COPPER MOUNTAIN®
TECHNOLOGIES

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PE0312-75

Switch Matrix

Operating and Programming Manual

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Introduction

This manual contains designs, specifications, functional overview, and detailed operation procedures for the Copper Mountain Technologies Switch Matrix PE0312-75 to ensure effective and safe use of its technical capabilities.

Maintenance and operation of the Analyzer should be performed by qualified engineers with basic experience in the operation of microwave circuits.

Websites

Copper Mountain Technologies

Safety Instructions

Follow all safety warnings and precautions provided in this document to operate, service, and repair the PE0312-75.

To ensure reliable operation of USB devices manufactured by CMT, it is recommended to use a powered USB hub (USB port extender with external power supply).

The PE0312-75 should be used only by skilled and thoroughly trained personnel with the required skills and knowledge of safety precautions.

The PE0312-75 complies with INSTALLATION CATEGORY II as well as POLLUTION DEGREE 2 as defined in IEC61010–1.

The PE0312-75 is a MEASUREMENT CATEGORY I (CAT I) device. Do not use the Analyzer as a CAT II, III, or IV device.

The PE0312-75 is for INDOOR USE only.

The PE0312-75 has been tested as both a stand-alone device and in combination with the accessories supplied by Copper Mountain Technologies, in accordance with the requirements of the standards described in the Declaration of Conformity. If the PE0312-75 is integrated with another system, compliance with related regulations and safety requirements are to be confirmed by the builder of the system.

Never operate the PE0312-75 in an environment containing flammable gasses or fumes.

Operators must not remove the cover or any other part of the housing. The PE0312-75 must not be repaired by the operator. Component replacement or internal adjustment must be performed by qualified maintenance personnel only.

Never operate the PE0312-75 if the power cable is damaged.

Never connect the test ports to A/C power mains.

Electrostatic discharge can damage the PE0312-75, whether connected to or disconnected from the DUT. Static charge can build up on your body and damage sensitive internal components of both the PE0312-75 and the DUT. To avoid damage from electric discharge, observe the following:

- Always use a desktop anti-static mat under the DUT.
- Always wear a grounding wrist strap connected to the desktop anti-static mat via daisy-chained 1 MΩ resistor.
- Connect the post marked ⏚ on the body of the PE0312-75 to the common ground of the test station.
- PC and DUT connection to protective grounding.

All general safety precautions related to operation of electrically energized equipment must be observed.

Definitions of safety symbols used on the instrument and in the manual are listed below.

Refers to the Manual if the instrument is marked with this symbol.

Alternating current.

Direct current.

On (Supply).

Off (Supply).

A chassis terminal; a connection to the instrument's chassis, which includes all exposed metal surfaces.

WARNING

This sign denotes a hazard. It calls attention to a procedure, practice, or condition that, if not correctly performed or adhered to, could result in injury or death to personnel.

CAUTION

This sign denotes a hazard. It calls attention to a procedure, practice, or condition that, if not correctly performed or adhered to, could result in damage to or destruction of part or all of the instrument.

NOTE

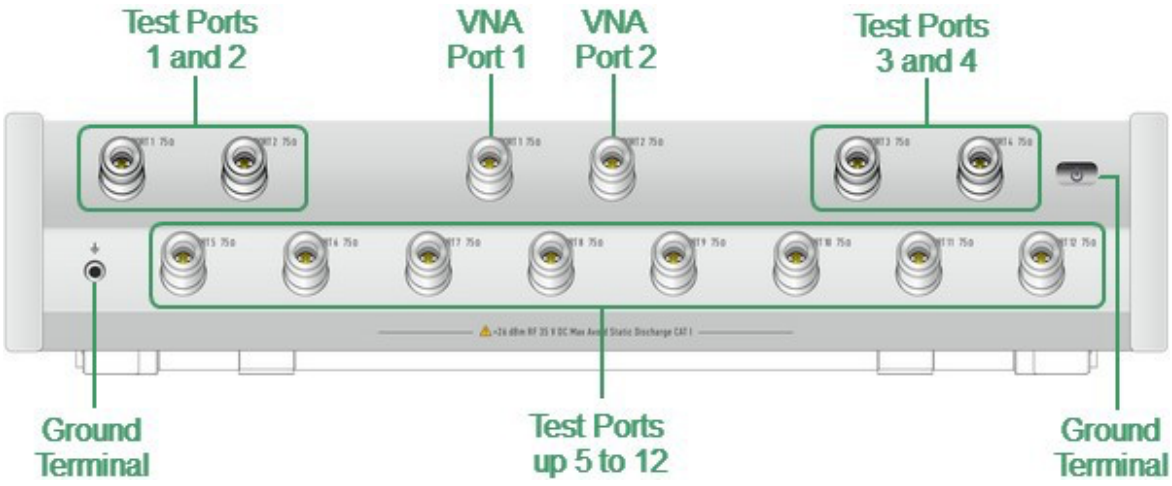
This sign denotes important information. It calls attention to a procedure, practice, or condition that is essential for the user to understand.

