

KEITHLEY DATA ACQUISITION

MODEL 575 Measurement and Control System

For IBM PC/XT/AT, PS/2, and 100% Compatible Computers



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Model 575 Specifications

General Specifications

Standard Channel Capacity

Analog Input Performance, AMM1A

Analog Input Performance, AMM2

Analog Trigger Performance

Analog Output Performance

Digital Input/Output Performance

Power Control Performance

General Specifications

Models: 575-1 — base model 575 chassis with AMM1A 12-bit Analog Master Measurement module.
575-2 — base model 575 chassis with AMM2 16-bit Analog Master Measurement module.

Host Computer Configuration: IBM PC, XT, AT, and PS/2 models and 100% compatible personal computers with at least 512K of RAM, dual disk drives, approved DOS, color graphics card and monitor.

Interface and Bus Compatibility: IBIN/A for PC/XT/AT bus and PS/2 Model 25 and 30; requires a half-length slot. IBIN-PS/2 for PS/2 Microchannel bus; requires one full-length PS/2 expansion slot.

Power Requirements: 5V @ 2A maximum from host computer (not including power requirement of optional plug in card). Can also be powered from any external source of 8-18V AC or DC @ 3A. Wall transformer power supply or automotive power cable available as options.

Expansion Slots: 2. One slot normally used for AMM1A or AMM2 Master Analog Measurement Module. If analog input is not needed, both slots may be used for digital, analog output, stepper control, or pulse-counting modules.

Signal Connections: Quick disconnect screw terminals and multi-pin ribbon cable connectors.

Operating Temperature: 0 to 40 degrees C.

Storage Temperature: -20 to +70 degrees C.

Humidity (Non-condensing): up to 80%.

Certification: Meets FCC part 15J, Class A.

Dimensions and Weight: 85mm high x 241mm wide x 302mm deep. 3.0 kg

Interface Cable: 6-foot, shielded.

Supplied software: KDAC500/I Interpreter Software for IBM BASICA, Compaq BASICA, and Microsoft GW BASIC, providing realtime interrupt-driven acquisition and control.

Standard Channel Capacity

Analog input: 16 single-ended, or 8 differential channels. 8 additional single-ended channels through external mass termination (typically used for Analog Devices 3B).

Trigger: single differential input channel for monitoring an external signal acting as a trigger. Trigger signal may be a dedicated trigger signal, or any analog input to the Model 575. The trigger output may trigger an A/D conversion, assert an interrupt request (IRQ) to the PC, or both.

Analog output: 2 channels

Digital input and output: 32 channels total, programmable for input or output in groups of 8 channels. TTL compatible; high-true logic.

Power relay control: 16 channels for sensing or control (uses two digital I/O ports). TTL compatible low-true logic for power control.

Analog Input Performance, AMM1A

Input Channels: Local: 8 differential or 16 single-ended inputs. Global input for analog inputs from option slot 3-10 (external input function).

LOCAL PROGRAMMABLE GAIN AMPLIFIER

Programmable Gains: x1, x10

Gain Accuracy: $\pm 0.045\%$ @ x1 gain; $\pm 0.08\%$ @ x10 gain

Nonlinearity: $\pm 0.01\%$

Temperature Coefficient: $\pm 0.001\%$ per degree C @ x1 gain; $\pm 0.0017\%$ per degree C @ x10 gain

Input Resistance: $>100\text{M}\Omega$

Input Bias Current: $<1\text{nA}$

Input Noise: $<100\mu\text{V}$ p-p, 0.1Hz to 100kHz

CMRR: $>70\text{dB}$, DC to 60Hz

Input Protection: $\pm 30\text{V}$ maximum with system powered, $\pm 15\text{V}$ maximum with system off.

10.000 VOLT REFERENCE

Accuracy: $\pm 0.025\%$

Temperature Coefficient: $\pm 0.0017\%$ per degree C

Noise: $25\mu\text{V}$ p-p, 0.1 to 10Hz

GLOBAL AMPLIFIER AND A/D CONVERTER

A/D Converter: Successive approximation type, self-calibrating for gain and offset.

A/D Range: Software selectable, 0 to +10V unipolar and $\pm 10\text{V}$ bipolar.

Resolution: 12 bits (1 part in 4096)

Conversion Time: $16\mu\text{S}$, including acquisition time

Software Trigger: One-shot mode: A single reading is available $16\mu\text{S}$ after trigger location in memory is addressed. Continuous Mode: Conversions are continuously triggered every $16\mu\text{S}$ by internal crystal-controlled clock

External Trigger: Continuous conversions begin with the falling edge of EXT TRIG input and stop when trigger input is high. TTL-compatible.

Noise: $<1/2$ LSB on all ranges

Programmable Gains: x1, x2, x5, x10

Gain Accuracy: $\pm(0.04\% + 1\text{LSB})$ @ x1 gain; $\pm(0.15\% + 1\text{LSB})$ @ x2, x5, and x10 gain.

Non-linearity: $\pm 0.033\%$

Temperature Coefficient: $\pm 0.003\%$ per degree C.

Filter: Software selectable, 100kHz or 2kHz single pole.

Settling Time (to 0.05% of final reading): $12\mu\text{S}$ with 100kHz filter, $600\mu\text{S}$ with 2kHz filter.

Analog Input Performance, AMM2

Input Channels: Local: 8 differential or 16 single-ended inputs. Global input for analog inputs from option slots 3-10 (external analog input function).

LOCAL PROGRAMMABLE GAIN AMPLIFIER

Programmable Gains: x1, x10

Gain Accuracy: $\pm 0.016\%$ @ x1 gain; $\pm 0.025\%$ @ x10 gain

Nonlinearity: $\pm 0.01\%$

Temperature Coefficient: $\pm 0.001\%$ per degree C @ x1 gain; $\pm 0.0017\%$ per degree C @ x10 gain

Input Resistance: $>100\text{M}\Omega$

Input Bias Current: $<1\text{nA}$

Input Noise: $<50\mu\text{V}$ p-p, 0.1Hz to 100kHz

CMRR: $>80\text{dB}$, DC to 60Hz

Input Protection: $\pm 30\text{V}$ maximum with system powered, $\pm 15\text{V}$ maximum with system off.

10.000 VOLT REFERENCE

Accuracy: $\pm 0.02\%$

Temperature Coefficient: $\pm 0.0012\%$ per degree C

Noise: $20\mu\text{V}$ p-p, 0.1 to 10Hz

GLOBAL AMPLIFIER AND A/D CONVERTER

A/D Converter: Successive approximation type, self-calibrating for gain and offset.

A/D Range: Software selectable, 0 to +10V unipolar and $\pm 10\text{V}$ bipolar.

Resolution: 16 bits (1 part in 65,536)

Conversion Time: $20\mu\text{S}$, including acquisition time

Software Trigger: One-shot mode: A single reading is available $20\mu\text{S}$ after trigger location in memory is addressed. Continuous Mode: Conversions are continuously triggered every $20\mu\text{S}$ by internal crystal-controlled clock

External Trigger: Continuous conversions begin with the falling edge of EXT TRIG input and stop when trigger input is high. TTL-compatible.

Noise: $<0.005\%$ of full scale rms on all ranges and gains, $>85\text{dB}$ signal to noise ratio (sine wave rms signal to rms noise).

Programmable Gains: x1, x2, x5, x10

Gain Accuracy: $\pm(0.02\% + 1 \text{ LSB})$ @ x1 gain; $\pm(0.03\% + 1 \text{ LSB})$ @ x2, x5, and x10 gain.

Non-linearity: $\pm 0.006\%$

Temperature Coefficient: $\pm 0.002\%$ per degree C.

Filter: Software selectable, 100kHz or 2kHz single pole.

Settling Time (to 0.003% of final reading): 16 μ S with 100kHz filter, 800 μ S with 2kHz filter.

Analog Trigger Performance

Channels: 1, differential input

Trigger Source: External trigger input, Global Amplifier output of AMM1A or AMM2, or Software Strobe.

Ranges: 0 to +1V, 0 to -1V, 0 to +10V or 0 to -10V.

Resolution: 8-bits

Level Accuracy: $\pm 2\% + 1 \text{ LSB}$.

Input Impedance: 10M Ω (External Input).

Input Protection: $\pm 30\text{V}$ max (powered), $\pm 15\text{V}$ max (unpowered).

Input Coupling: AC or DC

Trigger Slope: Rising or Falling Slope.

Input Connection: 3-pin quick disconnect screw terminal block for external input. Cable to AMM card for global amp connection supplied.

Revision Level: For use with AMM1A or AMM2 Master Measurement Module Revision D (July, 1989) or later.

Input filter: Software-selectable single pole low-pass filter with the following characteristics:

-3db Frequency	Settling time to 1/2LSB
1MHz	1 μ S
300kHz	3.3 μ S
100kHz	10 μ S
30kHz	33 μ S
10kHz	100 μ S
3kHz	333 μ S
1kHz	1mS
300Hz	3.3mS

Output:

1. Low-true trigger signal to mother board connector for triggering AMM1A or AMM2 in adjacent slot, and or
2. interrupt request (IRQ) to host computer,
3. status register.

IRQ is open collector low-true pulse 500nS typical. A/D trigger signal is software selectable to be either a 500nS low-true pulse, or a low-true level.

Analog Output Performance

Channel capacity: 2

Resolution: 13 bits (12 data bits plus polarity bit).

Ranges: $\pm 10\text{V}$, $\pm 5\text{V}$, $\pm 2\text{V}$, $\pm 1\text{V}$

Output updating: Instantaneous or global strobe update of analog output.

Maximum output load: $2\text{k}\Omega$ minimum. 100pF maximum.

Settling time: $5\mu\text{S}$ to 0.01% $\pm 1\text{LSB}$ for any step size.

Maximum output frequency: 200kHz

Non-linearity: $\pm 1\text{LSB}$

Accuracy: $\pm 0.15\%$ $+5\text{mV}$ for $\pm 10\text{V}$ range; $\pm 0.2\%$ $+4\text{mV}$ for other ranges.

Temperature coefficient: $\pm 0.0025\%$ per degree C.

Digital Input/Output Performance

Channel Capacity: 32 channels, non-isolated. Programmable in groups of 8 channels for input or output.

Input Range: TTL compatible, high true.

High Level Input Current: $20\mu\text{A}$

Low Level Input Current: -0.4mA

Output Drive Capability: 10 TTL loads, 20mA sink @ 0.5V .

Power Control Performance

Channel Capacity: 16, non-isolated. Programmable for power sense or control in groups of 8 channels. Channels used for power control are taken from the available digital I/O port C and port D channels.

Input/Output Range: TTL compatible, low true.

Drive Capability: For use with optional PCM3 mounting board and extension cable. Solid-state relays available for AC or DC sense and control.

Model 575 Setup and Operation

Welcome to the Model 575

Features of the Model 575

Scope of this Manual

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Installing the IBIN Card

Installing the Model 575

Software Installation

KDAC500 Hardware Configuration

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Program Initialization at Power-Up

Technical Support

Welcome to the Model 575

The Model 575 is a work station data acquisition and control device — an interface between a personal computer and the real world. With this system, you can use various IBM, Compaq, and compatible personal computers for direct data acquisition and intelligent process control.

The Model 575 is a complete system. It integrates hardware, software, and documentation to make measurement and control technology easy to use. The Model 575 combines the most often used analog and digital I/O functions into a single package. It provides the convenience, performance, channel counts, and expansion capability normally associated with main-frame acquisition instruments with the economy of single-board type systems.

The Model 575 has two expansion slots, one of which is normally occupied by a master analog input module. This leaves one slot for other modules you might want to add. If your application does not require analog input, you may use both slots for expansion. (The STEP1/STEP2 module set may also be mounted in the expansion slots, but must be accessed through PEEK and POKE commands).

Features of the Model 575

- Shielded all-metal case, external to the PC.
- One option slot for adding a signal-conditioning module.
- Accepts 12-bit (62.5kHz) AMM1A or 16-bit AMM2 (50kHz) Master Analog Measurement Module. Add up to 32 more analog input channels via option slot.
- Trigger circuitry for synchronizing data acquisition to external analog or digital events. Provides oscilloscope-like trigger modes. Add a TRG1 module for specialized triggering based on two trigger input signals.
- Dual high-speed 13-bit analog output channels. Add up to five more analog output channels via option slot.
- Thirty-two digital I/O channels organized as four 8-bit ports A, B, C, and D. Programmable in groups of 8 channels for input or output. Add up to 32 more digital I/O channels via option slot.
- Sixteen power control channels use digital I/O ports C and D. Programmable for sensing or switching of AC or DC loads. Up to 16 more power control channels via option slot.
- Convenient mass-termination connector for direct connection of up to 8 Analog Devices 3B signal conditioning modules, or other single-ended analog inputs.
- Memory-mapped interface for PC/XT, AT, PS/2, or compatibles.
- Operates from power supplied by PC, or optional transformer or automotive cable. Requires 8-18V AC or DC @ 3A max.

Scope of This Manual

This manual is one of several documents you have received with the Model 575. Its purpose is to help you get your Model 575 fully operational and acquiring data as quickly as possible. The Model 575 manual will refer you to the manuals which came with your IBIN interface card, analog master measurement module, and other modules you may have received with the Model 575. There is a place for these manuals at the end of the reference section of the Model 575 manual. Please insert them in the Model 575 binder and keep them handy through the following discussions.


This manual presumes that you have a working knowledge of how to turn on your computer, load the disk operating system, and enter commands. If you are setting up a new computer for use with the Model 575, please complete the set-up. Verify that your computer is working correctly before you continue with the Model 575 installation.

Your computer may have two floppy disk drives, or a combination of floppy and fixed disk drives. You should be able to use the DOS commands which format diskettes, make directories, and change directories. You should also be familiar with techniques for copying individual files and groups of files from disk to disk for your particular configuration. You'll also need to run Advanced BASIC (BASICA, GWBASIC, or GW-BASIC) and BASIC programs.

Please refer to the DOS manuals which came with your computer if you need to review any of these operations. The Model 575 manual does not replace the DOS or computer hardware manuals.

Conventions Used in This Manual

The following safety symbols and terms are used in this manual and are found on the instrument:

The symbol  indicates that you should refer to the operating instructions in this manual for further details.

The **WARNING** heading indicates dangers that might result in personal injury or death. Always read the associated information very carefully.

The **CAUTION** heading indicates hazards that could damage the instrument. Such damage may invalidate the warranty.

The **NOTE** heading indicates useful information which will simplify or otherwise explain a procedure.

From time to time, this manual will refer to the personal computer used to control and communicate with the Model 575. The computer will be referenced generically as "computer" or "PC" unless a given piece of information refers to a specific type of machine. If so, the computer will be mentioned by name.

This manual will also provide instructions for entering commands and specific key strokes. Keyboard functions such as "Control", "Alt", "Enter", "Shift", etc. will be abbreviated as they appear on most keyboards, and enclosed in brackets. Examples: <Ctrl>, <Alt>, <Enter>, <Shift>.

Software for the Model 575

The Model 575 is shipped with KDAC500/I, a BASICA interpreter version of the KDAC500 software family. Optional versions of this software include KDAC500/B and KDAC500/M.

KDAC500/B is a Borland-compatible compiler version for use with Borland Turbo C and Turbo Pascal. KDAC500/M is compatible with Microsoft C, Quick C, QuickBASIC, Quick PACAL, and FORTRAN. Any references in this manual to KDAC500 are intended for the "/I" interpreter version of the software.

The Model 575 is **not** compatible with Keithley's Soft500 or Quick500. These packages predate the Model 575 and do not support all its features. This manual may direct you to another hardware manual which mentions Soft500 or Quick500. Generally, these remarks can be considered equally valid for KDAC500/I unless noted otherwise.

If you have questions about the compatibility of the Model 575 with third-party software, check with Keithley or the publisher of the software.

System Requirements

The Model 575 is compatible with most personal computers using the PC/XT/AT bus or the Microchannel bus. These computers may use the V20, V30, 8086, 8088, 80286, or 80386 processor.

The interface between the Model 575 and computer is the Keithley IBIN-A for PC, XT, AT, and PS/2 models with conventional bus, or the IBIN-PS/2 for PS/2 models with the Microchannel bus. Be certain that the interface you received with your Model 575 is the correct one for your computer.

Personal computers are available with a wide variety of disk drives, memory cards, video adapters, and other accessories. A workable computer configuration for use with the Model 575 will include the following elements:

Correct DOS version: For IBM personal computers, PS/2 systems, and compatibles, select the DOS version recommended by the computer manufacturer, but nothing earlier than IBM PC-DOS 3.1, Compaq DOS 3.0, or MS-DOS 3.0.

Sufficient Memory: The computer should contain 640K for maximum data capacity. 512K is the minimum RAM requirement.

Disk Drives: running KDAC500 and most other data acquisition software can most efficiently be done from a fixed disk drive. While it is possible to use dual 360K floppy drives, the installation will not provide much room for data, nor will it provide the speed of a fixed disk.

Video Adapter: KDAC graphics require an IBM Color Graphics Adapter, IBM Enhanced Graphics Adapter, or Hercules Color Card. Most current EGA cards have 256K of video memory. Such cards preclude addressing the IBIN interface card at AFF80 or anywhere in the memory block A0000-BFFFF. Use CFF80, or another address which does not conflict with the computer hardware.

For VGA-based video, you may need to locate the IBIN address in the D000 page of memory or higher. No-bit VGA boards may require reconfiguration for 8-bit operation.

Hercules-type monochrome graphics cards may be used with KDAC500. However, KDAC graphics functions will not operate in Hercules graphics mode.

The dual-mode text-and-graphics adapter in Compaq portables is compatible with KDAC500 graphics.

Graphic adapters which make use of the computer's non-maskable interrupt require an installation of KDAC500 which does not use the computer's NMI. See the KDAC500 manual for details.

NOTE: Some computers may offer switchable clock speeds. These computers should be operated only at clock speeds for which the software was installed.

NOTE: Installation of a math coprocessor will increase the speed of execution of KDAC500 commands handling graphics and data arrays. Interpreter BASIC does not generally recognize or use the coprocessor for BASIC functions. Make sure that any computer configuration switches associated with a coprocessor are correctly set, or your software or hardware may operate improperly.

KDAC500's installation process will normally check the computer, BASIC, and other set-up parameters. If a compatibility problem exists with your computer, a message or some other indication will result during installation. For this reason, it is advisable to install KDAC500, even if you plan to use another software package exclusively. If you have any questions regarding suitability of a certain computer or hardware with KDAC500, contact Keithley Data Acquisition and Control.

Unpacking the Model 575

The Model 575, documentation, and accessories are shipped in one or more cartons. Locate all shipping cartons, and check that you have the following items.


In addition to the Model 575 manual which you are reading, you should have the following:

- Model 575 Measurement and Control System
- AMM1A or AMM2 Analog Master Measurement Module with mounting hardware and trigger cable assembly. (Model 575-1 and 575-2 only).
- IBIN-A or IBIN-PS/2 Interface Card
- Connecting Cable for the IBIN and 575.
- Ground wire assembly
- KDAC500/I Diskette Set
- KDAC500/I Software Manual
- Any options you may have purchased

If any items are missing, check the shipping paperwork to see if they have been back ordered. If a problem exists, contact Keithley Data Acquisition and Control customer support.

Opening the Model 575 or Computer


This manual will instruct you to open the case of the Model 575 and computer during installation and when making connections to the system.

 **WARNING:** User supplied lethal voltage may be present on connections and option card. To avoid the possibility of electric shock, disable external power sources before making any adjustments or connections to this product. The Model 575 is not for use in electrically sensitive areas, nor for connection to humans.

ALWAYS observe the following safety rules during installation.

1. If you need to open the computer:
 - A. Turn off or disconnect any equipment connected to inputs of the Model 575.
 - B. Turn off the computer and disconnect the power cord.
2. If you need to open the Model 575:
 - A. Set the Model 575 ON/OFF switch to OFF.
 - B. Turn off or disconnect any equipment connected to the inputs of the Model 575.

NOTE: It is not necessary to turn off the computer when you open only the Model 575 case.

 **WARNING:** To avoid the possibility of electric shock, connect a safety ground wire from the ground post on the rear panel of the Model 575 to a safety ground. This wire is included with the Model 575, and is an important part of the installation.

CAUTION: The Model 575, like the computer, is a delicate electronic device. Keep and operate both at room temperature. If the Model 575 or computer have been subjected to more than 110 degrees F or less than 32 degrees F, allow them to return to normal room temperature (60 to 90 degrees F) before you turn them on. Otherwise, serious damage may result.

CAUTION: Maintain enough space around each part of the system to provide ample cooling air. Do not block ventilation grillwork at the front or back of the computer, on any other equipment.

CAUTION: Do not exceed the input ratings of the Model 575. Apply no more than $\pm 15\text{VDC}$ to a non-isolated analog input of the Model 575.

CAUTION: Do not apply more than +5.5 VDC or negative voltages to any digital input of the Model 575.

CAUTION: Do not install or remove a module from the Model 575 option slot while power to the Model 575 is on.

Installing the IBIN Interface Card

The Model 575 requires that an IBIN-A or IBIN-PS/2 interface card be installed in the computer. This card contains circuitry which enables the PC to communicate with the Model 575.

For the following steps, you may consult the IBIN-A or IBIN-PS/2 manuals for further details. These manuals may refer to Soft500 and Quick500. For the purposes of interface installation, the information applies equally to the KDAC500/I software package except as noted.

1. Turn off the PC and disconnect the power cord.
2. Consult the documentation which came with your PC for instructions on opening the cabinet. Remove the cover(s) from the computer in order to gain access to the expansion slots in the computer.
3. Locate your IBIN-A or IBIN-PS/2 interface card and manual.

If you are installing an IBIN-A, note the dipswitch bank which sets the interface address. Check the IBIN manual for information on setting these switches. Generally, the address "CFF80" can be used with the widest range of computer configurations. For CFF80, set switches 1, 2, and 5-8 OFF, and switches 3 and 4 ON. Refer to IBIN-A manual for detailed steps to complete the IBIN configuration.


If you are installing an IBIN-PS/2, there are no switches to be set. The card will be configured later through software.

4. You can plug the interface card into any appropriate expansion slot in the computer. (Slot 8 in the original IBM PC/XT should not be used.)
5. After the IBIN is installed, replace all screws, covers, and other hardware on the computer.

Installing the Model 575

The 575-1 and 575-2 include an AMM module. You must install this module in the 575 before installing any option modules. The AMM modules are physically identical and are installed in the same way. Continue with the following steps after you have installed the interface in your computer.

1. Connect one end of the Model 575 cable to the mating connector on the interface card. Tighten the screws on the cable end to the interface card connector.
2. Attach the free end of the connecting cable to the Model 575 and tighten the connector screws.
3. Attach one end of the safety ground to the binding post on the rear of the Model 575. Attach the other end of the ground wire to a properly grounded point.

 **WARNING:** To eliminate the possibility of shock, connect an 18 AWG ground wire from the terminal post on the rear of the Model 575 to a safety ground. Plug the computer and other AC-powered equipment into a properly-grounded 3-wire receptacle.

4. If you have an AMM1A or AMM2 module or an option module, make sure the Model 575 is turned off. Unlatch the fastener on the side of the Model 575 cabinet and open the Model 575.

5. Prepare the AMM module for installation. Confirm that trigger select jumper J3 on the AMM module is over pins 1 and 2 (see Figure 2-1). Confirm that trigger select jumper W201 on the Model 575 mother board is over pins 1 and 2.

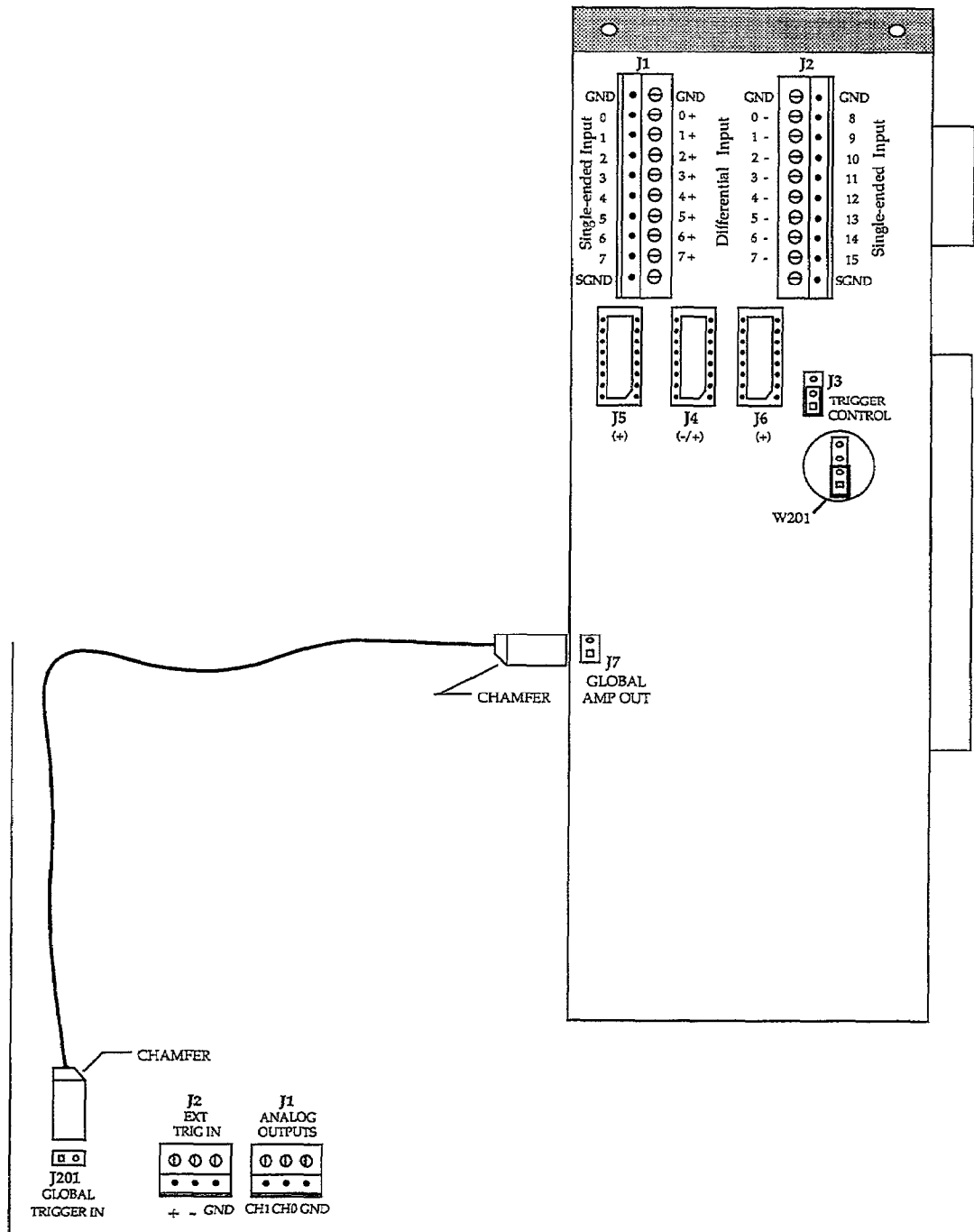


Figure 2-1. AMM Module and Analog Trigger Cable

6. If you wish to connect your signals to the AMM module at this time, consult the sections of this manual covering the appropriate topics. Remove the cable clamp along the back edge of the AMM module. Attach your input signals to the quick-disconnect blocks on the AMM module and replace the connectors. Replace the cable clamp and attach the mounting screw nearest the card edge connector on the AMM module.
7. A small right-angle bracket and screw are included to fasten the rear corner of the AMM module to the rear panel of the Model 575. Install this bracket to the other cable clamp mounting hole on the rear corner of the AMM module with the remaining cable clamp mounting screw (see Figure 2-2).

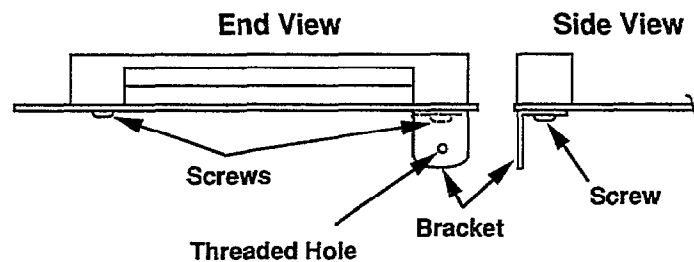


Figure 2-2. AMM Module Mounting Bracket

8. Install the module in the Model 575 now. Hold the module with the component side facing upward. Insert the forward edge of the module into the lower module guide located on the power supply shield, and slide the module into the lower option slot connector. Fasten the support tab to the rear panel of the Model 575 with the supplied screw.
9. Attach the trigger cable from the GLOBAL OUTPUT J7 at the top edge of the AMM module to the trigger GLOBAL INPUT terminal J201 on the Model 575 mother board using the supplied cable. Pay close attention to the orientation of the beveled corner on the connector at each end of the cable. (see Figure 2-1).

NOTE: If you reverse the connections of the trigger transmission cable at J7 or J201, you may introduce noise into all analog input measurements, or invert the polarity of the trigger signal.

10. To install an optional module, see the manual for your option module for any required configuration of gains, ranges, switches, etc. Set up the module and make connections according to your application. Hold the module with the component side facing upward. Insert the forward edge of the module into the upper module guide located on the power supply shield, and slide the module into the upper option slot connector. Attach a right-angle bracket to the rear corner, plus any necessary mounting screws or strain relief to complete the hardware installation.
11. If you are powering the Model 575 from the optional external transformer, set the switch SW301 located on the Model 575 side board "up" for external power and connect the transformer plug to the rear of the Model 575. Plug in the transformer.

CAUTION: DO NOT switch the "PC/EXT" power switch inside the 575 to "PC" when operating the 575 off the transformer supply. This can send a transient through the PC's 5V supply and crash the computer system. It does no damage to the 575, but may damage the computer under some conditions. To return to internal power, first turn off the computer.

