Keysight 11636C/D Power Divider

Operating and Service Manual

KEYSIGHT TECHNOLOGIES

Notices

Copyright Notice

© Keysight Technologies 2007-2021

No part of this manual may be reproduced in any form or by any means (including electronic storage and retrieval or translation into a foreign language) without prior agreement and written consent from Keysight Technologies as governed by United States and international copyright laws.

Manual Part Number

11636-90005

Edition

Edition 4, November 5, 2021

Printed in:

Printed in Malaysia

Published by:

Keysight Technologies
Bayan Lepas Free Industrial Zone,
11900 Penang, Malaysia

Technology Licenses

The hardware and/or software described in this document are furnished under a license and may be used or copied only in accordance with the terms of such license.

Declaration of Conformity

Declarations of Conformity for this product and for other Keysight products may be downloaded from the Web. Go to http://www.keysight.com/go/conformity. You can then search by product number to find the latest Declaration of Conformity.

U.S. Government Rights

The Software is “commercial computer software,” as defined by Federal Acquisition Regulation (“FAR”) 2.101. Pursuant to FAR 12.212 and 27.405-3 and Department of Defense FAR Supplement (“DFARS”) 227.7202, the U.S. government acquires commercial computer software under the same terms by which the software is customarily provided to the public. Accordingly, Keysight provides the Software to U.S. government customers under its standard commercial license, which is embodied in its End User License Agreement (EULA), a copy of which can be found at http://www.keysight.com/find/sweula. The license set forth in the EULA represents the exclusive authority by which the U.S. government may use, modify, distribute, or disclose the Software. The EULA and the license set forth therein, does not require or permit, among other things, that Keysight: (1) Furnish technical information related to commercial computer software or commercial computer software documentation that is not customarily provided to the public; or (2) Relinquish to, or otherwise provide, the government rights in excess of these rights customarily provided to the public to use, modify, reproduce, release, perform, display, or disclose commercial computer software or commercial computer software documentation. No additional government requirements beyond those set forth in the EULA shall apply, except to the extent that those terms, rights, or licenses are explicitly required from all providers of commercial computer software pursuant to the FAR and the DFARS and are set forth specifically in writing elsewhere in the EULA. Keysight shall be under no obligation to update, revise or otherwise modify the Software. With respect to any technical data as defined by FAR 2.101, pursuant to FAR 12.211 and 27.404.2 and DFARS 227.7102, the U.S. government acquires no greater than Limited Rights as defined in FAR 27.401 or DFAR 227.7103-5 (c), as applicable in any technical data.

Warranty

THE MATERIAL CONTAINED IN THIS DOCUMENT IS PROVIDED “AS IS,” AND IS SUBJECT TO BEING CHANGED, WITHOUT NOTICE, IN FUTURE EDITIONS. FURTHER, TO THE MAXIMUM EXTENT PERMITTED BY APPLICABLE LAW, KEYSIGHT DISCLAIMS ALL WARRANTIES, EITHER EXPRESS OR IMPLIED, WITH REGARD TO THIS MANUAL AND ANY INFORMATION CONTAINED HEREIN, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. KEYSIGHT SHALL NOT BE LIABLE FOR ERRORS OR FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES IN CONNECTION WITH THE FURNISHING, USE, OR PERFORMANCE OF THIS DOCUMENT OR OF ANY INFORMATION CONTAINED HEREIN. SHOULD KEYSIGHT AND THE USER HAVE A SEPARATE WRITTEN AGREEMENT WITH WARRANTY TERMS COVERING THE MATERIAL IN THIS DOCUMENT THAT CONFLICT WITH THESE TERMS, THE WARRANTY TERMS IN THE SEPARATE AGREEMENT SHALL CONTROL.

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.

Regulatory Information

CE	The CE mark is a registered trademark of the European Community. If it is accompanied by a year, it indicates the year the design was proven.	40	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.
ccr.keysight@keysight.com	This Keysight CCR (Customer Compliance Response) email ID is for manufacturer identification and indicates that the product complies with all the relevant European Legal Directives.		
	The crossed out wheeled bin symbol indicates that separate collection for waste electric and electronic equipment (WEEE) is required, as obligated by the EU DIRECTIVE and other National legislation. Please refer to www.keysight.com/go/takeback to understand your Trade-in options with Keysight in addition to product take back instructions.		

