

TYPE 4211
X PRE-AMPLIFIER PLUG-IN
INSTRUCTION MANUAL

DU MONT

ALLEN B. DU MONT LABORATORIES, Clifton, N. J.

DIVISIONS OF

FAIRCHILD
CAMERA AND INSTRUMENT
CORPORATION

**TYPE 4211
X PRE-AMPLIFIER PLUG-IN
INSTRUCTION MANUAL**

Serial No. 150



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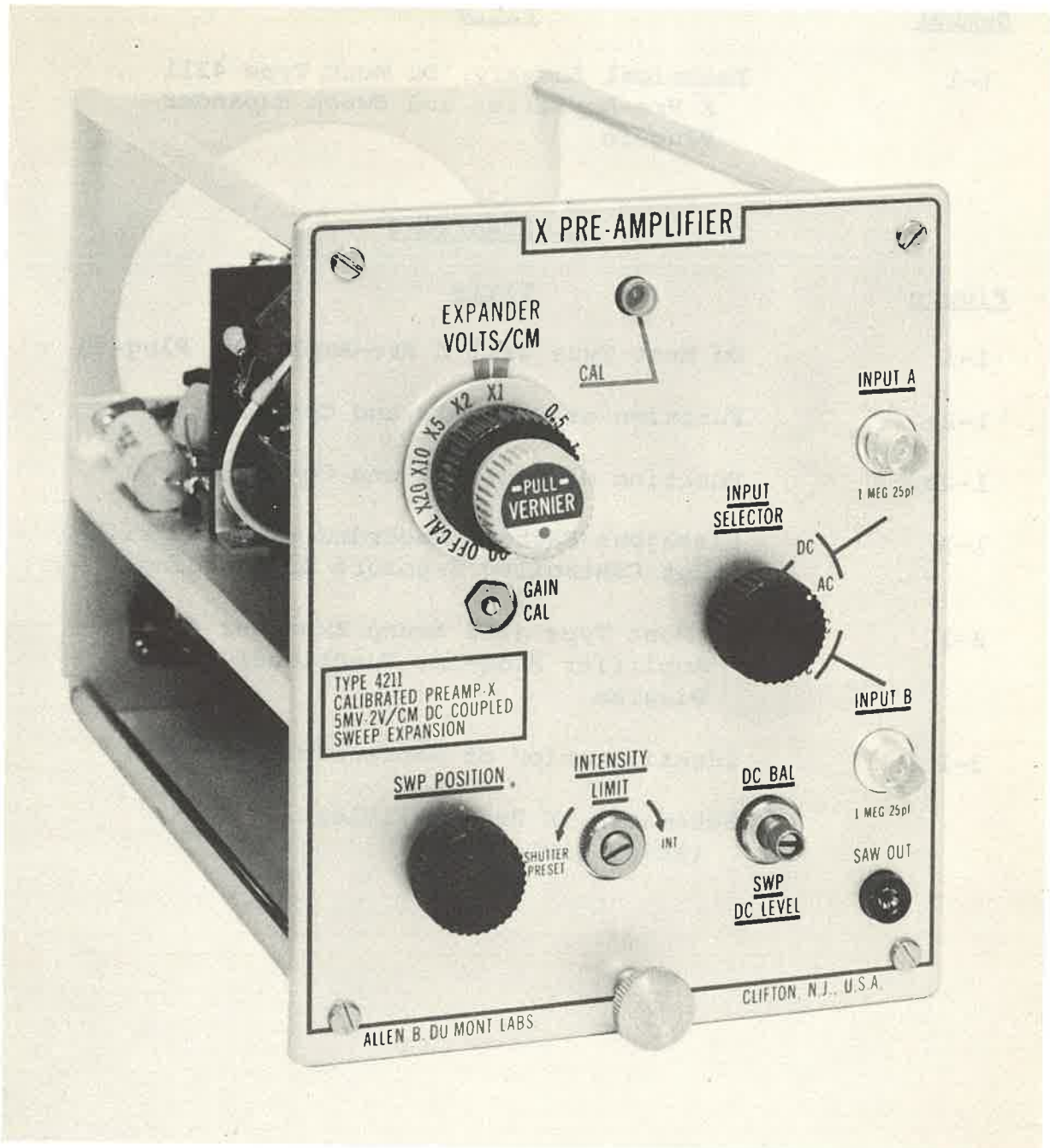


FIGURE 1-1. DU MONT TYPE 4211 X PRE-AMPLIFIER PLUG-IN

SECTION 1

OPERATING INSTRUCTIONS

1-1. INTRODUCTION

The Du Mont Type 4211 X Pre-Amplifier and Sweep Expander Plug-in is used with the horizontal amplifier of the Du Mont Type 425 Oscilloscope for investigation requiring X-Y displays with highly stable, wide-band characteristics. The Type 4211 provides 6 attenuator positions from 500 millivolts/cm to 20 volts/cm with constant input impedance. OFF and CAL positions are also provided. The X5 setting of the EXPAND switch on the Type 425 Oscilloscope applies to all settings of the Type 4211 attenuator (VOLTS/CM switch).

Two inputs are provided on this plug-in, enabling the investigation of two phenomena without the necessity of connecting or disconnecting input signal cables or probes.

The Type 4211 permits the time-shared display of an X-Y plot and a normal time base pattern, making it possible to see both an amplitude-frequency plot and a phase-frequency plot on screen at the same time.

The EXPAND switch on the Type 425 Oscilloscope permits expansion of the Main Sweep for sweep magnification from 1 to 100 times. This provides an effective sweep delay with high accuracy, and a maximum sweep rate of 0.01 microsecond/cm.

1-2. TECHNICAL SUMMARY

The electrical and physical characteristics of the Type 4211 X Pre-Amplifier and Sweep Expander are listed in Table 1-1 which follows.

TABLE 1-1

TECHNICAL SUMMARY

DU MONT TYPE 4211

X PRE-AMPLIFIER AND SWEEP EXPANDER PLUG-IN

X PRE-AMPLIFIER

(Specified with Main Frame EXPAND switch set to x1 and using deflection of ± 4 centimeters from screen center)

Bandwidth	DC to 1.5 megacycles, down 3 db ± 2 db
Rise Time	Nominally 0.23 microsecond
Input Attenuator and Sensitivity	From 500 millivolts/cm to 20 volts/cm in 6 positions of 1, 2, and 5 sequence. The EXPAND switch on the Main Frame will increase sensitivity to 0.1 volt/cm with a small loss of bandwidth
VERNIER Gain Control	This control is provided to give continuous overlap between attenuator steps. A push-pull switch assures calibrated X Pre-Amplifier setting. The CAL Indicator goes out when VERNIER switch is activated for uncalibrated operation
Inputs	2 BNC type connectors, UG-625/U, are provided. An INPUT SELECTOR switch will permit choice of A or B INPUT with AC or DC coupling. With AC coupling, response is down less than 3 db at 10 cycles

TABLE 1-1. TECHNICAL SUMMARY (Continued)

X PRE-AMPLIFIER (continued)	
Input Impedance	1 megohm, $\pm 2\%$ shunted by 28 pf, ± 2 pf. Input impedance is nominally constant on all attenuator ranges
INTENSITY LIMIT Control	This control is provided to permit adjustment of maximum beam brightness and thereby minimize danger of damaging the cathode-ray tube screen while X-Y plotting
Electronic Shutter (Selective beam brightening)	An electronic SHUTTER PRESET position is provided on the INTENSITY LIMIT control so that the Main Frame Sweep beam-brightening gate may be used to intensify all or selected portions of the X-Y display. The Main Sweep may be triggered from the vertical signal and only the desired parameter may be selected for display on screen. Effect of hum may be minimized, multiple displays simplified and CRT screen protection is provided when X-Y deflection signals are removed
Calibration Signal	The pre-amplifier attenuator is provided with a calibrated position permitting 4-centimeter calibration of the amplifier system regardless of attenuator accuracy. This trapezoidal waveform may be used to calibrate the time axis wherever the power-line frequency is a controlled standard. Accuracy, $\pm 2\%$

TABLE 1-1. TECHNICAL SUMMARY (Concluded)

SWEEP EXPANDER

Main Sweep Expansion

The Main Frame Sweep may be expanded by 1 to 20 times in 1, 2, and 5 sequence. An additional x5 expansion on the Main Frame will permit any 1% portion of the normal sweep to be displayed full screen. (Expansion by x100.)

Sweep Expansion Ranges

20 microseconds/cm. Sweep speeds faster than 10 microseconds/cm may be achieved with some loss in sweep linearity

Sweep Position

A ten-turn SWP position control is provided on the plug-in panel to simplify and assure accurate positioning of displays expanded to 100 times

Main SAW OUT

A pin jack is provided on the plug-in panel to permit access to the Main Sweep voltage. A sawtooth waveform equal in time to the Main Sweep is available. Amplitude is greater than 20 volts positive into an impedance of 1 megohm shunted by less than 15 pf. The base voltage is nominally ground within ± 5 volts

1-3. FIRST-TIME OPERATION (Figures 1-2a and 1-2b)

Unless otherwise designated, it is presumed that the Du Mont Type 4201 Y Pre-Amplifier Plug-in is inserted in the Y cavity of the Main Frame. In the instructions which follow, capital letters within the text indicate front-panel controls, connectors, or settings. Refer to Figures 1-2a and 1-2b for a brief description of the front-panel controls and connectors.

1-4. INPUT COUPLING SELECTION

Two inputs are provided on this plug-in, enabling the investigation of two phenomena without the necessity of connecting or disconnecting input signal cables or probes.

The AC/DC position of the INPUT SELECTOR switch permits choice of retaining the dc level of the externally applied INPUT signal or blocking the dc component of the INPUT signal by inserting a capacitor in series with the INPUT. If it is desired to display both the ac and dc components of a signal, set the INPUT SELECTOR switch to DC. Thus, the position of the display at any instant is a function of the instantaneous signal voltage with respect to ground.

There are times when it is neither necessary nor desirable to display the dc component of the input waveform. A capacitor placed in series with the input connector will exclude the dc component while simultaneously permitting the ac component to be displayed. This is accomplished when the INPUT SELECTOR switch is set to AC. In this instance, the effect of the dc component is excluded from the display. It should be noted that when the INPUT SELECTOR switch is set to the AC position, the lower frequency limit (3 db) of the amplifier is about 10 cycles. Therefore, some low-frequency distortion and loss of amplitude will occur if the pattern on display contains frequency components below the specified cutoff.