Principles of Operation

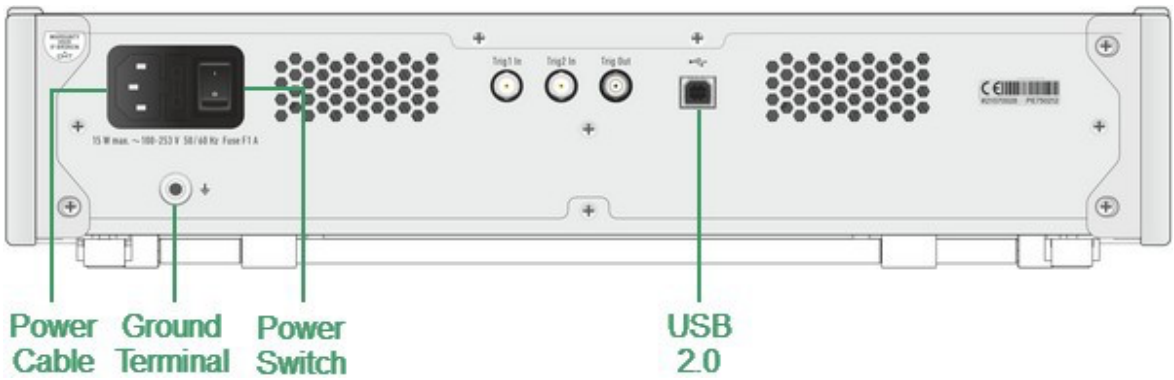
Switch Matrix PE0312-75 is designed to be used as a port expander when working with a 2-port VNA with an impedance of 75 Ohms. You can have up to 12 ports using a PE0312-75.

PE0312-75, Front and Rear Panel

In this section, the front and rear panels of PE0312-75 are shown further, along with the controls located on panels.



Front Panel



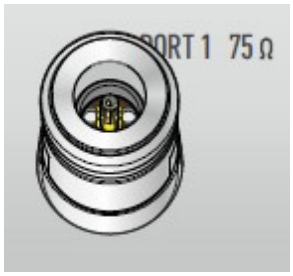
Rear Panel PE0312-75 Switch Matrix

Part of Front Panel

Power Button

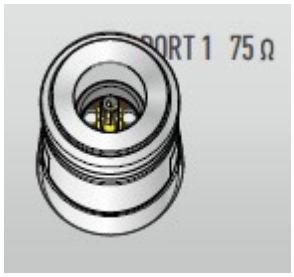
Switches the PE0312-75 ON and OFF.

VNA Ports



Ports for VNA connection.

Test Ports



Test Port 1, Port 2 etc. are intended for DUT connection (12 ports in all). PE0312-75 models have type-N 75 Ω female test port connector types.

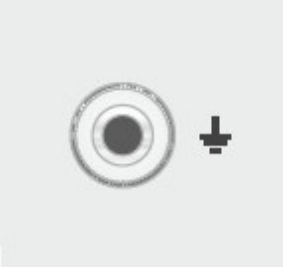
Each test port has an LED indicator. A test port can be used either as a source of the stimulus signal or as a receiver of the response signal from the DUT. The stimulus signal can only appear on one port at a time.

Connecting the DUT to only one test port on the PE0312-75 allows the measurement of reflection parameters (e.g. S11 or S22) of the DUT.

Connecting the DUT to all test ports of the PE0312-75 allows the measurement of the full S-parameter matrix of the DUT.

NOTE	The LED indicator shows which DUT port is connected to which VNA port.

Ground Terminal



Use the terminal for grounding.

To avoid damage from electric discharge, connect the ground terminal on the body of the PE0312-75 to a reliable earth ground shared with the DUT in the test environment.

