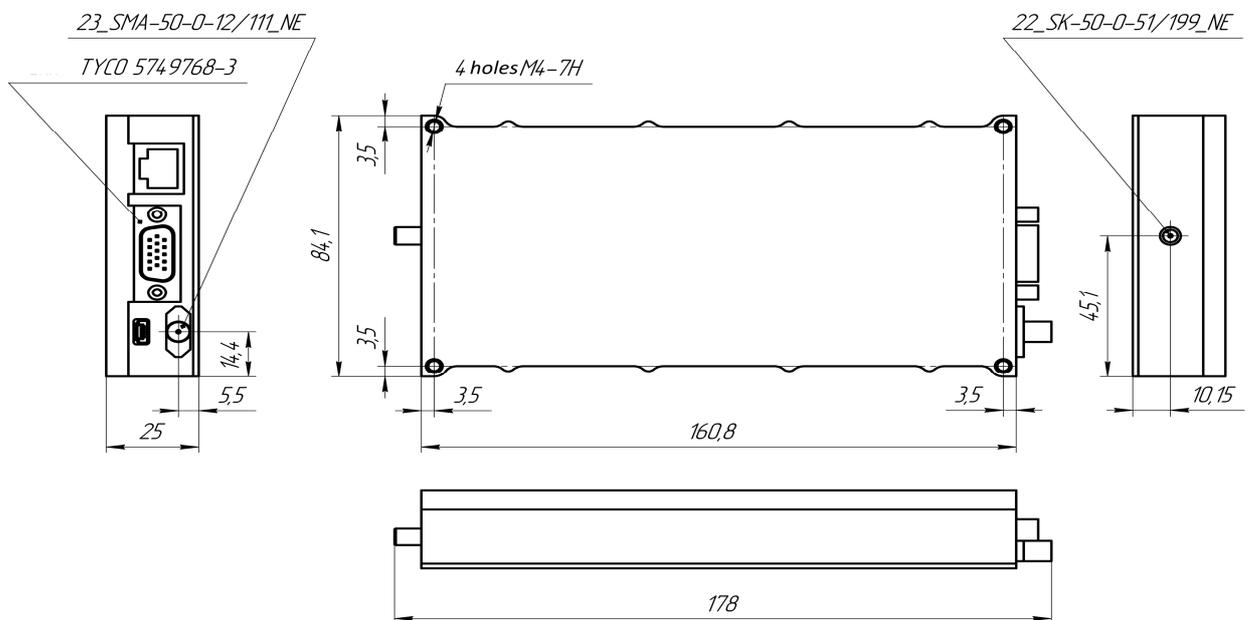
Dimension drawing of SPS-20

– Operating frequency range, ………..……………..……9 kHz…20 GHz
– Frequency resolution, Hz…………………..…………………………0,001
– Frequency stability …………………………………………………1×10^{-6}
– Output power range, dBm*:
160 MHz $\leq$ f < 20 GHz……..…………………………………… -10…+10
– Output power resolution, dB ………………………………………………0,5
– Output power accuracy , dB …………………….………...…………… 0,8
– Phase adjustment range, deg ………………………….…...………….360
– Phase adjustment resolution, deg ……………………………..…..0,03
– Harmonics, dBc*:

160 ≤ f < 1000 MHz…………………………..……………..………< -40
1 ≤ f < 20 GHz……………………………………………..………..< -50
− Spurious (non-harmonic) components, dBc …………………..… < -60
− Spurious (non-harmonic) components (offset >1 kHz), dBc:
160 ≤ f < 2500 MHz.……………………………………….............. < -88
2,5 ≤ f < 5 GHz.………………………………………………..…< -82
5 ≤ f < 10 GHz …………………………………………….............< -76
10 ≤ f < 20 GHz …………………………………………...............< -70
− Frequency switch time (since download via the external interfaces), us
.... 5
− Output VSWR ……………………………………….……...... <2

Pulse modulation mode
− Pulse on-time …………………………………………....100ns…1s
− Pulse rise, ns ……………………………………………….... <20
− Pulse period …………………………………….……....200ns…2s
− Isolation, dB………………………………………………..…>70

− RF connector type ………………………………….. 2,92/1,27 mm
− Power consumption, W………………………………….……..30

* Parameters for frequencies from 9 kHz to 160 MHz are not specified.

Reference input
− Signal frequency at the reference input «10 MHz» (CMOS), MHz
……………………………………………………………………10
− Phase noise at offset 10 kHz, dBc/Hz …………………….......-140

