GMW

USER'S MANUAL

MODEL: 5403AC

63MM LAMINATED ELECTROMAGNET

Date Sold: _______________

Serial number: ___________

PROPRIETARY
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File No: Revision Date: Oct 06, 2005

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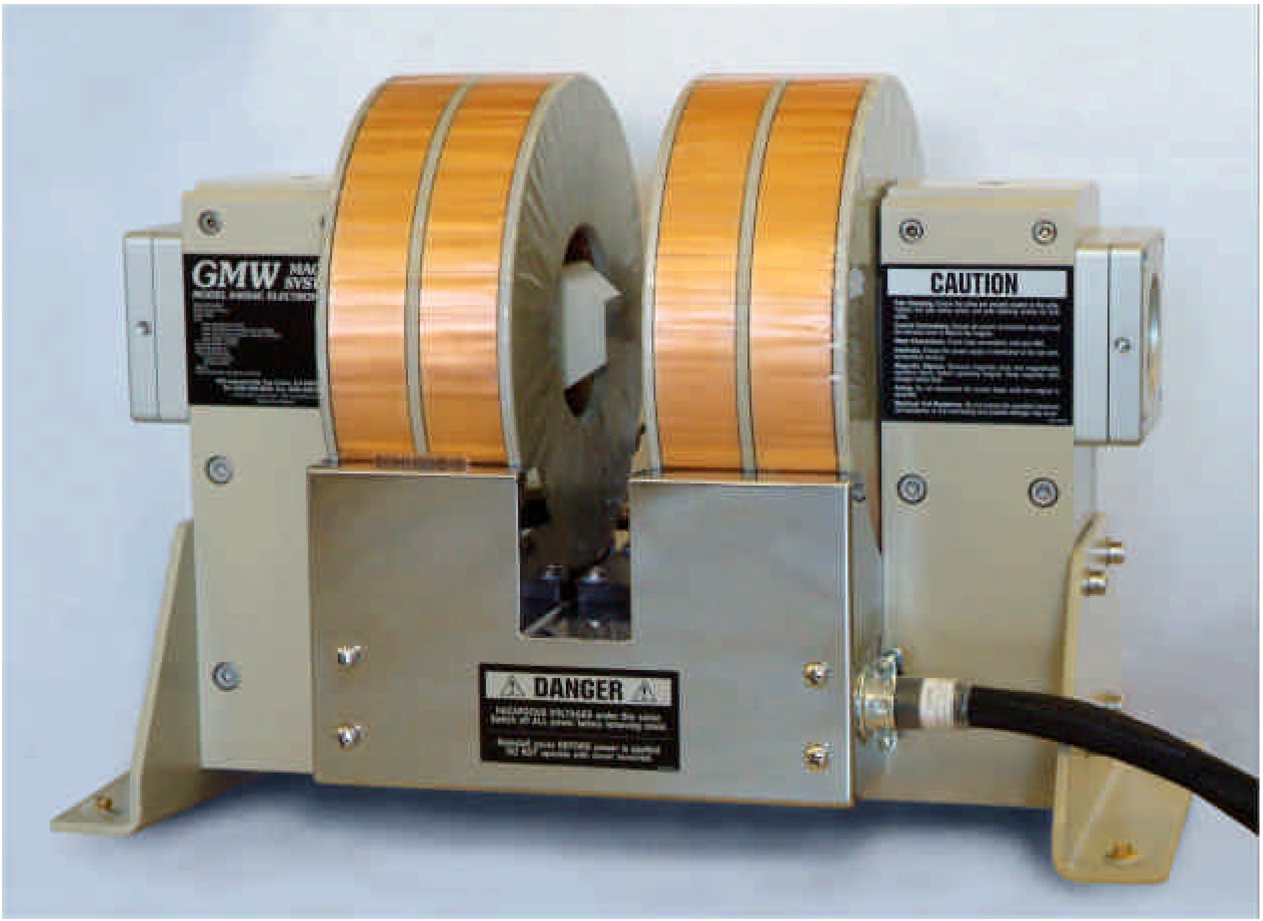
Drawing 18907-0002-0 5403AC Electromagnet Tool Kit
Drawing 18800770 5403AC Shipping Crate Assembly
Elmwood 3450 Thermostats

PHOTOGRAPHS

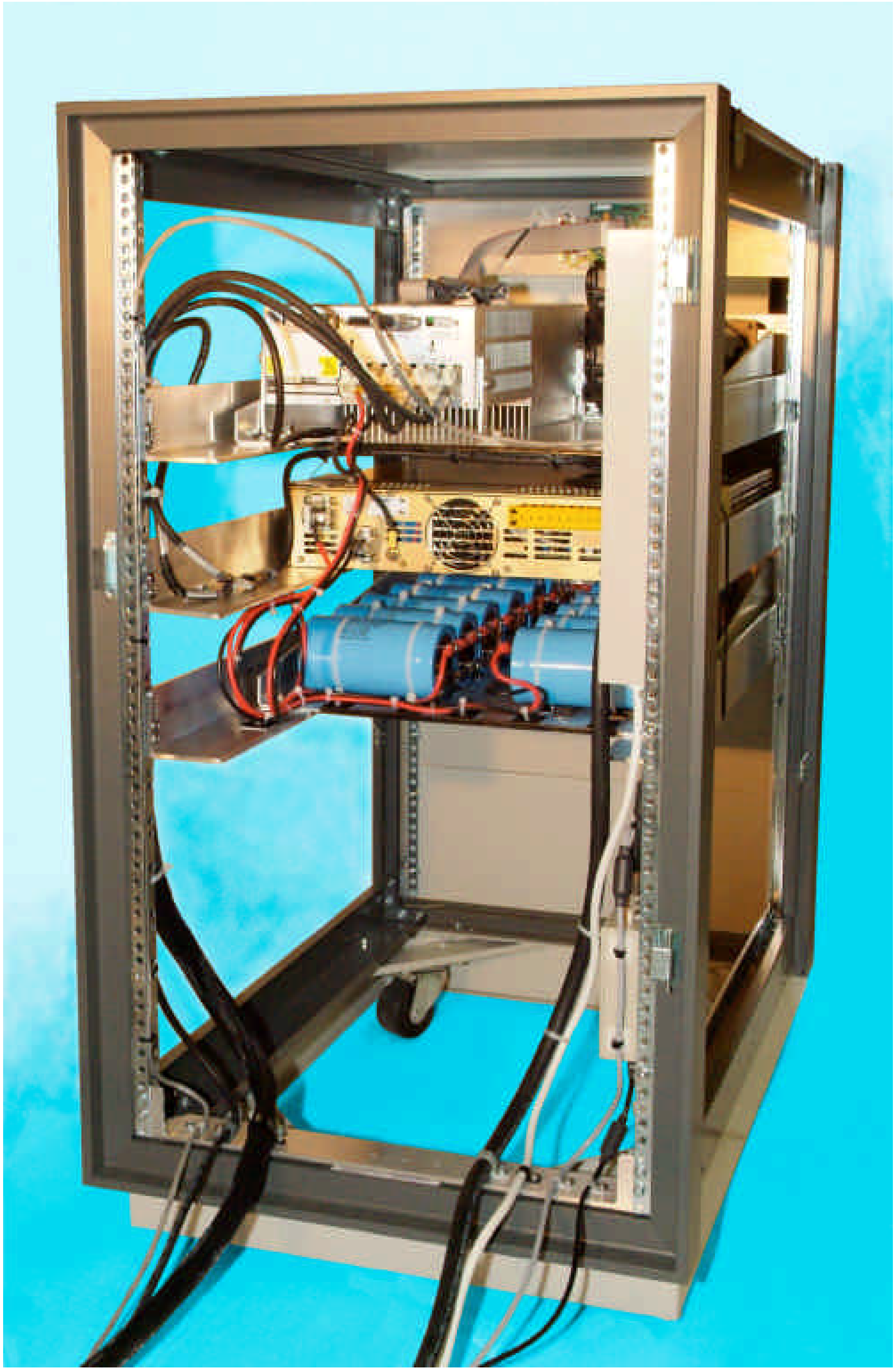


<u>GMW Model 5403AC Laminated Electromagnet</u>
63mm square poles tepered to 32mm square with a 32mm pole gap. The peak central field is approximately ±1T at ±60A.

PHOTOGRAPHS

GMW RC-351930 Bench Height Rack – Front View
Shown equipped with 231P Power Amplifier and EMS 150-16 150V, 16A DC Power Supply. For bipolar operation ±60A, ±160V, 1.8kW maximum. Refer to drawing 11907-0046-0 for layout details.

PHOTOGRAPHS



GMW RC-351930 Bench Height Rack – Rear View
Shown equipped with 231P Power Amplifier and EMS 150-16 150V, 16A DC Power Supply. For bipolar operation ±60A, ±160V, 1.8kW maximum. Refer to drawing 11907-0046-0 for layout details and 13907-0000-0 for electrical details.

Section 1
SPECIFICATIONS
Table 1. Model 5403AC Specifications

Pole Size:	Square, 63 x 63mm (2.5 inch)
Pole Gap: (adjustable using pole spacers)	0 - 60mm (0 to 2.4 inch)
Standard Pole Face:	Square, 63 x 63mm (2.5 x 2.5 inch) Square, 38 x 38mm (1.5 x 1.5 inch) Square, 32 x 32mm (1.3 x 1.3 inch) Square, 12 x 12mm (0.5 x 0.5 inch)
Coils (series connection)	
coil resistance (20°C)	0.45 Ohm
max resistance (hot)*	0.55 Ohm
max continuous power (air)	20A/10V (0.2kW)
max continuous power (water)	50A/25V (1.25kW)
max intermittent power (water)	100A/50V(5kW) for 3 min
max peak voltage	500V
Self Inductance	220mH
Water Cooling (18°C)	2 liters/m (0.5 US gpm) 0.5 bar (8 psid)
Overtemperature Interlock	Elmwood 3450G thermostat part number 3450G 611-1 L50C 89/16 mounted on each coil and wired in series. Contact rating 120Vac,0.5A. Closed below 50°C.
Dimensions	Drawing 11907-0008-0 556mm W x 281mm D x 383mm H 21.9 inch W x 11.1 inch D x 15.1 inch H
Mass	125 kg (275 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 1
SPECIFICATIONS
Table 2. Model 5403AC Electrical and Water Connections

DC Current (as seen from the front refer to Drawing 11907-0008-0)

Right hand terminal:	Negative
Left hand terminal:	Positive

Ground

An M6 screw (Item 31 on drawing 11907-0008-0) is inside the terminal cover to enable the magnet frame to be grounded according to local safety regulations. It is normally appropriate to connect the magnet frame to the power supply ground.

Interlocks (refer to Drawing 11907-0008-0).

The temperature interlock wiring connections are made directly onto the temperature thermostats (Item 17 on drawing 11907-0008-0).

Water (refer to Drawing 11907-0008-0).

Outlet	1/8 inch NPT
Inlet	1/8 inch NPT
	(mating couplings for ¼ inch hose provided)

CAUTION - Ensure that the high current connections are tight. Loose connections may lead to oxidation and overheating. The field stability may be degraded and the current terminations damaged.

Section 2

WARNINGS

REFER TO WARNINGS BELOW BEFORE OPERATING ELECTROMAGNET

1 Hazardous Voltages

THE 5403AC MAGNET HAS LETHAL VOLTAGES PRESENT DURING OPERATION. VOLTAGES UP TO 500 VOLTS CAN BE PRESENT ACROSS THE MAGNET COILS. DO NOT OPERATE THIS MAGNET WITHOUT THE TERMINAL COVER CORRECTLY INSTALLED.

