

USER'S MANUAL

MODEL: 5201

PROJECTED FIELD ELECTROMAGNET

Date Sold: _____

Serial number: _____

PROPRIETARY

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Section 1
SPECIFICATIONS
Model: 5201 Electromagnet Specifications

Field: (at max current) $B_x = \pm 0.3T$ (3000G)
(X,Y,Z = 0, 0, 4mm)

Projected Field Region (for B_x) X = ± 2 mm
Y = ± 5 mm
Z = 0 to 12mm

Coil:
coil resistance (20°C) 0.85 Ohm
max resistance (hot)* 1.02 Ohm
max power 20A/20V (400W)

Self Inductance:

Cooling: (measured at water I/O manifold) 0.5 Liter/min 1.0 bar [0.13USG/Min14 psid]

Thermal Interlock: Open circuit above 75° C (167° F)

Dimensions : Drawing 11901860
70.0 mm W x 60.0 mm D x 120 mm H
2.8 inch W x 2.4 inch D x 4.7 inch H

Mass: 2.1 kg (4.6 lb)

***CAUTION - The value of maximum coil resistance given should not be exceeded.
At this resistance the coils are at maximum safe temperature for continuous operation.**

Section 2

WARNINGS

REFER TO WARNINGS BELOW BEFORE OPERATING ELECTROMAGNET SYSTEM

1 Personnel Safety

In operation the magnet fringing field in the vicinity of the pole gap is in excess of 0.5mT (5G).

This can cause malfunctioning of sensitive electronic and magnetic components. We recommend that warning signs are posted indicating that a magnetic field may be present.

2 Ferromagnetic Objects

During operation the magnet exerts magnetic attraction towards ferromagnetic objects in the near vicinity of its pole faces. Keep ferromagnetic items clear!

3 Arcing

This magnet stores energy in its field during operation. Do not disconnect any current lead while under load or the magnetic field energy will be discharged across the interruption causing arcing and possible damage to electronic circuits.

4 Coil Hot Resistance

Do not exceed the maximum coil hot resistance given in the specifications or coil overheating and possible damage may occur

5 Watches, Credit Cards, and Magnetic Disks

Do not move magnetically sensitive items into the dose vicinity of the magnet pole gap. Even some anti-magnetic watches can be damaged when placed in close proximity to the pole gaps during operation. Credit cards, and magnetic disks are affected by magnetic fields as low as 0.5mT (5G). Depending on the previous operating field and the pole gap, the remanent field in the gap can be in excess of 0.5mT (5G) with the magnet power supply off or disconnected.

Section 3

INSTALLATION

Mounting Position (Refer to drawing 11902050)

The magnet system can be mounting in any orientation, including being completely inverted. Four M3 clearance holes are provided on the magnet transition plate for mounting the magnet.

Electrical Connections

The magnet system comes with integrated wiring for the magnet.. Never connect or remove cables from the magnet system with the DC power energized otherwise damage to the magnet power supply may occur. Follow instruction below for making electrical connections.

Power Supply (Refer to drawing 11902000 & 13900420)

1. Firstly ensure the power supply is turned off and the AC power cable is disconnected.
2. Plug in the magnet cable plug into the back of Kepco BOP power supply.
3. Secure the connecting plug with the two securing thumbscrews.
4. Connect the three sleeved wires to the output connector block on the rear of the Kepco BOP power supply as detailed below.
 - Black Wire with RED sleeve to Output
 - Black Wire with Blue sleeve to Common
 - Green wire to Ground

Note: Reconnect AC power cable to power supply . The magnet system is now ready to use.

Do not power up the magnet unless the cooling water is turned on and flowing at 0.5 liters/min.

Section 3

INSTALLATION

Electrical Interlocks

The Model 5201 has two thermostats, Selco part no 802L-075. They are located on the pole/coil assembly heatsinks and wired in series. The thermostats are normally closed, opening when the coil heatsink temperature exceeds $75^{\circ}\text{C} \pm 5^{\circ}\text{C}$.

Water Cooling (Refer to drawing 11902000)

The Model 5201 can be operated to an average coil temperature of 70°C . Assuming an ambient laboratory temperature of 20°C and a temperature coefficient of resistivity for copper of $0.0039/^{\circ}\text{C}$, the hot resistance of the coil should not exceed 20% more than the ambient temperature "cold" resistance. The coil thermostat will open when either pole/coil heatsink temperature exceeds approximately 75°C . If either temperature switch opens then the Magnet power supply circuit breaker will trip to the off position. Clean, cool ($16^{\circ}\text{C} - 20^{\circ}\text{C}$) water at 0.5 l/min at 1.0 bar (14 psid) should be used to cool the 5201 magnet.

The cooling copper tubes are electrically isolated from the coils to avoid electrochemical corrosion. A 50 micron filter should be placed before the input to the magnet to trap particulates and avoid blockage of the cooling circuits.

Water Cooling Connections

The magnet is supplied with two 3.0mm (1/8") ID 1 meter long flexible hoses that connected the water cooling circuit to the hose couplings on the rear of the Water I/O Manifold. On the front of the Water I/O Manifold are two barbed "push on" hose couplings to suit 6 mm (1/4") ID rubber hose.

- Water Inlet: Connect to a clean water source fitted with a suitable metering valve
(to control water flow).
- Water Outlet: Connect to drain.

Inlet Water Metering Valve Kit.

Metering Valve (brass)

Hex Nipple (brass) 1/8" NPT female

Hose Push on (black) 1/4"D

SWAGELOCK Cat No: B-4MG4-MH (1 required)

SWAGELOCK Cat No: B-2-CN (1 required)

SWAGELOCK Cat No: PB-4-BK (as required)

Section 4

OPERATION

Electromagnet System (Kepco Power Supply operating in Current Control)

1. Before turning on power main circuit breaker.
 - . Set Voltage and Current toggle switches to off.
2. Set Current control potentiometer to fully counterclockwise position. Turn the potentiometer clockwise five turns. This position is approximately equal to a zero current setting.
3. Select Mode switch to Current.
4. Turn on power supply main circuit breaker.
5. Turn on Current control toggle switch
6. Turn the Current control potentiometer clockwise for positive current or counterclockwise for negative current as required.

Section 5

MAINTENANCE

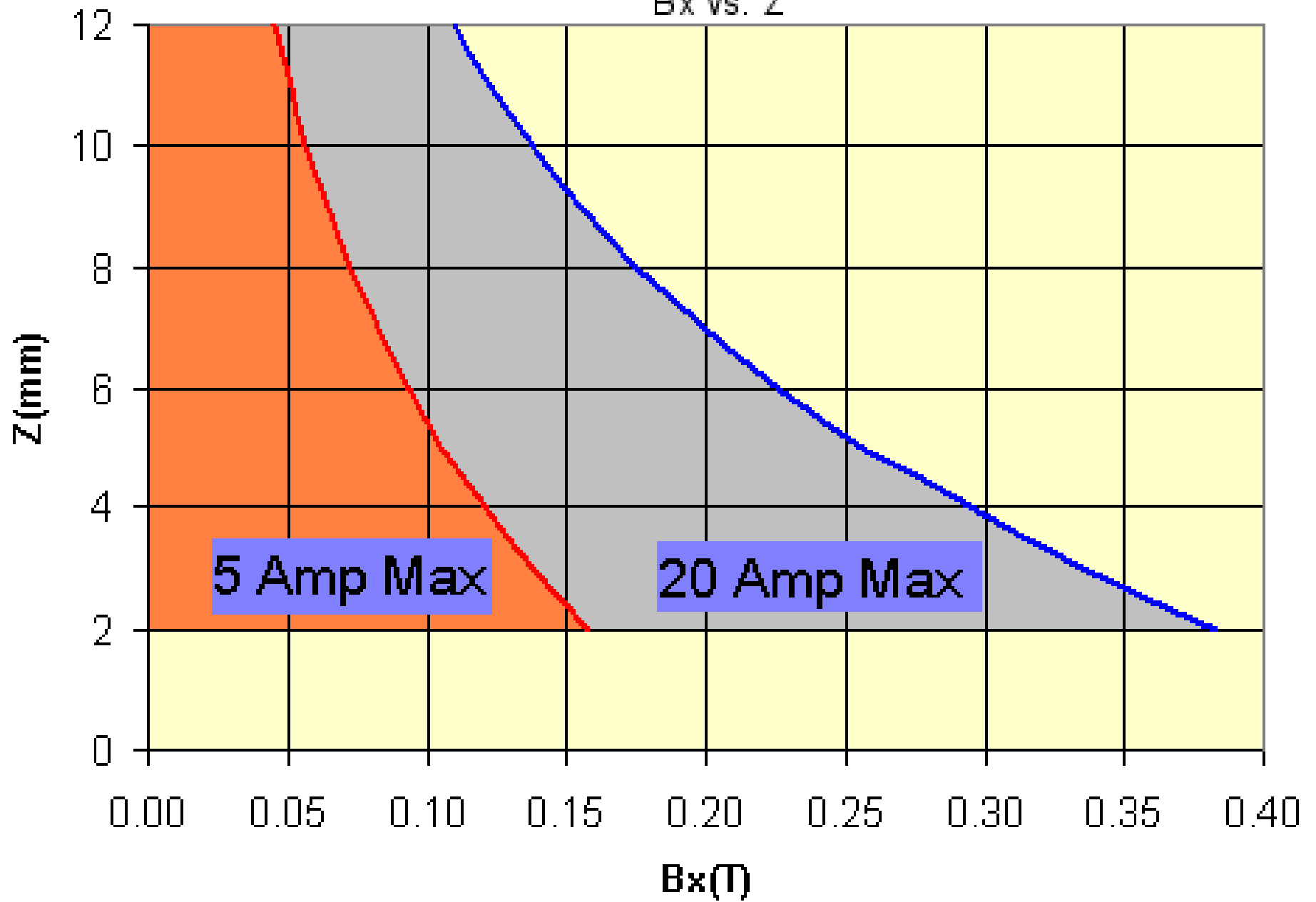
Electrical Connections on the magnet terminal block should be check annually. The electrical connections should be clean and tight. Discoloration is a sign that the connection is overheating and must be rectified before further use of the magnet.

Water Hoses should be checked regularly for water leaks. Any leaks should be rectified before further use of the magnet.

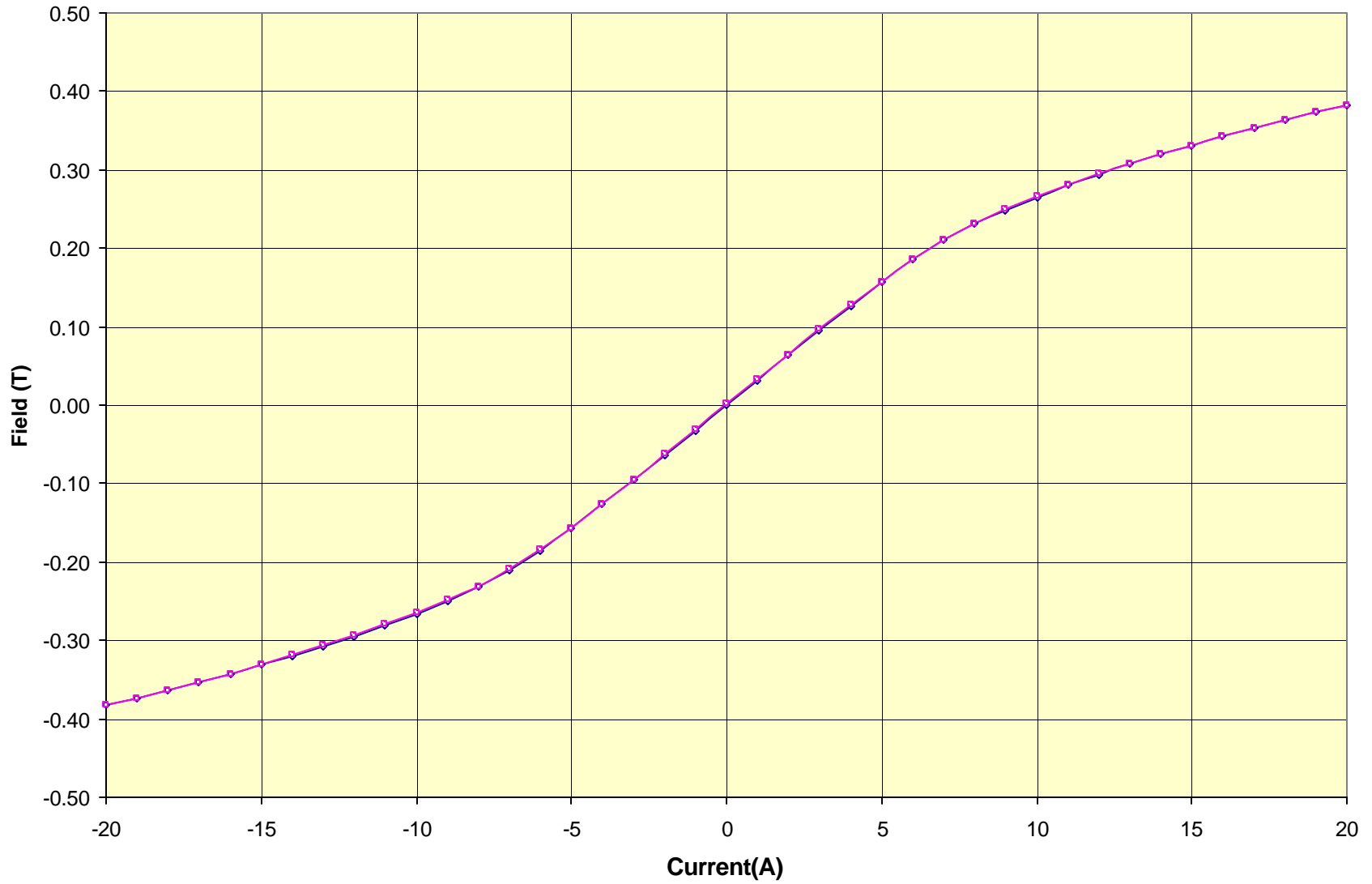
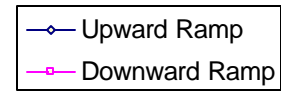
Section 6

