Model 850
Quad Single-Channel Analyzer
Operating and Service Manual

Printed in U.S.A.

ORTEC® Part No. 688830
Manual Revision D

1202

Advanced Measurement Technology, Inc.

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

WARRANTY

ORTEC* warrants that the items will be delivered free from defects in material or workmanship. ORTEC makes no other warranties, express or implied, and specifically NO WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

ORTEC's exclusive liability is limited to repairing or replacing at ORTEC's option, items found by ORTEC to be defective in workmanship or materials within one year from the date of delivery. ORTEC's liability on any claim of any kind, including negligence, loss, or damages arising out of, connected with, or from the performance or breach thereof, or from the manufacture, sale, delivery, resale, repair, or use of any item or services covered by this agreement or purchase order, shall in no case exceed the price allocable to the item or service furnished or any part thereof that gives rise to the claim. In the event ORTEC fails to manufacture or deliver items called for in this agreement or purchase order, ORTEC's exclusive liability and buyer's exclusive remedy shall be release of the buyer from the obligation to pay the purchase price. In no event shall ORTEC be liable for special or consequential damages.

Quality Control

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.

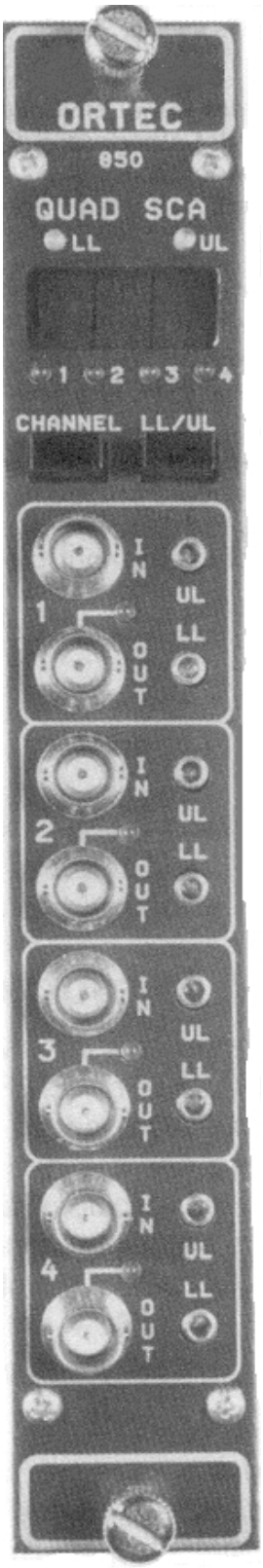
Cleaning Instructions

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
850
QUAD SCA
LL
UL
1 2 3 4
CHANNEL LL/UL
IN
OUT
UL
LL
1
2
3
4


OUTPUTS
LL — 0 — UL
LL — 1 — UL
LL — 2 — UL
LL — 3 — UL
LL EXT REF
SET
PWB
JUMPERS

ORTEC MODEL 850
QUAD SINGLE-CHANNEL ANALYZER

1. DESCRIPTION

1.1. GENERAL

The ORTEC 850 Quad Single-Channel Analyzer has the exceptionally wide dynamic range, the stability, and the high resolution necessary for use in high-resolution HPGe spectroscopy experiments. These same features provide more than adequate performance with scintillation counters and ionization chambers. Dc-coupled input, integrated circuit discriminators, and logic are employed to obtain these characteristics and to assure maximum performance at high counting rates.

The 850 accepts either positive unipolar or bipolar input pulses from linear amplifiers that have either active, RC, or delay-line shaping. The amplitude of each input pulse is examined, and appropriate NIM-standard positive logic output pulses are generated separately for SCA, LLD, and ULD responses. The instrument is designed to meet the recommended interchangeability standards of USAEC Report TID-20893 (Rev). An ORTEC 4001A/402D Bin and Power Supply provides all the necessary power (including +6 V) through the rear module power connector. All signal levels and impedances are compatible with other ORTEC modules.