Parts of Rear Panel

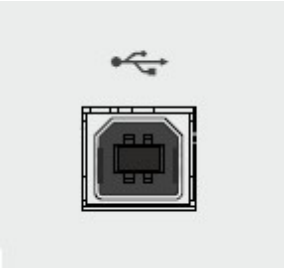
Power Cable Receptacle

The power cable receptacle is intended for 100 to 240 VAC 50/60 Hz power cable connection.

Power Switch

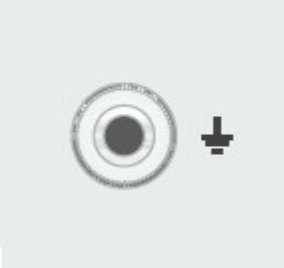
The power switch serves as the disconnecting device (device that cuts off power supply) of the PE0312-75. Power supply must be turned off to avoid danger, such as electric shock when the device is unused for prolonged periods of time. When the power switch is on, it lights up green.

USB 2.0 High Speed Port



The USB port is intended for connection to an external PC.

Ground Terminal



To avoid electric shock, use the terminal for grounding. The ground terminal allows connection directly to the body of the PE0312-75 to the test station ground to ensure electrical safety. Connecting a 50 ohm male N-Connector to any of the front panel 75 ohm N connectors will cause permanent damage.

Preparation for Use

Unpack the PE0312-75 and other accessories.

CAUTION	Please keep packaging to safely ship the instrument for annual calibration!

Connect Port 1 and Port 2 of the Analyzer to VNA Port 1 and VNA Port 2 of the PE0312-75, respectively.

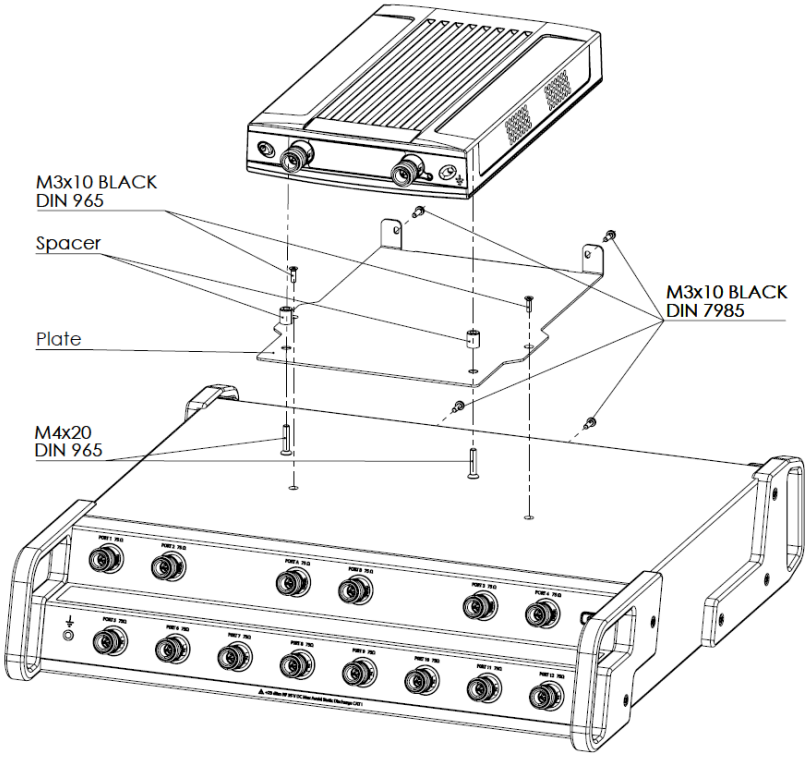
Connect the PE0312-75 to a 100 to 253 VAC 50/60 Hz power source by means of the external power cable supplied with the instrument. Connect the USB-port of the PE0312-75 to the PC using the USB Cable supplied in the package.

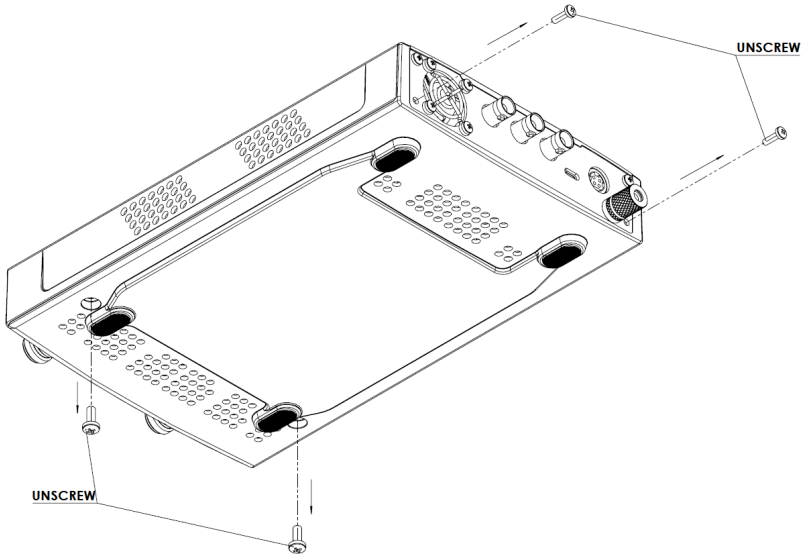
Warm up the PE0312-75 for 15 minutes.