Leave the 575 turned on and then unplug the transformer from the back of the 575. Wait a few minutes for the voltage to decay in the 575 power supply. Turn the 575 off, and then set the internal switch to "PC". Turn the computer and 575 back on.

12. Connect the power cable of the PC to a properly grounded 3-wire outlet.
13. If this is a floppy disk system, insert your DOS diskette in Drive A:.
14. Turn on the computer. It should complete power-on self test and boot as usual. If the computer behaves abnormally during or after the power-on self test, or if you encounter error messages or other problems, turn off the computer and check your work. If you cannot solve the problem, contact Keithley Data Acquisition and Control Applications Support.
15. If you are installing the Model 575 in a PS/2 computer with Microchannel architecture, you should now do the hardware configuration as described in the IBIN-PS/2 manual. This procedure makes reference to a Soft500 diskette as the "option diskette". For KDAC500/I, the option diskette is the Supplemental Diskette. The necessary disk file is "@6571.ADF". Note that you must perform this installation with a "back-up copy" of the IBM Reference diskette as described in your computer documentation.

This completes installation of the Model 575 hardware.

A Note on External Power Supplies

The Model 575 can be powered by several different methods. Normally, the system operates from +5V which it receives from the computer bus through the IBIN card and cable. The power supply section of the Model 575 converts a portion of this power to $\pm 15V$ which is also required by the Model 575.

The maximum current draw of the Model 575 is specified as 2A. Generally, a computer with at least a 60W power supply and no high-current options will be sufficient. Example of high-current options include some types of video and memory cards, and older, full-length plug-in modem cards. If you have a marginal problem, it may become evident as a failure of the system to boot on power up, or frequent disk access or memory errors. A severe problem will probably result in the computer power supply or Model 575 power supply shutting down immediately upon power-up (the "ONLINE" or "POWER" light may flicker).

If a problem exists, the Model 575 may be powered by an external source of 8-18V AC or DC. The actual source of power may be an external AC transformer, DC supply, or automotive power connection.

NOTE: If you operate the 575 using the 15-foot "CABL-15" cable, you will require the external power supply.

CAUTION: DO NOT switch the "PC/EXT" power switch inside the 575 to "PC" when operating the 575 off the transformer supply. This can send a transient through the PC's 5V supply and crash the computer system. It does no damage to the 575, but may damage the computer under some conditions. To return to internal power, first turn off the computer. Leave the 575 turned on and then unplug the transformer from the back of the 575. Wait a few minutes for the voltage to decay in the 575 power supply. Turn the 575 off, and then set the internal switch to "PC". Turn the computer and 575 back on.

Software Installation

You should now install your data acquisition software. Consult the manual which accompanies the software for complete installation instructions. The Model 575 package includes

KDAC500/I software, which supports all functions of the Model 575. You may use KDAC500 or any other software package which supports the Model 575.

If you are using KDAC500, consult the KDAC500/I manual now, particularly the sections **covering installation for your particular disk drive and memory configurations**. After you have installed a working copy of KDAC500 to a floppy or fixed disk, continue with the following configuration information to create a KDAC500 hardware configuration file for the Model 575.

Hardware Configuration

Virtually all data acquisition software packages include some form of utility which supplies the software with a record of your specific data acquisition hardware and how it is set up. Most configuration utilities generate a file which is read into the software when you run the package.

You should now run the configuration utility for your chosen software package. Consult your software documentation for specific instructions.

Safe Control Set-Ups

Keithley Instruments manufactures its data acquisition and control products to the highest technical and safety standards. However, you, the user of this equipment, have ultimate control over how the equipment is used in the field. It is important that you follow safe operating procedures, especially where you are controlling external equipment or processes which are sensitive to power-on sequences or drive levels.

When the Model 575 is turned on, all digital channels on the Model 575 mother board power up as digital inputs, and the analog output channels stabilize at 0V output. These outputs will remain off until commanded to change state. Note, however, that any output module mounted in the Model 575 option slot may initialize with random output levels when the Model 575 is turned on. See the manual covering the specific module for more details.

If you are using an optional output module and its power-on output levels are important, you may want to use the HARDINIT.EXE utility which is included in the KDAC500/I software. HARDINIT.EXE will set the output levels of all analog and digital outputs to 0, including those on any module in the option-slot. Note that there will still be a short period between power-on of the computer and execution of HARDINIT where the output of optional digital or analog output modules may be random.

Consult the KDAC500/I Software Manual for instructions on setting up and using HARDINIT.EXE. Normally you will not need to use HARDINIT.EXE unless you plug a digital or analog output module into the Model 575 option slot.

Please consider the following points about the Model 575 and your particular applications when you design control configurations:

1. Where loss of power, interruption of the control program, or failure of any equipment can lead to unsafe conditions, do not leave equipment unattended.
2. Before you energize any external equipment or processes, make sure the computer and Model 575 have been switched on and have stabilized.
3. During power-up of the Model 575, a power-on reset circuit holds the Model 575's outputs off for a few seconds. Outputs will not respond to programmed changes during this time. After the power-on reset period, the outputs will remain off until programmed to change state.
4. If you are using the HARDINIT utility, wait until the computer has fully executed HARDINIT before powering up any external equipment or processes.
5. Revision A, B, and C of the DOM1, PCM1, and PCM2 modules, which you may use in the Model 575 option slot, do not contain a power-on reset (the feature was added with Revision D). Output lines on pre-Rev D. modules may power up in a random state under some circumstances. Do not use pre-Rev D. versions of these modules where random output at power up is undesirable. Where necessary, use the HARDINIT.EXE utility to reset these modules at power-up. Older modules can be factory-modified to include the power-on reset. Contact Keithley Data Acquisition and Control for more information.
6. DIO1 modules do not contain a power-on reset. Use the DIO1 only to sense TTL level digital signals, or for digital applications where random output at power-up is of no consequence. Use HARDINIT where necessary. DIO1A modules do contain power-on reset.
7. The AOM1, AOM2, AOM3, and AOM4 analog output modules do not contain a power-on reset. Therefore, these modules may power up with random output. Properly initialize all analog output channels with HARDINIT or a KDAC500 program before applying power to external equipment or processes. AOM5 modules do contain power-on reset.
8. AIM7 modules do not incorporate an "open thermocouple sense". Make sure thermocouple used with the AIM7 are in good condition and operating properly.
9. The CALL KDINIT command in KDAC500 will initialize digital and analog output channels to 0, and can be called after KDAC500 has loaded.
10. In some cases, external equipment or processes must be returned to a particular state before control can be interrupted or power can safely be removed. For power-down, turn off or otherwise prepare external equipment before turning off the computer or Model 575.

Program Initialization at Power-Up

The following techniques can be used with KDAC500/I software to implement automatic hardware initialization and program recovery under many circumstances. For other software, consult the appropriate documentation.

CAUTION: Any momentary loss of +5V power on the computer bus will cause the reset circuitry in the Model 575 to return the digital and analog output circuitry to the reset state.

1. To execute a KDAC500 test program automatically when KDAC500 loads:
 - A. Write and debug a KDAC500 program to perform the desired measurement or control.
 - B. Boot the computer and then enter the command KDAC500 <your program name>. The KDAC500 test program will execute automatically when KDAC500 loads.
2. To initialize all output modules to 0 when the computer and data acquisition system are turned on (the system will pause and prompt for the data acquisition system to be turned on):
 - A. Modify the AUTOEXEC.BAT file on disk from which computer boots to execute the KDAC500 HARDINIT utility. Include the HARDINIT pause option ("-p") to remind that data acquisition system must be on.

- B. Make sure all external equipment is turned off.
 - C. Boot the computer using an AUTOEXEC.BAT file containing the KDAC500 HARDINIT command.
 - D. When HARDINIT instructs, confirm that the data acquisition system is on, and then press the <Enter> key.
 - E. When AUTOEXEC.BAT completes execution, all outputs will be initialized.
3. To initialize all output modules to 0 when the computer and data acquisition system are re-energized after a power failure (the control program will not be restored):

NOTE: Output channels may produce random levels until HARDINIT initializes hardware.

- A. Modify the AUTOEXEC.BAT file on the disk from which computer boots to execute the KDAC500 HARDINIT utility. DO NOT use HARDINIT's pause option ("-p").
 - B. When power is restored, AUTOEXEC.BAT will execute HARDINIT and automatically initialize output hardware to 0.
4. To initialize all output modules to 0 and resume a control program when computer and data acquisition system are re-energized after a power failure:

NOTE: Output channels may produce random levels until HARDINIT initializes hardware.

- A. Modify the AUTOEXEC.BAT file on disk from which computer boots to execute KDAC500 HARDINIT utility. DO NOT use HARDINIT's pause option ("-p").
- B. Add as a last line of the DOS AUTOEXEC.BAT file a command to execute KDAC500 and your program: KDAC500 <your program name>. If necessary, include a DOS ChDir command before the KDAC500 command to move to the directory containing KDAC500.
- C. Write and debug a KDAC500 program to perform the desired measurement or control task.
- D. When power is applied to the computer, AUTOEXEC.BAT will execute HARDINIT. HARDINIT will initialize all output channels to 0 automatically. AUTOEXEC.BAT will then run KDAC500 which will automatically execute AUTOEXEC.BAS and your KDAC500 test program.

Technical Support

If you experience any difficulty with the Model 575 or your software, first try to determine whether the problem lies with software or hardware. You can contact Keithley technical support at (508) 880-3000. Before you call, please have the following information available.

- 1. Your computer make, model, and type, including amount of RAM, disk drives, and whether you have a coprocessor chip. Be specific; "clone" is meaningless.
- 2. The type of data acquisition software you are using with the Model 575.
- 3. Your DOS version.
- 4. A printout of your DOS AUTOEXEC.BAT and CONFIG.SYS files. If you are running KDAC500, also have a copy of your KDAC500.BAT and INSTALL.KIF files.
- 5. A list of any options of special configuration in your computer or the Model 575.

If at all possible, have your computer and data acquisition system powered up and accessible when you call. If the problem seems to be more with third-party software than the Model 575, consider contacting the publisher of the software.

Connecting Signals to the Model 575

Setting Up Measurement and Control

Signal Connections

“Channel” and “Slot”

Detailed Connection Information

Analog Input – Slot 1

Trigger – Slot 2

Option Slot – Slot 3

Analog Output – Slot 4

Digital I/O – Slot 5

Power Control – Slot 5

External Input – Slot 6

Advanced Topics

Gain

A/D Converter Ranges

Single-Ended vs Differential Input

Measuring Currents

Measuring Floating Sources

Input Filtering

Analog Output Ranges

KDAC500 Hardware Configuration Table

If You Have Trouble SHELLing to CONFIG.EXE

Setting Up Measurement and Control

The Model 575 permits you to conveniently make measurements and generate control signals for a wide variety of conditions. This section of the Model 575 manual presents information you will need for setting up the various acquisition and control functions of the Model 575.

Signal Connections

The Model 575 uses quick-disconnect terminal blocks for convenient connection and disconnection of signal leads. The AMM1A, AMM2 and AIM3A modules also provide for a ribbon cable mass termination for analog input connections. This hardware is available with newer AMM1A and AMM2 modules.

Open your Model 575 and you will note a series of brown screw-terminal blocks mounted on the rear of the Model 575 mother board. These terminals are for digital I/O. You will also note a pair of smaller brown terminal blocks located at the front of the mother board near the front panel. These terminals are for analog output and trigger input. Finally, the AMM1A or AMM2 module, as well as most other modules you may mount in the remaining option slot, will have these brown terminal blocks. See Figure 3-1.

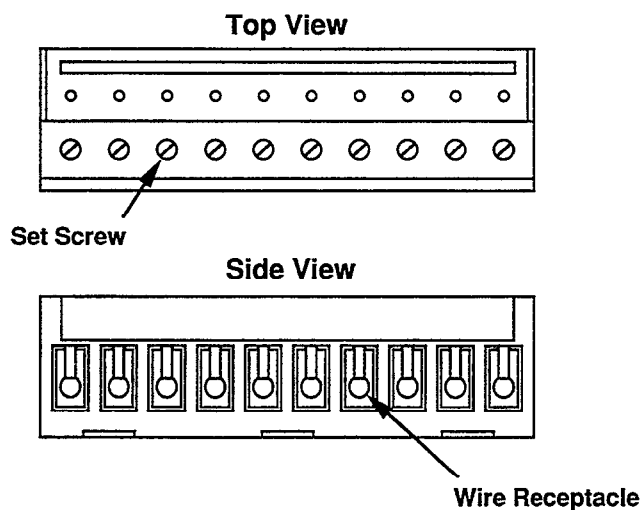


Figure 3-1. Model 575 Terminal Block

A quick-disconnect terminal block can be removed from the mother board by pulling it straight off the motherboard with a firm, even pressure. Do not pry the terminals with a screwdriver or sharp object, or you may damage the board.

CAUTION: Some older Keithley signal conditioning modules do not have removable terminal blocks. These blocks are blue, rather than brown. You may find these types of terminals on modules which you are installing in the Model 575 option slot(s). Do not attempt to remove the blue terminal blocks or you will damage the board.

To make connections to a quick-disconnect terminal block, first strip 3/16 of insulation from the end of the wire which you want to attach. Loosen the desired terminal screw on the block and slide the bare end of the wire into the hole beneath metal tab visible in the hole. Tighten the screw to compress the tab against the wire.

After you have attached all the desired signal wires to a terminal block, replace the terminal block on the mother board or module from which it was removed.

There are also four "D" holes each in the Model 575 front and rear panels that will accommodate standard BNC connectors. To install a BNC connector in the front panel, use a pointed knife to cut the panel overlay (the rear panel holes are open). Solder leads to the BNC connector and mount the connector in the open hole. Connect the leads to the desired terminal block according to the steps listed above. The rear panel also contains an empty area which can be custom punched for your own special connectors.

"Channel" and "Slot"

This manual uses the terms "slot" and "channel". Channel refers to an independent path over which signals travel between the Model 575 and the outside world. Individually-numbered screw terminals on each Model 575 terminal block provide connection to its various input and output channels. One to three screws make up a channel connection, depending on the type of measurement or control signal.

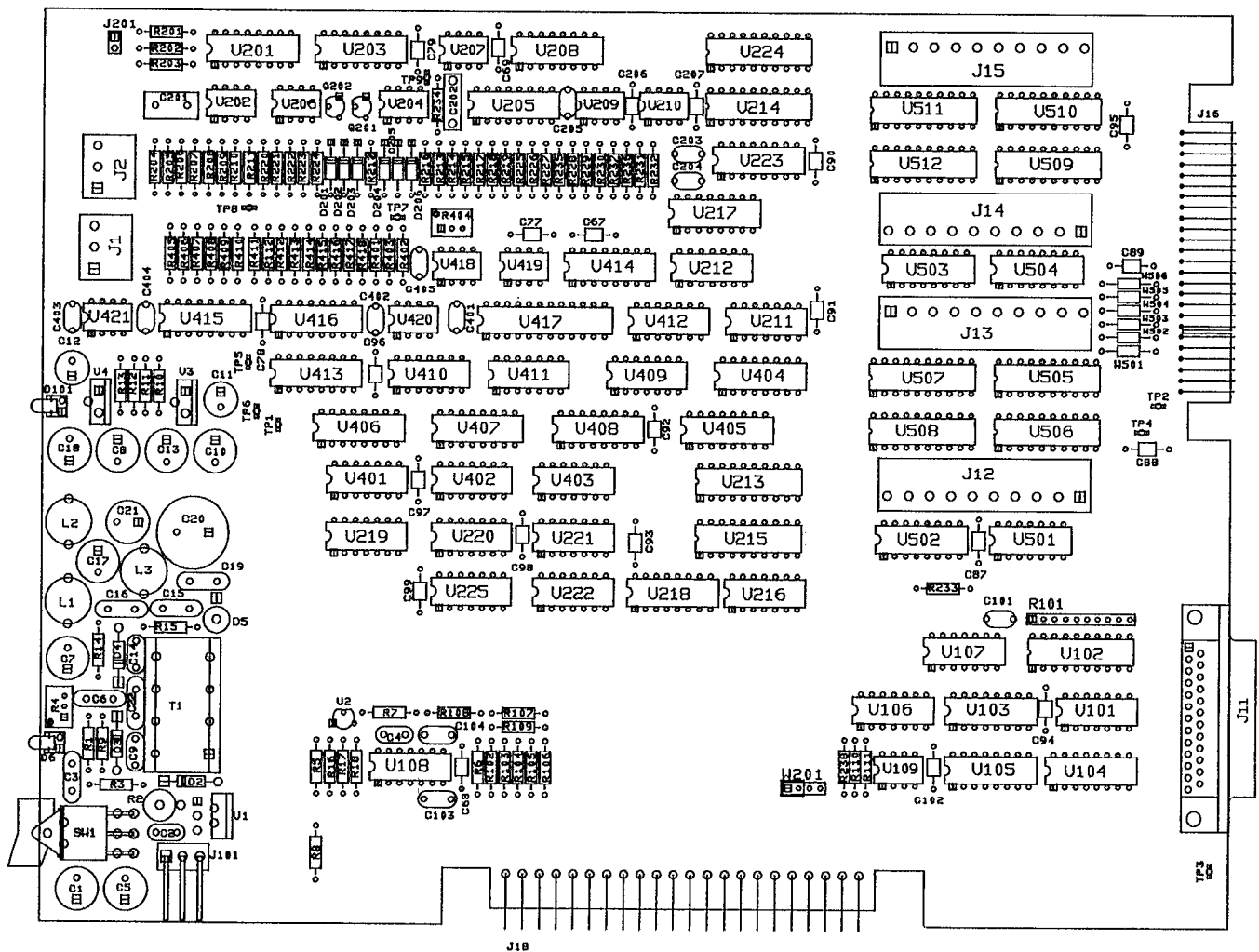
The meaning of "slot" is not as obvious as "channel". The Model 575's companion product, the 500-series, will accept up to 10 optional I/O modules which plug into physical slots on the Model 500 mother board. Thus, one describes modules as being mounted in certain "slots".

The Model 575 has two physical slots in which modules may be mounted. One slot is normally occupied by an AMM1A or AMM2 module, leaving the other slot for an optional signal conditioning module. However, the term "slot" is still associated with other I/O functions on the Model 575 mother board. The test software views the Model 575 as a series of slots into which certain modules have been mounted. Some of these are "virtual" slots which consist of circuitry built into the Model 575 mother board. Table 3-1 shows these I/O functions and their corresponding slot numbers.

The following information describes connections and jumpering for the various functions of the Model 575. You should also consult the manual for the AMM1A or AMM2 if one is mounted in slot 1. Similarly, consult the documentation for any optional module you have mounted in slot 3. Throughout the following discussion, refer to Figure 3-2, 3-3, and 3-4 which are component and terminal I/O drawings of the Model 575 mother board and side-board.

Table 3-1. Model 575 Functions and Slot Assignments

Slot	Type	Function
1	Physical slot	Used to mount an AMM1A or AMM2 (described hereinafter as "AMM") analog input module, or an option module where analog I/O is not required.
2	Virtual slot	Trigger circuitry performs all functions of the TRG1 module.
3	Physical slot	Used to mount optional signal conditioning module.
4	Virtual slot	Analog output circuitry performs functions of an AOM5/2 analog output module.
5	Virtual slot	Digital I/O circuitry performs all functions of DIO1A TTL digital I/O module.
6	Virtual slot	8 single-ended analog inputs which are connector compatible to Analog Devices 3B or equivalent signal conditioning systems. Termination on Model 575 sideboard for ribbon cable connector. NOTE: These external analog inputs are shown in the KDAC500 configuration table as being slot 6. This is for convenience only. The external function actually uses the AMM global analog inputs 3-10 which feed the A/D converter of the AMM module in slot 1. If an analog input module is used in slot 3, only 7 external inputs will be available.



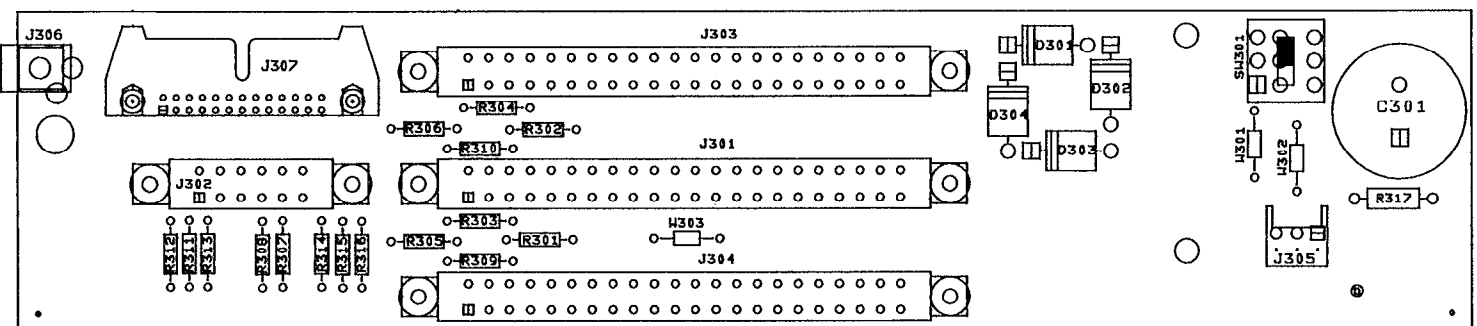


Figure 3-3. Model 575 Sideboard

Analog Input – Slot 1

The lower option slot is normally occupied by AMM1A in the Model 575-1, or AMM2 module in the Model 575-2. The AMM1A offers 12-bit A/D resolution, while the AMM2 offers 16 bits. Both AMM modules are physically identical, and share the same speed performance. If your system is a Model 575-1 or 575-2, it includes an AMM module and corresponding manual. Consult the AMM manual for more information on the AMM1A or AMM2 module.

The AMM modules contain quick-disconnect terminals for connection of up to 8 differential channels or 16 single-ended channels. If the AMM module is used in single-ended mode, connect the input signal to the desired signal terminal screw (0-15). Connect signal low to an AMM SGND terminal.

If the AMM module is used in differential mode, connect the signal high input to the desired (+) terminal 0(+) to 7(+). Connect signal low to the corresponding (–) terminal. Attach the cable ground to the AMM GND terminal screw. See Figure 3-4.

NOTE: For best analog input performance, be sure to use the proper ground screw on the AMM module for single-ended or differential measurements. Single-ended measurements use the SGND screw for signal low. Differential measurements use the GND screw for the cable shield connection. Do not use the SGND terminal as part of differential measurements.

NOTE: You may have to detach the AMM mounting bracket from the rear panel of the Model 575 to make or change analog connections. Be sure to reassemble the bracket when you are done.

NOTE: The AMM module input mode is controlled through software. Be sure to update the KDAC500 configuration table (or other test software configuration data) to indicate that you want to operate the AMM module in single-ended or differential mode. The default operating modes for the AMM1A and AMM2 are 16 single-ended inputs and $\pm 10\text{V}$ A/D converter range.

The AMM modules are fully software programmable; there are no hardware switches. Programmable features include local amplifier gains of X1 and X10, global amplifier gains of x1, x2, x5, and x10, programmable filter (2kHz or 100kHz), and 0-10V unipolar or $\pm 10\text{V}$ bipolar A/D ranges. The AMM modules also contain DIP sockets for current shunt, pull-up, and pull-down resistors which are sometimes useful in making analog measurements. The A/D converter on the AMM modules also performs A/D conversion for any other analog input module which may be plugged into the system. Further, these modules can also perform an A/D gain and offset calibration under software control.

If analog input is not required, slot 1 may be used for another module.

NOTE: The precision reference on the AMM module is used by the Model 575 analog output circuitry. If an AMM module is not mounted in the Model 575, the analog output circuitry will not achieve its rated accuracy.

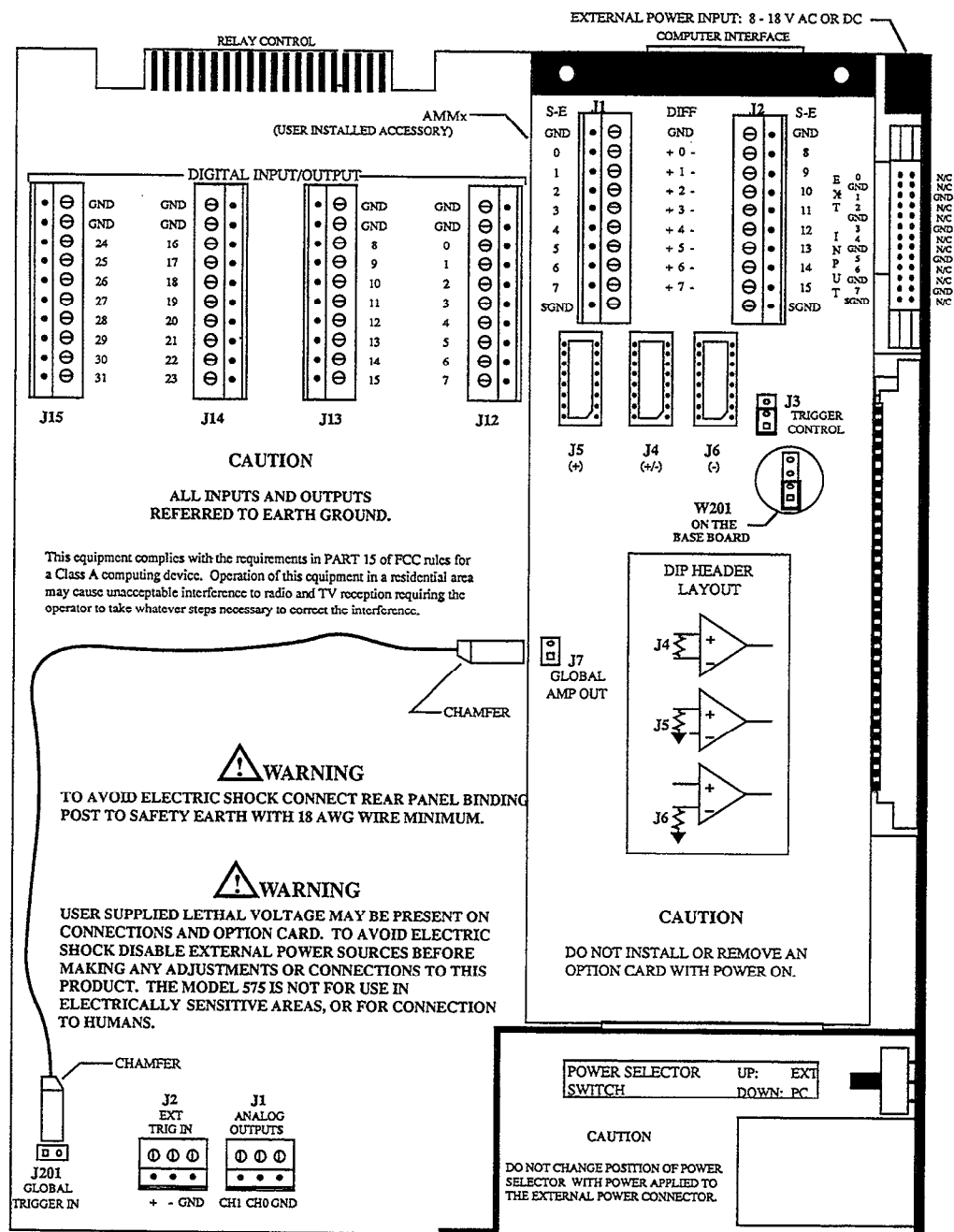


Figure 3-4. Model 575 I/O Connections

Trigger – Slot 2

The trigger function is built into the Model 575 mother board and provides one trigger input channel. Further, the Model 575 will support the use of a TRG1 trigger module in the option slot 3, giving the Model 575 the ability to acquire data on logical AND and OR combinations of the two trigger signals.

The trigger function is a true hardware trigger by which data acquisition and control can be synchronized to external digital or analog signals. The trigger input is located on terminal block J2 at the forward left corner of the Model 575 mother board. Jumper W201, which also controls trigger operation, is located on the Model 575 mother board beneath the option slot area.

The trigger function only operates in the AMM module's high-speed "auto-acquire" mode which is driven by the crystal oscillator on the AMM module. If you are running KDAC500, the trigger function requires simultaneous use of the ANINQ and ANTRIG commands.

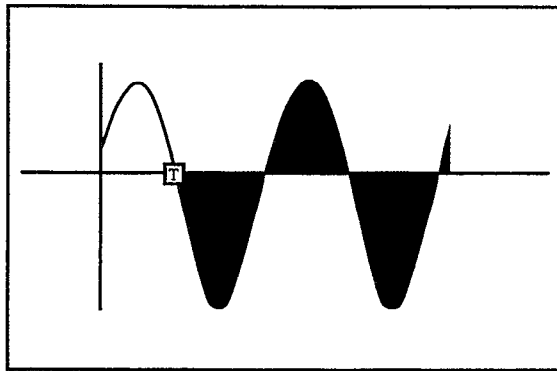
The Model 575 mother board also includes a global input to the trigger circuitry, which is accessed via the "GLOBAL IN" connector J201. J201 is located in the forward left corner of the Model 575 mother board. This connector permits a signal input to the AMM module to also be used as the trigger input without requiring that the signal be connected to J2.

NOTE: The GLOBAL OUT terminal on the AMM1A and AMM2 modules is located near the top edge of the module. If you want to use the global input feature of the trigger circuitry, you must connect the GLOBAL OUT terminal pins of the AMM module to the GLOBAL IN terminal pins of the Model 575. If a TRG1 module is also plugged into the Model 575 option slot, you must connect the GLOBAL IN pin terminals of both the Model 575 and TRG1 module to the GLOBAL OUT pin terminals of the AMM module. A cable for this purpose (CA-85-1) is provided with the 575 and TRG1 module. Refer to Figure 3-4.

