OPERATOR'S MANUAL

MODEL 1461

HIGH VOLTAGE MODULE

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LeCroy

Innovators in Instrumentation

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General Information

Purpose

This manual is intended to provide instruction regarding the setup and operation of the Model 1461 High Voltage Module. In addition, it describes the theory of operation and presents other information regarding its functioning and application.

Unpacking and Inspection

It is recommended that the shipment be thoroughly inspected immediately upon delivery. All material in the container should be checked against the enclosed Packing List and shortages reported promptly. If the shipment is damaged in any way, please notify the Customer Service Department or the local field service office. If the damage is due to mishandling during shipment, you may be requested to assist in contacting the carrier in filing a damage claim.

Warranty

LeCroy warrants its instrument products to operate within specifications under normal use and service for one year from the date of shipment. Component products, replacement parts, and repairs are warranted for 90 days. This warranty extends only to the original purchaser. Software is thoroughly tested, but is supplied "as is" with no warranty of any kind covering detailed performance. Accessory products not manufactured by LeCroy are covered by the original equipment manufacturers' warranty only.

In exercising this warranty, LeCroy will repair or, at its option, replace any product returned to the Customer Service Department or an authorized service facility within the warranty period, provided that the warrantor's examination discloses that the product is defective due to workmanship or materials and has not been caused by misuse, neglect, accident or abnormal conditions or operations.

The purchaser is responsible for the transportation and insurance charges arising from the return of products to the servicing facility. LeCroy will return all in-warranty products with transportation prepaid.

This warranty is in lieu of all other warranties, express or implied, including but not limited to any implied warranty of merchantability, fitness, or adequacy for any particular purpose or use. LeCroy shall not be liable for any special, incidental, or consequential damages, whether in contract, or otherwise.

Product Assistance

Answers to questions concerning installation, calibration, and use of LeCroy equipment are available from the Customer Services Department, 700 Chestnut Ridge Road, Chestnut Ridge, New York 10977-6499, (914) 578-6030, or your local field service office.

Maintenance Agreements

LeCroy offers a selection of customer support services. For example, Maintenance agreements provide extended warranty that allows the customer to budget maintenance costs after the initial warranty has expired. Other services such as installation, training, on-site repair, and addition of engineering

improvements are available through specific Supplemental Support Agreements. Please contact the Customer Service Department or the local field service office for details.

Documentation Discrepancies

LeCroy is committed to providing state-of-the-art instrumentation and is continually refining and improving the performance of its products. While physical modifications can be implemented quite rapidly, the corrected documentation frequently requires more time to produce. Consequently, this manual may not agree in every detail with the accompanying product and the schematics in the Service Documentation. There may be small discrepancies in the values of components for the purposes of pulse shape, timing, offset, etc., and, occasionally, minor logic changes. Where any such inconsistencies exist, please be assured that the unit is correct and incorporates the most up-to-date circuitry.

Software Licensing Agreement

Software products are licensed for a single machine. Under this license you may:

- Copy the software for backup or modification purposes in support of your use of the software on a single machine.
- Modify the software and/or merge it into another program for your use on a single machine.
- Transfer the software and the license to another party, if the other party accepts the terms of this agreement and you relinquish all copies, whether in printed or machine readable form, including all modified or merged versions.

Service Procedure

Products requiring maintenance should be returned to the Customer Service Department or authorized service facility. If under warranty, LeCroy will repair or replace the product at no charge. The purchaser is only responsible for the transportation charges arising from return of the goods to the service facility. For all LeCroy products in need of repair after the warranty period, the customer must provide a Purchase Order Number before any inoperative equipment can be repaired or replaced. The customer will be billed for the parts and labor for the repair as well as for shipping. All products returned for repair should be identified by the model and serial numbers and include a description of the defect or failure, name and phone number of the user. In the case of products returned, a Return Authorization Number is required and may be obtained by contacting the RSD Customer Service Department, (914) 578-6030.

Introduction

The 1461 is a 12 channel, high voltage generation module in the 1450 system. The 1461 supplies up to 3 kV for photomultiplier tubes. Each channel is fully independent.

This manual is divided into two sections. The first part describes the operation of the 1461 when used in a 1450 mainframe. The second part include additional information required to use the 1461 independent of a 1450 mainframe. Independent operation is *not recommended* because the user is required to supply several power supply voltages, clock frequencies and safety features for correct operation.

Product Description

Specifications

Channels:	12, fully independent
Output Voltage:	0 to 3 kV, programmable
Voltage Set Resolution:	< 1 V (750 mV nominal)
Voltage Measurement Resolution:	< 1 V (750 mV nominal)
Voltage Measurement Accuracy:	±(0.10 % + 1.5 V) at 25°C
Voltage Output Accuracy:	±(0.10 % + 1.5 V) at 25°C, from 3% to 100% of Full Scale (Below F.S. a minimum load is required)
Voltage Output Temperature Stability:	< 100 ppm/°C
Voltage Repeatability:	< ±0.5 V at constant load, line and temperature
Voltage Output Ripple:	< 100 mV p-p; < 50 mVpp for output current < 1 mA
Voltage Ramp Rates:	Programmable per channel, separate up and down rates. nominally 50 to 1000 V/s in 50 V steps.
Output Current Capability:	> 2.5 mA from 2.8 kV to 3 kV, > 1.0 mA from 0 to 1.3 kV, linear derate from 1.3 kV to 2.8 kV, max resistive load 1.2 MΩ (See Power Requirements)
Current Trip:	Programmable per channel; < 1 µA resolution; programmable from 50 to 2550 µA
Current Measurement Resolution:	< 1 µA
Current Measurement Accuracy:	±(2 % + 15 µA)
Power Requirements:	171 mA supply per mA output + 38 mA supply per channel. This can exceed the power supplied by the standard mainframe.
Hardware Voltage Limit:	One potentiometer and 1000 to 1 test point.
HV ON LED:	One; on if any channel generates output
Connectors:	SHV (12) and 96-pin DIN
Dimensions:	6U (10.3" high x 14.6" deep x 1" wide; Eurocard C size)

Description

Versions

The 1461 is available in both polarities (Model numbers 1461N and 1461P). The polarity of the module cannot be changed by the user.

A lower noise, reduced output version is also available. The output current is restricted to 1 mA and the peak to peak voltage noise specification is reduced to 50 mV. These are the Model numbers 1461N1 and 1461P1 (mod 100).

Hardware HV Limit

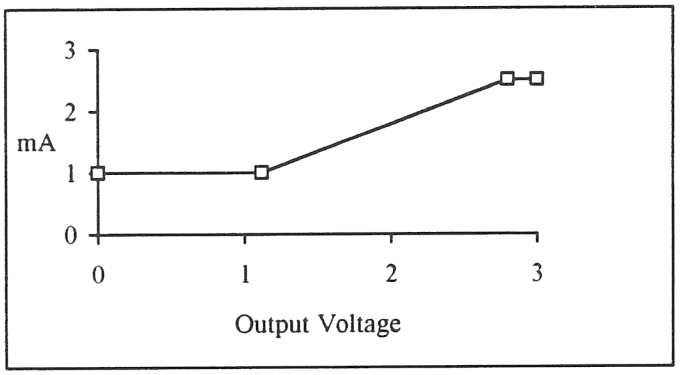
The 1461 HV module supports a hardware based high voltage limit. A single potentiometer and test point are located on the front panel of the 1461 HV module. The voltage at the test point measures the high voltage limit with a 1000 to 1 reduction. The potentiometer sets the limit, clockwise increases the limit. The test point voltage is always positive regardless of the module's polarity.

The test point voltage is actually measured by the 1461's ADC and the firmware blocks any voltage settings above the limit. The voltage limit is not 'live' and cannot be used to control the output. If the voltage limit is adjusted to a value below an existing output, the channel is tripped, even if the high voltage is off. The target voltage must be set below the limit and the channel re-enabled to clear the trip condition.

The HV limit has a resolution of 10 volts. The maximum value is above 3 kV. Settings above 3 kV disable the front panel HV limit since the module's inherent 3 kV limit applies.

Hardware Current Limit

The nature of the high voltage generation circuit limits the output current of the 1461. The graph below shows the limits as a function of output voltage. The data plotted is listed in the specifications above. The firmware in the 1461 enforces these limits by tripping channels in violation.



Note that this profile allows the 1461 to power a resistive load of 1.12 MΩ to 2800 volts. A load of 1.2 MΩ can be powered to 3000 volts.

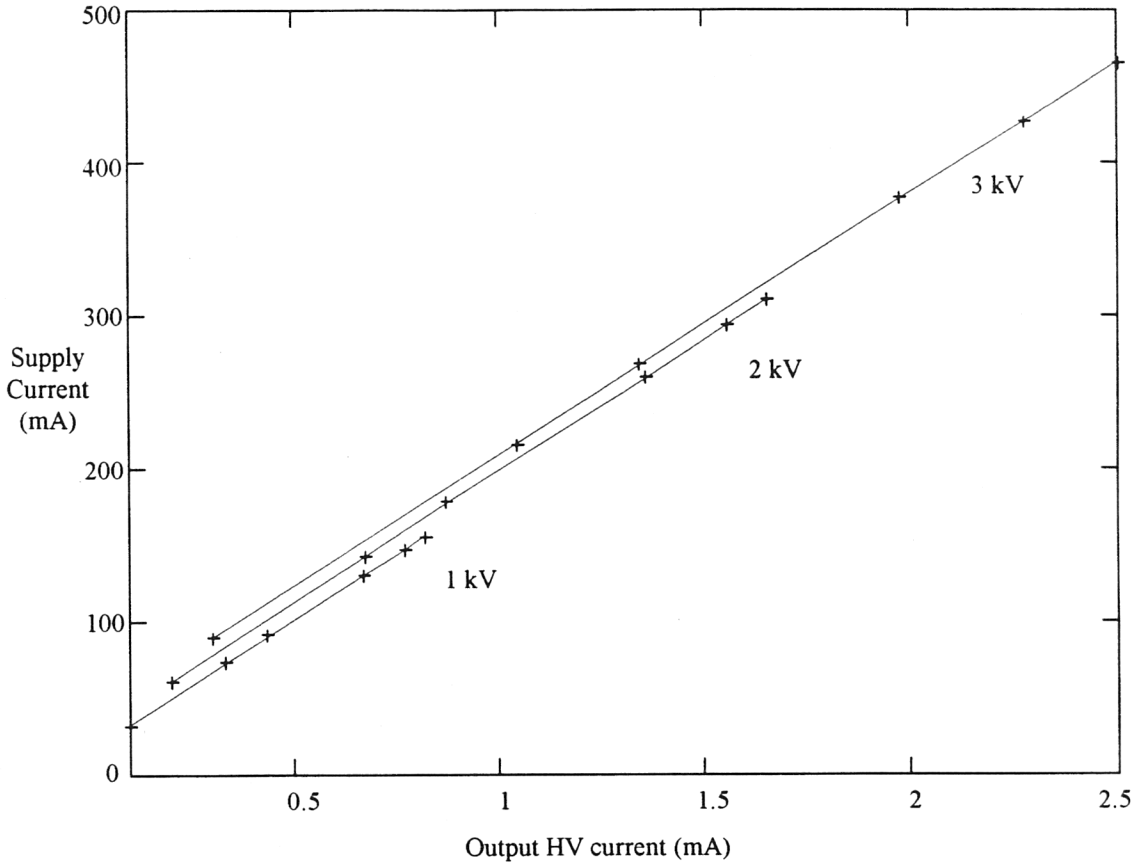
Front Panel LED

The LED on the front panel of the 1461 is a visual indication of the state of high voltage generation. When the LED is flashing, the outputs of the 1461 are ramping to a new voltage. When the LED is on, steady high voltage is being generated. When the LED is off, no power is being delivered to the output but there could still be substantial voltage at the output, depending on the type of load.

Power Requirements

The standard mainframe supplies an average of about 3.75 amperes per slot. The 1461 HV card can sink as much as 5.5 amperes. Most applications do not require this power level (3 kV, 2.5 mA on all channels). The following graph shows the supply current required as a function of the output current. With this it is possible to compute the supply current required for any particular application. If the supply current requirements exceed the specifications of the selected mainframe, it will be necessary to use modified mainframes or to redistribute the required channels over more mainframes.

Supply Current requirement vs. Output Current (mA) per Channel



The points shown are measurements. The lines are fit to the corresponding data. The nominal slope is 171 mA Supply Current per mA Output Current. The intercepts are 16.8, 27.6 and 38.1 mA for 1, 2 and 3 kV respectively. This data is the result of measurements and may change with revision of the 1461 hardware.

When computing the supply current requirements of a specific application, remember to observe the output current limits of the 1461 HV card. The data shown are all within the output current limits.

Installation

To install the Model 1461 HV module in a 1450 series mainframe:

1. Turn mainframe power off
2. Insert 1461 into a numbered slot of the 1450 mainframe.
3. Tighten both captive screws at the top an bottom of the 1461 front panel. Do not use the captive screws to force the module into the slot.
4. Turn On AC power.
5. Check HV limit at the test point on the front panel. Factory defaults should place the HV limit at maximum.
6. Check that the 1461 generates high voltage correctly without loads.
7. Turn off high voltage and wait until the LED on the 1461 front panel is off and stops flashing. Make HV connections to equipment or detectors.

Operation

Usually, the 1461 is operated with a 1450 mainframe. In this case, the properties supported by the 1461 simply appear in the database of the mainframe. To operate this way, only the Properties section is required reading.

To operate the 1461, independent of the mainframes, significant support is required. The Hardware section describes the connectors, signals and power supplies required.

Properties

Properties describe the state of each channel in the 1450 system. All the channels in a module have the same properties. The properties usually have different values. For example, the demand voltage (DV) is a property of a 1461 channel. The value of this property (for example -3000.0) is the desired output voltage for that channel.

Each channel of the 1461 has 11 properties. The chart below lists all these properties and a little information about each.

Property	Type	Mnemonic
Measured Current	Read Only	MC
Measured Voltage	Read Only	MV
Demand Voltage	Read/Write	DV
Ramp Rate Up	Read/Write	RUP
Ramp Rate Down	Read/Write	RDN
Trip Current	Read/Write	TC
Channel Enable	Read/Write	CE
Channel Status	Read Only	ST
Measured Voltage Dead Zone	Read/Write	MVDZ
Measured Current Dead Zone	Read/Write	MCDZ
High Voltage Limit	Read Only	HVL

The Measured Current (MC) and the Measured Voltage (MV) properties are self-explanatory. When the value of this property is required, the 1461 return the most recent measurements. These properties are naturally read-only.

The Demand Voltage (DV), Ramp Rate Up (RUP), Ramp Rate Down (RDN), and Trip Current (TC) properties are also straight forward. The values given to these properties control the functioning of the channel. The 1461 firmware imposes limits on the value of these properties. When a property is set, the 1461 firmware computes its best attempt at the value and uses it. When the property value is read, the changes required by the hardware limitations are shown. The Demand Voltage is and exception and the hardware limitations are not shown by modifiying value set.

The Channel Enable (CE) simply permits a channel to generate output. If a channel is not enabled, no power is delivered to the output. When a channel is changed from enabled to disabled, the output voltage ramps at the programmed ramp rate to zero. Tripped channels are cleared with an enable command.

The Channel Status (ST) property gives information on why a channel is tripped, if it is enabled, and if it is ramping up or down.

The Measured Voltage Dead Zone (MVDZ) and Measured Current Dead Zone (MCDZ) properties are part of a system controlling updates. Whenever a property changes, the update system increments a control word. The MVDZ and MCDZ properties define how much change in the measured value (MV and MC respectively) is considered significant. If these properties are zero, virtually every measurement is identified by the update system as a change since, the LSB of the measurement is likely to change with each measurement. If these properties are set to 2 V and 2 μA, respectively, then the measurement must change by this much to be noticed by the update system. Regardless of the value of MVDZ and MCDZ, reading of MV and MC return the most recent measurements.

The update system is used by the 1454 mainframe for the display updates. Increasing the Dead Zones, reduces the amount of time spend on screen updates.

The High Voltage Limit (HVL) is voltage limit imposed by the front panel potentiometer. This value is the same for all channels but for convenience is shown individually for each channel.

Hardware

Backplane Signal Descriptions

GA 0-7	Geographic address bits.
CONFIG 0-7	Configuration for HV Modules. Pull-up on backplane, selected bits are driven low by 1450-1 interface card.
100 kHz	Clock for HV switching power supplies, sync to 800 kHz
800 kHz	Clock for HV switching power supplies
8 MHz	Clock for microprocessors
20 MHz	Clock for ARCNET network
ARCNET	ARCNET data path. bussed, open collector, 5 V
+15 V	Power supply, two pins
-15 V	Power supply, two pins
+24 V	Power supply, three pins
MOSI, MISO	Master Out Slave In and Master In Slave Out; 5 V, open collector, bussed serial data line
ATTN*	Attention from HV card to HV mainframe; 5 V, open collected, bussed.
HVENB*	Drive by mainframe to enable High Voltage generation
UCLK	Uncommitted Clock

Backplane Connector Pinout

Pin No	Row A	Row B	Row C
1	GA0	GND	ATTN*
2	GA1	GND	GND
3	GA2	GND	HVENB*
4	GA3	GND	GND
5	GA4	GND	100 kHz
6	GA5	GND	GND
7	GA6	GND	800 kHz
8	GA7	GND	GND
9	+24 V	GND	+15 V
10	8 MHz	GND	GND
11	+24 V	GND	GND
12	MISO	GND	SYSRESET*
13	GND	GND	GND
14	MOSI	GND	20 MHz
15	+24 V	GND	GND
16	GND	GND	ARCNET
17	+12 V	GND	GND
18	GND	GND	UCLK
19	-15 V	GND	GND
20	GND	GND	GND
21	CONFIG 0	GND	CONFIG 4
22	GND	GND	GND
23	CONFIG 1	GND	CONFIG 5
24	GND	GND	GND
25	CONFIG 2	GND	CONFIG 6
26	GND	GND	GND
27	CONFIG 3	GND	CONFIG 7
28	GND	GND	GND
29	GND	GND	GND
20	GND	GND	GND
31	-15V	VCC	+15V
32	VCC	VCC	VCC

Configuration Register

The configuration register controls 1461 module during power-up. This register is static and read only during the power-up sequence. The 1461 interprets the bits as follows:

Bit	Description for 1	Description for 0
0	Normal Bootstrap	Special Bootstrap
1	EEPROM Write Inhibit	EEPROM Write Enable
2	Normal Operation	Stand-Alone Operation
3	Cold Reboot	Hot Reboot
4:5	Baud Rate Select: 115.2 k, 38.4 k, 19.2 k, 9600 = 3,2,1,0 resp.	
6		Maintenance
7	(reserved)	(reserved)

Some bits are interpreted by the hardware and some by the software. When all of these bits are driven high (1), the 'normal user' mode results. This allows a user's mainframe to be constructed without the ability to drive these bits low.

Special Bootstrap mode is only used by manufacturing for the initial in-circuit programming of the system. In this mode the microprocessor executes ROM code inside the HC11 device. Programming data is then accepted over the serial (SCI) port. This module will not operate with this bit low and blocks the use of the serial interface by other modules in the same backplane.

The EEPROM Write Inhibit simply prevents the programming from being changed. This is enforced by hardware so even program failures cannot alter the programming. The system must be write enabled during calibration to allow calibration constants to be copied to the EEPROM. It must also be enabled for initial programming of the EEPROM.

Normal versus Stand-Alone operation differ only in that the Normal operation demands regular serial messages in order to continue the generation of high voltage. No particular message is required, only continued contact with the host. A failure to communicate with the mainframe on a regular basis terminates the high voltage generation. Stand-Alone operation simply omits this requirement.

Hot reboot causes the module to use previously saved start-up data for the output voltage and initiates high voltage generation. Before this is allowed to happen, 1) the output voltage settings must have been saved in the EEPROM previously, 2) Stand-Alone Operation configuration bit must be asserted in addition to Hot Reboot configuration bit.

The baud rate select controls the default speed for the serial connection over the backplane. Some implementations require the serial data be relayed to other systems. The lower baud rate selection (9600) eases the system hardware requirements. The highest baud rate, 115.2 k, is the maximum possible rate with the current hardware.

The maintenance-off bit turns-off several properties used during testing and calibration.

Theory of Operation

Calibration Theory

The 1461 design does not include any hardware adjustments for calibrating the output voltage, measured voltage or measured current. All corrections are done by the microprocessor with its software. During the calibration procedure, measurements are made with external, calibrated instruments (high voltage divider and precision voltmeter) and a computer. These measurements are converted into coefficients to be used by the module for all reported measurements and settings. Thus the high voltage generation hardware requires only an adequate range and stability to produce accurate output and measurements.

This system requires three transfer functions:

1. convert ADC codes to measured voltage
2. convert ADC codes to measured current
3. convert voltage request to DAC codes

The first two transfer functions are straight forward since there is simply a 12-bit ADC. The first transfer function requires a quadratic polynomial (3 constants). This is primarily because high voltage resistors have significant voltage coefficients. This effect is completely compensated for with a quadratic polynomial. The measured current does not have this effect and a linear transfer function is completely adequate.

The third transfer function is more of a problem. The DAC is composed of a pair of 8-bit DACs with their outputs summed. The relative gains of the DACs differ by factor of approximately 64. This creates the situation where multiple DAC setting can create the same output voltage. To solve this we simply chose a method of setting the DACs. First, the Coarse DAC (high gain) is set to the code that generates the voltage closest to the target voltage. Then, the Fine DAC is adjusted to correct the predicted error.

The polynomial for the Coarse DAC is a quadratic. This compensates for the voltage coefficient. The polynomial for the Fine DAC is linear. The Fine DAC spans only a small range of voltage and the error from the voltage coefficient is insignificant. The combined transfer function from target voltage to output voltage appears to be a quadratic approximated by 256 line segments.

Voltage Ramp Procedures

Ramping of the output voltage is done by successively programming the output voltage to values closer to the target. Because of the two DAC system, not all ramp rates are possible.

The HV module begins a ramp by computing the data values for both the Fine and the Coarse DACs which will generate the correct target voltage. If the ramp is to a voltage of higher magnitude, the Fine DAC is changed first. Next the Coarse DAC is changed several times a second, with a step size computed from the ramp rate. Finally, if Fine DAC is not correct it is changed to the correct value.

Changing the Fine DAC at the beginning of are ramp-up and at the end of a ramp-down, insures that the output voltage never exceeds the target voltage.

Hardware Trip Limits

The firmware is partly responsible for protecting the hardware by detecting and correcting overcurrent situations. The firmware is required to trip off the voltage within a few seconds to protect the hardware from over heating.

Appendix A

This appendix describes communication protocols used by the 1461. Any number of HV modules are connected together on a single pair of serial line. The protocol includes arbitrating access to these lines and addressing messages to their destinations.

The content of messages consists of command to examine or modify properties. The section on commands describes the syntax and meaning of all the commands recognized by the 1461. Other HV modules may have larger or smaller command sets but the same command always performs the same function.

Finally, the properties of 1461 channels are described. The host

Message Routing Protocol

Two serial connections are used to transfer data to and from the HV module (slave) and the host system (master). Both lines are unidirectional and named MasterOut-SlaveIn (MOSI) and MasterIn-SlaveOut (MISO). All HV modules receive data on the MOSI line and transmit on the MISO line. The host system is in control of all arbitration and must avoid contention by the slaves..

To begin a message the host transmits (on MOSI) an address byte followed by additional bytes ending with a terminator byte. All slaves receive the address byte and compare it to their geographic address. The slave with a match is said to have received the token. The slave must promptly send one response, possibly empty, on MISO to return the token. In this way the host sends the token to each slave in turn, searching for responses to previously sent messages.

In every message is a status byte regarding receipt of the last message. The slaves are required to re-transmit the previous response message whenever a negative host-receive-status is received. The host can re-transmit or send a new message.

If the message is not empty it contains an optional sub-module-address, a ticket-number and a command string. The ticket-number for each command is included in the response. This allows the host to route responses back to the originator of the command. This allows multiple sources to send commands to the HV module and have the responses correctly returned.

The following describes the syntax for messages on the serial line in detail. No separators or terminators are implied. All bytes appearing on the back plane are described. The construction [xx] indicates a single byte with the hex value 'xx'. Curly brackets '{}' enclose optional items

host-message:
address host-receive-status {sub-module-address space} {ticket-number space command} terminator

slave-message:
slave-receive-status {ticket-number space response} terminator

address:
[80 + geographic address]

sub-module-address:

ASCII-digit {ASCII-digit} space

ticket-number:
ASCII-digit {ASCII-digit {ASCII-digit}} space

host-receive-status:
ack
nak

slave-receive -status:
ack
nak

ack:
[06]

nak:
[15]

space:
[20]

terminator:
[0D]

Command Syntax

The following describes the syntax for commands. Literal text is shown in bold. Alternative formats are shown on consecutive lines or separated by a vertical bar (|). Syntax elements are shown in italics. All items are separated by one or more spaces.

command:
ATTR *property-name*
DMP *channel-number*
HVON
HVOFF
HVSTATUS
ID
LD *property-name channel-number property-value-list*
PROP
PSUM
RC *property-name*
SAVE *channel-number*
SM
SN *serial-number*

property-value-list:
property-value {property-value-list}

property-name:
MV
DV
MC

RUP
RDN
TC
CE
ST
MVDZ
MCDZ

channel-number:
0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11

Commands and Responses

This section describes each command an the HV module's responses. Each response is returned with the ticket number of the command. All successful responses consist of the original command followed the requested data or the original parameters corrected to the constraints of the HV module.

