Analog Circuitry

The Analyzer card has three main Analog circuits, the WBC, RBC, and Plt Processors. The WBC and RBC Processor circuits accept a PULSE TRAIN signal from the aperture sensors, then amplify and count the pulses that fall within specific size ranges. The RBC Processor circuit also produces information about the average pulse size. The Plt Processor circuit channelizes the pulses according to size. Additional functions include monitoring the voltage across the aperture, providing a high-burn voltage for cleaning the aperture, and producing pulse-width information to be used for clog detection.

WBC Processor Circuitry

The primary input to the WBC processor circuitry is the APERTURE signal from the WBC bath assembly. This signal, received at J8 on the Analyzer card (Figure A.2-1), is sent to the Aperture Voltage Sensor circuit and the Preamplifier circuit. The Aperture Voltage Sensor circuit produces the white aperture voltage (WAV), which is the voltage measured across the aperture. This voltage is used for clog detection and is provided on the Voltages/Sensors screen to monitor aperture integrity. The chief component of this circuit is U65, an operational amplifier. Output from this circuit can be measured at TP29 (Figure A.2-1). The Preamplifier circuit amplifies the pulses the Threshold and Count circuit uses. The main amplifier is an HA-5137 on U76. Output of the Preamplifier circuit, which can be monitored at TP35 (Figure A.2-1), is fed into the Dc Restorer circuit. Output from the Preamplifier circuit is in the form of a negative-going pulse offset from zero. The Dc Restorer circuit inverts the pulse and sets it to a baseline of 0.0 V. The Dc Restorer circuit uses several operational amplifiers found on chips U49 and U66. The Count Comparator circuit and the Width Integrator circuit use the output from the Dc Restorer circuit. The Count Comparator circuit ensures that only pulses representing a cell >36 fL are used for analysis. The comparator used is an LM311 found on chip U43. Output of the comparator is sent to U73, an EPLD that shapes the pulse before being sent to the 80C188 microprocessor for counting.

Output from the comparator is also input to the Width Integrator circuit with the INITIAL PULSE signal. This ensures that only pulses used for the WBC count are used for establishing the WBC pulse width, WPWV (white pulse-width voltage). The integration process is controlled using a 1.6-µs PULSE signal and the original PULSE TRAIN signal from the Dc Restorer circuit. They control one input of an operational amplifier U65. Output charges C182, making available a voltage representing the average pulse width. Resistor R249 establishes the pulse height at which the width is measured, which should be just above the noise threshold. Output can be monitored at TP34 (Figure A.2-1).

Additional circuitry is added to the input of the WBC processor. The 200-V supply is used to burn protein from the aperture. This voltage is applied directly to the aperture electrode cable from which the APERTURE signal is received. Control is established using a microprocessor signal (ZAPON) applied to the base of Q13. Q13 supplies the burn voltage to both apertures at the same time. Electronic test pulses are also applied to the incoming electrode cable. These pulses are used to test the integrity of the WBC analyzer. They do not have the complexity of the aperture pulse train in terms of timing or shape, therefore they can only impart information on whether the circuit is working, not how well it is working.

RBC Processor Circuitry

The RBC processor circuitry is almost identical to the WBC processor circuitry, with the addition of the MCV circuit. The APERTURE signal is connected to J7 (Figure A.2-1) and input to the Preamplifier and Aperture Voltage Sensor circuits. The amplifier used is on chip U75. TP33 (Figure A.2-1) can be used to monitor preamplifier output. The Aperture Voltage Sensor circuit and its output, red aperture voltage (RAV), measured at TP28 (Figure A.2-1), use the U63 operational amplifier. The Dc Restorer circuit is comprised of amplifiers found on chips U48 and U64. Output from the Dc Restorer circuit is fed to the Count Comparator, Width Integrator, MCV and Plt Processor circuits. The Count Comparator circuit's primary component is an LM311 comparator labelled U42. The Width Integrator circuit primarily uses a pair of analog switches on U54 and an amplifier on U63. Burn voltage and test pulses are added to the beginning of the circuit where the ELECTRODE signal enters.