2 Arcing

This magnet stores considerable 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 hazardous arcing.

3 Fringing Magnetic Fields

In operation the magnet fringing field can be in excess of 0.5mT (5G) within about 1m of the magnet. This can cause malfunctioning of heart pacemakers and other medical implants. We recommend that the fringing field should be mapped and warning signs be placed outside the 0.5mT (5G) contour. Entry to this region should be restricted to qualified personnel.

4 Ferromagnetic Objects

During operation the magnet can exert a strong magnetic force on ferromagnetic objects in the near vicinity of its pole gap or coils. Loose objects can be accelerated to sufficient velocity to cause personnel injury or damage to the coils or pole faces if struck. Keep ferromagnetic tools clear!

5 Draw/Clamp Bolts

Before operation always ensure that the clamp bolts (item 4 on drawing 11907-0010-0) are properly tightened.

6 Interlocks

These should ***always*** be connected if the magnet is operated unattended, to avoid the possibility of coil overheating caused by excessive power dissipation or inadequate cooling.

7 Watches, Credit Cards, and Magnetic Disks

Do not move magnetically sensitive items into the close vicinity of the magnet. 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 50G (5mT) with the magnet power supply off or disconnected.

8 Coil Hot Resistance

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

Section 3

INSTALLATION

Caution: This electromagnet weighs 125kg (275lb). All movement, lifting and installation of the 5403AC Electromagnet must be under the supervision of an experienced person to prevent the possibility of serious injury or damage to the Electromagnet and associated equipment.

Unpacking Instructions and Damage Inspection

To unpack the electromagnet please use the following procedure (Refer to Drawing 18900770).

1. First remove all of the "Hex Head Screws" located at the lower edge of all the side panels of the "Crate Top Cover".
2. Gently rock the "Crate Top Cover" to work it loose from the shipping crate base.
3. Grip the side panels of the Crate Top Cover. Lift "Crate Top Cover" high enough to clear top of electromagnet, walk cover sideways to a clear area and place on floor.
4. Inspect the magnet to ensure that no damage has occurred to the magnet in shipment. If damage is evident report the damage in detail to the shipper for claim and simultaneously notify GMW in case assessment of the damage must be made. If no damage is found proceed with magnet unpacking and installation.
5. Remove the M12 hex head coach bolts that secure the magnet to the shipping crate base".
6. Install M12 lifting eyebolt and washer to top of magnet yoke, screw down firmly.
7. The magnet is now prepared for final installation. Follow the appropriate procedure for direct or base mounting listed below.

Direct Mounting

1. With suitable lifting equipment e.g. 250kg (550 lb) minimum safe lifting rating, lift magnet 50mm (2") clear of shipping crate base.
2. Slide shipping crate base clear.
3. Lower magnet to 50mm (2") above floor.
4. Move magnet to final location and bolt magnet down through the four mounting holes provided in the magnet angle bracket (Item 4 on drawing 11907-0008-0).

Section 3

INSTALLATION

Pole Selection and Installation (Refer to drawing 11907-0008-0).
Using the field uniformity and induction curves determine the most desirable pole shape for the required pole gap. In general, the pole face side dimension should be equal or greater than the pole gap.

Pole removal (refer to drawing 11907-0008-0 and 11907-0010-0).
1. Turn off the power supply.
2. Loosen the two pole clamping bolts two full turns (item 4 on drawing 11907-0010-0).
3. Remove the eight cap securing screws and lock washers (item 29 and 39 on drawing 11907-0008-0).
4. Pull off the pole retainers (item 6 on drawing 11907-0008-0).
5. Pull the pole and pole spacer out of the magnet yoke about 75mm (3 inches).
6. Grip the pole with pole hands and gently side the pole out of the magnet yoke.
   Take care that the pole face is not damaged by contacting the magnet yoke.
7. Remove the pole retainer (item 6 on drawing 11907-0008-0).

Pole fitting (refer to drawing 11907-0008-0).
1. Ensure the poles and pole sleeves are clean and free from debris.
2. Reverse the above pole removal sequence above.

Electrical Circuit
NEVER CONNECT OR REMOVE CABLES FROM THE MAGNET WITH AC POWER ON THE POWER SUPPLY.). The terminal voltage may be lethal. The stored energy in the magnet can cause arcing resulting in severe injury to personnel or equipment damage.

The magnet has two coils which are connected in series, (refer to drawing 11907-0008-0 and the power supply cables should be connected directly to the current terminals marked + and -. Recommended current cable for the 5403AC is stranded copper of 16mm^2 cross section (4 AWG).

Because the magnet operates at high currents, special care should be taken to insure that the current terminations are secure and cannot work loose in operation. Local heating at the terminations can cause rapid oxidation leading to a high contact resistance and high power dissipation at the terminals. If left unattended this can cause enough local heating to damage the terminals and the coils.

Section 3

INSTALLATION

The 5403AC Interlocks
The Model 5403AC has two thermostats, Elmwood 3450G Part Number 3450G611-1 L50C 89/16. They are located on the center coil cooling plate and wired in series. The thermostats are normally closed, opening when the coil central cooling plate temperature exceeds 50°C +/3°C. When the Power Supply is provided by GMW, either thermal switch opening will turn the Power Supply to zero current until the switches reclose when the temperature drops below the nominal temperature. Note that the Power Supply is not "latched" permanently off.

Cooling
The Model 5403AC 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/°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 center coil cooling plate temperature exceeds approximately 50°C . Clean, cool (16°C - 20°C) water at 2 *l*/min at 0.5 bar (8 psid) should be used to cool the 5403AC 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 particulate and avoid unreliable operation of the water flow switch interlock (if fitted).

For continuous operation of the magnet it may be appropriate to use a recirculating chiller to reduce water and drainage costs. The chiller capacity will depend on whether cooling is required for the magnet alone or magnet and power supply. For the Model 5403AC Electromagnet alone, a suitable chiller is the Bay Voltex Model: MC-050.

For recirculating cooling systems, use distilled or deionized water with a biocide to prevent bacterial growth and corrosion. Do not use corrosion inhibitors in high quality electrical systems since the water conductivity is increased which can result in increased leakage currents and electrochemical corrosion.

At currents of approximately 20A and below the Model 5403AC can be operated safely without water cooling. However the coil temperature will vary with the power dissipation. This results in dimensional changes of the magnet yoke and air cooling is not suitable when high field stability is required.

Freon, oil, ethylene glycol or other cooling mediums can be used. The flow required will be approximately inversely proportional to their specific heats. An experimental determination of the flow and pressure required will be necessary.

Avoid cooling the magnet below the dew point of the ambient air. Condensation may cause electrical shorts and corrosion.

During operation the resistance can be checked using a voltmeter across each coil. The voltage will rise to a constant value once thermal equilibrium has been reached. If it is desired to save water, the flow can be reduced until the hot resistance is approached. NOTE: This adjustment must be made slowly enough to allow for the thermal inertia of the coils.

Section 4

OPERATION

General

The 5403AC magnet yoke and poles consist of thin, electrically isolated magnetic steel sheets/(or laminations) to reduce eddy current effects when the excitation current is changed. This results in fast field settling. The 5403AC can be operated with sine wave excitation at frequencies to about 100Hz. Due to the self inductance of about 220mH, even with a 500V applied voltage the peak current is limited to about 3.6A at 100Hz.

The pole gap of the 5403AC is set by pole gap spacers between the yoke and a flange on the outer end of the pole. Each pole gap spacer is of equal thickness and is half the desired pole gap. For a 20mm pole gap the pole spacer thickness is 10mm, and it is Part No 17907-0017-0-10 . The suffix of the part no denotes the pole spacer thickness.

Asymmetrical Pole Gap

For special applications and geometry requirements the pole gap can be asymmetrical in the yoke. In this case the pole spacers will be of unequal thickness, Refer to drawing 17907-0017-0-XX for pole spacer dimensional details.

Adjust the cooling water flow to about 2 liters/min (0.5 USgpm) for the 5403AC. For operation at less than maximum power the water flow may be correspondingly reduced. Note that the inlet water temperature will determine the actual flow rate required. The above specified flow rates were determined with a water inlet temperature of approximately 18°C.

Current Excitation

The induction curves may be used to estimate the field in the air gap to within four or five percent. More accurate field determination may be obtained by deriving experimentally a calibration curve for the particular pole and pole gap combination being used. Magnetic hysteresis in the yoke and poles can cause an error of 30 to 70G (3 to 7mT) with an arbitrary application of such a calibration curve. This effect may be reduced to less than one percent by following a prescribed 'current setting schedule' designed to make the magnet 'forget' its prior magnetic history. The schedule should be used both in establishing the calibration curve and in its subsequent use. A possible schedule would be:

From zero current, increase to maximum current and reduce again to zero current. Increase again to maximum current and reduce to the current to give the desired field setting. Approaching the desired field from a higher setting will typically produce better field uniformity. This is because the field changes at the pole edges will normally lag the field change at the center thereby helping to compensate the radial decrease in field.

Greater precision in setting up the calibration curve will be achieved with the use of a magnetic field teslameter and by making a numerical table. This table used with an interpolation routine will eliminate the error associated with reading a graph.

Continued

Section 4

OPERATION

Three points need to be remembered:

1. A calibration curve or table is only as good as the precision employed in generating it.

2. The field is defined only at the point it is measured. It will generally be different at a different point in the air gap. For example, the induction curves refer to the field on the pole axis and at the center of the air gap (median plane).

3. The field is most directly a function of the current in the magnet coils. Voltage across the coils is not a good measure of field since the electrical resistance of the coils depends on the temperature (about 0.4% per degree celsius).

Section 4

OPERATION

Field Control Operation

The necessity to use calibration curves can be avoided by using a field controller to sense the magnetic field and provide a corresponding power supply control signal through the power supply programming inputs. Contact GMW for suitable instrumentation.

Section 5

MAINTENANCE

Periodically check that the pole adjustment mechanism (when fitted) is clean, properly lubricated and free of grit and dirt. Be very careful not to damage the relatively soft pole surface since this may degrade the magnetic field uniformity in the gap.

Note that the surface treatments used provide good corrosion protection but in order to maintain the inherent mechanical precision of the magnet, heavy build-up of plating material or paint is deliberately avoided. As a result, high humidity or otherwise seriously corrosive atmospheres can cause corrosion. Periodically apply an appropriate corrosion protection on plated components, particularly when the magnet is stored for an extended period.

Check the cooling water circuit to ensure the water is clean and free of debris and bacterial growth. Ensure the in-line water filter is clean.

