



INSTRUCTION MANUAL

**Models 1792, 6422
Isolated BCD Outputs**

**Keithley Instruments, Inc.
28775 Aurora Road/Cleveland, Ohio 44139/(216) 248-0400**

WARRANTY

Keithley Instruments, Inc. warrants this product to be free from defects in material and workmanship for a period of 1 year from date of shipment. During the warranty period, we will, at our option, either repair or replace any product that proves to be defective.

To exercise this warranty, write or call your local Keithley representative, or contact Keithley headquarters in Cleveland, Ohio. You will be given prompt assistance and return instructions. Send the instrument, transportation prepaid, to the indicated service facility. Repairs will be made and the instrument returned, transportation prepaid. Repaired products are warranted for the balance of the original warranty period, or at least 90 days.

LIMITATION OF WARRANTY

This warranty does not apply to defects resulting from unauthorized modification or misuse of any product or part. This warranty also does not apply to fuses, batteries, or damage from battery leakage.

This warranty is in lieu of all other warranties, expressed or implied, including any implied warranty of merchantability or fitness for a particular use. Keithley Instruments, Inc. shall not be liable for any indirect, special or consequential damages.

STATEMENT OF CALIBRATION

This instrument has been inspected and tested in accordance with specifications published by Keithley Instruments, Inc.

The accuracy and calibration of this instrument are traceable to the National Bureau of Standards through equipment which is calibrated at planned intervals by comparison to certified standards maintained in the Laboratories of Keithley Instruments, Inc.

KEITHLEY

KEITHLEY INSTRUMENTS, INC.

INSTRUMENT DIVISION / 28775 Aurora Road / Cleveland, Ohio 44139 / U.S.A. / (216) 248-0400 / Telex: 98-5469

WEST GERMANY: Keithley Instruments GmbH / Heiglhofstr. 5 / 8000 München 70 / (089) 710020 / Telex: 52-12160

GREAT BRITAIN: Keithley Instruments, Ltd. / 1, Boulton Road / Reading, Berkshire RG 2 ONL / (0734) 86-12-87/88 / Telex: 84-7047

FRANCE: Keithley Instruments SARL / 2, Bis Rue Léon Blum / B.P. 60 / 91121 Palaiseau Cedex / (6) 011-51-55 / Telex: 600-933

NETHERLANDS: Keithley Instruments BV / Arkelsedijk 4 / Postbus 559 / 4200 AN Gorinchem / (0) 1830-25577 / Telex: 24-684

SWITZERLAND: Keithley Instruments SA / Kriesbachstr. 4 / 8600 Dübendorf / 01/821-94-44 / Telex: 57-536

AUSTRIA: Keithley Instruments Ges.m.b.H. / Döblinger Haupstr. 32 / 1190 Wien / 314 289 / Telex: 13-4500

MODELS 1792, 6422

ISOLATED BCD OUTPUTS

Copyright 1979, Keithley Instruments, Inc.

Third Printing, May 1981, Cleveland, Ohio U.S.A.

Document No. 30155, Rev. B

TABLE OF CONTENTS

SECTION	TITLE	PAGE
1.	GENERAL INFORMATION	1-1
1-1.	INTRODUCTION	1-1
1-3.	COMPATIBILITY	1-1
1-5.	WARRANTY INFORMATION	1-1
1-7.	CHANGE NOTICES	1-1
1-9.	SAFETY SYMBOLS	1-1
1-11.	SPECIFICATIONS	1-1
2.	INITIAL PREPARATION	2-1
2-1.	INTRODUCTION	2-1
2-3.	UNPACKING AND INSPECTION	2-1
2-5.	PREPARATION FOR USE	2-1
2-7.	MODEL 1792 INSTALLATION	2-3
2-9.	Model 1792 Output Connections	2-3
2-11.	MODEL 6422 INSTALLATION	2-4
3.	OPERATION	3-1
3-1.	INTRODUCTION	3-1
3-3.	OVERALL OPERATION	3-1
3-9.	CIRCUIT DESCRIPTION	3-3
3-11.	Control Circuitry	3-3
3-14.	Switching Circuitry	3-4
3-16.	Isolator Network	3-4
3-18.	Busy/Hold Circuit	3-4
3-20.	Output Registers And Buffers	3-5
3-22.	DC-to-DC Converter	3-5
3-24.	TEST POINT DATA	3-5
3-26.	SPECIAL HANDLING OF STATIC SENSITIVE DEVICES	3-6
4.	REPLACEMENT PARTS	4-1
4-1.	GENERAL	4-1
4-3.	ORDERING INFORMATION	4-1
4-5.	SCHEMATIC	4-1
4-7.	COMPONENT LAYOUT	4-1

ILLUSTRATIONS

FIGURE	TITLE	PAGE
2-1	Installation of Model 1792	2-2
2-2	Installation of Model 6422	2-5
3-1	Model 1792/6422 Block Diagram	3-1
3-2	Timing Diagram	3-2
3-3	Ring Counter and Gating	3-3
3-4	Busy/Hold Circuit	3-4

SECTION 1 GENERAL INFORMATION.

1-1. INTRODUCTION.

1-2. The Models 1792 and 6422 are isolated BCD output options that convert displayed meter readings to electrically isolated, latched, and buffered parallel BCD outputs. These can be applied to line printers or other external data handling equipment. Logic levels are TTL/DTL and CMOS compatible. Output data includes sign and overrange signals. In addition, a BUSY control line indicates that the meter is updating data. The trailing edge of this signal is normally used to initiate a print or load operation at the listening device. An input control line (HOLD) allows the listening device to inhibit the update of output data. When this line is high, the data update rate is the same as the meter conversion rate, typically 2.5 readings/second. Operating characteristics for the Models 6422 and 1792 are given in their respective Specification Tables (Table 1-1 and 1-2). Both options can be either factory or field installed. Separate installation procedures are provided in this manual, because of the different mounting and output cabling provisions of the options.

1-3. COMPATIBILITY.

1-4. The Models 1792 and 6422 interface options are compatible with the following Keithley Instruments:

Model 6422

Model 642 Electrometer Serial Number 53402A and above.

Model 1792

Model 179 DMM Serial Number 20000 and above.
 Model 179-20A DMM all Serial Numbers.
 Model 177 DMM Serial Number 14500 and above.
 Model 480 Picoammeter Serial Number 12000 and above. Note: First 3-1/2 digits at BCD output same as Model 480 display.

1-5. WARRANTY INFORMATION.

1-6. The Warranty is given on the inside front cover of this Instruction Manual. If there is a need to exercise the warranty, contact the Keithley Representative in your area to determine the proper action to be taken. Keithley maintains service facilities in the United Kingdom and West Germany, as well as in the United States. Check the inside front cover of this Manual for addresses.


1-7. CHANGE NOTICES.


1-8. Improvements or changes to the equipment which occur after printing of the Instruction Manual will be explained on a Change Notice sheet attached to the inside back cover.

1-9. SAFETY SYMBOLS

1-10. Safety symbols used in this manual are as follows:

IMPORTANT

The  symbol can be found in various places in this manual. Carefully read the associated CAUTION statements with regard to proper use and handling of the equipment. Damage to the equipment may occur if these precautions are ignored.

This  symbol can be found in various places in this manual. This symbol indicates those areas on the equipment which are potential shock hazards. Carefully read the associated WARNING statements with regard to proper use and handling of the equipment. Serious personal injury may result if these precautions are ignored.

1-11. SPECIFICATIONS.

1-12. Detailed specifications for the Model 1792 and 6422 are given in Tables 1-1 and 1-2, respectively.

SPECIFICATIONS

TABLE 1-1

SPECIFICATIONS, MODEL 1792 ISOLATED BCD OUTPUT

OUTPUTS: 4-1/2 digit parallel BCD, polarity, overrange bit, busy.

$\overline{\text{BUSY}}$: Low during output update (50ms max).

OUTPUT UPDATE RATE: Same as meter conversion rate (2.5 reading/second typical).

CONTROL: $\overline{\text{HOLD}}$ inhibits subsequent output updates when low.