Sales and Technical Support

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

- www.keysight.com/find/mta
  (product-specific information and support, software and documentation updates)
- www.keysight.com/find/assist
  (worldwide contact information for repair and service)

THIS PAGE HAS BEEN INTENTIONALLY LEFT BLANK.

Table of Contents

Regulatory Information 3
Sales and Technical Support 3

1 Introduction

Product Overview 10
Features 11

2 Characteristics and Specifications

Specifications and Characteristics 14
Physical Dimensions 14
Environmental Conditions 16

3 Installation and Verification

Installation 20
Initial inspection 20
Operating Instructions 21
Operator's Check 21
Performance Tests 22
Input Return Loss 22
Output Tracking 24
Service Instructions 27
Adjustment 27
Repair 27
Maintenance 27

THIS PAGE HAS BEEN INTENTIONALLY LEFT BLANK.

List of Figures

Figure 1-1 Keysight 11636C DC to 50 GHz Power Divider 10
Figure 1-2 Keysight 11636D DC to 67 GHz Power Divider 11
Figure 2-1 Keysight 11636C/D schematic and dimensions 15
Figure 3-1 Quick-check configuration 21
Figure 3-2 Input return loss test setup 23
Figure 3-3 Output tracking test setup (Port 3 Terminated) 25
Figure 3-4 Output tracking test setup (Port 2 Terminated) 26

THIS PAGE HAS BEEN INTENTIONALLY LEFT BLANK.

1 Introduction

Product Overview 10

This chapter provides an overview of the Keysight 11636C/D power divider.

Product Overview

Keysight 11636C and 11636D Power Dividers operating from DC to 50 GHz and 67 GHz respectively, provide an excellent output power symmetry between the two output ports. Their design features excellent amplitude and phase tracking to ensure excellent source match for fault location applications using network analyzers and also precise power division.

Any port may be used as an input, as the Keysight 11636C/D provides a symmetrical power division. The 11636C/D can also be used as a power combiner. When signals are input at two output ports, the sum of the two appears at the input port. However, this is not recommended for ratio or source leveling applications.



Figure 1-1 Keysight 11636C DC to 50 GHz Power Divider



Figure 1-2 Keysight 11636D DC to 67 GHz Power Divider

Features

11636C

- Broadband coverage from DC to 50 GHz
- Excellent amplitude (0.3 dB from DC to 50 GHz) and phase tracking (±2° typical) minimizes amplitude and phase difference between the two outputs to ensure an accurate power division.
- Low SWR of 1.67 at 50 GHz minimizes your measurement uncertainty

11636D

- Broadband coverage from DC to 67 GHz
- Excellent amplitude (0.4/0.65 dB from DC to 67 GHz) and phase tracking (±4°/ ±7° typical) minimizes amplitude and phase difference between the two outputs to ensure an accurate power division.
- Low SWR of 2.1 at 67 GHz minimizes your measurement uncertainty

THIS PAGE HAS BEEN INTENTIONALLY LEFT BLANK.

2 Characteristics and Specifications

Specifications and Characteristics 14
Environmental Conditions 16

Specifications and Characteristics

For the specifications and characteristics of the 11636C/D power divider, refer to the technical overview document at www.keysight.com/us/en/assets/7018-01590/technical-overviews/5989-6698.pdf.

Physical Dimensions

The table below lists the physical dimensions of 11636C/D Power Divider.

Pin depth	0.000 to 0.076 mm (0.000 to 0.003 in)[a]
Dimensions	35.1 mm H x 35.5 mm W x 10 mm D (1.38 x 1.39 x 0.39 in)
Weight	0.036 kg (0.079 lb)

[a] Allowable recession of the end of the female center pin behind the outer conductor mating plane.