EXCITATION CURVES

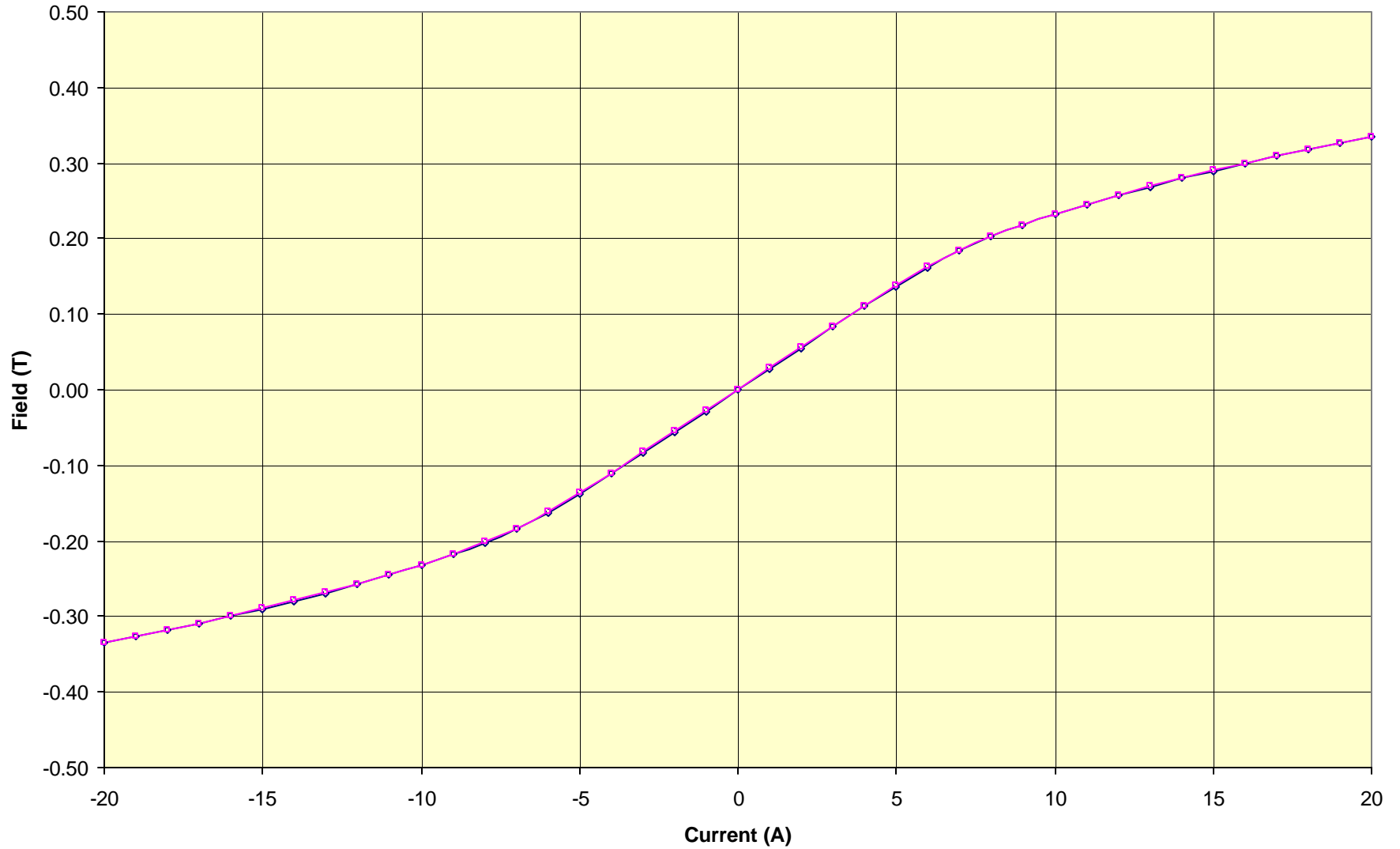
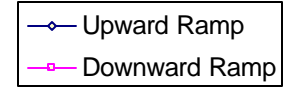
GMW 5201 Projected Field Magnet
Bx vs. Z



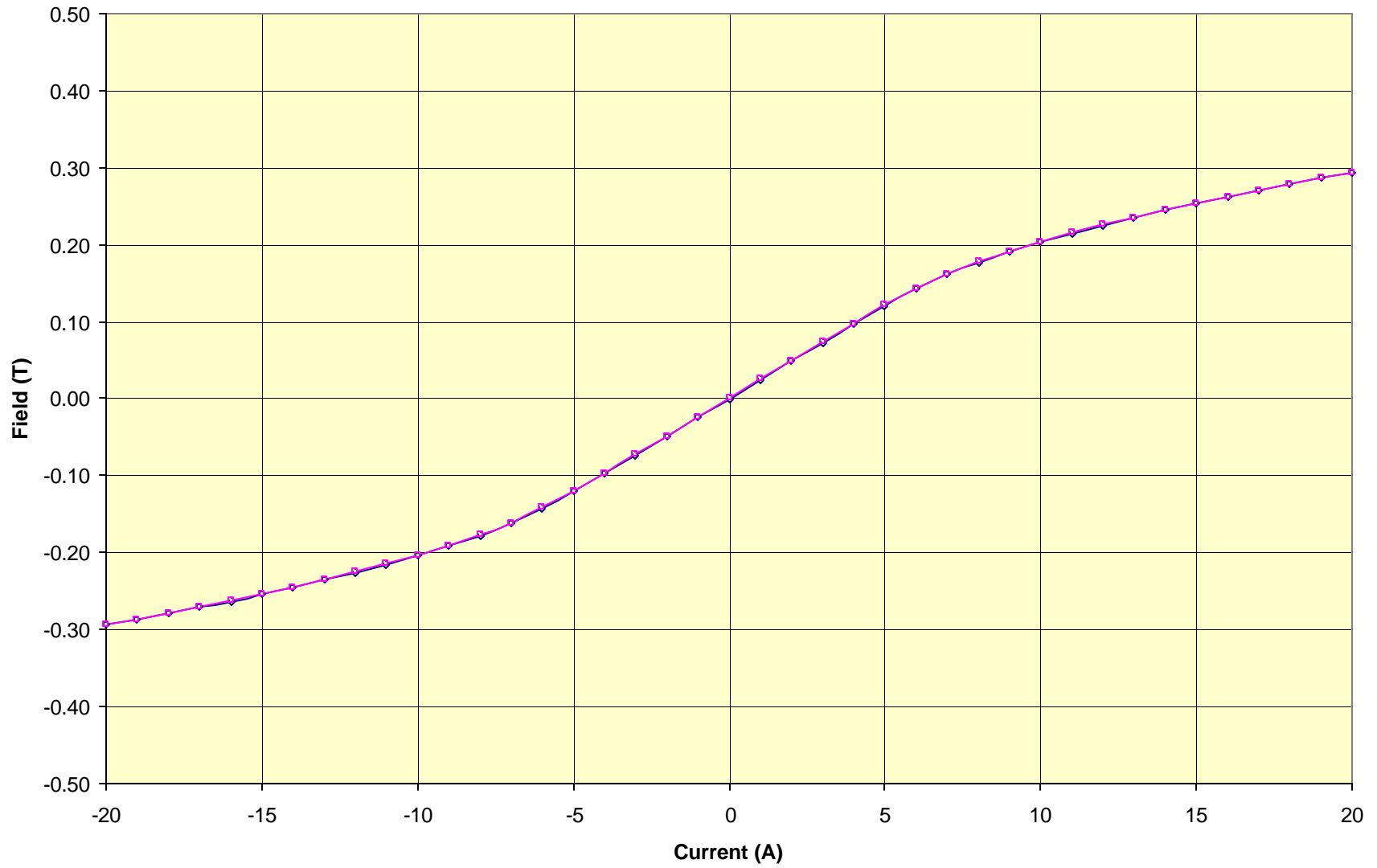
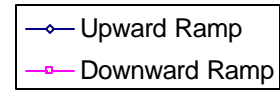
Projected Field Magnet SN:001
Bx vs. Current (X=Y=0mm, Z=2mm)



Projected Field Magnet SN:001
Bx vs. Current (X=Y=0mm, Z=3mm)

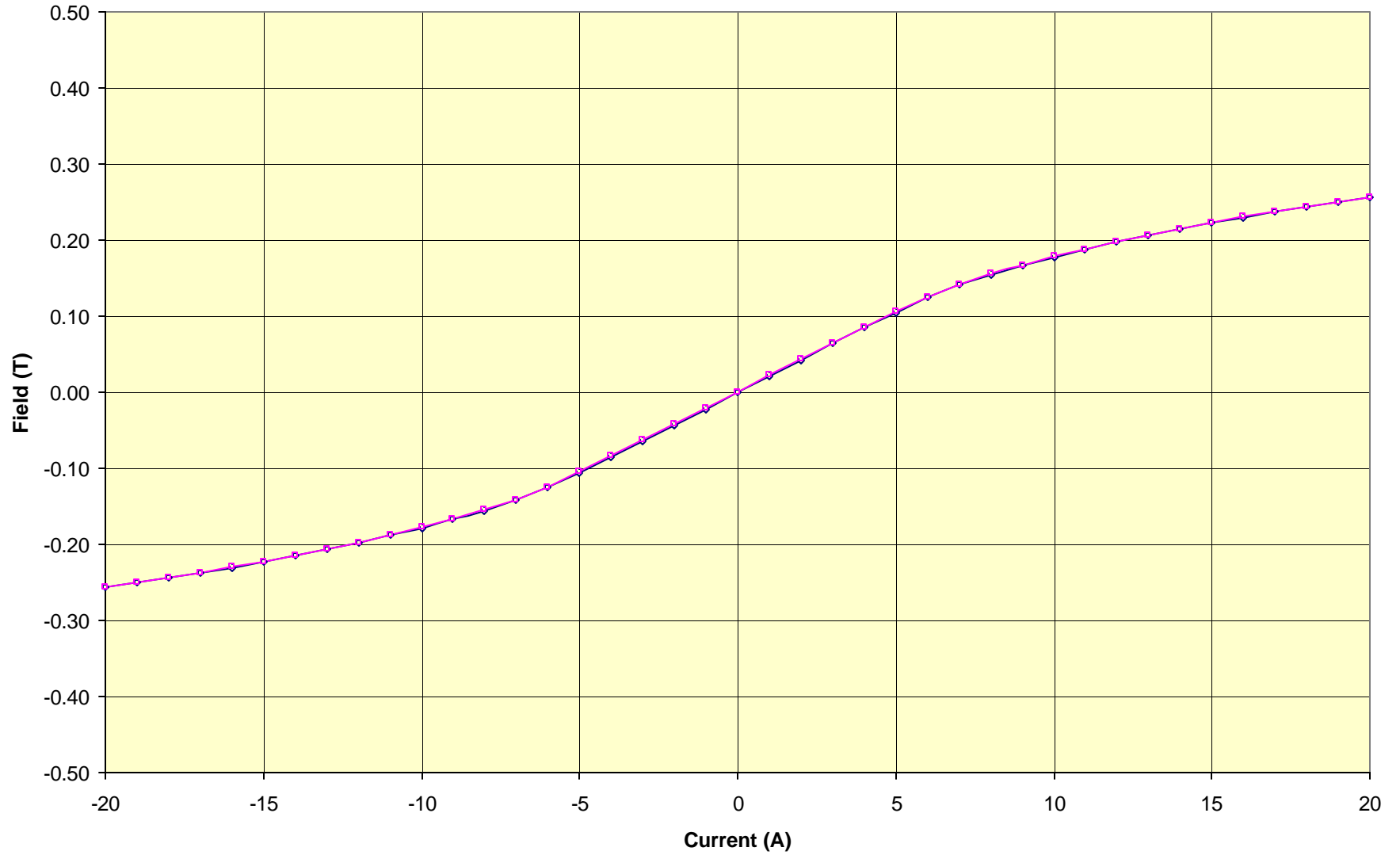


Projected Field Magnet SN:001
Bx vs. Current (X=Y=0mm, Z=4mm)

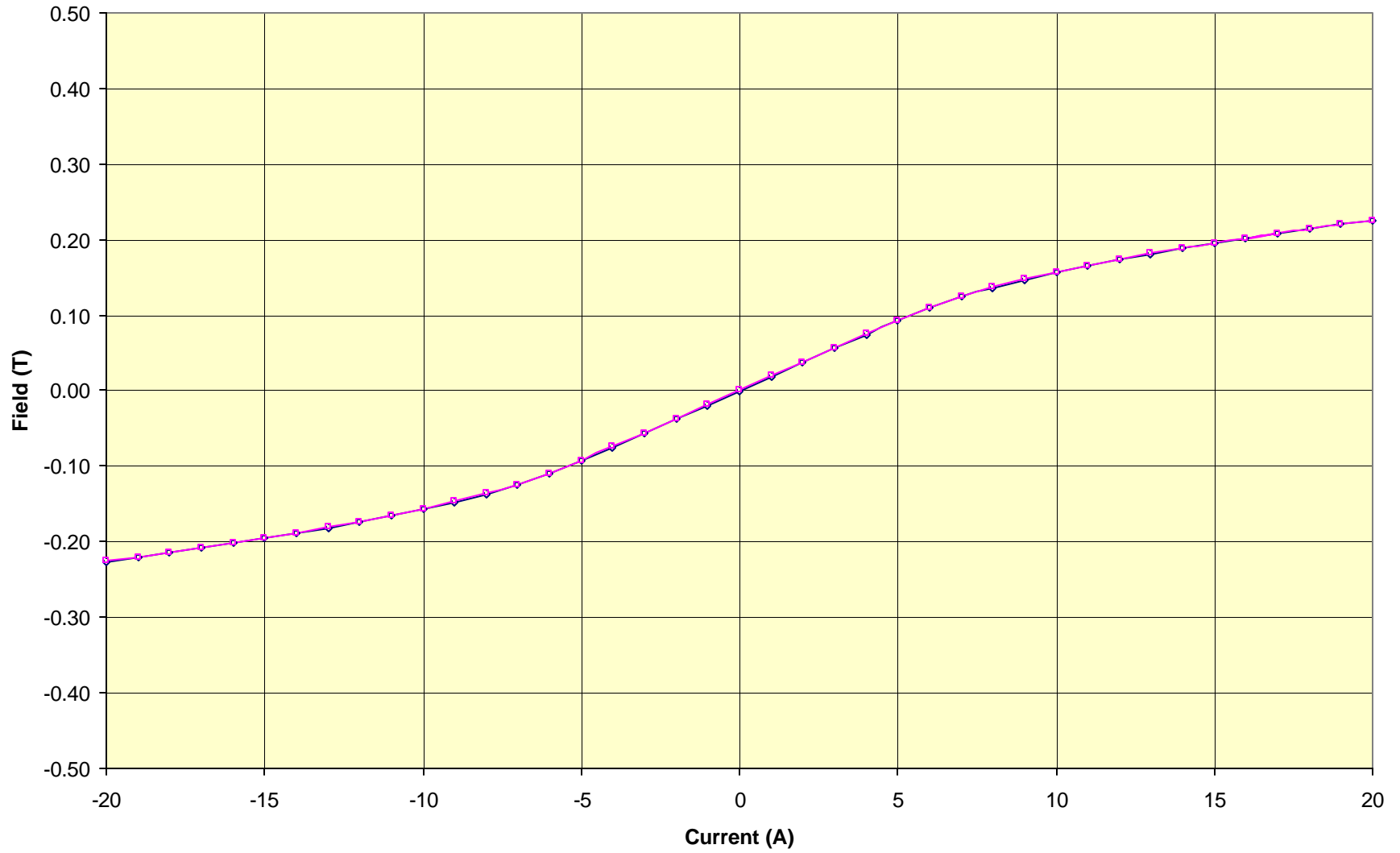
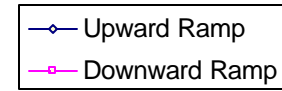


Projected Field Magnet SN:001
Bx vs. Current (X=Y=0mm, Z=5mm)

