Pulse Analyser Facilities

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A summary of the facilities available on the six presently available Multichannel Pulse Analysers.
Pulse Analyser Facilities in CERN N.P. Division

This report summarizes the facilities available on the six multichannel Pulse Analysers available at present in N.P. Division. These facilities may be original to the analyser, by modification, or by additional units which we have constructed for the purpose.

We have at present in the N.P. Division the following analysers:

3 100 channel C.D.C. (Computing Devices Of Canada) partially transistorised
2 256 channel T.M.C. (Technical Measurement Corp) fully transistorised
1 200 channel 'Laben' (Laboratori Elettronici e Nucleari) partially transistorised

C.D.C. Analysers

These Analysers are mounted in standard racks. The additional space we have utilised to house the Print Out system, comprising a transistorised decimal scaler and a Hewlett Packard Printer. In addition we have mounted a power supply for N.P. Plug-In Units.

Input Requirements

- Bi-polar or Negative Uni-polar.
- Duration 3 - 10 μsec.
- Rise Time 0.3 μsec approx.
- Four amplitude ranges will give 100 channels deflection
  0 - 3 Volt  0 - 6 Volt  0 - 15 Volt  or  0 - 30 Volt.
  Two transistorised Plug-In Amplifier Units exist to increase the flexibility.

Unit 3-2207. Gives switched again of 1 - 10.
- Accepts either polarity or bi-polar pulses.
- Output polarity same as input.
- Max. Output Volts 12 Volts.
Unit 3-2206. This is uni to bi-polar convertor with a gain of unity. Accepts Input Signals of either polarity. Two outputs are available both bi-polar. The first gives to the leading half of the signal the same polarity as the input. The other gives inversion. Pulses into this amplifier should not be longer than 4 μsec. Max. output 7 Volts.

Back Bias

The original C.D.C. step-switch circuit has been removed and a continuously variable circuit substituted. 0 - 30 Volts.

Conversion Time

35 + N μsec, where N equals channel no.

Display

Display is linear analogue on a C.R.T.

In P.S. Display mode and Count mode may be automatically switched. This facility is provided by the transistorised Plug-In Unit No. 3-2206 normally located in the Plug-In Power Unit which is mounted in the lower portion of the rack.

Read Out

Manually by push button, each channel being displayed in binary form on indicator lamps.

Automatically by Hewlett Packard Printer to give normal channel by channel count or to total the contents of the channels. The logic of the binary-to-decimal conversion was designed and made in CERN including the decimal scaler.

Pen Recorder

A low level analogue signal is available on a front panel plug for connection to a pen recorder. Channel advance must be made by the pen recorder. Two pen recorders have been modified to supply this need.
Punch Tape Output

A Punch Tape Driver box has been made by M. Iselin and suitable signals exist on the analyser to drive this box in parallel with the Hewlett Packard Printer.

Gating

The analyser has two Gate Inputs.

The first gating input can be either an anti-coincidence or coincidence signal, i.e. inhibits all main input pulses that are in coincidence or passes only those that are in coincidence.

The Plug-In Unit 'Gate Pulse Generator' No. 2207A has been designed to furnish suitable pulses for this input. Width is continuously variable from 1 - 11 μsec.

The second gate input (the former 'BLANK' input and now labelled Ext. Gate) has been modified to allow the analyser to count when driven from the 6 volt output of the CERN Stop Start. A switch allows the Gate to be permanently opened if so desired.

Fast Linear Gate - Plug-In Unit No. 2209A

The C.D.C. analyser, like most P.H.A. requires input pulses of a few μsec duration. Since the pulses available are often of only a few nsec duration some form of adaptor was necessary. This we have made in the form of a fast linear gate. The unit is made as a Plug-In Unit. After accepting a fast event the unit re-shapes the pulse to a form suitable for direct application to the Pulse Height Analyser, while preserving the linearity. The unit is self paralysing to avoid pile up of events.

The Analyser Main Gate

The Main Gate signal is brought out to a front panel connector. It may be used to paralyse further the above mentioned Fast Gate or other apparatus. 15 Volt neg Output.