Phase noise

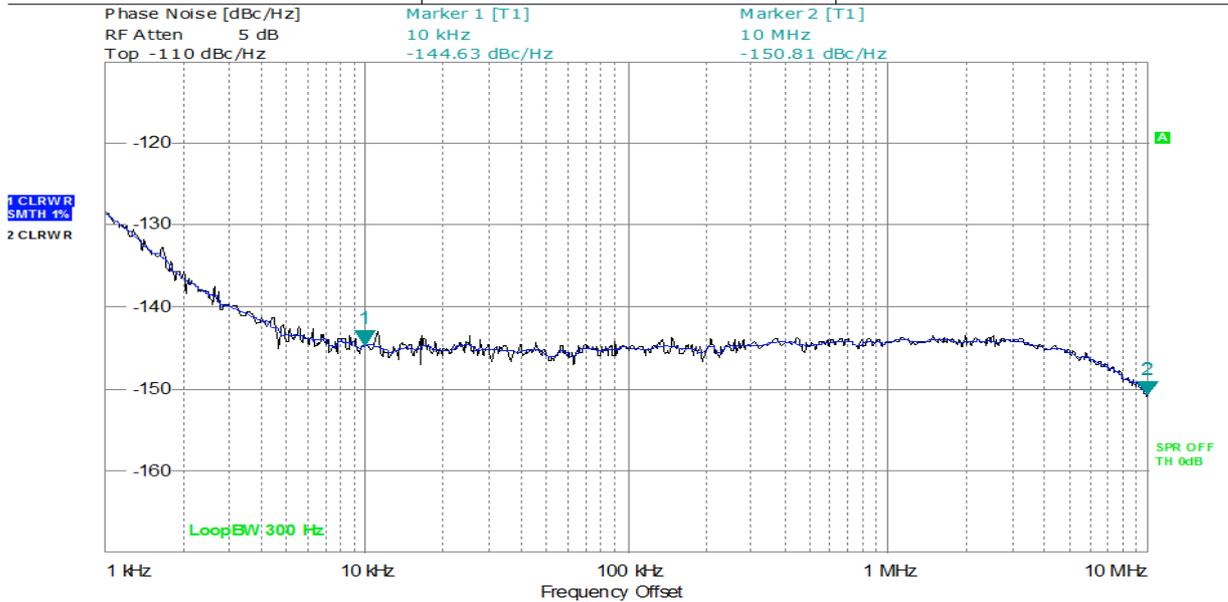| F, MHz	Phase noise, dBc/Hz					
	100 Hz	1 kHz	10 kHz	100 kHz	1 MHz	10 MHz
200	-100	-131	-143	-144	-143	-149
500	-93	-123	-135	-135	-134	-142
1000	-86	-116	-128	-129	-128	-138
4000	-73	-104	-117	-117	-117	-129
8000	-69	-99	-112	-111	-111	-127
10000	-67	-97	-110	-110	-110	-124