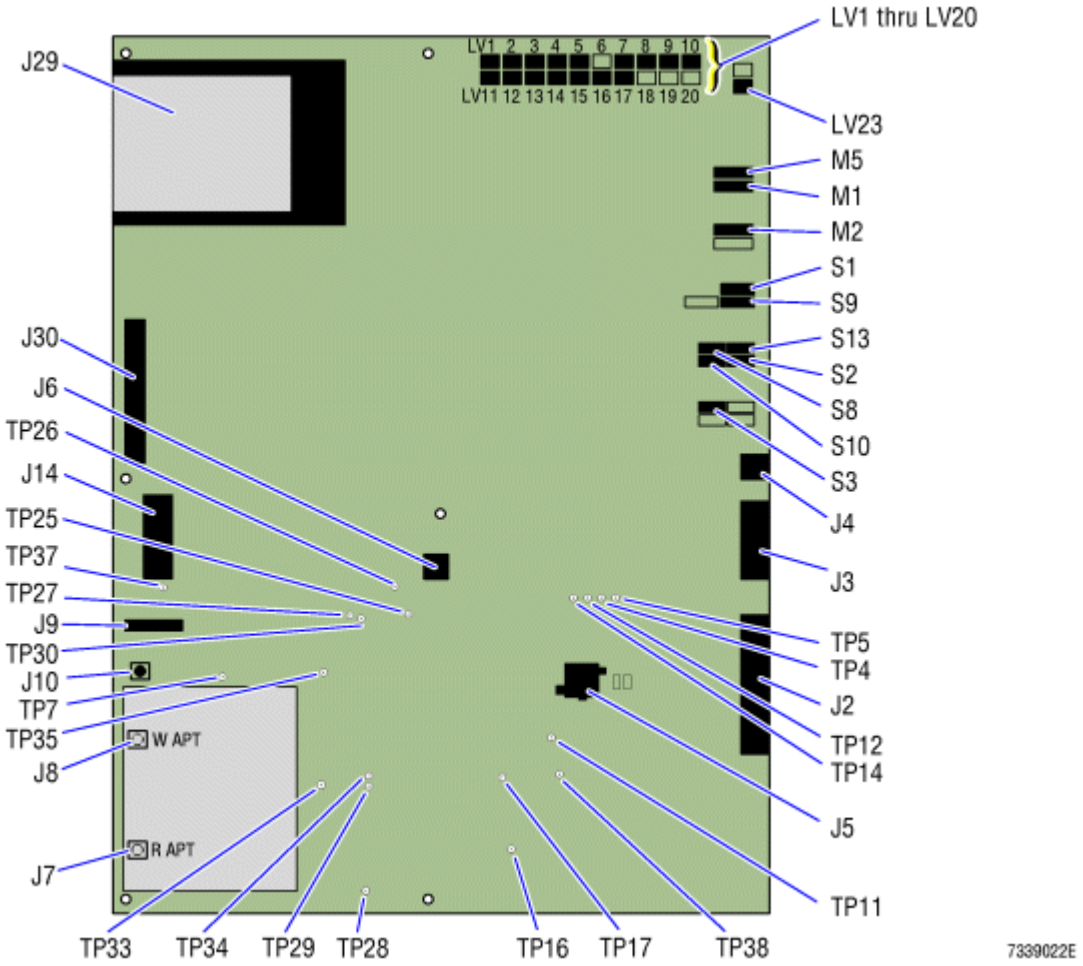
In addition to the RBC parameter, the RBC Processor circuitry must produce an MCV parameter. Peak Detector, Inverter and MCV Integrator circuits make up the MCV circuitry. The Peak Detector circuit uses the Dc Restorer circuit's output. This circuit establishes and holds the peak voltage of input pulses. Two amplifiers on U28 are used to sample, then hold, this peak voltage. Output of the Peak Detector circuit can be monitored at TP16 (Figure A.2-1). The Inverter circuit uses an operational amplifier on U39 to invert the peak waveform. This inverted signal is then input to the integrator, which uses the other amplifier on U39. Two signals using two analog switches on U29 control the integrator. One signal tells the circuit when to be active, the other controls when the integrator is reset. Output from the integrator can be monitored at TP17 (Figure A.2-1).