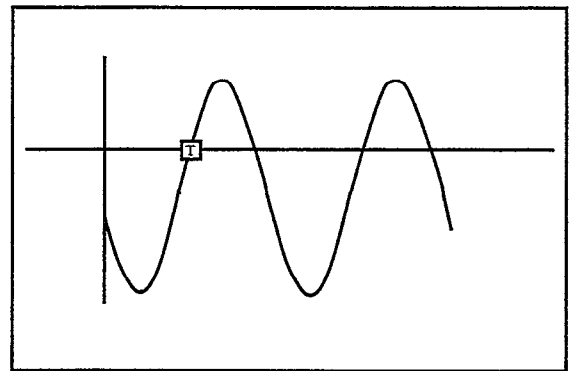
NOTE: Make sure the trigger cable is installed correctly or you may introduce noise into the measurements. The trigger cable extends from the GLOBAL OUTPUT J7 at the top edge of the AMM module to the trigger GLOBAL INPUT terminal J201 on the Model 575 mother board. Pay close attention to the orientation of the beveled corner on the connector at each end of the cable. The bevel must be over pin 1 on J7 and over pin 2 on J201.

Typical trigger modes include the following (see Figure 3-5):

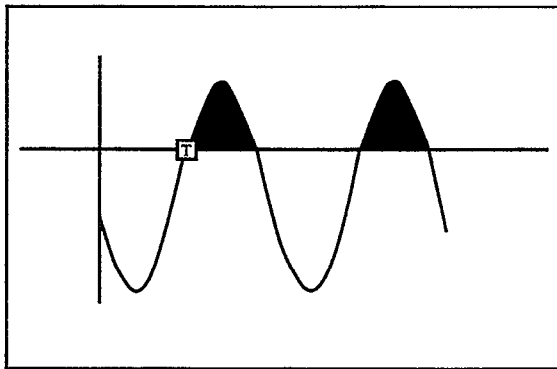
1. Trigger at a user-defined threshold on the falling slope of the trigger signal. Stop when the prescribed number of points have been acquired.
2. Trigger at a user-defined threshold on the rising slope of the trigger signal, and acquire data only when the signal is above the threshold. Stop when the prescribed number of points have been acquired.
3. Trigger at a user-defined threshold on the falling slope of the trigger signal, and acquire data only the first time the signal goes below the threshold level. Stop when the signal goes back up above the threshold.
4. Trigger at a user-defined threshold on the rising slope of the trigger signal and take only one reading. Normally used to trigger a reading off of another channel.
5. Trigger at a user-defined threshold on the falling slope of the trigger signal and acquire one reading. Repeat each time the trigger condition is satisfied until the prescribed number of points have been taken. Normally used to synchronize readings to an external event.



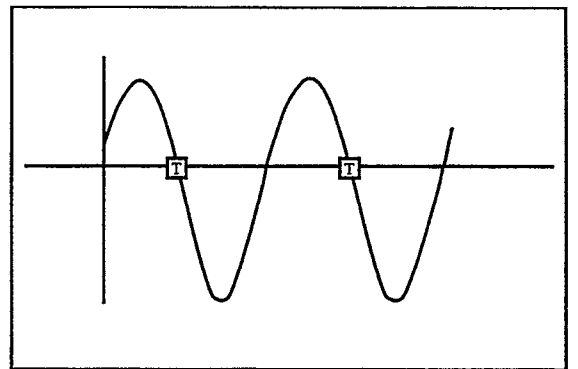
1.



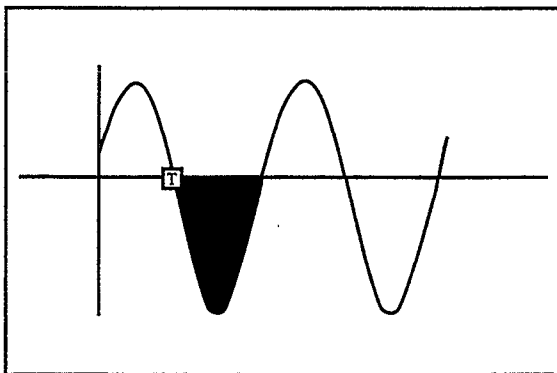
4.



2.



5.



3.

Figure 3-5. Typical Trigger Modes

Setting Jumpers for Trigger Modes

Jumpers on the Model 575 mother board and the AMM module select and configure the trigger function. If a TRG1 module is added to the Model 575 option slot, it must also have its jumpers configured (see Figure 3-4).

Single Trigger Input – to trigger an AMM1A or AMM2 analog input module off a single trigger signal fed to the Model 575, set jumpers and connections as follows:

Model 575 trigger jumpers – Locate W201. Jumper pin 1 to pin 2. Connect the trigger signal to J2.

AMM module – place jumper J3 over pins 1 and 2. Connect the signal of interest to one of the AMM input channels.

Dual Trigger Inputs – to trigger an AMM1A or AMM2 analog input module off some combination of two trigger signals, add a TRG1 module to slot 3. Set jumpers and connections as follows:

“OR” Operation (data will be acquired when the trigger conditions assigned to either trigger input is satisfied):

Model 575 trigger jumpers – Locate W201. Jumper pin 1 to pin 2, and pin 3 to pin 4 (2 jumper blocks required). Connect one trigger signal to the Model 575 at J2.

Optional TRG1 jumpers – Locate W1. Jumper pin 1 to pin 2 and pin 3 to pin 4. Connect the other trigger signal to the TRG1 input.

AMM module – place the jumper J3 over pins 1 and 2. Connect the signal of interest to one of the AMM input channels.

“AND” Operation (data will be acquired only when the trigger conditions assigned to both trigger inputs are satisfied):

Model 575 trigger jumpers – Locate W201. Jumper pin 2 to pin 3 (1 jumper block required). Connect one trigger signal to the Model 575 at J2.

Optional TRG1 jumpers – Locate Jumper W1. Connect pin 1 to pin 2. Connect the other trigger signal to the TRG1 input.

AMM module – place the jumper J3 over pins 1 and 2. Connect the signal of interest to one of the AMM input channels.

NOTE: To gain access to the jumpers on the AMM module and Model 575 mother board, you must remove the AMM module from slot 1. If you have a module in slot 3, you must also remove it to gain access to the AMM module and Model 575 mother board.

Option Slot – Slot 3

The Model 575 has two option slots. Slot 1 is normally used for an AMM1A or AMM2 analog measurement module. The second option slot can be used to operate any one of several modules from the Keithley Module Library. Normally, you will install a module in the option slot to provide a capability which is not built into the Model 575. Examples are modules for isolated input, current input or output, thermocouples, strain gauges, frequency measurement, and LVDTs.

Consult the Keithley catalog for more information on specific available module functions and capabilities. If you are in doubt as to the compatibility of a certain module with the Model 575, contact Keithley Data Acquisition and Control product support in the U.S. at (216)248-0400.

CAUTION: Before you install or remove a module from the Model 575 option slot, turn off the Model 575 front panel power switch or you will damage the module.

To install an optional module, see the manual for your option module for any required configuration of gains, ranges, switches, etc. Set up the module and make connections according to your application. Hold the module with the component side facing upward. Insert the rear edge of the module into the upper module guide located on the power supply shield, and slide the module into the upper option slot connector. Attach any necessary mounting screws or strain relief to complete the hardware installation. If you are using both slots for option modules, install the slot 1 (lower) option module first. The steps are the same as outlined for slot 3.

NOTE: If you install an option in the Model 575, be sure to change the KDAC500 configuration table (or the configuration data in your specific software package) to show the presence of the optional module. Indicate all gains and other necessary setup information in the configuration data.

NOTE: A module you plug into the Model 575 may have gain or range setting switches, or may be totally software-configured. In either case, any set-up for the optional module will only govern the performance of that module.

NOTE: The use of some option modules may require more power than is available from the bus of your computer. If so, power the Model 575 from an external source, such as the optional wall transformer. A power supply kit, 575-PWR, is available from Keithley.

Analog Output – Slot 4

The analog output function is built into the Model 575 mother board, and consists of two high-speed 13-bit output channels which behave as an AOM5 module. Terminal screws are

located on J1 at the forward left corner of the Model 575 mother board. The Model 575 analog output circuitry has a 5 μ S settling time, and can theoretically achieve speeds upwards of 200kHz. However, the speed of the computer limits the analog output speed, with a typical speed being about 50kHz for a 10MHz 80286-based computer. High-speed analog output is supported in Keithley's KDAC500 software by the ANOUTQ (ANalog OUTput Quick) command.

There are restrictions as to the output capabilities of each channel. Generally, there is an upper limit on the amount of capacitance and a lower limit to the resistance that can be connected across the output. To avoid possible oscillation, load capacitance must be less than 100pF.

If it is necessary to drive a capacitive load larger than 100pF, a 100 Ω or larger resistor must be placed in series with the output. This will slow down the settling time somewhat, depending on the value of the capacitive load. If an analog output channel must drive a load with both low resistance and high capacitance, the output must be buffered by an external voltage amplifier.

Similar restrictions apply to the output current, which is determined largely by the resistive component of the load connected across the output. If the resistance is too small, accuracy will suffer. To maintain rated accuracy, the load resistance should be no smaller than 2k Ω with a maximum output of ± 10 V. Maximum output current is 5mA or less.

The analog output circuitry also offers an "auto-sequence" mode which can be implemented through PEEK and POKE commands or assembler language. This feature makes it possible to write optimized high-speed analog output routines. It is described later in this manual.

NOTE: The Model 575 analog output function uses 10.00 V precision reference on the AMM module. If an AMM1A or AMM2 module is not mounted in slot 1, the Model 575's analog output feature cannot be used at the rated accuracy.

Digital I/O – Slot 5

The digital input and output functions are built into the Model 575 mother board. Digital I/O consists of 32 non-isolated, TTL-compatible channels which can be configured in groups of eight channels for input or output (see Figure 3-4).

TTL standards define an input "0" or "low" as being less than 0.8V, and an input "1" or "high" as being greater than 2.0V. A typical output high level is 3.75-4V.

The channels are configured through software control. When the Model 575 is switched on, and before any software has been run, all digital channels on the Model 575 mother board initialize as input channels. The digital I/O channels can be accessed individually, or as ports A, B, C, and D, each port being eight channels. Four terminal blocks (J12 – J15) are located at the rear of the Model 575 mother board. These terminal blocks provide connections to the 8 channels plus two ground screws for ports A, B, C, and D, respectively. The ports correspond to the connectors as shown in Table 3-2.

CAUTION: If you are using a software package other than KDAC500, the software may initialize the digital output channels differently.

CAUTION: Do not short a digital output terminal to ground or you may damage the digital circuitry of the Model 575.

WARNING: The digital ports C and D are used for power control as well. Do not leave a PCM3 relay board connected to the Model 575 mother board unless you are doing power control.

Table 3-2. Digital Channels and Ports

Connector	Port Designation	Channel Numbers
J12	A	0-7
J13	B	8-15
J14	C	16-23
J15	D	24-31

Power Control – Slot 5

Ports C and D of the digital I/O circuitry can also be used for power control. These ports are internally connected to the card-edge J16 located at the rear of the Model 575 mother board (see Figure 3-4). Thus, they are shared by the power control connector and C/D port digital terminals. When the ports are used for power control, they should not be used for digital I/O, and vice versa.

Power control requires the optional PCM3 relay card and ribbon cable assembly, plus whatever relays are needed for the application. The power control function includes switching of external loads as well as sensing when current is flowing through an external circuit. The ports C and D can both be configured for sensing, control, or one port can be dedicated to each function. You must select relays according to the voltage range, function, and AC or DC voltage. See Table 3-3 for available types.

WARNING: The digital ports C and D are used for digital I/O as well. Do not leave a PCM3 relay board connected to the Model 575 mother board unless you are doing power control.

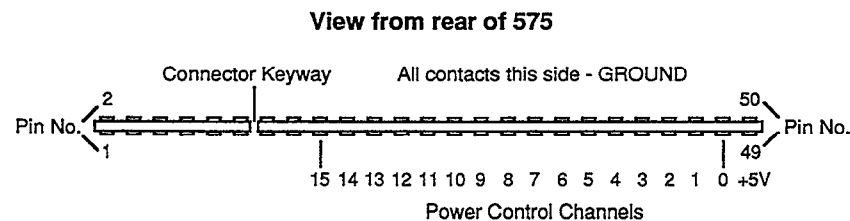
When programming the power control (output) function, note that the logic is “low-true”. The output of the Model 575 channel corresponding to a selected relay must be set to logic “0”, or “low” in order to turn on the relay. A channel will be read as “low” when a sensing relay detects current flow to an external load.

NOTE: The PCM2 module is similar in function to the power control circuitry of the Model 575. The PCM2 module includes an external relay board and ribbon cable, and uses the same

types of relays. Note, however, that the PCM module inverts the control signals that are sent to its external relay board. Thus, you would write a logic "1", or "high", to a channel corresponding to a selected relay in order to turn on the relay. This is the opposite of what must be done for the Model 575's built-in power control channels.

Table 3-3. Power Control Relays for the PCM3

Keithley P.N.	Description
500-OAC1	120VAC Control Relay
500-OAC2	240VAC Control Relay
500-IAC1	120VAC Sensing Relay
500-IAC2	240VAC Sensing Relay
500-ODC1	60V DC Control Relay
500-ODC2	200V DC Control Relay
500-IDC1	32V DC Sensing Relay



- Notes :
1. All even pins are ground.
 2. Pin 49 is +5V
 3. Mating connector - 3M Scotchflex PN 3415-0000
 4. Mating cables - Opto CA-x (2 connector ends), Opto 00-x (1 connector, 1 bare end)
 5. Any user-supplied connector other than 3M-Scotchflex 3415-0000 must have key to match keyway on card edge.

Figure 3-6. Power Control Pinout

External Input – Slot 6

The external input function offers eight single-ended analog input channels for direct connection to an optional Analog Devices 3B signal conditioning rack, or any single-ended input. Connection is made through mass-termination connector J307 which is located near the lower option slot on the Model 575 sideboard assembly. The connector is a 26-pin ribbon-cable type. You will normally make connection to this termination using a cable you receive with the Analog Devices 3B subsystem. The pinout data for this connector is shown on Figure 3-4.

Input signals from J307 are routed directly to the global multiplexer of the AMM module in slot 1 along analog pathways 3-10 as shown in Table 3-4. This frees all the input channels on AMM module for other signals. As such, the external input is really an extension of slot 1, not slot 6. Slot 6 is used in the KDAC500 configuration table for convenience in setting up channel names.

The external signals are selected by the AMM global multiplexer and sent to the AMM A/D converter for digitizing. Programmable global gains of x1, x2, x5, and x10 can be applied to external analog input signals. However, local gain is not available.

Table 3-4. External Input Channels - Slot 6

External Input Channel	AMM Global Multiplexer Input
0	10
1	9
2	8
3	7
4	6
5	5
6	4
7	3

NOTE: If an analog input module is used in slot 3 of the Model 575, the external channel 7 will not be available for use.

NOTE: The EXTERNAL function requires an AMM module in Slot 1. The input signal may be analog or digital.

Advanced Topics

The following information covers topics which will enable you to optimize the performance of your Model 575.

Gain

Most analog input modules compatible with the Model 575 offer some type of gain which can be applied to the input signal. The gain will be set according to software parameters, or with older modules, according to hardware switches on the module.

The value of applying gain conditioning is that it can increase a relatively low input voltage before the voltage is digitized by the A/D converter. This provides a greater number of A/D counts which improves the effective resolution of the reading.

For instance, with a 12-bit A/D converter input range of $\pm 10V$, an input of 0V produces 2047 counts from the A/D converter, while 0.1V produces 2068 counts. With a gain of X100 applied, the 0.1V signal will be amplified to 10V at the input of the A/D converter. This corresponds to 4095 counts from the A/D converter. Thus, the A/D converter now breaks a difference of 0.1V into 2048 steps, not 20. This substantially improves the resolution of the measurement.

Two types of gain are available. First, the AMM1A and AMM2 modules and several other analog input modules include a front-end amplifier called the "local gain amplifier" or "instrument amplifier". This stage applies gain to the signals input directly to the screw termi-

nals of that module. For the AMM1A and AMM2 modules, local gain is selected through software control, and consists of x1 and x10 gain ranges. Other modules may have available gains of x1, x10, x100, or x1000, set through software control or hardware switches depending on the module. Some “high-level input” modules, such as the AIM2, have a gain of only x1.

The second type of gain available in a Model 575 is applied by an amplifier stage immediately before the AMM A/D converter. The amplifier stage is called a “global gain amplifier” because its gain can be applied “globally” to any analog input signal as it is routed to the system A/D. This circuitry and the A/D converter are both located on the analog master measurement module. In the case of the Model 575, this is an AMM1A or AMM2 module. The global gain amplifier normally has ranges of x1, x2, x5, and x10, which are selected on a channel-by-channel basis through software.

Local gain and global gain can both be applied to a signal simultaneously, and the overall gain is multiplicative. Therefore, gains as high as x10,000 are available (AIM8 module local gain at x1000, followed by A/D global gain of x10).

NOTE: To optimize low-level measurements, use shielded cable and other low-noise measurement techniques, such as differential input. Use the proper ground terminal on the analog input module for connection of the cable shield. As much as possible, avoid noisy environments. These are good practices for any measurement set-up, but especially important when measuring low-level signals.

A/D Converter Range


A second general method of optimizing analog input signals is to change the A/D converter input range. The AMM1A and AMM2 modules used in the Model 575 provide two A/D ranges: -10V to +10V and 0 to +10V. This range is selected through software.

Changing the A/D converter range allows you to more precisely match the converter to the voltage produced by the instrument amplifier. You can make measurements with different A/D ranges, global amplifier gains, and local amplifier gains in your test programs. This matches the system to a wide range of voltage inputs.

Single-Ended vs Differential Input

Analog inputs applied to the Model 575 will fall into two general categories: single-ended inputs and differential inputs. These input schemes can usually be identified by the numbers of wires which must be connected for one signal.

Single-ended inputs normally have two wires, or a wire and shield. For two wires, one wire is generally considered the signal lead, while the other is the ground lead. For a shielded cable, the center wire is usually signal, while the shield is ground.

 **WARNING:** To prevent a shock hazard, the ground lead of equipment powered from 115V AC must be connected to ground potential. The voltage difference between the equipment ground and the Model 575 ground should never exceed a few millivolts.

CAUTION: Maximum input voltage for Model 575 inputs is $\pm 15\text{V}$. Note that if any input exceeds $\pm 10\text{V}$, all inputs will be inoperative.

Differential signals may have two or three wires. For two-wire circuits, one wire is signal positive and the other is signal negative. Unlike single-ended configurations, this negative lead is not necessarily at ground potential. Three-wire differential inputs normally consist of a positive lead, a negative lead, and a ground shield.

Differential outputs are commonly found on laboratory instrumentation and other precision instrumentation. The use of two leads plus ground offers maximum immunity from common mode noise and ground loops. The shield should be connected to the GROUND terminal screw on the analog input module.

Whether you use a differential or single-ended input depends on several factors. You can measure many types of differential signals in single-ended mode. Three-wire differential signals must be measured in differential mode. Low-level signals should be measured in differential mode to minimize noise. Differential input should also be used where maximum precision is required. Single-ended mode affords the greatest number of channels, and can be used where you need the maximum number of inputs for measuring higher-level voltages.

Measuring Currents

The Model 575 cannot measure current directly, but it can measure the voltage drop produced across a resistor when current flows through the resistor. The AMM1A and AMM2 modules have three 16-pin DIP sockets (J4, J5, and J6) see Figure 3-4, each of which accepts a "header" plug which can hold up to eight analog input resistors. Each resistor must be connected from a pin on one side of the header to the corresponding pin on the other side of the header. See the AMM1A or AMM2 manual for details.

For differential current measurements, the header must be plugged into J4 on the AMM module. This places the resistor across the (+) and (–) inputs of the differential channel.

For single-ended current measurements, the header must be plugged into J5 and J6 on the AMM module. This places the resistor across the (+) and ground inputs of the single-ended channel.

Choose a value for the resistor which produces a voltage drop of one to a few volts. Calculate the resistor value you need with Ohm's law $E = I \times R$,

$$E \text{ (desired voltage drop)} = I \text{ (in amperes)} \times R \text{ (in ohms)}$$

Generally, you may choose any resistor value which gives a suitable voltage drop. To avoid heating which may affect measurement accuracy, make sure the maximum power dissipated in the resistor is well within the power rating of the resistor. Calculate this dissipation with another Ohm's law equation,

$$P = I^2 \times R$$

There is one case where you must install a specific value resistor. KDAC500 includes an engineering units flag which facilitates measurement of 4-20mA current loops. This EUF returns a reading of current in milliamps. It equates 4mA as 1V measured across the resistor, and 20mA as 5V. Ohm's law requires a resistor value of 250 ohms for this relationship to hold. Single-ended or differential mode can be used. Resistors with a value of 250 ohms @ 0.01% are available from DALE resistors; part number RN55E2500B, or from Keithley in packs of eight resistors as 500-RES-250.

Measuring Floating Sources

You may need to install analog input resistors when you measure a floating signal in differential mode. A floating signal has no low-impedance return path to ground. Under these circumstances, the input of the AMM module or other analog input module may exhibit a capacitive effect and build a charge from the input signal. Over several minutes, the common mode voltage may rise until the analog input no longer functions properly. This causes no damage to the module, but does make it impossible to measure signals.

The solution is to connect a resistor of 10K ohms or less from the negative analog input terminal to ground for each signal input. These resistors can be soldered to headers plugged into input resistor sockets on the module. The header should be plugged into J6 on the AMM module.

Input Filtering

When noise is a problem, filtration may be applied to analog input signals. The AMM1A and AMM2 modules in the Model 575 both include a programmable filter between the global gain amplifier and A/D converter stages. This filter has cut-off frequencies of 100kHz and 2kHz.

Where further filtering is desired, a single-pole input filter may be placed on the incoming signal line for any analog input (see Figure 3-7). The relative RC values will depend on a variety of factors, including the frequency of the noise, the required attenuation, and the necessary response time. The RC values can be computed from the formula:

$$f_{(3db)} = \frac{1}{2\pi RC}$$

Where f is in Hz, C is farads, and R is ohms. The resulting system response time within .01% is then equal to $9.2 \times RC$.

As an example, assume that 10 counts of 60Hz noise is present in the signal. To reduce the noise to one count, an attenuator factor of 10(-20dB) will be necessary at 60Hz. A single-pole filter will roll off at a rate of -20dB per decade. Thus, a 3dB point of 6Hz would be chosen to attenuate to 60Hz noise by -20dB. Rearranging the above equation to solve for R we have:

$$R = \frac{1}{2\pi \times C \times F_{(3db)}}$$

Picking a nominal value of 0.5 μ F for C, the necessary resistance is:

$$R = \frac{1}{2\pi \times (0.05 \times 10^{-6}s) \times 6}$$

$$R = 53,000 \text{ ohms}$$

The resulting response time (T_r) is:

$$T_r = 9.2 \times RC$$

$$T_r = 9.2 \times 53000 \times 0.5$$

$$T_r = 0.24 \text{ sec}$$

Note that there are a number of RC values that can be used in a given application. To minimize the effects of the series resistance, however, it is recommended that the value of R be kept as low as possible.

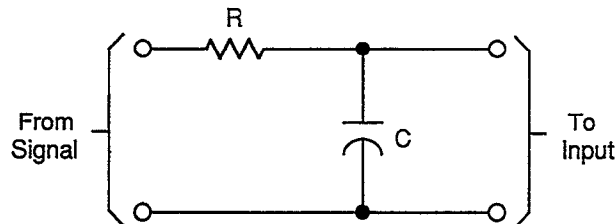


Figure 3-7. Single-Pole Input Filter

Analog Output Range

You may select from several ranges for the Model 575 analog output function. The default D/A range is $\pm 10V$. Available ranges of analog output are $\pm 10V$, $\pm 5V$, $\pm 2V$, and $\pm 1V$.

The analog output converter circuitry is 12 bits plus a sign bit. For unipolar ranges, the D/A output will be divided over 4096 steps. For bipolar operation, the sign bit causes the polarity of the converter to be positive or negative. The result is that the full A/D range of -10 to $+10V$ is effectively divided into 8192 steps. By selecting a narrower output range, the output resolution can be improved further at the expense of the available voltage span. Programming $+0V$ or $-0V$ results in the same output.

The analog output range is set through software control. For KDAC500 software, the CONFIG.TBL file selects the output range.

Model 575 Technical Reference

Introduction

Communicating with the PC

Interface Card

Power Supply

Model 575 Mother Board

Mother Board Functions

Analog Input

Analog Trigger

Option Slot

Analog Output

Digital Input and Output

Relay Control

External Input

Command Locations in Numeric Order

Introduction

In the sections that follow, you will find a discussion of the Model 575 interface, power supply, mother board, including theories of operation and command locations (addresses). Command locations are generally of interest only to users who want to access the Model 575 on a low level, such as when performing diagnostics or writing custom software.

System mother board information includes an explanation on how the Model 575 communicates with the PC.

Hardware information pertaining to the operating functions of the Model 575 is broken down into the following sections (see Figure 4-1):

1. Analog Input and A/D Conversion
2. Trigger Control
3. Optional Modules
4. Analog Output
5. Digital Input and Output and Relay Control
6. External Input Function

Communicating with the PC

Communication between the Model 575 and the computer is based on a memory mapped input/output system, where each command function is mapped to a memory location in system memory. The Model 575 command location is located in a segment of memory 128 bytes long which can be set to occupy the last 128 bytes of any consecutive 4k block of system memory. The specific locations for the Model 575 Input/Output commands are determined by setting switch set S1 on the IBIN-A, or by configuring the POS registers in the PS/2 for the IBIN-PS/2.

Theoretically, there are 256 regions of memory where the interface might be assigned. However, many regions of memory are used by the computer's internal memory or other hardware, and are unavailable as addresses for the Model 575. Keithley recommends the 128 byte segment of memory beginning at hex address CFF80. Alternately, most systems can accommodate the IBIN anywhere in the block D0000-DFFFF. The memory locations given in this manual assume CFF80. An address prefaced with "xxx", implies that the first three characters of the address are "CFF". If the IBIN interface card is configured for a different address, the information given in this manual must be modified.

The Model 575 has a number of memory mapped command locations, as mentioned previously. Command locations will aid those users not planning to use KDAC500 with the Model 575.

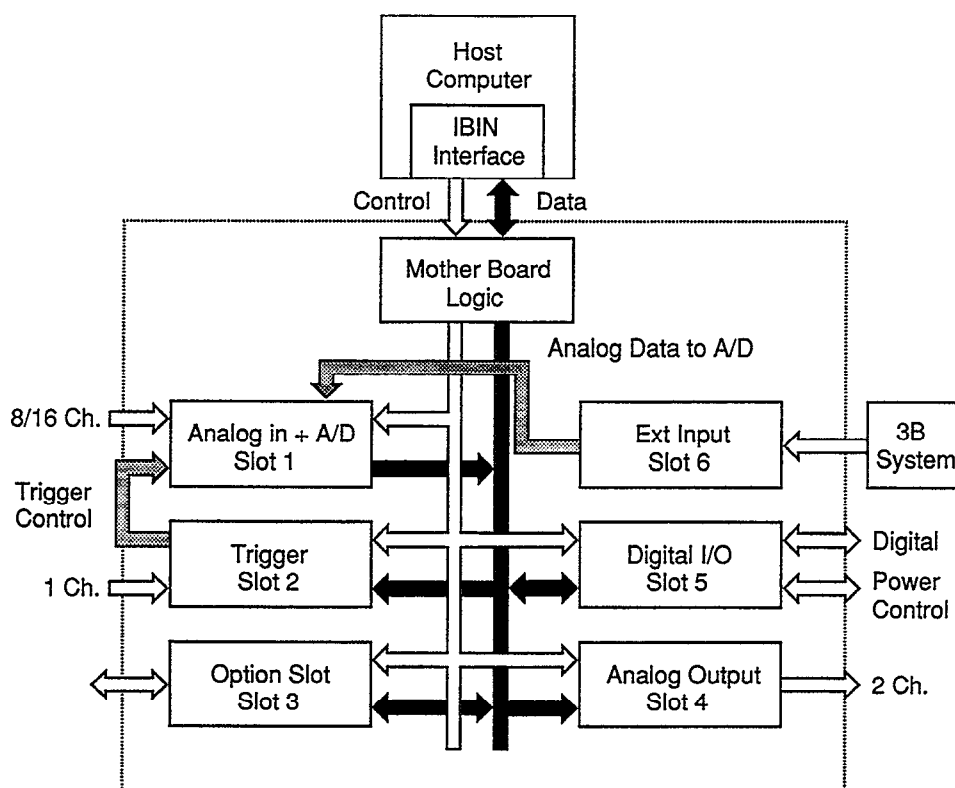


Figure 4-1. System Block Diagram

Interface Card

The IBIN (IBM Interface) card plugs into a slot in IBM, Compaq, and 100%-compatible computers. Beside acting as a logical interface, the IBIN supplies +5VDC to the Model 575 where it is converted to ± 15 VDC and +5VDC for powering the Model 575.

The address programming of the IBIN-A or IBIN-PS/2 card determines the most significant 8 bits of the Model 575's address region. The 128 bytes comprising the actual command region of the Model 575 is positioned at the top of a 4k block.

The cable connecting the PC to the Model 575 is a shielded 25-contact cable.

Consult the manual for your particular type of IBIN card for details on installation, switch settings, and other information.

Power Supply

Components on the Model 575 mother board are powered by +5 volt and ± 15 volt power supplies. Input power to the system can come from a variety of sources. Power can be supplied by the host PC (5VDC @ 2A max) or by an external power source 8-18V AC or DC at 3A max. Keithley offers a power adapter kit, 575-PWR, which contains a wall mount transformer, 12VAC @ 2A, and an automotive power adapter. This versatility results from the use of a switching power supply located on the mother board, and a full wave bridge rectifier located

on the side board. Switch S301 (on the side board) selects the input power source; down for power from the PC, up for the external power adapter.

The power consumed by the power supply remains nearly constant across the specified supply range for a particular Model 575 configuration. This means that less supply current is drawn at higher supply voltages. The Model 575 will consume 10-25 watts when powered externally.

