1454 / 1458
HV Mainframe

User's Guide V2.62

V2.72

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1454/8-MAN
ECO-1002

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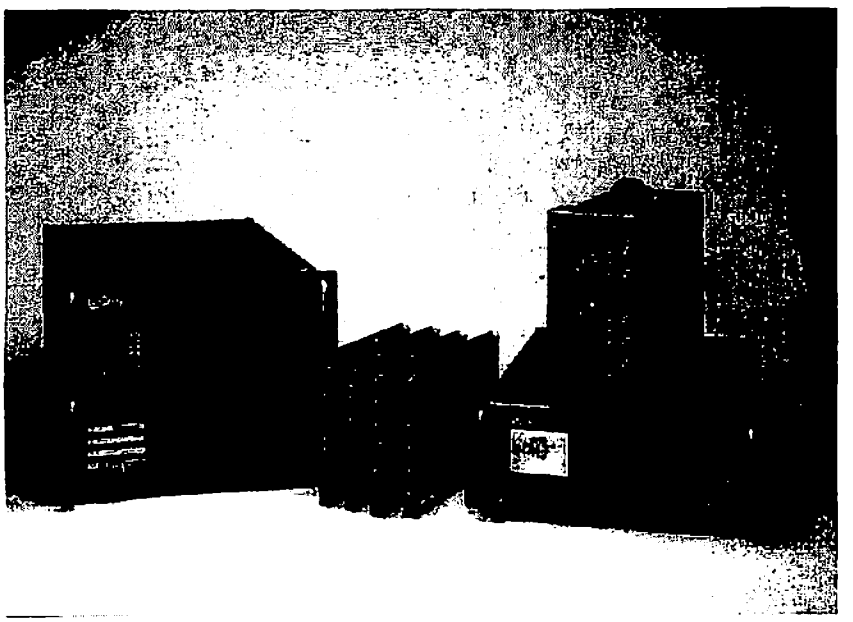
TECHNICAL DATA

LeCroy

1450 MODULAR HIGH VOLTAGE SYSTEM - VISyN™



- 8 U Model 1458, High Channel Density Mainframe
- 4 U Model 1454, Medium Channel Density Mainframe; LCD Display and Keypad for Local Control
- Model 1451 Portable HV Crate for Small Channel Density
- Local Area Network and RS-232 for Remote Control
- Password Protection
- Powerful HV Ramp Controls
- Low Cost per Channel
- Easy Expansion

FLEXIBLE HIGH VOLTAGE SYSTEM FOR PMTS, WIRE CHAMBERS AND SILICON STRIP DETECTORS

The LeCroy Model 1450 Modular High Voltage System, known as VISyN (Voltage & Current System on Network), represents the state-of-the-art in performance and ease-of-use in high voltage generation. It also offers a lower cost per channel than other commercial or laboratory designed high voltage products.

The 1450 VISyN system includes two different mainframes, a portable HV crate and a large and diverse line of compatible HV cards. These HV cards span the voltage and current ranges that satisfy most detectors used in High Energy, Nuclear and Heavy Ion Physics. The open ended system and modular architecture allow effective future expansion.

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FUNCTIONAL DESCRIPTION

The LeCroy 1450 VISyN™ system represents the next generation in high voltage instrumentation. This system is designed to meet the demanding requirements of new experiments:

- Accurate and Stable Outputs
- Reliable Remote Communications
- Improved User Interface
- Increased System Flexibility
- Safety Features
- Easy Service
- Cost Effective

This system represents a dramatic improvement over previous commercial and laboratory designs.

The 1450 VISyN system includes combinations of mainframes and HV cards. The mainframes supply space, power and control for the HV cards. The 1451 HV crate relies on an external computer to provide control. The HV cards supply the actual high voltage output. All the specifications for the high voltage output (accuracy, range, current, polarity) are determined by the selected HV card. All HV cards operate in all mainframes and HV crates.

MAINFRAMES/CRATES

The Model 1451 HV Crate is designed for small channel count or portable applications. It contains 2 slots for HV cards and weighs less than 20 pounds fully loaded with 24 channels of PMT high voltage. The 1451 is exclusively controlled via a serial connection to a (user-supplied) IBM-compatible PC running the provided (DOS) control program, HV51.

The Model 1454 Mainframe addresses medium to low channel count requirements. The mainframe supplies four slots for HV cards and a front panel user interface. Four slots accept 48 channels of the Model 1461 HV card. The front panel user interface consists of a backlit 320 x 200 pixel LCD display and custom keypad. This interface controls the HV cards inserted in the 1454. The 1454 may be remotely controlled via RS-232 or a local area network.

The Model 1458 Mainframe addresses the high channel count application. This mainframe supplies sixteen (16) slots for HV cards, but no keypad or LCD display. All control is via RS-232 or a local area network. The 1458 supports 192 channels of the 1461 HV card in 14 inches of vertical rack space.

COMMUNICATIONS FEATURES

VISyN has three major user interface systems for communications. The most visible is the front panel display and keypad (Model 1454 only). This interface provides complete control over all channels in the mainframe. The LCD display shows which HV cards are in the mainframe, the settings for these cards, and the measurements made by the HV cards. With the keypad, all settings for the HV cards can be programmed.

Both of the mainframes (1454 and 1458) provide an RS-232 interface, allowing the use of a standard terminal for control and display. This interface provides the same capabilities as the front panel display in a text command format or full screen format (VT100 compatible). The front panel and RS-232 interfaces are always available for reviewing information in the mainframe, but changes can be locked out remotely or via a front panel key switch.

Lastly, VISyN mainframes can be controlled over a local area network (LAN) via ARCNET, a proven industrial standard. ARCNET is a high speed (2.5 Mbaud) token-passing network protocol. The standard implementation of ARCNET is readily available and inexpensive for many types of host systems, including VME. Large distances (4 miles) can be covered; the token-passing system is deterministic; in heavy traffic, throughput does not decrease.

RELIABILITY

VISyN is designed for high reliability, serviceability and long operating life. Wherever possible, the use of batteries, lamps, and other limited life components are avoided. Major sections of the mainframe are modular and easily replaced. High voltage circuits are potted and insulated for safety and for protection against the accumulation of dirt.

HV SUPPLY CARDS

Each of the various HV cards is a complete HV subsystem. The HV card includes its own ADCs, DACs, references and interface circuitry. The interface to the mainframe is completely digital and very flexible. All information about ranges, resolution, limits, etc., is stored in the HV card. New 1460 series HV cards with different features can be inserted into older 1450 systems with no loss in performance.

Depending on load and voltage, the HV card can require more supply current than available in the average HV mainframe slot. The user must confirm that sufficient supply current is available for their application. The required information is in the data sheets for the HV cards and HV mainframes.

MODEL 1461 3 kV INDEPENDENT HV SUPPLY

The Model 1461 HV card supplies 12 independent channels, in a single slot, suitable for photomultiplier tubes. The high voltage output is programmable from 0 to 3 kV, and output current limit supports a 1.2 MΩ load to 3 kV. Other features include voltage measurement, current measurement, programmable current

trip, hardware voltage limit (once per card), and separate programmable ramp up and ramp down rates.

MODEL 1469 3.5 kV DISTRIBUTED HV SUPPLY

The Model 1469 HV Card is ideal for chamber applications. The card supplies 24 channels of high voltage, programmable in groups of 8 channels. All channels within a group are programmed to the same output voltage, in steps of 1 V, from 0 to 3.5 kV with channel-to-channel variation within each group nominally less than 500 mV. Each channel provides current readback and current trip resolution of 25 nA and a maximum output current of 100 µA.

Features include 12-bit voltage readback for each group, current trip for each channel, programmable ramp up rate, and programmable ramp down rate. In the event of a trip, a relay disconnects the output. Other outputs within the group remain powered.

SPECIFICATIONS

Model 1451
HV Crate

Dimensions: 12" high x 6.30" wide x 16.25" deep.
Capacity: Two vertical HV card slots.
Output Power (available to HV cards): 192 W (8 A at 24 V).
Airflow: Rear to front.
Power: Auto selecting, 90 to 130 VAC or 180 to 260 VAC; 50 - 60 Hz.
Remote Communications: Serial port, RS232C.
Display: None.
Operating Temperature: 0°C to 40°C.
Ambient Humidity: 0 - 90% relative humidity, non-condensing.
Control Software: 1450-SW included.

Model 1454
HV Mainframe

Dimensions: 4 U (7") high x 19" wide x 24" deep.
Capacity: 4 horizontal HV card slots.
Output Power (available to HV cards): 360 W maximum (15 A at 24 V).
Airflow: Front to rear.
Power: 90 V to 260 VAC; 50 to 60 Hz; power factor corrected.
Remote Communications: Local Area Network (LAN) ARCNET Standard; Ethernet is an option in development; Serial Port: RS232C.
Display: Back-lit 320 x 200 pixel LCD display.
Operating Temperature: 5°C to 40°C.
Ambient Humidity: 0 - 90% relative humidity, non-condensing.

Model 1458 and 1458P
High Density HV Mainframes

Dimensions: 8 U (14") high x 19" wide x 26" deep.
Capacity: 16 vertical HV card slots.
Output Power (available to HV cards): 1440 W maximum (60 A at 24 V) for 1458; 720 W maximum (90 A at 24 V) for 1458P.
Airflow: Front to rear; vertical option.
Power: 90 V to 260 VAC; 50 to 60 Hz; power factor corrected, > 220 VAC required for full power output.
Remote Communications: Local Area Network (LAN) ARCNET Standard; (Ethernet is an option in development; Serial Port: RS232C.
Display: None; LCD display option.
Operating Temperature: 0°C to 40°C.
Ambient Humidity: 0 - 90% relative humidity, non-condensing.

Model 1461
Independent 12-Channel, 3 kV Card

Channels: 12, fully independent.
Voltage: Programmable 0 to 3 kV.
Voltage Polarity: Model 1461N for negative voltage, Model 1461P for positive voltage.
Voltage Set Resolution: < 1 V (nominally 750 mV).
Voltage Output Accuracy: ±(0.1% of setting + 1.5 V) at 25°C, from 5 to 100% of full scale (Below 5% of full scale, a minimum load may be necessary.)
Temperature Stability: < 100 ppm/°C.
Voltage Repeatability: < ±0.5 V at constant load, line and temperature.
Voltage Ripple: < 100 mV p-p max (< 50 mV p-p for < 1 mA).

Voltage Measurement Resolution: < 1 V (nominally 750 mV).
Voltage Measurement Accuracy: ±(0.1% of reading + 1.5 V) at 25°C.
Voltage Ramp Rate: Programmable per channel, separate ramp up and ramp down rates (nominally 50 to 500 V per second in 50 V increments).
Current: 2.5 mA from 2.8 kV to 3 kV, derate 0.83 mA/kV from 2.8 kV down to 1.0 kV, > 1 mA from 0 to 1 kV; supports 1.2 MΩ load to 3 kV. (See Power Requirements.)
Current Trip: Programmable per channel, < 1 µA resolution. (Settable from 50 µA up to 2.550 mA.)
Current Measurement Resolution: < 1 µA.
Current Measurement Accuracy: +(2% of reading + 15 µA).
Power Requirements: 171 mA supply required per mA output + 38 mA supply per channel. This can exceed the power supplied by the standard mainframe.
Hardware Voltage Limit: One potentiometer on panel and 1000:1 test point.
HV On LED: One per card, flash for any changing output, Steady on for any stable HV.
Dimensions: 6 U (10.3" high x 14.6" long x 1" wide; Eurocard C size).
Connector Type: SHV.

Model 1462 - Preliminary
Independent 6-Channel, 3 kV Card

Channels: 6, fully independent.
Output Voltage: 0 to 3 kV, programmable.
Voltage Polarity: Model 1468N for negative voltage, Model 1468P for positive voltage.
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 5% to 100% of full scale (below 5% of full scale 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 mV p-p for output current < 1 mA.
Voltage Ramp Rate: Programmable per channel, separate ramp up and ramp down rates, nominally 50 to 1,000 V per second in 50 V steps.
Output Current Capability: > 4.0 mA from 2.8 kV to 3 kV, > 1.6 mA from 0 to 1.0 kV, linear derate from 1.0 kV to 2.8 kV, (see Power Requirements).
Current Trip: Programmable per channel, < 1 µA resolution; programmable from 50 µA to 5050 µA.
Current Measurement Resolution: < 1 µA.
Current Measurement Accuracy: ±(2% + 15 µA).
Power Requirements: 171 mA supply per mA output + 76 mA supply per channel. This can exceed the power supplied by the standard mainframe.
Hardware Voltage Limit: One potentiometer on panel and 1000:1 test point.
HV On LED: One; on if any channel generates output.
Connector Type: SHV.
Dimensions: 6U (10.3" high x 14.6" deep x 1" wide; Eurocard C size).

Model 1468
Independent 6-Channel, 6 kV Card

Channels: 6, fully independent.
Output Voltage: Programmable 0 to 6 kV.
Voltage Polarity: Model 1468N for negative voltage, Model 1468P for positive voltage.
Voltage Set Resolution: < 1 V (0.5 V nominal).
Voltage Output Accuracy: ±(0.10% of setting + 3 V) at 25°C, from 5 to 100% of full scale (below 5% of full scale, a minimum load is required).
Voltage Output Temperature Stability: < 100 ppm/°C.
Voltage Repeatability: < ±1 V at constant load, line and temperature.
Voltage Output Ripple: < 100 mV p-p.
Voltage Measurement Resolution: < 2 V (1.5 V nominal).
Voltage Measurement Accuracy: ±(0.10% of reading + 3 V) at 25°C.
Voltage Ramp Rate: Programmable per channel, separate ramp up and ramp down rates (nominally 100 to 4000 V per second in 100 V steps).
Current: Maximum 500 µA per channel.
Current Trip: Programmable per channel, < 1 µA resolution. (Programmable from 50 µA to 500 µA.)
Current Measurement Resolution: < 1 µA.
Current Measurement Accuracy: ±(2% of reading + 15 µA).
Power Requirements: Required supply current (24 V) is (56 mA + 330 mA/output mA) per channel.
Hardware Voltage Limit: One potentiometer on panel and 2000:1 test point.
HV On LED: One per card, flash for any changing output, steady on for any stable HV.
Dimensions: 6 U (10.3" high x 14.6" deep x 1" wide; Eurocard C size).
Connector Type: SHV (6) and 96-pin DIN.

Model 1469 24-Channel, 3.5 kV Supply/ Distributor Card

Channels: 24, programmable in groups of 8.
Voltage: Three programmable groups of 8 channels; 0 to 3.5 kV in 1 V steps.
Voltage Polarity: Model 1469N for negative voltage, Model 1469P for positive voltage.
Voltage Set Resolution: < 1 V.
Voltage Output Accuracy: ±(0.1 % of setting +1.5 V) at 25°C.
Voltage Output Matching: < 500 mV voltage difference within 8 channel groups.
Temperature Stability: < 100 ppm/°C.
Voltage Repeatability: < ±0.5 V at constant load, line and temperature.
Voltage Ripple: < 50 mV p-p.
Voltage Measurement Resolution: < 1 V (only on source channels).
Voltage Measurement Accuracy: ±(0.1% of reading + 1.5 V) at 25°C.
Voltage Ramp Rate: Programmable per group, 1 V/sec to 500 V/sec in 1 V/sec steps. Separate ramp up and ramp down rates.
Current: Maximum 100 µA per channel.
Current Trip: Programmable per channel, 25 nA steps.
Current Measurement Resolution: 25 nA.
Current Measurement Accuracy: ±(1% of reading + 100 nA).
Connector Type: Three 8 HV channel multiconductor, block type.
Power Requirements: (To be determined)
Dimensions: 6 U (10.3" high x 14.6" long x 1" wide; Eurocard C size).

Model 1450-SW Control/Simulation Software

- 1451 Control Software
- 1454 and 1458 Simulation Software

Computer System Requirements: IBM PC compatibles with 80386 or higher performance processor, 3.5" high density floppy drive, MS DOS version 6.0 or later.

General Information

Purpose

This manual is intended to provide instruction regarding the setup and operation of the Model 1454 High Voltage Mainframe. 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.

Under this license you may *not*:

- Make copies of the software except as noted above.
- Distribute, in any form, any source code, or linkable object code.
- Reverse engineer, decompile, or disassemble the software.

Firmware Licensing Agreement

A number of hardware products contained programmed parts which contain firmware. Under this license you may:

- Use the firmware only through the interface provided by the hardware product.

Under this license you may *not*:

- Make copies of the firmware or the programmed parts containing the firmware.
- Reverse engineer, decompile, or disassemble the firmware.

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.

Licensed Products contained in 1450 series Products

The 1450 product line firmware and software is based on a number of software products licensed by LeCroy and are distributed in accordance with these licenses. The following is an all inclusive list of licensed products which may be have used in this product.

WATCOM C/C++, WATCOM, Inc., 42 Nagog Park, Acton, MA 01720-3409.

ROM-DOS, DATALIGHT, 307 North Olympic Ave., Suite 201, Arlingtion, WA 98223.

METAGRAPHICS, Metagraphics Software Corporation, 269 Mount Hermon Road, P.O. Box 66779, Scotts Valley, CA 96055

INTERWORK PROFESSIONAL, Block Island Technologies, 15455 N. W. Greenbrier Parkway, Suite 210, Beaverton, OR 97006.

PHAR LAP TNT DOS-EXTENDER RTK, Phar Lap Software, Inc., 60 Aberdeen Avenue, Cambridge, MA 02138.

SYSKIT, Annabooks, 15010 Avenue of Science, Suite 101, San Diego, CA 92128.

PKSFX, PKWARE, Inc., 9025 N. Deerwood Dr., Brown Deer, WI 53223.

Chapter 1

Introduction

Product Description

Overview

The LeCroy 1454 and 1458 High Voltage (HV) mainframes provide support for LeCroy 1460 or 1470 series HV modules. A 1454 can house as many as four (4) modules while a 1458 can support up to sixteen (16) modules.

A 1454 HV mainframe includes a complete local user interface, a 1458 does not. However, a suitable interface for the 1458 can be implemented by the user with the addition of VT100 compatible video terminal.

Otherwise, the operational characteristics of 1454 and 1458 mainframes are nearly identical. The term "the 1454/8 HV mainframe" or more simply "the HV mainframe" will used throughout this manual in reference to those operational features jointly supported by a 1454 or a 1458 HV mainframe.

The 1454/8 HV mainframe contains two separate remote interfaces, RS-232 and ARCNET, to provide additional access to both users and host computer systems.

The HV mainframe allows the operator to utilize all the features of the HV module. Usually, these include a) enable HV generation, b) set ramp rates, c) set target voltage, d) set current and voltage levels for tripping, e) examine voltage and current measurements, on a per channel basis. Further, the mainframe allows the user to maintain HV limits, save and restore complete HV module configurations, lock module settings or limits, enforce safety interlocks, and interface to computer networks.

The HV mainframe is designed to accommodate new (yet to be designed) HV modules. The mainframe controller queries each installed module (in a general fashion) in order to determine the requirements and features of the particular module. General commands and/or front panel/VT100 operations allow control and display of a module's configuration.

1454 Local Interface

The 1454 local interface includes a 320 x 240 pixel LDC display and a custom keypad mounted to the front panel of the 1454 HV mainframe. With the keypad, all of the 1454 HV mainframe features are accessible. The data are presented in a spread-sheet style with several different formats available. Pop-up menus are used for system configuration.

1458 Local Interface

The 1458 local interface includes only buttons for turning on or off HV generation and a panic off button and a few LED indicators. By connecting a VT100 compatible terminal to the mainframe serial port all of the HV mainframe features are accessible. A VT100 (full-screen, editing) display can be activated wherein data are presented in a spread-sheet style with several different formats available. Pop-up menus are used for system configuration.

Remote Interfaces

Two hardware interfaces are provided for remote command and control. The first is the RS-232 serial interface suitable for control by a host computer or an ANSI video terminal. The serial interface provides both a command line and a VT100 (full-screen, editing) interface for the HV mainframe.

The second remote interface is an ARCNET network interface. Multiple HV mainframes connected to a single ARCNET network can be easily controlled from a single host. A mainframe's ARCNET address is determined by the switches above the network hardware connection.

Both the serial and ARCNET interfaces use the same ASCII-commands. Nevertheless, remote control of a HV mainframe via ARCNET is much more efficient than RS-232 control. The character transmission time for ARCNET is less than 4 microseconds while this time for 19.2Kbaud RS-232 is nearly half of a millisecond. Since ARCNET is a message based protocol, the HV mainframe CPU only processes complete command messages when this remote interface is used. For RS-232 each character of the command must be serviced by the CPU which slows processing of command messages and effects the mainframe's maximum update rate.

Safety Interlocks

A Panic Off condition simply prevents any HV generation by removing the necessary power from the HV modules. This condition can be reached in two ways. The simplest is by pressing the front panel *PANIC OFF* button. A Panic Off condition can also be caused by *not* grounding the *INTERLOCK* input port.. (In future mainframes, the polarity of this input will be configurable via an internal jumper.)

A Panic Off condition is indicated by two red LEDS on either side of the *PANIC OFF* button being on. HV generation cannot be turned on (via the *HVON* button or HVON command) until the Panic Off condition is cleared.

Once the reason for a given Panic Off condition has been addressed, the condition can be cleared via the *HVOFF* button on the HV mainframe front panel only if the front panel key switch is in the local position.

Also for safety reasons, HV generation can always be turned off (at programmed ramp down rates) via the HVOFF front panel button or a remote "HVOFF" command independent of the front panel key switch position or any other "restricted access" operating mode.

Rear and Front Panel Power Switches

Two power switches are provided. The rear panel rocker switch controls the AC power to the entire HV mainframe. The front panel key switch, *STANDBY* position disables power generation, except for a small housekeeping supply. When the front panel key switch is in the *STANDBY* position, the internal mainframe power is off and HV generation is impossible. The *REMOTE* and *LOCAL* positions of the front key switch controls the source of HV setting edit operations, as discussed in a later section.

By factory default, the HV generation is not enabled upon powerup. However, as discussed in the "Automatic HV On after AC power failure" section, the HV mainframe can be configured to automatically restore HV generation after an AC power failure or a mainframe power down caused by the rear panel rocker switch.

External BNC Connections

There are three BNC's (located on the rear panel of the 1454 and on the front panel of the 1458) providing the *INTERLOCK* input, *STATUS* output, and *MACRO* input ports. The *INTERLOCK* port causes an HV Panic Off condition when it is clamped to ground. The operational characteristics of the STATUS and MACRO ports are determined by "system default" (discussed in a later section) settings.

When the mainframe power is off the *STATUS* output floats. Immediately upon powerup the *STATUS* output is clamped to ground. Once the HV mainframe is "Ready" (after the NETWORK and REMOTE LED's have stopped flashing), the *STATUS* ouput level is determined by the mainframe system defaults. The *STATUS* output port can be configured to clamp to ground on any or all of the following conditions: 1) Panic Off, 2) any channel being tripped off, or 3)HV generation is disabled (HVOFF).

The *MACRO* input port can be configured to turn off HV generation when the input is clamped to ground. The HV mainframe also supports modules (yet to be designed) which provide an alternate setup (of HV settings) by using the MACRO input to signal the selection of the alternate setup.

A typical use of the STATUS and MACRO signals could be to cause HV generation to be turned off on a group of mainframes when any HV channel trips off in that group.

