

Mbari Underwater Temperature Probe System

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Initial Release 1.0 7/14/00

1. System Description

The Mbari Underwater Temperature Probe System is designed to meet the following specifications:

- 4000 meter depth rating
- 0 to 30 deg. C with +/- 1.0 deg. C accuracy on the low range.
- 0 to 400 deg. C with +/- 1.0 deg. C accuracy on high range.
- Probes 18" long, suitable for ROV manipulator insertion.
- 24vdc, RS-232 serial ROV Science Port Interface (Ventana and Tiburon)

The system consists of a aluminum 4000 meter capable housing with a Brantner SeaCon MINK-10-BCR connector for the power and data interface. The temperature probes connect to 2 each Subcon LPBH-4-FS connectors. A Swagelock -4-vent/purge port is also provided.

Housed in the aluminum pressure can are two Omega Engineering TX-66A RTD in/ 4 – 20ma digital temp transmitters and an Mbari A/D PC board that digitizes the 4-20 signal with a 12 bit a/d converter. The temp transmitter current outputs terminate on the A/D PCB with a 0.1% 250 ohm resistor creating a 1-5 VDC range for the A/D converter inputs. The converter samples each of the two channels at 20 Hz and has a moving average filter that has a 20-sample average. The data is then sent out serially via a MAX232 driver chip at 9600 baud, no parity and 1 stop bit. The A/D PCB also contains a .5 amp fuse that protects the a/d circuits and a .5 amp fuse that protects the temp transmitter 4-20 loops.

The resulting data output is transmitted through either the ROV Ventana's or Tiburon's telemetry system. The string contains three 12 bit a/d values. The first two represent probes 1 and 2. The third is a spare channel and is nominally zero (or near it).

The string looks like this: SMADC,XXXX,XXXX,XXXX<CR><LF>
Where the XXXX represent the 12 bit A/D values. (0 – 4095 counts) The temp transmitters produce a 4-20ma signal which in turn produces a 1-5 VDC signal. This is digitized and produces a 0% (4ma) of about 780 counts and a 100% (20ma) of 4095 counts. So the measurement range is 0-100% temp is equal to 780-4095 A/D counts (0-30 deg C. for low range). The actual zero and max A/D outputs are contained in the calibration section in

the back of this manual. The values may be slightly offset due to A/D converter input reference variations.

The probes are 100-ohm platinum RTD types with a four wire connection to the transmitters via a mating pair of Subcon LPIL-4 MP / LPBH-4 FS. A individual offset for each probe is located in the back of this manual.

There are two types of probes available. The low range probes are ¼” in diameter and the high range probes are 1/8” in diameter. Both types are usable for the low range but the high range probes should be only used if the expected temp is over 200 deg C.

2. Installation and Operation

Installation consists of mounting the transmitter housing on the ROV and connecting the MINK-10 cable from the transmitter housing to the vehicles science port. A 10 ft MINK-10 to MINK-10 cable is provided for this connection. It is a orange P/U insulated Falmat cable with molded-on Seacon MINK connectors. The probes connect to the transmitter housing with a Subcon LPIL-4-MP connector. The system may be used with only one channel attached. Either ch-1 (low range) or ch-2 (high range) may be utilized alone. When a probe is not attached the A/D will output 4095 counts. Normal precautions should be taken with the rubber molded cable connectors like using silicone or other lubricants. Dummy off any unused port.

Also check that the Sawgelock vent port is tight!

Important note: the probe excitation is common with the system 24 vdc. So if the probe gets a water leak it can show a ground fault on the 24 vdc supply.

The probes are electrically identical and they are interchangeable except if the expected temp is over 250C. The 1/8" probes should be used for the high range measurements.

Operation of the system consists of applying power to the system and observing the output data. The A/D PCB will transmit data as soon as power is applied. No command is required. The data is output at a rate of approximately 1-hz.

Data can be observed with any terminal program and logged as a text file.

3. Troubleshooting:

First: before you open the can, insure there is DC 24 volts at pins 3 and 5 of the MINK-10-CCP going to the temp probe can.

Pin 3 is DC return.

Pin 5 is +24 VDC.

Second: check the RS-232 com line in/out. Try and jump pin-1 to pin-2. This will loop back the RS-232. Type something in a terminal program and you should get the same characters back on the screen.

Third use a terminal program to check if you are getting data back from the probe. The unit transmits as soon as power is applied and it set to 9600, N,8,1.

If all else fails check the fuse on the ckt board. F1 is a .5 amp fuse and protects the entire system. A .5 amp fuse on the 24 VDC input fuses the 4-20 ma loops.

The digital displays on the Omega transmitters display temp in deg. C. and are on all of the time power is applied. They will display "FAIL-SAFE" if no probe is attached. The Omega calibrator can be attached to the system and can be set to simulate a probe to test the transmitter and A/D converter.

4. Calibration Data and Software Set Up Data:

The Probes have the following set up values for the **display software**. These settings will produce displayed temperatures that are in Degrees C. for real time display only.

Probe #	Range	zero	hi	Hi counts	Low Counts
1	HI	0	403	4095	826
2	HI	0	403	4095	826
3	LOW	0	33	4095	780
4	LOW	0	33	4095	780
5	LOW	0	33	4095	780

A/D Cal data as of 7/12/00

A/D CH 0 (Probe ch 1)

<u>Calibrator degrees</u>	<u>A/D counts</u>
0	782
5	1596
10	2097
15	2596
20	3079
25	3598
30	4089

A/D CH 1 (Probe ch 2)

<u>Calibrator degrees</u>	<u>A/D counts</u>
0	847
50	1253
100	1659
200	2473
400	4095

This was measured using the Omega CL-307B RTD simulator attached to the inputs of the temp probe system at the LPIL-4 connectors and read with a terminal program on the serial out.

5. Documentation

- Connection Diagram
- Internal Can Wiring
- PCB Schematic
- PCB layout
- Mechanical Drawings