1-5. DC BAL ADJUSTMENT

If the dc balance of the Type 4211 Pre-Amplifier is not properly adjusted, the reference trace on the screen will be depositions when the VERNIER control is rotated. To properly adjust the DC BAL front-panel screwdriver control, proceed as follows:

1. Set DISPLAY LOGIC switch to MAIN SWP and adjust Y Pre-Amplifier and Main Frame controls to display the calibrator pattern.

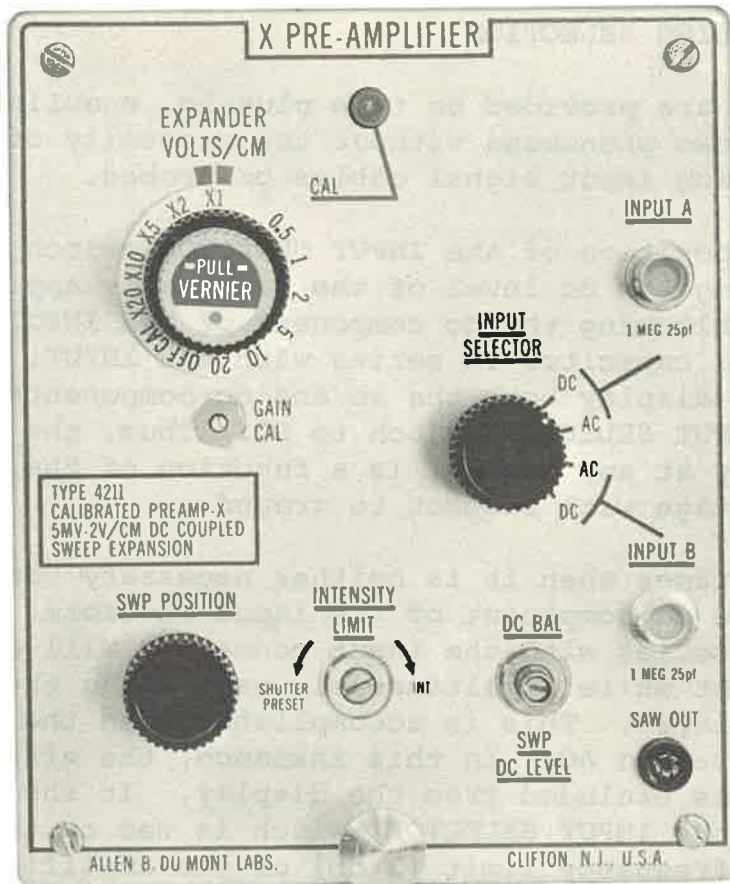
EXPANDER SWITCHVOLTS/CM

The VOLTS/CM sector provides calibrated attenuators variable from 0.5 v/div to 20 v/div in 6 steps; OFF and CAL positions also provided

The EXPANDER sector provides expansion of the Main Sweep by factors of 1, 2, 5, and 20. An additional X5 expansion on the Main Frame will permit any 1% portion of the normal sweep to be displayed full screen (expansion up to 100)

VERNIER

Control with switch: provides continuous overlap between attenuator steps; push-pull switch assures calibrated X Pre-amplifier setting

INPUT A OR B

BNC connector: for applying external signals to the input of the X Pre-amplifier, 1M, 25 pf

SAW OUT

Pin jack: provides a positive saw signal coincident with the Main Sweep; 20V, 1M, 15 pf

INTENSITY LIMIT

Control with switch: limits beam brightness while X-Y plotting. SHUTTER PRESET position permits all or selected portions (strobe) of the X-Y display to be intensified

FIGURE 1-2a. FUNCTION OF CONTROLS AND CONNECTORS

CAL

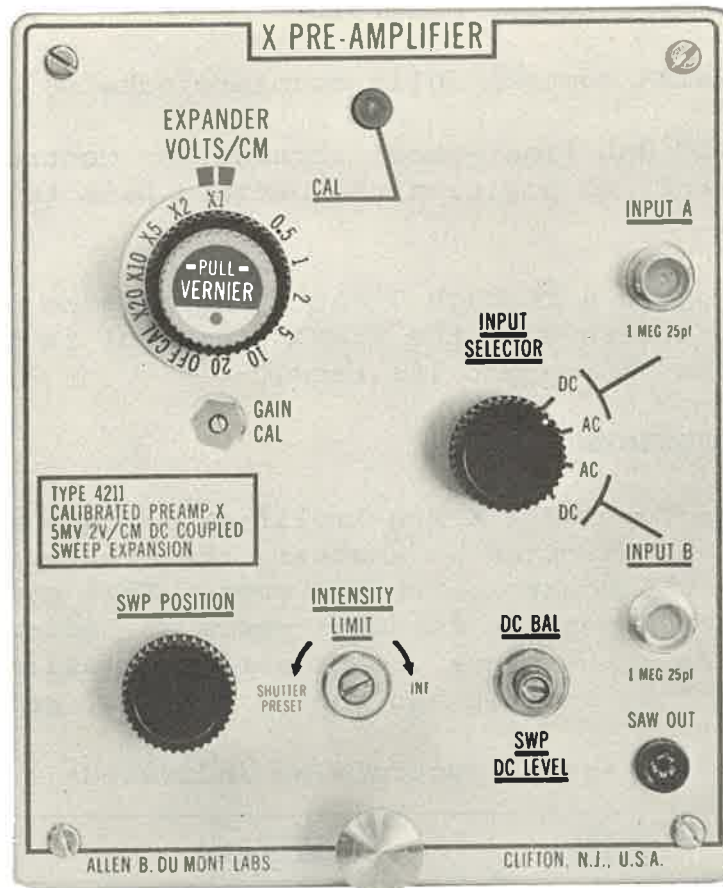
Lamp: lighted condition indicates calibrated X Amplifier operation; off condition serves as a warning indicator when VERNIER switch is activated for uncalibrated operation

GAIN CAL

Screwdriver control: used to normalize the gain between the Plug-in unit and the Main Frame

SWP POSITION

Control: a ten-turn potentiometer is provided to simplify and assure accurate positioning of displays expanded up to 100 times

INPUT SELECTOR

Switch: selects either of two INPUT signals (A or B) with or without a dc blocking capacitor

DC BAL

Screwdriver control: when properly adjusted, prevents deposition of the pattern when VERNIER control is varied

SWP DC LEVEL

Screwdriver control: when properly adjusted, the horizontal display will be positioned to the center of the screen

FIGURE 1-2b. FUNCTION OF CONTROLS AND CONNECTORS

2. Set DISPLAY LOGIC switch to X AMP.
3. Set VOLTS/CM switch on the X Plug-in to OFF. A vertical line should be displayed on the screen.
4. Pull out VERNIER control on the X Plug-in and set this control fully clockwise.
5. Reposition pattern to center of the screen with the PATTERN POSITIONING control.
6. Set VERNIER control fully counterclockwise.
7. Adjust DC BAL front-panel screwdriver control (inner adjustment) to position the pattern back to screen center.
8. Repeat steps 4 through 7 until there is no deposition of the pattern when the VERNIER control is rotated back and forth throughout its range.

1-6. GAIN CAL ADJUSTMENT

Whenever the Type 4211 X Pre-Amplifier is removed from the Main Frame and inserted in another, the front-panel screwdriver GAIN CAL control must be reset. This procedure is necessary to compensate for difference in deflection plate sensitivities. Therefore, to properly normalize the gain between the Plug-in Unit and the Main Frame, proceed as follows:

1. Preset front-panel controls as indicated:

<u>CONTROL</u>	<u>SETTING</u>
MAIN FRAME	
DISPLAY LOGIC	X AMP
TRIGGER MODE	AUTO SLOW
TRIG LEVEL	PRESET
TRIGGER SOURCE	+LINE
Y PLUG-IN	
VOLTS/CM	OFF
X PRE-AMPLIFIER	
VOLTS/CM	CAL
VERNIER	Pushed in to CAL

A horizontal line should now be displayed on the screen.

2. Adjust GAIN CAL control for precisely 4 centimeters of horizontal deflection.

The VERNIER gain control is provided to give continuous overlap between attenuator steps. A push-pull switch assures calibrated X Pre-Amplifier setting. The CAL Indicator goes out when VERNIER switch is activated for uncalibrated operation.

1-7. X-Y DISPLAYS AND ELECTRONIC SHUTTER

a. INTRODUCTION

When desiring to view one voltage plotted against another (not the internal time base) apply the Y signal to the INPUT A connector on the Y Plug-in and the X signal to the INPUT A or B connector on the X Plug-in. Adjust the VOLTS/CM switch to obtain an appropriate display on the CRT screen. It will be necessary to set the INTENSITY LIMIT control to INT to obtain "steady" intensity". Keep the intensity low to avoid screen damage.

X-Y plots obtained from transducers on rotating machinery, or other sources supplying a family of curves, may be difficult to interpret. For these cases, set the INTENSITY LIMIT control to SHUTTER PRESET. The Main SWEEP RATE switch then may be used as an "electronic shutter" timing selector which will brighten the display for a period of nominally 10.5 times the sweep rate indicated. Exact timing may be controlled with the Main Sweep VERNIER control and precisely measured with a counter as described in the paragraph entitled "Gate Output."

The starting point of the illuminated or "strobed" section of the X-Y display may be adjusted with the TRIG LEVEL control. AC, ACF, or DC coupled triggering from Y Channel internal, line frequency, or an external source related to the device under test, may be selected with the TRIGGER switches.

b. PHOTO-RECORDING APPLICATIONS

When the oscilloscope is used to record X-Y displays (without use of the internal time base) the saw generator remains inoperative. If it is triggered from an external source, a normal unblanking gate pulse will be produced. To use this unblanking gate pulse for controlling a photographic exposure (an electronic shutter) proceed as follows.

Set the sweep range and vernier controls equal to the desired exposure time. Set the INTENSITY control so that the trace is blanked. Open the camera shutter on "Bulb" or "Time" and apply the sweep trigger pulse. Close the camera shutter. Figures 1-3 (a) and 1-3 (b) show a drifting Lissajous pattern with and without controlled exposure brightening.

