J16PS ROOM TEMPERATURE GERMANIUM POSITION SENSORS

Operating Instructions

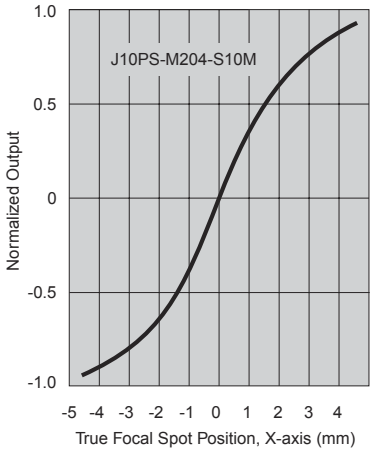
TELEDYNE JUDSON TECHNOLOGIES
A Teledyne Technologies Company

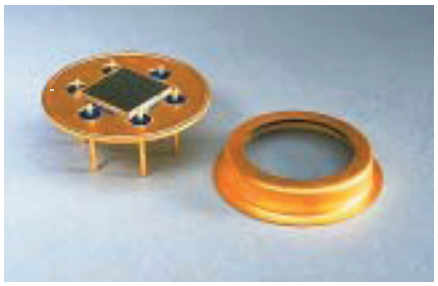
PB 4208

J16PS Position Sensors

A Ge position sensor consists of a single element photodiode with a quadrupole electrode geometry. These devices can provide linear X-Y beam position information for lasers and other infrared beams. Positioning information is determined as shown in Fig. 2. The PA6:4C preamplifier is recommended for Teledyne Judson position sensitive detectors.

Figure 1
Example of Position Linearity

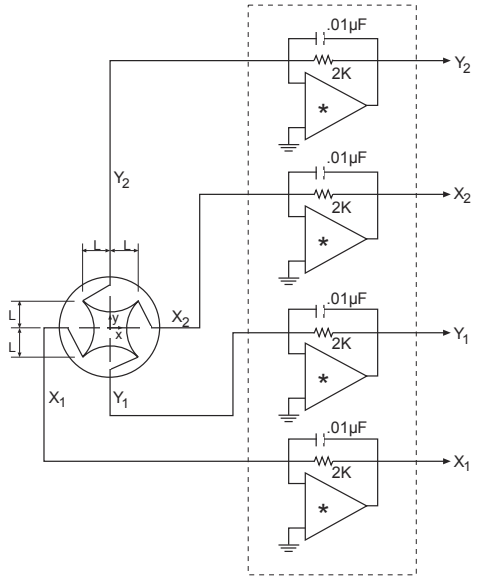




Typical Specifications **Linear Position Sensors**

Model Number	Part Number	Detector Type	Wavelength Range (µm)	Active Size "2L" (mm)	Linear Position Zone (Dia.) (mm)	Typical Position Resolution (µm)	Typical Interelectrode Resistance (ohms)	Peak Responsivity	Detector Temp.	Package Type
J16PS-P6-S10M-HS	460284	Ge	0.8 - 1.8	10 x 10	6	5	~ 100	0.6	22°C	TO3
J16PS-8E6-S05M-HS	460743	Ge	0.8 - 1.8	5 x 5	3	5	~ 100	0.6	22°C	TO8

Figure 2
Position Sensor Detector Configuration



Device Options

Teledyne Judson's unique "-HS" option Ge position sensing device has a p-i-n structure for extremely low capacitance and excellent speed of response, with R_D and noise similar to the standard device. This option is ideal for pulsed laser diode monitoring and general use above ~10 KHz.

$$\frac{x}{L} = \frac{(X_2 + Y_1) - (X_1 + Y_2)}{X_1 + X_2 + Y_1 + Y_2}$$

$$\frac{y}{L} = \frac{(X_2 + Y_2) - (X_1 + Y_1)}{X_1 + X_2 + Y_1 + Y_2}$$

TELEDYNE JUDSON TECHNOLOGIES
A Teledyne Technologies Company

221 COMMERCE DRIVE
MONTGOMERYVILLE, PA 18936-9641
PHONE: 215-368-6901
FAX: 215-362-6107
www.teledynejudson.com

SAMPLE TEST DATA
FOR 5MM GERMANIUM POSITION SENSOR

PART NUMBER: **460743**

DESCRIPTION: **J16PS-8E6-S05M-HS**

SERIAL NUMBER: **49961-1**

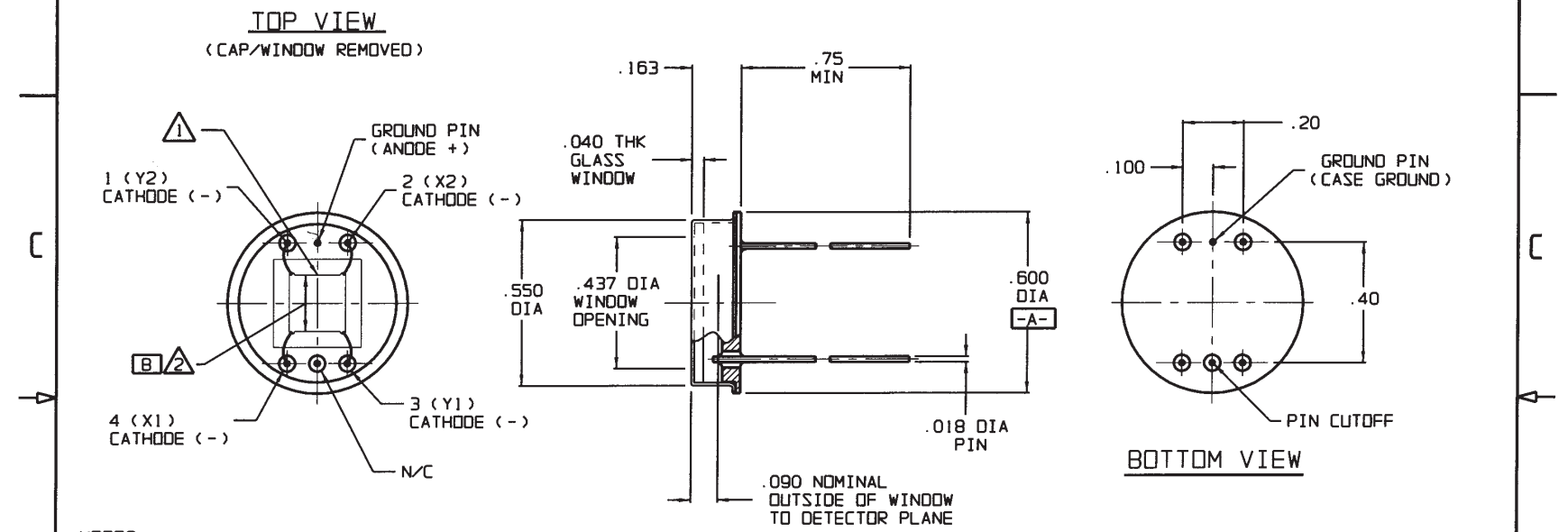
Shunt Resistance R_D at 22°C (ohms)	Dark Current I_D @ 1V (μA)	Dark Current I_D @ 3V (μA)
12739	3	4

Detector Series Resistance, R_S (ohms)				
Adjacent Contacts at 22°C	$(R_S^{1,2})$	$(R_S^{1,4})$	$(R_S^{3,2})$	$(R_S^{3,4})$
	77	80	79	80
max (R_S^{Adj}) = 80		min (R_S^{Adj}) = 77		
Non-Uniformity Specification = ≤ 5%				
Non-Uniformity = $\frac{\max(R_S^{Adj}) - \min(R_S^{Adj})}{\max(R_S^{Adj})}$ x 100 = 3.75 %				

