Model 863
Quad Timing Filter Amplifier
Operating and Service Manual

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Manual Revision C

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Advanced Measurement Technology, Inc.

a/k/a/ ORTEC®, a subsidiary of AMETEK®, Inc.

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Before being approved for shipment, each ORTEC instrument must pass a stringent set of quality control tests designed to expose any flaws in materials or workmanship. Permanent records of these tests are maintained for use in warranty repair and as a source of statistical information for design improvements.

Repair Service

If it becomes necessary to return this instrument for repair, it is essential that Customer Services be contacted in advance of its return so that a Return Authorization Number can be assigned to the unit. Also, ORTEC must be informed, either in writing, by telephone [(865) 482-4411] or by facsimile transmission [(865) 483-2133], of the nature of the fault of the instrument being returned and of the model, serial, and revision ("Rev" on rear panel) numbers. Failure to do so may cause unnecessary delays in getting the unit repaired. The ORTEC standard procedure requires that instruments returned for repair pass the same quality control tests that are used for new-production instruments. Instruments that are returned should be packed so that they will withstand normal transit handling and must be shipped PREPAID via Air Parcel Post or United Parcel Service to the designated ORTEC repair center. The address label and the package should include the Return Authorization Number assigned. Instruments being returned that are damaged in transit due to inadequate packing will be repaired at the sender's expense, and it will be the sender's responsibility to make claim with the shipper. Instruments not in warranty should follow the same procedure and ORTEC will provide a quotation.

Damage in Transit

Shipments should be examined immediately upon receipt for evidence of external or concealed damage. The carrier making delivery should be notified immediately of any such damage, since the carrier is normally liable for damage in shipment. Packing materials, waybills, and other such documentation should be preserved in order to establish claims. After such notification to the carrier, please notify ORTEC of the circumstances so that assistance can be provided in making damage claims and in providing replacement equipment, if necessary.

CONTENTS

SAFETY INSTRUCTIONS AND SYMBOLS

This manual contains up to three levels of safety instructions that must be observed in order to avoid personal injury and/or damage to equipment or other property. These are:

DANGER Indicates a hazard that could result in death or serious bodily harm if the safety instruction is not observed.

WARNING Indicates a hazard that could result in bodily harm if the safety instruction is not observed.

CAUTION Indicates a hazard that could result in property damage if the safety instruction is not observed.

Please read all safety instructions carefully and make sure you understand them fully before attempting to use this product.

In addition, the following symbol may appear on the product:

ATTENTION – Refer to Manual

DANGER – High Voltage

Please read all safety instructions carefully and make sure you understand them fully before attempting to use this product.

SAFETY WARNINGS AND CLEANING INSTRUCTIONS

DANGER	Opening the cover of this instrument is likely to expose dangerous voltages. Disconnect the instrument from all voltage sources while it is being opened.

WARNING	Using this instrument in a manner not specified by the manufacturer may impair the protection provided by the instrument.

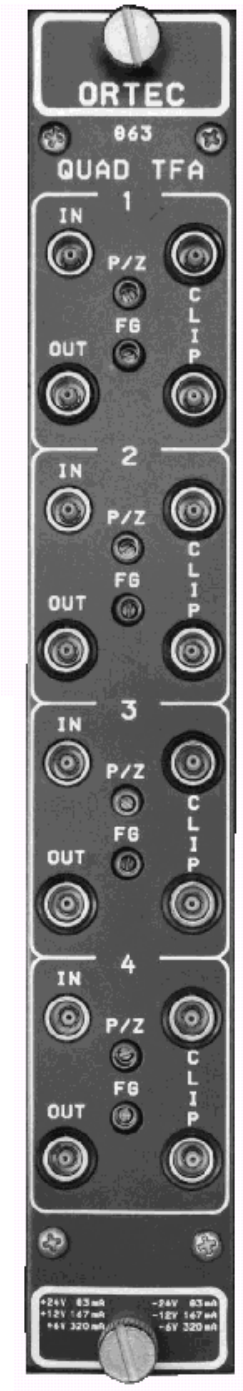
Cleaning Instructions

To clean the instrument exterior:

- Unplug the instrument from the ac power supply.
- Remove loose dust on the outside of the instrument with a lint-free cloth.
- Remove remaining dirt with a lint-free cloth dampened in a general-purpose detergent and water solution. Do not use abrasive cleaners.