LOGIC LEVELS: TTL/DTL and CMOS compatible.
 Output High = 4.5V minimum while sourcing 100 μ A.
 Low = 0.5V maximum while sinking 3.2mA.
 Control High = open or 4V minimum.
 Low = .5V maximum while sinking 1mA.

ISOLATION: All outputs and controls isolated from meter up to 1400V peak, 10⁵V \cdot Hz. (10¹⁰ Ω , ||40pf typ)

ENVIRONMENT: Operate 0 to 55°C, 0 to 80% RH.
 Storage -25 to 70°C.

OUTPUT CONNECTOR: 26 pin card edge, mates with CS294-1 (3M 3462 or equivalent)

INSTALLATION: Field installable, mounts within and powered from Keithley meter.
 Adds 0.2kg (0.5lbs).
 Precludes Model 1788 battery pack installation.

ASSESSORIES AVAILABLE: Model 1796 - 10' output mating cable, one end unterminated.
 Model 1797 - 10' interconnect cable to 750/7502 printer.

TABLE 1-2

SPECIFICATIONS, MODEL 6422 ISOLATED BCD OUTPUT

OUTPUT: 4-1/2 digit parallel BCD, polarity, overrange bit, busy.

$\overline{\text{BUSY}}$: Low during output update (50ms max).

OUTPUT UPDATE RATE: Same as meter conversion rate (2.5 reading/second typical).

CONTROL: $\overline{\text{HOLD}}$ inhibits subsequent output updates when low.

LOGIC LEVELS: TTL/DTL and CMOS compatible.
 Output High = 4.5V minimum while sourcing 100 μ A.
 Low = 0.5 maximum while sinking 1mA
 Control High = open or 4V minimum.
 Low = .5V maximum while sinking 3.2mA

ISOLATION: All outputs and controls isolated from meter up to 30V peak, 10⁵V \cdot Hz. (10¹⁰ Ω || ,40pf typ)

ENVIRONMENT: Operate 20°C to 30°C
 Storage -25°C to +55°C.

OUTPUT CONNECTOR: 26 pin ribbon cable, unterminated.

INSTALLATION: Field installable, mounts within and powered from Keithley meter. Adds 0.4kg (1.0 Lbs).
 Precludes Model 6428 battery adapter installation.

SECTION 2. INITIAL PREPARATION.

2-1. INTRODUCTION.

2-2. This section provides information for incoming inspection and preparation for use of your Model 1792/6422 BCD output option.

2-3. UNPACKING AND INSPECTION.

2-4. The Model 1792/6422 was carefully inspected, both mechanically and electrically before shipment. Upon receiving your BCD output option, unpack all items from the Shipping container and check for any obvious damage which may have occurred during transit. Report any damages to the shipping agent. Retain and use the original packaging materials if reshipment is required. The following items (Keithley Part No. in parentheses) are shipped with all orders of your option:

Model 1792

- a. PC-498 and shield Assembly
 - 1) PC-488 Assembly (29961D)
 - 2) Shield Assembly (30108C)
- b. Replacement Top Cover (30136C)
- c. A copy of this Instruction Manual (30155)
- d. Separate Optional Cable (Model 1796 or 1797), as ordered.

Model 6422

- a. Assembled PC Board (29961D) with modified PC-498 (30165B).
- b. Shield (30132B).
- c. Output Cable assembly with back panel and strain reliefs.
 - 1) Cable assembly (30234B-1)
 - 2) Back panel (30131B).
 - 3) Two strain reliefs (27686A).
- d. Mounting Hardware
 - 1) Eight Standoffs (ST-94).
 - 2) Eight 6-32 X 5/16" screws.
- e. A copy of this Instruction Manual (30155).

2-5. PREPARATION FOR USE.

2-6. The Models 1792 and 6422 are shipped ready for installation. Separate installation procedures are provided. Install the Model 1792/6422 in your instrument using the applicable installation procedure.

TABLE 2-1
MODEL 1792/6422 Output Connections

1792/6422 FUNCTION	P401 PIN NO.	CS-294-1 PIN NO	CABLE* WIRE NO. & COLOR
Common	1	1	1 BRN
Common	2	2	2 RED
HOLD (Input)	3	3	3 ORN
BUSY	4	4	4 YEL
D1-B (2)	5	5	5 GRN
D1-A (1)	6	6	6 BLUE
D1-D (8)	7	7	7 VIO
D1-C (4)	8	8	8 GRAY
D2-B (2)	9	9	9 WHT
D2-A (1)	10	10	10 BLK
D2-D (8)	11	11	11 BRN
D2-C (4)	12	12	12 RED
D3-B (2)	13	13	13 ORN
D3-A (1)	14	14	14 YEL
D3-D (8)	15	15	15 GRN
D3-C (4)	16	16	16 BLUE
D4-B (2)	17	17	17 VIO
D4-A (1)	18	18	18 GRAY
D4-D (8)	19	19	19 WHT
D4-C (4)	20	20	20 BLK
Common	21	21	21 BRN
D5	22	22	22 RED
Ovrange	23	23	23 ORN
Sign	24	24	24 YEL
Common	25	25	25 GRN
Common	26	26	26 BLUE

*Part of 6422 cable assembly or optional Model 1796 cable assembly.

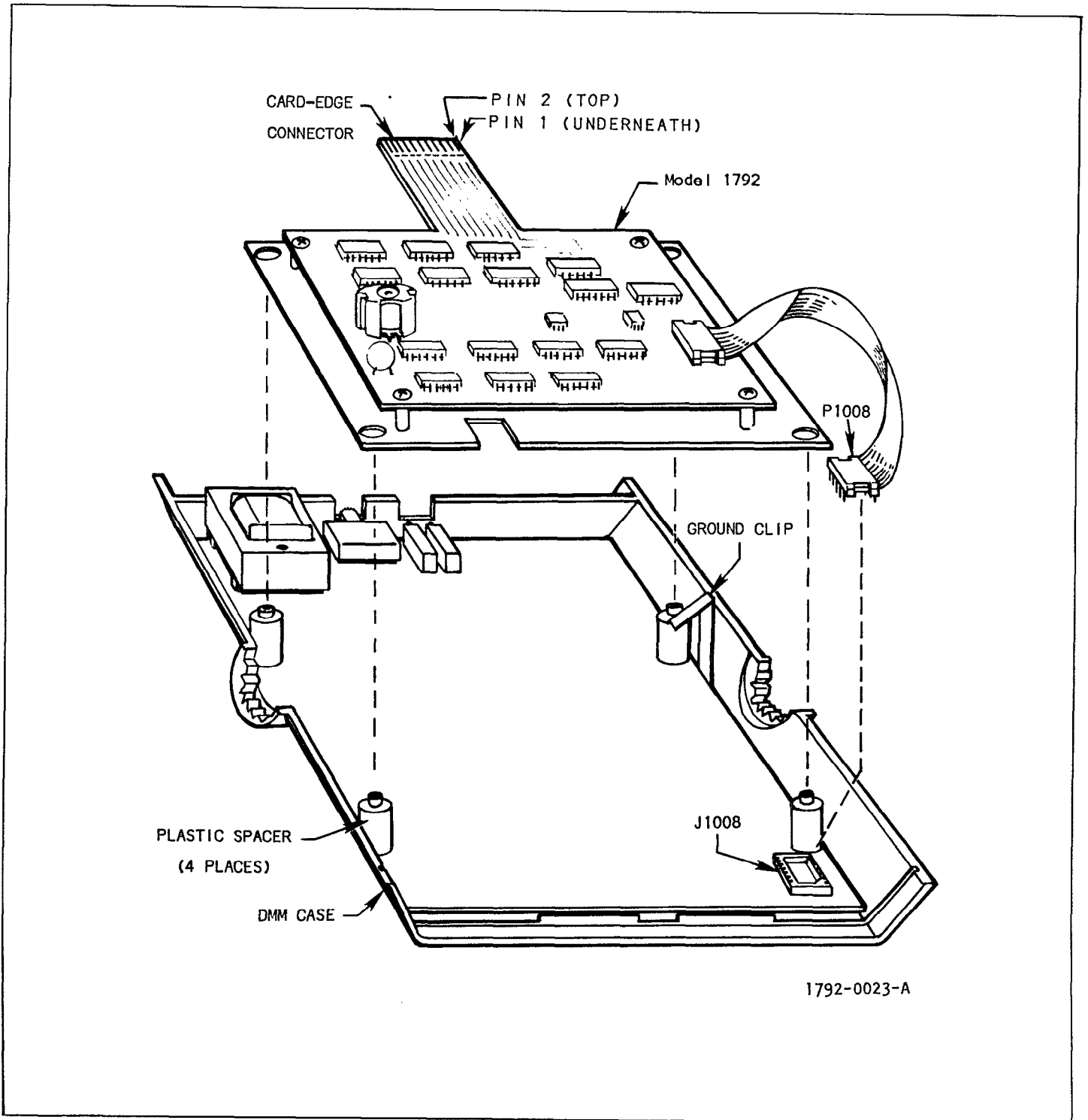


FIGURE 2-1. Installation of Model 1792.