Error messages are also returned on the same ticket number but begin with the text "US", for unsolicited. Some errors return the part of the part of the command string that was successfully parsed. The ticket number is not checked in any way.

ATTR Command

This command returns all the attributes for the named property. This response consists of exactly six space separated tokens which describe the property. If any of the six attributes requires spaces these are replaced with the underscore. See the section on property attributes for details of the possible attributes

Examples:

Command: ATTR DV
Returns: ATTR DV Demand V P N -5000.0_0.0_0.5 %7.1f

Command: ATTR MC
Returns: ATTR MC Current µA M N 7 %7.1f

DMP Command

HVON/HVOFF Commands

These two commands switch the high voltage on and off. When HV is off, all clocks to the HV generation hardware are blocked. The response to this command is exactly the same as the command. In other words, the command "HVON" responds with the string "HVON".

Both commands causes the outputs to be ramped, at the appropriate ramp rate. HVOFF ramps outputs to zero at the ramp down (RDN) rate and then disables the HV generation circuits. HVON ramps the output from zero to the target voltage (DV) at the ramp up rate (RUP).

HVSTATUS Command

This command returns the current status of the HV. The string "HVSTATUS HVON" or the string "HVSTATUS HVOFF" is returned

ID Command

This command returns a fixed descriptor for the module. The fields in the descriptor are module number, sub module number, number of sub modules, number of channels, serial number, revision number, ECO number, and firmware version.

Example:

Command: ID
Response: ID 1462N 0 0 6 20 A123456 -1 1000 0.04

LD Command

The load command modified the values of a single property. The property specified must be writable. The channel number is the first channel to be modified. The list must be compatible with the property specified. The first value is assigned to the channel specified. The number of items in the list must not exceed the number of channels in the module. The response to this command is exactly the values listed possibly adjusted to conform to the limitations of the module

Example:

Command: LD DV 3 -1000 -1000 -2000
Response: LD DV 3 -1000.5 -1000.7 -1999.7

PROP Command

This command returns a list of the user properties supported by the module. Property names are separated by spaces and are used as arguments to command which accept property-names. The number of property names to expect can be determined with the ID command.

Example:

Command: PROP
Response: PROP MC MV DV RUP RDN TC CE ST MVDZ MCDZ HVL

PSUM Command

This command (Property Summary) returns a change control number for each user property. This number is computed by incrementing a 16 bit number whenever a significant change to the property value occurs. This command identifies a properties whose values have changed. The host reads the change control numbers first and then the data. The next time, the host reads the control numbers and compares them to the older control numbers read previously. If the control number for a particular property has not changed, then the values of the corresponding property need not be re-read. This one command checks all the data in the module.

In the case of measured properties (e.g. Measured Voltage, Measured Current), a dead zone concept is used. If the value of the measured property has moved more than a dead zone amount from a previous reading, the new reading is saved and the change control number is incremented. The most recent measurements are always returned with the recall command, they are just not considered different in the change control system.

The maximum rate at which the change control can be incremented is about 10 Hz. This means that change control numbers do not reoccur for about 1.8 hours.

RC Command

The recall command returns all the values for one property. The values are returned in channel order.

Example:

Command: RC MV
Response: RC MV -1000.5 -1000.8 -2380.5 ...

SAVE command

This command causes the previously loaded calibration constants to be copied to the EEPROM. If EEPROM writes are blocked an error message is returned. If the command is successful, significant delays are created during the EEPROM writes. After the token is returned to the host, communication must be suspended for about 1 second to avoid communication failures. During the EEPROM write, processor interrupts are disabled. Arriving data will cause an immediate overrun error.

The target voltage, ramp rate, enable status and trip current are also copied to initial value arrays in the EEPROM. This data is used when power is restored. If the configuration bits indicate, high voltage generation is started and outputs ramp to the previously saved values.

SM Command

This command returns the number of sub modules present in the physical module. The 1461 has only one submodule.

SN Command

The command sets the module serial number. This is the same number which appears on the HV modules' front panel.

The default serial number is "000000" Only the default serial number can be overwritten. The only way to change the serial number of board is to download a new copy of the firmware.

Properties

The following properties are considered "golden" and will probably appear in all HV modules. The attributes listed are examples only.

MV Measured Voltage

Label: Meas_V
Units: V
Protection: Measured (M)
Type: Numeric (N)
Range: 7 (maximum string length)
Format: %7.1f

This is the measured output voltage.

DV Demand Voltage

Label: Target_V
Units: V
Protection: None(N)
Type: Numeric (N)
Range: -3000 0 0.5
Format: %7.1f

This is the desired output voltage

MC Measured Current

Label: Meas_uA
Units: µA
Protection: Measured(M)
Type: Numeric (N)
Range: 7 (maximum string length)
Format: %7.1f

This is the current measured on the channel.

RUP Ramp Up Rate

Label: RUp_V/s
Units: V/s
Protection: Password(P)
Type: Numeric (N)
Range: 50 1000 10
Format: %7.1f

This property is loaded with the desired ramp up rate. This rate is used when the HV is turned on or the output voltage is set to a higher (in magnitude) value..

RDN Ramp Down Rate

Label: RDn_V/s
Units: V/s
Protection: Password(P)
Type: Numeric (N)
Range: 50 1000 10
Format: %7.1f

This property is loaded with the desired ramp down rate. This rate is used when the HV is turned on or the output voltage is set to a higher (in magnitude) value..

TC Trip Current

Label: Trip_uA
Units: µA
Protection: Password(P)
Type: Numeric (N)
Range: 1000 10 1
Format: %7.1f

This property is loaded with the maximum allowed current. If this current is exceeded the channel is tripped. HV generation is discontinued.

CE Channel Enable

Label: Ch_En
Units:
Protection: Password(P)
Type: Numeric (N)
Range: En Ds
Format: %2s

This property is used to enable and disable HV channels. While this property can be examined it is more informative to examine the ST (status) property.

ST Channel Status
Label: Status
Units:
Protection: Measured(M)
Type: Numeric (N)
Range: 2 (maximum string length)
Format: %2x

Bit	Description
0	Channel is enabled
1	Output is ramping to a higher absolute value.
2	Output is ramping to a lower absolute value or zero
3	(reserved)
4	Trip for violation of supply limits
5	Trip for violation user's current limit
6	Trip for voltage error
7	Trip for violation of voltage limit

This property is a measured value and cannot be loaded. The return value is a number which describes the state of the HV channel. The returned data is a bit wise-status word. The following table describes the meaning of each bit.

Tripped is defined as a state where the firmware as shut the channel down because it has exceeded some user limit e.g. current limit. This state is cleared by cycling the Enable/Disable status.

MVDZ Measured Voltage Dead Zone

Label: MV_Zone
Units: V
Protection: None (N)
Type: Numeric (N)
Range: 0_3000
Format: %8f

MCDZ Measured Current Dead Zone

Label:	MC_Zone
Units:	µA
Protection:	None (N)
Type:	Numeric (N)
Range:	0_1000
Format:	%8f

Property Attributes

Properties are used to describe the state of each channel. Each property has exactly one value for each channel. Some properties can be set by the user and others can only be examined.

Each property has six attributes which describe how to manipulate the value of each property.

Label Attribute

The label is simply a short text string suitable for the top of a column containing the values of this property.

Units Attribute

The units is a short string which assigns the correct units to the property value.

Protection Attribute

The protections attribute describes the accessibility of the property. "N" indicates no protection. Any user can alter this attribute. "P" indicates password protection. The password must have been previously enabled and presented to the unit before the property can be altered. The 1461 does not use passwords. "M" indicates the value is measured and cannot be altered by user commands.

Type Attribute

This attribute describes what kind of value the property accepts or delivers. "N" indicates a numeric value, "S" is a general string value. and "L" indicates logical values.

Range Attribute

This attribute describes the allowed values for properties which can be written and the maximum size of properties which are measurements.

For numeric, not measured, values this attribute is a string of three numbers which are the minimum, maximum and resolution. For example the target voltage property has a minimum of 0.0 volts, a maximum of 3000.0 volts and a resolution of 1 volt.

For measured value and strings, the range is a single number indicating the maximum length of the string returned. This is use for set up of displays containing the measured data.

For logical values, the range is list of all the allowed values of the property separated by spaces. For example "ON OFF".

Format Attribute

The format attribute is a 'C' format string which can be used to reprint the value of the property.

TECHNICAL INFORMATION

(PARTS LIST, SCHEMATICS)

PART NUMBER	DESCRIPTION REMARK	QTY PER
1461-1	12 CH HV MAIN BOARD	1
1461-2N	1461 NEG HV MULTIPLIER BOARD	1
1461N-MECH	MECH ASSBLY NEG POLARITY	1
597000100	SHIPPING CARTON (FASTBUS PAD)	1

End of report. 4 Details encountered.

PART NUMBER	DESCRIPTION REMARK	QTY PER
103447105	CAP CERA MONO 100V 1 UF C44 C46 C48 C52 C66 C68 C70 C74 C87 C89 C91 C95 C108 C110 C116 C129 C131 C133 C137 C150 C152 C154 C158	24
103625221	CAP CERA MONO 100V 220 PF C247	1
106338224	CAP CERA MONO .22UF C47 C51 C69 C73 C90 C94 C111 C115 C132 C136 C153 C157	12
106348334	CAP CERA MONO .33UF C5 C10 C11 C16 C18 C24 C30 C31 C37 C38 C43 C54 C55 C59 C60 C76 C77 C81 C82 C97 C98 C102 C103 C118 C119 C123 C124 C139 C140 C144 C145 C160 C161 C165 C166	38
106433471	CAP CERA MONO 470PF C239 C246	8
106435102	CAP CERA MONO .001UF C62 C63 C83 C84 C104 C105 C125 C126 C146 C147 C167 C168	12
106438104	CAP CERA MONO .1UF C1 C3 C4 C6-C9 C12-C15 C17 C19-C23 C25-C29 C32-C36 C39-C42 C49 C50 C53 C56-C58 C61 C64 C65 C71 C72 C75 C78-C80 C85 C86 C92 C93 C96 C99-C101 C106 C107 C113 C114 C117 C120-C122 C127 C128 C134 C135 C138 C141-C143 C148 C149 C155 C156 C159 C162-C164 C169-C175 C178-C188 C191-C194 C196 C197 C200-C217 C237 C238	122
141854685	CAP TANT DIP 6.8 UF C219 C221	3
146654107	CAP MINI ALUM 20% 100 UF C2 C45 C67 C88 C109 C130 C151 C176 C177 C189 C190 C195 C198	15

PART NUMBER	DESCRIPTION REMARK	QTY PER
146654107	CAP MINI ALUM 20% 100 UF C199 C218	15
161225101	RES CARBON FILM 100 OHMS R1A R4 R15 R29 R56 R57 R80 R81 R108 R109 R136 R137 R164 R184 R190	15
161225102	RES CARBON FILM 1 K R2 R18 R21 R26 R27 R32 R51 R73 R84 R103 R112 R129 R140 R159 R167 R173 R180 R186 R189 R197-R199 R210-R212 R220	26
161225103	RES CARBON FILM 10 K R12 R14 R43 R45 R65 R67 R95 R97 R121 R123 R151 R153 R169 R176 R192 R206	16
161225201	RES CARBON FILM 200 OHMS R182 R183	2
161225331	RES CARBON FILM 330 OHMS R1	1
161225431	RES CARBON FILM 430 OHMS R6 R7 R9 R10 R37 R38 R40 R41 R59 R60 R62 R63 R89 R90 R92 R93 R115 R116 R118 R119 R145 R146 R148 R149 R187	25
161225470	RES CARBON FILM 47 OHMS R194 R196 R209	3
161225472	RES CARBON FILM 4.7 K R28 R185	2
161225683	RES CARBON FILM 68 K R11 R13 R42 R44 R64 R66 R94 R96 R120 R122 R150 R152	12
161335022	RES CARBON FILM 2.2 OHMS R5 R8 R36 R39 R58 R61 R88 R91 R114 R117 R144 R147 R5A R8A R36A R39A R58A R61A R88A R91A R114A R117A R144A R147A	24
161335100	RES CARBON FILM 10 OHMS R175	1
161335102	RES CARBON FILM 1 K R191	1
161335200	RES CARBON FILM 20 OHMS R177 R193	2

PART NUMBER	DESCRIPTION REMARK	QTY PER
161335470	RES CARBON FILM 47 OHMS R188	1
161335471	RES CARBON FILM 470 OHMS R200	1
168139399	RES RN55E .1% 1.15 K R17 R25 R47 R48 R53 R54 R69 R70 R77 R78 R99 R100 R105 R106 R125 R126 R133 R134 R155 R156 R161 R162 R174 R178	24
168139518	RES RN55E .1% 20.0 K R171	1
168139539	RES RN55E .1% 33.2 K R170	1
168139585	RES RN55E .1% 100 K R19 R20 R22 R30 R31 R33 R49 R50 R52 R71 R72 R74 R82 R83 R85 R101 R102 R104 R110 R111 R113 R127 R128 R130 R138 R139 R141 R157 R158 R160 R165 R166 R168 R202 R205 R229	36
168139617	RES RN55E .1% 215 K R16 R46 R55 R68 R79 R98 R107 R124 R135 R154 R163 R179	12
168139661	RES RN55E .1% 619 K R23 R24 R34 R35 R75 R76 R86 R87 R131 R132 R142 R143	12
168531326	RES PREC RN55D 200 OHMS R172	1
168531489	RES PREC RN55D 10.0 K R181	1
182537203	RES VARI CERMET 20 K R3	1
190042472	RESISTOR NETWORK 4.7 K RN34	1
190642472	RESISTOR NETWORK 4.7 K RN31-RN33	3
190662271	RESISTOR NETWORK 270 OHMS RN1-RN12	12
190832102	RESISTOR NETWORK 1 K RN13-RN24	12
200032010	IC 2-INPUT NAND 74LS38PC U31	1
200071540	IC OCT INV BUFFER 74HCT540 U2	1
200332004	IC HEX INVERTER HCT04	1

PART NUMBER	DESCRIPTION REMARK	QTY PER
200332004	IC HEX INVERTER HCT04 U30	1
200373374	IC D-TYP FLOP 74HCT374 U38	1
200671373	IC D-TYPE FLOP HCT373 U36	1
205034014	IC CMOS HEX SCHMITT 74HCT14 U35	1
205271256	IC 32K X 8 RAM 62256-12 U32	1
205370028	EEPROM 32K X 8 AT28C256 U33	1
205640165	IC SHIFT REG HCT165 U28 U29	2
205644094	IC 8-BIT SHIFT REG HCT4094 U1 U4	2
205750008	IC AND-OR LOGIC ARRAY 16R8 DO NOT INCLUDE ON KIT. SEND TO THE PROGRAMMING CENTER FOR PROGRAMMING. U3	1
205750168	IC 7-WIDE AND-OR-INV 16L8A DO NOT INCLUDE ON KIT. SEND TO THE PROGRAMMING CENTER FOR PROGRAMMING. U37	1
207270188	IC 12-BIT ADC,12 CH 188DCPP U26	1
207270528	IC OCTAL BIT DAC U18 U20 U22	3
207345052	IC DUAL 4CH MUX/DEMUX 74HCT4052 U19 U21 U23	3
208011007	IC DUAL OP AMP LM358N U24 U40	2
208011011	IC JFET OP AMP TL082CP U5 U7 U9 U11 U13 U15	6
208130324	IC QUAD OP AMP LM324A U6 U8 U10 U12 U14 U16 U39	7
208166012	IC VOLT REG +12 UA78L12AC VR15	1
208213002	IC VOLT REF +5V REF-02 U25	1
208217005	IC VOLT REG +5V MC78L05AC VR13	1
208570317	IC ADJ +V REG LM317 VR1-VR12	12
208590337	IC VOLT REG NEG ADJ LM337 VR14	1

PART NUMBER	DESCRIPTION REMARK	QTY PER
208738215	IC VOLTAGE MONITOR MAX8215 U27	1
227148110	IC 8-BIT MICROCONTROLLER 68HC11A0P U34	1
229020055	TRANS VOLT SUPPR P6KE6.8 CR2 CR3	2
230110005	DIODE SWITCHING 1N4448 CR4-CR19 CR21 CR22 CR24-CR47 CR49	43
240425751	DIODE ZENER 5.1V 1N751A CR20	1
240425752	DIODE ZENER 5.6V 1N752A CR48	1
253050817	DIODE HOT CARRIER 1N5817 CR23	1
256270505	DIODE LED RED 5V 550-0405 CR1	1
270170904	TRANSISTOR NPN 2N3904 Q39	1
280170104	TRANSISTOR FET N VN0104N3 Q37 Q38	2
280170210	TRANSISTOR N-CHANNEL MOSFET 2210N3 Q1-Q36	36
300050002	CHOKE FERRITE SINGLE LEAD L2	1
433220003	FUSE PICO II 125V .5 AMP F2 F3 F4	3
433221007	FUSE PICO II 125V 7 AMP F1	1
454121008	HDR SOLD TAIL/FEM 8 J1-J6 J1N J1P J2N J2P J3N J3P J4N J4P J5N J5P J6N J6P	18
454610096	HDR SOLD TAIL/MALE 96 J7	1
468099008	TEST POINT W/GLASS INSULATOR TP1 TP2 TP3	3
500900001	INSULATOR, CUSTOM, SELF ADHESIVE	2
521256012	SPACER HEX 2-56X3/4	3
524440024	STANDOFF M/F 4-40 X 1/2" LG	3
555511005	SCREW SELF-TAPPING PHIL HD	2
559440004	SCREW 4-40 SLOTTED 1/4"	9
560256005	SCREW PHILIPS 2-56X5/16	3
560440012	SCREW PHILIPS 4-40X3/4	4
576210001	WASHER SPLIT LOCK SIZE 2	6
576410001	WASHER SPLIT LOCK SIZE 4	4
577400001	WASHER SHAKEPROOF SIZE 4	9
581440001	NUT HEX SMALL OD SS 4-40	4
590221014	WIRE TEFLON 19/27 RED 14	1
701461003	MOUNTING BLOCK 1461-1	3
711461100	PC BD PREASS'Y 1461-1	1

PART NUMBER	DESCRIPTION REMARK	QTY PER
731461104	STIFFENER/HEATSINK 1461-1	2

End of report. 259 Details encountered.

PART NUMBER	DESCRIPTION REMARK	QTY PER
102945502	CAP CERA DISC 1KV .005UF C26-C32 C35-C41 C44-C50 C53-C59 C62-C68 C71-C77 C80-C86 C89-C95 C98-C104 C107-C113 C116-C122 C125-C131	84
124002472	CAP FILM AXIAL .0047 UF C1-C24	24
161305103	RES COMP 1/4W 5% 10 K R3 R7 R11 R15 R19 R23 R27 R31 R35 R39 R43 R47	12
161335273	RES CARBON FILM 27 K R1 R2 R5 R6 R9 R10 R13 R14 R17 R18 R21 R22 R25 R26 R29 R30 R33 R34 R37 R38 R41 R42 R45 R46	24
168001107	HV RES 1% 100 MEG SPECIAL TCR R4 R8 R12 R16 R20 R24 R28 R32 R36 R40 R44 R48	12
235830020	DIODE HV RECTIFIER NV20FP CR1-CR96	96
390710265	POTTING TRAY, PVC AS REQUIRED	0
402070000	CONN CO-AX SHV	12
440272461	TRANSFORMER CUSTOM HIGH VOLTAGE T1-T12	12
454116008	HDR SOLD TAIL/MALE 8 P1-P6 P1N-P6N	12
468911001	TEST POINT (JACK) WHT	2
485224001	BUMPER (FOOT) CLR PLASTIC	2
520001014	SPACER NYLON 7/16	12
520632108	STANDOFF ROUND 6-32X.600	5
555800001	COLLAR SCREW FOR VME	2
555800003	PLASTIC SLEEVE FOR VME PANEL	2
557632404	SCREW ROUND HD 6-32X1/4	5
589691124	WIRE 3KV PVC BLACK 24AWG	3
591101022	WIRE BUS TIN-COPP AWG 22	0
595003103	SLEEVING SHRINK BLK 1/4"	1
595901020	SLEEVING TEFLON AWG 20	0
701461001	FRONT PANEL 1461	1
711461200	PC BD PREASS'Y 1461-2	1
CH599811013	2 PART CLEAR SILICONE POT COMPOUND THE QUANTITY IS 14 OUNCES BY WEIGHT.	14

End of report. 49 Details encountered.

PART NUMBER	DESCRIPTION REMARK	QTY PER
557632404	SCREW ROUND HD 6-32X1/4	5
567440005	SCREW FLAT PHIL 4-40X5/16	3
568256002	SCREW FLAT PHIL 2-56X1/8	6
731461102	SIDE COVER 1461-1	1

End of report. 4 Details encountered.

PART NUMBER	DESCRIPTION REMARK	QTY PER
1461-1	12 CH HV MAIN BOARD	1
1461-2P	1461 POS HV MULTIPLIER BOARD	1
1461P-MECH	MECH ASSBLY POS POLARITY	1
597000100	SHIPPING CARTON (FASTBUS PAD)	1

End of report. 4 Details encountered.