CAUTION	To prevent moisture inside of the instrument during external cleaning, use only enough liquid to dampen the cloth or applicator.

- Allow the instrument to dry completely before reconnecting it to the power source.


ORTEC
863
QUAD TFA
1
IN
P/Z
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CLIP
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ORTEC MODEL 863
QUAD TIMING FILTER AMPLIFIER

1. INTRODUCTION

The ORTEC Model 863 Quad Timing Filter Amplifier incorporates four separate timing filter amplifiers in a single-width NIM module. This design provides a compact and cost-effective solution for experiments where timing is required on a number of detectors. Together with an ORTEC Model 934 Quad Constant Fraction Timing Discriminator, the Model 863 can provide optimum timing for up to four germanium detectors. The unit can also be used for timing with other solid-state detectors, or as a general purpose wide-band amplifier with selectable bandwidth.

The signals from germanium or silicon detectors at the preamplifier output are not always optimum for achieving good timing resolution. Before presentation to a timing discriminator, the signals normally require amplification with a wide-band amplifier, and they may need additional pulse shaping to minimize the noise contribution to the time resolution. The Model 863 provides a flexible approach in serving these two functions in order to handle a wide variety of solid-state detector types.

The gain can be selected as either inverting or noninverting and is adjustable over the nominal range of 2 to 250. The fine gain is adjustable from 2 to 50 using a front-panel screwdriver potentiometer, while a printed wiring board (PWB) jumper selects a coarse gain of either 1× or 5×. The output will drive a 50 Ω load to ±5 V with good linearity. This ensures that the full −50 mV to −5 V dynamic range of a constant fraction timing discriminator can be used. Excellent dc stability of the output is maintained by a continuous baseline restorer.

Several means of bandpass limiting are included to achieve the pulse shaping that yields the optimum time resolution. With all jumpers in the Out position, the Model 863 is a wide-band amplifier with an output rise time <10ns. To reduce low frequency noise and shorten the output pulse width, the CR differentiation time constant can be decreased from 0.1 ms (Out position) to 200 ns using a PWB jumper. Alternatively, two front-panel connectors can be employed (using a 50 Ω coaxial cable) to add delay line clipping. This results in a more abrupt termination of the output pulse duration while reducing low frequency noise. Both the CR differentiation and the cable clip can be used together to yield a bipolar output signal for fast, zero-crossing timing.

In some cases it is beneficial to select a 50 ns RC integration time constant using the PWB jumper provided for that purpose. This reduces the high frequency noise while slowing the output rise time to 110 ns.

In addition to the two standard jumper selections incorporated into each of the Differentiation and Intergration controls, a third position is provided for both jumpers. By adding the appropriate components to each third position, it is possible for the user to select a customized set of integration and differentiation time constants.

In order to ensure that the output pulse returns to baseline as quickly as possible, the differentiation circuit includes a front-panel pole-zero trimmer. This control permits compensation for the preamplifier decay time constant.

Each section of the Model 863 have five sets of PWB jumpers to control the various functions of the unit. These jumpers are accessible by removing the left side panel of the module.

2. SPECIFICATIONS

2.1. PERFORMANCE

INPUT SIGNAL AMPLITUDE RANGE 0 to ±1.0 V ac signal; 0 to ±2 V dc offset; maximum input ±2 V signal plus offset.

OUTPUT AMPLITUDE RANGE 0 to ±5 V linear into a 50 Ω load. Output dc-coupled with dc offset <±10mV.

RISE TIME <10 ns with Integration and Differentiation time constants set to Out, or ≈2.2 τ for other Integration settings and Differentiation Out.

CROSS TALK <0.01% from any output to any input measured at maximum gain with Integration and Differentiation time constants set to Out.

NOISE For maximum gain, rms noise referred to the input <50 μV with Integration and Differentiation set to Out; measured using a Hewlett-Packard 3400A true rms meter.

INTEGRAL NONLINEARITY <±0.5% over ± 5 V into a 50 Ω load.