12000	-64	-96	-107	-108	-107	-116
14000	-61	-94	-107	-107	-106	-117
16000	-61	-93	-105	-106	-104	-118
18000	-62	-92	-104	-105	-104	-118
20000	-60	-91	-103	-103	-102	-119
21000	-58	-91	-103	-103	-104	-121
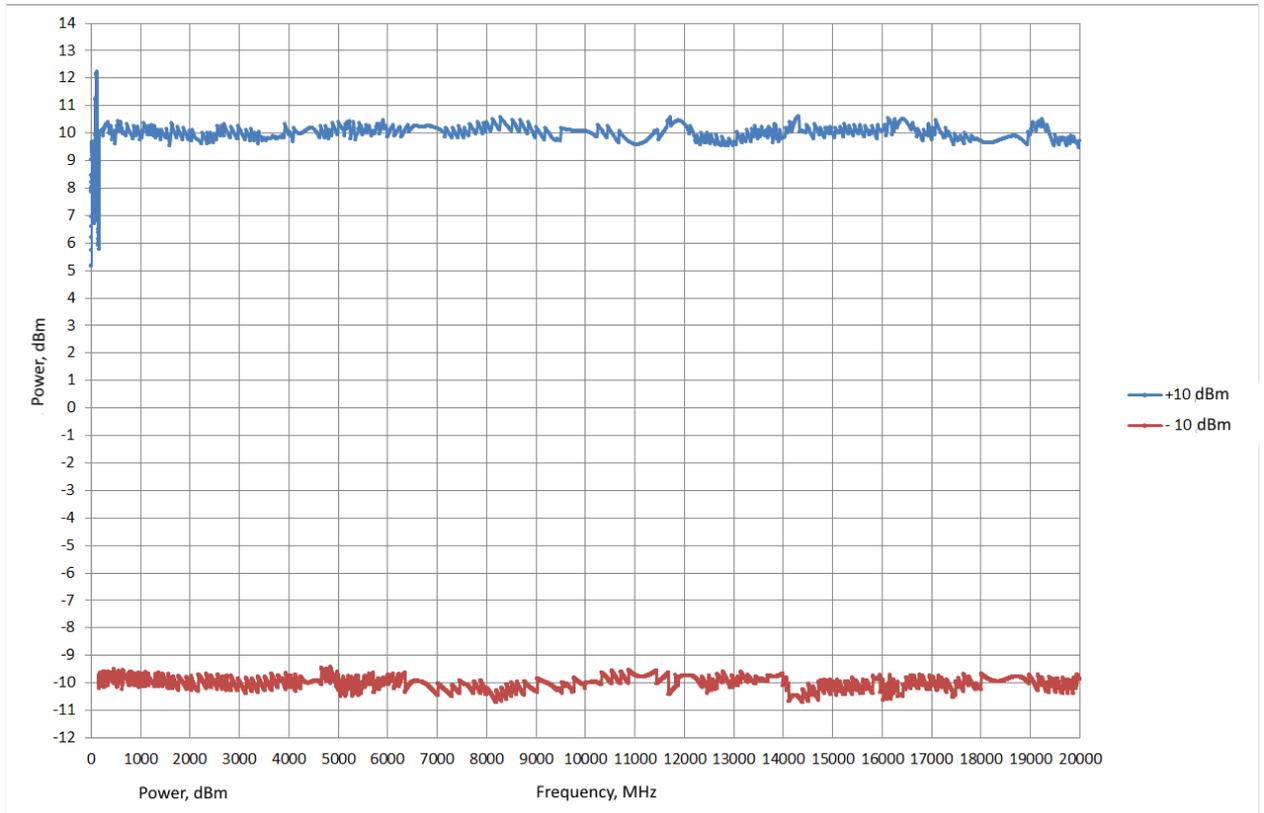
Typical output power level
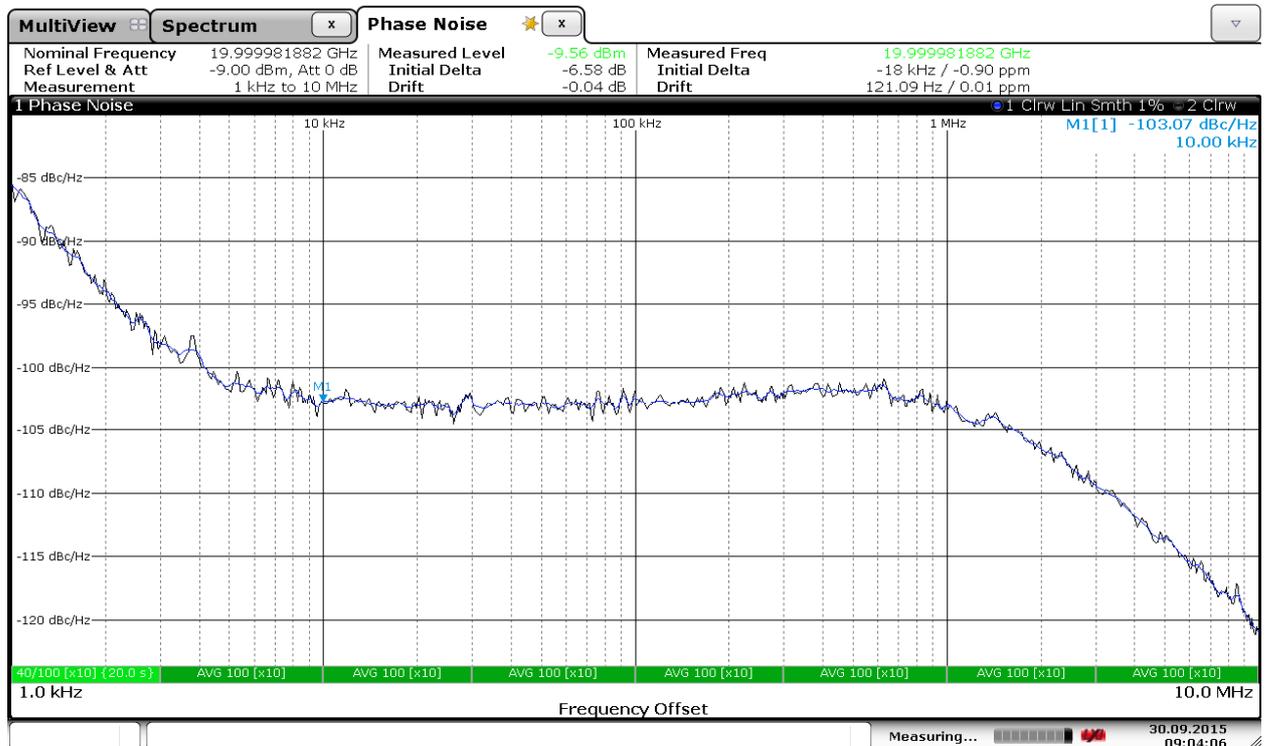
Typical phase noise at 20 GHz

