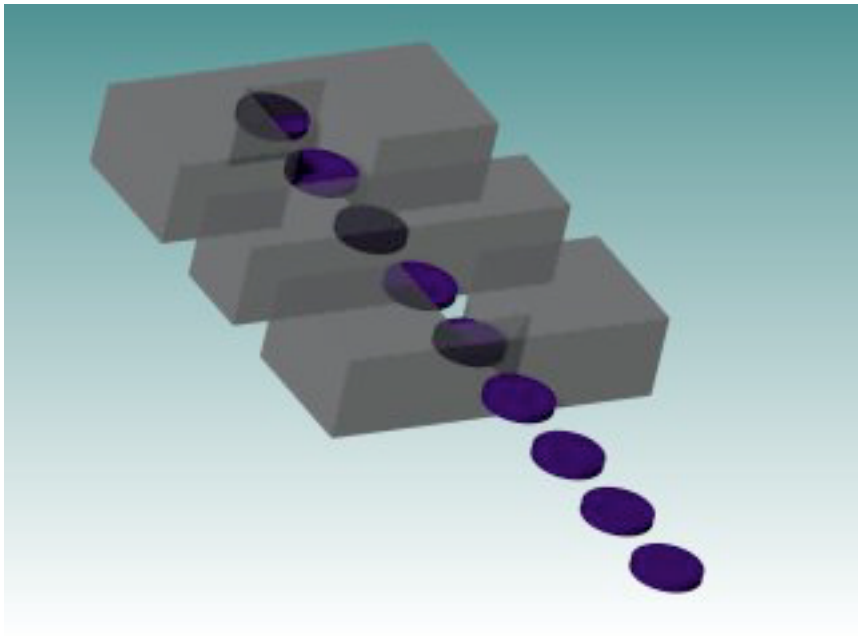
SHORT FORM MANUAL FOR CAPACITEC 4000 SERIES ELECTRONICS, PROBES AND ACCESSORIES



Capacitec, Inc.
87 Fitchburg Road
P.O. Box 819
Ayer, Massachusetts USA 01432
(978) 772-6033
www.capacitec.com

IMPORTANT WARNINGS

If you purchased a system, it comes fully calibrated, and is traceable to NIST. No further adjustment is necessary, and unauthorized adjustment will void the calibration warranty.

Always retain the original Calibration Data Sheets with the system. These documents provide important information that will aid in the set-up and use of Capacitec systems.

A one-year Calibration Cycle is recommended for most systems.

It is important to match all serial numbers shown on a given Calibration Data Sheet (see Section 3 for an example Calibration data Sheet).

Capacitec cable is custom manufactured. The use of non-Capacitec Cables between the Probe and the Amplifier is NOT recommended, will yield unexpected results and will void the Calibration.

Never allow the “Guard” or “Sensor” element of a Probe to touch earth ground, or any other metal object, when energized.

Never allow the coaxial shield or connector shell of a Probe Cable or Extension Cable to touch earth ground, or any other metal object, including other Cable connectors, when energized.

Use anti-static precautions whenever touching the metal portions of a Probe or Cable while it is connected to an Amplifier, whether energized or not. Touching the Equipment Rack frame or earth ground for a few seconds helps prevent static discharge into the pre-amplifier section of an Amplifier.

Never allow water or other conductive fluids to contact the Probe face while energized.

Failure to observe the above may result in permanent damage to the pre-Amplifier component, and will void the Amplifier Warranty.

When installing or removing threaded or cylindrical Probes, care must be taken not to twist the Cable-to-Probe body junction.

Do not over-tighten lock nuts on threaded Probes, or set screws on cylindrical Probes.

Do not attempt to remove a button or flat style Probe by pulling on the cable.

Failure to observe the above may result in permanent damage to the Probe, and will void the Probe Warranty.

Capacitec supplies free telephone/email tech support for all systems sold. We recommend that you contact us before any new installation, maintenance, or re-calibration activity.

Tech Support, Sales info: sales@capacitec.com

INTRODUCTION

The Series 4000 Capacitec Amplifiers and Racks were designed to offer the best signal to noise ratio and wide bandwidth response options in a simple modular package. Utilization of redundant 32 pin DIN type connectors increases reliability for more industrial applications where vibrations are present. The small Euro-style 2U size boards have appeal for small portable packaging as well as high lightweight density applications.

When used with Capacitec non-contact displacement Probes, Capacitec 4000 Series Amplifiers produce an output voltage proportional to the gap spacing between the Probes and a ground plane. They are designed to produce stable and reliable operation with excellent gain and zero stability with respect to changes in ambient temperature. Stability is achieved with a digitally derived sine-wave oscillator, having a crystal clock oscillator as the frequency reference.

Other special features include synchronous detection, low drift operational Amplifiers and a modular pre-amplifier (PC-201). Most 4000 Series Racks feature linear power supplies, and DC powered versions are available. The Amplifiers also have an optional linearization board to improve performance by a factor of ten from +/-2% to +/-0.2% linearity with no outside computer compensated curve fitting and without sacrificing frequency response (to 5kHz, -3dB).

While most specifications and instructions in this manual apply to all models, each system is factory configured for a specific application. Calibration sensitivity, accuracy, and features may vary from the descriptions provided. Note the differences of unique features and do not hesitate to consult the factory for specific questions.