Section 6

STANDARD OPTIONS

Drawing 11907-0015-0 5403AC Electromagnet/Probe Mount General Assembly

PROPRIETARY
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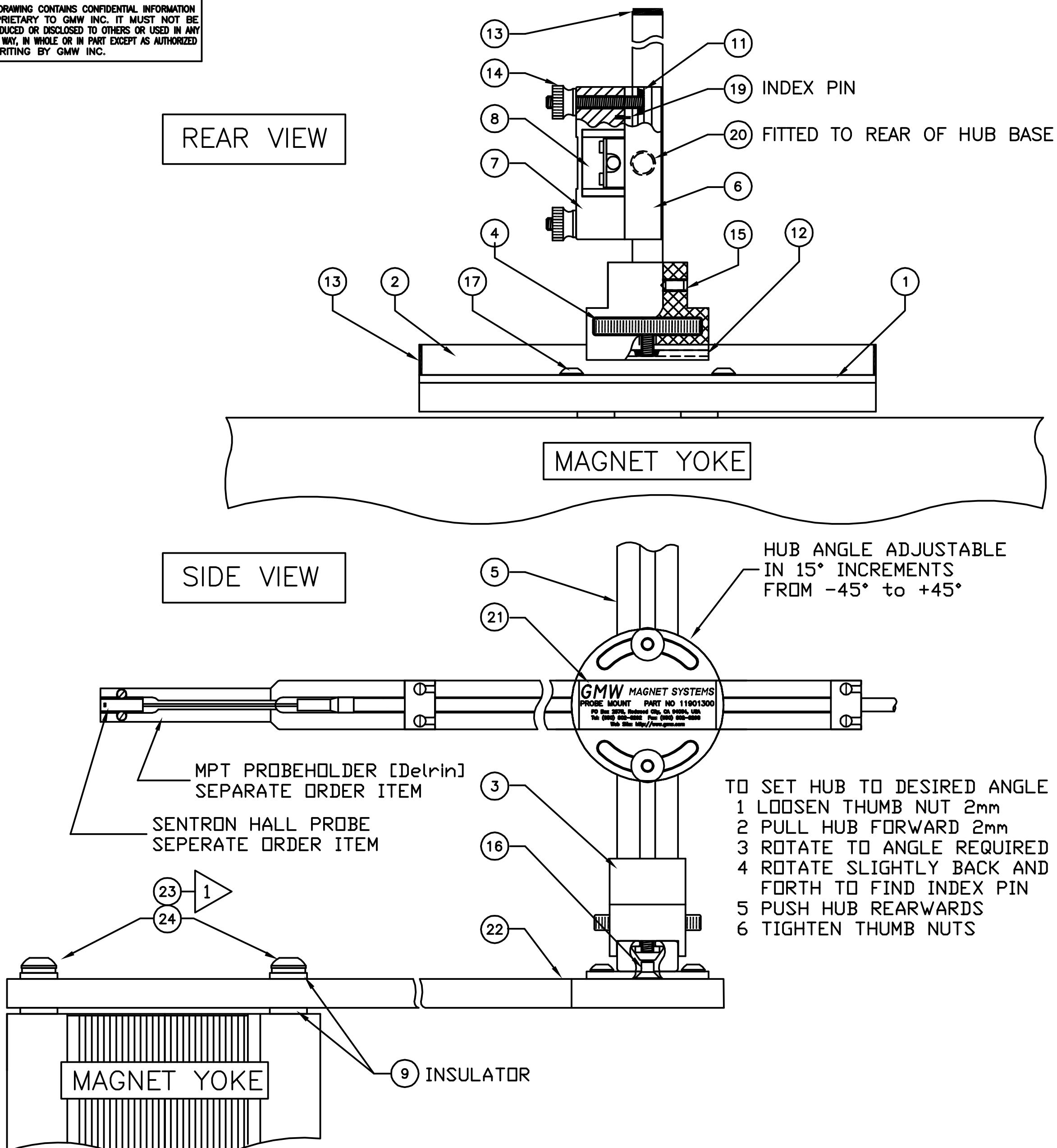


REVISIONS

REV	DESCRIPTION	DRAFT	DATE	APPROVED
A	RELEASE		06/13/05	G.DOUGLAS

NOTE:

1 MOUNTING SCREWS ITEMS 23 AND 24 ARE SUPPLIED WITH 5403AC ELECTROMAGNET SEE DWG NO: 11907-0008-0 FOR PROBE MOUNT LOCATION ON MAGNET YOKE.

ITEM	QTY	PART NUMBER	DESCRIPTION	NOTE
24	4	ISO 7380	SHCS M6 X 12 BUTTON HD S/S	1
23	4	DIN 433	WASHER, M6 X 1.6 FLAT S/S	1
22	1	17907-0032-0	PROBE MOUNT- MAGNET MOUNTING PLATE	
21	1	10900320	LABEL, INDENTIFICATION	
20	1	SBMH8	BALL PLUNGER, M8 S/S VLIER	
19	2	VSM 12771B	DOWEL PIN M1 X 5 S/S [Index Pin]	
18	1	BN 1073	SET SCREW, M6 X 5 SLOTTED HD NYLON	
17	4	ISO 7380	SHCS M4 X 8 BUTTON HD S/S	
16	5	DIN 7991	SHCS, M4 X 6 FLAT HEAD S/S	
15	2	DIN 917	SHSS M4 X 8 CONE POINT S/S	
14	2	08M040070TN	THUMB NUT, NYLON	
13	3	18-830	ITEM PRODUCTS, END CAP, PLASTIC	
12	1	17902010	BASE STUD	
11	1	17902000	HUB STUD	
10			Deleted	
9	4	178-822	INSULATOR, NYLON R/S	
8	1	17901970	HUB INSERT [for Grp3 MPT Hall Probes]	
7	1	17901960	HUB COVER	
6	1	17901950	HUB BASE	
5	1	17901943	VERTICAL MOUNTING EXTRUSION [200mm long]	
4	1	17901930	BASE NUT	
3	1	17901920	BASE SUPPORT	
2	1	17902090	BASE MOUNTING EXTRUSION	
1	1	17902080	BASE MOUNTING PLATE	

PARTS LIST

DRAWN	DATE
G.DOUGLAS	06/13/05
CHECK	DATE
ENGINEERING	DATE
NEXT ASSY	SYSTEM

SOFTWARE AUTOCAD 2000

DO NOT SCALE FROM DRAWING
DIMENSIONS & TOLERANCES (UNLESS OTHERWISE SPECIFIED)

LINEAR	INCHES	mm
X.XXX	±.005	±0.03
X.XX	±.01	±0.1
X.X	±.03	±0.3
X	±.06	±1
DEG.	±.5	±0.5
FINISH	63	1.6

THIRD ANGLE PROJECTION

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

TITLE
PROBE ASSEMBLY MODEL: 5403AC

SIZE	DRAWING NO.	REV
A2	11907-0015-0	A

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

Section 7

CUSTOM OPTIONS

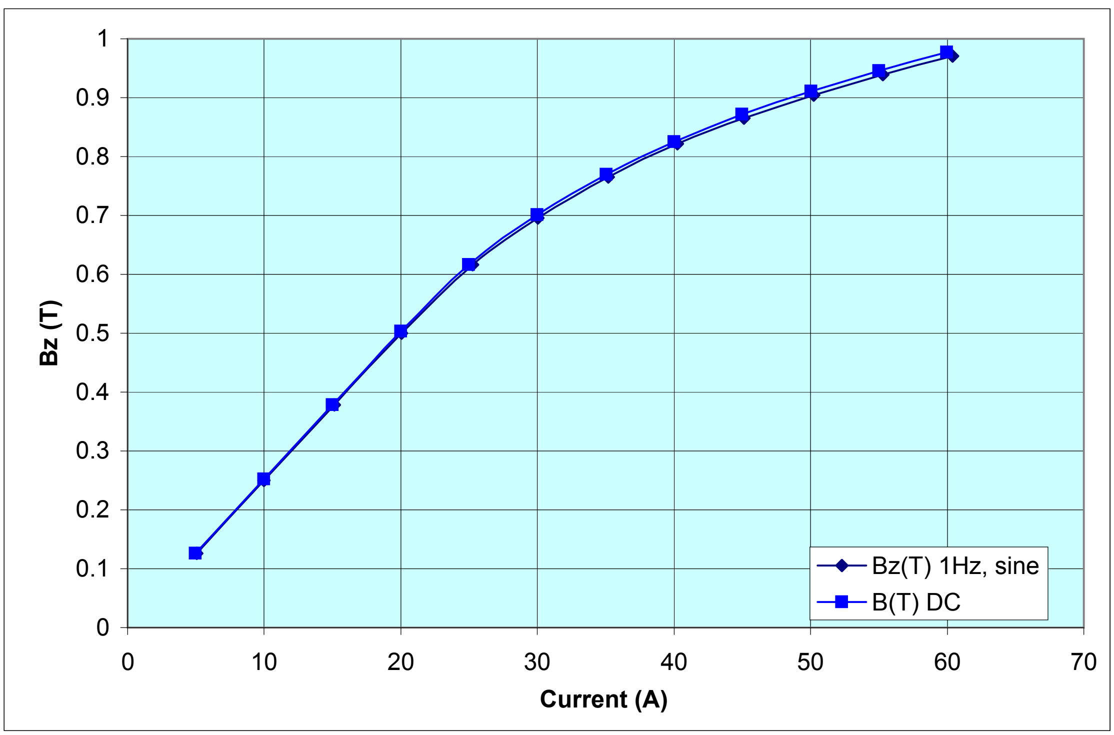
Section 8

EXCITATION CURVES

GMW ASSOCIATES
Electromagnet B vs.I Excitation

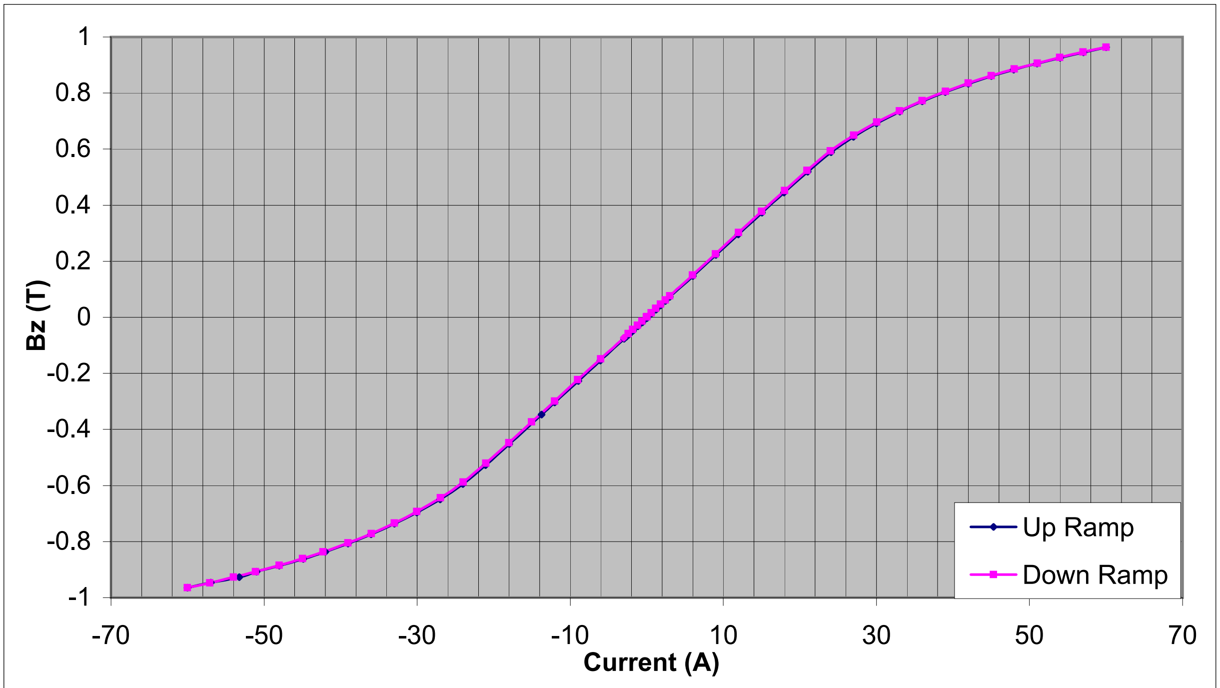
Model:	5403AC	Engr:	Y.Q.
Serial No:	1	Date:	10/4/2005
Pole Face:	32mmx32mm, square	Page:	1 of 1
Pole gap:	32mm		
Power Supply:	Copley 231P		
PS SN:	2905901		
Position:	X=Y=Z=0mm		