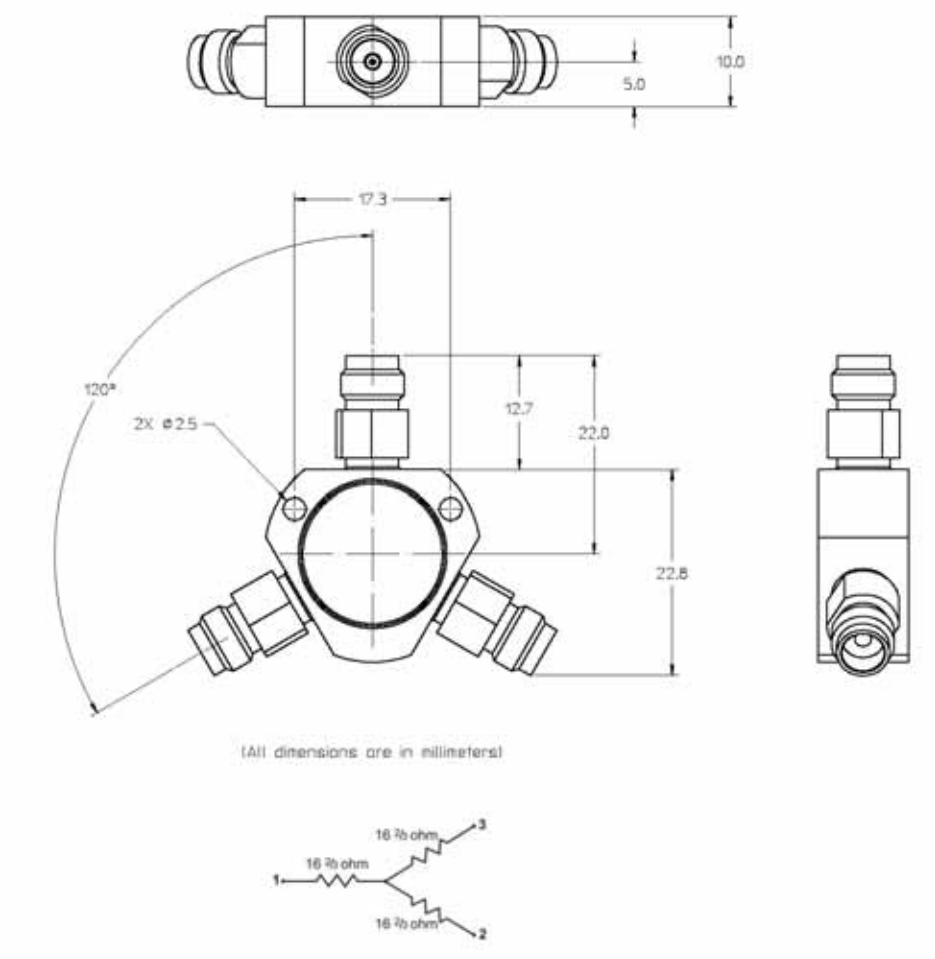


Figure 2-1 Keysight 11636C/D schematic and dimensions

Environmental Conditions

The 11636C/D is designed to fully comply with Keysight Technologies' product operating environmental specifications. Table 2-1 and Table 2-2 list the environmental specifications of 11636C and 11636D power dividers respectively.

Table 2-1 11636C Environmental Conditions

Environmental condition	Requirement
Temperature – Operating – Storage – Cycling	 -45 °C to +70°C –65 °C to +85°C –65 °C to +85°C, 10 cycles at 20 °C per minute ramp rate, 20 minutes dwell time per MIL-STD-833F, Method 1010.8, Condition C (modified)
Humidity – Operating – Storage	 50% to 95% RH at 40 °C, 24 hours cycling, 5 cycles 90% RH at 65 °C, 24 hours
Shock – End-user handling – Mechanical Survival – Transportation	 Delta-V: 3m/s ±5%, Duration <3ms at 6 faces Half Sine: 1000g, 0.5ms at 6 faces 50g, delta-V: 8m/s at 6 faces
Vibration – Operating (Random)	 2.41 Grms, 10 min/axis
Altitude – Operating – Non-operating	 4,600 meters (15,092 feet) 4,600 meters (15,092 feet)
ESD immunity – Contact Discharge – Air Discharge	 4 kV (to center conductor) 15 kV (to outer conductor)