Preparation for Use

Mounting the SC7540 to the PE0312-75

1. Unscrew the two screws at the bottom of the device, as well as the two lower screws on the rear panel.
2. Install the spacer and rack.
3. Tighten the two M4X20 DIN 965 screws included in the optional mounting rack assembly on the bottom and screw the two M3X10 DIN 7985 screws into the rear panel.
4. Install the VNA with the rack onto the PE0312-75, then tighten the two M3X10 DIN 7985 screws on the rear side of the PE0312-75 and then the two M3X10 DIN965 screws on the top of the PE0312-75.





Programming

The following section describes PE0312-75 remote control.

SCPI (Standard Commands for Programmable Instruments) text commands are used to control the PE0312-75 remotely.

Commands sent to the plug-in and responses from the plug-in are sent as ASCII text that comply with the SCPI standard. These messages are delivered over computer networks using the USB port.

SCPI Overview

The PE0312-75 implements a set of commands based on the standard SCPI-1999 (Standard Commands for Programmable Instruments). This is a set of instructions for the exchange of text messages.

SCPI was developed by the SCPI Consortium (currently supported by the IVI Foundation). The main details of the SCPI standard are described further on.

Messages

The SCPI is an ASCII text protocol. The commands are sent as character messages. One message can contain one or several commands.

Command Tree

The SCPI commands are organized in a tree structure. Each tree structure forms a functional system. The base of the tree is called the *root*. Each functional system can have subsystems of lower level. The final nodes are called *leaves*. The entire sequence from root to leaf makes up the command.

Long and Short Formats

Each keyword in a command specification has a long format and a short format. The short format of a command is indicated by capital letters. For example, the following command specification can be written as:

SYSTem:ERRor[:NEXT]? or SYST:ERR?

Only one form can be used at a time, as combining forms will be incorrect. For example, the following specification is incorrect:

SYSTem:ERR?

Case Sensitivity

The commands are not case sensitive. Upper case and lower case letters are only used to indicate the long and short formats of a command specification. For example, the following commands are equivalent:

CTRL:PORT?

ctrl:port?

Parameters

The commands can have parameters. The parameters are separated from the command by a space. If a command has several parameters, they are separated by commas (',').

Query Commands

The query commands read out the parameter values from the PE0312-75. After a query command has been sent, the response should return via remote control interface. The query commands has a question mark ('?') at the end of the command.

For example:

CTRL:PORT?

Command Reference

The following conventions are used throughout this section.

Syntax	Description
<>	Identifiers enclosed in angular brackets indicate that a particular type of data must be specified.
[]	Parts enclosed in square brackets can be omitted.
{}	Parts enclosed in curly brackets indicate that you must select one of the items in this part. Individual items are separated by a vertical bar "|".
Space	Space separates commands from parameters.
,	Comma separates adjacent parameters.
…	Ellipses indicate that parameters in that part are omitted.

Identifiers

Identifier	Parameter	Description
<numeric>	Number	{<integer>|<real>}
<string>	String parameter	Quoted string

IEEE488.2 Common Commands

The set of common commands from the IEEE488.2 standard. These commands start with an asterix ("*").

Command	Description	
*CLS	Status System	Clear status
*ESE		Event status enable
*ESR?		Event status enable register
*IDN?		Identify
*OPC		Operation complete command
*OPC?		Operation complete query
*SRE		Service request enable
*STB?		Status byte query

*CLS

SCPI Command

*CLS

Description

Clears the following:

- Error Queue.
- Status Byte Register.
- Standard Event Status Register.

no query

*ESE

SCPI Command

*ESE <numeric>

*ESE?

Description

Sets or reads out the value of the Standard Event Status Enable Register.
command/query

Parameter

<numeric> 0 to 255

Query Response

<numeric>

Out of Range

Bitwise AND with number 255

Preset Value

0

*ESR

SCPI Command

*ESR?