INSTRUMENTATION DESCRIPTION

Series 4000 Amplifiers:

4100-S: A basic single channel Amplifier Card a 1.0 inch rack mountable front panel with screwdriver implemented Offset, Gain and Drive boost controls. Typical linearity of +/-2%, with 0.01% repeatability is standard. It is suitable for OEM and high volume multi-point applications where computer interface and possible linearization is available. (1 slot rack requirement).

4100-SL: The same as the 4100-S except that an add on linearization board gives the basic Amplifier an enhanced stand alone linearity of +/-0.2% accuracy of full scale using only screwdriver adjustable pots (1 slot rack requirement).

4100: Same as the 4100-S except the single width front panel is replaced with a double width front panel of 2.0 inches to accommodate large counting style Offset and Gain dials. +/-2% linearity and 0.01% repeatability of full scale are typical. (2 slot rack requirement).

4100-L: Same as the 4100 except that the optional linearization board has been added to yield the same performance as the 4100-SL card but with the convenience of the large adjustment dials 0.2% linearity and 0.01% repeatability of full scale are typical. (2 slot rack requirement).

4200-GP: Dual channel, open frame circuit card with a built in Oscillator circuit. Screwdriver adjustable Offset and Gain controls. Typical linearity of +/-1% of full-scale, with 0.01% repeatability is standard. It is ideally suited for OEM and high volume dual-point applications where computer interface and possible linearization is available. (Not intended for rack mounting).

Series 4000 Rack Enclosures:

All Series 4000 Rack Enclosures feature high strength extruded aluminum frames and panels to provide optimum performance in industrial or laboratory environments while maintaining high EMI/RFI rejection for “CE” Compliance.

4016: 16 Channel (with single width Amplifiers), 19 inch rack enclosure with an additional slot for the 4100-C clock driver card. A +/-15 Vdc linear power supply at 850 mA is standard in this unit. Linear types are preferred for lowest signal to noise performance. The unit has 16 individual 0 - 10 Vdc analog output connectors in parallel to dual 50 pin Centronics type connectors for computer or data acquisition interface. International AC power supply voltage options are available by signifying -P100, -P115, -P220, -P230, or -P240.

4008: 8 Channel (with single width Amplifiers) rack enclosure approximately half the size of the 4016 with the same standard features. The unit has 8 individual 0 - 10 Vdc analog output connectors in parallel with a single 50 pin Centronics type connector for computer or data acquisition interface. A linear +/-15 Vdc power supply at 500 mA is standard. International AC power supply voltage options are also available for this unit.

4004: 4 Channel (with single width Amplifiers) rack enclosure approximately half the size of the 4008 with the same standard features. The unit has 4 individual 0 – 10 Vdc analog output connectors in parallel with a single 25 pin Centronics type connector for computer or data acquisition interface. A linear +/–15 Vdc power supply at 350 mA is standard. International AC power supply voltage options are also available for this unit.

Automotive and Aerospace specification DC power options are also available.

Series 4000 Accessory Cards and Modules:

4100-B: Blank Filler Plate. This panel covers unused spaces in a Rack to help maintain EMI/RFI integrity as well as the CE rating.

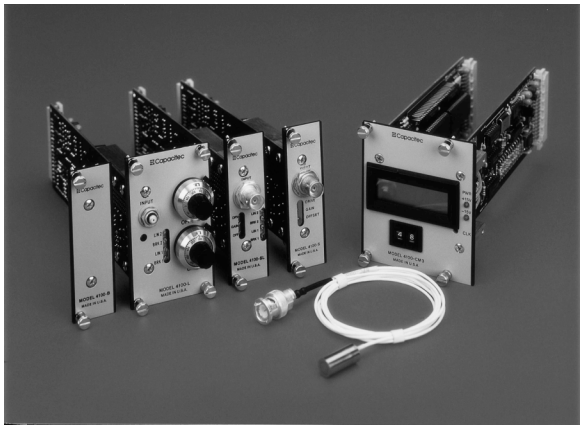
4100-C: A separate Clock Driver Card is required to drive 1 or more Amplifier cards. This unit indicates the "on" condition of the +/-15 volts D.C. supply voltage with individual red LED lights and has a X1 to X6 amplitude drive adjustment pot for the 15kHz excitation signal. This control is used to match a desired calibration sensitivity to a particular displacement Probe model. (1 Clock Card, 0.80" wide normally fits in a far right slot).

4100-CM3: An optional 4-1/2 digit LED meter which incorporates the same circuits as the 4100-C. A larger, 4.800 inch wide front panel has been added to accommodate a standard 4-1/2 digit LED meter with a multi channel selector switch. This unit occupies the far right slot as well as two adjacent Amplifier slots in a given Rack. The meter normally reads Vdc (e.g. 10.000), or can optionally read in percent of full-scale (e.g. 100.00). Available for the 4004 Rack only.

4100-CM3-MUX: Identical to the 4100-CM3, except with the addition of a Multiplexing circuit to handle the additional channels of the 4008 and 4016 Racks.

4100-CQ: The 4100-CQ is an “Intelligent Process Monitor” capable of single channel programmable signal conditioning and optional RS232 output. This unit occupies the far right slot as well as six adjacent Amplifier slots in a given Rack. Available for the 4008 and 4016 Racks only.

4100-X: An extender Card for maintenance purposes. Can also be used for “bread-boarding”.