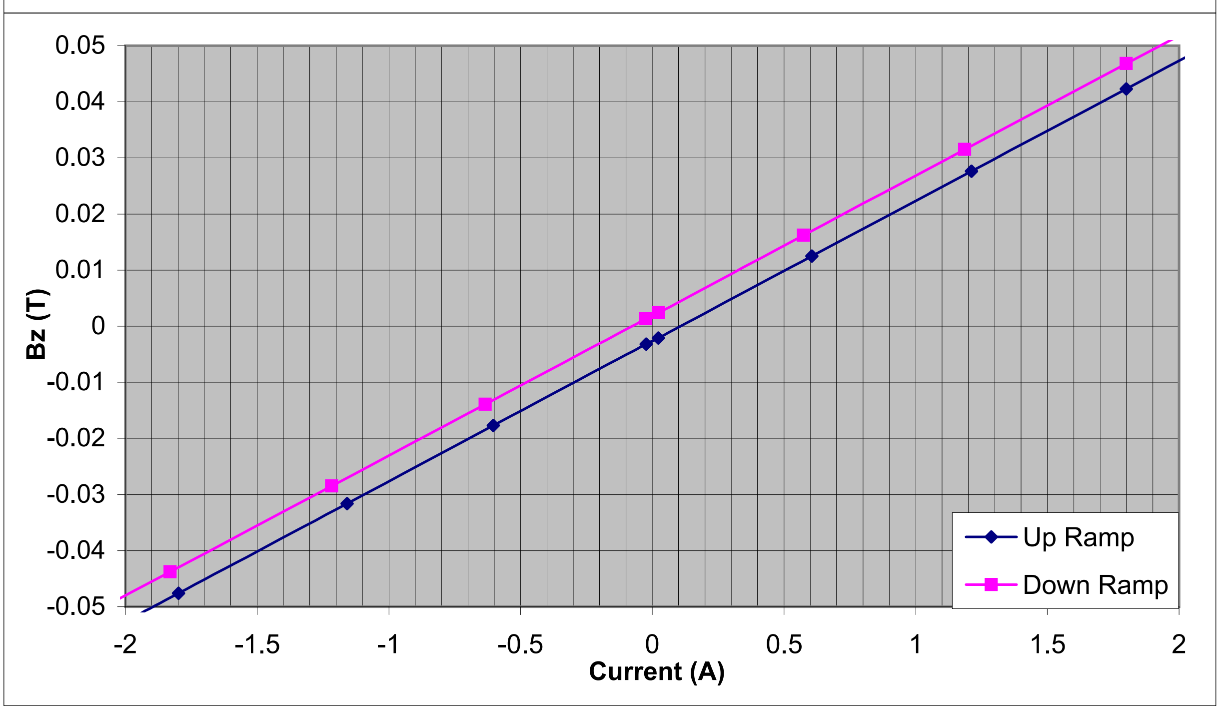
I(A)	Bz(T) 1Hz, sine	I(A)	B(T) DC
5.0684	0.1259	4.9898	0.125869
9.9805	0.2495	9.9846	0.252405
15.144	0.3782	14.9934	0.378339
20.0439	0.5	20.0177	0.503581
25.2686	0.616	24.9843	0.616341
30.0488	0.6956	29.9704	0.700792
35.1685	0.7651	35.0431	0.769258
40.2417	0.8218	40.0122	0.825283
45.1147	0.8655	44.9789	0.871521
50.2466	0.9048	50.0495	0.911013
55.2686	0.9388	55.0206	0.945466
60.3931	0.9708	59.9817	0.97675



GMW ASSOCIATES
Electromagnet Hysteresis Plot

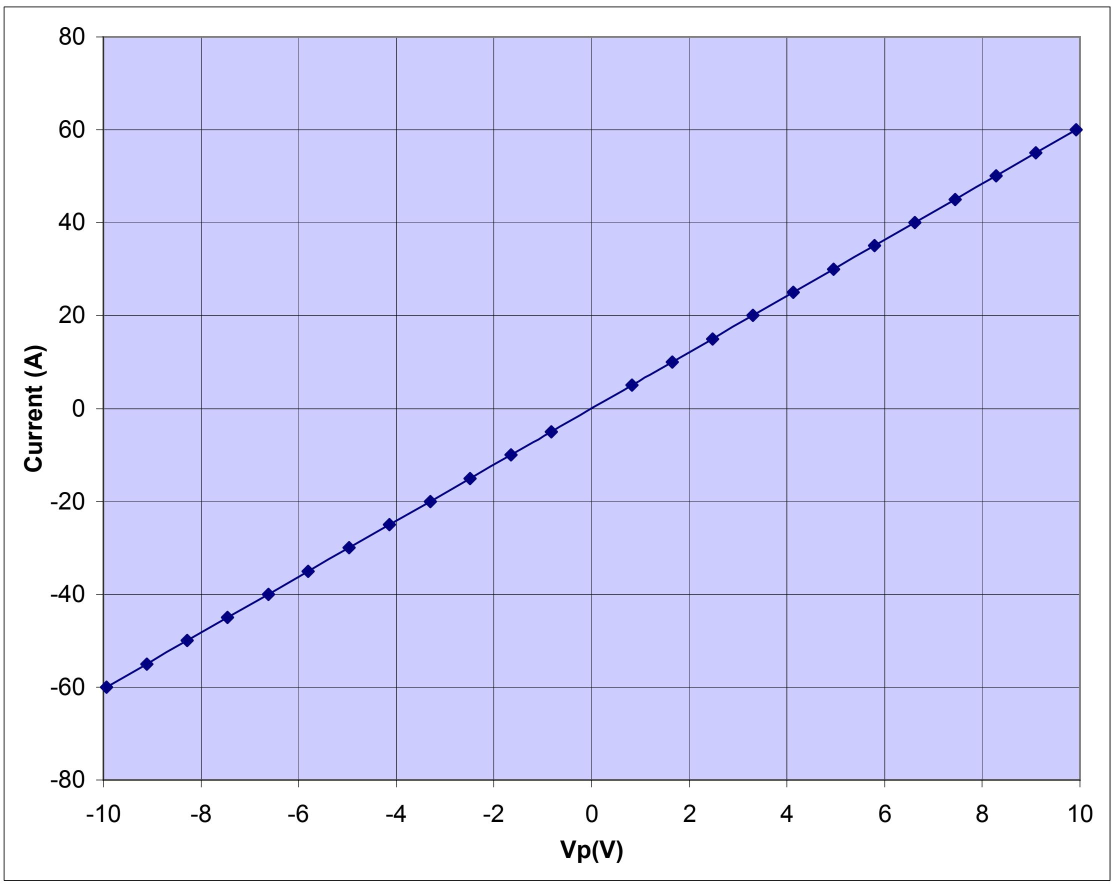
Model:	5403AC	Engr:	Y.Q.
Serial No:	1	Date:	10/7/2005
Pole Face:	32mmx32mm, square	Page:	1 of 1
Pole gap:	32mm		
Power Supply:	Copley 231P		
PS SN:	2905901		
Position:	X=Y=Z=0mm		
Current:	DC		





GMW ASSOCIATES
Power Supply I vs. Vp

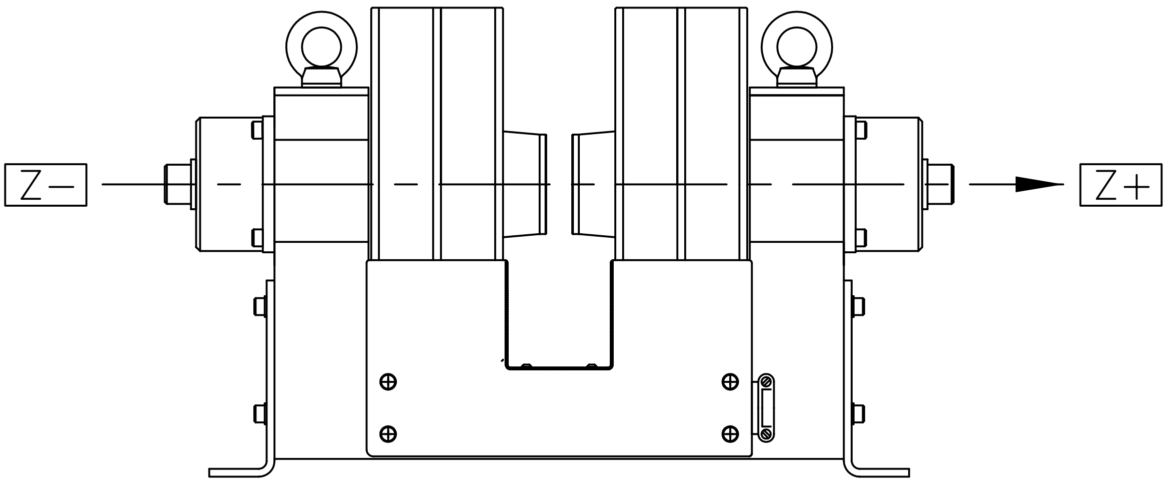
Power Supply:	Copley	Engr:	Y.Q.
Model:	231P	Date:	10/4/2005
PS SN:	2905901	Page:	1 of 1