2.5" ID PRESSURE HOUSING

TIBURON OR VENTANA SCIENCE PORT

1 232 TXD
2 232 RXD
3 GND
4 N/C
5 N/C
6 +24 VDC
7-10 N/C

MINK-10-FCR

INTERFACE CABLE

1 1
2 2
3 3
4 4
5 5
6 6
7 7
8 8
9 9
10 10

MINK-10-CCP

MINK-10-CCP

1 1
2 2
3 3
4 4
5 5
6 6
7 7
8 8
9 9
10 10

MINK-10-BCR

A/D CONVERTER PCB 12 BIT, 4 CH

232 IN
232 OUT
GND
+24 OUT
CH-1 IN
0-5 VDC
CH-2 IN
0-5 VDC
GND

TEMP CH-1 OMEGA RTD AMPLIFIER RTD IN, 4-20 MA OUT

IN REF HI
IN 1
IN 2
IN REF LOW
OUT

TEMP CH-1

1 1
2 2
3 3
4 4

LPBH-4FS

1 1
2 2
3 3
4 4

LPIL-4MP

100 ohm
RTD

TEMP CH-2 OMEGA RTD AMPLIFIER RTD IN, 4-20 MA OUT

IN REF HI
IN 1
IN 2
IN REF LOW
OUT

TEMP CH-2

1 1
2 2
3 3
4 4

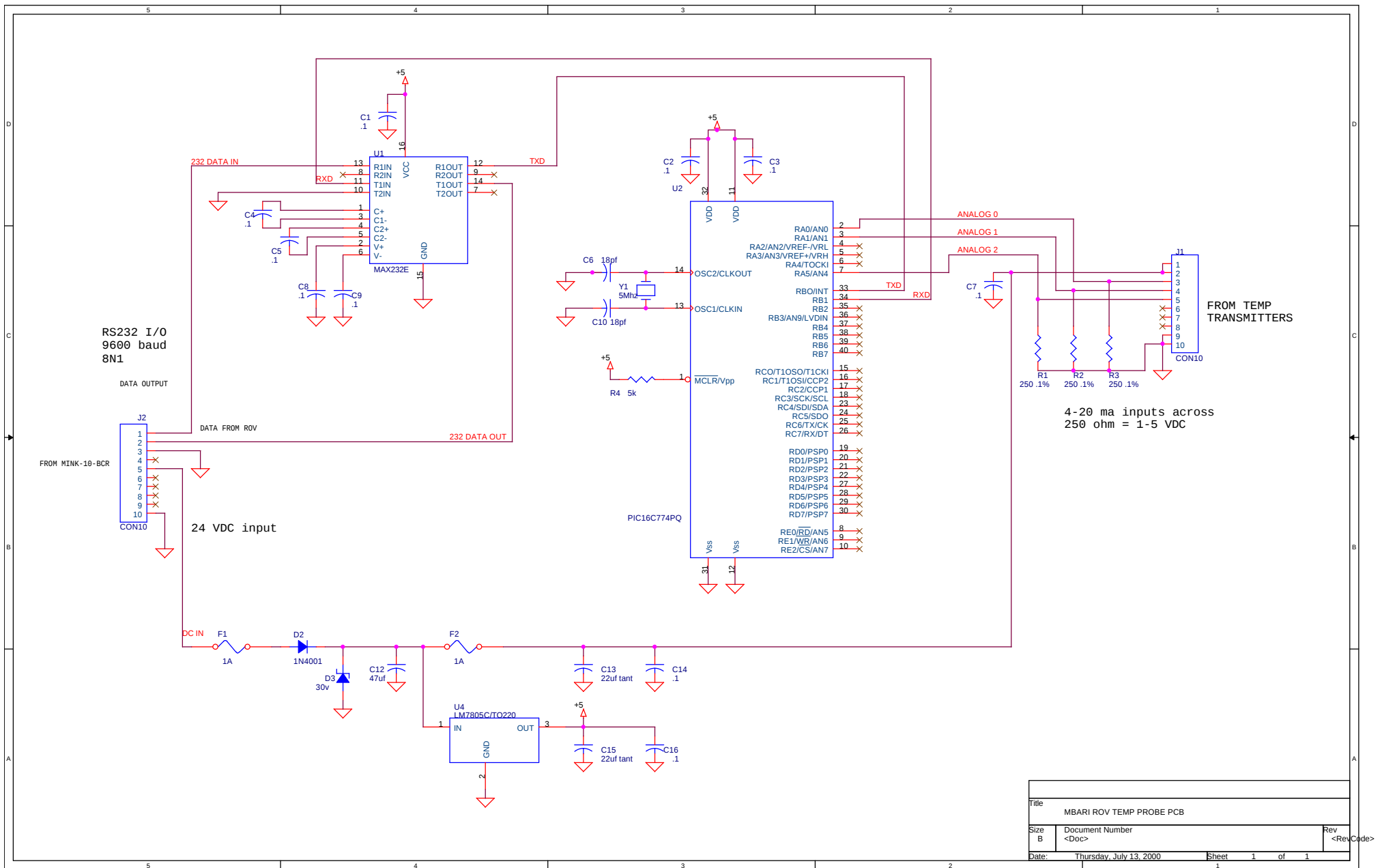
LPBH-4FS

1 1
2 2
3 3
4 4

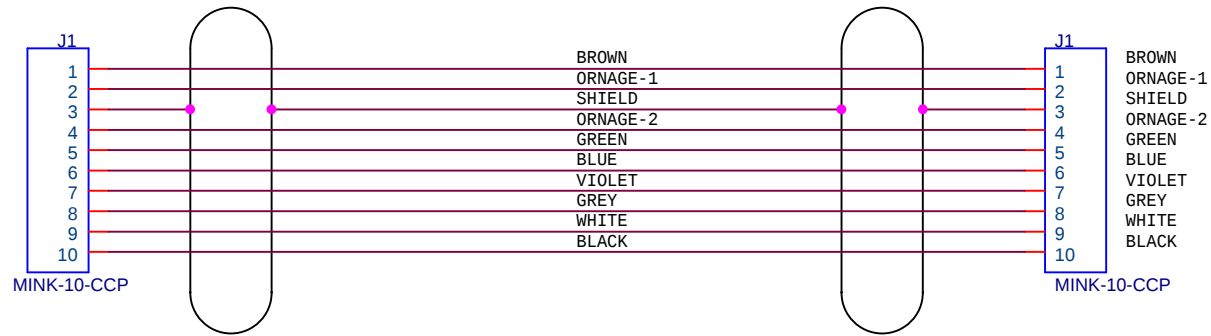
LPIL-4MP

100 ohm
RTD

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TIBURON TEMP PROBE BLOCK DIAGRAM		
Size	Document Number	Rev
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Date:	Wednesday, June 28, 2000	Sheet 1 of 1



