



HIGH ENERGY PHYSICS

Operating and Service Manual

Model C315/NL Regenerative Majority Coincidence

This manual applies to instruments
"Rev 02" (on rear panel)

EG&G/ORTEC C315/NL MAJORITY COINCIDENCE

Manual Change Sheet

September 24, 1975
ECN C315/NL-05

On schematic C315/NL-0101-S1 and in the List of Replaceable Parts, change resistors R183 and R283 from 10 Ω (P/N 40202) to 27 Ω CC 5% 1/4W (P/N 40217).

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STANDARD WARRANTY FOR EG&G/ORTEC INSTRUMENTS

EG&G/ORTEC instruments are warranted to be free from defects in material and workmanship for **one year** from date of shipment or for the specified period for certain components listed in the operating manual. EG&G/ORTEC will repair or replace, at its option, any product that proves to be defective during the warranty period, provided it has been used in a proper manner. No other warranty is expressed or implied.

EG&G/ORTEC must be informed in writing of the nature of the fault of the instrument being returned and of the model and serial numbers. Failure to do so may cause unnecessary delays in getting the unit repaired. Instruments that are returned should be packed so that they will withstand normal handling and must be shipped **PREPAID** via Air Parcel Post or United Parcel Service to the Customer Service Department, 100 Midland Road, Oak Ridge, Tennessee.

QUALITY CONTROL

Before being approved for shipment, each EG&G/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.

Our standard procedure requires that instruments returned for repair pass the same quality control tests that are used for new-production instruments.

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 EG&G/ORTEC of the circumstances so that we may assist in damage claims and in providing replacement equipment if necessary.

C315/NL REGENERATIVE MAJORITY COINCIDENCE

1. CHARACTERISTICS

Each of the two sections of the EG&G/ORTEC C315/NL Regenerative Majority Coincidence generates a set of logic outputs when input signals overlap in time. The two sections operate independently and the functions are completely duplicated. The instrument is packaged in a single-width NIM-standard module (per TID-20893) for installation in a NIM-standard bin and power supply containing ± 6 -V power distribution.

There are four input circuits in each section that can accept NIM-standard fast negative logic pulses into an impedance of 50Ω . A toggle switch adjacent to each input connector selects In or Out to control whether or not its circuit is effective. A majority (Maj) switch selects how many input signals must be in coincidence for an output to be generated. The generation of an output can be inhibited by a NIM-standard fast negative logic signal through the front panel Veto connector and/or by a signal from the common bin gate line if a rear panel switch selects gated operation.

When there is an overlap in time of enough input signals to satisfy the requirements of the Maj switch, an output is generated unless the input discriminator has not been reset after having been triggered previously. The output pulse width is determined by the setting of the front panel W control, a screwdriver 10-turn potentiometer, and is within the range of 3 to 150 ns. The output is furnished through five front panel connectors. NIM-standard fast negative logic pulses are furnished through two pairs of dual Yes connectors, and the complement is furnished through the back-terminated $\overline{\text{Yes}}$ connector. Each Yes connector will normally be terminated in 50Ω and the dual pairs can be fanned out for multiple control. The rise and fall times of the output pulses are <1.5 ns.

The C315/NL input circuit is dc-coupled and will function properly with input rates of up to 200 MHz without significant loss of pulse timing. The minimum input overlap time to regenerate an output pulse is 1 ns.

2. SPECIFICATIONS

2.1. INPUTS

A-D Four coincidence inputs per section, selectable by front panel switch.

Impedance 50Ω , dc-coupled.

Polarity Accepts NIM fast logic signals.

Reflections $<10\%$ for 1-ns rise-time input.

Protection ± 5 V dc; 50 V transient.

Veto Single anticoincidence input per section; a normal fast logic signal will inhibit operation.

Impedance 50Ω , dc-coupled.

Polarity Accepts NIM fast logic signals.

Protection ± 5 V dc; 50 V transient.

2.2. OUTPUTS

Yes Two dual NIM fast logic outputs per section from internal updating discriminator.

Width 3 ns to 150 ns, determined by discriminator width control.

$T_{01}, T_{10}^* < 1.5$ ns.

* T_{01} denotes transition time from zero to one. T_{10} denotes transition time from one to zero.

$\overline{\text{Yes}}$ Single back-terminated complementary NIM fast logic output per section from internal updating discriminator.

Width 3 ns to 150 ns, determined by discriminator width control.

$T_{01}, T_{10}^* < 1.5$ ns.

2.3. CONTROLS

In/Out Front panel toggle switches enable corresponding inputs; with switch in Out position, that input is inactive.

Maj Four-position front panel rotary switch selects coincidence majority level.

W 10-turn front panel recessed potentiometer controls width of output pulse from 3 ns to 150 ns.

Gated/Ungated Rear panel toggle switch selects bin gate line.

2.4. PERFORMANCE

Minimum Overlap Time <1.5 ns for 50% triggering.

Speed

CW Rate >200 MHz.

Pulse Pair Response <5 ns for two discrete pulses.

Timing <±0.5 ns for 5-ns input pulse separation.

Width Stability

Thermal <0.5%/°C typical.

Second Pulse Within 10% of setting.

Module Delay Typically 14 ns.

Operating Range 0 to 50°C.

2.5. ELECTRICAL AND MECHANICAL

Dimensions Single-width NIM-standard module (1.35 X 8.714 in.).

Connector LEMO 00C50.

Color Green.

Power Required

+6 V, 146 mA; +12 V, 126 mA; +24 V, 0 mA;
-6 V, 655 mA; -12 V, 154 mA; -24 V, 81 mA.

3. APPLICATIONS**3.1. GENERAL**

The C315/NL Regenerative Majority Coincidence is a high-performance general-purpose logic module. All four inputs to each section are switch-selectable so that the unit can be used as a 2-, 3-, or 4-fold coincidence recognition circuit. It is dc-coupled through its input and discrimination circuits and generates an output pulse according to a selectable input pulse coincidence condition. A majority selector switch (Maj) on the front panel determines how many inputs must overlap for an output to be generated. The output pulse width is determined by the adjustment of the W control on the front panel within the range of 3 through 150 ns. If the Maj switch is set at 1, an output is generated when there is an input through any active input circuit.

A front panel Veto connector accepts an input logic pulse to inhibit the generation of an output by anticoincidence control. The pulse through the Veto connector must arrive no later than 1 ns after the overlap coincidence conditions are met and must remain for at least 2 ns after the overlap in order to cancel the output.

If the bin in which the C315/NL is installed for operation includes a common bin gate line, the bin gate signals can be used to control acceptance of input signals. A rear panel switch selects either On or Off for the bin gate signals if they are available.

Each of the two sections of the C315/NL can be used independently. The sections are identical in operation and are completely isolated.

Figure 3.1 is a simplified block diagram of a section in the C315/NL. The input circuits are furnished into a majority coincidence head, where conditions are selected and imposed and where it is decided whether an output should be generated. The bin gate circuit furnishes a part of the

conditions. Each decision is subject to cancellation by a veto input, but otherwise an output is generated through the output driver stage and the output circuit. An output is furnished simultaneously as a NIM-standard fast negative pulse through two dual Yes outputs and as the complement of the NIM-standard pulse through a back-terminated connector marked $\overline{\text{Yes}}$.

3.2. MULTIPLE COINCIDENCE

Connect a negative signal source to each input circuit that is to be used. Set the adjacent toggle switches at In for the active circuits and at Out for any that will not be used. Two, three, or four inputs can be accommodated, and the active status of each can be selected by its toggle switch without the input cable having to be disconnected.

The relative times at which pulses arrive at the C315/NL inputs are affected by cable lengths. Propagation through the 50Ω cable will delay each pulse by about 5 ns/meter of cable length; so the cable lengths are important when fast signals are involved.

Set the Maj switch at 2 to obtain an output when any two or more active input signals overlap in time. Use the switch at 3 or 4 to provide an output for a 3-fold or 4-fold coincidence.

Figure 3.2 is a timing diagram of the output pulses that would be generated for four active inputs when the Maj switch is set at each of its selector positions and the W control is adjusted for an output pulse width of about 10 ns. When the switch is set at 1, an output is generated for 10 ns as a result of the B input pulse and again for the second C input pulse; these are the only times in this diagram when the discriminator senses the change from no input to one or more inputs and the discriminator must be reset before it can respond again. There is an output for a Maj setting of 2 when the A pulse occurs while the B pulse

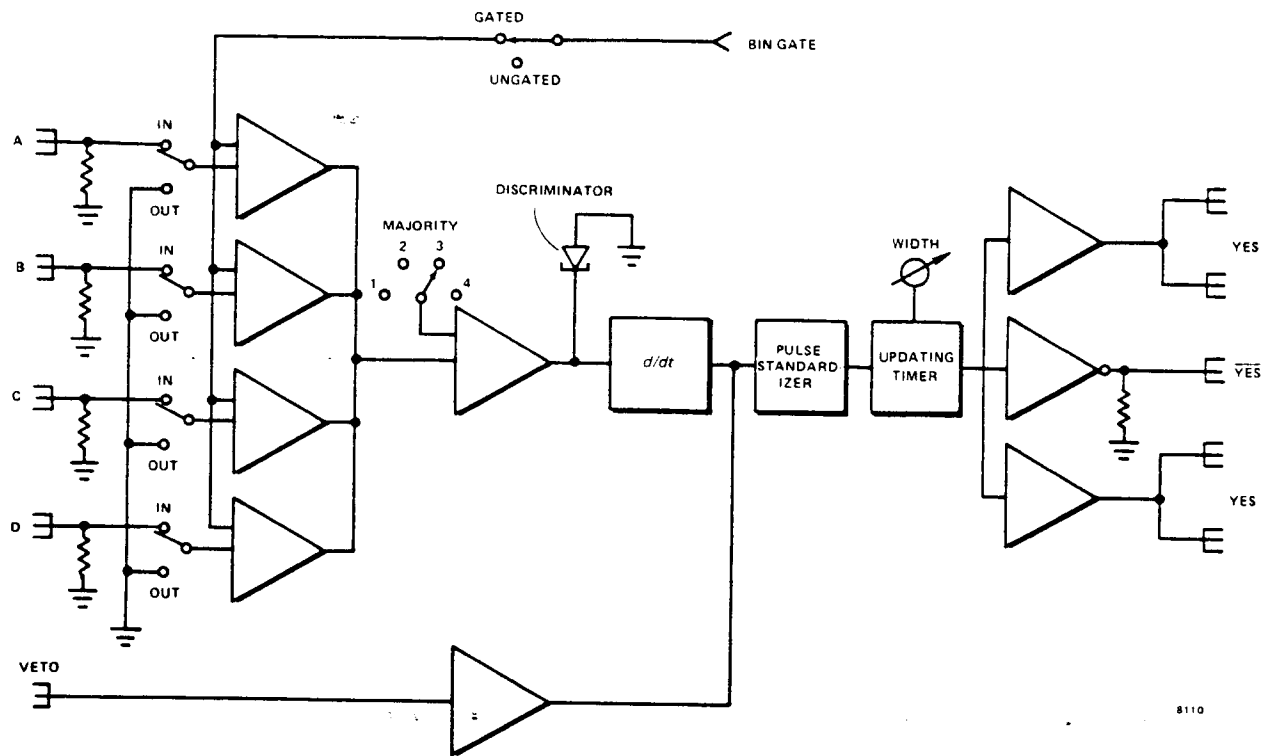


Fig. 3.1. Simplified Block Diagram of C315/NL.