This is an extremely useful technique for recording the output of one transducer versus another, particularly when the phenomenon is non-cyclical. For example, the strain at one point in a mechanical system may be plotted against the velocity, acceleration, or displacement of some member or the prime mover of the system. Wherever the phase of the Y signal is changing relative to the phase of the X signal, this electronically controlled exposure technique is useful.

The start of the exposure can sometimes be controlled by one of the two signals being displayed. For example, the sweep controls can be set for internal triggering and the trigger sensitivity set so that when the Y signal reaches a set amplitude, the unblanking pulse will occur. Or, one may wish to start the exposure when the X or Y signal reaches its maximum rate of change. In this case the signal can be differentiated and the differentiated signal used to initiate the sweep trigger (through the external trigger input circuit).

Finally, the intensity modulation input of the oscilloscope (Z Input) can also be used for controlled exposure brightening (or blanking) of varying or drifting patterns. In this case the exposure control pulse must be taken from an external source, such as a pulse generator.

In using any form of electronically controlled blanking or trace brightening, it should be remembered that the camera mechanical shutter must be fully opened before triggering the gate pulse generator. The most common method of taking a photograph with electronic trace brightening is to use a "Bulb" or "Time" exposure, as previously mentioned.

If the oscilloscope camera shutter has "synchro" contacts, these contacts may be used to initiate the trace brightening, or to arm the oscilloscope sweep circuit. Thus, one may set the camera shutter to some "instantaneous" value from

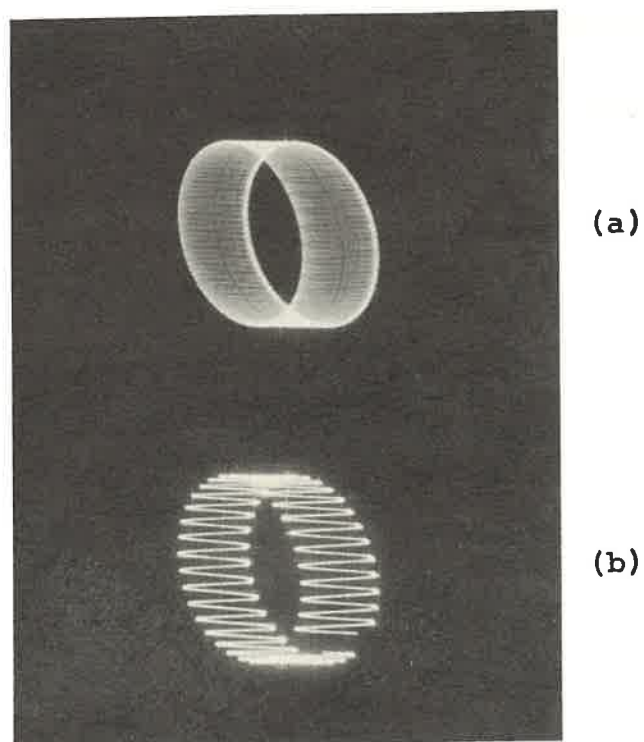


FIGURE 1-3. LISSAJOUS PATTERN RECORDED WITH AND WITHOUT CONTROLLED EXPOSURE BRIGHTENING

- (a) X-Y Lissajous Pattern is Blurred Because Varying phase Causes Drift**
- (b) Same Pattern as (a) Photographed Using Electronic Exposure Brightening**

1 second to 1/100 second and use the shutter contacts to initiate the actual electronically controlled exposure.

1-8. SAWTOOTH OUTPUT

A front-panel pin jack labelled SAW OUT, provides a positive-going saw of more than 20 volts amplitude. The saw output is referenced within ± 5 volts of ground and is time-coincident with the sweep.

The sawtooth may be used for initiating delayed activities, controlling an X-Y plotter, or acting as a time base for associated analog equipment. The sawtooth output should not be loaded by impedance to ground of less than 100,000 ohms shunted by no more than 15 pf. Voltage take-off through a Du Mont Type 4290 or 4298 Attenuator Probe is recommended.

1-9. MAIN FRAME GATE OUTPUT

A positive gate coincident with the Main Sweep output is available on a front-panel BNC connector labelled GATE OUT on the Main Frame. This positive pulse may be used to trigger other devices in order to achieve sufficient delay to view the output of such devices completely displayed on the oscilloscope.

The period of the positive gate may, of course, be measured extremely accurately with an electronic counter. Since the period of the gate output is a direct measure of total sweep time, it is possible to use this oscilloscope in conjunction with a counter to digitize the time duration of input signals. Use of the SWEEP RATE and the VERNIER controls will permit the operator to display the waveform to be measured over the entire sweep. Timing accuracies of 1 part in 10^7 are thus readily obtainable.

1-10. SWEEP EXPANSION

The EXPANDER sector of the VOLTS/CM switch provides magnification of the Main Sweep by factors of 1, 2, 5, 10, and 20. The EXPAND switch on the Type 425 Oscilloscope permits expansion of the Main Sweep for sweep magnification from 1 to 100 times. This provides an effective sweep delay with high accuracy, and a maximum sweep rate of 0.01 microsecond/cm. A ten-turn SWP POSITION control is provided on the Type 4211 panel to simplify and assure accurate positioning of Main Sweep displays expanded to 100 times. This control is

disconnected when sweep expansion is not employed. However, the Main Frame EXPAND switch applies to all settings of the Type 4211 Attenuator switch (including the EXPANDER sector).

1-11. INTRODUCTION TO THE DU MONT TYPE 4213 RASTER DISPLAY PLUG-IN

The Du Mont Type 4213 Plug-in Unit is a triangular time base generator. It consists of a crystal controlled oscillator, a Schmitt Trigger Generator, an RC integrator, and an amplifier. The oscillator generates a sinusoidal waveform at 5 different frequencies of 50 Kc, 100 Kc, 250 Kc, 500 Kc and 1 Mc. The sine wave is then applied to the Schmitt Trigger and the output, which is a rectangular pulse, is integrated. The output of the integrator is a triangular waveform which is then amplified and applied to X deflection plates.

This plug-in unit, together with the Du Mont Type 4211 X Pre-Amplifier Plug-in, provides a very accurately calibrated time base which has an equivalent screen diameter many times that of the CRT. Therefore, these plug-ins may be used to observe the rise time and duration of a pulse and a train of pulses simultaneously. The Type 4211 X Pre-Amplifier Plug-in provides additional gain required to drive the horizontal deflection plates. It also brings the Main Frame Sweep to front panel pin jack labelled SAW OUT so that it may be connected to the Y Amplifier of the Type 4213. The Lissajous figure as a result of the X-Y plot between the triangular time base and the Main Frame Sweep is a series of triangular waveforms displaced in the horizontal direction. Each side of the triangle represents time in microseconds as indicated by the TIME/LINE switch. An external signal may now be injected into the Y Amplifier of the Type 4213 and superimposed on the triangular waveforms.

Additional information will be found in the Du Mont Type 4213 Raster Display Plug-in Instruction Manual.

SECTION 2

MAINTENANCE AND RECALIBRATION

2-1. INTRODUCTION

This section of the Instruction Manual contains the circuit description, trouble-shooting instructions, and calibrating procedures for the Du Mont Type 4211 X Pre-Amplifier Plug-in.

2-2. CIRCUIT DESCRIPTION (Figure 2-1)

a. INPUT CIRCUIT

In the discussion to follow, emphasis is placed on the interrelation of circuits rather than on detail of operation. It is also recommended that the schematics at the rear of the manual be referred to in following the circuit description.

Either of two BNC inputs connects the signal to the grid of the input cathode follower, V801A, through the INPUT SELECTOR and VOLTS/CM switches. Each X Input presents an impedance of 1 megohm and 28 picofarads to the signal source. When the INPUT SELECTOR switch is set to AC on either INPUT A or INPUT B, a capacitor is inserted in series with the input, thereby blocking the dc component of the waveform and allowing only the ac component to be displayed. The INPUT SELECTOR switch enables the operator to connect two signals, one to each input, and switch from one input to the other without removing and reconnecting the input signal leads.

The VOLTS/CM sector of switch S802 consists of compensated RC attenuators permitting the desired attenuation of the input signal in 6 steps from 500 millivolts to 20 volts per centimeter. The EXPAND switch on the Main Frame will increase sensitivity to 0.1 volts/cm with a small loss of bandwidth.

In the CAL position, the calibrator signal is applied to the input cathode follower, V801, and may be used to facilitate calibration check. When gains are normalized, the peak-to-peak value of the calibrated waveform will indicate 4 centimeters of horizontal deflection on the screen.