Table 2-2 11636D Environmental Conditions

Environmental condition	Requirement
Temperature	
– Operating	-45°C to +70°C
– Storage	–65 °C to +85°C
– Cycling	–65 °C to +85°C, 10 cycles at 20 °C per minute ramp rate, 20 minutes dwell time per MIL-STD-833F, Method 1010.8, Condition C (modified)
Humidity	
– Operating	95% RH at 40°C, 24 hours cycling, 5 cycles
– Condensation	95% RH at -10°C to 25°C, Method 2
– Resistance	95% RH at 65°C, 10 Days per JEDEC HAST Standard
Shock	
– End-user handling	Delta-V: 3m/s ±5%, Duration <3ms at 6 faces
– Mechanical Survival	Half Sine: 1000g, 0.5ms at 6 faces
– Transportation	50g, delta-V: 8m/s at 6 faces
Vibration	
– Operating (Random)	0.3 Grms, 5-500 Hz
Altitude	
– Operating	4,600 meters (15,092 feet)
– Non-operating	4,600 meters (15,092 feet)
ESD immunity	
– Contact Discharge	4 kV (to center conductor)
– Air Discharge	15 kV (to outer conductor)

THIS PAGE HAS BEEN INTENTIONALLY LEFT BLANK.

3 Installation and Verification

Installation 20
Operating Instructions 21
Performance Tests 22
Service Instructions 27

This chapter mainly focuses on the installation of the power divider and operating instructions to walk you through the quick-check procedure to ensure that the power divider is working before its implementation in the system. There are also the performance tests and service instructions available in this chapter.

Installation

Initial inspection

1. Inspect the shipping container for damage. If the shipping container or cushioning material is damaged, it should be kept until the contents of the shipment have been checked for completeness and the instrument has been checked both mechanically and electrically.
   - Check for mechanical damage such as scratches or dents.
   - Procedures for checking electrical performance are given under “Operator’s Check” on page 21 or “Performance Tests” on page 22.
2. If the contents are incomplete, if there is mechanical damage or defect, or if the instrument does not pass the electrical performance test, contact the nearest Keysight Technologies Sales and Service office (refer to “Sales and Technical Support” on page 3). Keysight will arrange for repair or replacement of the damaged or defective equipment. Keep the shipping materials for the carrier’s inspection.
3. If you are returning the instrument under warranty or for service, repackaging the instrument requires original shipping containers and materials or their equivalents. Keysight Technologies can provide packaging materials identical to the original materials. Refer to “Sales and Technical Support” on page 3 for the Keysight office nearest to you. Attach a tag indicating the type of service required, return address, model number and serial number. Mark the container ***FRAGILE*** to insure careful handling. In any correspondence, refer to the instrument by model number and serial number.

Operating Instructions

Operator's Check

The operator's check is supplied to allow the operator to make quick check of the power divider prior to use or if a failure is suspected.

CAUTION ESD exceeding the level specified in the technical overview may cause permanent damage to the device.

Description

The power divider is connected to a network analyzer configured for the s- parameter measurement. The network analyzer may be set to sweep over the whole or selected frequency range of the power divider to be verified. The s-parameter measurement is the best way to determine if the power divider is working properly.

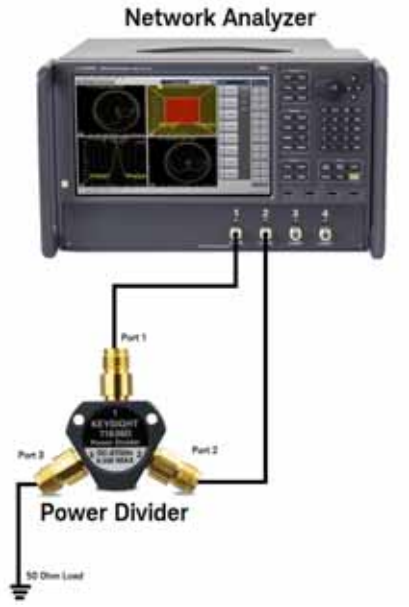


Figure 3-1 Quick-check configuration

Quick-check procedure

1. Visually inspect the input port and both output ports for defect or damage. Mating defective or unclean connectors degrade the measurement and damage the mating connector.
2. Perform the Performance tests (over the frequency range you will be using). For detailed instructions, refer to "Performance Tests" on page 22.

If the power divider fails either check, contact Keysight for repair or replacement.

Performance Tests

Input Return Loss

Input return loss is a measurement of the input port match of the power divider. The reflected RF signal is measured at the input port with both output ports terminated in 50 ohms.

