Keysight U3900DAQ Switching System Lab Solution

Getting Started Guide

KEYSIGHT TECHNOLOGIES

Notices

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Safety Information

CAUTION

A CAUTION notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in damage to the product or loss of important data. Do not proceed beyond a CAUTION notice until the indicated conditions are fully understood and met.

WARNING

A WARNING notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in personal injury or death. Do not proceed beyond a WARNING notice until the indicated conditions are fully understood and met.

Safety Symbols

The following symbols on the instrument and in the documentation indicate precautions which must be taken to maintain safe operation of the instrument.



Caution, risk of danger (refer to this manual for specific Warning or Caution information)

Safety Consideration

Read the information below before using the instrument.

The following general safety precautions must be observed during all phases of operation, service, and repair of this instrument. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, intended use of the instrument, and could result in electrical shock or injury. Keysight Technologies assumes no liability for the customer's failure to comply with these requirements.

WARNING

BEFORE APPLYING POWER

Verify that all safety precautions are taken. Make all connections to the unit before applying power.

GROUND THE INSTRUMENT

This product is provided with protective earth terminals. To minimize shock hazard, the instrument must be connected to the ac power mains through a grounded power cable, with the ground wire family connected to an electrical ground (safety ground) at the protective (grounding) conductor. Disconnection of the protective earth terminal will cause a potential shock hazard that could result in personal injury.

BEFORE POWER ON AND OFF

Before powering on the instrument, make sure all signal sources connected to modules are turned off. Turn on signal sources after the instrument is powered on. Turn off signal sources before the instrument is powered off.

DO NOT REMOVE THE INSTRUMENT COVER

Only qualified, service-trained personnel who are aware of the hazards involved should remove the instrument covers. Always disconnect the power cable and any external circuits before removing the instrument cover.

MODULE COVERS

Always replace module covers after terminal wiring and before inserting into mainframe.

DO NOT OPERATE IN AN EXPLOSIVE ATMOSPHERE

Do not operate the instrument in the presence of flammable gases or fumes.

DO NOT MODIFY THE INSTRUMENT

Do not install substitute parts or perform any unauthorized modification to the product. Return the product to a Keysight Sales and Service Office for service and repair to ensure that safety features are maintained.

DO NOT MEASURE MORE THAN THE RATED VOLTAGE

Maximum voltage as marked on each module is as below:

a) DAQM901A, DAQM903A: 300 Vrms

b) DAQM905A: 42 Vpk

DO NOT CONNECT ANY MODULE CHANNELS TO MAINS

Measurement category of the instrument is rated as CAT 'Others', terminals should not be directly connected to the mains.

AC POWER CORD

Removal of the AC power cord is the disconnect method to remove power from the instrument. Be sure to allow for adequate access to the power cord to permit disconnection from AC power. Use only the Keysight specified power cord for the country of use or one with equivalent ratings.

SELF-TEST

Before measuring any hazardous voltage or current, run the *TST? query from the remote interface, and read the result to verify that the instrument is performing properly. The *TST? query is a self-test that returns +0 if the instrument passes and +1 if the instrument fails. You can also perform this query from the front panel by pressing [Utility] > Self Test > Quick Test. If this self-test fails, make sure that the instrument is repaired and passes the self-test before continuing.

This is a sensitive measurement apparatus by design and may have some performance loss when exposed to ambient continuous electromagnetic phenomenon. Measurement Considerations – use shielded or twisted cable, use common mode choke, ferrite clamp and damping resistor before the input.

CLEANING

To prevent electrical shock, disconnect the instrument from AC mains power before cleaning. Clean the outside of the instrument with a soft, lint-free, slightly dampened cloth. Do not use detergent, volatile liquids, or chemical solvents. Do not attempt to clean internally. If needed, contact a Keysight Technologies Sales and Service Office to arrange for proper cleaning to ensure that safety features and performance are maintained.

NOTE Connect USB cable with ferrite core to the rear panel USB port of the instrument.

CAUTION Electrostatic discharge (ESD) can result in damage to the components at the exposed area of the educational kit. To prevent electrostatic discharge (ESD):

- Select a static-free work location when installing and removing sensitive component.
- Handle sensitive components to the minimum extent possible with ESD safe practices.
- Transport and store in ESD preventive bags or containers that protect sensitive components from static electricity.