Left to right:
The 4100-B, 4100-L-M, 4100-SL-BNC, 4100-S-BNC, and 4100-CM3-MUX
(shown with TPC-200 Probe)

Top to bottom:
4004-P115-OBNC, 4008-P115-OBNC, and 4016-P115-OBNC
(shown with HPB-1000 Probe)

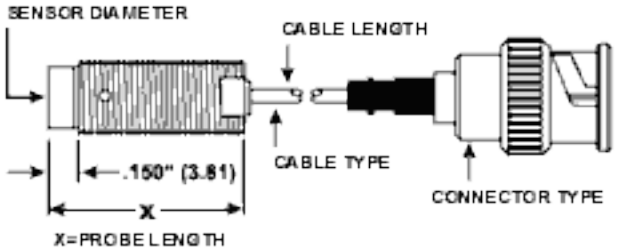
STANDARD PROBE DESCRIPTION

Capacitec Probes measure displacements or gaps to conductive targets without touching the part directly. The total range of displacement measurable is proportional to the Probe size; the larger the Probe outside diameter, the greater the gap. Typically, the maximum range achievable with any Probe is the diameter of the sensor.

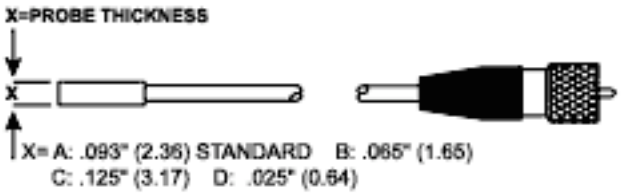
A complete line of Capacitec Probes is available to match the range, temperature and mounting requirements for most applications.

Many custom Probe configurations are available upon request.

PROBE PART NUMBER FORMAT					
HPX	X	-X	-XX	-XX	-XX
Probe Type	Probe Length (Example 1 only)	Operating Temperature	Cable Type	Cable Length	Connector Type
C: Cylindrical B: Button T: Threaded R: Rectangular S: Flat D: Dual Flat	A: 0.500" (12.70) B: 0.625" (15.87) C: 0.750" (19.05) D: 0.875" (22.23) E: 1.000" (25.40) F: 1.250" (31.75) G: 1.500" (38.10) H: 1.750" (44.45) I: 2.000" (50.8)	A: 32 to 300ºF (0 to 149ºC) E: -100 to 400ºF (-73 to 204ºC) V: -100 to 1600ºF (-73 to 871ºC) S: -100 to 1832ºF (-73 to 1000ºC)	L2: .093 (2.36) L3: .063 (1.60) I2: .125 (3.18) N: .125 (3.18) ND: .165 (4.19) T: .063 (1.60)	In feet (about 0.3m)	M: 10-32 Microdot Male B: BNC Male FX: MCX Female MX: MCX Male
	Probe Thickness (Example 2 only) A: .093" (2.36) B: .065" (1.65) C: .125" (3.18) D: .025" (0.64)				



EXAMPLE (1) HPT–150X–A–L2–5–B



EXAMPLE (2) HPB–75X–E–L3–5–M

STANDARD COAXIAL CABLE DESCRIPTIONS

MEDIUM TEMPERATURE CABLES; -65°F – +450°F (-54°C– +230°C)

TYPE	DESCRIPTION
L2	100% double shielded, 0.093" diameter all Teflon® construction, approximately 30 PF/foot total capacitance.
R2	Same as Type L2, except Kapton® replaces Teflon® as the insulation material.
L3	100% double shielded, 0.063" " diameter all Teflon® construction, approximately 26 PF/foot total capacitance.
R3	Same as Type L3, except Kapton® replaces Teflon® as the insulation material.
I2	100% double shielded, 0.110 inch diameter all Teflon® construction, approximately 14 PF/foot total capacitance.

HIGH TEMPERATURE CABLES: -100°F – +1600°F (-75°C–+870°C)

TYPE	DESCRIPTION:
N2	99% double shielded, 0.140 inch outside diameter flexible braided Inconel® 600 Shield /Alumina Boria Silica insulators. Approximately 20 PF/foot total
N3	97% single shielded, 0.063" diameter flexible braided Inconel® 600 Shield /Alumina Boria Silica insulator. Approximately 26 PF/foot total capacitance.
T	100% single shield, 0.063 inch outside diameter Inconel 600 tube/MGO filled powder insulator approximately 60 PF/foot total capacitance.

i. All high temperature cables include a high temperature Alumina Boria Silica cover.

ii. For higher temperature protection of "T" type cable, ceramic beads may be added of for an additional cost.