Refer to schematic drawing number 575-106, page 2, for the following discussion:

PC Power Operation

Input to the power supply from the PC bus enters at J11. This regulated +5V is applied to the mother board circuits requiring a +5V supply and is also applied to the input of the switching regulator U1 (LT1070CT). U1 operates as a pulse-width modulated flyback switching regulator, and outputs a square wave with varying duty cycle to the T1 primary. Diodes D3 and D5 rectify the output of T1. After filtering by a pi-type LC filter, linear post-regulators U3 and U4 provide a +15 and -15 volt supply to all of the analog circuitry in the system Model 575.

CAUTION: DO NOT switch the "PC/EXT" power switch inside the 575 to "PC" when operating the 575 off the transformer supply. This can send a transient through the PC's 5V supply and crash the computer system. It does no damage to the 575, but may damage the computer under some conditions. To return to internal power, first turn off the computer. Leave the 575 turned on and then unplug the transformer from the back of the 575. Wait a few minutes for the voltage to decay in the 575 power supply. Turn the 575 off, and then set the internal switch to "PC". Turn the computer and 575 back on.

Optional Power Pack/Automotive Adapter Operation

External power is selected by setting switch SW301 located on the Model 575 sideboard assembly to the external power position. The power pack or automotive adapter plugs in to J101 on the rear of the Model 575 cabinet. The bridge rectifier formed by D301 through D304 provide rectification of the AC input from the power pack, or passes the DC from the automotive adapter or DC source through one half of the bridge.

The unregulated voltage is then applied to the input of U1. The balance of operation is similar to PC power operation with the exception that the +5V supply is used to power the mother board logic circuits. Note that, if the 575 is powered from an external source, it must still be connected to the computer before the "POWER" lamp will light.

Power Indicator and Reset Circuit

Components U2, U108C, U108D, U106D, U106E, and associated components function as a combined power-up reset circuit and power supply test circuit. U2 is a 2.5V reference. The switching supply +5V output is reduced by voltage divider R5/R6 and compared to U2's output by U108D. When the power supply output exceeds 4.4V, the output of U108D goes to a

high impedance state. U108C similarly checks the +5V supply coming from the host computer. When both power supplies are above 4.4V, capacitor C4 charges through R17. When the voltage on C4 reaches about 2V, Schmitt trigger gate U106E switches low, turning on the power indicator D6 and releasing the RESET line. If the power supply cannot start up or is overloaded, the power supply +5 level will be below 4.4V, keeping D6 off and asserting RESET low.

Model 575 Mother Board

The mother board, shown in Figure 4-2, contains circuitry for trigger operation, digital input, digital output, and relay control. The mother board also includes the system control circuitry which is responsible for the generation of commands.

After the required control and data processing, signals are fed through the interface cable to the mother board. Additional logic circuitry further decodes the control signals into the various command signals that control operation. The purpose of the various commands will depend on the particular operating function. With the digital input, for example, commands are used to read data bits out of the channel. Similarly, these commands control latching of data to turn the PCM outputs on or off. With the analog output section, data is latched into DACs (Digital to Analog Converters). For the analog triggering circuitry, these commands control latching of data into trigger level and sense circuitry and the selection of various triggering modes.

Digital commands also control the analog input and the analog-to-digital conversion process that transforms analog signals into digital information that can be used by the computer. Analog to digital conversion is controlled by the particular Analog Master Measurement module (AMM) that is installed in slot 1 of the side board. See the AMM manual for specific information on the AMM module.

Two option slots are located on the side board assembly which is mounted vertically to the right edge of the motherboard. Slot 1 is used for the AMM1A or AMM2 module. The other, slot 3, is used for optional modules. If analog input is not required, both slots can be used for motion control, analog output, or other digital applications.

The side board, shown in Figure 4-3, contains a full-wave bridge rectifier for the optional AC transformer (which will pass DC from the optional automotive adapter), the power input select switch, a connector to interface an Analog Devices Series 3B modular rack to the 575, and three card edge receptacles (the connector for the mother board, the connector for slot 1 and an AMM module, and the third connector for an optional module (this can be any single module from the Series 500 module catalog, except the STEP modules).

Figure 4-4 illustrates the pinout diagram of the option slot connector. Power for the mother board (+5V, +15V and -15V supplies) comes from the power supply in the Model 575 which, in turn, operates from the 5V supply of the computer. This 5V power is derived from the computer's bus or an external voltage source.

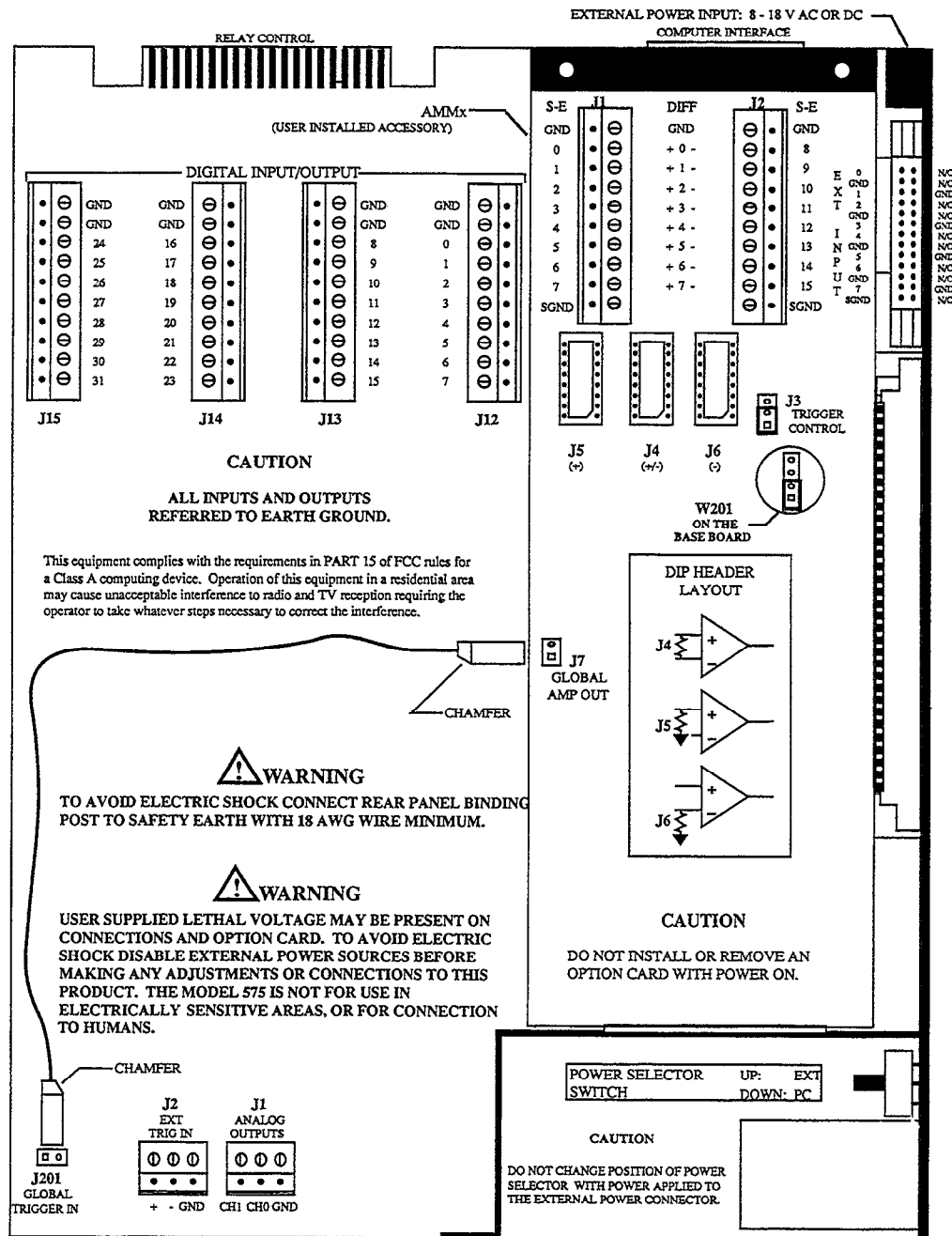


Figure 4-2. System Mother Board

Table 4-1. Model 575 Slot Assignments

Slot	Type	Function
1	Physical slot	AMM1A or AMM2 analog input module, or other module where analog I/O is not required.
2	Virtual slot	Trigger circuitry.
3	Physical slot	Optional signal conditioning module.
4	Virtual slot	Analog output circuitry.
5	Virtual slot	Digital I/O circuitry and relay control.
6	Virtual slot	8 single-ended analog inputs which are connector compatible to Analog Devices 3B or 100% equivalent signal conditioning subsystem. Termination on Model 575 sideboard for ribbon cable connector.
<p>NOTE: These analog inputs are shown in the KDAC500 configuration table as being slot 6. This is for convenience only. The external function actually uses the AMM global analog inputs 3-10 which feed the A/D converter of the AMM module in slot 1. If an analog input module is used in slot 3, only 7 external inputs will be available.</p>		

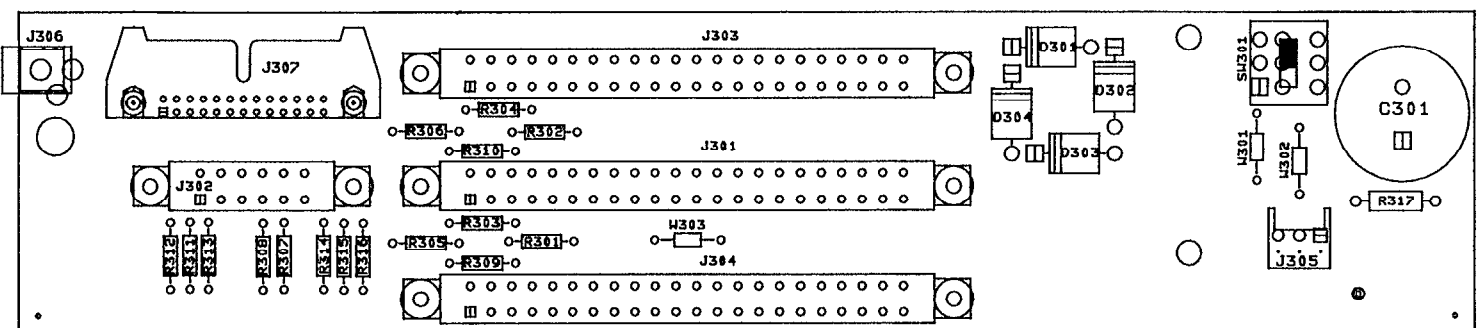
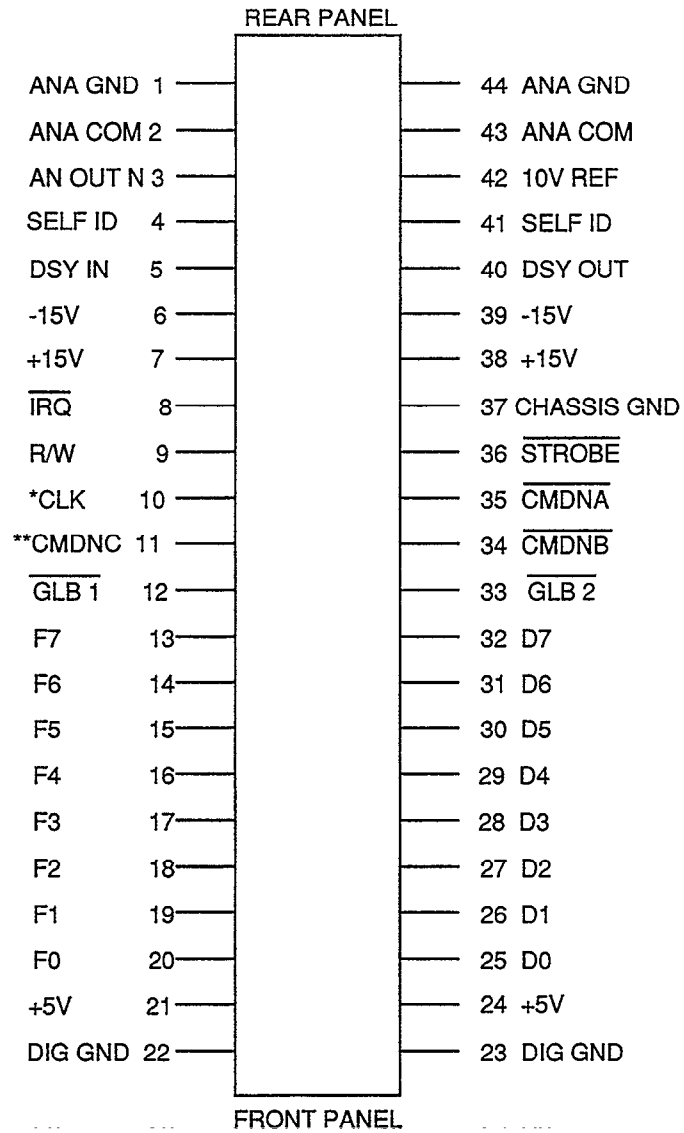


Figure 4-3. System Side Board



* In slot 1 pin 10 carries CMDC and pin 11 carries CMDD.
 + In slots 2 and 3 pin 11 carries CMDC.

Figure 4-4. Option Slot Pinout

Mother Board Functions

The mother board-based features and functions of the Model 575 include the hardware trigger, option slot, analog output, digital input and output, power control, and the “external” input function. The following information describes the functions and command locations for each slot in the Model 575. This includes the physical slots 1 and 3, and the virtual slots 2, 4, 5, and 6. The descriptions of command locations assume that the IBIN card address is CFF80.

Analog Input

All analog input functions are served by an Analog Master Measurement module AMM installed in slot 1 of the side board. The default analog input range accepts signals up to $\pm 10\text{V}$ full scale with $300\mu\text{V}$ resolution-per-bit for the AMM2 module, or 4.88mV -per-bit resolution for the AMM1A. Both modules offer 16 channels of single-ended input or 8 channels of differential input at 50kHz (AMM2) or 62.5kHz (AMM1A) A/D speed.

The AMM modules also provides a 2kHz/100kHz filter, a high-speed multiplexing, and local gain amplification of $\times 1$ or $\times 10$. Global gain signal conditioning is provided by a high-speed programmable gain amplifier. The programmable gain (“global”) amplifier offers software-controlled gain steps of $\times 1$, $\times 2$, $\times 5$, and $\times 10$.

CAUTION: Always turn off system power before making any connections or adjustments to the Model 575. To minimize the possibility of EMI radiation, never operate the system with the top cover open.

Jumpers, optional resistors, and screw terminals are user-configured components on the AMM modules. DIP headers are provided for the installation of optional resistors between the positive and negative input terminals. With these resistors in place, the analog input can be modified to allow for current to voltage conversion. DIP headers also permit the installation of a resistor from input low or high to ground for each channel. With the appropriate resistors, the analog input can be modified to accept current inputs in the single-ended mode, or provide a return path for bias currents from “floating source” signals in the differential mode.

Two quick-disconnect terminal blocks provide signal connection for all analog inputs. Each terminal block provides eight terminals for signal inputs. Screw terminals accept 16-24 gauge wire stripped 3/16 of an inch. The terminal blocks lift off the mother board to simplify the connection process. Revision D and later AMM modules also accept a ribbon connector socket and plug. See your AMM manual for details.

The AMM modules have provisions for a maximum of 16 single-ended input channels or 8 differential input channels. For many applications, differential measurements floated from ground are required; these measurements must be made using the differential mode.

NOTE: When the differential mode is used, noise common to both input lines is reduced due to increased Common-Mode Rejection.

CAUTION: To minimize the possibility of EMI radiation, use shielded cable for input signals. Connect the shield to module ground, but do not connect the opposite end of the shield to anything. Maximum input voltage is $\pm 15\text{V}$. If any input exceeds $\pm 10\text{V}$, all inputs will be inoperative.

Gain

The AMM module contains circuitry which allows you to apply a software-programmed global gain. This gain will affect any signal which is connected to the analog input of the Model 575 (including signals connected to an optional AIM module). This is because incoming signals are routed through the programmable gain amplifier before they are sent to the A/D converter. Since this is a programmable amplifier, different gain can be programmed for each measurement channel.

Programmable global gain is available in four steps: x1, x2, x5, and x10. To apply a particular gain, you must write the appropriate value to the GLOBAL GAIN command location. See the discussion of the GLOBAL GAIN command for more information.

Programmable Filter

The AMM modules include a programmable filter immediately before the A/D sample-and-hold input. The filter is a single-pole type with cutoff frequencies of 2kHz and 100kHz. The AMM2 100kHz filter requires a 16 μS settling time, and prevents high-frequency noise from affecting the A/D conversion. The 2kHz filter requires a 800 μS settling time, and reduces noise that may have been picked up with the signal (AMM1A conversion time is 12 μS with 600 μS settling time for the 2kHz filter). The 2kHz filter is especially useful with higher gains, where it reduces thermal noise by a factor of 5.

Analog-to-Digital Conversion

Analog-to-Digital Conversion is the final element of the multiplexed analog input subsystem. The analog-to-digital converter receives conditioned signals from all analog input channels via the global circuitry.

The A/D converter offers fast, accurate measurement and digitization. A conversion time of 16 μS and a sample and hold acquisition time of only 4 μS allows sampling speeds as high as 50 kHz with AT computers.

To take full advantage of the converters resolution, ranges of $\pm 10\text{V}$ and 0-10V can be selected through software.

When programming high-speed sampling sequences, certain timing constraints of the A/D conversion cycle should be kept in mind. When the A/D START COMMAND is issued, the converter begins immediately to assess the value of the signal, a process which takes 16 μS to complete. During this time, the sample and hold remains in the hold mode, freezing the sig-

nal for the duration of the conversion. When the conversion is complete, new data is made available for reading, and the sample and hold returns automatically to the sample mode and begins to track the signal again.

If the signal has changed significantly since the beginning of the last conversion, the sample and hold requires some time to adjust to the new voltage. This period is called the “acquisition time” of the sample and hold, and is 4 μ S. Thus, a new conversion cannot be started for at least 4 μ S following the completion of the last conversion.

To increase system throughput, a data latch has been provided which makes data from the last conversion available while the converter is busy with another conversion. The data is refreshed (updated) as soon as the converter has finished its current conversion cycle.

Analog Input Command Locations

The commands associated with Slot 1 are Commands A, B, C, and D (CMDA1, CMDB1, CMDC1, and CMDD1). Since slot 1 is normally associated with the AMM1A and AMM2 modules, the following information concerns those modules. Note, however, that if slot 1 is used for any other module, the applicable command functions are determined by that module. See the following chart and pages for detailed information. You may also consult the AMM1A or AMM2 module manuals for details.

Table 4-2. SLOT 1 (AMM) Command Locations and Functions

Read Functions:		
COMMAND	ADDRESS	FUNCTION
CMDA1	xxx80	(D4=1) Read low data bytes (D4=0) Read status
CMDB1	xxx81	Read high data bytes
CMDC1	N/A	Not used
CMDD1	xxx9B	Read Status

Write Functions:		
COMMAND	ADDRESS	FUNCTION
CMDA1	xxx80	Select channel, gain, modes, filters.
CMDB1	xxx81	Select slot, range, global gain, read mode.
CMDC1	xxx9A	Reset and recalibrate A/D gain and offset.
CMDD1	xxx9B	Start conversion

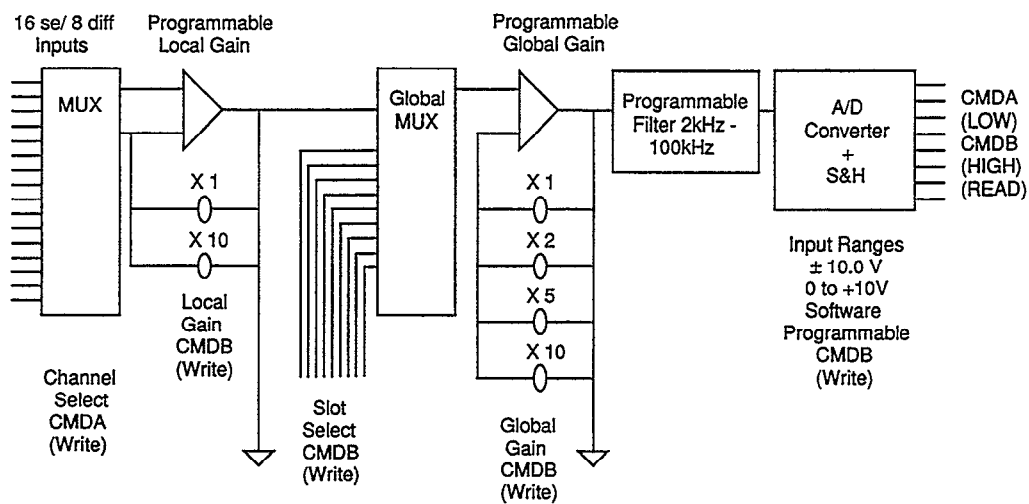
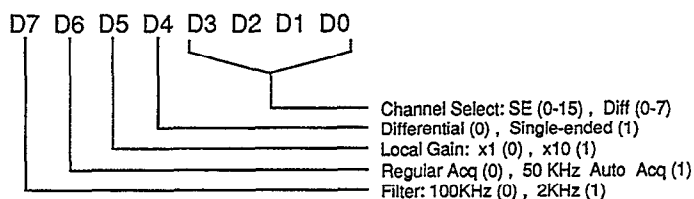
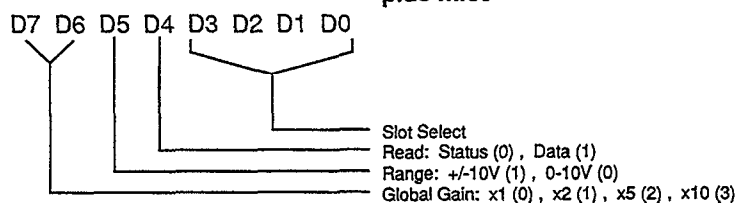


Table 4-2. SLOT 1 (AMM) Command Locations and Functions, cont'd

CMDA1 (write) Address xxx80 - Select: channel, local gain, filter, plus misc



CMDB1 (write) Address xxx81 - Select: slot, range, global, gain, plus misc

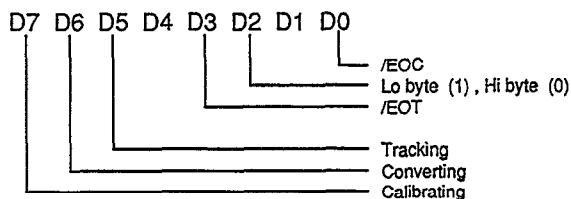


CMDC1 (write) Address xxx9a - Reset and recal the A/D (360 mSec).

CMDD1 (write) Address xxx9b - Start Conversion

CMDA1 (read) Address xxx80 - (D4 = 1) Read Low Data Byte

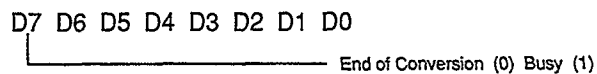
CMDA1 (read) Address xxx80 - (D4 = 0) Read Status



CMDB1 (read) Address xxx81 - Read High Data Byte

CMDC1 (read) Not Used

CMDD1 (read) Address xxx9b - Read status



Analog Trigger

The Model 575 contains circuitry for real-time triggering with a wide variety of input and output options. Input ranges are 0 to +1V, 0 to -1V, 0 to +10V, and 0 to -10V with a resolution of 8 bits. The trigger circuit can be cascaded with a secondary trigger module installed in the option slot for AND/OR conditional triggering.

Refer to schematic drawing 575-106 for the following discussion:

The triggering circuit can be divided into three sections: the command decoding circuitry, the analog input and comparator circuitry, and the trigger/level selection circuitry.

In the command circuitry, input data from the PC bus is buffered by octal latch/buffers U213 and U214 (74LS273). Output data to the bus is buffered out by the octal transparent latch U215 (74LS373). Command and read/write information is decoded by U211, U212, and U216. Input selection is accomplished by a 4-to-2 demultiplexer U223 (74LS153) and quad analog SPST switches U201 and U203 (DG211). The CMDA2 write cycle controls trigger input and configures the trigger and IRQ outputs. The command B2 write cycle controls the selection of filter, range, AC or DC coupling, and triggering edge. The command C2 write cycle latches the trigger level data (in counts) into the D/A converter U208 (AD7523JN) by the octal latch/buffer U224 (74LS273). The command A2 read cycle latches the trigger status information to the PC data bus from U215. The command B2 read cycle also retrieves status information. Additionally, it performs a manual reset of the trigger and IRQ latching circuits. Command C2 read is not implemented.

There are four possibilities of input selection: external analog input (EXT TRIG IN) at J2, global amplifier input (GLOBAL IN) at J201, update from the global strobe, and no trigger input. Input selection is accomplished by electrically switching the input with the quad SPST analog switches U201 and U203; by disabling both inputs and strobing the addressing of the demultiplexer at U223; or deselecting all inputs. Gain selection is performed by switching precision resistors in and out of the feedback circuitry of the dual JFET op amp U202 (LF412CN). Filtering of the input signal is accomplished by a series of precision resistors (R213 through R219), an 8-channel analog demultiplexer U205 (IH6108) and a capacitor (C202). The filter cap is fed by switching in one of the seven (or no) resistors to form a single-pole low pass filter with cutoff frequencies of 300Hz, 1kHz, 3kHz, 10kHz, 30kHz, 100kHz, 300kHz, and 1 MHz.

Polarity selection is performed by switching the reference voltage on the D/A converter U208 between +10 and -10 volts. Edge selection is performed by demultiplexing the inputs from the dual one shot U217 (74LS221) in the 4-to-2 demultiplexer U218 (74LS153) to separate IRQ and trigger pulses dependent upon the trigger region status. The POS PULSE output from U217A is enabled whenever the input is above the trigger voltage. This 500nsec pulse is switched to the 2Y output of U218 when triggering on the rising edge is selected. Similarly, the NEG PULSE output from U217B is switched to the 2Y output when the input is below the trigger voltage and triggering on the falling edge is selected. The IRQ is handled similarly but is dependent upon the selection of IRQ on trigger start or trigger finished.

For input to the trigger circuit from the AMM global amplifier, a low-loss transmission line, part number CA-85-1, is included with the Model 575. Since the global output amplifier on the AMM card is capable of amplifying at relatively high frequency, a low capacitance con-

nection is required to minimize distortion of the input to the trigger circuit. For low frequency applications, a regular wired connection would be sufficient. In any case, a wired path must be provided to the global amp input of the trigger circuit (if used) as none is provided on the mother board.

In applications requiring the use of two trigger circuits (the circuit on the mother board and the modularized version of the Series 500 TRG1 which is completely compatible), two jumpers are located on the board in a single 4 pin header identified as W201.

ONE TRIGGER CIRCUIT (Model 575 mother board only)

Jumper pins 1 to 2, and 3 to 4 to enable A/D triggering on the AMM module installed in slot 1.

TWO TRIGGER CIRCUITS (575 mother board and TRG1 module in the option slot)

The use of two trigger circuits allows the user to trigger the A/D on (A or B) or (A and B).

LOGICAL OR (A or B)

Jumper pins 1 to 2, and 3 to 4 on both trigger circuits.

LOGICAL AND (A and B).

Jumper pins 1 to 2, and 3 to 4 on the trigger circuit installed in the option slot.
Jumper pins 2 to 3 on the mother board trigger circuit.

The trigger circuit, through the use of a power up reset circuit, allows power up in a known condition. Power up conditions are as follows:

No trigger input selected

IRQ and A/D trigger disabled

The trigger is set up for continuous mode on all events of the trigger condition

The 1MHz filter is selected

Trigger is set for falling edge and DC coupling

Trigger Command Locations

The commands associated with the slot 2 Trigger function are Commands A and B (CMDA2 and CMDB2). See the following chart and pages for detailed information.