Date: 30.SEP.2015 09:04:06

R&S FSUP 26 Signal Source Analyzer LOCKED

Settings		Residual Noise [T1 w/o spurs]		Spur List			
Signal Frequency:	199.999872 MHz	Int PHN (1.0 k .. 10.0 M)	-75.8 dBc	8.217	kHz	-107.70	dBc
Signal Level:	12.05 dBm	Residual PM	13.206 m°				
Cross Corr Mode	Harmonic 1	Residual FM	1.076 kHz				
Internal Ref Tuned	Internal Phase Det	RMS Jitter	0.1834 ps				

Phase Noise [dBc/Hz]
RF Atten 5 dB
Top -110 dBc/Hz

Marker 1 [T1]
10 kHz
-144.63 dBc/Hz

Marker 2 [T1]
10 MHz
-150.81 dBc/Hz

Typical phase noise at 200 MHz

Typical harmonics

SPS-20 structure

Frequency synthesizer SPS-20 is constructed on base of indirect synthesis system with direct digital synthesis elements. SPS-20 consists of functional blocks:

− reference oscillator with direct digital synthesis system, providing step adjustment of the master oscillator frequency 10…20 GHz;
− control unit based on FPGA and a microprocessor;
− division and filtering unit, for a generation of frequency 9 kHz…10 GHz, lowering of level harmonic and subharmonic spectrum components and control of output power level.
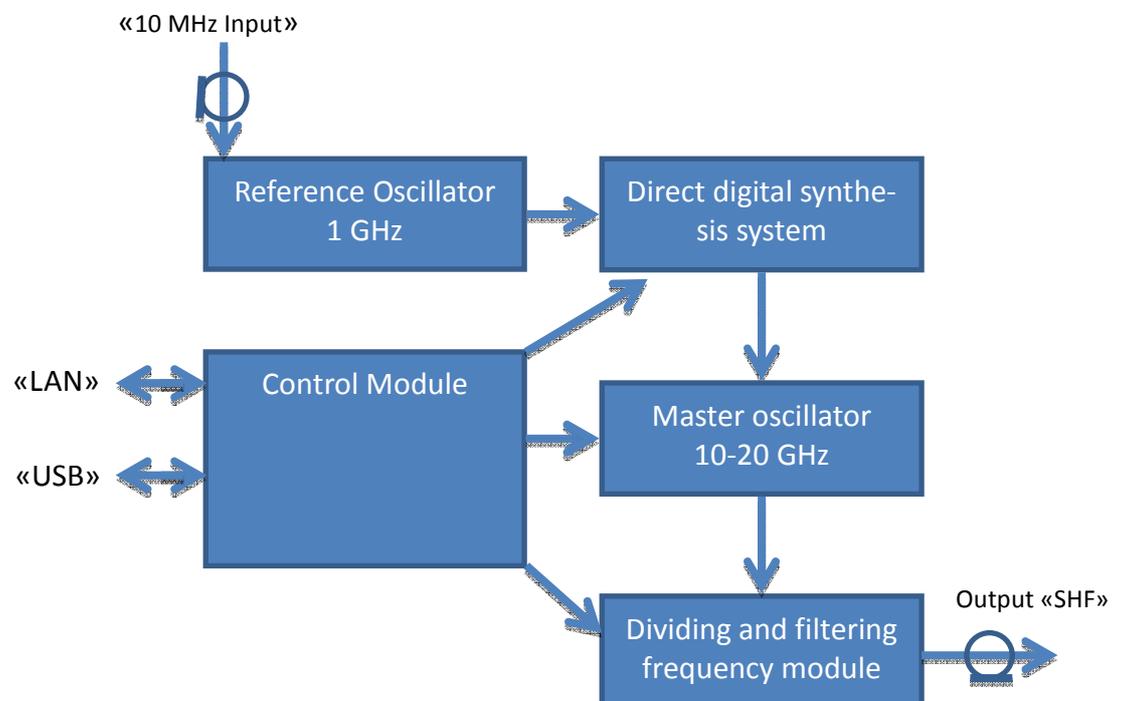
SPS-20 structure
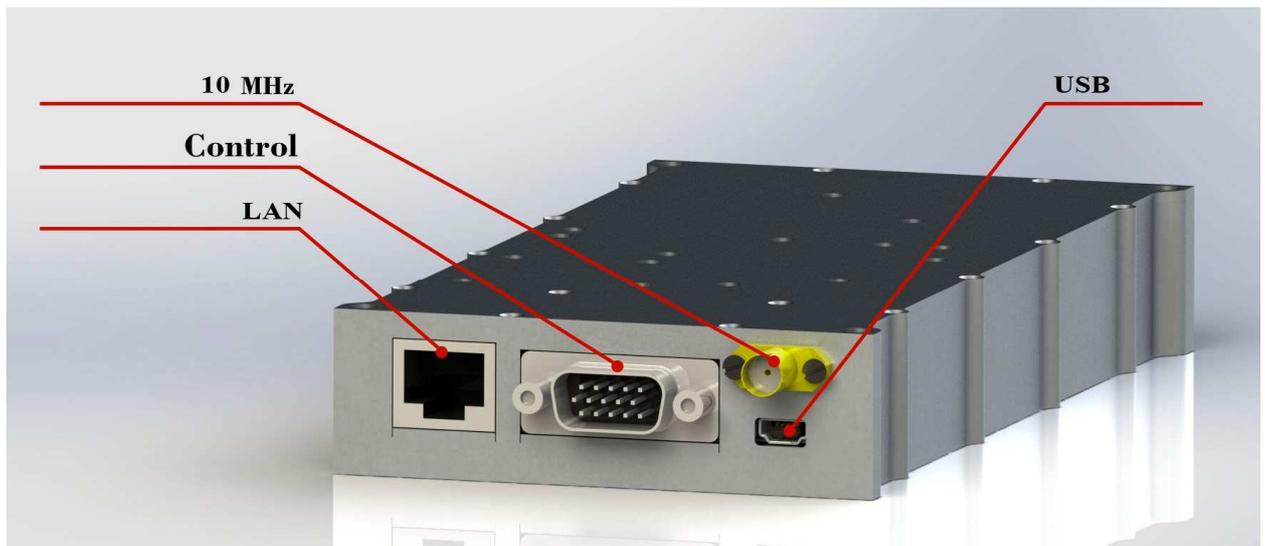
SPS-20 outside appearance

Frequency synthesizer SPS-20 has microprocessor control for different modes. The control is performed remotely via standard digital interfaces LAN, USB, RS-232, SPI.

Frequency synthesizer SPS-20 has following basic operating modes:

1. Generation of the signal with fixed frequency and power level.

In this mode continuous harmonic signal with specified frequency and power is generated.

2. Frequency sweep.

In this mode frequency sweep is performed with specified step and switch time from the start to stop frequency point.

3. Power sweep.

In this mode power sweep is performed with specified step and switch time from the start to stop power level point.

SPS-20 control connector pinouts

# Pin	Type	Parameter	Notes
1	POWER	+10 V	2,5A
2	POWER	+10 V	
3	POWER	+27 V	100 mA
4	POWER	-7 V	50 mA
5	GND	COMMON	
6			
7	RS232_RX		output
8	RS232_TX		input
9	GND	COMMON	
10	SPI	SCLK	input
11	SPI	SDIO	input/output
12	SPI	CS	input
13	GND	COMMON	
14	Input 1	Synchronizing input	input TTL 3.3 V
15	Output 1	Synchronizing output	output TTL 3.3 V

Operating SPS-20

NOTE! Good grounding and sufficient external fan cooling are needed for frequency synthesizer SPS-20!

Setting modes of operating for the frequency synthesizer SPS-20 is performed via digital interfaces using SCPI commands.

SCPI determines standard for the commands and queries syntax for test and measurement equipment. SCPI command or query is a text ASCII string, sent into the test and measurement equipment via physical interface (LAN, USB, RS-232). Valid length of the string is limited to 255 characters.

In general, command (query) of SCPI standard is a series of keywords, divided by colons. After the keywords space-divided parameters follow. Example of SCPI command:

POWer[:AMPLitude] MAXimum|MINimum

Here **POWer** and **AMPLitude** – are keywords, **MAXimum** and **MINimum** – parameters.

SCPI queries are used for reading data and control measurement equipment parameters and differ from SCPI commands by the presence of '?' symbol at the end of the string. Response to the query is a text ASCII string with requested value.

Another special symbols, using for marking SCPI command and queries are shown into the table below.