Mainframe Power Considerations

In order to optimize price/performance for a variety of applications, 1454 and 1458 mainframes can be factory configured for a number of different output power capabilities. A standard 1454, while suitable for a number of applications does not , for example, provide the ability to supply full voltage along with full output current simultaneously for all channels for four 1461 modules. A higher powered 1454, the 1454 Mod100, is available to furnish sufficient power for such applications.

The 1458 mainframes come in three possible power configurations, the 1458e, 1458 and 1458 Mod100. The "e" or economy or low power configuration is the most cost effective for applications requiring "low power". The 1458 Mod100 is the high power configuration.

Detailed information on the output power capabilities of these mainframe configurations should be obtained from LeCroy technical data sheets. The amount of current provided on the mainframes 24V supply determines the module output power capability (since it source for the module's HV generation). As a rough guide, the 1454 and 1454 Mod100 mainframes contain 15A and 30A 24V power supplies. While the 1458e, 1458, and 1458 Mod100 contain 30A, 60A, and 90A 24V power supplies, respectively.

Operational Features

Remote versus Local Operations

When the front panel key switch is in the *REMOTE* position, local control of the unit is disabled. In this condition, the user may locally view but not edit HV settings. When the front panel key switch is in the *LOCAL* position, a remote user may only issue commands which do not change HV settings.

For safety, a user is permitted to turn off HV generation either remotely or locally independent of the front panel key switch position. However, the HV generation can only be turned on remotely if the front panel switch key switch is in the *REMOTE* position and locally if it is in the *LOCAL* position.

The HV *PANIC OFF* button, which immediately turns off HV generation, is always operable in either key position. Operation of the *STATUS* output and the *MACRO* and *INTERLOCK* inputs are also independent of the key position.

HV Generation

Once HV mainframe CPU has started, the unit restores the HV settings as they were when the unit was turned off or the AC power was removed. Unless changed from the factory default (See the "Automatic HV On after AC power failure" section), the mainframe DOES NOT restart HV generation. A user command or front panel operation is required to begin HV generation.

Even though HV generation is indicated as ON, whether or not a given channel supplies HV depends on whether the channel is enabled, the channel's target voltage, ramp up rate, and trip condition. All of the former settings are observable and controllable.

Save and Restore Sets

The HV mainframe includes battery backed-up memory, which provides storage for save sets. Save sets are accessed via the *SAVE* and *RESTORE* buttons on the front panel or via remote commands. A save operation places the current configuration and settings in a save set. The set name is shown in the save menu with time and date of the save operation. Save sets are only valid for a specific module configuration determined by the model number and the slot location of the installed modules. This allows direct replacement of HV modules with no loss of configuration data.

The mainframe also maintains an internal power-up save set which always reflects the current configuration and settings. On power-up, if the installed module configuration has not changed, the settings at the time of the last power-down are restored. If a different module configuration is detected, none of the settings are restored and all modules start with their factory default values (typically target voltages zero.) The 1454 mainframe issues a warning and pauses in its power-up sequence if the previous settings cannot be restored.

By factory default, the HV generation condition is NOT restored on powerup or as part of a named save set restore operation. However, the HV mainframe can be configured to automatically restore HV generation after an AC power failure or a power down caused by the rear panel rocker switch. (See the "Automatic HV On after AC power failure" section.)

The power-up save sets for a previous module configuration are not lost until after the first change of the module settings in the current configuration. Named save sets which are invalid for a new configuration are not lost until overwritten with a new save set.

System Defaults

System defaults refer to a group of HV mainframe operating features which can be user configured and are generally module and communications setup independent. System defaults can be configured locally (1454 only) or by remote command.

Current system defaults include the ability to: 1) disable/enable the 1454 mainframe from automatically switching to the large font three-line display after 1 minute with no key input, 2) enable/disable the remote password, 3) configure the STATUS output signal, 4) configure MACRO input signal, and 5) enable/disable the automatic restoration of HV generation after an AC power failure or a power down via the rear panel rocker switch. (See the "Automatic HV On after AC Power Failure" section.)

Battery Failure

The HV mainframe includes battery backed-up memory which is used to store save sets. In the event of a battery failure while the power is off, data in save sets may be lost. When save sets are lost, *default* module settings (not the last power down settings) are restored with the high voltage off on the next power-up. The mainframe's communications setup and system defaults are stored in an EEPROM, a battery failure does not effect remote communications or system defaults once power is restored.

In the event of a battery failure while the power is on, data in save sets are not necessarily lost. A large capacitor provides sufficient power to retain data for several hours after the mainframe is turned off. In this case, prompt replacement of batteries does not result in lost data.

Software Limits

The HV mainframe supports *software limits* for all settable module parameters. These limits can be set on a per channel basis and set an upper bound to the absolute value of any entered setting. Attempts to set values greater than this limit are blocked and cause an error message to be issued. The default limits are determined by the HV modules and are typically independent of a module's hardware HV limit. Software limits are NOT included in named save sets; but, they are included as part of the power-up save set.

Hardware High Voltage Limits

Some HV modules have a hardware controlled, adjustable HV limit. This type of limit cannot be violated by any remote or local commands. The result of attempts to operate beyond the these limits is dependent on the HV module type.

Trip Conditions

Typically, HV modules can promptly disable or trip off a channel's HV generation without any action by the HV mainframe. Once a trip condition occurs the tripped channel can be re-enabled once the cause for the trip has based addressed. Possible causes for trips are dependent on module type. However, typical causes for trips include 1) exceeding the current or voltage trip limits set by the user, 2) exceeding the HV the current/voltage capability of a module, 3) attempting to operate a module above its Hardware Voltage Limits, 4) a fault which prevents the unit from maintaining a set value, 5) thermal overload.

Because of the local monitoring and trip capability HV modules, there is typically no need for close monitoring by a external host to compare measured to set HV values. Rather, channel status values are available which indicate trip conditions, whether a channel is enabled or disabled, and whether it is ramping up or down.

Locking of HV Settings or Software Limits

In order to prevent inadvertent or unauthorized changes to either HV settings or software limits, the HV mainframe supports the "locking" of these values via remote command or local front panel input. The locking of HV settings is completely independent of the locking of software limits.

As part of the locking procedure the user must supply a 4-digit PIN (personal identification number). HV settings (or software limits) which are locked cannot be changed until the 4-digit PIN is supplied causing these values to become unlocked. Once all value changes have been made, the unlocked condition remains until the user explicitly locks the values with a PIN. The HV mainframe does not remember a given PIN after it is has been successfully used to unlock values. Locking/unlocking of values is independent of the front panel key switch setting (local or remote).

Even though HV settings have been locked, HV generation can be turned on or off without unlocking values or supplying the 4-digit PIN. In the event a PIN has been forgotten, the user can unlock both HV setting and software limit locks by powering up the HV mainframe with no modules plugged into the mainframe backplane. Once the HV mainframe powerup is complete (less than 1 minute) and no modules are found (repeated double beeps), all value locks are unlocked.

Setting and software limit locks are stored in the same as save sets and thus are affected in the same way as save sets by a battery failure (see the "Battery Failure section).

Automatic HV On after AC Power Failure

By factory default, the HV mainframe is configured to require a user operation or command to initiate HV generation. However, the mainframe can be configured to restore HV generation after an AC power failure or a mainframe power down via the rear panel rocker arm switch.

If this feature is enabled and the AC power is removed while the mainframe is actively generating HV then after the AC power is restored and module settings have been successfully restored, the mainframe begins a 10 second countdown (one beep/sec) during which the user may abort (via front panel keystroke) the pending HV On operation. During this countdown the front panel HVON LED's *flash*, but the mainframe is not generating HV. (Note, that once the countdown expires and HV generation begins these LED's will *flicker* (indicating ramping HV).

This feature is automatically disabled and remains disabled until explicitly enabled as a system default when any of the following conditions occur: 1) a new or no module configuration is detected, 2) an error is detected when restoring mainframe or module settings , 3) the mainframe PANIC OFF button has been hit, or 4) the mainframe has undergone a reset because of some internal error.

Thermal Overload Protection

The HV mainframe power supply subsystems have thermal overload protection. The following system conditions result in the event of a thermal overload:

1) The 24 Volt supply to the HV modules is cut off preventing modules from generating HV.
2) Typically, HV modules with enabled channels will register a "voltage" trip condition if HV is On without the 24 Volt supply.
3) The HV mainframe will turn off HV generation placing the mainframe in the HVOFF state.
4) The 1454/VT100 display will issue a warning message at the top of the display.
5) The CONFIG command will return status information indicating the 24V is bad.

A thermal overload does not cause a PANIC OFF condition. However, since the mainframe system does go to the HVOFF state when a thermal overload is detected, the STATUS output (if configured to be sensitive to HVOFF) provides an indirect hardware indication of a thermal overload..

Most HV modules have thermal overload protection independent of the HV mainframe and indicate an overload via a channel trip condition code. Consult the module's manual for further information.

Once the reason for the thermal overload has been addressed, the HV mainframe can be reset by cycling the AC power.

Mainframe Maintenance

To facilitate the maintenance of HV mainframes (by, for example, an equipment pool technician) certain mainframe features can be overridden by powering up the mainframe with no modules. When powered with no modules the mainframe clears all setting and software limit locks, disables remote passwords, and disables the "restore HV after ACFAIL" feature (if enabled) until explicitly enabled by user. When the previous actions are complete the mainframe issues a specific repeating beep code sequence (indicating no modules found). (See the appendix "HV Mainframe Powerup.)

Chapter 2

Local Operation

The 1454 Front Panel

Keys

The 1454 mainframe front panel has a number of control keys appropriately grouped according to their function. Typically, keys close to the display do not change the current settings.

The **HardCopy** key brings up a menu for printing (not supported at this time).
The **Save** and **Recall** keys save and restore configuration data in save sets.
The **Help, Prev Page, Arrow, Next Page, Select keys,** and **Module 0-3** keys move the cursor in the current display and select data for modification.
The **System, Group, Chan, Display Up, Previous, Next,** and **Display Dn** keys control which display is active.
The **Numeric (0-9 & ".")**, **ESC, Backspace, Increment, Decrement, Delta,** and **"+/-" (Polarity)** keys are used to edit numbers.
The **Enter** key transfers the edited numbers to the data base, thus altering the current settings.
The **Channel Enable/Disable** and the **HV On/Off** keys control HV generation.
The **Panic Off** key immediately terminates HV generation on all channels.

Lights

The 1454 mainframe front panel indicator LED's include: **Panic Off, HV Error, Interlock Error, HVON, Remote, Network, System, Group, Chan,** and **Module 0-3** lights.

The **Panic Off** lights come on when a panic off condition exits. If the panic off condition was caused by an external interlock signal, the **Interlock Error** light will be on. The **HV Error** light flashes when one or more HV channels are in a tripped condition. The **HVON** light flashes when the HV is ramping up or down and remains on when HV generation is active and stable. The **Remote** light is on when local editing of values has been disabled. The **Network** light is on when the external network is active. The **System, Group,** and **Chan** lights indicate which display type is active. Slots which have installed modules are shown by their associated **Module 0-3** lights. These same lights flash when a channel in the designated module is ramping or is tripped.

The 1458 Front Panel

Keys

The 1458 mainframe front panel has only two control keys. The **HV On/Off** keys control HV generation and the **Panic Off** key immediately terminates HV generation on all channels. Control of HV settings with a 1458 mainframe should done via a remote interface.

Lights

The 1458 mainframe front panel indicator LED's include: **Panic Off, HV Error, Interlock Error, HVON, Remote, and Network** lights. These lights all operate in the same manner as described in the lights section for the 1454 front panel.

Display and Control

1458 Local Display

The remainder of this chapter would seem to discuss the use of the 1454 front panel to control HV modules and display HV module values. However, a "local" display for the 1458 which operates in a fashion similar to the 1454 display is available.

By connecting a VT100 video terminal to the 1458 serial port, a control/display interface can be started wherein each of the 1454 front panel keys correspond to standard VT100 keys or key combinations as listed on the next page. To start this control/display interface consult the "Remote Interface" chapter and documentation on the VT100 command. The VT100 control/display interface is also available for the 1454 HV mainframe.

VT100 Keyboard	1454 Front Panel
h	Help
PF1	Prev Page
PF2	Next Page
Back Space	Backspace
i	Increment
d	Decrement
p	+/- (Change Polarity)
r	Reverse Video
e	ESC
[	Channel Enable
]	Channel Disable
{	HV ON
}	HV OFF
c	Chan
Shift0-3	Slot 0-3
PF3	Previous
PF4	Next
>	Select
/	Delta
S	Save
R	Recall
s	System
q	(quit VT100 mode)

The key map listed above is typically displayed on the right-hand side of the VT100 display for easy reference once the control/display interface is properly initiated.

The Spread Sheet Paradigm

The channel vs. value display is one of many spread sheet-like formats for presenting module settings and measurements. The user interface is similar to a large spread sheet which extends beyond the limits of the display.

The display is typically divided into two areas, a small edit box at the top of the display and a larger sheet display area.

The edit box generally contains information on the channel values highlighted in the sheet below. Inside the edit box is the edit value area. Data highlighted in the sheet below also appears in this area if it can be edited. The edit value area is highlighted when an edit or data entry operation is active.

Small arrow-like indicators along the border of the sheet display indicate where additional information can be brought into view. A small flashing heart, in the upper left corner of the display shows when the display is live. Each time a scan of all modules for their measurements is completed the heart is toggled on or off. The display update rate is twice the blink rate of this heart.

The current HVSTATUS is displayed on the upper right corner of the display. The title of the current sheet is displayed in the middle of the top edge of the display. Error messages are generally written on the bottom border of the display.

Moving Around and Simple Value Entry

The **Arrow**, **Prev Page (Page Up)**[†], and **Next Page (Page Down)** keys move the cursor around the sheet display, bringing into view values of interest. The **Module # (Alt-#)** keys jump to the beginning of a specific module.

When a sheet value is highlighted and also appears in the edit box, it is a settable value. Simply entering a numeric value begins a data entry operation. The **Enter** key causes the value in the value edit box to be 1) checked against limits, 2) sent to the HV module, and 3) replaced by the actual value registered by the HV module. A number of value entry/editing modes are supported which are discussed in a later section.

Although the first sheet displayed is the Channel vs. Value sheet, other sheet formats can be displayed with the **Previous (F7)** and **Next (F10)** keys. A number of these sheets simply display a given property value for all channels. Repeated use of either a **Previous (F7)** or **Next (F10)** key will eventually go through all possible sheets and loop back to the initial sheet.

The Channel vs. Value Sheet

The first sheet, Channel vs. Value, has columns headed by property names and rows headed by channel numbers. Channel labels include an indicator dot which if visible indicates that a given channel is enabled and stable. The channel status of the value highlighted in the sheet display is presented in the right corner of edit box.

Immediately after **HVON (F5)** is initiated, enabled channels which have non-zero (but reasonably low ramp up rates) have a ramp up status indicated in the channel label with an up-arrow. Once an enabled channel's target voltage has been achieved, its status character becomes a dot again. Turning off the HV with **HVOFF (F6)**, causes the channel status character to become a down-arrow (for a reasonably low ramp down rate). Once an enabled channel has reached ground potential, its status character becomes a dot (if it is enabled).

[†] The equivalent key used from a PC keyboard (NOT a VT100 terminal) is given here and later in parentheses for convenience of those using the PC simulation SW or the HV51 control program.

For the Channel vs. Value sheet and many other sheets, the **Channel Enable (F3)** and **Disable (F4)** keys may be used to enable/disable a channel or a series of previous selected channels. Selecting any value or series values (as discussed in the following section), selects the associated channel(s) for the possibly of being enabled/disabled.

Channels which exceed their trip current settings become tripped and the channel status character flashes, first a ramping down indication, then an exclamation point "!". To clear a trip condition(s) select any value of the tripped channel(s) and press the **Channel Enable (F3)** or **Disable (F4)** key.

Value Entry and Editing

If the value highlighted in the sheet display also appears in the value edit box, then this is a value which may be modified. A number of value entry and editing modes are supported. These include 1) simply entering a new value, 2) changing a specific character in the current value, 3) incrementing and decrementing the current value, 4) selecting a series of channels to receive an entered value, and 5) applying a delta value to be added to current value.

The value edit box is highlighted when an entry or edit operation is in progress. Hitting the **ESC (e)** key at any time *prior* to completion of the edit operation with an **Enter** key, terminates the operation with no change in value(s).

Entering A New Value

The value to be replaced should be highlighted in the display sheet and appear in the value edit box. The first **Numeric** key entry clears the edit value area and inserts the character in the left most position. Additional **Numeric** key entries build the numeric value in the conventional way.

The **Left** and **Right arrow** keys may be used to position the cursor inside the enter character string. Entered characters are inserted into the string at the cursor position. The **Backspace** key deletes characters to the left of the cursor.

The **Increment (i)** and **Decrement (d)** keys add and subtract one from the digit indicated by the cursor. Increments increase and decrements decrease the absolute value of the entered character string. Rollovers to the next digit are done correctly. This allows any value to be quickly stepped in 1's, 10's or 100's (or any other decimal location available).

Generally, the appropriate sign for a value is maintained in the edit value area. To change this value's sign use the **"+/-"** or **Polarity (p)** key.

Editing an Existing Value

The value to be edited should be highlighted in the display sheet and also appear in the edit box. Hitting the **Select (Home)** key activates an edit operation indicated by the highlighting of the edit value area. All key operations discussed in the "Entering A New Value" section may now be used to edit this character string.

Incrementing or Decrementing an Existing Value

The **Increment (i)** or **Decrement (d)** key immediately starts an edit session and changes the digit under the edit cursor. The edit cursor position is saved from last edit session. Additional keystrokes continue to modify the data in the edit value window, but the data is not transferred to the HV module until the operation is completed with the **Enter** key.

For example, when incrementing the same value by repeatedly hitting **Increment (i)** followed by **Enter** will cause each new value to be registered by the HV module in question.

If the current cursor indicator is not at the desired location for an increment or decrement operation, hit the **Select (Home)** key then use the **Left** or **Right arrow** keys to position cursor as desired.

Selecting a Series of Channels for Value Entry

The first channel value in the series is highlighted in the display. The **Select (home)** key anchors one end of the select region. Use any of the vertical cursor movement keys (**Up** and **Down arrow**, **Prev Page (Page Up)**, **Next Page (Page Down)**, **Module 0 - 3 (Alt-0 - Alt-3)**) to extend the select region. The channel values that are selected and currently displayed are highlighted. *The selected channel range can include channels not visible on the current display.* The currently selected channel range is shown in the left corner of the edit box. The value edit area is cleared by any vertical cursor movement key. All key operations discussed in the "Entering A New Value" section may be used to enter a single value for all the channels selected.

Once a select/value entry operation has begun, the vertical cursor/display control keys operate in reasonable fashion to select the final channel in the selected channel range relative to the first channel (highlighted before the Select key was hit). For example, if the first channel selected is the first channel of module 1 then hitting the Module 1 (Alt-1) key selects all channels in that unit. If channel 3 were the first channel selected in the previous example, then the Module 1 (Alt-1) key selects channel 3 through the last channel in that unit (not channels 0 through 2).

Here are two range select short cuts:

- To select all channels in a unit use: a **Module # (Alt-#)** key hit; a **Select (Home)** key hit, then a **Module # (Alt-#)** key hit.
- To select all channels in all units in a displayed column: move the sheet display highlight to the top of the display either by repeated **Prev Page (Page Up)** key hits or a **Module # (Alt-#)** key hit of the first installed module, then a **Select (Home)** key hit, followed by an **Up arrow** key hit.

Delta Mode Editing

Delta mode editing adds or subtracts a given value (delta) from a channel value or series of channel values. Hitting the **Delta (F2)** key, causes the entered value to be considered a delta value and begins a select value entry operation. An up or down arrow character in place of the sign in the edit area value indicates delta mode editing is active. The arrows in the sign place of the value indicate whether the value will be added (arrow up) or subtracted (arrow down) from the *absolute value(s)* of the value (or the range of values selected). Use the **"+/-"** or **Polarity (p)** key to change from addition to subtract (or vice versa) of the current delta value. All key operations discussed in the "Selecting a Series of Channels for Value Entry" section apply for delta mode editing.

Using Help

The **Help (F1)** key activates the help menu system where the **Prev Page, Arrow, Next Page, Select (Home)** and **Help (F1)** keys provide for navigational control. Help text keywords are preceded by a "*". A highlighted "*" indicates the location of the cursor. To display information on a keyword, use the arrow keys to move the cursor to the preceding "*" the keyword of interest and hit the **Select (Home)** or **Enter** keys. The **Prev** and **Next Page** keys to scroll up and down a small portion of the screen if text on a particular topic extends off screen. The **Help (F1)** key jumps back to a previously selected topic. The **ESC (e)** key exits the help menu system.

Currently, the help menu system cannot be activated from one of the system menu displays. Help menu system features such as help based on a touched key, help on the last error, context sensitive help, etc. have yet to be implemented. The help menu files installed on the 1454 are also available as formatted Window help file (help.hlp) and are included on the 1450-SW diskette.

Chapter 3

Remote Interface

Hardware Connections

Interfaces

For RS-232 control of the 1454 mainframes, an XON/XOFF flow control is implemented. Control can be accomplished by a VT100 compatible terminal or a host computer via a RS-232 null modem cable.

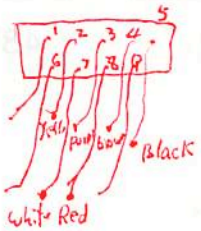
For ARCNET control of the 1454 mainframes, the user's host system should be prepared to send ARCNET packets containing HV command messages and receive ARCNET packets containing previous command status and response messages. The Host's ARCNET driver software should support both 256 and 512 ARCNET packet sizes.

In applications containing multiple HV mainframes or where higher speed control is desired, ARCNET is the recommended control mode. ARCNET's token passing access method guarantee's equal access to the network for all nodes. In heavy network traffic conditions, apparent data transfer speeds saturate in a predictable fashion. On a fully loaded network with every node ready to send, the total ARCNET protocol overhead is just 3.2%;. whereas, ETHERNET has shown to become unpredictable under heavy loading conditions.

RS-232 Connections

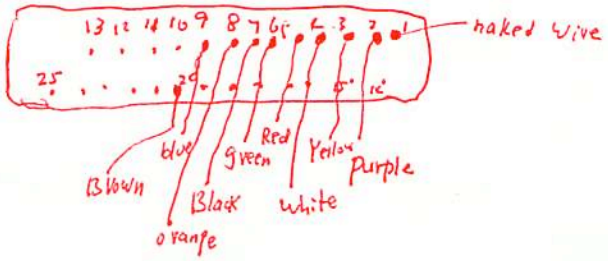
A 9-pin DIN connector using the standard IBM-AT serial port pin definitions (listed below), provides an RS-232 port for the HV mainframe. In addition to the standard serial communication on the Tx and Rx lines, the RTS line is used by the HV mainframe in association with the GS command as discussed in a later section.

Pin	Designation	Pin	Designation
2	Rx	5	GND
3	Tx	7	RTS
4	DTR	8	CTS



1454 Serial Port Configuration

The 1454 HV mainframe external serial port configuration can be changed in the *Serial Port Setup* menu selected from *System* menu (via the *SYSTEM* front panel button). The baud rate, the number of stop bits, the number of data bits, the parity, and local echo can be configured in this menu. Once saved, the serial port settings are preserved in eeprom.