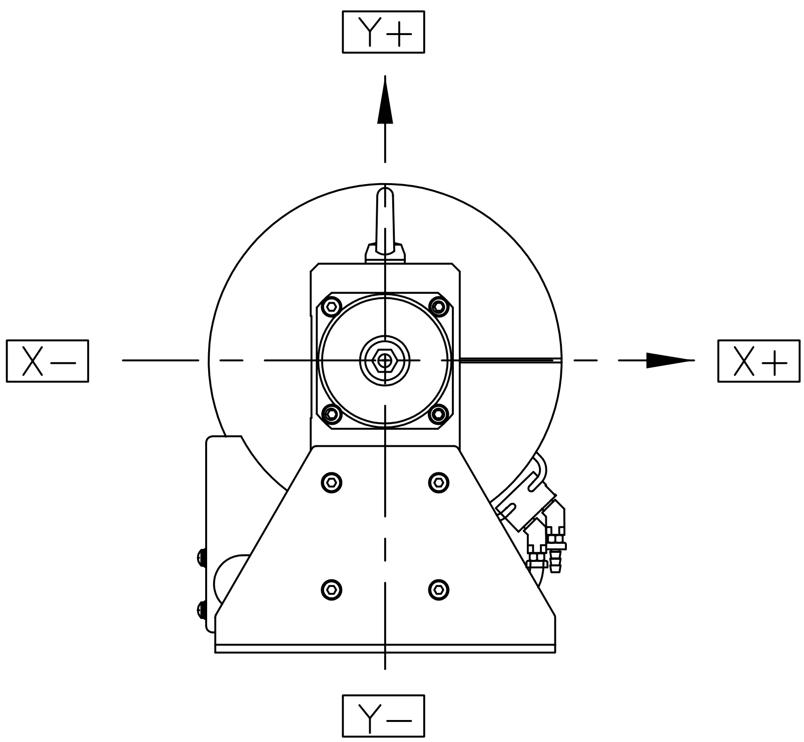
Section 9

TEST DATA

FRONT VIEW



SIDE VIEW



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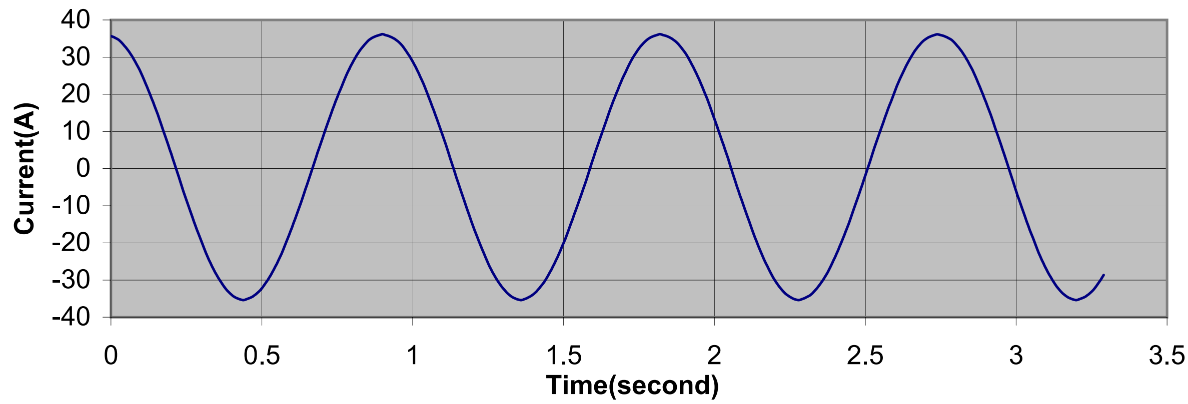
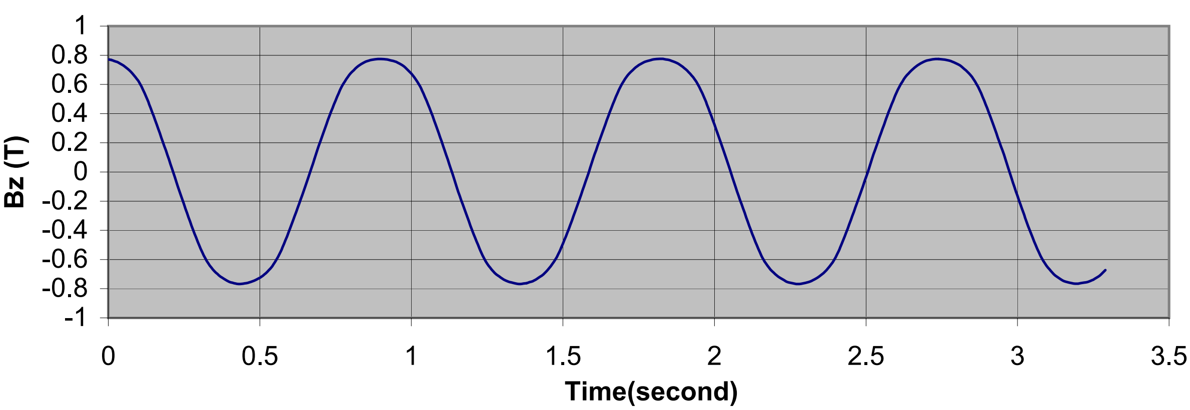
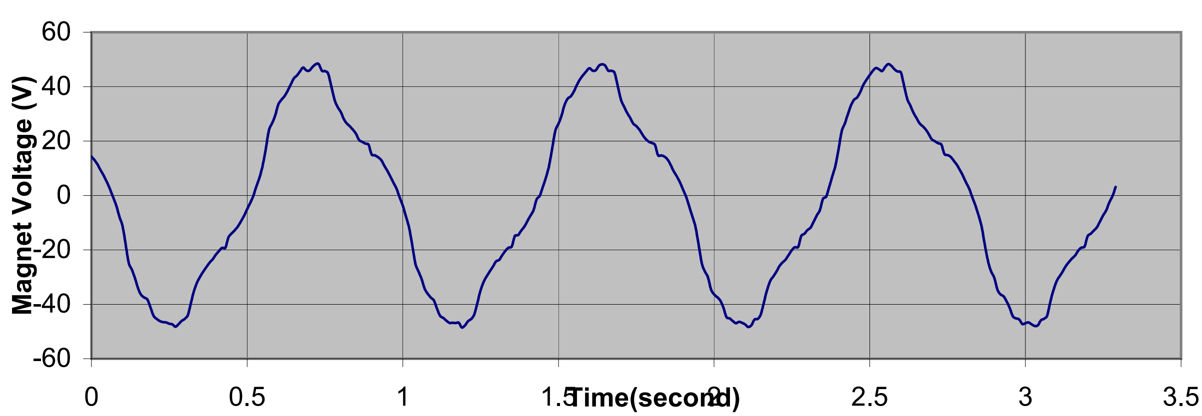
MAGNETIC PLOTTING AXES		
18900740	A	SHEET 1 OF 1

GMW ASSOCIATES
Electromagnet: Typical Waveform

Model:	5403AC	Engr:	Y.Q.
Serial No:	1	Date:	10/4/2005
Pole Face:	32mmx32mm, square	Page:	1 of 1
Pole gap:	32mm		
Power Supply:	Copley 231P		
PS SN:	2905901		
Position:	X=Y=Z=0mm		
Current:	I=+/-35A peak to Peak		
Frequency:	1Hz		
Waveform:	Sine		

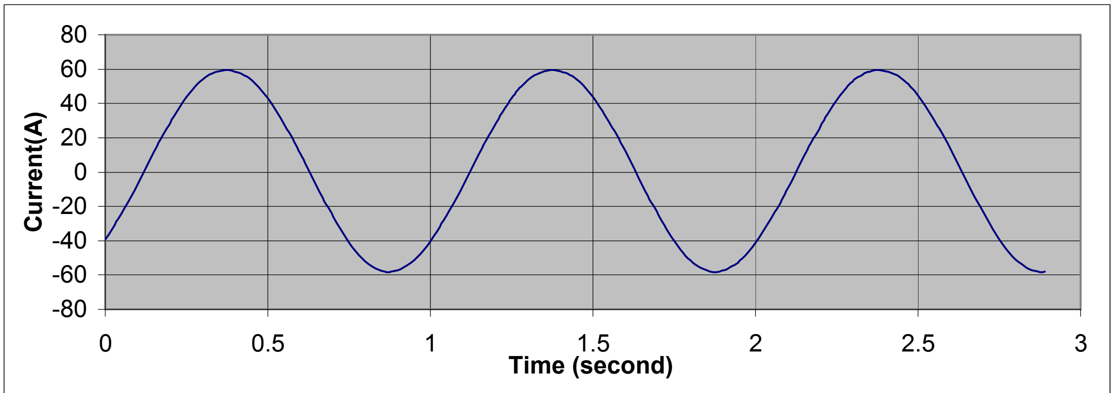


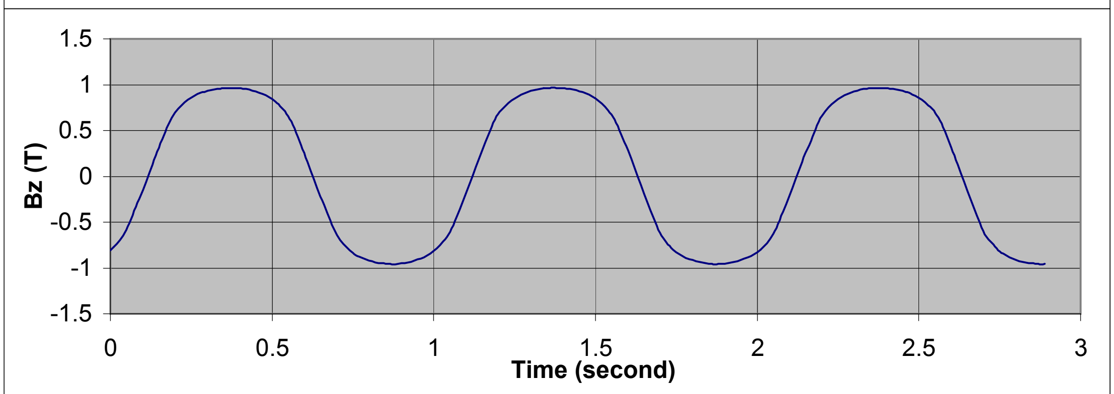


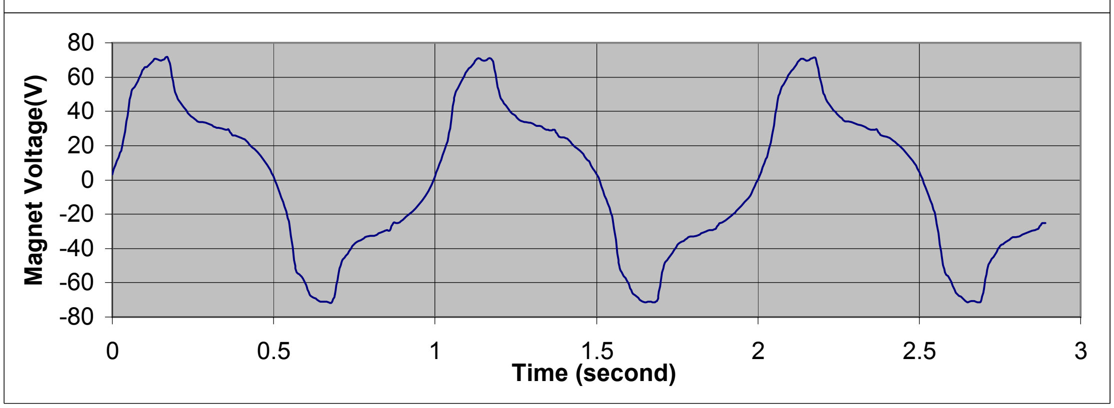


GMW ASSOCIATES
Electromagnet: Typical Waveform

Model:	5403AC	Engr:	Y.Q.
Serial No:	1	Date:	10/4/2005
Pole Face:	32mmx32mm, square	Page:	1 of 1
Pole gap:	32mm		
Power Supply:	Copley 231P		
PS SN:	2905901		
Position:	X=Y=Z=0mm		
Current:	I=+/-60A peak to Peak		
Frequency:	1Hz		
Waveform:	Sine		