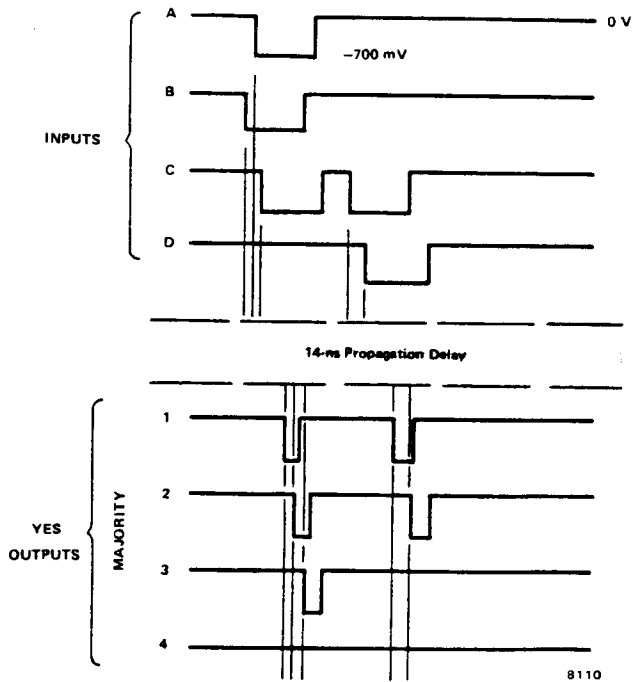


Fig. 3.2. Typical Timing Diagram with 10-ns Output Width Adjusted.

is present and again when the D input occurs following the start of the second C input. The leading edge of the C input is the only time in this diagram when a majority of 3 occurs. There is no time when all four inputs are coincident; so there is no output when the Maj switch is set at 4.

Each output pulse in Fig. 3.2 is subject to cancellation by a veto input that arrives no later than 1 ns after the leading edge of a coincidence and remains for at least 2 ns after the coincidence. All responses can be blocked during the absence of a signal through the bin gate common line if the rear panel switch on the C315/NL is set at Gated.

3.3. FAN-IN OPERATION

Signals can be connected to two or more In connectors and the Maj switch can be set at 1 for a fan-in operation. In this arrangement an output signal is generated when an input signal is furnished through an active input circuit. If the input signals overlap or if they occur prior to the trailing edge of an output for a previous input signal, the output width is extended by the updating timer. Otherwise, there is one output with an adjusted width to correspond to each unique input pulse.

3.4. DUAL OUTPUT TERMINATIONS

Standard logic signal outputs through the pairs of dual Y- connectors depend on the use of 50Ω termination of both

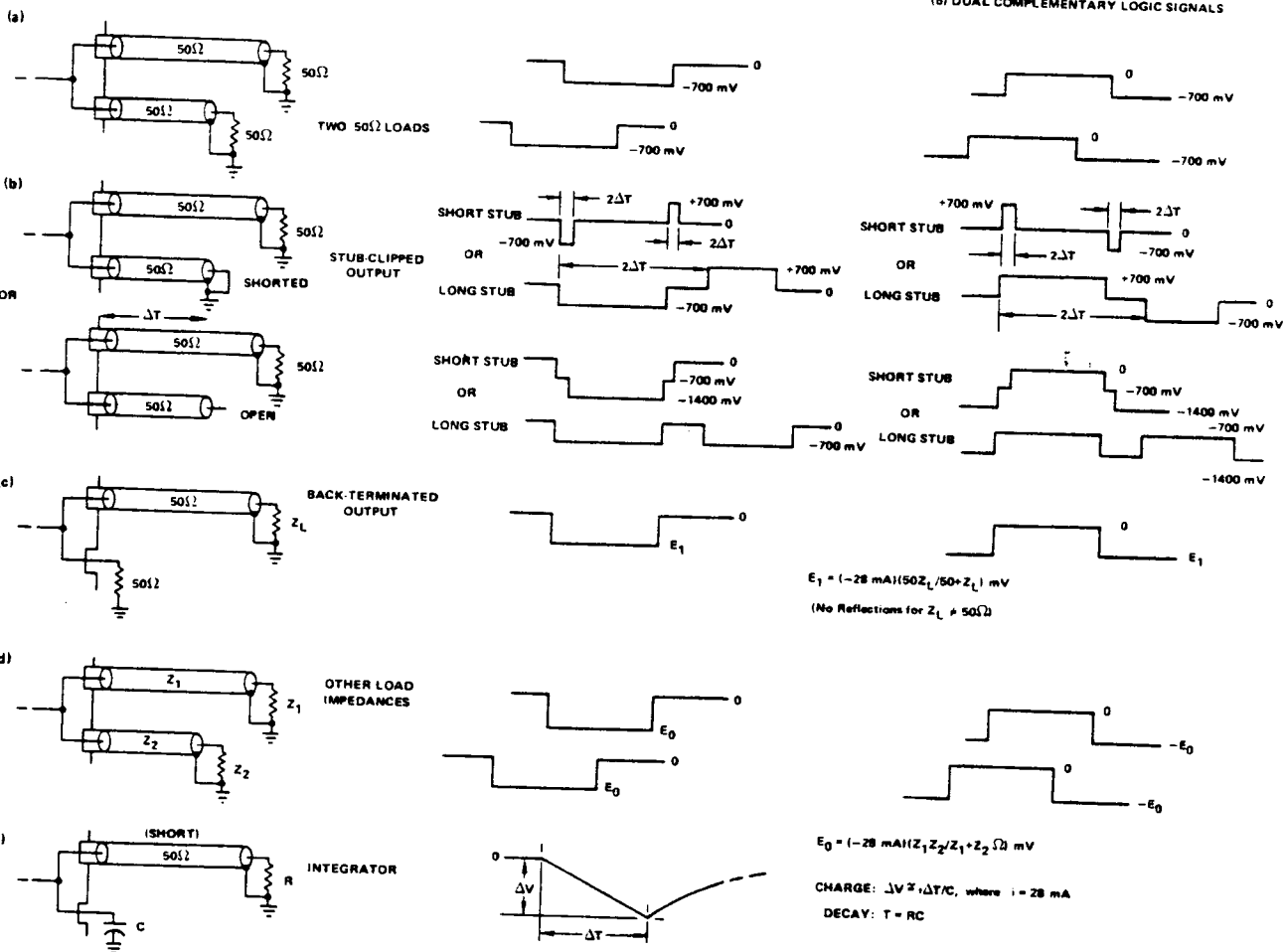
connectors in both pairs. Cable lengths determine the signal delays and can be selected to provide timing differences for the two signals that are otherwise identical.

Several other signal conditioning circuit arrangements are possible when a signal is required from only one of a pair of dual Yes connectors. Some circuits are suggested in Fig.

3.3, where (a) illustrates the standard circuit with dual outputs and (b) through (e) are suggestions for alternate circuit arrangements. All the suggestions relate to external circuit connections and show their effects on one pair of Yes connectors in the C315/NL. The use of any of these suggested arrangements will not reflect a change to the outputs through the other pairs of Yes connectors.

(a) DUAL LOGIC SIGNALS

(b) DUAL COMPLEMENTARY LOGIC SIGNALS



NOTE: Relative Timing Depends upon Relative Delay of Cables

8100

Fig. 3.3. Uses of Dual Outputs.

4. CIRCUIT DESCRIPTION

4.1. GENERAL

Component designations in this circuit description refer to schematic C315/NL-0101-S1, which is included at the back of the manual.

The nomenclature used to identify the IC packages referred to in this manual is defined below for the example

IC102(4),

where

IC = integrated circuit,
102 = component number,
(4) = pin number.

Any portion of an IC package can be designated by its output pin number identification.

4.2. COINCIDENCE OPERATION

The four coincidence input circuits, A through D, in each of the two sections are identical in operation. If switch S101 is set at In, diode D101 is reverse-biased and the input signal is fed through D102 and R103 to IC101(14). If the switch is set at Out, D101 shorts the input signal to ground and it does not enter the coincidence circuit; the input A circuit is disabled.

Q101 and Q102, with their associated resistors, provide a 4-level bias for IC102(6). When the majority (Maj) switch, S105, is set at 1, the bias at IC102(6) is adjusted to 150 mV above the dc level at IC102(7); it is adjusted by R130 on the printed circuit board. When Maj switch S105 is set at 2, the bias level at IC102(6) is increased by 400 mV. When the switch is advanced to 3, the bias is increased by another 400 mV, and by still another 400 mV when the switch is set at 4.

Pin 1 of IC101 is common to all four active gates, and functions as a current summing point. The number of gates that are turned on determines the total current through pin 1. If switches S101 through S104 are all set at In and Maj switch S105 is set at 1, an input signal through any of the four input gates provides enough current through pin 1 to generate an excursion of 400 mV at IC102(7) and to trigger IC102(3). Under the same conditions for the input circuits, with switch S105 set at 2, the IC101(1) current would be sufficient to trigger IC102(3) only if two or more input circuits accepted coincident input signals. This logic extends to the requirements for S105 settings of 3 and 4. Since the summed current through IC101(1) is the criterion of the number of coincident input signals and since any input circuit is inhibited from contributing to the summed current if its toggle switch is set at Out, the multiple input coincidence conditions are properly defined by the response of IC102(3).

The signal at IC102(3) triggers tunnel diode D113 to call for generation of an output pulse. The switching of D113 is differentiated by L105 and C115 and amplified through IC102(2) and IC102(15). The amplified signal is further shaped by D114 and its associated circuitry, and the negative-going leading edge of the signal at IC102(15) toggles D114 to turn on Q104 and turn off Q105. When Q105 turns off, it feeds a positive excursion back to the base of Q104 and turns on Q104 harder than before. D114 is reset, giving a pulse width that is approximately equal to the propagation delay through Q104 and Q105. Q104 amplifies the pulse and the pulse is then level-translated by D116 and furnished to the base of Q107.

The pulse that is furnished to the base of Q107 has an amplitude and width that are relatively independent of variations in the input signals to the module. Q107 turns on and charges C125, and then Q107 is turned off again. C125 is discharged by the current source that includes Q108, Q109, D117, and their associated circuits. The rate of discharge is controlled by the adjustment of W control R164 and can be varied from about 3 ns to >150 ns. Should another pulse arrive at the base of Q107 before C125 is fully discharged, C125 is again charged to its original level and starts to discharge over again, and this accomplishes updating.

IC103(6) is biased below IC103(7), and there is an output at IC103(3) when this condition is reversed. The output continues until IC103(7) changes its level to one that is above IC103(6), and this condition corresponds to the discharge interval of C125. The signal at IC103(3) is amplified through IC103(14) to drive the output stages through IC103(2) and IC103(15).

IC103(2) drives output switching pair Q110 and Q111 to furnish 32 mA of current through one pair of Yes dual connectors. IC103(15) duplicates this function through switching pair Q112 and Q113 to deliver 32 mA of current through the other pair of Yes connectors. Under the condition of no input signal at IC103(12), Q112 is conducting the 32-mA current, and this is divided between the Yes output connector circuit and R186; when the signal is furnished to IC103(12), the current through the Yes output connector and R186 drops to 0 mA for the complementary signal.