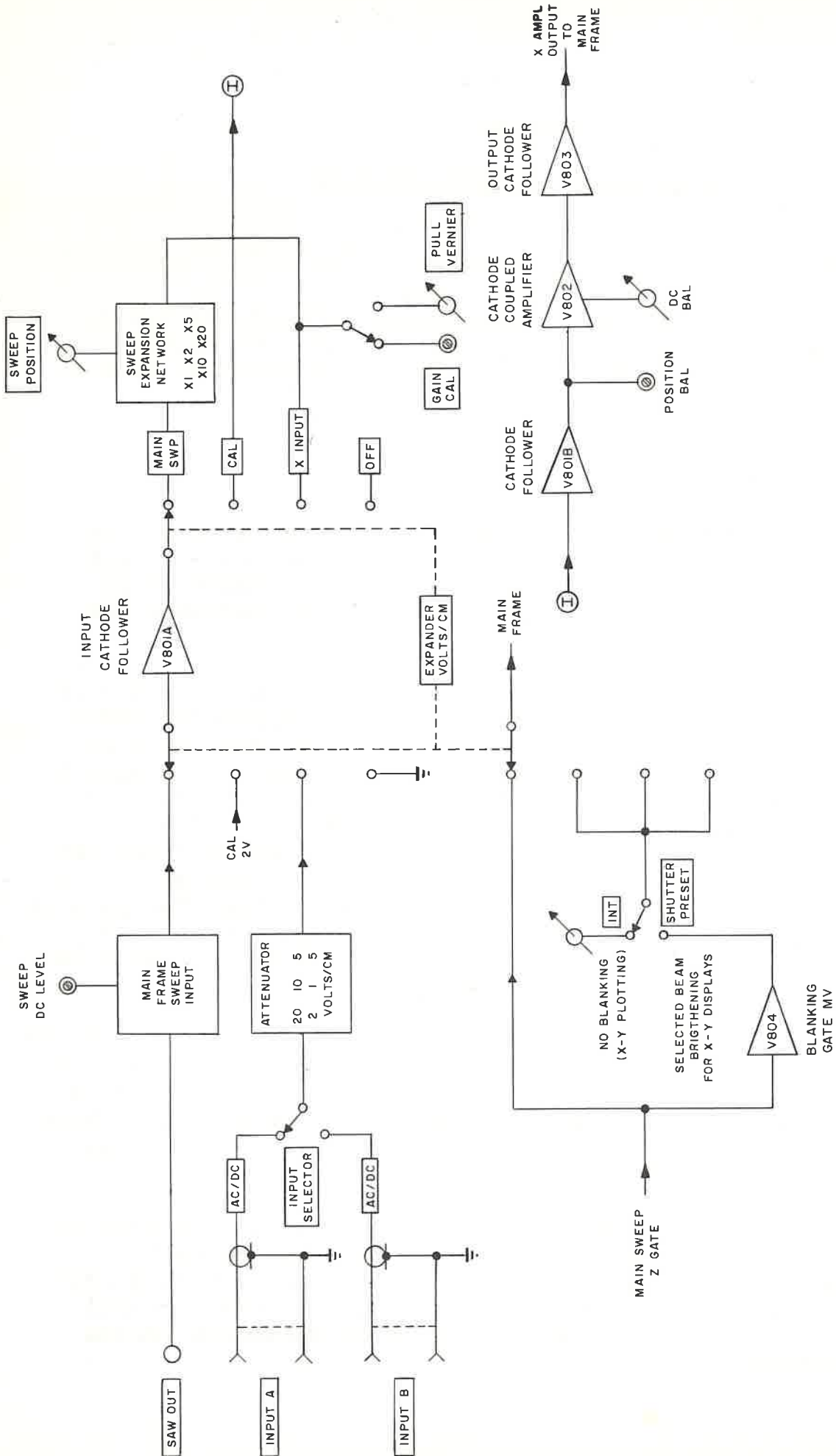


FIGURE 2-1. DU MONT TYPE 4211 SWEEP EXPANDER & X PRE-AMPLIFIER PLUG-IN, FUNCTIONAL BLOCK DIAGRAM

The EXPANDER sector of switch S802 applies the saw from the Main Frame to the input cathode follower, V801A. The cathode load of V801B is changed when the instrument is set up for sweep magnification thereby permitting sweep expansion by 1 to 20 times in 1, 2, and 5 sequence. An additional X5 expansion on the Main Frame will permit the Main Sweep to be expanded up to 100 times.

b. PRE-AMPLIFIER

The externally applied X input signal on the Main Sweep signal progresses through the X Pre-Amplifier as indicated on the functional block diagram, Figure 2-1. Refer to Figures 1-2a and 1-2b for an explanation of the front-panel controls and connectors. However, a brief word about the INTENSITY LIMIT control is applicable at this point.

The INTENSITY LIMIT front-panel screwdriver control is provided to permit selection of constant intensity or an X-Y display selectively intensified by the sweep brightening circuit, V804.

The latter feature permits triggering the sweep from the signals on display so that:

- (1) the desired display time is triggered on and off (unblanked), thereby reducing unwanted parameters;
- (2) the beam is extinguished when no signals are present, and;
- (3) unwanted low-frequency noise or hum signals are eliminated from X-Y plots.

2-3. LOCATION OF SERVICE ADJUSTMENTS

Identifications of service adjustments are shown on the over-all schematic at the rear of this manual.

Since the production of this instrument, some of the parts may have been superseded by improved components. In such cases, the part numbers of these new components will not be listed in your Parts List. However, if you order a part from Du Mont and it has been superseded by an improved component, the new part will be shipped in place of the part ordered. Your local Du Mont representative has knowledge of these changes and may call you if a change in your purchase order is necessary.

It is the aim of the Du Mont organization to make available the most reliable commercial oscilloscopes within the state of the art and to provide services which will help the user to rapidly restore any Du Mont equipment to its specified performance. Your local Du Mont field representative maintains a limited number of spare parts, or the factory may be asked to air-ship replacement parts.

2-4. SERVICING HINTS

In trouble-shooting a Plug-in Unit, it becomes necessary to determine if the defect is in the plug-in or in the Main Frame of the oscilloscope. The quickest and easiest way of isolating the trouble is to substitute another plug-in unit and determine if the same trouble persists. If the trouble continues after substitution, it can be safely assumed that the defect is in the Main Frame.

There is no simple way of locating troubles. An understanding of the functions of the circuits is the best help. With an understanding of the circuit operation, it will be possible to make a good guess at the general source of troubles from the symptoms. As an aid in trouble-shooting this unit, refer to the functional block diagram, Figure 2-1 and to the schematic.

To keep electronic units operating at top performance, it is desirable to check the equipment at regular intervals. The period between checks will depend on the installation and the conditions of operation. In general, portable units moved about constantly, or units operated in very hot, moist, or dirty areas will require more frequent service.

For these regular checks, clean all dust and dirt from the unit, using a light air blast or soft brush.

In the event of improper performance of the Plug-in Unit, the following suggestions are recommended:

1. The Du Mont Type 4294 Extension Cable for remote operation of the plug-in from oscilloscope, is available as an accessory. This plug-in extender will be helpful for routine maintenance and recalibration.
2. To check waveform, use a high-impedance probe. The Du Mont Type 4290 or 4298 Attenuator Probe is recommended for this application.
3. Maintain a high quality of workmanship. Use a clean bench and soldering iron; keep solder joints smooth and bright; do not overheat any component while soldering. Use heat sinks when soldering semiconductors. The use of a 30-watt iron such as a Hexacon Type 26S is recommended. When using accessory probes or adapters, be sure the trouble is not originating in the accessory before suspecting the oscilloscope itself.

2-5. GAINING ACCESS TO CHASSIS

Since the plug-in is not contained in its own dust cover, most of the components are readily accessible when the plug-in is removed from the Main Frame. To gain access to the chassis, simply unscrew the knurled thumbscrew at center bottom of unit and pull it free of the Main Frame.

WARNING

WHEN THE PANELS OR PLUG-INS ARE REMOVED FROM THE INSTRUMENT FOR SERVICING, EXERCISE CAUTION WHILE THE POWER IS ON. The lower-voltage busses are potentially more dangerous than the cathode-ray tube potential because of the high-current capabilities and large filter capacitors employed in these supplies. When you reach into the instrument with one hand while it is turned on, do not grasp the metal frame with the other hand. If possible, stand on an insulated floor and use insulated tools. It is advisable to ground the third lead in the power cord whenever the instrument is in use.

2-6. TEST EQUIPMENT REQUIRED FOR SERVICE ADJUSTMENTS

a. INTRODUCTION

The adjustments outlined in the following paragraphs are based on the test procedure followed at the factory. All adjustments should be made at mid-line voltage, 115V/230V $\pm 2\%$.

To set up the Type 4211 X Pre-Amplifier Plug-in Unit for calibration, insert it and the Y Pre-Amplifier Plug-in into the Main Frame. The Y Pre-Amplifier Plug-in module and the Main Frame must be fully tested and certified units.

b. TEST EQUIPMENT REQUIRED (Equivalent may be substituted)

<u>TYPE</u>	<u>DESCRIPTION</u>
Square Wave Generator	Tektronix Type 105A and 93-ohm Cable Termination Type B93R
Volt-Ohmmeter	Simpson Model 260, 20,000 ohms/volt
Alignment Tool	Insulated Screwdriver
Extension Cable for Remote Operation of Plug-in	Du Mont Type 4294

Turn on the power and allow 5 minutes of warmup time. In the meantime, preset X Pre-Amplifier front-panel controls as indicated:

<u>CONTROL</u>	<u>SETTING</u>
VOLTS/CM	OFF
PULL VERNIER	OUT (Uncalibrated)
INTENSITY LIMIT	PRESET
INPUT SELECTOR	Input A; AC

2-7. POSITION BAL ADJUSTMENT (R8406)

1. Adjust DC BAL front-panel screwdriver control as given in Section 1, Operation, paragraph 1-5.
2. Pull out VERNIER control and set it fully counterclockwise.
3. Connect a Simpson Voltmeter from the cathode pin 3 (or 6) of V803 to ground.
4. Adjust the POSITION BAL potentiometer, R8406, for an indicated reading of 63 volts.
5. Readjust the DC BAL control.
6. Repeat steps 2 through 5 until the following conditions prevail.
 - a. There is no depositioning of the trace when the PULL VERNIER control is rotated back and forth throughout its range.
 - b. An indicated reading of 63 volts is maintained at all times on the cathode of V803 when the VERNIER control is actuated.

2-8. GAIN CAL ADJUSTMENT (R8313)

Whenever the Type 4211 X Pre-Amplifier is removed from the Main Frame and inserted in another, the front-panel screwdriver GAIN CAL control must be reset. To properly normalize the gain between the Plug-in Unit and the Main Frame, refer to Section 1, Operation, paragraph 1-6 for instructions.

2-9. ATTENUATOR ADJUSTMENTS
(C8201, C8202, C8204, C8206, & C8208)

The attenuators are factory aligned and should not be touched unless there is positive indication that they require readjustment. If adjustment is necessary, proceed as follows:

1. Set the DISPLAY LOGIC switch to X AMP.
2. On the X Pre-Amplifier, set the VOLTS/CM switch to 0.5 and apply a 5 Kc signal from a Tektronix Type 107 Square-Wave Generator to the INPUT A connector on the X Plug-in Unit.

3. Connect a lead from the Square-Wave Generator to the EXT SYNC connector on the Main Frame; set TRIGGER SOURCE switch to EXT.
4. Connect a lead from the SAW OUT pin jack on the X Pre-Amplifier to the BNC Input connector on the Y Plug-in Unit.
5. Adjust Main Frame Oscilloscope controls to obtain 2 or 3 cycles of the test signal.
NOTE: The X and Y axes have been interchanged, hence the pattern will be rotated 90° when viewed with respect to a normal display.
6. Adjust C8206 for flat-topped square wave.
7. Adjust the following trimmers for flat-top response as indicated.

