Programming Manual

9801
Programmable AC
Power Supplies

B&K PRECISION

Contents

About Commands & Queries

The 9800 Series power supplies support communication protocols, which include standard SCPI commands and a few proprietary commands that follow the SCPI convention. The SCPI interface enables users to operate the power supply through a computer or a terminal equipped with RS-232, or USB interface. SCPI IEEE-488.2 also supports multi-unit control allowing a user to control up to 32 power supplies.

This manual lists and describes the remote control commands and queries recognized by the instrument. All commands and queries can be executed in remote state.

The description, command syntax, query syntax, example and respond can be found in a section. The commands are given in both long and short form. All examples are shown in short form. Queries perform actions such as obtaining information an can be recognized by the question mark (?) following the header.

1.1 How They are Listed

The commands are listed by subsystem and alphabetical order according to their short form.

1.2 How They are Described

In the descriptions themselves, a brief explanation of the function performed is given. This is followed by a presentation of the formal syntax, with the header given in Upper-and-Lower-Case characters and the short form derived from it in ALL UPPER-CASE characters. Where applicable, the syntax of the query is given with the format of its response.

1.3 When can they be used?

The commands and queries listed here can be used for 980X Series Programmable AC Power Source.

1.4 Command Notation

The following notation is used in the commands:

$<>$ Angular brackets enclose words that are used as placeholders, of which there are two types: the header path and the data parameter of a command.

:= A colon followed by an equals sign separates a placeholder from the description of the type and range of values that may be used in a command instead of the placeholder.

{ } Braces enclose a list of choices, one of which one must be made.

[ ] Square brackets enclose optional items.

… An ellipsis indicates that the items both to its left and right may be repeated a number of times.

The following table lists all of the numerical parameters.

Symbol	Response Formats
<bool>	Boolean value, can be 1 or "ON", 0 or "OFF"
<NR1>	Integer value, can be zero, positive or negative integer number
<NRf>	Flexible numerical value, can be zero, positive or negative float point numeric value
<string>	String value, characters enclosed in single or double
<NL>	New line, hex code 0x0Ah
<Rtn>	Return, hex code 0x0Dh

Table 1.1   Numerical Parameters

Note:

All commands should be ended with the <Rtn> and <NL> and
there should be a space between command and numerical parameter.

1.5 Interface Connection

RS232

For RS-232 connectivity, refer to the diagram below for pin out information. The RS-232 is labeled in the rear panel and it is a female DB-9 interface.
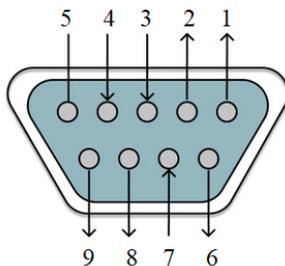
Figure 1.1
System I/O Interface Pins

Pin Number	Function
1	—
2	Transmit Data
3	Receive Data
4	—
5	GND
6 to 9	—

Table 1.2   DB9 Pinout

Note:

A straight pin-to-pin DB9 female to DB9 male serial cable is required for using
the RS-232 interface. Do not use a null modem or crossover DB9 serial cable.

Refer to the user manual for details on configuring all serial settings as required for RS-232 communication.

USBTMC

The standard USB port is a USBTMC-compliant port that can be used for remote communication. There are no settings in the menu system for USB configuration. The only requirement is that NI-VISA is installed on the computer, which can be downloaded at http://www.ni.com/visa/.

Common Command Introduction

The IEEE 488.2 standard defines the common commands used for querying the basic inSyntaxion of the instrument or executing basic operations. These commands usually start with "*" and the length of the keywords of the command is usually 3 characters.

Short	Long Form	Subsystem	What Command/Query does
*CLS	*CLS	SYSTEM	Clears the instrument status byte by emptying the error queue and clearing all event registers.
*ESE	*ESE	SYSTEM	Sets bits in the standard event status enable register.
*ESE?	*ESE?	SYSTEM	Returns the results of the standard event enable register. The register is cleared after reading it.
*ESR?	*ESR?	SYSTEM	Reads and clears the contents of the Event Status Register (ESR).
*IDN?	*IDN?	SYSTEM	Returns a string that uniquely identifies the instrument.
*OPC	*OPC	SYSTEM	Generates the OPC message in the standard event status register when all pending overlapped operations have been completed.
*OPC?	*OPC?	SYSTEM	Returns an ASCII "+1" when all pending overlapped operations have been completed.
*PSC?	*PSC?	SYSTEM	Gets or sets the OPC bit (0) in the Event Status Register (ESR).
*RCL	*RCL	SYSTEM	Recalls a saved instrument state.
*RST	*RST	SYSTEM	Initiates a device reset.
*SAV	*SAV	SYSTEM	Save instrument state.
*SRE	*SRE	SYSTEM	Set status byte enable register.
*SRE?	*SRE?	SYSTEM	Query status byte enable register.
*STB?	*STB?	SYSTEM	Query status byte.
*TRG	*TRG	SYSTEM	Generates an immediate trigger.

Table 2.1

2.1 *CLS

Description This command clears the following registers.
Standard event register, Query event register, Operation event register, Status byte register, Error code

Command Syntax *CLS

Example *CLS

2.2 *ESE

Description This command can set the parameter of standard event enable register. Setting parameter can determine which bit of standard event register is 1 and the byte will enable ESB of status byte register as 1.

The value when power on: Refer to *PSC command

Command Syntax *ESE <NR1>
<NR1> := { 0 ~ 255}

Example *ESE 128

Query Syntax *ESE?

Returned Syntax <NR1> The bit definition of the standard event enabled register:

Bit Position	7	6	5	4	3	2	1	0
Bit Name	PON	Not used	CME	EXE	DDE	QYE	Not used	OPC
Bit Weight	128		32	16	8	4		1

Table 2.2 Standard Event Enable Register

PON: Power-on
CME: Command error
EXE : Execution error
DDE: Device-dependent error
QYE: Query error
OPC: Operation complete

2.3 *ESR?

Description This command can read the value of standard event status register. After executing this command, standard event status register is reset. Bit definition of standard event status register is the same as the standard event status enable register.

Query syntax *ESR?

Return Syntax <NR1>

2.4 *IDN?

Description   This command can read information about power supply. The returns parameter contains 4 segments divided by comma.

Query Syntax   *IDN?

Returned Syntax   <AARD> segment description
B&K Precision Manufacturer
9801 Product model
XXXXXX Product serial number
VXXX –VXXX Software version

Example   B&K Precision, 9801, 00000000000004, V1.01-V1.00

2.5 *OPC

Description   The operation complete command causes the device to generate the operation complete message in the Standard Event Status Register, on completion of the selected device operation.

The operation complete query places an ASCII character 1 in the output queue on completion of the selected device operation.

Command Syntax   *OPC

Query Syntax   *OPC?

Example   OUTP:STAT 1;*OPC

Response Syntax   <NR1>

2.6 *RST

Description   The *RST command initiates a device reset. The *RST recalls the default setup equivalent to the **Default** key on the front panel..

Command Syntax   *RST

Example   *RST

2.7 *SRE

Description   This command can set the parameter of state byte enable register. Setting parameter can determine which byte value of state byte register is 1 and the byte will set RQS of state byte register to 1. Bit definition of state byte enable register is the same as the state byte register.

Command Syntax   *SRE <NR1>
<NR1> := { 0 ~ 255}

Query Syntax   *SRE?

Returned Syntax   <NR1>

2.8 *STB?

Description This command can read the data from status byte register.

Query Syntax *STB?

Returned Syntax <NR1>

2.9 *TRG

Description When power supply trigger source is a command from via BUS, this command will give a trigger signal. And its function is the same as "TRIGger" command.

Query Syntax *TRG

2.10 *SAV

Description This command can save the current setups of power supply to specified memory. The memory is divided into 10 groups, each contain 0 9 (10 total) setups. Up to 100 setups can be saved in total.

Command Syntax *SAV<NRf>
<NRF> := { 0 ~ 9}

Example *SAV 1

2.11 *RCL

Description This command can recall the setups you saved previously from the specified memory location.

Command Syntax *RCL<NRf>

STATUS Subsystem

The current status of the power supply can be read using the operation status registers. The power supply records the different status of the instrument through the four status register group. The four status register groups are: status byte register, standard event register, query status register and operation status register. Status byte register records the information of the other status registers.

```
:STATus ─┬─ :QUEStionable ─┬─ [:EVENt]?
         │                 ├─ :CONDition?
         │                 ├─ :ENABle
         │                 ├─ :NTRansition
         │                 └─ :PRTansition
         │
         └─ :OPERation ─────┬─ [:EVENt]?
                           ├─ :CONDition?
                           ├─ :ENABle
                           ├─ :NTRansition
                           └─ PRTansition
```
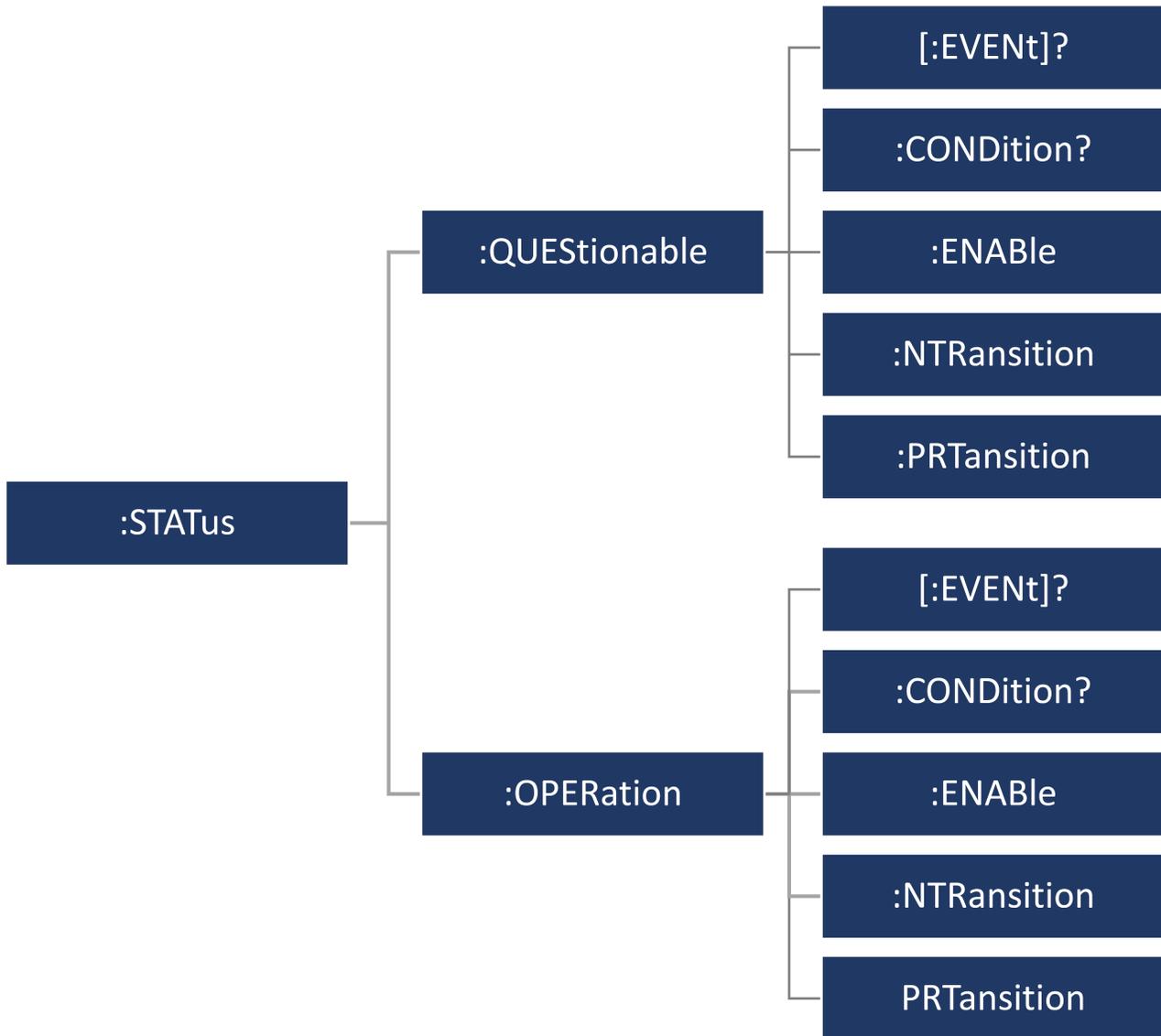
3.1 STATus:QUEStionable[:EVENt]?