1.2. MODES OF OPERATION

The 850 consists of four completely independent channels of single-channel analyzer. Each channel has a set of four printed wiring board (PWB) jumpers (accessible through the side panel) that control the operation of the unit. The function of each jumper is labeled on the side panel. Channel SCA1 jumpers are labeled W1 through W4. Jumper, W1 selects dc− or ac-coupled input. Jumper W2 selects the front-panel LL potentiometer or the voltage signal applied to the rear-panel LL Ref Ext connector as the LL discriminator reference threshold. Jumpers W3 and W4 select the mode of operation as either Integral, Normal, or Window.

The 850 has an easy-to-use, built-in digital voltmeter for setting the Lower-Level and Upper Level thresholds of each channel. A front-panel push button selects which of the four channels is being read. A second front-panel push button selects either the Lower-Level or the Upper-Level reading. Each threshold can be set over the range from 20 mV to 9.99 V. In the Window mode, the range of setting is 2 mV to 0.999 V. The digital voltmeter reading must be divided by 10 to determine the Window setting. The display flashes on overrange.

INTEGRAL MODE In the Integral mode, each channel of the 850 provides an output signal to the Out connector on the front panel if the input pulse amplitude exceeds the adjusted Lower-Level threshold. The input range is 0 to 10 V. For Integral mode operation, jumper W3 must be in the Intg/Norm position, and jumper W4 must be in the Intg position.

NORMAL MODE In the Normal mode, the 850 provides an output pulse to the Out connector on the front panel if the input pulse amplitude exceeds the Lower-Level threshold but does not exceed the Upper-Level threshold. In this mode, each threshold is adjusted independently in the range of 20 mV to 9.99 V, and the ULD level must be set higher than the LLD level to permit the SCA output to be generated. For Normal mode operation, jumper W3 must be in the Intg/Norm position, and jumper W4 must be in the Norm/Win position.

WINDOW MODE In the Window mode, the 850 provides an output pulse to the Out connector on the front panel if the input pulse amplitude exceeds the Lower-Level threshold, but by an amount that is less than the adjusted window width. The range of the LLD is 20 mV to 9.99 V, and the range of the window is adjusted from 2 mV to 0.999 V above the LLD level. This mode is especially adapted to high-resolution spectroscopy because the very narrow windows that are required for this type of operation are reproducible and easy to obtain. For Window mode operation, jumper W3 must be in the Win position, and jumper W4 must be in the Norm/Win position.

The SCA output pulses from each channel of the 850 are generated when the trailing edge of the input signal being analyzed crosses the Lower-Level threshold, provided the LLD and ULD

threshold requirements have been met. For this reason, the 850 cannot be used effectively for crossover timing applications.

1.3. LEADING EDGE TIMING

Connectors are included on the real panel for LL and UL outputs for each channel of the 850. The pulses that are furnished through these connectors are generated on the leading edge of the input signal, each one occurring when the corresponding discriminator is triggered by the input pulse amplitude. Either of these pulses can be used for timing applications or for pulse-routing into a multichannel analyzer. In any mode of operation, either the LL or the UL output can be used to monitor the number of input pulses that cross the corresponding threshold.

1.4. LOWER-LEVEL REFERENCE

Each channel of the 850 has a PWB jumper, W2, that selects either the front-panel Lower-Level control or the voltage signal applied through the rear-panel LL Ext Ref connector as the reference level for the Lower-Level discriminator. This permits flexibility in operation when an external reference source can furnish the LLD with a stepped- or sliding-threshold to automatically sweep the SCA response through a spectral range.

2. SPECIFICATIONS

2.1. PERFORMANCE

DYNAMIC RANGE 500:1.

PULSE-PAIR RESOLVING TIME 200 ns plus output pulse width.

THRESHOLD TEMPERATURE INSTABILITY ≤±0.01%/°C of full scale, 0 to 50°C using a NIM class-A power supply (referenced to -12 V).

WINDOW WIDTH INCONSISTENCY <±0.1% variation of full-scale window width over the linear 0- to 10-V input range.

DISCRIMINATOR NONLINEARITY <±0.25% of full scale (integral) for both discriminators.

2.2. CONTROLS

WINDOW OR UPPER LEVEL Front-panel screwdriver potentiometer determines the window width (0 to 1 V) in the Window mode or the Upper-Level (20 mV to 9.99 V) threshold in the Normal mode. This control is disabled in the Integral mode. The built-in voltmeter is used to read the Window- or Upper-Level setting.