VOLTS/CM set to	Adjust Trimmer
1	C8201
2	C8208
5	C8206
10	C8204
20	C8202

2-10. SWEEP DC LEVEL (R8103F)

The SWP DC LEVEL front-panel screwdriver control is provided so that the horizontal display may be positioned to the center of the screen. To adjust, proceed as follows:

1. Set DISPLAY LOGIC switch to MAIN SWP.
2. Direct-couple the sweep from the SAW OUT pin jack on the Type 4211 to the Y Input BNC on the Y Plug-in.
3. Adjust the SWP DC LEVEL control to center the sweep.

2-11. SWEEP CAL ADJUSTMENT (R8315)

The SWEEP CAL adjustment is provided to standardize accurately the steps of the EXPANDER switch. To adjust, proceed as follows:

1. Apply a 100-millisecond pulse from a Tektronix Type 180A Time-Mark Generator to the Input connector on the Y Plug-in Unit.
2. On the Main Frame, set the DISPLAY LOGIC switch to MAIN SWP, the EXPAND switch to X1, and the SWEEP RATE switch to 20 MS.
3. Using the Main Frame VERNIER control, adjust the display until 2 pulses precisely occupy 10 centimeters.
4. On the X Pre-Amplifier, set the EXPANDER switch to X20.
5. Set DISPLAY LOGIC switch to X AMP.
6. Change the input pulse from 100 milliseconds to 5 milliseconds.
7. Use the SWP POSITION control on the X Pre-Amplifier to position the display.
8. Adjust the SWP CAL potentiometer, R8315, for precisely 2 pulses per 10-centimeter display.

2-12. CHECKING SWEEP EXPANSION

1. Set the EXPANDER switch to X10; there should be 4-pulse intervals per 10 centimeters of display, $\pm 2\%$.
2. Set the EXPANDER switch to X5 and change rate of input pulse from 5 milliseconds to 10 milliseconds. Four-pulse intervals should be observed per 10 centimeters of display, $\pm 2\%$.
3. Set the EXPANDER switch to X2 and observe 9-pulse intervals per 10 centimeters of display, $\pm 2\%$.
4. Set the EXPANDER switch to X1 and change rate of input pulse from 10 milliseconds to 180 milliseconds. There should be 2-pulse intervals per 10 centimeters of display, $\pm 2\%$.

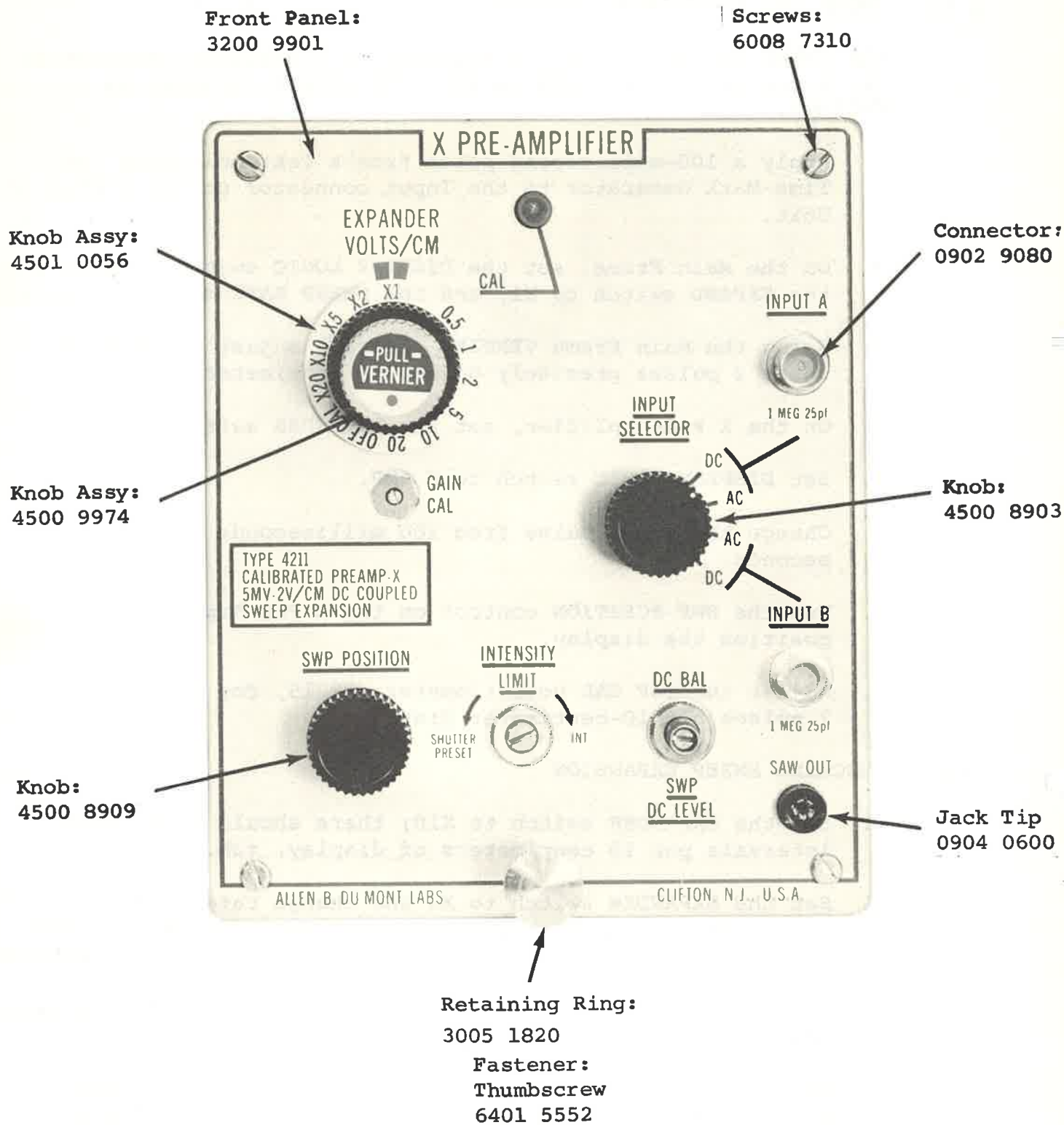


FIGURE 3-1. IDENTIFICATION OF REPLACEABLE PARTS

SECTION 3

ELECTRICAL PARTS LIST AND SCHEMATIC

TYPE 4211 X PRE-AMPLIFIER

Recommended Vendor

Code Type

Description

Part Number

Symbol

CAPACITORS

- Notes: 1. All capacitors are fixed, ceramic, and 500V unless otherwise specified.
 2. GMV denotes Guaranteed Minimum Value.

Symbol	Part Number	Description	Code	Type	Recommended Vendor
C8100	0319 6050	paper, .1 uf, ±20%, 600V	AST		MQLFP
C8101	0326 4640	.01 uf, GMV, 500V	ERC		811
C8102	0310 1270	.001 uf, ±100 -0%, 1KV	RMC		B
C8103	0310 1270	.001 uf, ±100 -0%, 1KV	RMC		B
C8104	0310 1270	.001 uf, ±100 -0%, 1KV	RMC		B
C8105	0310 1270	.001 uf, ±100 -0%, 1KV	RMC		B
C8106	0310 1270	.001 uf, ±100 -0%, 1KV	RMC		B
C8107	0319 5950	27, ±10%, 500V	ERC		NF0332
C8108	0315 3000	68, ±10%, 500V	ERC		GFSL-338
C8109	0326 6290	plastic, .1 uf, ±20%, 200V	GUD		355C
C8200	0326 4640	.01 uf, GMV, 500V	ERC		811
C8201	0319 4000	variable, plastic, 1-7.5 pf, 350V	ERC		535-036
C8202	0312 8320	variable, ceramic, 5-25 pf, 350V	ERC		557-07
C8203	0326 7300	mica, 534 pf, ±1%, 500V	EMC		CM19C
C8204	0312 8320	variable, ceramic, 5-25 pf, 350V	ERC		557-07
C8205	0326 7180	mica, 260 pf, ±1%, 300V	EMC		CM15C
C8206	0312 8320	variable, ceramic, 5-25pf, 350V	ERC		557-07
C8207	0326 7170	mica, 123 pf, ±1%, 300V	EMC		CM15C
C8208	0312 8320	variable, ceramic, 5-25pf, 350V	ERC		557-07
C8209	0326 7020	mica, 40.8 pf, ±.5 pf, 300V	EMC		CM15C

LIST OF RECOMMENDED VENDORS

CODE	NAME	CODE	NAME
ABD	Allen B. Du Mont Laboratories	HWP	Hewlett-Packard Company
AER	Aerovox Corporation	IRC	International Resistance Company
AHH	Arrow-Hart & Hegeman Electric Company	IRP	International Rectifier Corporation
ALB	Allen-Bradley Company	ITT	ITT Components Division
ALC	Allied Control	JEF	Jeffers Electronics, Inc.
ALD	Alden Products Company	JHN	E. F. Johnson Company
AMA	Amaton Electronic Hardware	JWM	J. W. Miller Co.
AMP	Amp Inc.	KUL	Kulka Electric Mfg. Co. Inc.
AMR	Amperite Company, Inc.	KXM	Klixon Metals and Control Corporation
AMX	Ampere Electronic Products Inc.	LFI	Littlefuse, Inc.
APC	American Phenolic Corporation	MAL	P. R. Mallory & Company, Inc.
APH	Amphenol Electronics Corporation	MIC	Micamold Electronics Mfg. Corporation
ARC	Arco-Elementco	MIL	Miller Electric Company
AST	Astron Corporation	MUT	The Muter Company
BUS	Bussmann Mfg. Co.	NYT	New York Transformer Company, Inc.
CAN	Cannon Electric Company	OAK	Oak Mfg. Company
CBS	CBS-Hytron Division of CBS	PHC	Philco Corporation
CGW	Corning Glass Works	PHI	Philips Electronic Tube Division
CH	Cutler-Hammer, Inc.	PLS	Plastoid Corporation
CHC	Chester Cable Corporation	POT	Potter & Brumfield, Inc.
CHM	Chatham Electronics	PRC	Precision Resistor Co., Inc.
CLS	Clarostat Mfg. Co., Inc.	PYR	Pyramid Electric Company
CDE	Cornell-Dubilier Electric Corporation	RCA	Radio Corporation of America
COC	Continental Carbon	RMC	Radio Materials Corporation
CPC	C. P. Clare & Company	ROY	Royal Electric Corp., Inc.
CRL	Centralab, Division of Globe-Union Inc.	RTN	Rortron Mfg. Company
CST	Chicago Standard Transformer	SLT	Sealectro Corporation
CTS	Chicago Telephone Supply Corporation	SPG	Sprague Electric Company
DAG	Dage Electric Company, Inc.	STC	Stackpole Carbon Company
DAL	Dale Products, Inc.	STW	Standard Winding Company
DLC	Dialight Corporation	SUM	Summit Coil Company
EBY	Hugh H. Eby, Inc.	SYL	Sylvania Electric Products, Inc.
EIA	Any manufacturer meeting EIA standards	SYN	Syntronic Instruments, Inc.
ELC	Electra Mfg. Company	TEC	Transistor Electronics Corporation
ELD	Eldema Corporation	TEX	Texas Instruments, Inc.
EMC	Electro Motive Mfg. Company	THC	Thermal Control, Inc.
ER	Eastern Radio	TOR	Torrington Mfg. Company
ERC	Erie Resistor Corporation	TRS	Tresco, Inc.
ESX	Essex Electronics	TRU	Tru-Ohm Products
FCI	Fairchild Camera and Instrument Corporation	TUG	Tung-Sol Electric Inc.
FER	Ferroxcube Corporation of America	UCN	Ucinite Co.
GE	General Electric Company	VIC	The Victoreen Instrument Company
GRC	General Radio Company	WDL	Ward Leonard Electric Company
GRY	Grayhill, Inc.	WES	Weston Electrical Instrument Corporation
GUD	The Gudeman Company	WYN	Welwyn International Inc.
HOP	Hopkins' Engineering Company		