Desctiption	This command can be used to read the value in query event register. After executing this command, the query event register will be cleared.
Query Syntax	STATus:QUEStionable[:EVENt]?
Returned Syntax	<NR1>
Relative Command	STATus:QUEStionable:ENABle

The bit definition of query event enable register:

Bit Position	7	6	5	4	3	2	1	0
Bit Name	Not used	Not used	OT	OP	OV	Not used	OCrms	OC Peak
Bit Weight			32	16	8		2	1

Table 3.1   Status Questionable Event Register

3.2 STATus:QUEStionable:CONDition?

Desctiption	This command is used to read the value of query condition register. When a bit of QUES condition changes, the bit value corresponding in QUEST event register is 1.
Query Syntax	STATus:QUEStionable: CONDition?
Returned Syntax	<NR1>

3.3 STATus:QUEStionable:ENABle

Desctiption	This command can set the parameter of quest event enable register. Setting parameter can determine which bit value of quest event register is 1 and the bit will enable QUES.
Command Syntax	STATus:QUEStionable:ENABle <NR2> <NR2> := {0~ 65535}
Example	STATus:QUEStionable:ENABle 128
Query Synta	: STATus:QUEStionable:ENABle?
Returned Syntax	<NR1>

3.4 STATus: QUEStionable:NTRansition

Desctiption	This command is used to edit the negative transition trigger register of operation event. The parameter determines which bits of operation event register is 1 and will change the OPER of status byte register to be 1.
Command Syntax	STATus: QUEStionable:NTRansition <NR1> <NR1> := {0 ~ 255}
Example	STATus: QUEStionable:NTRansition 128
Query Syntax	STATus: QUEStionable:NTRansition?

3.5 STATus: QUEStionable:PTRansition

Desctiption This command is used to edit the positive transition trigger register of operation event. The parameter determines which bits of operation event register is 1 and will change the OPER of status byte register to be 1.

Command Syntax STATus: QUEStionable:PTRansition <NR1>
<NR1> := {0 ~ 255}

Example STATus: QUEStionable:PTRansition 128

Query Syntax STATus: QUEStionable:PTRansition?

3.6 STATus:OPERation[:EVENt]?

Desctiption This command can read the parameter from operation event register. After executing this order, operation event register is reset.

Query Syntax STATus:OPERation [:EVENt]?

Returned Syntax <NR1>

Relative Command STATus: OPERation:ENABle Bit definition of operation event register:

Bit Position	7	6	5	4	3	2	1	0
Bit Name	Not used	Not used	Not Used	Not Used	WTG	SWEEP	LIST	CAL
Bit Weight					8	4	2	1

Table 3.2 Status Questionable Event Register

3.7 STATus:OPERation:CONDition?

Desctiption This command can read the parameter from the operation condition register. When the parameter of operation condition register changes, the bit corresponding in operation event register is 1.

Query Syntax STATus: OPERation: CONDition?

Returned parameter <NR1>

3.8 STATus:OPERation:ENABle

Desctiption This command can set the parameter of operation event enable register. Setting parameter can determine which bit value of operation event register is 1 and the bit will change OPER of status byte register to be 1.

Command Syntax STATus: OPERation:ENABle <NR1>
<NR1> := { 0 ~ 255}

Example STATus: OPERation:ENABle 128

Query Syntax STATus: OPERation:ENABle?

Returned parameter <NR1>

3.9 STATus:OPERation:NTRansition

Desciption   This command is used to edit the negative transition trigger register of operation event. The parameter determines which bits in operation event register is 1 and will change the OPER bit of status byte register to be set to 1.

Command Syntax   STATus:OPERation:NTRansition <NR1>
<NR1> := {0 ~ 255}

Example   STATus:OPERation:NTRansition 128

Query Syntax   STATus:OPERation:NTRansition?

3.10 STATus:OPERation:PTRansition

Desciption   This command edits the positive transition trigger register of operation event. The parameter determines which bits of operation event register is 1 and will change the OPER bit of status byte register to be set to 1.

Command Syntax   STATus:OPERation:PTRansition <NR1>
<NR1> := { 0 ~ 255}

Example   STATus:OPERation:PTRansition 128

Query Syntax   STATus:OPERation:PTRansition?
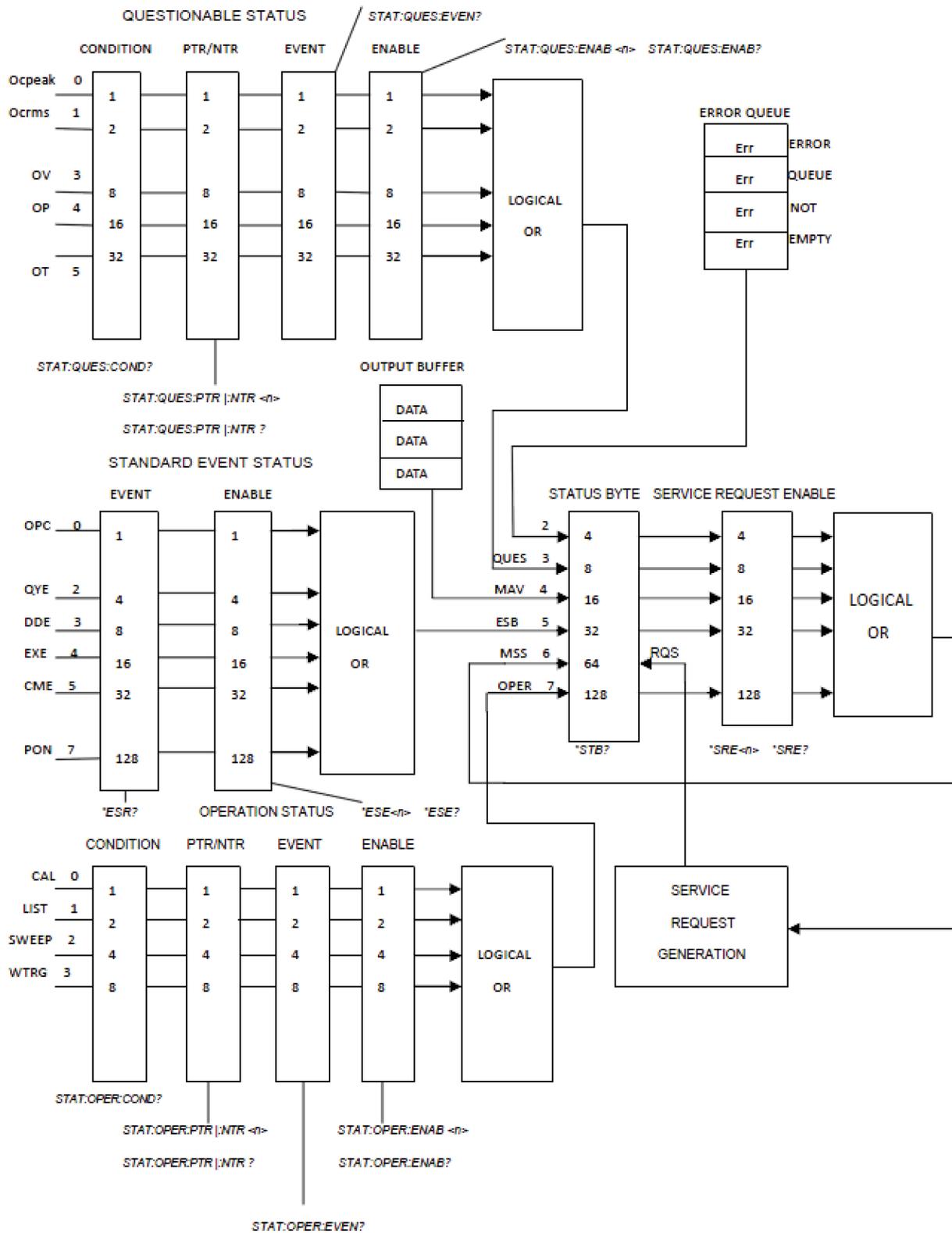
Figure 3.1 Register Tree