SPECIFICATIONS FOR TYPICAL AMPLIFIER/PROBE COMBINATION

Input Probe:	Capacitec® HPC, HPB, HPT or HPS Series, Capacitive Displacement Type, Proximic® Sensors
Input Cable:	Proprietary Low Noise Coaxial Cable, 100% shielded Maximum recommended length, 30 feet (typical)
Input Connector:	Microdot 10-32 miniature coaxial or BNC
Standard Probe:	Capacitec® HPC-150 with 5 feet of cable and connector
Linear Range:	0.100 (2.54mm) inches with HPC-150 and 4100-SL, 4100-L
Linearity, 4100-L & 4100-SL:	+/-0.2% of full scale 4100-S: +/-2.0% of full scale
Resolution:	+/-0.01% of full scale, or +/-1 millivolt @200Hz (other frequencies available)
Measuring Surface:	Electrically conductive (100 ohms/cm)
Probe Excitation Voltage:	AC, proportional to Gap 20V p-p max.
Probe Excitation Frequency:	15.625 kHz +/-0.01%(typical)
Linearization:	2 positive slope corrections with adjustable break-points (Models 4100-SL & 4100-L only)
Analog Output:	0-10.000 volts DC signal, proportional to gap
Output Impedance:	100 ohms
Offset Adjustment:	-10 volts to +10 volts, maximum
Frequency Response:	-3 dB at 200 Hz (standard unit) -3 dB at 3.1 kHz (optional wide band unit) -3 dB at 5.0KHz (optional wide band unit)
Operating Temperature:	+15° C to +35° C (typical)
Power Requirements:	+/-15 VDC @ 850 mA. Optional -P115, -P100, -P230 -P240 and-220 Vac at 50/60Hz
Physical Dimensions:	
4100 cards:	6.3" long x 1.0" wide x 3.17" high

4016 rack:	11.5" deep x 19.0" wide x 3.54 high
4008 rack:	11.5" deep x 9.0" wide x 3.54" high
4004 rack:	11.5" deep x 5.0" wide x 3.54" high

Weight:

4100 cards:	0.5 pounds
4016 rack:	10.0 pounds
4008 rack:	7.0 pounds
4004 rack:	5.0 pounds

Capacitec® trademark of Capacitec, Inc. Ayer, Massachusetts. Proximic® trademark of Capacitec, 1986.

COMMON CONTROLS

All user-oriented controls are located on the front panel of the 4100 Series Amplifier and clock/driver cards.

The Model 4100 Series Amplifier outputs are designed typically for direct computer interface or input to data collection instruments; therefore, a minimal amount of customer adjustable controls are present.

FRONT PANEL CONTROLS

4100-S

Drive - A precision 10-turn pot is located as the top adjustment of a stack of three screwdriver adjustable pots. It allows an adjustable increase of X1 to X3 drive multiplier for an input drive coming from the 4100-C clock card (which is normally set at 3Vpp). This control is normally not operated unless a drive of over 6V P-P is required for high sensitivity calibration or to drive a very large Probe (e.g., the HPB-2000).

Gain - The gain pot is a screwdriver adjustable attenuator located in the middle of the set of three. It adjusts the slope of the calibration that is being sought. A counting dial is used for Models 4100 and 4100-L for this purpose.

Offset - The lowest pot is an offset screwdriver adjustable pot allowing an additive +/-10 volt D.C. shift to any value on the analog output. Again, a counting dial is used for Models 4100 and 4100-L which would be the top most pot in that case.

4100-SL

Linearizers - 4 adjustment pots are located in a vertical array which allow approximately a 5% adjustment linearizing to any non-linear curve from a standard 4100-S or 4100. These are located to the right of the drive pot adjustments. See the later Section 2.6 and 3-2.6 for the use of these adjustments.

4100-C Clock Card

Driver - the Model 4100-C also has a drive adjustment on which the gain of the entire measurement system is based. A screwdriver adjustable pot is located on the front panel which allows a 1 to 6X drive adjust to be sent to all Model 4000 Series Amplifier cards via a rack assembly. This control is usually set at 3V P-P at the factory.

ELECTRICAL CONNECTIONS

All electrical connections are made through 4000 Series racks.

The standard input connectors are BNC, (with Microdot 10-32 miniature coaxial type connectors optional) located on the front panel.

The Ground connector is a universal banana jack which must be connected to the specimen (for the Amplifier to operate properly) and then to the back of the rack.

The analog output jacks are standard 1/8" phone jacks to provide easy connection to most recording equipment.

An additional 50 pin analog output "phone jack" gives parallel output to go directly to data acquisition systems without needing to be unplugged to check an individual channel while testing.

If an optional power supply is purchased with the 4000 rack a standard line cord will be supplied. Otherwise +/-15 Vdc power and common will be required to run the rack.

MODEL 4016, 4008, 4004 RACKS

The 4100 Amplifiers are designed for mounting in a 4000 Series Equipment Rack. These Racks will hold four, eight, or sixteen channels. All input and output connections on the rear connector of the 4016 are automatically made available at the rear panel of the Model 4016 Rack. This includes a signal ground binding post, a 50 pin connector rear panel provides signal outputs.

To avoid crosstalk between Model 4100 Capacitec® Amplifiers within the rack, the reference signal for all units is derived from the unit in the rightmost card slot, that is, the reference output for this slot is connected to the reference input for all 4000 Amplifiers installed in the rack. None of the units will operate without a Model 4100-C in a card slot in the 4016 rack. Since all Model 4100 Amplifiers have a reference signal, any 4100 may be used in this position. Two coaxial cables with BNC connectors must be used to connect the clock and sync lines of one rack to another with the use of only one Model 4100-C card for up to 64 channels.