2-7. MODEL 1792 INSTALLATION

2-8. The Model 1792 is installed internally in the Model 177, 179, 179-20A, or 480 and is powered by the instrument's line operated power supply. Installation of the Model 1792 precludes use of the Model 1788 Battery Pack. Refer to Figure 2-1 and install the Model 1792 as follows:



Disconnect the line cord before removing the case cover.

- a. Turn off power and disconnect line cord.
- b. Turn the DMM bottom side up and loosen the four screws in the bottom cover.
- c. Hold the top and bottom covers together to prevent their separation and turn the DMM over to the normal position.
- d. Lift off the top cover and the calibration shield if installed. If the Model 1788 Battery Pack is installed, disconnect its connector from the plug on the main printed circuit board and remove the Model 1788. The four plastic spacers must remain in place on the upright studs projecting through the main printed circuit board.

NOTE

Do not discard the calibration shield. This shield must be installed during calibration, as described in the Instruction Manual for your instrument.

- e. If the Model 1788 was removed, set the LINE/BAT switch on the main printed circuit board to the LINE position.
- f. Connect P1008 to its mating receptacle on the printed circuit board (J1002 on the Model 480 and J1008 on the Models 177, 179 and 179-20A).

g. Install the Model 1792 in the instrument so that it rests on the plastic spacers. The ground clip must make contact with the upper side of the shield on the Model 1792.

h. Install the top cover that was shipped with the Model 1792. This cover has a slot to accommodate the card edge connector of the Model 1792.

i. Save all removed parts for reinstallation in the event that the 1792 is to be removed at a later date.

2-9. Model 1792 Output Connections.

2-10. The Model 1792 uses a 26 pin card-edge connector (P401) to provide all input and output connections to external equipment. This connector mates with a Keithley CS-294-1 flat-ribbon connector (3M 3462 or equivalent), which is not supplied. The output connector pins are identified in Table 2-1.

Two optional cable accessories are available for interfacing the Model 1792 with external equipment. The Model 1796 is a 10 foot (3 meter) flat ribbon cable with 26 wires and an output mating connector (CS-294-1) on one end. The other end is left unterminated so that a connector can be installed that is compatible with the equipment to be interfaced. Pin identification for the Model 1796 is the same as that given in Table 2-1 for the Model 1792 output connector. The wires are color coded with the brown wire to pin 1, the red wire to pin 2, and so on.

The Model 1797 is a 10 foot (3 meter) cable that provides the connections to interface the Model 1792 with the Keithley 750/7502 Line Printer. This cable is plug-to-plug compatible with both the Model 1792 and Model 750/7502 for easy installation. Table 2-2 identifies the cable connector pins and wires.

2-11. MODEL 6422 INSTALLATION

2-12. The Model 6422 is installed internally in the Model 642 and is powered by the Model 642 line operated power supply. Installation of the Model 6422 precludes the use of the Model 6428 Battery Adapter option. Refer to Figure 2-2 and install the Model 6422 as follows:



Disconnect the line cord before removing the case cover.

- a. Turn off power and disconnect the line cord.
- b. Remove the four attaching screws and remove the top cover.
- c. Remove the two attaching screws from the plate (or Model 6428) on the rear panel of the mainframe. If the Model 6428 is installed, remove it as follows:
 - 1) Disconnect the connector from the plug on the mother board.
 - 2) Remove the attaching screw and spacer, and remove the Model 6428 through the opening in the rear panel.
- d. Remove the front four attaching screws from the mother board and replace them with the metal spacers, as shown in Figure 2-2. These spacers may fit snugly and require use of a wrench to install them. Take care not to cross thread or tighten them too tight.

e. Connect P1008 to J1013 on the mother board. After making the connection, place the printed circuit board outside of the Model 642 so that there is no strain on the cable and the board will be out of the way during installation of the shield and spacers in the following steps.

f. Place the shield on the spacers and attach with the four screws, as shown. The printed circuit board will not fit properly unless the shield is installed with the nut plates on the bottom side and with the hole pattern positioned as illustrated.

g. Install the four spacers into the shield.

h. Place the printed circuit board on the spacers (component side down) and attach it with four screws.

i. Connect the output cable to the card-edge connector and attach the assembly to the rear panel of the mainframe with the two screws removed in step c above.

j. Reinstall the case top cover.

k. Connect the Model 6422 to your equipment by installing an appropriate connector on the un-terminated end of the cable. Pin identification for the Cable assembly connector is the same as that given in Table 2-1 for the Model 1792/6422 output connector. The wires are color coded with the brown wire to Pin 1, the red wire to pin 2, and so on.

l. Save all removed parts for reinstallation in the event that the Model 6422 is to be removed at a later date.

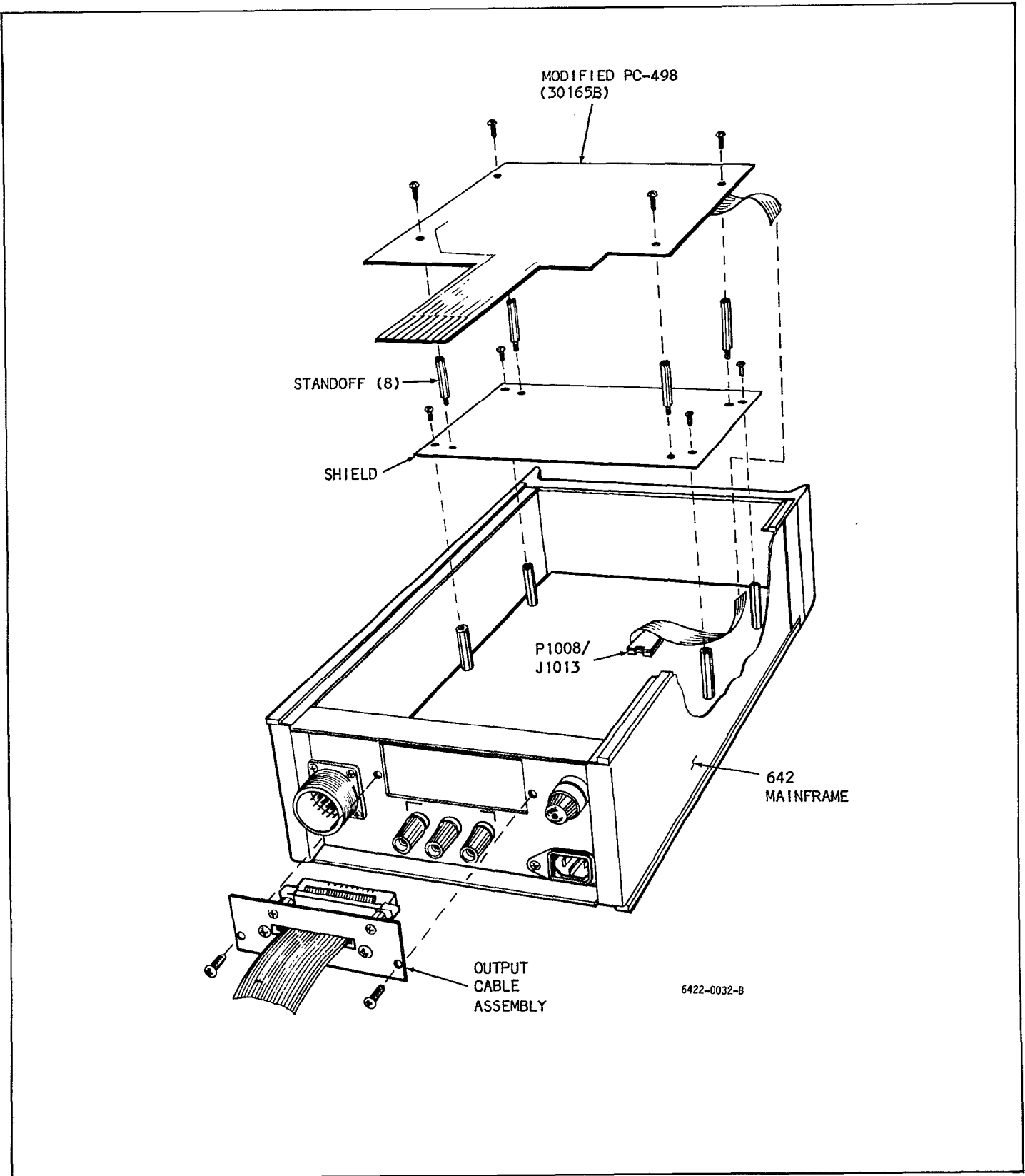
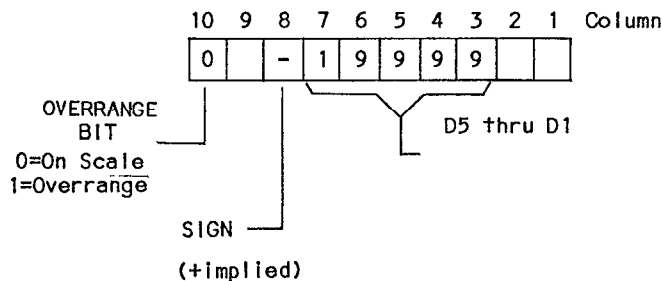


