User Manual

Model 9250

Dual Channel/Differential Power Amplifier

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Tabor Electronics Ltd.

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FOR YOUR SAFETY

Before undertaking any troubleshooting, maintenance or exploratory procedure, read carefully the **WARNINGS** and **CAUTION** notices.

This equipment contains voltage hazardous to human life and safety, and is capable of inflicting personal injury.

If this instrument is to be powered from the AC line (mains) through an autotransformer, ensure the common connector is connected to the neutral (earth pole) of the power supply.

Before operating the unit, ensure the conductor (green wire) is connected to the ground (earth) conductor of the power outlet. Do not use a two-conductor extension cord or a three-prong/two-prong adapter. This will defeat the protective feature of the third conductor in the power cord.

Maintenance and calibration procedures sometimes call for operation of the unit with power applied and protective covers removed. Read the procedures and heed warnings to avoid “live” circuit points.

Before operating this instrument:

1. Ensure the proper fuse is in place for the power source to operate.

2. Ensure all other devices connected to or in proximity to this instrument are properly grounded or connected to the protective third-wire earth ground.

If the instrument:

- fails to operate satisfactorily
- shows visible damage
- has been stored under unfavorable conditions
- has sustained stress

Do not operate until, performance is checked by qualified personnel.

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Chapter 1
PORTRAYAL

What's in This Chapter

This chapter contains general and functional description of the Model 9250 dual/differential wideband power amplifier. It also describes the front and rear panel connectors and its operational modes. It also and provides description of all features available with the instrument.

Introduction

The Model 9250, as shown in Figure 1-1, is a bench-top, 2U, half 19" rack size, fully metal case dual channel amplifier. The instrument can be configured to be used as two, single-ended independent channels, or as a one input with two differential outputs.

The inputs to the amplifiers be configured to match different source impedances such as 50Ω, 75Ω, or 1MΩ and the outputs can be configured to match different load impedances such as 50Ω, 75Ω, or 600Ω.

There are three inputs for each channel:

1. Main input. This input is located on the front panel is normally be used for signal inputs.

2. Auxiliary input. This input is located on the rear panel and can be used as a summing input.

3. DC Offset input. This input is also located on the rear panel and can be used for offsetting the signal level within the specified output level window.

The outputs are located on the front panel. There are two outputs, one for each channel. When the 9250 is configured as two separate amplifiers, the outputs generate amplified signals within the range of 40Vp-p into open circuit or 20Vp-p into matching load impedance. The bandwidth of the outputs is around 20MHz for large signals. Small signal bandwidth can reach 50MHz.

The 9250 can be configured as a differential amplifier. In this case, the channel 2 input is disabled and channel 1 input is amplified and distributed differentially to both outputs. In this case, channel 1 output generates in-phase signal while channel 2 outputs an inverted signal that has exactly 180° phase offset to the normal output. Full amplitude and bandwidth is preserved when the 9250 operates in differential mode. The output impedance of the differential outputs is modified to 25Ω, 37.5Ω, or 300Ω for differential drive of 50Ω, 75Ω, or 600Ω loads. Using the differential mode, the 9250 does not sacrifice accuracy, nor does it sacrifice bandwidth.

The 9250 has two additional inputs for each channel allowing summation of two signals and providing an external control of DC level offset. These inputs are accessible from the rear panel only.

9250 Feature Highlights

- Bench-top, all metal case
- Large signal bandwidth to 20 MHz
- Small signal bandwidth to 50 MHz
- High amplitude to 40Vp-p (high impedance)
- Low distortion
- Custom Configuration of:
  - Gain
  - Input Impedance
  - Output Impedance
  - Output configuration – single ended or differential

Conventions Used in this Manual

The following symbols may appear in this manual:

Note

A Note contains information relating to the use of this product

TIP

A Tip contains information relating to the performance of this product

Caution

A Caution contains information that should be followed to avoid personal damage to the instrument or the equipment connected to it.

Warning

A Warning alerts you to a potential hazard. Failure to adhere to the statement in a WARNING message could result in personal injury.

Figure 1-1, The Model 9250

Functional Description

Detailed functional description of the features, operation and options available with the 9250 is given in the following paragraphs. The wideband amplifier can be ordered with different configurations such as input/output impedance, gain, etc. Therefore read the following description carefully and make sure your amplifier is configured correctly for your application before you connect the cables to your circuits.

Configuration Options

The Model 9250 must be ordered from the factory already configured for your application. This manual has no schematics and no instructions how to modify the amplifier for other configurations as any configuration change, without full engineering supervision, may affect the performance of the amplifier. Below, you'll find a list of optional configurations for the amplifier:

Basic Configuration – defines if the 9250 will operate as two single-ended and independent amplifiers, or as single input with differential outputs.

Input Impedance – determines the matching source impedance at the input connectors. Three options are available: 50Ω, 75Ω and

1MΩ. Input impedance can be configured for the front panel main inputs and for the rear panel auxiliary inputs.

Output Impedance – determines the matching load impedance at the output connectors. Three options are available: 50Ω, 75Ω and 600Ω.

Gain – specifies gain magnitude of the input signal. Factory default setting is 10. Custom gain can also be specified. Note that some characteristics of the output section may change for gain setting above 10.