4.3. VETO OPERATION

A signal can be furnished through the Veto connector to be fed through D109 and R1003 to IC102(10). The output at IC102(14) is wire-ORed to IC102(15), together with the shaped response of the input discriminator. When the veto signal is present, IC102(15) is held high and this prevents D114 from triggering an output response.

The veto signal can arrive as much as 1.5 ns later than the leading edge of a coincidence condition and still be effective, although 1 ns is preferred as the specification limit to ensure its effect. The veto signal must then continue for at least 2 ns after the coincidence response trailing edge.

4.4. BIN GATE OPERATION

The bin gate circuit normally applies about -5.2 V to IC101 at pins 10, 13, 4, and 7 when rear panel Bin Gate switch S1 is set at Off or when the switch is set at On and there is a bin gate signal. If the Bin Gate switch is On and there is no bin gate signal, the level at all four input gates is about -0.8 V and the gates are inhibited. When a bin gate signal is applied through switch S1, the circuit applies -5.2 V to all four OR gates and this allows response to input signals. Both sections of the C315/NL are controlled simultaneously by the signals through switch S1.

4.5. OUTPUT SIGNAL GENERATION

Under no-signal conditions, Q110 and Q112 conduct. The

Q112 current is the $\overline{\text{Yes}}$ connector signal that is back-terminated by R186. When a coincidence is recognized and an output signal is generated, Q110 and Q112 are cut off and their currents switch to Q111 and Q113. The current through Q111 is routed to one pair of dual Yes connectors and the current through Q113 is routed to the other pair. Terminate each unused connector with 50Ω or the output waveform will be distorted as shown in Fig. 3.3.

4.6. POWER DISTRIBUTION

Power at $+6$ V, -6 V, $+12$ V, -12 V, and -24 V is obtained from the bin and power supply in which the C315/NL is operated. Each power level is filtered as shown at the top right corner of schematic C315/NL-0101-S1. All three negative power levels are connected with a bleeder network for extra stability in the module. The -6 -V level is furnished through diode D1 to drop the level to -5.2 V for the various circuit locations where this level is required.

5. MAINTENANCE AND CALIBRATION

5.1. PREVENTIVE MAINTENANCE

The only preventive maintenance required is reasonable attention to mechanical details. Keep the signal connectors clean and remove the cover plates to inspect the module for excessive dust accumulation. Clean as often as required by local conditions (normally about once in 12 months).

CAUTION

Handle the printed circuit board with care.

5.2. CORRECTIVE MAINTENANCE

When replacing components on a printed circuit board, be careful to ensure that the board is not damaged due to excessive heating. Heat the solder joint as little as possible while maintaining a pull on the component lead to assure prompt removal of the lead. After removal of a component use a vacuum solder puller carefully to remove excess solder and prepare the hole to accept the lead for the replacement component. A common practice is to apply heat and push a wire through the hole to clean it; **DO NOT** use this method or the copper may peel off the printed circuit board.

5.3. VOLTAGE READINGS

The voltages listed in Table 5.1 are typical of a properly operating circuit with no input signal present and with the Out circuits properly terminated in 50Ω . Use a high-impedance dc meter. Set the Majority selector switch at 1.

5.4. CALIBRATION

The bias levels that are generated according to the number of OR gates accepting coincident input signals are calibrated by R130, mounted on the printed circuit board. The adjustment of R130 is based on comparative voltage levels at pins 6 and 7 of IC102 under quiescent conditions with switch S105, Maj, set at 1. The resulting bias levels that are generated for 2, 3, or 4 coincident inputs are matched by the tapped levels in the series of R131 through R133.

Use the following procedure to calibrate R130:

1. Set the Maj selector switch at 1.
2. Measure the voltage at pin 7 of IC102.
3. Adjust R130 until the voltage at pin 6 of IC102 is 150 mV more positive than the voltage level measured at pin 7.

There are no other calibration adjustments on the C315/NL.

5.5. REPAIR

This instrument can be returned to the ORTEC factory for service and repair at a nominal cost. Our standard proce-

cedure for repair ensures the same quality control and check-out that are used for a new instrument. Always contact the Customer Service Department at ORTEC, (615) 482-4411, before sending in an instrument for repair for shipping instructions and so that the required Return Authorization Number can be assigned to the unit. This number should be written on the address label and on the package.

Table 5.1. Voltage Readings

| Test Point | Voltage (V) | Test Point | Voltage (V) | Test Point | Voltage (V) | Test Point | Voltage (V) | | | | |
|------------|-------------|------------|-------------|------------|-------------|------------|-------------|-------|------|---|-------|
| IC101 | 1 | 0.2 | IC103 | 9 | -1.3 | Q101 | E | -3.4 | Q109 | E | 2.2 |
| | 2 | -0.8 | | 10 | -1.0 | | B | -4.0 | | B | 1.6 |
| | 3 | -0.8 | | 11 | -1.3 | | C | -6.0 | | C | -0.15 |
| | 4 | -5.2 | | 12 | -1.2 | Q102 | E | -4.0 | Q110 | E | -1.5 |
| | 5 | -0.98 | | 13 | -1.3 | | B | -3.4 | | B | -0.8 |
| | 6 | -0.98 | | 14 | -0.8 | | C | -1.85 | | C | -0.3 |
| | 7 | -5.2 | | 15 | -0.8 | Q103 | E | 0 | Q111 | E | -1.5 |
| | 8 | -5.2 | | 16 | 0 | | B | 0.6 | | B | -1.2 |
| | 9 | -1.3 | | 1 | 0 | | C | -5.2 | | C | 0 |
| | 10 | -5.2 | | 2 | -0.8 | Q104 | E | -0.05 | Q112 | E | -1.5 |
| | 11 | -0.98 | | 3 | -1.5 | | B | 0 | | B | -0.8 |
| | 12 | -0.98 | | 4 | -1.2 | | C | 5.2 | | C | -0.9 |
| | 13 | -5.2 | | 5 | -0.8 | Q105 | E | -0.7 | Q113 | E | -1.5 |
| | 14 | -0.8 | | 6 | -1.0 | | B | 0 | | B | -1.2 |
| | 15 | -0.8 | | 7 | -0.9 | | C | 5.6 | | C | 0 |
| | 16 | 0 | | 8 | -5.2 | Q106 | E | -0.7 | | | |
| IC102 | 1 | 0 | 9 | -1.3 | B | | -0.2 | | | | |
| | 2 | -1.2 | 10 | -1.5 | C | | 0 | | | | |
| | 3 | -0.8 | 11 | -1.3 | Q107 | E | -1.0 | | | | |
| | 4 | -1.2 | 12 | -0.8 | | B | -0.3 | | | | |
| | 5 | -1.2 | 13 | -1.2 | | C | -5 | | | | |
| | 6 | -1.85 | 14 | -0.8 | Q108 | E | 1.6 | | | | |
| | 7 | -2.0 | 15 | -0.8 | | B | 2.2* | | | | |
| | 8 | -5.2 | 16 | 0 | | C | 12 | | | | |

*R164 Full CCW

Note: The voltage readings for IC201 through IC203 and Q201 through Q216 are the same as those listed above for their respective equivalent components in the 100 series.

APPENDIX

REPLACEABLE PARTS

ORDERING INFORMATION

The Replaceable Parts List shown below contains information needed for ordering spare and/or replacement parts. Each listing indicates the reference designator number, the part number, a description of the component, and the part manufacturer and manufacturer's part number.

All inquiries concerning spare and/or replacement parts and all orders for same should include the model serial, and revision ("Rev" on rear panel) numbers of the instruments involved and should be addressed to the Customer Service Department at 100 Midland Road, Oak Ridge, Tennessee 37830. The Manager of Customer Services can be reached

by telephone at (615) 482-4411. The minimum order for spare and/or replacement parts is \$25.00.

ORDERING INFORMATION
FOR PARTS NOT LISTED

In order to facilitate the ordering of a part not listed below, the following information should be submitted to the Customer Service Department:

1. the instrument model number,
2. the instrument serial number,
3. revision ("Rev" on rear panel) number,
4. a description of the part,
5. information as to the function and location of the part.

The solid-state-device (diodes, transistors, and integrated circuits) types installed in your instrument may differ from those shown in the schematic diagram and parts list. In such cases, necessary replacements can be made with either the type shown or the type actually installed in the instrument.

Replaceable Parts List

C315/NL-0100 C315/NL-0100 CHAS ASM

| REFDES | PART NUMBER | DESCRIPTION |
|--------|--------------|----------------------------------|
| | 9 097 608150 | CONN PA00.250 LEMO PANEL |
| | 9 168 528980 | CONN NUT LEMO 6400-0133 |
| P164 | 9 047 435780 | 10 KOHM 20T CER TPT SPT 43Y-R10K |
| P264 | 9 047 435780 | 10 KOHM 20T CER TPT SPT 43Y-R10K |
| S1 | 9 094 492710 | SW TOGGLE SPDT AEP MSTL-0106D |
| S101 | 9 094 492710 | SW TOGGLE SPDT AEP MSTL-0106D |
| S102 | 9 094 492710 | SW TOGGLE SPDT AEP MSTL-0106D |
| S103 | 9 094 492710 | SW TOGGLE SPDT AEP MSTL-0106D |
| S104 | 9 094 492710 | SW TOGGLE SPDT AEP MSTL-0106D |
| S105 | 9 094 641980 | SWITCH 4 POS ROTARY SPT 87-31-14 |
| S201 | 9 094 492710 | SW TOGGLE SPDT AEP MSTL-0106D |
| S203 | 9 094 492710 | SW TOGGLE SPDT AEP MSTL-0106D |
| S204 | 9 094 492710 | SW TOGGLE SPDT AEP MSTL-0106D |
| S205 | 9 094 641980 | SWITCH 4 POS ROTARY SPT 87-31-14 |

C315/NL-0200 C315/NL-0200 PC 8D

| REFDES | PART NUMBER | DESCRIPTION |
|--------|--------------|---------------------------------|
| C1 | 9 055 408550 | .01 UF 20% 50V DISC SPR TG-S10 |
| C2 | 9 055 408550 | .01 UF 20% 50V DISC SPK TG-S10 |
| C3 | 9 065 409420 | 1 UF 20% 35V SPR 150D105X0035A2 |
| C4 | 9 055 408550 | .01 UF 20% 50V DISC SPR TG-S10 |
| C5 | 9 055 408550 | .01 UF 20% 50V DISC SPK TG-S10 |
| C6 | 9 055 408550 | .01 UF 20% 50V DISC SPR TG-S10 |
| C7 | 9 055 408550 | .01 UF 20% 50V DISC SPR TG-S10 |
| C8 | 9 055 408550 | .01 UF 20% 50V DISC SPK TG-S10 |
| C9 | 9 055 408550 | .01 UF 20% 50V DISC SPR TG-S10 |
| C10 | 9 055 408550 | .01 UF 20% 50V DISC SPK TG-S10 |
| C11 | 9 065 409420 | 1 UF 20% 35V SPR 150D105X0035A2 |
| C12 | 9 055 408550 | .01 UF 20% 50V DISC SPR TG-S10 |
| C13 | 9 055 408550 | .01 UF 20% 50V DISC SPR TG-S10 |
| C14 | 9 055 408550 | .01 UF 20% 50V DISC SPR TG-S10 |
| C101 | 9 055 408550 | .01 UF 20% 50V DISC SPK TG-S10 |
| C102 | 9 055 408550 | .01 UF 20% 50V DISC SPR TG-S10 |
| C103 | 9 055 408550 | .01 UF 20% 50V DISC SPR TG-S10 |
| C104 | 9 055 408550 | .01 UF 20% 50V DISC SPR TG-S10 |
| C105 | 9 055 408550 | .01 UF 20% 50V DISC SPR TG-S10 |