Upward Ramp
Downward Ramp

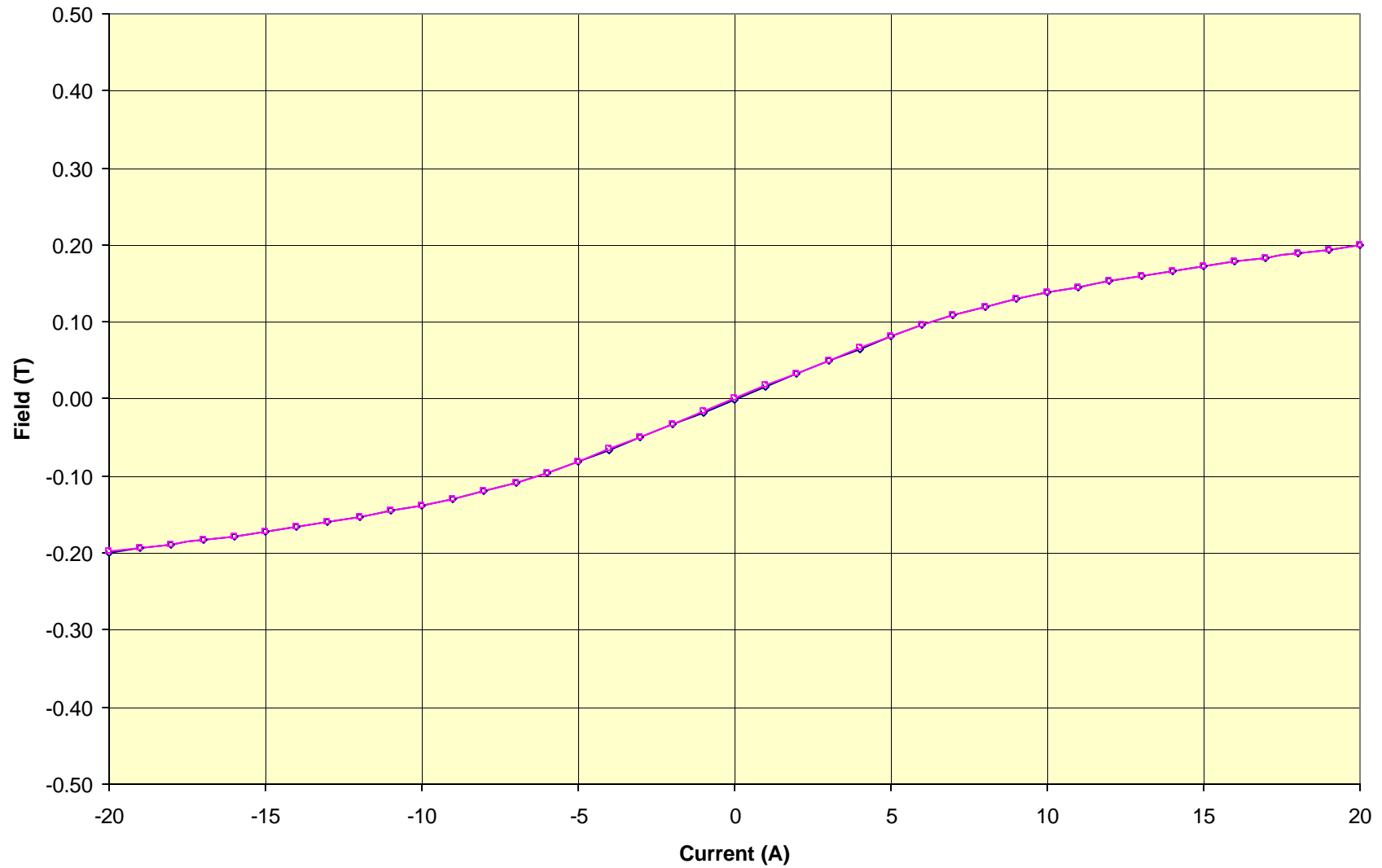


Projected Field Magnet SN:001
Bx vs. Current (X=Y=0mm, Z=6mm)



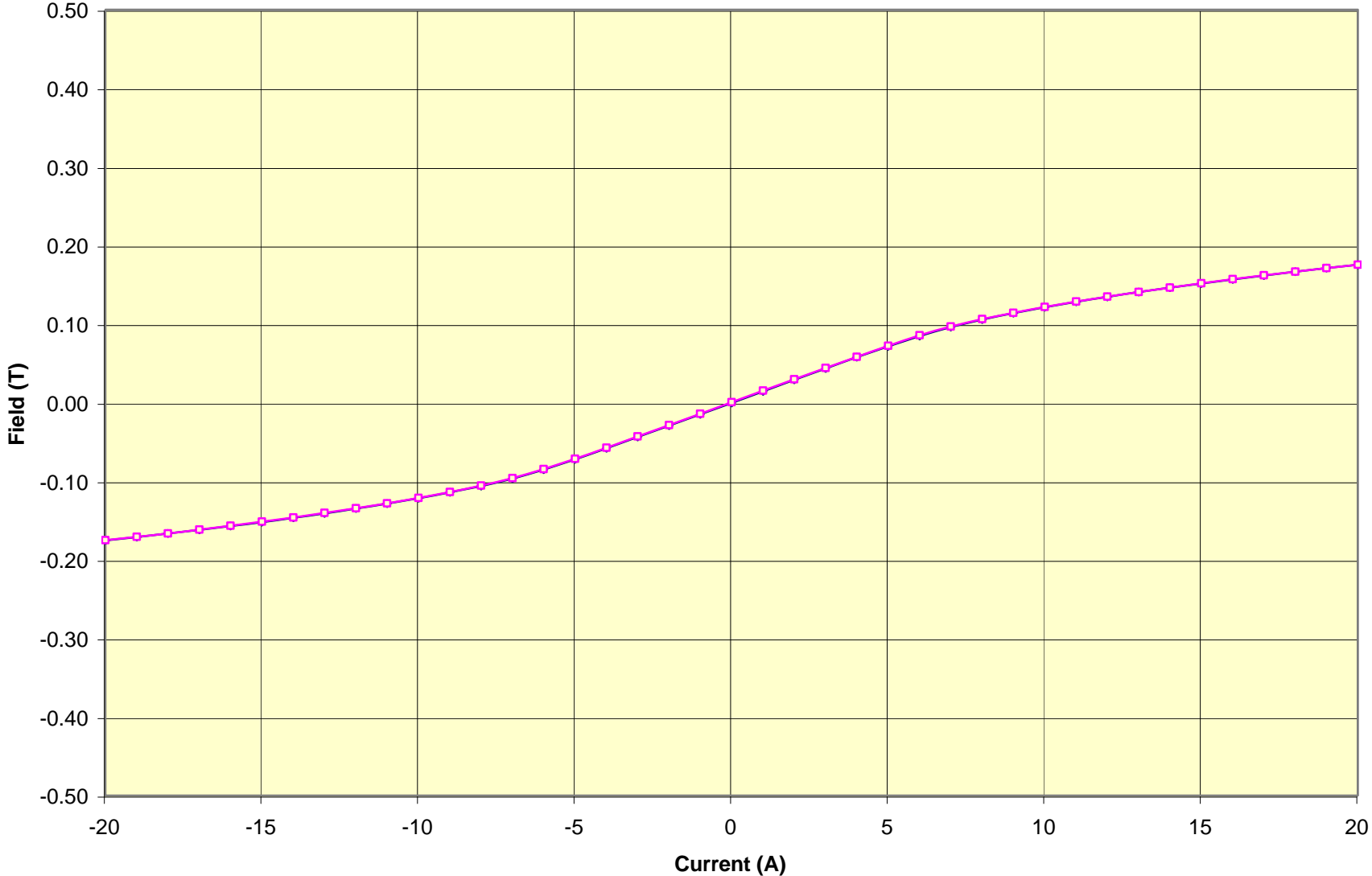
Projected Field Magnet SN:001
Bx vs. Current (X=Y=0mm, Z=7mm)

Upward Ramp
Downward Ramp



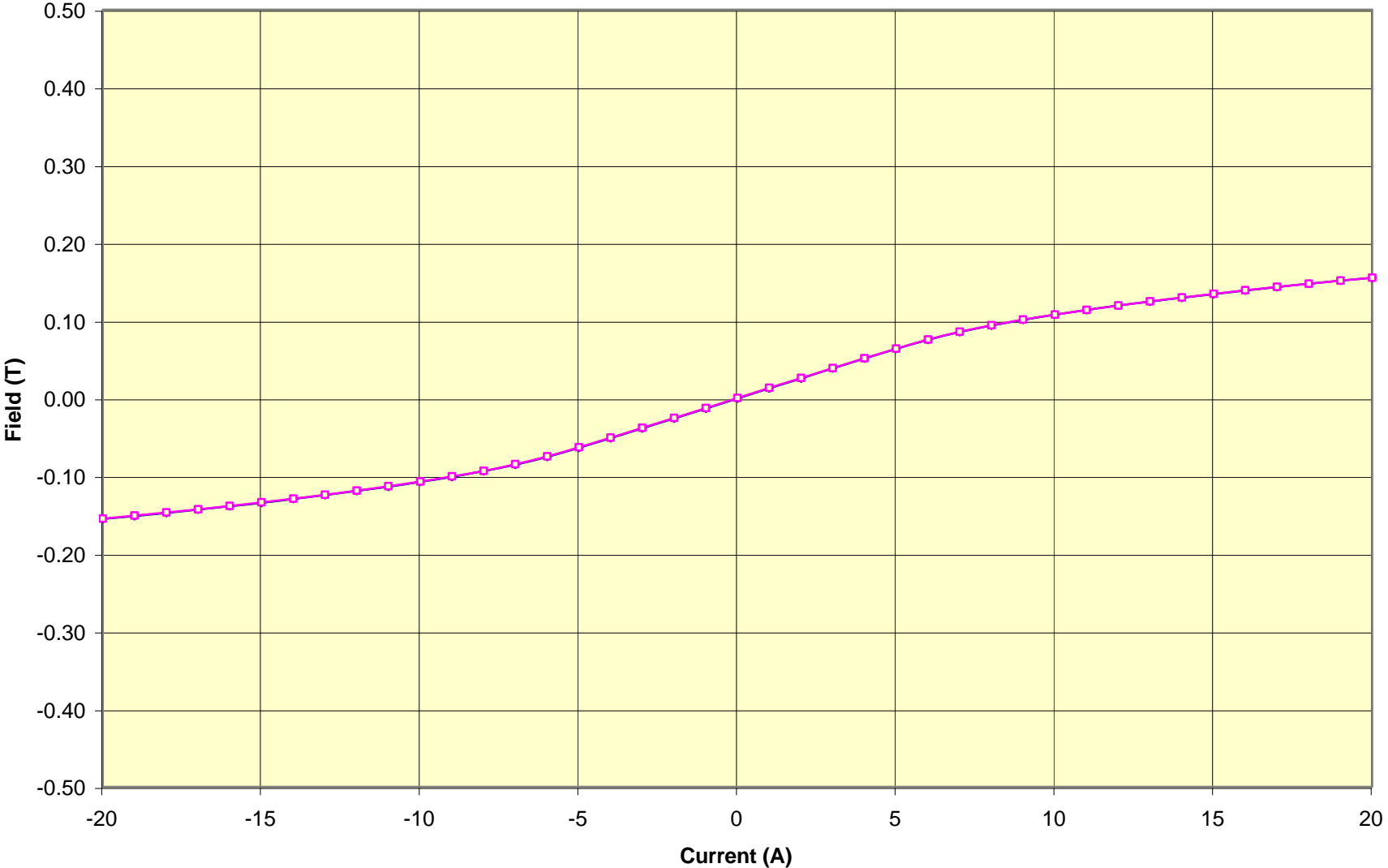
Projected Field Magnet SN:001
Bx vs. Current (X=Y=0mm, Z=8mm)

Upward Ramp
Downward Ramp

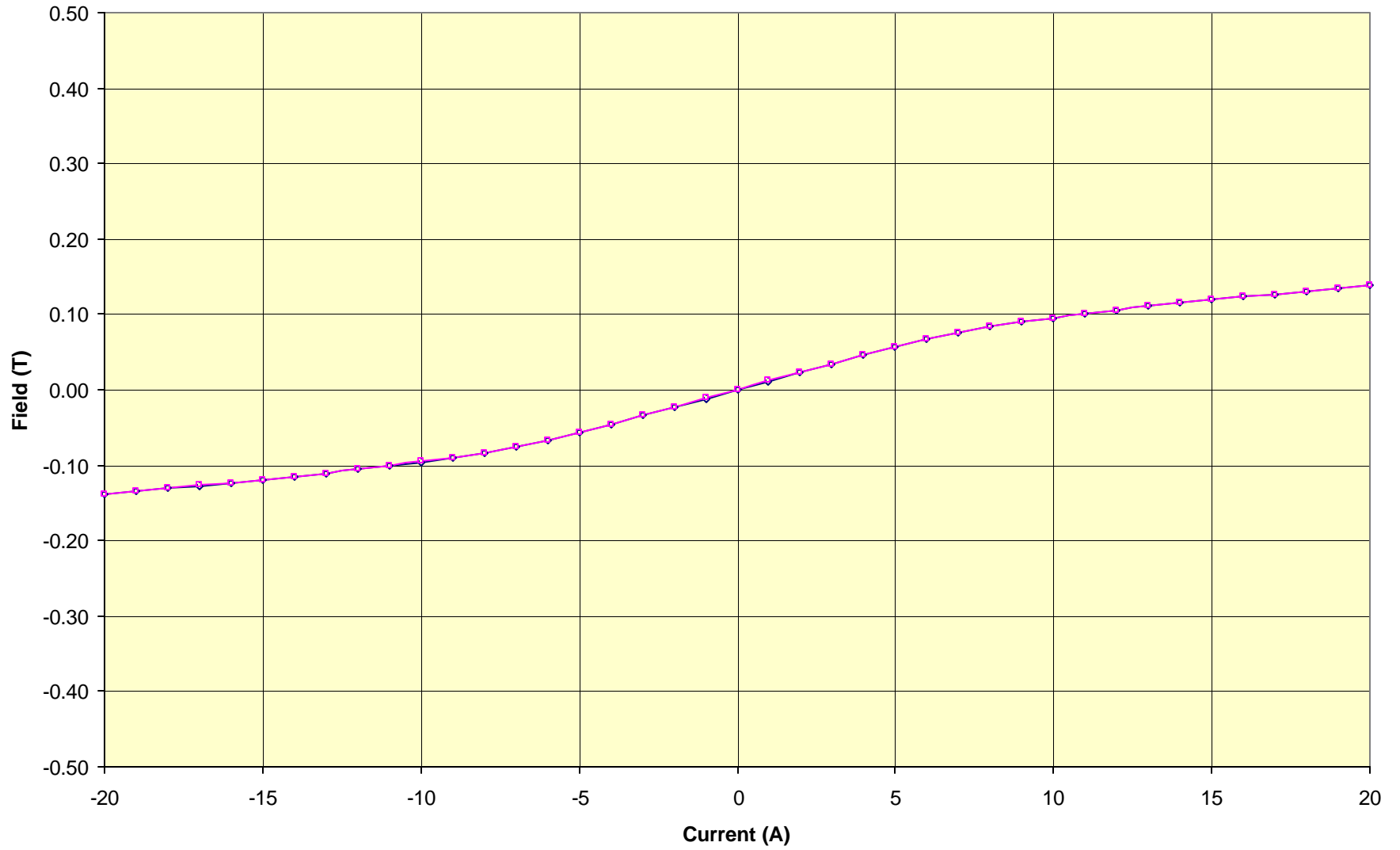
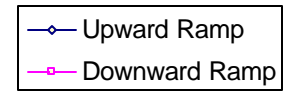


Projected Field Magnet SN:001
Bx vs. Current (X=Y=0mm, Z=9mm)

Upward Ramp
Downward Ramp



Projected Field Magnet SN:001
Bx vs. Current (X=Y=0mm, Z=10mm)