Symbol	Description	Example
|	Vertical line between the keywords indicates that alternative options can be used. Result will depend on selected value.	**REFerence[:SOURce] INTernal |External** Parameters **INTernal** and **EXTernal** – are alternative options, any of the options can be used.
[ ]	Squared brackets indicate that keywords or parameters can be missed when writing a command. These implied parameters will be considered, even if they are excluded.	**FREQuency[:CW] MAXimum |MINimum** Keyword **CW** can be missed.
< >	Angle brackets indicate that the word shouldn't be used literally. This word should be replaced by parameter value.	**PULM:INTernal:PERiod <val> <unit>** In this command **<val>** and **<unit>** should be replaced by real values for the period of internal pulse modulation and units for period time **PULM:INTernal:PERiod 250 ms**
{ }	Figure brackets indicate that the parameter should be used in command one time only, few times, or not be used at all. If you using several parameters in one command, they must be comma separated.	**LIST:POWer[:AMPLitude] <val> <unit>{,<val> <unit>}** One power value in the list **LIST:POWer 5 dBm** Several values of power level in list **LIST:POWer 1 dBm, 2 dBm, 3 dBm**

When writing SCPI commands and queries keywords and parameters also can be shortened to parts, marked with capital letters. Moreover, this SCPI commands and queries are non-casesensitive. So these following commands are equal:

TRIG:SOUR IMM
TRIGger:SOURce IMMediate
Trigger:Source Immediate
trig:sour imm

Syntax of the units of measurement, transmitted as parameters in SCPI commands:

- units of time:
ns – nanoseconds
us – microseconds
ms – milliseconds
s – seconds

- units of frequency:
Hz – hertz
kHz – kilohertz
MHz – megahertz
GHz – gigahertz

- units of power level:
dBm – decibel referred to 1 milliwatt

- units of phase:
deg – degrees
rad – radians

SCPI commands and queries are divided on the two types: common for all kinds of test and measurement equipment and specialized for specific instrument.

Common SCPI commands and queries begin with an asterisk with following keyword:

*IDN?

This is query of identification information of the instrument. Identification information has the following form:
<company_name>, <instrument_model>, <model_number>, <firmware_revirsion >

*RST

This command resets most parameters of the instrument to the factory values. Description of every SCPI command in this documentation contains factory value affected by the command.

*SAV

This command saves current instrument state in specific area of the nonvolatile memory. After the power-on of the device this state is restored.

*TRG

This command starts process of frequency or power sweep, if external interface is chosen as trigger source. For more information about synchro signal sources, go to the **TRIGger:SOURce** command description.

Specific SCPI command and queries:

ABORt

This command aborts frequency or power sweep of frequency synthesizer. If the parameter of **INITiate:CONTinuous** command set to ON, sweep immediately starts from start point.

INITiate:CONTinuous ON|OFF
INITiate:CONTinuous?

This command sets repeating or single type of frequency or power sweep. Performing of the command does not affect current sweep process.

ON   Continuous mode of sweep, after the finishing of current sweep cycle new one starts from the beginning automatically.

OFF Single mode of sweep, after the finishing of current sweep cycle for new one synchro signal is needed according to the source chosen by **TRIGger:SOURce** command.

Default value of parameter– **OFF**.

INITiate

This command allows frequency or power sweep.

[LIST:]TRIGger:SOURce BUS|IMMediate|EXTernal
[LIST:]TRIGger:SOURce?

This command sets source for synchro signal to start frequency or power sweep.

BUS   Start of sweep by SCPI command ***TRG** via external interfaces.

IMMediate Immediate start of sweep.

EXTernal   Start of sweep by external trigger.

Default parameter value– **BUS**.

LIST:TYPE STEP|LIST
LIST:TYPE?

This command sets type of frequency and power sweep.

STEP   Intermediate frequency or power level points are spaced at equal intervals from each other.

LIST   Intermediate frequency or power level points have arbitrary values.

Default parameter value – **STEP**.

LIST:MODE AUTO|MANual
LIST:MODE?
This command sets automatic or manual (using **LIST:MANual** command) mode for access to intermediate points of sweep range.

AUTO   Auto sweep from start to stop point.

MANual   Switch to the intermediate points of sweep range manually using **LIST:MANual** command.

Default parameter value– **AUTO**.

LIST:MANual <val>|UP|DOWN
This command performs switch to arbitrary intermediate point of sweep range that set by the parameter **<val>**. Parameter value should be less than number of sweep points, set by command **SWEep:POINts**   (sweep mode **STEP**) or numbers of frequency values or power level values in the list (sweep mode **LIST**).

UP   Switch to the next intermediate point of sweep range.

DOWN   Switch to the previous intermediate point of sweep range.

To execute this command it is necessary to set parameter specified by **LIST:MODE** command in **MANual**.

Example:

LIST:MAN 5

This command performs switch to fifth intermediate point of sweep range.

LIST:POWer[:AMPLitude] <val> <unit>{,<val> <unit>}
This command determines a list of power level values for sweep. For power level sweep in accordance with list of values, it is necessary that parameter defined by the command **LIST:TYPE** specifies the type of sweep as **LIST**.

Example:

LIST:POW 0.1 DBM,0.2 DBM,0.1 DBM,0.3 DBM,0.1 DBM,-0.1 DBM

This command sets power level sweep of six values.

Maximum number of power level values in list– 100.

LIST:FREQuency <val> <unit>{,<val> <unit>}
This command determines a list of frequency values for sweep. For frequency sweep in accordance with list of values, it is necessary that parameter defined by command **LIST:TYPE** specifies the type of sweep as **LIST**.

Example:

LIST:FREQ 10 GHZ,12 GHZ,14 GHZ,16 GHZ

This command sets frequency sweep of four values.

Maximim number of frequency values in list – 100.

SWEep:POINts <val>
SWEep:POINts?

This command sets number of points for frequency or power level sweep. Parameter matters only in case you chose sweep mode **STEP** by command **LIST:TYPE**.

Example:

SWEEP:POINTS 2001

Command sets number of sweep points 2001.