PART NUMBER	DESCRIPTION REMARK	QTY PER
103447105	CAP CERA MONO 100V 1 UF C44 C46 C48 C52 C66 C68 C70 C74 C87 C89 C91 C95 C108 C110 C116 C129 C131 C133 C137 C150 C152 C154 C158	24
103625221	CAP CERA MONO 100V 220 PF C247	1
106338224	CAP CERA MONO .22UF C47 C51 C69 C73 C90 C94 C111 C115 C132 C136 C153 C157	12
106348334	CAP CERA MONO .33UF C5 C10 C11 C16 C18 C24 C30 C31 C37 C38 C43 C54 C55 C59 C60 C76 C77 C81 C82 C97 C98 C102 C103 C118 C119 C123 C124 C139 C140 C144 C145 C160 C161 C165 C166	38
106433471	CAP CERA MONO 470PF C239 C246	8
106435102	CAP CERA MONO .001UF C62 C63 C83 C84 C104 C105 C125 C126 C146 C147 C167 C168	12
106438104	CAP CERA MONO .1UF C1 C3 C4 C6-C9 C12-C15 C17 C19-C23 C25-C29 C32-C36 C39-C42 C49 C50 C53 C56-C58 C61 C64 C65 C71 C72 C75 C78-C80 C85 C86 C92 C93 C96 C99-C101 C106 C107 C113 C114 C117 C120-C122 C127 C128 C134 C135 C138 C141-C143 C148 C149 C155 C156 C159 C162-C164 C169-C175 C178-C188 C191-C194 C196 C197 C200-C217 C237 C238	122
141854685	CAP TANT DIP 6.8 UF C219 C221	3
146654107	CAP MINI ALUM 20% 100 UF C2 C45 C67 C88 C109 C130 C151 C176 C177 C189 C190 C195 C198	15

PART NUMBER	DESCRIPTION REMARK	QTY PER
146654107	CAP MINI ALUM 20% 100 UF C199 C218	15
161225101	RES CARBON FILM 100 OHMS R1A R4 R15 R29 R56 R57 R80 R81 R108 R109 R136 R137 R164 R184 R190	15
161225102	RES CARBON FILM 1 K R2 R18 R21 R26 R27 R32 R51 R73 R84 R103 R112 R129 R140 R159 R167 R173 R180 R186 R189 R197-R199 R210-R212 R220	26
161225103	RES CARBON FILM 10 K R12 R14 R43 R45 R65 R67 R95 R97 R121 R123 R151 R153 R169 R176 R192 R206	16
161225201	RES CARBON FILM 200 OHMS R182 R183	2
161225331	RES CARBON FILM 330 OHMS R1	1
161225431	RES CARBON FILM 430 OHMS R6 R7 R9 R10 R37 R38 R40 R41 R59 R60 R62 R63 R89 R90 R92 R93 R115 R116 R118 R119 R145 R146 R148 R149 R187	25
161225470	RES CARBON FILM 47 OHMS R194 R196 R209	3
161225472	RES CARBON FILM 4.7 K R28 R185	2
161225683	RES CARBON FILM 68 K R11 R13 R42 R44 R64 R66 R94 R96 R120 R122 R150 R152	12
161335022	RES CARBON FILM 2.2 OHMS R5 R8 R36 R39 R58 R61 R88 R91 R114 R117 R144 R147 R5A R8A R36A R39A R58A R61A R88A R91A R114A R117A R144A R147A	24
161335100	RES CARBON FILM 10 OHMS R175	1
161335102	RES CARBON FILM 1 K R191	1
161335200	RES CARBON FILM 20 OHMS R177 R193	2

PART NUMBER	DESCRIPTION REMARK	QTY PER
161335470	RES CARBON FILM 47 OHMS R188	1
161335471	RES CARBON FILM 470 OHMS R200	1
168139399	RES RN55E .1% 1.15 K R17 R25 R47 R48 R53 R54 R69 R70 R77 R78 R99 R100 R105 R106 R125 R126 R133 R134 R155 R156 R161 R162 R174 R178	24
168139518	RES RN55E .1% 20.0 K R171	1
168139539	RES RN55E .1% 33.2 K R170	1
168139585	RES RN55E .1% 100 K R19 R20 R22 R30 R31 R33 R49 R50 R52 R71 R72 R74 R82 R83 R85 R101 R102 R104 R110 R111 R113 R127 R128 R130 R138 R139 R141 R157 R158 R160 R165 R166 R168 R202 R205 R229	36
168139617	RES RN55E .1% 215 K R16 R46 R55 R68 R79 R98 R107 R124 R135 R154 R163 R179	12
168139661	RES RN55E .1% 619 K R23 R24 R34 R35 R75 R76 R86 R87 R131 R132 R142 R143	12
168531326	RES PREC RN55D 200 OHMS R172	1
168531489	RES PREC RN55D 10.0 K R181	1
182537203	RES VARI CERMET 20 K R3	1
190042472	RESISTOR NETWORK 4.7 K RN34	1
190642472	RESISTOR NETWORK 4.7 K RN31-RN33	3
190662271	RESISTOR NETWORK 270 OHMS RN1-RN12	12
190832102	RESISTOR NETWORK 1 K RN13-RN24	12
200032010	IC 2-INPUT NAND 74LS38PC U31	1
200071540	IC OCT INV BUFFER 74HCT540 U2	1
200332004	IC HEX INVERTER HCT04	1

PART NUMBER	DESCRIPTION REMARK	QTY PER
200332004	IC HEX INVERTER HCT04 U30	1
200373374	IC D-TYP FLOP 74HCT374 U38	1
200671373	IC D-TYPE FLOP HCT373 U36	1
205034014	IC CMOS HEX SCHMITT 74HCT14 U35	1
205271256	IC 32K X 8 RAM 62256-12 U32	1
205370028	EEPROM 32K X 8 AT28C256 U33	1
205640165	IC SHIFT REG HCT165 U28 U29	2
205644094	IC 8-BIT SHIFT REG HCT4094 U1 U4	2
205750008	IC AND-OR LOGIC ARRAY 16R8 DO NOT INCLUDE ON KIT. SEND TO THE PROGRAMMING CENTER FOR PROGRAMMING. U3	1
205750168	IC 7-WIDE AND-OR-INV 16L8A DO NOT INCLUDE ON KIT. SEND TO THE PROGRAMMING CENTER FOR PROGRAMMING. U37	1
207270188	IC 12-BIT ADC,12 CH 188DCPP U26	1
207270528	IC OCTAL BIT DAC U18 U20 U22	3
207345052	IC DUAL 4CH MUX/DEMUX 74HCT4052 U19 U21 U23	3
208011007	IC DUAL OP AMP LM358N U24 U40	2
208011011	IC JFET OP AMP TL082CP U5 U7 U9 U11 U13 U15	6
208130324	IC QUAD OP AMP LM324A U6 U8 U10 U12 U14 U16 U39	7
208166012	IC VOLT REG +12 UA78L12AC VR15	1
208213002	IC VOLT REF +5V REF-02 U25	1
208217005	IC VOLT REG +5V MC78L05AC VR13	1
208570317	IC ADJ +V REG LM317 VR1-VR12	12
208590337	IC VOLT REG NEG ADJ LM337 VR14	1

PART NUMBER	DESCRIPTION REMARK	QTY PER
208738015	IC VOLTAGE MONITOR MAX8215 U27	1
227148110	IC 8-BIT MICROCONTROLLER 68HC11A0P U34	1
229020055	TRANS VOLT SUPPR P6KE6.8 CR2 CR3	2
230110005	DIODE SWITCHING 1N4448 CR4-CR19 CR21 CR22 CR24-CR47 CR49	43
240425751	DIODE ZENER 5.1V 1N751A CR20	1
240425752	DIODE ZENER 5.6V 1N752A CR48	1
253050817	DIODE HOT CARRIER 1N5817 CR23	1
256270505	DIODE LED RED 5V 550-0405 CR1	1
270170904	TRANSISTOR NPN 2N3904 Q39	1
280170104	TRANSISTOR FET N VN0104N3 Q37 Q38	2
280170210	TRANSISTOR N-CHANNEL MOSFET 2210N3 Q1-Q36	36
300050002	CHOKE FERRITE SINGLE LEAD L2	1
433220003	FUSE PICO II 125V .5 AMP F2 F3 F4	3
433221007	FUSE PICO II 125V 7 AMP F1	1
454121008	HDR SOLD TAIL/FEM 8 J1-J6 J1N J1P J2N J2P J3N J3P J4N J4P J5N J5P J6N J6P	18
454610096	HDR SOLD TAIL/MALE 96 J7	1
468099008	TEST POINT W/GLASS INSULATOR TP1 TP2 TP3	3
500900001	INSULATOR, CUSTOM, SELF ADHESIVE	2
521256012	SPACER HEX 2-56X3/4	3
524440024	STANDOFF M/F 4-40 X 1/2" LG	3
555511005	SCREW SELF-TAPPING PHIL HD	2
559440004	SCREW 4-40 SLOTTED 1/4"	9
560256005	SCREW PHILIPS 2-56X5/16	3
560440012	SCREW PHILIPS 4-40X3/4	4
576210001	WASHER SPLIT LOCK SIZE 2	6
576410001	WASHER SPLIT LOCK SIZE 4	4
577400001	WASHER SHAKEPROOF SIZE 4	9
581440001	NUT HEX SMALL OD SS 4-40	4
590221014	WIRE TEFLON 19/27 RED 14	1
701461003	MOUNTING BLOCK 1461-1	3
711461100	PC BD PREASS'Y 1461-1	1

PART NUMBER	DESCRIPTION REMARK	QTY PER
731461104	STIFFENER/HEATSINK 1461-1	2

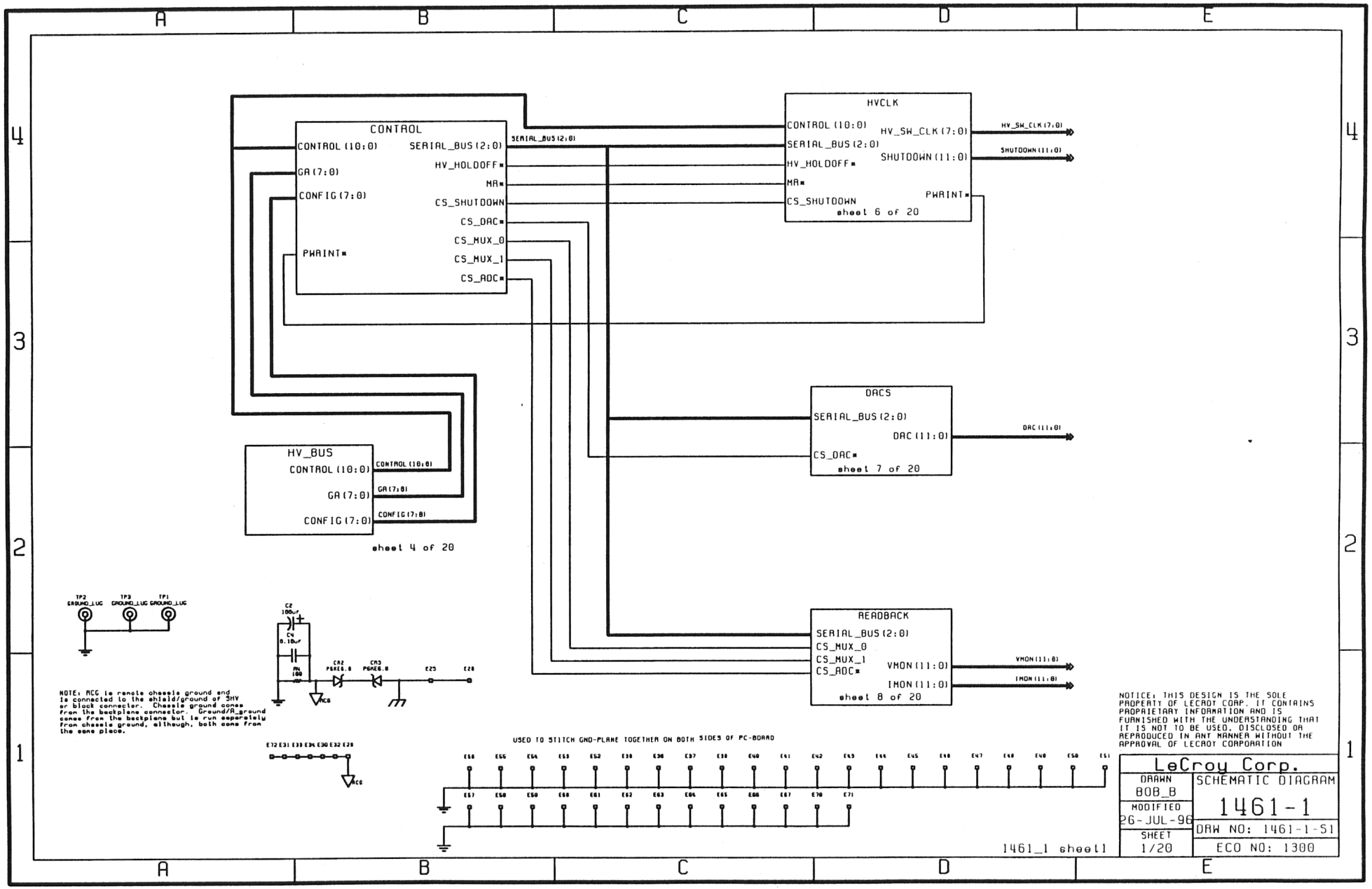
End of report. 259 Details encountered.

PART NUMBER	DESCRIPTION REMARK	QTY PER
102945502	CAP CERA DISC 1KV .005UF	84
124002472	CAP FILM AXIAL .0047 UF	24
161305103	RES COMP 1/4W 5% 10 K	12
161335273	RES CARBON FILM 27 K	24
168001107	HV RES 1% 100 MEG SPECIAL TCR	12
235830020	DIODE HV RECTIFIER NV20FP	96
390710265	POTTING TRAY, PVC AS REQUIRED	0
402070000	CONN CO-AX SHV	12
440272461	TRANSFORMER CUSTOM HIGH VOLTAGE	12
454116008	HDR SOLD TAIL/MALE 8	12
468911001	TEST POINT (JACK) WHT	2
485224001	BUMPER (FOOT) CLR PLASTIC	2
520001014	SPACER NYLON 7/16	12
520632108	STANDOFF ROUND 6-32X.600	5
555800001	COLLAR SCREW FOR VME	2
555800003	PLASTIC SLEEVE FOR VME PANEL	2
557632404	SCREW ROUND HD 6-32X1/4	5
589621124	WIRE 3KV PVC RED 24AWG	3
591101022	WIRE BUS TIN-COPP AWG 22	0
595003103	SLEEVING SHRINK BLK 1/4"	1
595901020	SLEEVING TEFLON AWG 20	0
701461001	FRONT PANEL 1461	1
701461201	LABEL 1461P	1
711461200	PC BD PREASS'Y 1461-2	1
CH599811013	2 PART CLEAR SILICONE POT COMPOUND THE QUANTITY IS 14 OUNCES BY WEIGHT.	14

End of report. 28 Details encountered.

PART NUMBER	DESCRIPTION REMARK	QTY PER
567632404	SCREW ROUND HD 6-32X1/4	5
567440005	SCREW FLAT PHIL 4-40X5/16	3
568256002	SCREW FLAT PHIL 2-56X1/8	6
731461102	SIDE COVER 1461-1	1

End of report. 4 Details encountered.


CONTROL
CONTROL (10:0)
GA (7:0)
CONFIG (7:0)
PWRINT*
SERIAL_BUS (2:0)
HV_HOLDOFF*
MR*
CS_SHUTDOWN
CS_DAC*
CS_MUX_0
CS_MUX_1
CS_ADC*
HVCLK
CONTROL (10:0)
SERIAL_BUS (2:0)
HV_HOLDOFF*
MR*
CS_SHUTDOWN
HV_SW_CLK (7:0)
SHUTDOWN (11:0)
PWRINT*
sheet 6 of 20
DACS
SERIAL_BUS (2:0)
CS_DAC*
DAC (11:0)
sheet 7 of 20
HV_BUS
CONTROL (10:0)
GA (7:0)
CONFIG (7:0)
sheet 4 of 20
READBACK
SERIAL_BUS (2:0)
CS_MUX_0
CS_MUX_1
CS_ADC*
VMON (11:0)
IMON (11:0)
sheet 8 of 20
NOTE: ACG is remote chassis ground and is connected to the shield/ground of SHV or block connector. Chassis ground comes from the backplane connector. Ground/A_ground comes from the backplane but is run seperately from chassis ground, although, both come from the same place.
USED TO STITCH GND-PLANE TOGETHER ON BOTH SIDES OF PC-BOARD
1461_1 sheet1
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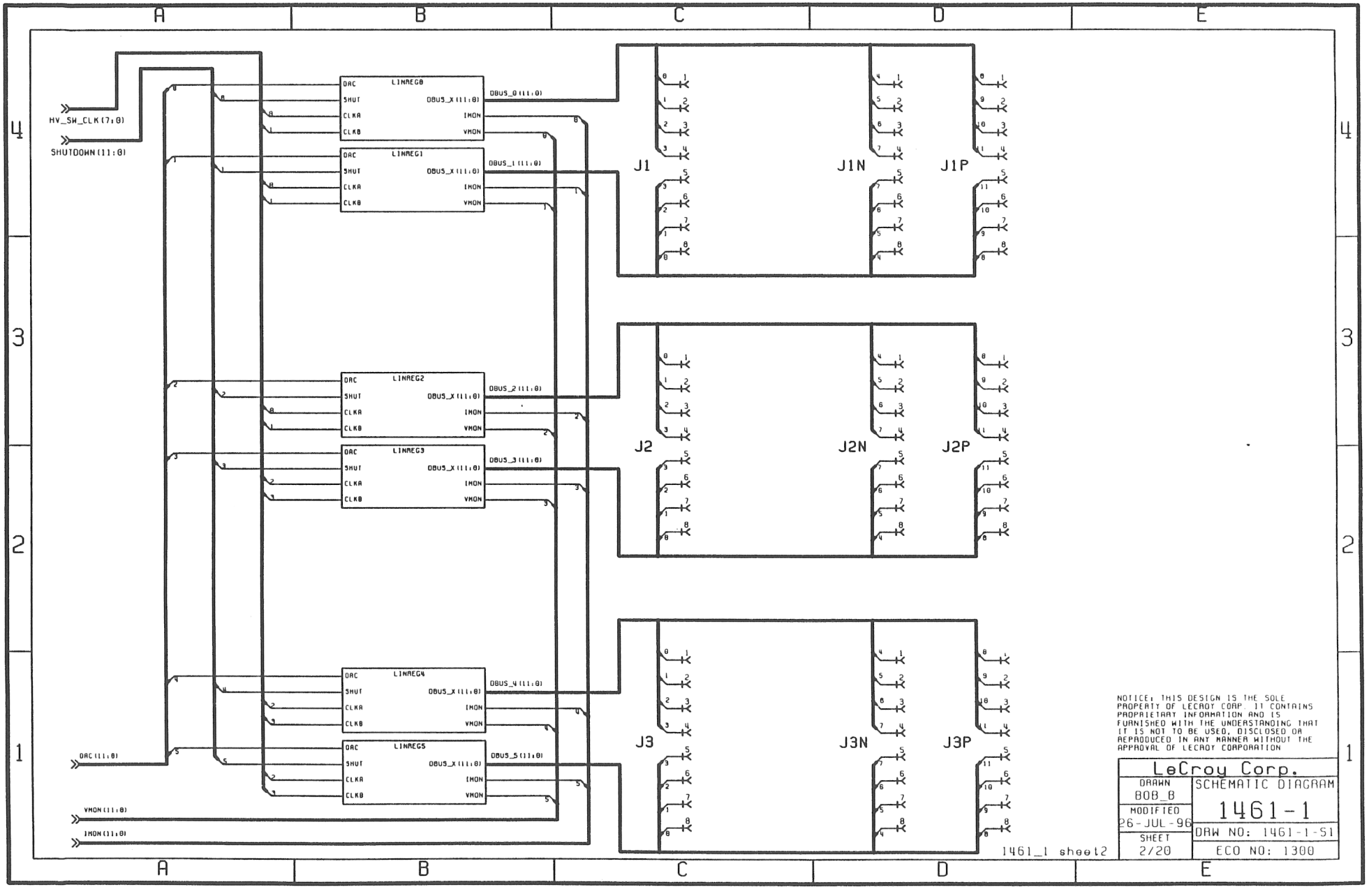
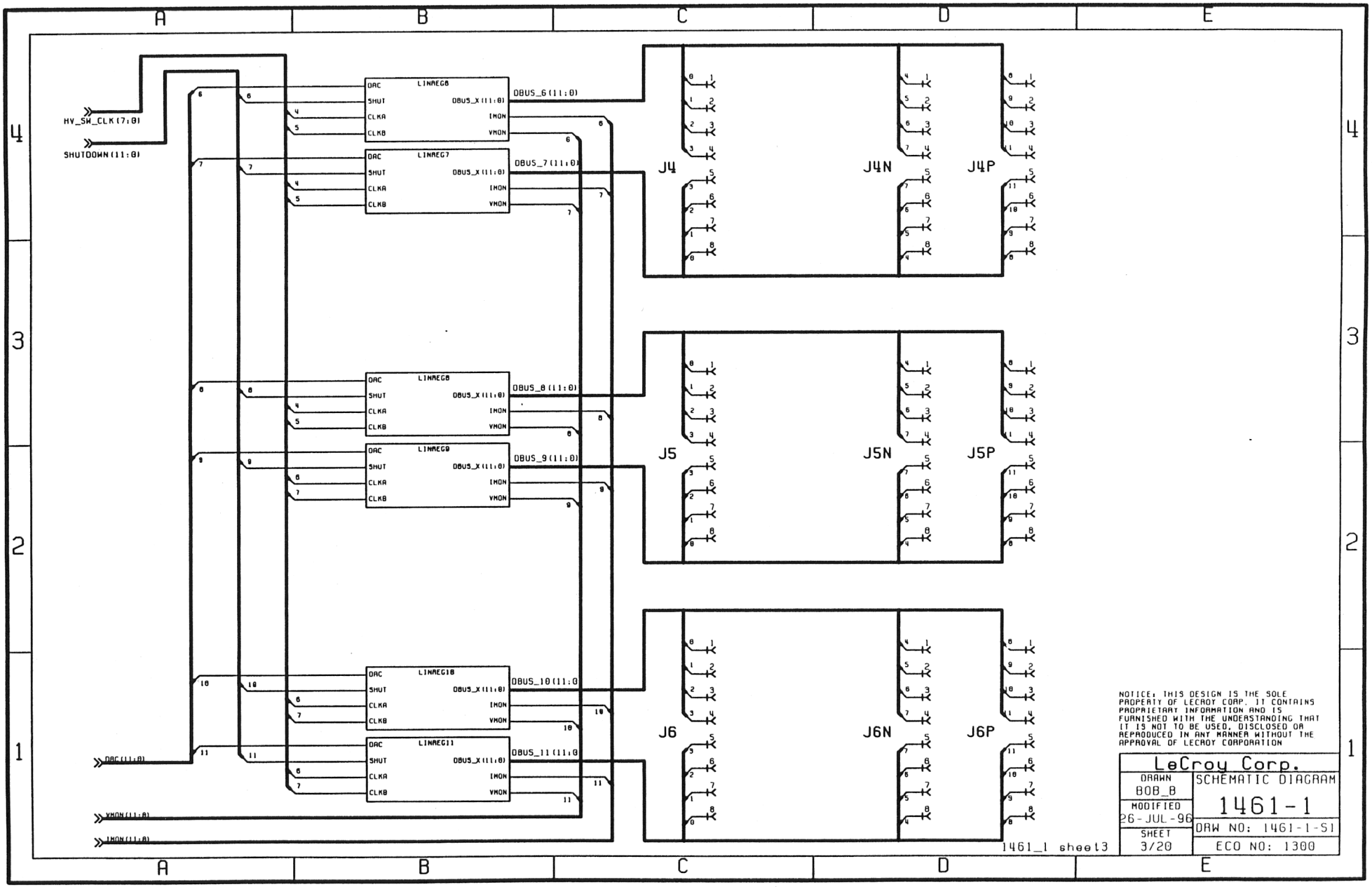
LeCroy Corp.
DRAWN BOB_B
MODIFIED 26-JUL-96
SHEET 1/20
SCHEMATIC DIAGRAM
1461-1
DRW NO: 1461-1-S1
ECO NO: 1300

ORIGINAL

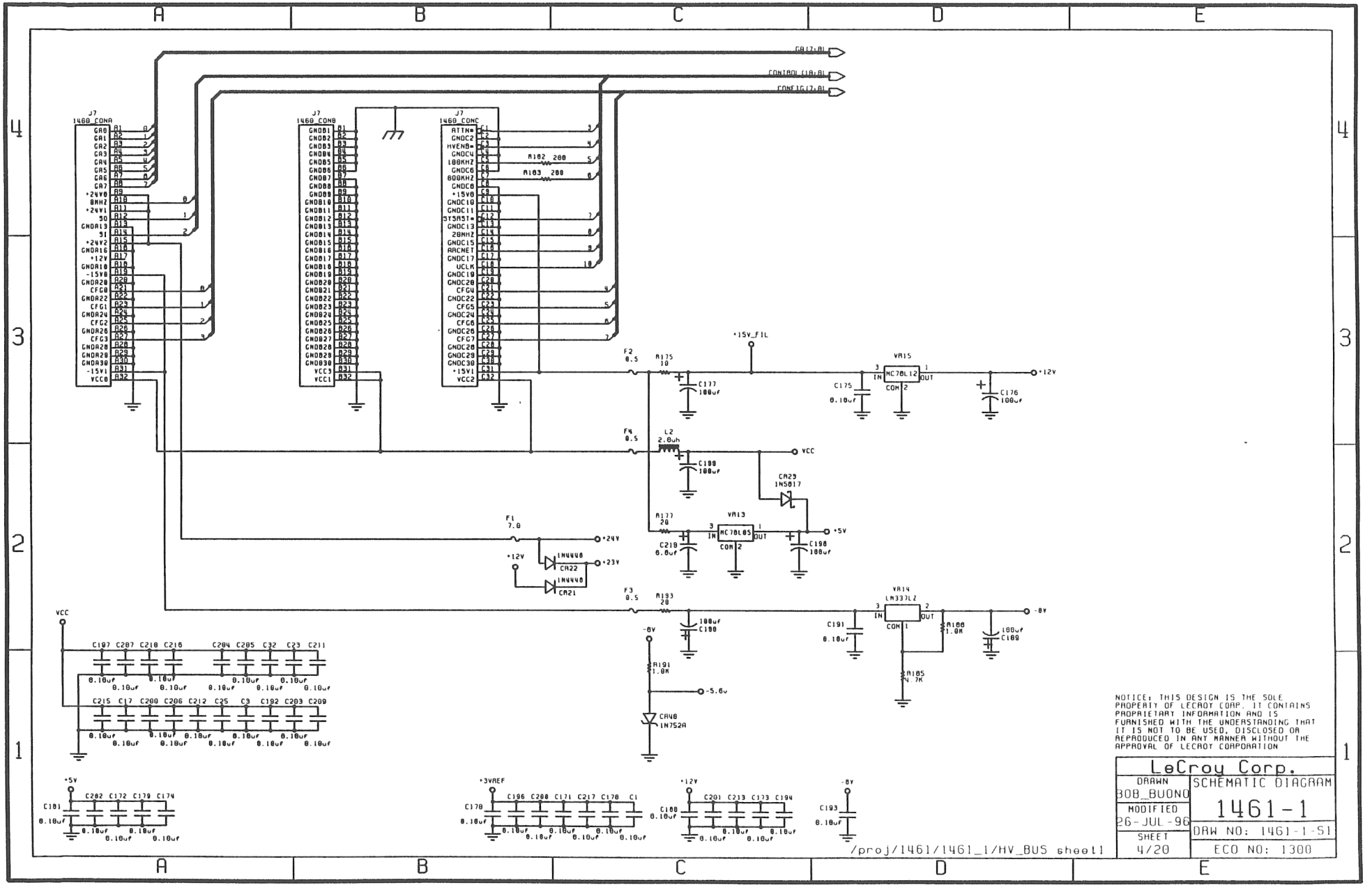


LeCroy Corp.	
DRAWN BOB_B	SCHEMATIC DIAGRAM
MODIFIED 26-JUL-96	1461-1
SHEET 2/20	DRW NO: 1461-1-S1
	ECO NO: 1300

ORIGINAL


A
B
C
D
E
1
2
3
4
HV_SW_CLK(7:0)
SHUTDOWN(11:0)
DAC(11:0)
VMON(11:0)
IMON(11:0)
LINREG6
LINREG7
LINREG8
LINREG9
LINREG10
LINREG11
DAC
SHUT
CLKA
CLKB
OBUS_X(11:0)
IMON
VMON
OBUS_6(11:0)
OBUS_7(11:0)
OBUS_8(11:0)
OBUS_9(11:0)
OBUS_10(11:0
OBUS_11(11:0
J4
J4N
J4P
J5
J5N
J5P
J6
J6N
J6P
NOTICE: THIS DESIGN IS THE SOLE PROPERTY OF LECROY CORP. IT CONTAINS PROPRIETARY INFORMATION AND IS FURNISHED WITH THE UNDERSTANDING THAT IT IS NOT TO BE USED, DISCLOSED OR REPRODUCED IN ANY MANNER WITHOUT THE APPROVAL OF LECROY CORPORATION
LeCroy Corp.
DRAWN
BOB_B
MODIFIED
26-JUL-96
SHEET
3/20
SCHEMATIC DIAGRAM
1461-1
DRW NO: 1461-1-S1
ECO NO: 1300
1461_1 sheet3