CAUTION

- If the instrument is used in a manner not specified by the manufacturer, the instrument protection may be impaired.
- Always use a dry cloth to clean the instrument. Do not use ethyl alcohol or any other volatile liquid.

Safety Symbol and Regulatory Markings

Symbol	Description
	Alternating current (AC)
	Protective earth (ground) terminal.
	Earth (ground) terminal.
	Caution, risk of danger (refer to the manual for specific Warning or Caution information).
	Frame or chassis (ground) terminal.
	Instrument cable lock.
	This product is marked with the ACMA RCM mark for compliance in Australia/New Zealand. A copy of the Manufacturer's Australia Declaration of Conformity for this instrument can be obtained by contacting your local Keysight Technologies Sales Representative.
	This symbol indicates the time period during which no hazardous or toxic substance elements are expected to leak or deteriorate during normal use. Forty years is the expected useful life of the product.
	The CSA mark is a registered trademark of the Canadian Standards Association, with the 'C' and 'US' subscript indicates the instrument is certified to the applicable Canadian and United States of America standards respectively.
	The CE mark is a registered trademark of the European Community. This CE mark shows that the product complies with all the relevant European Legal Directives. ICES/NMB-001 - This ISM device complies with the Canadian ICES-001. Cet appareil ISM est conforme a la norme NMB-001 du Canada. ISM GRP 1-A - This is an Industrial Scientific and Medical (ISM) Group 1 Class A product.
	This symbol is a South Korean Class A EMC Declaration, with the product identification code "R-REM-Kst-GM16412". **R** - Identification of authorization prefix. **REM** - Identification of basic certification information. **Kst** - Identification of applicant's information **GM16412** - Product identification. This is a Class A instrument suitable for professional use and in electromagnetic environment outside of the home.

WARNING	The WARNING sign denotes a hazard. It calls attention to a procedure, practice, or the like, which, if not correctly performed or adhered to, could result in personal injury. Do not proceed beyond a WARNING sign until the indicated conditions are fully understood and met.
CAUTION	The CAUTION sign denotes a hazard. It calls attention to an operating procedure, or the like, which, if not correctly performed or adhered to, could result in damage to or destruction of part or all of the product. Do not proceed beyond CAUTION sign until the indicated conditions are fully understood and met.
NOTE	The NOTE sign denotes important information. It calls attention to a procedure, practice, condition or the like, which is essential to highlight. Safety and Regulatory Information 12

South Korean Class A EMC Declaration

Information to the user:

This instrument has been conformity assessed for used in business environments. In a residential environment this equipment may caused radio interference.

This EMC statement applies to the equipment only for use in business environment.

사 용 자 안 내 문사 용 자 안 내 문

이 기 기 는 업 무 용 환 경 에 서 사 용 할 목 적 으 로 적 합 성 평 가 를 받 은 기 기 로 서 가 정 용 환 경 에 서 사

용 하 는 경 우 전 파 간 섭 의 우 려 가 있 습 니 다 .

사용자 안내문은"업무용 방송통신기자재"에만 적용한다.

Safety and EMC Requirements

This instrument is designed to comply with the following safety and EMC requirements:

Safety compliance

- IEC 61010-1:2010/EN 61010-1:2010; IEC 61010-2-030:2010/EN61010-2-030:2010
- Canada: CAN/CSA-C22.2 No.61010-1-12; CAN/CSA-C22.2 No. 61010-2-030-12
- USA: ANSI/UL Std. No. 61010-1:2012; ANSI/UL Std No.61010-2-030:2012

EMC compliance

- IEC 61326-1:2012 / EN 61326-1:2013
- Canada: ICES/NMB-001:2006
- Australia/New Zealand: AS/NZS CISPR 11:2011
- South Korea RRA Notice 2016-24

NOTE Maximum transients on all inputs are limited to 1500 Vpk referenced to earth except for DAQM905A which is 0 Vpk. Measurement is rated for CAT 'none', and terminals are not to be connected directly to mains. Do not use this equipment to measure circuits where transient overvoltages could exceed this level.