LOWER LEVEL Front-panel screwdriver potentiometer (adjustable from 20 mV to 9.99 V) determines the threshold setting for the Lower-Level discriminator when the PWB LL Ref mode jumper is set on Int. When the LL Ref mode jumper is in the Ext position, the control is ineffective.

INTEGRAL/NORMAL/WINDOW Two PWB jumpers select one of the three operating modes:
Integral LL sets a single discriminator threshold (20 mV to 9.99 V) and UL is disabled.
Normal UL and LL are independently adjustable levels (20 mV to 9.99 V).
Window LL sets the baseline level (20 mV to 9.99 V) and UL sets the window width (2 mV to 9.99 V). The Digital Voltmeter reading must be divided by 10 to determine the Window setting.

LL REF MODE A PWB jumper selects either the front-panel LL potentiometer or the voltage signal applied to the rear-panel Ll Ref Ext connector as the LL discriminator reference threshold.

DIGITAL VOLTMETER
Channel Front-panel push button to select channel 1 through 4. Front-panel red LED indicates the selected channel.
LL/UL Front-panel push button selects Lower-Level or Upper-Level threshold for viewing on the Digital Voltmeter. Front-panel yellow LED indicates the selected threshold.
Inaccuracy ±1 digit.

2.3. INPUTS

SIGNAL INPUTS Front-panel BNC connector accepts positive, unipolar or bipolar signal, 0- to 10 V linear range. PWB jumper selects either dc- or ac-coupled input. For dc-coupled input, ±12 V maximum; width >100 ns; Z_{in} =1 kΩ. For ac-coupled input, ±100 V maximum; 0.2− to 10-µs width: Z_{in} = 1 kΩ.

LL REF EXT When the PWB jumper is on Ext, the rear-panel BNC connector accepts the Lower-Level biasing. (An input of -20 mV to -9.99 V on this connector corresponds to a range of 20 mV to 9.99 V for the Lower-Level discriminator setting.) Input protected to ±24 V.

2.4. OUTPUTS

SCA OUT Front-panel BNC connector provides positive NIM-standard output, nominally +5 V; 500 ns wide; $Z_o \leq 10\ \Omega$. Output occurs as the trailing edge of linear input crosses the LL threshold.

LL OUT Rear-panel BNC connector provides positive NIM-standard output, nominally +5 V; 500 ns wide; $Z_o \leq 10\ \Omega$. Output occurs as the leading edge of linear input crosses the LL threshold.

UL OUT Rear-panel BNC connector provides positive NIM-standard output, nominally +5 V: 500 ns wide; $Z_o \leq 10\ \Omega$. Output occurs as leading edge of linear input crosses the UL threshold.

2.5. RELATED EQUIPMENT

The 850 is compatible with all ORTEC amplifiers and other amplifiers having a 0- to 10-V positive, linear output range.

2.6. ELECTRICAL AND MECHANICAL

POWER REQUIRED +12 V, 145 mA: -12 V, 140 mA; +6 V, 400 mA.

WEIGHT
Net 0.91 kg (2.0 lb).
Shipping 2.27 kg (5.0 lb).

DIMENSIONS NIM-standard single-width module, 3.43 X 22.13 cm (1.35 X 8.714 in.) Per TID-20893 (Rev).

3. INSTALLATION

Since the 850 contains no internal power supply, it is used in conjunction with an ORTEC 4001A/4002D NIM Bin and Power Supply, which is intended for rack mounting. Note that the power supply must provide +6 V as well as ±12 V and ±24 V. If vacuum tube equipment or any other source of heat is operated in the same rack, there must be sufficient cooling air circulating to prevent any localized heating of the transistorized circuitry used throughout the 850. The temperature of equipment mounted in racks can easily exceed the recommended maximum unless precautions are taken; the 850 should not be subjected to temperatures in excess of 120°F (50°C).

3.1. CONNECTION TO POWER

Turn off the bin power supply when inserting or removing modules. Power supply voltages should be checked after the modules have been inserted. Use the test points on the power supply control panel of the ORTEC 4001A/402D Bin and Power Supply to monitor dc voltages.