Detector Series Resistance, R_S (ohms)		
Diagonal Contacts at 22°C	$(R_S^{1,3})$	$(R_S^{2,4})$
	84	85
max (R_S^{Diag}) = 85	min (R_S^{Diag}) = 84	
Non-Uniformity Specification = ≤ 5%		
Non-Uniformity = $\frac{\max(R_S^{Diag}) - \min(R_S^{Diag})}{\max(R_S^{Diag})}$ x 100 = 1.176 %		

Responsivity, Rλ at 1300nm = 0.70 A/W Responsivity, Rλ at 850nm = 0.22 A/W

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
0	INITIAL RELEASE	07/13/98	KWM/RO'L
1	CHANGES PER DCN 402379	02/05/01	WR/DFG



NOTES:

1. ACTIVE AREA CENTERED TO -A- WITHIN ±.010.
2. ACTIVE AREA EDGES -B- NORMAL TO LINE CONNECTING OPPOSITE N/C & GROUND PINS WITHIN ±2°.
3. FLAT GLASS WINDOW EPOXIED INTO CAP.
4. SPECIFICATIONS:

	J16
MATERIAL TYPE:	Ge
ACTIVE AREA SIZE:	5.0 mm SQ
PACKAGE SPECIFICATION:	6 PIN TO-8

5. DETECTOR SPECIFICATIONS:

MINIMUM RESPONSE AT 1.3 um:	0.6 A/W
MINIMUM RESPONSE AT 0.85 um:	0.2 A/W
DETECTOR SHUNT IMPEDANCE (Rd):	2.5 Kohms
MAX REVERSE VOLTAGE (Rd):	3 VOLTS
DARK CURRENT AT MAX VR:	100 uA
WINDOW MATERIAL:	GLASS
SERIES RESISTANCE ADJACENT CONTACTS:	(Rs 1->2), Rs(1->4), Rs(3->2),Rs(3->4)= ≥250Ω
SERIES RESISTANCE DIAGONAL CONTACTS:	(Rd 1->3),(Rd 1->4)= ≥250Ω
SERIES NON UNIFORMITY=	≤5%

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES
TOLERANCES
DECIMALS: X ±.02, .XX ±.01, .XXX ±.005
ANGULAR: ±1/2°

DRAWN	K.F.M.	07/06/98
DESIGN	K.F.M.	7/13/98
CHECK	JEFF BRISKER	7/13/98
PROJECT	N/A	-------
MFG APPRVL	ROBERT O'LEARY	7/13/98
QA APPRVL	HOAN DUONG	7/13/98

THIRD ANGLE PROJECTION

NEXT ASSY | USED ON

JUDSON TECHNOLOGIES
221 COMMERCE DRIVE MONTGOMERYVILLE, PA 18936

TITLE: J16PS-8E6-S05M-HS

SIZE		DWG NO.	REV
C	56586	460743P00	1

SCALE 4:1 | DO NOT SCALE DWG | SHEET 1 of 1

1300-1650 nm Two Dimensional Position Sensors

The J16PS-8E6-S05M-HS is a room temperature Germanium position sensor consisting of a single element photodiode with the improved tetra-lateral geometry called the Pin-Cushion Type. The active size of the detector is 5mm x 5mm. It has 4 electrodes (cathodes) at the corners on the front surface of the photodiode, and the common anode is at the back surface. A light spot within the spectral range of germanium generates a photocurrent which flows from the incident point through the resistive layers to the electrodes. If the resistivity of the sheet layer is extremely uniform, then the photocurrent at each electrode is inversely proportional to the distance between the incident spot and the electrodes.

A typical test data sheet of the detector characteristics supplied is shown in Figure 1.

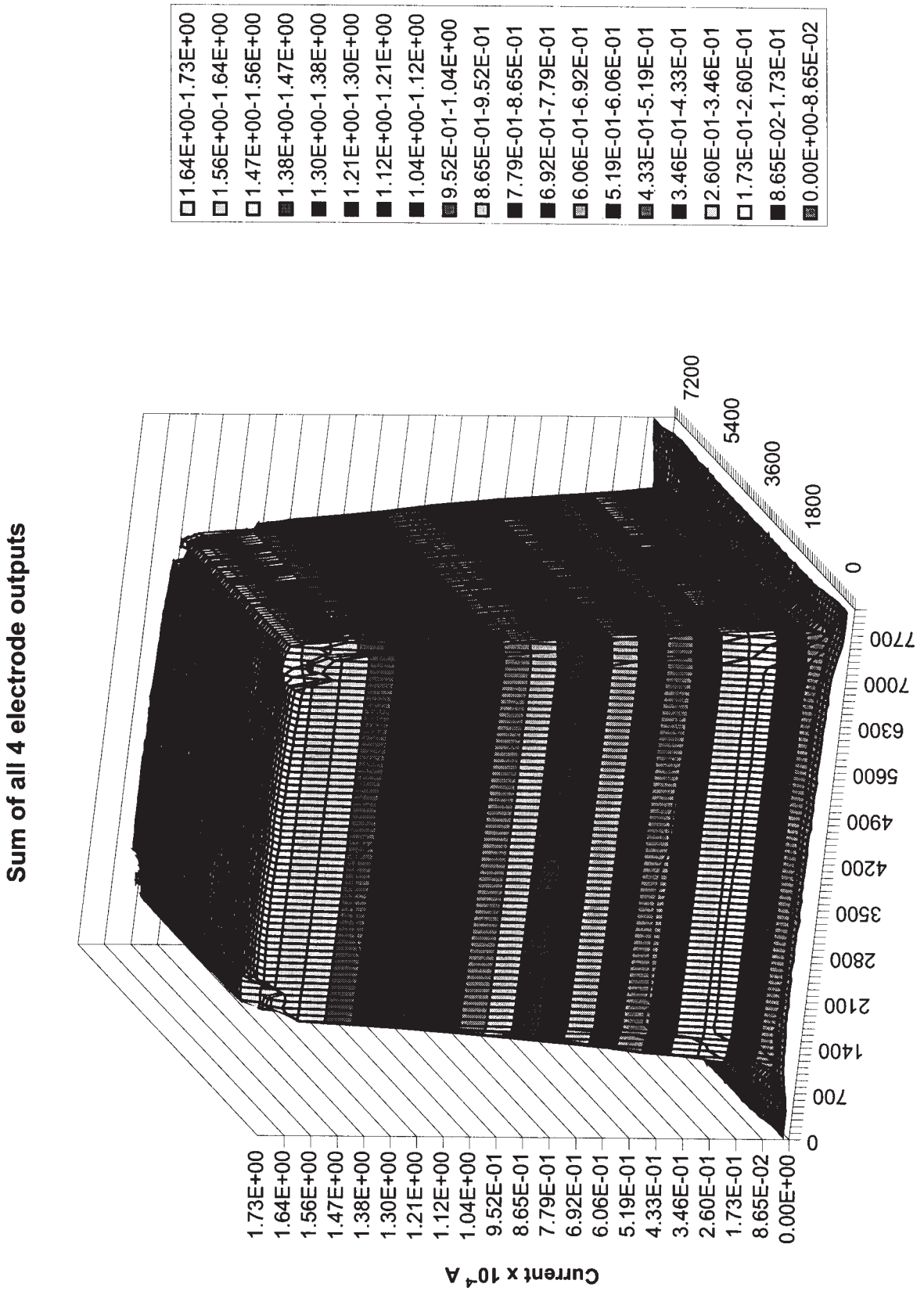
A detailed analysis of a detector was done and some of the data is presented.
The entire surface of the detector was scanned using an automated spot scanning set-up. A 1550nm laser diode source chopped at 1KHz was used. The laser power was regulated to give a constant output. The spot size was about 120um. The scanning was done in 100um steps. The current outputs of the 4 electrodes were fed through a 4-channel transimpedance amplifier and the rms voltage value of the fundamental(1KHz) was recorded to 4 separate files through software. Current flows into each electrode. The magnitude of the current will depend on the distance of the electrode from the spot position.