Description

Reads out the value of the Standard Event Status Register. Executing this command clears the register value.
query only

Query Response

<numeric>

*IDN

SCPI Command

*IDN?

Description

Reads out the Analyzer identification string.

The identification string is in format: <manufacturer>, <model>, <serial number>, <software version>/<hardware version>.

For example: CMT, SWB-00-SIM, 00000001, 1.0/01

query only

Query Response

String up to 40 characters

*OPC

SCPI Command

*OPC

Description

Sets the OPC bit (bit 0) of the Standard Event Status Register at the completion of all pending operations.

NOTE The command is implemented only for compatibility, since there are no asynchronous operations in the switch.

no query

*OPC?

SCPI Command

*OPC?

Description

Reads out the "1" at the completion of all pending operations.

NOTE The command is implemented only for compatibility, since there are no asynchronous operations in the switch..

query only

Query Response

1

*RST

SCPI Command

*RST

Description

Sets the device to the initial state
no query

*SRE

SCPI Command

*SRE <numeric>

*SRE?

Description

Sets or reads out the value of the Service Request Enable Register.
command/query

Parameter

<numeric> 0 to 255

Query Response

<numeric>

Out of Range

Bitwise AND with number 255

Preset Value

0

*STB

SCPI Command

*STB?

Description

Reads out the value of the Status Byte Register.
query only

Query Response

<numeric>

SYSTem

SYST:ERR?

SCPI Command

SYSTem:ERRor[:NEXT]?

Description

Reads out the error message when executing SCPI commands, from the FIFO (First In First Out) error queue stored in the Analyzer. The read-out error is deleted from the error queue. The *CLS command clears the error queue. The maximum size of the queue is 16 messages.

query only

Query Response

<numeric>, <string>

Where:

<numeric> — error code,

<string> — error message.

If there is no error in the queue, "0, No error" is read out.

Switch Commands

CTRL:PORT

SCPI Command

CTRL:PORT N1, N2

Description

Switches port N of the PE750212 to one of the available outputs of the analyzer.
query

Parameter

N1 — switch port number from 1 to 12 (to analyzer port 1).

N2 — switch port number from 1 to 12 (to analyzer port 2).

If the port is not switched, then 0 is sent.

Invalid parameter

Error is returned

Query Response

{OK}

Example

CTRL:PORT 4, 5 Switch port 1 of the analyzer to output 4 of the PE0312-75, port 2 of the analyzer to output 5 of the PE0312-75.

CTRL:PORT?

SCPI Command

CTRL:PORT?

Description

Reads out the switching status of PE750212 ports.
command

Invalid parameter

Error is returned

Query Response

{N1, N2}

Where N1, N2 are numbers of switched outputs (for the first and second ports of the analyzer, respectively).

N1, N2 are an integers between 1 and 12

Example

CTRL:PORT? Get port switching status.

Maintenance and Storage

The following section describes the proper maintenance and storage procedures for the PE0312-75.

Maintenance Procedures

This section describes the guidelines and procedures of maintenance, which will ensure fault-free operation of the PE0312-75.

The maintenance of the PE0312-75 consists of cleaning the instrument.

Instrument Cleaning

This section provides the cleaning instructions required for maintaining proper operation of the PE0312-75.

To remove contamination from parts other than test ports or any connectors of the PE0312-75, wipe them gently with a soft cloth that is either dry or wetted with a small amount of water and wrung tightly.

Always keep the test ports clean, as any dust or stains on them can significantly affect the measurement capabilities of the instrument. To clean the test ports (as well as other connectors of the PE0312-75), use the following procedure:

1. Using compressed air, remove or loosen the contamination particles.
2. Clean the connectors using a lint-free cleaning cloth wetted with a small amount of ethanol and isopropyl alcohol. When cleaning a female connector, avoid snagging the cloth on the center conductor contact fingers by using short strokes.
3. Dry the connector with low-pressure compressed air.
4. Always completely dry any connector before using it.

Never use water or abrasives for cleaning any connectors on the PE0312-75. Do not allow alcohol contact on the surface of the connector.

When connecting male-female coaxial connectors, always use a calibrated torque wrench.

WARNING Never clean the instrument if the power cable is connected to the power outlet.

Never clean the internal components of the instrument.