When operating the 850 outside the 4001A/402D Bin and Power Supply, be sure that the power extension cable that is used properly accounts for the power supply grounding circuits that are provided according to the recommended AEC standards outlined in TID-20893 (Rev). Both high-quality and power-return ground connections are provided to ensure proper reference voltage feedback into the power supply, and these must be preserved in remote cable installations. Take care to avoid ground loops when the module is operated outside the bin.

3.2. CONNECTION FROM LINEAR AMPLIFIER

Each channel of the 850 has a front-panel input to be used for the analog signals that are furnished from a linear amplifier. The front-panel BNC can be set as a dc-coupled path or as an ac-coupled path using the W1 connector accessible through the side panel. The dc-coupled path is generally preferred. However, if there is an dc-baseline offset, if signal amplitudes exceed the +12 V maximum limit or the dc circuit, or if the input pulses decay slowly, ac-coupling is available by proper setting of the W1 jumper.

Either input circuit accepts positive unipolar pulses or bipolar pulses (the positive lobe will be analyzed) into an input impedance of 1 kΩ. When cables more than 1.5-meters long are used to connect the amplifier output to the 850 input, cable termination may be necessary in order to prevent reflections. In this case, the cable impedance must be matched with a terminator at the 850 input.

The input operating range is from the Lower-Level threshold, typically <20 mV minimum to 10 V. This range is compatible with the range of output pulses that are normally available from NIM-modular linear amplifiers and biased amplifiers.

3.3. OUTPUT CONNECTION

A logic output pulse is available at the front-panel BNC connector when input pulses satisfy the amplitude and logic requirements of the 850. When the 850 is set for either differential single-channel mode (normal or window), the logic output pulse indicates that the input pulse amplitude is sufficient to trigger the Lower-Level discriminator without also triggering the Upper-Level discriminator. When the 850 is set for Integral mode of operation, the logic output indicates that the input pulse amplitude is sufficient to trigger the Lower-Level discriminator.

Separate logic outputs are available through the rear panel to indicate when, on the leading edge of an input pulse, each of the two discriminators is triggered. These responses can be used to monitor the discriminator levels during adjustment, to be counted in external counters, or to provide subgroup routing in a multichannel analyzer.

Each logic output is a NIM-standard slow positive pulse that is compatible with all ORTEC counters, counting rate meters, and other instruments. The output impedance of each output is sufficiently low to drive as many as ten paralleled 1-kΩ inputs.

3.4. LOWER-LEVEL REFERENCE INPUT

Each channel of the 850 has a PWB jumper to allow selection of an external reference level for the Lower-Level discriminator. When the LL Ref jumper, W2, is set in the Ext position, the front-panel Lower-Level control is disconnected, and the reference level must be furnished through the LL Ext Ref connector on the rear panel. An input of 0 to -10 V through this connector corresponds directly to a range of 0 to +10 V for the Lower-Level discriminator threshold.

If an input is connected to the LL Ref connector, only those channels with W2 set in the Ext position will have the LL reference derived from the LL Ext Ref signal. All channels with W2 set in the Int position will have the Lower-Level reference derived from the front-panel control.

The front-panel voltmeter will read the Lower-Level value when jumper W2 is set in either the Int or the Ext position.

4. OPERATING INSTRUCTIONS

Prior to operation, each channel of the 850 should be set in the desired configuration. Four PWB jumpers are available in each channel to select Integral, Normal, or Window mode; Internal or External Lower-Level reference; and dc- or ac-coupled input. Once the 850 is properly configured, it can be connected into a system according to the installation information in Section 3.

Figure 4.1 illustrates the timing relationships that will be effective in the 850 for each of two possible input pulse conditions. One is a pulse that exceeds the Lower-Level threshold without also exceeding the Upper-Level, and the other is a pulse that exceeds both thresholds. If the 850 is configured in the Integral mode, there is an SCA output pulse for each of the input pulses generated when the trailing edge of the input pulse crosses through the LLD level. If the 850 is configured in either the Normal or Window mode and operates in a differential single-channel analyzer mode, an SCA output pulse is generated for the first pulse but not for the second. For either mode, the LL Out and UL Out signals are available when the corresponding discriminator is triggered on the leading edge of the input pulse.

The adjusted Lower-Level threshold is furnished either by the front-panel Lower-Level control or from a dc-bias level through the rear-panel LL Ref connector; the alternate selection is made with the W2 PWB jumper. In either case, the range is from 20 mV to 9.99 V, measured on the analog input pulse. The value of the Lower-Level threshold can be read using the built-in front-panel voltmeter.