ANALOG OUTPUT DESIGNATIONS MODEL 4000 RACK

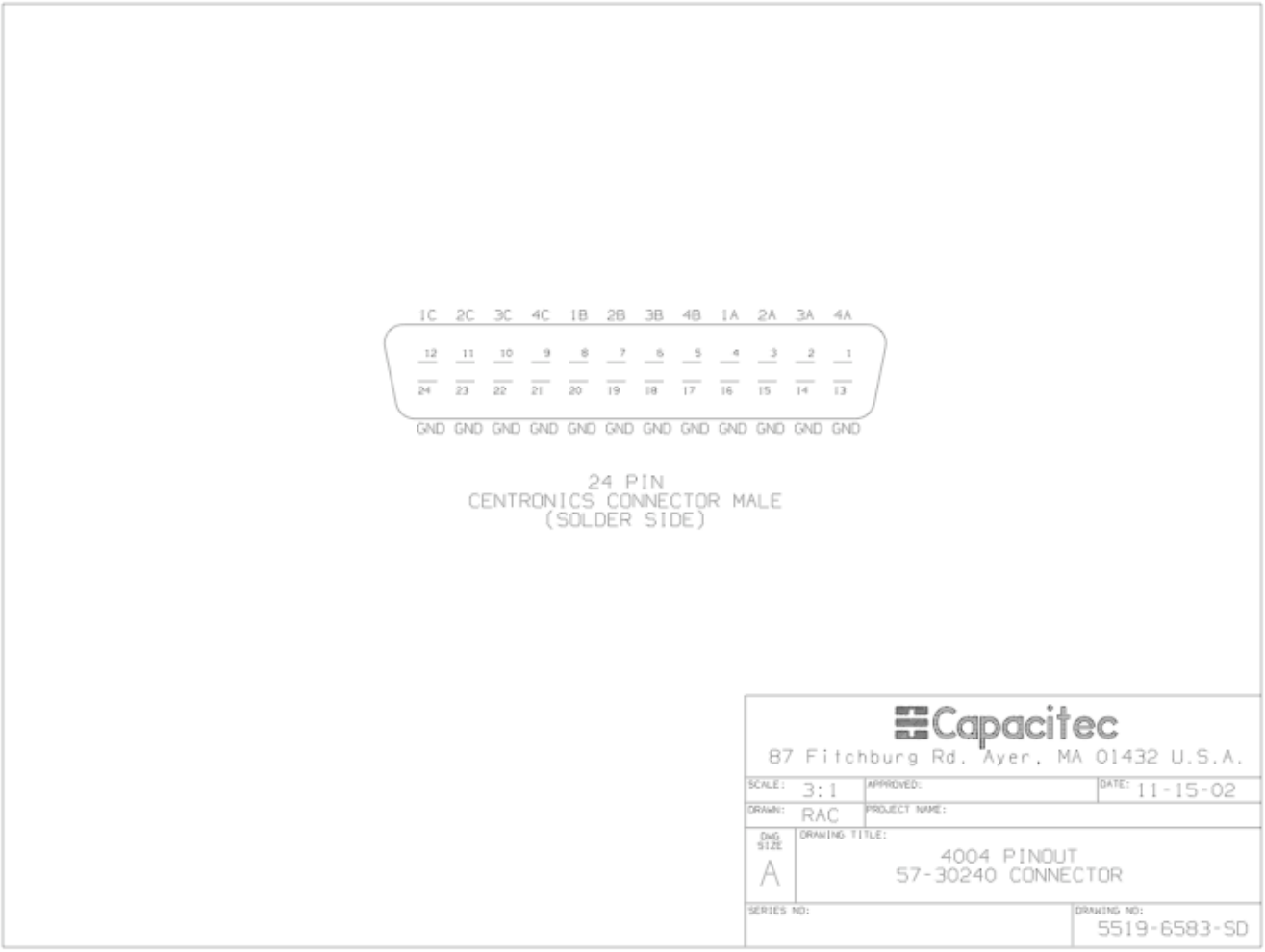
Slot Number	Rear Output connector#	4016 Motherboard Designation
1	Analog 1	J16
2	Analog 2	J15
3	Analog 3	J14
4	Analog 4	J13
5	Analog 5	J12
6	Analog 6	J11
7	Analog 7	J10
8	Analog 8	J9
9	Analog 9	J8
10	Analog 10	J7
11	Analog 11	J6
12	Analog 12	J5
13	Analog 13	J4
14	Analog 14	J3
15	Analog 15	J2
16	Analog 16	J1
17	Clock Card Slot	J17

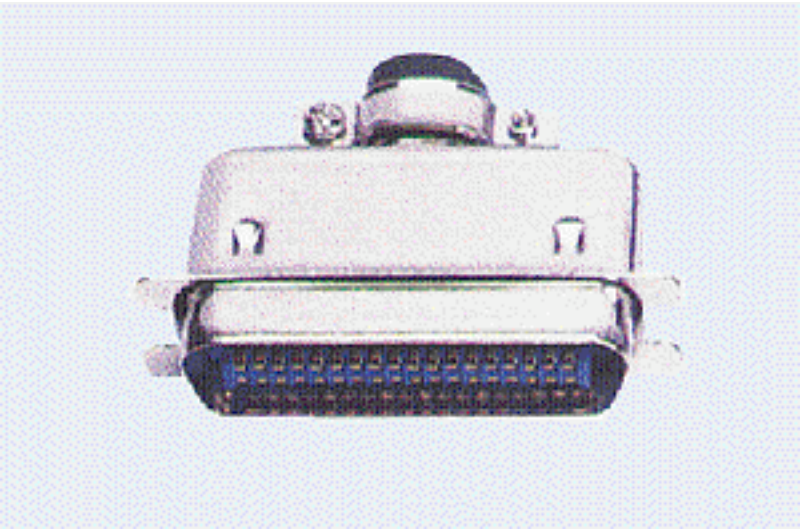
Note:

Pins 1-16 are at ground potential.
Pins 17-25 and 45-50 are unused spares.
Slots are numbered 1-17 from a front view of the rack from left to right.
Slot 17 is reserved for the 4100-C Clock Card.