Plt Processor Circuitry

The Plt processor circuitry uses the output from the Dc Restorer circuit of the RBC processor circuitry as a signal source. Since Plt pulses are much smaller than RBC pulses, the first action of the Plt processor circuitry is to amplify the signal. An operational amplifier on U24 achieves additional signal gain of 8.09. This larger signal can be monitored at TP38 (Figure A.2-1). It is fed into a Peak Detector circuit and the Plt

Window Comparator circuit. The Peak Detector circuit is comprised of two amplifiers on U32, one used to sample the input pulse, the second used to hold the pulse at its peak. Capacitor C65 is used to stretch the pulse at its peak voltage. This stretched signal is fed through a scaling amplifier for input to an A/D converter. This signal (A/D BOUND) can be monitored at TP11 (Figure A.2-1).
The Plt Window Comparator circuit uses two LM311 comparators to set the lower and upper Plt thresholds of 2 fL and 20 fL. U44 sets the lower threshold and can be monitored at TP25 (Figure A.2-1) while U56 sets the upper threshold and can be monitored at TP30 (Figure A.2-1). These signals, along with the 1.25-MHz CLOCK signal, are sent to EPLD U22. This EPLD controls the Plt Processor circuit's actions. One output, SQLCH, inhibits input of additional pulses to the Peak Detector circuit while it is already processing a pulse. Another control signal, DSCHRG, resets the Peak Detector circuit once a pulse has been channelized with the A/D converter. The PCONVERT signal tells the A/D converter to convert the current output of the scaling amplifier.

Figure A.2-1 Analyzer Card Component Locations - A^{C}·T 8/10 Analyzers



Connectors

Table A.2-1 Analyzer Card Connectors - A^{C}·T 8/10 Analyzers (Figure A.2-1)

Reference Designator DCN 6322891	Card Label	Plug	Location	Description
J2	J2	P2	Lower rear	Parallel Printer, rear panel interface, 25 conductor
J3	J3	P3	Center rear	Serial out, rear panel interface, 9 conductor
J4	J4	P4	Center rear	Waste sensor, rear panel interface, BNC connector

Reference Designator DCN 6322891	Card Label	Plug	Location	Description
J5	J5	P5	Lower rear	Power in, from Power Supply module, 9 conductor
J6	J6	P6	Top center	Cover interlock, currently just jumpered, 2 conductor
J7	J7	P7-R	Lower front	Red aperture cable, coaxial
J8	J8	P8-W	Lower front	White aperture cable, coaxial
J9	J9	P9	Lower front	Hgb lamp, 4 conductor
J10	J10	P10	Lower front	Hgb sensor (preamp), coaxial
J11	LV22	Unused	Top rear	Spare, solenoid 22, dc motor, 2 conductor
J12	LV23	WM23	Top rear	Solenoid 23, vacuum pump, 2 conductor
J13	S13	WM13	Center rear	Sensor 13, diluent reservoir thermistor sensor, 3 conductor
J14	J14	P14	Center front	Traverse module, flex-connect cable, 20 conductor
J15	S1	WM1	Top rear	Diluent reservoir sensor, 4 conductor
J16	S12	Unused	Top rear	Spare sensor for M6, 4 conductor
J17	S9	WM9	Top rear	Syringe motor sensor, 4 conductor
J18	S10	WM10	Center rear	Sensor 10, vacuum transducer, 3 conductor
J19	S2	WM2	Center rear	Sensor 2, lytic reagent optical-fluid sensor, 3 conductor
J20	S3	WM3	Center rear	Sensor 3, A^{C}·T Rinse, optical-fluid sensor, 3 conductor
J21	S14	Unused	Center rear	Spare, sensor 14, 3 conductor
J22	S15	Unused	Center rear	Spare, sensor 15, 3 conductor
J23	S16	Unused	Center rear	Spare, sensor 16, 3 conductor
J24	M5	WM5	Top rear	Motor 5, syringe-assembly motor, 5 conductor
J25	M6	Unused	Top rear	Spare, motor 6, spare sensor motor, 5 conductor
J26	M1	WM1	Top rear	Motor 1, waste peristaltic pump motor, 5 conductor
J27	M2	WM2	Top rear	Motor 2, diluent peristaltic pump motor, 5 conductor
J28	S8	WM8	Center rear	Sensor 8, aspirate switch, 3 conductor