NOTE Gating Signals into the Analyser should precede the Linear Signal by at least 2 μsec.
Logic Facilities

Overflow

Input pulses which are too large to be recorded within the 100 channels will produce a pulse at the 'Overflow' plug 3 Volts 1 μsec. positive.

Add '1'

Each time an impulse is added into the memory a pulse for scaling purposes appears at the 'Add 1' plug. 3 Volts 2 μsec positive.

Stop Count

Analyzer counting may be stopped after a preset maximum number of counts has been registered in any one channel. Set by a 6 position front panel switch.

Background Subtraction

Subtraction of a Background spectrum may be made.

Code Out and Stop Code

The 1 Mc/s code to the temporary scaler of the analyser is brought out to a plug. When used with a suitable stop pulse the analyzer may be used with a 'Digitron' for time of flight measurement.

Memory Split (Available on No. 1 Analyser only)

The Memory may be broken into groups of channels as follows: 1 x 100 ch. 2 x 50 ch. 5 x 20 ch. 10 x 10 ch.

Routing pulses must be provided. 4 - 6 Volt positive 1 μsec.

10 x 10 Coincidence (Available on No. 1 Analyser only)

Pulses required
'X' address
'Y' address
Coincident with or followed by an 'Action Pulse'.
The possibility to erase Addresses exists.
Storage time per event = 35 μsec after the 'Action Pulse'.
All pulses 4 - 6 Volts 1 μsec.

'EIXIE' Channel Number Read Out (Available on No. 3 Analyser only)

This is provided so that the channel number of a single event may be photographed along with other information.

T.M.C. Analysers

These Analysers are rack mounted for ease of transportation. An N.P. Plug-In Unit power supply is also mounted in the same rack.

Each analyser consists of four units. A C.N. 110 computer unit, a 220 Data output unit, a Hewlett-Packard Printer, and a Plug-In Driver Unit to the computer.

A number of different Plug-In units are available thereby allowing the analyser to be used in a variety of ways.

Computer Unit

Memory capacity $2^{16}$ Counts/channel.
Memory may be divided into groups of channels as follows:

One group 256 channels
Two groups 128 channels
Four groups 64 channels

Selection of a group of channels may be made by:

1) Front panel switch
2) External contact
3) Electronically by the use of a suitable plug-in unit.

Data may be retained in any group and it may be transferred to any other group. PROVIDED THIS LATER GROUP IS EMPTY.

Counts may be added or subtracted.

Display

Linear analogue on a C.R.T.
Full scale vertical deflection may be varied from 2^6 to 2^8 counts/channel. Intensity modulation is provided on alternate groups of 16 channels. The second group of 128 channels may be overlapped on the first group of 128 channels for comparison purposes.

Gating

A plug has been mounted on a small front panel which spaces the main units of the analyser so that the analyser may be gated from the 6 volt output of the CENM Stop Start Unit. A switch allows the gate to be permanently opened if desired. This gate operates on the Computer Unit so that it will function irrespective of Plug-In Used.

Data Output Unit

Read out may be obtained

1) **Manually** by push button the channel content being displayed in decimal form.

2) **Semi-automatically.** On switching off the count mode the channel contents are printed out by a Hewlett-Packard Printer.

3) **Automatically.** As for Semi-automatic except that after printing the analyser returns to the count mode.

During print-out the contents of each channel may be returned to the memory or may be erased as desired.

On count mode this unit may be used as a timer. Timing may be preset from 0.1 min to 999.9 min in 0.1 min steps.

Pen Recorder Output

Spectra may be applied to a strip chart recorder or an 'X' 'Y' recorder. The 'X' output gives a max. deflection of 100 mv. The 'Y' output gives a max. deflection of 75 mv.
T.M.C. Plug-In Units

No. 210 Pulse Height Logic Unit

Low Level Input          Polarity Negative

An Input Amplifier allows input voltage levels which will give 256 channels deflection to be varied from 50 mv to 11.5 volts.