C315/NL-0200 C315/NL-0200 PC 8D

| REFDES | PART NUMBER | DESCRIPTION |
|--------|--------------|---------------------------------|
| C106 | 9 055 408550 | .01 UF 20% 50V DISC SPR TG-S10 |
| C107 | 9 055 436140 | 5 PF 10% 1KV DISC SPR 10TS-V50 |
| C108 | 9 055 436140 | 5 PF 10% 1KV DISC SPR 10TS-V50 |
| C109 | 9 055 408550 | .01 UF 20% 50V DISC SPR TG-S10 |
| C110 | 9 055 436140 | 5 PF 10% 1KV DISC SPR 10TS-V50 |
| C111 | 9 055 436140 | 5 PF 10% 1KV DISC SPR 10TS-V50 |
| C112 | 9 055 408550 | .01 UF 20% 50V DISC SPR TG-S10 |
| C113 | 9 055 408550 | .01 UF 20% 50V DISC SPR TG-S10 |
| C114 | 9 055 408550 | .01 UF 20% 50V DISC SPR TG-S10 |
| C115 | 9 055 408550 | .01 UF 20% 50V DISC SPR TG-S10 |
| C116 | 9 071 489970 | 270 PF 50V ERC 1034-00-271P |
| C117 | 9 055 408550 | .01 UF 20% 50V DISC SPR TG-S10 |
| C118 | 9 055 408550 | .01 UF 20% 50V DISC SPR TG-S10 |
| C119 | 9 055 408550 | .01 UF 20% 50V DISC SPR TG-S10 |
| C120 | 9 055 408550 | .01 UF 20% 50V DISC SPR TG-S10 |
| C121 | 9 055 408550 | .01 UF 20% 50V DISC SPR TG-S10 |
| C122 | 9 055 408550 | .01 UF 20% 50V DISC SPR TG-S10 |
| C123 | 9 055 408550 | .01 UF 20% 50V DISC SPR TG-S10 |
| C124 | 9 055 408550 | .01 UF 20% 50V DISC SPR TG-S10 |
| C125 | 9 059 408830 | 22 PFMIC 5% 500V ARC DML5-220D |
| C126 | 9 055 408550 | .01 UF 20% 50V DISC SPR TG-S10 |
| C127 | 9 055 408550 | .01 UF 20% 50V DISC SPR TG-S10 |
| C128 | 9 055 408550 | .01 UF 20% 50V DISC SPR TG-S10 |
| C129 | 9 071 48957C | 270 PF 50V ERC 1034-00-271P |
| C130 | 9 055 408550 | .01 UF 20% 50V DISC SPR TG-S10 |
| C131 | 9 065 409420 | 1 UF 20% 35V SPR 150D105X0035A2 |
| C133 | 9 055 408550 | .01 UF 20% 50V DISC SPR TG-S10 |
| C134 | 9 055 408550 | .01 UF 20% 50V DISC SPR TG-S10 |
| C135 | 9 071 489970 | 270 PF 90V ERC 1034-00-271P |
| C136 | 9 055 408550 | .01 UF 20% 50V DISC SPR TG-S10 |
| C137 | 9 065 409420 | 1 UF 20% 35V SPR 150D105X0035A2 |
| C138 | 9 055 408550 | .01 UF 20% 50V DISC SPR TG-S10 |
| C139 | 9 055 408550 | .01 UF 20% 50V DISC SPR TG-S10 |
| C143 | 9 055 408550 | .01 UF 20% 50V DISC SPR TG-S10 |
| C144 | 9 055 408550 | .01 UF 20% 50V DISC SPR TG-S10 |
| C145 | 9 055 408550 | .01 UF 20% 50V DISC SPR TG-S10 |
| C146 | 9 055 408550 | .01 UF 20% 50V DISC SPR TG-S10 |

Replaceable Parts List (continued)

C315/NL-0200 C315/NL-0200 PC 8D

C315/NL-0200 C315/NL-0200 PC 8D

| REFDES | PART NUMBER | DESCRIPTION | REFDES | PART NUMBER | DESCRIPTION |
|--------|--------------|---------------------------------|--------|--------------|--------------------------------|
| C147 | 9 055 408550 | .01 UF 20% 50V DISC SPR TG-S10 | D109 | 9 080 442170 | DIODE 75V SYL IN4153 |
| C148 | 9 055 408550 | .01 UF 20% 50V DISC SPR TG-S10 | D110 | 9 080 442170 | DIODE 75V SYL IN4153 |
| C149 | 9 055 408550 | .01 UF 20% 50V DISC SPR TG-S10 | D111 | 9 080 442170 | DIODE 75V SYL IN4153 |
| C150 | 9 055 408550 | .01 UF 20% 50V DISC SPR TG-S10 | D112 | 9 080 442170 | DIODE 75V SYL IN4153 |
| C151 | 9 055 408550 | .01 UF 20% 50V DISC SPR TG-S10 | D113 | 9 080 602360 | DIODE FAST 10MA306733) TD BLU |
| C153 | 9 071 489970 | 270 PF 50V ERC 1034-00-271P | D114 | 9 080 602380 | DIODE FAST 20MA A306735 TD GRN |
| C154 | 9 071 489970 | 270 PF 50V ERC 1034-00-271P | D115 | 9 080 411060 | DIODE GLI IN752A |
| C155 | 9 071 489970 | 270 PF 50V ERC 1034-00-271P | D116 | 9 080 411060 | DIODE GLI IN752A |
| C156 | 9 071 489970 | 270 PF 50V ERC 1034-00-271P | D117 | 9 080 411040 | DIODE GLI IN 750A |
| C157 | 9 055 408550 | .01 UF 20% 50V DISC SPR TG-S10 | D201 | 9 080 442170 | DIODE 75V SYL IN4153 |
| C158 | 9 071 489970 | 270 PF 50V ERC 1034-00-271P | D202 | 9 080 442170 | DIODE 75V SYL IN4153 |
| C201 | 9 055 408550 | .01 UF 20% 50V DISC SPR TG-S10 | D203 | 9 080 442170 | DIODE 75V SYL IN4153 |
| C202 | 9 055 408550 | .01 UF 20% 50V DISC SPR TG-S10 | D204 | 9 080 442170 | DIODE 75V SYL IN4153 |
| C203 | 9 055 408550 | .01 UF 20% 50V DISC SPR TG-S10 | D205 | 9 080 442170 | DIODE 75V SYL IN4153 |
| C204 | 9 055 408550 | .01 UF 20% 50V DISC SPR TG-S10 | D206 | 9 080 442170 | DIODE 75V SYL IN4153 |
| C205 | 9 055 408550 | .01 UF 20% 50V DISC SPR TG-S10 | D207 | 9 080 442170 | DIODE 75V SYL IN4153 |
| C206 | 9 055 408550 | .01 UF 20% 50V DISC SPR TG-S10 | D208 | 9 080 442170 | DIODE 75V SYL IN4153 |
| C207 | 9 055 436140 | 5 PF 10% 1KV DISC SPR 10TS-V50 | D209 | 9 080 442170 | DIODE 75V SYL IN4153 |
| C208 | 9 055 436140 | 5 PF 10% 1KV DISC SPR 10TS-V50 | D210 | 9 080 442170 | DIODE 75V SYL IN4153 |
| C209 | 9 055 408550 | .01 UF 20% 50V DISC SPR TG-S10 | D211 | 9 080 442170 | DIODE 75V SYL IN4153 |
| C210 | 9 055 436140 | 5 PF 10% 1KV DISC SPR 10TS-V50 | D212 | 9 080 442170 | DIODE 75V SYL IN4153 |
| C211 | 9 055 436140 | 5 PF 10% 1KV DISC SPR 10TS-V50 | D213 | 9 080 602360 | DIODE FAST 10MA306733) TD BLU |
| C212 | 9 055 408550 | .01 UF 20% 50V DISC SPR TG-S10 | D214 | 9 080 602380 | DIODE FAST 20MA A306735 TD GRN |
| C213 | 9 055 408550 | .01 UF 20% 50V DISC SPR TG-S10 | D215 | 9 080 411060 | DIODE GLI IN752A |
| C214 | 9 055 408550 | .01 UF 20% 50V DISC SPR TG-S10 | D216 | 9 080 411060 | DIODE GLI IN752A |
| C215 | 9 055 408550 | .01 UF 20% 50V DISC SPR TG-S10 | D217 | 9 080 411040 | DIODE GLI IN 750A |
| C216 | 9 071 489970 | 270 PF 50V ERC 1034-00-271P | IC101 | 9 079 604790 | IC-MC1664L MOT |
| C217 | 9 055 408550 | .01 UF 20% 50V DISC SPR TG-S10 | IC102 | 9 079 604800 | IC-MC1692L MOT |
| C218 | 9 055 408550 | .01 UF 20% 50V DISC SPR TG-S10 | IC103 | 9 079 604800 | IC-MC1692L MOT |
| C219 | 9 055 408550 | .01 UF 20% 50V DISC SPR TG-S10 | IC201 | 9 079 604790 | IC-MC1664L MOT |
| C220 | 9 055 408550 | .01 UF 20% 50V DISC SPR TG-S10 | IC202 | 9 079 604800 | IC-MC1692L MOT |
| C221 | 9 055 408550 | .01 UF 20% 50V DISC SPR TG-S10 | IC203 | 9 079 604800 | IC-MC1692L MOT |
| C222 | 9 055 408550 | .01 UF 20% 50V DISC SPR TG-S10 | L1 | 9 090 611770 | FERROXCUBE FEX VK200 10/38 |
| C223 | 9 055 408550 | .01 UF 20% 50V DISC SPR TG-S10 | L2 | 9 090 611770 | FERROXCUBE FEX VK200 10/38 |
| C224 | 9 055 408550 | .01 UF 20% 50V DISC SPR TG-S10 | L3 | 9 090 611770 | FERROXCUBE FEX VK200 10/38 |
| C225 | 9 059 408830 | 22 PFMIC 5% 500V ARC DM15-2200 | L4 | 9 090 611770 | FERROXCUBE FEX VK200 10/38 |
| C226 | 9 055 408550 | .01 UF 20% 50V DISC SPR TG-S10 | L5 | 9 090 611770 | FERROXCUBE FEX VK200 10/38 |
| C227 | 9 055 408550 | .01 UF 20% 50V DISC SPR TG-S10 | L101 | 9 090 412230 | FERRITE BEAD FEX 56-590-65/48 |
| C228 | 9 055 408550 | .01 UF 20% 50V DISC SPR TG-S10 | L102 | 9 090 412230 | FERRITE BEAD FEX 56-590-65/48 |
| C229 | 9 071 489970 | 270 PF 50V ERC 1034-00-271P | L103 | 9 090 412230 | FERRITE BEAD FEX 56-590-65/48 |
| C230 | 9 055 408550 | .01 UF 20% 50V DISC SPR TG-S10 | L104 | 9 090 412230 | FERRITE BEAD FEX 56-590-65/48 |
| C231 | 9 065 409420 | 1 UF 20% 35V SPR 150D105X0035A2 | L015 | 7 092 412470 | INDUCTOR ASM C315/NL-0107 |
| C233 | 9 055 408550 | .01 UF 20% 50V DISC SPR TG-S10 | L106 | 9 090 611770 | FERROXCUBE FEX VK200 10/38 |
| C234 | 9 055 408550 | .01 UF 20% 50V DISC SPR TG-S10 | L107 | 9 090 611770 | FERROXCUBE FEX VK200 10/38 |
| C235 | 9 071 489970 | 270 PF 50V ERC 1034-00-271P | L108 | 9 090 611770 | FERROXCUBE FEX VK200 10/38 |
| C236 | 9 055 408550 | .01 UF 20% 50V DISC SPR TG-S10 | L201 | 9 090 412230 | FERRITE BEAD FEX 56-590-65/48 |
| C237 | 9 065 409420 | 1 UF 20% 35V SPR 150D105X0035A2 | L202 | 9 090 412230 | FERRITE BEAD FEX 56-590-65/48 |
| C238 | 9 055 408550 | .01 UF 20% 50V DISC SPR TG-S10 | L203 | 9 090 412230 | FERRITE BEAD FEX 56-590-65/48 |
| C239 | 9 055 408550 | .01 UF 20% 50V DISC SPR TG-S10 | L204 | 9 090 412230 | FERRITE BEAD FEX 56-590-65/48 |
| C243 | 9 055 408550 | .01 UF 20% 50V DISC SPR TG-S10 | L205 | 7 092 412470 | INDUCTOR ASM C315/NL-0107 |
| C244 | 9 055 408550 | .01 UF 20% 50V DISC SPR TG-S10 | L206 | 9 090 611770 | FERROXCUBE FEX VK200 10/38 |
| C245 | 9 055 408550 | .01 UF 20% 50V DISC SPR TG-S10 | L207 | 9 090 611770 | FERROXCUBE FEX VK200 10/38 |
| C246 | 9 055 408550 | .01 UF 20% 50V DISC SPR TG-S10 | L208 | 9 090 611770 | FERROXCUBE FEX VK200 10/38 |
| C247 | 9 055 408550 | .01 UF 20% 50V DISC SPR TG-S10 | Q101 | 9 080 410890 | TRANS-2N3906 MOT |
| C248 | 9 055 408550 | .01 UF 20% 50V DISC SPR TG-S10 | Q102 | 9 078 478600 | 2N3904 TRANSISTOR MOT |
| C249 | 9 055 408550 | .01 UF 20% 50V DISC SPR TG-S10 | Q103 | 9 080 410890 | TRANS-2N3906 MOT |
| C250 | 9 055 408550 | .01 UF 20% 50V DISC SPR TG-S10 | Q104 | 9 078 436590 | TRANS-2N5179 MOT 3304840) |
| C251 | 9 055 408550 | .01 UF 20% 50V DISC SPR TG-S10 | Q105 | 9 078 478450 | TRANS-MPS2369 SEL FM 47844 REC |
| C253 | 9 071 489970 | 270 PF 50V ERC 1034-00-271P | Q106 | 9 078 478450 | TRANS-MPS2369 SEL FM 47844 REC |
| C254 | 9 071 489970 | 270 PF 50V ERC 1034-00-271P | Q107 | 9 078 436440 | TRANS 2N4260 MOT EG&G AB0329-4 |
| C255 | 9 071 489970 | 270 PF 50V ERC 1034-00-271P | Q108 | 9 078 478600 | 2N3904 TRANSISTOR MOT |
| C256 | 9 071 489970 | 270 PF 50V ERC 1034-00-271P | Q109 | 9 080 410890 | TRANS-2N3906 MOT |
| C257 | 9 055 408550 | .01 UF 20% 50V DISC SPR TG-S10 | Q110 | 9 078 480200 | TRANS-FMT5954 SEL RED/WHT |
| C258 | 9 071 489970 | 270 PF 50V ERC 1034-00-271P | Q111 | 9 078 480200 | TRANS-FMT5954 SEL RED/WHT |
| D1 | 9 080 602280 | IN4005 DIODE GPL | Q112 | 9 078 480200 | TRANS-FMT5954 SEL RED/WHT |
| D101 | 9 080 442170 | DIODE 75V SYL IN4153 | Q113 | 9 078 480200 | TRANS-FMT5954 SEL RED/WHT |
| D102 | 9 080 442170 | DIODE 75V SYL IN4153 | Q201 | 9 080 410890 | TRANS-2N3906 MOT |
| D103 | 9 080 442170 | DIODE 75V SYL IN4153 | Q202 | 9 078 478600 | 2N3904 TRANSISTOR MOT |
| D104 | 9 080 442170 | DIODE 75V SYL IN4153 | Q203 | 9 080 410890 | TRANS-2N3906 MOT |
| D105 | 9 080 442170 | DIODE 75V SYL IN4153 | Q204 | 9 078 436590 | TRANS-2N5179 MOT 3304840) |
| D106 | 9 080 442170 | DIODE 75V SYL IN4153 | Q205 | 9 078 478450 | TRANS-MPS2369 SEL FM 47844 REC |
| D107 | 9 080 442170 | DIODE 75V SYL IN4153 | Q206 | 9 078 478450 | TRANS-MPS2369 SEL FM 47844 REC |
| D108 | 9 080 442170 | DIODE 75V SYL IN4153 | Q207 | 9 078 436440 | TRANS 2N4260 MOT EG&G AB0329-4 |