Environmental Conditions and General Characteristics

Keysight U3900DAQ Switching System Lab Solution is designed for indoor use and in an area with low condensation. Tables below show the general environmental requirements and general characteristics for this instrument.

Environmental condition	Requirement
Temperature	Operating condition 0 to 55 °C Storage condition -40 to 70 °C
Humidity	Operating condition Up to 80% RH at 40 °C (non-condensing), decreasing linearly to 50% RH at 55 °C (non-condensing) Storage condition: Up to 50% RH at 55 °C (non-condensing)
Altitude	Up to 3000 m
Pollution degree	2

The electrical (power) requirements of the DAQ970A/DAQ973A are summarized as below.

General characteristics	Requirement
Power supply	100 – 240 VAC (Mains supply voltage fluctuation is not allowed to exceed ± 10%)
Power line frequency	50/60/400 Hz
Power consumption	45 watts

WARNING DO NOT OPERATE IN AN EXPLOSIVE ATMOSPHERE OR WET ENVIRONMENTS
Do not operate the instrument around flammable gases or fumes, vapor, or wet environments.

Sales and Technical Support

To contact Keysight for sales and technical support, refer to the support links on the following Keysight websites:

- Product-specific information and support, software and documentation updates
  - www.keysight.com/us/en/industries/education/teaching-solutions.html
  - www.keysight.com/find/DAQ970A
- Worldwide contact information for repair and service
  - www.keysight.com/find/assist

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Overview

Tools to Support Remote Teaching and Learning

U3900DAQ Switching System for Education Lab consist of the DAQ970 data acquisition system (DAQ), this instrument enabling remote switching measurement point on a DUT (device under test), to provide a complete hands-on learning for engineering students to measure different points in a training board circuit.

As a web-enabled Solution, it offers engineering solution to enable remote laboratory with simple and flexible choices of GPIO switches and RF switch multiplexers.

Taking advantage of Keysight DAQ capabilities to link up student computers and the physical lab setup over the internet which can immediately be deployed.

Intended Use of Getting Started Guide

The Getting Started Guide is intended for use by a University Teaching Lab Manager as a guide for unpacking, set up, verification, and maintenance of the U3900DAQ Switching System.

Characteristics and Specifications

For more information about the key features and specifications, refer to the DAQ970A/DAQ973A Data Acquisition System User's Guide at https://literature.cdn.keysight.com/litweb/pdf/DAQ97-90000.pdf

The respective webpages for the modules are as follows:

- DAQ970A
- DAQM901A
- DAQM903A
- DAQM905A

Hardware Requirements



Keysight's U3900DAQ Switching System consists of the following hardware:

1. DAQ970A Data Acquisition System (DAQ mainframe)
2. DAQM901A 20-Channel Armature Multiplexer Module
3. DAQM903A 20-Channel Actuator/General-Purpose Switch Module
4. DAQM905A Dual 1:4 RF Multiplexer (50 Ω) Module

Equipment Required

1. Keysight DAQ970A Data Acquisition System

Sub-modules (Optional)

1. Keysight DAQM901A 20 Channel Multiplexer (2/4-wire) Module
2. Keysight DAQM903A 20 Channel Actuator/GP Switch Module
3. Keysight DAQM905A 2 GHz Dual 1:4 RF Mux, 50 Ohm Module

Accessories Required

- U3900DAQ-AC1: U3810-31306.
- U3900DAQ-AC2: U3810-31308.

For DAQM901A / DAQM903A

- Including: U3900DAQ-AC1. Alpha 78025 1.5 m, five twisted pairs, OD 5.26mm, 24 AWG

For DAQM905A

- Including U3900DAQ-AC2.
- Description: SMA (M) Straight Plug to SMB Right Angle Plug on Flexible Cable RG-316/U (1300 mm)

1 SMB(F) - SMA (F) (optional)

– KPN: U3810-31307

– Description: SMA (F) Bulkhead Jack to SMB Right Angle Plug on Flexible Cable RG-316/U (1300 mm)