SYSTEM Subsystem

	:ERRor?
	:REMote
	:LOCal
	:RWLock
:SYSTem	:POSetup
	:POSetup?
	:CLEar
	:BEEPer
	:INTerface
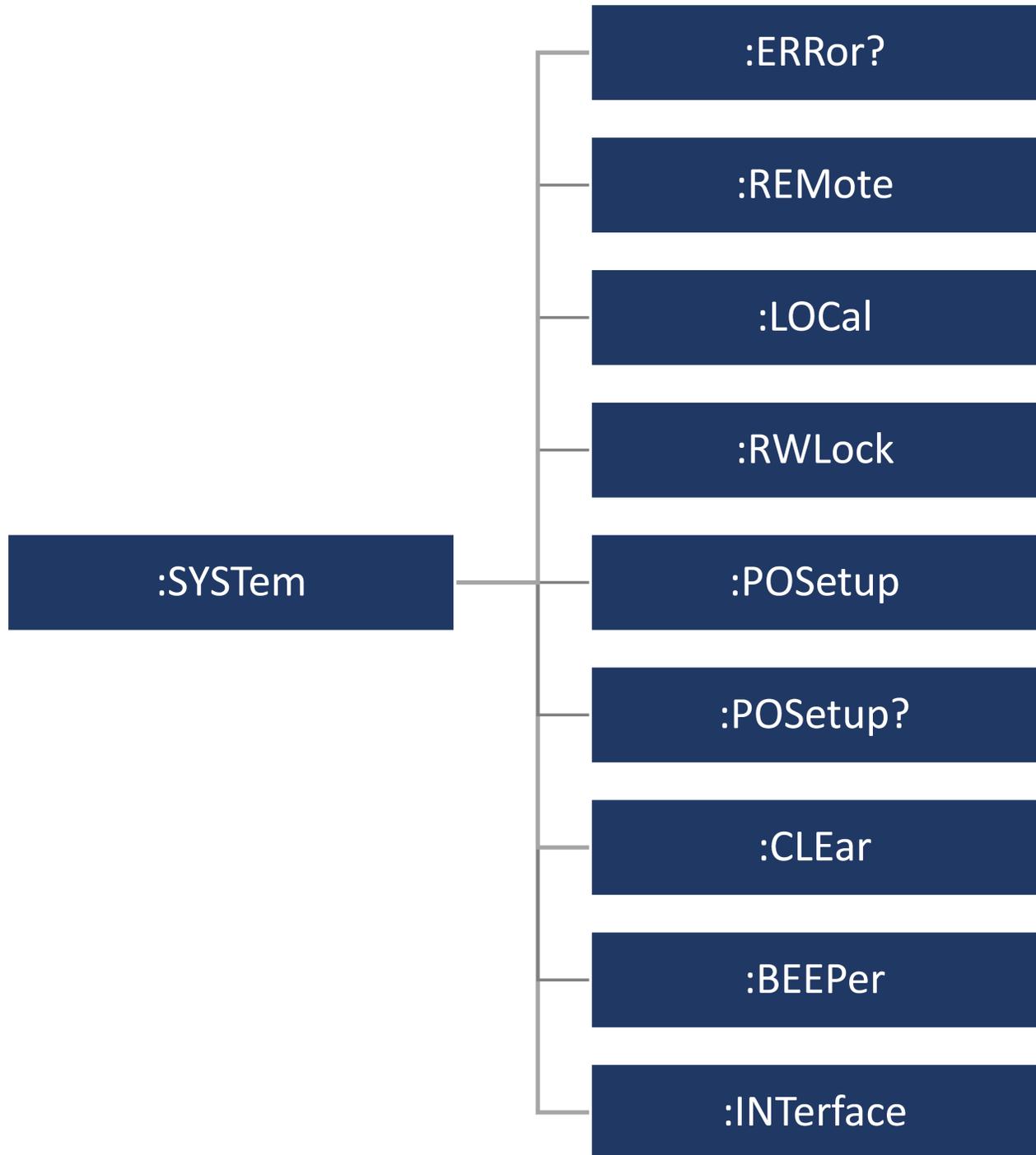
4.1 SYSTem:ERRor?

Description   This command is used to read the error code and the error information.

Command Syntax   SYST:ERR?

Returned Syntax   <NR1>,<SRD>
The following is the error code and the definition:

(101) Too many numeric suffices

(110) No input command

(114) Invalid Numeric suffix

(116) Invalid value

(117) Invalid dimensions

(120) Parameter overflowed

(130) Wrong units for parameter

(140) Wrong type of parameter

(150) Wrong number of parameter

(160) Unmatched quotation mark

(165) Unmatched bracket

(170) Invalid command

(180) No entry in list

(190) Too many dimensions

(191) Too many char

(-200) Execution error

(-221) Settings conflict

(-222) Data out of range

(-223) Too much data

(-224) Illegal parameter value

(-225) Out of memory

(-230) Data Corrupt or Stale

(-270) Macro error

(-310) System error

(-350) Too many errors [errors lost due to queue overflow]

(-400) Query error

(-410) Query INTERRUPTED

(-420) Query UNTERMINATED

(-430) Query DEADLOCKED

(-440) Query UNTERMINATED

(0) No error

(1) Module Initialization Lost

(2) Mainframe Initialization Lost

(3) Module Calibration Lost

(4) Eeprom failure

(5) RST checksum failed

(10) RAM selftest failed

(40) Flash write failed

(41) Flash erase failed

(213) RS-232 buffer overrun

(216) RS-232 receiver framing

(217) RS-232 receiver parity

(218) RS-232 receiver overrun

(220) Front panel uart overrun

(221) Front panel uart framing

(222) Front panel uart parity

(223) Front panel buffer overrun

(224) Front panel timeout

(225) Front Crc Check error

(226) Front Cmd Error

(401) CAL switch prevents

(402) CAL password is incorrect

(403) CAL not enabled

(404) readback cal are incorrect

(405) programming cal are incorrect

(406) Incorrect sequence of cal

(603) FETCH of data was not acquired

(604) Measurement overrange

4.2 SYSTem:VERSion?

Description This command is used to query the current SCPI version. The returned parameter is a string like"YYYY.V", in which the YYYY is the year of that version, V is the software version of that year.

Command Syntax SYST:VERS?

Returned Syntax <NRf>

4.3 SYSTem:REMote

Description This command is used to switch to the remote control mode (PC control).

4.4 SYSTem:LOCal

Description This command is used to switch the instrument to local control mode (front panel control).

Command Syntax SYST:LOCal

4.5 SYSTem:RWLock

Description This command is the same function as SYSTem:REMote, except this command can lock "LOCAL" button as well. When this command is executed, the "Local" button will be disabled.

Command Syntax SYSTem:RWLock

4.6 SYSTem:POSetup

Description This command configures the power on state of the instrument.

Command Syntax SYSTem:POSetup <string>
<string> := {RST | SAV0}

Query Syntax SYSTem:POSetup?

Returned Syntax <string>

4.7 SYSTem:POSetup?

Command Syntax SYSTem:POSetup?

Returned Syntax {RST | SAV0}

4.8 SYSTem:CLEar

Description This command is used to clear the error codes and information.

Command Syntax SYSTem:CLEar

4.9 SYSTem:BEEPer

Description This command is used to enable or disable the beeper.

Command Syntax SYSTem:BEEPer <bool>
<bool> := {0 | 1 | ON | OFF}

Query Syntax SYSTem:BEEPer?

Return Syntax <bool>
Returned value 0 corresponds to the off state of beeper.
Returned value 1 corresponding to the on state of beeper.

4.10 SYSTem:INTerface

Description This command is used to select the communication interfaces.

Command Syntax SYSTem:INTerface <string>
<string> := {USB | RS232 | LAN}

TRIGGER Subsystem
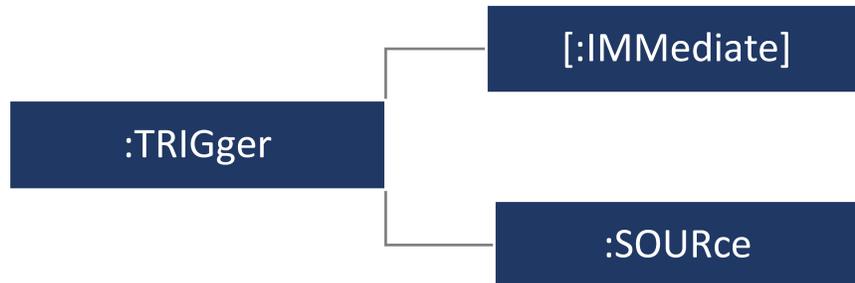
5.1 TRIGger[:IMMediate]

Description	This command is used to create a trigger signal. It will give a trigger signal in BUS trigger source mode. The function is the same as command *TRG.
Command Syntax	TRIGger[:IMMediate]
Related Commands	*TRG[sec:*TRIG]

5.2 TRIGger:SOURce

Description	This command is used to select the trigger source. Power supply can receive trigger signals directly from front panel by pushing "Trigger" button or receive from a BUS trigger signal (using the *TRG command).
Command Syntax	TRIG:SOURce <string> <string> := {MANUAL	BUS	EXTern}
Query Syntax	TRIGger:SOURce?
Return Syntax	<string>