Replaceable Parts List (continued)

C315/NL-0200 C315/NL-0200 PC 8D

C315/NL-0200 C315/NL-0200 PC 8D

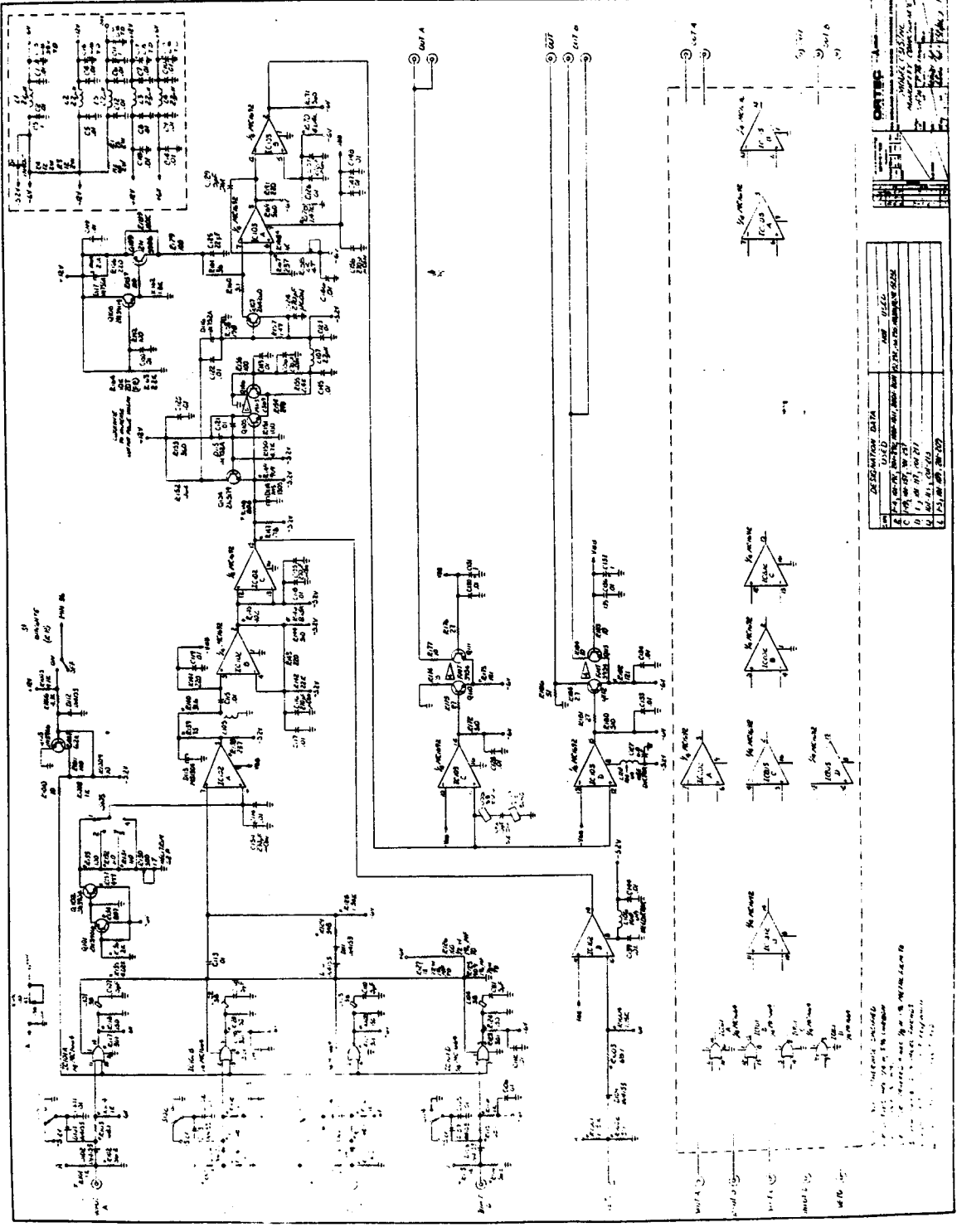
| REFDES | PART NUMBER | DESCRIPTION |
|--------|--------------|----------------------------------|
| Q208 | 9 078 478600 | 2N3904 TRANSISTOR MOT |
| Q209 | 9 080 410890 | TRANS-2N3904 MOT |
| Q210 | 9 078 480200 | TRANS-FMT5954 SEL RED/WHT |
| Q211 | 9 078 480200 | TRANS-FMT5954 SEL RED/WHT |
| Q212 | 9 078 480200 | TRANS-FMT5954 SEL RED/WHT |
| Q213 | 9 078 480200 | TRANS-FMT5954 SEL RED/WHT |
| R1 | 9 020 611970 | 75 OHM CC 2W 5% ABC HB |
| R2 | 9 020 611980 | 68 OHM CC 1/4W 5% ABC HB |
| R3 | 9 020 611990 | 12 OHM C 2W 5% |
| R4 | 9 020 611990 | 12 OHM C 2W 5% |
| R101 | 9 027 405780 | 1.21 KOHM MF 1/8W 1% IRC CEA T-O |
| R102 | 9 027 404850 | 56.2 OHM MF 1/8W 1% IRC CEA T-O |
| R103 | 9 027 405740 | 68.1 OHM MF 1/8W 1% IRC CEA T-O |
| R104 | 9 027 405150 | 1 KOHM MF 1/8W 1% IRC CEA T-O |
| R105 | 9 027 405780 | 1.21 KOHM MF 1/8W 1% IRC CEA T-O |
| R106 | 9 027 404850 | 56.2 OHM MF 1/8W 1% IRC CEA T-O |
| R107 | 9 027 405740 | 68.1 OHM MF 1/8W 1% IRC CEA T-O |
| R108 | 9 027 405150 | 1 KOHM MF 1/8W 1% IRC CEA T-O |
| R109 | 9 027 405780 | 1.21 KOHM MF 1/8W 1% IRC CEA T-O |
| R110 | 9 027 404850 | 56.2 OHM MF 1/8W 1% IRC CEA T-O |
| R111 | 9 027 405740 | 68.1 OHM MF 1/8W 1% IRC CEA T-O |
| R112 | 9 027 405150 | 1 KOHM MF 1/8W 1% IRC CEA T-O |
| R113 | 9 027 405780 | 1.21 KOHM MF 1/8W 1% IRC CEA T-O |
| R114 | 9 027 404850 | 56.2 OHM MF 1/8W 1% IRC CEA T-O |
| R115 | 9 027 405740 | 68.1 OHM MF 1/8W 1% IRC CEA T-O |
| R116 | 9 027 405150 | 1 KOHM MF 1/8W 1% IRC CEA T-O |
| R117 | 9 027 436970 | 301 OHM MF 1/8W 1% IRC CEA T-O |
| R118 | 9 027 492910 | 150 OHM MF 1/8W 1% CGW C-4 |
| R119 | 9 027 436970 | 301 OHM MF 1/8W 1% IRC CEA T-O |
| R120 | 9 027 492910 | 150 OHM MF 1/8W 1% CGW C-4 |
| R121 | 9 027 436970 | 301 OHM MF 1/8W 1% IRC CEA T-O |
| R122 | 9 027 492910 | 150 OHM MF 1/8W 1% CGW C-4 |
| R123 | 9 027 436970 | 301 OHM MF 1/8W 1% IRC CEA T-O |
| R124 | 9 027 492910 | 150 OHM MF 1/8W 1% CGW C-4 |
| R125 | 9 027 404870 | 90.9 OHM MF 1/8W 1% IRC CEA T-O |
| R126 | 9 030 406600 | 100 OHM MF 1/2W 1% IRC CEC |
| R127 | 9 030 417750 | 15 OHM 1/2 WATT 1% MF |
| R128 | 9 027 405210 | 1.54 KOHM MF 1/8W 1% IRC CEA T-O |
| R129 | 9 027 405040 | 348 OHM MF 1/8W 1% CGW C4 T-O |
| R130 | 9 051 407920 | 500 OHM 1T POT BEK 62P-K500 |
| R131 | 9 027 404890 | 100 OHM MF 1/8W 1% CGW C4 T-O |
| R132 | 9 027 404890 | 100 OHM MF 1/8W 1% CGW C4 T-O |
| R133 | 9 027 404890 | 100 OHM MF 1/8W 1% CGW C4 T-O |
| R134 | 9 027 436940 | 887 OHM MF 1/8W 1% IRC CEA T-O |
| R135 | 9 027 405910 | 4.02 KOHM MF 1/8W 1% IRC CEA T-O |
| R136 | 9 027 405220 | 2 KOHM MF 1/8W 1% IRC CEA T-O |
| R137 | 9 027 436980 | 499 OHM MF 1/8W 1% IRC CEA T-O |
| R138 | 9 027 404980 | 237 OHM MF 1/8W 1% IRC CEA T-O |
| R139 | 9 027 404950 | 75 OHM MF 1/8W 1% IRC CEA T-O |
| R140 | 9 027 437060 | 31.6 OHM MF 1/8W 1% IRC CEA T-O |
| R141 | 9 015 402130 | 220 OHM CC 1/4W 5% ABC CB |
| R142 | 9 015 402510 | 22 KOHM CC 1/4W 5% ABC CB |
| R143 | 9 015 402130 | 220 OHM CC 1/4W 5% ABC CB |
| R144 | 9 015 402200 | 510 OHM CC 1/4W 5% ABC CB |
| R145 | 9 027 405060 | 402 OHM MF 1/8W 1% CGW C-4 T-O |
| R146 | 9 027 405390 | 8.25 KOHM MF 1/8W 1% IRC CEA T-O |
| R147 | 9 027 404940 | 178 OHM MF 1/8W 1% IRC CEA T-O |
| R148 | 9 027 437130 | 80.6 OHM MF 1/8W 1% IRC CEA T-O |
| R149 | 9 027 405080 | 909 OHM MF 1/8W 1% IRC CEA T-O |
| R150 | 9 015 402380 | 4.7 KOHM CC 1/4W 5% ABC CB |
| R151 | 9 015 402420 | 62 OHM CC 1/4W 5% ABC CB |
| R152 | 9 015 402160 | 330 OHM CC 1/4W 5% ABC CB |
| R153 | 9 015 402700 | 360 OHM CC 1/4W 5% ABC CB |
| R154 | 9 015 402140 | 270 OHM CC 1/4W 5% ABC CB |
| R155 | 9 015 402330 | 2.4 KOHM CC 1/4W 5% ABC CB |
| R156 | 9 015 402090 | 100 OHM CC 1/4W 5% ABC CB |
| R157 | 9 015 402090 | 100 OHM CC 1/4W 5% ABC CB |
| R158 | 9 015 402100 | 120 OHM CC 1/4W 5% ABC CB |
| R159 | 9 015 402050 | 33 OHM CC 1/4W 5% ABC CB |
| R160 | 9 015 439730 | 5.1 OHM 1/4 WATT 5% CC |
| R161 | 9 015 439800 | 35 OHM 1/4 WATT 5% CC |
| R162 | 9 015 402300 | 1.8 KOHM CC 1/4W 5% ABC CB |
| R163 | 9 015 402320 | 2.2 KOHM CC 1/4W 5% ABC CB |