2 SMB (F) - SMB (F) (optional)

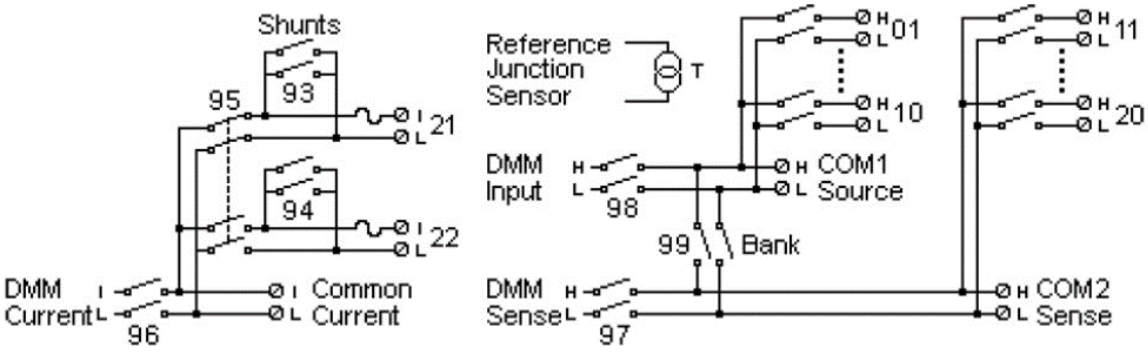
– KPN 8120-5028 (975mm)

– Description: SMB Right Angle (M) to SMB Right Angle (M) on Flexible Cable (975 mm)

Module Description

DAQM901A 20-Channel Armature Multiplexer Module

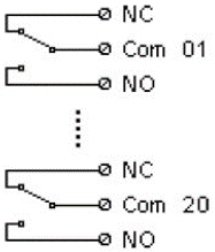
This module is divided into two banks of 10 two-wire channels each. Two additional fused channels are available on the module (total in 22 channels) for making direct, calibrated DC or AC current measurements with the internal DMM (external shunts resistors are not required). All 22 channels switch both HI and LO inputs, thus providing fully isolated inputs to the internal DMM or an external instrument. During the four-wire resistance measurements, channels from Bank A (channel n) are automatically paired with channels from Bank B (channel n+10) to provide the source and sense connections. The module has a built-in thermocouple reference junction to minimize errors due to thermal gradients when measuring thermocouples.



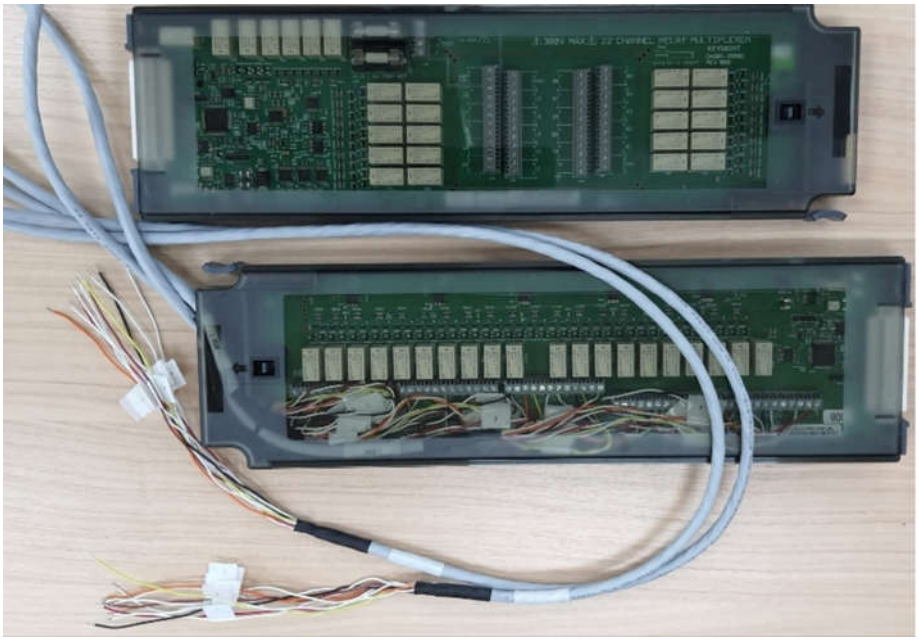
DAQM903A 20-Channel Actuator/General-Purpose Switch Module

This module contains 20 independent and SPDT (Form C) latching relays. This module can switch 300 V, 1 A (50 W maximum switch power) to your DUT or to actuate external devices. Screw terminals on the module provide access to the Normally-Open, Normally-Closed, and Common contacts for each of the 20 switches. This module does not connect to the internal DMM. Use this module for those applications that require high-integrity contacts or quality connections of non-multiplexed signals.