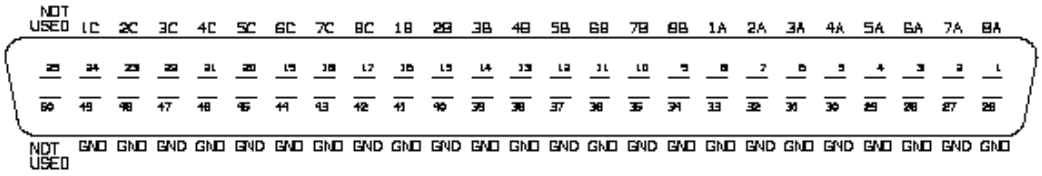
TABLE 1

REAR VIEW OF PINOUTS – P20
(4004 ONLY)





REAR VIEW OF PINOUTS – P21
(4008 ONLY)



50 PIN
CENTRONICS CONNECTOR MALE
(SOLDER SIDE)

Capacitec
87 Fitchburg Rd. Ayer, MA 01432 U.S.A.

SCALE: 3:1	APPROVED:	DATE: 2-26-02	
DRAWN: RAC	PROJECT NAME:		
DWG SIZE A	DRAWING TITLE: 4008 PINOUT 57-30500 CONNECTOR		
SERIES NO:		DRAWING NO: 5519-6467-S0	

GENERIC OPERATING INSTRUCTIONS

Series 4000 Amplifiers have been factory calibrated with matched Probes purchased with the instrument. This calibration provides a direct voltage output 0-10 volts DC with a linearity of +/-0.5% or better. Should a tighter calibration be required or a Probe change be made, see Section 2-7 for Recalibration Instructions.

Amplifiers should be checked as received following the steps below:

A. Turn Rack On. (Allow 20-30 minute warmup for best accuracy)

B. Connect Probes to front panel coaxial connectors according to the serial numbers shown on the Capacitec Calibration Data sheet. Observe anti-static procedures.

C. Connect signal ground wire from rear panel to target.

D. Aim Probe 1, perpendicularly at measuring surface. Output voltage will be directly proportional to displacement.

E. Factory supplied calibration worksheets are included with the customer required calibration.

TYPICAL CALIBRATION ADJUSTMENTS FOR HPC-SERIES PROBES (PRELIMINARY)

Adjustment Description	Nominal Output Volts	HPC-375* Displacement Inches	HPC-150 Displacement Inches	HPC-75 Displacement Inches	HPC-40 Displacement Inches
OFFSET	0.500	0.025	0.005	0.0025	0.0010
GAIN	2.500	0.125	0.025	0.0125	0.0050
B1	3.500	0.175	0.035	0.0175	0.0070
L1	6.000		0.060	0.0300	0.0120
B2	7.500		0.075	0.0375	0.0150
L2	10.000		0.100	0.0500	0.0200

*LIN 1 for HPC-375 is set at 4.500 volts/0.225" and B2 is set at 5.000 volts/0.250". L2 is not used.

All Probes may be calibrated with different sensitivities to allow a range versus accuracy trade off. The table above indicates the most widely utilized sensitivities. For other sensitivities versus range calibrations consult the factory. Several calibrations are available for each sensor.

TABLE 2

GENERIC PROBE RECALIBRATION INSTRUCTIONS

The procedures listed below outline the recalibration steps required should Capacitec® Probe models be changed, tighter accuracy's may be required or service be performed on the Amplifiers. Periodic calibration checks can be made with the Capacitec® calibration stand by following these procedures without presetting the front panel adjustments as described in step C. Minor adjustments of these controls can then be made as required.

The procedures described are for an HPC-150 Capacitec® Probe ONLY. Nominal adjustment points for other HPC-Series Probes are provided with the Probe. (Or consult the factory for a family of sensitivity scales).

A. Connect Probes to front panel coaxial input connectors. (Microdot of BNC)

B. Connect signal ground wire from Capacitec® calibration stand to rear panel "banana" jack.

C. Preset each of the six front panel adjustable potentiometers.

DRIVE:	Do not change small pot at this time.
GAIN:	Midrange (500) on counting dial (optional equipment) (Midrange on pot)
OFFSET:	Midrange (500) on counting dial (optional equipment) (Midrange on pot).
	NOTE: Control positions on 4100-S and 4100-SL are different than others.
BREAK 1:	Fully counterclockwise (optional equipment)
LIN 1:	Fully clockwise (optional equipment)
BREAK 2:	Fully counterclockwise (optional equipment)
LIN 2:	Fully clockwise (optional equipment)
DRIVE RANGE:	Internally set on HI (optional equipment)

D. Set the micrometer on the Capacitec® calibration stand to 0.0000".

E. The initial mechanical offset of the HPC-150 Probe/calibration stand target will determine the accuracy of absolute displacement measurements. Slide the HPC Probe into the calibration stand until it just contacts the calibration stand target, tighten Probe in place.