SOURCE Subsystem

```
[:SOURce] ─┬─ :OUTPut ─── [:STATe]
           │
           ├─ :FREQuency ─── [:IMMediate]
           │
           ├─ :RANGe
           │
           ├─ :PHASe ─┬─ :STARt
           │          └─ :END
           │
           ├─ :DIMMer ─── [:PHASe]?
           │
           └─ VOLTage ─── [:LEVel] ─── [:IMMediate] ─── [:AMPLitude]
```
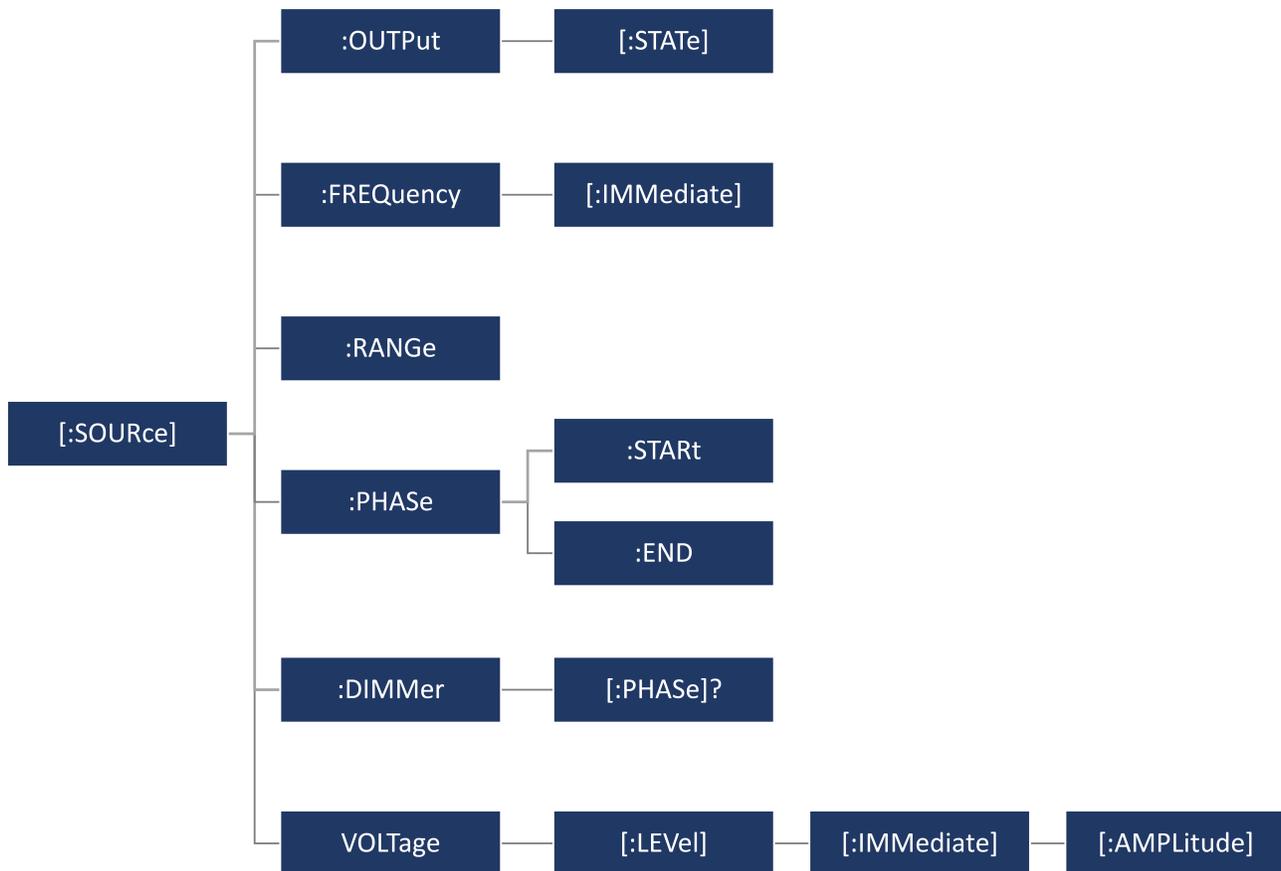
6.1 [SOURce:]OUTPut[:STATe]

Description   This command is used to control the output state of the power supply.

Command Syntax   [SOURce:]OUTPut [:STATe] <bool>
<bool> := {0 | 1 | ON | OFF}

Query Syntax   [SOURce:]OUTPut[:STATe]?

Return Syntax   <bool>

6.2 [SOURce:]RANGe

Description   This command is used to set the voltage and current ranges.

Command Syntax   [SOURce:]RANGe <string>
<string> := {AUTO | HIGH}

Query Syntax   [SOURce:]RANGe?

Return Syntax   <string>

6.3 [SOURce:]FREQuency[:IMMediate]

Description	This command is used to set the output frequency value.
Command Syntax	[SOURce:]FREQuency[:IMMediate] <NRf> <NRf> := {MIN TO MAX | MIN | MAX | DEF} **Unit**:= Hz
Query Syntax	[SOURce:]FREQuency[:IMMediate]?
Return Syntax	<NRf>

6.4 [SOURce:]PHASe:STARt

Description	This command is used to set the start phase angle.
Command Syntax	[SOURce:]PHASe:STARt <NRf> <NRf> := {MIN TO MAX | MIN | MAX | DEF} **Unit**:= °
Query Syntax	[SOURce:]PHASe:STARt?
Return Syntax	: <NRf>

6.5 [SOURce:]PHASe:END

Description	This command is used to set the stop phase angle.
Command Syntax	[SOURce:]PHASe:END <NRf> <NRf> := {MIN TO MAX | MIN | MAX | DEF} **Unit**:= °
Query Syntax	[SOURce:]PHASe:END?
Return Syntax	: <NRf>

6.6 [SOURce:]DIMMer[:PHASe]?

Description	This command is used to set the phase of the phase angle dimming function.
Command Syntax	[SOURce:]DIMMer[:PHASe]<NRf> <NRf> := {MIN TO MAX | MIN | MAX | DEF} **Unit**:= °
Query Syntax	[SOURce:]DIMMer[:PHASe]?
Return Syntax	: <NRf>

6.7 [SOURce:]VOLTage[:LEVel][:IMMediate][:AMPLitude]

Description	This command is used to set a voltage output of the power supply.
Command Syntax	[SOURce:]VOLTage[:LEVel][:IMMediate][:AMPLitude] <NRf> <NRf> := {MIN TO MAX | MIN | MAX | DEF} **Unit**:= V
Query Syntax	[SOURce:]VOLTage[:LEVel][:IMMediate][:AMPLitude]?
Return Syntax	: <NRf>

CONFIG Subsytem

```
                                                                    ┌──────────────┐
                                                                    │   :MINimum   │
                                        ┌──────────────┐   ┌──────────────┐  └──────────────┐
                                        │   :VOLTage   │───│   [:LEVel]   │──┤
                                        └──────────────┘   └──────────────┘  ┌──────────────┐
                        ┌──────────────┐                                     │   :MAXimum   │
                        │  [:SOURce]   │                    ┌──────────────┐ └──────────────┘
                        └──────────────┘                    │   :MINimum   │
                                        ┌──────────────┐    └──────────────┘
                                        │  :FREQuency  │────┤
                                        └──────────────┘    ┌──────────────┐
                                                            │   :MAXimum   │
                                                            └──────────────┘
    ┌──────────────┐   ┌──────────────┐   ┌──────────────┐   ┌──────────────┐   ┌──────────────┐
    │   :CONFig    │───│   :PROTect   │───│   :CURRent   │───│    :RMS      │───│    :MODe     │
    └──────────────┘   └──────────────┘   └──────────────┘   └──────────────┘   └──────────────┘
                        ┌──────────────┐   ┌──────────────┐   ┌──────────────┐
                        │     :BNC     │───│   [:PORT]    │───│   :FUNCtion  │
                        └──────────────┘   └──────────────┘   └──────────────┘
                        ┌──────────────┐   ┌──────────────┐
                        │   :DIMMer    │───│    :MODe     │
                        └──────────────┘   └──────────────┘
                        ┌──────────────┐   ┌──────────────┐   ┌──────────────┐
                        │    :LIST     │───│   :STARt     │───│    :MODe     │
                        └──────────────┘   └──────────────┘   └──────────────┘
```
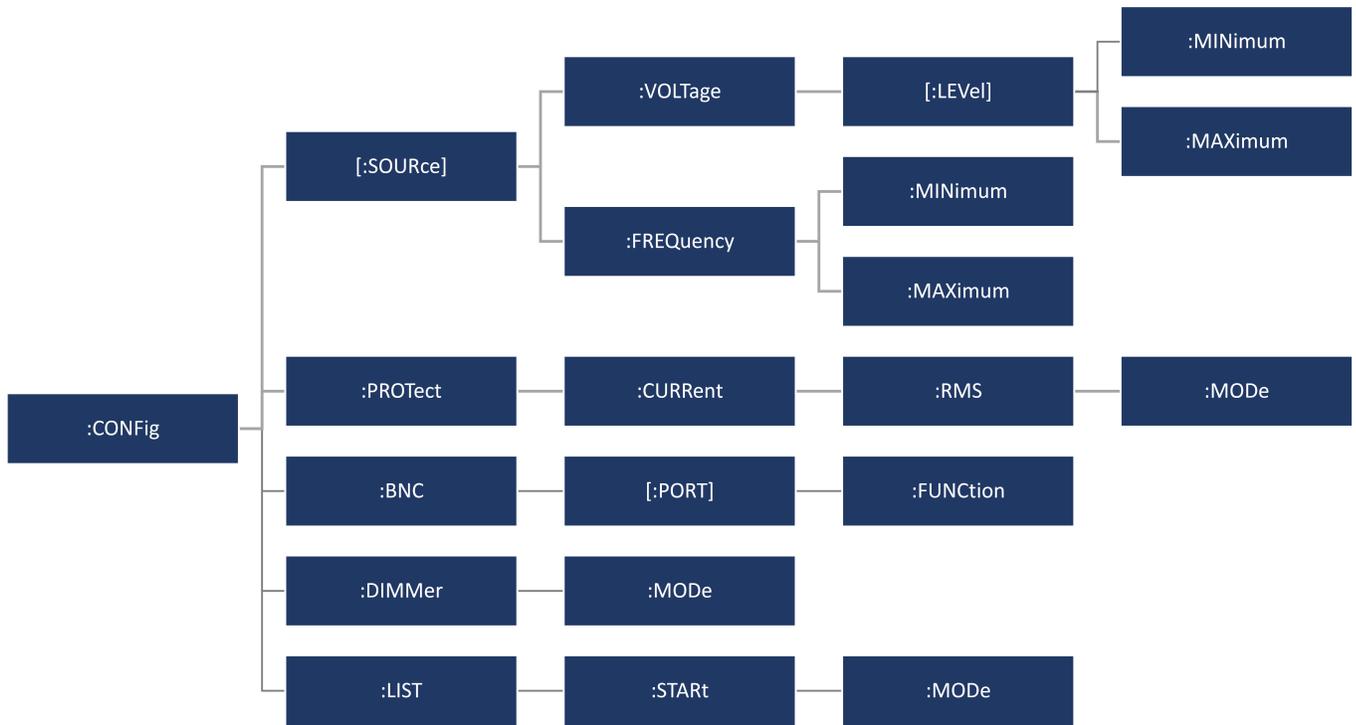
7.1 CONFig[:SOURce]:VOLTage[:LEVel]:MINimum

Description   This command is used to set the lower limitation (Volt-Min) of the output voltage.

Command Syntax   CONFig[:SOURce]:VOLTage[:LEVel]:MINimum <NRf>
<NRf> := {MIN TO MAX | MIN | MAX}
Unit: V

Query Syntax   CONFig[:SOURce]:VOLTage[:LEVel]:MINimum?