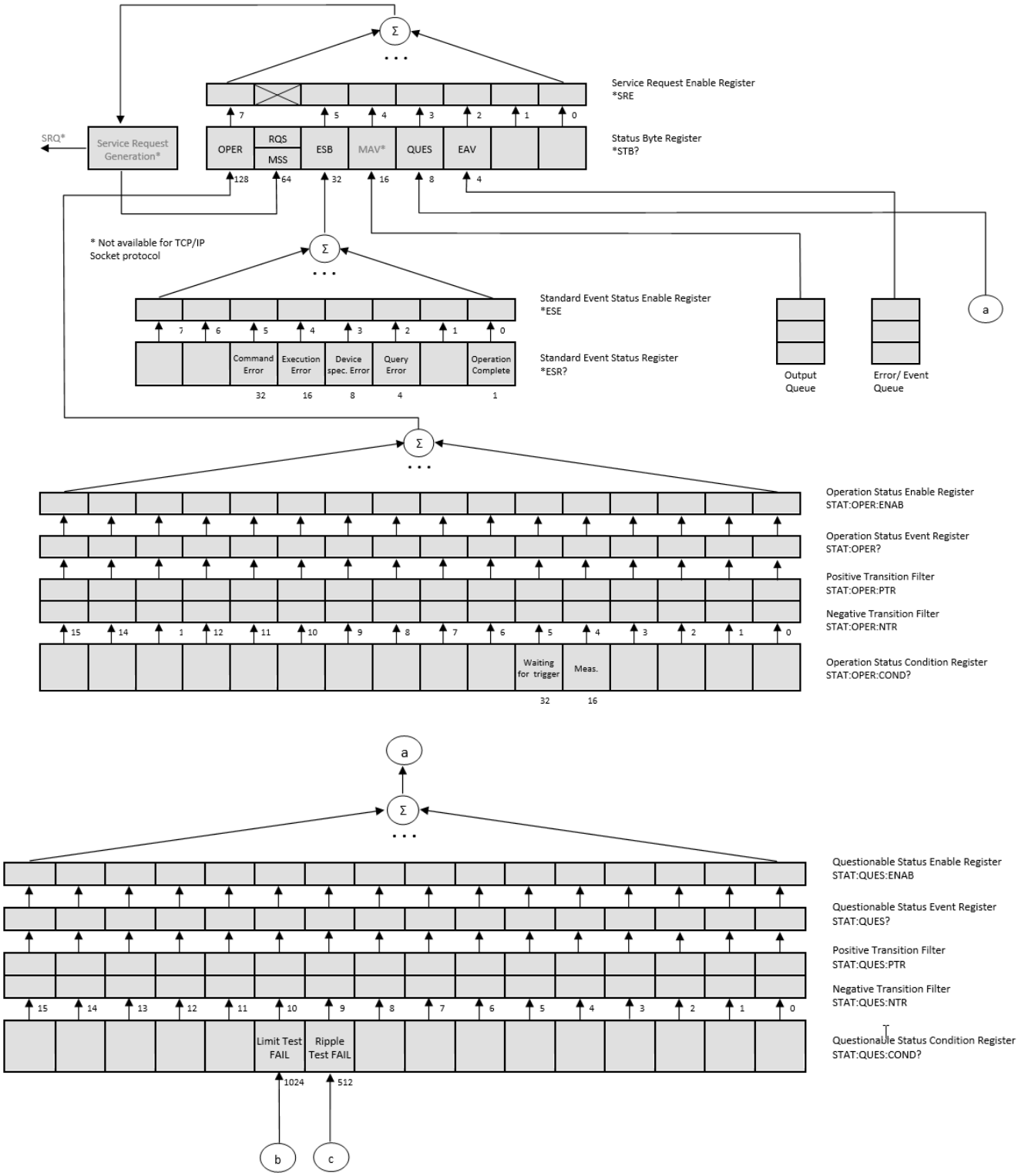
Storage Instructions

Before first use, store the PE0312-75 in the factory package at a room temperature between 0 and +40 C and a relative humidity of up to 80% (at 25˚C).

After the PE0312-75 has been removed from the factory packaging, it should be stored at a room temperature between +10 and +35˚ C and relative humidity up to 80% (at 25˚ C).

Be sure to keep the storage facilities free from dust, acidic or alkaline fumes, volatile gases, and other chemicals which can cause corrosion.