TEMPERATURE SENSITIVITY dc level <±10 μV/°C referred to the output. Gain sensitivity <±0.05%/°C.

OPERATING TEMPERATURE RANGE 0°C to 50°C.

2.2. CONTROLS

Each section of the Model 863 Quad Timing Filter Amplifier has separate controls for Coarse Gain, Fine Gain, P/Z, Differentiation, and Integration time constant.

COARSE GAIN PWB jumper selectable for nominally 1× or 5×. Gain is reduced by a factor of 2 when using cable clip. The model 863 is shipped with this jumper in the 5× position.

FINE GAIN Front-panel screwdriver potentiometer continuously adjustable from 2 to 50 (nominal).

P/Z Front-panel screwdriver adjustable potentiometer to adjust pole-zero cancellation for decay time constants from 25 μs to ∞.

DIFFERENTIATION Time constant PWB jumper selectable as either Out (equivalent to 0.1 ms) or 200 ns. A third position is available for custom modification. The Model 863 is shipped with this jumper in the Out position.

INTEGRATION Time constant PWB jumper selectable as either Out or 50 ns. A third position is available for custom modification. In the Out position, the 10% to 90% rise time is <10 ns. The Model 863 is shipped with this jumper in the Out position.

INVERT/NONINVERT PWB jumper selectable to Invert or Noninvert the Output signal relative to the Input signal. The Model 863 is shipped with this jumper in the Noninvert position.

2.3. INPUT

INPUT Positive or negative polarity selectable with a PWB jumper; amplitude 0 to ±1 V ac signal; 0 to ±2 V dc offset; maximum input ±2 V signal plus offset. Input impedance is 100 Ω, protected to ±6 V. Front-panel LEMO connector.

CLIP Two front-panel LEMO connectors to provide delay line clipping of the input pulse using an external 50 Ω coaxial cable. Delay line clip is two times the cable propagation delay. Gain is reduced by a factor of two when using cable clip.

2.4. OUTPUT

OUTPUT Front-panel LEMO connector furnishes the shaped and amplified signal through Z_o <1 Ω; amplitude to ±5 V, rise time and decay time controlled by the Integration and Differentiation time constant settings. Output is dc-coupled and controlled by a continuous baseline restorer.

2.5. ELECTRICAL AND MECHANICAL

POWER The Model 863 does not have an internal power supply and must obtain power from a NIM-standard power supply such as the ORTEC 4001A/4002D NIM Bin/Power Supply.

POWER REQUIREMENTS +24 V, 83 mA; -24V, 83mA; +12 V, 167 mA; −12 V, 167 mA; +6 V, 320mA; −6 V, 320 mA.

WEIGHT
Net 1.5 kg (3.3 lb).
Shipping 3.1 kg (7.0 lb).

DIMENSIONS NIM-standard single-width module 3.43 × 22.13 cm (1.35 × 8.714 in.) per DOE/ER-0457T.

3. INSTALLATION

The Model 863 contains no internal power supply and must be powered from a NIM-standard bin and power supply. The bin and power supply should be turned off when modules are inserted or removed. The power supply voltages should be checked after modules are inserted. Ensure that the Model 863 has sufficient cooling air circulating to prevent any localized heating of the circuitry. The Model 863 should not be subjected to temperatures greater than 50° C.

4. CIRCUIT DESCRIPTION

The Model 863 is composed of four separate timing filter amplifiers constructed on the same PWB. Each section is identical, and the circuit description that follows relates to any of the four sections. Component designations are the same for each channel.

Each section of the 863 consists of a hybrid differential amplifier, A1. The nominal gain of the input section is 1×. The overall amplifier polarity is selected by jumper W1 located on the PWB. See Fig 4.1 for an illustration of jumper selection settings on the PWB. To access this and other jumpers, remove the left side cover of the module. The 863 is shipped with the polarity set as noninverting.