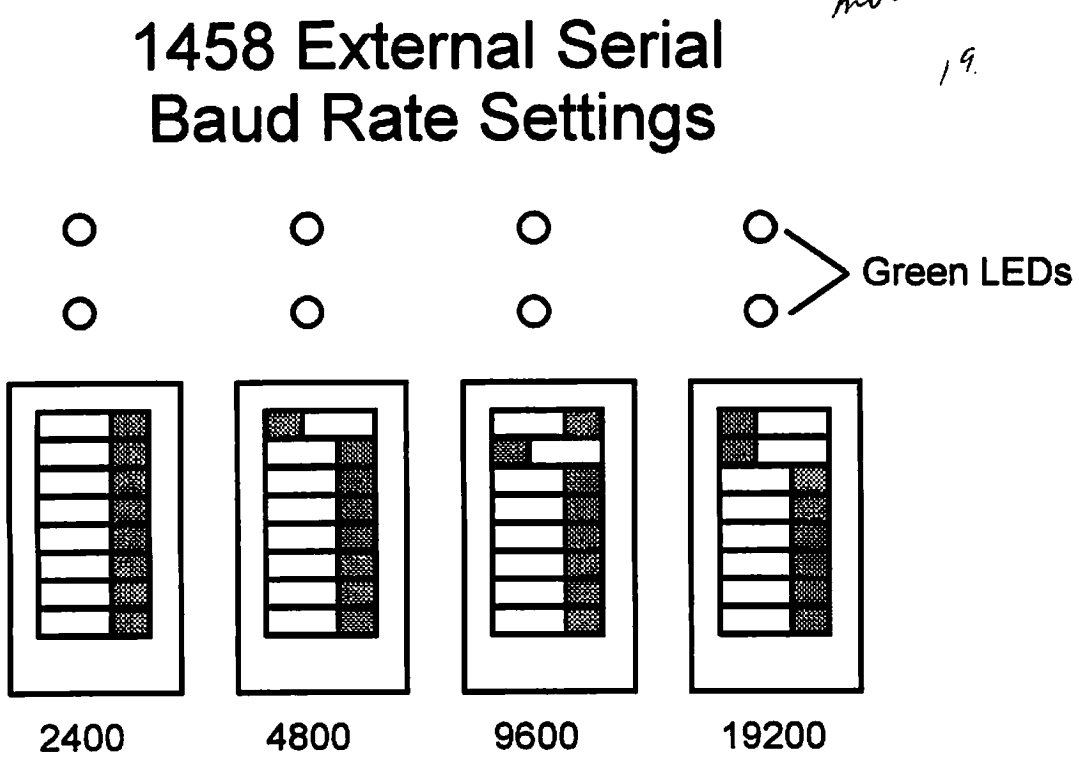
1458 Serial Port Configuration

The 1458 HV mainframe external serial port baud rate is determined by external switch settings of the switch block closest to the 9-pin serial port. Do not confuse the ARCNET card node id switch block with this switch block. The switches controlling serial baud rate are directly below two green LEDs. (The ARCNET interface switch block is below one red and one green LED and is above a BNC connector.)

The 1458 supports 19200, 9600, 4800, and 2400 baud rate settings and shipped with a factory default of 9600 baud. The settings of 1 stop bit, 8 data bits, no parity, and local echo on are "hardwired" for the 1458. Use the switch block diagram below to aid in changing the baud rate. Shaded areas in the diagram indicate where a switch is depressed. Once a new baud rate is set the mainframe AC power must be re-cycled for the new setting to take affect.

mode com1: baud, parity, data, stop

19.



ARCNET Connections

The HV mainframe contains an ARCNET interface card configured to operate in a coax bus topology using RG62/U cable and 93 Ohm terminators. By default, this interface card is configured for the standard "4-mile" network timing (Response time: 74-78 microseconds, Idle time: 82-86 microseconds, and Reconfiguration time: 840 milliseconds). The host ARCNET interface should be configured in a similar manner for proper operation. ARCNET Bus topology configuration rules are listed below. The "Active Links" and "Active Hubs" mentioned in these rules are standard ARCNET devices (available, for example, from Standard Micro Systems Inc.) which facilitate the interconnection of multiple ARCNET bus segments into a single network.

1) Up to eight nodes (HV mainframes and host) may be connected to a single bus.
2) Each bus may be a maximum of 1,000 feet in length and must be terminated at both ends by a 93 Ohm BNC terminator.
3) Pairs of buses may be joined by an Active Link; however, each Active Link reduces by one the number of nodes allowed on both buses.
4) Both nodes and Active Links must be separated by a minimum of ~~three~~ six feet of cable.
5) An Active Hub may be connected only to one end of a bus, in place of a terminator.
6) The maximum node-to-node distance across the network (via Active Links) is 4 miles.

A node can be connected to any point on the bus (even the ends) either by splicing the bus or extending its length with a minimum of three feet of cable and then attaching the node's BNC directly to the bus with a BNC T-connector. Remember to terminate the bus if this is the last node on the cable.

Each node on the ARCNET network must have a unique ID (1-255). An HV mainframe's node ID is determined by the hardware switches above the bus connection BNC. The node ID switches should only be changed when the mainframe power is off. There are eight switches for the 8 bits of the node ID setting. The most significant bit of the node ID is at the top of the switch. A switch toggled to the left sets the corresponding bit of the node ID to one (1). When the end of the switch arm is "head on" or toggled to the right, the corresponding bit is zero (0). Setting the node ID to zero (all switches to the right or head on) causes the HV mainframe to not join the network when it is powered up.

In the 1454 mainframe, the node ID (set by the switches) can be displayed via the front panel SYSTEM by selecting *Network Setup*. Again, the node ID switches should only be changed with the HV mainframe AC power off.

ARCNET LEDs

The mainframe ARCNET interface has two diagnostic LEDs. The green LED monitors network activity; the red LED, board activity. When the green LED is on, either the token is being passed, or a mesage or data from the board is being transmitted over the network, During the network reconfiguration process (this occurs whenever a host joins or leaves the network) the green LED blainks. When the red LED is on, the ARCNET interface is being accessed by the HV mainframe system.

Protocols and Commands

Command and response messages documented in later sections are the same for both RS-232 and ARCNET communications. The RS-232 session protocol requires the user to login prior to issuing commands, whereas the ARCNET does not. For RS-232 connections, a command prompt (containing status information) is issued after each response message. For ARCNET communications, each ARCNET packet sent by the HV mainframe contains a fixed length ASCII (decimal) status string.

Simultaneous RS-232 and ARCNET commands are supported, although each is processed serially in the order they are received. When operating in such a fashion the user should be aware that certain commands like EDIT and VIEW effect all remote control operations.

RS-232 Command Session

To initiate an RS-232 command session, the user must in effect login by sending one or two carriage returns then the text "1450" followed a carriage return. The prompt, "0\Enter "1450" to begin>", for the user to login is caused by one or more carriage returns. Once properly "logged in", a command prompt of "...1450>" is issued. The characters in front of the "1450>" are dependent on the session mode discussed in the following section. A command session is terminated with the command "QUIT" followed by a carriage return. The login procedure provides a way to establish and destroy a link to the host system in a controlled fashion.

Proper user protocol requires that the host only issue one command a time and await the RS-232 command prompt (discussed in a following section) before issuing the next command. If this protocol is violated the HV mainframe will terminate the command session and require the user to login prior to accepting further commands.

For reliable RS-232 control, the host control program should also use "character echo verification" (after a command session has begun). Character echo verification means the control program should only send a single character at a time, waiting for the character echo of HV mainframe before sending the next character in the command. This eliminates the remote possibility of the HV mainframe missing host transmitted characters due to collisions with higher priority mainframe activities (module monitoring).

ARCNET Command Session

Unlike the RS-232 command session, an HV mainframe properly configured on an ARCNET network does not require the user to login prior to sending command messages. Command messages from multiple sources are processed in the order that they arrive with response message(s) returned to the sender's ARCNET node ID.

RS-232 Command Session Security

Once an RS-232 command session has been initiated, the VIEW command can be used to inhibit any further commands *from any source* which might change settable values or cause HV generation to be started. After a VIEW command, the EDIT command enables further editing. If passwords are enabled, a four digit number password can be established with the PASSWORD command. In which case the VIEW and EDIT commands must always be followed by this four digit password. Also once a password has been set, following command sessions always begin in the "view mode".

To change settings or initiate HV generation in such sessions, the EDIT command with the password must be issued. Password protection can be disabled (Factory Default) by changing the mainframe's system defaults (via the 1454 front panel/VT100 display SYSTEM menu by selecting **System Defaults**). When password protection is enabled, no password is active until set by the PASSWORD command.

When active, the VIEW and EDIT modes *only* apply to RS-232 external commands and the serial VT100 mode. One may also start a VT100 monitor session with the "VT100 VIEW" command which provides a way to start "protected" VT100 monitoring while in edit mode. Once the VT100 monitoring is terminated the session returns to the mode that was active when the VT100 monitoring began.

RS-232 Command Session Prompts

A command session can be in either view or edit mode. The first decimal number in a session prompt should be interpreted as an error codes. All codes less than "20" are reserved for indicating operating modes. The return prompt for a session in edit mode is "1\EDIT\1450>" when the previous command was processed without error. If the previous command resulted in an error, an error code greater or equal to 20 would be returned in place of the "1".

Similarly, the prompt for view mode is "2\VIEW\1450>", if the mode is determined by a VIEW command. If the front panel switch is set to local, independent of the previous mode, the prompt becomes "3\LOCAL\VIEW\1450>". If a panic off condition is in effect, independent of any previous mode, the prompt becomes "4\PANICOFF\VIEW\1450>". In the two prior cases, the view mode is maintained until the panic off is reset or the key switch is set to remote, respectively. Again, if the previous command resulted in an error, an error code greater or equal to 20 would be returned in place of the normal mode numbers in these prompts.

ARCNET Command Status

A command session can be in either view or edit mode. The first seven bytes of the HV mainframe ARCNET (response) packet contain a continuation character followed by an ASCII decimal number which should be interpreted as a status or error code. The continuation character is used to indicate that additional packets follow in response to the previous commmand. A blank (0x20) indicates no additional response packets while a "C" (0x43) in this location indicates at least one more response packet will follow the current one. All command status codes less than 20 are reserved for indicating operating modes. The return code for a session in edit mode is " 1 " when the previous command was processed without error. If the previous command resulted in an error a code greater or equal to 20 would be returned in place of the "1".

Similarly, the status code for view mode is " 2 ", if the mode is determined by a VIEW command. If the front panel switch is set to local, independent of the previous mode, the status code becomes " 3 ". If a panic off condition is in effect, independent any previous mode, the status becomes " 4 ". In the two prior cases, the view mode is maintained until the panic off is reset or the key switch is set to remote, respectively. Again, if the previous command resulted in an error, an error code greater or equal to 20 would be returned in place of the normal mode numbers. All status or error codes are terminated with a space (0x20) (included in the seven byte command status region of the ARCNET packet)..

Command Messages and Strings

A valid *command message* is composed only of ASCII non-control characters (0x20 and 0x30 through 0x7e). For RS-232 connections ANSI/VT100 escape sequences are also permitted and in a few cases interpreted so as to allow command line editing. A valid *command string* is a command message followed by a carriage return and must not exceed 256 bytes.

Command messages are composed of a single verb followed by a space, followed by zero or more command qualifiers delimited by spaces, followed by zero or more command values delimited by a spaces.

Response Messages and Strings

For RS-232, the *response string* to a valid command string begins with a linefeed followed by a *response message* and ends with a carriage return. For ARCNET, the response strings begins with the command status (7 bytes) followed by a response message and ends with a null (0x00). Response strings are always less than 256 bytes.

A few commands cause multiple response strings to be generated. For RS-232 connections, the session prompt is not sent until after the last response string for a given command.

A command message which cannot be properly processed generates a response message beginning with "ERROR".

Commands which set values generate responses that contain the actual value registered in the hardware. For example the following command message,

LD S2.3 DV 1000

loads the demand voltage of 1000 into channel 3 of a the HV module in slot 2 and might generate the following response string,

LD S2.3 DV 1000.5

The HV module has modified the demand value to be consistent with its best estimate of the hardware's capabilities. (A value's units are a feature of the HV module.)

Command/Response String Syntax

The following formally describes the syntax of the previously discussed command and response strings. Lower case names are syntax elements, while upper case names are literal text. Text enclosed in single quotes requires only the separators shown. "{}" enclose optional elements. "[]" enclose hexadecimal codes for defined characters. Additional description of specific commands and their syntax appears in later sections.

command-strings

'command-message carriage-return'

command-messages

'command {qualifier-list} {value-list}'

qualifier-lists

'space qualifier {qualifier-list}'

value-lists

'space value {value-list}'

rs-232-response-strings

'linefeed response-message carriage-return'

arcnet-response-strings

'continue-char command-status response-message null'

response-messages

'command {qualifier-list} {value-list}'

'ERROR space error-message'

command-status

'5-place-ascii-decimal space'

continue-char

[0x20 or 0x43]

commands, qualifiers, values, response-messages, and error-messages

'ascii-non-ctrl {ascii-non-ctrl-list}'

ascii-non-ctrl-list

'ascii-non-ctrl {ascii-non-ctrl-list}'

5-place-ascii-decimal

'decimal decimal decimal decimal decimal'

ascii-non-ctrl

[0x20, 0x30, 0x31, ..., or 0x7e]

decimal

[0x20, 0x30, 0x31, ..., or 0x39]

carriage-return

[0x0D]

space

[0x20]

linefeed

[0x0A]

null

[0x00]

Summary Commands and Numbers

In addition to commands which read and modify basic data about HV modules, several commands return a summary of the system data. These commands permit the user or host system to determine if any of the basic data has changed since the last inquiry.

In the following discussion 'logical unit' refers to a unique combination of module and submodule. A submodule occurs when an HV module has more then one set of channels.

Global Summary

The global summary command (GS) returns five values. Each is a four digit hexadecimal. The first value is the mainframe measured value summary number. This number is incremented each time a measured value in any module undergoes a *significant change*. For example, a channel's measured voltage has undergone a significant change if the absolute value of the voltage has changed by more than a predetermined deadzone since its last measurement (by the HV module). (See the "Using Summary Numbers" section.)

The second value returned by the GS command is the mainframe settable value summary number. This number is incremented when a settable value of any module is changed. Any change of a settable value is a significant change.

The third value is the mainframe configuration summary number. This number is incremented anytime a mainframe configuration value is changed. Mainframe configuration values include settings or software limit locks, front panel key switch, serial or ARCNET communication setup, HV generation (HV on/off), software limits, system defaults and powerup status. (See the CONFIG command.)

The fourth value is the mainframe activity number. This number is incremented each time the mainframe measured and settable value summary numbers are updated (but possibly not changed).

The fifth value is the host activity number which is incremented each time the GS command is processed.

Each time the GS command is received, the serial RTS line is cleared. RTS is then set the next time when the mainframe measured, settable, or configuration summary number next changes. Thus a monitoring, *single*, host system can use the serial RTS line as signal to initiate an update procedure.

Logical Unit Summary

When the host finds that either a mainframe settable or measured summary number has changed from the value previously read, the logical unit summary command (LS) can be used to get more information. The response message contains a series of logical unit summary numbers, both a measured and settable summary number for each logical unit. Again these numbers are internally incremented when a significant change has occurred.

Property Summary

When the host finds that a logical unit summary number has changed, property summary numbers can be obtained with the PS command. This command generates a series of summary numbers for all properties of a given logical unit. The order of these numbers is given in the response to the PROP command.

Using Summary Numbers

In practice, a host computer maintains a database of summary numbers as well as HV values which it references and updates as needed. Simple polling of the mainframe with the GS command provides effective monitoring for the host system. When the GS command returns a value summary number different from that in the host's local database, further inquiry to a lower level of summary numbers is indicated. Once the host has determined what parameters values have changed, only those values need to be updated in the host's database. This system of summary numbers keeps the command traffic to a minimum (especially if a judicious choice of measured value deadzones has been made).

All measurable values have an associated deadzone property which is user settable and determines what is considered a *significant change* for that value. Any change to settable values is significant and results in the related summaries being incremented. Also, any change to HV status values (measured values) is significant.

Notice that the summary number scheme also supports access by multiple hosts; i.e., a change caused by one host shows up as changed summary number which another host using the summary number scheme should detect. The second host should then update its database appropriately.

Commands for 1454 and 1458 Systems

Slots, Modules/Submodules, Logical Units, and Channels

The commands discussed here are for the 1454 and 1458 systems. Since an interactive display mode separate from direct commands is supported, the commands favor ease of use by computer programmers over human typists. The 1450 system contains multiple slots which may or may not contain modules. A module may span more than one slot but is addressed only by a single slot number. Modules always contain one or more submodules. The term logical unit is used to refer to submodules and modules with only one submodule. Logical units generally have multiple channels. All the features and status of a logical unit are embodied in the values of its properties. All channels of a logical unit share identical properties and the values for these properties may not be channel independent.

Logical Unit Specification

A number of the mainframe commands have a logical unit specification (*logical-unit-spec*) as a qualifier. The logical unit specification has two distinct formats, one is the *logical-unit-number-spec* and the other the *module-slot-spec*. The former is defined as an L*logical-unit-number* and the latter defined as "S*slot-number*S*submodule-number*". For modules with only one submodule, this format can be abbreviated to "S*slot-number*". Logical unit numbers start with zero and are assigned sequence.

For example, a mainframe with 2 modules in slots 1 and 3 with the module in slot 1 containing one submodule and the module in slot 3 containing 4 submodules results in 5 logical units for the mainframe. The slot/module specifications in this case being S1, S3S0, S3S1, S3S2, S3S3 with the corresponding logical unit number specifications of L0, L1, L2, L3, L4, respectively.

Channel Specification

A channel specification (*channel-spec*) may refer to a single channel (*single-channel-spec*) or to all channels in a particular logical unit via the "*logical-unit-spec*" . The general format of a "*single-channel-spec*" is "*logical-unit-spec.channnel-number*".

Typical Channel Specification Strings

S1	All channels in module in slot 1.
S1.3	Channel 3 of slot 1.
S4S2.1	Channel 1 of submodule 2 in slot 4.
L0.3	Channel 3 of logical unit 0.
L1	All channels of logical unit 1

Command Messages

Listed below is the syntax for all the valid command messages. Literal text is shown in bold capitals. Syntax elements are shown in italics. Separators are spaces. Multiple spaces are interpreted as a single space. Alternative formats are shown on consecutive lines.

command-message

ATTR *logical-unit-spec property-name*

CONFIG

DATE {*date-spec*}

DMP *single-channel-spec*

ECHO *value*

EDIT {*password-number*}

GS

HVON

HVOFF

HVSTATUS

ID *logical-unit-spec*

IMOFF

LD *channel-spec property-name value* {*value-list*}

LL

LM *channel-spec property-name value-limit* {*value-limit-list*}

LOCK *lock-type-spec* {*PIN*}

LS

PASSWORD *password-number*

PROP *logical-unit-spec*

PS *logical-unit-spec*

PUPSTATUS

QUIT

RC *channel-spec property-name*

RESTORE *save-set-spec*

RM *channel-spec property-name*

SAVE *save-set-spec*

SM *slot-number*

SRC *property-name* {*property-name-list*}

SRM *property-name* {*property-name-list*}

SYSDEF {*system-default-word*}

SYSINFO

TIME {*time-spec*}

UNLOCK *lock-type-spec* {*PIN*}

VIEW {*password-number*}

VT100

channel-spec

single-channel-spec

logical-unit-spec

single-channel-spec

logical-unit-spec.channel-number

logical-unit-spec

L*logical-unit-number*

S*slot-number*

S*slot-number***S***submodule-number*

save-set-spec

save-set-number

save-set-name

value-list

value {*value-list*}

value-limit-list

value-limit {*value-limit-list*}

property-name-list

property-name {*property-name-list*}

lock-type-spec

SETTINGS

SWLIMITS

date-spec

day-number -- month-abreviation -- year-number

time-spec

hour-number : minute-number : second-number

The password numbers and PIN's mentioned above are simply 4-digit ASCII decimal numbers with leading zero's not truncated. A date specification always includes a full 4 digit year for example "15-MAR-1999". A typical time specfication is, for example, "13:42:35". The single-channel-spec requires a "." between the logical unit specificaion and the channel number.

RS-232 View and Edit Modes

After the VIEW command is processed or an RS-232 command session is started with a *password-number* previously set, the mainframe is in "view mode". In this mode, the following commands are disabled: HVON, LD, LM, RESTORE, and SAVE. These commands are enabled with the EDIT command, putting the mainframe in "edit mode".

If a password-number has not been set or passwords are NOT enabled (factory default), a command session always begins in "edit mode" (all commands enabled). If a password has been set in command session, all following sessions begin in "view mode".

The VIEW, EDIT, and PASSWORD commands are only recognized as serial (not network commands) only affect the operation of data access commands on the RS-232 port. See description of VIEW, EDIT, and PASSWORD commands and the previous discussion of RS-232 session security.

Command Message Descriptions

ATTR Command

ATTR *logical-unit-spec property-name*

This command returns all the attributes for the named property of the a specified logical unit. The response consists of exactly six space-separated tokens which describe the property. If any of the attributes use spaces they are replaced with an underscore (_). Attributes are only available for modules which are actually installed in the mainframe. In the examples, the attributes are requested for logical unit number 1 and the module in slot 2. These could be the same physical hardware.

Examples:

Command: ATTR L1 DV

Returns: ATTR L1 DV Demand V P N -5000.0_0.0_0.5 %7.1f

Command: ATTR S2 MC

Returns: ATTR S2 MC Current uA M N 7 %7.1f

CONFIG Command

CONFIG

This command returns 5 4-digit ASCII hexadecimal words encoded with HV mainframe configuration information. Bit fields of each word are assigned as indicated below. Bit fields currently set to zero may be assigned in future mainframe systems:

Configuration Word 0 :

<0>	Set indicates HV settings are locked
<1>	Set indicates HV software limits are locked
<2>	Set indicates front panel switch is in remote
<3>	0
<4>	Mainframe EEPROM Status code (0 - Bad EEPROM, 1 - EEPROM OK)
<5>	Battery Status code (0 - Bad Battery, 1 - Battery OK)
<6>	24 Volt Status code (0 - 24 Volts Bad possibly due to thermal overload, 1 - 24 Volts OK)
<7>	0
<8:9>	Powerup Status code (0 - Not Ready, 1 - Normal, 2 - Warning, 3 - Error)
<10:11>	0
<12>	0
<13:14>	Contains HV On/Off state code (0 - HV Off, 1 - HV On, 2 - HV Transition, 3 - HV Unknown)
<15>	Panic Off code (0 - Panic Off not active, 1 - Panic Off active)

Configuration Word 1 :

<0:2>	Contains external serial baud rate code (0 - 19200, 1 - 9600, 2 - 4800, 3 - 2400, 4 - 1200)
<3>	Contains external serial data bits code (0 - 8 data bits, 1 - 7 data bits)
<4>	Contains external serial stop bits code (0 - 1 stop bit, 1 - 2 stop bits)
<5:6>	Contains external serial parity code (0 - parity none, 1 - parity even, 2 - parity odd)
<7>	Contains external serial echo code (0 - echo on, 1 - echo off)
<8:15>	0

Configuration Word 2 :

<0:7>	Contains ARCNET node ID (0 - indicates mainframe is not part of network, 1-255 is node ID)
<8:15>	0

Configuration Word 3 :

<0:15> Contains summary number for software limit values

Configuration Word 4 :

<0:15> Contains systems default word.