The range of valid values 2…65535.

Default value – 2.

SWEep:TIME <val> <unit>
SWEep:TIME?

This command sets sweep time. If this command is executed while the signal generator is in auto sweep time mode, the manual sweep time mode is activated and the new sweep time value is applied. The sweep time cannot be set to a value less than the automatic sweep time mode provides.

The sweep time is the duration of the sweep from the start point to the stop point. It does not include the retrace time that occurs between sweep repetitions.

Range of the valid values   5 us … 99 s.

Default parameter value – 200 ms.

Response for a query is a string with sweep time value in microseconds.

SWEep:TIME:AUTO ON|OFF
SWEep:TIME:AUTO?

This command sets the sweep time mode.

ON   This choice enables the signal generator to automatically calculate and set the fastest possible sweep time.

OFF This choice allows to select the sweep time manually. The sweep time cannot be set to a value faster than the automatic mode provides. To set the sweep time refer to **:SWEep:TIME** command.

Default parameter value – **OFF**.

FREQuency:MODE   FIXed|CW|LIST
FREQuency:MODE?

This command sets the frequency mode of the synthesizer.

FIXed/CW These options are synonymous. Any currently running frequency sweep is turned off, and the current CW frequency settings are used to control the output frequency.

LIST   This choice selects the frequency sweep mode. Type of sweep is defined by **LIST:TYPE** command.

Default parameter value – **CW**.

FREQuency [:CW] <val> <unit>|MAXimum|MINimum|UP|DOWN
FREQuency [:CW]?

This command sets output frequency.

UP   Increases the current frequency by the value set with the **FRE-Quency[:CW]:STEP**.

DOWN   Decreases the current frequency by the value set with the **FREQuency[:CW]:STEP**.

Example:

FREQ:CW 20 GHZ

This command sets output frequency of synthesizer 20 GHz.

Values **MAXimum, MINimum** and also output frequency default value are determined by specification of frequency synthesizer.

Response on the query is a string with frequency value in Hz.

FREQuency[:CW]:STEP <val> <unit>
FREQuency[:CW]:STEP?

This command sets the incremental step value for the frequency.

Example:

FREQ:STEP .5 GHZ

This command sets step of the frequency in manual mode 500 MHz.

Default parameter value – 100 MHz

Response on the query is a string with frequency step value in Hz.

FREQuency:STARt <val> <unit>|MAXimum|MINimum
FREQuency:STARt?

This command sets the frequency start point for a sweep.

Example:

FREQ:START 520 MHZ

This command sets start value for frequency sweep 520 MHz.

Values **MAXimum, MINimum,** and default start value are defined by specification of frequency synthesizer.

Response on the query is a string with start frequency value in Hz.

FREQuency:STOP <val> <unit>|MAXimum|MINimum
FREQuency:STOP?

This command sets the frequency stop point for a step sweep.

Example:

FREQ:STOP 10 GHZ

This command set stop value for frequency sweep 10 GHz.

Values **MAXimum, MINimum,** and default stop value are defined by specification of frequency synthesizer.

Response on the query is a string with stop frequency value in Hz.

POWer:MODE   FIXed|LIST
POWer:MODE?

FIXed   Any currently running power level sweep is turned off, and the current fixed power level settings are used to control the output power.

LIST   This choice selects the power level sweep mode. Type of sweep is defined by **LIST:TYPE** command.

Default parameter value – **FIXed**.

POWer[:AMPLitude] <val> <unit>|MAXimum|MINimum|UP|DOWN
POWer[:AMPLitude]?

This command sets output power level.

UP   Increases output power level by the value set with command **POWer[:AMPLitude]:STEP**.

DOWN   Decreases output power level by the value set with command **POWer[:AMPLitude]:STEP**.

Example:

POW .5 DBM

This command sets power level on level 0,5 dBm.

Values of **MAXimum, MINimum,** and default power level are defined by frequency synthesizer specification.

Response on the query is a text string with power level value in decibels referred to 1milliwatt.

POWer[:AMPLitude]:STEP <val> <unit>
POWer[:AMPLitude]:STEP?

This command sets the incremental step value for the power level in manual mode.

Example:

POW:STEP 0.5 DBM

This command sets power level step 0,5 dBm in manual mode.

Default parameter value – 0,1 dBm.

Response on the query is a text string with power level step value in decibels referred to 1 milliwatt.

POWer:STARt <val> <unit>|MAXimum|MINimum
POWer:STARt?

This command sets start point for power level sweep.

Example:

POW:START -20 DBM

This command sets start value of power level -20 dBm.

Values of **MAXimum, MINimum,** and default start value of power level are defined by frequency synthesizer specification.

Response on the query is a text string with start power level value in decibels referred to 1 milliwatt.

POWer:STOP <val> <unit>|MAXimum|MINimum
POWer:STOP?
This command sets stop point for power level sweep.
Example:
POW:STOP 10 DBM
This command sets stop value of power level 10 dBm.
Values of **MAXimum, MINimum,** and default stop value of power level are defined by frequency synthesizer specification.
Response on the query is a text string with stop power level value in decibels referred to 1 milliwatt.

PHASe[:ADJust] <val> <unit>|MAXimum|MINimum|UP|DOWN
PHASe[:ADJust]?
This command adjusts the phase of the output signal.
UP   This command adjusts phase of the output signal by 1 degree up.
DOWN   This command adjusts phase of the output signal by 1 degree down.
Example:
PHAS:ADJ 5 DEG
This command adjusts the phase shift of the output signal to 5 degrees up.
Values of **MAXimum, MINimum** are defined by frequency synthesizer specification.
Response on the query is a text string with phase value in degrees.