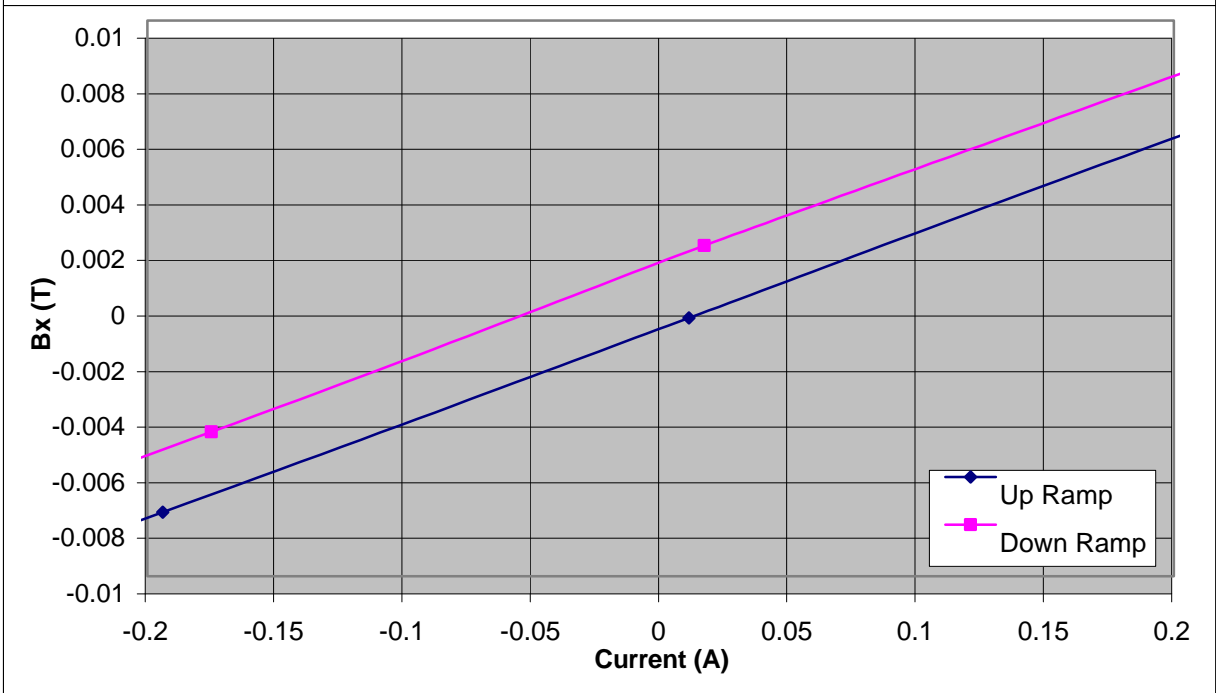
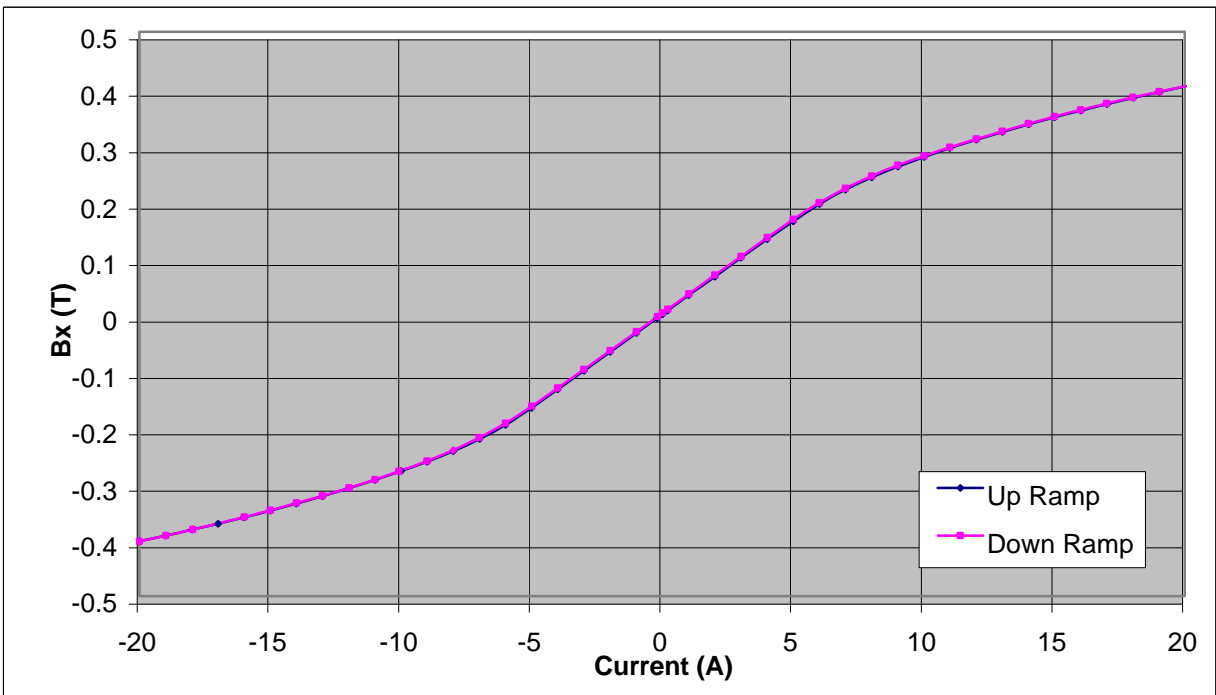


GMW ASSOCIATES
Electromagnet Hysteresis Plot

Model: 5201
Serial No: 15
Pole Face:
Pole gap: N/A

Engr: Y.Q.
Date: 12/16/2005
Page: 1 of 2

Power Supply: Kepco 20-20
PS SN: 155399 R31
Position: X=Y=0mm, Z= 2mm above pole
Current: -20A~+20A

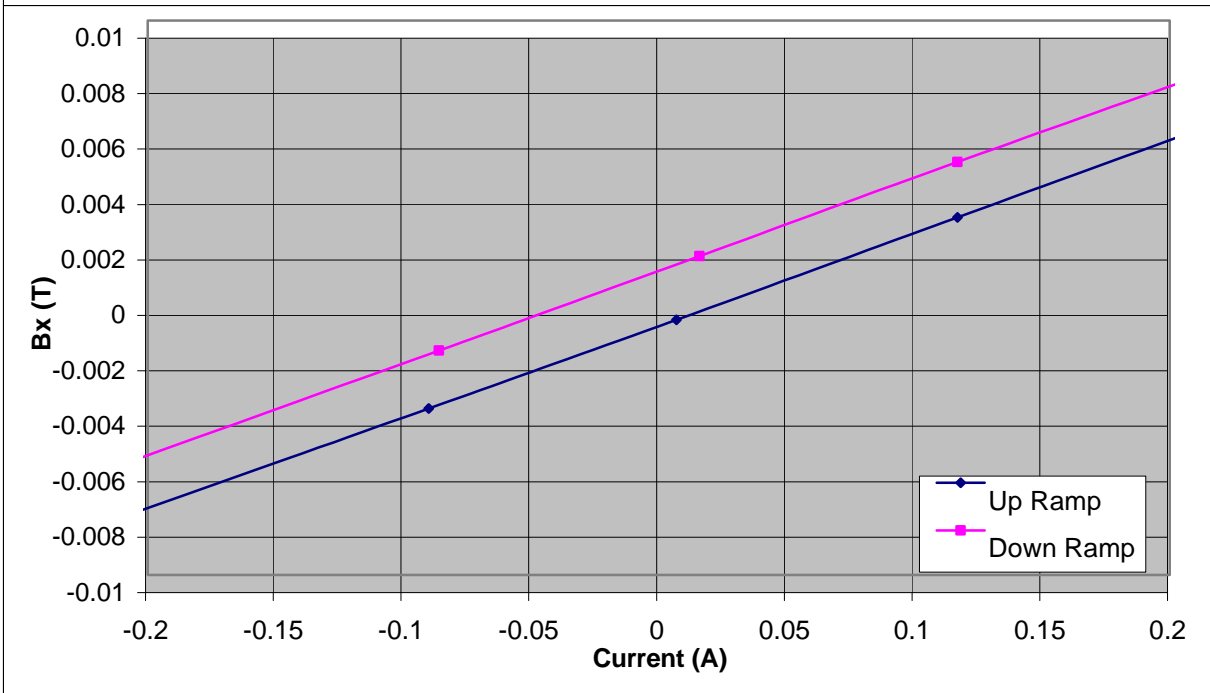
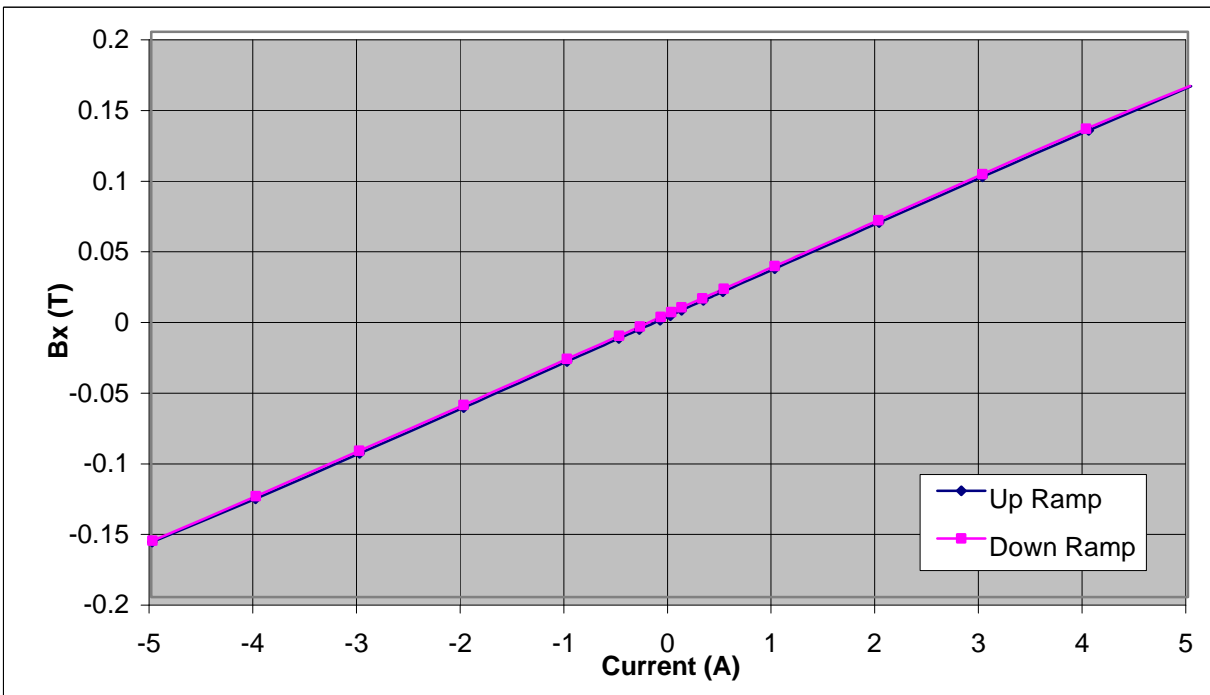


GMW ASSOCIATES
Electromagnet Hysteresis Plot

Model: 5201
Serial No: 15
Pole Face:
Pole gap: N/A

Engr: Y.Q.
Date: 12/16/2005
Page: 2 of 2

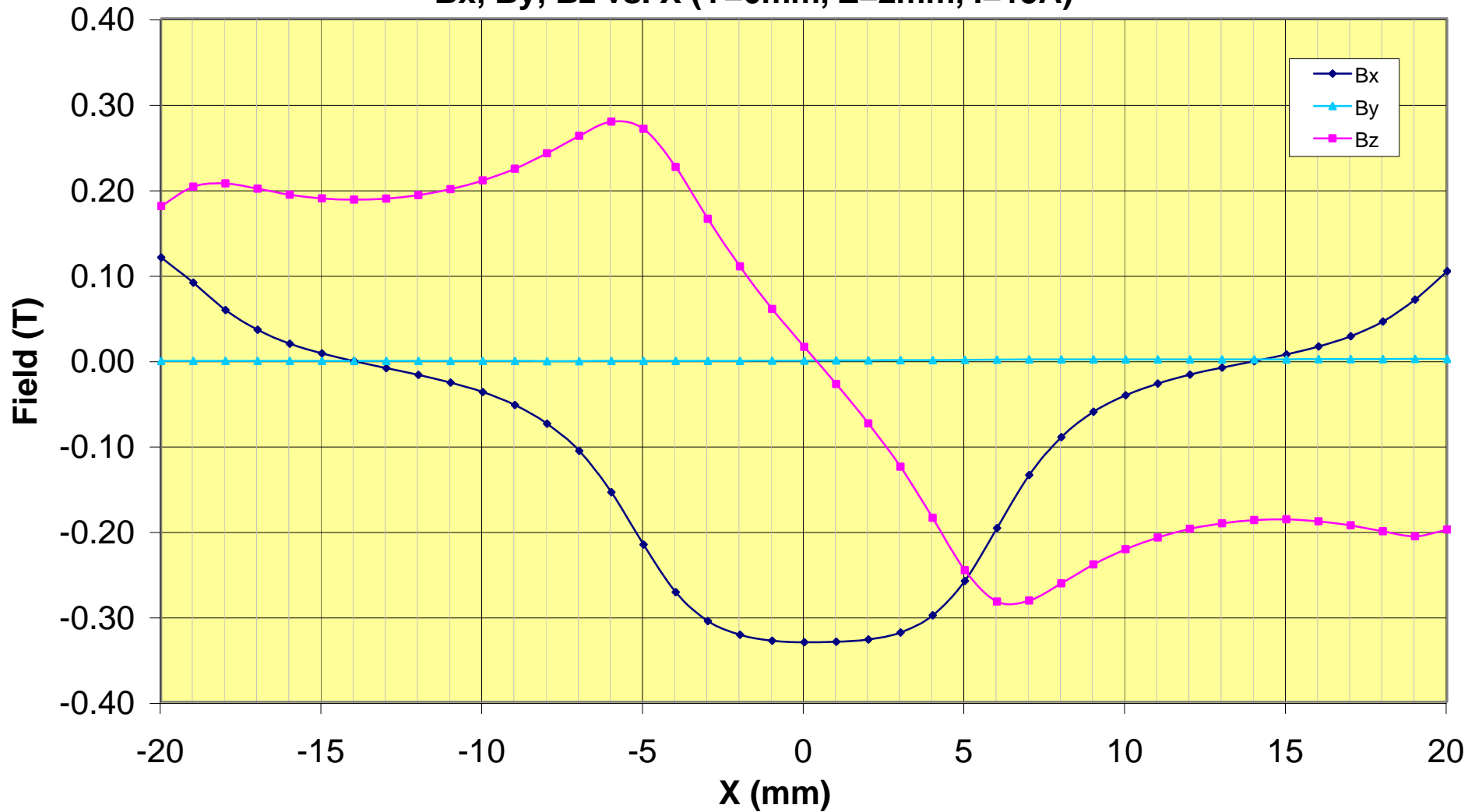
Power Supply: Kepco 20-5
PS SN: 147743 R15
Position: X=Y=0mm, Z= 2mm above pole
Current: -5A~+5A