Appendix A – IEEE488.2 Status Reporting System



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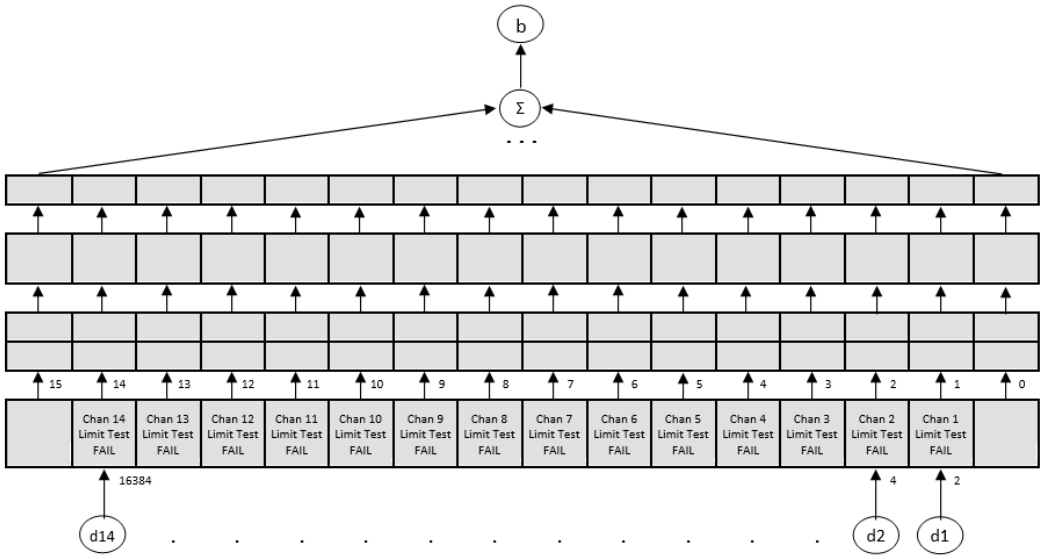