SECTION 3

ELECTRICAL PARTS LIST AND SCHEMATIC

TYPE 4211 X PRE-AMPLIFIER

Recommended Vendor

Code Type

Description

Part Number

Symbol

CAPACITORS

Notes: 1. All capacitors are fixed, ceramic, and 500V unless otherwise specified.

2. GMV denotes Guaranteed Minimum Value.

Symbol	Part Number	Description	Code	Type	Recommended Vendor
C8100	0319 6050	paper, .1 uf, ±20%, 600V	AST	MCILFP	
C8101	0326 4640	.01 uf, GMV, 500V	ERC	811	
C8102	0310 1270	.001 uf, ±100 -0%, 1KV	RMC	B	
C8103	0310 1270	.001 uf, ±100 -0%, 1KV	RMC	B	
C8104	0310 1270	.001 uf, ±100 -0%, 1KV	RMC	B	
C8105	0310 1270	.001 uf, ±100 -0%, 1KV	RMC	B	
C8106	0310 1270	.001 uf, ±100 -0%, 1KV	RMC	B	
C8107	0319 5950	27, ±10%, 500V	ERC	NP0332	
C8108	0315 3000	68, ±10%, 500V	ERC	GPSL-338	
C8109	0326 6290	plastic, .1 uf, ±20%, 200V	GUD	355C	
C8200	0326 4640	.01 uf, GMV, 500V	ERC	811	
C8201	0319 4000	variable, plastic, 1-7.5 pf, 350V	ERC	535-036	
C8202	0312 8320	variable, ceramic, 5-25 pf, 350V	ERC	557-07	
C8203	0326 7300	mica, 534 pf, ±1%, 500V	EMC	CML9C	
C8204	0312 8320	variable, ceramic, 5-25 pf, 350V	ERC	557-07	
C8205	0326 7180	mica, 260 pf, ±1%, 300V	EMC	CML5C	
C8206	0312 8320	variable, ceramic, 5-25pf, 350V	ERC	557-07	
C8207	0326 7170	mica, 123 pf, ±1%, 300V	EMC	CML5C	
C8208	0312 8320	variable, ceramic, 5-25pf, 350V	ERC	557-07	
C8209	0326 7020	mica, 40.8 pf, ±.5 pf, 300V	EMC	CML5C	

TYPE 4211 ELECTRICAL PARTS LIST (continued)

Recommended Vendor

<u>Symbol</u>	<u>Part Number</u>	<u>Description</u>	<u>Code</u>	<u>Type</u>
		RESISTORS (continued)		
R8200	0229 4700	1M, .5W, 1%	TEX	CD 1/2 PR
R8201	0203 1040	220K, .5W, 5%	ALB	EB
R8202	0204 1530	39 Meg, .5W, 10%	IRC	BTS
R8205	0229 9060	52.6K, .5W, 1%	TEX	CD 1/2 PR
R8206	0204 1440	10 Meg, .5W, 5%	IRC	BTS
R8207	0229 9050	111K, .5W, 1%	TEX	CD 1/2 PR
R8208	0229 6460	4 Meg, .5W, 1%	TEX	CD 1/2 MR
R8209	0229 9040	333K, .5W, 1%	TEX	CD 1/2 PR
R8211	0229 4680	2 Meg, .5W, 1%	TEX	CD 1/2 PR
R8212	0229 4700	1 Meg, .5W, 1%	TEX	CD 1/2 PR
R8213	0203 0000	10, .5W, 5%	ALB	EB
R8124	0229 4700	1 Meg, .5W, 1%	TEX	CD 1/2 PR
R8300	0203 0240	100, .5W, 5%	ALB	EB
R8301	0203 0240	100, .5W, 5%	ALB	EB
R8302	0234 7070	24.9K, .5W, 1%	CGW	N70
R8303	0107 2521	variable, composition, 50K, 20% (SWP POS)	ABD	
R8304	0234 7070	24.9K, .5W, 1%	CGW	N70
R8305	0239 1394	8.2K, 2W, 5%	CGW	C42
R8306	0203 0320	220, .5W, 5%	ALB	EB
R8307	0203 0240	100, .5W, 5%	ALB	EB
R8308	0203 0240	100, .5W, 5%	ALB	EB
R8309	0227 8740	wire wound, 15K, 5W, 5%	DAL	RS-5
R8311	0203 0320	220, .5W, 5%	ALB	EB
R8312	0107 2531	variable, composition, 2.5K, .5W (VERNIER)	ABD	
R8313	0105 9360	variable, composition, 2.5K, .5W 10%, (GAIN CAL)	CTS	65
R8314	0203 1200	1 Meg, .5W, 5%	ALB	EB
R8315	0108 4620	variable, composition, 500, 1W, 20% (SWP CAL)	CTS	90CV

TYPE 4211 ELECTRICAL PARTS LIST (continued)

<u>Symbol</u>	<u>Part Number</u>	<u>Description</u>	<u>Code</u>	<u>Type</u>	<u>Recommended Vendor</u>
		RESISTORS (continued)			
R8316	0234 7090	1070, .5W, 1%	CGW	N70	
R8317	0234 7100	2135, .5W, 1%	CGW	N70	
R8318	0234 7060	12.8K, .5W, 1%	CGW	N70	
R8319	0234 7050	10.7K, .5W, 1%	CGW	N70	
R8320	0234 7060	12.8K, .5W, 1%	CGW	N70	
R8400	0234 7110	film, 2940, .5W, 1%	CGW	N70	
R8401	0230 1670	10K, 5W, 10%	CGW	LPI-5	
R8402	0203 0240	100, .5W, 5%	ALB	EB	
R8403	0234 3420	27.4K, 13W, 1%	CGW	R33	
R8404	0203 0240	100, .5W, 5%	ALB	EB	
R8405	0229 0950	7.5K, 10W, 10%	CGW	LPI-10	
R8406	1108 7580	variable, wire wound, 2.5K, 2W, 10% (POS BAL)	CLS	43-HT	
R8407	0203 0240	100, .5W, 5%	ALB	EB	
R8408	0203 0160	47, .5W, 5%	ALB	EB	
R8409	0203 0240	100, .5W, 5%	ALB	EB	
R8411	0203 0240	100, .5W, 5%	ALB	EB	
R8412	0203 0240	100, .5W, 5%	ALB	EB	
R8413	0229 0850	6.2K, 17W, 5%	CGW	HP33	
R8414	0203 0240	100, .5W, 5%	ALB	EB	
S801	0501 6041	2 deck, 4 position, (INPUT SEL)	ABD		
S802	0501 6531	5 deck, 13 position, (V/CM EXPANDER)	ABD		
S803	0503 1330	Slide, DPDT	STC		
S804		Part of R8107		SS-50	
		SWITCHES			
V801	2501 1760	E88CC/6922	AMX	E88CC/6922	
V802	2501 1760	E88CC/6922	AMX	E88CC/6922	
V803	2501 2200	7119/E182CC	AMX	7119/E182CC	
V804	2501 2220	6DJ8/ECC88	AMX	60J8/ECC88	
		TUBES			