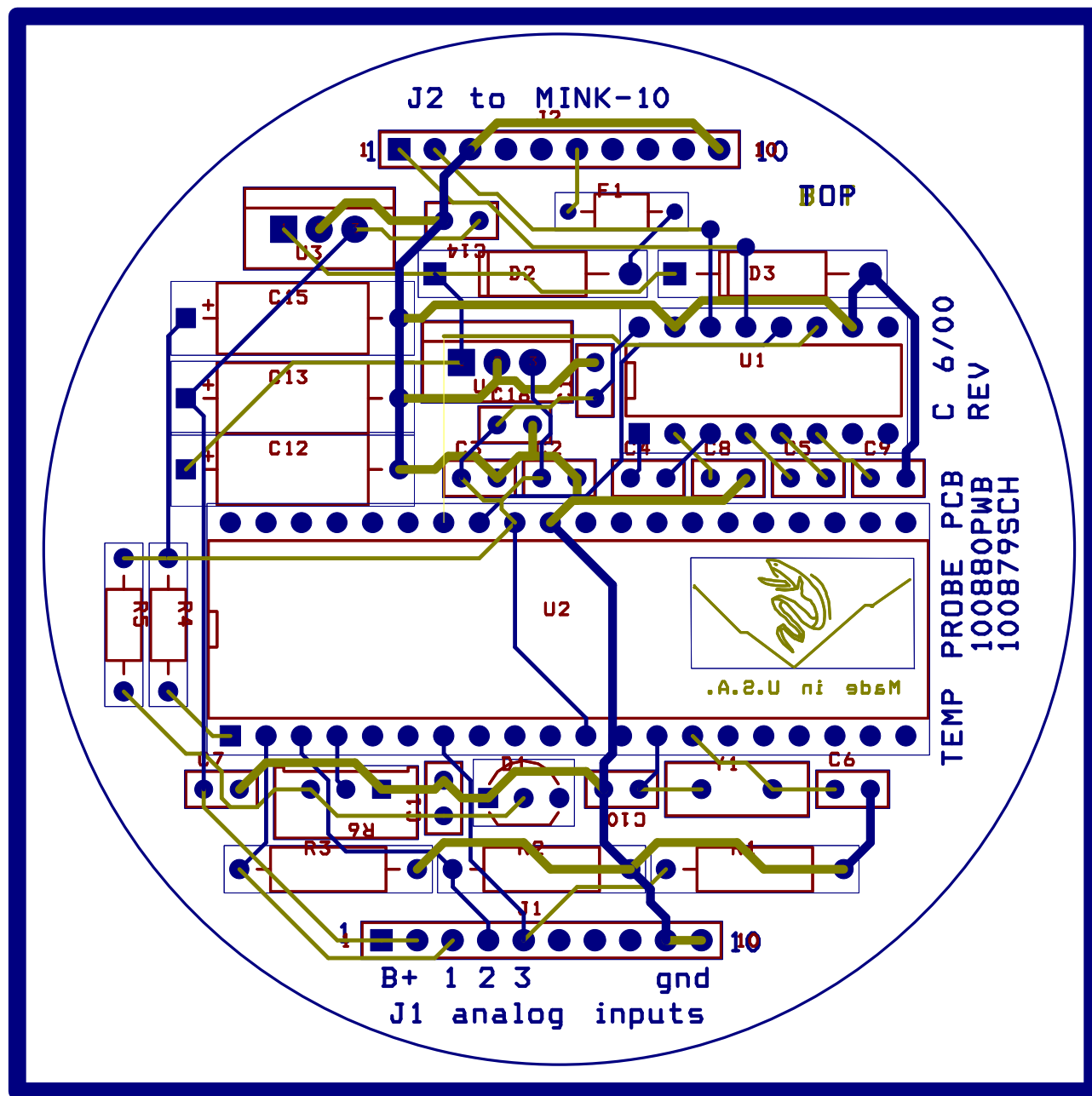
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MBARI PROVIDED P/U CABLE
10' OVER ALL LENGTH

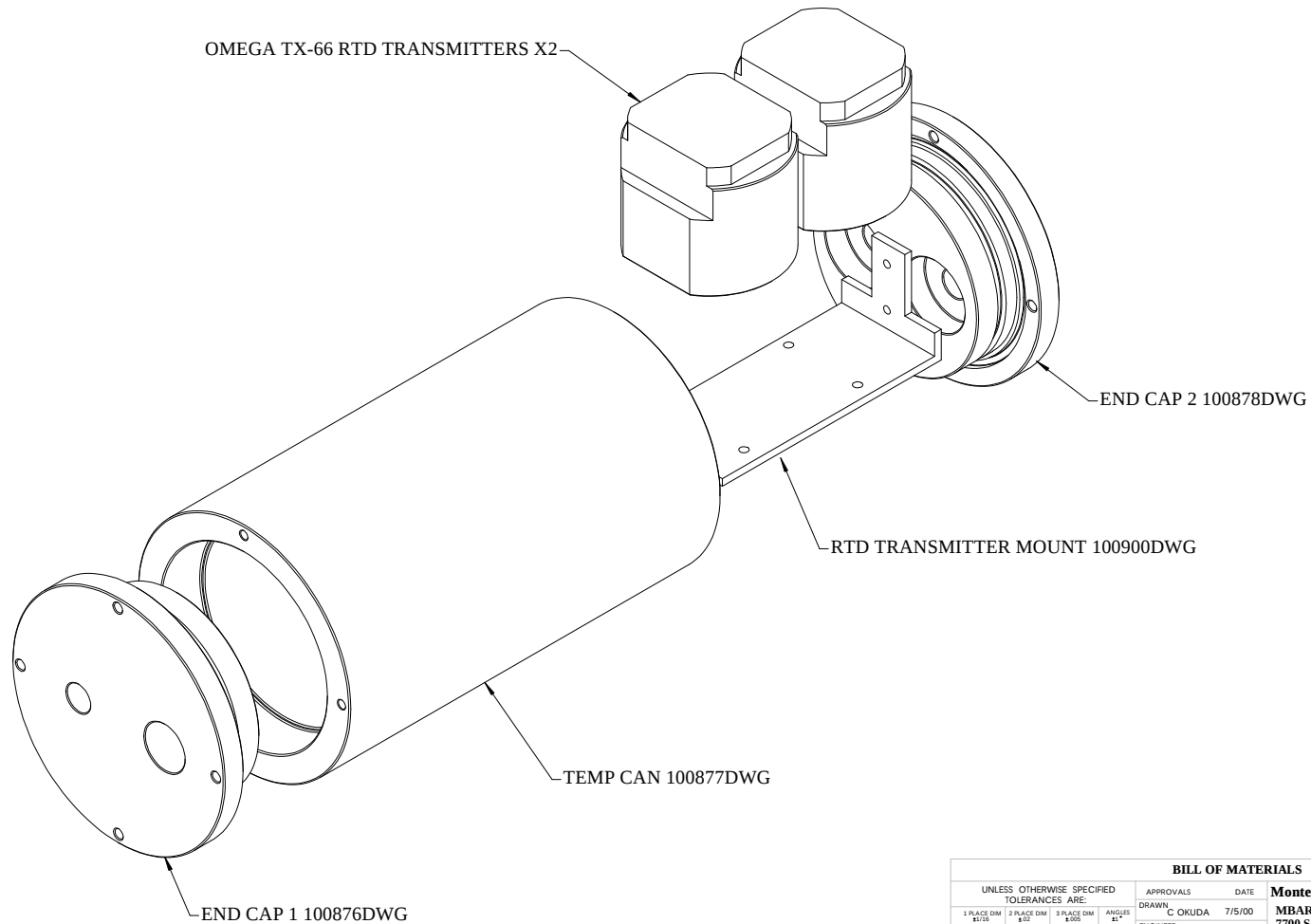
INITIAL RELEASE 6/15/00

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Date:	Monday, December 11, 2000	Sheet 1 of 1