If the powerup status is not zero use the PUPSTATUS command to obtain further information. The HV state "HV transition" only corresponds to the short time between when the mainframe commands modules to On or Off and their response, it does not correspond to any ramping condition. The HV state "Unknown" if persistent is an illegal state which can occur if some modules are On while others are Off. The summary number for software limit values is incremented when any software limit value is changed. See the SYSDEF command for bit field definitions of configuration word 3.

Examples:

Command: CONFIG

Response: CONFIG 0102 0001 0044 0081 0001

DATE Command

DATE *{date-spec}*

This command returns the current date maintained in the HV mainframe. If a date specification is the mainframe date will be set to this value. As indicated in the example below, the supplied year must be a full 4 digits.

Example:

Command: DATE

Response: DATE 15-MAR-1995

Command: DATE 20-APR-2003

Response: DATE 20-APR-2003

DMP Command

DMP *single-channel-spec*

This command returns the value of all the properties for a specified channel. The channel specification must refer to only a single channel. The order of the returned values is the same as returned by the PROP command. For the most efficient monitoring of a subset of properties, the RC or SRC command should be used. In the example below, logical unit 1 has 4 properties and the values of these are requested for channel 0.

Example:

Command: DMP L1.0

Returns: DMP L1.0 0.4 100.0 .2 1.0 250.0

ECHO Command

ECHO value

This command enables (ECHO ON) or disables (ECHO OFF) character echo for external serial command input. An external serial session begins with the echo state determined by the serial port setup. Once an external serial session has been initiated the ECHO command may be used to set the echo for that command session. Once a command session is terminated (via QUIT or a multiple command error) the echo state returns the state determined by the serial port setup.

Example:

Command: ECHO OFF

Returns: ECHO OFF

EDIT Command

EDIT {*password-number*}

This command is only valid as an RS-232 command only effects RS-232 operations. This command causes the RS-232 command session to enter "edit mode" and all commands are enabled. If passwords are not enabled or a password-number has not been set, the EDIT command can be issued without a password-number. This command canels a previous VIEW command.

Examples:

Command: EDIT

Returns: EDIT

Command: EDIT 1234

Returns: EDIT

GS Command

GS

This command returns five summary numbers. They are the measured value, settable value, configuration, activity, and host activity summary numbers. Each is a four digit hexadecimal.

The first value is the mainframe measured value summary number. This number is incremented each time a measured value in any module undergoes a *significant change*. For example, a channel's measured voltage has undergone a significant change if the absolute value of the voltage has changed by more than a predetermined deadzone since it's last measurement (by the HV module). (See the "Using Summary Numbers" section.)

The second value returned by the GS command is the mainframe settable value summary number. This number is incremented when a settable value of any module is changed. Any change of a settable value is a significant change.

The third value is the mainframe configuration summary number. This number is incremented anytime a mainframe configuration value is changed. Mainframe configuration values include settings or software limit locks, front panel key switch, serial or ARCNET communication setup, HV generation (HV on/off), software limits, system defaults and powerup status. (See the CONFIG command.)

The fourth value is the mainframe activity number. This number is incremented each time the mainframe measured and settable value summary numbers are updated (but possibly not changed).

The fifth value is the host activity number which is incremented each time the GS command is processed.

Each time the GS command is received, the serial RTS line is cleared. RTS is then set the next time when the mainframe measured, settable, or configuration summary number next changes. Thus a monitoring, *single*, host system can use the serial RTS line as signal to initiate an update procedure.

Example:

Command: GS

Returns: GS FEED FACE 0005 1234 0001

HVON/HVOFF Commands

HVON

HVOFF

This command switches the high voltage on and off. These either start the generation of HV or begin the termination of HV generation. To determine the presence of HV on any unit, the ST property values of the individual channels should be monitored. The IMOFF (Immediate Off) command can be used to immediately turn off HV generation independent of individual channel ramp down settings.

Example:

Command: HVON

Response: HVON

HVSTATUS Command

HVSTATUS

This command returns the current HV status. Five possible return values are possible HVON, HVOFF, HVTRANS, HVPANICOFF, or HV???. The condition of HVOFF only implies that all units are either not generating HV or are currently ramping HV to zero. To determine the presence of HV on any unit, the ST property values of the individual channels should be monitored. The condition HVON implies that HV generation is in progress possibly ramping up, again ST values should be monitored. The condition HVPANICOFF occurs when the PANIC OFF button has been hit. After a PANIC OFF has been initiated all HV generation is immediately disabled until a front panel operation has reset this condition (pushing HVOFF button). The condition of HV??? if persistent is an error condition possibly caused by some modules indicating their HV is ON while others indicate OFF. The condition HVTRANS only corresponds to the short time between when the mainframe commands modules to On or Off and their response, it does not correspond to any ramping condition.

Example:

Command: HVSTATUS

Response: HVSTATUS HVON

ID Command

ID *logical-unit-spec*

This command returns a descriptor for the logical unit specified. The defined fields in the descriptor are module number, submodule number, number of sub modules, number of channels, serial number, revision number, ECO number, firmware version and association. Additional fields may be returned as different module types are are implemented. In the first example, the logical unit number is used while in the second a module and submodule specification is used as a qualifier. In the second example, it was previously known that the module in slot 3 has only one submodule.

Examples:

Command: ID L0

Response: ID L0 1462N 0 1 6 20 A123456 -1 1000 0.04 0

Command: ID S3

Response: ID S3 1464P 1 2 6 20 A123456 -1 1000 0.04 0

IMOFF Command

IMOFF

The Immediate Off command should be used only to turn off HV generation independent of individual channel ramp down settings. This command removes 24 Volt DC power to the modules which is used to generate HV.

Example:

Command: IMOFF

Response: IMOFF

LD Command

LD *channel-spec property-name value {value-list}*

The load command modifies the values for a single property (for a number channels of a logical unit) . A channel specification of a single channel requires only a single value while using a logical unit specification with no channel number refers to all channels in that unit. Too few or too many values returns an error. The property specified must be settable. The value list must be compatible (within limits for example) with the property specified. The response to this command is exactly the values listed possibly adjusted to conform to the limitations of the unit.

The LD command promptly sets module values, but the mainframe internal powerup save sets are only updated if after a 5-sec delay there are no further LD or LM commands recieved. This should improve (slightly) the response time of the LD command, in the situation where the user to issues a series of LD commands to setup a mainframe of modules. The only downside to this feature is that a 5-sec window is opened where a loss of power can cause a loss of powerup save sets.

In the examples below, channel 3 of logical unit number 2 is being set with a DV (demand voltage) of -1000 and all the channels (6) of the module in slot 4 are being loaded with a new DV settings.

Examples:

Command: LD L2.3 DV -1000

Response: LD L2.3 DV -1000.5

Command: LD S4 DV 1000 1000 1000 2000 3000 1000

Response: LD S4 DV 1000.2 1000.2 1000.2 2000.0 3000.5 1000.2

LL Command

LL

This command returns the logical unit list in terms of slot-submodule-spec's, one for each logical unit in the order of logical unit number. In the example below, there are 3 modules in installed, one having 2 submodules. The module in slots 0 and 2 have only one submodule. The order of the return slot/submodule specification strings is by logical unit number.

Example:

Command: LL

Response: LL S0 S1S0 S1S1 S2

LM Command

LM *channel-spec property-name value-limit {value-limit-list}*

The limit command modifies the software limit values for a number channels of a logical unit for a single property. A channel specification of a single channel requires only a single limit value while using a logical unit specification with no channel number refers to all channels in that unit. Too few or too many limit values returns an error. The property specified must be settable. The value list must be compatible with the property specified. Software limit values are always positive numbers. They are used to prevent the LD command or a local panel operation from setting property values with an absolute value greater than the associated limit value. An error is returned if the absolute value of the current property value is greater than limit value to be set (values cannot be more than their limits).

If the property value has a negative polarity, LM returns negative values in its response.

The LM command promptly sets limit values, but the mainframe internal powerup save sets are only updated if after a 5-sec delay there are no further LD or LM commands recieved. This should improve (slightly) the response time of the LM command, in the situation where the user to issues a series of LM commands to setup a mainframe of modules. The only downside to this feature is that a 5-sec window is opened where a loss of power can cause a loss of powerup save sets.

In the example below, channel 3 of logical unit number 2 is being set with a software limit value of -2500 for its DV (demand voltage) and all 6 channels of the DV limit values of the unit in slot 4 are being set with new values (for a positive polarity demand voltage).

LM Examples:

Command: LM L2.3 DV 2500.0

Response: LM L2.3 DV -2500.0

Command: LM S4 DV 3000 2900 2800 2900 3000 3000

Response: LM S4 DV 3000.0 2900.0 2800.0 2900.0 3000.0 3000.0

LOCK Command

LOCK *lock-type-spec* {*PIN*}

The LOCK command can be used to prevent inadvertent or unauthorized changes to either HV settings or software limits. The lock type can either be SETTINGS or SWLIMITS. The locking of HV settings is completely independent of the locking of software limits. If a 4-digit decimal PIN (personal identification number) is not supplied, the current state of lock is returned either LOCKED or UNLOCKED. When a PIN is supplied and the previous lock state is UNLOCKED, the lock state LOCKED will be returned and further changes to the specified value type (SETTINGS or SWLIMITS) will be prevented.

The UNLOCK command should be used with the previous PIN to re-enable value changes. Both the LOCKED and UNLOCKED state persist until explicitly changed by either command or front panel/VT100 operations. The HV mainframe does not remember a given PIN after it is has been successfully used to unlock values. Locking/unlocking of values is independent of the front panel key switch setting (local or remote). A second LOCK command *cannot* re-lock a specified value type with a new PIN; i.e., a currently active PIN cannot be overridden.

Even though HV settings have been locked, HV generation can be turned on or off without unlocking values or supplying the 4-digit PIN. In the event a 4-digit PIN has been forgotten, the user can unlock both HV setting and software limit locks by powering up the HV mainframe with no modules plugged into the mainframe backplane. Once the HV mainframe has completed it's powerup procedure (less than 1 minute) and detected no installed modules, all value locks are unlocked.

Examples:

Command: LOCK SETTINGS

Response: LOCK SETTINGS UNLOCKED

Command: LOCK SETTINGS 1234

Response: LOCK SETTINGS LOCKED

Command: LOCK SETTINGS

Response: LOCK SETTINGS LOCKED

LS Command

LS

This command returns a series summary numbers (four digit ASCII hexadecimals), a measured value and a settable value summary for each logical unit. (See earlier discussion.) The example below is for a mainframe with 3 logical units resulting in 6 summary numbers. The order of the measured/settable pairs is by logical unit number. (See the "Summary Commands and Numbers" section).

Example:

Command: LS

Response: LS 023F 0009 F003 0009 F34A 0012

PASSWORD Command

PASSWORD *password-number*

This command is only valid as an RS-232 command only effects RS-232 operations. The PASSWORD command is only processed if passwords are enabled. The password-number is a 4 digit decimal number. This command must be issued twice to verify the password-number is set as desired. Once the password is set, the EDIT and VIEW commands must include this password-number. Also, following command sessions will begin in "view mode" until passwords are disabled. Disabling passwords in effect clears or resets the current password-number.

Example:

Command: PASSWORD 1234

Response: PASSWORD REPEAT TO VERIFY

Command: PASSWORD 1234

Response: PASSWORD SET

PROP Command

PROP *logical-unit-spec*

This command returns a list of the properties supported by the specified logical unit.

Example:

Command: PROP S2S0

Response: PROP S2S0 MV DV MC RR ST CE

PS Command

PS *logical-unit-spec*

This command returns a series of summary numbers (4 digit ASCII hexadecimals), one number for each property of the logical unit address. The property associated with a given summary number is determined by the order of the property names in the response to the PROP command. In the example below, logical unit 2 has 4 properties. (See the "Summary Commands and Numbers" section).

Example:

Command: PS L2

Response: PS L2 0D35 0020 FE43 0EC1

PUPSTATUS Command

PUPSTATUS

The powerup status command returns three values, the powerup status code (0 - Not Ready, 1 - Normal, 2 - Warning, 3 - Error), the powerup status error number, and the last reset error number. See the appendix on "HV Mainframe Powerup" for further information.

Example:

Command: PUPSTATUS

Response: PUPSTATUS 1 1 1

QUIT Command

QUIT

This command is only valid for an external serial command session. It stops current serial command session. A new command session must be initiated before any more commands are processed.

RC Command

RC *channel-spec property-name*

The recall command returns the values for a given property for a channel or all channels in a module. When the channel specification contains a channel number, a single value is returned for the property specified. When the channel specification is a logical unit with no channel number, property values for all channels that logical unit are returned. The data values are separated by spaces. In the examples, below the MV (measured voltage) values of logical unit 1 for channel 3 then for all channels of a 8 channel device. (See also SRC.)

Examples:

Command: RC L1.3 MV

Response: RC L1.3 MV -3005.0

Command: RC L1 MV

Response: RC L1 MV -1000.5 -1000.8 -2380.5 -3005.0 -1001.5 -1000.0 -1000.5 -999.5

RESTORE Command

RESTORE *save-set-spec*

This command causes the logical unit settings in the specified save set to be activated. If current logical unit configuration does not match that of the save set, an error is returned and no settings are restored. The save set may be a save set number or a predefined name (as shown on the save menu). Unless explicitly changed by the user the default save set names are the names of the six quarks (up, down, strange, charm, top, bottom).

Examples:

Command: RESTORE 2
Response: Restore in progess... please be patient.
Response: RESTORE 2 Complete
Command: RESTORE down
Response: Restore in progess... please be patient.
Response: RESTORE down Complete

RM Command

RM *channel-spec property-name*

The recall command returns the mainframe software limit values for a given settable property for a channel or all channels in a module. When the channel specification contains a channel number, a single value is returned for the property specified. When the channel specification is a logical unit with no channel number, software limit values for all channels that logical unit are returned. The data values are separated by spaces. In the examples, below the software limit values for DV (negative polarity, demand voltage) of logical unit 1 for channel 3 then for all channels of a 8 channel device. (See also SRM.)

Examples:

Command: RM L1.3 MV
Response: RM L1.3 MV -3300.0
Command: RM L1 MV
Response: RM L1 MV -3000.0 -3100.0 -3200.0 -3300.0 -3400.0 -3500.0 -3600.0 -3700.0

SAVE Command

SAVE *save-set-spec*

This command causes the current logical unit configuration and all unit settings to saved to the specified save set. The save set may be a save set number or a predefined name (as shown on the save menu). Unless explicitly changed by the user the default save set names are the names of the six quarks (up, down, strange, charm, top and bottom).

Examples:

Command: SAVE 2
Response: SAVE 2 Complete
Command: SAVE down
Response: SAVE down Complete

SM Command

SM *slot-number*

This command returns the number of submodules present at a given slot. A return value of 0 means there is no module in this slot.

SRC Command

SRC *property-name {property-name-list}*

The super recall command returns the values for each property given as an argument for all channels and all modules. A single SRC command generally results in multiple response messages which the user should be prepared to receive. Each response message contains the property values for all channels for a single property and module. Successive messages are in order of logical unit number then by order of property name argument. For external serial port operations, the command prompt following the SRC command is not issued until after the last response message. For network operations, each response message will contain a command status code. Also, all but the last network response message will begin (in front of the command status code) with a "C" indicating at least one more response message to follow. In the example below, the SRC command is used to interrogate a HV mainframe with 3 modules each containing 4 channels. (See also RC.)

Example:

Command: SRC MV ST MC
Response: SRC MV ST MC -1000.5 -1000.8 -2380.5 -2000.1
Response: -1001.5 -1000.0 -1000.5 -999.5
Response: 500.2 0.0 1500. 0.0
Response: 01 01 01 01
Response: 01 01 01 01
Response: 01 00 01 00
Response: -20.4 -25.8 -60.3 -55.3
Response: -23.2 -19.7 -21.5 -20.5
Response: 100.0 .5 350.6 -.3

SRM Command

SRM *property-name {property-name-list}*

The super recall command for limits returns the software limit values for each settable property given as an argument for all channels and all modules. A single SRM command generally results in multiple response messages which the user should be prepared to receive. Each response message contains the property values for all channels for a single property and module. Successive messages are in order of logical unit number then by order of property name argument. For external serial port operations, the command prompt following the SRM command is not issued until after the last response message. For network operations, each response message will contain a command status code. Also, all but the last network response message will begin (in front of the command status code) with a "C" indicating at least one more response message to follow. In the example below, the SRM command is used to interrogate a HV mainframe with 3 modules each containing 4 channels. (See also RM.)

Example:

Command: SRM DV CE RUP
Response: SRM DV CE RUP -2500.0 -2500.0 -2500.0 -2500.0
Response: -2000.0 -2000.0 -2000.0 -1000.0
Response: 1750.0 1750.0 1750. 1750.0
Response: 01 01 01 01
Response: 01 01 01 01
Response: 01 00 01 00
Response: 200.0 200.0 200.0 200.0
Response: 200.0 200.0 200.0 200.0
Response: 50.0 50.0 50. 50.0

SYSDEF Command

SYSDEF {system-default-word}

This command when given without the optional system default word returns the current system default word (4-digit ASCII hexadecimal}. If the system default word is supplied in the command, the mainframe system defaults will be set accordingly. Bit fields of system default word are assigned as indicated below:

Configuration Word 0 :

<0>	1
<1>	Set indicates timeout to large font display is enabled.
<2>	Set indicates remote password is enabled.
<3>	Set indicates Panic Off grounds the status output port.
<4>	Set indicates any channel trip grounds the status output port.
<5>	Set indicates HV Off grounds the status output port.
<6>	Set indicates restore of HV condition after an ACFAIL is enabled. (ACFAIL is either line or rear rocker switch power loss)
<7>	Set indicates grounding macro input port will cause HV Off.
<8>	Set indicates grounding macro input port will cause alternate module setup. (Module dependent - not implemented yet)
<9:15>	0 (Reserved for future use)

The current factory setup for system defaults is 000B (timeout to large font display enabled and Panic Off grounds the status output port).

Examples:

Command: SYSDEF

Response: SYSDEF 000B

Command: SYSDEF 0000

Response: SYSDEF 0001

SYSINFO Command

SYSINFO

This command returns the mainframe system information as contained in the 1454 submenu of the same name. Multiple lines are returned including the model number, hardware revision, hardware ECO level, test date, tester initials, mainframe firmware version, date, and time, the mainframe serial number, and the mainframe operational hours.

Example:

Command: INFO
Response: INFO
Response: LeCroy Model: 1454
Response: HW Revision: A
Response: HW ECO: 1000
Response: Test Date: 12/25/96
Response:: Tested by: WOL
Response: FW Version: 26.12
Response: FW Date: 20-APR-2003
Response: FW Time: 03:30:20
Response: Mainframe S#: G23789
Response: Op Hours: 10000
Response: LeCroy Corporation
Response: Research Systems Division

TIME Command

TIME *{time-spec}*

This command returns the current time maintained in the HV mainframe. If a time specification is the mainframe date will be set to this value.

Example:

Command: TIME
Response: TIME 15:30:24
Command: TIME 15:20
Response: TIME 15:20:27

UNLOCK Command

LOCK *lock-type-spec {PIN}*

The UNLOCK command can be used to enable to either HV settings or software limits which have been previously been locked. The lock type can either be SETTINGS or SWLIMITS. The locking of HV settings is completely independent of the locking of software limits. If a 4-digit decimal PIN (personal identification number) is not supplied in the UNLOCK command message, the current state of lock is returned either LOCKED or UNLOCKED. When the proper PIN is supplied and the previous lock state is LOCKED, the lock state UNLOCKED will be returned and further changes to the specified value type (SETTINGS or SWLIMITS) will be allowed.

The LOCK command can be used with a PIN to disable value changes. Both the LOCKED and UNLOCKED state persist until explicitly changed by either command or front panel/VT100 operations. The HV mainframe does not remember a given PIN after it is has been successfully used to unlock values. Locking/unlocking of values is independent of the front panel key switch setting (local or remote). A second LOCK command *cannot* re-lock a specified value type with a new PIN; i.e., a currently active PIN cannot be overridden.

Even though HV settings have been locked, HV generation can be turned on or off without unlocking values or supplying the 4-digit PIN. In the event a 4-digit PIN has been forgotten, the user can unlock both HV setting and software limit locks by powering up the HV mainframe with no modules plugged into the mainframe backplane. Once the HV mainframe has completed its powerup procedure (less than 1 minute) and detected no installed modules, all value locks are unlocked.

Examples:

Command: UNLOCK SETTINGS
Response: UNLOCK SETTINGS LOCKED
Command: UNLOCK SETTINGS 1234
Response: UNLOCK SETTINGS UNLOCKED
Command: UNLOCK SETTINGS
Response: UNLOCK SETTINGS UNLOCKED

VIEW Command

VIEW *password-number*

This command is only valid as an RS-232 command only effects RS-232 operations. The VIEW command causes an RS-232 command session to enter "view mode" and all commands which change module settings and HVON are disabled. If passwords are not enabled or a password-number has not been set, the VIEW command may be issued without a password-number to in effect cancel a previous EDIT command.

VT100 Command

VT100

VT100 VIEW

This command is only supported for external *serial* operations and causes the external serial port to enter a special VT100 mode. This mode can only be activated when the front panel key switch is REMOTE. In VT100 mode, all 1454/8 front panel keys are disabled (except HVOFF and PANIC OFF). Switching the front panel key to LOCAL terminates VT100 mode to allow local user input.

In VT100 mode, ANSI/VT100 screen/cursor commands are issued and received to simulate a 1454-style front panel interface on a VT100 terminal. The user may exit VT100 mode by typing "q" (quit) (or switching the front panel switch to LOCAL). The mapping of VT100 keys to 1454 front panel keys is documented in the "Local Operation" chapter of this manual. In the example below, the entire sequence to startup a VT100 display is given including starting the external serial session.

In order to operate properly with a VT100 terminal the XOFF/XON feature of the terminal should be disabled.

When the VIEW keyword is included in the VT100 command, the user may view parameters but not change them including settable values and HVON. For safety reasons HVOFF is always permitted. The upper right corner of the VT100 display will contain the word "VIEW" if this feature is active.

Since the remote and local applies to both the ARCNET and RS-232 communication ports, it is impossible to operate an RS-232 port in local while having the ARCNET port remote. However, by using the "VT100 VIEW" a mainframe configured for remote operation can have a VT100 monitor which is only permitted view access.

Example:

Input:	<CR> <CR>
Response:	0\Enter "1450" to begin>
Input:	1450<CR>
Response:	1\EDIT\1450>
Command:	VT100 VIEW<CR>
Response:	(Begins VT100 full-screen display in view only mode)

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 may alter this attribute. "P" indicates password protection. The password must have been previously enabled and presented to the unit before the property may be altered. Presently no passwords are implemented. "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 may 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 give the minimum, maximum and step size. For numeric measured value and strings, the range is a single number indicating the maximum length of the string returned. For logical values, the range is list of all the allowed values of the property separated by spaces.

Format Attribute

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

Properties

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

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.