Return Syntax   <NRf>

7.2 CONFig[:SOURce]:VOLTage[:LEVel]:MAXimum

Description   This command is used to set the upper limitation (Volt-Max) of the output voltage.

Command Syntax   CONFig[:SOURce]:VOLTage[:LEVel]:MAXimum <NRf>
<NRf> := {MIN TO MAX | MIN | MAX}
Unit: V

Query Syntax   CONFig[:SOURce]:VOLTage[:LEVel]:MAXimum?

Return Syntax   <NRf>

7.3 CONFig[:SOURce]:FREQuency:MINimum

Description This command is used to set the lower limitation (Freq-Min) of the output frequency.

Command Syntax CONFig[:SOURce]:FREQuency:MINimum <NRf>
<NRf> := {MIN TO MAX | MIN | MAX}
Unit: Hz

Query Syntax CONFig[:SOURce]:FREQuency:MINimum?

Return Syntax <NRf>

7.4 CONFig[:SOURce]:FREQuency:MAXimum

Description This command is used to set the upper limitation (Freq-Max) of the output frequency.

Command Syntax CONFig[:SOURce]:FREQuency:MAXimum <NRf>
<NRf> := {MIN TO MAX | MIN | MAX}
Unit: Hz

Query Syntax CONFig[:SOURce]:FREQuency:MAXimum?

Return Syntax <NRf>

7.5 CONFig:PROTect:CURRent:RMS

Description This command is used to set the RMS current protection point (Irms-Protect).

Command Syntax CONFig:PROTect:CURRent:RMS <NRf>
<NRf> := {MIN TO MAX | MIN | MAX}
Unit: A

Query Syntax CONFig:PROTect:CURRent:RMS?

Return Syntax <NRf>

7.6 CONFig:PROTect:CURRent:RMS:MODe

Description This command is used to set the RMS current protection (Irms-Protect) delay mode.

Command Syntax CONFig:PROTect:CURRent:RMS:MODe <NRf>
<NRf> := {DELay | IMMediate}

Query Syntax CONFig:PROTect:CURRent:RMS:MODe?

Return Syntax <NRf>

7.7 CONFig:PROTect:CURRent:PEAK

Description This command is used to set the peak current protection point (Ipeak-Protect).

Command Syntax CONFig:PROTect:CURRent:PEAK <NRf>
<NRf> := {MIN TO MAX | MIN | MAX}
Unit: A

Query Syntax CONFig:PROTect:CURRent:PEAK?

Return Syntax <NRf>

7.8 CONFig:PROTect:CURRent:PEAK:MODe

Description This command is used to set the peak current protection (Ipeak-Protect) delay mode.

Command Syntax CONFig:PROToct:CURRent:PEAK:MODe <NRf>
<NRf> := {DELay | IMMediate}

Query Syntax CONFig:PROToct:CURRent:PEAK:MODe?

Return Syntax <NRf>

7.9 CONFig:BNC[:PORT][:FUNCtion]

Description This command is used to configure the BNC terminal functionality.

Command Syntax CONFig:BNC[:PORT][:FUNCtion]<NRf>
<NRf> := {I-TRigger | I-RI | O-PHase | O-ON}

Example CONF:BNC I-TR

Query Syntax CONFig:BNC[:PORT][:FUNCtion]?

Return Syntax <NRf>

7.10 CONFig:DIMMer:MODe

Description This command is used to configure the dimmer mode to either leading/trailing edge or off.

Command Syntax CONFig:DIMMer:MODe <NRf>
<NRf> := {LEADingedge | TRAilingedge | OFF}

Query Syntax CONFig:DIMMer:MODe?

Return Syntax <NRf>

7.11 CONFig:LIST:STARt:MODe

Description This command is used to configure the mode to start/initiate a list program. This controls the List-Set setting in the menu.

Command Syntax CONFig:LIST:STARt:MODe <NRf>
<NRf> := {ON/OFF | TRIGGER}

Example CONF:LIST:STAR ON/OFF

Query Syntax CONFig:LIST:STARt:MODe?

Return Syntax <NRf>

MEASURE and FETCH Commands

```
:MEASure — [:SCALar] ┬ :VOLTage ——— [:AC]?
                     │
                     ├ :CURRent ——— [:AC]?
                     │
                     ├ :POWer ——— [:AC] ┬ [:REAL]?
                     │                  ├ :APParent?
                     │                  └ :PFACtor?
                     │
                     ├ :FREQuency?
                     │
                     └ :CURRent ——— [:AC] ┬ :PEAK?
                                          └ :PEAK ——— MAXimum?
```

```
                              ┌──────────────┐   ┌──────────────┐
                              │  :VOLTage    │───│   [:AC]?     │
                              └──────────────┘   └──────────────┘

                              ┌──────────────┐   ┌──────────────┐
                              │  :CURRent    │───│   [:AC]?     │
                              └──────────────┘   └──────────────┘
                                                                    ┌──────────────┐
                                                                    │   [:REAL]?   │
                                                                    └──────────────┘
                              ┌──────────────┐   ┌──────────────┐   ┌──────────────┐
                              │   :POWer     │───│    [:AC]     │───│  :APParent?  │
                              └──────────────┘   └──────────────┘   └──────────────┘
  ┌──────────┐   ┌──────────┐                                       ┌──────────────┐
  │  :FETCh  │───│ [:SCALar]│                                       │   :PFACtor?  │
  └──────────┘   └──────────┘                                       └──────────────┘
                              ┌──────────────┐
                              │  :FREQuency? │
                              └──────────────┘
                                                                    ┌──────────────┐
                                                                    │    :PEAK?    │
                                                                    └──────────────┘
                              ┌──────────────┐   ┌──────────────┐   ┌──────────────┐   ┌──────────────┐
                              │  :CURRent    │───│    [:AC]     │───│    :PEAK     │───│  MAXimum?    │
                              └──────────────┘   └──────────────┘   └──────────────┘   └──────────────┘
```
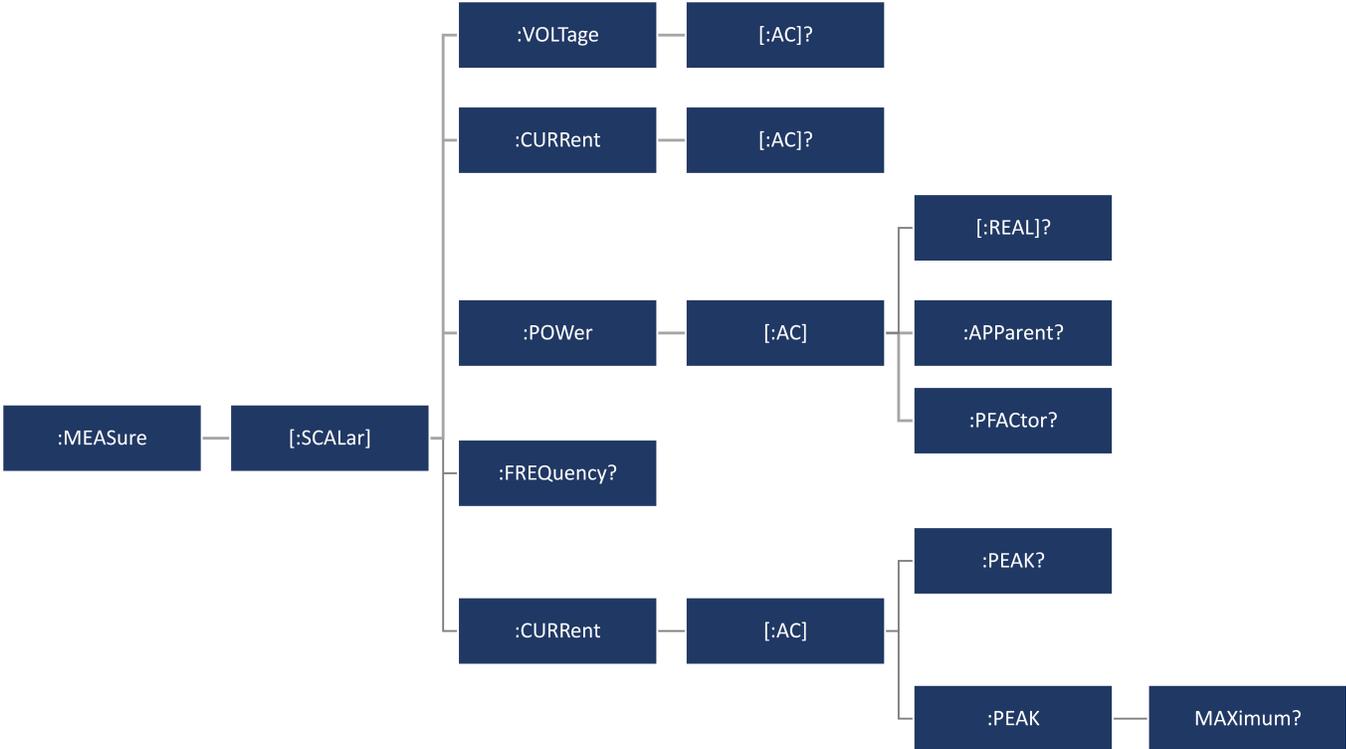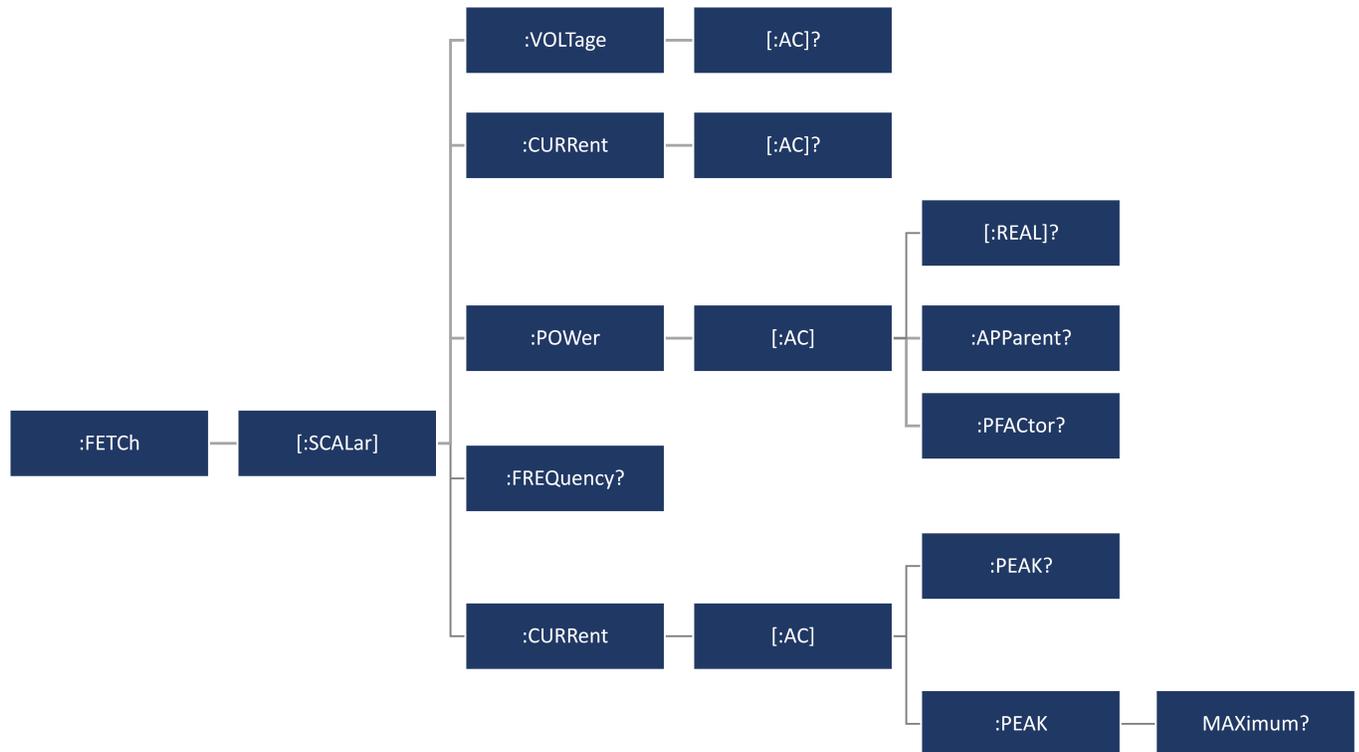
8.1 MEASure[:SCALar]:VOLTage[:AC]?