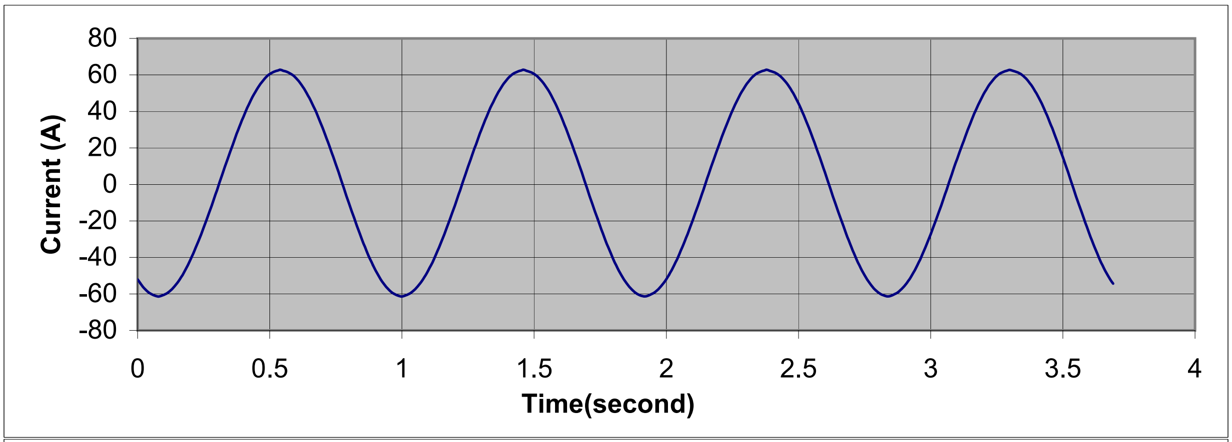


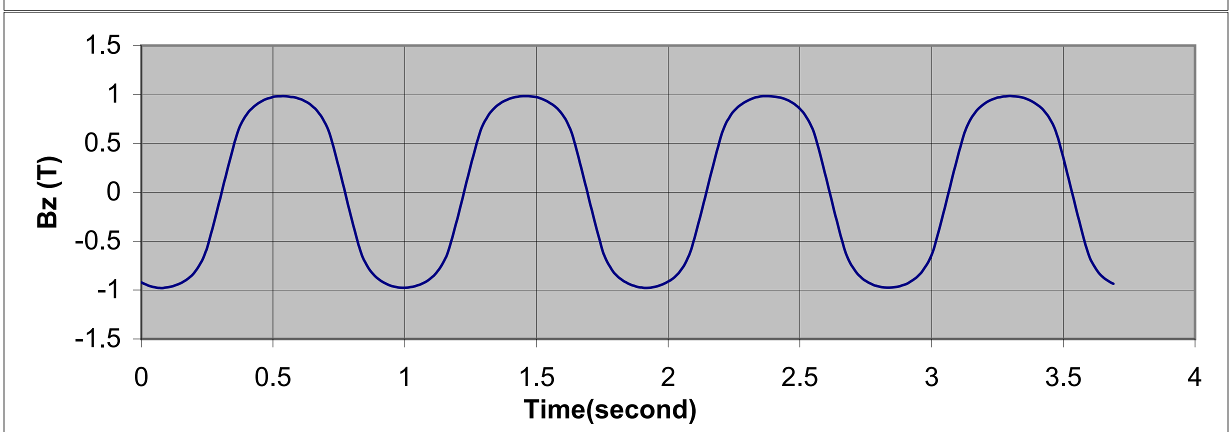


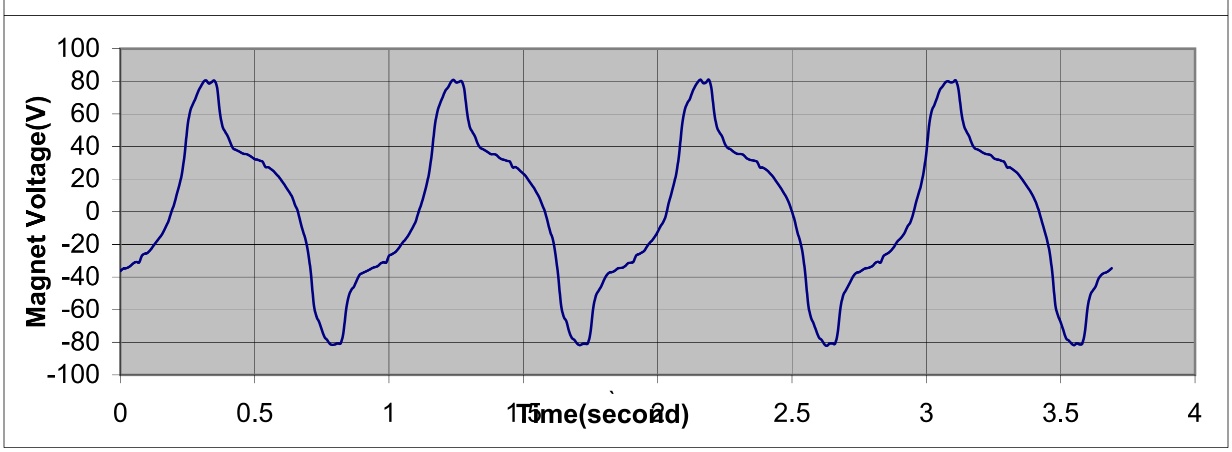


GMW ASSOCIATES
Electromagnet: Typical Waveform

Model:	5403AC	Engr:	Y.Q.
Serial No:	1	Date:	10/4/2005
Pole Face:	32mmx32mm, square	Page:	1 of 1
Pole gap:	32mm		
Power Supply:	Copley 231P		
PS SN:	2905901		
Position:	X=Y=Z=0mm		
Current:	I=+/-MAX (62A) Peak to Peak		
Frequency:	1Hz		
Waveform:	Sine		

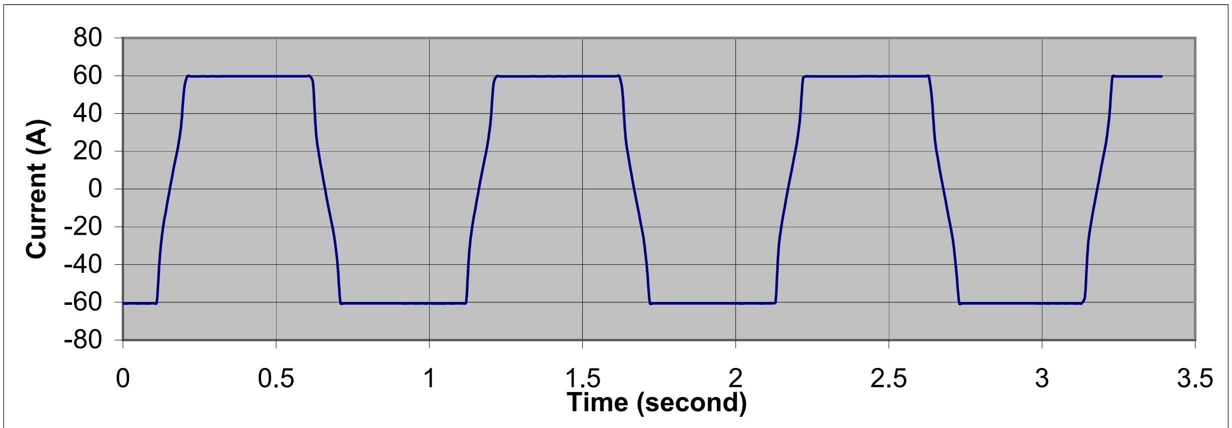


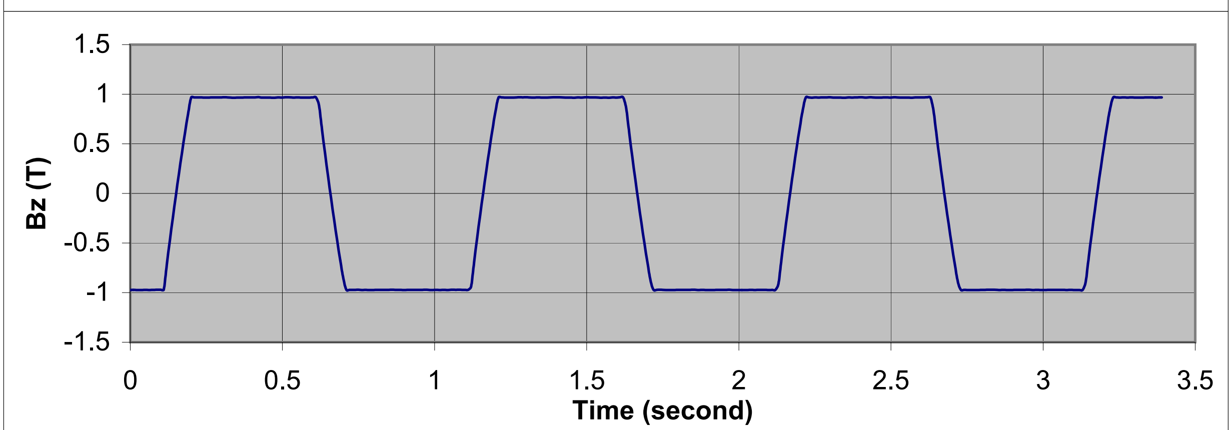


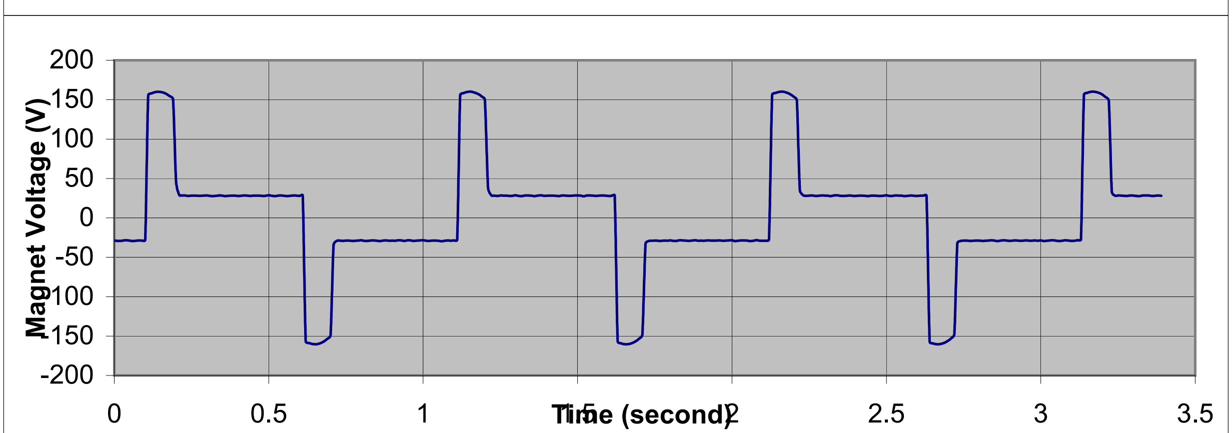


GMW ASSOCIATES
Electromagnet: Typical Waveform

Model:	5403AC	Engr:	Y.Q.
Serial No:	1	Date:	10/4/2005
Pole Face:	32mmx32mm, square	Page:	1 of 1
Pole gap:	32mm		
Power Supply:	Copley 231P		
PS SN:	2905901		
Position:	X=Y=Z=0mm		
Current:	I=+/-60A peak to Peak		
Frequency:	1Hz		
Waveform:	Square		