High Level Input          Polarity Positive

Min signal for 256 channels deflection 16 Volts.
Max signal for 256 channels deflection 80 Volts.
These are chosen by a two position switch.
Input Pulse shape 0.5 μsec Rise, 3.0 μsec Fall, for both Inputs.

Gating

Coincidence +10 Volts.
Anti Coincidence -10 Volts.

These gate signals should arrive some few tenths of a μsec before the Linear Input signal.

N.P. Plug-In Unit 'Gate Pulse Generator' No. 2207A will supply suitable input signals for this gate input.

N.P. Plug-In Unit 'Fast Linear Gate' No. 2209A may be used to gate the signal Input, when shaping of the input pulse is required from a Fast signal.

Back Bias, continuously variable by helipot.

Upper Level,    "    "    "    "

Dead Time, 10 + 0.25N μsec where N = channel into which the count falls.

No. 213 Pulse Height Logic Unit 6

This unit has four Signal Input Plugs, each addressing 64 channels of the analyser.

Inputs 2, 3 and 4 can be operated in coincidence with input No. 1 to route pulses entering No. 1 into one of four 64 channel sub-groups. Polarity of input signal POSITIVE 16 or 60 Volts for F.S.D.
No. 214 Multi Scaler Unit

This unit allows the computer unit to count in one channel at a time for a preset time. Set by an internal clock or by external timing pulses.

No. 216 Coincidence Pair Spectrometer

This unit has two separate height-to-time converters so that the analyser may be used as a 16 x 16 Three-dimensional analyser.

6 Units at present on order.

Digitron Unit

A Plug-In has been specially made for use with the G-2 Digitron.

Remarks

We see no reason why Plug-In Units cannot be made to meet other requirements. We will welcome suggestions for such units.

The print out of this analyser will be adapted to the Iselin Teletype Puncher box whenever this box becomes available.

'LABEN' Analyser

This analyser may be used in any one of the following ways:

1) A single analyser of 200 channels
2) A single analyser of 100 channels
3) An analyser of 100 channels with automatic transfer to the second group of 100 channels when the input pulse is coincident with an external routing pulse
4) By using the two pulse height to time converters and a trigger signal 3 dimensional analysis may be performed. 20 x 10 channels
5) May be used as 100 scalers addressed sequentially. This allows the measurement of fast decay times. A suitable clock pulse must be supplied to advance the channels. This same system may be used in conjunction with an additional unit to automatically plot magnet curves on SC machine.

6) May be used as 10 analysers of 20 channels. A routing pulse must be supplied to address the appropriate group of channels. N.P. Plug-In Unit No. 3-2005 was designed specially for this purpose.

Dead Time

When used as a Pulse Height Analyser

\[
\text{Dead time} = 20 + 0.5N \times \text{Rtp}, \mu\text{sec.}
\]

Where \( N \) = channel number into which count falls

\( \text{Rtp} = \text{Rise Time Protection. Variable by front panel control to 1, 2, 4, 7, 10, \mu\text{sec.}} \)

or fixed at 120 + Rtp \( \mu\text{sec.} \)

Counts/Channel

\[2^{16} - 1.\]

Display

Linear analogue by C.R.T.

The two groups of 100 channels may be overlapped for comparison.

Display may be viewed during counting if desired.

Background Subtraction

Background subtraction may be made. Results may be stored in one half of the memory and transferred to the other half as required.
Print Out
By electric typewriter. Channel by channel content or total count.

Pen Recorder Output
A 10 mv signal exists for driving a strip chart recorder. External pulses must be supplied for driving the channel advance of the analyser.

Input Pulse Requirements
Positive or Bipolar 1 - 60 Volts.
Rise Time 0.2 μsec - 10 μsec.

Other Analysers in CERN
For completeness we mention that both S.C. Machine Division and the Health Physics Group possess T.M.C. Analysers.

Reservations
If you wish an Analyser you are advised to make advanced reservation in the Reservations Book which is located in the Electronics Lab. (1-322) or by telephoning Ext. 700.