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	INITIAL RELEASE	7/5/00	



BILL OF MATERIALS			
UNLESS OTHERWISE SPECIFIED TOLERANCES ARE:		APPROVALS	DATE
1 PLACE DIM ±.150	2 PLACE DIM ±.02	DRAWN C OKUDA	7/5/00
3 PLACE DIM ±.005	ANGLES ±1°	ENGINEER C OKUDA	7/5/00
1. DIMENSIONS ARE IN INCHES		CHECKED	
2. DIMENSION LIMITS HELD AFTER PLATING		PROJECT NO.	600083
3. REMOVE BURRS AND SHARP EDGES .015 MAX.		PROJECT	underwater temp
4. MACHINED FILET RADI .0150-.030		WEIGHT	
5. MACHINED DIAMETERS ON A COMMON CENTERLINE CONCENTRIC WITH .005		SIZE	B
6. PERPENDICULARITY & PARALLELISM OF MACHINED SURFACES .002 PER INCH MAX. .02 INCHES FOR SINGLE SURFACE		DWG. NO.	100904DWG
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APPLICATION		CAD FILE: MECH ENG ON TORNADO	SHEET 1 OF 1
DO NOT SCALE DRAWING			

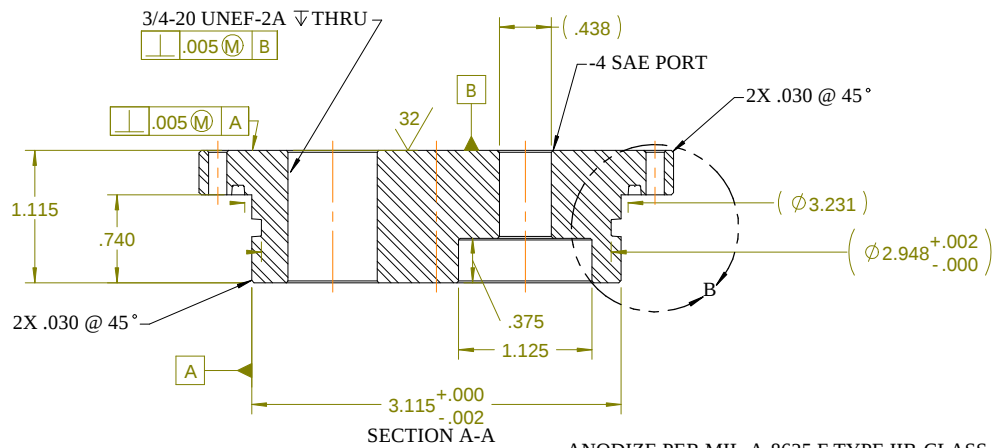
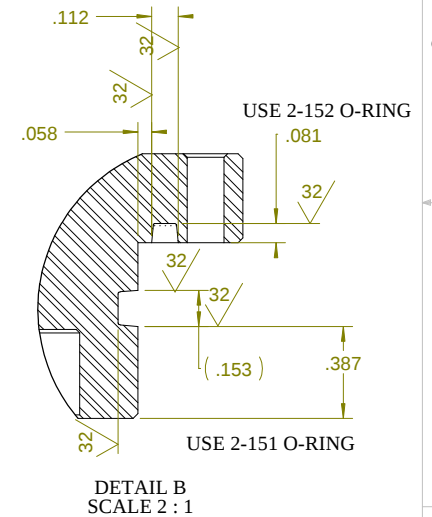
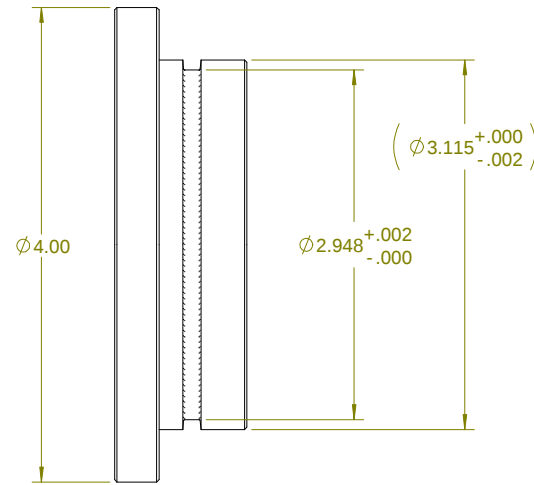
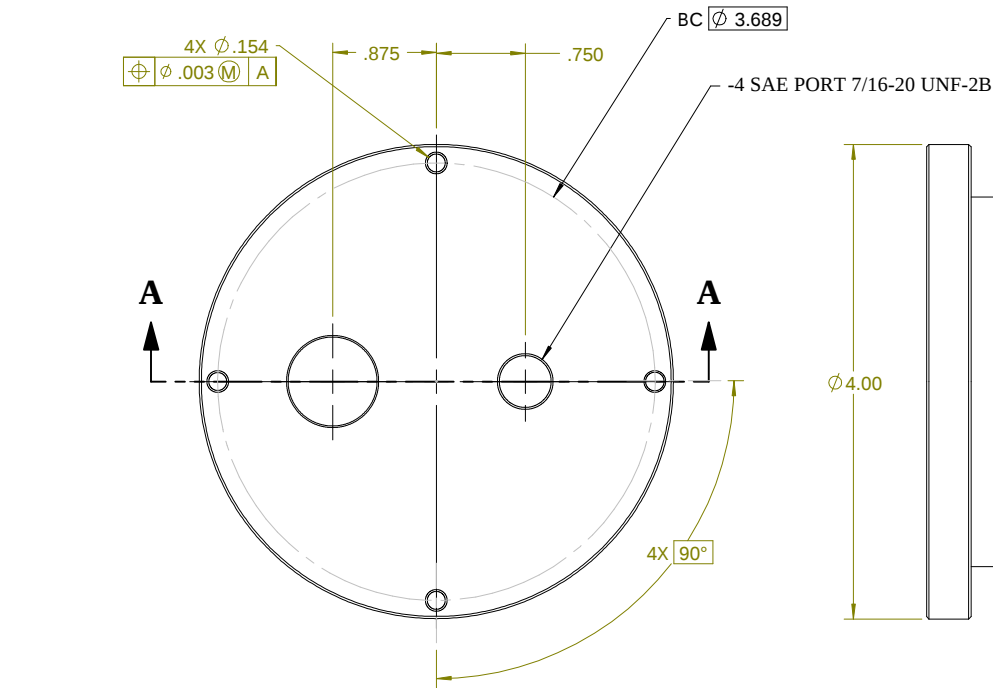
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can exploded view

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A	INITIAL RELEASE	6/9/00	
	CHANGE TO -4 SAE PORT	8/29/00	