DV Demand Voltage

Label: Target_V

Units: V

Protection: Password (P)

Type: Numeric (N)

Range: -3000 0 0.5

Format: %7.1f

This is the desired output voltage

HVL Hardware Voltage Limit

Label: HV_LIM

Units: V

Protection: Measured(M)

Type: Numeric (N)

Range: 7(maximum string length)

Format: %7.1f

This is the hardware voltage limit., which is typically adjusted via a front panel screw on the HV module.

MC Measured Current

Label: Meas_uA

Units: uA

Protection: Measured(M)

Type: Numeric (N)

Range: 7 (maximum string length)

Format: %7.1f

This is the current last measured on the channel.

MCDZ Measured Current Dead Zone

Label: MC_Zone
Units: uA
Protection: None(N)
Type: Numeric (N)
Range: 0_100.0_1.0
Format: %7.1f

0-10

This property is loaded with the desired deadzone for the output current measurement. When the absolute value of the measured current changes by more than this value from a previous reference measurement, the measured current property sum is incremented AND the reference for the next deadzone check is set to this new value (only when the current measurement falls outside the zone).

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.

MVDZ Measured Voltage Dead Zone

Label: MV_Zone
Units: V
Protection: None(N)
Type: Numeric (N)
Range: 0_100.0_1.0
Format: %7.1f

Range 0-30.0

This property is loaded with the desired deadzone for the output voltage measurement. When the absolute value of the measured voltage changes by more than this value from a previous reference measurement, the measured voltage property sum is incremented AND the reference for the next deadzone check is set to this new value (only when the voltage measurement falls outside the zone).

RUP Ramp Up Rate

Label: RUp_V/s
Units: V/s
Protection: Password(P)
Type: Numeric (N)
Range: 300 10 10
Format: %7.1f

Range 50-2000

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:	300 10 10
Format:	%7.1f

Range
50-2000

The value of this property is the ramp-down rate. . This rate is used when the HV is turned off (not panic off), tripped or the output voltage is set to a lower (in magnitude) value.

ST Channel Status

Label:	Status
Units:	
Protection:	Measured(M)
Type:	Numeric (N)
Range:	2, 3, or 4 (maximum string length)
Format:	%2x, %3x, or %4x

This property is a measured value and cannot be loaded. The return value is a 2, 3, or 4 digit hexadecimal number which describes the state of the HV channel. Whether the value has 2, 3 or, 4 digits is module dependent. Each bit of the first digit has a meaning as described below. The following bits (as many as 12 in the next 3 digits) indicate a tripped condition. The type of trip condition is module dependent. It is possible for a trip condition to be indicated by one or more of these bits being set.

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 Condition 0
5	Trip Condition 1
...	
15	Trip Condition 11

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

In the particular case of the 1461 module, the above trip conditions are assigned as indicated below. Consult the 1461 user's manual for further information.

Trip Condition 0 (=1):	Violation of supply limits
Trip Condition 1 (=2):	Violation of user's current limit
Trip Condition 2 (=4):	Voltage Error
Trip Condition 3 (=8):	Violation of Voltage limit

TC Trip Current

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

Range
10 to 2550

This property is the maximum allowed current. If this current is exceeded the channel is tripped. HV generation is discontinued. The output voltage may be ramped down.

Sample Session

Below is listed a sample session with a fictitious module located in slot 3 having a single submodule with 9 properties and 8 channels. The host first uses LL to discover that there is a single module in slot 3 with one submodule (which must be logical unit 0). The ID command reveals information about the model #, properties, number of channels, etc. which the host should find useful in allocating storage for its local database The PROP command is issued to gather property names, then attributes (ATTR) are requested for each property. Finally property values for each channel are obtained with the DMP command.

```
>LL
  LL S3
>ID L0
  ID L0 1550P-A 0 1 9 8 B12345 -1 1001 1.0
>PROP L0
  PROP L0 MV DV MC RUP MVDZ TC CE ST MCDZ
>ATTR L0 MV
  ATTR L0 MV Meas_V V M N 8 %8.11f
>ATTR L0 DV
  ATTR L0 DV Target_V V N N 0.0_5500.0_0.5 %8.11f
>ATTR L0 MC
  ATTR L0 MC Meas_uA uA M N 8 %8.31f
>ATTR L0 RUP
  ATTR L0 RUP RUp_V/s V/s N N 0.0_200.0_0.5 %8.11f
>ATTR L0 MVDZ
  ATTR L0 MVDZ MV_Zone V N N 0.0_100.0_0.5 %8.11f
>ATTR L0 TC
  ATTR L0 TC Trip_uA uA N N 0.0_510.0_0.01 %8.31f
>ATTR L0 CE
  ATTR L0 CE  Ch_En NA N L 0_1 %1s
>ATTR L0 ST
  ATTR L0 ST Status NA M N 8 %8f
>ATTR L0 MCDZ
  ATTR L0 MCDZ MC_Zone uA N N 0.0_50.0_0.2 %8.3f
>DMP L0.0
  DMP L0.0 0.0 00.0 0.0 20.0 0.0 500.0 1 01 0.0
```

```
>DMP L0.1
  DMP L0.1 0.0 20.0 0.0 20.0 0.0 500.0 1 01 0.0
>DMP L0.2
  DMP L0.2 0.0 40.0 0.0 20.0 0.0 500.0 0 00 0.0
>DMP L0.3
  DMP L0.3 0.0 50.0 0.0 20.0 0.0 500.0 1 01 0.0
>DMP L0.4
  DMP L0.4 0.0 60.0 0.0 20.0 0.0 500.0 0 00 0.0
>DMP L0.5
  DMP L0.5 0.0 70.0 0.0 20.0 0.0 500.0 0 00 0.0
>DMP L0.6
  DMP L0.6 0.0 20.0 0.0 20.0 0.0 500.0 1 01 0.0
>DMP L0.7
  DMP L0.7 0.0 40.0 0.0 20.0 0.0 500.0 1 01 0.0
```

Having initialized the local database, the host now sets some target voltages and the measured voltage deadzones, initializes its summary numbers and turns on HV generation.

```
>LD L0 DV 1000.0 900.0 0.0 800.0 0.0 0.0 2000.0 1000.0
  LD L0 DV 1000.5 900.0 0.0 800.5 0.0 0.0 2000.0 1000.5
>LD L0 MVDZ 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0
  LD L0 MVDZ 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0
>GS
  GS 00D5 00A 0003 0005 001
>LS
  LS 00D5 00A
>PS L0
  PS L0 00CF 0002 01CA 0001 0002 0001 0001 0001 0001
>HVON
  HVON
```

Since there is only one logical unit, the PS command is adequate to monitor summary numbers and update measured value changes by observing which summary numbers change from a previous reading. Though not done in the following sequence, the GS command could be used to monitor the update frequency of the 1454/1458 mainframe database via the returned mainframe activity number.

As the HV ramps up the ST values for the enable channels are changed to ramping up and the disabled channels to disabled on. From the results of the second PS , the host observes that only the summary numbers for MV and MC have changed, so only those property values are readout. Later, when some of the channels have finished ramping, the ST property sum is observed to have changed and the host reads the ST values as well as the DV and MC values.

```
>PS L0
  PS L0 00FE 0002 01D3 0001 0001 0001 0001 0002 0001
>RC L0 MV
  RC L0 MV 202.5 204.0 0.0 201.4 0.0 0.0 210.0 202.4
>RC L0 MC
```

```
  RC L0 MC 10.4 12.5 0.4 11.6 0.2 -0.1 14.6 10.8
>RC L0 ST
  RC L0 ST 03 03 00 03 00 00 03 03
>PS L0
  PS L0 010D 0002 01E6 0001 0001 0001 0001 0002 0001
>RC L0 MV
  RC L0 MV 512.4 507.3 0.0 501.6 0.0 0.0 521.2 508.4
>RC L0 MC
  RC L0 MC 25.4 30.5 -0.1 25.6 0.2 -0.0 31.6 25.8
...
>PS L0
  PS L0 023c 0002 02B8 0001 0001 0001 0001 0005 0001
>RC L0 MV
  RC L0 MV 915.5 901.0 0.0 799.4 0.0 0.0 921.0 935.4
>RC L0 MC
  RC L0 MC 50.4 53.5 0.2 42.6 0.2 0.1 64.6 57.8
>RC L0 ST
  RC L0 ST 03 01 00 01 00 00 03 03
...
```

Chapter 4

PC 1454 HV Mainframe/Module Simulation

Getting Started with LHV

Background

This chapter documents the PC HV simulation program LHV which may be used to demonstrate and exercise both the local and remote control interfaces implemented in the LeCroy 1454/8 HV mainframe. Indeed, the 1454/8 runs the same control program (with the simulation disabled and other hardware control features enabled) on the mainframe's embedded 386/DOS motherboard. As such, most of the operating features (bugs) of the mainframe control system can be accessed. In particular, a user developing control software for the 1454/8 can run this program on his own PC and exercise the RS-232 or ARCNET interface protocol and commands on the PC's COM2 serial port or a ARCNET interface card (Standard Microsystems Corporation Model PC600WS).

Following sections discuss how to install and run the simulation program, document the mapping of the 1454 front panel keys to the PC keyboard, and indicate differences between the simulation and the actual 1454/8 operation.

Installation

The minimum required hardware to run the simulation program, LHV includes a 386 based PC running MS-DOS version 6.0 or greater with an available serial port (preferably COM 2). Due to memory constraints, the LHV program cannot (in general) be run from Windows. Typically LHV requires a PC with at least 2MB of installed memory.

For serial port operations, an RS-232 null modem cable is required to connect to COM 2 to the terminal or host system supplying command messages. By default the external serial communication is setup for a baud rate of 9600, 8 data bits, 1 stop bit, no parity, and echo on. All of these settings can be reconfigured via the system menu once the program has started.

For ARCNET operations, the user must install an SMC Model PC600WS ARCNET interface in the simulation PC. In order to use default LHV settings, the ARCNET card should be configured for Interrupt number 5 and base address 0x350. The PC600WS's RAM base address is not used by LHV although some settings will interfere with PC booting or other installed devices. Typically a RAM base address of E1800 (all RAM base address bit switches off or "1") will work. If the interrupt number or base address cause conflicts in your PC choose values which don't and use the "AI" and "AP" LHV command line options to override software defaults. The ARCNET port ID switches on the front of the interface card should be set to some non-zero value. Also configure the interface card for BUS network topology and observe the rules discussed in the "Remote Interface" chapter in this manual for connecting to your host. You will need a RG-62 BNC cable and at least 2 BNC tee's and 2 90 Ohm terminators.

The LHV program should be run from a hard disk in order for the save set and locking features to operate correctly. To install LHV, simply copy all files from the 1450-SW program diskette to an empty subdirectory (\LHV) of your hard drive (preferably c:). Then run the self-extracting executable to 1450sw.exe to unpack the files it contains. Check the readme.txt file for release information.

```
>c:
c:\> md LHV
c:\LHV> cd LHV
c:\LHV> copy a:*.*
c:\LHV> 1450SW
```

Running LHV

The LHV simulation program is setup with four fictitious HV modules each with twelve channels. All module properties, module model numbers, etc. should be considered as reasonable examples of those found on any HV module, though actual modules may implement more or fewer properties.

By default, LHV expects the hard disk to be a C: drive, the serial port for RS-232 operations to be COM2, the ARCNET interface (if any) to be set for interrupt 5, base address 0x350. In which case, the program may be started from the installation subdirectory simply by entering "LHV" to the DOS prompt.

```
\LHV> LHV
```

There are number of command line options available for LHV. You should only have to use those that control the hard drive for save operations (S), the port used for serial communications (C), the display of received or transmitted serial messages (E), the generation of a wide screen display(W), and the setup of the ARCNET interface (AI and AP).

In the following example, LHV is started with the save operations to be done on the current default directory of the D: drive, the serial port set to COM1, the display of received serial messages enabled, and in wide screen mode.

```
\LHV> LHV Sd: C1 EI W
```

If we had used "EO" instead of "EI" in the above example, the display of transmitted messages would have been enabled. Command line options can be given in any number or order and must be separated by at least one space.

In the next example, LHV is started for an ARCNET interface installed at interrupt 10 and base address 0x300.

```
\LHV> LHV AI10 AP0300
```

In order to facilitate host ARCNET driver development, the LHV program diskette also includes a program ARCTALK which you may run in place of LHV to test your host's ARCNET communication. "ARCTALK ?" display's all command line options, beware that the default interrupt number and base address for this program may not be the same. ARCTALK will send entered messages to a designated node ID and also display all received messages indicating the node ID of the sender.

PC Keyboard Mapping

Shown below is the mapping between the 1454 front panel push button keys and the PC keyboard used by LHV. This table is also displayed along side of the sheet displays when LHV is started without the wide-screen option. Not listed are the **Cursor**, **Numeric**, and **Enter** keys which operate in a similar fashion on both the front panel and keyboard. See the discussion in the "Local Interface" chapter for details on key usage.

The **Group**, **Display Up**, **Display Down**, and **Help** front panel keys have yet to implemented.

Beware that for keys which are simply mapped as letters, the lower case version of the letter is required. Also, notice that there are **Previous (F7)** and **Next (F10)** keys as well as **Prev Page (Page Up)** and **Next Page (Page Down)** keys. The latter pair of keys function as cursor control keys in a given display while the former pair result in completely new displays. (This confusion is avoided on the 1454 front panel by the appropriate grouping of keys with similar functions.)

Notice that the letter "q" is used to exit LHV. In the event the program hangs up due to some program bug, Ctrl-Break may be successful in terminating the program.

VT100 Keyboard	PC Keyboard	Front Panel
PF1	PgUp	Prev Page
PF2	PgDn	Next Page
Back Space	Bkspc	Backspace
i	i	Increment
d	d	Decrement
p	p	+/- (Change Polarity)
r	r	Reverse Video
e	e	Escape or abort editing
[	F3	Channel Enable
]	F4	Channel Disable
{	F5	HV ON
}	F6	HV OFF
c	c	Chan
Shift0-3	Alt0-3	Slot 0-3
PF3	F7	Previous
PF4	F10	Next
h	h	Hardcopy
>	Home	Select
/	F2	Delta
S	Alt-s	Save
R	Alt-r	Recall
s	s	System
	q	quit program

LIVE or LHV

Besides the too perfect measured voltages and currents in the simulated modules of LHV, there are a few other differences in the operation of LHV as a simulation program versus a 1454/8 control program. These include:

The distinction between local and remote operation is ignored in the simulation.

Channel trip conditions which are indicated by the front panel lights have no analog on the LHV display and simulation.

The LHV simulation typically updates the display faster.

Panic Off conditions and the resetting of PANIC Off conditions are not simulated.

All System Default features which refer to the STATUS output and MACRO input ports (1454/8 Hardware) are not simulated. The System Default feature "Restore HVON after ACFAIL" is also not simulated. System Default settings are maintained between after the LHV simulation terminates as a disk file on the save drive. (In a 1454/8 mainframe these settings are saved in EEPROM.)

Most HV modules have a hardware limit property (HVL) which is not simulated.

Under special conditions, most HV modules can have their factory default powerup settings overwritten. This feature is not simulated.

The measured property, polarity (POL) is used by LHV to simulate modules of positive or negative voltage polarity. Currently no HV modules have such a property.

Appendix I

HV Mainframe Powerup

Sequence of Powerup Events

On power up of the HV mainframe, the following sequence of events occurs:

1) The mainframe system boots and issues either *1 beep* or *4 beeps* (2, pause, 1, pause, 1). If any other initial beep sequence is observed and the system fails to initialize (REMOTE/NETWORK LED's fail to flash), a mainframe CPU/motherboard problem (most likely) exists. The STATUS output level is clamped to ground.
2) A quick check of mainframe hardware is done. If any failures are found, the mainframe repeats a *5-sec delay, 3 beep* sequence indefinitely (mainframe repair needed).
3) The REMOTE and NETWORK front panel LED's begin flashing. These LED's flash until the mainframe is ready for front panel or remote input.
4) Each slot is interrogated for the presence of an HV module.
5) If no modules are found, the mainframe clears all setting and software limit locks, disables remote passwords, disables the "restore HV after ACFAIL" feature (if enabled) until explicitly enabled by user. The mainframe then repeats *5-sec delay, 2 beep* sequence indefinitely.
6) **Module 0-3** lights are turned on for slots containing modules (1454 only).
7) All installed modules are queried for their properties and property attributes.
8) Default module settings are retrieved from each module.
9) System configuration parameters for the System Defaults, Ext. Serial Port configuration, and Save Menu's are restored.
10) Previous (from last power down) module settings and software limits are restored, if the slot and module configuration has not changed.
11) The last system reset condition is checked.
12) If any restore operation fails, a new slot and module configuration are detected, the last system reset was not normal, or a panic off is active; the "restore HV after ACFAIL" feature (if enabled) is disabled until explicitly enabled by user.
13) The mainframe issues a beep code indicating its powerup status according to following table:

NORMAL *1 Beep*

This indicates the mainframe powered up in a normal fashion is ready for external commands.

WARNING *2 Beeps*

This indicates the mainframe detected a new module configuration, the previous module configuration was not found, or the panic off is active. If a new module configuration is detected or the previous configuration was not found, the module default HV settings (typically zero) were used. The mainframe is now ready for external commands.

ERROR *4 Beeps (2 then 2)*

This indicates a possibly serious (but not fatal) mainframe error has been detected. Possible error conditions include the mainframe or module powerup save files were corrupted (module defaults were used), the last system reset was not normal, or some other system error. The mainframe is now ready for external commands. The PUPSTATUS command or the system menu (1454 front panel/VT100 display) should be used to obtain further information.

14) The STATUS output level is determined by mainframe system defaults.

15) The REMOTE and NETWORK front panel LED's stop flashing.

16) If a powerup warning or error condition occurs, the user is prompted to hit ENTER or SELECT to continue (1454 only).

17) If panic off is active, the user is given the option to reset this condition (1454 only).

18) If the "restore HV after ACFAIL" feature if enabled *and* the HV generation was on when the mainframe power was turned off *and* the previous mainframe power down was due to an AC power failure or the rear panel rocker switch, the mainframe begins a *10 beep* countdown after which HV generation is turned on. Any front panel key press during the countdown will abort the HV turn on. (See step 12.)

19) A three line, single channel display is started showing a single channel's measured current, voltage, and the mainframe HV status (1454 only).

20) The user is prompted to hit ENTER or SELECT to continue, which replaces the three line display with the channel vs. value display (1454 only).

Powerup Beep Sequence Variations

The initial powerup beep sequence for a 1454/8 HV mainframe may be 1 or 4 beeps (2 beeps, pause, beep, pause beep) prior to the commencement of REMOTE/NETWORK LED flashing (and the illumination of the 1454 display). This variation is due to different versions of mainframe motherboard BIOS and has no effect on 1454/8 mainframe performance.

Decoding Powerup Beeps

While the 1454 mainframe has a front panel display to inform the user of various powerup conditions, the 1458 mainframe does not. However, by listening to the beeps issued by the HV mainframe, the user can determine to some degree it's power up condition. Below is a table for decoding the meaning of various powerup beep sequences. For example, the beep sequence for item 7) is 1 or 4 beeps followed by a single beep at least 10 seconds later (dependent on number of modules installed) which is followed by 10 beeps beginning 5 seconds later. The initial 1 or 4 beeps when system boots may only be a single beep if a keyboard is installed.

Item	System Boot	HW Check	Restore Config	Restore HV On	Condition
1)	>4 Beeps				CPU/motherboard problem, if mainframe fails to initialize.
2)	1 or 4 Beeps	5 sec delay, 3 Beeps, repeat			Low - Level Mainframe HW problem
3)	1 or 4 Beeps	5 sec delay, 2 Beeps, repeat			No Modules Detected
4)	1 or 4 Beeps		delay > 10 sec, 1 Beep		Normal (Ready for ext. commands)
5)	1 or 4 Beeps		delay > 10 sec, 2 Beeps		Warning (Ready for ext. commands) New slot/module configuration or No previous slot/module config or Panic Off is active
6)	1 or 4 Beeps		delay > 10 sec, 4 Beeps (2 then 2)		Error (Ready for ext. commands) Previous mainframe/module configuration corrupted or Last reset was not normal or Some other system error
7)	1 or 4 Beeps		delay > 10 sec, 1 Beep	5 sec delay, 10 Beeps	Restoring HV On Hit any front panel key during 10 Beeps aborts pending HV On

Appendix II

Error Numbers

Listed below are all the possible error numbers for V2.00 version of 1454/8 control software. Later versions of this software may extend this list. Error numbers between 100 and 400 are general errors which may be encountered in the use of remote or local interfaces. The local interface issues these errors as short text explanations while the remote interface gives both the error number and shot text explanation. Otherwise, error numbers greater that 400 do not include short text explanations for either interface.

Error numbers between 400 and 600 may be encountered when installed modules violate certain parameter definition rules. Error numbers greater or equal to 600 but less than 2000 are low-level system errors. Error numbers in the 2000 to 2999 range should be considered informational. Error numbers greater or equal to 3000 are again reserved for low-level system errors.