F. Advance the micrometer to 0.005".

G. Turn Amplifier on. A 30 minute warm up should be allowed.

H. At 0.005" turn the OFFSET pot until 0.50 volts is at the output in.

I. Advance micrometer to 0.025" and adjust GAIN pot until 2.50 volts is at the output.

J. Repeat steps H and I until a repeatable "zero" and span of 5.0 mils and 25.0 mils is obtained.

K. Advance micrometer to 0.035". The output will show a voltage lower than 3.50 volts (i.e. 3.47). Turn BREAK 1 clockwise several times until the output voltage is equal to 3.50 volts.

L. Advance micrometer to 0.060". The output will show a voltage much greater than 6.0 volts (i.e. 6.30). Turn LIN 1 counter-clockwise several times until the output voltage equals 6.0 volts.

M. Repeat steps L and M until a repeatable 35.0 mil to 60.0 mil increment it obtained.

N. Advance micrometer to 0.075". The output will show a voltage lower than 7.50 volts (i.e. 7.47). Turn BREAK 2 clockwise several times until output voltage is equal to 7.50 volts.

O. Advance micrometer to 0.100". The output will show a voltage much greater than 10.00 volts (i.e. 10.30). Turn LIN 2 counterclockwise several times until the output voltage equals 10.00 volts.

P. Repeat steps O and P until a repeatable 75.0 mil to 100.0 mil increment is obtained.

Q. Return micrometer to 0.005". Exercise micrometer to 0.0005" steps to the maximum 0.100" range to inspect calibration.

R. Repeat steps H-Q to fine adjust the calibration.

Typical calibration adjustment points are shown in TABLE 2. A typical final calibration is shown in Figure 15.

NOTE: By positioning the nominal BREAK and LIN adjustment points closer together, a tighter linearity may be obtained at the sacrifice of maximum range. The HPC-150 Probe has a "nonlinearized" range of about 30.0 mils.

NOTE: For models with -L linearization wand option, linearization circuits are always on. To operate unit without linearization, follow step "C".

TROUBLESHOOTING/QUICK CHECK

The overall performance of the system may be checked with all equipment in place with a portable scope. Simply set the scope to 20us per division (horizontal) and 5 volts per division (vertical) and place a 10:1 Probe on the Amplifier front panel input connector. If a 15Khz sine wave that varies smoothly and proportionally to sensor gap is seen, it can be assumed the majority of the active circuitry is functional. This is helpful when trying to determine if a suspected problem is a defective component or simply misadjusted controls.

COMMON PROBLEMS TABLE Table 3 shows some common symptoms, their causes and recommended actions.

SYMPTOMS	POSSIBLE CAUSES	ACTION
Good sine wave at Amplifier's input connector, but irratic or incorrect analog output	-Improper grounding from target to 4000 rack chassis.	-Ground target to chassis.
	-Bad signal conditioning section.	-Troubleshoot rectifier/filter/output amp/associated circuitry.
	-Amp J4 jumper missing/wrong resistor.	-Replace jumper correctly.
	-Amplifier misaligned.	-Recalibrate Amplifier.
	-Clock sync not present at pin.	-Troubleshoot clock sync path.
	-Clock J3 jumper missing/wrong position.	-Replace jumper correctly.
Improper wave form or no wave form at Amplifier input connector.	-A1 static charged/blown.	-Replace A1.
	-U1 static charged/blown.	-Replace U1.
	-Proximic sensor shorted or open.	-Check continuity/isolation of proximic sensor.
	-Excitation signal not present at E11.	-Troubleshoot excitation path.
	-Clock J2 missing/improper.	-Replace J2 correctly.
	-Bad + or - 15 VDCsupply.	-Troubleshoot supplies.
No + or - 15 VDCindicator light on clock card.	-Bad + or - 15 VDCsupply.	-Troubleshoot supplied.
	-Bad secondary regulators.	-Check all regulator (check amp).
Seemingly good waver form at amp input connector, but instrument won't calibrate (no gain).	-A1 static charged/blown.	-Remove and replace A1.
	-U1 static charge/blown.	-Remove and replace U1.
	-Amp improperly aligned.	-Recalibrate Amplifier.
	-Amp J4 jumper missing/incorrect position.	-Replace jumper correctly.
	-Amp card J3 jumper missing/incorrect position.	-Replace jumper correctly.
	-Blown A1 or U1.	-Remove and replace A1 or

		U1.
	-Bad gain pot, Lin pot or break pot (if installed).	-Remove and replace pot.