ANODIZE PER MIL-A-8625 F TYPE IIB-CLASS 2

1 EA 6061 T-6 ALUMINUM

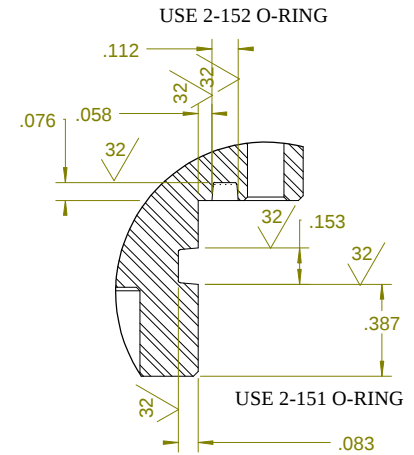
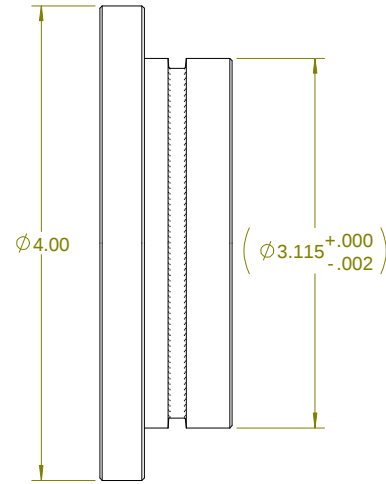
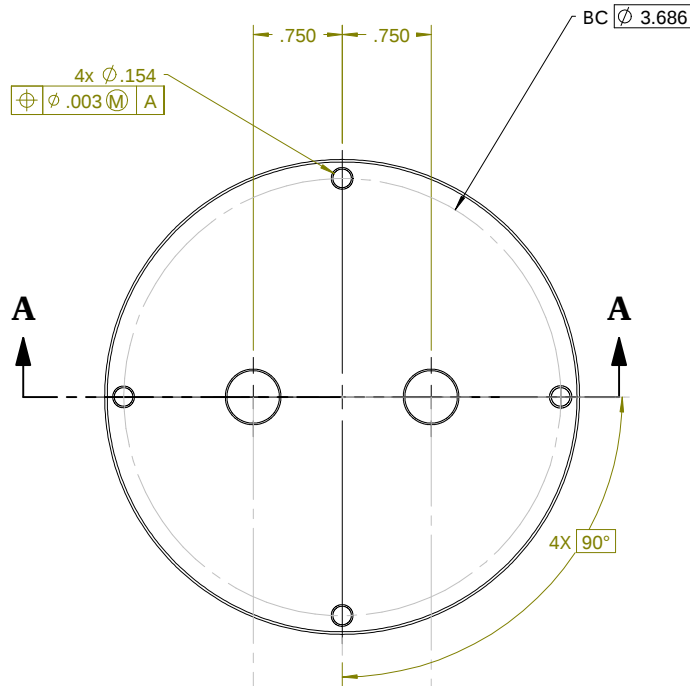
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Ø.005	Ø.005	C OKUDA	
1. DIMENSIONS ARE IN INCHES		ENGINEER	6/9/00
2. DIMENSION UNITS HELD AFTER PLATING		C OKUDA	
3. REMOVE BURRS AND SHARP EDGES .015 MAX.		CHECKED	
4. MACHINED FILET RADI .0150-.030		PROJECT NO.	600083
5. MACHINED DIAMETERS ON A COMMON CENTERLINE CONCENTRIC WITH .005		PROJECT	UNDERWATER TEMP
6. PERPENDICULARITY & PARALLELISM OF MACHINED SURFACES .002 PER INCH MAX. .02 INCHES FOR SINGLE SURFACE.		WEIGHT	
DO NOT SCALE DRAWING		endcap 1	
		SIZE B	DWG. NO. 100876DWG
		SCALE 1:1	REV. A
		CAD FILE: MECH ENG ON TORNADO	SHEET 1 OF 1

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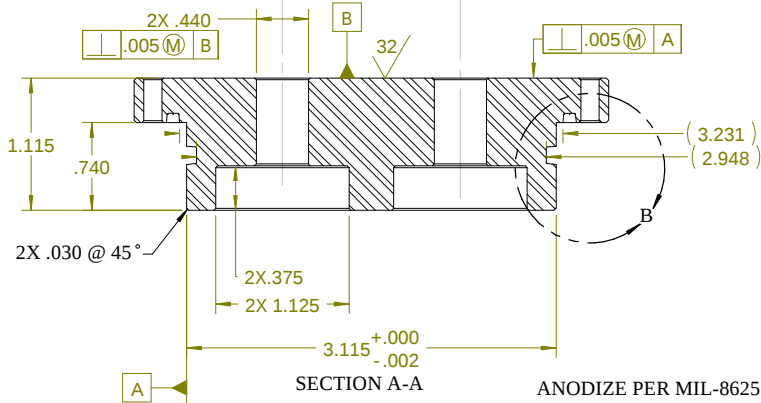