A 3D plot of the sum of all 4 voltage outputs is plotted as shown in Figure 2. The transimpedance gain of each channel was 10Kohm. The sum of all 4 currents from each electrode should be a constant depending on the uniformity of the surface. The 3D plot of the sum of the 4 voltages as a function of position depicts the uniformity of the detector surface.

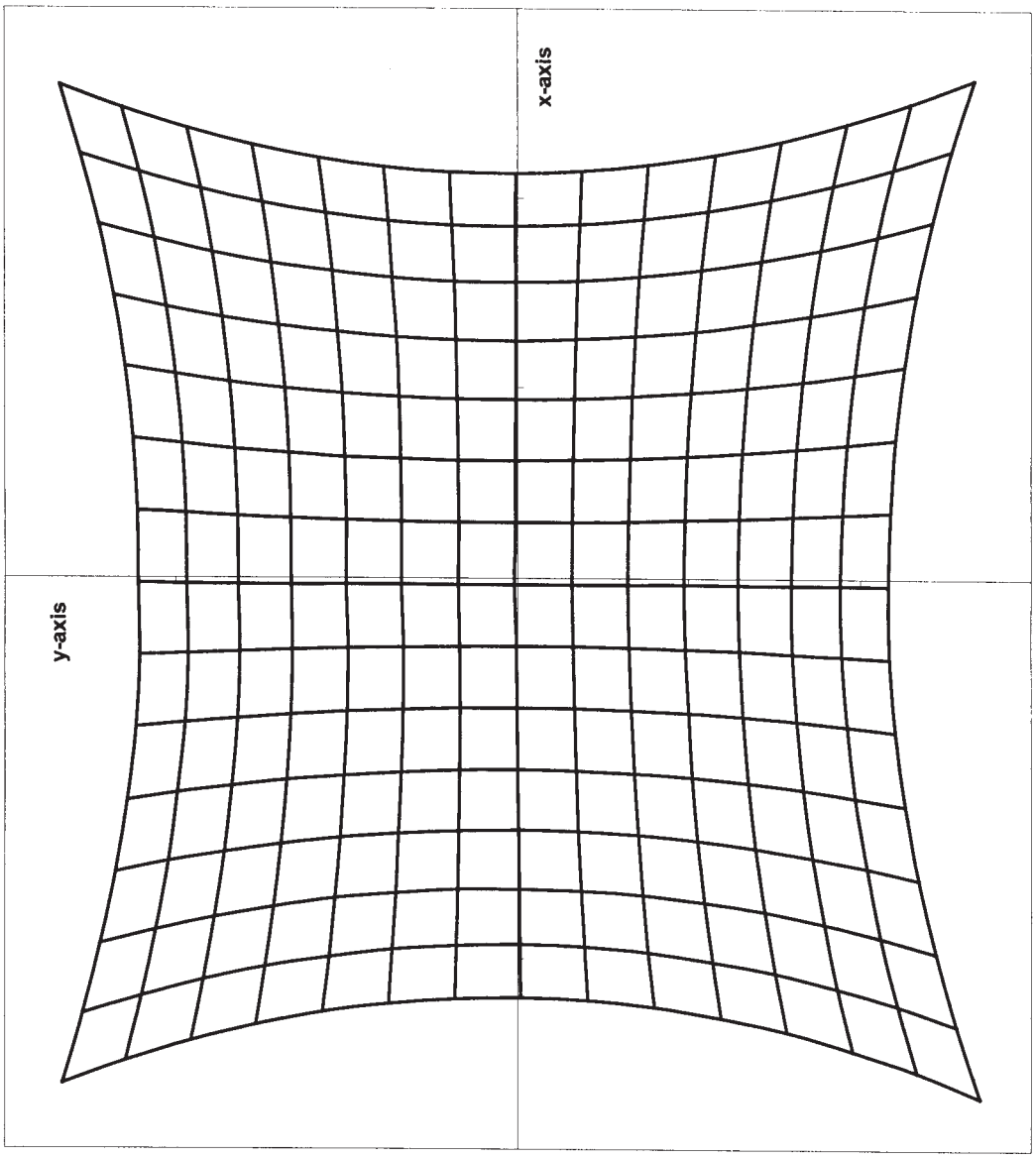
The normalized x and y position values are computed using the equations and a contour position plot of x from 1.4mm to –1.4mm and y from 1.4mm to –1.4mm is obtained as shown in Figure 3. This plot depicts the linearity of the detector.

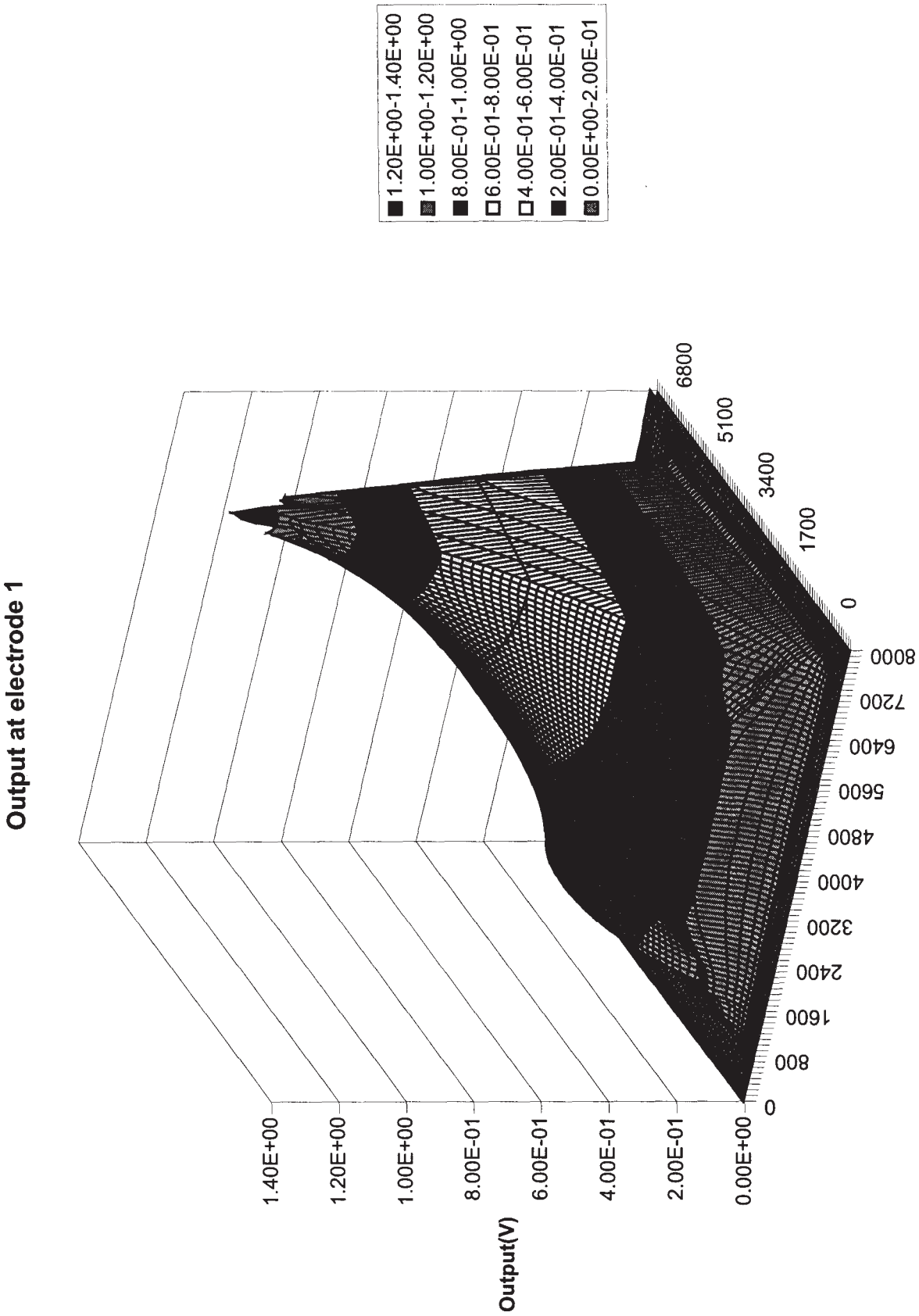
The voltage output from each electrode is plotted as a function of position. The 3D plots are shown in Figures 4, 5, 6,and 7. The output voltage gets higher as the light spot gets closer to the electrode.