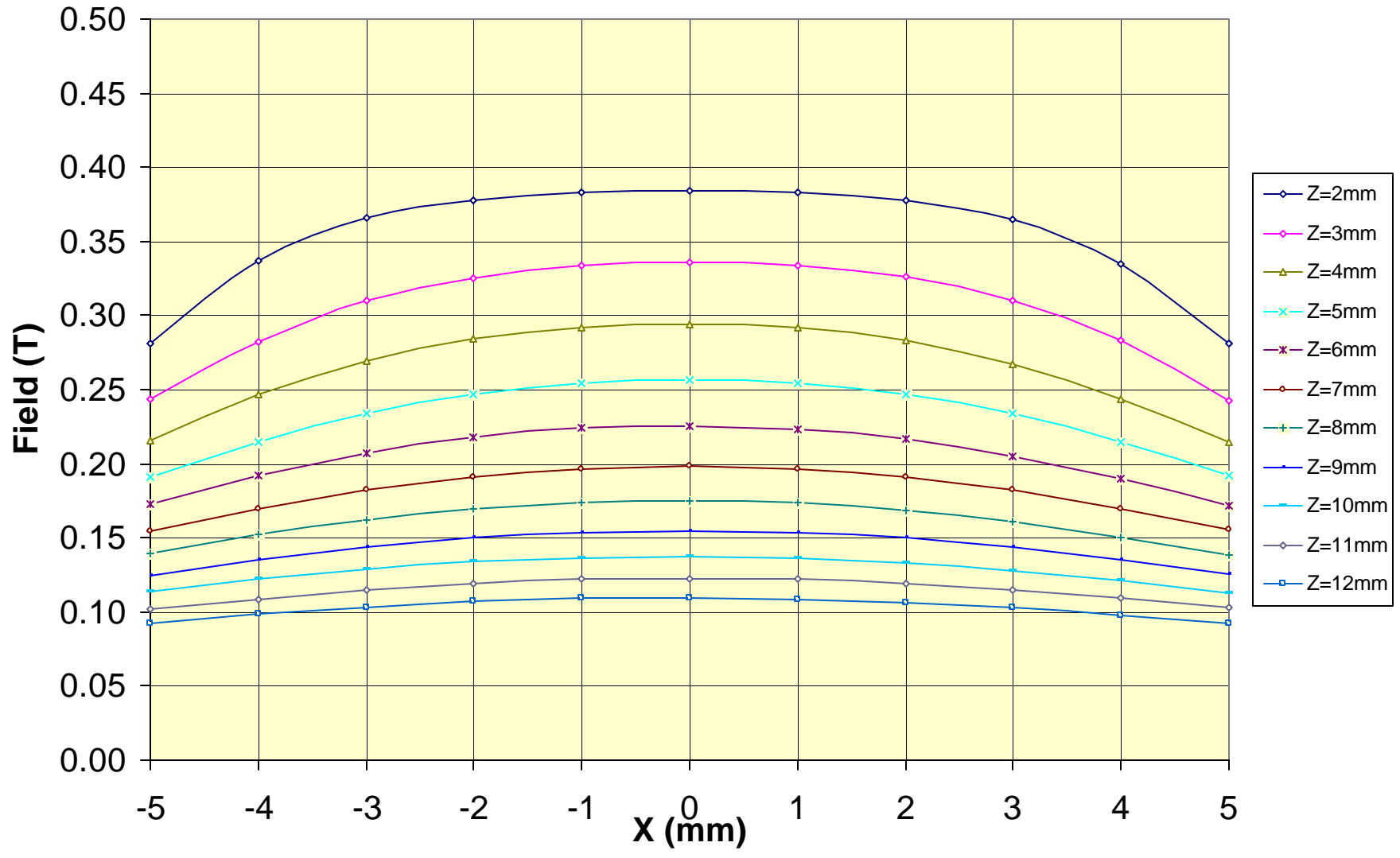
Section 7

TEST DATA

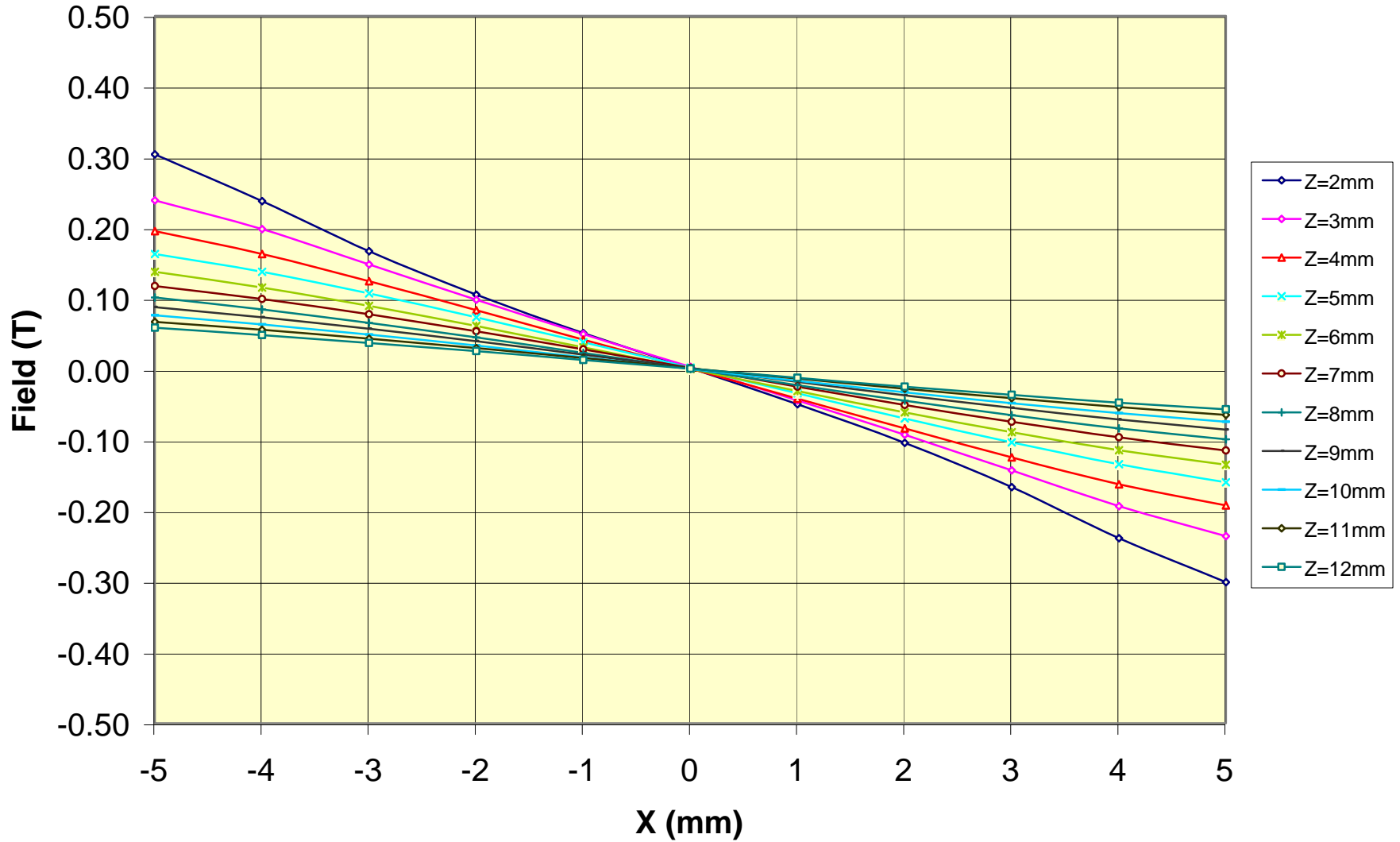
GMW 5201 Projected Field Magnet SN:004
-Bx, By, Bz vs. X (Y=0mm, Z=2mm, I=15A)



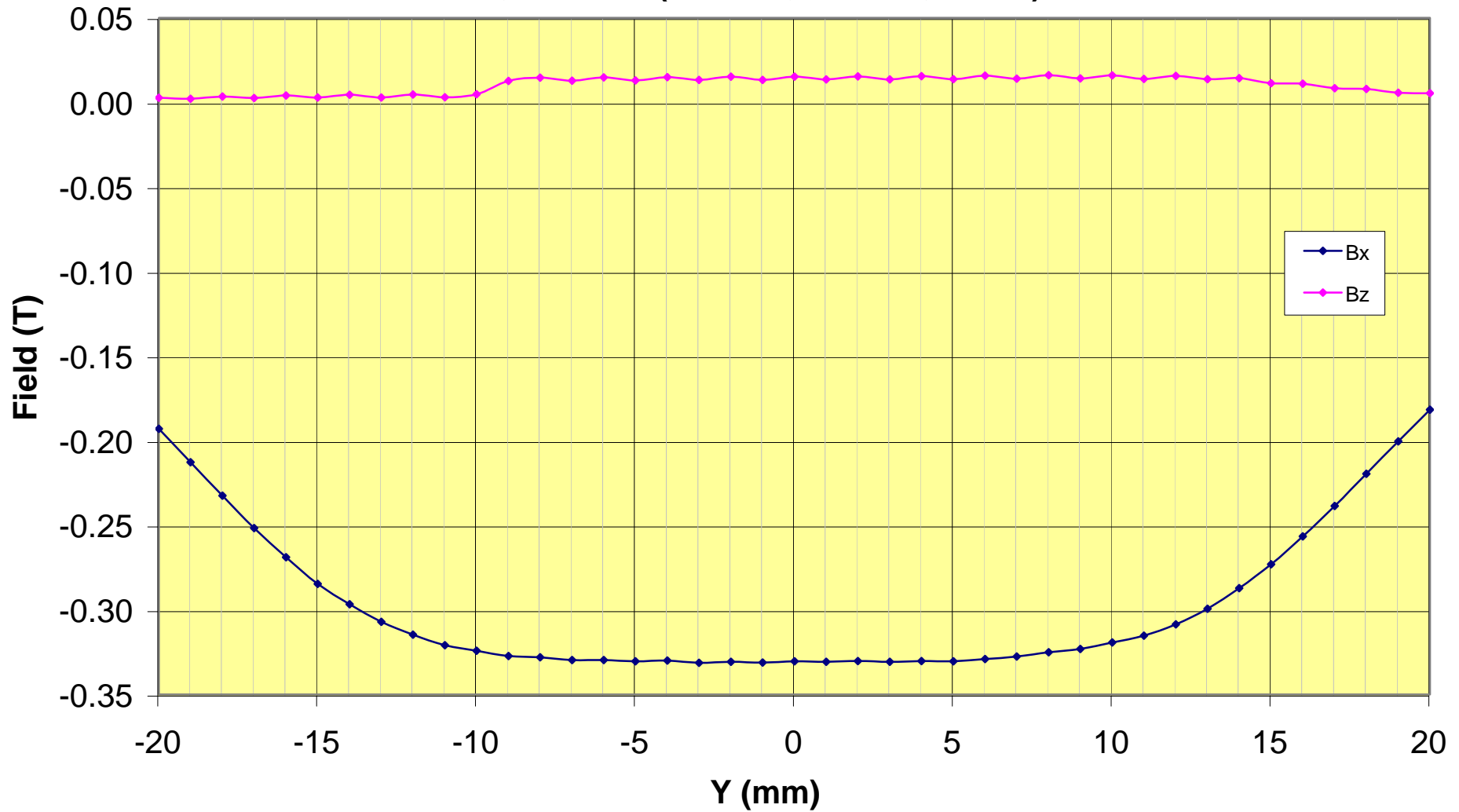
Projected Field Magnet SN:001
Bx vs. X (Y=0mm)
Current=20A



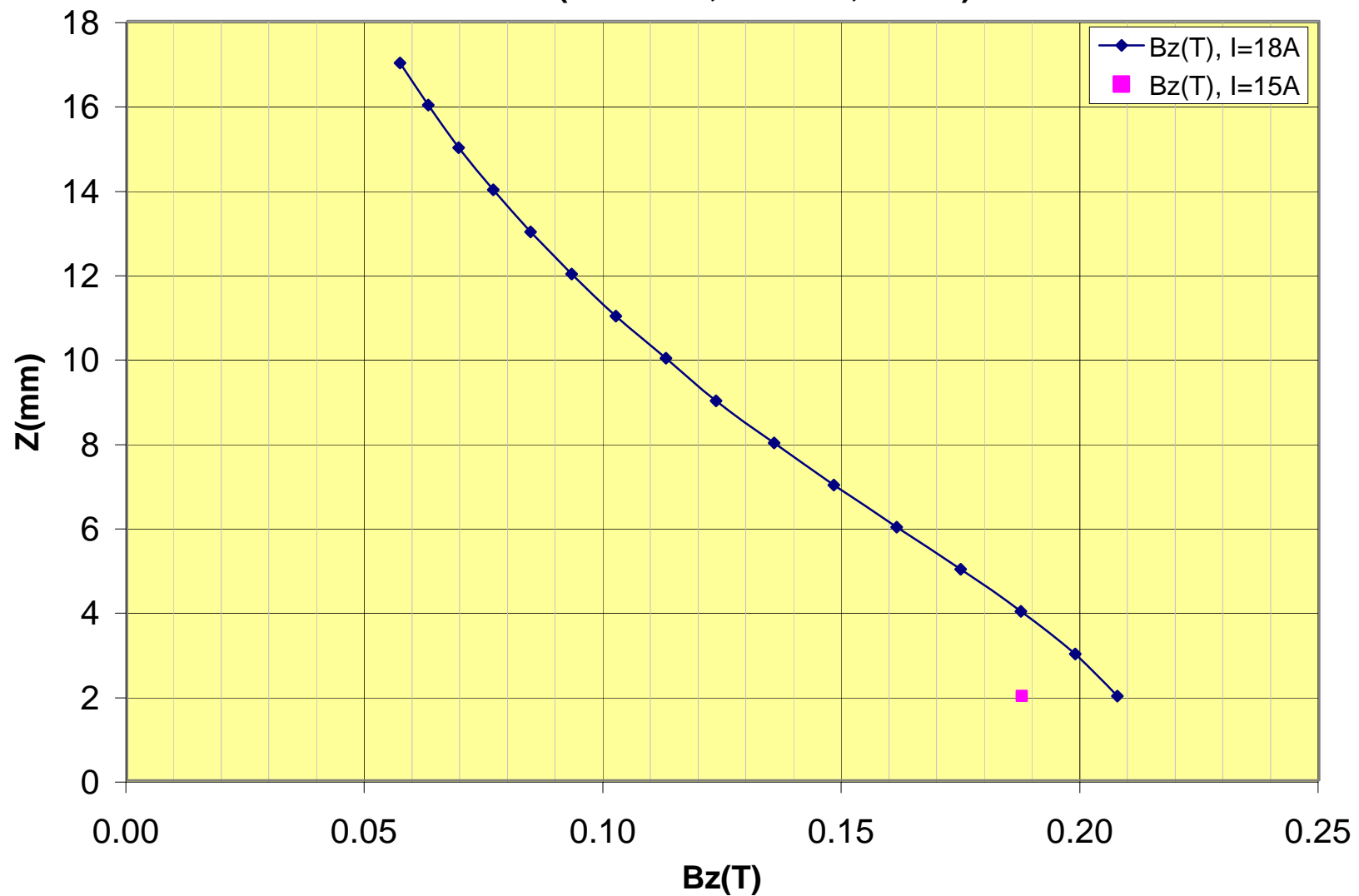
Projected Field Magnet SN:001
Bz vs. X (Y=0mm)
Current=20A



GMW 5201 Projected Field Magnet SN:004
-Bx, Bz vs. Y (X=0mm, Z=2mm, I=15A)