Description	This command is used to query the actual output AC voltage.
Command Syntax	MEASure[:SCALar]:VOLTage[:AC]?
Return Syntax	<NRf> **Unit**: V
Example	MEAS:VOLT?

8.2 FETCh[:SCALar]:VOLTage[:AC]?

Description	This command is used to read the output AC voltage which is in the sample cache. After sending the command, the readings will be sent to the computer. This command does not affect the instrument settings. This command does not trigger a measurement operation, and queries only the latest available reading. Before reading the new reading, the command returns old readings.
Command Syntax	FETCh:VOLTage?
Return Syntax	<NRf> **Unit**: V

8.3 MEASure[:SCALar]:CURRent[:AC]?

Description This command is used to query the actual output AC current.

Command Syntax MEASure[:SCALar]:CURRent[:AC]?

Return Syntax <NRf>
Unit: A

Example MEAS:CURR?

8.4 FETCh[:SCALar]:CURRent[:AC]?

Description This command is used to read the output AC current which is in the sample cache. After sending the command, the readings will be sent to the computer. This command does not affect the instrument settings. This command does not trigger a measurement operation, and queries only the latest available reading. Before reading the new reading, the command returns the old readings.

Command Syntax FETCh:CURRent?

Return Syntax <NRf>
Unit: A

8.5 MEASure[:SCALar]:POWer[:AC][:REAL]?

Description This command is used to query the actual output active power.

Command Syntax MEASure[:SCALar]:POWer[:AC][:REAL]?

Return Syntax <NRf>
Unit: W

Example MEAS:POWer?

8.6 FETCh[:SCALar]:POWer[:AC][:REAL]?

Description This command is used to read the output power which is in the sample cache. After sending the command, the readings will be sent to the computer. This command does not affect the instrument settings. This command does not trigger a measurement operation, and queries only the latest available reading. Before reading the new reading, the command returns the old readings.

Command Syntax FETCh:POWer?

Return Syntax <NRf>
Unit: W

8.7 MEASure[:SCALar]:POWer[:AC]:APParent?

Description This command is used to query the actual output apparent power.

Command Syntax MEASure[:SCALar]:POWer[:AC]:APParent?

Return Syntax <NRf>
Unit: VA

Example   MEAS:POWer:APP?

8.8 FETCh[:SCALar]:POWer[:AC]:APParent?

Description   This command is used to read the output apparent power which is in the sample cache. After sending the command, the readings will be sent to the computer. This command does not affect the instrument settings. This command does not trigger a measurement operation, and queries only the latest available reading. Before reading the new reading, the command returns the old readings.

Command Syntax   FETCh:POWer:APParent?

Return Syntax   <NRf>
Unit: VA

8.9 MEASure[:SCALar]:POWer[:AC]:PFACtor?

Description   This command is used to query the actual power factor.

Command Syntax   MEASure[:SCALar]:POWer[:AC]:PFACtor?

Return Syntax   <NRf>

Example   MEAS:POWer:PFAC?

8.10 FETCh[:SCALar]:POWer[:AC]:PFACtor?

Description   This command is used to read the power factor which is in the sample cache. After sending the command, the readings will be sent to the computer. This command does not affect the instrument settings. This command does not trigger a measurement operation, and queries only the latest available reading. Before reading the new reading, the command returns the old readings.

Command Syntax   FETCh:POWer:PFACtor?

Return Syntax   <NRf>

8.11 MEASure[:SCALar]:FREQuency?

Description   This command is used to query the actual output frequency.

Command Syntax   MEASure[:SCALar]:FREQuency?

Return Syntax   <NRf>
Unit: Hz

Example   MEAS:FREQ?

8.12 FETCh[:SCALar]:FREQuency?

Description   This command is used to read the output frequency which is in the sample cache. After sending the command, the readings will be sent to the computer. This command does not affect the instrument settings. This command does not trigger a measurement operation, and queries only the latest available reading. Before reading the new reading, the command returns the old readings.

Command Syntax   FETCh:FREQuency?

Return Syntax   <NRf>
Unit: Hz

8.13 MEASure[:SCALar]:CURRent[:AC]:PEAK?

Description   This command is used to query the actual output AC current peak.

Command Syntax   MEASure[:SCALar]:CURRent[:AC]:PEAK?

Return Syntax   <NRf>
Unit: A

Example   MEAS:CURR:PEAK?

8.14 FETCh[:SCALar]:CURRent[:AC]:PEAK?

Description   This command is used to read the output AC current peak which is in the sample cache. After sending the command, the readings will be sent to the computer. This command does not affect the instrument settings. This command does not trigger a measurement operation, and queries only the latest available reading. Before reading the new reading, the command returns the old readings.

Command Syntax   FETCh:CURR:PEAK?

Return Syntax   <NRf>
Unit: A

8.15 MEASure[:SCALar]:CURRent[:AC]:PEAK:MAXimum?

Description   This command is used to query the actual maximum output AC current peak.

Command Syntax   MEASure[:SCALar]:CURRent[:AC]:PEAK:MAXimum?

Return Syntax   <NRf>
Unit: A

Example   MEAS:CURR:PEAK:MAX?

8.16 FETCh[:SCALar]:CURRent[:AC]:PEAK:MAXimum?

Description   This command is used to read the maximum output AC current peak which is in the sample cache. After sending the command, the readings will be sent to the computer. This command does not affect the instrument settings. This command does not trigger a measurement operation, and queries only the latest available reading. Before reading the new reading, the command returns the old readings.

Command Syntax   FETCh:CURR:PEAK:MAX?

Return Syntax   <NRf>
Unit: A

LIST Commands

```
:LIST ──┬── :STATe
        │
        ├── :STEP ──────── :COUNt
        │
        ├── :RECall
        │
        ├── :REPeat
        │
        ├── :STEP ──┬── :VOLTage
        │           │
        │           ├── :FREQuecny
        │           │
        │           ├── :SLOPe
        │           │
        │           ├── :DWELl ──────── :UNIT
        │           │
        │           ├── :SD
        │           │
        │           ├── :STATe
        │           │
        │           ├── :CONTinue
        │           │
        │           ├── :VOLTage
        │           │
        │           ├── :SITE
        │           │
        │           └── :TIMe
        │
        ├── :SAVe ──────── :BANK
        │
        └── :RUN ──────── STEP ──┬── :COUNt?
                                 │
                                 └── :REPeat?
```
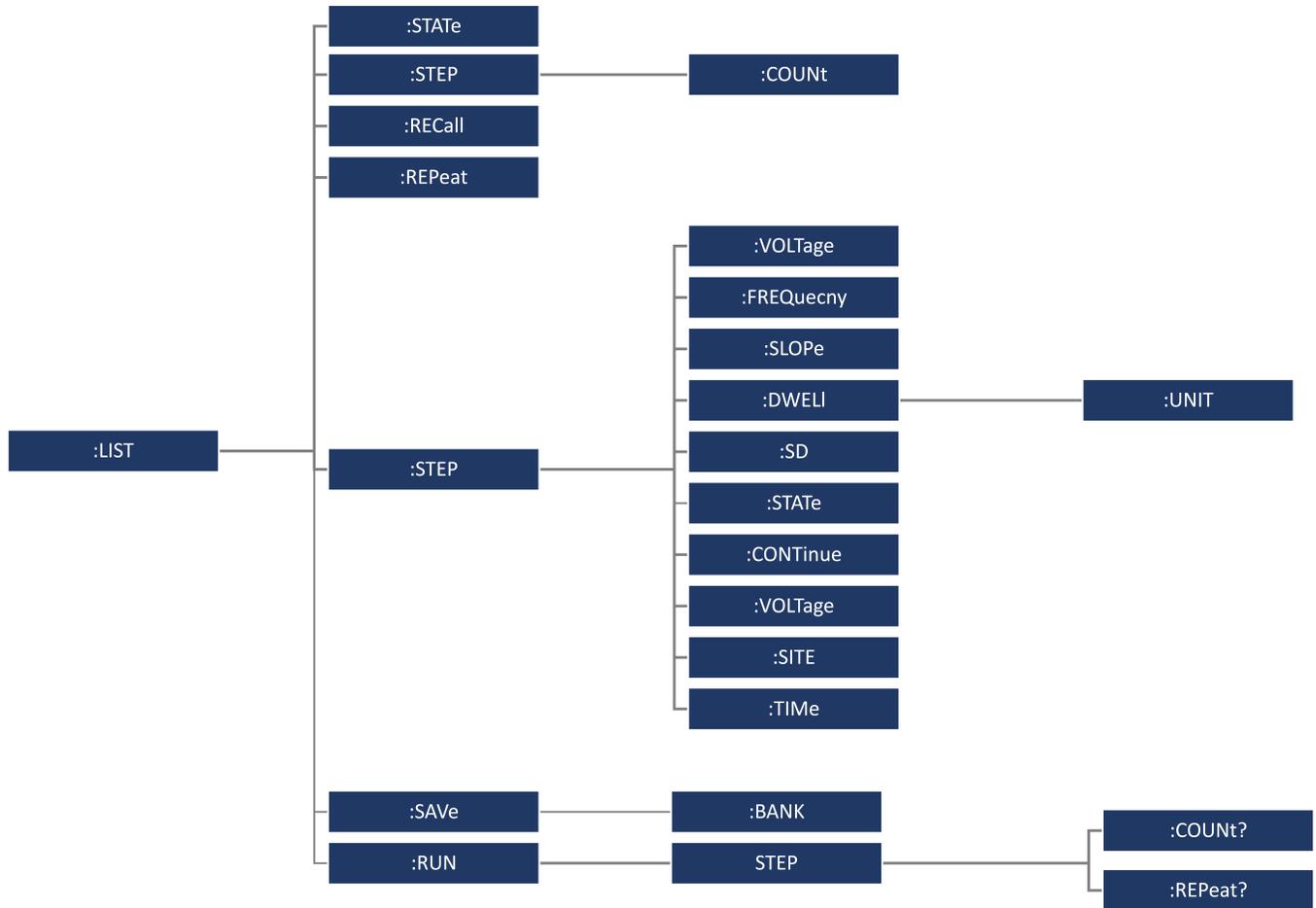
9.1 LIST:STATe