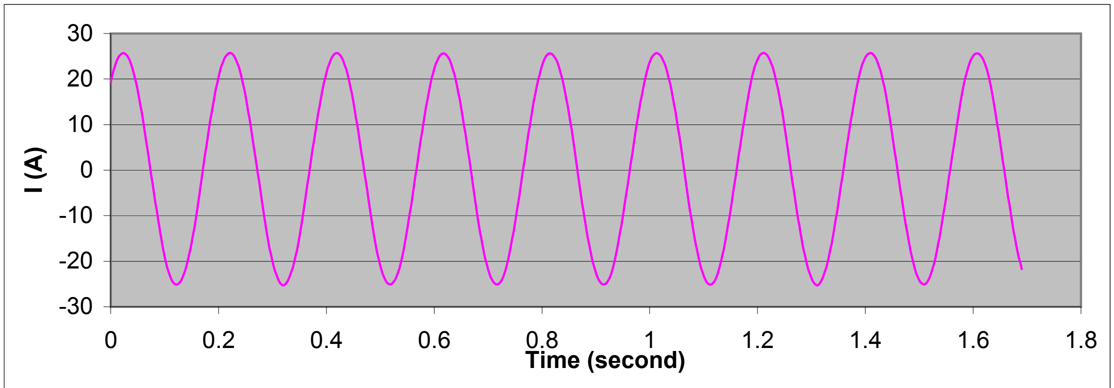


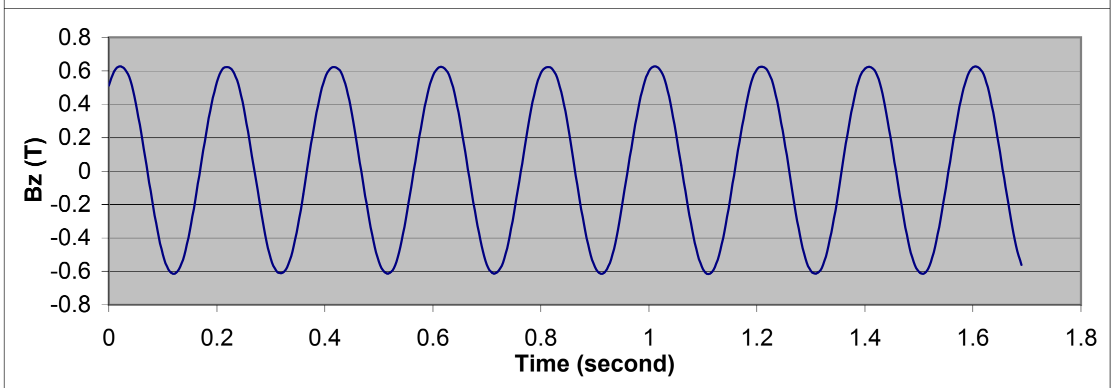


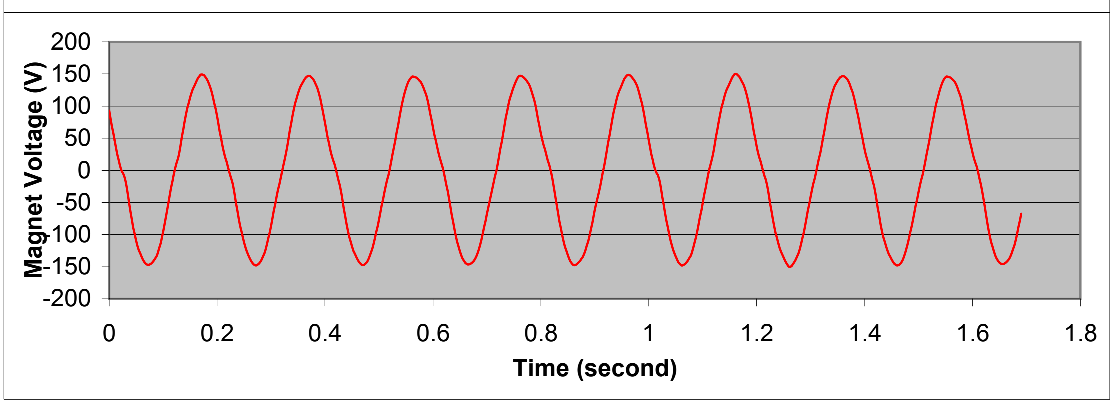


GMW ASSOCIATES
Electromagnet: Typical Waveform

Model:	5403AC	Engr:	Y.Q.
Serial No:	1	Date:	10/4/2005
Pole Face:	32mmx32mm, square	Page:	1 of 1
Pole gap:	32mm		
Power Supply:	Copley 231P		
PS SN:	2905901		
Position:	X=Y=Z=0mm		
Current:	I=+/-25A peak to peak		
Frequency:	5Hz		
Waveform:	Sine		

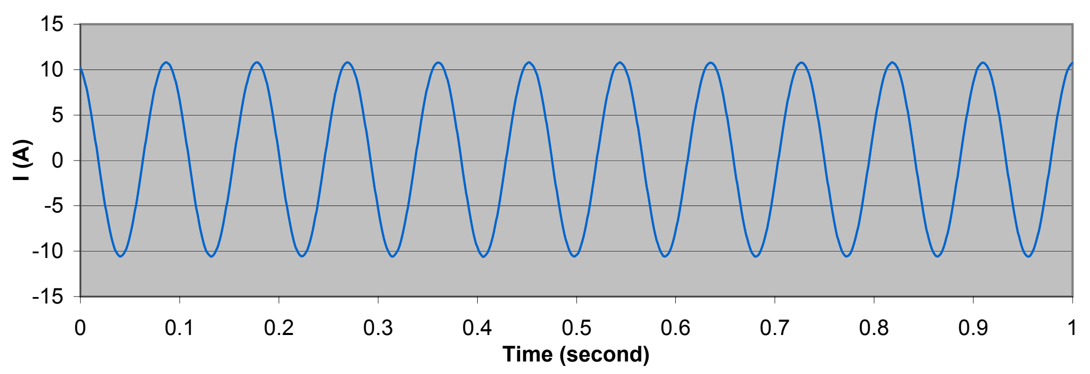


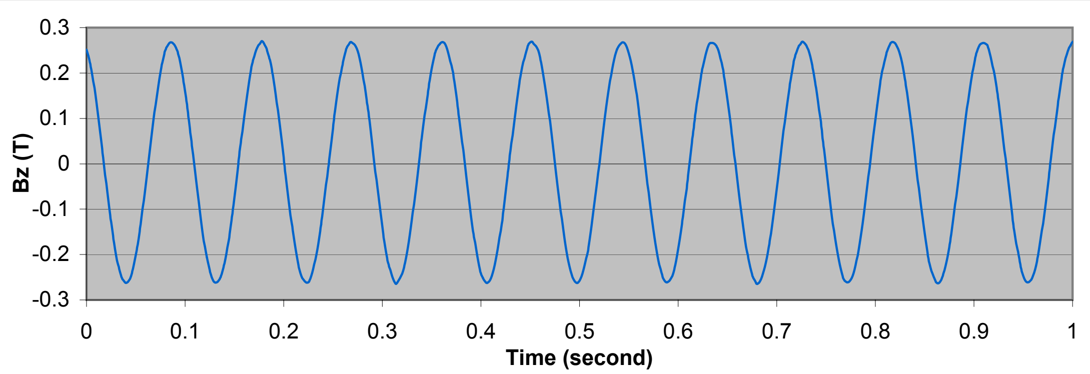


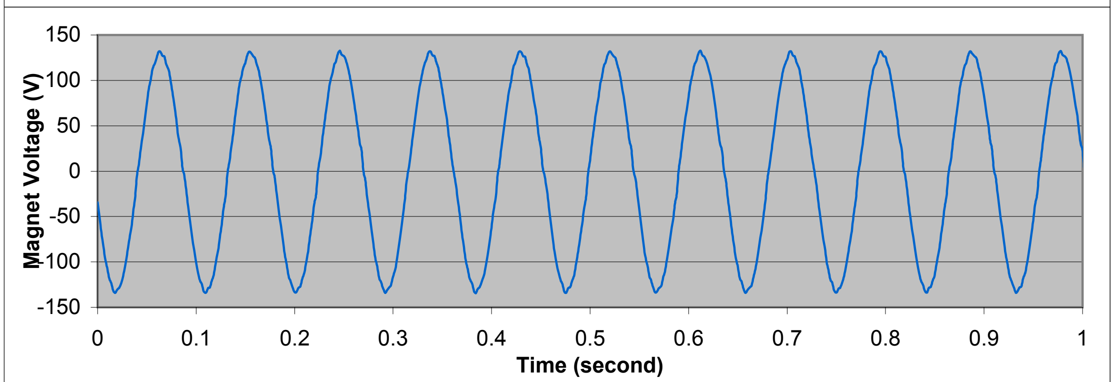


GMW ASSOCIATES
Electromagnet: Typical Waveform

Model:	5403AC	Engr:	Y.Q.
Serial No:	1	Date:	10/4/2005
Pole Face:	32mmx32mm, square	Page:	1 of 1
Pole gap:	32mm		
Power Supply:	Copley 231P		
PS SN:	2905901		
Position:	X=Y=Z=0mm		
Current:	I=+/-11A peak to peak		
Frequency:	10Hz		
Waveform:	Sine		

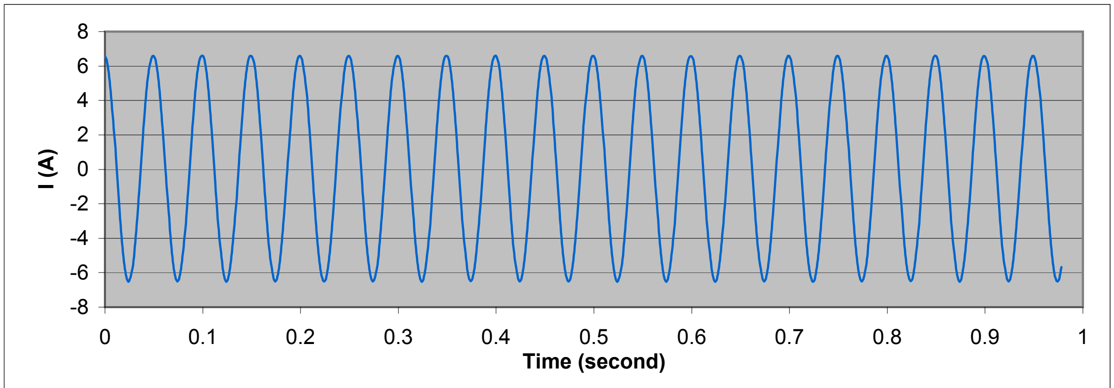


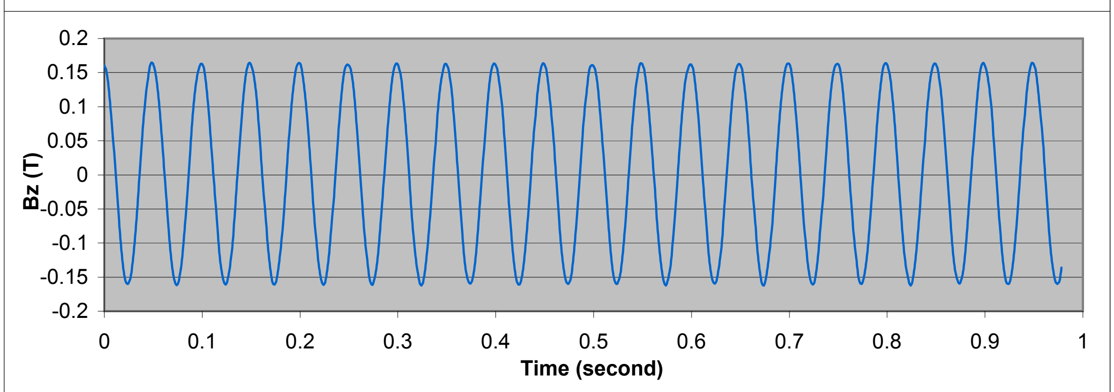


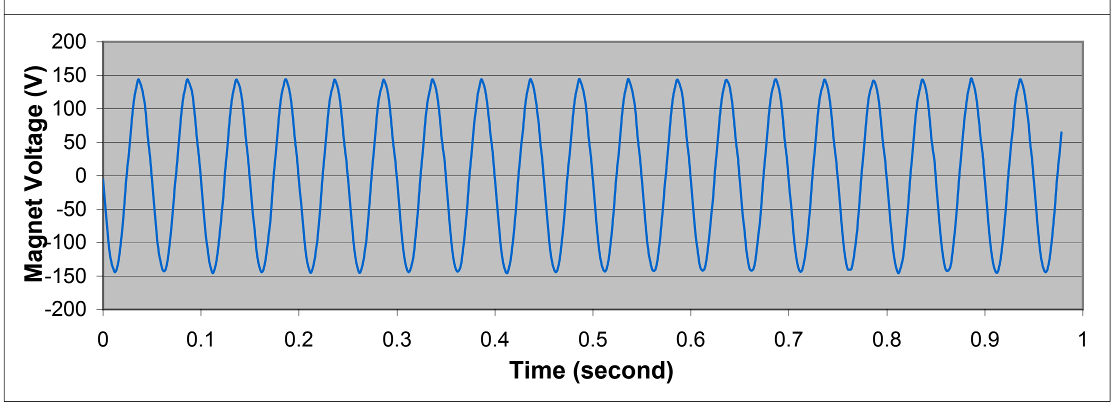


GMW ASSOCIATES
Electromagnet: Typical Waveform

Model:	5403AC	Engr:	Y.Q.
Serial No:	1	Date:	10/4/2005
Pole Face:	32mmx32mm, square	Page:	1 of 1
Pole gap:	32mm		
Power Supply:	Copley 231P		
PS SN:	2905901		
Position:	X=Y=Z=0mm		
Current:	I=+/-7A peak to peak		
Frequency:	20Hz		
Waveform:	Sine		