LIST OF RECOMMENDED VENDORS

CODE	NAME	CODE	NAME
ABD	Allen B. Du Mont Laboratories	HWP	Hewlett-Packard Company
AER	Aerovox Corporation	IRC	International Resistance Company
AHH	Arrow-Hart & Hegeman Electric Company	IRP	International Rectifier Corporation
ALB	Allen-Bradley Company	ITT	ITT Components Division
ALC	Allied Control	JEF	Jeffers Electronics, Inc.
ALD	Alden Products Company	JHN	E. F. Johnson Company
AMA	Amaton Electronic Hardware	JWM	J. W. Miller Co.
AMP	Amp Inc.	KUL	Kulka Electric Mfg. Co. Inc.
AMR	Amperite Company, Inc.	KXM	Klixon Metals and Control Corporation
AMX	Amperex Electronic Products Inc.	LFI	Littlefuse, Inc.
APC	American Phenolic Corporation	MAL	P. R. Mallory & Company, Inc.
APH	Amphenol Electronics Corporation	MIC	Micamold Electronics Mfg. Corporation
ARC	Arco-Elemento	MIL	Miller Electric Company
AST	Astron Corporation	MUT	The Muter Company
BUS	Bussmann Mfg. Co.	NYT	New York Transformer Company, Inc.
CAN	Cannon Electric Company	OAK	Oak Mfg. Company
CBS	CBS-Hytron Division of CBS	PHC	Philco Corporation
CGW	Corning Glass Works	PHI	Philips Electronic Tube Division
CH	Cutler-Hammer, Inc.	PLS	Plastoid Corporation
CHC	Chester Cable Corporation	POT	Potter & Brumfield, Inc.
CHM	Chatham Electronics	PRC	Precision Resistor Co., Inc.
CLS	Clarostat Mfg. Co., Inc.	PYR	Pyramid Electric Company
CDE	Cornell-Dubilier Electric Corporation	RCA	Radio Corporation of America
COC	Continental Carbon	RMC	Radio Materials Corporation
CPC	C. P. Clare & Company	ROY	Royal Electric Corp., Inc.
CRL	Centralab, Division of Globe-Union Inc.	RTN	Rortron Mfg. Company
CST	Chicago Standard Transformer	SLT	Sealectro Corporation
CTS	Chicago Telephone Supply Corporation	SPG	Sprague Electric Company
DAG	Dage Electric Company, Inc.	STC	Stackpole Carbon Company
DAL	Dale Products, Inc.	STW	Standard Winding Company
DLC	Dialight Corporation	SUM	Summit Coil Company
EBY	Hugh H. Eby, Inc.	SYL	Sylvania Electric Products, Inc.
EIA	Any manufacturer meeting EIA standards	SYN	Syntronic Instruments, Inc.
ELC	Electra Mfg. Company	TEC	Transistor Electronics Corporation
ELD	Eldema Corporation	TEX	Texas Instruments, Inc.
EMC	Electro Motive Mfg. Company	THC	Thermal Control, Inc.
ER	Eastern Radio	TOR	Torrington Mfg. Company
ERC	Erie Resistor Corporation	TRS	Tresco, Inc.
ESX	Essex Electronics	TRU	Tru-Ohm Products
FCI	Fairchild Camera and Instrument Corporation	TUG	Tung-Sol Electric Inc.
FER	Ferroxcube Corporation of America	UCN	Ucinite Co.
GE	General Electric Company	VIC	The Victoreen Instrument Company
GRC	General Radio Company	WDL	Ward Leonard Electric Company
GRY	Grayhill, Inc.	WES	Weston Electrical Instrument Corporation
GUD	The Gudeman Company	WYN	Welwyn International Inc.
HOP	Hopkins Engineering Company		

SECTION 3

ELECTRICAL PARTS LIST AND SCHEMATIC

TYPE 4211 X PRE-AMPLIFIER

Recommended Vendor

Type

Code

Description

Part Number

Symbol

CAPACITORS

Notes: 1. All capacitors are fixed, ceramic, and 500V unless otherwise specified.

2. GMV denotes Guaranteed Minimum Value.

Symbol	Part Number	Description	Code	Type	Recommended Vendor
C8100	0319 6050	paper, .1 uf, $\pm 20\%$, 600V	AST	MQLFP	
C8101	0326 4640	.01 uf, GMV, 500V	ERC	811	
C8102	0310 1270	.001 uf, $\pm 100 -0\%$, 1KV	RMC	B	
C8103	0310 1270	.001 uf, $\pm 100 -0\%$, 1KV	RMC	B	
C8104	0310 1270	.001 uf, $\pm 100 -0\%$, 1KV	RMC	B	
C8105	0310 1270	.001 uf, $\pm 100 -0\%$, 1KV	RMC	B	
C8106	0310 1270	.001 uf, $\pm 100 -0\%$, 1KV	RMC	B	
C8107	0319 5950	27, $\pm 10\%$, 500V	ERC	NP0332	
C8108	0315 3000	68, $\pm 10\%$, 500V	ERC	GPSL-338	
C8109	0326 6290	plastic, .1 uf, $\pm 20\%$, 200V	GUD	355C	
C8200	0326 4640	.01 uf, GMV, 500V	ERC	811	
C8201	0319 4000	variable, plastic, 1-7.5 pf, 350V	ERC	535-036	
C8202	0312 8320	variable, ceramic, 5-25 pf, 350V	ERC	557-07	
C8203	0326 7300	mica, 534 pf, $\pm 1\%$, 500V	EMC	CML9C	
C8204	0312 8320	variable, ceramic, 5-25 pf, 350V	ERC	557-07	
C8205	0326 7180	mica, 260 pf, $\pm 1\%$, 300V	EMC	CML5C	
C8206	0312 8320	variable, ceramic, 5-25pf, 350V	ERC	557-07	
C8207	0326 7170	mica, 123 pf, $\pm 1\%$, 300V	EMC	CML5C	
C8208	0312 8320	variable, ceramic, 5-25pf, 350V	ERC	557-07	
C8209	0326 7020	mica, 40.8 pf, ± 1.5 pf, 300V	EMC	CML5C	

TYPE 4211 ELECTRICAL PARTS LIST (continued)

Recommended Vendor

<u>Symbol</u>	<u>Part Number</u>	<u>Description</u>	<u>Code</u>	<u>Type</u>
		CAPACITORS (continued)		
C8211	0326 7010	mica, 27.1 pf, 4.5 pf, 300V	EMC	CM15C
C8212	0326 7000	mica, 13.4 pf, 4.5 pf, 300V	EMC	CM15C
C8300	0326 5800	plastic, .1 uf, 20%, 150V	GUD	335Y
C8301	0326 4640	.01 uf, GMV, 500V	ERC	
C8302	0326 5800	plastic, .1 uf, 20%, 150V	GUD	355Y
C8303	0326 6290	plastic, .1 uf, 20%, 200V	GUD	355C
C8304	0326 5830	plastic, .22 uf, 20%, 150V	GUD	355Y
C8305	0326 6290	plastic, .1 uf, 20%, 200V	GUD	355C
C8306		Selected Capacitor		
C8307	0302 0580	mica, .001 uf, 500V, 1KV	ECMC	RCM20B
C8308	0326 7200	mica, 510 pf, 1%, 300V	EMC	CM15C
C8309	0326 7190	mica, 270 pf, 1%, 300V	EMC	CM15C
C8311	0326 7160	mica, 82 pf, 1%, 300V	EMC	CM15C
C8312	0326 7150	mica, 62 pf, 1%, 300V	EMC	CM15C
C8400	0326 4640	.01 uf, GMV, 500V	ERE	811
C8401	0326 6280	plastic, .22 uf, 20%, 200V	GUD	355C
C8402	0319 9880	plastic, .22 uf, 20%, 400V	GUD	355E
C8403	0326 5800	plastic, .1 uf, 20%, 150V	GUD	355Y
C8404	0326 6280	plastic, .22 uf, 2%, 200V	GUD	355C
		SEMICONDUCTORS		
CR8300	2600 6830	diode, ZT82A	ITT	
CR8400	2600 6820	diode, FD281	FCI	
CR8401	2600 6820	diode, FD281	FCI	
		LAMPS		
DS8300	1201 1530	NE-IE neon with built in resistor	DLC	249 7841-143
E8200	1201 1680	indicator ultra min bayonet neon	GE	NE96

TYPE 4211 ELECTRICAL PARTS LIST (continued)

<u>Symbol</u>	<u>Part Number</u>	<u>Description</u>	<u>Code</u>	<u>Type</u>	<u>Recommended Vendor</u>
J8100	0902 9080	receptacle, rf, female, 1 contact BNC (INPUT A) UG-625/U	EIA		
J8101	0902 9080	receptacle, rf, female, 1 contact BNC (INPUT B) UG-625/U	EIA		
J8102	0904 0600	Jack tip, black (SAW OUT)	AID		110 BCS ECS
P8400	0905 7340	plug, male, 32 contacts	APH		26-159-32

ELECTRICAL CONNECTORS

RESISTORS

Notes: 1. All resistors are fixed, film, unless otherwise specified.

2. Resistance values in ohms: K thousand, M million

R8100	0203 0000	10, .5W, 5%	ALB		EB
R8101	0203 0000	10, .5W, 5%	ALB		EB
R8102	0239 0335	33.2K, .5W, 1	CGW		N120
R8103	0108 8810	variable, wire wound, 10K/1K 2W, 5% (SWP DC level & DC balance)	CTS		C2-25V
R8104	0234 7040	6.34K, .5W, 1	CGW		N70
R8105	0203 0800	22K, .5W, 5%	ALB		EB
R8106	0234 7080	8780, .5W, 1	CGW		N70
R8107	0108 5800	variable, composition, 50K, 1W, 20% (INT. LIMIT)	CTS		VF 90 CV
R8108	0203 0870	43K, .5W, 5%	ALB		EB
R8109	0203 0960	100K, .5W, 5%	ALB		EB
R8111	0203 0620	3.9K, .5W, 5%	ALB		EB
R8112	0203 0240	100, .5W, 5%	ALB		EB
R8113	0203 0930	75K, .5W, 5%	ALB		EB
R8114	0203 1030	180K, .5W, 5%	ALB		EB
R8115	0203 0240	100, .5W, 5%	ALB		EB
R8116	0203 0400	470, .5W, 5%	ALB		EB
R8117	0239 1392	6.8K, 2W, 5%	CGW		C42

TYPE 4211 ELECTRICAL PARTS LIST (continued)

Recommended Vendor

<u>Symbol</u>	<u>Part Number</u>	<u>Description</u>	<u>Code</u>	<u>Type</u>
		RESISTORS (continued)		
R8200	0229 4700	1M, .5W, 1%	TEX	CD 1/2 PR
R8201	0203 1040	220K, .5W, 5%	ALB	EB
R8202	0204 1530	39 Meg, .5W, 10%	IRC	BTS
R8205	0229 9060	52.6K, .5W, 1%	TEX	CD 1/2 PR
R8206	0204 1440	10 Meg, .5W, 5%	IRC	BTS
R8207	0229 9050	111K, .5W, 1%	TEX	CD 1/2 PR
R8208	0229 6460	4 Meg, .5W, 1%	TEX	CD 1/2 MR
R8209	0229 9040	333K, .5W, 1%	TEX	CD 1/2 PR
R8211	0229 4680	2 Meg, .5W, 1%	TEX	CD 1/2 PR
R8212	0229 4700	1 Meg, .5W, 1%	TEX	CD 1/2 PR
R8213	0203 0000	10, .5W, 5%	ALB	EB
R8124	0229 4700	1 Meg, .5W, 1%	TEX	CD 1/2 PR
R8300	0203 0240	100, .5W, 5%	ALB	EB
R8301	0203 0240	100, .5W, 5%	ALB	EB
R8302	0234 7070	24.9K, .5W, 1%	CGW	N70
R8303	0107 2521	variable, composition, 50K, 20% (SWP POS)	ABD	
R8304	0234 7070	24.9K, .5W, 1%	CGW	N70
R8305	0239 1394	8.2K, 2W, 5%	CGW	C42
R8306	0203 0320	220, .5W, 5%	AIB	EB
R8307	0203 0240	100, .5W, 5%	AIB	EB
R8308	0203 0240	100, .5W, 5%	AIB	EB
R8309	0227 8740	wire wound, 15K, 5W, 5%	DAL	RS-5
R8311	0203 0320	220, .5W, 5%	AIB	EB
R8312	0107 2531	variable, composition, 2.5K, .5W (VERNIER)	ABD	
R8313	0105 9360	variable, composition, 2.5K, .5W 10%, (GAIN CAL)	CTS	65
R8314	0203 1200	1 Meg, .5W, 5%	ALB	EB
R8315	0108 4620	variable, composition, 500, 1W, 20% (SWP CAL)	CTS	90CV