The adjusted Upper-Level threshold is determined by the setting of the front-panel Upper-Level control. When the 850 is configured in the Window mode, the range of the control is from 2 mV to 0.999 V. The front-panel voltmeter reading must be divided by 10 to obtain the proper value of the Window setting. When the 850 is configured in the Normal mode, the range of the control is from 20 mV to 9.99 V. The value of the Upper-Level threshold can be read directly by using the built-in front-panel voltmeter.

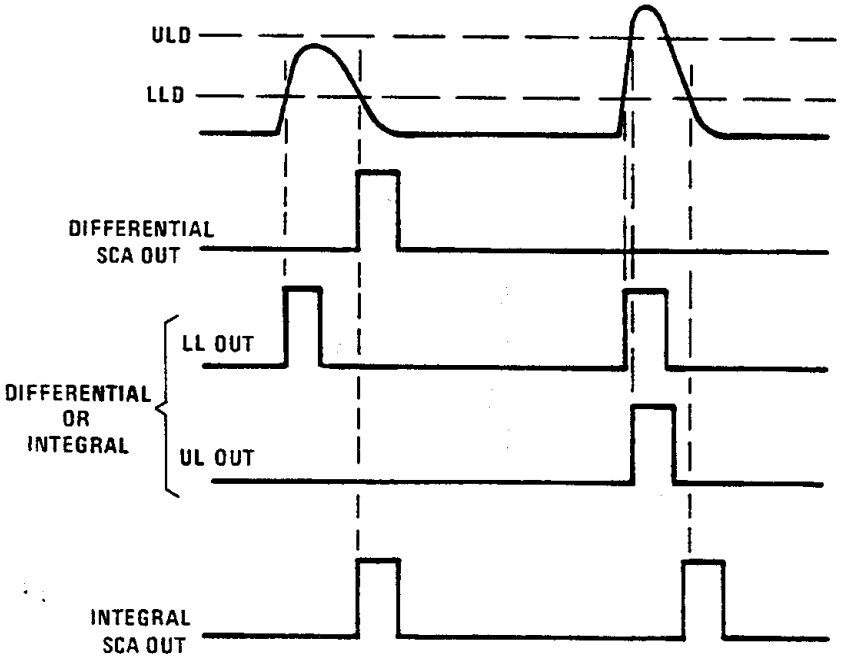


Fig. 4.1. Timing Relationships for Input and Output Pulses.

5. MAINTENANCE AND CALIBRATION

5.1. GENERAL

The basic performance of the 850 Quad Single-Channel Analyzer can be inferred from its operating responses.

5.2. FACTORY REPAIR

This instrument can be returned to ORTEC for service and repair at a nominal cost. Our standard procedure for repair ensures the same quality control and checkout that are used for a new instrument. Always contact the Customer Service Department at ORTEC, (865) 482-4411, before sending in an instrument for repair to obtain shipping instructions and so that the required Return Authorization Number can be assigned to the unit. Write this number on the address label and on the package to ensure prompt attention when it reaches the ORTEC factory.

5.3. TABULATED TEST POINT VOLTAGES

The voltages given in Table 5.1 are intended to indicate typical dc-levels that can be measured on the PWB. In some cases the circuit will perform satisfactorily even though, due to component tolerances, there may be some voltages that differ slightly from the listed values. Therefore, the tabulations should not be interpreted as absolute values but are intended to serve as an aid in troubleshooting. All voltages in Table 5.1 were measured with no input signal and with the mode jumpers set for Integral mode.

Table 5.1 Typical dc Voltages

Location	Voltage
1R1-1R5 junction	-5
1R2-1R7 junction	-5
1U2(3)	0
1U2(11)	TTL-Low
1U2(13)	TTL-High
1U3(3)	0
1U3(9)	TTL-High
1U3(11)	TTL-Low
1U3(13)	TTL-High
1U4(10)	5
1U4(13)	TTL-Low
1U5(4)	TTL-High
1U5(6)	TTL-High
1U5(8)	TTL High
Q2E	5
TP1-TP2	4.5
TP3-TP2	0.9

.

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.