TROUBLESHOOTING MATRIX

SYMPTOMS	POSSIBLE CAUSES	ACTION
Output stuck at a fixed low value, won't change with a change in displacement	Probe shorted (touching) to ground	Eliminate short condition
	Cable/connector shorted to ground	Eliminate short condition
	Improper connection of output to data acquisition	Verify proper connection/set-up
	Blown PC201 (A1) or AD744 (U1)	Remove & replace bad component
	Sensor to guard short in the Probe	Clean, repair or replace the Probe
Output stuck at a fixed high value, won't change with a change in displacement	Probe disconnected	Connect the Probe to the Amplifier
	Probe faulty	Replace the Probe
Output unstable or incorrect	Improper/missing target ground connection	Verify proper grounding
	Not enough warm-up	Allow 30 minute warm-up
	Improper voltage to the rack, usually when a 220 Vac unit is used on 115 Vac (a 115 Vac unit plugged into 220Vac will cause equipment smoking)	Connect to proper Mains voltage
	Probe/Amplifier mis-matched	Connect the Probe to the Amplifier it was originally calibrated with
	You have changed the Probe	Recalibrate
	More than (1) 4100-C in operation	Systems must be synchronized, consult the factory for assistance
No output, no +/-15 VDC indicator lights	Blown fuse	Check & Replace fuse
	Loose connection between power supply and motherboard	Disconnect Rack from power, remove the top cover and check all connections.
System won't calibrate	Many	Gather all pertainent info, including equipment serial numbers, calibration data

sheets, and approximate date of purchase and consult the factory.

JUMPER DEFINITIONS

S1-1: (Not installed in all units).	Note: S1-1, S1-2, S1-3: Set the primary gain ratio of the analog output stage and should only be changed at the factory.
S1-2: (Not installed in all units).	
S1-3: Factory installed.	
S1-4: User selectable.	Note: S1-4, S1-5: Set the final output gain. S1-4 should be used for a "X10" operation.
S1-5: Factory installed.	
S2: Factory installed on pins 1&2.	Note: S2, S3: Control where the user desires to operate the main offset and sum offset controls, either front panel or onboard. To swap the sum offset and main offset, change S2 to pins 2 and 3, and S3 to pins 1 and 2. These are the only advisable configurations.
S3: Factory installed on pins 2&3.	
S4: Not normally used.	Note: Eliminates a 100 ohm output impedance resistor.
S5: Factory installed on pins 2&3.	Note: Feeds output of U6B to input of U6A. When on pins 1 and 2, feeds output to U5A to input of U6A, when summing is desired.
S6: Factory installed on pins 1&2.	Note: Links the "A" output pin to primary output amp (U5A). When on pins 2 and 3, links the "A" output pin to the inverter amp (U6B), for an inverted output.
S7: Not normally used.	Note: When shorted, these pads configure the "B" input/output as an output, usually to sum with another card. When open, they set the input ratio's to U6A.
S9: Not normally used.	

6-1 WARRANTY

A. Capacitec specifically disclaims any warranties of Merchantibility of Fitness for Purpose of any products sold or service work performed by Capacitec.

B. Purchaser warrants that it is not a consumer as such term is defined in the Magnuson-Moss Warranty Act.

C. Capacitec warrants each Capacitec instrument system to be free from defects in material and workmanship for one year from date of shipment to the original purchaser. This warranty does not extend to units that have been altered or repaired outside Capacitec's factory. Defects covered by this warranty will be remedied by Capacitec at no charge provided the instrument is delivered to Capacitec's factory with all transportation charges prepaid. If upon examination Capacitec determines that any defect is not within the scope of this warranty, Capacitec will promptly so notify the Purchaser and provide an estimate of repair charges; Capacitec will not then proceed with the repairs before receipt of Purchaser's repair authorization.

D. Major system components such as, but not limited to, power supplies, air conditioners, and computer terminals bearing the original manufacturer's label shall be warranteed only to the extent of the original manufacturer's warranty terms which shall also date from the time of initial shipment to the purchaser. Warranty registration shall be retained by Capacitec or passed directly to the customer at Capacitec's option. Customer shall assume responsibility for all shipment and repair costs incurred beyond the manufacturer's warranty period.

Limitation of Damage

In the event any Capacitec product or service defect is found to be the responsibility of Capacitec, the Purchaser's sole and exclusive remedy will be the replacement of defective Capacitec product or service or the refund of the purchase price paid to Capacitec by the Purchaser, at the option of Capacitec. The Purchaser assumes all other risks and liability for any loss, damage, or injury to persons or property arising out of connected with, or resulting from the use of Capacitec's products and services. When requested by Purchaser, Capacitec will to the best of its ability provide Purchaser with prompt technical assistance to locate and identify the source of any difficulties involving Capacitec products or services.

Capacitec reserves the right to modify or change specifications of its products. This right extends to changes in component specifications, if they become obsolete or discontinued from production.

ADDENDUM

In order to realize the full potential of the 4100 Series Capacitive Displacement System, a few revisions have been incorporated to both the backplane configuration of the instrument racks, and to the analog output circuitry of the Amplifier cards themselves.

If a 4100-SL or 4100-L Amplifier has a serial number of 4100343 or greater, and a 4008 or 4016 rack serial number suffix of 133 or greater; you may realize the benefits of these improvements. The new system allows external data acquisition to access any of 3 outputs per Amplifier slot, simultaneously via P20 (and P21 for 4016's). Each Amplifier card can be configured to provide a raw output, an inverted output and/or a summed output. Note that, all units are normally shipped with the "B" output actually configured as an input. In order to obtain the sum of any single channel card, the "B" input must be reconfigured as an output, then it must be fed the "B" input of the second Amplifier card. The second Amplifier card's "C" output becomes the sum of both individual inputs. It is also possible to sum two inverted outputs. These arrangements are useful when a gap or thickness is to be measured, or when a PCOD type sensor is used.

For more complete information please consult the Capacitec Calibrations Lab. Also see 4100-L, 4100-SL output jumper definitions sheet.