Table 4-3. SLOT 2 (TRIGGER) Command Locations and Functions

Read Functions:		
COMMAND	ADDRESS	FUNCTION
CMDA2	xxx82	Read trigger status
CMDB2	xxx83	Read trigger status and reset TRG/IRQ latches
Write Functions		
COMMAND	ADDRESS	FUNCTION
CMDA2	xxx82	Interrupt and trigger setup
CMDB2	xxx83	Select filter, range, coupling, and edge
CMDC2	xxx98	Set trigger voltage

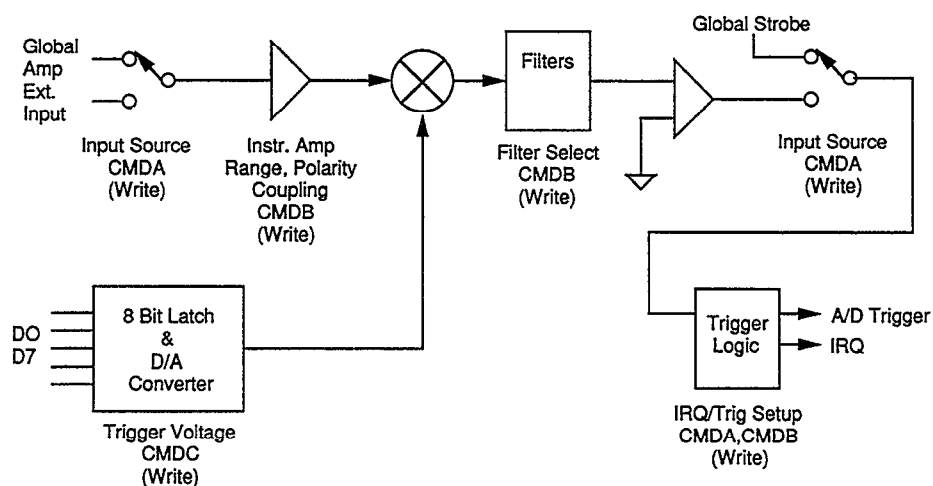
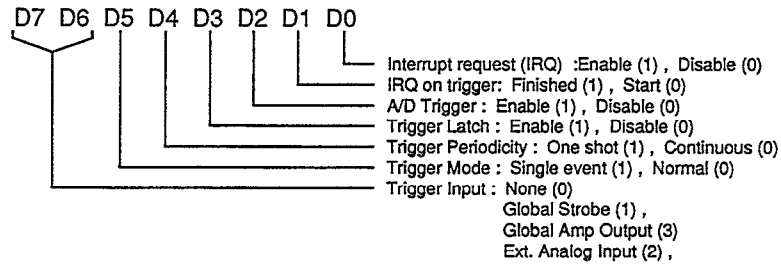
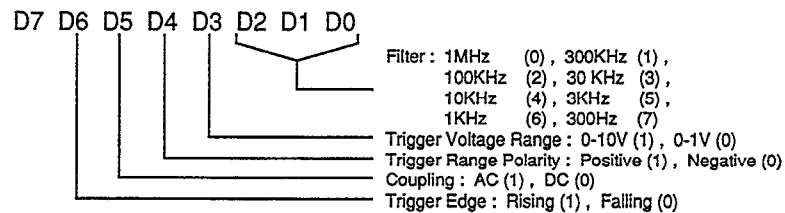


Table 4-3. SLOT 2 (TRIGGER) Command Locations and Functions, cont'd

CMDA2 (write) Address xxx82 - IRQ and Trigger setup

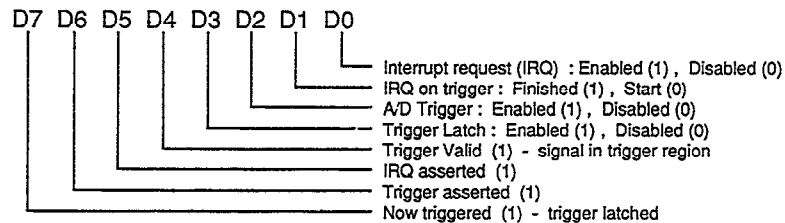


CMDB2 (write) Address xxx83 - Select Filter, Range, Coupling, Edge



CMDC2 (write) Address xxx98 - Trigger Voltage (0 - 255)

CMDA2 (read) Address xxx82 - Read Status



**CMDB2 (read) Address xxx83 - Reset Trigger and One Event Latch
Data same as CMDA Read Above**

Option Slot

All Keithley modules compatible with the Model 575 are listed in the MODULE section of this manual. Always consider the power consumption of any module you plug into the option slot, especially those which supply excitation to several channels (e.g. AOM4 and AIM8). Some modules require more operating current than others. In the case of a marginal computer power supply, the option module may exceed the power available from the computer. This would necessitate use of an external power supply for the Model 575.

Installation

Perform the following procedure to install a compatible Keithley module in the Model 575:

1. Turn off the power to the Model 575.
2. Hold the module with its component side facing upward and its cable clamp toward the rear of the Model 575. Make sure the rear edge of the module is positioned in the card guide located on the Model 575 power supply shield. Slide the module into the option slot until it is firmly and evenly seated in the option slot connector. Mount the module to the Model 575 rear panel using the L-bracket provided with the Model 575.
3. Close the top cover and turn on the Model 575 front panel power switch.
4. Update the KDAC500 configuration table file CONFIG.TBL, or otherwise inform your software that the new module is in place.
5. When programming the Model 575 keep in mind that the module is located in "Slot 3".

Option Slot Command Locations

The functions of the option slot command locations depend on the module installed in the slot. Command lines A, B, and C are available. See the following table and pages for specifics.

Table 4-4. SLOT 3 (OPTION) Command Locations and Functions

Read and Write:		
COMMAND	ADDRESS	FUNCTION
CMDA3	xxx84	See manual for installed module.
CMDB3	xxx85	See manual for installed module.
CMDC3	xxx99	See manual for installed module.

The option slot (slot 3, directly above the AMM(x) module included with the Model 575 unit) utilizes the following command locations :

CMDA3 (READ OR WRITE) Address xxx84

CMDB3 (READ OR WRITE) Address xxx85

CMDC3 (READ OR WRITE) Address xxx99

Usage of these command locations depends upon the module that is installed in the option slot. Consult the appropriate manual for the command information necessary to the proper operation of optional modules.

Analog Output

The Model 575 provides two channels of high-speed analog output. Each channel has an independent D/A converter. A system strobe feature, supported by two levels of data latching in the D/A converter, allows both D/A channels to be updated simultaneously.

The D/A converters offer 13-bit resolution with a maximum nonlinearity of $\pm 0.024\%$. Four output ranges are available for each converter: $\pm 10V$, $\pm 5V$, $\pm 2V$, and $\pm 1V$. These ranges are selected through software. The D/A converters offer true 12-bit resolution plus a sign bit. A sign bit switches the output of the 12-bit converter either positive or negative. Thus, the effective resolution for a bipolar range is 8192 steps from the negative output limit to the positive output limit. Programming $+0V$ or $-0V$ results in the same output.

Refer to schematic drawing 575-106 for the following discussion:

The analog output circuitry can be divided into three groups: multiplying D/A conversion circuitry for each channel, command decoding circuitry for each channel, and data buffering circuitry.

The primary components of the D/A conversion circuitry are a single 12 bit dual channel D/A converter (AD7537), reference buffer amplifiers (LF353N), and dual DPDT analog switches (DG423DJ). The dual channel converter contains high speed analog switches, two levels of data latching, and a precision resistor ladder network.

The D/A converter is designated U417 and serves both output channels through the use of output amplifiers U420 and U421 (LF412CN). Output range selection is accomplished by switching precision resistors into the feedback networks of the output amps with quad SPST analog switches U415 and U416 (DG211DJ). Switches are selected by the dual 2 to 4 decoder U413 (74LS139).

The command decoding circuitry is composed of U401 thru U409 and U412. A quad transparent latch U404 (74LS75) stores the 4 bit command select data. A 4 bit presetable counter U405 (74LS163) provides auto sequencing of the write commands for register selection. Write commands are decoded by U401, U402, U403, and U412.

Selection of polarity is accomplished by switching a $+10$ volt or -10 volt reference to the reference inputs of the D/A converter U417 by the analog switch U414. The D/A output amplifiers U420A and U420B invert the output signal. A negative reference is used to develop a positive output, and vice-versa. A negative polarity is selected when the D7 bit is set in the MSB of the 2 byte D/A data word.

Calibration of the analog output circuit is not necessary other than the calibration of the $+10$ volt reference voltage (described in the Model 575 calibration procedure).

NOTE: The Model 575 analog output circuitry uses the $10V$ precision reference of the AMM card, and will not operate at rated accuracy without an AMM module mounted in slot 1.

NOTE: For analog output connections, use shielded cable to minimize the possibility of EMI radiation. Connect the shield to ground. Leave the other end of the shield disconnected.

Output Limitations

There are restrictions as to the output capabilities of each channel. Generally, there is an upper limit on the amount of capacitance and a lower limit to the resistance that can be connected across the output. To avoid possible oscillation, load capacitance must be less than 100pF.

If it is necessary to drive a capacitive load larger than 100pF, a 100 Ω or larger resistor must be placed in series with the output. This will slow down the settling time somewhat, depending on the value of the capacitive load. If an analog output channel must drive a load with both low resistance and high capacitance, the output must be buffered by an external voltage amplifier.

Similar restrictions apply to the output current, which is determined largely by the resistive component of the load connected across the output. If the resistance is too small, accuracy will suffer. To maintain rated accuracy, the load resistance should be no smaller than 2k Ω with a maximum output of $\pm 10V$. Maximum current output is 5mA or less.

Automatic Register Sequencing

The Model 575 analog output circuitry includes an automatic incrementing circuit for the analog output range and data registers. The incrementing circuitry aids in high-speed output programming. The following information will be useful for generating analog output by directly accessing the CMDA4 and CMDB4 registers. These operations are normally handled by KDAC500.

Generally, standard (non-auto sequenced) analog output is generated by first writing register select information to CMDA4, followed by writing the corresponding data to CMDB4. These steps are repeated until all the necessary range and output data have been written for a desired channel. For channel 0, a typical sequence might be as follows:

1. Write "15" to CMDA4 to select the channel 0 range register.
2. Write the desired range to CMDB4.
3. Write "0" to CMDA4 to indicate that the following data will be analog output low-order byte for channel 0.
4. Write the channel 0 low-order data byte to CMDB4.
5. Write "1" to CMDA4 to indicate that the following data will be analog output high-order byte for channel 0.
6. Write the channel 0 high-order data byte to CMDB4. (Note that bit D7 governs the polarity of the output.)
7. Write to the GLOBAL STROBE location (xxx9D) to update the channel 0 output.

Automatic register sequencing automates several of the write operations listed above. It first requires that a control byte be written to CMDA4 (see Table 4-5). This byte must include the

register selection and last channel desired for auto sequencing. The most significant bit (MSB) of the byte must be 1 to disable the global strobe function.

Next, data must be written to CMDB4. This data may be range data or the output low-order or high-order data byte, according to the information written to CMDA4. The information written to CMDA4 also sets the "entry point" in the autosequencing loop, thus establishing the expected order of subsequent bytes written to CMDB4. The auto sequence logic assumes that the next bytes will conform to the following sequence:

Register No.	Description	Sequence
0	Channel 0 LSB data	
1	Channel 0 MSB data	
2	Channel 1 LSB data	
3	Channel 1 MSB data	
14	Channel 1 range	
15	Channel 0 range	

Note that entry points in the loop may be range information or output data. As an example, if the initial write to CMDA4 is "14", the analog output circuitry would assume that the next byte is the channel 1 range, followed by the channel 0 range, the channel 0 least significant data byte, the channel 0 most significant data byte, and so on.

Once the sequence moves out of the range registers, it will cycle continuously through the channel registers without returning to registers 14 and 15.

If the first control byte written to CMDA4 is 0, 1, 2, or 3, the auto sequence logic will expect that the next bytes written to CMDB4 will be data. The loop will not enter the range selection registers at all.

If the first control byte written to CMDA4 specifies that channel 0 is the last channel for auto sequencing, then the loop will run only through registers 0 and 1 (channel 0 LSB and MSB data) and not include registers 2 and 3. This path will confine output to channel 0 and permit the maximum output speed from channel 0.

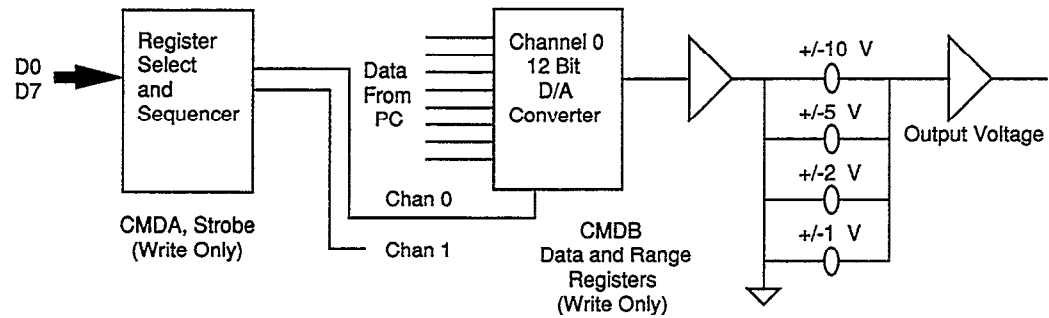
The GLOBAL STROBE must also be disabled for auto sequencing. This enables the output of a channel will be updated as soon as the MSB data for the channel is written to the channel MSB register.

Analog Output Command Locations

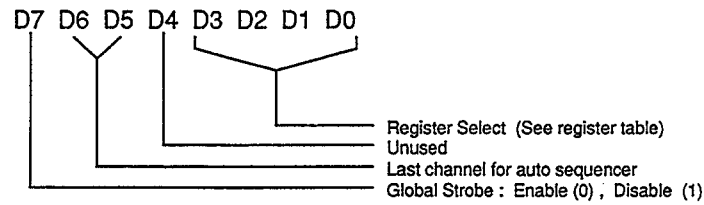
The commands associated with the slot 4 Analog Output function are Commands A and B (CMDA4 and CMDB4), plus the analog output GLOBAL STROBE. There are no read functions for analog output. See the following chart and pages for detailed information.

Table 4-5. SLOT 4 (ANALOG OUT) Command Locations and Functions

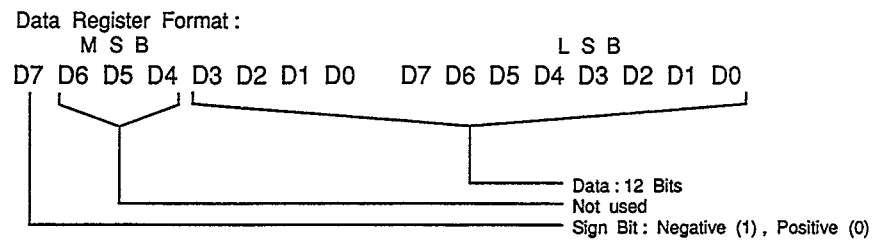
Write Function:		
COMMAND	ADDRESS	FUNCTION
CMDA4	xxx86	D/A control and data register select
CMDB4	xxx87	Range and output data
STROBE	xxx9D	Channel update



CMDA4 (write) Address xxx86 D/A Control.



CMDB4 (write) Address xxx87 D/A Data.



Range Register Format :

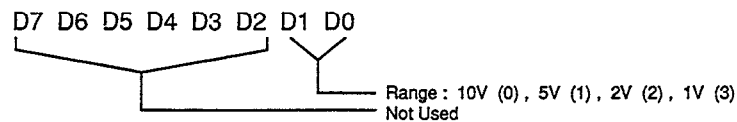


Table 4-5. SLOT 4 (ANALOG OUT) Command Locations and Functions Cont'd

CMDB Write Register Table :

Register Number	Description	Count Sequence	
0	Channel 0 LSB		last channel = 0
1	Channel 0 MSB		
2	Channel 1 LSB		
3	Channel 1 MSB		
4	Not Used		last channel = 1
5	Not Used		
6	Not Used		
7	Not Used		
8	Not Used		
9	Not Used		
10	Not Used		
11	Not Used		
12	Not Used		
13	Not Used		
14	Channel 1 Range		
15	Channel 0 Range		

STROBE (WRITE) Address is xxx9D. See description.

Global Strobe can be used to simultaneously update all D/A outputs in system. Must be enabled using CMDA write bit D7.

Use of a 12 bit D/A Converter implies that there exist 4096 steps to full scale output. To determine the binary data value corresponding to your desired output voltage, use the following formula: $DATA\ VALUE = \frac{ABS(VOUT)}{RANGE} * 4096$

Note: If desired VOUT is negative, the sign bit in CMDB write for the appropriate channel must be set.

TIMING SUMMARY

The slew rate of the D/A Converter is 5 microseconds (to .01% of full scale transition).

Digital Input and Output

The Model 575 provides up to 32 single-ended, non-isolated digital I/O channels. The digital channels can be software-configured in groups of 8 channels for input or output. Thus, 8, 16, 24, or all 32 channels may be used for input or output.

Digital input channels may also be grouped into four ports of eight channels. Each port is treated as a single byte from software. This grouping allows simultaneous reading or writing of eight channels as a byte, and enables communication with 4 and 8-bit TTL devices.

The Model 575 is designed to read and write TTL-compatible levels. With TTL logic, any input signal less than 0.8V is read as "off" or "low", and any input signal greater than 2.0V is read as "on", or "high". A typical logic "high" output is 3.5V or more.

CAUTION: Digital outputs should only be connected to other TTL-compatible equipment. Shorting a digital output to ground or excessive current draw may damage the Model 575.

Digital Input Terminals

There are four banks of quick-disconnect blocks. Each block has screw terminals for eight digital signals and two grounds. These terminals accept 16-24 gauge wire stripped 3/16 of an inch.

NOTE: To minimize the possibility of EMI radiation, use shielded cable for connections. One end of the shield should be connected to ground, and the other end of the shield should be left disconnected. In this configuration the shield cannot be used as one of the signal-carrying wires.

Refer to schematic diagram 575-106 for the following discussion:

Digital input and output is possible through four 8 bit software configurable ports. Each port can be configured for input or output individually. The inputs and outputs are for TTL compatible signals only (each input represents a single TTL load, and each output can drive 20 standard TTL loads) and are not optically isolated. All ports power up in a high impedance state configured as inputs through the use of a power on reset circuit.

Data from the PC bus is buffered by U102. Command information is decoded and latched by quad latches U502 and U503 (74LS75 and 74LS175, respectively), triple positive nor gates U501 (74LS27) and a 3 to 8 line decoder U504 (74LS138). U501A prevents U503 from changing the port input/output configuration on writes to CMDA5 unless data bit 7 is a "1" at the time of the CMDA write cycle. Writing of data out on the ports is accomplished by latching data from the bus into the tri state octal latches U505, U507, U509, or U511 (74LS244). Reading of data from the ports is accomplished by enabling data into the bus from the octal buffers U506, U508, U510, or U512 (74LS374).

Digital I/O Command Locations

The commands associated with the slot 5 digital I/O function are Commands A and B (CMDA5 and CMDB5). Note that a read or write require that you first configure the circuitry by writing to CMDA5.

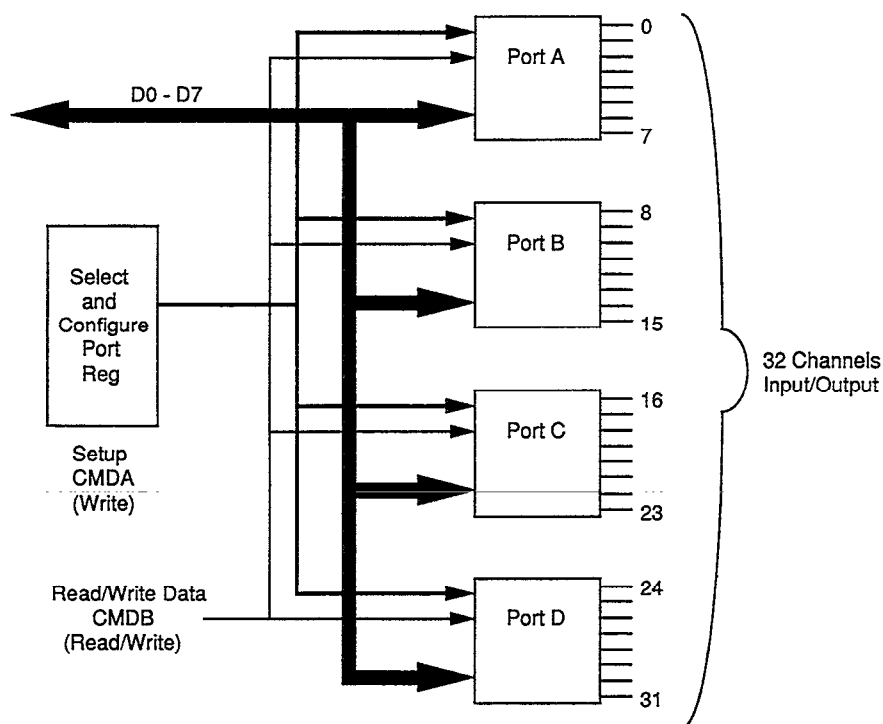
Table 4-6. SLOT 5 (DIGITAL I/O) Command Locations and Functions

Read Functions:		
COMMAND	ADDRESS	FUNCTION
CMDA5	N/A	N/A
CMDB5	xxx89	Read input data. Before a read, port select and configuration data must be written to CMDA5.

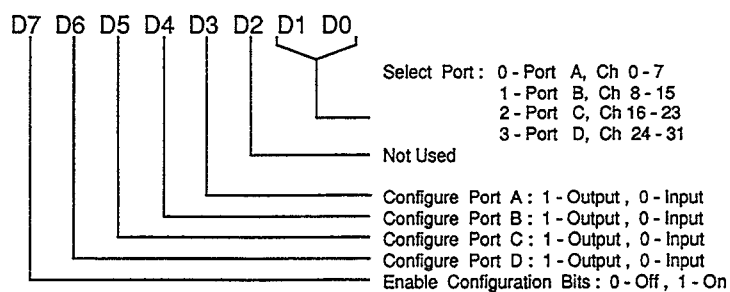
Write Functions		
COMMAND	ADDRESS	FUNCTION
CMDA5	xxx88	Select and configure port*
CMDB5	xxx89	Digital output data

* It is not necessary to output port configuration information to CMDA5 every time a port is selected. If D0=7, then D6, D5, D4, and D3 will be ignored by the hardware, and the last port I/O configuration will remain in effect.

Table 4-6. SLOT 5 (DIGITAL I/O) Command Locations and Functions, cont'd



CMDA5 (write) Address xxx88. - Select port, configure port
Must be issued in order to read or write data to a specified port.



CMDB5 (read) Address xxx89. Digital Input
Read data from specified port provided port is configured as an input port.

CMDB5 (write) Address xxx89. Digital Output
Write data to specified port provided port is configured as an output port.

Relay Control

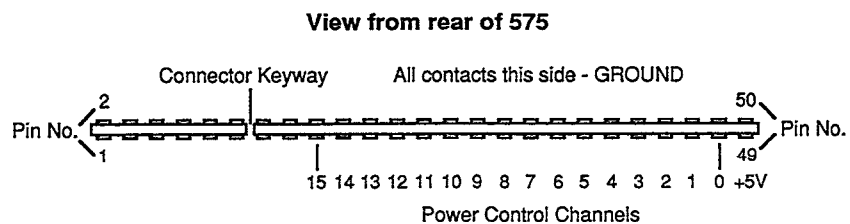
The Model 575 has a built in power control interface for the purpose of controlling and sensing AC and DC solid-state relays. The power control lines are ports C and D of the digital circuitry. Both ports can be used for power control or power sensing, or one port can be used for each function. Connections to these ports are available at the Relay Control card edge connector located at the rear of the Model 575. The power control channels follow positive logic. Writing a logic 1 to a power control channel causes the corresponding pin on the card edge connector to go to logic 1. Turning on a power control relay requires that its control line be taken to logic 0. Therefore, a logic 0 must be written to a power control channel on the Model 575 to turn on its respective relay.

To prevent overheating and subsequent damage, all power relay control circuits must be located outside of the Model 575 case. Figure 4-5 identifies the pins of the relay control connector.

Data from the bus is buffered and latched by U510 and U512 (ports C and D in the digital I/O circuitry) to provide for relay control. The TTL compatible outputs from U510 and U512 are routed to the relay control card edge connector J16. These outputs have sufficient output current to drive solid state relay output modules, such as the PCM3 Power Control Board/Cable.

Relay Board

The optional Keithley Model PCM3 is a general purpose, 16-channel control subsystem for the control and sensing of AC and DC loads. The PCM3 utilizes solid state switching with plug-in relays for DC and AC output. Each channel is fuse protected. See the PCM3 manual for specifications and installation of the ribbon cable and relays.



- Notes :
1. All even pins are ground.
 2. Pin 49 is +5V
 3. Mating connector - 3M Scotchflex PN 3415-0000
 4. Mating cables - Opto CA-x (2 connector ends), Opto 00-x (1 connector, 1 bare end)
 5. Any user-supplied connector other than 3M-Scotchflex 3415-0000 must have key to match keyway on card edge.

Figure 4-5. Power Control Pinout

Relay Control Command Locations

The commands associated with the slot 5 Digital I/O function are Commands A and B (CMDA5 and CMDB5). See the following chart and pages for detailed information.

Table 4-7. SLOT 5 (RELAY) Command Locations and Functions

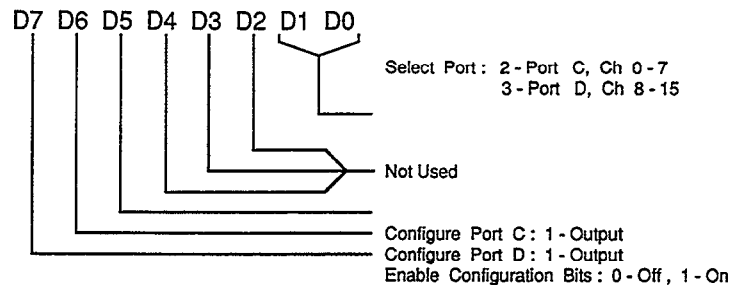
Read Functions:		
COMMAND	ADDRESS	FUNCTION
CMDA5	N/A	Not used
CMDB5	xxx89	Read input data. Before a read, port select and configuration data must be written to CMDA5.
Write Functions		
COMMAND	ADDRESS	FUNCTION
CMDA5	xxx88	Select and configure port*
CMDB5	xxx89	Digital output data

* It is not necessary to output port configuration information to CMDA5 every time a port is selected. If D0=7, then D6, D5, D4, and D3 will be ignored by the hardware, and the last port I/O configuration will remain in effect.

Relay control is provided through ports C and D of the Digital I/O circuitry. The commands used to access relay control are the same as those used for the control of the Digital I/O:

CMDA5 (write) Address xxx88. - Select and configure Relay Control Port

Must be issued in order to write control words to the relay control ports



CMDB5 (read) Address xxx89 - Read status of selected Relay Control Port

Reads status of the 8 control bits currently latched onto the port.

CMDB5 (write) Address xxx89 - Write Relay Control Word to selected Port

Latches relay control data onto the port.

External Input

As an extension of its “slot” architecture, the Model 575 will accept input from 8 additional single-ended analog inputs which are connector-compatible to an Analog Devices 3B Subsystem. If you use KDAC500 software to program the Model 575, you will note that the CONFIG table shows Slot 6 as being used for “EXT” analog input, with 8 channels that can be named and used as conventional single-ended analog input channels. These 8 channels are tied directly to the global multiplexer of the AMM module. Therefore, selection and use of the external function is actually accomplished by reads and writes to the command locations (CMDA, B, C, and D) for slot 1.

There are no commands sent to the Analog Devices 3B rack. Signal flow is limited to those coming to the Model 575 from the various signal conditioning modules on the 3B rack.

Access to the external channels is via the 26-pin mass termination connector J307 on the side board. Each external input channel is mapped into one of the analog input pathways 3-10 that can be selected by the AMM global multiplexer, and can be accessed by the SELECT SLOT command. Global gain, which is supplied after the multiplexer stage, is available for further conditioning of the external inputs.

The mapping of external channels to analog pathways is as follows:

External Input Channel	AMM Global Multiplexer Input
0	10
1	9
2	8
3	7
4	6
5	5
6	4
7	3

Note that the CH7 input from the 3B rack maps into the Slot 3 input on the AMM module. Therefore, no analog input module can be used in the option slot 3 if the same channel is used for 3B operation. However, this design has the advantage of freeing up all 16 of the inputs channels on the AMM module for other uses. This gives the system the capability of a total of 55 analog inputs -- channels 0-6 from the 3B rack, 16 channels on the AMM module, and 32 channels from a Keithley Series 500-AIM3 module installed in the option slot.

External Analog Input Command Locations

The commands associated with the slot 6 external input function are Commands A and B (CMDA1 and CMDB1). See the following chart and pages for detailed information.

Table 4-8. SLOT 6 (EXT) Command Locations and Functions.

Read Functions:		
COMMAND	ADDRESS	FUNCTION
CMDA1	xxx80	(D4=1) Read low data byte (D4=0) Read status
CMDB1	xxx81	Read high data byte
CMDC1	N/A	Not used
CMDD1	xxx9B	Read Status

Write Functions		
COMMAND	ADDRESS	FUNCTION
CMDA1	xxx80	Select channel, gain, modes, filters.
CMDB1	xxx81	Select slot, range, global gain, read mode.
CMDC1	xxx9A	Reset and recalibrate A/D gain and offset.
CMDD1	xxx9B	Start conversion

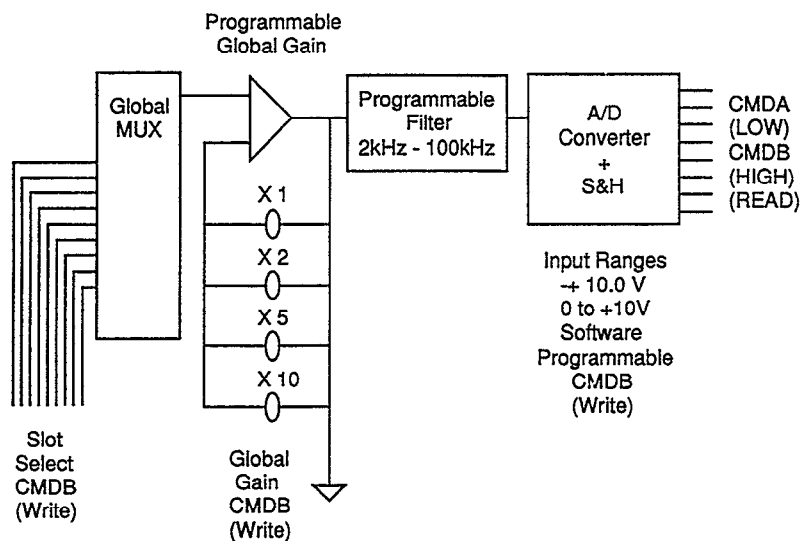
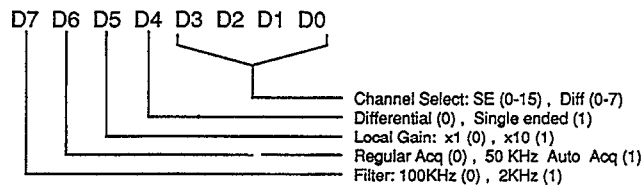
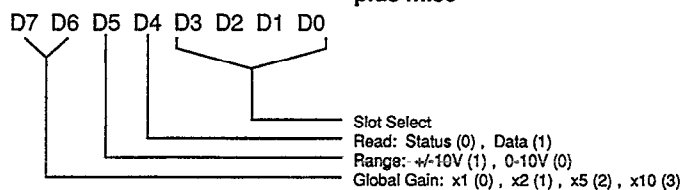


Table 4-8. SLOT 6 (EXT) Command Locations and Functions, cont'd

CMDA1 (write) Address xxx80 - Select: channel, local gain, filter, plus misc



CMDB1 (write) Address xxx81 - Select: slot, range, global, gain, plus misc

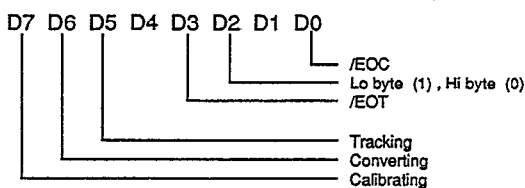


CMDC1 (write) Address xxx9a - Reset and recal the A/D (360 mSec).