To ensure that the power divider meets the input return loss specifications, the measured values must be greater than or equal to the specifications plus the measurement uncertainty.

Procedure

1. Set up the network analyzer for 2-port measurement and perform 2-port calibration after the network analyzer has been warmed up for 30 minutes.

2 Connect ports 1 and 2 of the power divider to the ports 1 and 2 of the network analyzer respectively. Terminate port 3 of the power divider with 50 ohm load (refer to Figure 3-2).



Figure 3-2 Input return loss test setup

3 Measure the reflection parameter, S11.

Output Tracking

Output tracking compares the frequency response of one output port to the other output port. A swept measurement is stored from the first output port and compared to the measurement of the other output port. Output tracking is measured as the maximum peak-to-peak variation.

Procedure

1. Set up the network analyzer for 2-port measurement and perform 2-port calibration after the network analyzer has been warmed up for 30 minutes.
2. Connect ports 1 and 2 of the power divider to the ports 1 and 2 of the network analyzer respectively. Terminate port 3 of the power divider with 50 ohm load (refer to Figure 3-3).

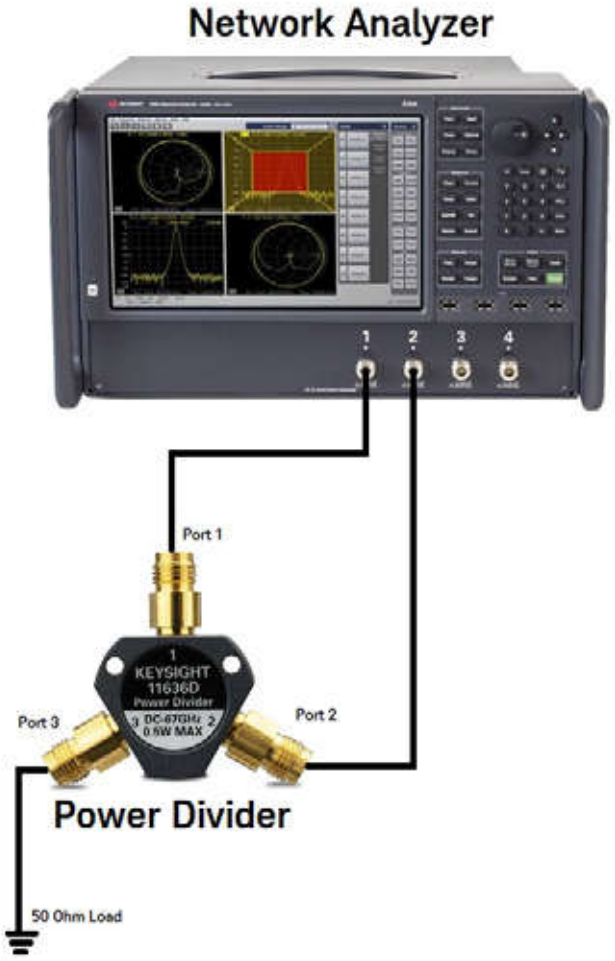


Figure 3-3 Output tracking test setup (Port 3 Terminated)

3 Measure the S11, S21 and S22 parameter values and save the measured value to the memory.

4 Now connect ports 1 and 3 of the power divider to the ports 1 and 2 of the network analyzer respectively. Terminate port 2 of the power divider with 50 ohm load (refer to Figure 3-4).



Figure 3-4 Output tracking test setup (Port 2 Terminated)

5 Measure the S31, S32 and S33 parameter values and perform “Data-Memory” math operation.
The “Data-Memory” operation result is the output (phase and amplitude) tracking measurement result.

Service Instructions

Adjustment

The power divider does not have internal adjustments and should not be opened.

Repair

The 11636C/D power divider is not recommended for repair as most components are not easily removed.

Maintenance

The connectors, particularly the connector faces, must be kept clean.

For instructions on connecting and care of the connectors, refer to Microwave Connector Care Quick Reference Card (08510- 90360).

THIS PAGE HAS BEEN INTENTIONALLY LEFT BLANK.



This information is subject to change without notice. Always refer to the English version at the Keysight website for the latest revision.

© Keysight Technologies 2007-2021

Edition 4, November 5, 2021

Printed in Malaysia



11636-90005

www.keysight.com