REFerence[:SOURce] INTernal|EXTernal
REFerence[:SOURce]?
This command sets as a source of reference signal for synthesizer either internal high stable quartz oscillator or external signal with 10 MHz frequency.
INTernal   High quartz oscillator is selected as a source of reference signal.
EXTernal   a source of reference signal chosen External signal with 10 MHz frequency is selected as a source of reference signal.
Default value of parameter – **INTernal**.

AM:SOURce INTernal|EXTernal
AM:SOURce?
This command selects amplitude modulation and sets source of the modulating signal.
INTernal   Internal source of modulating signal.
EXTernal   External signal is selected as modulating signal.
Default parameter value – **INTernal**.

AM:INTernal:FREQuency <val> <unit>

AM:INTernal:FREQuency?

This command sets a frequency of modulating signal for amplitude modulation with internal source of modulating signal.

Example:

AM:INT:FREQ 5 kHz

This command sets frequency of modulating signal for amplitude modulation with internal source 5 kHz.

The range of valid values   1 Hz … 100 kHz.

Default parameter value – 20 kHz.

Response on the query is a text string with frequency of modulating signal for amplitude modulation with internal source of modulating signal in Hz.

AM:INTernal:FUNCtion:SHAPe   SINE|TRIangle|SQUare|RAMP
AM:INTernal:FUNCtion:SHAPe?

This command sets waveform shape of modulating signal for amplitude modulation with internal source of modulating signal.

Example:

AM:INT:FUNC:SHAP SINE

This command sets sine shape of modulating signal for amplitude modulation.

SINE	Sine modulating waveform shape.
TRIangle	Triangle modulating waveform shape.
SQUare	Square modulating waveform shape.
RAMP	Sawtooth modulating waveform shape.

Default parameter value – **SINE**.

AM:DEPTt <val>
AM:DEPTh?

This command sets depth of amplitude modulation in percents.

Example:

AM:DEPT 30.5

This command set the depth of amplitude modulation 30,5%.

Range of valid values   0 … 100%.

Default parameter value – 100%.

Response on query is a text string with value of depth of amplitude modulation in percents.

PULM:SOURce INTernal|EXTernal
PULM:SOURce?

This command selects pulse modulation and sets source of modulating signal.

INTernal	Internal source of modulating signal.
EXTernal	External signal is selected as modulating signal.

Default parameter value – **INTernal**.

PULM[:INTernal]:PERiod <val> <unit>
PULM[:INTernal]:PERiod?
This command sets period of pulses for pulse modulation with internal source of modulating signal. Value should be more or equal to pulse on-time value, defined by command **PULM[:INTernal]:PWIDth**.
Example:
PULM:INT:PER .5 s
This command sets period of pulse for pulse modulation with internal source 500 ms.
Range of valid values   200 ns … 2 s.
Default parameter value – 250 ms.
Response on query is a text string with value pulses period for pulse modulation with internal source of modulating signal in nanoseconds.

PULM[:INTernal]:PWIDth <val> <unit>
PULM[:INTernal]:PWIDth?
This command sets on-time of pulses for pulse modulation with internal source of modulating signal. Value should be less or equal to value of pulse period, defined by command **PULM[:INTernal]:PERiod**.
Example:
PULM:INT:PWID 100 MS
This command sets pulses on-time for pulse modulation with internal source 100 ms.
Range of valid values   100 ns … 2 s.
Default parameter value – 100 ns.
Response on query is a text string with value of pulses on-time for pulse modulation with internal source of modulating signal in nanoseconds.

FM:SOURce INTernal|EXTernal
FM:SOURce?
This command selects frequency modulation and sets source of the modulating signal.
INTernal   Internal source of modulating signal.
EXTernal   External signal is selected as modulating signal.
Default parameter value – **INTernal**.

FM:INTernal:RATE <val> <unit>
FM:INTernal:RATE?
This command sets a modulation rate for frequency modulation with internal source of modulating signal.
Example:

FM:INT:RATE 5 kHz

This command sets modulation rate for frequency modulation with internal source 5 kHz.

The range of valid values 1 Hz … 100 kHz.

Default parameter value – 20 kHz.

Response on the query is a text string with modulation rate for frequency modulation with internal source of modulating signal in Hz.

FM:INTernal:FUNCtion:SHAPe   SINE|TRIangle|SQUare|RAMP
FM:INTernal:FUNCtion:SHAPe?

This command sets waveform shape of modulating signal for frequency modulation with internal source of modulating signal.

Example:

FM:INT:FUNC:SHAP SINE

This command sets sine shape of modulating signal for frequency modulation.

SINE   Sine modulating waveform shape.
TRIangle   Triangle modulating waveform shape.
SQUare   Square modulating waveform shape.
RAMP   Sawtooth modulating waveform shape.
Default parameter value – **SINE**.

FM:DEViation <val> <unit>
FM:DEViation?

This command sets frequency deviation for frequency modulation.

Example:

FM:DEV 1 MHz

This command set the frequency deviation for frequency modulation 1 MHz.

The range of valid values 1 Hz … 128 MHz.

Default parameter value – 1 MHz.

Response on query is a text string with value of frequency deviation for frequency modulation in Hz.

OUTPut ON|OFF
OUTPut?

This command turns on/off output power of frequency synthesizer.

ON   Output signal on.
OFF Output signal off.
Default parameter value – **OFF**.

Response on query is a text string with current state of a synthesizer output.

OUTPut:MODulation ON|OFF
OUTPut:MODulation?

This command turns on/off modulation of output signal for frequency synthesizer.

ON   Enable modulation of output signal.

OFF Disable modulation of output signal.

Default parameter value – **OFF**.

Response on query is a text string with current state of a synthesizer output.

SYSTem:COMMunication:LAN:IP <ipstring>
SYSTem:COMMunication:LAN:IP?