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1	INITIAL RELEASE	6/8/00	



DETAIL B
SCALE 2 : 1



SECTION A-A

ANODIZE PER MIL-8625 F TYPE IIB CLASS 2

1 EA 6061 T-6 ALUMINUM

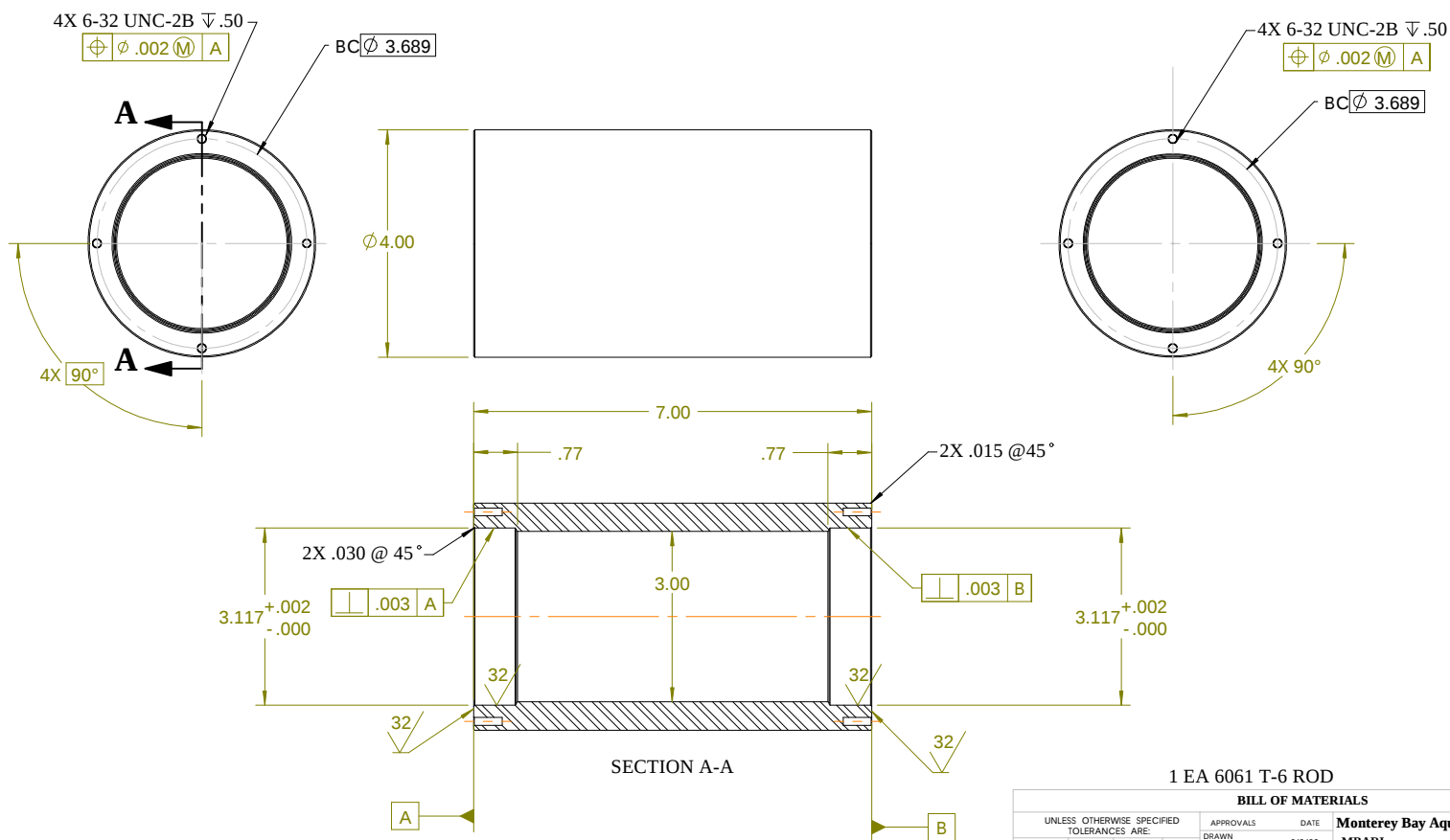
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3 PLACE DIM ±.005	ANGLES ±1°	ENGINEER C OKUDA	6/8/00
1. DIMENSIONS ARE IN INCHES 2. DIMENSION LIMITS HELD AFTER PLATING 3. REMOVE BURRS AND SHARP EDGES .015 MAX. 4. MACHINED FILET RADII .0150-.030 5. MACHINED DIAMETERS ON A COMMON CENTERLINE CONCENTRIC WITH .005 6. PERPENDICULARITY & PARALLELISM OF MACHINED SURFACES .002 PER INCH MAX. .02 INCHES FOR SINGLE SURFACE.		CHECKED	
PROJECT NO. 600083		PROJECT UNDERWATER TEMP	
NEXT ASSY		WEIGHT	
USED ON		SCALE	
APPLICATION		DWG. NO. 100878.DWG	
DO NOT SCALE DRAWING		REV.	
3		1	
2		SHEET 1 OF 1	

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endcap2

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REV.	DESCRIPTION	DATE	APPROVED
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1 EA 6061 T-6 ROD

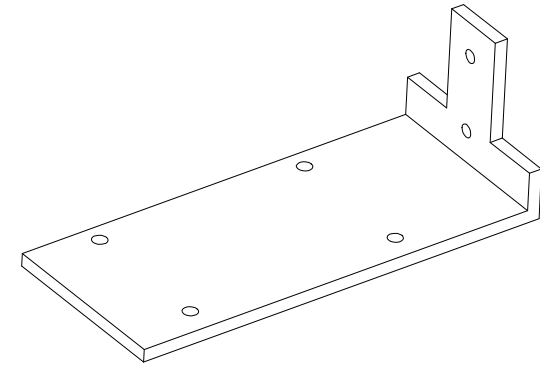
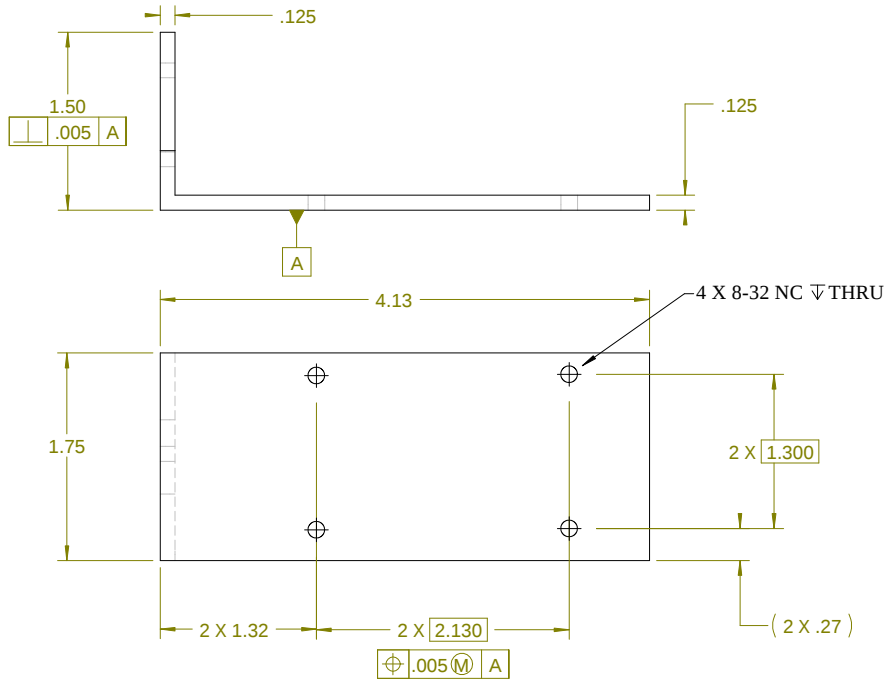
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UNLESS OTHERWISE SPECIFIED TOLERANCES ARE:				
1 PLAGE DM	2 PLAGE DM	3 PLAGE DM	ANGLES	
		.005		
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2. DIMENSION LIMITS HELD AFTER PLATING.				
3. REMOVE BURRS AND SHARP EDGES .015 MAX.				
4. MACHINED FILET RADIUS .0150-.030.				
5. MACHINED DIAMETERS ON A COMMON CENTERLINE CONCENTRIC WITHIN .005				
6. PERPENDICULARITY & PARALLELISM OF MACHINED SURFACES .005 PER INCH MAX .002 INCHES FOR SINGLE SURFACE.				
DO NOT SCALE DRAWING				
APPROVALS		DATE		
DRAWN		C OKUDA 6/9/00		
ENGINEER		C OKUDA 6/9/00		
CHECKED				
PROJECT		600083		
PROJECT		UNDER WATER TEMP		
WEIGHT				
SIZE		DWG. NO.		
SCALE		1:2		
		CAD FILE MECH ENG ON TORNAO		
		SHEET 1 OF 1		
		temp can		
		100877DWG		
		MBARI		
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		Moss Landing, CA 95039		
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ANODIZE PER MIL-A-8625 F TYPE IIB CLASS 2