As explained above, all options must be specified at the time of your purchase and the 9250 is supplied fully configured. Reconfiguration of fielded instruments can be done by qualified and trained persons only.

Specifications

Instrument specifications are listed in Appendix A. These specifications are the performance standards or limits against which the instrument is tested. Specifications apply under the following conditions: output terminated into matching impedance, after 30 minutes of warm up time, and within a temperature range of 20°C to 30°C. Specifications outside of the temperature range are degraded by 0.1% per °C.

Front Panel Connectors

The 9250 has 4 BNC connectors on its front panel, two for each channel. Two are marked INPUT and the other two are marked OUTPUT. These connectors are described below.

Channel 1 Input

The input connector accepts signals within the range of DC to over 20 MHz and amplifies them by a fixed gain. The gain is normally x10 however, this number may be different if you ordered the amplifier with different gain setting. Input impedance is factory pre-conditioned and has one of the following values: 50Ω, or 1MΩ. 1MΩ input impedance can be used for low frequency signals (up to 100kHz) however, higher frequencies require 50Ω termination at the input of the amplifier to eliminate standing waves and reflections in the input cable, which can cause excessive ringing and aberrations at the output.

The amplifier input can not tolerate high voltage on its 50Ω resistance. Therefore, before applying the cable to the input connector, make sure your signal will not exceed input rating, as specified in Appendix A of this manual.

Note

Channel 1 Input only is used when the Model 9250 is configured to operate in differential mode.

Channel 2 Input

This input connector accepts signals within the range of DC to over 20 MHz and amplifies them by a fixed gain. The gain is normally x10 however, this number may be different if you ordered the amplifier with different gain setting. Input impedance is factory pre-conditioned and has one of the following values: 50Ω, or 1MΩ. 1MΩ input impedance can be used for low frequency signals (up to 100kHz) however, higher frequencies require 50Ω termination at the input of the amplifier to eliminate standing waves and reflections in the input cable, which can cause excessive ringing and aberrations at the output.

The amplifier input can not tolerate high voltage on its 50Ω resistance. Therefore, before applying the cable to the input connector, make sure your signal will not exceed input rating, as specified in Appendix A of this manual.

Note

Channel 2 Input is disabled when the 9250 is configured to operate in differential output mode.

Channel 1 Output

The channel 1 output connector outputs amplified signals. When the 9250 is configured as two separate amplifiers, this output connector generates amplified signals that are applied to the channel 1 input connector. If the instrument is configured for differential output, this channel generates normal, non-inverted signals while the other output connector generates the inverted signal at 180° phase offset.

Gain at this output is fixed at 10 (or another gain factor that was specified at the time of your purchase). Output source impedance is one of: 50Ω, 75Ω or 600Ω.

Tip

Knowing your source impedance is very important because the output gain accuracy is calibrated to specific source impedance and therefore, any unmatched load impedance may have an affect on

output level accuracy. For example, with properly terminated signals at the input and output connectors (say 50Ω each), an input of 2Vp-p will generate an output of 20Vp-p. On the other hand, if you increase your load impedance by a large factor, the output will increase by a factor of:

$$\mathbf{Vout = 40Vp\text{-}p - 40Vp\text{-}p \times 50\Omega / (50\Omega + X\Omega)}$$

where X = your load impedance

If you look at the equation above, with exactly 50Ω load impedance, the output will be 20Vp-p and as you increase the load impedance, the output increases proportionally until, at very high load impedance, the output is doubled to 40Vp-p.

40Vp-p is the maximum amplitude level this amplifier can produce however, only into high impedance loads.

WARNING

Applying the output signal on inductive or capacitive loads may damage the amplifier.

Channel 2 Output

The channel 2 output connector outputs amplified signals. When the 9250 is configured as two separate amplifiers, this output generates amplified signals that are applied to the channel 2 input connector. If the instrument is configured for differential output, this channel generates an inverted signal at 180° phase offset while channel 1 output generates the normal, non-inverted.

Gain at this output is fixed at 10 (or another gain factor that was specified at the time of your purchase). Output source impedance is one of: 50Ω, 75Ω or 600Ω.

Tip

Knowing your source impedance is very important because the output gain accuracy is calibrated to specific source impedance and therefore, any unmatched load impedance may have an affect on output level accuracy. For example, with properly terminated signals at the input and output connectors (say 50Ω each), an input of 2Vp-p will

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40Vp-p is the maximum amplitude level this amplifier can produce however, only into high impedance loads.

WARNING

Applying the output signal on inductive or capacitive loads may damage the amplifier.

Front Panel Indicators

The 9250 has 2 indicators on its front panel. The POWER LED will light as soon as you press the switch to power up the 9250. An illuminated power light designates power is applied to the instrument and you should expect to have signal at its output connector(s).

An LED at the center of the front panel is marked Differential ON. When this light is on, channel 2 input is disabled and signal applied to the channel 1 input is routed to both channel 1 and channel 2 outputs, except the signal is now differential. The differential mode is selected with a rear panel switch.

Rear Panel Parts and Connectors

The rear panel is rarely used for normal operation however, there are some connections you must do before you can operate the amplifier for example, connecting the mains power to the instrument. There are other connectors and parts on the rear panel; These are discussed in the following paragraphs. Refer to Figure 1-2 throughout the following description.