FIGURE 2-2. Installation of Model 6422

TABLE 2-2
Model 1797 Cable Connections

1792 FUNCTION	CS-294-1 PIN NO.	CABLE WIRE NO. AND COLOR	CS-271 PIN NO.	750/7502* FUNCTION
Common	1	1 BRN	9	8-1 gnd.
Common	2	2 RED	14	Common
HOLD (Input)	3	3 ORN	15	HOLD (Output)
BUSY	4	4 YEL	13	EXTERNAL PRINT
D1-B (2)	5	5 GRN	2	3-2
D1-A (1)	6	6 BLUE	18	3-1
D1-D (8)	7	7 VIO	37	3-8
D1-C (4)	8	8 GRAY	19	3-4
D2-B (2)	9	9 WHT	22	4-2
D2-A (1)	10	10 BLK	5	4-1
D2-D (8)	11	11 BRN	23	4-8
D2-C (4)	12	12 RED	6	4-4
D3-B (2)	13	13 ORN	39	5-2
D3-A (1)	14	14 YEL	38	5-1
D3-D (8)	15	15 GRN	41	5-8
D3-C (4)	16	16 BLUE	40	5-4
D4-B (2)	17	17 VIO	24	6-2
D4-A (1)	18	18 GRAY	7	6-1
D4-D (8)	19	19 WHT	25	6-8
D4-C (4)	20	20 BLK	8	6-4
Common	21	21 BRN	43,44,45	7-2,7-4,7-8 gnd.
D5	22	22 RED	42	7-1
OVERRANGE	23	23 ORN	11	10-1
SIGN	24	24 YEL	10	8-4
Common	25	25 GRN	12	10-4 gnd.
Common	26	26 BLUE	28,29	10-8,10-2 gnd.

*Printer Format



SECTION 3. OPERATION.

3-1. INTRODUCTION.

3-2. This section describes operation of the Model 1792/6422. Except where noted, the descriptions apply to both models. The information is arranged to provide overall operation, circuit descriptions, test point data and special handling requirements for static sensitive devices.

3-3. OVERALL OPERATION.

3-4. Figure 3-1 shows the Model 1792/6422 in block diagram form. The 1792/6422 operates by first converting multiplexed BCD input data into synchronous serial data. Serial data is then transmitted across an opto-electric coupler network and loaded into a twenty bit shift register. Data is then buffered and appears at the output in parallel BCD format.

3-5. The STROBE and CLOCK lines come from the meter motherboard and provide timing for the 1792/6422. The control consists of a divider and a ring counter. The divider is phase-locked to the STROBE

pulse and divides the 100kHz CLOCK by ten to produce the 10kHz SYNC train. The ring counter output drives the switching to convert the multiplexed BCD digit data into a serial one bit format. The digit five (D5) line is decoded to serialize the SIGN and OVERRRANGE lines.

3-6. The isolating network consists of two opto-couplers and buffers. The SYNC and DATA pulses are transmitted with the opto-couplers normally off to conserve power.

3-7. The SYNC train after transmission goes into a BUSY/HOLD network which controls the output shift register. This network consists of a flip-flop, one shot, and gating. The BUSY output goes low during data update. However, if the HOLD line is low, no data will be loaded, and the output will not change. With the HOLD line high, data is updated at the meter conversion rate, typically 2.5 readings/second.