ERR_ParamOutOfRange	100
ERR_NotSettable	101
ERR_NotUsed0	102
ERR_NonExistentChan	103
ERR_OutOfMemory	104
ERR_TooManyLogicalUnits	105
ERR_TooManyChannels	106
ERR_NotInList	107
ERR_Syntax	108
ERR_ChannelIndexOutOfRange	109
ERR_UnknownProperty	110
ERR_InvalidSlot	111
ERR_SubmoduleRequired	112
ERR_MeasuredValue	113
ERR_CalibrationValue	114
ERR_NoMatchInList	115
ERR_SubmoduleOutOfRange	116
ERR_TooManyProperties	117
ERR_TooManyPropertyLists	118
ERR_FailedToTurnHVON	119
ERR_NotUsed1	120
ERR_FailedToTurnHVOFF	121
ERR_ImproperHVOnOffCondition	122
ERR_TooManyCharacters	123
ERR_NoModuleInSlot	124
ERR_SerialProtocalNoAckOrNak	125
ERR_SerialRecTimeout	126
ERR_UnknownCommand	127
ERR_SerialInOverFlow	128
ERR_SerialInUnderFlow	129

ERR_AttemptQuitWithHvOn	130
ERR_TokenCountZero	131
ERR_TooManyTokens	132
ERR_NoAssociatedChannel	133
ERR_NotNumericValue	134
ERR_DifferentProperties	135
ERR_TooManyDigits	136
ERR_SerialOverrun	137
ERR_SerialParity	138
ERR_SerialFraming	139
ERR_NotUsed2	140
ERR_NotUsed3	141
ERR_NotUsed4	142
ERR_TooManyMenuLevels	143
ERR_ExtSerialOverrun	144
ERR_ExtSerialParity	145
ERR_ExtSerialFraming	146
ERR_ExtSerialSessionActive	147
ERR_SheetSaveNotPermitted	148
ERR_NotUsed5	149
ERR_SaveFileOpen	150
ERR_SaveBadChecksum	151
ERR_SaveSlotMismatch	152
ERR_SaveFileCorrupted	153
ERR_SerialSendTimeout	154
ERR_SerialBreak	155
ERR_DeltaNotAllowed	156
ERR_FailedToRemoveFile	157
ERR_ReplyCorrupted	158
ERR_SoftwareLimit	159
ERR_ValueExceedsSWLimit	160
ERR_PasswordTooLong	161
ERR_PasswordTooShort	162
ERR_PasswordNotDigits	163
ERR_PasswordsDisabled	164
ERR_InvalidPasswordMode	165
ERR_PasswordNotSet	166
ERR_PasswordMismatch	167
ERR_InvalidSwitchMode	168
ERR_ModeAccessDenied	169
ERR_LastPowerDownFail	170
ERR_NotUsed6	171
ERR_PanicOffActive	172
ERR_SwitchModeLocal	173
ERR_NotInEditMode	174
ERR_PasswordVerifyFailed	175
ERR_SessionModeView	176
ERR_SwitchModeRemote	177
ERR_AlreadyPanicOff	178
ERR_RemotePanicOff	179
ERR_InterlockPanicOff	180

ERR_ManualPanicResetFailed	181
ERR_LocalPanicOff	182
ERR_WatchDogTimeout	183
ERR_BadFrontKeySwitch	184
ERR_SystemInitOrHung	185
ERR_HelpFileOpen	186
ERR_HelpStackOverflow	187
ERR_PasswordCorrupted	188
ERR_NoPrintForThisSheet	189
ERR_ParallelPortNotInstalled	190
ERR_EEPromSaveFailed	191
ERR_EEPromSaveChanMismatch	192
ERR_UseChanEnableDisableKey	193
ERR_ArcnetRecTimeout	194
ERR_ArcnetSendTimeout	195
ERR_ArcInterfaceNotFound	196
ERR_EPROMWriteChecksum	197
ERR_EPROMReadChecksum	198
ERR_FactorySystemDefaults	199
ERR_AttentionTimeout	200
ERR_LockSyntax	201
ERR_UnLockMismatch	202
ERR_ValuesLocked	203
ERR_LimitsLocked	204
ERR_AlreadyLocked	205
ERR_AlreadyUnlocked	206
ERR_MacroHoldingHVOFF	207
ERR_SerialProtocolViolation	208
ERR_Test82C59AMask	209
ERR_TestCom1SerialScratch	210
ERR_TestCom2SerialScratch	211
ERR_BadBattery	212
ERR_BatteryRAMDriveFail	213
ERR_ArcInvalidNodeID	214
ERR_NoAssociatedLUN	215
ERR_OnlySerialCommand	216
ERR_ResetPanicOnlyViaFP	217
ERR_Bad24Volts	218
ERR_VT100ViewOnly	219
ERR_SerialCommmandOnly	220
ERR_WatchDogUpdateTimeout	221
ERR_ExtSerialFifoRcvr	222
ERR_VT100MonitorActive	223
ERR_LimitsNotSavedByName	224
INFO_NewModuleConfiguration	2001
INFO_NoPowerupSaveFile	2002
INFO_DisableACFAILRestoreHV	2003
INFO_PanicOffActive	2004

Appendix III

Firmware Version History

Introduction

The following sections contain listings of 1454/8 mainframe firmware changes implementing new features, fixing known bugs, and possible changing the operation of previously implemented features. The large jump between version numbers is due to the development of "inhouse" versions of the firmware which are not released (in product form). Version 2.10 was never installed in any 1454 product although there exist some preliminary manuals with this version number.

Changes Since V1.01

- The external serial command prompt now contains the string "1450" instead of "1454". A external serial command session can be initiated with "1450", "1454", or "1458".
- When a external serial command error is detected the response message begins with "ERROR" instead of " ERROR" (space removed). Text translations of error numbers returned in error message are now enclosed in "|"; for example, "<Syntax Error>" becomes "|Syntax Error|". This is so a host can wait for ">" before transmitting the next command.
- The definition for the channel ST value has been extended from a minimum of a 2 digit hexadecimal to possibly a 3 or 4 digit hexadecimal. The definitions of the first and second digit remain the same. Whether a 3 or 4 digit value is returned is module dependent.
- New commands include CONFIG, ECHO, IMOFF, LOCK, PUPSTATUS, SRC (Super Recall of values), SRM (Super Recall of software limits), SYSDEF, UNLOCK, and VT100.
- No longer supported commands PANICOFF and PANICRESET.
- Support for remote Panic Off (PANICOFF and PANICRESET) has been dropped since it does not operate in the same fashion as the hitting the local panic button; namely, persisting after a power outage. A new command IMOFF (Immediate Off) has been implemented to still allow a remote user to quickly turnoff HV generation independent of ramp down settings.
- The LOCK/UNLOCK commands and system menu options allow the user to inhibit changes to either HV settings or software limits based on an entered PIN.
- CONFIG returns mainframe configuration data. When a host system uses the GS command to monitor an HV mainframe, a change in the configuration summary number should cause the use of the CONFIG command to see what has changed.
- The PUPSTATUS commands returns status information from the last mainframe powerup.
- The super recall command for values (SRC) and limits (SRM) allows the user to fetch a the values for all channels and all modules in a mainframe for a list of properties with a single command.

- Especially needed for 1458 systems is the VT100 command which creates a 1454-like full screen interface on your favorite VT100 compatible terminal. Please note the key map for the terminal is different from the PC key map and that one must hit the VT100 ESC key *twice* to cause an escape action similar to the 1454 interface.

- Remote setting of system defaults is supported with the SYSDEF command. The 1454 front panel/VT100 system menu has a "system defaults" entry. The status output port and macro input port are configured in this display along with other new mainframe features. New features include automatic timeout to the large font three line display (not in VT100 mode) and restore of HV condition (On/Off) after an ACFAIL or power down via the rear panel rocker switch.

- The 1454 front panel/VT100 displays always fall back to the most recently active main spread-sheet style displays if no key entry is detected after 1 minute. In this version of the firmware, this timeout cannot be adjusted or disabled. As separate feature, if not disabled in the system defaults, the 1454 front panel display will eventually timeout into the large font three line display when there is no key input (not supported in the VT100 display mode).

- Support for an ARCNET hardware interface for remote commands has been added. Although controlling an HV mainframe with ARCNET makes use of the same commands as RS-232, the session protocol is quite different.

- The 1454 front panel/VT100 system menu has a few new entries including a "system information" display which shows mainframe HW manufacturing and test data as well as ECO, Revision and Version information. A "special options" entry in the system menu which now only supports writing values to a module's eeprom memory (for use with a 1451 only).

- For external serial port operations, if a second host command is received prior to completely processing the first command (indicated by the return of the command prompt), an error message is emitted and the host is required to re-initiate the command session (login again).

- A new mainframe backplane serial protocal for mainframe/module communications has been implemented, which frees up the mainframe CPU from sitting in an idle loop waiting for a message to be processed. This should improve 1454 front panel key response.

- The LD and LM commands which load values or limits previous caused an immediate update of the internal powerup save sets in the mainframe. These commands still promptly set module values or limits, but the mainframe internal powerup save sets are only updated if after a 5-sec delay there are no further LD or LM commands recieved. This should improve (slightly) the response time of the LD and LM commands, in the situation where the user to issues a series of LD or LM commands to setup a mainframe of modules. The only downside to this feature is that a 5-sec window is opened where a loss of power can cause a loss of powerup save sets.

- For simulation and systems with a single module the update rate is currently throttled to no more than once a second.

- HV mainframe power testing is now done to check HV specific mainframe hardware works at a low-level.

- Powerup Beep sequences have been implemented so a 1458 user gets some indication on the powerup status of his box.

- Numerous bug fixes and feature implementations which should not effect the remote interface protocol.

Changes Since V2.10

- The bit field definitions of the returned words of the CONFIG command were slightly changed. An Eeprom status field was added. The locations of the Battery status fields and the Powerup status fields were moved.
- The REMOTE and NETWORK front panel LED's flash upon mainframe powerup until the mainframe is ready for front panel or remote operations.
- HV error conditions (HV trips) now cause the "HV ERROR" LED's to flash instead of flicker.
- The option to display Powerup status information has been added to System Information display.
- The STATUS output port previously floated after a reset or power on. Starting with version 2.14 the hardware now clamps this output to ground when the mainframe is "not ready" (Independent of system default settings). The "not ready" state occurs immediately upon powerup and persists until the front panel NETWORK and REMOTE LED's stop flashing. The mainframe can also become "not ready" in the unlikely event of a mainframe CPU reboot (which also turns off HV generation). The STATUS output level floats when the mainframe power is off.

Changes Since V2.14

- Support for 1458 slot configurations and front panels.
- CONFIG now returns the 24 Volt status. A bad 24 volt status (possibly due to thermal overload) will prevent HV generation. The 1454 front panel/VT100 display indicates a bad 24 volt status by a message at the top of the display.
- The INTERLOCK input polarity is reversed from earlier versions. This input now operates in a "FAIL SAFE" mode where the input must be shorted to ground to prevent a Panic Off condition. Future mainframe hardware will contain an internal jumper to configure the INTERLOCK in either polarity.
- The 1458 external serial baud rate is determined by HW jumpers on the 1450-1 (the main control board inside the unit plugged into the ISAbus).
- Upon Powerup if there are no CPU/Motherboard detected errors only 1 beep issued. This was 4 beeps in previous versions.
- The Powerup Status Display was extended to contain additional Informantion.
- The VT100 command was eztended to allow a VIEW option which when activated prevents the user from changing settable values or turning on HV. For safety reasons, HVOFF is always permitted. This allows the front panel switch to be in remote for network operations and permit "safe" VT100 viewing of parameter values.
- In order to prevent inadvertent side effects of ASCII escape sequences the front panel ESC key is now mapped to the "e" key for both VT100 and keyboard operations. The VT100 mode <ESC> <ESC> key sequence (formly translated as a front panel ESC) is no longer supported.

Changes Since V2.25

- The following commands CONFIG, LOCK/UNLOCK, and RM contained various bugs which prevented their proper operation. CONFIG returned invalid values when certain fields were set multiple times. (Old bit settings were no cleared out prior to inserting new settings.) The LOCK/UNLOCK commands apparently lost their original functionality during a recent "code optimization". RM failed on single limit value recalls for channels other than 0. We reget any inconvenience these problem may have caused.
- The EDIT, VIEW and PASSWORD commands are only recognized as serial commands and only effect the access for serial commands or serial vt100 operations. The network command access is no longer effected by these commands.
- The RESTORE command response now includes an extra line "Restore in progess... please be patient." prior to the "Restore () Complete" response.
- SYSDEF and LOCK/UNLOCK changes are inhibited remotely when in the front panel switch are in local. Changes via the serial port (either by command or VT100) are inhibited when view mode is active.
- When the "HVON restore after ACFAIL" feature is active and starting it's countdown to turn on HV not only does the mainframe beep but the HVON LED's **flash**. When the countdown completes without the interruption and HV generation begins these LED's **flicker** (during voltage ramping) as usual for HVON.
- The 1454 screen contrast is now controlled through the system menu by selecting "Screen Contrast" then using the increment and decrement keys to adjust the contrast. The contrast setting wraparound at minimum and maximum settings. If the user selects to save the setting, the contrast setting is retained between powerups in the same manner as module settings.
- For VT100 displays a parameter access indication appears in the top righthand corner of the display. The possible indicators are "EDIT", "VIEW", "LOCAL", "PANIC". See the Access protection modes summary table.
- A Panic condition can only be reset if the front panel switch is in local. This permits a user to panic a system, then switch the mainframe to remote, and remove the key to assure that the panic state is not reset.
- New Commands TIME and DATE allow the user to view and set the mainframe time and date. Also the command SYSINFO was added to allow a command-line user to view data in the system information submenu.
- The PS command now returns the entered logical unit specification. Previously this command incorrectly omitted this token.
- The LM, RM, and SRM commands return a negative limit value if the polarity of the value for which the limit applies is negative. However, the LM command will accept either polarity independent of the values polarity.
- The IMOFF now returns IMOFF instead of IOFF.
- The 1454 simulation program is now called LHV (formerly called IHV). This program is now able to allocate and use memory above the 640KB limit. Typically, 2MB of PC memory is adequate to run the simulation.

Changes Since V2.34

- A section was added to this document discussing the use of the serial port for host control. In particular for reliable serial control (after a serial session has begun) the host should send one command character at a time waiting for the echo from the HV mainframe before sending the next character.
- Due to different mainframe motherboard BIOS configurations, there is some variation in the initial powerup beep sequence. Current normal motherboard beeps are either 1 or 4 (2, pause, 1, pause, 1) prior to the commencement of REMOTE/NETWORK LED flash. Different BIOS configurations do not effect mainframe performance.
- More efficient mainframe firmware initialization decreases the unit powerup time by more than 50% and also reduces processing time for restore/recall operations.
- Previous versions allowed local (front panel) save/recall operations while in remote or when values were locked. Now local save and recall operations can only be done if the front panel switch is in the local position and the values are not locked.
- The number of values returned by the ID command is no longer restricted to a fixed number. Their are currently 10 fields defined in the command response. Future module types may require additional fields.
- Once an RS-232 session has begun, sending a space followed by carriage return in previous versions caused the mainframe to beep, pause, then beep and eventually return the prompt with a 5 second delay. This "feature" has been removed. Now the session prompt is returned without beeps or delay.
- The serial **VT100** command is not accepted with the front panel switch is in LOCAL. After a the VT100 full screen mode is activated switching the front panel switch to LOCAL terminates this display mode.
- Previous versions did not properly handle modules with more than 1 submodule (like the 1469).
- Ext Serial HW can sometimes fail to transmit characters while at the same time receiving characters. Mainframe firmware driver changed to correct this condition.

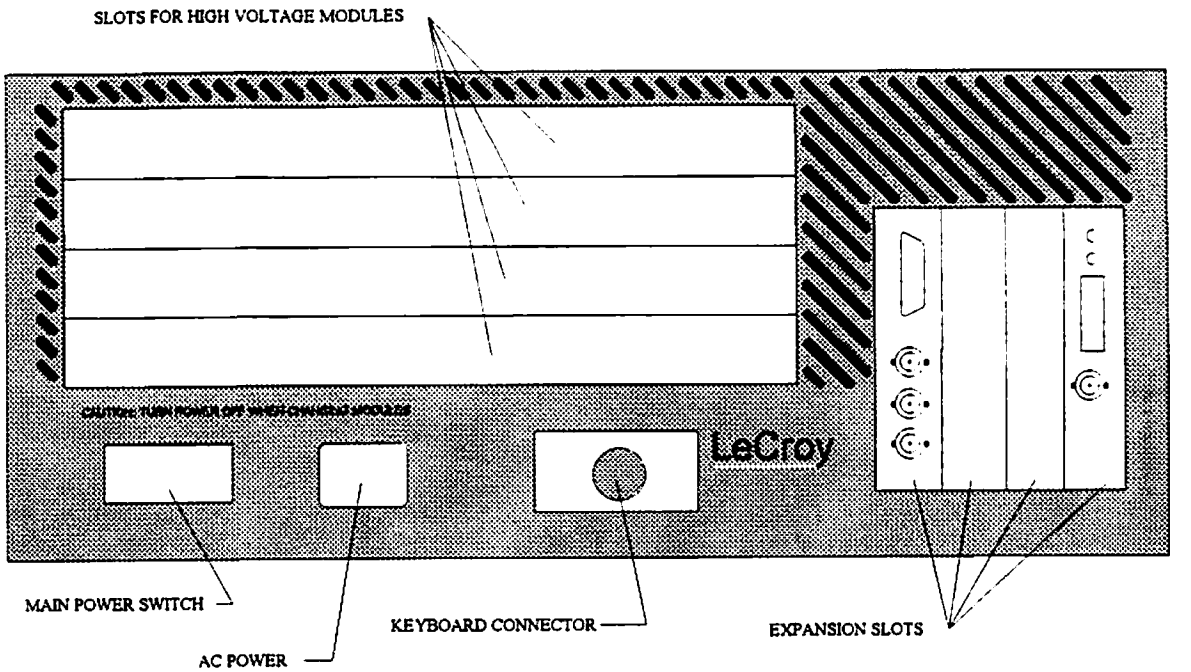
Changes Since V2.36 (1454), V2.51 (1458)

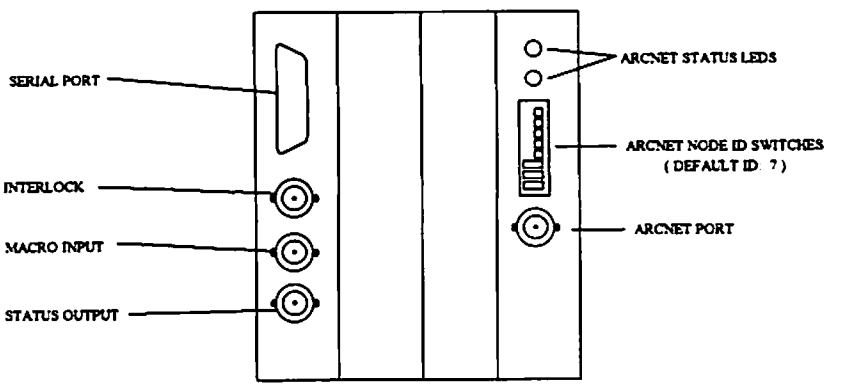
- New hardware for handling module communication, decreases update period for full 1458 mainframe of 1461s by 1 second. 1454 displays "Turbo Update Installed" in initial startup display sequence. Previously delivered 1458's with FW version < 2.61, should be upgraded with a 1450-8, a recent rev 1450-1, and 2 more MB of motherboard memory.
- 1458 external serial port baud rate is now controlled via two switches in the switch block closest to the 9-PIN serial port. Previous hardware required the removal of the 1458 front panel to change the baud rate. Remember to cycle AC power after changing the baud setting (factory default 9600).
- 1458's must contain at least 4MB of memory on their motherboard to handle a full crate of 1461's. Previously shipped 1458's (FW version < 2.61) should be field upgraded with to contain this amount of memory (as indicated earlier).

- 1458's are now shipped with a US 220V AC cord to emphasize that full output power for this unit may only be attained at 220V. The 1458 may be operated at 110V when full power is not required.
-

Appendix IV

1454 BackPanel Layout





TECHNICAL INFORMATION

(PARTS LIST, SCHEMATICS)

PART NUMBER	DESCRIPTION REMARK	QTY PER
1450-1	1450 SERIES INTERFACE BOARD	1
1450-2	1454 LCD GRAPHICS CONTROLLER	1
1454-CAGE	CARD CAGE ASSY	1
1454-FP	FRONT PANEL ASS'Y	1
1454-FRAME	MAINFRAME METAL STRUCTURE	1
1454-MB	MOTHERBOARD ASS'Y	1
1454-PS	POWER SUPPLY ASS'Y	1
1454-RP	REAR PANEL ASS'Y	1
1454CABLES	1454 CABLE KIT	1
334060001	ARCNET CONTROL CARD FOR ISA BUS	1
402222001	ADAPTER "T" (BNC TYPE)	1
402322050	TERMINATOR (LOAD) 50 OHMS	1
402323091	TERMINATOR BNC 91 OHMS	1
589204016	POWER CORD 3-COND 2-METER	1
597403201	SHIPPING CARTON 4032 & 1454	1
597403202	SHIPPING CARTON END CAP 4032 & 1454	2
597403203	SHIPPING SLEEVE 4032 & 1454	1

End of report. 17 Details encountered.

PART NUMBER	DESCRIPTION REMARK	QTY PER
103326473	CAP CERA MONO 50V .047UF	4
106433221	CAP CERA MONO 220PF	1
106438104	CAP CERA MONO .1UF	45
141454336	CAP TANT DIP CUT .300+/-75 33UF	4
141854685	CAP TANT DIP 6.8 UF	4
148078100	CAP MEMORY B/U 5.5V 1F	1
161225101	RES CARBON FILM 100 OHMS	2
161225102	RES CARBON FILM 1 K	7
161225103	RES CARBON FILM 10 K	4
161225104	RES CARBON FILM 100 K	2
161225300	RES CARBON FILM 30 OHMS	1
161225301	RES CARBON FILM 300 OHMS	2
161225302	RES CARBON FILM 3 K	7
161225391	RES CARBON FILM 390 OHMS	1
161225471	RES CARBON FILM 470 OHMS	1
161225472	RES CARBON FILM 4.7 K	1
161225475	RES CARBON FILM 4.7 MEG	2
161225682	RES CARBON FILM 6.8 K	2
190642103	RESISTOR NETWORK 10 K	1
200031049	IC D-TYP FLOP SN74LS74N	1
200031066	IC POS NAND SN74LS132N	1
200031095	IC HEX INVERTER SN74LS14N	2
200041028	IC UP/DOWN CTR SN74LS193N	1
200041062	IC DEC/DEMULTP SN74LS138N	1
200071005	IC D-TYP FLOP SN74LS273N	1
200330032	IC 2-INPUT OR 74F32	1
200330126	IC BUS BUFFER SN74LS126A	1
200371273	IC OCTAL D-FLOP 74F273	1
200440017	IC DECADE COUNTER 72HC4017	1
205008002	IC SERIAL EEPROM AT24C02	1
205298128	IC 128K X 8 SRAM	2
205370040	IC 4-MEGABIT CMOS PROM 27C040 DO NOT INCLUDE ON KIT. SEND TO THE PROGRAMMING CENTER FOR PROGRAMMING.	2
205757208	IC GAL 20V8A-25L DO NOT INCLUDE ON KIT. SEND TO THE PROGRAMMING CENTER FOR PROGRAMMING.	4
207143037	IC LINE DRIVER F3037	2
207170541	IC BUFF/LINE DRIV 74LS541	5
207440232	IC XMTR/RCVR MAX232	1
207470245	IC BIDIRECT XVR 74F245	1
208124002	IC VOLT REG -5V UA7905UC	1
208124003	IC VOLT REG -12V LM320T-12	1
208541210	IC NONVOL CONTROLLER 1210	1
208738215	IC VOLTAGE MONITOR MAX8215	1
208740693	IC UP SUPERVISORY CIRCUIT MAX693	1
227128259	IC INTERRUPT CONTROLLER 82C59A-2	1
230110005	DIODE SWITCHING 1N4448	9

PART NUMBER	DESCRIPTION REMARK	QTY PER
253010835	DIODE SCHOTTKY HP2835	1
256232216	DIODE LED (RED) TIL216-1	2
270170650	TRANSISTOR NPN MPS650	2
280170104	TRANSISTOR FET N VN0104N3	1
309040007	CRYSTAL OSCILLATOR 7.3728 MHZ	1
309040020	CRYSTAL OSCILLATOR 20 MHZ	1
312682430	BATTERY LITHIUM 3V	1
313080105	BATTERY HOLDER	1
333400317	DR-DOS FIRMWARE LICENSE/KERNAL ONLY	1
335990003	GLOBE BRACKET FOR 1450-1	1
400041024	SOCKET IC SOLD TAIL DIP-24	4
400062032	SOCKET IC SOLD TAIL DIP-32	4
400419068	IC SOCKET GRID TYPE 68-PIN	1
400419084	IC SOCKET GRID TYPE 84-PIN	1
402120003	CONN BNC RT ANGLE PC MTG	3
403171050	HEADER STRAIGHT ST 50-PIN	1
403181002	HDR SINGL ROW STRAIGHT 2	6
403181003	HDR SINGL ROW 3	5
403950002	POLARIZING KEY	4
411830001	SWITCH ROCKER PC MTG (8)	1
430530011	RELAY 1 FORM C SPDT	1
454212040	HEADER STRAIGHT 40	1
454310016	HDR SOLD TAIL/MALE 16	1
454370002	SHUNT 2 POS	7
454610009	D-SUBMINIATURE SOLD TAIL/MALE 9	1
505070004	HEATSINK FOR TO-220	2
530040216	BUZZER 3-9V 2KHZ	1
560440003	SCREW PHILIPS 4-40X3/16	2
711450101	PC BD PREASS'Y 1450-1	1
SM206860165	ARCNET CONTROLLER 90C165	1
SM207763552	IC DUAL UART W/FIFO & PRINTER PORT	1

End of report. 83 Details encountered.