CMDD1 (write) Address xxx9b - Start Conversion

CMDA1 (read) Address xxx80 - (D4 = 1) Read Low Data Byte

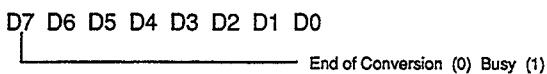
CMDA1 (read) Address xxx80 - (D4 = 0) Read Status



CMDB1 (read) Address xxx81 - Read High Data Byte

CMDC1 (read) Not Used

CMDD1 (read) Address xxx9b - Read status



Command Locations in Numeric Order

The following information provides more details on the use of command locations in the Model 575. The first three characters of each memory location are shown as “xxx”. Normally, these characters would be “CFF”, assuming that the Model 575 interface card memory map switch is set for address CFF80.

For a further discussion of analog input commands, refer to the appropriate AMM manual for the module installed in the System 575.

xxx80 (CMD1A) SELECT A/D CHANNEL

The SELECT CHANNEL command is used to control the local signal multiplexer on the AMM module installed in slot 1. Refer to the appropriate AMM1A or AMM2 manual for a discussion of this command.

xxx81 (CMD1B) SELECT SLOT

The SELECT SLOT command controls the global multiplexer on the AMM module installed in slot 1. Refer to the appropriate AMM manual for a discussion of this command. The select slot is also important in selecting the EXT function for use of Analog Devices 3B subsystems. Specifically, the mass-termination connector on the side board can be cabled to an Analog Devices 3B module rack, and the 3B rack outputs can be sent directly to the AMM module slot inputs for global multiplexing.

xxx82 (CMD2A) ANALOG TRIGGER AND IRQ CONFIGURATION

Writing to this command location configures the interrupt request, trigger mode, and selects the trigger input for the analog trigger circuit. Reading this command location returns the contents of the trigger status register.

Writing to this command location allows the configuration of the input to the analog trigger circuit; selection of the input filter, trigger voltage range, trigger voltage polarity, input coupling, and triggering edge are selected by the appropriate binary data word. Reading this command location also returns the contents of the status register, and additionally performs a reset of the trigger and one event latch if the trigger is configured for one event or single mode triggering.

The triggering and IRQ output can operate in several modes. IRQ can be enabled or disabled, and asserted on either the falling or rising edge of the trigger signal. IRQ can operate even if the trigger is disabled. However, the triggering parameters must still be configured as if triggering were going to be used. Triggering can be enabled or disabled. The triggering can be latched or automatically reset. Additionally, the triggering can be used in one shot mode, where the trigger pulses briefly when a triggering condition is satisfied; or in a continuous mode where the trigger is latched into an asserted state until the triggering condition is no longer satisfied. Finally, the trigger can be set to trigger as a single event (where a reset must

be performed before a trigger can be asserted again) or in a normal mode where the trigger asserts with each entry into the trigger region.

Reading from this location returns a byte that can be interpreted as the TRIGGER STATUS word. This should be used if status information is desired, but no reset of the trigger is to be asserted.

xxx83 (CMD2B) ANALOG TRIGGER INPUT CONFIGURATION

The analog trigger circuit has the capability to produce two separate outputs: a trigger signal that can start A/D conversion on the AMM module installed in slot 1, and an Interrupt Request (IRQ) that can divert the processor in the host PC to a servicing routine to perform programmed functions in the background.

Trigger input can come from any of 3 sources: from asserting a GLOBAL STROBE, from the external analog input (at J2), or from the output of the global amplifier on the AMM module in slot 1. The four possible selections for input include those mentioned above in addition to a no input setting, used at power up of the circuit.

The main feature of the analog triggering circuit is its ability to provide a triggering signal with control similar to that of an oscilloscope. Therefore, the object input signal must be analysed to determine if it meets a triggered condition. These conditions include input magnitude, input polarity, and whether the signal is on a rising edge or falling edge. These conditions, as well as filtering (8 ranges, from 300 Hz to 1 MHz) and input coupling, are selectable by writing to location xxx84.

Performing a read of the xxx84 location will return the same TRIGGER STATUS word as reading location xxx83. However, reading xxx84 will perform a reset of the trigger and IRQ latches when the trigger latch reset bit is set to manual or the trigger mode bit is set to single event in the CONFIGURE IRQ AND TRIGGER command above.

xxx84 (CMD3A) UNSPECIFIED OPTION SLOT COMMAND

This command location is the CMDA location of the option slot. The command specified at this location depends on the optional module that is installed. See the appropriate manual for the module installed in the option slot for the usage of this command.

xxx85 (CMD3B) UNSPECIFIED OPTION SLOT COMMAND

This location is the CMDB location of the option slot. The command specified at this location depends on the optional module that is installed. See the appropriate manual for the module installed in the option slot for the usage of this command.

xxx86 (CMD4A) D/A CONTROL FOR ANALOG OUTPUT

Writing to this command location controls the register selection, auto sequencing, and global strobe updating of the D/A converter in the analog output circuitry.

DAC control must precede any change in range register data to reset the register auto-sequencing circuit to the proper register. The lower four bits represent the register to be written to first. Bits D5 and D6 represent the last channel for auto sequencing of the data written to the output data registers (registers 0 through 3). Setting bit D7 enables global strobe (see below) to update analog outputs simultaneously.

xxx87 (CMD4B) D/A DATA FOR ANALOG OUTPUT

Through the use of register auto sequencing, the various D/A control registers are filled by writing repeatedly to this location. Range registers are filled first, in decending order from 1 to 0. After filling the range registers, the DAC data bytes are written for each channel, LSB first. The 12 bit DAC requires 2 write operations to supply the 13 bits necessary for data and polarity information. The range registers are only set once, until a write to CMD4A points to the range registers again, and the data registers are continuously updated to allow variable output. When the global strobe update feature is not enabled, the output channel is automatically updated upon receipt of the second byte of data. When the global strobe update feature is enabled, data is not latched into the conversion register of the D/A converter until receipt of the global strobe signal. Only six of the available 16 registers are implemented in this circuitry.

Initially, a D/A control is issued which must select either register 14 (channel 1 range) or register 15 (channel 0 range). Additionally, the D/A control must select the last channel for auto sequencing, and either enable or disable the global strobe update feature.

After the D/A control is issued, the D/A data is loaded. The command circuitry selects the appropriate range register, and register control is relinquished to the auto-sequencer. The range registers are filled with the proper range data. The auto sequencer drops to the output data registers. D/A output data is written, and the sequencer automatically 'points to' the next register to be written to. The data is written *LSB first*, then *MSB*, going from channel 0 to channel 1. If the global strobe update feature is disabled (in the D/A control word) the output of the D/A converter is updated immediately upon receipt of the *MSB* of data (including the polarity bit). If the strobe input is enabled, the data is not latched into the output registers of the D/A converter until receipt of the active low strobe input.

To determine the digital value to input for a given voltage, it is necessary to know the output range setting of the DAC. With the 12-bit DAC, there are 4096 possible voltage levels, specified with digital values of 0-4095. Therefore, the actual full scale value is the nominal full-scale value minus 1 LSB. This corresponds to a resolution of 1 part in 4096, or about 2.44mV on the 10 volt range. The DAC counts for a particular output are given by:

$$\text{COUNTS} = \text{ABS}[(\text{VOLTS} / \text{RANGE}) \times 4096]$$

where counts = DAC data, volts = desired voltage output, and range = the output range setting for the particular channel. It should be noted that the digital data must be adjusted to

include the sign bit (the D7 bit in the MSB of the data). This may be accomplished adding 128 to the MSB if negative voltage output is desired.

xxx88 (CMD5A) DIGITAL I/O PORT SELECTION AND CONFIGURATION

Writing to this command location selects and configures the digital input/output ports. Note that ports C and D are also used for relay control via the PCM connector on the back of the Model 575 mother board.

The digital input and output ports on the Model 575 mother board are fully software programmable for directionality in sets of 8 channels. Port A corresponds to channels 0-7; Port B, channels 8-15; Port C, channels 16-23; and Port D, channels 24-31. Each port is completely independent of the others for these configuration purposes. Generally, more than one write to this location can be used; one to configure all the ports (where the lower 3 bits are insignificant), and the rest to select ports for input or output (in which the upper 6 bits are insignificant). Once the ports are configured, they will remain that way until another write to this command enables the configuration bits and provides new configuration data.

Ports C and D provide for power control and sensing exterior to the Model 575 unit. When power control is desired (using the optional Keithley 500-PCM3 relay rack), configure Ports C and D as output. For power sensing applications, use the PCM3 with input modules and configure the ports as input ports.

xxx89 (CMD5B) DIGITAL I/O DATA

Writing to this command location sends digital data to the port selected by the CMD5A write above. For power control, Writing to ports C and D sends data to the PCM connector. Reading this location retrieves the digital data from the specified port or reads the current state of the power sensing modules.

For any port configured as an output port and selected by performing the above command, writing to location xxx89 will latch the data onto the port (any value between 0 and 255). Digital output follows positive logic. When ports C and D are being used for power control application, the one's complement of the logical output must be written to the port. The PCM3 rack is wired such that a logical 0 must be written to the input to turn on the relay...negative logic.

For any port configured as an input port by the above command, reading location xxx89 will latch the data at the port onto the data bus (again, a value between 0 and 255). Digital input also follows positive logic; when ports C and D are being used for power sensing applications, the one's complement of the logical input will be read into the port (the input modules for use as power sensing modules will provide a logic 0 when the module is sensing the rated voltage or current...again, negative logic).

xxx98 (CMD2C) ANALOG TRIGGER VOLTAGE (0-255 COUNTS)

Writing to this command location sets the output of the D/A converter in the analog triggering circuit to a voltage between 0 and 10 volts, with a resolution of approximately 47mV (1 part in 256). To determine the counts necessary, use the following formula:

$$\text{COUNTS} = \text{ABS}[(\text{VOLTS} / \text{RANGE}) \times 256]$$

where volts = the desired trigger voltage; range = the setting of the range bit (10V or 1V); and counts = number of DAC counts necessary for the desired output (this value is what will be written to the xxx98 location).

Writing to this location sets the absolute magnitude at which triggering will occur in DAC counts. A conversion, based upon selected range and level, will give the proper number of counts (see the command description given above for the formula).

xxx99 (CMD3C) UNSPECIFIED OPTION SLOT COMMAND

This command location is the CMDC location of the option slot. The command specified at this location depends on the optional module that is installed. See the appropriate manual for the installed module for the usage of this command.

xxx9A (CMD1C) GLOBAL GAIN

The GLOBAL GAIN command controls the PGA (Programmable Gain Amplifier) located on the AMM module installed in slot 1. For a discussion of this command, refer to the appropriate AMM manual.

xxx9B (CMD1D) A/D START/STATUS

Writing to this command location starts A/D conversion on the AMM module installed in slot 1. Any value can be written to trigger conversion; however, a value of 255 should be written to minimize noise. Reading this location returns the status byte of the A/D conversion (busy or ready). A value of 255 (FF in hex) indicates that the conversion process is under way. A value of 127 (7F hex) indicates that the conversion is complete.

xxx9C (BoxID) HARDWARE IDENTIFICATION

The Model 575 provides for self identification of the hardware installed in slot 1 to the PC host. Reading this command location should return a value of 112 (70 hex) if no module is installed, a value of 113 (71 hex) if an AMM1A is installed, or a value of 114 (72 hex) if an AMM2 is installed. Any other value returned from this location indicates that there is an unidentified module installed.

xxx9D (STROBE) GLOBAL ANALOG OUTPUT UPDATE

The strobe command is used to synchronously update two or more analog output channels. The strobe feature is global, affecting the D/A channels in the Model 575, as well as the D/A channels in any analog output module installed in the option slot.

Writing to the global strobe command location causes the STROBE line to go active low, and allows global update of all DAC outputs if the analog output circuit is so configured. Global strobe affects any analog output, whether the analog output circuit is on the mother board or an analog module in the option slots.

xxx9E (GLOBAL 1) GLOBAL COMMAND 1

This command location is not currently implemented in the virtual slots of the Model 575. However, to allow for future upgrades to modules, the physical slots have this signal available. This command signal is simultaneously active (low at pin 12) at both physical slots when a write or read to the GLOBAL 1 command location is performed.

xxx9F (GLOBAL 2) GLOBAL COMMAND 2

This command location is identical to the GLOBAL 1 command discussed above, but is active low at pin 33 of the physical slots.

Option Modules and Interfaces

Introduction

Keithley Module Library

Module Power Consumption

Modules

IBIN Interface Card(s)

Introduction

This section of the Model 575 Manual includes generic information on Keithley signal conditioning modules. It also provides a localized place within the manual where you may insert documentation for your modules and IBIN card(s).

Keithley Module Library

The following modules are compatible with the Model 575. New modules are added to the library from time to time. The specified ranges include the cumulative effects of global and local gains. If you do not see what you need, contact Keithley DAC Technical Support.

Table 5-1. Signal Conditioning Modules

AMM1A	16 single-ended or 8 differential channel Analog Master Measurement module. 62.5kHz, 12-bit A/D converter. Programmable filter. 100mV/1V/10V input.
AMM2	16 single-ended or 8 differential channel Analog Master Measurement module. 50kHz, 16-bit A/D converter. Programmable filter. 100mV/1V/10V input.
AIM2	32 single-ended analog input channels. 1V/10V ranges.
AIM3A	32 single-ended or 16 differential analog input channels. 10mV/100mV/1V/10V ranges.
AIM4	4 isolated analog input channels. 5mV/50mV/500mV/5V ranges.
AIM5	4 isolated analog low-level input channels. 5mV/50mV ranges.
AIM6	4 channel analog input module for 100 Ω resistive temperature devices (RTDs).
AIM7	16 channel thermocouple and analog input module for types J, K, S, T, B, E, and R. Reference junction. 10mV/100mV ranges.
AIM8	4 channel strain gage and low-level analog input module. Excitation and bridge completion circuitry. Programmable filters. 1mV/10mV/100mV/1V/10V ranges.
AIM9	2 channel LVDT/RVDT/carrier amplifier module with 1/2/5/10/20kHz AC excitation.
AOM1	2 or 5 channel analog output module. 12-bit. $\pm 2.5V/\pm 5V/\pm 10V/0-5V/0-10V$ ranges.
AOM2	1 or 2 channel analog output module. 16-bit. $\pm 10V/0-10V$ ranges.
AOM3	4 channel 0-20mA current loop analog output module.
AOM4	4 channel 0-10V excitation analog output module.
AOM5	4 channel analog output module. 13-bit $\pm 1V/\pm 2V/\pm 5V/\pm 10V$ ranges.
DIM1	16 channel isolated digital input module.
DIO1A	32 channel TTL-level digital input/output module.
DOM1	16 channel isolated digital output module.
PCM1	4 channel isolated AC power control module, 12-140VAC.
PCM3	16-channel external relay mounting board for use with Model 575 and 570. Includes cable. Does not require an expansion slot.
PIM1	7 channel isolated high-level input plus 1 channel direct low-level input pulse/frequency counting module.
PIM2	4 channel TTL-level event counter. Settable as four 16-bit or two 32-bit counters.
PROTO	Prototyping module with one bidirectional data port.
STEP1*	Stepper Motor Controller Module (1 per up to 4 STEP2 modules)
STEP2*	Stepper Motor Indexer Module (1 per motor)
TRG1	Analog Trigger Module
WAV1	Waveform generator module.

* Supported by PEEK and POKE commands in the Model 575. STEP set uses both available slots in the Model 575; precludes use of analog input. Analog output may be used, but accuracy will be less than rated accuracy (analog output requires the precision reference on the AMM module.)

Table 5-2. Module Power Consumption

Module	±15V	±5V	Remarks
	(ma)	(ma)	
AMM1A	65	125	
AMM2	65	125	
AIM2	2	20	
AIM3A	18	30	
AIM4	30	30	
AIM5	30	30	
AIM6	30	30	
AIM7	15	15	
AIM8	75	75	Plus excitation current
AIM9	125	60	
AOM1	90	60	
AOM2	30	180	
AOM3	150	65	
AOM4	200	75	
DIM1	0	277 max ¹	
DIO1A	0	330	Internal power, all outputs on
DOM1	0	650 max ²	
PCM1	0	90 max ³	
PCM2	0	415 max ⁴	Power supplied by Model 575.
PCM3	0	0	
PIM1	0	380	
PIM2	0	475	
TRG1			

Notes:

1 – 14mA for each input on.

2 – 15mA for each output on (EXT), or 35mA (INT)

3,4 – 12mA for each output on

Table 5-3. Module Self-Id Resistor Values

Module	Resistor Value (Ω)	ID Number
AMM1A	845	29
AMM2	976	31
AIM2	1050	32
AIM3A	1090	33
AIM4	1150	34
AIM5	1260	35
AIM6	1320	36
AIM7	1400	37
AIM8	1520	38
AIM9	1600	39
PIM1	1740	40
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Module Manuals

(Use this space to insert the dividers and manuals for your modules)

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(Use this space to insert the divider and manual for your interface card)

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Introduction


This section contains information necessary to service your Model 575. The following information is included:

Calibration – instructions for calibrating the Model 575.

Troubleshooting – guidelines for troubleshooting the mainframe and interface card.

Replaceable Parts – describes parts which you may need to replace or add to the Model 575.

Some of the information presented is intended for skilled technical personnel who are familiar with sophisticated equipment and the necessary servicing procedures. Do not attempt certain procedures unless you are qualified.

 **WARNING:** Some of the procedures described in this section may expose you to potentially lethal voltages. Use standard safety practices when such dangerous voltages are encountered.

CAUTION: Always follow the indicated procedure exactly as written. Failure to do so may damage equipment, possibly voiding the warranty.

Calibration Information

This section contains general field calibration information for the Model 575. The procedures given are not necessarily as accurate as factory calibration. Also, the procedures given assume a certain amount of expertise on the part of the user. If you are not familiar with calibrating equipment, do not attempt calibration. The procedures in this section assume that you are familiar with general module operation. Refer to the appropriate manual for details on calibrating each module.

When You Should Calibrate

The Model 575 is calibrated at the factory, and should require no further calibration before use. Calibration is necessary only under the following conditions:

1. If you are performing periodic calibration as part of an established maintenance procedure.
2. If you suspect the Model 575 of faulty or inaccurate operation.

NOTE: If an input or output function which had been working correctly suddenly becomes inaccurate by more than a few percent, the problem is more likely a malfunction and not a calibration problem. If you cannot calibrate the Model 575 after two attempts, you should return it to Keithley for repair or calibration at the factory.

Environmental Conditions

Calibration should be performed at an ambient temperature of 23 degrees C \pm 5 degrees. Turn on the system power and allow at least 10 minutes of warm up before beginning calibration procedures. Consult the manual for the calibration equipment listed below for similar required warm up periods.

Recommended Calibration Equipment

The following equipment is recommended for Model 575 calibration. Other equipment may be substituted as long as accuracy specifications are at least as good as those given below:

1. Keithley Model 175 DMM (\pm 0.1% basic DC accuracy). 4-1/2 digit resolution is required for calibrating the Model 575. Tighter specifications may be required for calibrating an AMM2 module. Refer to the AMM1A or AMM2 manual for AMM calibration instructions.
2. Electro Development Corporation (EDC) Model E100C DC Millivolt Reference Source, or other similar equipment with a basic accuracy of \pm 0.05%.

Complete calibration of the Model 575 requires calibration of the AMM module, calibration of the analog output +10V reference, and calibration of the +5V power supply. These steps may be done in any order.

Calibrating the AMM1A or AMM2

The 10V reference on the AMM module is used as a reference for the Model 575 on-board analog output circuitry. Therefore, you must have a properly functioning and calibrated AMM module in place before you can use the analog output channels. The AMM module may be calibrated before or after the Model 575.

Calibrating the +5 Volt Supply

The +5V power supply can only be adjusted when operating the Model 575 from an external power source. Adjustment is necessary only if the Model 575 is operated from an external source, or if it has been repaired. The +5V supply does not have to be calibrated if the Model 575 will be powered exclusively from the host computer.

1. Ensure power is off on the front panel of the Model 575.
2. Set the switch SW301 to the UP position to select external power.
3. Connect a suitable power source to the external power input. If possible, use the power source which will normally be used to power the Model 575. If the Model 575 is normally powered from the computer, a 12VDC @ 3A supply is recommended.
4. Connect the negative lead of the DMM to the DGND test point (pin 1 of J12) and the positive lead of the DMM to the Vcc testpoint (pin 20 of U508)
5. Verify that the power supply is fully loaded as in normal operation. The AMM module should be in slot 1, and the option module (if used) should be in slot 3. Any external sensors or loads normally used with the option module should be connected.
6. Turn on the Model 575 power switch. Verify that the power light comes on. If the power light does not come on, check for the following conditions:
 - A. If the Model 575 is being powered by the host computer, verify that the IBIN cable is connected to the Model 575 and computer, and that the computer is on.

- B. Check that the power supply is not over loaded. If the power supply cannot handle the initial surge requirements of the Model 575, or if the external power supply sags to less than 75% of its nominal output, the Model 575 power supply may fail to start up.

If the power light comes on, go to the next step.

7. Adjust R4 to obtain a reading of $5.00V \pm 0.05V$.
8. This completes calibration of the +5V power supply. Turn of the Model 575 for one minute. Then set switch SW301 to the normal operating position.

Calibrating the +10 Volt Reference

Normally, calibration of the +10V reference is necessary only in the case of repairs the the Model 575. Calibration of the +10V reference on the AMM module will normally correct errors in the analog outputs. See the AMM manual for a calibration of the +10V reference.

NOTE: A properly functioning AMM1A or AMM2 module must be installed in slot 1

1. Confirm that power is turned off at front panel of the Model 575.
2. Connect the negative (black) lead of DMM to pin 1 of J1 (remove the terminal block to facilitate this connection).
3. Connect the positive (red) lead of DMM to the +10V reference test point (pin 9 of U414).
4. Apply power. Allow several minutes of warm up time for +10 volt reference on the AMM module to stabilize.
5. Note the DMM reading to the nearest millivolt, for example 10.013V.
6. Connect the positive (red) lead of DMM to pin 1 of J1.
7. Connect the negative (black) lead of DMM to the -10V reference test point (pin 4 or 5 of U414).
8. Adjust R404 to obtain the same reading that was noted in step 5, within 0.001V.
9. Calibration of the -10 volt reference is now complete.

Troubleshooting Information

This section contains information necessary to troubleshoot the Model 575. Information is presented on two levels; a procedure designed to aid the typical user in isolating faults to a specific region or board, and more detailed information intended for the skilled technician who has access to electronic test equipment.

If a defective component is found, replacement parts may be obtained from Keithley. If factory service is desired, the Model 575 may be returned for repair. For information on replacement parts or factory service, see the Parts List section of this manual.

General Troubleshooting

Any observed or suspected problem with a system or module may be the result of malfunctions in any part of the system. A hierarchy of possible problem areas is listed below. The list should help you apply an organized approach to troubleshooting, starting with software and working toward a specific module. It assumes that your system and software have both worked properly in the past. If you have spares, you can most quickly verify a system component through simple substitution. Check your data acquisition system manual or computer documentation - they may contain additional instructions on troubleshooting.

1. Faulty software or applications programs — If you have completed a new program which does not work as anticipated, review the program design and be certain that it actually functions as you assume. If a program which had been running properly begins to behave erratically, either the supporting software package or the application program may have been corrupted. This may occur through disk media failures, power supply problems, hardware failures, or operator error.

Compare your software package to a back-up copy or the original diskettes. If the software is questionable, you should reinstall the software from the original diskettes or known-good copies. Likewise, your applications program should be restored from back-ups if a problem develops.

Note that it is crucial to back up important software and programs. Ideally, you should make at least two copies, and store one in a location away from your work site. Application programs should be backed up regularly as they are being developed. Printouts of program listings may also be desirable.

2. Faulty computer system — A malfunctioning computer or peripheral can affect the data acquisition software and hardware, ranging from minor problems to total failure. These problems may be continuous or intermittent. If you suspect your computer, remove the data acquisition interface and run any diagnostics which came with the system to verify its performance. Also try running other software with which you are familiar. Pay close attention for any erratic behavior of the software which points to hardware problems.
3. Defective interface — A malfunctioning data acquisition interface can prevent the computer from booting up and operating properly, or it can affect only the data acquisition system. Some graphics, mouse, and networking adapters have been observed to conflict with data acquisition interfaces as a result of both using the same addresses or interrupts. The system operates properly with only one of the cards in place, but diagnostic error messages or other problems result with both cards plugged into the system. You can usually determine incompatibility by trying each suspected card individually, and then together in the system. Such incompatibility can often be overcome through switch settings, configuration changes, or minor modifications to the hardware.
4. Defective data acquisition interface cable — The cable carries essential power, control, or data signals. Open conductors in a cable will disrupt the process. Cable shorts, especially in lines carrying system power supply voltages, may cause a total shutdown of the computer or data acquisition mainframe. If these problems exist, try disconnecting the interface cable from the computer and data acquisition system.

There is a maximum permissible length specified for interface cables. Exceeding the length will also introduce problems. You may note erratic operation of the computer, corrupt data, or a failure of the indicator lamps on the data acquisition system to light.

5. Defective data acquisition mainframe — A mainframe defect can affect any and all data acquisition functions. Main areas of include the mother board logic and connectors, the expansion slots, and the power supply. In the case of a completely dead system, always check any fuses and cabling which carry power.

An individual slot may also be bad. A known good module can be tried in various slots to determine the condition of individual mainframe slots.

6. Defective module(s) in general — Failures in a module's address, data, or control circuitry can affect other modules if they ultimately reach the data acquisition mother board or power supply. You may be able to locate a faulty module by removing modules individually until the problem clears.

The master A/D module in slot 1 is a special case because it processes data from all analog input channels. Any analog input involves its global multiplexer, programmable gain

amplifier, and A/D converter. If only the analog input functions are faulty, you should also consider the master A/D module. Use a known-good A/D module, or first verify your A/D module for proper operation before troubleshooting another analog module.

Analog output normally relies only on circuitry within an analog output module unless documentation for the module states otherwise.

Digital input and output are also performed wholly on a single module, with the exception of the PIM1 and PIM2 power control modules. The PIM modules use an external board and solid state relays. These should also be considered in situations where PIM modules are suspected of being faulty.

In troubleshooting modules, use a software package with which you are familiar to write a few simple test programs for the suspected module. Elaborate programs should generally not be used. They may contain their own errors which mask problems with hardware.

If a suspected module does not respond as expected, you may assume that the module requires calibration or is defective. If a module has no calibratable components, a problem at this point will normally indicate a failure within the module.

7. Defective module — A specific module can be verified through substitution, or by using it in conjunction with known software programs. The command (CMD) registers can also be exercised to determine correct operation of the module. See information elsewhere in this manual.

A skilled technician who has access to electronic test equipment may be able to troubleshoot individual circuits on a module to isolate the faulty parts. A full parts list and diagram set are included with each module to aid the technician.

If a defective component is found, replacement parts may be obtained from Keithley. If factory service is desired, the module may be returned for repair. All Keithley-manufactured systems and modules are warranted against defects in material and workmanship for a period of one year. For information on replacement parts or factory service, see the Parts List section of the appropriate manual.

NOTE: If a calibratable module which had been working accurately suddenly becomes inaccurate by more than a few percent, the problem is more likely a malfunction and not a calibration problem. If you cannot calibrate the hardware after two attempts, you should return it to Keithley for repair or calibration at the factory.

Isolating the Problem

The following four symptoms suggest specific system problems:

NOTE: The following checks assume that the PC is functioning properly.

575 power indicator not on.

The power indicator on the front panel of the Model 575 is controlled by circuitry which checks several conditions within the Model 575. If the power-on indicator does not light, check the following:

1. The Model 575 front panel power switch is on.
2. Host computer power is not on, or interface cable is not connected.
3. If an external power source is being used, switch SW301 is in the internal (down) position.
4. If an external power source is being used, the power supply lacks sufficient capacity..
5. A power fault, such as a momentary overload, has caused the Model 575 power supply to shut down. This condition can be reset by switching the Model 575 off and back on.

CAUTION: DO NOT switch the "PC/EXT" power switch inside the 575 to "PC" when operating the 575 off the transformer supply. This can send a transient through the PC's 5V supply and crash the computer system. It does no damage to the 575, but may damage the computer under some conditions. To return to internal power, first turn off the computer. Leave the 575 turned on and then unplug the transformer from the back of the 575. Wait a few minutes for the voltage to decay in the 575 power supply. Turn the 575 off, and then set the internal switch to "PC". Turn the computer and 575 back on.

As long as the front panel power indicator is off, the Model 575 internal reset circuitry will hold all internal registers in the reset state and the Model 575 will not respond to commands.

If the Model 575 power indicator fails to light after you add an option module or change host computer, the host computer may have insufficient reserve to power the Model 575. An external power source will be necessary.

System dead (POWER indicator not on): The Model 575 is powered by the +5V power supply of the computer.

1. Check to see that the PC is plugged into a live outlet and that the computer and the Model 575 are turned on. Try switching the Model 575 off for a few seconds, and then power up again.
2. Check to see if the interface cable is properly connected to the computer and Model 575 mainframe.
3. If the computer itself is malfunctioning, the Model 575 may be overloading the +5V supply. Proceed as follows to locate the source of the overload:
 - A. Remove the module from the option slot, if one is installed. If power comes up, the module is either drawing too much power or is defective.
 - B. Disconnect the interface cable at the Model 575 mainframe. If the problem with the PC clears, the Model 575 mainframe is either drawing too much power or is defective.
 - C. Disconnect the interface cable at the computer. If the computer now functions properly, the defect is located in the interface cable.
 - D. Turn off the PC and remove the interface board. If the PC functions properly after turning it back on, the defect is located on the IBIN interface board.