W1 Jumper selection for invert/noninvert

W2 and W3 Jumper selection for setting differentiation (both jumpers should be set identically)

W4 Jumper selection for setting integration

W5 Jumper selection for setting coarse gain

The differentiation circuit follows the input stage and consists of a CR filter and a pole-zero cancellation network. Both jumpers W2 and W3 should be set when selecting the differentiation time constant. Three differentiation time constant positions are available: Out, 200 ns, and Optional. The 863 is shipped with the W2 and W3 jumpers in the Out position. The Optional selection requires the addition of resistor R5 and capacitor C7. The following table lists values of R5 and C7 corresponding to different differentiation time constants.

Differentiation Time Constant	R5	C7
20 ns	499k	47 pF
50 ns	215k	150 pF
100 ns	100k	270 pF
200 ns	51k	470 pF
500 ns	21k	1200 pF

The Fine Gain stage is built around hybrid amplifier A2 and is adjusted by the front-panel potentiometer, R11. The overall gain of this stage ranges nominally from 0.2× to 5×, and is inverting.

The integration circuit follows the Fine Gain stage and consists of an RC network. Jumper W4 selects the integration time constant as Out, 50 ns, or Optional. The 863 is shipped with the W4 jumper in the Out position. The Optional selection requires the addition of capacitor C12. The following table lists values of C12 corresponding to different integration time constants.

Following the integration circuit is the Coarse Gain stage built around hybrid amplifier A4. The Coarse Gain can be selected as either nominally 1× or 5×

using jumper W5, and is inverting. The 863 is shipped with W5 in the 5× position.

The output driver stage is hybrid amplifier A5. This amplifier can drive ±5 V into a 50 Ω load impedance. Overall dc-stability of the output level of the 863 is provided by a continuous baseline restorer. The operational amplifier, U1, is connected as an integrator and feeds back the dc value of the output voltage to amplifier A1. The nominal voltage gain of the output driver stage is 10× noninverting.

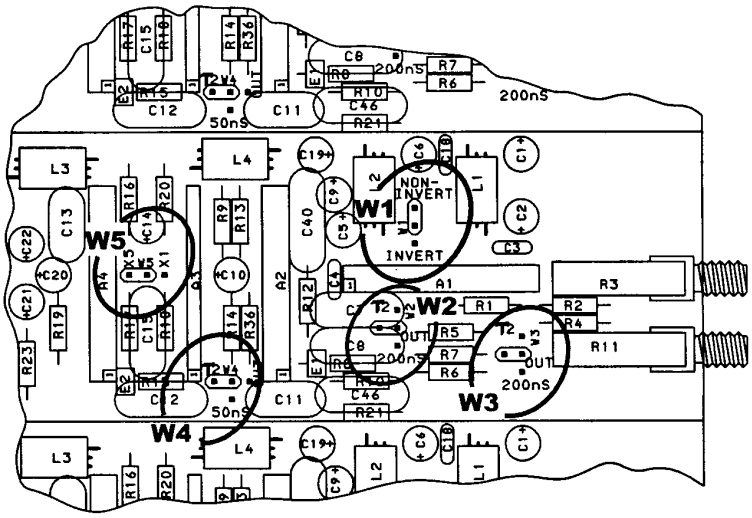

Fig. 4.1. Jumper Selection Settings.

Bin/Module Connector Pin Assignments For Standard Nuclear Instrument Modules per DOE/ER-0457T.

Pin	Function	Pin	Function
1	+3 V	23	Reserved
2	- 3 V	24	Reserved
3	Spare bus	25	Reserved
4	Reserved bus	26	Spare
5	Coaxial	27	Spare
6	Coaxial	*28	+24 V
7	Coaxial	*29	- 24 V
8	200 V dc	30	Spare bus
9	Spare	31	Spare
*10	+6 V	32	Spare
*11	- 6 V	*33	117 V ac (hot)
12	Reserved bus	*34	Power return ground
13	Spare	35	Reset (Scaler)
14	Spare	36	Gate
15	Reserved	37	Reset (Auxiliary)
*16	+12 V	38	Coaxial
*17	- 12 V	39	Coaxial
18	Spare bus	40	Coaxial
19	Reserved bus	*41	117 V ac (neutral)
20	Spare	*42	High-quality ground
21	Spare	G	Ground guide pin
22	Reserved		

Pins marked (*) are installed and wired in ORTEC's 4001A and 4001C Modular System Bins.