A breadboard area is provided near the screw terminals to implement custom circuitry, such as simple filters, snubbers, and voltage dividers. The breadboard area provides the space necessary to insert your own components but there are no circuit board traces here. You must add your own circuitry and signal routing.



DAQM901A and DAQM903A with Five Twisted Pair Cables



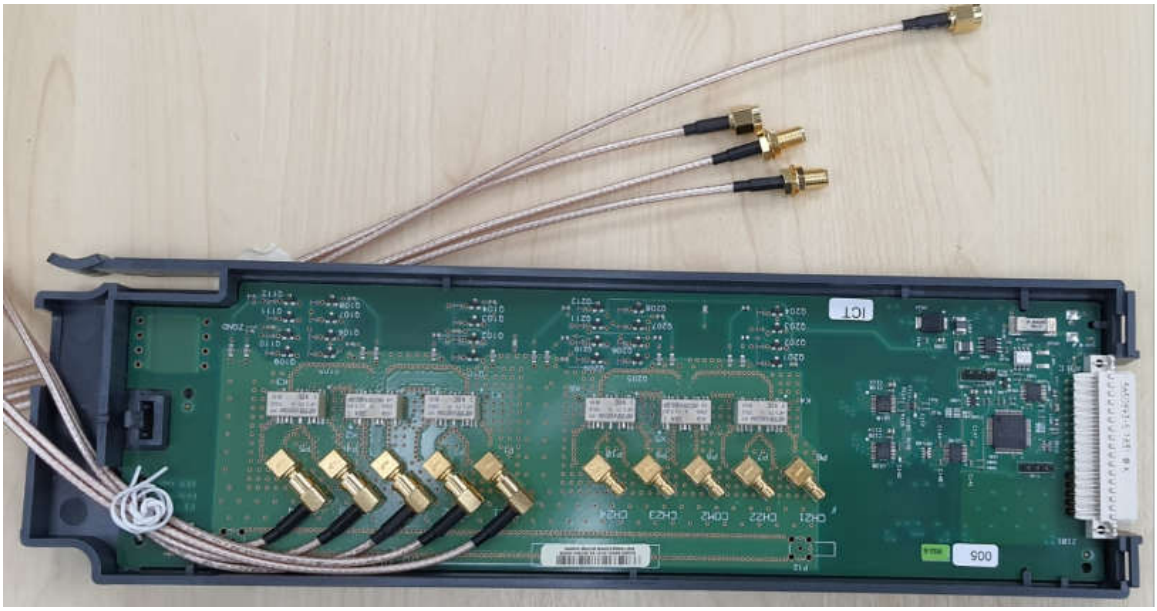
DAQM905A Dual 1:4 RF Multiplexer (50 Ω) Module

These modules consist of two independent banks of 4-to-1 multiplexers, which offer wideband switching capabilities for high frequency and pulsed signals. The channels in each bank are organized in a “tree” structure to provide high isolation and low VSWR. Both modules have a common earth ground, offer low crosstalk and excellent insertion loss performance. To create larger RF multiplexers, you can cascade multiple banks together.

This module does not connect to the internal DMM. You can connect your signals directly to the on-board SMB connectors or to the SMB-to-BNC cables provided with the module or with specific accessories based on the application.