Description	This command is used to set the state of list mode.
Command Syntax	LIST:STATe <string> <string> := { DISable	ENABle}
Query Syntax	LIST:STATe?
Return Parameter	<string>

9.2 LIST:RECall

Description   This command is used to recall a list file.

Command Syntax   LIST:RECall <NR1>
                    <NR1> := { 0 ~9}

Example   LIST:REC 6

Query Syntax   LIST:RECall?

Return Parameter <NR1>

9.3 LIST:STEP:COUNt

Description   This command is used to set the number of steps in a list file.

Command Syntax   LIST:STEP:COUNt <NR1>
                    <NR1> := { 1 ~100}

Example   LIST:STEP:COUN 5

Query Syntax   LIST:STEP:COUNt?

Return Parameter <NR1>

9.4 LIST:REPeat

Description   This command is used to edit the number of repeat times of the list file.

Command Syntax   LIST:REPeat <NR1>
                    <NR1> := {1 ~10000}

Example   LIST:REP 20

Query Syntax   LIST:REPeat?

Return Parameter <NR1>

9.5 LIST:STEP:VOLTage

Description   This command is used to edit the voltage level for a single step in the list file.

Command Syntax   LIST:STEP:VOLTage <NR1>,<NRf>
                    <NR1> := { 0 ~99}
                    <NRf> := {Voltage, **Unit**: V

Example   LIST:STEP:VOLT 1, 30

Query Syntax   LIST:STEP:VOLTage? <NR1>

Example   LIST:STEP:VOLT? 1

Return Parameter <NRf>

9.6 LIST:STEP:FREQuency

Description This command is used to edit the frequency for a single step in the list file.

Command Syntax LIST:STEP: FREQuency <NR1>,<NRf>
<NR1> := { 0 ~99}
<NRf> := {Frequency, **Unit**: Hz}

Example LIST:STEP:FREQ 2, 60

Query Syntax LIST:STEP: FREQuency? <NR1>

Example LIST:STEP:FREQ? 2

Return Parameter <NRf>

9.7 LIST:STEP:SLOPe

Description This command is used to edit the slope time for a single step in the list file.

Command Syntax LIST:STEP:SLOPe <NR1>,<NRf>
<NR1> := { 0 ~99}
<NRf> := { Slope time, **Unit**: s}

Example LIST:STEP:SLOPe 3, 5.5

Query Syntax LIST:STEP:SLOPe? <NR1>

Example LIST:STEP:SLOPe? 3

Return Parameter <NRf>

9.8 LIST:STEP:DWELl:UNIT

Description This command is used to edit the dwell time units for a single step in the list file.

Command Syntax LIST:STEP:DWELl:UNIT <NR1>,< string >
<NR1> := { 0 ~99}
<string> := { SECond | MINUte | HOUR}

Example LIST:STEP:DWELl:UNIT 2, SEC

Query Syntax LIST:STEP:DWELl:UNIT? <NR1>

Example LIST:STEP:DWELl:UNIT? 3

Return Parameter <string>

9.9 LIST:STEP:DWELl

Description This command is used to edit the dwell time for a single step in the list file.

Command Syntax LIST:STEP:DWELl <NR1>,<NRf>
<NR1>:= { 0 ~99}
<NRf>:= {Dwell time}

Example	LIST:STEP:DWELl 3, 20
Query Syntax	LIST:STEP:DWELl? <NR1>
Example	LIST:STEP:DWEL? 3
Return Parameter	<NRf>

9.10 LIST:STEP:SD:STATe

Description	This command is used to enable or disable the disturbance simulation status for a single step in the list file.
Command Syntax	LIST:STEP:SD:STAT <NR1>,<string> <NR1> := { 0 ~99} <string> := { DISable | ENABle}
Example	LIST:STEP:SD:STAT 3, DIS
Query Syntax	LIST:STEP:SD:STAT? <NR1>
Example	LIST:STEP:SD:STAT? 2
Return Parameter	<string>

9.11 LIST:STEP:SD:CONTinue

Description	This command is used to turn on or off the continuous trigger for disturbance simulation for a single step in the list file.
Command Syntax	LIST:STEP:SD:CONTinue <NR1>,<bool> <NR1> := { 0 ~99} <bool> := { OFF | ON | 0 | 1}
Example	LIST:STEP:SD:CONT 3, ON
Query Syntax	LIST:STEP:SD:CONTinue? <NR2>
Example	LIST:STEP:SD:CONT? 2
Return Parameter	<bool>

9.12 LIST:STEP:SD:VOLTage

Description	This command is used to set the voltage surge for disturbance simulation for a single step in the list file.
Command Syntax	LIST:STEP:SD:VOLTage <NR1>,<NRf> <NR1> := { 0 ~99} <NRf> := { Voltage, **Unit**: V}
Example	LIST:STEP:SD:VOLT 2, 30
Query Syntax	LIST:STEP:SD:VOLTage? <NR2>
Example	LIST:STEP:SD:VOLT? 2

Return Parameter <NRf>

9.13 LIST:STEP:SD:SITe

Description This command is used to set the initial time the disturbance occurs for a single step in the list file.

Command Syntax LIST:STEP:SD:SITe <NR1>,<NRf>
<NR1> := {0 ~99}
<NRf> := { Time, **Unit**: ms}

Example LIST:STEP:SD:SIT 5, 10

Query Syntax LIST:STEP:SD:SITe? <NR1>

Example LIST:STEP:SD:SIT? 2

Return Parameter <NRf>

9.14 LIST:STEP:SD:TIMe

Description This command is used to set the duration of the disturbance for a single step in the list file.

Command Syntax LIST:STEP:SD:SITe <NR1>,<NRf>
<NR1> := { 0 ~99}
<NRf> := { Time, **Unit**: ms}

Example LIST:STEP:SD:TIM 3, 20

Query Syntax LIST:STEP:SD:TIMe? <NR1>

Example LIST:STEP:SD:TIM? 2

Return Parameter <NRf>

9.15 LIST:SAVe:BANK

Description This command is used to save a list file into a specified memory location.

Command Syntax LIST:SAVe:BANK <NR1>
<NR1> := { 0 ~9}

Example LIST:SAV:BANK 0

9.16 LIST:RUN:STEP:COUNt?

Description This command is used to query the step currently running

Query Syntax LIST:RUN:STEP:COUNt?

9.17 LIST:RUN:STEP:REPeat?

Description This command is used to query the step currently running

Query Syntax LIST:RUN:STEP:REPeat?

9.18 Creating a List

Description Creating a list requires the commands to be sent in a sequence. If the commands are not sent in the correct sequence the unit will beep indicating it does not recognize the command.

Additional Information A list can be broken down into 3 parts: **List Setup**, **Step Parameters**, and **List Save**.

List Setup : List setup includes the following parameters:

LIST:STEP:COUNT   LIST:REPeat

These parameters are independent and can be set at any point.

List and Step Parameters The list and step parameters are codependent and must be sent in a sequence for the unit to recognize the commands.

Note:

While editing a list's parameters new changes will be stored in temporary memory.
LIST:SAVe:BANK must be used to save the changes to the internal memory.
ABORT all list initiated in any channels before you begin the sequence.

Sequence

1. Set the list parameters:

   - **LIST:STEP:COUNT** <count>
     count := {1 to 100}
   - **LIST:REPeat** <repeat>
     repeat := { 1 to 10000}

2. To set each step's parameters send the commands below in the follwoing sequence:

   - **LIST:STEP:VOLT** <step number>,<voltage value>
   - **LIST:STEP:FREQ** <step number>,<frequency>
   - **LIST:STEP:SLOP** <step number>,<dwell time>
   - **LIST:STEP:DWELL:UNIT** <step number>,<dwell unit>
   - **LIST:STEP:SD:STAT** <step number>,<state>

   If SD state is disabled the following SD commands can be ignored.

   - **LIST:STEP:SD:CONT** <step number>,<state>
   - **LIST:STEP:SD:VOLT** <step number>,<voltage value>
   - **LIST:STEP:SD:SIT** <step number>,<initial time of disturbance>
   - **LIST:STEP:SD:TIM** <step number>,<duration time of disturbance>

3. Once the parameters of the steps have been set save the list to the desired memory location.

   - **LIST:SAV:BANK** <memory location>
   - Include a delay to provide enought time for the list to be saved. 2000 ms should be more than enough.

9.19 Running a List

Description   After saving a list, run the list by following the sequence below.

1. Configure the trigger source.

   - Set the Trigger source to bus using the command **TRIG:SOURC BUS**

2. Recall the saved list.

   - Load the saved list using the command **LIST:REC** <memory location>

3. Enable list mode.
   Set the instrument to list mode using the command **LIST:STAT ENAB**.

4. Configure the instrument to use a trigger to initate the start of the list.

   - Set the list initiation to trigger using the command **CONF:LIST:STAR:MOD TRIGGER**

5. Enable the output before running the list.

   - Enable the output using the command **OUTP ON**

6. Set a short delay (approximately 500 ms) to allow the output to be enabled.

7. Run the list.

   - Initiate the list by sending the ***TRG**.