The mechanical properties of the packaging are shown in Figure 8.

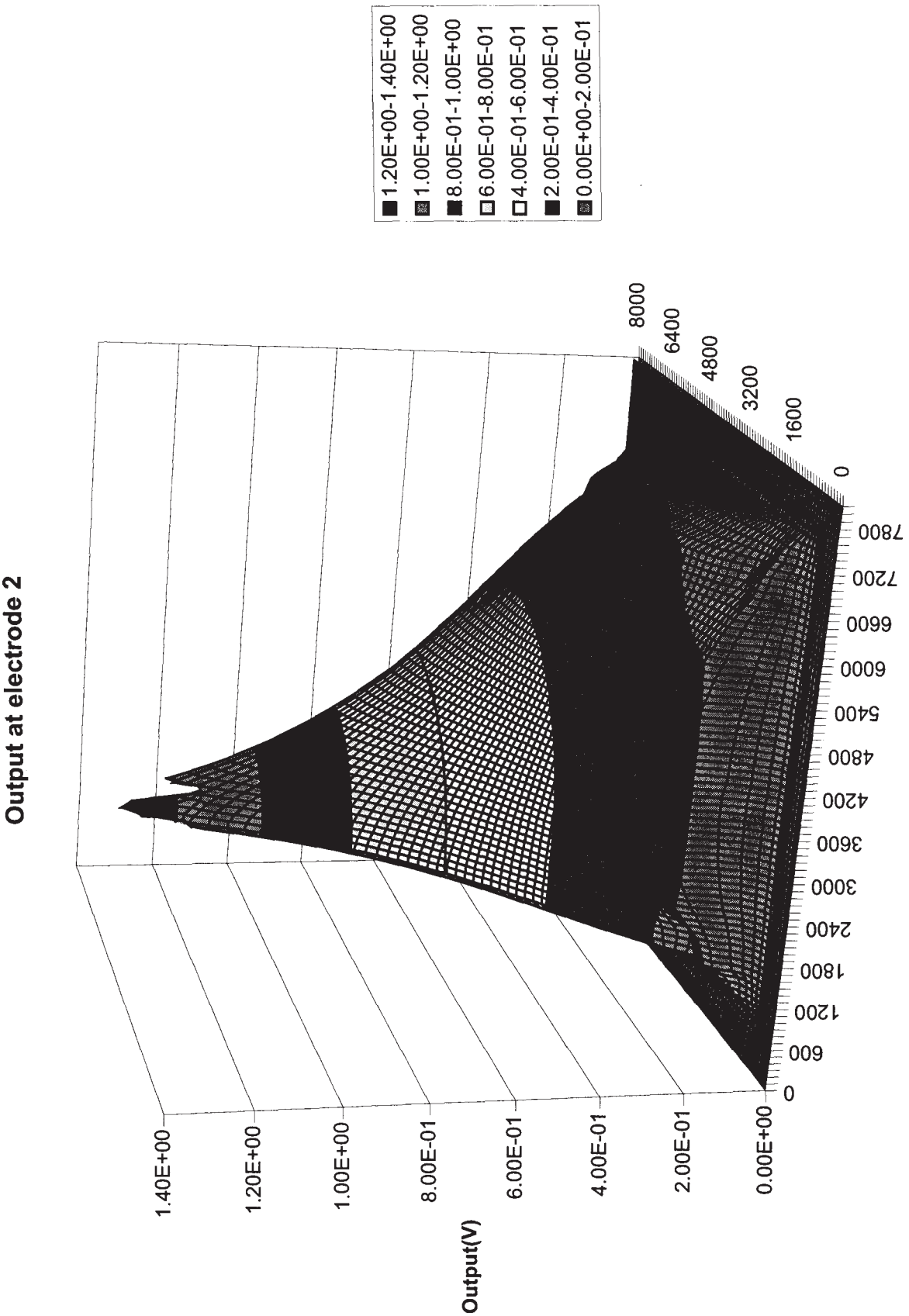

Sum of all 4 electrode outputs
1.64E+00-1.73E+00
1.56E+00-1.64E+00
1.47E+00-1.56E+00
1.38E+00-1.47E+00
1.30E+00-1.38E+00
1.21E+00-1.30E+00
1.12E+00-1.21E+00
1.04E+00-1.12E+00
9.52E-01-1.04E+00
8.65E-01-9.52E-01
7.79E-01-8.65E-01
6.92E-01-7.79E-01
6.06E-01-6.92E-01
5.19E-01-6.06E-01
4.33E-01-5.19E-01
3.46E-01-4.33E-01
2.60E-01-3.46E-01
1.73E-01-2.60E-01
8.65E-02-1.73E-01
0.00E+00-8.65E-02
Current x 10⁻⁴ A
1.73E+00
1.64E+00
1.56E+00
1.47E+00
1.38E+00
1.30E+00
1.21E+00
1.12E+00
1.04E+00
9.52E-01
8.65E-01
7.79E-01
6.92E-01
6.06E-01
5.19E-01
4.33E-01
3.46E-01
2.60E-01
1.73E-01
8.65E-02
0.00E+00
0
700
1400
2100
2800
3500
4200
4900
5600
6300
7000
7700
0
1800
3600
5400
7200

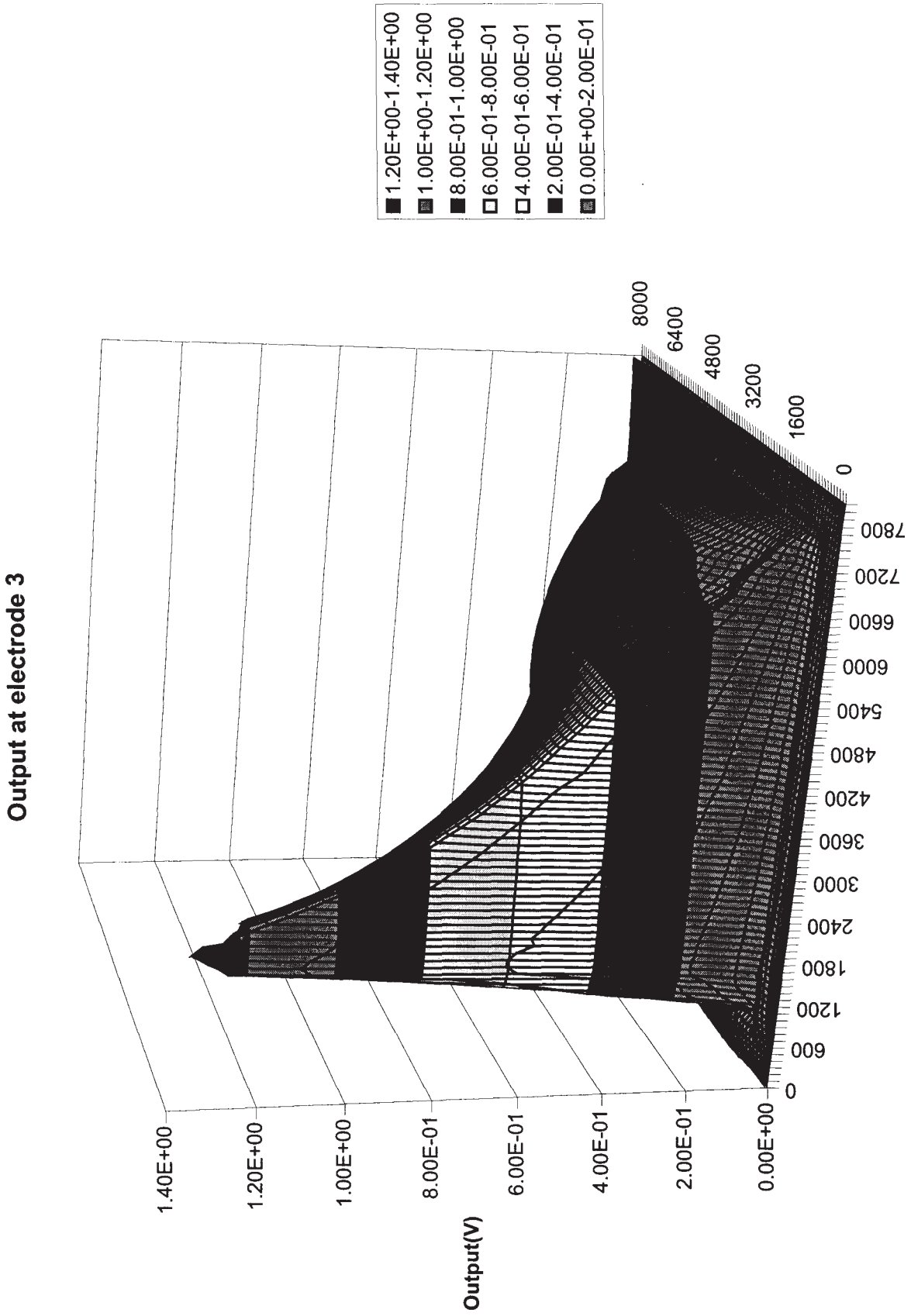
Linearity Plot (x & y from -1.4mm to 1.4mm)