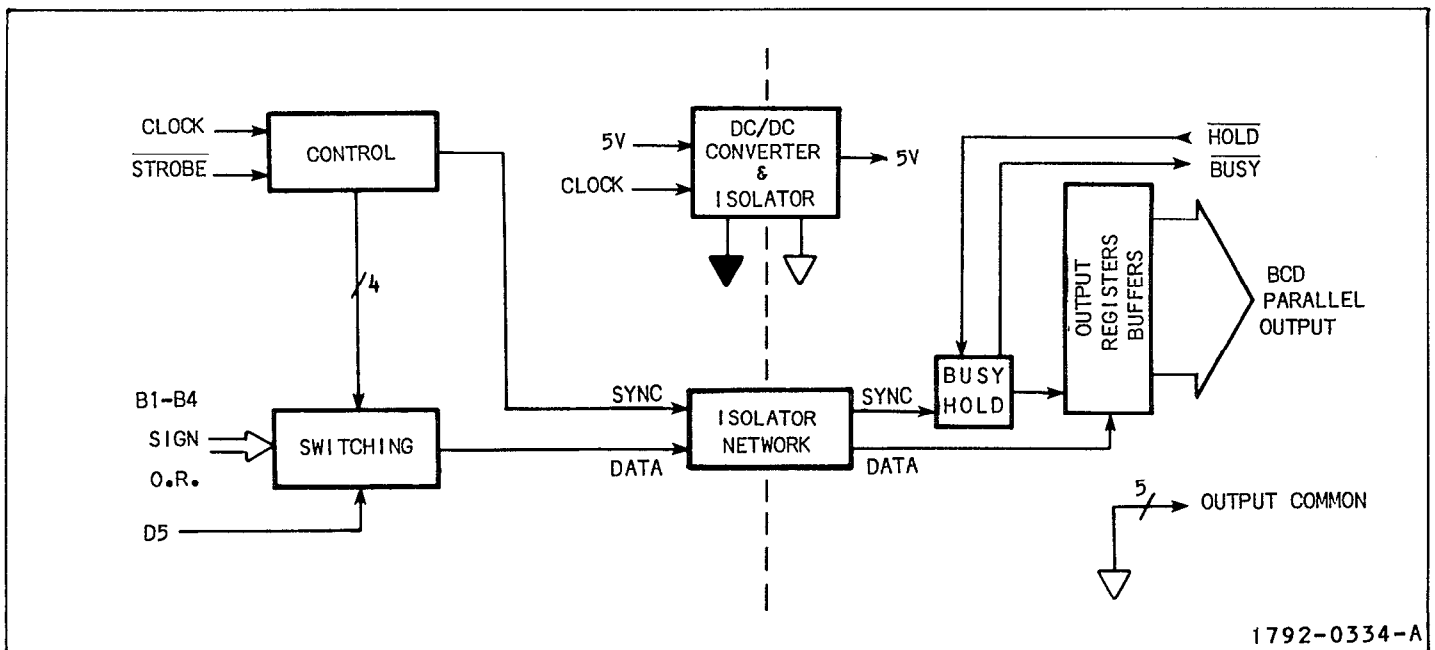


Figure 3-1. Model 1792/6422 Block Diagram

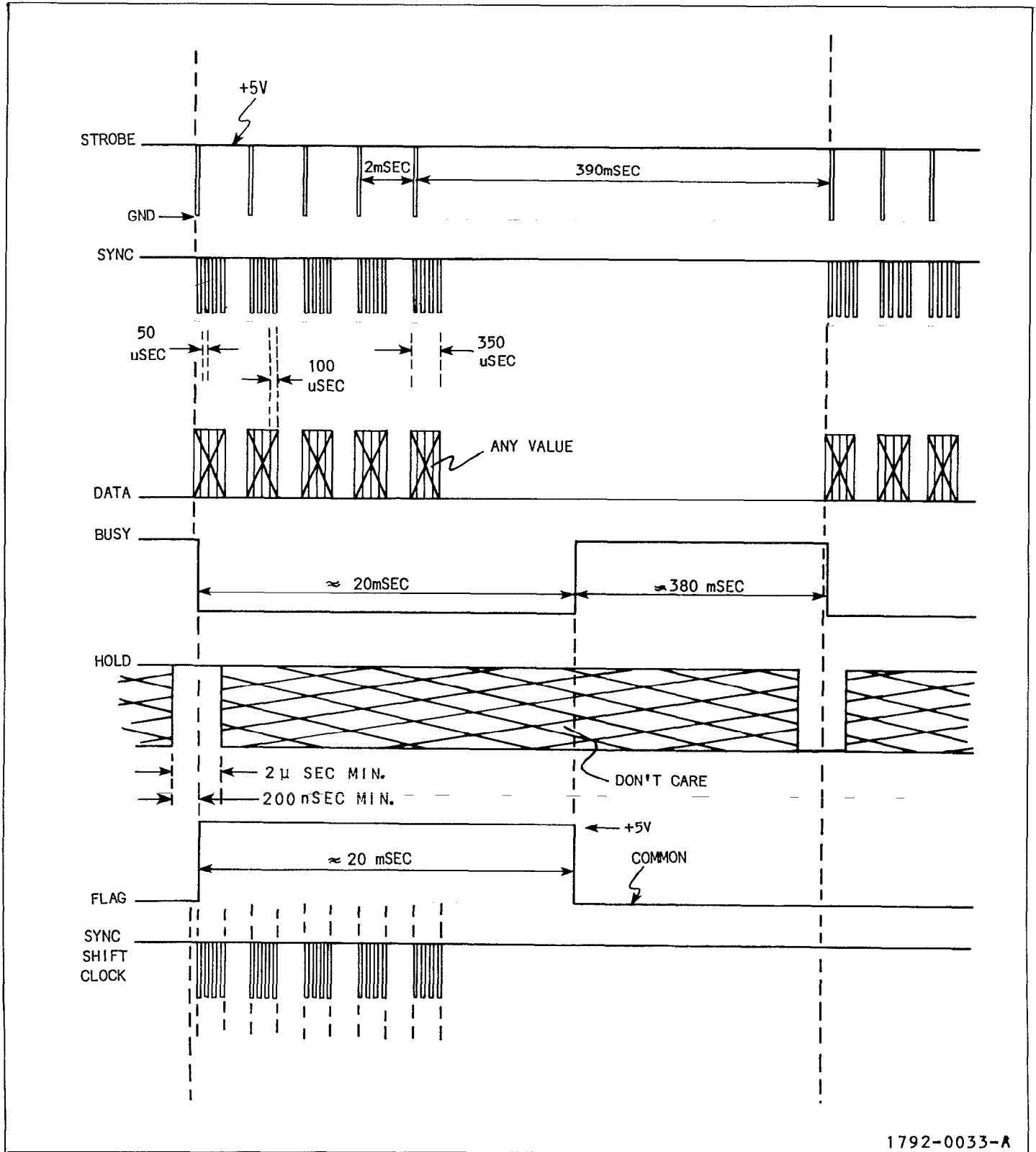


FIGURE 3-2. Timing Diagram.

3-8. Input power is furnished by the host meter (+5V for the Model 1792 and +6V for the Model 6422). The power for the isolated (output) side is provided by a DC-to-DC converter running at 100kHz.

3-9. CIRCUIT DESCRIPTIONS.

3-10. This section provides detailed descriptions of the major circuit blocks described in Overall Operation of the Model 1792/6422. The descriptions are referenced to the Model 1792/6422 (schematic 29965D, Page 4-4). Where necessary, simplified schematics are also provided. Timing is shown in the Model 1792/6422 Waveform Diagram (Figure 3-2).

3-11. Control Circuitry.

3-12. The control consists of a divide-by-ten counter (U414) and a ring counter (U411A) with gating. U414 divides the 100kHz CLOCK by ten to produce 10kHz optional transmission of the DATA and SYNC trains across the opto-electric couplers. The STROBE pulses phase-lock the counter by presetting

it to 2 on each pulse. This ensures synchronous long term operation.

3-13. A simplified schematic of the ring counter and gating is given in Figure 3-3. Each STROBE pulse enables the transfer of one digit (four bits) one bit at a time. There are five STROBE pulses in each complete data transfer. In operation, the STROBE pulse sets the latch comprised of U415A and U415B, enabling U415D to gate the 10kHz SYNC pulses to the opto-electric coupler and to the CLOCK input of U411A. U411A gates a "1" in sequence on its output lines Q1 through Q4 to drive the quad switch and serialize the digit data. U415C resets the latch when the Q1 through Q4 lines are clocked to all zeros, and it remains in reset until the next STROBE pulse. Since the latch is not reset until U411A is clocked to all zeros, a pulse of ≈ 500 nanoseconds is produced on the SYNC line after each 4 SYNC pulses, but this is too fast to be acknowledged by the opto electric couplers.

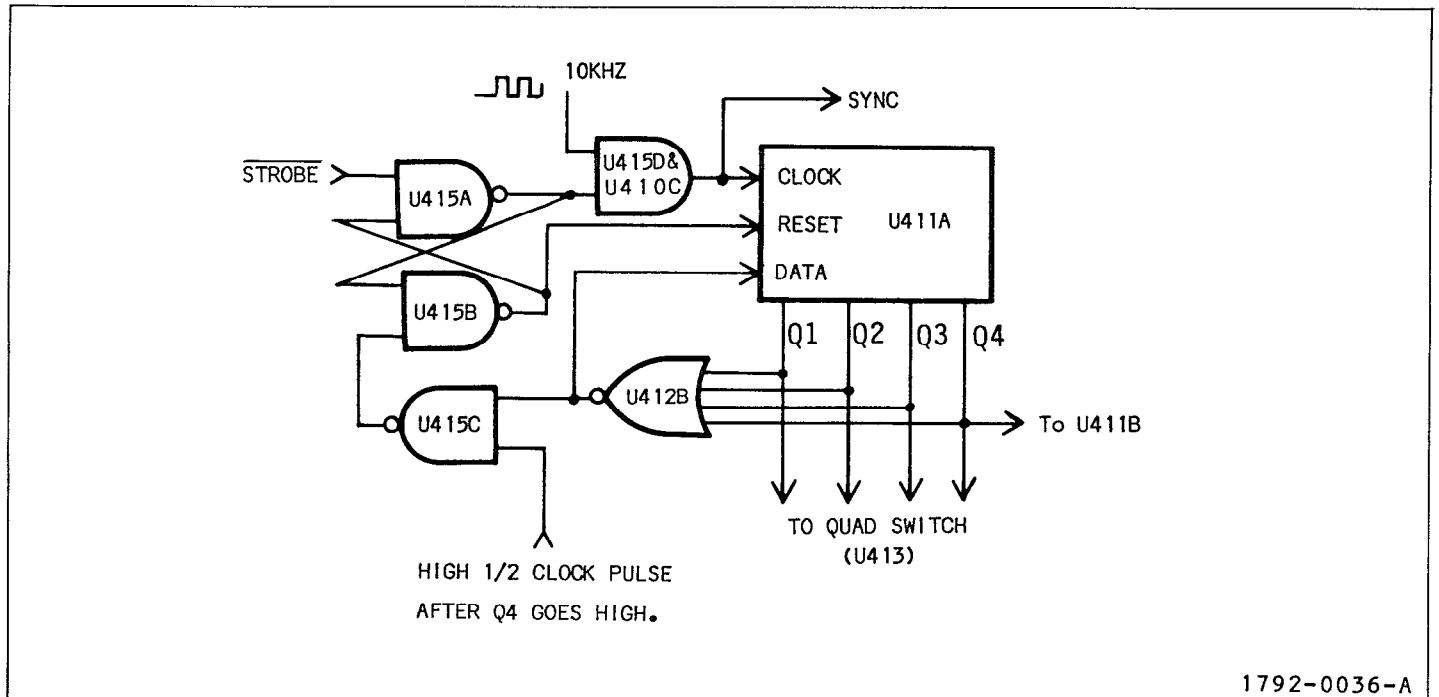


FIGURE 3-3. Ring Counter and Gating.