This command sets the frequency synthesizer's local area network (LAN) internet protocol (IP) address for IP network connection. The <ipstring> variable is the frequency synthesizer's IP address, formatted as xxx.xxx.xxx.xxx. The setting enabled by this command is not affected by the frequency synthesizer power-on or ***RST** command. Restart of the frequency synthesizer is needed to apply new IP-address.

Example:

SYST:COMM:LAN:IP 192.168.2.127

The preceding example sets the frequency synthesizer's LAN IP address 192.168.2.127.

Response on query is a text string with current IP address of a synthesizer.

SYSTem:COMMunication:LAN:PORT <val>
SYSTem:COMMunication:LAN:PORT?

This command sets the frequency synthesizer's local area network (LAN) internet protocol (IP) port defined by <val> value. The setting enabled by this command is not affected by the frequency synthesizer power-on or ***RST** command. Restart of the frequency synthesizer is needed to apply new port value.

Example:

SYST:COMM:LAN:PORT 5023

The preceding example sets the frequency synthesizer's LAN port 5023.

Response on query is a text string with current port of a synthesizer.

SYSTem:COMMunication:SERial:BAUD <val>
SYSTem:COMMunication:SERial:BAUD?

This command sets the baud rate for the RS–232 interface. The setting enabled by this command is not affected by a frequency synthesizer power-on or ***RST** command. Restart of the frequency synthesizer is needed to apply new baud rate.

The variable <val> is an integer value corresponding to baud rates: 14400, 19200, 38400, 56000, 57600, 115200, 128000 or 256000.

Example:

SYST:COMM:SER:BAUD 19200

The preceding example sets the baud rate for serial communication to 19200.

Response on query is a text string with current baud rate of a synthesizer.

Programming of frequency synthesizer SPS-20 via SPI-interface

Command codes for control of synthesizer via SPI are shown in the table below

Address, MSB		Data, MSB		Parameter
Value	Length	Value	Length	
0x01	8 bits	F_out,Bits[47:0]	48 bits	Output frequency (mHz)
0x02	8 bits	P_out[15:0]	16 bits	Output power (dBm*0,1)
0x04	8 bits	Output ON	0	Output power on
0x05	8 bits	Output OFF	0	Output power off
0x13	8 bits	Mod[7:0]	8 bits	Enable (0x01)/ Disable (0x00) amplitude modulation (**AM**) Enable (0x02)/ Disable (0x00) pulse modulation (**PAM**)
0x21	8 bits	Freq_mod[23:0]	24 bits	Modulating frequency for **AM** (Hz)
0x22	8 bits	Lev_ mod [7:0]	8 bits	Modulation depth for **AM** (%)
0x11	8 bits	Time_mod [31:0]	32 bits	Pulse period for **PAM** (ns)
0x12	8 bits	Time_imp[31:0]	32 bits	Pulse on-time for **PAM** (ns)
0x03	8 bits	Phase[15:0]	16 bits	Phase adjustment $\Delta\Phi = 2\pi\left(\dfrac{\Delta phase}{2^{14}}\right)$
Frequency sweep mode				
0x08	8 bits	Freq_start[47:0]	48 bits	Start frequency
0x09	8 bits	Freq_stop[47:0]	48 bits	Stop frequency
0x20	8 bits	Step_time[23:0]	24 bits	Switch time to the next point

| Address, MSB | | Data, MSB | | Parameter |
Value	Length	Value	Length	
0x16	8 bits	Trigger_source[7:0]	8 bits	=0 by step time =1 by external trigger
0x0F	8 bits	Start_sweep	0	Frequency sweep on
0x10	8 bits	Stop_sweep	0	Frequency sweep off
0x0D	8 bits	Freq_step[47:0]	48 bits	Frequency sweep step
0x0C	8 bits	Sweep_point[15:0]	16 bits	Number of sweep points
0x14	8 bits	Type_sweep[7:0]	8 bits	Frequency sweep (0x01)
Power sweep mode				
0x0A	8 bits	Pow_start[15:0]	16 bits	Start power
0x0B	8 bits	Pow_stop[15:0]	16 bits	Stop power
0x20	8 bits	Step_time[23:0]	24 bits	Switch time to the next point
0x16	8 bits	Trigger_source[7:0]	8 bits	=0 by step time =1 by external trigger
0x0F	8 bits	Start_sweep	0	Power sweep on
0x10	8 bits	Stop_sweep	0	Power sweep off
0x0E	8 bits	Pow_step[15:0]	16 bits	Power sweep step
0x0C	8 bits	Sweep_point[15:0]	16 bits	Number of sweep points
0x14	8 bits	Type_sweep[7:0]	8 bits	Power sweep (0x02)
Amplitude modulation				
0x21	8 bits	am_freq	24 bits	AM frequency
0x22	8 bits	am_depth	8 bits	AM depth
Pulse amplitude modulation				
0x11	8 bits	pam_period	32 bits	PAM period
0x12	8 bits	pam_ontime	32 bits	PAM on-time
frequency modulation				
0x24	8 bits	fm_rate	24 bits	FM rate
0x25	8 bits	fm_dev	32 bits	FM deviation
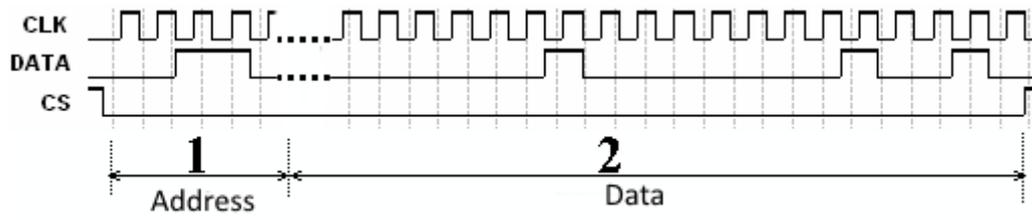
Data transmission via serial peripheral interface (SPI)