System dead (POWER indicator not on): The Model 575 is powered by the optional power pack or the automotive connector.

1. Check to see that the power pack (or automotive adapter) is plugged into a live source of power and the Model 575 is turned on.
2. Check to see if the interface cable is properly connected to the computer and Model 575 mainframe.

3. Check to see that the PC is plugged into a live outlet and that the computer is turned on. Try switching the Model 575 off for a few seconds, and then power up again.
4. If the computer is also malfunctioning, the Model 575 may be the cause.
 - A. Disconnect the interface cable at the Model 575 mainframe. If the problem with the PC clears, the Model 575 is the cause.
 - B. Disconnect the interface cable at the computer. If the computer now functions properly, the defect is located in the interface cable.
 - C. Turn off the PC and remove the interface board. If the PC functions properly after turning it back on, the defect is located on the IBIN interface board.

System inoperative (POWER indicator turns on, but ON LINE does not flash during acquisition):

1. Check that the interface address switches are set correctly.
2. Check for a shorted module by removing it from the option slot.
3. Other possible causes include defective interfacing cable, defective $\pm 15V$ supplies, defective interface card, or defective logic circuits.

No module works in the option slot.

1. Inadequate power source (see the previous discussions)
2. Check for a bad option slot connector.
3. Check for bad mother board logic circuit.

A particular module is inoperative in the option slot:

1. Inadequate power source (see the previous discussions)
2. The module is defective and should be repaired.

NOTE: For defective modules, refer to the module instruction manual for troubleshooting information.

System Checks

The following troubleshooting information is intended for skilled electronics servicing personnel who are familiar with electronic test equipment. Information is provided to enable troubleshooting to the circuit level. Troubleshooting to the component level is left up to the technician. Use the component layouts and schematic diagrams located at the end of this manual as an aid in troubleshooting. In some cases, information contained in the Theory of Operation section may also be helpful.

The success of any troubleshooting procedure depends on the use of accurate, reliable test equipment. The following equipment is recommended as an aid in troubleshooting the Model 575: 4-1/2 digit DMM with 0.03% basic DC accuracy (Keithley Model 175 or equivalent). A dual-trace triggered-sweep oscilloscope with 25MHz bandwidth will also be necessary in monitoring digital waveforms. In addition, a logic probe may be useful in tracing digital signals.

Power Supply Checks

A good technique is to always check the power supply voltages first, since improper levels could cause partial or complete system failure. Check power supply voltages at the mother board first. The allowable voltage ranges of the supplies are listed in Table 6-1.

Table 6-1. Power Supply Voltage Tolerances

Supply	Acceptable Voltage Range
+5V	4.75V to 5.25V (May be as low as 4.5V when powered from computer)
+15V	14.5V to 15.5V
-15V	-14.5V to -15.5V

Mother Board Checks

Power is delivered to the mother board via the interface cable or the optional power pack/ automotive adapter. If the Model 575 is being powered by the computer, it must be connected to the computer and the computer must be on. If the Model 575 is powered by an external source of power, the internal/external switch within the Model 575 must be set for external operation and the power pack/adapter must be connected. Use the option slot connector to access the power supply voltage levels. Perform the following procedure to check the power supply voltages at the mother board:

1. Remove the option card if one is installed.
2. Connect the DMM low to chassis ground.
3. Turn on the Model 575.
4. Referring to Figure 6-1, check the voltage levels at the option slot. The allowable voltage readings are listed in Table 6-1.

Signal Checks

Operation of the Model 575 is supervised by the command signal lines. These logic signals are derived from information sent to the interface card from the host computer. Integrity of the various command lines can be verified by entering the following program into the computer and then testing the points listed in Table 6-2. If your interface is set to an address other than CFF80, adjust the DEF SEG command in line 10 as needed.

```
10 DEF SEG = &HCFF0:CA=&H80:CLS
20 PRINT "RUNNING TEST"
30 FOR I=0 TO 31
40 POKE I+CA,O:POKE I+CA,255
50 NEXT I
60 GOTO 30
```

For all the signal checks, connect the oscilloscope low signal lead to chassis ground, and connect the high signal lead to the indicated terminal of the designated component. Adjust the time base, triggering and input attenuator controls as required. Timing of the waveforms is not critical since failure is most likely to be seen as a complete absence of signal. A storage scope may be necessary to catch short pulses. Alternatively, a logic probe may be used to verify the presence of signals.

All command lines accessed by the program above are low true logic. Therefore, a low-going pulse will be seen on the appropriate terminal. Note that the R/W line is generated by the microprocessor in the PC. It is a 50% duty cycle square wave used for timing of read and write operations and is not accessed by the program above.

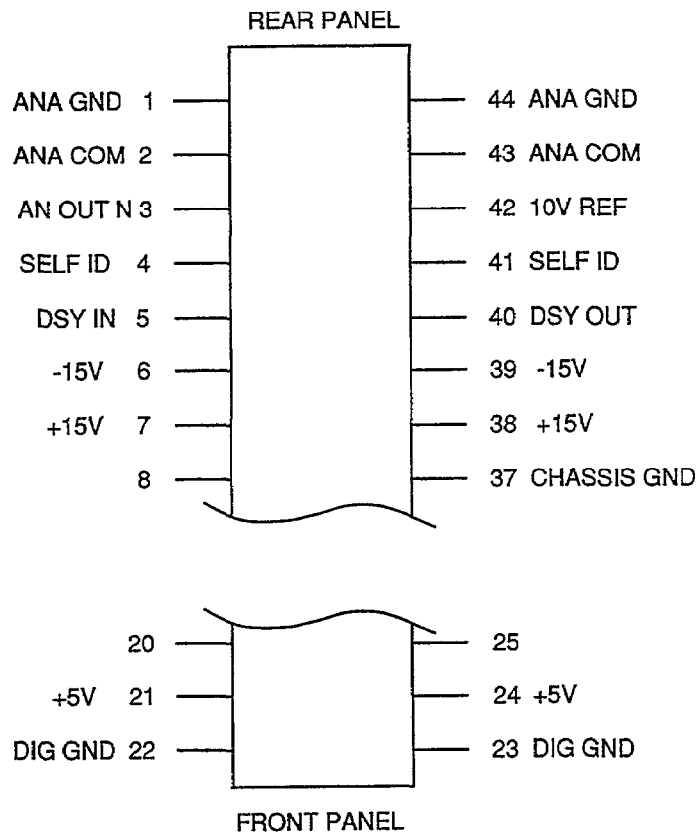


Figure 6-1. Power Supply Checks (Option Slot)

Table 6-2. Signal Checks

Function	Command	Component	Terminal(s)
All	D0	J303	20, 25
All	D1	J303	19, 26
All	D2	J303	18, 27
All	D3	J303	17, 28
All	D4	J303	16, 29
All	D5	J303	15, 30
All	D6	J303	14, 31
All	D7	J303	13, 32
All	STROBE	J303	36
All	R/W	J303	9
ALL	GLOBAL1	J303	12
ALL	GLOBAL2	J303	33
Analog In	CMDA1	J301	35
	CMDB1	J301	34
	CMDC1	J301	10
	CMDD1	J301	9
Trigger	CMDA2	U211	5
	CMDB2	U211	3
	CMDC2	U211	1
Option Slot	CMDA3	J303	35
	CMDB3	J303	34
	CMDC3	J303	11
Analog Out	CMDA4	U401	2
	CMDB4	U401	12
Digital I/O	CMDA5	U501	1, 4, 5
Relay Control	CMDB5	U504	4

Analog Input

The analog input circuitry is all contained on the AMM1A or AMM2 Analog Master Measurement module (AMM) that was included with the system unit. A separate troubleshooting and diagnostic procedure may be found in the appropriate AMM manual.

Analog Output

Analog output converts 12-bit digital values into analog voltages. Use the procedure listed below to troubleshoot analog output.

1. Connect the DMM to the output terminals of the channel to be tested.
2. Verify the presence of the +10V reference from the AMM module.
3. Using basic POKE commands, KDAC500, or your own software, program the Model 575 analog output circuitry for minimum output (for example: -10V on the $\pm 10V$ range (see the Reference section of this manual for PEEK/POKE command location). Check the DMM for an accurate reading.
4. Program the analog output for a mid-range output (e.g. 0V on the $\pm 10V$ range) and check the voltage with the DMM.
5. Program for the analog output for a maximum range value and read the voltage on the DMM. The voltage should be 9.997V on the $\pm 10V$ range.

Digital Input/Output

Trouble within digital input/output and power control can be traced simply by storing all logic "low" and then all logic "high" to all the various channel bit positions. A logic probe or DMM can be used to trace through the circuitry for each channel to determine the location of the fault.

The following short BASIC program will toggle the outputs of all channels about once per second: they may be checked with a logic probe or oscilloscope for an output that changes state properly: If your interface is set to an address other than CFF80, adjust the DEF SEG command in line 20 as needed.

```
10 CLS : LOCATE 12,20 : PRINT "SPACEBAR HALTS TEST"
20 DEF SEG = &HCFF8 : POKE 6,248 : DEFINT A-Z : REM SET BASE ADDRESS, CONFIG
30 WHILE INKEY$ <> " " : REM START TEST LOOP
40 DA% = 255 - DA%
50 FOR P% = 0 TO 3 : POKE 8,P% : POKE 9,DA% : REM SELECT PORT, SEND DATA
60 NEXT P%
70 FOR I% = 1 TO 2000 : NEXT I%
80 WEND : REM LOOP BACK TO START
90 FOR P% = 0 TO 3 : POKE 6,P% : POKE 7,0 : NEXT P% : REM TURN ALL PORTS OFF
100 END
```

Special Handling of Static Sensitive Devices

CMOS devices are designed to operate at very high impedance levels for low power consumption. As a result, any normal static charge that builds up on your person or clothing may

be sufficient to destroy these devices if they are not handled properly. When handling these devices, use the following precautions to avoid damaging them.

1. The devices should be transported and handled only in containers specially designed to prevent static build-up. Typically, these parts will be received in static-protected containers of plastic or foam. Keep these devices in their original containers until ready for installation.
2. Remove the devices from their protective containers only at a properly grounded work station. Also ground yourself with a suitable wrist strap.
3. Handle the devices only by the body; do not touch the pins.
4. Any printed circuit board into which the device is to be inserted must also be grounded to the bench or table.
5. Use only anti-static type soldering irons.
6. Use only grounded soldering irons.
7. Once the device is installed on the PC board, the device is normally adequately protected and normal handling may resume.

Parts List, Schematic Diagrams and Component Layouts

List of Replaceable Parts

Ordering Information

Schematic Diagrams

Component Layouts

List of Replaceable Parts

This section contains replacement parts information, component location drawings and schematic diagrams for the Model 575. Parts are listed alphanumerically in order of their circuit designations.

Ordering Information

To place an order, or obtain information concerning replacement parts, first contact the Keithley customer service department: (216) 248-0400. When ordering parts, include the following information:

1. Model Number
2. Serial Number
3. Part Description
4. Circuit Designation (if applicable)
5. Keithley Part Number

If an additional instruction manual is required, order the manual package (Keithley Part Number 575-901-00). The manual package contains an instruction manual and any applicable addenda.

MODEL 575 MOTHER BOARD PARTS LIST

CIRCUIT DESIGNATION	DESCRIPTION	KEITHLEY PART NO.
C1,C5,C7,C8,C10, C101	CAP,220uF,-20+100%,25V,ALUM ELEC	C-314-220
C11,C12, C13, C17	CAP,33pF,10%,1000V,CERAMIC	C-64-33P
C18,C21, C19,C22	CAP,22uF,-20+100%,25V,ALUM ELEC	C-314-22
C2,C4	CAP,1uF,20%,50V,CERAMIC	C-237-1
C20	CAP,2200,20%,16VDC MIN,ALUM ELEC	C-351-2200
C201	CAP,.047uF,20%,100V,POLYESTER	C-305-.047
C202	CAP,.001uF,10%,100V,POLYPROPYLENE	C-306-.001
C203,C204,C206, C207	CAP,150pF,10%,1000V,CERAMIC	C-64-150P
C3,C6,C15,C16	CAP,.01uF,20%,500V,CERAMIC	C-22-.01
C401-C404	CAP,22pF,10%,1000V,CERAMIC	C-64-22P
C405,C205	CAP,100pF,10%,1000V,CERAMIC	C-64-100P
C67-C69,C77..C79	CAP,.1uF,20%,50V,CERAMIC	C-365-.1
C87-C99,C102, C9,C14,C103,C104	CAP,1000pF,10%,1000V,CERAMIC	C-64-1000P
D101	PILOT LIGHT,GREEN,LED	PL-86-1
D201-D206	DIODE,SILICON,1N4148 (DO-35)	RF-28
D2-D4	DIODE,SILICON,SCHOTTKY,SB160	RF-70
D5	DIODE,IN5820 (CASE 267-01)	RF-53
D6	PILOT LIGHT,RED,LED	PL-86-2
J-14 J1,J2	CONN,STRIP,3 PIN	CS-521-1
J101	CONN,RT. ANGLE HEADER,MOLEX	CS-699-3
J11	CONN,FEMALE,25 PIN	CS-628
J12-J15	CONN,STRIP,10 PIN	CS-521-2
J201	CONN,BERG,2 PIN	CS-339-2
L1-L3	CHOKE,10uH	CH-20-2
Q201	TRANS,NPN SILICON,2N3904 (TO-92)	TG-47
Q202	TRANS,PNP SILICON,2N3906 (TO-92)	TG-84
R1	RES,619,1%,1/8W,METAL FILM	R-88-619
R10,R13	RES,121,1%,1/8W,METAL FILM	R-88-121
R101	RES NET,4.7K,2%,0.2W	TF-114-1
R102,R103,R234	RES,10K,5%,1/4W,COMPOSITION OR FILM	R-76-10K
R104	RES,4.99K,.1%,1/8W,METAL FILM	R-176-4.99K
R105	RES,4.75K,.1%,1/8W,METAL FILM	R-176-4.75K
R106,R107	RES,100K,.1%,1/8W,METAL FILM	R-176-100K
R108	RES,5.6M,5%,1/4W,COMPOSITION OR FILM	R-76-5.6M
R109	RES,422K,1%,1/8W,METAL FILM	R-88-422K
R11,R12	RES,1.3K,1%,1/8W,METAL FILM	R-88-1.3K
R110	RES,270K,5%,1/4W,COMPOSITION OR FILM	R-76-270K
R111	RES,330,5%,1/4W,COMPOSITION OR FILM	R-76-330
R112	RES,1.62K,1%,1/8W,METAL FILM	R-88-1.62K
R15	RES,15,5%,1/4W,COMPOSITION OR FILM	R-76-15
R16,R235	RES,390,5%,1/4W,COMPOSITION OR FILM	R-76-390
R17	RES,15K,5%,1/4W,COMPOSITION OR FILM	R-76-15K
R18	RES,2.2K,5%,1/4W,COMPOSITION OR FILM	R-76-2.2K
R2	RES,470,10%,2W,COMPOSITION	R-3-470

R201,R202	RES,1K,5%,1/4W,COMPOSITION OR FILM	R-76-1K
R203	RES,10M,5%,1/4W,COMPOSITION OR FILM	R-76-10M
R204,R205,R217	RES,49.9K,1%,1/8W,METAL FILM	R-88-49.9K
R206,R207	RES,5.49K,1%,1/8W,METAL FILM	R-88-5.49K
R208-R211	RES,20K,.1%,1/10W,METAL FILM	R-263-20K
R212,R229,R230	RES,100K,5%,1/4W,COMPOSITION OR FILM	R-76-100K
R213	RES,301,1%,1/8W,METAL FILM	R-88-301
R214	RES,1.33K,1%,1/8W,METAL FILM	R-88-1.33K
R215,R405,R412	RES,4.99K,1%,1/8W,METAL FILM	R-88-4.99K
R216	RES,15K,1%,1/8W,METAL FILM	R-88-15K
R218	RES,150K,1%,1/8W,METAL FILM	R-88-150K
R219 R220-R223	RES,499K,1%,1/8W,METAL FILM	R-88-499K
R224	RES,470K,5%,1/4W,COMPOSITION OR FILM	R-76-470K
R225,R226	RES,4.7K,5%,1/4W,COMPOSITION OR FILM	R-76-4.7K
R227,R228	RES,1.5K,5%,1/4W,COMP OR FILM	R-76-1.5K
R231-R233,R238		
R3	RES,2.7K,5%,1/4W,COMPOSITION OR FILM	R-76-2.7K
R4	POT,2K,10%,.5W,NON-WIREWOUND	RP-104-2K
R401,R402,R406	RES,10K,.1%,1/10W,METAL FILM	R-263-10K
R403	RES,22.1,1%,1/8W,METAL FILM	R-88-22.1
R404	POT,200,10%,.5W,NON-WIREWOUND	RP-104-200
R407,R414	RES,6K,.1%,1/10W,METAL FILM	R-263-6K
R408,R415	RES,1.82K,1%,1/8W,METAL FILM	R-88-1.82K
R409,R411,R416	RES,2K,.1%,1/10W,METAL FILM	R-263-2K
R410,R417, R413, R418	RES,3.16K,1%,1/8W,METAL FILM	R-88-3.16K
R5,R8	RES,187K,1%,1/8W,METAL FILM	R-88-187K
R6,R7	RES,249K,1%,1/8W,METAL FILM	R-88-249K
R9,R14,R236,R237	RES,100,5%,1/4W,COMPOSITION OR FILM	R-76-100
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U220,U403,U501	IC,TRIPLE 3 INPUT NOR,74LS27	IC-233

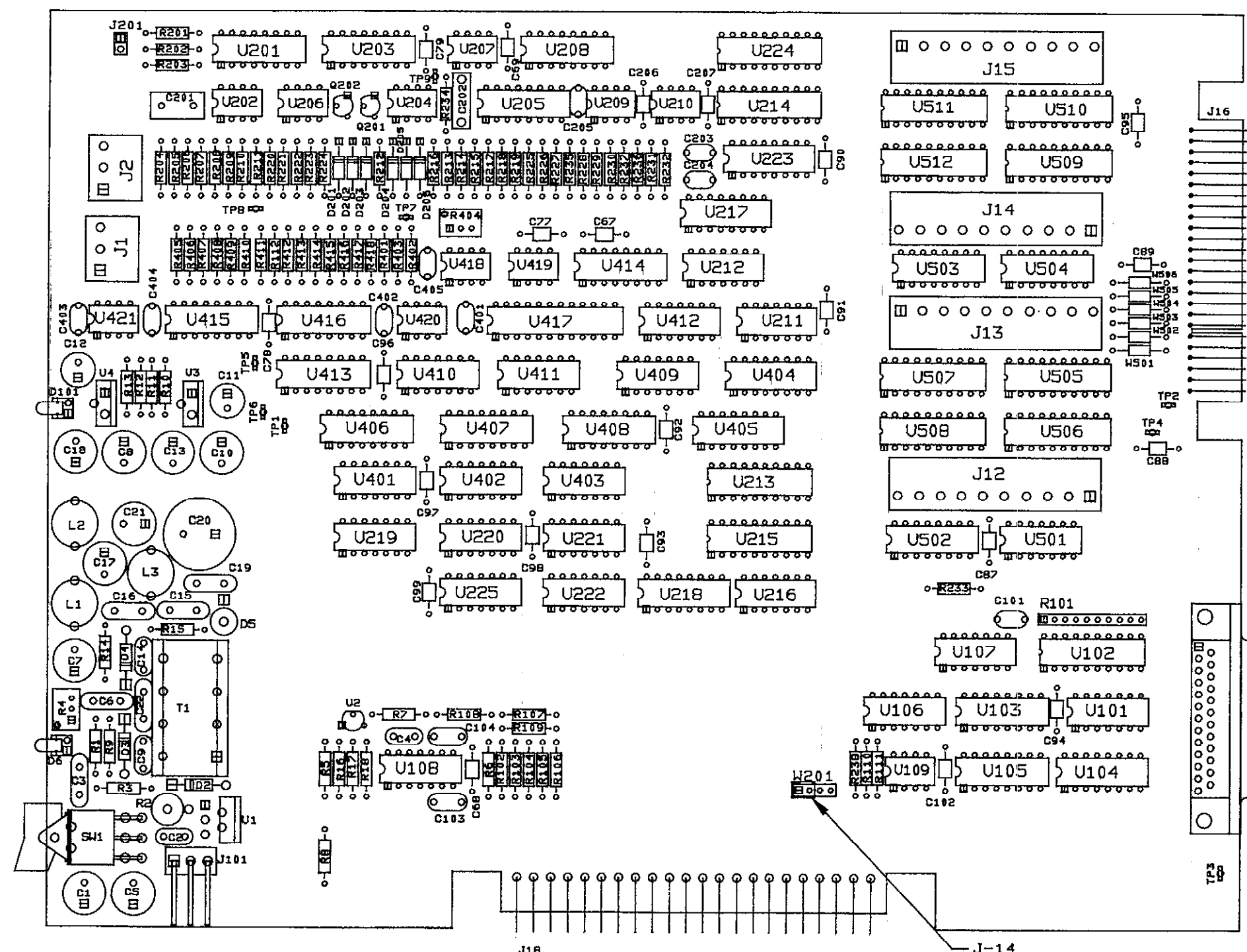
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U4	IC,VOLTAGE REGULATOR,LM337MP	IC-309
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W201	CONN,4 PIN	CS-339-4

MODEL 575 SIDE BOARD PARTS LIST

CIRCUIT DESIG.	DESCRIPTION	KEITHLEY PART NO.
	SCREW,PHILLIP PAN-HEAD SEMS #2 LOCKWASHER NUT SCREW, PHILLIPS PAN HEAD BRACKET	6-32x1/4 PPHSEMS 2LKWA #2-56 2-56 NUT 2-56x3/8PPH BR-17
C301	CAP,10,000uF,-20+30%,25V,ALUM ELEC	C-342-10000
D301-D304	DIODE,SILICON,5400 (267-01) FOR J301..J304 #4-40x3/8 LG PHIL PAN HD SCR	RF-34 4-40x3/8PPH
J301,J303,J304	CONN, RIGHT ANGLE,22 PIN DUAL	CS-481-6
J302	CONN, RIGHT ANGLE, 6 PIN DUAL	CS-481-1
J305	CONN,FEMALE,3 PIN	CS-618-3
J306	CONN,D.C. POWER JACK	CS-711
J307	CONN,RT. ANGLE,26-PIN	CS-295-1
R301,R302	RES,10K,.1%,1/8W,METAL FILM	R-176-10K
R303,R304	RES,21.5,1%,1/8W,METAL FILM	R-88-21.5
R305,R306	RES,1.09K,.1%,1/8W,METAL FILM	R-176-1.09K
R307-R317	RES,1K,5%,1/4W,COMPOSITION OR FILM	R-76-1K
SW301	SWITCH, SLIDE (TPDT)	SW-470
W301-W303	JUMPER,CIRCUIT	J-3

MODEL 575 MECHANICAL PART LIST

DESCRIPTION	KEITHLEY PART NO.
BINDING POST	BP-25
CABLE	CA-28
CARD GUIDE BRACKET	575-309
CASE ASSEMBLY	575-301
CASE BOTTOM	575-303
CASE TOP	575-302
DRAW LATCH ASEMBLY	FA-198
FEET	FE-17-1
FRONT PANEL	575-304
FRONT PANEL OVERLAY	575-305
GROUND STRAP ASSEMBLY	570-319
HINGE	H-5
INTERCONNECT BOARD ASSEMBLY	575-170
LUG	LU-116-1
MOUNTING KIT	MK-18
REAR PANEL	575-307
SAFETY GND WIRE ASS'Y	575-311
SHIELDED CABLE ASS'Y	CA-85-1
SHOULDER WASHER	WA-92-1
TOP COVER LABEL	MC-536
WIRE	SC-42 #4-40
MOTHER BOARD ASSEMBLY	575-100
BIVAR #FR-250 CARD GUIDE	CS-705



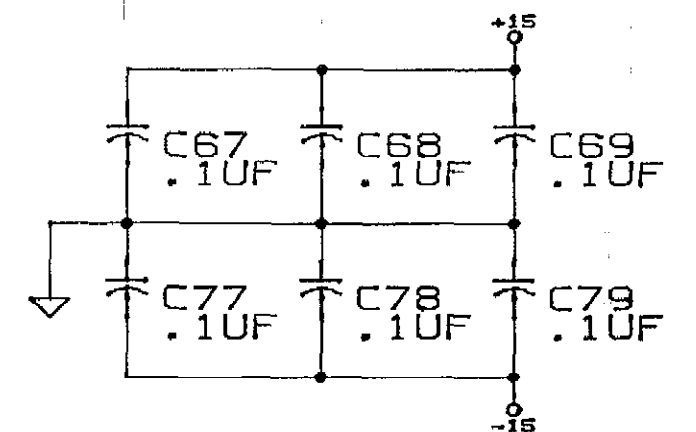
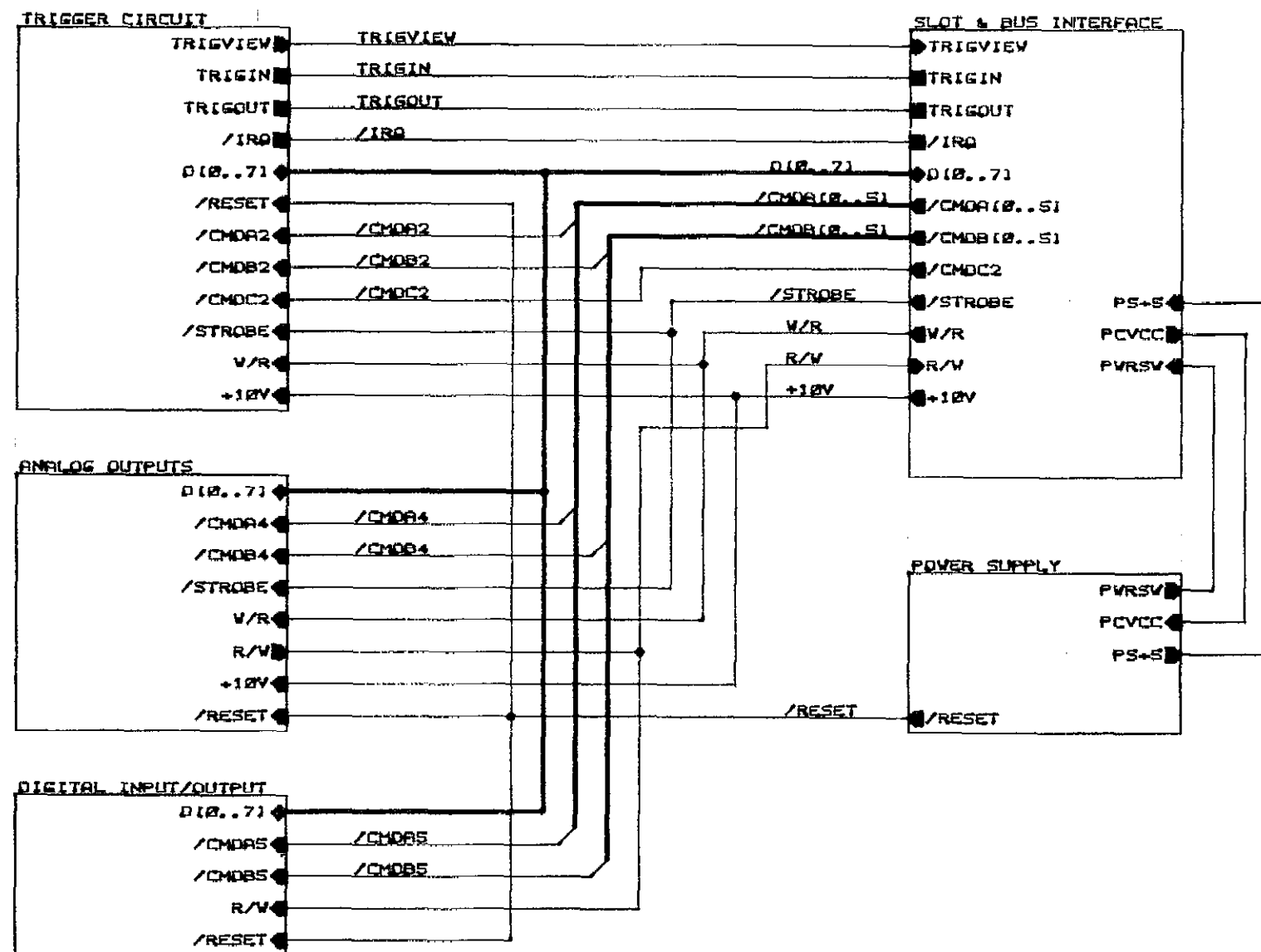
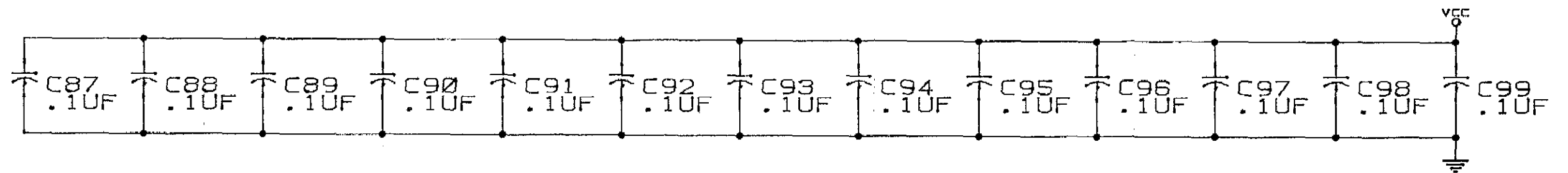
LTR.	ECO NO.	REVISION	ENG.	DATE
B	13388	RELEASED	MS	3-22-89
C	13520	ENG'D ART. REV. FROM B TO C. ADDED R317, C88-D J386 TO CORRECT SHAPE AND REVISED LOC. OF RES. ADDED NOTE AND HARDWARE.	Q d.	7-21-89

NOTE: DO NOT INSTALL W501 THRU W506.