Figure 1-2, The 9250 Rear Panel

Line Receptacle and Fuse

Power is connected to the 9250 through the line receptacle. The amplifier accepts any voltage from 80 to 265Vac and there is no need to select the voltage range between different countries. Instructions how to connect the line cord and how to replace the line fuse is given in Chapter 2. If a fuse blows, make sure you replace it with the same type and rating to avoid possible damage to the product from unsuitable fuse value.

Auxiliary Inputs Channel 1

There are two Channel 1 auxiliary inputs on the rear panel marked INPUT and OFFSET.

The INPUT connector can be used as summing input to the front panel signal. It also can be used as the main input if connectors are available on the back only. However, the output is always from the front panel connectors. Observe the input limitations as specified in Appendix A to avoid damage to the amplifier circuit.

The OFFSET connector is used for dc signals only. Use this input to offset your signal to any direction, positive or negative however, always observe the positive and negative rail limitations as specified in Appendix A to avoid damaging the amplifier circuits.

With normal configuration, this input is used for driving the front panel output for channel 1 only. When the 9250 is configured for differential outputs, channel 2 auxiliary inputs are disabled and only channel 1 signal is amplified.

Auxiliary Inputs Channel 2

There are two Channel 2 auxiliary inputs on the rear panel marked INPUT and OFFSET.

The INPUT connector can be used as summing input to the front panel signal. It also can be used as the main input if connectors are available on the back only. However, the output is always from the front panel connectors. Observe the input limitations as specified in Appendix A to avoid damage to the amplifier circuit.

The OFFSET connector is used for dc signals only. Use this input to offset your signal to any direction, positive or negative however, always observe the positive and negative rail limitations as specified in Appendix A to avoid damaging the amplifier circuits.

With normal configuration, this input is used for driving the front panel output for channel 2 only. When the 9250 is configured for differential outputs, these inputs are disabled and only channel 1 signal is amplified.

Differential Outputs Switch

The Differential Outputs switch has two actions. In normal mode, it separates between the two channels so each channel can be used separately. In Differential Mode, this switch disables channel 2 inputs and converts the internal circuits to output differential signals. Channel 1 is used for outputting the normal output and channel 2 is used for outputting the inverted signal. When this switch is depressed, the front panel led illuminates, designating that the differential mode has been selected.

Grounding Considerations

Understanding how to connect your ground path could be critical to preserving the integrity of your output signal. If you are using a single-ended output then it will probably be safe for you to connect the circuit ground to case ground. Always bear in mind the following warning:

WARNING

Input and output grounds are tied together to case ground and therefore, it is absolutely forbidden to connect the output ground to a different level than the input ground. Failure to adhere to this limitation may damage the 9250 and the surrounding equipment connected to its I/O connectors.

Operating Instructions

Being a passive device, there are no controls, nor computer programming required to operate the Model 9250. The following procedure is recommended for proper operation of the power amplifier:

1. Make sure your box is configured for input and output impedance and gain

2. Follow the installation instructions given in Chapter 2 of this manual

3. Connect the output terminal to your load

4. Connect the input terminal to your source

5. Turn on power to your 9250

WARNING

There is no switch control to turn 9250 amplification on and off and therefore, the amplifier is active immediately after you power it up. Always make sure your load is protected from inadvertent power up conditions before you turn on your 9250.

Chapter 2
CONFIGURING the INSTRUMENT

Installation Overview

This chapter contains information and instructions necessary to prepare the Model 9250 for operation. Details are provided for initial inspection, grounding safety requirements, repackaging instructions for storage or shipment, installation information and Ethernet address configuration.

Unpacking and Initial Inspection

Unpacking and handling of the generator requires normal precautions and procedures applicable to handling of sensitive electronic equipment. The contents of all shipping containers should be checked for included accessories and certified against the packing slip to determine that the shipment is complete.

Safety Precautions

The following safety precautions should be observed before using this product. Although some instruments and accessories would normally be used with non-hazardous voltages, there are situations where hazardous conditions may be present.

CAUTION

This product is intended for use by qualified persons who recognize shock hazards and are familiar with the safety precautions required to avoid possible injury. Read the operating information carefully before using the product.

Exercise extreme caution when a shock hazard is present. Lethal voltage may be present on power cables, connector jacks, or test fixtures. The American National Standard Institute (ANSI) states that a shock hazard exists when voltage levels greater than 30V RMS, 42.4V peak or 60 VDC are present.

WARNING

For maximum safety, do not touch the product, test cables, or any other instrument parts while power is applied to the circuit under test. ALWAYS remove power from the entire test system before connecting cables or jumpers, installing or removing cards from the computer, or making internal changes such as changing the module address.

Do not touch any object that could provide a current path to the common side of the circuit under test or power line (earth) ground. Always keep your hands dry while handling the instrument.

When using test fixtures, keep the lid closed while power is applied to the device under test. Carefully read the Safety Precautions instructions that are supplied with your test fixtures.

Before performing any maintenance, disconnect the line cord and all test cables. Only qualified service personnel should perform maintenance.

Performance Checks

The instrument has been inspected for mechanical and electrical performance before shipment from the factory. It is free of physical defects and in perfect electrical order. Check the instrument for damage in transit and perform the electrical procedures outlined in the section entitled **Unpacking and Initial Inspection.**

Operating Environment

The 9250 is intended for operation on the bench or inside a rack of instruments. It is intended for indoor use only and should be operated in a clean, dry environment with an ambient temperature within the range of 0 °C to 50 °C.