| R165 | 9 015 402320 | 2.2 KOHM CC 1/4W 5% ABC CB |

| REFDES | PART NUMBER | DESCRIPTION |
|--------|--------------|----------------------------------|
| R166 | 9 015 439410 | 240 OHM CC 1/4W 5% ABC CB |
| R167 | 9 015 402220 | 680 OHM CC 1/4W 5% ABC CB |
| R168 | 9 015 402860 | 130 OHM CC 1/4W 5% ABC CB |
| R169 | 9 015 402740 | 560 OHM CC 1/4W 5% ABC CB |
| R170 | 9 015 402130 | 220 OHM CC 1/4W 5% ABC CB |
| R171 | 9 015 402740 | 560 OHM CC 1/4W 5% ABC CB |
| R172 | 9 015 402200 | 510 OHM CC 1/4W 5% ABC CB |
| R173 | 9 015 402170 | 27 OHM CC 1/4W 5% ABC CB RR-0025 |
| R174 | 9 015 402020 | 10 OHM CC 1/4W 5% ABC CB |
| R175 | 9 027 405770 | 121 OHM MF 1/8W 1% IRC CEA T-O |
| R176 | 9 015 402170 | 27 OHM CC 1/4W 5% ABC CB RR-0025 |
| R177 | 9 015 402020 | 10 OHM CC 1/4W 5% ABC CB |
| R180 | 9 015 402200 | 510 OHM CC 1/4W 5% ABC CB |
| R181 | 9 015 402170 | 27 OHM CC 1/4W 5% ABC CB |
| R182 | 9 027 405770 | 121 OHM MF 1/8W 1% IRC CEA T-O |
| R183 | 9 015 402170 | 27 OHM CC 1/4W 5% ABC CB RR-0025 |
| R184 | 9 015 402020 | 10 OHM CC 1/4W 5% ABC CB |
| R185 | 9 015 439490 | 2.7 OHM CC 1/4W 5% ABC CB |
| R186 | 9 015 402710 | 51 OHM CC 1/4W 5% ABC CB |
| R191 | 9 015 402130 | 220 OHM CC 1/4W 5% ABC CB |
| R192 | 9 015 402090 | 100 OHM CC 1/4W 5% ABC CB |
| R1001 | 9 027 405180 | 1.33 KOHM MF 1/8W 1% IRC CEA T-O |
| R1002 | 9 027 404850 | 56.2 OHM MF 1/8W 1% IRC CEA T-O |
| R1003 | 9 027 404860 | 82.5 OHM MF 1/8W 1% IRC CEA T-O |
| R1004 | 9 027 405850 | 1.10 KOHM MF 1/8W 1% IRC CEA T-O |
| R1005 | 9 015 402380 | 4.7 KOHM CC 1/4W 5% ABC CB |
| R1006 | 9 015 402380 | 4.7 KOHM CC 1/4W 5% ABC CB |
| R1007 | 9 015 402590 | 6.2 KOHM CC 1/4W 5% ABC CB |
| R1008 | 9 015 402260 | 1 KOHM CC 1/4W 5% ABC CB |
| R1009 | 9 015 402020 | 10 OHM CC 1/4W 5% ABC CB |
| R1010 | 9 015 402020 | 10 OHM CC 1/4W 5% ABC CB |
| R1011 | 9 015 402090 | 100 OHM CC 1/4W 5% ABC CB |
| R201 | 9 027 405780 | 1.21 KOHM MF 1/8W 1% IRC CEA T-O |
| R202 | 9 027 404850 | 56.2 OHM MF 1/8W 1% IRC CEA T-O |
| R203 | 9 027 405740 | 68.1 OHM MF 1/8W 1% IRC CEA T-O |
| R204 | 9 027 405150 | 1 KOHM MF 1/8W 1% IRC CEA T-O |
| R205 | 9 027 405780 | 1.21 KOHM MF 1/8W 1% IRC CEA T-O |
| R206 | 9 027 404850 | 56.2 OHM MF 1/8W 1% IRC CEA T-O |
| R207 | 9 027 405740 | 68.1 OHM MF 1/8W 1% IRC CEA T-O |
| R208 | 9 027 405150 | 1 KOHM MF 1/8W 1% IRC CEA T-O |
| R209 | 9 027 405780 | 1.21 KOHM MF 1/8W 1% IRC CEA T-O |
| R210 | 9 027 404850 | 56.2 OHM MF 1/8W 1% IRC CEA T-O |
| R211 | 9 027 405740 | 68.1 OHM MF 1/8W 1% IRC CEA T-O |
| R212 | 9 027 405150 | 1 KOHM MF 1/8W 1% IRC CEA T-O |
| R213 | 9 027 405780 | 1.21 KOHM MF 1/8W 1% IRC CEA T-O |
| R214 | 9 027 404850 | 56.2 OHM MF 1/8W 1% IRC CEA T-O |
| R215 | 9 027 405740 | 68.1 OHM MF 1/8W 1% IRC CEA T-O |
| R216 | 9 027 405150 | 1 KOHM MF 1/8W 1% IRC CEA T-O |
| R217 | 9 027 436970 | 301 OHM MF 1/8W 1% IRC CEA T-O |
| R218 | 9 027 492910 | 150 OHM MF 1/8W 1% CGW C-4 |
| R219 | 9 027 436970 | 301 OHM MF 1/8W 1% IRC CEA T-O |
| R220 | 9 027 492910 | 150 OHM MF 1/8W 1% CGW C-4 |
| R221 | 9 027 436970 | 301 OHM MF 1/8W 1% CGW C-4 |
| R222 | 9 027 492910 | 150 OHM MF 1/8W 1% CGW C-4 |
| R223 | 9 027 436970 | 301 OHM MF 1/8W 1% IRC CEA T-O |
| R224 | 9 027 492910 | 150 OHM MF 1/8W 1% CGW C-4 |
| R225 | 9 027 404870 | 90.9 OHM MF 1/8W 1% IRC CEA T-O |
| R226 | 9 030 406600 | 100 OHM MF 1/2W 1% IRC CEC |
| R227 | 9 030 417750 | 15 OHM 1/2 WATT 1% MF |
| R228 | 9 027 405210 | 1.54 KOHM MF 1/8W 1% IRC CEA T-O |
| R229 | 9 027 405040 | 348 OHM MF 1/8W 1% CGW C4 T-O |
| R230 | 9 051 407920 | 500 OHM 1T POT BEK 62P-K500 |
| R231 | 9 027 404890 | 100 OHM MF 1/8W 1% CGW C4 T-O |
| R232 | 9 027 404890 | 100 OHM MF 1/8W 1% CGW C4 T-O |
| R233 | 9 027 404890 | 100 OHM MF 1/8W 1% CGW C4 T-O |
| R234 | 9 027 436940 | 887 OHM MF 1/8W 1% IRC CEA T-O |
| R235 | 9 027 405910 | 4.02 KOHM MF 1/8W 1% IRC CEA T-O |
| R236 | 9 027 405220 | 2 KOHM MF 1/8W 1% IRC CEA T-O |
| R237 | 9 027 436980 | 499 OHM MF 1/8W 1% IRC CEA T-O |
| R238 | 9 027 404980 | 237 OHM MF 1/8W 1% IRC CEA T-O |
| R239 | 9 027 404950 | 75 OHM MF 1/8W 1% IRC CEA T-O |
| R240 | 9 027 437060 | 31.6 OHM MF 1/8W 1% IRC CEA T-O |
| R241 | 9 015 402130 | 220 OHM CC 1/4W 5% ABC CB |
| R242 | 9 015 402510 | 22 KOHM CC 1/4W 5% ABC CB |