NEXT ASSY	USED ON
APPLICATION	

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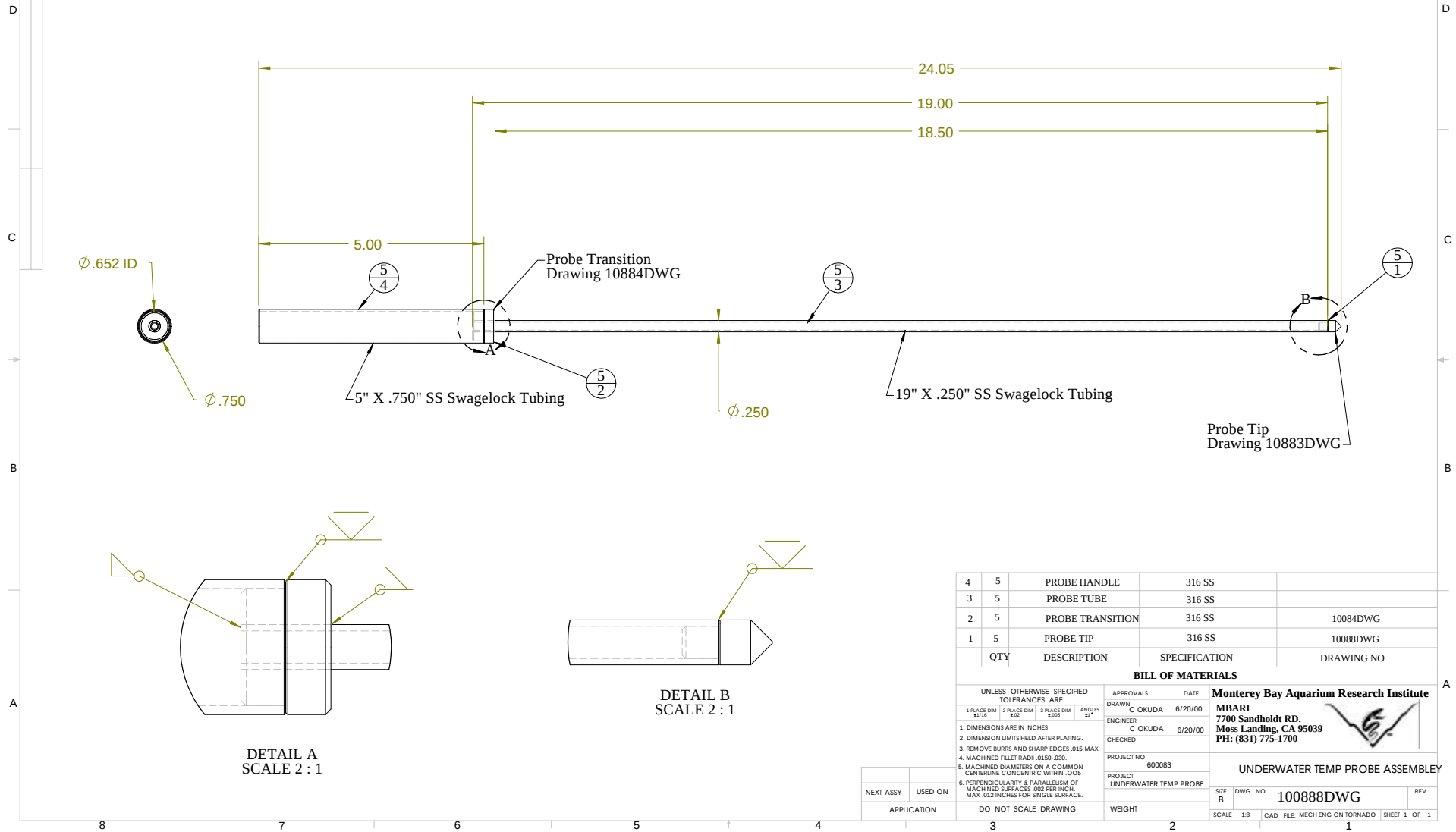
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2. DIMENSION LIMITS HELD AFTER PLATING		ENGINEER	6/27/00
3. REMOVE BURRS AND SHARP EDGES .015 MAX.		CHECKED	
4. MACHINED FILET RADI .0150-.030		PROJECT NO.	600083
5. MACHINED DIAMETERS ON A COMMON CONTRIBUTING CONCENTRIC WITHIN .005		PROJECT	UNDERWATER TEMP
6. PERPENDICULARITY & PARALLELISM OF MACHINED SURFACES .002 PER INCH MAX. .02 INCHES FOR SINGLE SURFACE		WEIGHT	
DO NOT SCALE DRAWING		RTD transmitter mount	
NEXT ASSY		SIZE	DWG. NO.
USED ON		B	100900DWG
APPLICATION		SCALE	1:1
		CAD FILE: MECH.ENG ON TORNADO	SHEET 1 OF 1

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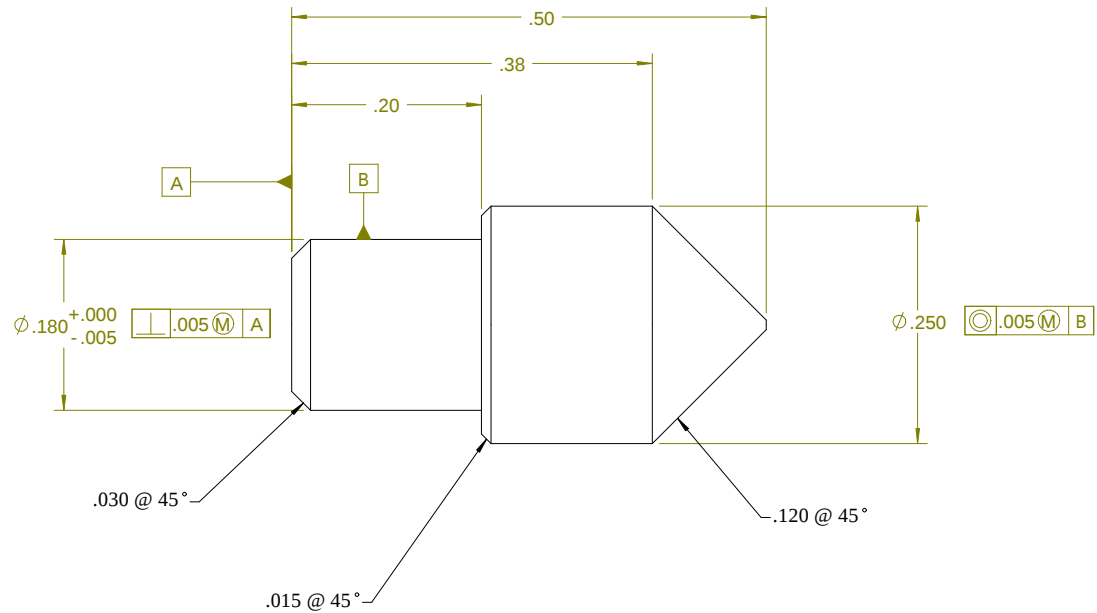
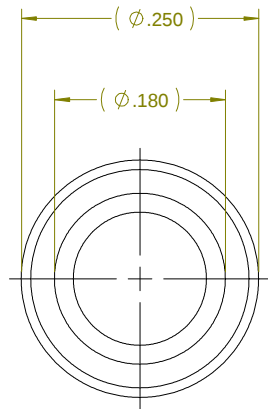
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5 EACH, 316SS ROD