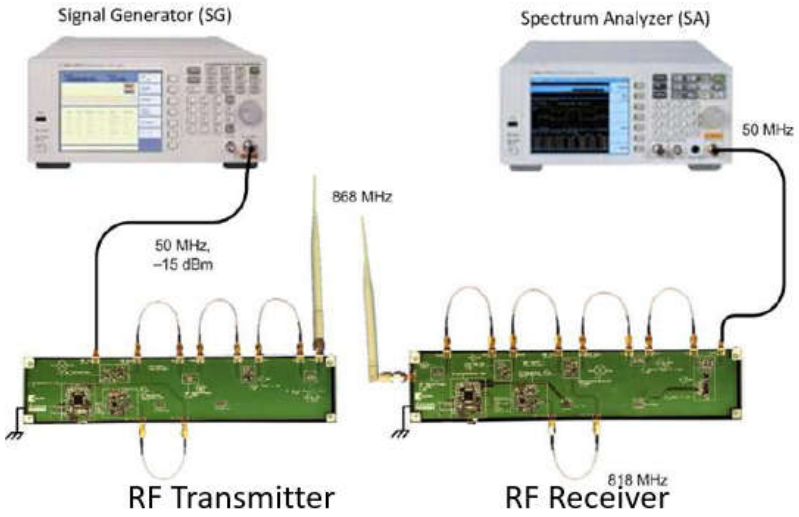
DAQM905A with SMB – SMA Coax Cable



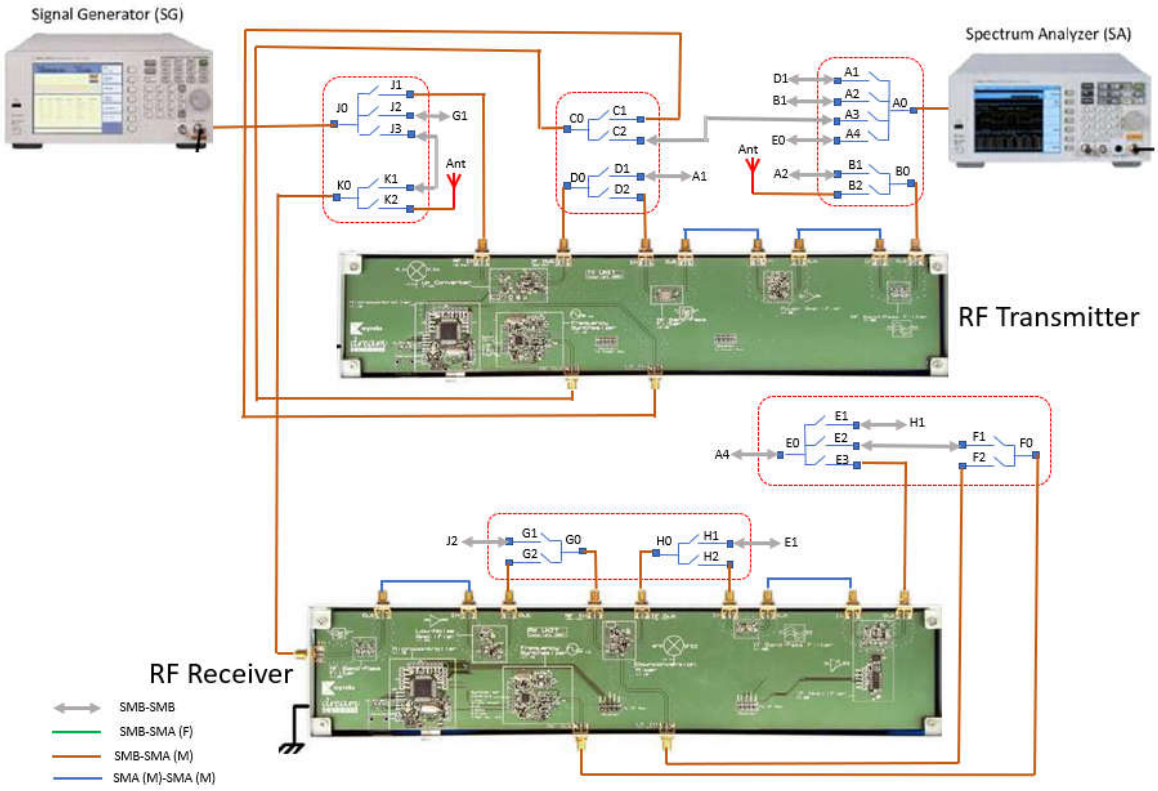
Sample Application

Sample Application 1

Conventional End to End RF Transceiver Lab Task

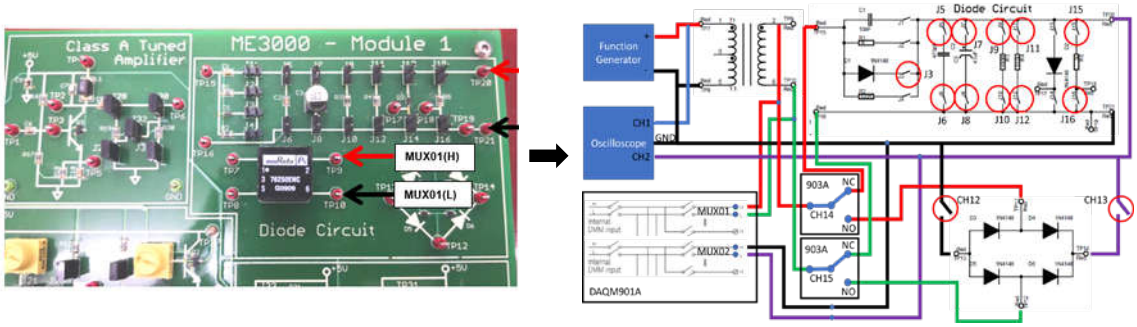


This lab setup can flexibly be configured with DAQ905A RF multiplexer as web-enabled remote RF lab task.