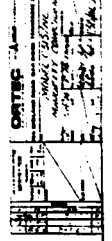
Replaceable Parts List (continued)

C315/NL-0200 C315/NL-0200 PC 8D

| REFCES | PART NUMBER | DESCRIPTION |
|--------|--------------|----------------------------------|
| R243 | 9 015 402130 | 220 OHM CC 1/4w 5% ABC CB |
| R244 | 9 015 402200 | 510 OHM CC 1/4w 5% ABC CB |
| R245 | 9 027 405060 | 402 OHM MF 1/8w 1% IRC CEA T-0 |
| R246 | 9 027 405390 | 0.25 KOHM MF 1/8w 1% IRC CEA T-0 |
| R247 | 9 027 404940 | 178 OHM MF 1/8w 1% IRC CEA T-0 |
| R248 | 9 027 437130 | 80.6 OHM MF 1/8w 1% IRC CEA T-0 |
| R249 | 9 027 405080 | 909 OHM MF 1/8w 1% IRC CEA T-C |
| R250 | 9 015 402360 | 4.7 KOHM CC 1/4w 5% ABC CB |
| R251 | 9 015 402820 | 62 OHM CC 1/4w 5% ABC CB |
| R252 | 9 015 402160 | 330 OHM CC 1/4w 5% ABC CB |
| R253 | 9 015 402700 | 360 OHM CC 1/4w 5% ABC CB RR0051 |
| R254 | 9 015 402140 | 270 OHM CC 1/4w 5% ABC CB |
| R255 | 9 015 402330 | 2.4 KOHM CC 1/4w 5% ABC CB |
| R256 | 9 015 402090 | 100 OHM CC 1/4w 5% ABC CB |
| R257 | 9 015 402090 | 100 OHM CC 1/4w 5% ABC CB |
| R258 | 9 015 402100 | 120 OHM CC 1/4w 5% ABC CB |
| R259 | 9 015 402050 | 33 OHM CC 1/4w 5% ABC CB |
| R260 | 9 015 439730 | 5.1 OHM 1/4 WATT 5% CC |
| R261 | 9 015 439800 | 36 OHM 1/4 WATT 5% CC |
| R262 | 9 015 402300 | 1.8 KOHM CC 1/4w 5% ABC CB |
| R263 | 9 015 402320 | 2.2 KOHM CC 1/4w 5% ABC CB |
| R265 | 9 015 402320 | 2.2 KOHM CC 1/4w 5% ABC CB |
| R266 | 9 015 439410 | 240 OHM CC 1/4w 5% ABC CB |
| R267 | 9 015 402220 | 680 OHM CC 1/4w 5% ABC CB |
| R268 | 9 015 402860 | 130 OHM CC 1/4w 5% ABC CB |
| R269 | 9 015 402740 | 560 OHM CC 1/4w 5% ABC CB |
| R270 | 9 015 402130 | 220 OHM CC 1/4w 5% ABC CB |
| R271 | 9 015 402740 | 560 OHM CC 1/4w 5% ABC CB |
| R272 | 9 015 402200 | 510 OHM CC 1/4w 5% ABC CB |
| R273 | 9 015 402170 | 27 OHM CC 1/4w 5% ABC CB RR-0025 |
| R274 | 9 015 402020 | 10 OHM CC 1/4w 5% ABC CB |
| R275 | 9 027 405770 | 121 OHM MF 1/8w 1% IRC CEA T-0 |
| R276 | 9 015 402170 | 27 OHM CC 1/4w 5% ABC CB RR-0025 |
| R277 | 9 015 402020 | 10 OHM CC 1/4w 5% ABC CB |
| R280 | 9 015 402200 | 510 OHM CC 1/4w 5% ABC CB |
| R281 | 9 015 402170 | 27 OHM CC 1/4w 5% ABC CB RR-0025 |
| R282 | 9 027 405770 | 121 OHM MF 1/8w 1% IRC CEA T-0 |
| R283 | 9 015 402170 | 27 OHM CC 1/4w 5% ABC CB RR-0025 |
| R284 | 9 015 402020 | 10 OHM CC 1/4w 5% ABC CB |
| R285 | 9 015 439480 | 620 KOHM CC 1/4w 5% ABC CB |
| R286 | 9 015 402710 | 51 OHM CC 1/4w 5% ABC CB |
| R291 | 9 015 402130 | 220 OHM CC 1/4w 5% ABC CB |
| R292 | 9 015 402090 | 100 OHM CC 1/4w 5% ABC CB |
| R2001 | 9 027 405180 | 1.33 KOHM MF 1/8w 1% IRC CEA T-0 |
| R2002 | 9 027 404850 | 56.2 OHM MF 1/8w 1% IRC CEA T-0 |
| R2003 | 9 027 404860 | 82.5 OHM MF 1/8w 1% IRC CEA T-0 |
| R2004 | 9 027 405850 | 1.10 KOHM MF 1/8w 1% IRC CEA T-0 |
| R2005 | 9 015 402380 | 4.7 KOHM CC 1/4w 5% ABC CB |
| R2006 | 9 015 402380 | 4.7 KOHM CC 1/4w 5% ABC CB |
| R2007 | 9 015 402590 | 6.2 KOHM CC 1/4w 5% ABC CB |
| R2008 | 9 015 402260 | 1 KOHM CC 1/4w 5% ABC CB |
| R2009 | 9 015 402020 | 10 OHM CC 1/4w 5% ABC CB |
| R2010 | 9 015 402020 | 10 OHM CC 1/4w 5% ABC CB |
| R2011 | 9 015 402090 | 100 OHM CC 1/4w 5% ABC CB |
| 7 176 | 653570 | C315/NL-0201 PC 8D |