ORIGINAL


GA[7:0]
CONTROL[18:0]
CONFIG[7:0]
J7 1460_CONA
J7 1460_CONB
J7 1460_CONC
A102 200
A103 200
+15V_FIL
F2 0.5
A175 10
C177 100uF
VR15 MC78L12
C175 0.10uF
C176 100uF
+12V
F4 0.5
L2 2.0uh
C188 100uF
VCC
CR29 1N5817
F1 7.8
+24V
+12V
1N4448 CR22
1N4448 CR21
+23V
A177 20
VR13 MC78L05
C218 6.8uF
C198 100uF
+5V
F3 0.5
A183 20
C190 100uF
VR14 LM337LZ
C191 0.10uF
A188 1.8K
C189 100uF
-8V
A185 1.7K
A191 1.8K
-5.6V
CR48 1N752A
VCC
C197 C207 C218 C216 C204 C205 C32 C23 C211
C215 C17 C200 C206 C212 C25 C3 C192 C203 C209
0.10uF
+5V
C181 C202 C172 C179 C174
+3VREF
C178 C196 C208 C171 C217 C178 C1
+12V
C188 C201 C213 C173 C194
-8V
C193
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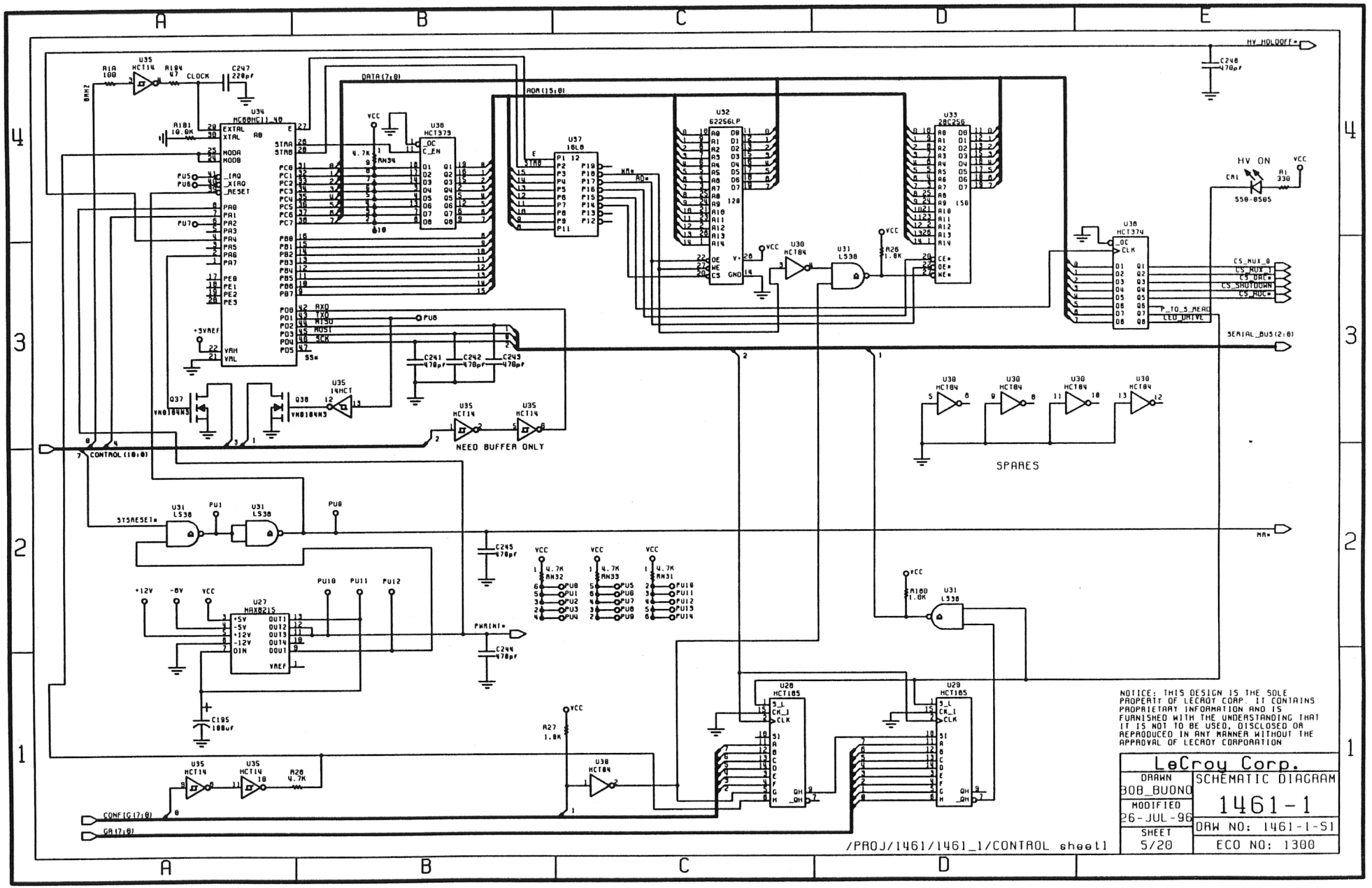
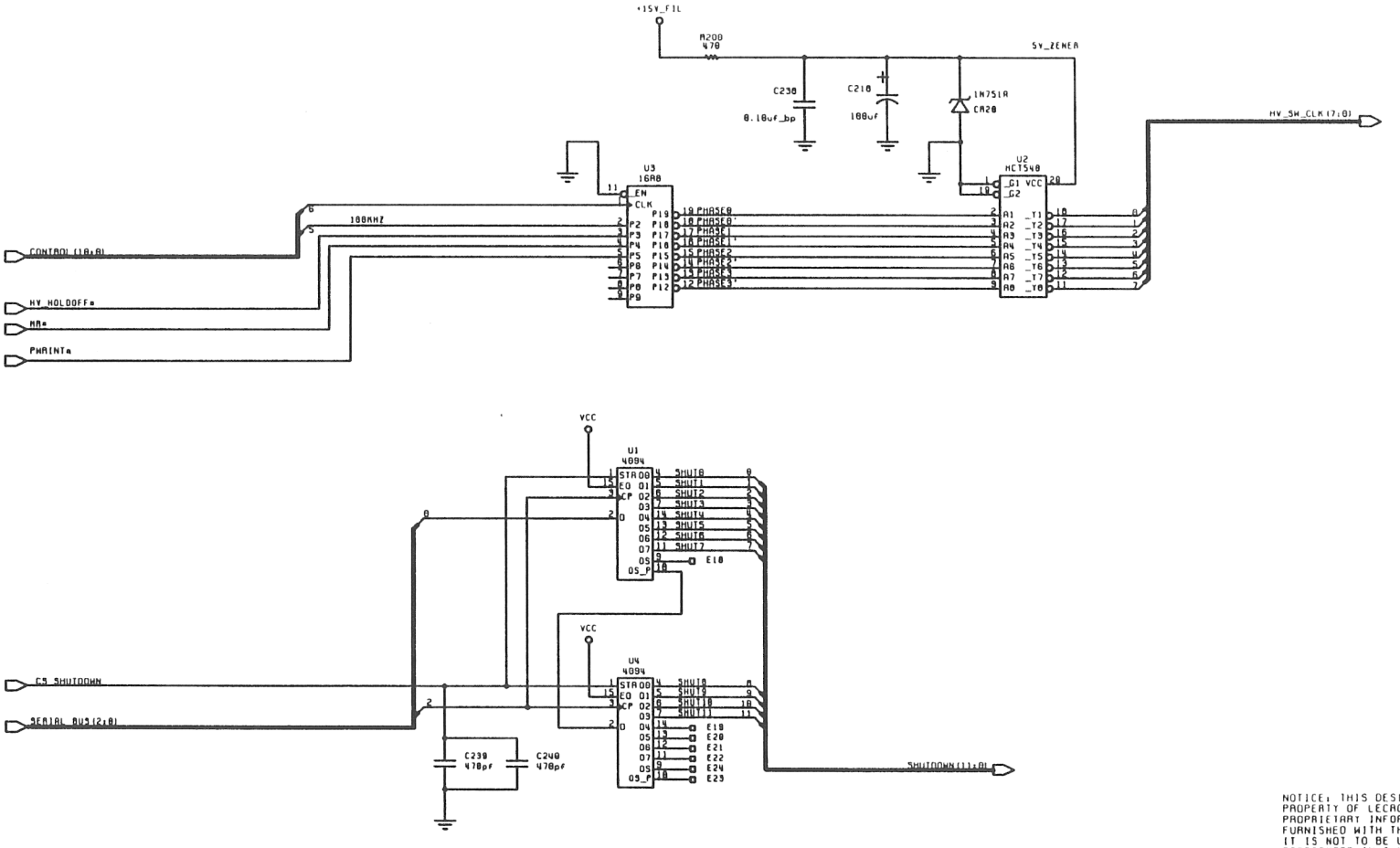
LeCroy Corp.
DRAWN 308_BUONO
MODIFIED 26-JUL-96
SHEET 4/20
SCHEMATIC DIAGRAM
1461-1
DRW NO: 1461-1-S1
ECO NO: 1300
/proj/1461/1461_1/HV_BUS sheet1

ORIGINAL


CONTROL (10:0)
NEED BUFFER ONLY
SPARES
SERIAL_BUS(2:0)
DATA(7:0)
ADR(15:0)
CONFIG(7:0)
GA(7:0)
HV ON
HV_HOLDOFF*
/PROJ/1461/1461_1/CONTROL sheet1
NOTICE: THIS DESIGN IS THE SOLE PROPERTY OF LECROY CORP. IT CONTAINS PROPRIETARY INFORMATION AND IS FURNISHED WITH THE UNDERSTANDING THAT IT IS NOT TO BE USED, DISCLOSED OR REPRODUCED IN ANY MANNER WITHOUT THE APPROVAL OF LECROY CORPORATION
LeCroy Corp.
DRAWN 308_BUONO
MODIFIED 26-JUL-96
SHEET 5/20
SCHEMATIC DIAGRAM
1461-1
DRW NO: 1461-1-S1
ECO NO: 1300

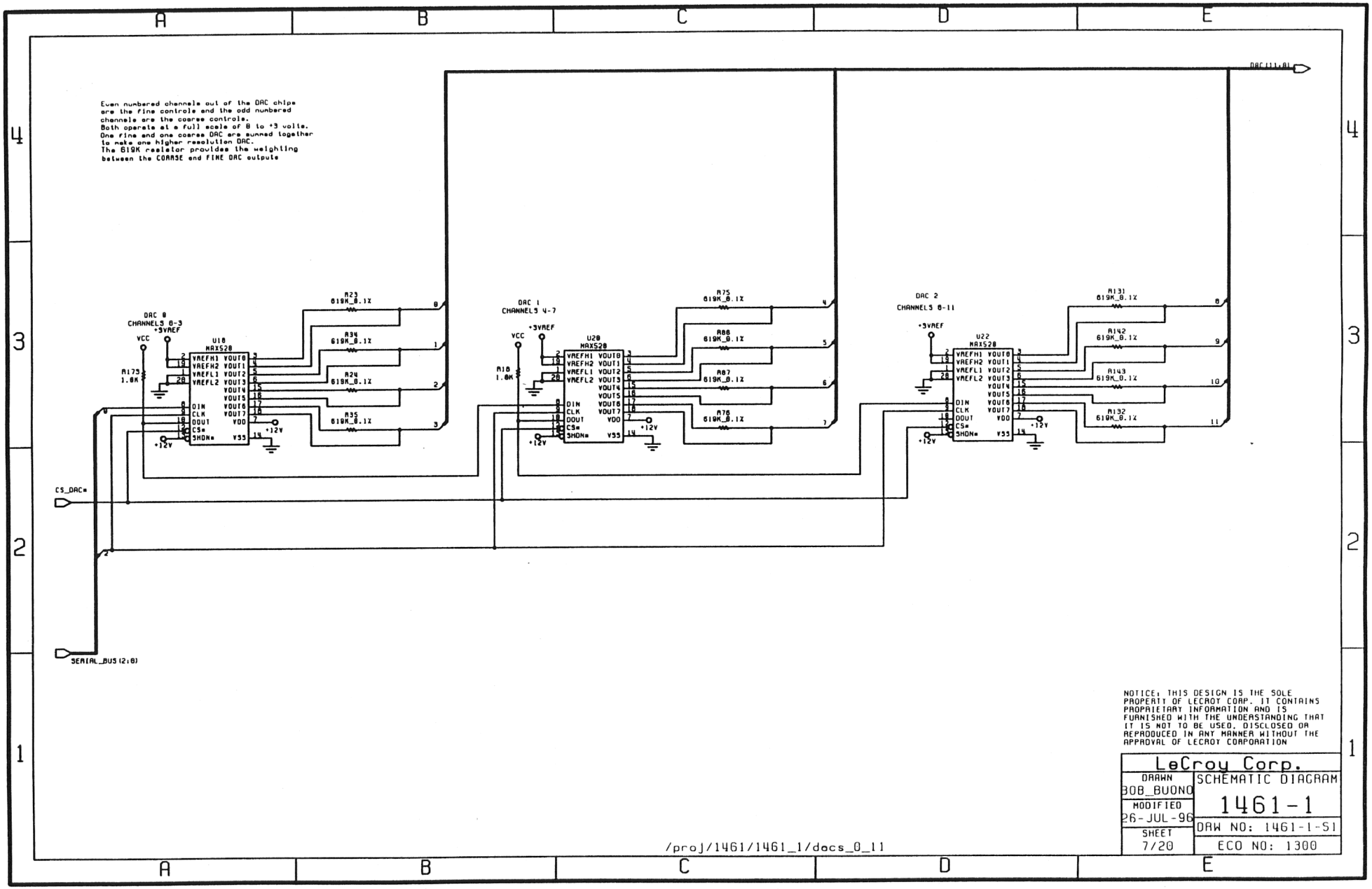
ORIGINAL



LeCroy Corp.	
DRAWN: BOB_BUONO	SCHEMATIC DIAGRAM
MODIFIED: 26-JUL-96	1461-1
SHEET: 6/20	DRW NO: 1461-1-S1
	ECO NO: 1300

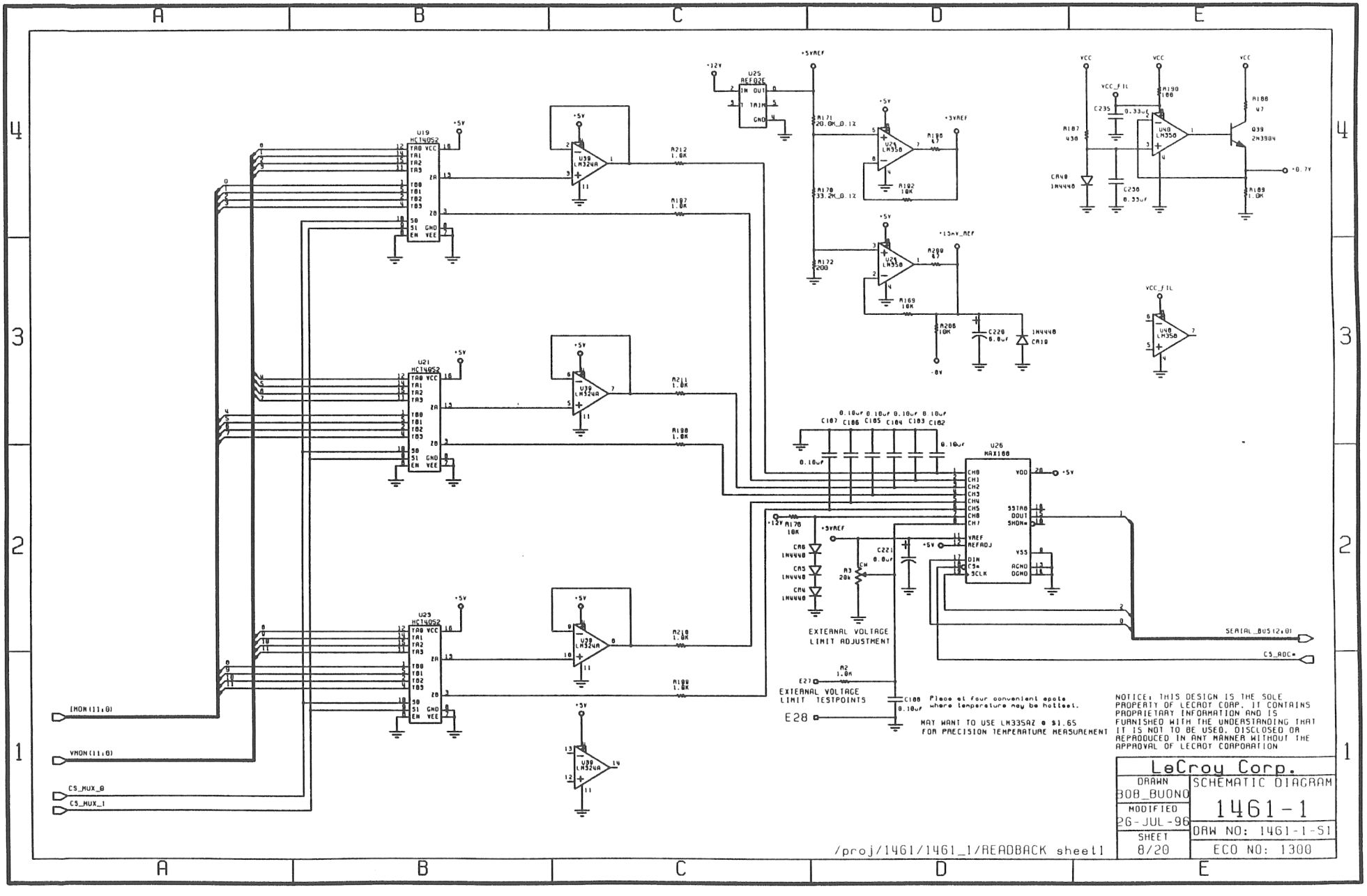
/proj/1461/1461_1/HVCLK sheet1

ORIGINAL



LeCroy Corp.	
DRAWN BOB_BUONO	SCHEMATIC DIAGRAM
MODIFIED 26-JUL-96	1461-1
SHEET 7/20	DRW NO: 1461-1-S1
	ECO NO: 1300

ORIGINAL


IMON(1:0)
VMON(1:0)
CS_MUX_0
CS_MUX_1
EXTERNAL VOLTAGE LIMIT ADJUSTMENT
EXTERNAL VOLTAGE LIMIT TESTPOINTS
E28
Place at four convenient spots where temperature may be hottest.
MAY WANT TO USE LM335AZ @ $1.65 FOR PRECISION TEMPERATURE MEASUREMENT
SERIAL_BUS(2:0)
CS_ADC*
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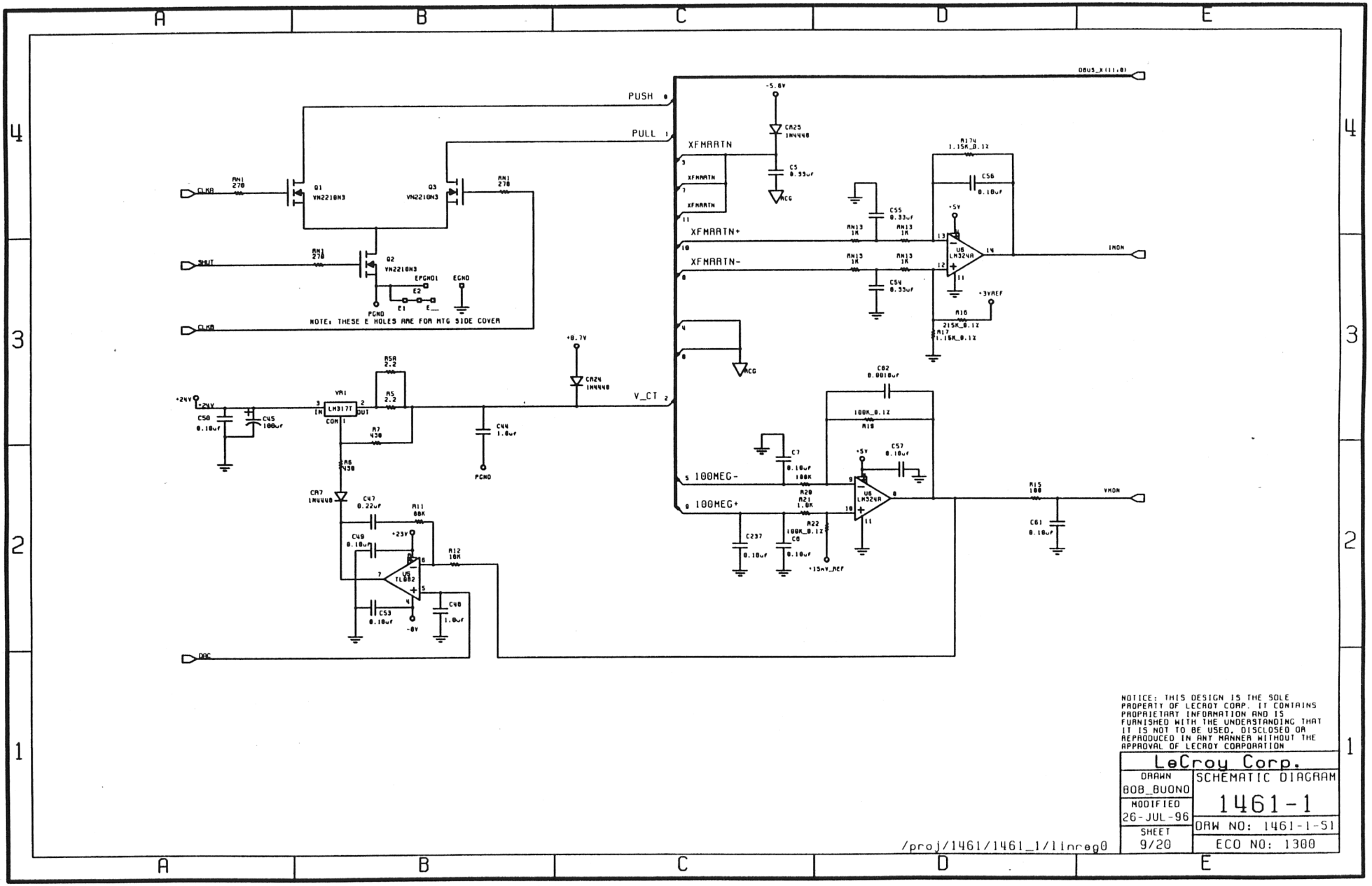
LeCroy Corp.
DRAWN
BOB_BUONO
MODIFIED
26-JUL-96
SHEET
8/20
SCHEMATIC DIAGRAM
1461-1
DRW NO: 1461-1-SI
ECO NO: 1300
/proj/1461/1461_1/READBACK sheet1