PART NUMBER	DESCRIPTION REMARK	QTY PER
103317222	CAP CERA MONO 50V 2200 PF	2
106438104	CAP CERA MONO .1UF	15
142864476	CAP TANT DIP CASE 47 UF	4
161225103	RES CARBON FILM 10 K	3
161225125	RES CARBON FILM 1.2 MEG	2
161225202	RES CARBON FILM 2 K	2
161225244	RES CARBON FILM 240 K	2
161225431	RES CARBON FILM 430 OHMS	2
161335010	RES CARBON FILM 1 OHM	8
190042103	RESISTOR NETWORK 10 K	1
200031051	IC 2-INPUT NOR SN74LS02N	1
200332004	IC HEX INVERTER HCT04	1
200371574	IC D-TYP FLOP 74HCT574	3
200373273	IC D-TYP FLOP HCT273	1
205272832	IC 32K X 8 CMOS RAM HM62832	1
205370764	IC 8K X 8 UV E-PROM 2764	1
205757208	IC GAL 20V8A-25L DO NOT INCLUDE ON KIT. SEND TO THE PROGRAMMING CENTER FOR PROGRAMMING.	1
207110749	IC SMPS CONTROLLER W/CONTROL DAC	2
207171541	IC BUFFER/LINE DRIVER HCT541	4
207472245	IC BUS TRANSCVR HCT245	1
253050817	DIODE HOT CARRIER 1N5817	2
275170750	TRANSISTOR PNP MEDIUM POWER	2
302152047	INDUCTOR RADIAL 1.77A 47UH	2
335990036	BRACKET PERSONAL COMPUTER	1
400041024	SOCKET IC SOLD TAIL DIP-24	1
400360028	SOCKET IC SOLD TAIL DIP-28	1
400419084	IC SOCKET GRID TYPE 84-PIN	1
454311003	HDR SOLD TAIL/MALE 3	1
454311016	HDR SOLD TAIL/MALE 16	1
560440004	SCREW PHILIPS 4-40X1/4	2
576410001	WASHER SPLIT LOCK SIZE 4	2
711450201	PC BD PREASS'Y 1450-2	1
SM207109366	IC LCD GRAPHIC CONTROLLER V6366	1

nd of report. 37 Details encountered.

PART NUMBER	DESCRIPTION REMARK	QTY PER
1454-4	1454 BACKPLANE BOARD	1
529145409	CARD CAGE, 1454	1
529145410	CARD CAGE TOP COVER, 1454	1
529145423	THREADED STRIP FOR CARD CAGE	2
529145424	BACKPLANE STIFFENER 1454	1
529145430	CAGE BAFFLE PLATE 1454	2
550125506	SCREW FLAT HD PHIL M2.5X6	4
550130116	SCREW PAN HD M3X16	2
550135106	SCREW PAN HD M3.5X6	6
550135110	SCREW PAN HD M3.5X10	4
550135510	SCREW FLAT HD M3.5X10	2
551135201	WASHER SPLIT LOCK M3.5	6
551140201	WASHER SPLIT LOCK M4	1
552440100	NUT HEX M4	1

End of report. 14 Details encountered.

PART NUMBER	DESCRIPTION REMARK	QTY PER
106428104	CAP CERA MONO .1UF	3
161030000	RES COMP ZERO OHMS	2
161335101	RES CARBON FILM 100 OHMS	1
190042472	RESISTOR NETWORK 4.7 K	3
190102001	RES NETWORK 220/330 OHMS	1
403950002	POLARIZING KEY	2
405777003	CONTACT CRIMP WIRE END	2
407009004	DISK-DRIVE POWER CONNECTOR	1
454111020	HD MINI-FIT FAMILY 2X10 20	1
454114012	HDR MALE SOLD TAIL 12	1
454212010	HEADER STRAIGHT 10	1
454212040	HEADER STRAIGHT 40	1
454312002	HDR SOLD TAIL/MALE 2	2
454321096	HDR SOLD TAIL/FEM 96	4
455121002	BLOCK FOR FEM PINS 2	1
468099008	TEST POINT W/GLASS INSULATOR	3
530409120	FAN AXIAL 12V 1" THICK	1
550125110	SCREW PAN HD M2.5X10	8
550135112	SCREW PAN HD M3.5X12	4
551125201	WASHER SPLIT LOCK M2.5	8
551135201	WASHER SPLIT LOCK M3.5	4
552425100	NUT HEX M2.5	8
552635101	NUT HEX M3.5	4
711454401	PC BD PREASS'Y 1454-4	1

End of report. 24 Details encountered.

PART NUMBER	DESCRIPTION REMARK	QTY PER
1454-3	1454 FRONT PANEL BOARD	1
258000001	LCD 320 X 240 B/W MODULE	1
412111003	SWITCH, KEY 3 POS SPDT	1
454311007	HDR SOLD TAIL/MALE 7	2
522600804	SPACER ROUND #6 1/8 LONG	4
529145413	FRONT CASTING 1454	1
529145414	LCD CASTING 1454	1
529145416	CONTROL PANEL OVERLAY 1454	1
529145419	MOUNTING FLANGE 1454	2
530301012	HANDLE OVAL 7/16 X 9/32	2
550040025	SCREW M4X25	4
550130106	SCREW PAN HD M3X6	4
550135110	SCREW PAN HD M3.5X10	4
550140108	SCREW PAN HD M4X8	4
551135201	WASHER SPLIT LOCK M3.5	4
551135401	WASHER SHAKEPROOF M3.5	4
551140201	WASHER SPLIT LOCK M4	4
567832005	SCREW FLAT PHIL 8-32X5/16	4
721451007	LABEL "VISYN"	1

End of report. 19 Details encountered.

PART NUMBER	DESCRIPTION REMARK	QTY PER
102004390	CAP CERA DISC 6KV 39PF	1
106438104	CAP CERA MONO .1UF	11
124171154	CAP POLYSTYRENE 1% .15 UF	1
141834335	CAP TANT DIP 3.3 UF	1
141854685	CAP TANT DIP 6.8 UF	4
161225103	RES CARBON FILM 10 K	1
161225241	RES CARBON FILM 240 OHMS	7
161225272	RES CARBON FILM 2.7 K	1
161225472	RES CARBON FILM 4.7 K	3
161225911	RES CARBON FILM 910 OHMS	1
161335102	RES CARBON FILM 1 K	1
161335202	RES CARBON FILM 2 K	1
161335203	RES CARBON FILM 20 K	1
161335473	RES CARBON FILM 47 K	1
190042103	RESISTOR NETWORK 10 K	3
207105451	IC LED DISPLAY DRIVER M5451	1
207110752	IC CURRENT-MODE DC-DC CONVRT MAX752	1
207170541	IC BUFF/LINE DRIV 74LS541	1
230110005	DIODE SWITCHING 1N4448	2
235010005	DIODE RECTIFIER 1N4005	2
253065822	DIODE SCHOTTKY 1N5822	1
256020110	DIODE LED FLV110	2
256243301	DIODE LED RECTANGULAR RED	8
256443401	DIODE LED YEL HLMP-0401	12
256532232	DIODE LED (GRN) TIL232-1	8
256542222	DIODE LED (GREEN) MV5253	3
256542503	DIODE LED GRN HLMP-0503	8
270170650	TRANSISTOR NPN MPS650	2
280170104	TRANSISTOR FET N VN0104N3	1
302380480	FILTER CHOKE 2 AMP 48 UH	1
403171050	HEADER STRAIGHT ST 50-PIN	1
403950002	POLARIZING KEY	2
440030010	TRANSFORMER INVERTER	1
454315004	HDR SOLD TAIL/MALE 4	1
454710018	HDR SOLD TAIL/MALE 18	1
455021008	CONTACT (CRIMP) FEMALE	2
455120003	BLOCK FOR FEM PINS 3	1
589601124	WIRE SPECIAL HI VOLTAGE	1
711454301	PC BD PREASS'Y 1454-3	1
MFP414	IC MONO FRNT PANEL PROCESSOR MFP414	1

End of report. 40 Details encountered.

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1454-FRAME PARTS LIST

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PART NUMBER	DESCRIPTION REMARK	QTY PER
455020007	CONTACT (CRIMP) FEMALE	2
455121002	BLOCK FOR FEM PINS 2	1
485023015	FOOT 1454	2
529145401	LEFT SIDE EXTRUSION 1454	1
529145403	CROSS EXTRUSIONS, MIDDLE 1454	4
529145405	TOP COVER 1454	1
529145420	BOTTOM COVER 1454	1
529145431	RIGHT SIDE EXTRUSION 1454	1
530010402	TILT FOOT 1454	2
550040012	SCREW M4X12	27
550135106	SCREW PAN HD M3.5X6	5
550425106	SCREW CYL HD PHIL M2.5X6	6
551125201	WASHER SPLIT LOCK M2.5	4
552425100	NUT HEX M2.5	4
701451030	CAGE FAN BAFFLE 1454	1

End of report. 15 Details encountered.

PART NUMBER	DESCRIPTION REMARK	QTY PER
205370012	IC CMOS EPROM 64KX8 27C512 DO NOT INCLUDE ON KIT. SEND TO THE PROGRAMMING CENTER FOR PROGRAMMING.	1
205800070	IC DRAM MODULE 1MEG X 9	2
333400386	FIRMWARE LICENCE FOR ALL 386 BD TYP	1
334001386	PC-AT 386SX-40 MOTHERBOARD	1
405777003	CONTACT CRIMP WIRE END	2
455121002	BLOCK FOR FEM PINS 2	1
485043002	U-CHANNEL RUBBER CATERPILLAR	1
529145403	CROSS EXTRUSIONS, MIDDLE 1454	3
529145406	FAN BRACKET 1454	1
529145408	MOTHER BOARD ADAPTER PLATE 1454	1
530409135	FAN, 12V, 92MM X 25 MM	1
550130106	SCREW PAN HD M3X6	7
550140206	SCREW PAN HD SLOT M4X6	1
550430112	SCREW CYL HD PHIL M3X12	4
550440630	SCREW PAN HD PHIL M4X30	4
551130201	WASHER SPLIT LOCK M3	9
551140201	WASHER SPLIT LOCK M4	5
552440100	NUT HEX M4	4

End of report. 22 Details encountered.

PART NUMBER	DESCRIPTION REMARK	QTY PER
1454-5	1454 PWR SUP SUPPORT BOARD	1
315010005	POWER SUPPLY 5 OUTPUT 516 W	1
521800006	SPACER ROUND #8 3/16 LG	2
524104001	STANDOFF M/F M4 X 10MM	2
529145407	POWER SUPPLY BRACKET 1454	1
550140108	SCREW PAN HD M4X8	4
551140201	WASHER SPLIT LOCK M4	4

End of report. 7 Details encountered.

PART NUMBER	DESCRIPTION REMARK	QTY PER
142424156	CAP TANT DIP CASE 15 UF	1
145794228	CAP MINI ALUM 20% 2200 UF	1
161225200	RES CARBON FILM 20 OHMS	2
161225203	RES CARBON FILM 20 K	2
161225472	RES CARBON FILM 4.7 K	2
161445472	RES CARBON FILM 4.7 K	1
168531305	RES PREC RN55D 121 OHMS	1
168531401	RES PREC RN55D 1.21 K	2
208591385	IC VOLT REF ADJUST 385	1
235010005	DIODE RECTIFIER 1N4005	3
270170904	TRANSISTOR NPN 2N3904	4
275178599	TRANSISTOR PNP MPS8599	3
440030009	TRANSFORMER 2.4 VA 220 VAC PRI	1
454113004	HDR VERTICAL PC MOUNT 4	1
454116004	HDR PC MOUNT VERTICAL 4	1
454212010	HEADER STRAIGHT 10	1
454711004	HDR SOLD TAIL/FEM 4	1
594120001	TIEWRAP	1
711454501	PC BD PREASS'Y 1454-5	1

nd of report. 19 Details encountered.

PART NUMBER	DESCRIPTION REMARK	QTY PER
315913010	LINE FILTER RFI 250V 10A	1
432402012	CKT BRKR 240V 12A	1
529145417	REAR CHASSIS 1454	1
529145418	REAR PANEL 1454	1
530301014	HANDLE ROUND 5/16 8-32	2
550135510	SCREW FLAT HD M3.5X10	2
550140206	SCREW PAN HD SLOT M4X6	4
551135201	WASHER SPLIT LOCK M3.5	2
551140100	WASHER FLAT M4	4
551140201	WASHER SPLIT LOCK M4	1
552440100	NUT HEX M4	1
552635101	NUT HEX M3.5	2
560832006	SCREW PHILIPS 8-32X3/8	4

End of report. 13 Details encountered.

PART NUMBER	DESCRIPTION REMARK	QTY PER
403010010	CONN KIT FLAT CABL 10-PIN	2
403010040	CONN KIT FLAT CABL 40-PIN	3
403211050	CONN FLAT CABLE 50-POS	2
405120002	CONN HOUSING 2-POS	3
405123005	CONN HOUSING 5-POS	1
405130001	CONN HOUSING 6	4
405580001	CONTACT CRIMP TERMINAL	24
405595001	CONN PIN LOCKING (FEMALE)	2
405734012	CONTACT CRIMPED WIRE END	6
405740001	TERM WIRE END SINGL INSUL	7
405770005	TERMINAL WIRE END #6	5
405770014	TERMINAL WIRE END #10	4
405770105	TERMINAL WIRE END SPADE 6	9
405770106	TERMINAL WIRE END SPADE 6	6
405777001	CONTACT CRIMPED WIRE END	4
405777002	TERM FEM CRIMP #18-24 AWG WIRE	16
412111003	SWITCH, KEY 3 POS SPDT	1
455011002	CONTACT (CRIMP) MALE	2
455020007	CONTACT (CRIMP) FEMALE	4
455020014	CRIMP TERMINAL FOR 22-28 AWG	8
455110003	BLOCK FOR MALE PINS 3	1
455121120	CONN HOUSING CABLE-END 20-POS	1
455122004	BLOCK FOR FEM PINS 4	1
455124004	BLOCK FOR FEM PINS 4	1
455125004	BLOCK FOR FEM PINS 4	1
455126004	BLOCK FOR FEM PINS 4	2
590001016	WIRE TEFLON 19/29 BLK 16	3
590001018	WIRE TEFLON 19/30 BLK 18	21
590001022	WIRE TEFLON 7/30 BLK 22	1
590111022	WIRE TEFLON 7/30 BRN 22	1
590221018	WIRE TEFLON 19/30 RED 18	8
590331018	WIRE TEFLON 19/30 ORA 18	21
590441018	WIRE TEFLON 19/30 YEL 18	4
590441022	WIRE TEFLON 7/30 YEL 22	2
590441024	WIRE TEFLON 7/32 YEL 24	1
590551018	WIRE TEFLON 19/30 GRN 18	2
590551022	WIRE TEFLON 7/30 GRN 22	1
590661018	WIRE TEFLON 19/30 BLU 18	2
590661024	WIRE TEFLON 7/32 BLU 24	1
590771018	WIRE TEFLON 19/30 VIO 18	2
590921018	WIRE TEFLON 19/30 WHT/RED 18	6
590931024	WIRE TEFL 7/32 WHT/ORA 24	1
590961024	WIRE TEFL 7/32 WHT/BLU 24	1
590991016	WIRE TEFLON 19/29 WHT 16	3
590991018	WIRE TEFLON 19/30 WHT 18	3
590991022	WIRE TEFLON 7/30 WHT 22	1
591922022	WIRE TEF TWISTED PAIR AWG 22	1
591922122	WIRE TEF TWISTED PAIR AWG 22	1
592011010	CABLE FLAT 10-COND	2
592011034	CABLE FLAT 34-COND	2
592011040	CABLE FLAT 40-CONN	2
592011050	CABLE FLAT 50-COND	2

PART NUMBER	DESCRIPTION REMARK	QTY PER

End of report. 52 Details encountered.

PART NUMBER	DESCRIPTION REMARK	QTY PER
1458-4	1458 BACKPLANE BOARD	1
1458-FP	FRONT PANEL ASSEMBLY 1458	1
1458-FRAME	FRAME ASSEMBLY 1458	1
1458-MB	MOTHERBOARD ASSEMBLY 1458	1
1458-PS	POWER SUPPLY ASSEMBLY 1458	1
1458CABLES	1458 CABLE KIT	1
597145801	SHIPPING BOX FOR 1458	1
597145802	SHIPPING CAPS TOP & BOTTOM FOR 1458	2

End of report. 8 Details encountered.

PART NUMBER	DESCRIPTION REMARK	QTY PER
161335101	RES CARBON FILM 100 OHMS	1
161335511	RES CARBON FILM 510 OHMS	1
190042472	RESISTOR NETWORK 4.7 K	2
190102001	RES NETWORK 220/330 OHMS	1
405777003	CONTACT CRIMP WIRE END	6
407009004	DISK-DRIVE POWER CONNECTOR	1
454111020	HD MINI-FIT FAMILY 2X10 20	3
454112024	HDR SOLD TAIL/MAIL 24	1
454114012	HDR MALE SOLD TAIL 12	1
454212010	HEADER STRAIGHT 10	1
454212040	HEADER STRAIGHT 40	1
454312002	HDR SOLD TAIL/MALE 2	3
454321096	HDR SOLD TAIL/FEM 96	16
455121002	BLOCK FOR FEM PINS 2	3
468099008	TEST POINT W/GLASS INSULATOR	3
530409138	FAN AXIAL 12VDC	3
550125110	SCREW PAN HD M2.5X10	32
550135116	SCREW PAN HD M3.5X16	12
550140312	SCR FILLISTER PHIL M4X12	8
551125201	WASHER SPLIT LOCK M2.5	32
551135201	WASHER SPLIT LOCK M3.5	12
552425100	NUT HEX M2.5	32
552635101	NUT HEX M3.5	12
701458003	BACKPLANE SUPPORT BRACKET 1458	1
711458401	PC BD PREASS'Y 1458-4	1

End of report. 25 Details encountered.

PART NUMBER	DESCRIPTION REMARK	QTY PER
1458-3	1458 FRONT PANEL AND CONTROL BOARD	1
412111003	SWITCH, KEY 3 POS SPDT	1
551440400	WASHER SHAKEPROOF M4	4
552440100	NUT HEX M4	4
553540408	SPACER ROUND NYLON M4	4
701458012	MEMBRANE CONTROL PANEL 1458	1
701458023	FRONT PANEL 1458	1
721451007	LABEL "VISYN"	1

End of report. 8 Details encountered.

PART NUMBER	DESCRIPTION REMARK	QTY PER
106438104	CAP CERA MONO .1UF	8
141854685	CAP TANT DIP 6.8 UF	4
161225241	RES CARBON FILM 240 OHMS	10
161225272	RES CARBON FILM 2.7 K	1
161225472	RES CARBON FILM 4.7 K	2
190042103	RESISTOR NETWORK 10 K	3
207105451	IC LED DISPLAY DRIVER M5451	1
207170541	IC BUFF/LINE DRIV 74LS541	1
235010005	DIODE RECTIFIER 1N4005	2
256243301	DIODE LED RECTANGULAR RED	13
256443401	DIODE LED YEL HLMP-0401	12
256542503	DIODE LED GRN HLMP-0503	8
280170104	TRANSISTOR FET N VN0104N3	1
403171050	HEADER STRAIGHT ST 50-PIN	1
454315004	HDR SOLD TAIL/MALE 4	1
454710005	HDR SOLD TAIL/MALE 5	1
711458301	PC BD PREASS'Y 1458-3	1
MFP414	IC MONO FRNT PANEL PROCESSOR MFP414	1

End of report. 18 Details encountered.

PART NUMBER	DESCRIPTION REMARK	QTY PER
315910120	LINE FILTER RFI 250V 20 A	1
405130001	CONN HOUSING 6	2
405580001	CONTACT CRIMP TERMINAL	24
405770005	TERMINAL WIRE END #6	3
405770009	TERMINAL WIRE END #10	4
405770014	TERMINAL WIRE END #10	5
405777002	TERM FEM CRIMP #18-24 AWG WIRE	40
405834203	TERMINAL BLOCK SINGLE ROW 3-POS	1
407099011	CONN (AC RECEPT) 3-POS	1
432430015	CKR BRKR 240V 15A	1
455121120	CONN HOUSING CABLE-END 20-POS	2
485013113	RUBBER GROMMET	1
485023016	BUMPER (FOOT) BLACK RUBBER	6
530301012	HANDLE OVAL 7/16 X 9/32	4
530301014	HANDLE ROUND 5/16 8-32	4
550040012	SCREW M4X12	2
550125110	SCREW PAN HD M2.5X10	8
550125506	SCREW FLAT HD PHIL M2.5X6	16
550125510	SCREW FLAT HD PHIL M2.5X10	4
550135106	SCREW PAN HD M3.5X6	6
550140108	SCREW PAN HD M4X8	30
550140312	SCR FILLISTER PHIL M4X12	36
550140312	SCR FILLISTER PHIL M4X12	20
550140808	SCREW CHEESE HEAD M4X8	38
550150112	SCREW PAN HD PHIL M5X12	6
550440120	SCREW CYL HD PHIL M4X20	8
550440120	SCREW CYL HD PHIL M4X20	16
550440910	SCREW HEX HEAD M4 X 10	4
551440300	WASHER SHAKEPROOF M4	16
551440400	WASHER SHAKEPROOF M4	4
552440100	NUT HEX M4	16
552440100	NUT HEX M4	20
553540408	SPACER ROUND NYLON M4	4
568832008	SCREW FLAT PHIL 8-32X1/2	16
701458001	UPPER CARD CAGE MODULE 1458	1
701458002	LOWER CARD CAGE MODULE 1458	1
701458003	BACKPLANE SUPPORT BRACKET 1458	1
701458004	TOP COVER 1458	1
701458005	BOTTOM COVER 1458	1
701458011	RACK MOUNTING EAR 1458	2
701458014	SIDE EXTRUSION 1458	4
701458015	SIDE SPACER EXTRUSION 1458	2
701458016	END CROSS EXTRUSION 1458	4
701458017	MIDDLE CROSS EXTRUSION 1458	3
701458018	SIDE DRESS EXTRUSION 1458	4
701458020	THREADED MOUNTING STRIP 1458	6
701458021	REAR SIDE TRIM 1458	2
701458022	RAIL STOP 1458	4

End of report. 48 Details encountered.