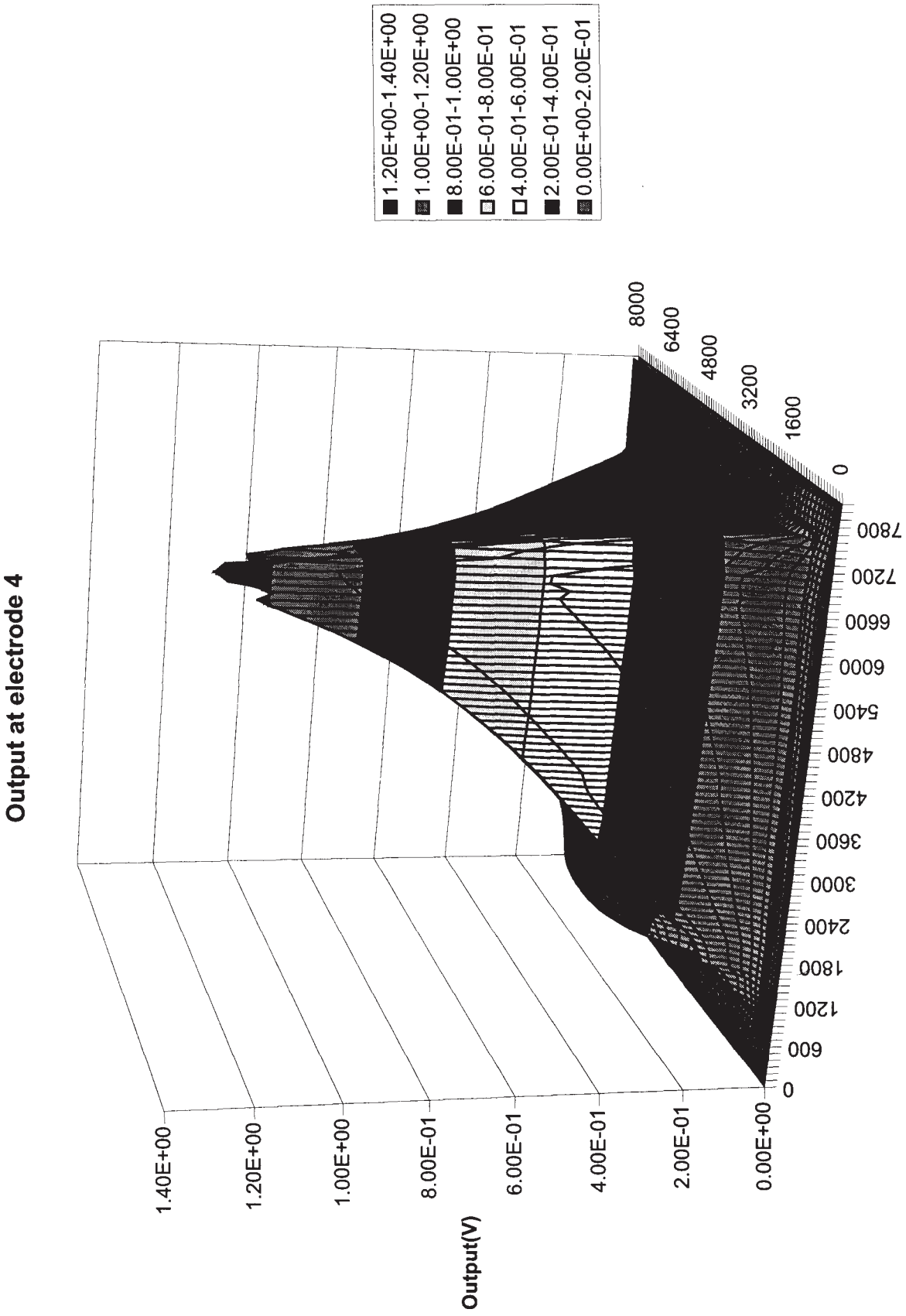

Output at electrode 1
1.20E+00-1.40E+00
1.00E+00-1.20E+00
8.00E-01-1.00E+00
6.00E-01-8.00E-01
4.00E-01-6.00E-01
2.00E-01-4.00E-01
0.00E+00-2.00E-01
Output(V)
1.40E+00
1.20E+00
1.00E+00
8.00E-01
6.00E-01
4.00E-01
2.00E-01
0.00E+00
0
800
1600
2400
3200
4000
4800
5600
6400
7200
8000
0
1700
3400
5100
6800

J16PS ROOM TEMPERATURE
GERMANIUM POSITION SENSORS




Output at electrode 3
1.20E+00-1.40E+00
1.00E+00-1.20E+00
8.00E-01-1.00E+00
6.00E-01-8.00E-01
4.00E-01-6.00E-01
2.00E-01-4.00E-01
0.00E+00-2.00E-01
Output(V)
1.40E+00
1.20E+00
1.00E+00
8.00E-01
6.00E-01
4.00E-01
2.00E-01
0.00E+00
0
600
1200
1800
2400
3000
3600
4200
4800
5400
6000
6600
7200
7800
0
1600
3200
4800
6400
8000

J16PS ROOM TEMPERATURE
GERMANIUM POSITION SENSORS



SAMPLE

FINAL TEST DATA

PART NUMBER: 460284

DESCRIPTION: J16PS-P6-S10M-HS

SERIAL NUMBER: 57984-7

Shunt Resistance R_D (ohms)	Dark Current I_D @ 1V (µA)	Dark Current I_D @ 3V (µA)	Junction Capacitance C_D @ 0V 10Khz	Junction Capacitance C_D @ 0V 1Mhz
4477	10	50	19nF	3nF

Detector Series Resistance, R_S (ohms)				
Adjacent Contacts	$(R_S^{1,2})$	$(R_S^{1,4})$	$(R_S^{3,2})$	$(R_S^{3,4})$
	82	81	82	81

max (R_S^{Adj}) = 82 min (R_S^{Adj}) = 81

Non-Uniformity Specification = ≤ 5%

$$\text{Non-Uniformity} = \frac{\max(R_S^{Adj}) - \min(R_S^{Adj})}{\max(R_S^{Adj})} \times 100 = 1\ \%$$