ORIGINAL



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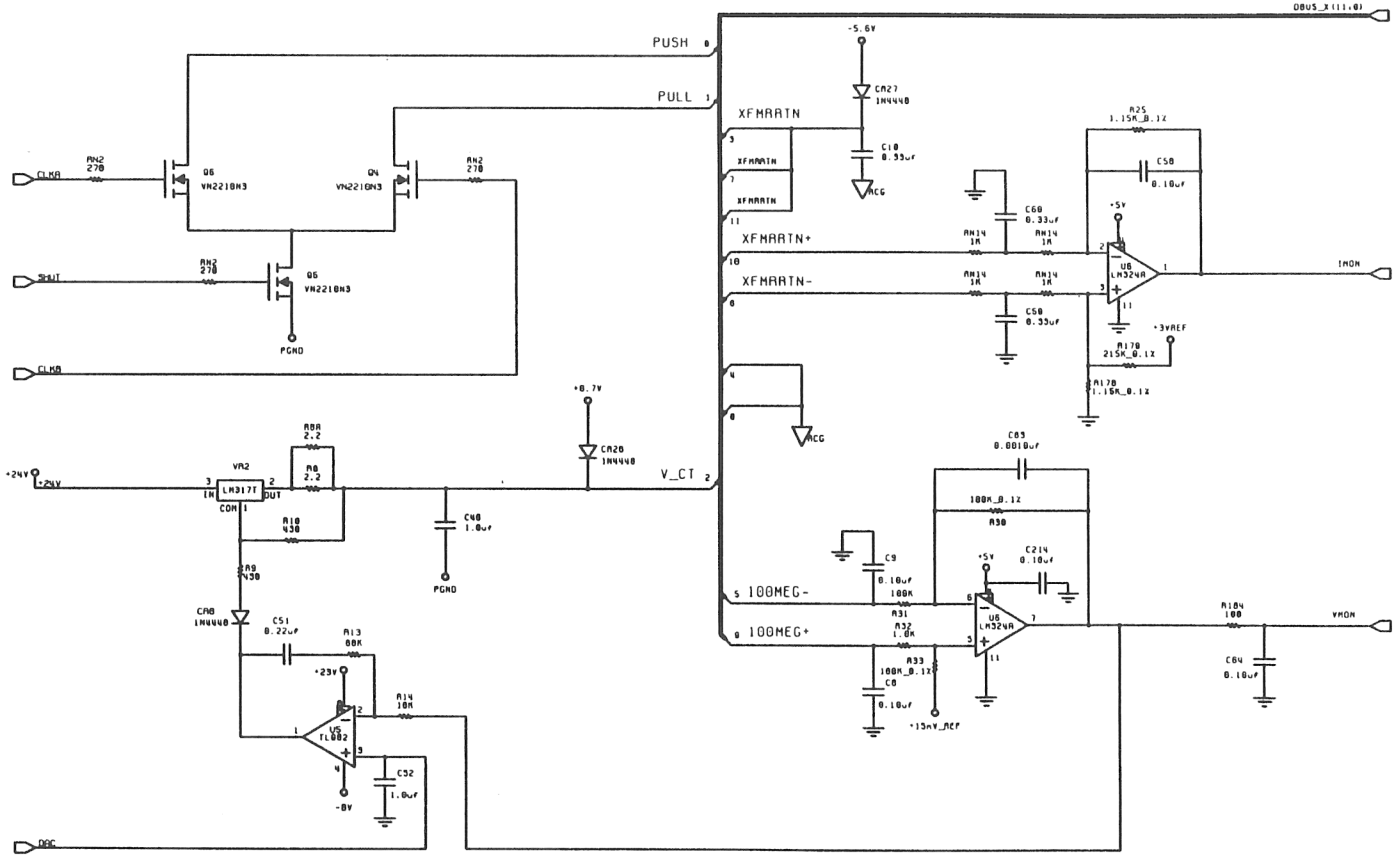
ORIGINAL



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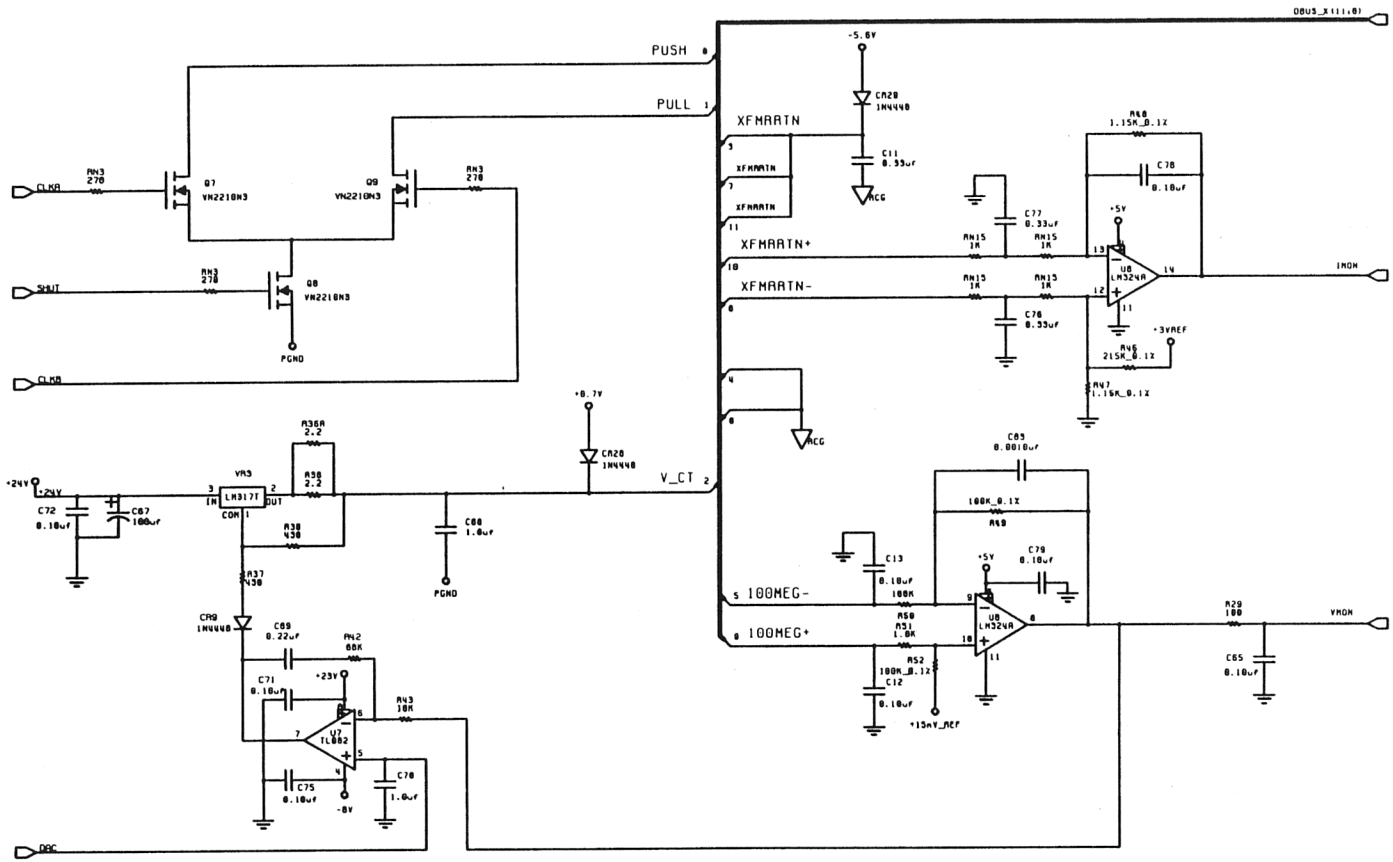
LeCroy Corp.	
DRAWN: BOB_BUONO	SCHEMATIC DIAGRAM
MODIFIED: 26-JUL-96	1461-1
SHEET: 10/20	DRW NO: 1461-1-S1
	ECO NO: 1300

/proj/1461/1461_1/linregl

ORIGINAL



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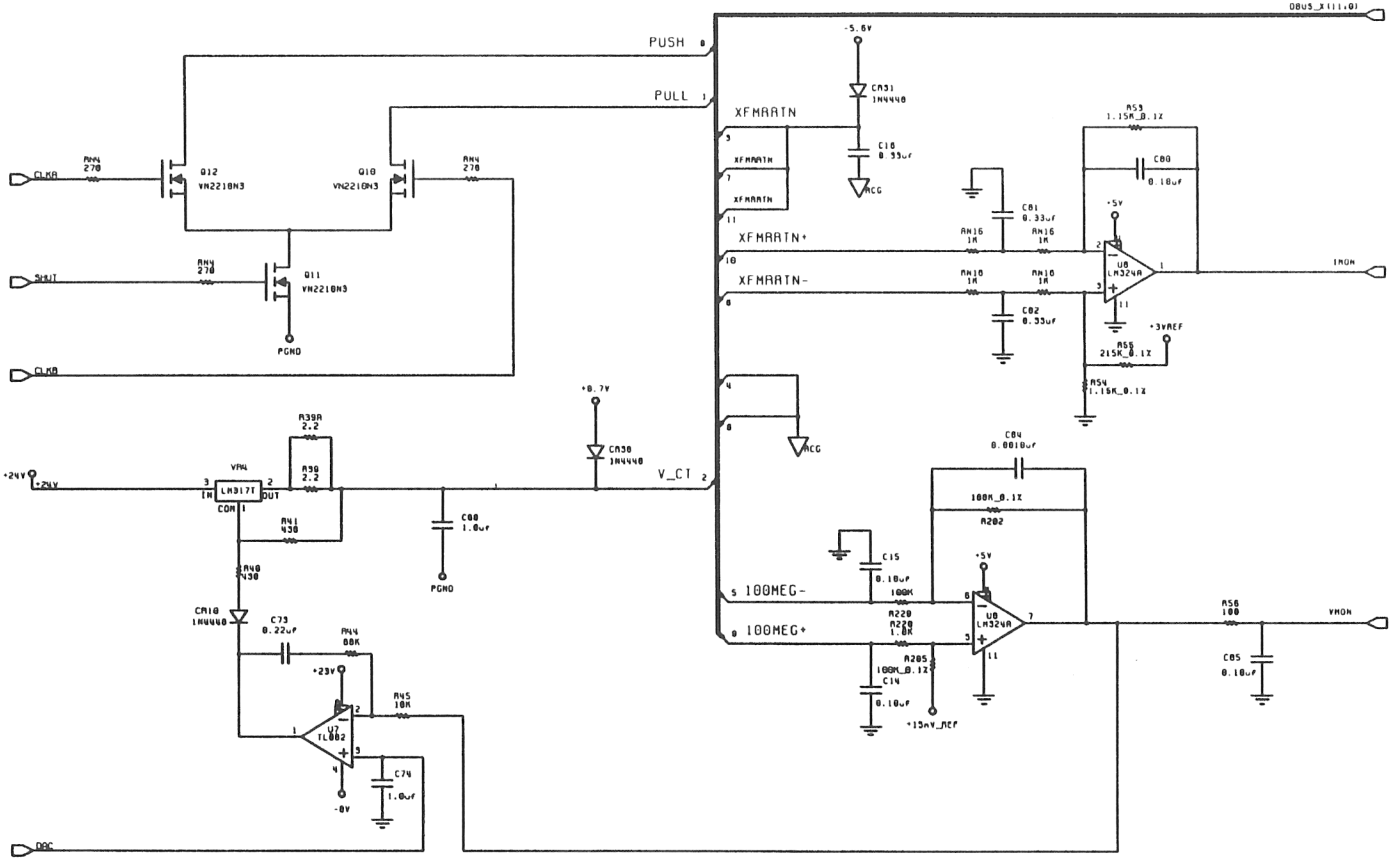
LeCroy Corp.	
DRAWN BOB_BUONO	SCHEMATIC DIAGRAM
MODIFIED 26-JUL-96	1461-1
SHEET 11/20	DRW NO: 1461-1-S1
	ECO NO: 1300

/proj/1461/1461_1/llnreg2

ORIGINAL



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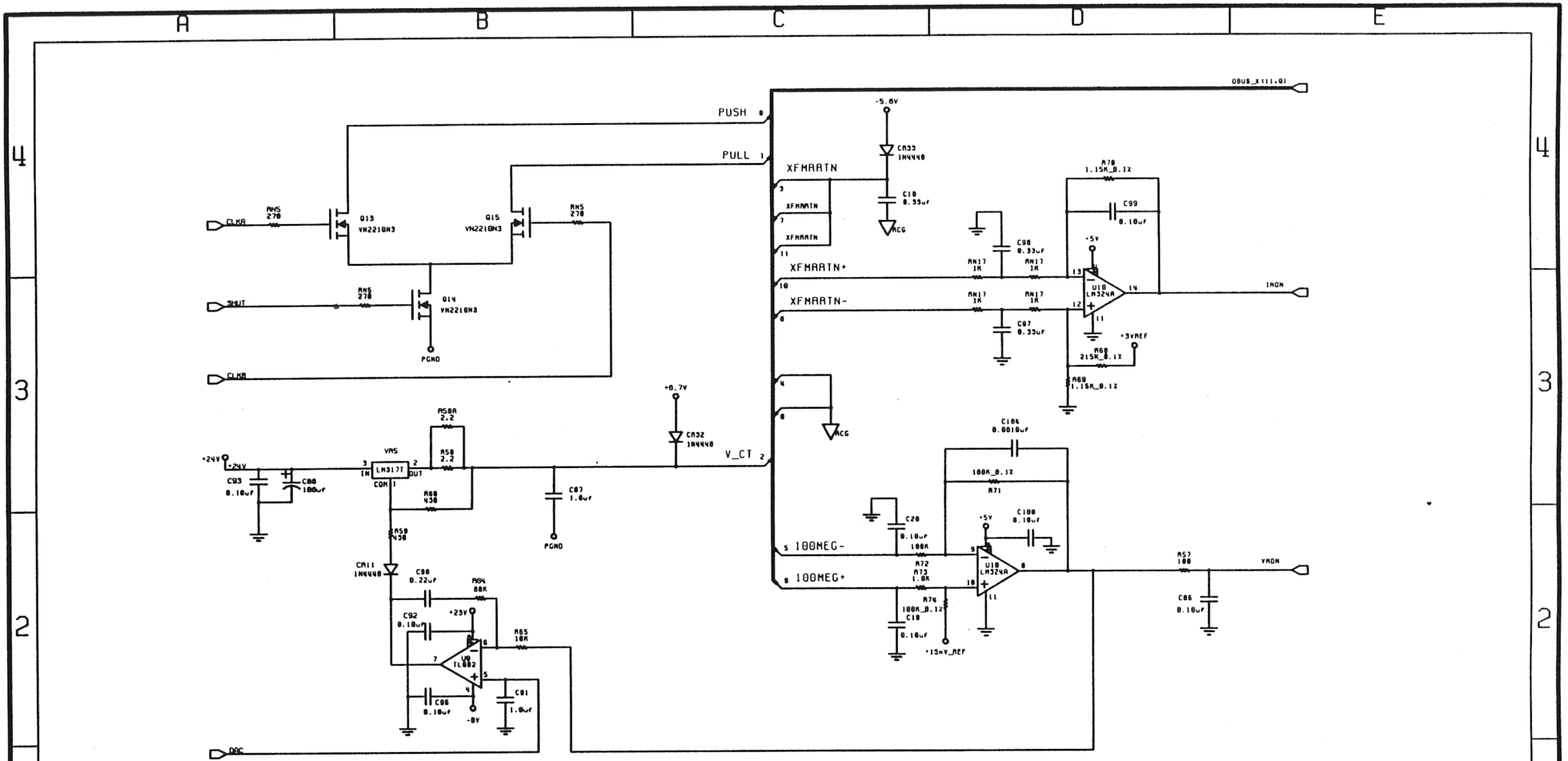
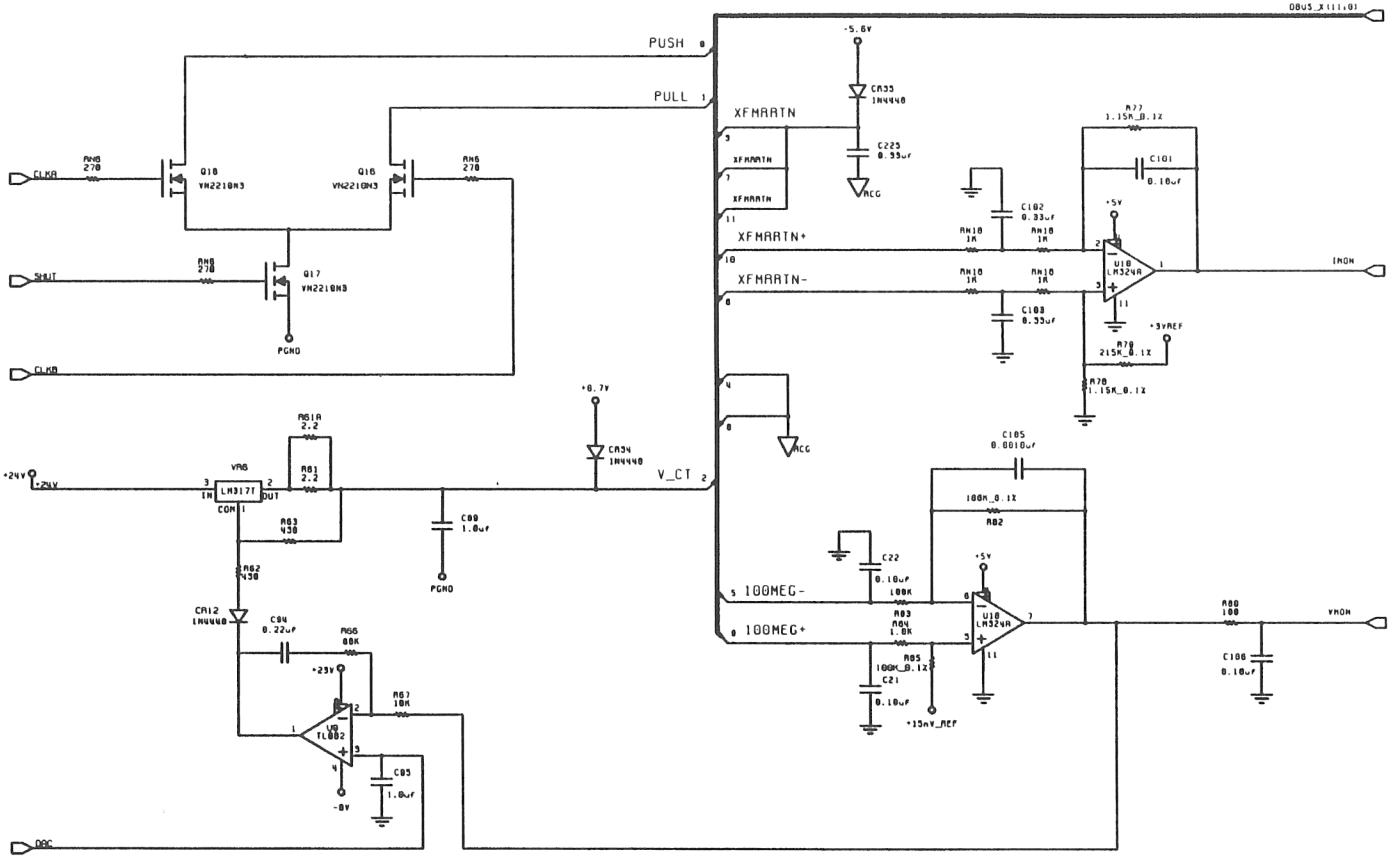
LeCroy Corp.	
DRAWN BOB_BUONO	SCHEMATIC DIAGRAM
MODIFIED 26-JUL-96	1461-1
SHEET 12/20	DRW NO: 1461-1-S1
/proj/1461/1461_1/linreg3	ECO NO: 1300

ORIGINAL



LeCroy Corp.	
DRAWN: BOB_BUONO	SCHEMATIC DIAGRAM: 1461-1
MODIFIED: 26-JUL-96	DRW NO: 1461-1-S1
SHEET: 13/20	ECO NO: 1300

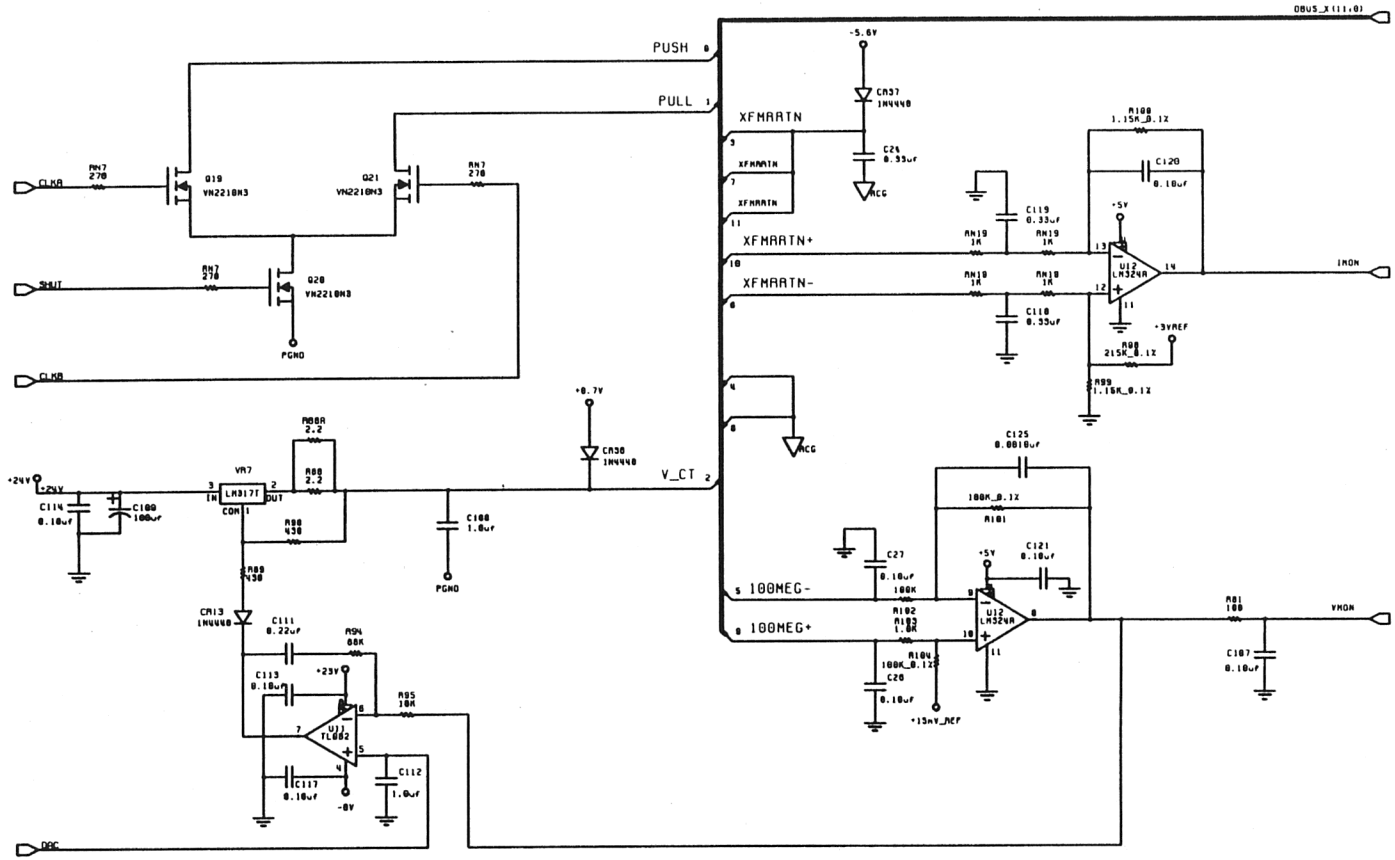
/proj/1461/1461_1/linreg4



LeCroy Corp.	
DRAWN: BOB_BUONO	SCHEMATIC DIAGRAM: 1461-1
MODIFIED: 26-JUL-96	DRW NO: 1461-1-S1
SHEET: 14/20	ECO NO: 1300

/proj/1461/1461_1/linreg5

ORIGINAL



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LeCroy Corp.	
DRAWN: BOB_BUONO	SCHEMATIC DIAGRAM
MODIFIED: 26-JUL-96	1461-1
SHEET: 15/20	DRW NO: 1461-1-S1
	ECO NO: 1300