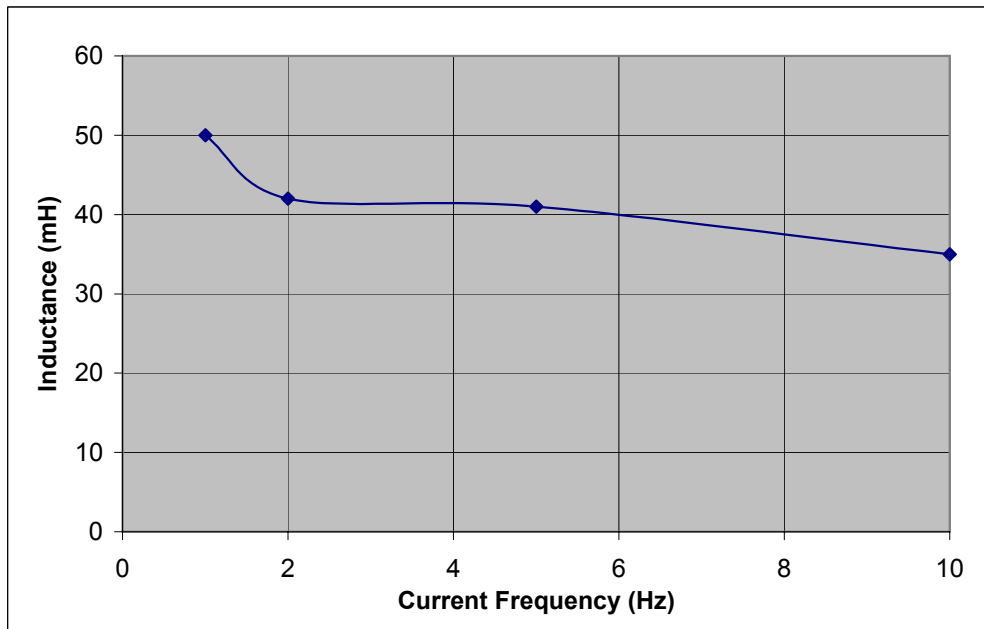
Projected Field Magnet SN:004
Bz vs. Z (X=14mm, Y=0mm, I=18A)



GMW ASSOCIATES
5201 Electromagnet Inductance

Model:	5201	Engr:	Y.Q.
Serial No:	15	Date:	12/16/2005
Pole Face:		Page:	1 of 1
Pole gap:	N/A		
Power Supply:			
PS SN:			
Position:	X=Y=0mm, Z= 2mm above pole		
Current:	1Hz, 2Hz, 5Hz, 10Hz, sine		

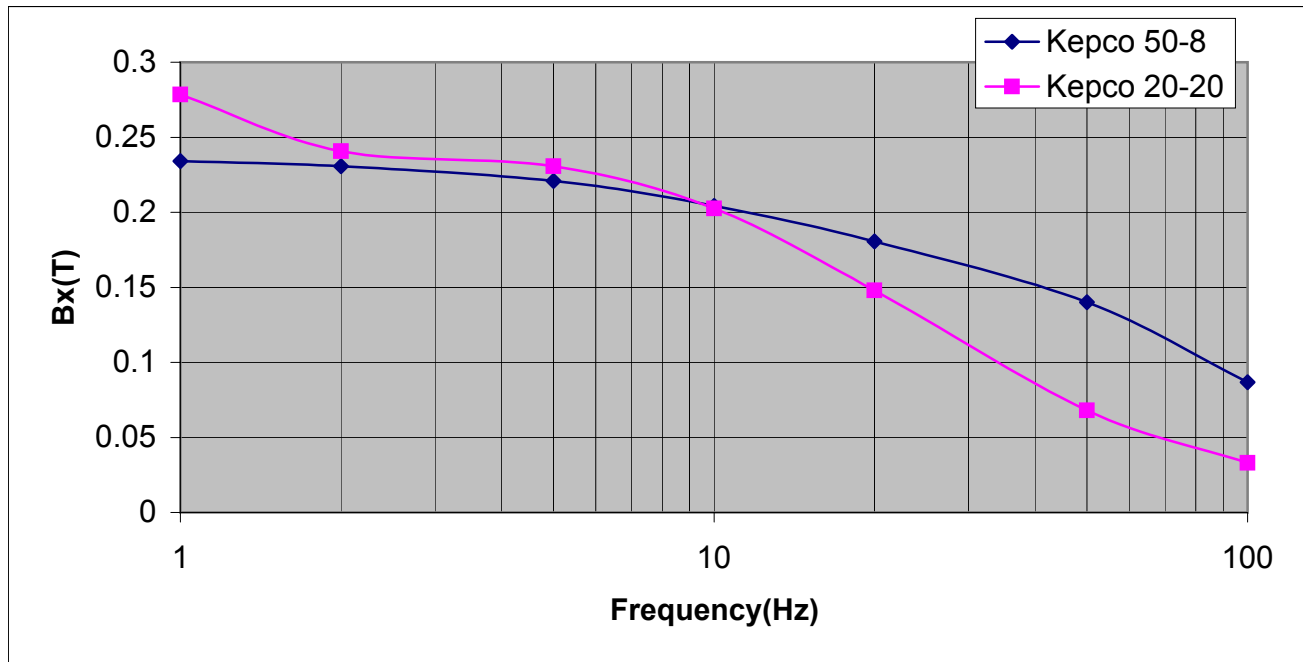
Current Frequency (Hz)	Inductance(mH)
1	50
2	42
5	41
10	35



GMW ASSOCIATES
Electromagnet Bx vs Frequency (sine wave) Plot

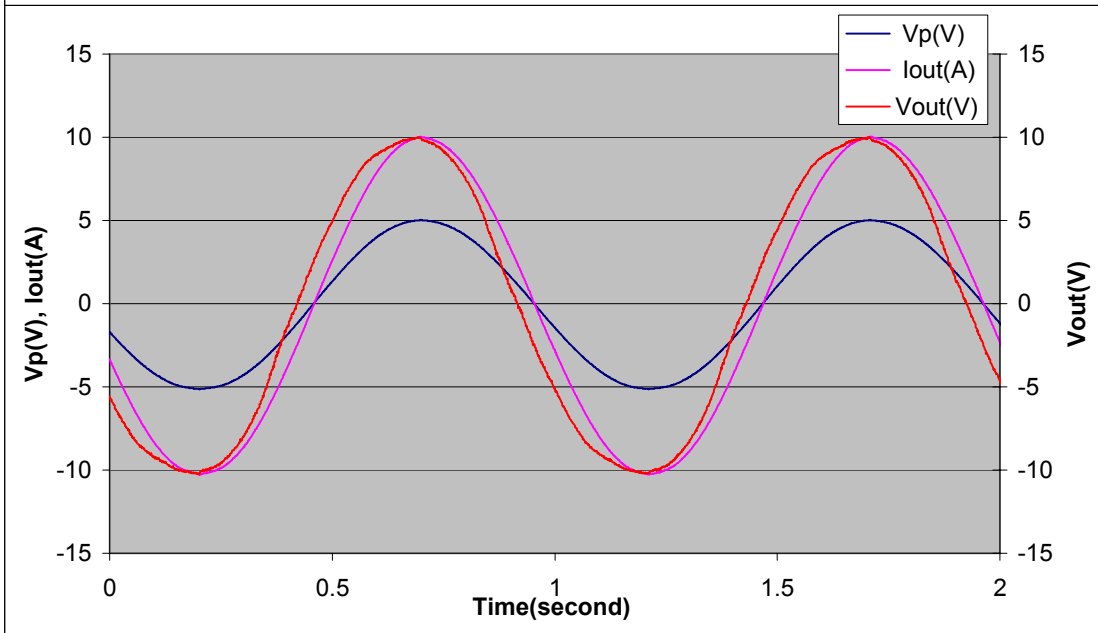
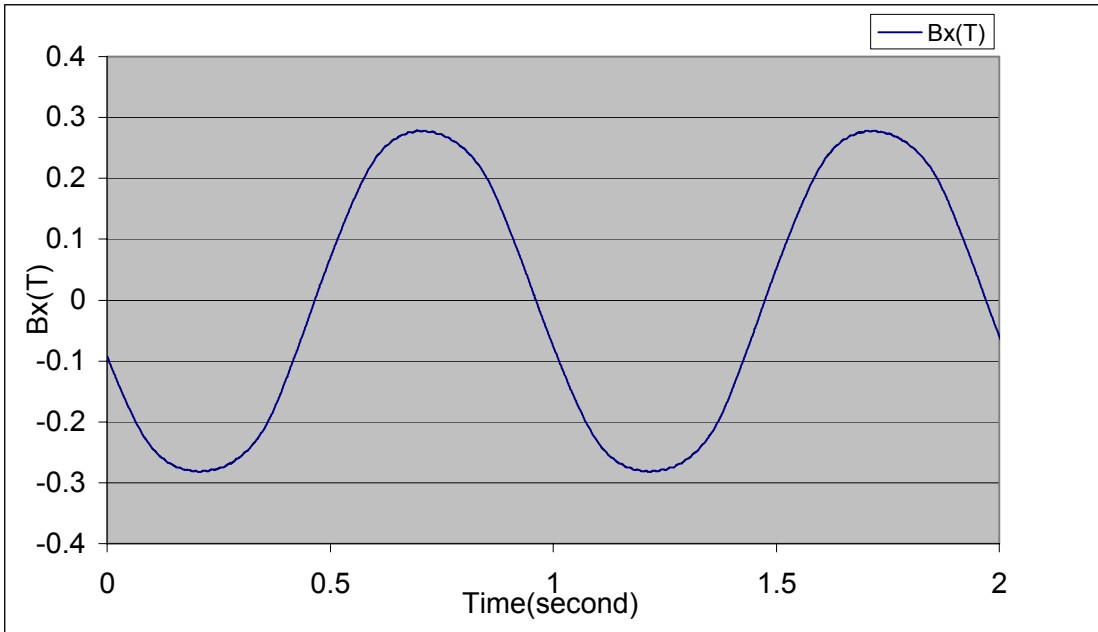
Model:	5201	Engr:	Y.Q.
Serial No:	15	Date:	12/16/2005
Pole Face:		Page:	1 of 1
Pole gap:	N/A		
Power Supply:	Kepeco 20-20	PS SN:	155399 R31
Power Supply:	Kepeco 50-8	PS SN:	154897 R24
Position:	X=Y=0mm, Z= 2mm above pole		
Current:	Sine, before visual distortion of sine waveform		

Frequency(Hz)	Kepeco 50-8	Kepeco 20-20
1	0.2341	0.2785
2	0.2307	0.2408
5	0.2208	0.2307
10	0.2043	0.2025
20	0.1805	0.1479
50	0.1401	0.0681
100	0.0867	0.0331



GMW ASSOCIATES
5201 Electromagnet 1Hz sine wave waveform

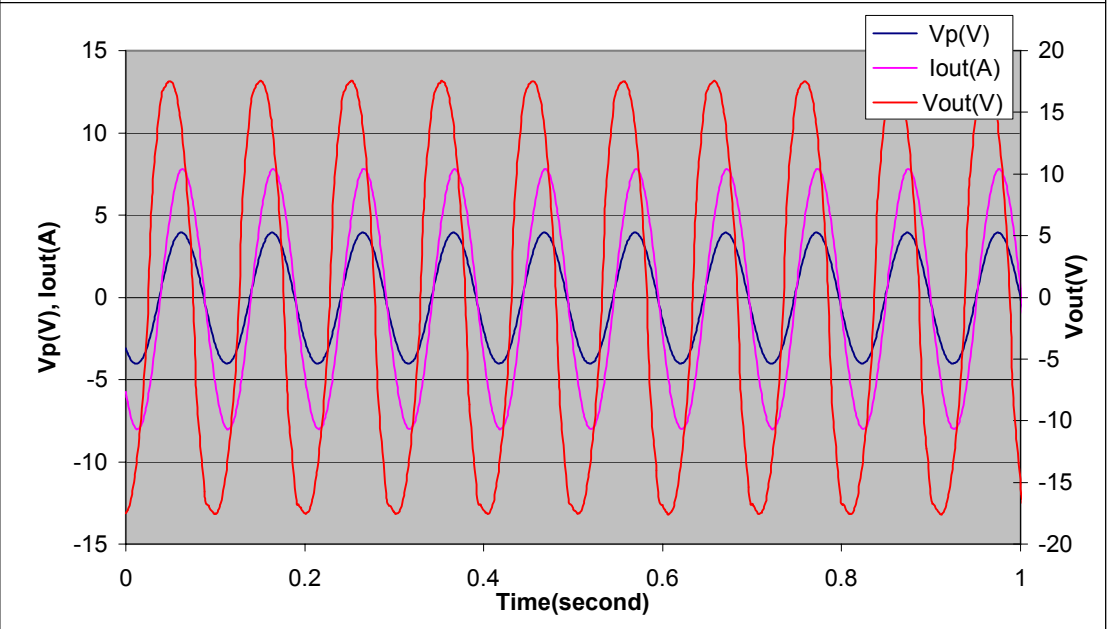
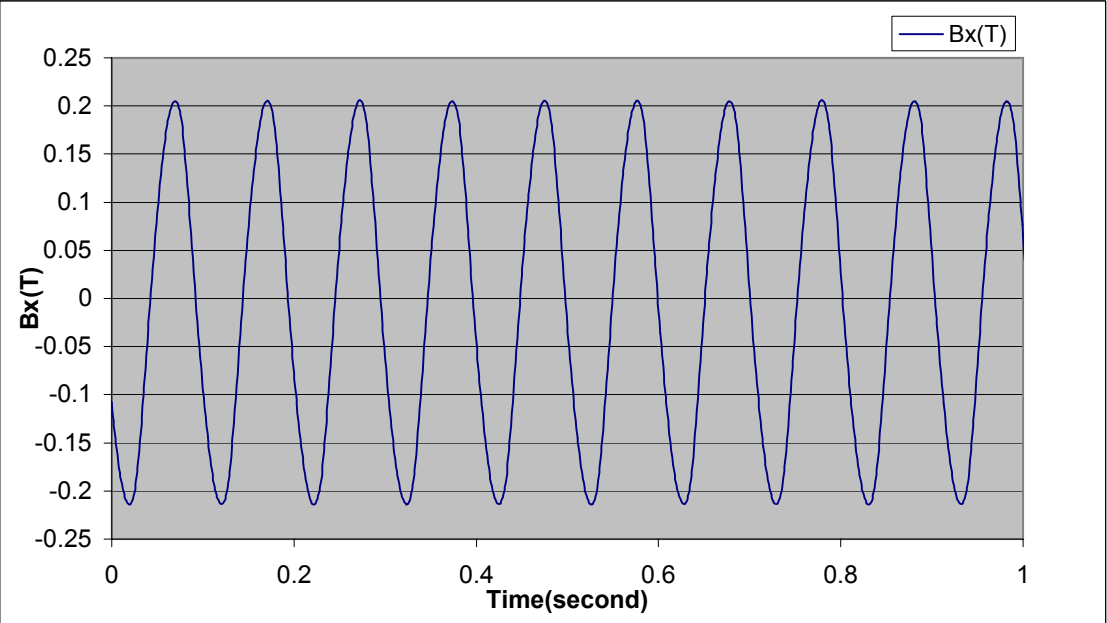
Model:	5201	Engr:	Y.Q.
Serial No:	15	Date:	12/2/2005
Pole Face:		Page:	1 of 1
Pole gap:	N/A		
Power Supply:	Kepeco 20-20		
PS SN:	155399 R31		
Position:	X=Y=0mm, Z= 2mm above pole		
Current:	1Hz sine, -10A~+10A		