TYPE 4211 ELECTRICAL PARTS LIST (continued)

<u>Symbol</u>	<u>Part Number</u>	<u>Description</u>	<u>Code</u>	<u>Type</u>	<u>Recommended Vendor</u>
		RESISTORS (continued)			
R8316	0234 7090	1070, .5W, 1%	CGW	N70	
R8317	0234 7100	2135, .5W, 1%	CGW	N70	
R8318	0234 7060	12.8K, .5W, 1%	CGW	N70	
R8319	0234 7050	10.7K, .5W, 1%	CGW	N70	
R8320	0234 7060	12.8K, .5W, 1%	CGW	N70	
R8400	0234 7110	film, 2940, .5W, 1%	CGW	N70	
R8401	0230 1670	10K, 5W, 10%	CGW	LPI-5	
R8402	0203 0240	100, .5W, 5%	ALB	EB	
R8403	0234 3420	27.4K, 13W, 1%	CGW	R33	
R8404	0203 0240	100, .5W, 5%	ALB	EB	
R8405	0229 0950	7.5K, 10W, 10%	CGW	LPI-10	
R8406	1108 7580	variable, wire wound, 2.5K, 2W, 10% (POS BAL)	CLS	43-HT	
R8407	0203 0240	100, .5W, 5%	ALB	EB	
R8408	0203 0160	47, .5W, 5%	ALB	EB	
R8409	0203 0240	100, .5W, 5%	ALB	EB	
R8411	0203 0240	100, .5W, 5%	ALB	EB	
R8412	0203 0240	100, .5W, 5%	ALB	EB	
R8413	0229 0850	6.2K, 17W, 5%	CGW	HP33	
R8414	0203 0240	100, .5W, 5%	ALB	EB	
S801	0501 6041	2 deck, 4 position, (INPUT SEL)	ABD		
S802	0501 6531	5 deck, 13 position, (V/CM EXPANDER)	ABD		
S803	0503 1330	Slide, DPDT	STC	SS-50	
S804		Part of R8107			
		SWITCHES			
		TUBES			
V801	2501 1760	E88CC/6922	AMX	E88CC/6922	
V802	2501 1760	E88CC/6922	AMX	E88CC/6922	
V803	2501 2200	7119/E182CC	AMX	7119/E182CC	
V804	2501 2220	6DJ8/ECC88	AMX	60J8/ECC88	

LIST OF RECOMMENDED VENDORS

CODE	NAME	CODE	NAME
ABD	Allen B. Du Mont Laboratories	HWP	Hewlett-Packard Company
AER	Aerovox Corporation	IRC	International Resistance Company
AHH	Arrow-Hart & Hegeman Electric Company	IRP	International Rectifier Corporation
ALB	Allen-Bradley Company	ITT	ITT Components Division
ALC	Allied Control	JEF	Jeffers Electronics, Inc.
ALD	Alden Products Company	JHN	E. F. Johnson Company
AMA	Amaton Electronic Hardware	JWM	J. W. Miller Co.
AMP	Amp Inc.	KUL	Kulka Electric Mfg. Co. Inc.
AMR	Amperite Company, Inc.	KXM	Klixon Metals and Control Corporation
AMX	Amperex Electronic Products Inc.	LFI	Littlefuse, Inc.
APC	American Phenolic Corporation	MAL	P. R. Mallory & Company, Inc.
APH	Amphenol Electronics Corporation	MIC	Micamold Electronics Mfg. Corporation
ARC	Arco-Elementco	MIL	Miller Electric Company
AST	Astron Corporation	MUT	The Muter Company
BUS	Bussmann Mfg. Co.	NYT	New York Transformer Company, Inc.
CAN	Cannon Electric Company	OAK	Oak Mfg. Company
CBS	CBS-Hytron Division of CBS	PHC	Philco Corporation
CGW	Corning Glass Works	PHI	Philips Electronic Tube Division
CH	Cutler-Hammer, Inc.	PLS	Plastoid Corporation
CHC	Chester Cable Corporation	POT	Potter & Brumfield, Inc.
CHM	Chatham Electronics	PRC	Precision Resistor Co., Inc.
CLS	Clarostat Mfg. Co., Inc.	PYR	Pyramid Electric Company
CDE	Cornell-Dubilier Electric Corporation	RCA	Radio Corporation of America
COC	Continental Carbon	RMC	Radio Materials Corporation
CPC	C. P. Clare & Company	ROY	Royal Electric Corp., Inc.
CRL	Centralab, Division of Globe-Union Inc.	RTN	Rortron Mfg. Company
CST	Chicago Standard Transformer	SLT	Sealectro Corporation
CTS	Chicago Telephone Supply Corporation	SPG	Sprague Electric Company
DAG	Dage Electric Company, Inc.	STC	Stackpole Carbon Company
DAL	Dale Products, Inc.	STW	Standard Winding Company
DLC	Dialight Corporation	SUM	Summit Coil Company
EBY	Hugh H. Eby, Inc.	SYL	Sylvania Electric Products, Inc.
EIA	Any manufacturer meeting EIA standards	SYN	Syntronic Instruments, Inc.
ELC	Electra Mfg. Company	TEC	Transistor Electronics Corporation
ELD	Eldema Corporation	TEX	Texas Instruments, Inc.
EMC	Electro Motive Mfg. Company	THC	Thermal Control, Inc.
ER	Eastern Radio	TOR	Torrington Mfg. Company
ERC	Erie Resistor Corporation	TRS	Tresco, Inc.
ESX	Essex Electronics	TRU	Tru-Ohm Products
FCI	Fairchild Camera and Instrument Corporation	TUG	Tung-Sol Electric Inc.
FER	Ferroxcube Corporation of America	UCN	Ucinite Co.
GE	General Electric Company	VIC	The Victoreen Instrument Company
GRC	General Radio Company	WDL	Ward Leonard Electric Company
GRY	Grayhill, Inc.	WES	Weston Electrical Instrument Corporation
GUD	The Gudeman Company	WYN	Welwyn International Inc.
HOP	Hopkins' Engineering Company		

DU MONT

INSTRUMENT WARRANTY AND SERVICE NOTICE

WARRANTY

Allen B. Du Mont Laboratories warrants that each new Cathode-ray Oscilloscope, Automotive Test Equipment, and other Electronic or Electrical Test or Measuring Equipment (hereinafter referred to as "Instrument") manufactured or sold by it, is free from defects in material or workmanship under normal use and service for a period of one year from the date of its sale to the first purchaser for use. If, upon examination by Du Mont, the Instrument is determined to be defective in workmanship or material, Du Mont will, subject to the conditions set forth below, either repair the defective part or replace it with a new part. Du Mont shall not be liable for any delay or failure to furnish a replacement part resulting directly or indirectly from any governmental restriction, priority or allocation or any other governmental regulatory order or action, nor shall Du Mont be liable for damages by reason of the failure of the Instrument to perform properly or for any consequential damages. This warranty does not apply to any Instrument that has been subject to negligence, accident, misuse or improper installation or operation or that in any way has been tampered with, altered or repaired by any person other than an authorized Du Mont service organization or an employee thereof, or to any Instrument whose serial number has been altered, defaced or removed, or to any Instrument purchased within, and thereafter removed beyond, the continental limits of the United States.

This warranty shall, at Du Mont's option, become void unless registration thereof is promptly effected as provided below. This warranty is in lieu of all other warranties, expressed or implied, and no one is authorized to assume any liability on behalf of Du Mont or impose any obligation upon it in connection with the sale of any Instrument, other than as stated above.

REGISTERING THE WARRANTY

To register this warranty, the enclosed warranty registration card must be properly filled out and mailed to the Instrument Service Department immediately upon receipt of the equipment. Complete information is necessary. **BOTH THE TYPE NUMBER AND THE SERIAL NUMBER OF THE INSTRUMENT MUST BE GIVEN ON THIS CARD.** Instruments must be examined immediately upon receipt, since claims for damage in transit will not be honored by the carrier unless prompt action is taken.

CHANGES IN SPECIFICATIONS

The right is reserved to change the published specifications of equipment at any time and to furnish merchandise in accordance with current specifications without incurring any liability to modify equipment previously sold, or to supply new equipment in accordance with earlier specifications excepting under the classification of special apparatus.

SERVICE

In order to insure service under our warranty, the enclosed warranty service card must be properly filled out and returned to the factory. In all cases where service or adjustment is requested, please first contact the factory or authorized depot, giving complete information concerning the nature of the failure and describing the manner in which the equipment was used when failure occurred. **THE TYPE NUMBER AND SERIAL NUMBER** of the equipment must also be given. In this way, much time can be saved and unnecessary inconvenience often avoided. When writing to the factory in this respect, address:

ALLEN B. DU MONT LABORATORIES

Divisions of Fairchild Camera and Instrument Corporation
Industrial Electronics Division

750 Bloomfield Avenue, Clifton, New Jersey

The Instrument Service Department will then send to the customer the written procedure for disposition and shipping instructions. All equipment should be packed and shipped in accordance with this procedure; and identification tags should be attached to each tube or instrument.

REPLACEMENT PARTS

If it is necessary to order a replacement component from the factory, always give the Type number and Serial number of the Instrument. Before ordering parts for in-warranty replacement or purchasing them for out-of-warranty replacement, be sure to consult the Parts List in the Instruction Manual. The Parts List gives the values, tolerances, ratings, and Du Mont part number for all electrical components used in the Instrument. This will help to expedite service.

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Industrial Electronics Division

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