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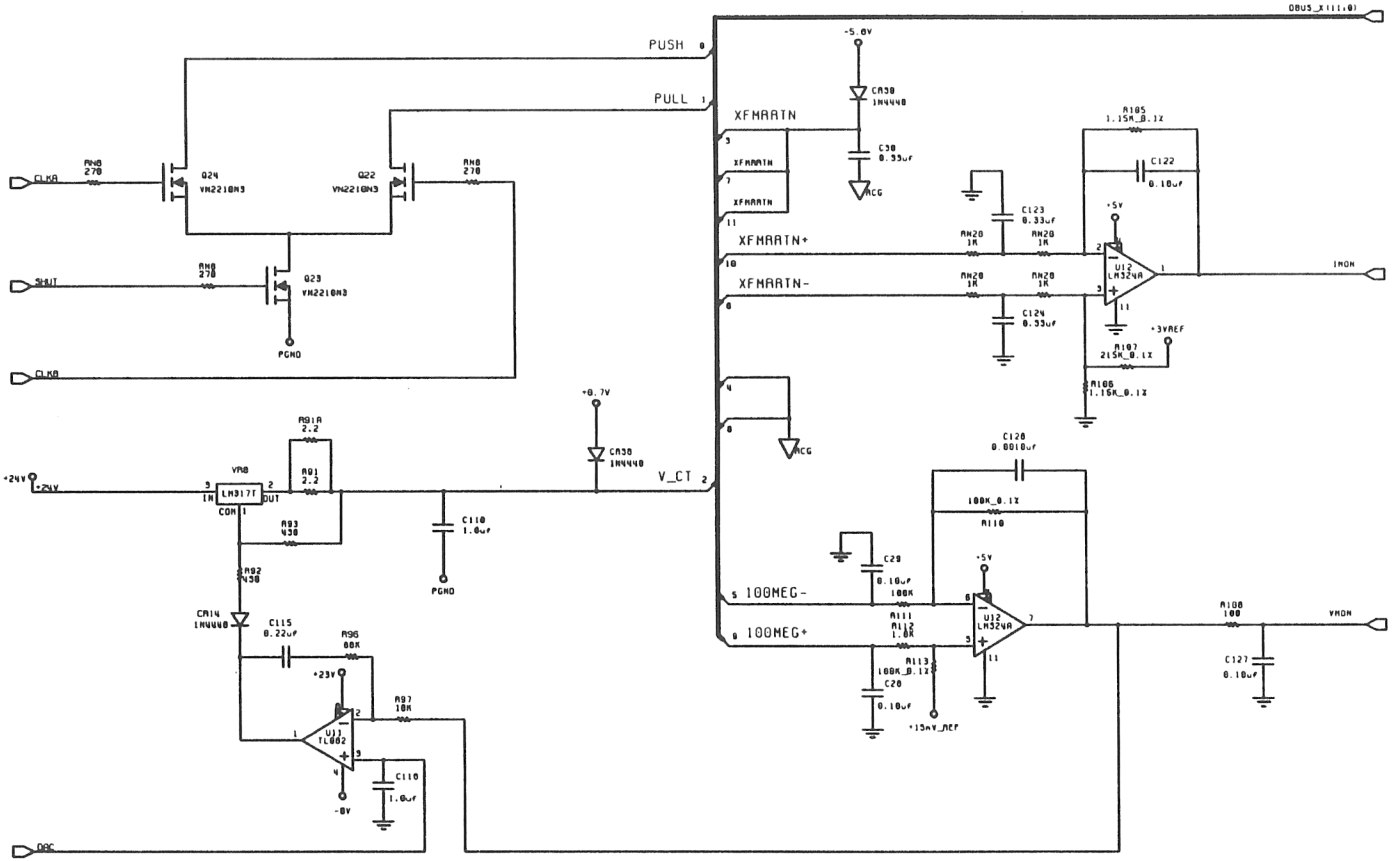
ORIGINAL



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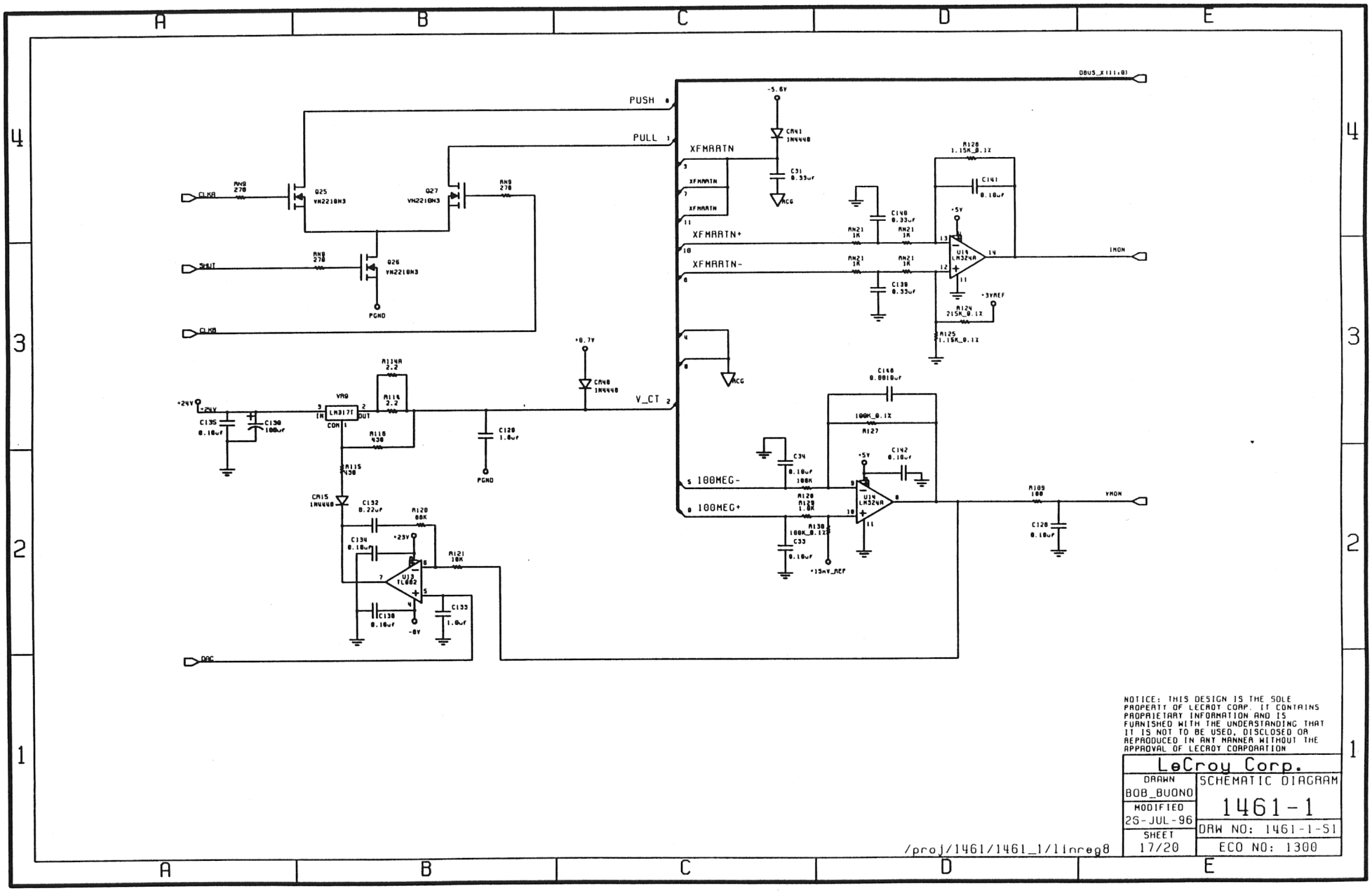
LeCroy Corp.	
DRAWN: BOB_BUONO	SCHEMATIC DIAGRAM
MODIFIED: 26-JUL-96	1461-1
SHEET: 16/20	DRW NO: 1461-1-S1
	ECO NO: 1300

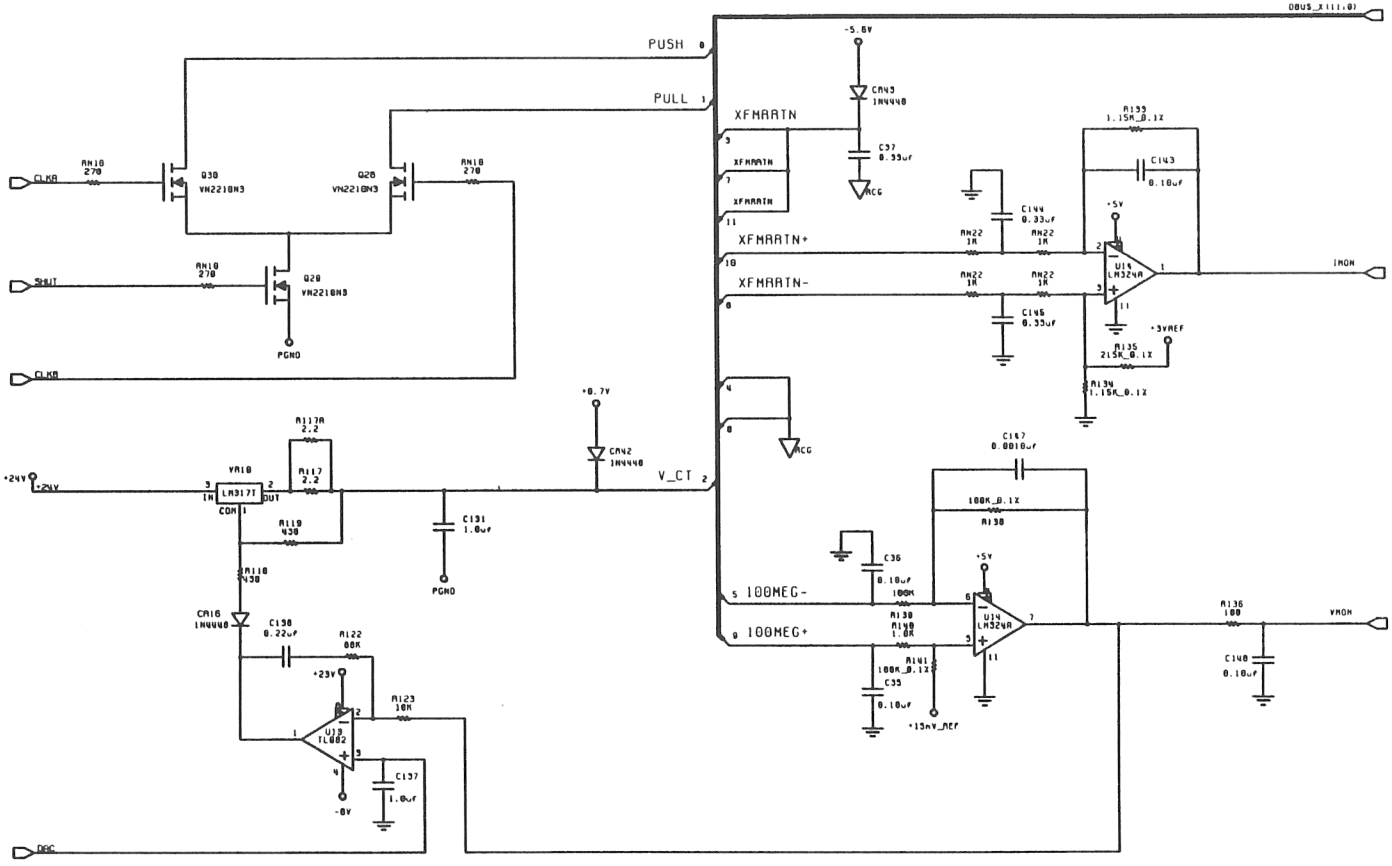
/proj/1461/1461_1/linreg7



LeCroy Corp.	
DRAWN: BOB_BUONO	SCHEMATIC DIAGRAM
MODIFIED: 25-JUL-96	1461-1
SHEET: 17/20	DRW NO: 1461-1-S1
	ECO NO: 1300

/proj/1461/1461_1/linreg8

ORIGINAL



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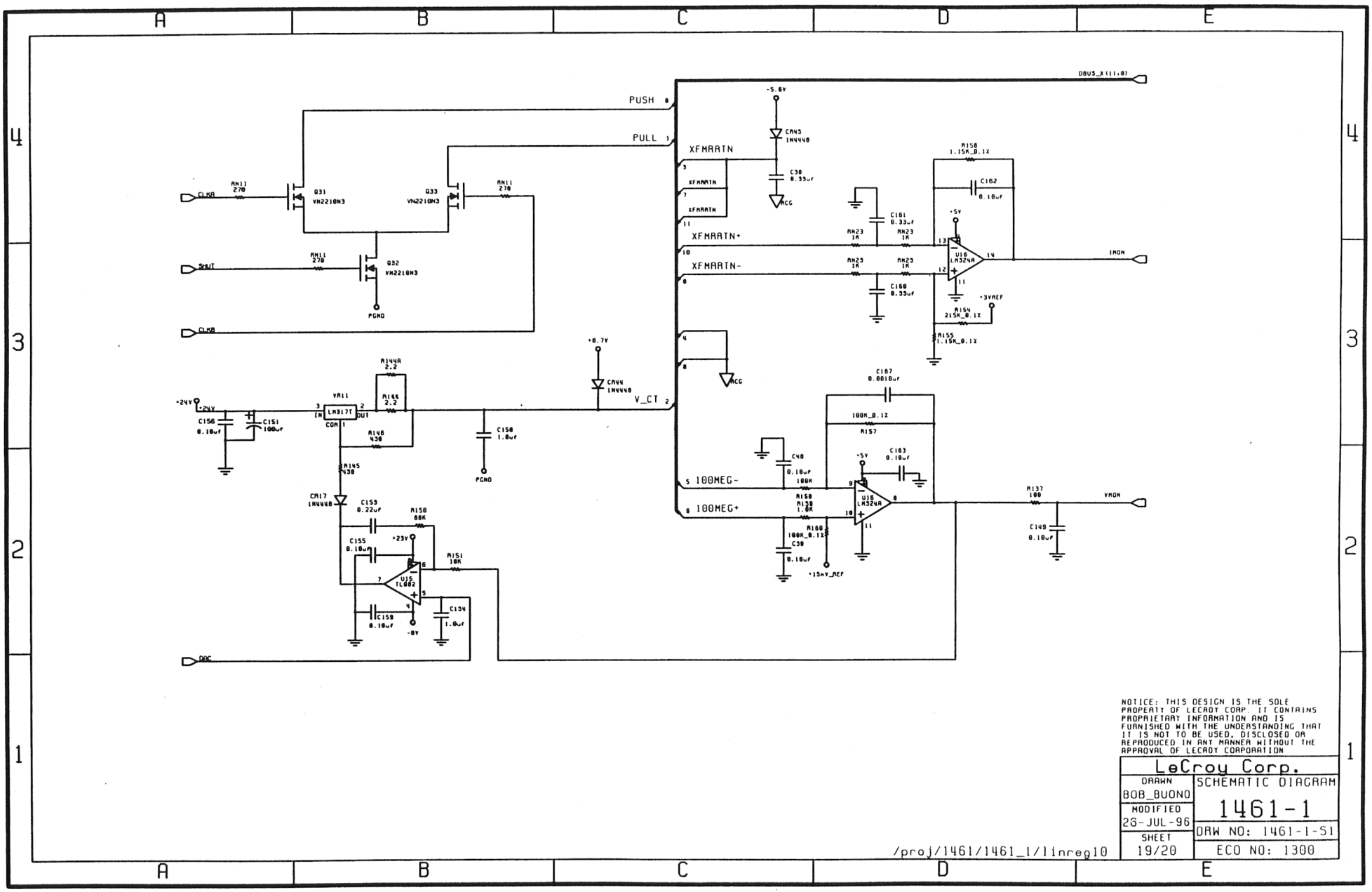
LeCroy Corp.	
DRAWN: BOB_BUONO	SCHEMATIC DIAGRAM
MODIFIED: 26-JUL-96	1461-1
SHEET: 18/20	DRW NO: 1461-1-S1
	ECO NO: 1300

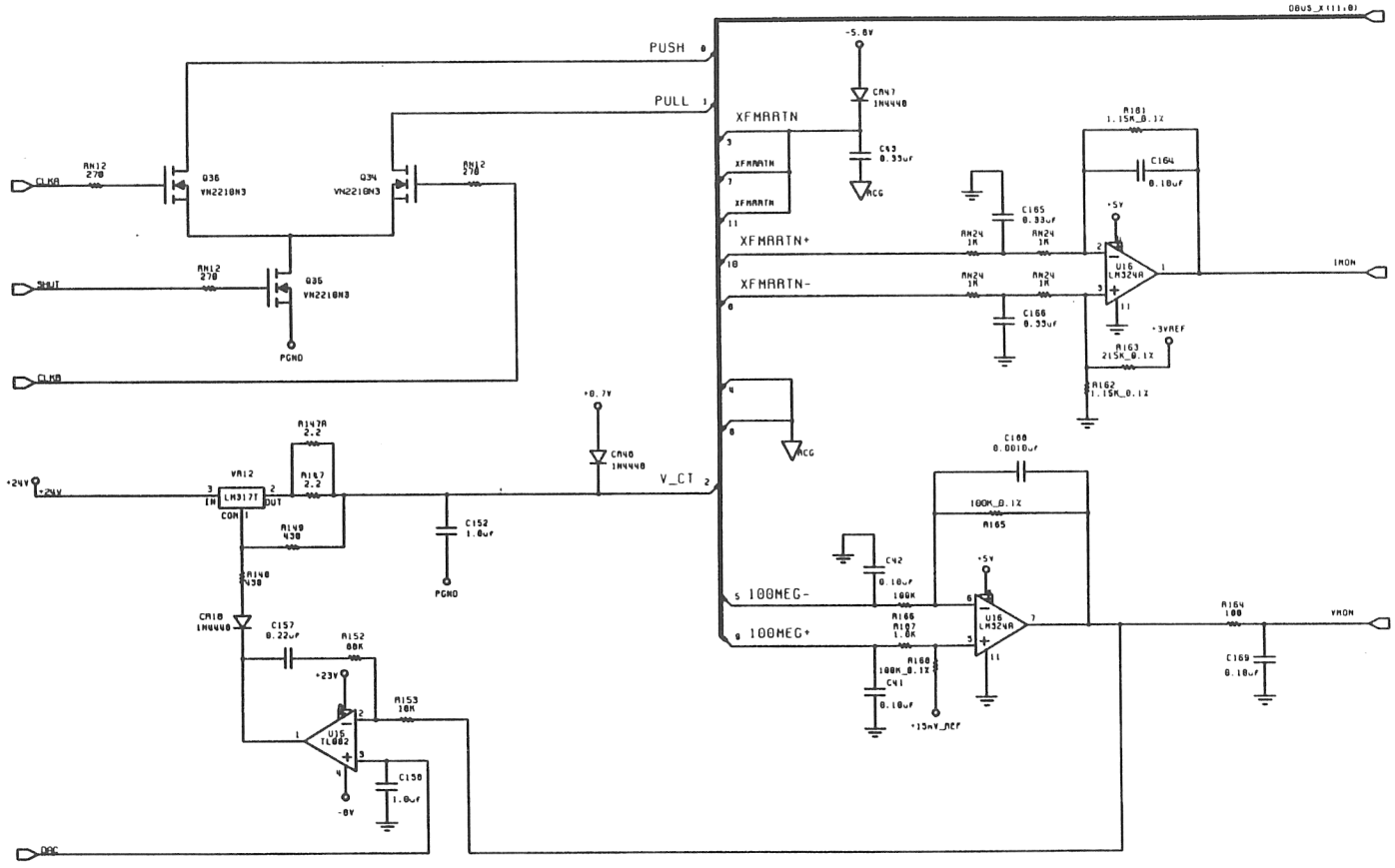
/proj/1461/1461_1/linreg9

ORIGINAL



LeCroy Corp.	
DRAWN: BOB_BUONO	SCHEMATIC DIAGRAM
MODIFIED: 26-JUL-96	1461-1
SHEET: 19/20	DRW NO: 1461-1-S1
	ECO NO: 1300

ORIGINAL



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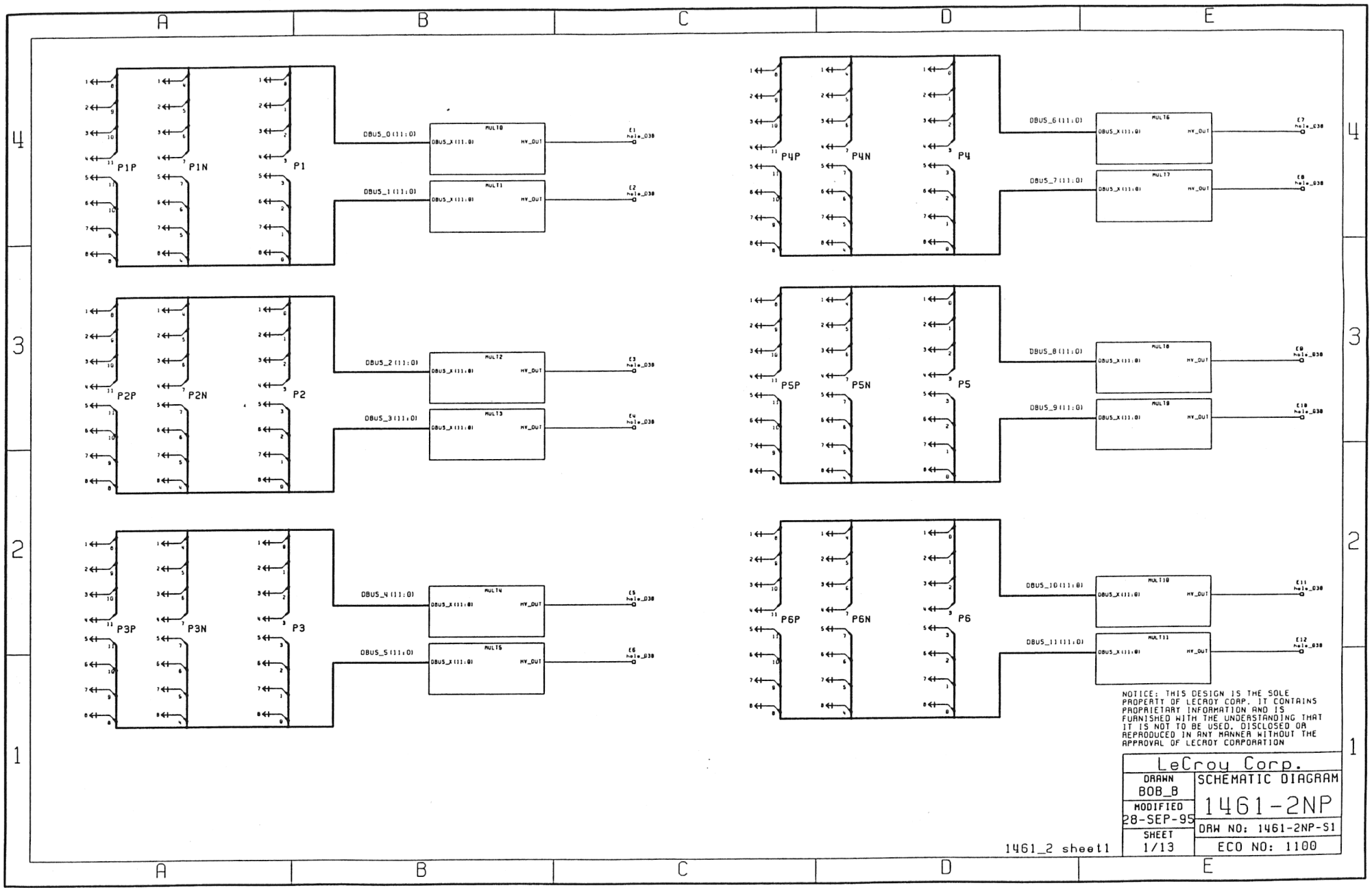
LeCroy Corp.	
DRAWN: BOB_BUONO	SCHEMATIC DIAGRAM
MODIFIED: 26-JUL-96	1461-1
SHEET: 20/20	DRW NO: 1461-1-S1
	ECO NO: 1300