WARNING

The 9250 must not be operated in explosive, dusty, or wet atmospheres. Avoid installation of the module close to strong magnetic fields.

The design of the 9250 has been verified to conform to EN 61010-1 2nd addition safety standard per the following limits: Installation (Overvoltage) Category I (Measuring terminals) Pollution Degree 2.

Installation (Overvoltage) Category I refers to signal level, which is applicable for equipment measuring terminals that are connected to source circuits in which measures are taken to limit transient voltages to an appropriately low level.

Pollution Degree 2 refers to an operating environment where normally only dry non-conductive pollution occurs. Occasionally a temporary conductivity caused by condensation must be expected.

Power Requirements

The function generator may be operated from a wide range of mains voltage 90 to 264Vac. Voltage selection is automatic and does not require switch setting. The instrument operates over the power mains frequency range of 48 to 63Hz. Always verify that the operating power mains voltage is the same as that specified on the rear panel.

The 9250 should be operated from a power source with its neutral at or near ground (earth potential). The instrument is not intended for operation from two phases of a multi-phase ac system or across the legs of a single-phase, three-wire ac power system. Crest factor (ratio of peak voltage to rms.) should be typically within the range of 1.3 to 1.6 at 10% of the nominal rms. mains voltage.

Grounding Requirements

To ensure the safety of operating personnel, the U.S. O.S.H.A. (Occupational Safety and Health) requirement and good engineering practice mandate that the instrument panel and enclosure be “earth” grounded. Although BNC housings are isolated from the front panel, the metal part is connected to earth ground.

WARNING

Do not attempt to float the output from ground as it may damage the Model 9250 and your equipment.

WARNING

Input and output grounds are tied together and therefore, it is absolutely forbidden to connect the output ground to a different level than the input ground. Failure to adhere to this limitation may damage the 9250 and the surrounding equipment connected to its I/O connectors.

Long Term Storage or Repackaging for Shipment

If the instrument is to be stored for a long period of time or shipped to a service center, proceed as directed below. If repacking procedures are not clear to you or, if you have questions, contact your nearest Tabor Electronics Representative, or the Tabor Electronics Customer Service Department.

1. Repack the instrument using the wrappings, packing material and accessories originally shipped with the unit. If the original container is not available, purchase replacement materials.

2. Be sure the carton is well sealed with strong tape or metal straps.

3. Mark the carton with the model and serial number. If it is to be shipped, show sending and return address on two sides of the box.

NOTE

If the instrument is to be shipped to Tabor Electronics for calibration or repair, attach a tag to the instrument identifying the owner. Note the problem, symptoms, and service or repair desired. Record the model and serial number of the instrument. Show the RMA (Returned Materials Authorization) order as well as the date and method of shipment. ALWAYS OBTAIN AN RMA NUMBER FROM THE FACTORY BEFORE SHIPPING THE 9250 TO TABOR ELECTRONICS.

Preparation for Use

Preparation for use includes removing the instrument from the container box and connecting the cables to its input and output connectors.

Installation

If this instrument is intended to be installed in a rack, it must be installed in a way that clears air passage to its cooling fans. For inspection and normal bench operation, place the instrument on the bench in such a way that will clear any obstructions to its rear fan to ensure proper airflow.

CAUTION

Using the 9250 without proper airflow will result in damage to the instrument.

Factory Configuration of the 9250 Settings

When you order the Model 9250, you should provide details how you want this product configured. There is some amount of flexibility in the configuration before the instrument is shipped from the factory. The following are factory configured settings:

Gain

The default gain setting is x10. The 9250 can be ordered with different gain values up to x20. Bear in mind that gain x bandwidth product remains constant and therefore, you should expect proportional reduction in bandwidth if the gain of the amplifier is increased above x10.

Input Impedance

The default input impedance is 50Ω. The 9250 can be ordered with different input impedance values such as 75Ω and 1MΩ. The 1MΩ is recommended for low frequency operation as the high input impedance degrades the frequency response of the amplifier. Appendix A specifies the bandwidth for the various source and input impedances.

Source (output) Impedance

The default source (output) impedance is 50Ω. The 9250 can be ordered with different load impedance values such as 75Ω and 600Ω. The 600Ω is recommended for low frequency operation as the high source impedance degrades the frequency response of the amplifier. Appendix A specifies the bandwidth for the various input and source impedances.

Input/Output Coupling

The default input/output coupling is DC. The 9250 can be ordered AC coupled. DC coupling is recommended for signals that have dc components with low frequencies operation. Appendix A specifies the frequency limitation for inputs/outputs configured to AC coupling.

Single-ended/Differential Outputs

The default configuration is single-ended. With this configuration, there are two independent channels that amplify signals that are applied to the channel 1 and 2 inputs. The 9250 can be ordered with differential outputs; In this case, channel 2 input is disabled and channel 1 output is amplified and routed differentially to both channels 1 and 2. Channel 1 outputs the normal signal and channel 2 outputs the inverted phase signal. Appendix A specifies the properties of the 9250 when configured for differential outputs operation.