Reference Designator DCN 6322891	Card Label	Plug	Location	Description
J29	J29	P29	Top front	Flash Memory card, 68 conductor
J30	J30	P30	Center front	Display assembly ribbon cable, 26 conductor
J31	LV1	WM1	Top rear, upper row	Solenoid 1, 2 conductor
J32	LV2	WM2	Top rear, upper row	Solenoid 2, 2 conductor
J33	LV3	WM3	Top rear, upper row	Solenoid 3, 2 conductor
J34	LV4	WM4	Top rear, upper row	Solenoid 4, 2 conductor
J35	LV5	WM5	Top rear, upper row	Solenoid 5, 2 conductor
J36	LV6	WM6	Top rear, upper row	Spare, solenoid 6, 2 conductor
J37	LV7	WM7	Top rear, upper row	Solenoid 7, 2 conductor
J38	LV8	WM8	Top rear, upper row	Solenoid 8, 2 conductor
J39	LV9	WM9	Top rear, upper row	Solenoid 9, 2 conductor
J40	LV10	WM10	Top rear, upper row	Solenoid 10, 2 conductor
J41	LV11	WM11	Top rear, lower row	Solenoid 11, 2 conductor
J42	LV12	WM12	Top rear, lower row	Solenoid 12, 2 conductor
J43	LV13	WM13	Top rear, lower row	Solenoid 13, 2 conductor
J44	LV14	WM14	Top rear, lower row	Solenoid 14, 2 conductor
J45	LV15	WM15	Top rear, lower row	Solenoid 15, 2 conductor
J46	LV16	WM16	Top rear, lower row	Solenoid 16, 2 conductor
J47	LV17	WM17	Top rear, lower row	Solenoid 17, 2 conductor
J48	LV18	Unused	Top rear, lower row	Spare, solenoid 18, 2 conductor
J49	LV19	Unused	Top rear, lower row	Spare, solenoid 19, 2 conductor

Reference Designator DCN 6322891	Card Label	Plug	Location	Description
J50	LV20	Unused	Top rear, lower row	Spare, solenoid 20, 2 conductor
J51	J51	Unused	Lower front	Spare, Hgb lamp, 3 conductor

Test Points

Table A.2-2 Analyzer Card Test Points - A^{C}·T 8/10 Analyzers (Figure A.2-1)

Test Point	Description	Circuit
TP4	-15 Vdc	From the Power Supply
TP5	+24 Vdc	From the Power Supply
TP7	Hgb preamp output	Hgb Support
TP11	A/D BOUND signal	Plt Processor
TP12	+5 Vdc	From the Power Supply
TP14	+15 Vdc	From the Power Supply
TP16	Output	Peak Detector
TP17	Integrator output	Inverter
TP25	Lower Plt threshold	Plt Window Comparator
TP26	-10 Vdc	Supply generated on card
TP27	+10 Vdc	Supply generated on card
TP28	Operation amplifier output	RBC Processor
TP29	Operation amplifier output	WBC Processor
TP30	Upper Plt threshold	Plt Window Comparator
TP33	Preamplifier output	RBC Processor
TP34	Comparator output	WBC Processor
TP35	Preamplifier output	WBC Processor
TP37	Hgb lamp voltage	Hgb Support
TP38	Plt amplifier output	Plt Processor