/proj/1461/1461_1/linreg11

ORIGINAL


A
B
C
D
E
4
3
2
1
P1P
P1N
P1
P2P
P2N
P2
P3P
P3N
P3
P4P
P4N
P4
P5P
P5N
P5
P6P
P6N
P6
DBUS_0(11:0)
DBUS_1(11:0)
DBUS_2(11:0)
DBUS_3(11:0)
DBUS_4(11:0)
DBUS_5(11:0)
DBUS_6(11:0)
DBUS_7(11:0)
DBUS_8(11:0)
DBUS_9(11:0)
DBUS_10(11:0)
DBUS_11(11:0)
MULT0
MULT1
MULT2
MULT3
MULT4
MULT5
MULT6
MULT7
MULT8
MULT9
MULT10
MULT11
DBUS_X(11:0)
MY_OUT
E1
E2
E3
E4
E5
E6
E7
E8
E9
E10
E11
E12
hole_038
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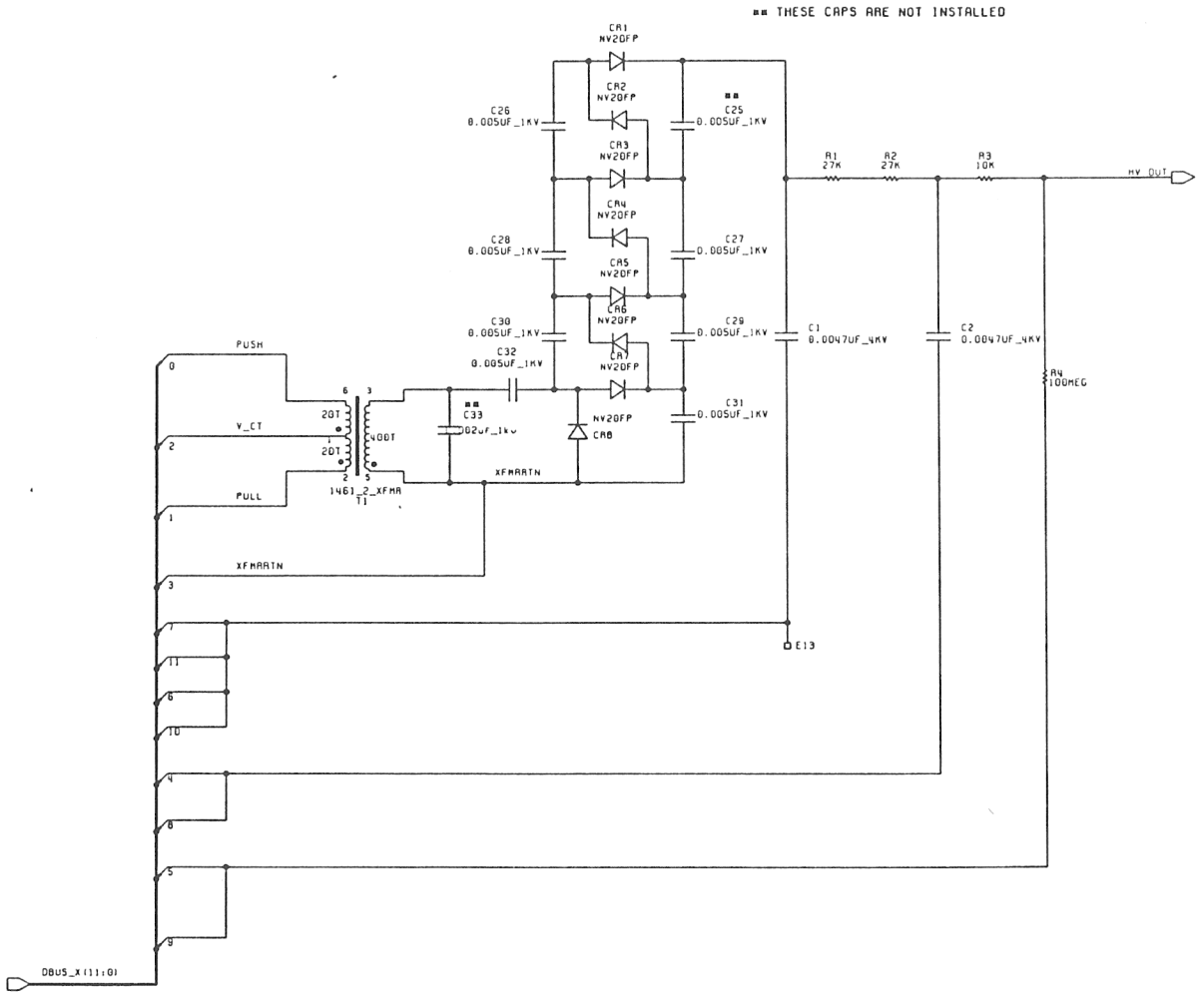
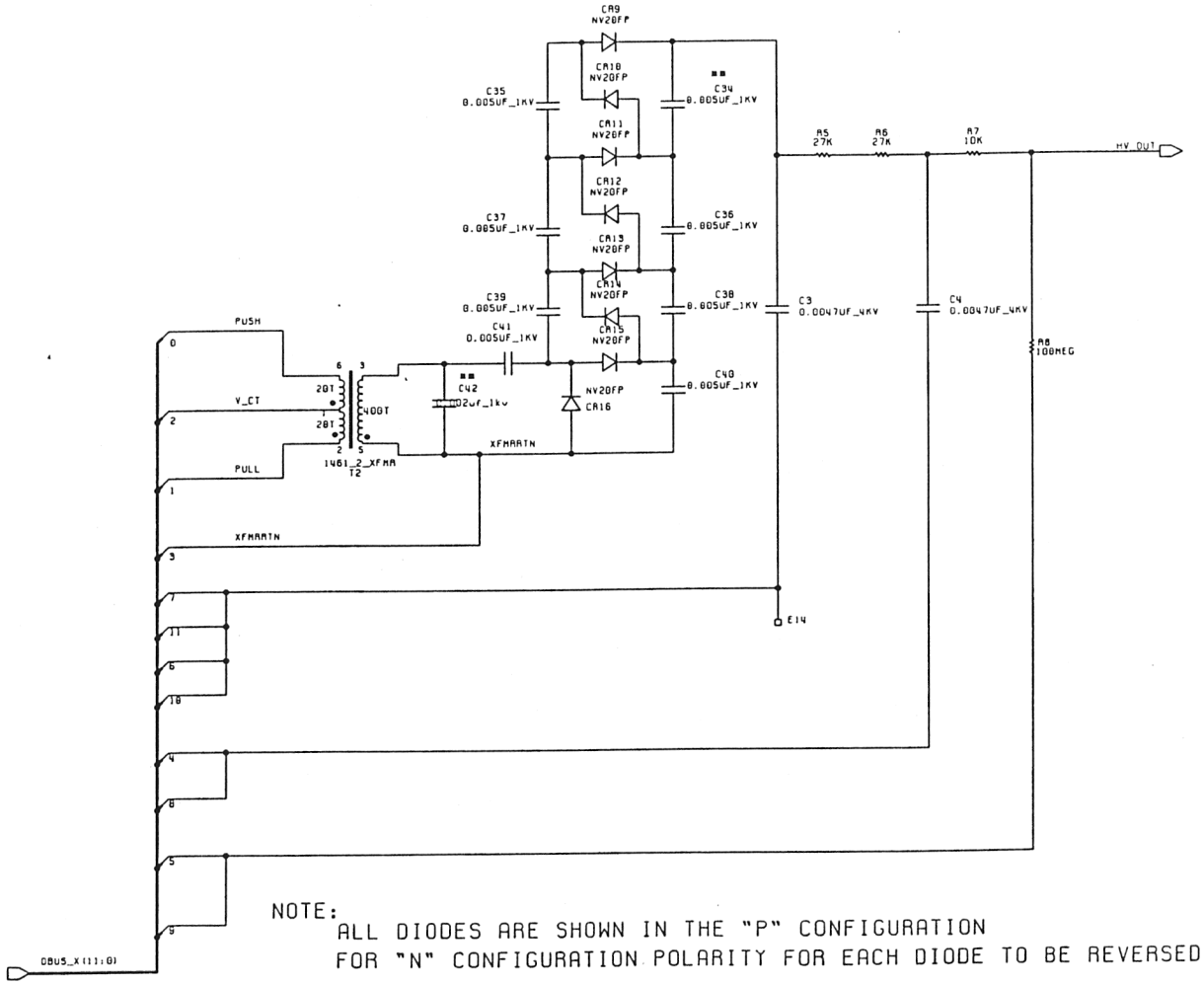
LeCroy Corp.
DRAWN
BOB_B
MODIFIED
28-SEP-95
SHEET
1/13
SCHEMATIC DIAGRAM
1461-2NP
DRW NO: 1461-2NP-S1
ECO NO: 1100
1461_2 sheet1



NOTE:
ALL DIODES ARE SHOWN IN THE "P" CONFIGURATION
FOR "N" CONFIGURATION POLARITY FOR EACH DIODE TO BE REVERSED.

LeCroy Corp.	
DRAWN BOB_B	SCHEMATIC DIAGRAM
MODIFIED 28-SEP-95	1461-2NP
SHEET 2/13	DRW NO: 1461-2NP-S1
	ECO NO: 1100

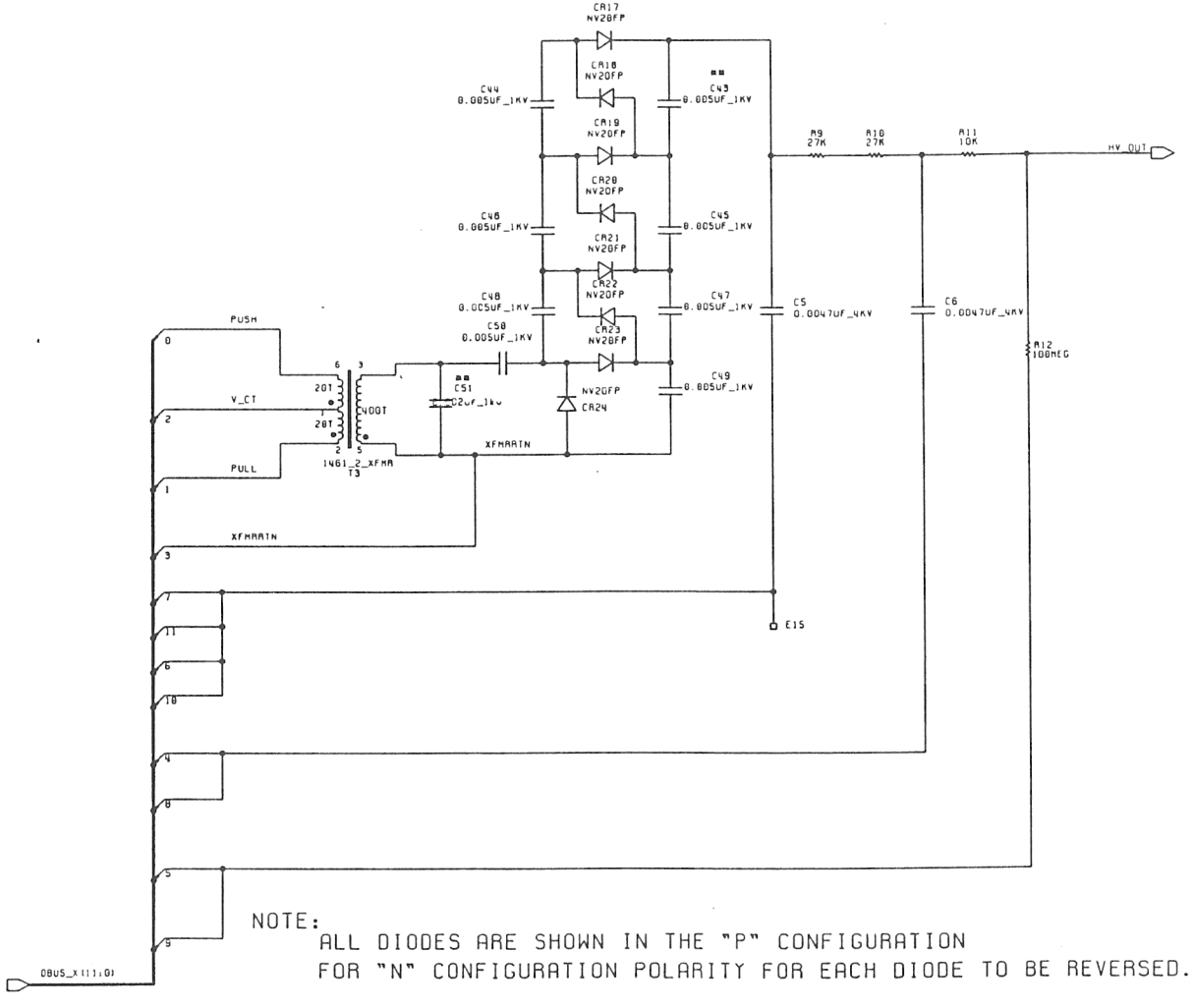


NOTE:
ALL DIODES ARE SHOWN IN THE "P" CONFIGURATION
FOR "N" CONFIGURATION POLARITY FOR EACH DIODE TO BE REVERSED.

1461_2/MULT1 sheet1

LeCroy Corp.	
DRAWN BOB_B	SCHEMATIC DIAGRAM
MODIFIED 28-SEP-95	1461-2NP
SHEET 3/13	DRW NO: 1461-2NP-S1
	ECO NO: 1100

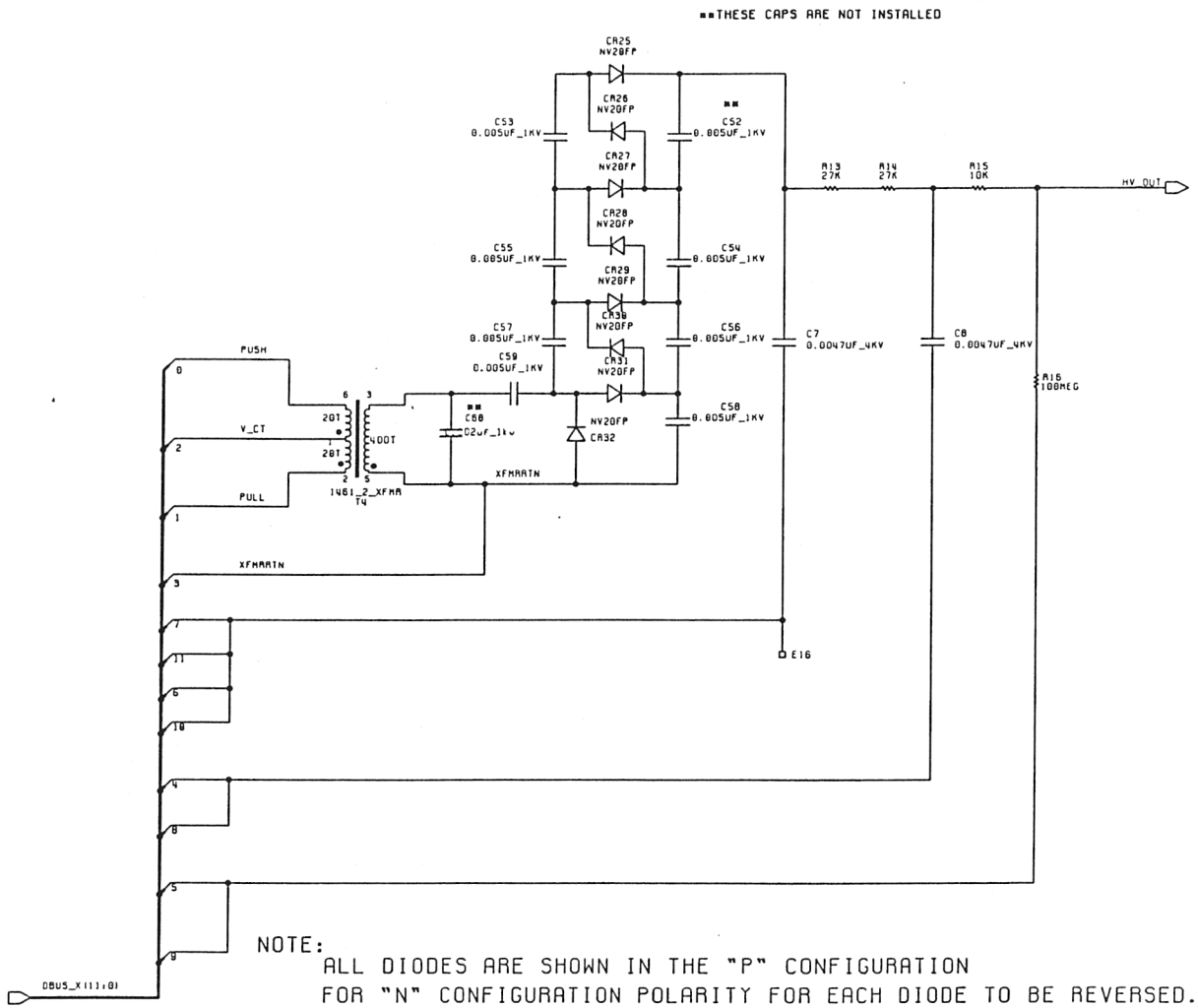
■■ THESE CAPS ARE NOT INSTALLED



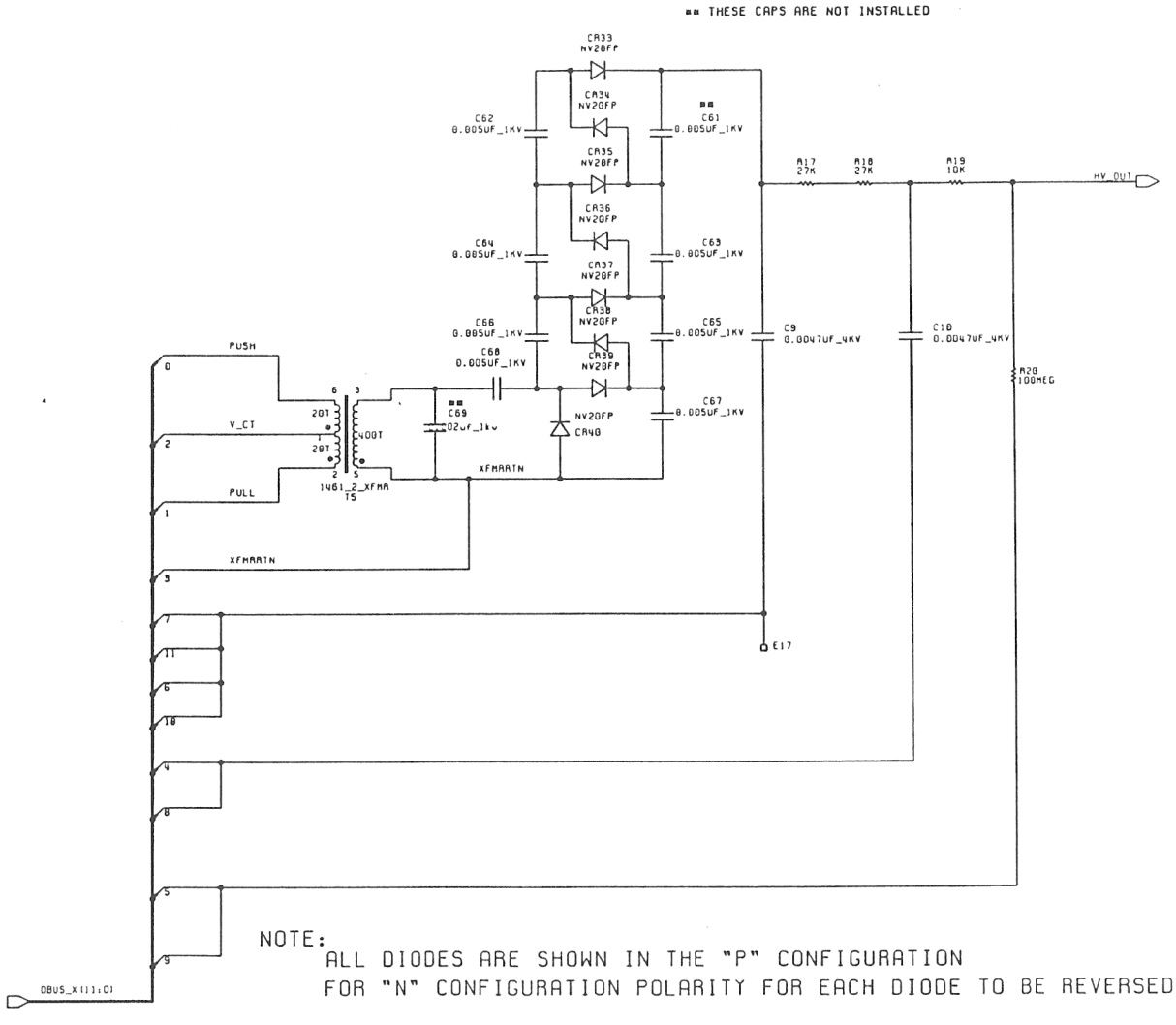
NOTE:
ALL DIODES ARE SHOWN IN THE "P" CONFIGURATION
FOR "N" CONFIGURATION POLARITY FOR EACH DIODE TO BE REVERSED.

1461_2/MULT2 sheet1

LeCroy Corp.	
DRAWN BOB_B	SCHEMATIC DIAGRAM
MODIFIED 28-SEP-95	1461-2NP
SHEET 4/13	DRW NO: 1461-2NP-S1
	ECO NO: 1100



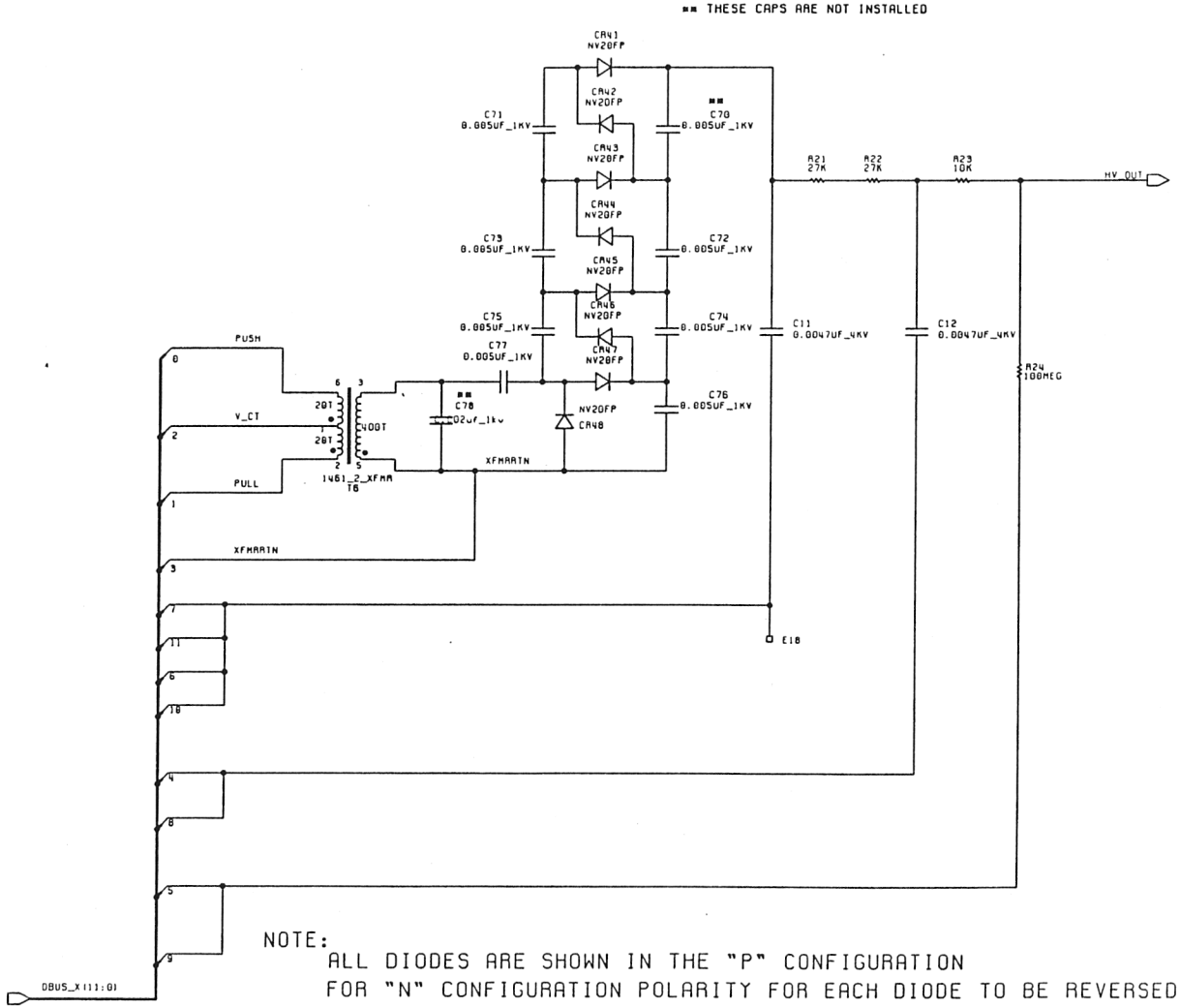
LeCroy Corp.	
DRAWN BOB_B	SCHEMATIC DIAGRAM
MODIFIED 28-SEP-95	1461-2NP
SHEET 5/13	DRW NO: 1461-2NP-S1
1461_2/MULT3 sheet1	ECO NO: 1100



NOTE:
ALL DIODES ARE SHOWN IN THE "P" CONFIGURATION
FOR "N" CONFIGURATION POLARITY FOR EACH DIODE TO BE REVERSED.