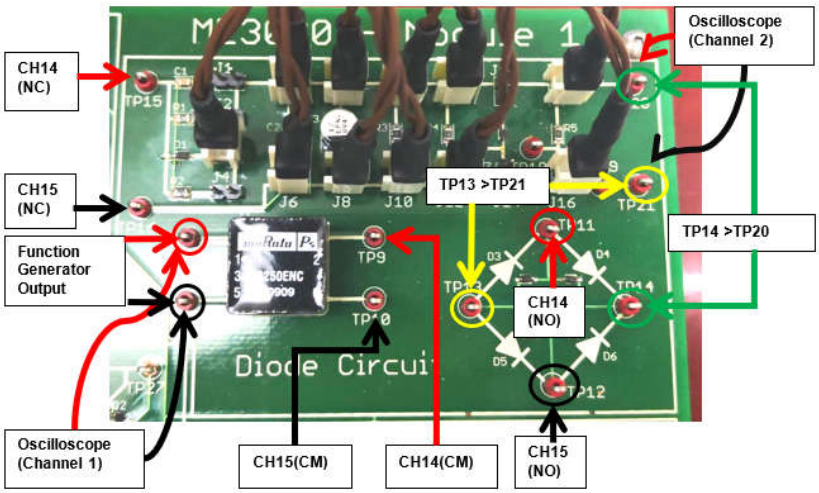


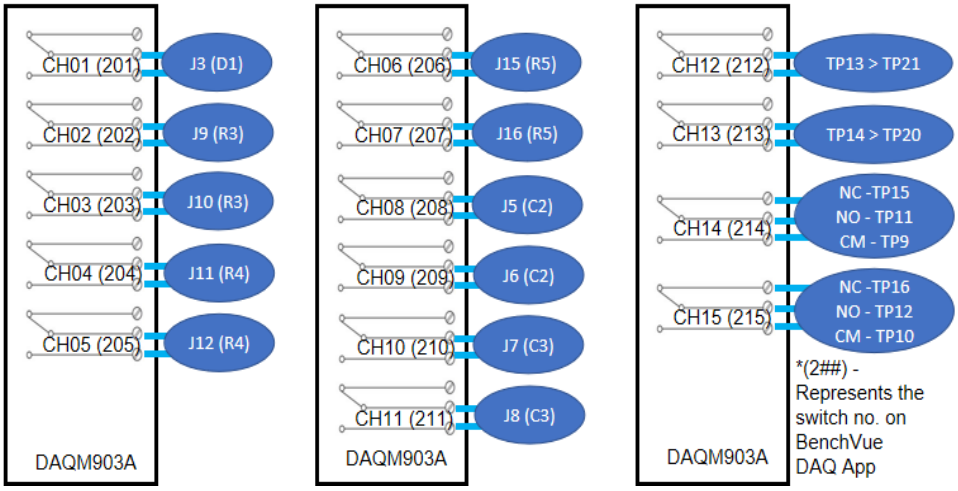
Sample Application 2

Conventional Analog Signal Measurement Lab Task



Multiples jumpers / test points / switches can be replaced with DAQ solution.





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