Detector Interlaced Resistance R_L		
Diagonal Contacts	$(R_S^{1,3})$	$(R_S^{2,4})$
	86	86

max (R_S^{Diag}) = 86 min (R_S^{Diag}) = 86

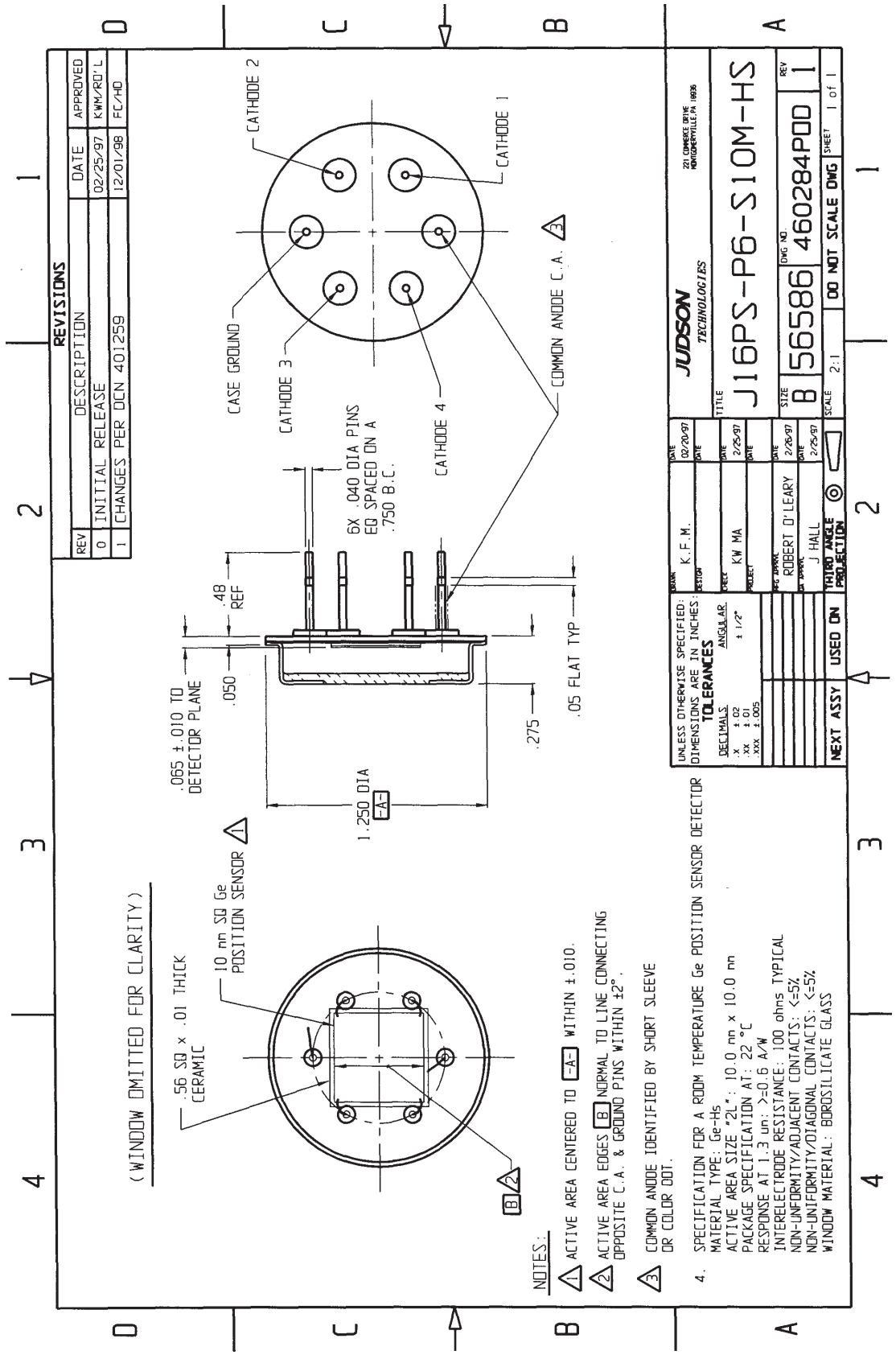
Non-Uniformity Specification = ≤ 5%

$$\text{Non-Uniformity} = \frac{\max(R_S^{Diag}) - \min(R_S^{Diag})}{\max(R_S^{Diag})} \times 100 = 0\ \%$$

Responsivity, Rλ at 1.3µm = 0.94 A/W

Approved by: [signature] Date: 8/23/07

J16PS ROOM TEMPERATURE
GERMANIUM POSITION SENSORS



4-channel Preamplifier with 4 digitally programmable gains

Theory of Operation

This pre-amplifier can be used for testing all the four outputs of a 4 channel position sensor. There are 4 independent preamplifiers for each channel. The current output of each channel is converted to voltage using a high speed transimpedance amplifier. This voltage is further amplified with a voltage amplifier using a selection of 4 different gains. The high speed amplifier gives a 1 MHz bandwidth dependent on detectors characteristics. A chopper stabilized operational amplifier with a low maximum offset voltage of +/- 5uV removes the offset voltage of the high speed transimpedance amplifier.

Operating Instructions PA-PS: 4C, SMA, HIGH SPEED (490181)
Please refer to Drawing No. 490181POD for electrical connections and gain selections.

The power input jack has 5 pin connections. 4 digitally programmable gains can be selected via pins A & B. The gain select table depicts the gain values for the 4 combinations. The power supply required is +/- 6V. The detector connections are made to the detector input jack. The 4 outputs are accessible on the 4 SMA connectors.

SMA connector outputs OUT1, OUT2, OUT3, & OUT4 correspond to outputs Y2, X2, Y1, & X1 in the catalog for position calculations.

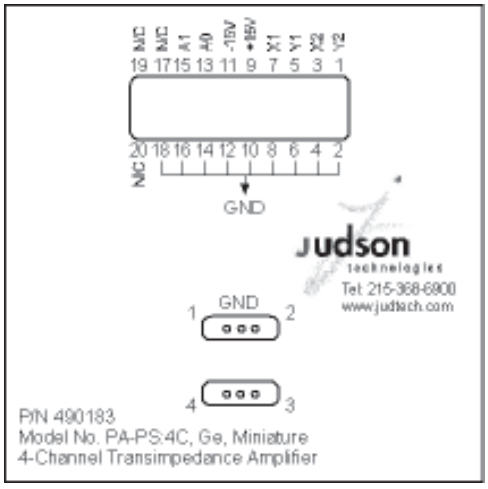
Specifications

Power Supply: +/-6V at 80mA
Input Offset Voltage: +/-5uV
Average Input Offset Drift: +/- 6uV/°C
Output Offset Voltage: +/-40mV max
Input Bias Current: 1.2uA
Input Noise Voltage: 6nV/rtHz at 100KHz
Input Noise Current: 9pA/rtHz
Output Impedance: 50ohms
Maximum Output Current: 25mA
Maximum Output Voltage: +/-2.5V
Bandwidth: DC to 3MHz
Selectable Gains: 200V/A, 401V/A, 804V/A, 1608V/A

Operating Instructions:

PA-PS: 4C, Miniature, Standard (490183)

This model has a 6-pin socket to accept the position sensor, and a 20-pin connector for power supply, 4-channel outputs, and gain select control lines. The label below indicates the connections for the 20-pin connector and the

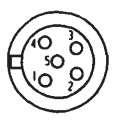


position sensor. Pins 13(A0) & 15(A1) are the gain select control lines. The table below gives the 4 gain selection options depending on the TTL compatible signals supplied to A1 and A0.

A1	A0	Gain KV/A
0	0	6.03
0	1	19.135
1	0	60.850
1	1	150.384

Pins 1, 3, 5, & 7 on the 20-pin connector correspond to outputs Y2, X2, Y1, & X1 in the catalog for position calculations.