Field Configuration of the 9250 Settings

Limited flexibility is available for you, as the user, to change 9250 configuration in the field. Changing configuration involves the opening of the top cover and therefore, it is suggested that this operation be completely avoided or, if absolutely necessary, should be carried out by factory-trained person.

Use the following instructions to re-configure 9250 settings in the field:

Remove the Top Cover

There are four screws bolting the top cover to the case. These are located on both sides of the cover. Identify and remove these screws. Use Philips screwdriver only to remove the screws. Hold the cover from both sides and pull upwards until the top is clear of the case sides. Once the top cover is open, you'll be able to access jumpers that set the different configuration.

Configure the Input Impedance

Before you change the 9250 input impedance settings, identify first the jumper location for all of the inputs. Figure 2-1 shows an example of the channel 1 input impedance jumpers. Place the jumpers as required according to the following table:

Table 2-1, Input Impedance Jumpers

Impedance	CH1	CH2	Aux CH1	Aux CH2
50Ω	J23	J5	J29	J14
75Ω	J24	J11	J28	J13
1MΩ	J22	J6	J30	J15

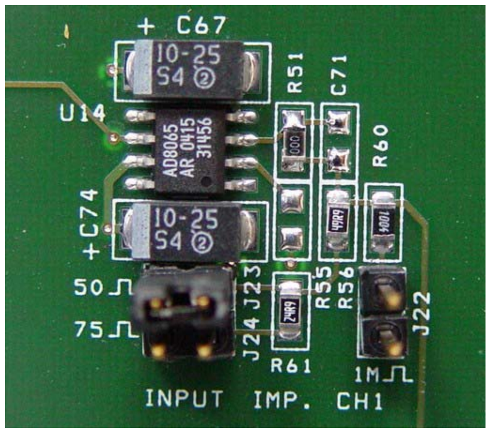

Figure 2-1, Field Modification of Channel 1 Input Impedance

Configure the Source (Output) Impedance

Before you change the 9250 source (output) impedance settings, identify first the jumper location for all of the Outputs. Place the jumpers as required according to the table 2-2.

Table 2-2, Output Impedance Jumpers

Impedance	CH1	CH2
50Ω	J20	J9
75Ω	J21 2-3	J10 2-3
600Ω	J21 1-2	J10 1-2

Configure Input/Output Coupling

The default input/output coupling is DC. Before you change the 9250 input/output coupling settings, identify first the jumper location for all of the inputs and outputs. When the jumpers are on the links, the path is DC coupled. Remove the jumpers from the link to modify the settings to AC. Place or remove the jumpers as required according to table 2-3 and 2-4.

Table 2-3, Input coupling Jumpers

Input	CH1	CH2	Aux CH1	Aux CH2
Link	J27	J4	J31	J16

Table 2-4, Output coupling Jumpers

Impedance	CH1	CH2
Link	J19	J8

Configure Single-ended or Differential Outputs

The default configuration is single-ended. If you order the amplifier with differential outputs, channel 2 input is disabled and channel 1 output is amplified and routed differentially to both channels 1 and 2. Channel 1 outputs the normal signal and channel 2 outputs the inverted phase signal.

The rear panel, as shown in Figure 1-2 has a push-push switch. Pressing the switch once, will activate the differential mode and will cause a light on the rear panel to illuminate. Pressing the switch again will disable the differential mode and allow each amplifier to operate separately.

The differential source impedance must be adjusted in the factory to your requirement. For true differential source impedance, the output source impedance is halved. For example, instead of 600Ω, each channel has 300Ω however, since each channel is inverted 180° to the other channel, the source impedance is summed and presents true 600Ω to the load.

WARNING

Output impedance for differential mode is factory set for differential drive. If you change the rear panel switch setting to Differential OFF position, the source impedance is half of what should be for normal operation. Changing from differential mode to normal must without changing the internal source resistors will double the output amplitude and may damage your equipment.

Chapter 3

MAINTENANCE, PERFORMANCE CHECKS and ADJUSTMENTS

What's in This Chapter

This chapter provides maintenance and service information, performance tests, and the procedures necessary to adjust and troubleshoot the Model 9250 Universal Waveform Generator.

WARNING

The procedures described in this section are for use only by qualified service personnel. Many of the steps covered in this section may expose the individual to potentially lethal voltages that could result in personal injury or death if normal safety precautions are not observed.

CAUTION

ALWAYS PERFORM DISASSEMBLY, REPAIR AND CLEANING AT A STATIC SAFE WORKSTATION.

Disassembly Instructions

If it is necessary to troubleshoot the instrument or replace a component, use the following procedure to remove the side panels:

1. Using a Phillips head screwdriver, remove the screws from the top and bottom covers.

2. Carefully lift the top cover from its back end and slide the cover to the rear to clear the front panel spring latch. Do the same for the bottom. After removing the covers from the instrument, access the component side for calibration and checks, and the solder side when replacing components.

3. When replacing the top and bottom covers, reverse the above procedure.

Special Handling of Static Sensitive Devices

CMOS devices are designed to operate at very high impedance levels for low power consumption. As a result, any normal static charge that builds up on your person or clothing may be sufficient to destroy these devices if they are not handled properly. When handling such devices, use the precautions described below to avoid damaging them:

1. CMOS IC's should be transported and handled only in containers specially designed to prevent static build-up. Typically, these parts are received in static-protected containers of plastic or foam. Keep these devices in their original containers until ready for installation.