NOTE: FOR COMPONENT INFORMATION, SEE BILL OF MATERIAL 575-000-01.

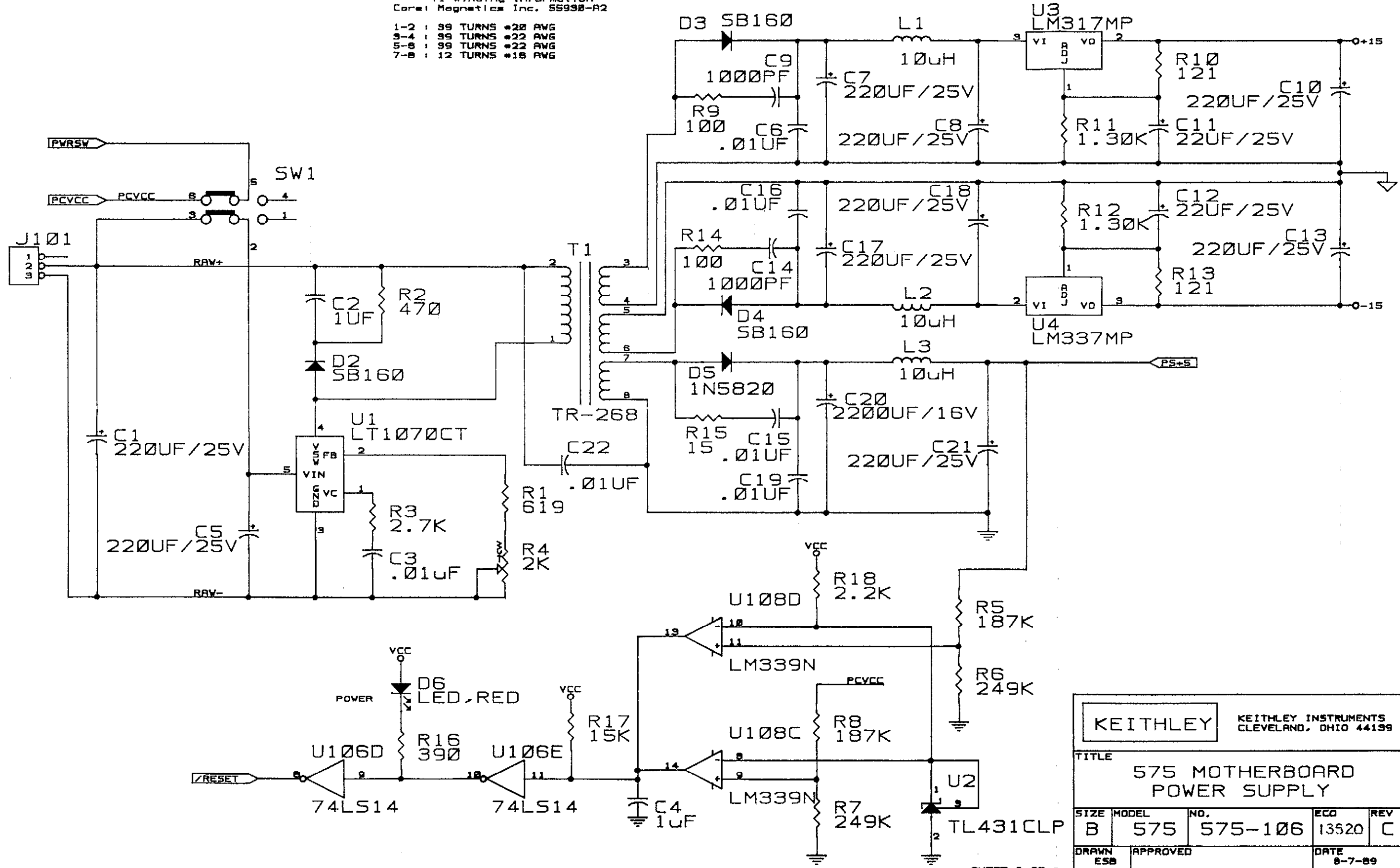
DO NOT SCALE THIS DRAWING		DIMENSIONAL TOLERANCES UNLESS OTHERWISE SPECIFIED		DATE 3-15-89	SCALE 1:1	TITLE COMPONENT LAYOUT, MOTHER BOARD	
XX=±.015		ANG.=±1°		DRN. CB	ENG. MS		
XXX=±.005		FRAC.=±1/64		MATERIAL	APPR. E.S.B.	C	NO. 575-100
SURFACE MAX. Ø3				FINISH			

KEITHLEY KEITHLEY INSTRUMENTS INC.
CLEVELAND, OHIO 44139

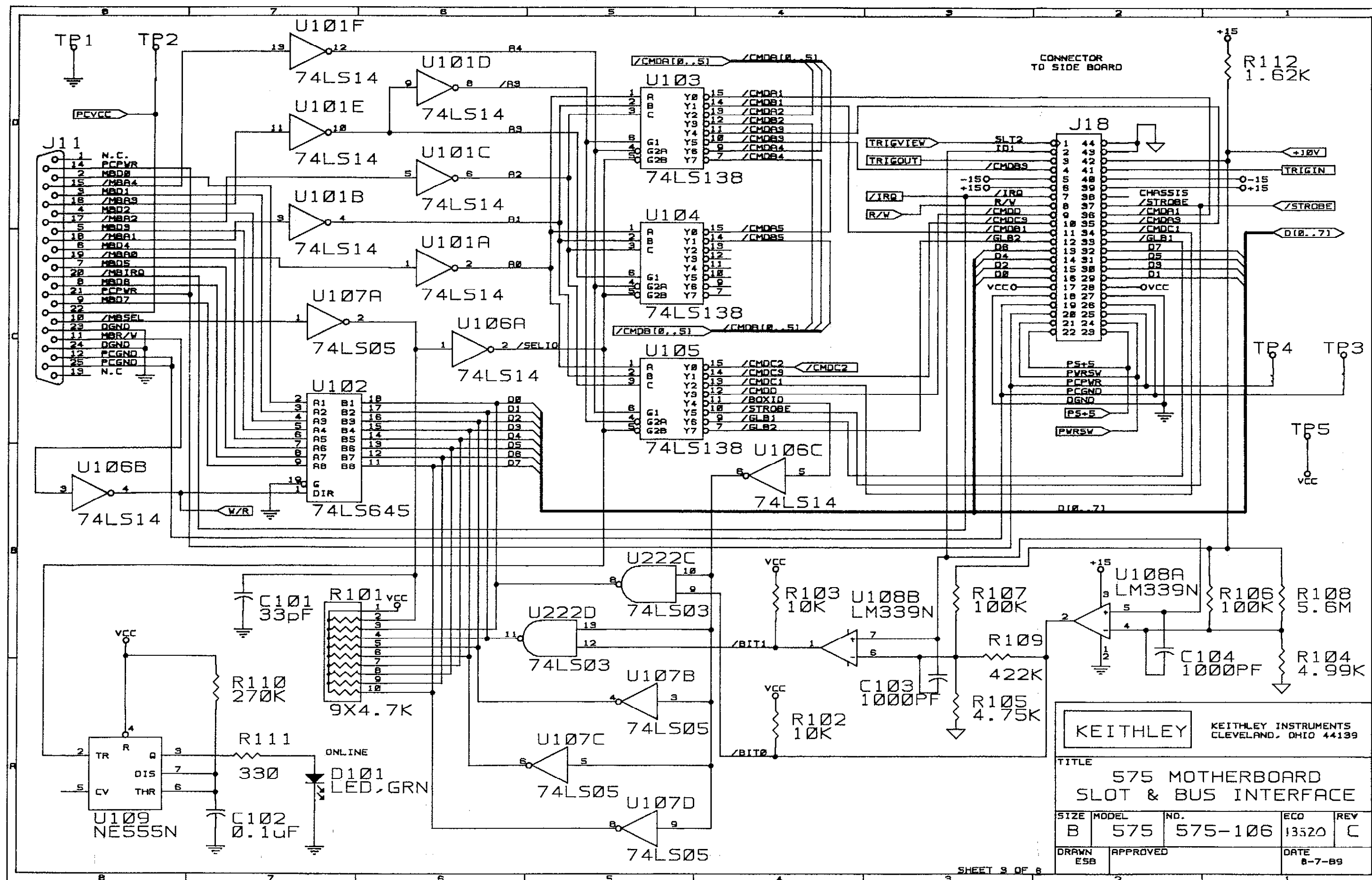


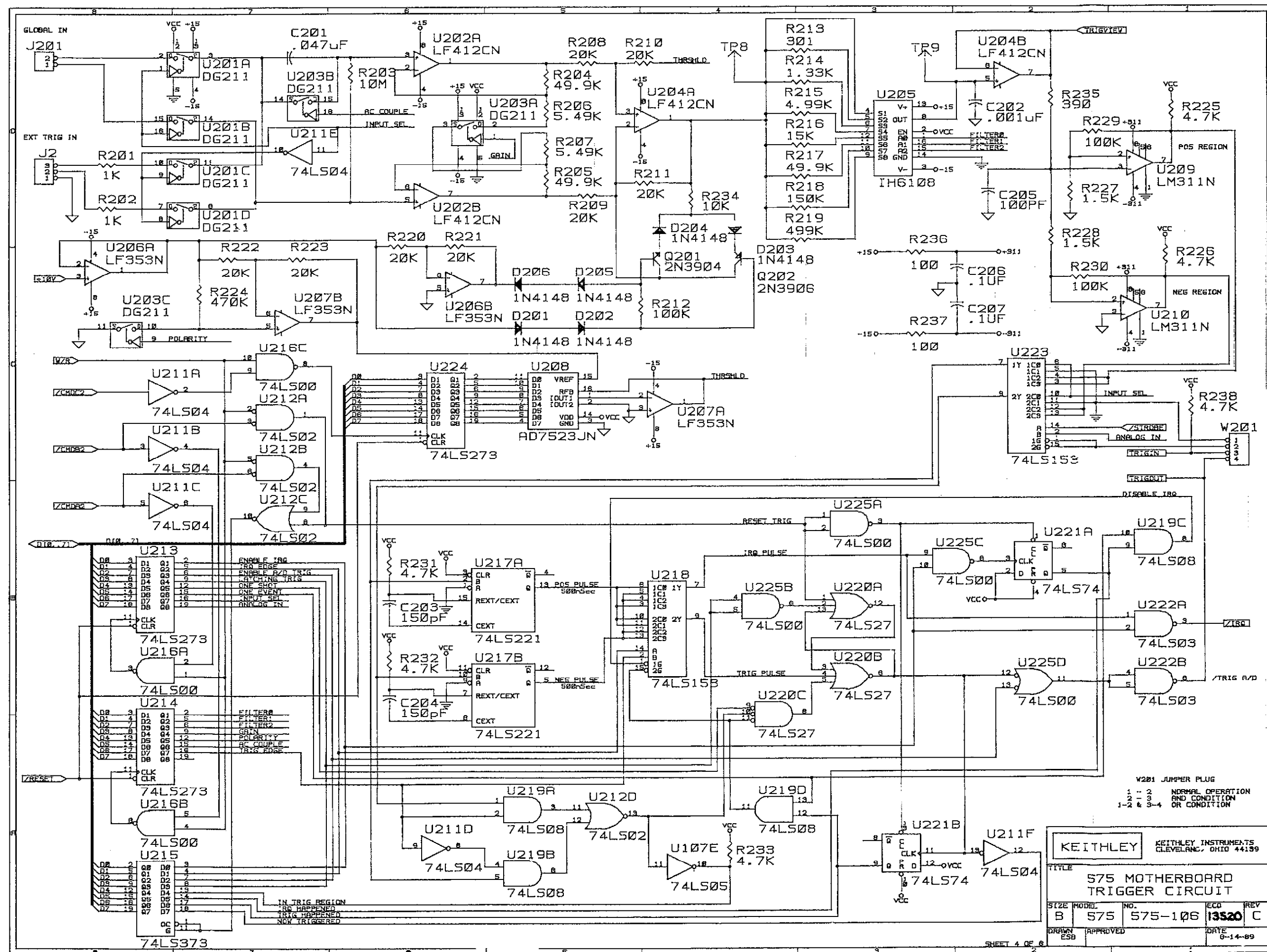
KEITHLEY		KEITHLEY INSTRUMENTS CLEVELAND, OHIO 44139	
TITLE 575 MOTHERBOARD ROOT SCHEMATIC SHEET			
SIZE B	MODEL 575	NO. 575-106	ECO 13520
REV C	DATE 8-14-89		
DRAWN ESB		APPROVED	

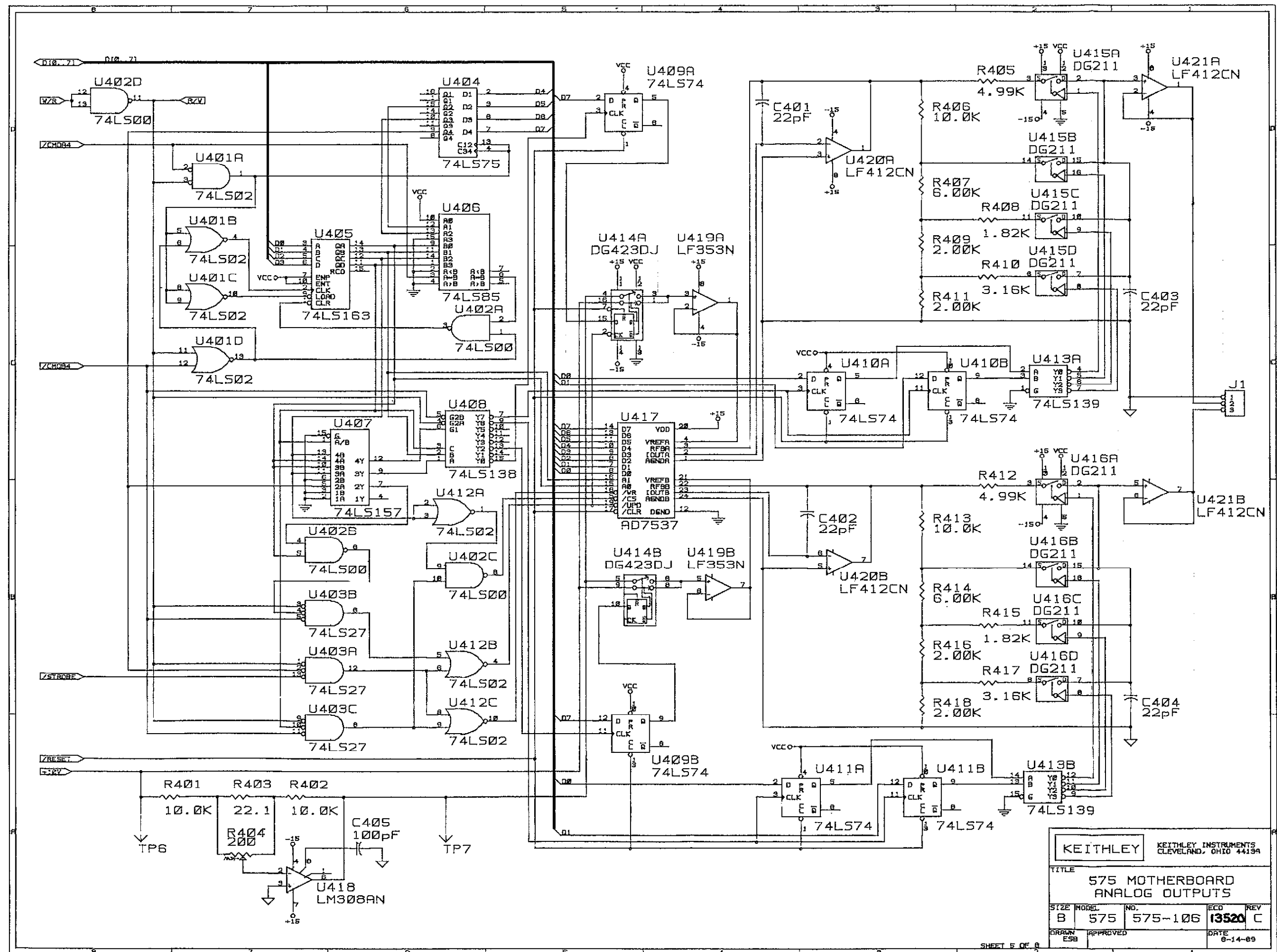
T1 Winding Information
 Core: Magnetics Inc. 55938-A2
 1-2 : 39 TURNS @22 AVG
 3-4 : 39 TURNS @22 AVG
 5-6 : 39 TURNS @22 AVG
 7-8 : 12 TURNS @16 AVG

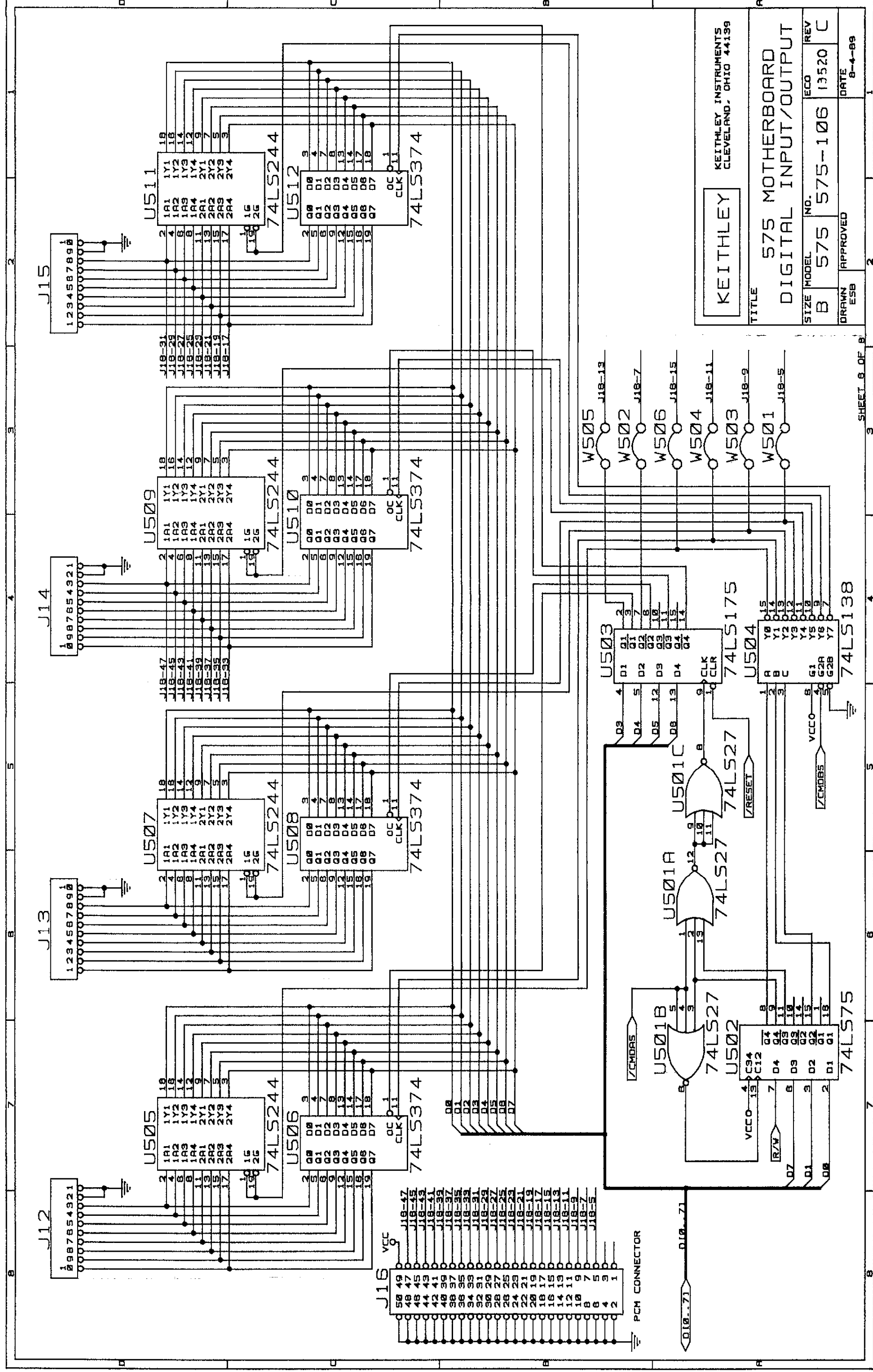


KEITHLEY		KEITHLEY INSTRUMENTS CLEVELAND, OHIO 44139			
TITLE 575 MOTHERBOARD POWER SUPPLY					
SIZE B	MODEL 575	NO. 575-106		ECO 13520	REV C
DRAWN ESB		APPROVED		DATE 8-7-89	









KEITHLEY

KEITHLEY INSTRUMENTS
CLEVELAND, OHIO 44139

TITLE

575 MOTHERBOARD
DIGITAL INPUT/OUTPUT

SIZE	MODEL	NO.	ECO	REV
B	575	575-106	13520	C

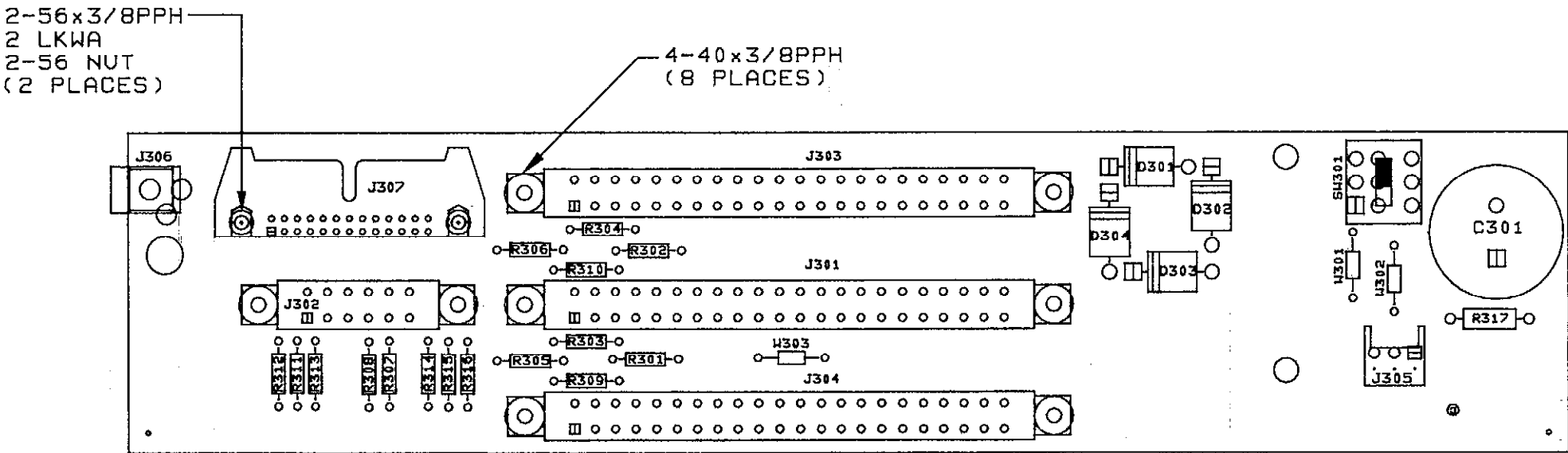
DRAWN E.S.B.	APPROVED
-----------------	----------

DATE 9-1-88

3-1-1-2

SHEET 8 OF

LTR.	ECD NO.	REVISION	ENG.	DATE
B	13388	RELEASED	MS	3-21-89
C	13520	CHG'D ART. REV. FROM B TO C. ADDED C205, C207, TP1, TP9, R112, R233, R238, J14 & NOTE.	QJ	7-21-89

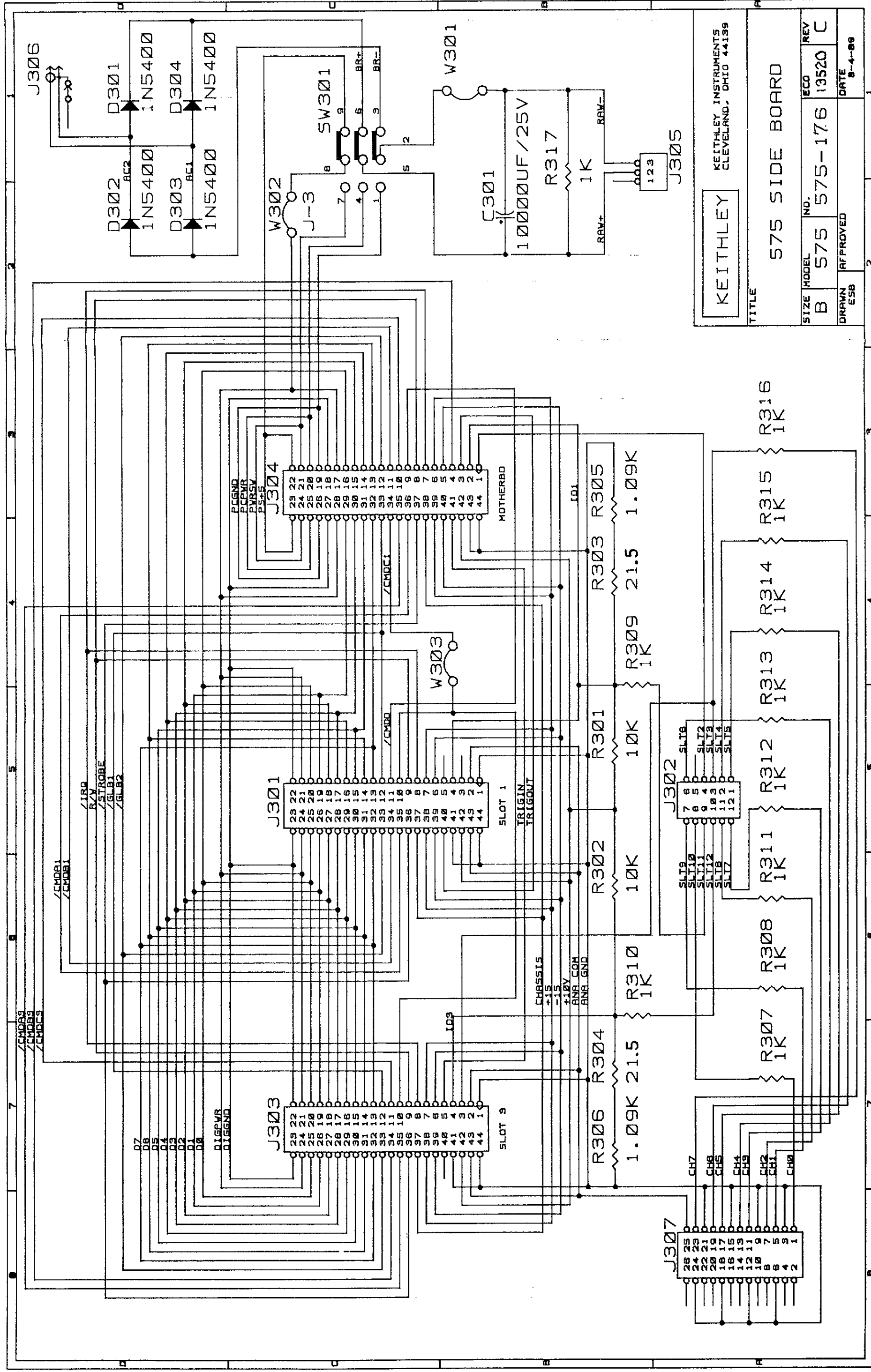


NOTE: MINUS (-) SIDE OF CAPACITOR C301 TO BE INSERTED INTO SQUARE PAD.

*BOARD TO BE LEADSAWED TO .050".

NOTE:
FOR COMPONENT INFORMATION,
REFER TO BILL OF MATERIAL
(575-000-02).

DO NOT SCALE THIS DRAWING	DIMENSIONAL TOLERANCES UNLESS OTHERWISE SPECIFIED	DATE 3-21-89	SCALE 1:1	TITLE COMPONENT LAYOUT, SIDE BOARD	
KEITHLEY KEITHLEY INSTRUMENTS INC. CLEVELAND, OHIO 44139	XX=±.015 ANG.=±1°	DRN. CB	ENG. MS APPR. E.S.B.		
	XXX=±.005 FRAC.=±1/64	MATERIAL		C	NO. 575-170
	SURFACE MAX. $\sqrt[3]{}$	FINISH			



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Service Form

Model No. _____ Serial No. _____ Date _____

Name and Telephone No. _____

Company _____

List all control settings, describe problem and check boxes that apply to problem. _____

- | | | |
|--|--|--|
| <input type="checkbox"/> Intermittent | <input type="checkbox"/> Analog output follows display | <input type="checkbox"/> Particular range or function bad; specify _____ |
| <input type="checkbox"/> IEEE failure | <input type="checkbox"/> Obvious problem on power-up | <input type="checkbox"/> Batteries and fuses are OK |
| <input type="checkbox"/> Front panel operational | <input type="checkbox"/> All ranges or functions are bad | <input type="checkbox"/> Checked all cables |

Display or output (check one)

- | | |
|-----------------------------------|--|
| <input type="checkbox"/> Drifts | <input type="checkbox"/> Unable to zero |
| <input type="checkbox"/> Unstable | <input type="checkbox"/> Will not read applied input |
| <input type="checkbox"/> Overload | |

- | | |
|---|--|
| <input type="checkbox"/> Calibration only | <input type="checkbox"/> Certificate of calibration required |
|---|--|

- ☐
- Data required

(attach any additional sheets as necessary)

Show a block diagram of your measurement system including all instruments connected (whether power is turned on or not). Also, describe signal source.

Where is the measurement being performed? (factory, controlled laboratory, out-of-doors, etc.)

What power line voltage is used? _____ Ambient temperature? _____ °F

Relative humidity? _____ Other? _____

Any additional information. (If special modifications have been made by the user, please describe.)

KEITHLEY DATA ACQUISITION

Data Acquisition Division

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