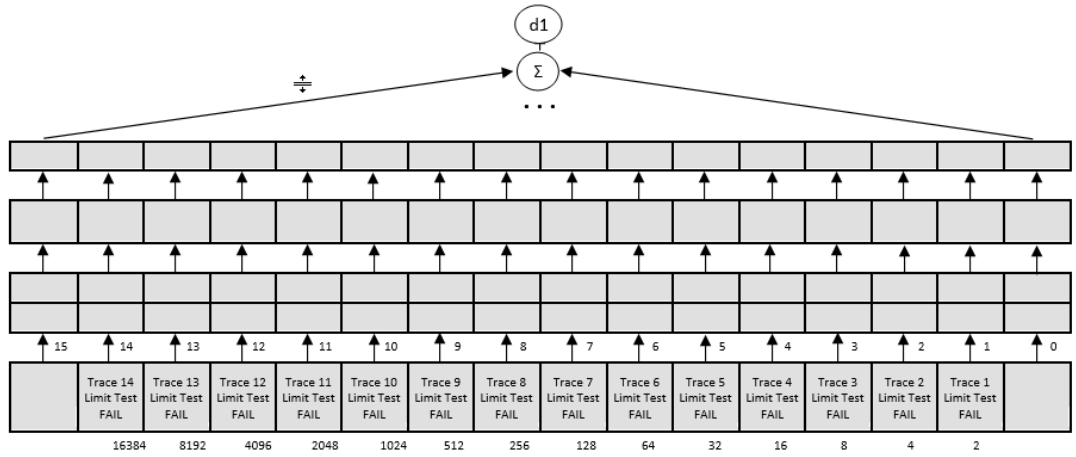

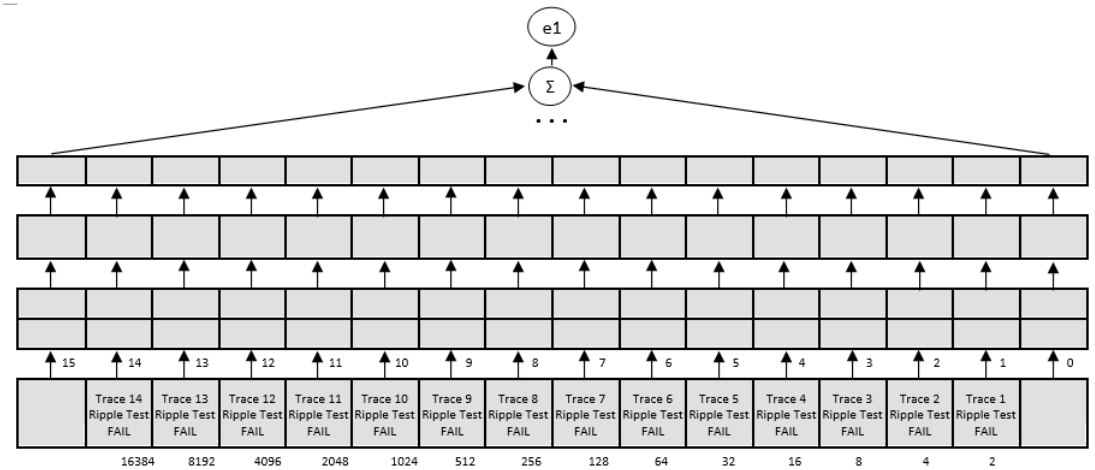

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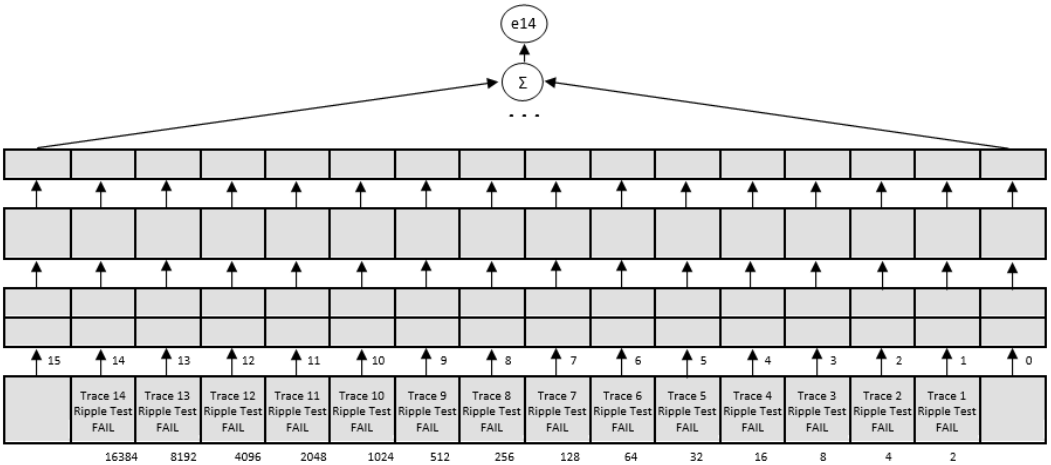

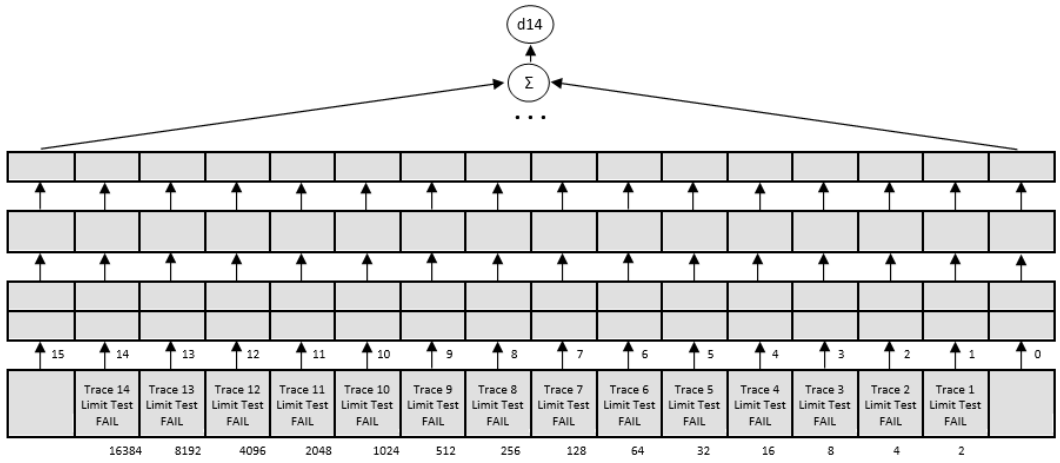

Appendix B – SCPI Error Codes

Name	Description
100	Command error
101	Unmatched quote
102	Unmatched bracket
103	Invalid value in numeric list
104	Data type error
106	Numeric parameter overflow
107	Wrong units in numeric data
108	Parameter not allowed
109	Missing parameter
110	Command header error
114	Header suffix out of range
115	Input buffer is full
130	Suffix error
300	Device-specific error
302	Status reporting system error
400	Query error
403	Query error: no data
404	Query truncated
410	Query Interrupted