1461_2/MULT4 sheet1

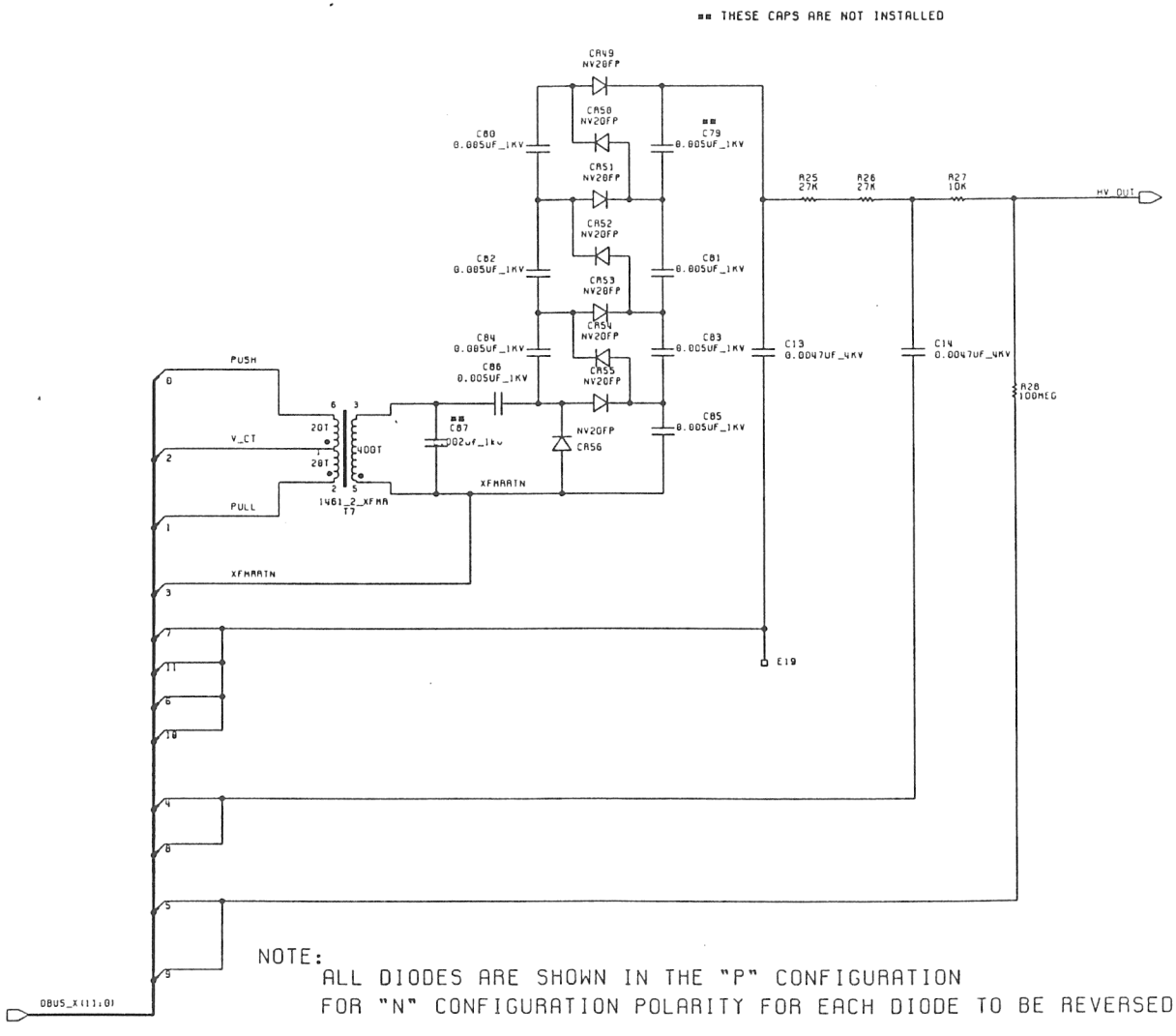
LeCroy Corp.	
DRAWN BOB_B	SCHEMATIC DIAGRAM
MODIFIED 28-SEP-95	1461-2NP
SHEET 6/13	DRW NO: 1461-2NP-S1
	ECO NO: 1100



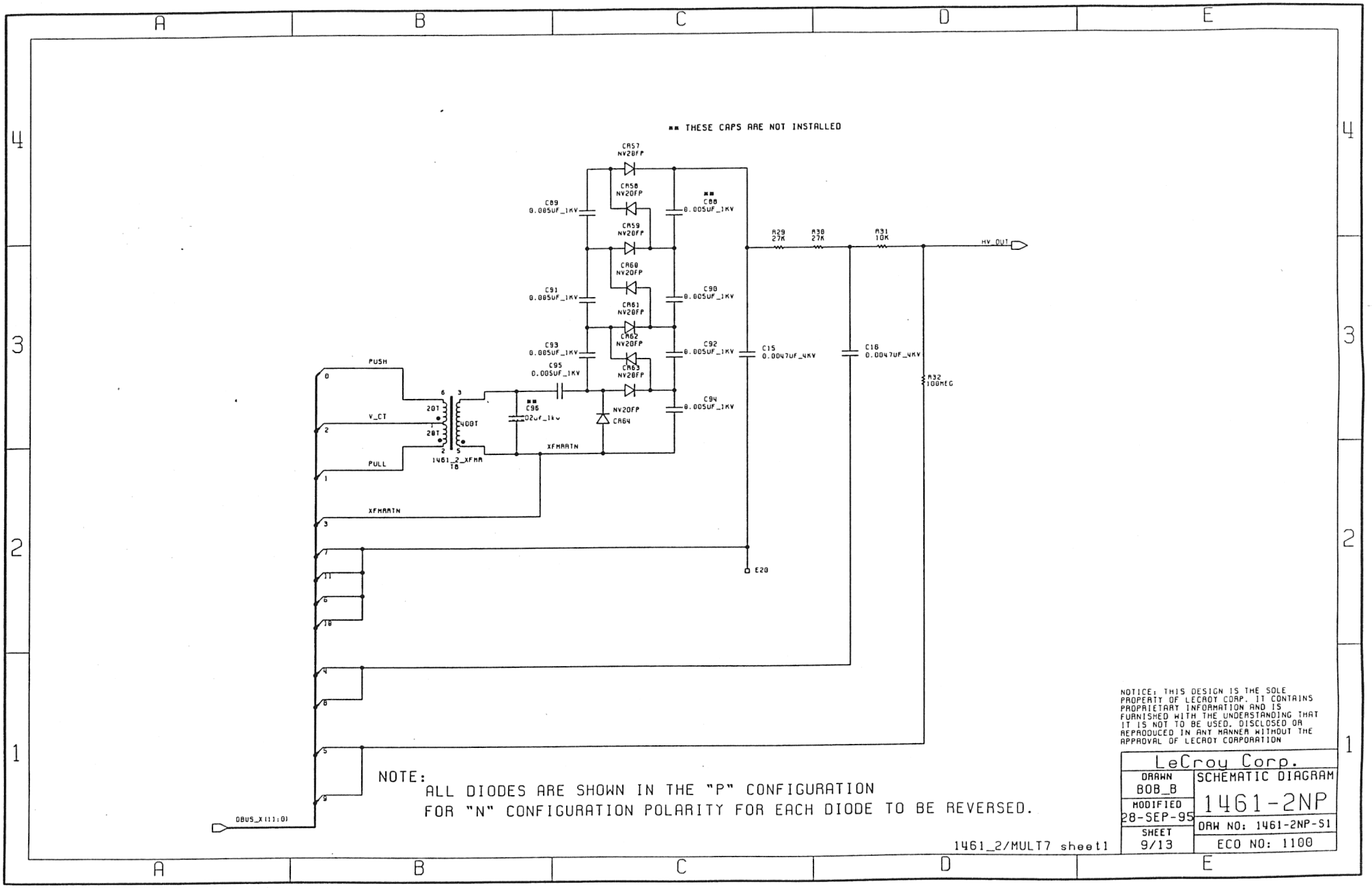
NOTE:
ALL DIODES ARE SHOWN IN THE "P" CONFIGURATION
FOR "N" CONFIGURATION POLARITY FOR EACH DIODE TO BE REVERSED.

1461_2/MULT5 sheet1

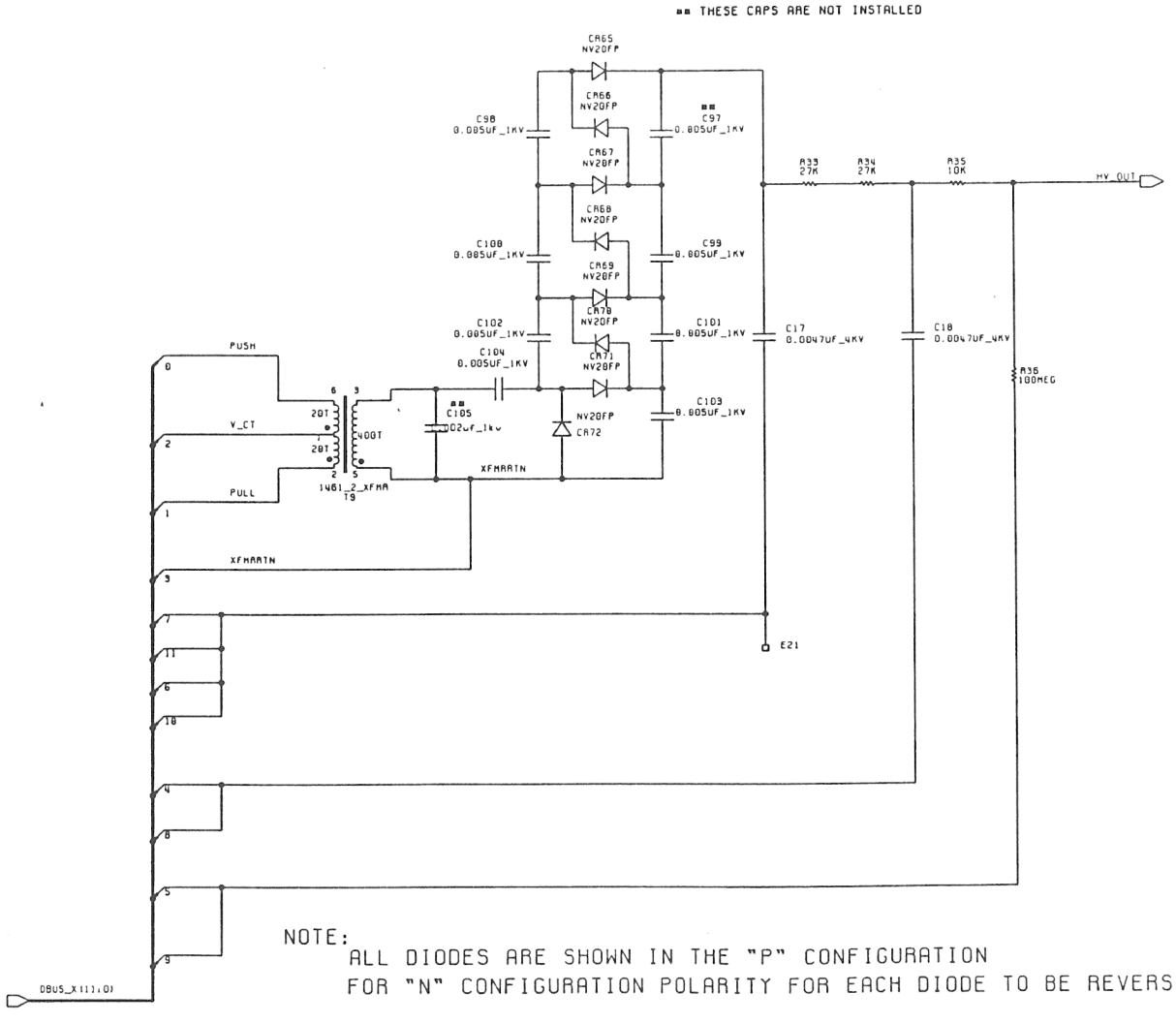
LeCroy Corp.	
DRAWN BOB_B	SCHEMATIC DIAGRAM
MODIFIED 28-SEP-95	1461-2NP
SHEET 7/13	DRW NO: 1461-2NP-S1
	ECO NO: 1100



LeCroy Corp.	
DRAWN BOB_B	SCHEMATIC DIAGRAM
MODIFIED 28-SEP-95	1461-2NP
SHEET 8/13	DRW NO: 1461-2NP-S1
	ECO NO: 1100



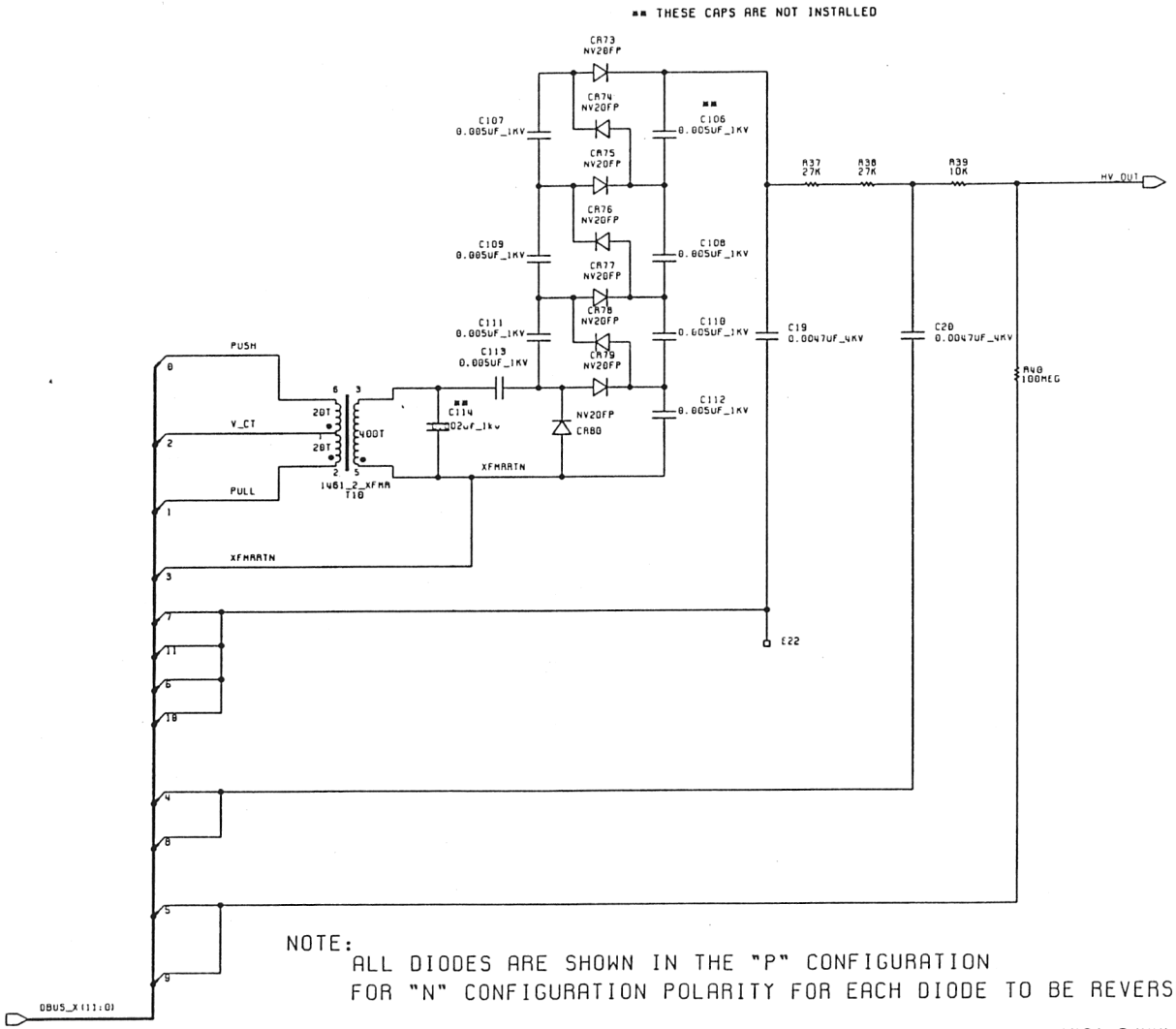
LeCroy Corp.	
DRAWN BOB_B	SCHEMATIC DIAGRAM
MODIFIED 28-SEP-95	1461-2NP
SHEET 9/13	DRW NO: 1461-2NP-S1
	ECO NO: 1100



NOTE:
ALL DIODES ARE SHOWN IN THE "P" CONFIGURATION
FOR "N" CONFIGURATION POLARITY FOR EACH DIODE TO BE REVERSED.

1461_2/MULT8 sheet1

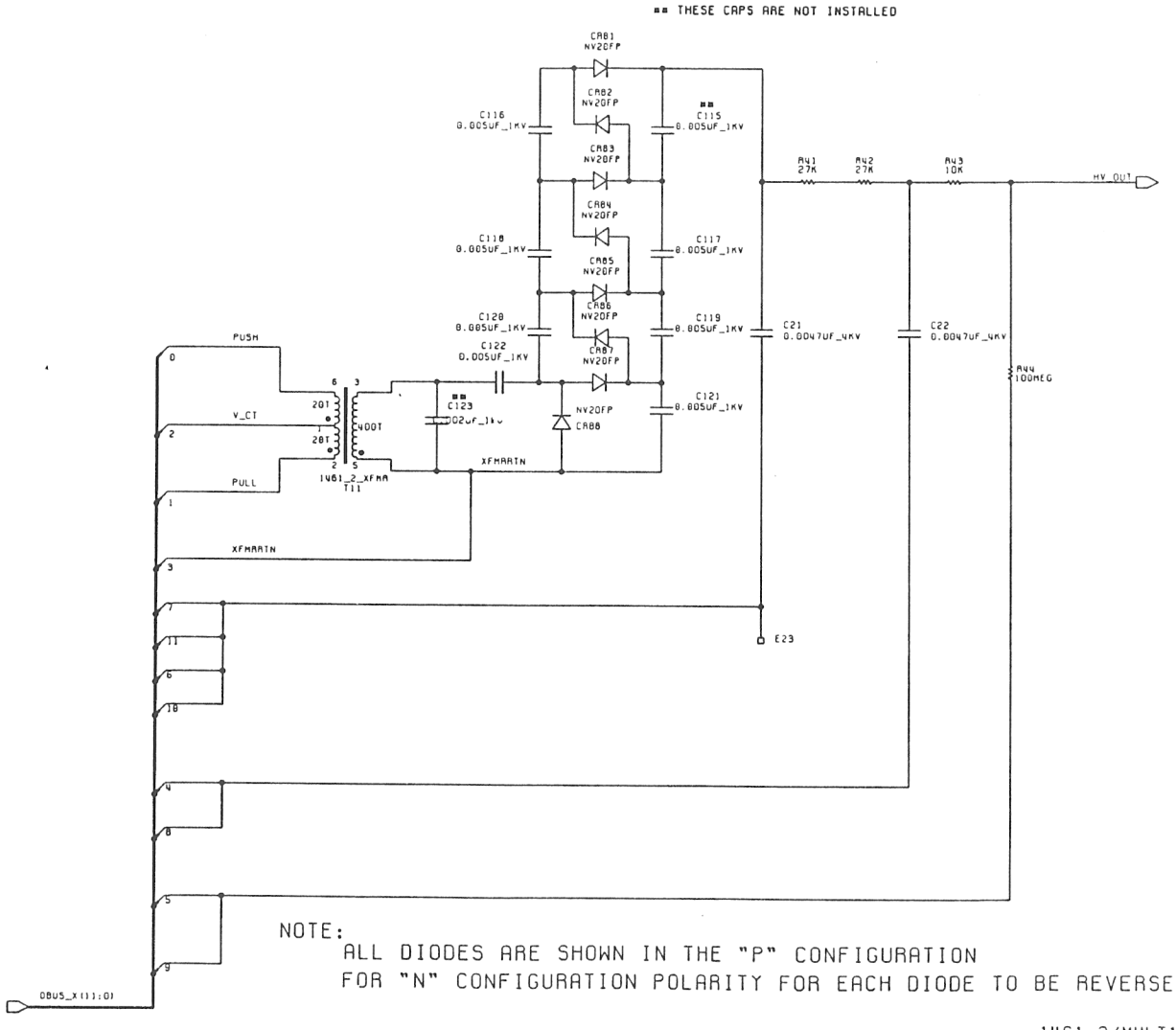
LeCroy Corp.	
DRAWN BOB_B	SCHEMATIC DIAGRAM
MODIFIED 28-SEP-95	1461-2NP
SHEET 10/13	DRW NO: 1461-2NP-S1
	ECO NO: 1100



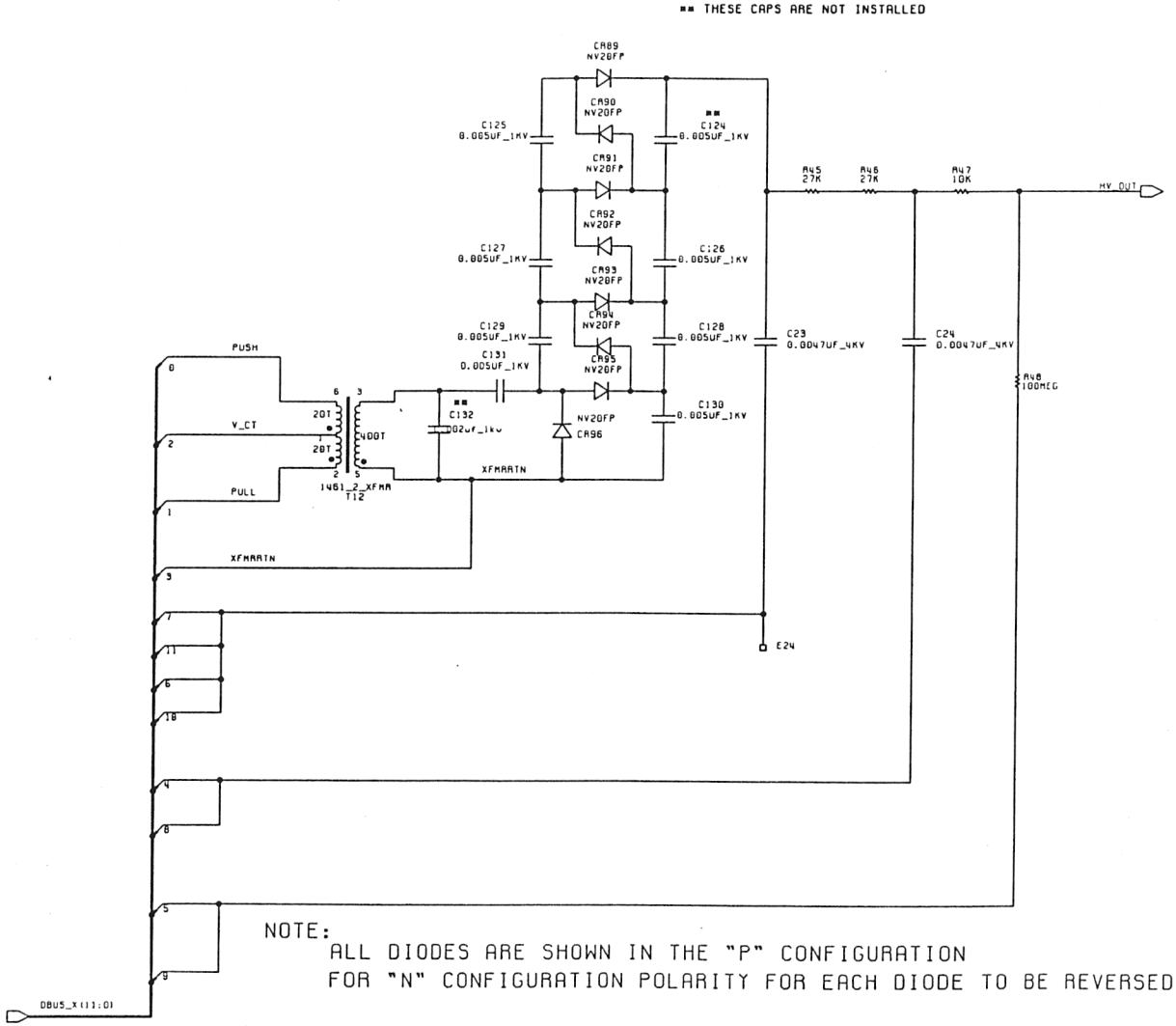
NOTE:
ALL DIODES ARE SHOWN IN THE "P" CONFIGURATION
FOR "N" CONFIGURATION POLARITY FOR EACH DIODE TO BE REVERSED.

1461_2/MULT9 sheet1

LeCroy Corp.	
DRAWN BOB_B	SCHEMATIC DIAGRAM
MODIFIED 28-SEP-95	1461-2NP
SHEET 11/13	DRW NO: 1461-2NP-S1
	ECO NO: 1100



LeCroy Corp.	
DRAWN BOB_B	SCHEMATIC DIAGRAM
MODIFIED 28-SEP-95	1461-2NP
SHEET 12/13	DRW NO: 1461-2NP-S1
	ECO NO: 1100



NOTE:
ALL DIODES ARE SHOWN IN THE "P" CONFIGURATION
FOR "N" CONFIGURATION POLARITY FOR EACH DIODE TO BE REVERSED.

1461_2/MULT11 sheet1

LeCroy Corp.	
DRAWN BOB_B	SCHEMATIC DIAGRAM
MODIFIED 28-SEP-95	1461-2NP
SHEET 13/13	DRW NO: 1461-2NP-S1
	ECO NO: 1100