3-14. Switching Circuitry.

3-15. Switching to serialize the input BCD data is provided by U413 and U416A. U413 is connected as a 4:1 multiplexer. One of its input lines is connected through to the DATA opto-electric coupler when its respective control line is driven high by the ring counter (U411A). U416A is connected as a dual 2:1 multiplexer, switching is controlled by the digit 5 (D5) line. The fifth digit is the most significant digit and is transmitted first. Since it is always a "0" or a "1", bits 2, 3 and 4 are not needed and can be used to transfer other information. When the D5 line is high, the overrange and sign status is sent on bits 4 and 3, respectively. Conversely, when the D5 line is low, B8 and B4 for digits 4 through 1 are sent.

3-16. Isolator Network.

3-17. The isolator network is comprised of two optically coupled isolators, two transistors and their associated biasing resistors. The isolators

provide $10^{10}\Omega$ isolation and are normally off to conserve power. The transistors invert the pulses and serve both as wave shapers and low impedance buffers into the high impedance CMOS circuits.

3-18. Busy/Hold Circuit.

3-19. A simplified schematic of the BUSY/HOLD circuit is given in Figure 3-4. The $\overline{\text{BUSY}}$ line always goes low during a potential data transfer. When $\overline{\text{BUSY}}$ goes low, the flip-flop is clocked and the $\overline{\text{HOLD}}$ line checked to see if a new data transfer is desired. If the $\overline{\text{HOLD}}$ line is high, the FLAG is set, enabling U409D to gate the SYNC pulse train. The $\overline{\text{BUSY}}$ line remains low for approximately 20 milliseconds. When the $\overline{\text{BUSY}}$ line returns high, it resets the flip-flop and no data transfer can occur until it goes low again. This will occur when the one-shot multivibrator is triggered by the first pulse of the next SYNC train.

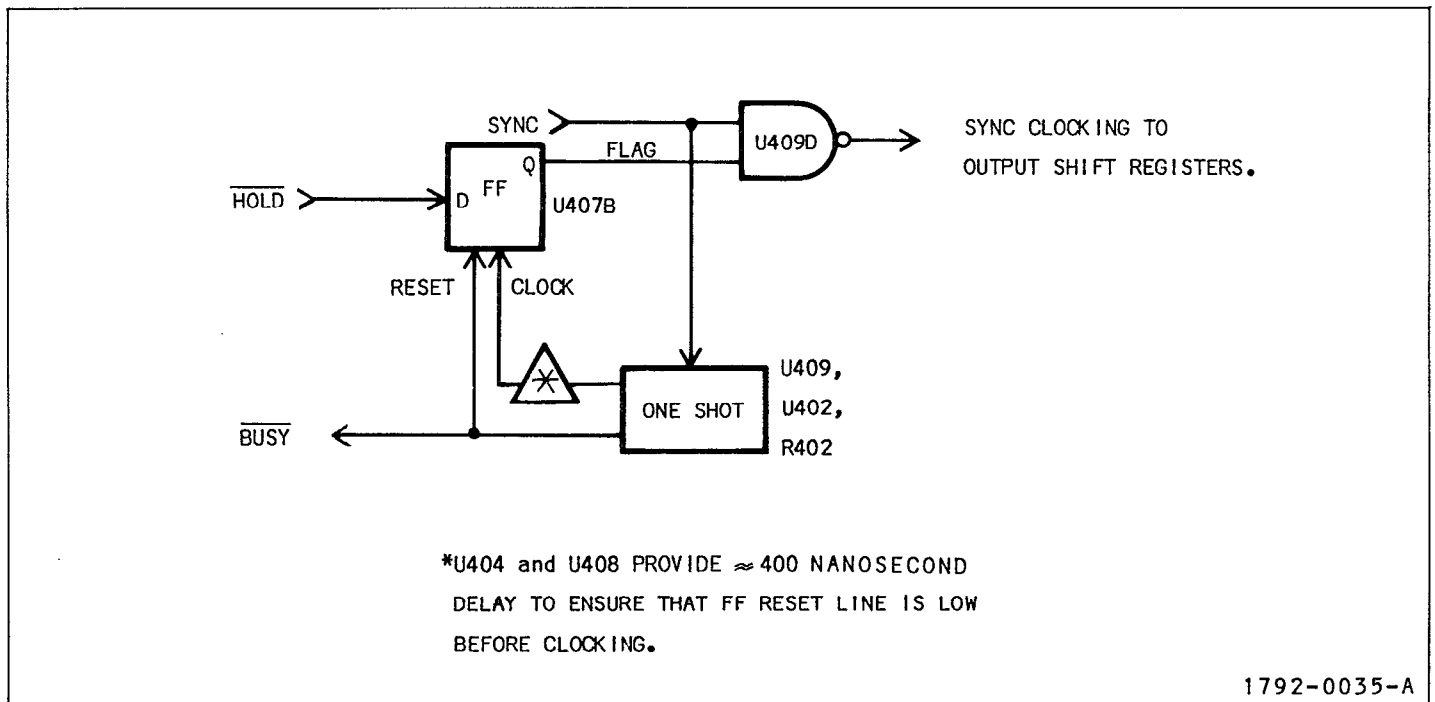


FIGURE 3-4. Busy/Hold Circuit.

3-20. Output Registers And Buffers.

3-21. Five 4-stage serial-input/parallel-output registers are connected together to form the twenty bit output shift register. Serial input data is applied to the "D" input of U407A. Data is set up on the falling edges of the SYNC pulses and latched on the rising edges. Data is shifted into the output register in a sequence that can be determined by reading the output line identification from top to bottom on Schematic 29965D, page 4-4. After data transfer is complete, the display information is available at the output card-edge connector in a buffered parallel BCD format.

3-22. DC-to-DC Converter.

3-23. The 100kHz clock is buffered by U410 and applied to switching transistor Q403. Diode CR402

shunts one half cycle of buffer drive and provides optimal switching of Q403 to produce maximum voltage in the secondary of the transformer. R411 limits the base current to Q403. Power is pulsed across transformer T401 and half-wave rectified by CR401. Capacitor C401 and voltage regulator VR401 provide a stable positive five volt supply to the isolated circuits.

3-24. TEST POINT DATA.

3-25. The Model 1792/6422 has ten test points that can be used for troubleshooting or confidence testing. Test point signals are described in Table 3-1. The test points are accessible by removing the instrument top cover as described in the applicable installation procedure (i.e, Para. 2-1 for Model 1792 or Para. 2-11 for Model 6422).

**TABLE 3-1.
Test Point Data**

Test Point	Signal	Reference
TP1	10kHz. Clock, 5Vpp, 50% duty cycle	TP3
TP2	SYNC (See Timing Diagram Figure 3-1).	TP3
TP3	Digital non-isolated common, 0V reference for TP1 and TP5.	
TP4	Non-isolated positive supply from meter (6V ± 5% Model 6422 and 5V ± 5% for Model 1792).	TP3
TP5	DATA (See Timing Diagram Figure 3-1).	TP3
TP6	Complement of TP2.	TP10
TP7	Isolated DATA, same as TP5.	TP10
TP8	Isolated +5V ± 0.25V.	TP10
TP9	SYNC SHIFT CLOCK-If $\overline{\text{HOLD}}$ is high, same as TP2. If $\overline{\text{HOLD}}$ is low, +5V (high). See Timing Diagram Figure 3-1.	
TP10	Isolated common, 0V reference for TP6 thru TP9.	