2. Ground yourself with a suitable wrist strap. Remove the devices from the protective containers only at a properly grounded workstation.

3. Remove a device by grasping the body; do not touch the pins.

4. Any printed circuit board into which the device is to be inserted must also be grounded to the bench or table.

5. Use only anti-static type solder sucker.

6. Use only grounded soldering irons.

Once the device is installed on the PC board, the device is adequately protected and normal handling may resume.

Cleaning

The Model 9250 should be cleaned as often as operating conditions require. To clean the instrument, use the following procedure:

1. Thoroughly clean the inside and outside of the instrument.

2. When cleaning inaccessible areas, remove dust with low-pressure compressed air or a vacuum cleaner.

3. Use alcohol applied with a cleaning brush to remove accumulation of dirt or grease from connector contacts and component terminals.

4. Clean the exterior of the instrument and the front panel with a mild detergent mixed with water, applying the solution with a soft, lint-free cloth.

Repair and Replacement

Repair and replacement of electrical and mechanical parts must be accomplished with great care. Printed circuit boards can become warped, cracked or burnt from excessive heat or mechanical stress. The following repair techniques are suggested to avoid inadvertent destruction or degradation of parts and assemblies:

1. Use a 60/40 solder and temperature-controlled 35 - 40 watt pencil-type soldering iron on the circuit board. The tip of the iron should be clean and properly tinned for best heat transfer to the solder joint. A higher wattage soldering iron may separate the circuit from the base material.

2. Keep the soldering iron in contact with the PC board for a minimum time to avoid damage to the components or printed conductors.

3. To de-solder components, use a commercial "solder sucker" or a solder-removing SOLDER - WICK, size 3.

4. Always replace a component with an exact duplicate as specified in the parts list.

Performance Checks

The performance of the 9250 should be checked to verify proper operation of the instrument and should normally be used:

1. As a part of the incoming inspection of the instrument specifications;

2. As part of the troubleshooting procedure;

3. After any repair or adjustment before returning the instrument to regular service.

Environmental Conditions

Tests should be performed under laboratory conditions having an ambient temperature of 25°C, ±5°C and at relative humidity of less than 80%. If the instrument has been subjected to conditions outside these ranges, allow at least one additional hour for the instrument to stabilize before beginning the adjustment procedure.

Warm-up Period

Most instruments are subject to small amount of drifts when first turned on. To ensure accuracy, turn on the power to the Model 9250 and allow it to warm-up for at least 10 minutes before beginning the performance test procedure.

9250 Configuration for the Tests

The 9250 is tested using the factory recommended configuration. The instrument should be configured as follows for the performance tests: Input impedance = 50Ω; Output impedance = 50Ω; Gain = 10; Coupling = DC. Other configurations can be tested but slight degradation of performance should be considered, as specified in Appendix A

Recommended Test Equipment

Recommended test equipment for troubleshooting, calibration and performance checking is listed below. Test instruments other than those listed may be used only if their specifications equal or exceed the required characteristics.

Table 33-31, Recommended Test Equipment

Equipment	Model No.	Manufacturer
Oscilloscope	LT342	LeCroy
Distortion Analyzer	6900B	Krohn Hite
Digital Multimeter	2000	Keithley
Freq. Counter	6020	Tabor Electronics
Spectrum Analyzer	E4411	HP
Pulse Generator	8500	Tabor Electronics

Performance Check Procedures

Use the following procedures to check the Model 9250 against the specifications. A complete set of specifications is listed in Appendix A. The following paragraphs show how to set up the instrument for the test, what the specifications for the tested function are, and what acceptable limits for the test are. If the instrument fails to perform within the specified limits, the instrument must be calibrated or tested to find the source of the problem.

Input/Output Impedance

Equipment: DMM

Preparation:

1. Perform test with the 9250 placed on the desk, power removed

Test Procedure:

1. Set DMM to Resistance measurements and 200Ω Range. Connect the DMM probes across the 9250 channel 1 input and verify DMM reading of 50Ω, ±2%
2. Repeat the test for all inputs and outputs. Do not measure the DC Offset terminals on the rear panel

Test Results	Pass		Fail	

Gain Accuracy

Equipment: DMM, Function generator

Preparation:

1. Configure the Function Generator as follows:
2. Function: Sine wave
3. Frequency: 1kHz
4. Amplitude: 2Vp-p
5. Connect function generator output to the 9250 channel 1 input
6. Configure the DMM as follows:
7. Function: ACV
8. Range:20V
9. Termination: 50Ω feed-through at the DMM input
10. Connect the DMM input to the 9250 channel 1 output

Test Procedure

11. Measure and verify DMM reading of 7.143V, ±142mV

Test Results	Pass		Fail	

12. Remove the cables from 9250 channel 1 input/output and connect to channel 2
13. Repeat the test procedure as above for channel 2

Test Results	Pass		Fail	

14. Repeat the test procedure as above for the auxiliary inputs

Test Results	Pass		Fail	

Square wave Characteristics

Equipment: Oscilloscope, Function generator

Preparation:

15. Configure the Oscilloscope as follows:
16. Termination: 50Ω feed through at the oscilloscope input
17. Setup: As required for the test
18. Connect 9250 Channel 1/2 output to the oscilloscope input
19. Configure the Function Generator as follows:
20. Function: Square wave
21. Frequency: 1MHz
22. Amplitude: 2Vp-p
23. Connect the function generator to the 9250 channel 1/2 input

Test Procedure

1. Perform Square wave Characteristics tests on both channels using Table 3-2

Table 3-32 , Square wave Characteristics Tests

9250 Setting	Error Limits	Oscilloscope Reading		Pass	Fail
		CH 1 Output	CH 2 Output		
Rise/Fall Time	≤ 22 ns				
Ringing	< 7% + 10 mV				
Over/undershoot	< 7% + 10 mV				

2. Repeat the test procedure as above for the auxiliary inputs

Test Results	Pass		Fail	

Output Distortion

Equipment: Distortion Analyzer, Function Generator

Preparation:

24. Connect the 9250 Channel 1/2 outputs to the distortion analyzer input. Use 50Ω feedthrough termination at the distortion analyzer input
25. Configure the function generator as follows:
26. Function: Sine wave
27. Frequency: 10Hz
28. Amplitude: 1Vp-p
29. Connect the function generator to the 9250 channel 1/2 input

Test Procedure

1. Perform distortion tests on both channels using Table 3-3

Table 3-3, Output Distortion Tests

Function Generator Frequency Setting	Reading Limits	Distortion Reading		Pass	Fail
		CH 1 Output	CH 2 Output		
10.00Hz	< 0.1%				
100.0Hz	< 0.1%				
1.000kHz	< 0.1%				
10.00kHz	< 0.1%				
100.00kHz	< 0.1%				

2. Remove the cables from the front panel inputs repeat the tests using the rear panel inputs

Test Results	Pass		Fail	

Output Spectral Purity

Equipment: Spectrum Analyzer, Function Generator

Preparation:

30. Connect the 9250 Channel 1/2 outputs to the spectrum analyzer input. Use 20dB feedthrough, 50Ω attenuator at the spectrum analyzer input
31. Configure the function generator as follows:
32. Function: Sine wave
33. Frequency: 1MHz
34. Amplitude: 1Vp-p
35. Connect the function generator to the 9250 channel 1/2 input

Test Procedure

1. Perform signal purity tests on both channels using Table 3-4

Table 3-4, Front Panel Sine wave Spectral Purity Test

Sine Freq	Reading Limits	Spectrum Analyzer Start	Stop	CH 1	CH 2	Pass	Fail
1MHz	>55dBc	100K	10M				
5MHz	>40dBc	1M	20M				
10MHz	>35dBc	1M	50M				
50MHz	>22dBc	10M	300M				

Adjustments

Introduction

This document contains the calibration procedure for the Model 9250. Specifications are listed in Appendix A. The calibration procedures that are described in this document are for use by qualified service person only. Do not perform these procedures unless qualified to do so. This procedure is intended to be used once before complete and final performance verification to verify that the 9250 meets or exceeds its published specifications.

Environmental Conditions

The 9250 can operate from 0°C to 50°C. Calibration should be performed under laboratory conditions having an ambient temperature of 25°C, ±5°C and at relative humidity of less than 80%. Turn on the power to the 9250 and allow it to warm up for at least 30 minutes before beginning the adjustment procedure. If the instrument has been subjected to conditions outside these ranges, allow at least one additional hour for the instrument to stabilize before beginning the adjustment procedure.

Required Equipment

Recommended equipment for calibration is listed in Table 3-5. Instruments other than those listed may be used only if their specifications equal or exceed the required minimal characteristics. Also listed below are accessories required for calibration.

Table 33-5, Required Equipment

Instrument	Manufacturer	Model
DMM	Keithley	2000
Oscilloscope	LeCroy	LT342
10MHz Reference	Oscilloqurz	10MHz
Counter/Timer	Tabor	6030
Accessories	BNC to BNC cable	
	50Ω Feedthrough termination	
	Dual banana to BNC adapter	

Adjustment Procedures

Use the following procedures to calibrate the Model 9250. The following paragraphs show how to set up the instrument for calibration and what the acceptable calibration limits are.

CH1 Low Frequency Response

Equipment: Oscilloscope, waveform generator, x10 attenuator

Procedure:

36. Configure the waveform generator as follows:
37. Function: Square wave
38. Frequency: 1kHz
39. Amplitude: 1.6Vp-p (may vary depending on the configured gain)
40. Connect the waveform generator output to the 9250 channel 1 input
41. Connect the 9250 channel 1 through the x10 attenuator to the oscilloscope
42. Set oscilloscope to dc coupling and 50Ω termination

Adjustment:

1. Adjust RV6 for best flatness of the square waveform shape

CH2 Low Frequency Response

Equipment: Oscilloscope, waveform generator, x10 attenuator

Procedure:

43. Configure the waveform generator as follows:
44. Function: Square wave
45. Frequency: 1kHz
46. Amplitude: 1.6Vp-p (may vary depending on the configured gain)
47. Connect the waveform generator output to the 9250 channel 2 input
48. Connect the 9250 channel 2 through the x10 attenuator to the oscilloscope
49. Set oscilloscope to dc coupling and 50Ω termination

Adjustment:

1. Adjust RV2 for best flatness of the square waveform shape

CH1 High Frequency Response

Equipment: Oscilloscope, waveform generator, x10 attenuator

Procedure:

50. Configure the waveform generator as follows:
51. Function: Square wave
52. Frequency: 1MHz
53. Amplitude: 1.6Vp-p (may vary depending on the configured gain)
54. Connect the waveform generator output to the 9250 channel 1 input
55. Connect the 9250 channel 1 through the x10 attenuator to the oscilloscope
56. Set oscilloscope to dc coupling and 50Ω termination

Adjustment:

1. Adjust RV5, RV8 and C77 for transition time between 18-20ns and lowest aberrations

CH2 Low Frequency Response

Equipment: Oscilloscope, waveform generator, x10 attenuator

Procedure:

57. Configure the waveform generator as follows:
58. Function: Square wave
59. Frequency: 1MHz
60. Amplitude: 1.6Vp-p (may vary depending on the configured gain)
61. Connect the waveform generator output to the 9250 channel 2 input
62. Connect the 9250 channel 2 through the x10 attenuator to the oscilloscope
63. Set oscilloscope to dc coupling and 50Ω termination

Adjustment:

1. Adjust RV1, RV2 and C35 for transition time between 18-20ns and lowest aberrations

Channel 1, Auxiliary Offset Adjustment

Equipment: Oscilloscope, waveform generator, x10 attenuator

Procedure:

64. Configure the waveform generator as follows:
65. Frequency: 1MHz
66. Function Ch1: Square wave
67. Function Ch2: DC
68. Amplitude Ch1: 200mVp-p (may vary depending on the configured gain)
69. Amplitude Ch2: 8V (may vary depending on the configured gain)
70. Connect the waveform generator channel 1 output to the 9250, channel 1 input
71. Connect the waveform generator channel 2 output to the 9250, rear panel Channel 1 DC Offset auxiliary input
72. Connect the 9250 channel 1 through the x10 attenuator to the oscilloscope
73. Set oscilloscope to dc coupling and 50Ω termination

Adjustment:

1. Adjust RV7 for dc offset of 8V ±1/2 small division

Channel 2, Auxiliary Offset Adjustment

Equipment: Oscilloscope, waveform generator, x10 attenuator

Procedure:

74. Configure the waveform generator as follows:
75. Frequency: 1MHz
76. Function Ch1: Square wave
77. Function Ch2: DC
78. Amplitude Ch1: 200mVp-p (may vary depending on the configured gain)
79. Amplitude Ch2: 8V (may vary depending on the configured gain)
80. Connect the waveform generator channel 1 output to the 9250, channel 2 input
81. Connect the waveform generator channel 2 output to the 9250, rear panel Channel 2 DC Offset auxiliary input
82. Connect the 9250 channel 2 through the x10 attenuator to the oscilloscope
83. Set oscilloscope to dc coupling and 50Ω termination

Adjustment:

1. Adjust RV4 for dc offset of 8V ±1/2 small division

Appendix A

9250 SPECIFICATIONS (preliminary)

Input Characteristics

Number of Channels	2 with single-ended outputs; 1 with differential outputs
Connectors	BNC
Impedance	50Ω, 75Ω, or 1MΩ.
Coupling	DC or AC
Damage Level	12Vp-p (-6V to +6V peaks)
Frequency Range	DC to 15MHz (full power bandwidth), DC coupled, 50Ω input/output impedance; 40kHz to 15MHz (full power bandwidth), AC coupled, 50Ω/75Ω input impedance; 20Hz to 15MHz (full power bandwidth), AC coupled, 1MΩ input impedance;

Output Characteristics

General

Connector	BNC
Impedance	
Single-Ended	50Ω, 75Ω, or 600Ω
Differential	600Ω
Coupling	DC or AC
Protection	Short-circuit, 10 seconds
Gain	x10, fixed (can be ordered from factory with different gain setting. Bandwidth may change with different gain configuration)
Polarity	Output normal
Amplitude	0 to 20Vp-p into matching impedance (50Ω, 75Ω, or 600Ω); 0 to 40Vp-p into high impedance

Square Wave Characteristics

Transition Time	<22ns
Aberrations	<7%

Sine Wave Characteristics

Small Signal Bandwidth	30MHz, at 2Vp-p (-3dB)
Accuracy	±(3% of full-scale amplitude range + 25mV), Square wave at 1kHz
Flatness (10Vp-p)	±5% of amplitude to 1MHz; ±10% of amplitude to 15MHz
THD	0.1%, 10Hz to 100kHz
Harmonics	<-50dBc, 100kHz to 5MHz <-40dBc, 5MHz to 15MHz (10Vp-p)

General

Physical Size	2U, half-rack size
Power Requirements	85V to 265V, 47-63Hz, <25W

Weight:	Approximately 7Lbs
Signal Ground	Grounded to case ground
EMC Certification	CE marked
Reliability	MTBF per MIL-HDBK-217E, 25 °C, Ground Benign
Safety	Designed to meet IEC EN61010-1, UL 3111-1
Workmanship Std.	Conform to IPC-A-610D
Warranty:	3 years standard; Extended warranty available upon request

Environmental

Operating Temperature	0 °C - 50 °C, RH 80% (non-condensing)
Storage Temperature	-30 °C - 80 °C