SWEEP Commands

```
:SWEep ─┬─ :STATe
        ├─ :RECall
        ├─ :STARt ─── :VOLTage
        ├─ :END ───── :VOLTage
        ├─ :STEP ─┬─ :VOLTage
        │         ├─ :TIMe ─── :UNIT
        │         └─ :TIMe
        ├─ :STARt ─── :FREQuency
        ├─ :END ───── :FREQuency
        ├─ :STEP ──── :FREQuency
        ├─ :SAVe ──── :BANK
        └─ :MEASure ─ [:SCALar] ─┬─ :VOLTage ─── [:AC]?
                                 ├─ :CURRent ─── [:AC]?
                                 └─ :POWer ─┬─ [:AC] ─┬─ [:REAL]?
                                            │         ├─ APParent?
                                            │         └─ PFACtor?
                                            └─ FREQuency?
```
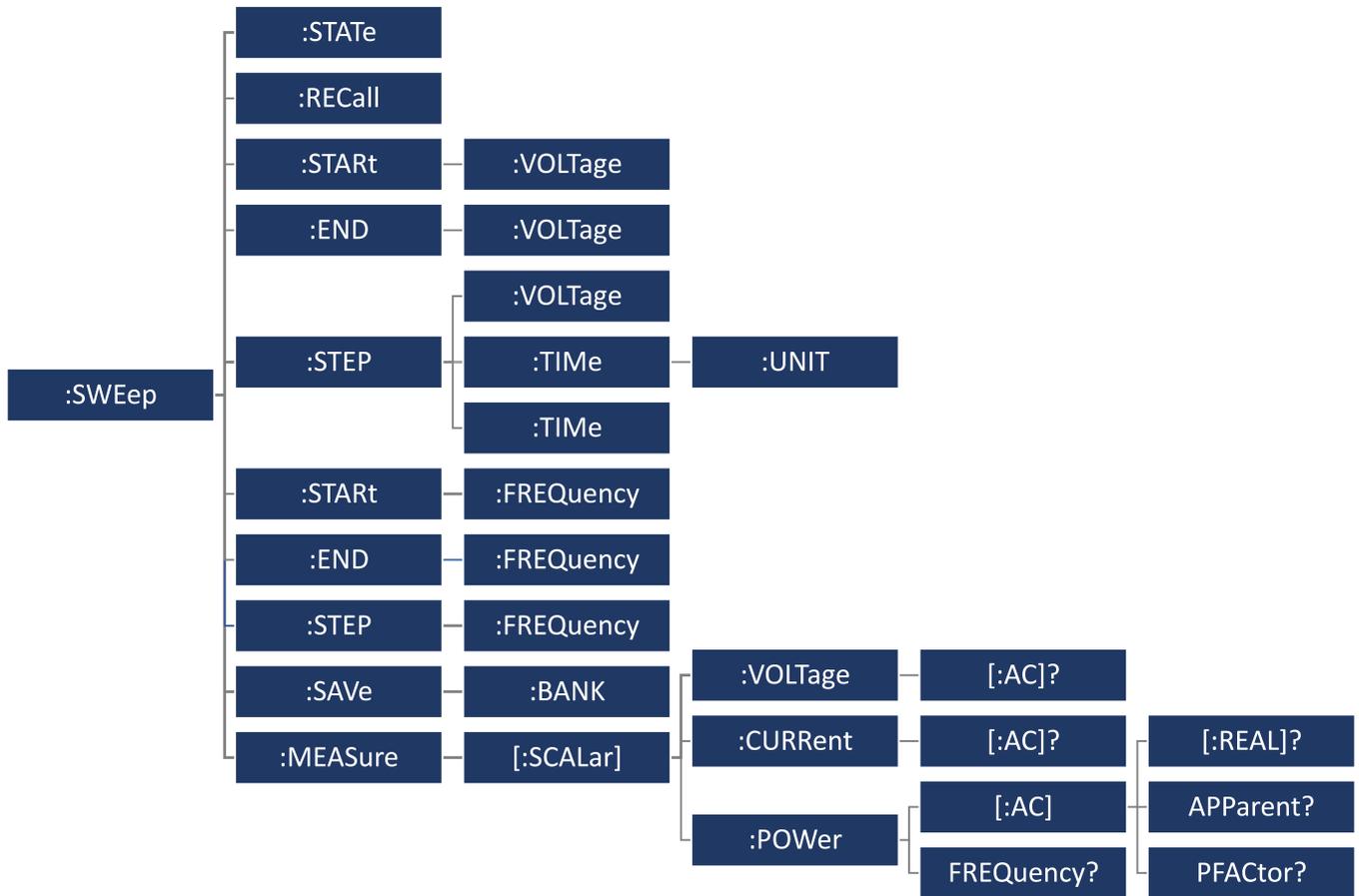
10.1 SWEep:STATe

Description	This command is used to set the state of sweep mode.
Command Syntax	SWEep:STATe <string> <string> := { DISable | ENABle}
Example	SWE:STAT ENAB
Query Syntax	SWEep:STATe?
Return Parameter	<string>

10.2 SWEep:RECall

Description   This command is used to recall a sweep setup file.

Command Syntax   SWEep:RECall <NR1> <NR1> := { 0 ~ 9 }

Example   SWE:REC 4

Query Syntax   SWEep:RECall?

Return Parameter <NR1>

10.3 SWEep:STARt:VOLTage

Description   This command is used to edit the sweep starting voltage.

Command Syntax   SWEep:STARt:VOLTage <NRf>
                     <NRf> := { MINimum | MAXimum | <NRf>}
                     Unit: V

Example   SWE:STAR:VOLT 5

Query Syntax   SWE:STAR:VOLT?

Return Parameter <NRf>

10.4 SWEep:END:VOLTage

Description   This command is used to edit the sweep starting voltage.

Command Syntax   SWEep:END:VOLTage <NRf>
                     <NRf> := { MINimum | MAXimum | <NRf>}
                     Unit: V

Example   SWE:END:VOLT 5

Query Syntax   SWE:END:VOLT?

Return Parameter <NRf>

10.5 SWEep:STEP:VOLTage

Description   This command is used to edit the sweep voltage step.

Command Syntax   SWEep:STEP:VOLTage <NRf>
                     <NRf> := { MINimum | MAXimum | <NRf>}
                     Unit: V

Example   SWE:STEP:VOLT 10.2

Query Syntax   SWEep:STEP:VOLTage?

Return Parameter <NRf>

10.6 SWEep:STEP:TIMe:UNIT

Description This command is used to set the sweep time unit for a single step.

Command Syntax SWEep:STEP:VOLTage <NRf>
<NRf> := { SECond | MINUte | HOUR}

Example SWE:STEP:TIM:UNIT SEC

Query Syntax SWEep:STEP:VOLTage?

Return Parameter <NRf>

10.7 SWEep:STEP:TIMe

Description This command is used to edit the sweep time for a single step.

Command Syntax SWEep:STEP:TIMe <NRf>
<NRf> := { MINimum | MAXimum | <NRf>}
Unit: ms

Example SWE:STEP:TIM 2, 60

Query Syntax SWEep:STEP:TIMe?

Return Parameter <NRf>

10.8 SWEep:STARt:FREQuency

Description This command is used to edit the sweep starting frequency.

Command Syntax SWEep:STARt:FREQuency <NRf>
<NRf> := { MINimum | MAXimum | <NRf>}
Unit: Hz

Example SWE:STAR:FREQ 50

Query Syntax SWEe:STARt:FREQuency?

Return Parameter <NRf>

10.9 SWEep:END:FREQuency

Description This command is used to edit the sweep ending frequency.

Command Syntax SWEep:END:FREQuency <NRf>
<NRf> := { MINimum | MAXimum | <NRf>}
Unit: Hz

Example SWE:END:FREQ 100

Query Syntax SWEep:END: FREQuency?

Return Parameter <NRf>

10.10 SWEep:STEP:FREQuency

Description   This command is used to edit the sweep frequency step.

Command Syntax   SWEep:STEP:FREQuency <NRf> <NRf> := { MINimum | MAXimum | <NRf>}
Unit: Hz

Example   SWE:STEP:FREQ 10

Query Syntax   SWEep:STEP:FREQuency?

Return Parameter   <NRf>

10.11 SWEep:SAVe:BANK

Description   This command is used to save a sweep file into a specified memory location.

Command Syntax   SWEep:SAVe:BANK <NR1>
<NR1> := { 0 ~ 9}

Example   SWE:SAV:BANK 0

10.12 SWEep:MEASure[:SCALar]:VOLTage[:AC]?

Description   This command is used to query the output AC voltage at the sweep maximum power point.

Query Syntax   SWEep:MEASure[:SCALar]:VOLTage[:AC]?

Return Parameter   <NRf>
Unit:V

10.13 SWEep:MEASure[:SCALar]:CURRent[:AC]?

Description   This command is used to query the output AC current at the sweep maximum power point.

Query Syntax   SWEep:MEASure[:SCALar]:CURRent[:AC]?

Return Parameter   <NRf>
Unit:A

10.14 SWEep:MEASure[:SCALar]:POWer[:AC][:REAL]?

Description   This command is used to query the output active power at the sweep maximum power point.

Query Syntax   SWEep:MEASure[:SCALar]:POWer[:AC][:REAL]?

Return Parameter   <NRf>
Unit:W

10.15 SWEep:MEASure[:SCALar]:POWer[:AC]:APParent?

Description This command is used to query the output apparent power at the sweep maximum power point.

Query Syntax SWEep:MEASure[:SCALar]:POWer[:AC]:APParent?

Return Parameter <NRf>
Unit:VA

10.16 SWEep:MEASure[:SCALar]:POWer[:AC]:PFACtor?

Description This command is used to query the power factor at the sweep maximum power point.

Query Syntax SWEep:MEASure[:SCALar]:POWer[:AC]:PFACtor?

Return Parameter <NRf>
Unit:None

10.17 SWEep:MEASure[:SCALar]:FREQuency?

Description This command is used to query the output frequency at the sweep maximum power point.

Query Syntax SWEep:MEASure[:SCALar]:FREQuency?

Return Parameter <NRf>
Unit:Hz