3-26. SPECIAL HANDLING OF STATIC SENSITIVE DEVICES.

3-27. CMOS devices are designed to function at very high impedance levels for low power consumption. For this reason, a normal static charge build up on your person or clothing can be sufficient to destroy these devices. The following steps list the static sensitive devices in your Model 1792/6422, and provide instructions on how to avoid damaging them when they must be removed/replaced.

a. Static sensitive devices:

Keithley Part Number	Reference Designation
IC-107	U401-U404 ,U408
IC-136	U405-U407 ,U411
IC-102	U409, U415
IC-106	U410
IC-105	U412
IC-221	U413
IC-145	U414
IC-222	U416

b. The above integrated circuits should be handled and transported only in protective containers. Typically they will be received in metal tubes or static protective foam. Keep the devices

in their original containers until ready for use.

c. Remove the devices from their protective containers only at a properly grounded work bench or table, and only after grounding yourself by using a wrist strap.

d. Handle the devices only by the body. Do not touch the pins.

NOTE

P1008 is shipped with a piece of conductive foam covering the pins to prevent static damage. This conductive foam should be replaced if you disconnect P1008 to remove your BCD option from its host instrument.

e. Any printed circuit board into which a device is to be inserted must also be grounded to the bench or table.

f. Use only anti-static type solder suckers.

g. Use only grounded tip soldering irons.

h. After soldering the device into the board, or properly inserting it into the mating receptacle, the device is adequately protected and normal handling can be resumed.

SECTION 4 REPLACEMENT PARTS

TABLE 4-1.

Cross-Reference of Manufacturers.

4-1. GENERAL.

4-2. This section contains information for ordering replacement parts. The Replaceable Parts List (Table 4-2, Page 4-2) is arranged in alphabetical order of the Circuit Designations of the components. A Cross-Reference List of Manufacturers, containing their addresses, is given in Table 4-1.

4-3. ORDERING INFORMATION.

4-4. To place an order, or to obtain information concerning replacement parts, contact your Keithley representative or the Factory. See the inside front cover for addresses. When ordering, include the following information.

- a. Equipment Model Number.
- b. Part Description.
- c. Circuit Designation (if applicable).
- d. Keithley Part Number.

4-5. SCHEMATIC

4-6. Model 1792/6422 BCD Option:
Schematic No. 29965D page 4-4.

4-7. COMPONENT LAYOUT.

4-8. Physical location of the components is shown in Component Layout No. 29961D, Page 4-5.

MFG. CODE	NAME AND ADDRESS	FED. SUPPLY CODE
CLB	Centralab Division Milwaukee, WI 53201	71590
F-1	Fairchild Inst. Corp. Mountain View, CA 94043	07263
ITT	Components Lawrence, MA	15238
K-1	Keithley Instruments, Inc. Cleveland, Ohio 44139	80164
MEP	Mepco, Inc. Morristown, NJ 07960	80031
NAT	National Semi Corp. Santa Clara, CA 95051	27014
NCI	National Components, Inc. West Palm Beach, FL	
RCA	RCA Corporation Morrestown, NJ 08050	02734
T-1	Texas Instruments, Inc. Dallas, TX 75231	01295

TABLE 4-2
REPLACEABLE PARTS LIST

Circuit Desig.	Description	Location		Mfr. Code	Mfr. Desig.	Keithley Part No.
		Sch.	Pcb.			
AT401	IC, Optically-Coupled Isolator	D-4	F-4	F-1	FCD 820	1C-82
AT402	IC, Optically-Coupled Isolator	D-2	F-4	F-1	FCD 820	1C-82
C401	Cap, 4.7 μ F, 20V, ETT	E-1	D-4	NCI	KNS475A020K	C-179-4.7
C402	Cap, 0.33 μ F, 20V, ETT	E-5	F-4	ITT	TAPA.33K20	C-204-.33
C403	Cap, 0.1 μ F, 16V, CerD	B-1	D-5	CLB	UK 16-104	C-238-.1
C404	Cap, 0.33 μ F, 20V, ETT	A-4	F-5	ITT	TAPA.33K20	C-204-.33
CR401	Diode, Silicon, 75mA, 75V	E-1	D-4	T-1	1N914	RF-28
CR402	Diode, Silicon, 75mA, 75V	B-2	D-5	T-1	1N914	RF-28
P1008	Cable Assembly (1792)	A-2	H-5	K-1	---	27961A-1
P1008	Cable Assembly (6422)	A-2	H-5	K-1	---	27961A-2
Q401	Transistor NPN Silicon	D-4	E-4	T-1	2N3904	TG-47
Q402	Transistor, NPN, Silicon	D-2	F-4	T-1	2N3904	TG-47
Q403	Transistor, NPN, Silicon	C-1	D-5	T-1	2N3904	TG-47
R401	10K Ω , \pm 5%, 1/4W, CarbF	E-6	D-3	MEP	CR25*	R-76-10K
R402	100K Ω , \pm 5%, 1/4W, CarbF	E-5	F-4	MEP	CR25*	R-76-100K
R403	10K Ω , \pm 5%, 1/4W, CarbF	E-3	E-4	MEP	CR25*	R-76-10K
R404	10K Ω , \pm 5%, 1/4W, CarbF	E-2	F-4	MEP	CR25*	R-76-10K
R405	100K Ω , \pm 5%, 1/4W, CarbF	D-4	E-4	MEP	CR25*	R-76-100K
R406	100K Ω , \pm 5%, 1/4W, CarbF	D-2	F-4	MEP	CR25*	R-76-100K
R407	390 Ω , \pm 5%, 1/4W, CarbF	D-4	F-4	MEP	CR25*	R-76-390
R408	390 Ω , \pm 5%, 1/4W, CarbF	D-3	F-4	MEP	CR25*	R-76-390
R409	100K Ω , \pm 5%, 1/4W, CarbF	D-5	F-4	MEP	CR25*	R-76-100K
R410	10K Ω , \pm 5%, 1/4W, CarbF	C-1	D-5	MEP	CR25*	R-76-10K
R411	1K Ω , \pm 5%, 1/4W, CarbF	B-1	D-5	MEP	CR25*	R-76-1K
R412	100K Ω , \pm 5%, 1/4W, CarbF	D-4	E-4	MEP	CR25*	R-76-100K
R413	100K Ω , \pm 5%, 1/4W, CarbF	D-3	F-4	MEP	CR25*	R-76-100K
T401	Transformer, Power	D-1	D-4	K-1	---	TR-170
U401	IC, CMOS, Hex Buffer	F-1, E6	D-3	RCA	CD4050AE	1C-107
U402	IC, CMOS, Hex Buffer	F-2, 3	E-3	RCA	CD4050AE	1C-107
U403	IC, CMOS, Hex Buffer	F-4	E-3	RCA	CD4050AE	1C-107
U404	IC, CMOS, Hex Buffer	F-5, D-5	F-3	RCA	CD4050AE	1C-107
U405	IC, CMOS, Dual 4-Stage Static Shift Register.	F-1, 2	D-4	RCA	CD4015AE	1C-136

*Manufacturers Designation includes Part Description; e.g., CR25, 10K Ω , \pm 5%, 1/4W, CarbF for R401.