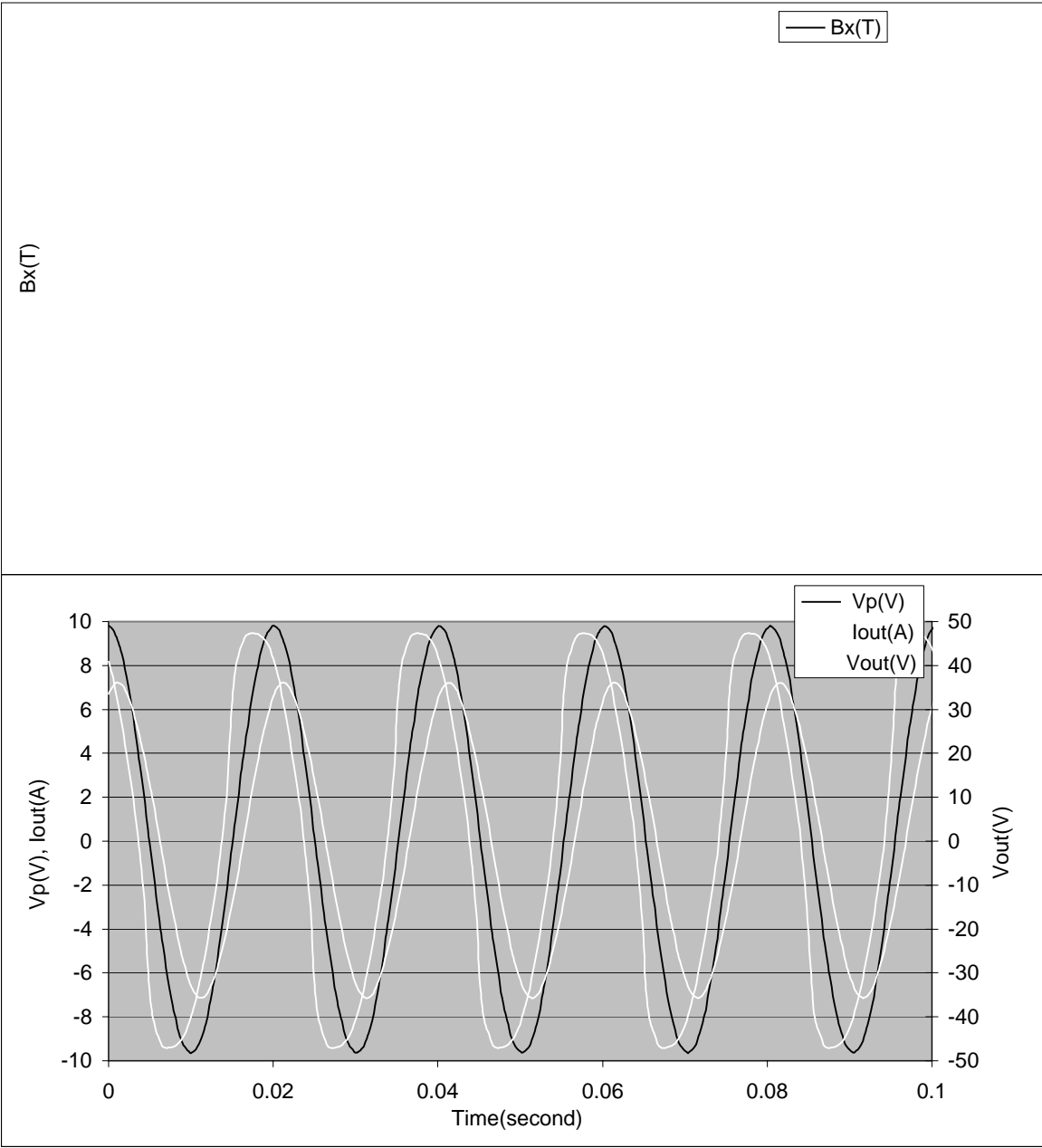
Date: 12/2/2005

GMW ASSOCIATES
5201 Electromagnet 10Hz sine wave waveform

Model:	5201	Engr:	Y.Q.
Serial No:	15	Date:	12/2/2005
Pole Face:		Page:	1 of 1
Pole gap:	N/A		
Power Supply:	Kepeco 20-20		
PS SN:	155399 R31		
Position:	X=Y=0mm, Z= 2mm above pole		
Current:	10Hz sine, -8A~+8A		



Date: 12/2/2005

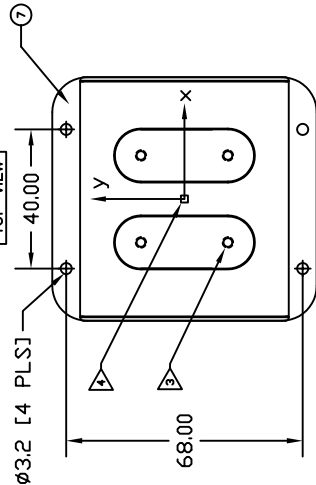


Section 8

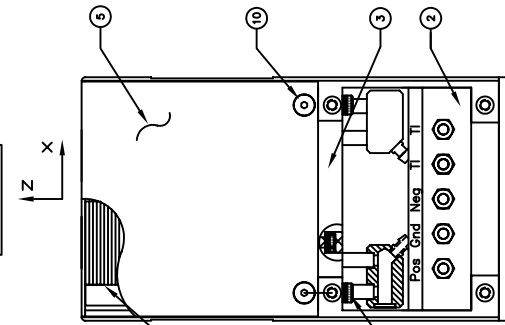
DRAWINGS

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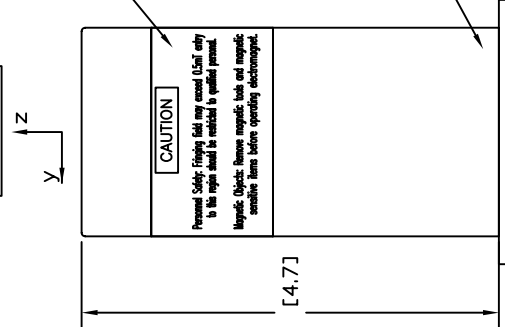
TOP VIEW



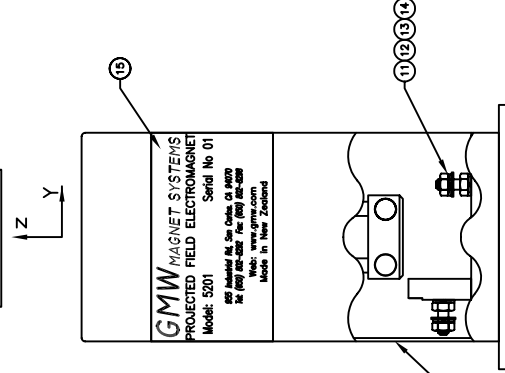
FRONT VIEW



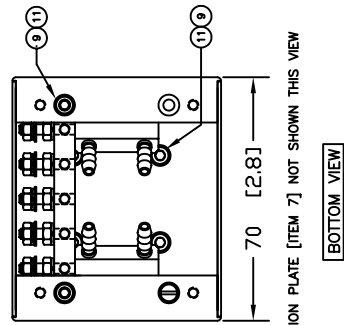
L.H. SIDE VIEW



R.H. SIDE VIEW

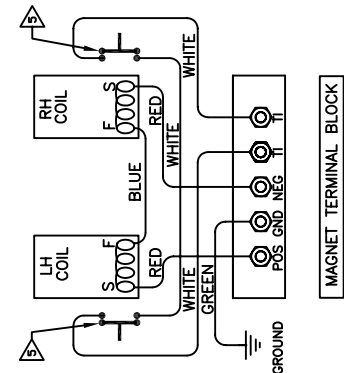


BOTTOM COVER [ITEM 6] NOT SHOWN THIS VIEW



BOTTOM VIEW

MAGNET SCHEMATIC



MAGNET TERMINAL BLOCK

- NOTE
1. SEE DWG NO 11902010 FOR MAGNET WIRING DETAILS.
 2. THIS DRAWING SHOWS MAGNET WITH ROTATING BASE MOUNTING. FOR DESKTOP MOUNTING MAGNET SEE DWG NO: 11901940.
 3. FILL HOLES WITH BLACK COLORED EPOXY RESIN [4 PLS]
 4. ROI [REGION OF INTEREST]
 5. TEMPERATURE SWITCHES SELCO 802L-075

REV	DESCRIPTION	DRAFT	DATE	APPROVED
A	RELEASE		04/10/03	G.DOUGLAS
B	UPDATE MAGNET SPECIFICATIONS & NOTES		07/30/03	G.DOUGLAS

MAGNET SPECIFICATIONS

FIELD (Bx max): 0.3 [4 mm above pole face]
 COIL RESISTANCE (20 °C) 0.85 ohm
 RESISTANCE (Hot) 1.02 ohm
 MAX POWER: 20V/20A [400 W]
 COOLING: 0.5 liter/min 1.0 bar [14 psid]
 THERMAL INTERLOCK: OPEN CIRCUIT ABOVE 75° C [167° F]
 MASS: 2.1 kg [4.6 lbs]

ITEM	QTY	PART NUMBER	DESCRIPTION	NOTE
16	1	10900670	LABEL, CAUTION	
15	1	10900660	LABEL, SPECIFICATION	
14	1	DIN 84A	SCREW, M3 X 10 CHEESE HD SLOTTED BRASS	
13	2	DIN 934	NUT, M3 BRASS	
12	1	DIN 433	WASHER, FLAT M3 x 6 x 0.5 BRASS	
11	12	BN 792	WASHER, RIBBED LOCK SPRING/STEEL	
10	8	DIN 7991	SHCS, M3 x 5 FLAT HD S/S	
9	6	DIN 912	SHCS, M3 x 6 S/S	
8	4	DIN 912	SHCS, M3 x 12 S/S	
7	1	17905190	TRANSITION PLATE	
6	2	17905130	COVER, BOTTOM	
5	1	17905120	COVER, TOP	
4	2	17905070	SHIELD POLE	
3	1	17905060	YOKE	
2	1	11901910	TERMINAL BLOCK ASSEMBLY	
1	2	11901870	POLE/COIL ASSEMBLY	

PARTS LIST

DO NOT SCALE FROM DRAWING (UNLESS OTHERWISE SPECIFIED)

LINEAR	INCHES	MM
X.XXX	±.001	±0.03
X.XX	±.01	±0.1
X.X	±.05	±0.3
X	±.08	±1
DEC.	±.5	±0.5
FINISH	±.5	±1.5

THIRD ANGLE PROJECTION

DATE: 08/13/02
 DRAWN: G.DOUGLAS
 CHECK: [blank]
 ENGINEERING: [blank]
 DATE: [blank]
 C71280
 SYSTEM: [blank]
 SOFTWARE: AUTOCAD 2000

GMW
 955 Industrial Rd, San Carlos, CA 94070
 Tel: (650)802-8292. Fax: (650)802-8298.

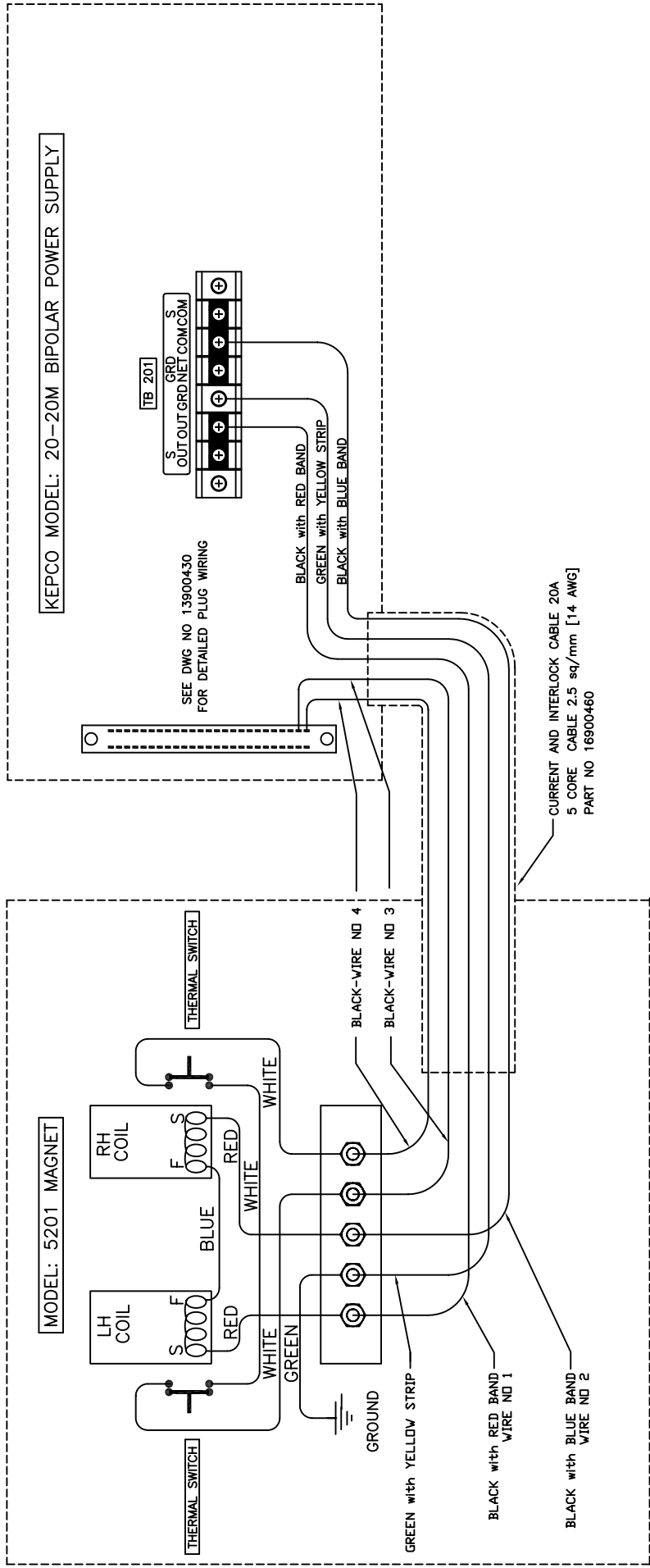
PROJ FIELD MAGNET
 MODEL: 5201

SCALE: 1:1 WT kg 1
 SHEET 1 OF 1

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REV	DESCRIPTION	DATE	APPROVED
A	RELEASE	04/10/03	G.D. DOUGLAS
B	ADD LINKS TO KEPCO T/B	09/09/03	G.D. DOUGLAS

REV	DESCRIPTION	DATE	APPROVED
A	RELEASE	04/10/03	G.D. DOUGLAS
B	ADD LINKS TO KEPCO T/B	09/09/03	G.D. DOUGLAS



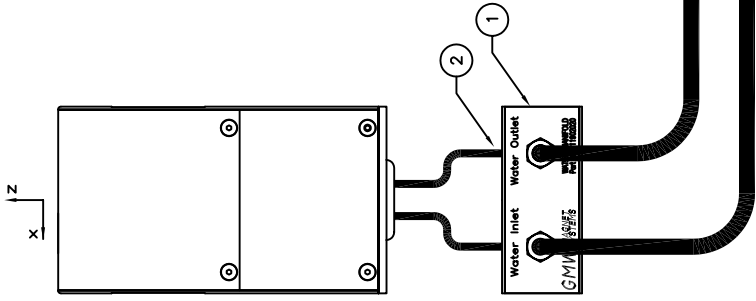
ELECTROMAGNET SYSTEM ELECTRICAL REQUIREMENTS	
AC INPUT POWER 1 PHASE 50 to 60HZ	115V 208V 230V
AC INPUT FULL LOAD CURRENT	11.0 6.5 6.0
RECOMMENDED MAIN AC BREAKER	15 10 10
RECOMMENDED AC POWER OUTLET	5-15R -
RECOMMENDED AC CABLE SIZE	1.5 SQ/MM 1.0 SQ/MM 1.0 SQ/MM