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
0	INITIAL RELEASE	06/28/01	WR/DFG
1	CHANGES PER DCN 402756	11/28/01	WR/DFG



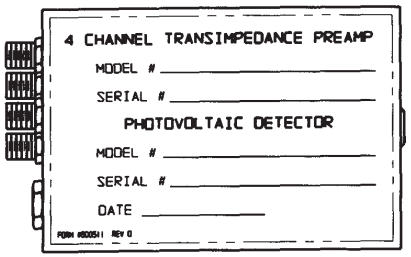
DETAIL "A"

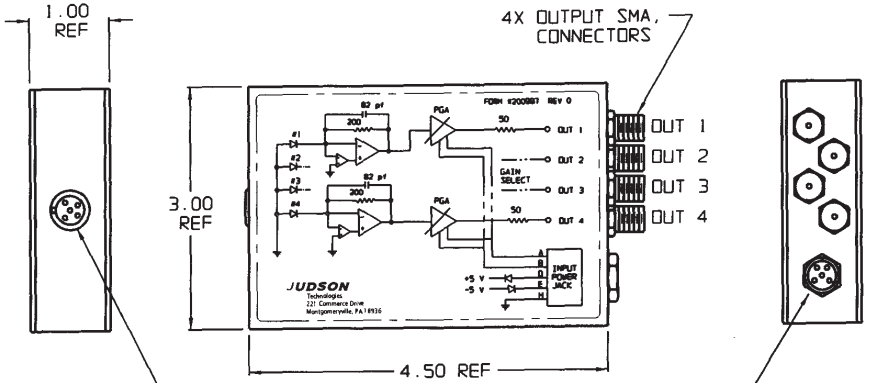
DETAIL "B"

DETECTOR INPUT JACK	
PIN #	CONNECTION
1	CHANNEL 1
2	CHANNEL 2
3	CHANNEL 3
4	CHANNEL 4
5	GND

POWER INPUT JACK	
PIN #	CONNECTION
*A	GND OR OPEN
*B	GND OR OPEN
D	+6 V
E	-6 V
H	GND

*GAIN SELECT TABLE		
A	B	GAIN V/A
GND	GND	200
OPEN	GND	400
GND	OPEN	800
OPEN	OPEN	1600





UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES
TOLERANCES
DECIMALS: X ± .02, XX ± .01, XXX ± .005
ANGULAR ± 1/2°

DRAWN	K.F.M.	06/28/01
DESIGN	K.F.MARSHALL	06/28/01
CHECK	VARSHA NALAVADE	06/28/01
PROJECT	ALEX KOMJATI	06/28/01
MFG APPRVL	WILLIAM ROLLS	06/28/01
QA APPRVL	D.F.GREENE	06/29/01

THIRD ANGLE PROJECTION

NEXT ASSY | USED ON

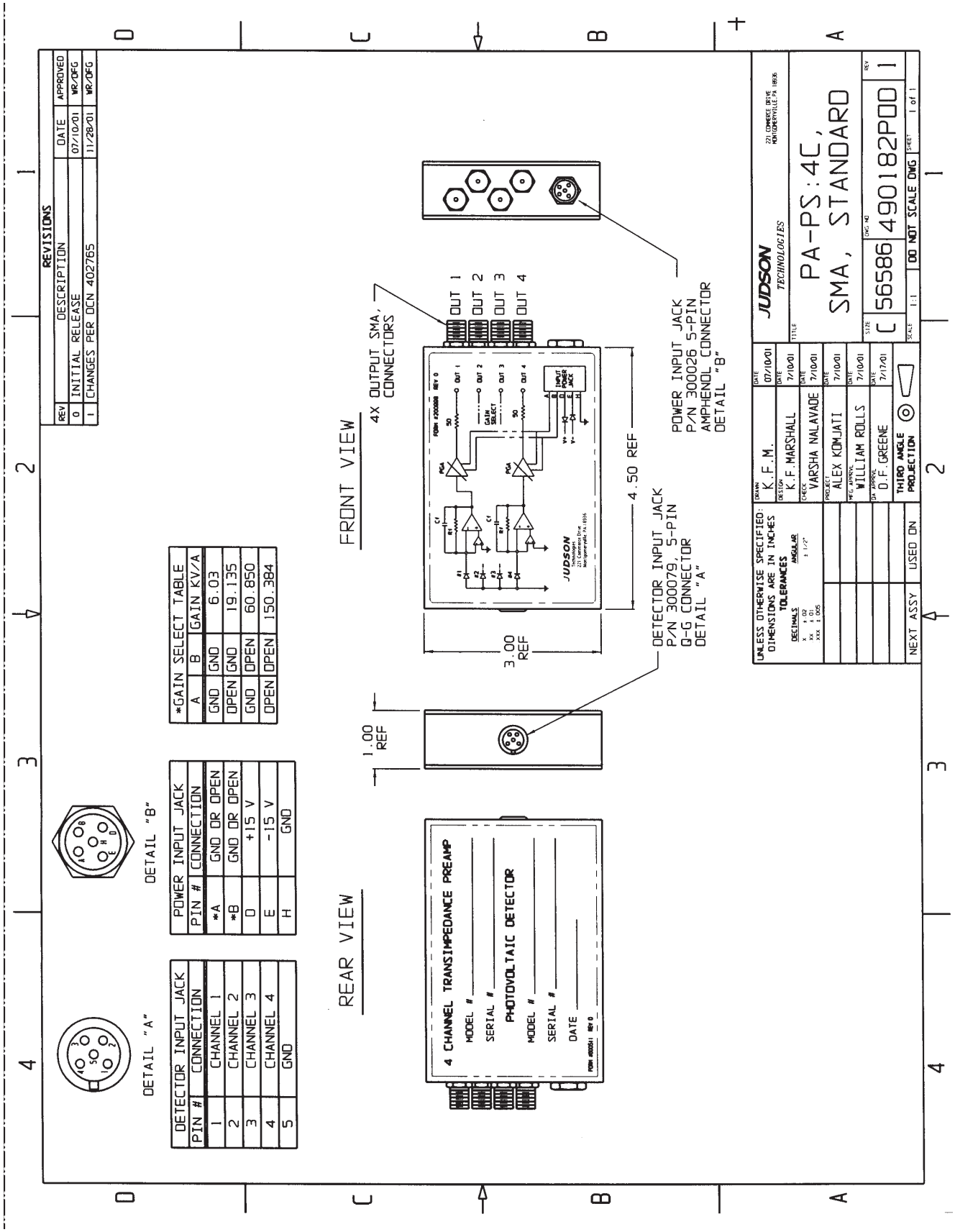
JUDSON TECHNOLOGIES
221 COMMERCE DRIVE MONTGOMERYVILLE, PA 18936