TABLE 4-2 (CONT.)
REPLACEABLE PARTS LIST

Circuit Desig.	Description	Location Sch.	Pcb.	Mfr. Code	Mfr. Desig.	Keithley Part No.
U406	IC, CMOS, Dual 4-Stage Static Shift Register.	F-3,4	E-4	RCA	CD4015AE	IC-136
U407	IC, CMOS, Dual 4-Stage Static Shift Register.	D-5,F-4	E-4	RCA	CD4015AE	IC-136
U408	IC, CMOS, Hex Buffer	E-2,4,5,	F-4	RCA	CD4050AE	IC-107
U409	IC, CMOS, Quad 2-Input NAND Gate	DE-4,5	F-4	RCA	CD4011AE	IC-102
U410	IC, CMOS, Hex Inverter	ABCD-1,2,3,5	D-5	RCA	CD4049AE	IC-106
U411	IC, CMOS, Dual 4-Stage Static Shift Register.	CD-3	E-5	RCA	CD4015AE	IC-136
U412	IC, CMOS, Dual 4-Input NOR Gate	B-4,A-5	E-5	RCA	CD4002AE	IC-105
U413	IC, CMOS, Quad Analog/Digital Switch	C-5	F-5	NAT	CD4016CN	IC-221
U414	IC, CMOS, Presettable Divide-by-N Counter.	B-2	D-5	RCA	CD4018AE	IC-145
U415	IC, CMOS, Quad 2-Input NAND Gate	BC-3,4	E-5	RCA	CD4011AE	IC-102
U416	IC, CMOS, Quad 2 Channel Data Selector	B-5	E-5	NAT	CD4519BCN	IC-222
VR401	IC, 3-Terminal, +5V Regulator $\pm 5\%$	E-1	D-4	NAT	LM78L05ACZ	IC-223

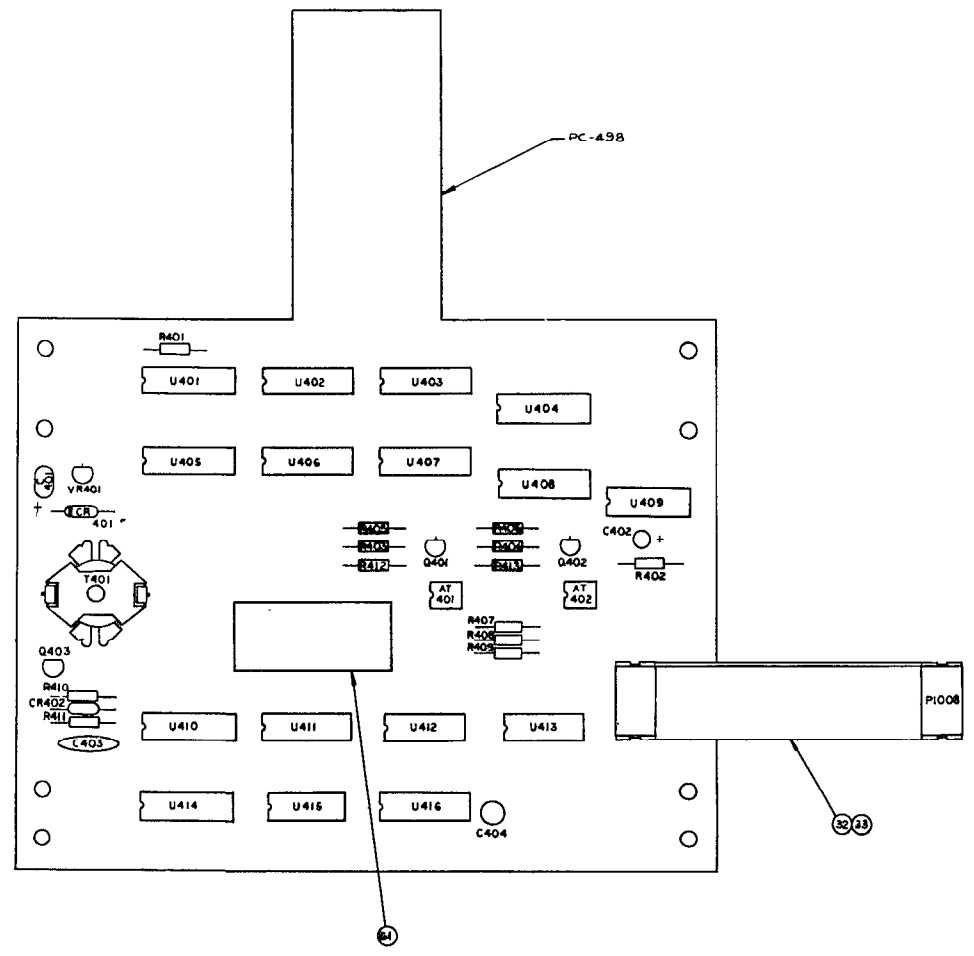
ZONE	LTN	ECNO	REVISON	DATE
A	19377		REL. CASE D	1-5-72

LTN	PART NO.	QTY	ZONE
1	29962D	PC-498	G4
2	30145B	PL 408	G4
3			
4			
5	IC-82	AT 401	F4
6	IC-82	AT 402	F4
7			
8	C-179-4.7	C401	D3
9	C-804-.39	C402	E4
10	C-238-.11	C403	D5
11	C180-.22	C404	F5
12			
13			
14	RF-28	C2401	D8
15	RF-28	C2402	D8
16			
17	R-76-10K	R401	E3
18	R-76-100K	R402	E4
19	R-76-10K	R403	E4
20	R-76-10K	R404	F4
21	R-76-100K	R405	E4
22	R-76-100K	R406	F4
23	R-76-390	R407	F4
24	R-76-390	R408	F4
25	R-76-100K	R409	F4
26	R-76-10K	R410	D5
27	R-76-1K	R411	D5
28	R-76-100K	R412	E4
29	R-76-100K	R413	E4
30			
31			
32	27961A-1	PI008	E6
33	27961A-2	PI008	E6
34			
35	TS-47	Q401	F4
36	TS-47	Q402	F4
37	TS-47	Q403	D5
38			
39	TS-170	T401	D4
40			
41	IC-107	U401	D3
42	IC-107	U402	E3
43	IC-107	U403	E3
44	IC-107	U404	F3
45	IC-136	U405	D5
46	IC-136	U406	E5
47	IC-136	U407	E5
48	IC-107	U408	F5
49	IC-102	U409	F5
50	IC-106	U410	D5
51	IC-136	U411	E5
52	IC-106	U412	E5
53	IC-221	U413	F5
54	IC-145	U414	D6
55	IC-102	U415	E6
56	IC-222	U416	E6
57			
58			
59	IC-283	VR401	D3
60			
61	MC-255		
62			
63			
64			
65			

MODEL 1792
Modu 6422

MODEL 1792
MODEL 6422

MODEL 6422



DO NOT SCALE THIS DRAWING	CONSTRUCTION TO DIMENSIONS	DATE: 1/5/72	SCALE: 1/8"	TITLE: COMPONENT LAYOUT
KEYLEY INSTRUMENTS CLEVELAND OHIO	DATE: 1/5/72	DATE: 1/5/72	DATE: 1/5/72	DATE: 1/5/72
				TO: 29961D



SERVICE FORM

Model No. _____ Serial No. _____ P.O. No. _____ Date _____

Name _____ Phone _____

Company _____

Address _____

City _____ State _____ Zip _____

List all control settings and describe problem. _____

_____ (Attach 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? _____ Variation? _____

Frequency? _____ Ambient Temperature? _____ °F.

Variation? _____ °F. Rel. Humidity? _____ Other? _____

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

*Be sure to include your name and phone number on this service form.

KEITHLEY

KEITHLEY INSTRUMENTS, INC.

INSTRUMENT DIVISION / 28775 Aurora Road / Cleveland, Ohio 44139 / U.S.A. / (216) 248-0400 / Telex: 98-5469

WEST GERMANY: Keithley Instruments GmbH / Heiglhofstr. 5 / 8000 München 70 / (089) 710020 / Telex: 52-12160

GREAT BRITAIN: Keithley Instruments, Ltd. / 1, Boulton Road / Reading, Berkshire RG 2 ONL / (0734) 86-12-87/88 / Telex: 84-7047

FRANCE: Keithley Instruments SARL / 2, Bis Rue Léon Blum / B.P. 60 / 91121 Palaiseau Cedex / (6) 011-51-55 / Telex: 600-933

NETHERLANDS: Keithley Instruments BV / Arkelsedijk 4 / Postbus 559 / 4200 AN Gorinchem / (0) 1830-25577 / Telex: 24-684

SWITZERLAND: Keithley Instruments SA / Kriesbachstr. 4 / 8600 Dübendorf / 01/821-94-44 / Telex: 57-536

AUSTRIA: Keithley Instruments Ges.m.b.H. / Döblinger Haupstr. 32 / 1190 Wien / 314 289 / Telex: 13-4500