NOTE: DRAWING SHOWS POWER SUPPLY SETUP FOR 1 PHASE 115V AC POWER

ITEM	QTY	PART NUMBER	DESCRIPTION	NOTE
PARTS LIST				
DO NOT SCALE FROM DRAWING				
G.D. DOUGLAS 955 Industrial Rd, San Carlos, CA 94070				
Tel: (650)902-8992 Fax: (650)902-8996				
TITLE: ELECTRICAL WIRING				
5201/BOP 20-20M				
SIZE: DRAWING NO. A113900420				
SCALE: NTS WT Lb				
SHEET 1 OF 1				

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MODEL: 5201 MAGNET



MAGNET REAR VIEW

SHUTOFF VALVES

METERING VALVE
 [TO SET MAGNET WATER FLOW]

FIT REDUCERS AS REQUIRED TO
 SUIT 1/8 NPT HOSE CONNECTOR

--- ALL EQUIPMENT ABOVE DOTTED LINE SUPPLY BY CUSTOMER ---

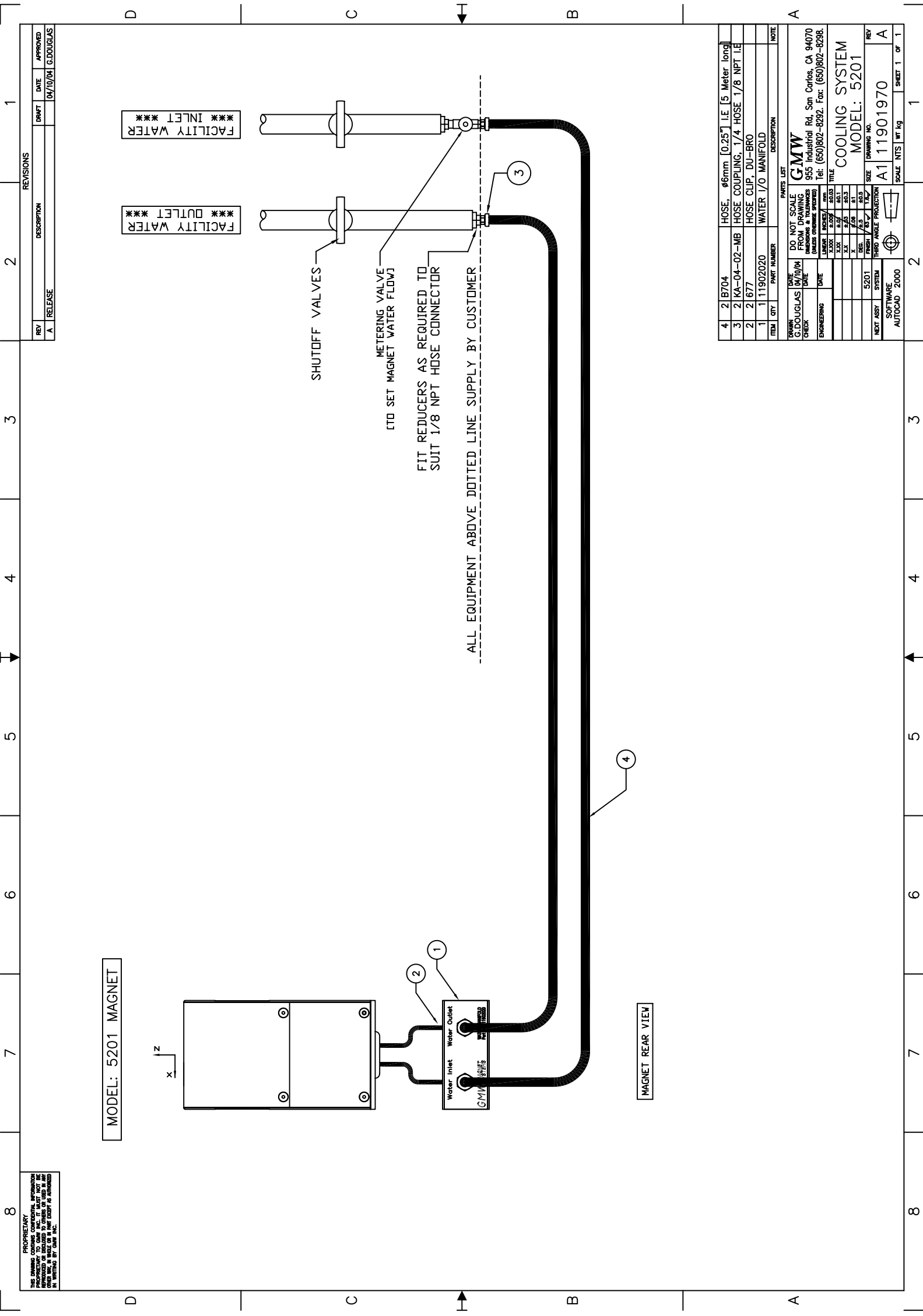
FACILITY WATER
 *** INLET ***

FACILITY WATER
 *** OUTLET ***

REV	DESCRIPTION	DRAFT	DATE	APPROVED
A	RELEASE		06/10/04	G.DOUGLAS

ITEM	QTY	PART NUMBER	DESCRIPTION	NOTE
4	2	B704	HOSE, #6mm [0.25"] I.E. [5 Meter long]	
3	2	KA-04-02-MB	HOSE COUPLING, 1/4 HOSE 1/8 NPT I.E	
2	2	677	HOSE CLIP, DU-BRO	
1	1	11902020	WATER I/O MANIFOLD	

PARTS LIST	
DO NOT SCALE FROM DRAWING (UNLESS OTHERWISE SPECIFIED)	GMW 955 Industrial Rd, San Carlos, CA 94070 Tel: (650)802-8292, Fax: (650)802-8298.
DATE	TITLE
06/10/04	COOLING SYSTEM
06/10/04	MODEL: 5201
06/10/04	DRAWING NO.
06/10/04	A111901970
06/10/04	REV
06/10/04	A
06/10/04	SCALE NTS
06/10/04	WT kg
06/10/04	SHEET 1 OF 1

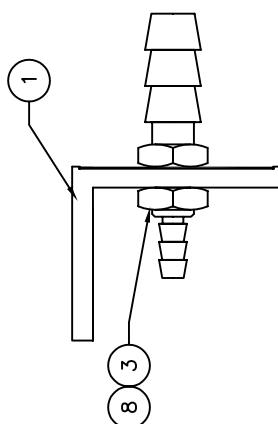


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 IN WRITING BY GMW INC.

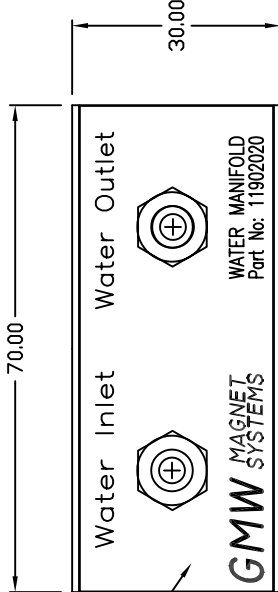
REVISIONS

REV	RELEASE	DESCRIPTION	DRAFT	DATE	APPROVED
A				10/22/03	G.DOUGLAS

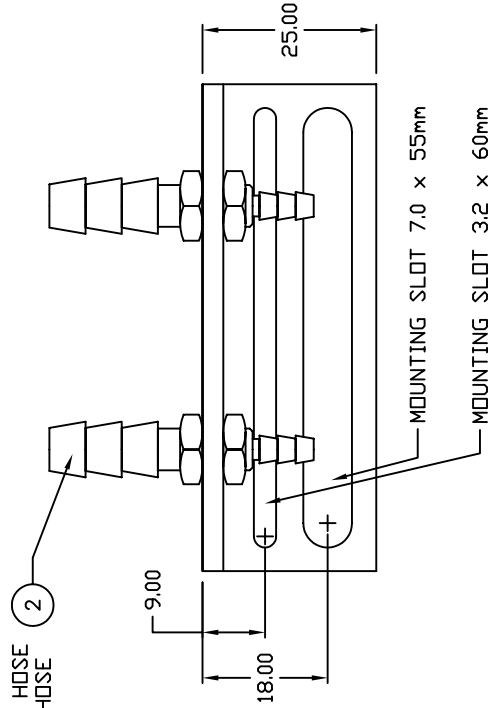
END VIEW



FRONT VIEW



BOTTOM VIEW



FRONT CONNECTION TO SUIT 6.0mm ID HOSE
 REAR CONNECTION TO SUIT 3.0mm ID HOSE

NOTE: 1 SUPPLY ITEMS 4 THRU 7 PACKED IN ZIP LOCK PLASTIC BAG. THESE ITEMS NOT SHOWN ON DRAWING.

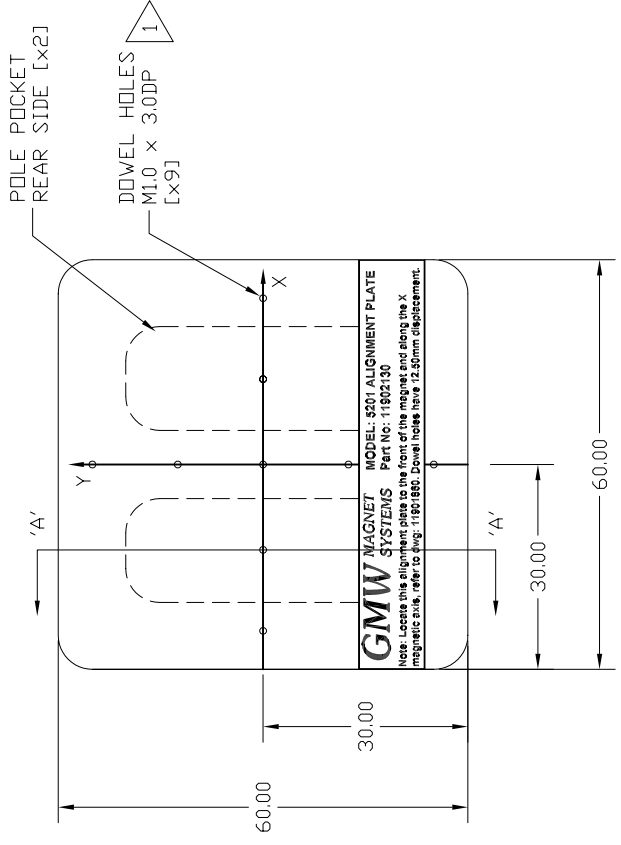
ITEM	QTY	PART NUMBER	DESCRIPTION	NOTE
9	1	10900650	LABEL, WATER MANIFOLD	
8	2	BN 792	WASHER, M6 LOCK SP/S	
7	2	DIN 934	NUT, M3 HEX S/S	1
6	2	DIN 433	WASHER, M3 FLAT S/S	1
5	2	BN 792	WASHER, M3 LOCK SP/S	1
4	2	DIN 912	SHCS, M3 x 12 S/S	1
3	2	DIN 439 B	NUT, M6 JAM BRASS	1
2	2	17905380	HOSE FEEDTHRU 6mm HOSE to 3mm HOSE	
1	1	17905210	MOUNTING BRACKET	

PARTS LIST

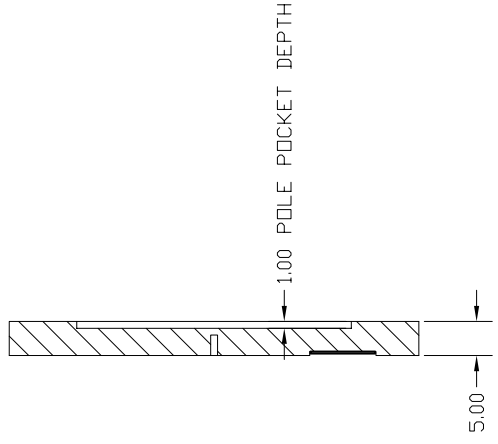
DO NOT SCALE FROM DRAWING (UNLESS OTHERWISE SPECIFIED)	DO NOT SCALE FROM DRAWING (UNLESS OTHERWISE SPECIFIED)	GMW	955 Industrial Rd, San Carlos, CA 94070	Tel: (650)802-8292. Fax: (650)802-8298.
LINEAR	INCHES/ mm	TITLE	WATER I/O MANIFOLD	
XXX	±.005	±.03	MODEL: 5201	
XX	±.01	±.01	DRAWING NO. A2 11902020	
XX	±.05	±.03	REV A	
X	±.08	±.1	SCALE 2:1 WT kg SHEET 1 OF 1	
DEC.	±.5	±.05		
FINISH	63	1.6		
THIRD ANGLE PROJECTION				
SOFTWARE	SYSTEM			
AUTOCAD	2000			

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TOP VIEW



SECTION VIEW A'-A'



REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
A	RELEASE	03/30/06	G.DOUGLAS

ITEM	QTY	PART NUMBER	DESCRIPTION	NOTE
3	1	DIN 6325	DOWEL PIN, $\phi 1.00\text{mm} \times 5.0$ LONG	C/S 4
4	1	VSM 12771B	DOWEL PIN, $\phi 1.00\text{mm} \times 5.0$ LONG	S/S 4
2	1	10901080	IDENTIFICATION LABEL	
1	1	11905220	ALIGNMENT PLATE [Aluminum]	

PARTS LIST		DO NOT SCALE FROM DRAWING DIMENSIONS & TOLERANCES (UNLESS OTHERWISE SPECIFIED)		TITLE	
UNITS	INCHES	MM	INCHES	MM	INCHES
XXX	3.00	40.0	XXX	3.00	40.0
XX	3.00	40.0	XX	3.00	40.0
X	3.00	40.0	X	3.00	40.0
DEC	3.00	40.0	DEC	3.00	40.0
FINISH	3.00	40.0	FINISH	3.00	40.0
THIRD ANGLE PROJECTION	3.00	40.0	THIRD ANGLE PROJECTION	3.00	40.0
11901860	5201		11901860	5201	
NEXT ASSY	SYSTEM		NEXT ASSY	SYSTEM	
SOFTWARE	AUTOCAD 2000		SOFTWARE	AUTOCAD 2000	

GMW
955 Industrial Rd, San Carlos, CA 94070
Tel: (650)802-8292. Fax: (650)802-8298.

PROJ FIELD MAGNET ALIGNMENT PLATE
DRAWING NO. A2 11902130
SCALE 2:1 WT kg SHEET 1 of 1

NOTE:

- DOWEL HOLES ARE PROVIDED ALONG THE X AND Y MAGNETIC AXES AND THE MAGNET POLE FACES. FIT ALIGNMENT PLATE WITH THE LABEL LOCATED TO THE MAGNET FRONT, REFER DWG NO: 11901860.
- BEFORE FITTING THIS ALIGNMENT PLATE, CLEAN THE POLE POCKETS AND THE MAGNET POLE FACES. FIT ALIGNMENT PLATE WITH THE LABEL LOCATED TO THE MAGNET FRONT, REFER DWG NO: 11901860.
- MAGNETIC FIELD DIRECTIONS ARE SHOWN FOR POSITIVE MAGNET CURRENT.
- USE ITEM 4 FOR MAGNETIC ALIGNMENT [CARBON STEEL] DOWEL PIN.
USE ITEM 3 FOR NON MAGNETIC LOCATION [STAINLESS STEEL] DOWEL PIN.