BILL OF MATERIALS			
UNLESS OTHERWISE SPECIFIED TOLERANCES ARE:		APPROVALS	DATE
1 PLACE DIM ±.150		DRAWN C OKUDA	6/19/00
2 PLACE DIM ±.02		ENGINEER C OKUDA	6/19/00
3 PLACE DIM ±.005		CHECKED	
ANGLES ±1°		PROJECT NO.	600083
1. DIMENSIONS ARE IN INCHES		PROJECT UNDERWATER TEMP	
2. DIMENSION LIMITS HELD AFTER PLATING		WEIGHT	
3. REMOVE BURRS AND SHARP EDGES .015 MAX.			
4. MACHINED FILET RADI .0150-.030			
5. MACHINED DIAMETERS ON A COMMON CENTERLINE CONCENTRIC WITH .005			
6. PERPENDICULARITY & PARALLELISM OF MACHINED SURFACES .002 PER INCH MAX .02 INCHES FOR SINGLE SURFACE			
DO NOT SCALE DRAWING			
NEXT ASSY	USED ON	SCALE	8:1
APPLICATION		CAD FILE: MECH ENG ON TORNADO	SHEET 1 OF 1

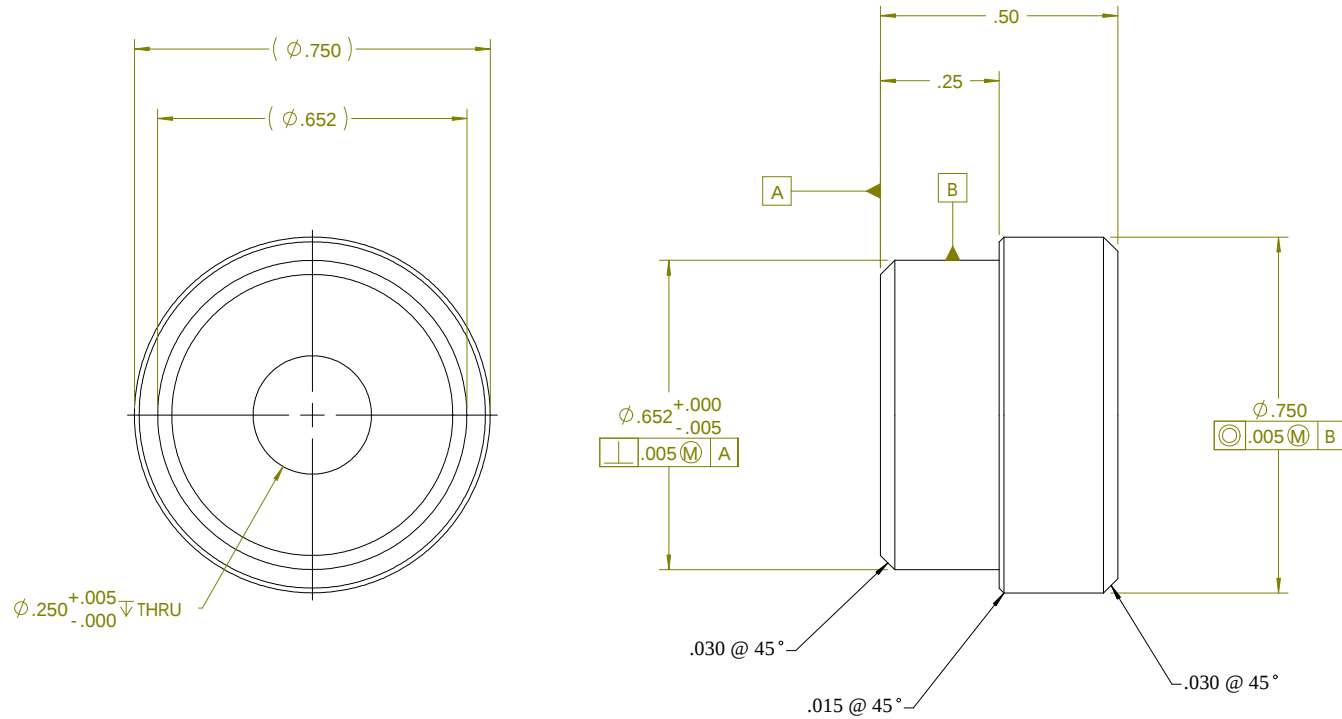
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UNDERWATER TEMP PROBE TIP

SIZE B DWG. NO. 100883DWG REV.

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	INITIAL RELEASE	06/19/00	



5ea 316SS ROD

UNLESS OTHERWISE SPECIFIED TOLERANCES ARE:				APPROVALS		DATE	BILL OF MATERIALS	
1 PLACE DIM ±.150	2 PLACE DIM ±.02	3 PLACE DIM ±.005	ANGLES ±1°	DRAWN	C OKUDA	06/19/00	Monterey Bay Aquarium Research Institute MBARI 7700 Sandholdt RD. Moss Landing, CA 95039 PH: (831) 775-1700	
1. DIMENSIONS ARE IN INCHES				ENGINEER	C OKUDA	06/19/00		
2. DIMENSION LIMITS HELD AFTER PLATING.				CHECKED				
3. REMOVE BURRS AND SHARP EDGES .015 MAX.				PROJECT NO.		600083	UNDERWATER TEMP PROBE TRANSITION	
4. MACHINED FILET RADI .0150-.030.				PROJECT		UNDERWATER TEMP PROBE		
5. MACHINED DIAMETERS ON A COMMON CENTERLINE CONCENTRIC WITHIN .005.				WEIGHT				
6. PERPENDICULARITY & PARALLELISM OF MACHINED SURFACES .002 PER INCH MAX. .02 INCHES FOR SINGLE SURFACE.				DO NOT SCALE DRAWING			SIZE B DWG. NO. 100884DWG	
NEXT ASSY	USED ON	APPLICATION		SCALE 4:1		CAD FILE: MECH-ENG ON TORNADO	SHEET 1 OF 1	

6. TX66A Set Up Data:

Follow the TX66 manual page 20 of the Omega TX66 manual (section 5 of this manual) for the specific programming procedure.

Set the following parameters:

9000 Input Type:	9022, RTD-4wire PT
9100 Units:	9135, Degrees Centigrade
9200 Lower Range Value	9202, Negative (does not matter) 000, for 0 deg C.
9300 Upper Range Value	9301, Positive 033, for 33 deg C. or 403 for 403 deg C. (+deg is set to prevent drift out of the range)

Make sure that the 4-20 ma out is not trimmed up or down at all.