PART NUMBER	DESCRIPTION REMARK	QTY PER
1450-1	1450 SERIES INTERFACE BOARD	1
1450-8	1450 SERIES INTERFACE BOARD	1
205370012	IC CMOS EPROM 64KX8 27C512 DO NOT INCLUDE ON KIT. SEND TO THE PROGRAMMING CENTER FOR PROGRAMMING.	1
205800070	IC DRAM MODULE 1MEG X 9	4
333400386	FIRMWARE LICENCE FOR ALL 386 BD TYP	1
334001386	PC-AT 386SX-40 MOTHERBOARD	1
334060001	ARCNET CONTROL CARD FOR ISA BUS	1
335990037	BRACKET PERSONAL COMPUTER	2
402222001	ADAPTER "T" (BNC TYPE)	1
402322050	TERMINATOR (LOAD) 50 OHMS	1
402323091	TERMINATOR BNC 91 OHMS	1
550135106	SCREW PAN HD M3.5X6	5
550135110	SCREW PAN HD M3.5X10	1
550135510	SCREW FLAT HD M3.5X10	12
551135401	WASHER SHAKEPROOF M3.5	6
594120001	TIEWRAP	3
594120004	CABLE TIE WITH SCREW BASE	1
701458008	MOUNTING PLATE WITH ISA BEZEL 1458	1
701458010	MOUNTING RAIL 1458	2

End of report. 23 Details encountered.

PART NUMBER	DESCRIPTION REMARK	QTY PER
103326473	CAP CERA MONO 50V .047UF	4
106433221	CAP CERA MONO 220PF	1
106438104	CAP CERA MONO .1UF	45
141454336	CAP TANT DIP CUT .300+/-75 33UF	4
141854685	CAP TANT DIP 6.8 UF	4
148078100	CAP MEMORY B/U 5.5V 1F	1
161225101	RES CARBON FILM 100 OHMS	2
161225102	RES CARBON FILM 1 K	7
161225103	RES CARBON FILM 10 K	4
161225104	RES CARBON FILM 100 K	2
161225300	RES CARBON FILM 30 OHMS	1
161225301	RES CARBON FILM 300 OHMS	2
161225302	RES CARBON FILM 3 K	7
161225391	RES CARBON FILM 390 OHMS	1
161225471	RES CARBON FILM 470 OHMS	1
161225472	RES CARBON FILM 4.7 K	1
161225475	RES CARBON FILM 4.7 MEG	2
161225682	RES CARBON FILM 6.8 K	2
190642103	RESISTOR NETWORK 10 K	1
200031049	IC D-TYP FLOP SN74LS74N	1
200031066	IC POS NAND SN74LS132N	1
200031095	IC HEX INVERTER SN74LS14N	2
200041028	IC UP/DOWN CTR SN74LS193N	1
200041062	IC DEC/DEMULTP SN74LS138N	1
200071005	IC D-TYP FLOP SN74LS273N	1
200330032	IC 2-INPUT OR 74F32	1
200330126	IC BUS BUFFER SN74LS126A	1
200371273	IC OCTAL D-FLOP 74F273	1
200440017	IC DECADE COUNTER 72HC4017	1
205008002	IC SERIAL EEPROM AT24C02	1
205298128	IC 128K X 8 SRAM	2
205370040	IC 4-MEGABIT CMOS PROM 27C040 DO NOT INCLUDE ON KIT. SEND TO THE PROGRAMMING CENTER FOR PROGRAMMING.	2
205757208	IC GAL 20V8A-25L DO NOT INCLUDE ON KIT. SEND TO THE PROGRAMMING CENTER FOR PROGRAMMING.	4
207143037	IC LINE DRIVER F3037	2
207170541	IC BUFF/LINE DRIV 74LS541	5
207440232	IC XMTR/RCVR MAX232	1
207470245	IC BIDIRECT XVR 74F245	1
208124002	IC VOLT REG -5V UA7905UC	1
208124003	IC VOLT REG -12V LM320T-12	1
208541210	IC NONVOL CONTROLLER 1210	1
208738215	IC VOLTAGE MONITOR MAX8215	1
208740693	IC UP SUPERVISORY CIRCUIT MAX693	1
227128259	IC INTERRUPT CONTROLLER 82C59A-2	1
230110005	DIODE SWITCHING 1N4448	9

PART NUMBER	DESCRIPTION REMARK	QTY PER
253010835	DIODE SCHOTTKY HP2835	1
256232216	DIODE LED (RED) TIL216-1	2
270170650	TRANSISTOR NPN MPS650	2
280170104	TRANSISTOR FET N VN0104N3	1
309040007	CRYSTAL OSCILLATOR 7.3728 MHZ	1
309040020	CRYSTAL OSCILLATOR 20 MHZ	1
312682430	BATTERY LITHIUM 3V	1
313080105	BATTERY HOLDER	1
333400317	DR-DOS FIRMWARE LICENSE/KERNAL ONLY	1
335990003	GLOBE BRACKET FOR 1450-1	1
400041024	SOCKET IC SOLD TAIL DIP-24	4
400062032	SOCKET IC SOLD TAIL DIP-32	4
400419068	IC SOCKET GRID TYPE 68-PIN	1
400419084	IC SOCKET GRID TYPE 84-PIN	1
402120003	CONN BNC RT ANGLE PC MTG	3
403171050	HEADER STRAIGHT ST 50-PIN	1
403181002	HDR SINGL ROW STRAIGHT 2	6
403181003	HDR SINGL ROW 3	5
403950002	POLARIZING KEY	4
411830001	SWITCH ROCKER PC MTG (8)	1
430530011	RELAY 1 FORM C SPDT	1
454212040	HEADER STRAIGHT 40	1
454310016	HDR SOLD TAIL/MALE 16	1
454370002	SHUNT 2 POS	7
454610009	D-SUBMINIATURE SOLD TAIL/MALE 9	1
505070004	HEATSINK FOR TO-220	2
530040216	BUZZER 3-9V 2KHZ	1
560440003	SCREW PHILIPS 4-40X3/16	2
711450101	PC BD PREASS'Y 1450-1	1
SM206860165	ARCNET CONTROLLER 90C165	1
SM207763552	IC DUAL UART W/FIFO & PRINTER PORT	1

End of report. 83 Details encountered.

PART NUMBER	DESCRIPTION REMARK	QTY PER
106433221	CAP CERA MONO 220PF	1
106438104	CAP CERA MONO .1UF	20
141854685	CAP TANT DIP 6.8 UF	2
161225103	RES CARBON FILM 10 K	1
161225221	RES CARBON FILM 220 OHMS	1
161225271	RES CARBON FILM 270 OHMS	3
161225331	RES CARBON FILM 330 OHMS	1
161225470	RES CARBON FILM 47 OHMS	1
190042101	RESISTOR NETWORK 100 OHMS	2
200331074	IC D-TYP FLOP 74HCT74	1
200373273	IC D-TYP FLOP HCT273	1
200671373	IC D-TYPE FLOP HCT373	1
205034014	IC CMOS HEX SCHMITT 74HCT14	1
205271256	IC 32K X 8 RAM 62256-12	1
205275202	IC 1024X9-BIT FIFO 7202LA	2
205370001	IC CMOS UV EPROM 27C256 DO NOT INCLUDE ON KIT. SEND TO THE PROGRAMMING CENTER FOR PROGRAMMING	1
205757208	IC GAL 20V8A-25L DO NOT INCLUDE ON KIT. SEND TO THE PROGRAMMING CENTER FOR PROGRAMMING.	3
207143037	IC LINE DRIVER F3037	1
207171541	IC BUFFER/LINE DRIVER HCT541	3
207472245	IC BUS TRANSCVR HCT245	1
227148110	IC 8-BIT MICROCONTROLLER 68HC11A0P	1
256571205	DIODE LED GREEN	2
335990005	GLOBE BRACKET FOR 1450-8	1
400041024	SOCKET IC SOLD TAIL DIP-24	3
400210016	SOCKET IC RT ANGLE DIP-16	1
400360028	SOCKET IC SOLD TAIL DIP-28	2
411830001	SWITCH ROCKER PC MTG (8)	1
433221004	FUSE PICO II 125V 1 AMP	1
454212040	HEADER STRAIGHT 40	1
560440003	SCREW PHILIPS 4-40X3/16	2
711450801	PC BD PREASS'Y 1450-8	1

End of report. 39 Details encountered.

PART NUMBER	DESCRIPTION REMARK	QTY PER
1458-5	1458 POWER SUPPLY AND CONTROL BOARD	1
1458-6PS	24V POWER SUPPLY 720W	2
315010350	POWER SUPPLY AC/DC QUAD OUTPUT 350W	1
315070015	POWER SUPPLY 15W	1
550135110	SCREW PAN HD M3.5X10	24
550140312	SCR FILLISTER PHIL M4X12	4
550140510	SCREW FLAT HD PHIL M4X10	2
551440300	WASHER SHAKEPROOF M4	4
567440004	SCREW FLAT PHIL 4-40X1/4	2
567832005	SCREW FLAT PHIL 8-32X5/16	4
701458009	POWER SUPPLY SUPPORT TRAY 1458	1
701458010	MOUNTING RAIL 1458	4

End of report. 12 Details encountered.

PART NUMBER	DESCRIPTION REMARK	QTY PER
106435103	CAP CERA MONO .01UF	1
106438104	CAP CERA MONO .1UF	4
141854685	CAP TANT DIP 6.8 UF	2
145794228	CAP MINI ALUM 20% 2200 UF	1
161225102	RES CARBON FILM 1 K	2
161225103	RES CARBON FILM 10 K	4
161225105	RES CARBON FILM 1 MEG	1
161225203	RES CARBON FILM 20 K	1
161225221	RES CARBON FILM 220 OHMS	1
161225334	RES CARBON FILM 330 K	1
161225472	RES CARBON FILM 4.7 K	8
161225683	RES CARBON FILM 68 K	1
161335161	RES CARBON FILM 160 OHMS	1
161445391	RES CARBON FILM 390 OHMS	3
161445472	RES CARBON FILM 4.7 K	1
168531393	RES PREC RN55D 1.00 K	2
168531474	RES PREC RN55D 6.98 K	1
168531614	RES PREC RN55D 200 K	1
200331014	IC HEX INVERTER MM74HC14	1
208591431	IC ADJ SHUNT REG TL431	1
230110005	DIODE SWITCHING 1N4448	6
235010005	DIODE RECTIFIER 1N4005	2
240425751	DIODE ZENER 5.1V 1N751A	1
270170904	TRANSISTOR NPN 2N3904	6
275170906	TRANSISTOR PNP 2N3906	1
440030009	TRANSFORMER 2.4 VA 220 VAC PRI	1
454110002	HDR SOLD TAIL/MALE 2	1
454113004	HDR VERTICAL PC MOUNT 4	1
454212010	HEADER STRAIGHT 10	1
454711004	HDR SOLD TAIL/FEM 4	1
524104001	STANDOFF M/F M4 X 10MM	2
551140201	WASHER SPLIT LOCK M4	2
552440100	NUT HEX M4	2
594120001	TIEWRAP	1
711458501	PC BD PREASS'Y 1458-5	1

End of report. 35 Details encountered.

PART NUMBER	DESCRIPTION REMARK	QTY PER
103347155	CAP CERA MONO 50V 1.5 UF C1,C2	2
103896222	CAP CERA MONO 200V 2200PF C53,C58	2
106338224	CAP CERA MONO .22UF C15	1
106348334	CAP CERA MONO .33UF C27,C41,C46,C48	4
106433101	CAP CERA MONO 100PF C19,C39 C49	3
106433220	CAP CERA MONO 22PF C10,C45	2
106433331	CAP CERA MONO 330PF C28,C37	2
106433470	CAP CERA MONO 47PF C14,C20,C32,C47	4
106433681	CAP CERA MONO 680PF C42	1
106435103	CAP CERA MONO .01UF C9,C29,C35,C54	4
106438104	CAP CERA MONO .1UF C3 C7 C17 C18 C30 C33,C36,C59	8
106445222	CAP CERA MONO 2200PF C38,C11	2
128427102	CAP FILM/FOIL .001 UF C43	1
128457104	CAP METAL FILM .1 UF C5,C21,C22	4
128457105	CAP METAL FILM 1.0 UF C6	1
141854685	CAP TANT DIP 6.8 UF C4,C8,C16,C31,C34, C40,C44,C50	8
146644108	CAP MINI ALUM 20% 1000 UF C13	1
146664477	CAP MINI ALUM 20% 470 UF C51 C52 C55 C56 C57	5
146674157	CAP MINI ALUM 20% 150 UF C12,C26	2
148920220	CAP ALU METAL CAN 220 UF C23,C24,C25	3
161225100	RES CARBON FILM 10 OHMS R16,R21	2
161225101	RES CARBON FILM 100 OHMS R5,R14,R22,R65	4
161225102	RES CARBON FILM 1 K R70	1
161225103	RES CARBON FILM 10 K R27,R30,R36,R56	4
161225104	RES CARBON FILM 100 K	1

PART NUMBER	DESCRIPTION	QTY PER
	REMARK	
161225104	RES CARBON FILM 100 K	1
	R7	
161225105	RES CARBON FILM 1 MEG	1
	R3	
161225184	RES CARBON FILM 180 K	1
	R51	
161225202	RES CARBON FILM 2 K	1
	R33	
161225203	RES CARBON FILM 20 K	1
	R60	
161225273	RES CARBON FILM 27 K	1
	R54	
161225302	RES CARBON FILM 3 K	3
	R8,R63,R66	
161225393	RES CARBON FILM 39 K	3
	R15,R49	
	R50	
161225432	RES CARBON FILM 4.3 K	1
	R71	
161225433	RES CARBON FILM 43 K	1
	R76	
161225471	RES CARBON FILM 470 OHMS	2
	R26,R35	
161225512	RES CARBON FILM 5.1 K	1
	R11	
161225621	RES CARBON FILM 620 OHMS	1
	R4	
161225622	RES CARBON FILM 6.2 K	1
	R55	
161225911	RES CARBON FILM 910 OHMS	1
	R2	
161335010	RES CARBON FILM 1 OHM	1
	R31	
161335100	RES CARBON FILM 10 OHMS	4
	R48	
	R59,R61,R72	
161335101	RES CARBON FILM 100 OHMS	1
	R73	
161335202	RES CARBON FILM 2 K	1
	R77	
161445100	RES CARBON FILM 10 OHMS	4
	R28,R29,R32	
	R37	
161445150	RES CARBON FILM 15 OHMS	1
	R34	
161445240	RES CARBON FILM 24 OHMS	3
	R23	
	R24,R25	
161555101	RES COMP 1W 5% 100 OHMS	2
	R18,R19	
161555204	RES COMP 1W 5% 200 K	1
	R17	

PART NUMBER	DESCRIPTION REMARK	QTY PER
161555510	RES COMP 1W 5% 51 OHMS R38-R43	6
161665204	RES COMP 2W 5% 200 K R58B ..	1
168139483	RES RN55E .1% 8.56 K R75 R75	1
168531335	RES PREC RN55D 249 OHMS R12	1
168531393	RES PREC RN55D 1.00 K R69	2
168531403	RES PREC RN55D 1.27 K R62	1
168531405	RES PREC RN55D 1.33 K R6	1
168531444	RES PREC RN55D 3.40 K R13	1
168531458	RES PREC RN55D 4.75 K R53,R68	2
168531460	RES PREC RN55D 4.99 K R52	1
168531469	RES PREC RN55D 6.19 K R64	1
168531489	RES PREC RN55D 10.0 K R67	1
168531501	RES PREC RN55D 13.3 K R1	1
168531611	RES PREC RN55D 187 K R44-R47	4
168531639	RES PREC 1% 365 K R57 R58	2
172753050	RES PWR WIREWOUND 5 OHMS R9,R10	2
190662102	RESISTOR NETWORK 1 K RN7,RN10	2
190662103	RESISTOR NETWORK 10 K RN3,RN4,RN9	3
190662203	RESISTOR NETWORK 20 K RN5,RN8	2
190832103	RESISTOR NETWORK 10 K RN1,RN2,RN6	3
207112125	IC HI VOLT MOS-GATE DRIVER IR2125 U8	1
208031010	IC QUAD DIFF COMP LM339N U1	1
208570317	IC ADJ +V REG LM317 U5	1
208590431	IC ADJ SHUNT REG TL431 U2,U10	1
208743825	IC PWM CONTROLLER 3825 U7	1

PART NUMBER	DESCRIPTION	QTY PER
	REMARK	
208744812	IC POWER FACTOR CONTR ML4812CP	1
	U6	
230110005	DIODE SWITCHING 1N4448	4
	CR1,CR5,CR6,CR28	
235010105	DIODE RECTIFIER MUR105	4
	CR4,CR7,CR12,CR30	
235010160	DIODE RECTIFIER MUR160	5
	CR9.CR16,CR17	
	CR18,CR25	
235030756	DIODE RECTIFIER	1
	CR10	
235123060	DIODE SOFT REC HFA30PA60C	1
	CR14	
	CR14	
	CR14	
235700100	DIODE DUAL RECTIFIER 30CPQ100	2
	CR32,CR33	
236130508	RECTIFIER BRIDGE 35A 800V	1
	BR1	
	BR1	
240423966	DIODE ZENER 16V 1N966B	2
	CR27,CR31	
240425758	DIODE ZENER 10V 1N758A	1
	CR8	
240743744	DIODE ZENER 15V 1N4744A	3
	CR2,CR3,CR26	
253050817	DIODE HOT CARRIER 1N5817	7
	CR13,CR19,CR20,CR21	
	CR23,CR24,CR29	
253072110	DIODE SCHOTTKY 21DQ10	2
	CR15	
	CR22	
260022035	OPT ISOLATOR W/VDE0806 SAFETY	1
	U3	
	U3	
260028103	IC OPTOISOLATOR, TRANS OUTPUT	1
	U9	
260073063	OPTOISOLATOR 3063	1
	U4	
270170904	TRANSISTOR NPN 2N3904	5
	Q2,Q7,Q10-Q12	
270178099	TRANSISTOR NPN MPS8099	1
	Q1	
275170906	TRANSISTOR PNP 2N3906	3
	Q8,Q13,Q14	
280130440	TRANSISTOR MOSFET 440	1
	Q3	
280430025	TRANSISTOR MOSFET 5025	4
	Q4,Q5,Q6,Q9	
283490224	THYRISTOR 224	1
	CR11	
301660001	INDUCTOR WOUND 0.9 UH	1

PART NUMBER	DESCRIPTION REMARK	QTY PER
301660001	INDUCTOR WOUND 0.9 UH L4	1
302071102	INDUCTOR (SWITCH/REG) 1000UH L2	1
432500100	THERMAL CUTOUT S1	1
433242005	FUSE REG BLO 250V .5 AMP F1	1
440021250	TRANSFORMER BASE/GATE DRIVER T3	1
440242505	INDUCTOR CUSTOM 7200APWRB L3	1
440242506	INDUCTOR CUSTOM 7200APWRB L1	1
440282004	TRANSFORMER CUSTOM 7200APWRCT43 T1,T4	2
440282006	TRANSFORMER 200KHZ 24V HI TEMP	1
454112003	HDR SOLD TAIL/MALE 3 P1	1
454313006	HDR VERTICAL 6-POS P2	1
500330180	INSULATOR CERAMIC FOR TO-3P	8
500400008	INSULATOR THERMALLY CONDUCTIVE	2
505070004	HEATSINK FOR TO-220	1
505070025	HEAT SINK FOR TO-218/TO-220	1
505070102	HEATSINK FOR TO-220	1
505070922	HEATSINK CLAMP FOR TO-220	2
522600638	SPACER ROUND #6 1+3/16 LONG	1
550130116	SCREW PAN HD M3X16	10
550135116	SCREW PAN HD M3.5X16	1
551130101	WASHER FLAT M3	10
551130201	WASHER SPLIT LOCK M3	10
551135101	WASHER FLAT M3.5	2
551135201	WASHER SPLIT LOCK M3.5	1
551140100	WASHER FLAT M4	1
552635101	NUT HEX M3.5	1
560632004	SCREW PHILIPS 6-32X1/4	1
560632012	SCREW PHILIPS 6-32X3/4	1
560632028	SCREW PHILIPS 6-32X1+3/4	1
577600001	WASHER SHAKEPROOF SIZE 6	4
580632002	NUT HEX	2
590001018	WIRE TEFLON 19/30 BLK 18	0
594120030	CABLE TIE NYLON HI-TEMP	2
595003103	SLEEVING SHRINK BLK 1/4"	1
707200003	HEAT SINK MACHINING 7200APWR	1
717201210	PC BD PREASS'Y 7200APWRB	1

End of report. 257 Details encountered.

PART NUMBER	DESCRIPTION REMARK	QTY PER
403010010	CONN KIT FLAT CABL 10-PIN	2
403010040	CONN KIT FLAT CABL 40-PIN	3
403211050	CONN FLAT CABLE 50-POS	2
405120002	CONN HOUSING 2-POS	3
405130001	CONN HOUSING 6	4
405580001	CONTACT CRIMP TERMINAL	24
405595001	CONN PIN LOCKING (FEMALE)	2
405734012	CONTACT CRIMPED WIRE END	6
405740001	TERM WIRE END SINGL INSUL	16
405747003	TERMINAL WIRE END SINGLE	4
405770009	TERMINAL WIRE END #10	8
405770014	TERMINAL WIRE END #10	13
405770017	TERMINAL WIRE END 1/4	10
405770105	TERMINAL WIRE END SPADE 6	13
405770106	TERMINAL WIRE END SPADE 6	6
405777001	CONTACT CRIMPED WIRE END	4
405777002	TERM FEM CRIMP #18-24 AWG WIRE	66
405777003	CONTACT CRIMP WIRE END	2
412111003	SWITCH, KEY 3 POS SPDT	1
454120002	HDR SOLD TAIL/FEM 2	2
455020007	CONTACT (CRIMP) FEMALE	4
455020014	CRIMP TERMINAL FOR 22-28 AWG	2
455120024	CONN HOUSING CABLE-END 24-POS	1
455121120	CONN HOUSING CABLE-END 20-POS	2
455122004	BLOCK FOR FEM PINS 4	2
455124004	BLOCK FOR FEM PINS 4	1
455125004	BLOCK FOR FEM PINS 4	1
455126004	BLOCK FOR FEM PINS 4	1
455820003	CONN CABLE END 3-POS	2
590001018	WIRE TEFLON 19/30 BLK 18	62
590001022	WIRE TEFLON 7/30 BLK 22	4
590111014	WIRE TEFLON 19/27 BRN 14	7
590111018	WIRE TEFLON 19/30 BRN 18	5
590111022	WIRE TEFLON 7/30 BRN 22	2
590221018	WIRE TEFLON 19/30 RED 18	12
590221022	WIRE TEFLON 7/30 RED 22	3
590331018	WIRE TEFLON 19/30 ORA 18	10
590441018	WIRE TEFLON 19/30 YEL 18	11
590441022	WIRE TEFLON 7/30 YEL 22	2
590541014	WIRE TEFL 19/27 GRN/YEL 14	5
590551022	WIRE TEFLON 7/30 GRN 22	1
590661014	WIRE TEFLON 19/27 BLU 14	7
590661018	WIRE TEFLON 19/30 BLU 18	12
590661022	WIRE TEFLON 7/30 BLU 22	2
590771018	WIRE TEFLON 19/30 VIO 18	3
590881022	WIRE TEFLON 7/30 GRAY 22	2
590921018	WIRE TEFLON 19/30 WHT/RED 18	40
590991018	WIRE TEFLON 19/30 WHT 18	7
590991022	WIRE TEFLON 7/30 WHT 22	1
591922022	WIRE TEF TWISTED PAIR AWG 22	1
591922122	WIRE TEF TWISTED PAIR AWG 22	1
592011010	CABLE FLAT 10-COND	1

PART NUMBER	DESCRIPTION REMARK	QTY PER
592011040	CABLE FLAT 40-CONN	2
592011050	CABLE FLAT 50-COND	2

End of report. 54 Details encountered.