TITLE: PA-PS:4C, SMA, HIGH SPEED

SIZE	DWG NO.	REV
C	56586 490181P00	1

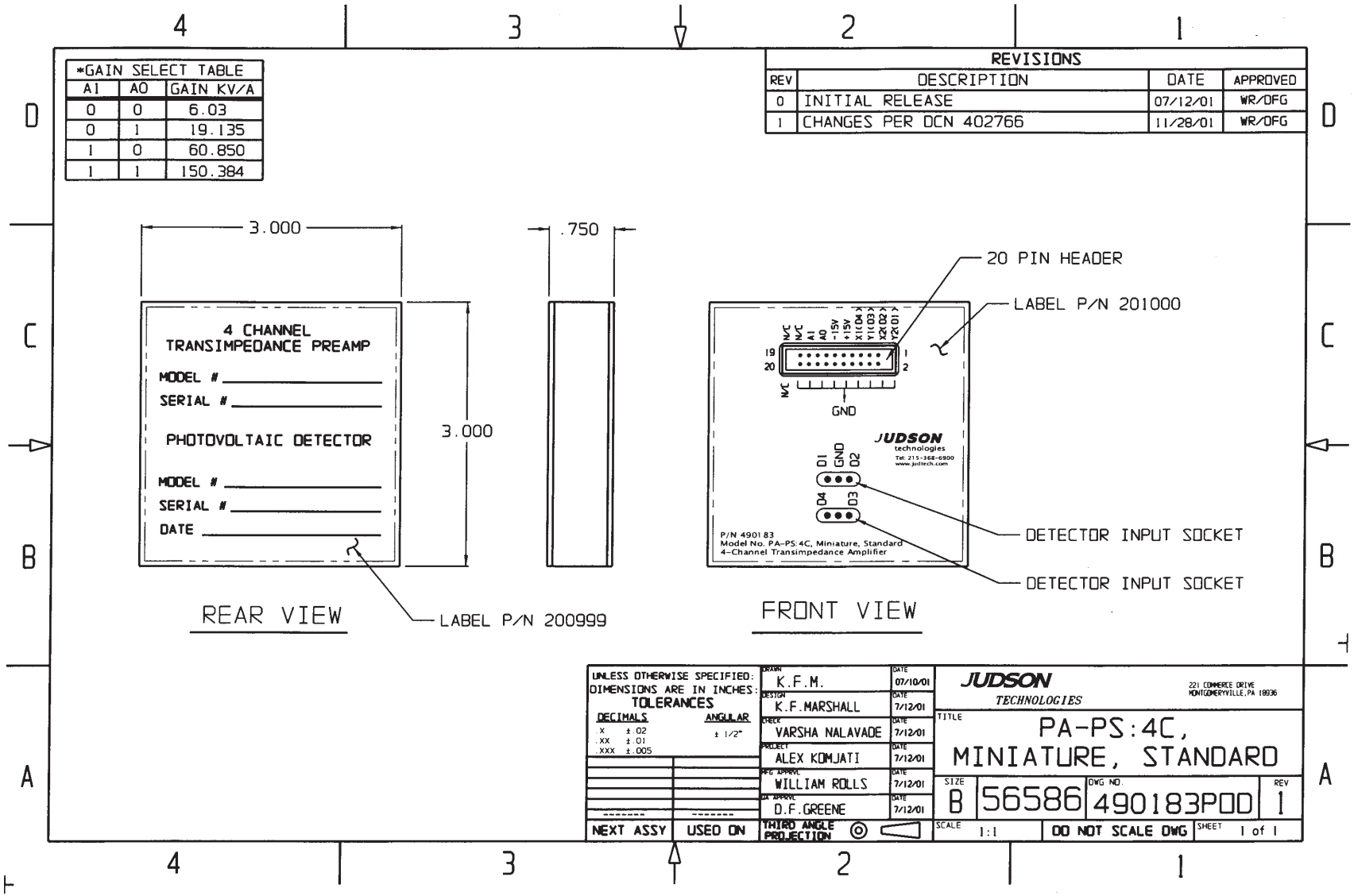
SCALE 1:1 | DO NOT SCALE DWG | SHEET 1 of 1

J16PS ROOM TEMPERATURE GERMANIUM POSITION SENSORS



*GAIN SELECT TABLE		
A1	A0	GAIN KV/A
0	0	6.03
0	1	19.135
1	0	60.850
1	1	150.384

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
0	INITIAL RELEASE	07/12/01	WR/DFG
1	CHANGES PER DCN 402766	11/28/01	WR/DFG



UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES
TOLERANCES
DECIMALS: .X ±.02, .XX ±.01, .XXX ±.005
ANGULAR: ± 1/2°

DRAWN	K.F.M.	07/10/01
DESIGN	K.F.MARSHALL	7/12/01
CHECK	VARSHA NALAVADE	7/12/01
PROJECT	ALEX KOMJATI	7/12/01
MFG APPRVL	WILLIAM ROLLS	7/12/01
QA APPRVL	D.F.GREENE	7/12/01

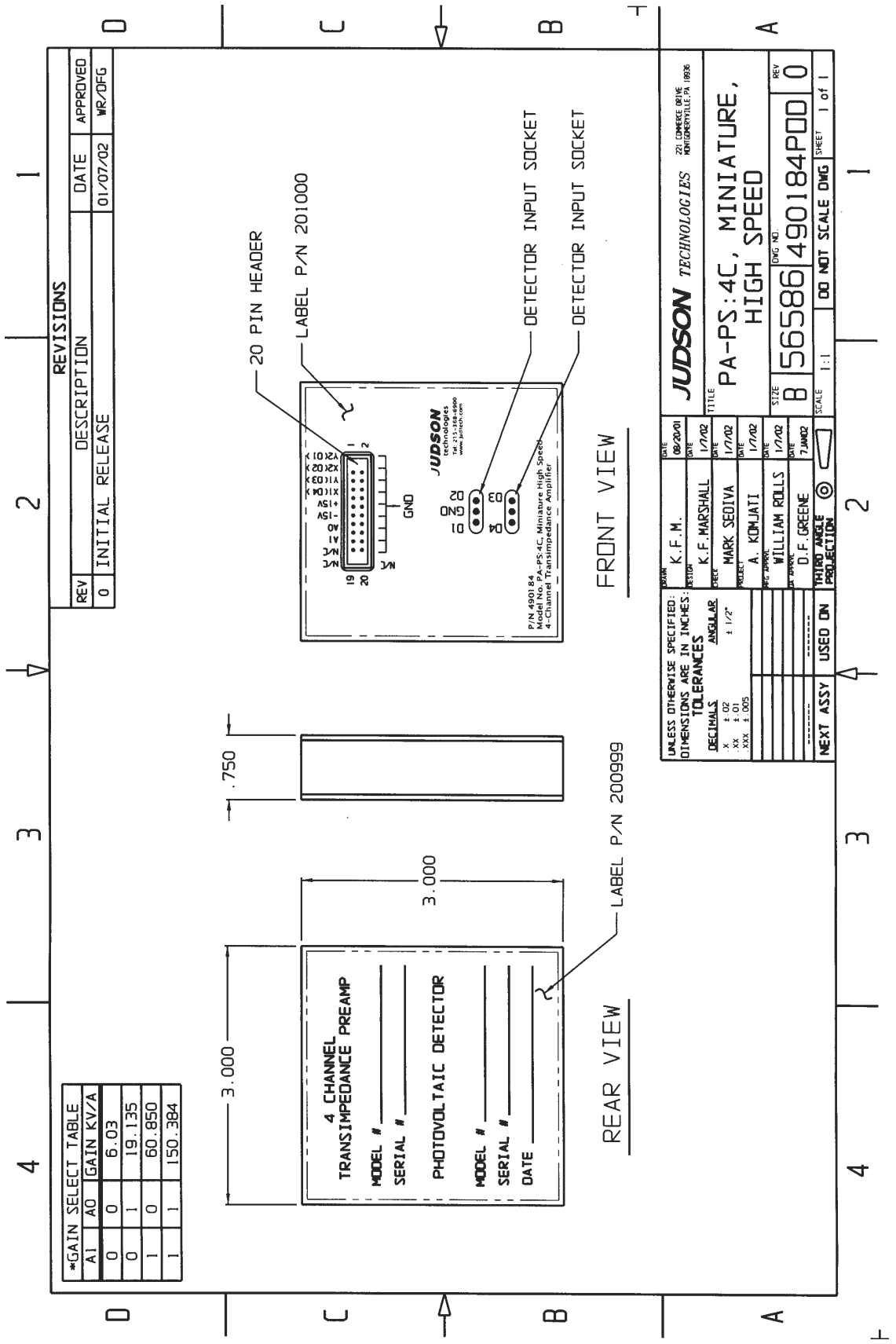
NEXT ASSY | USED ON | THIRD ANGLE PROJECTION

JUDSON TECHNOLOGIES
221 COMMERCE DRIVE
MONTGOMERYVILLE, PA 18936

TITLE: PA-PS:4C, MINIATURE, STANDARD

SIZE	DWG NO.	REV
B	56586 490183P00	1

SCALE 1:1 | DO NOT SCALE DWG | SHEET 1 of 1



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