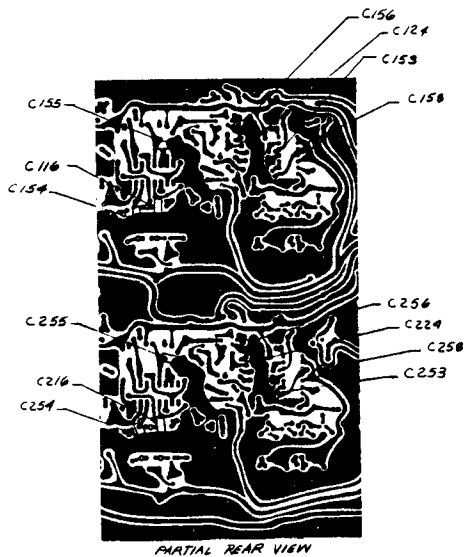
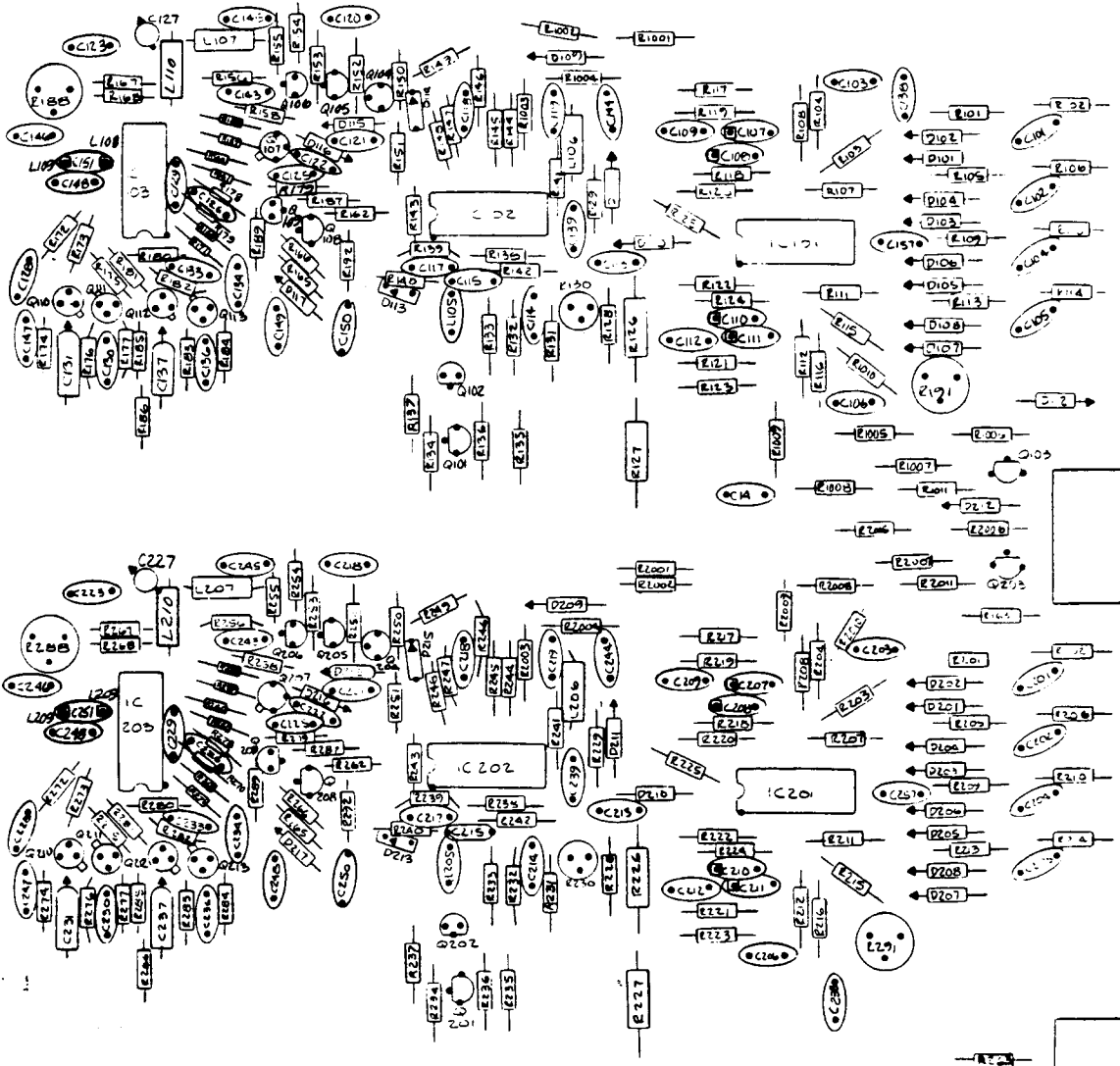
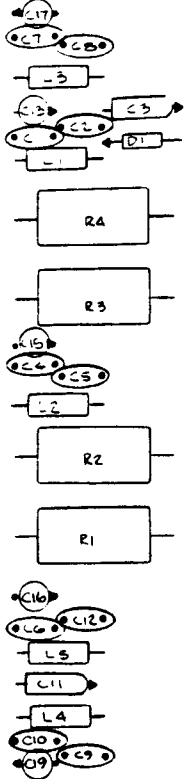
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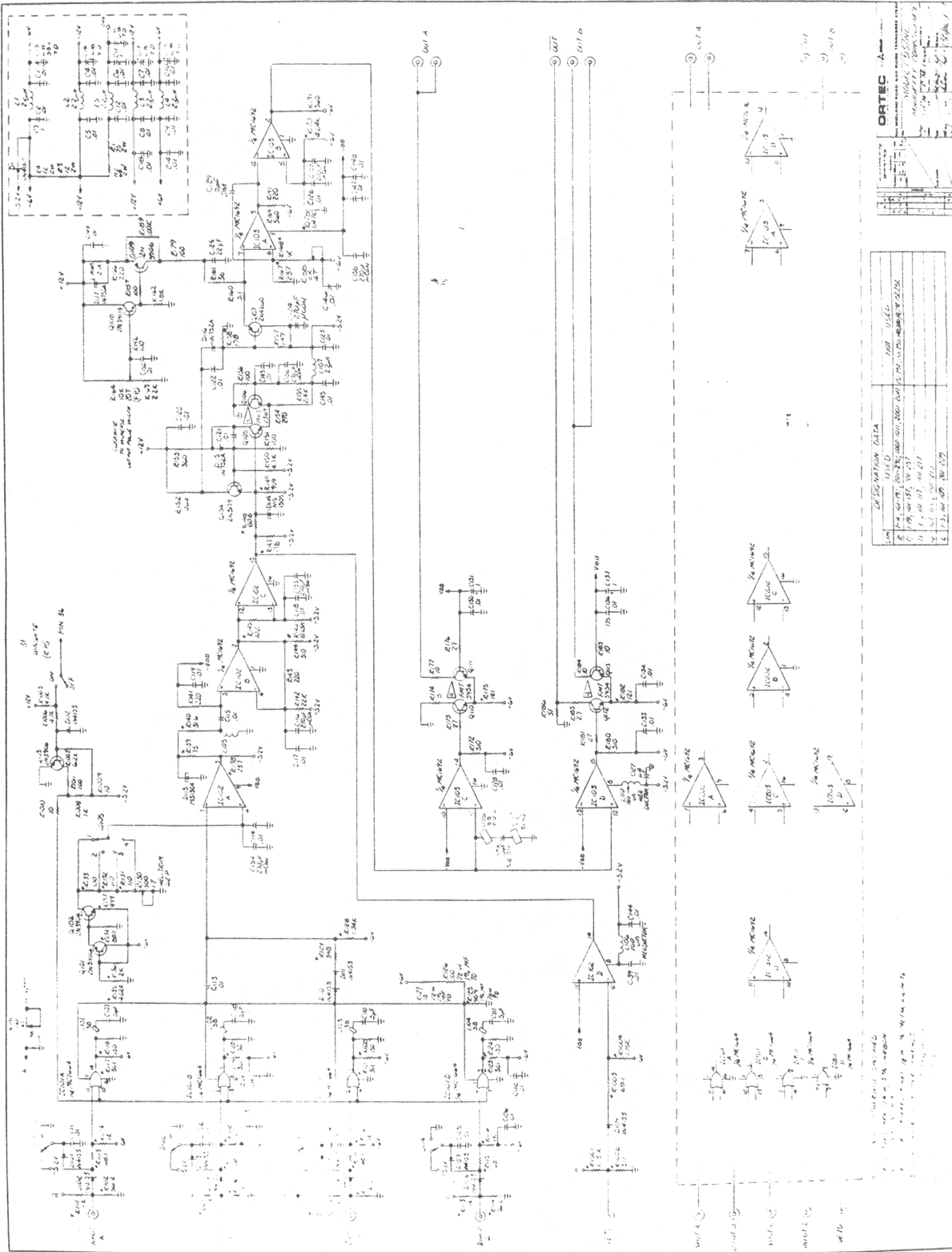
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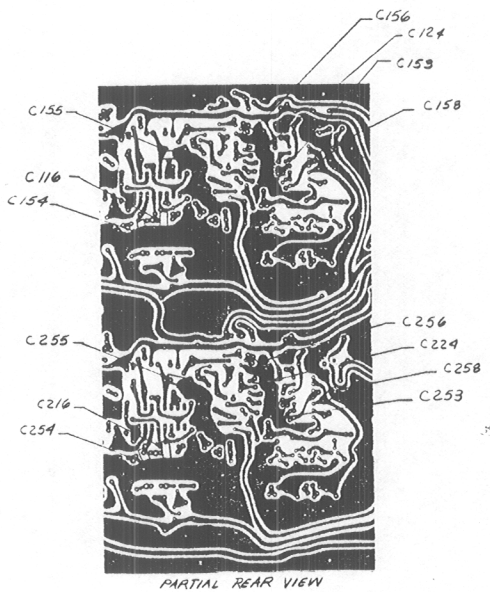
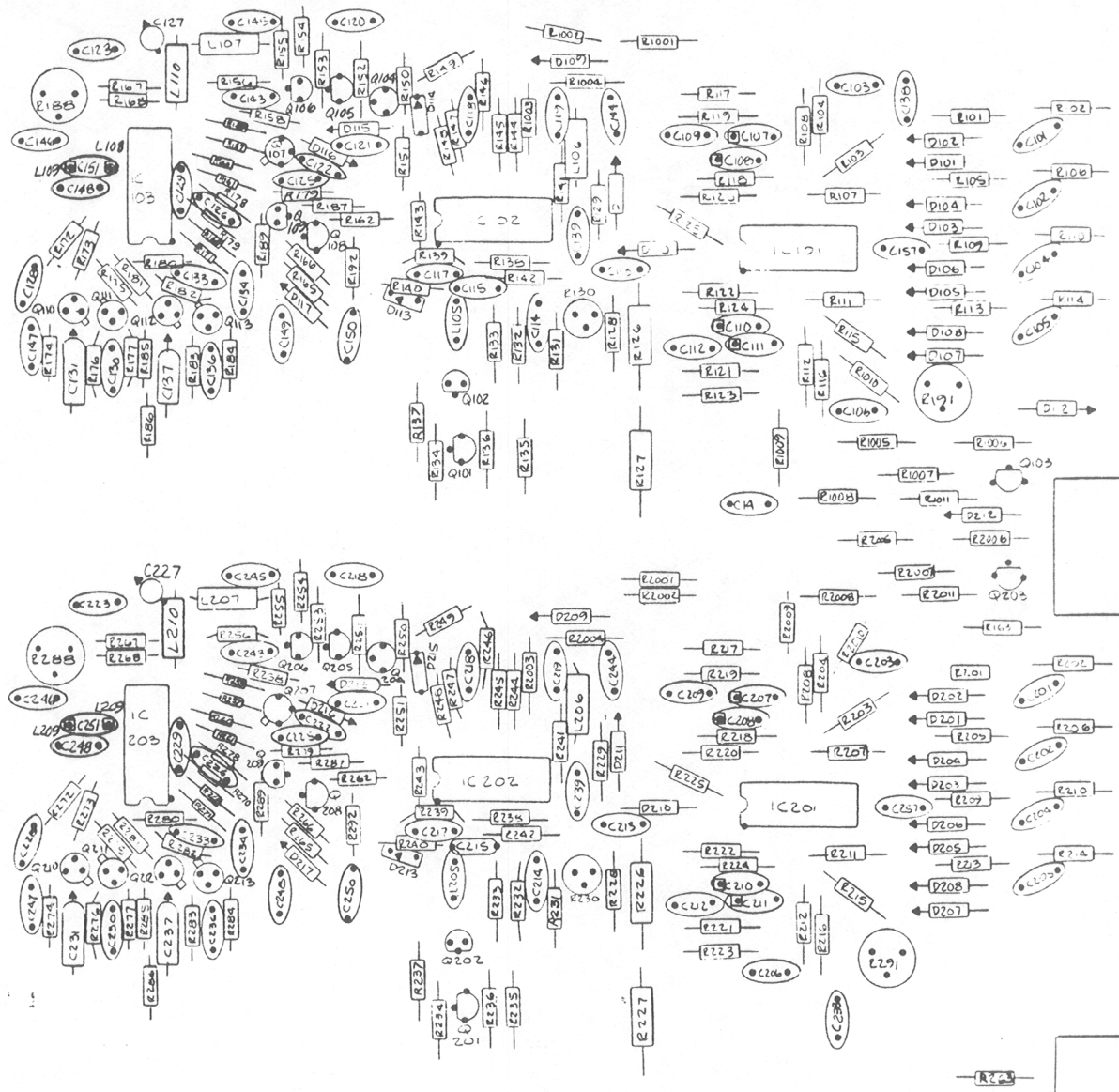
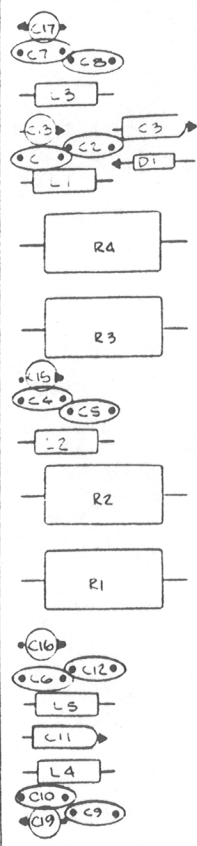
C315-2201 B



PARTIAL REAR VIEW



C315-0201 B



PARTIAL REAR VIEW