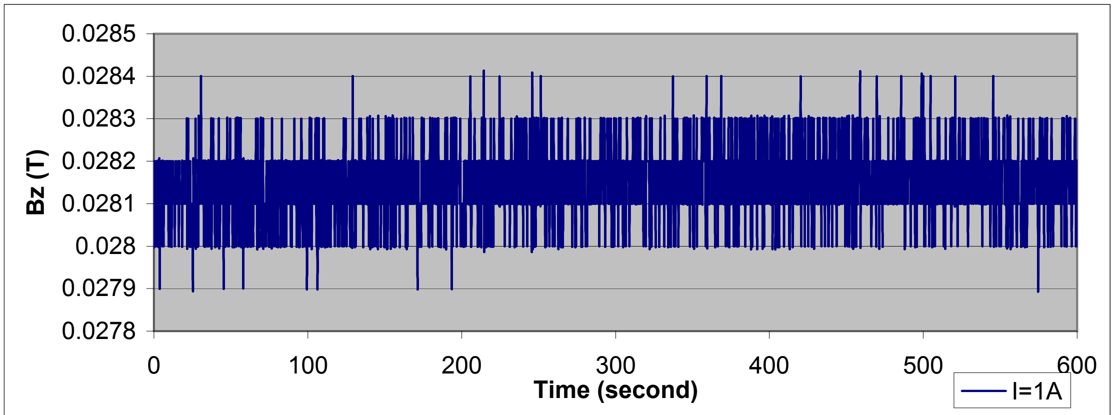


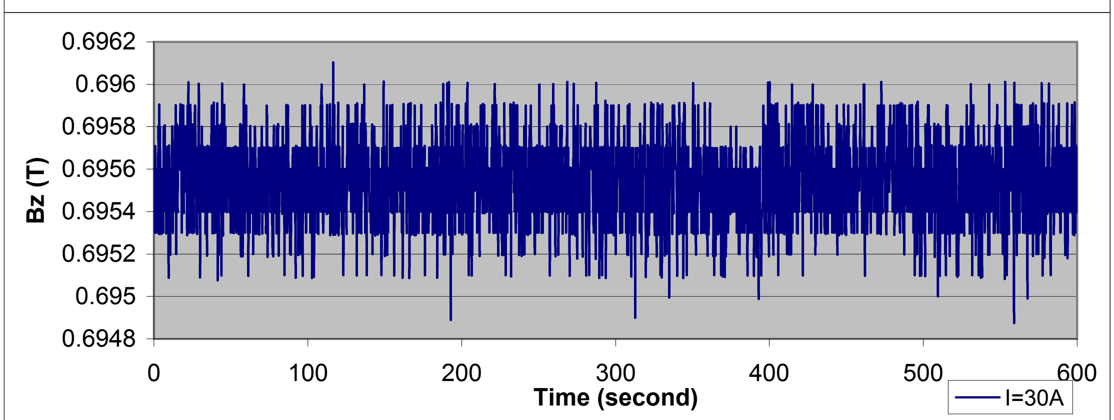


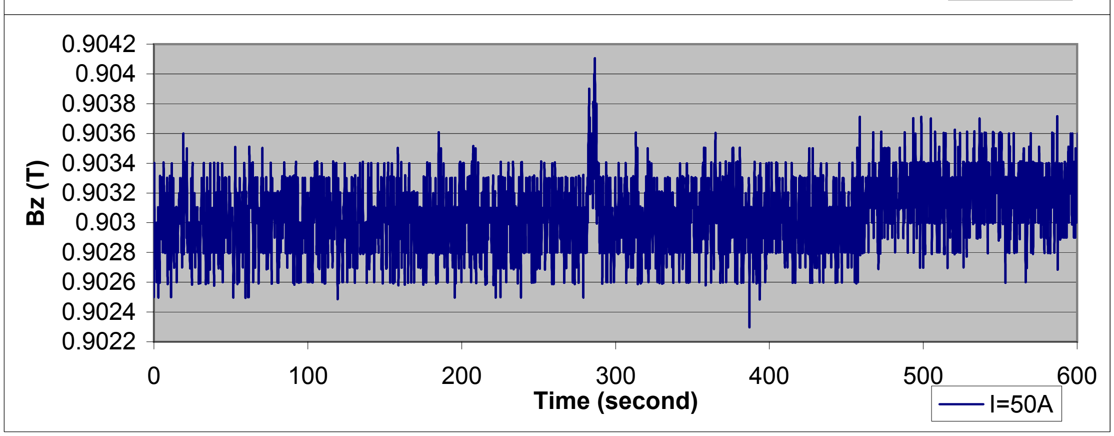


GMW ASSOCIATES
Electromagnet Stability Plot-Field

Model:	5403AC	Engr:	Y.Q.
Serial No:	1	Date:	10/4/2005
Pole Face:	32mmx32mm, square	Page:	1 of 3
Pole gap:	32mm		
Power Supply:	Copley 231P		
PS SN:	2905901		
Position:	X=Y=Z=0mm		
Current:	I=1A, 30A, 50A, DC		

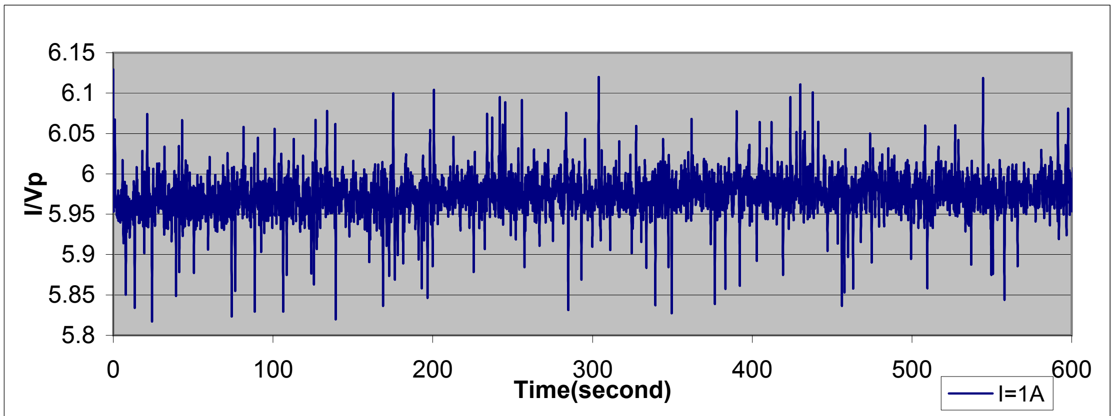


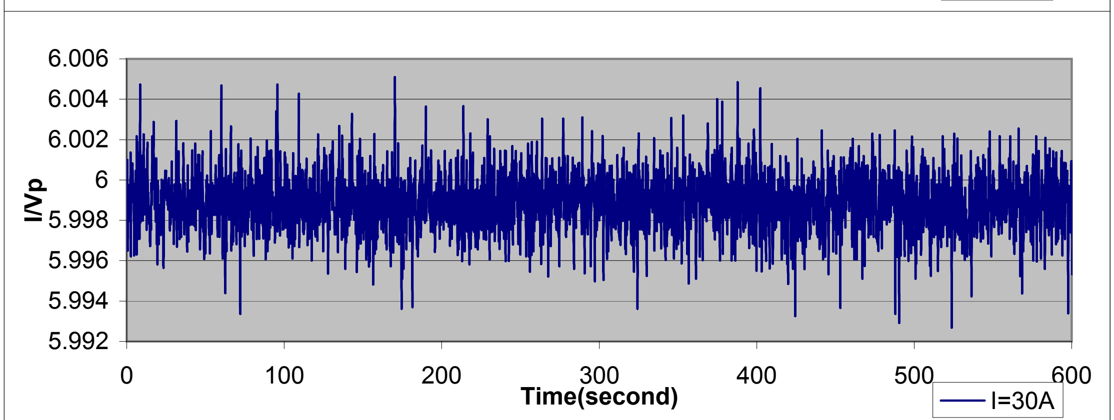


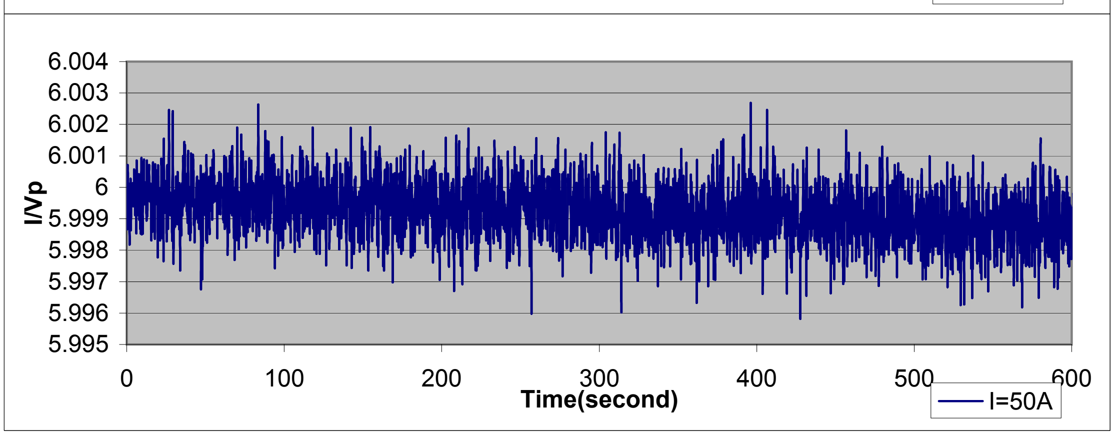


GMW ASSOCIATES
Electromagnet Stability Plot-Current over Vp

Model:	5403AC	Engr:	Y.Q.
Serial No:	1	Date:	10/4/2005
Pole Face:	32mmx32mm, square	Page:	2 of 3
Pole gap:	32mm		
Power Supply:	Copley 231P		
PS SN:	2905901		
Position:	X=Y=Z=0mm		
Current:	I=1A, 30A, 50A, DC		

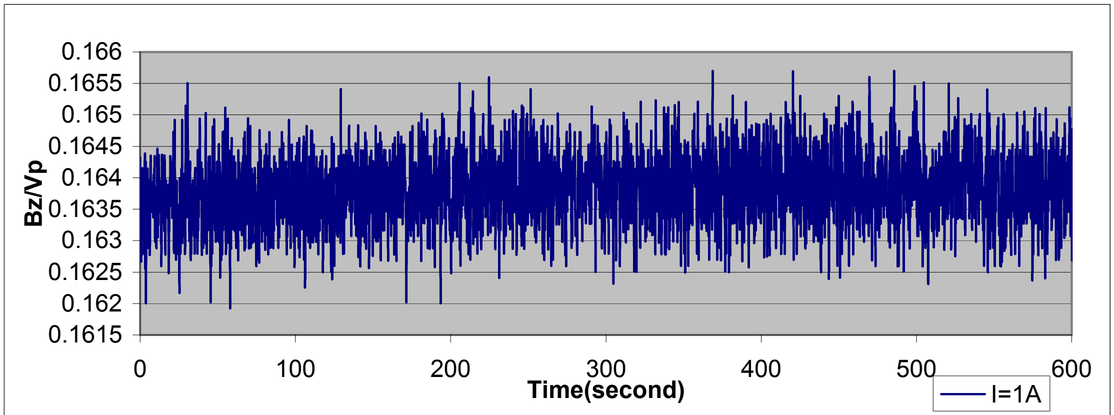


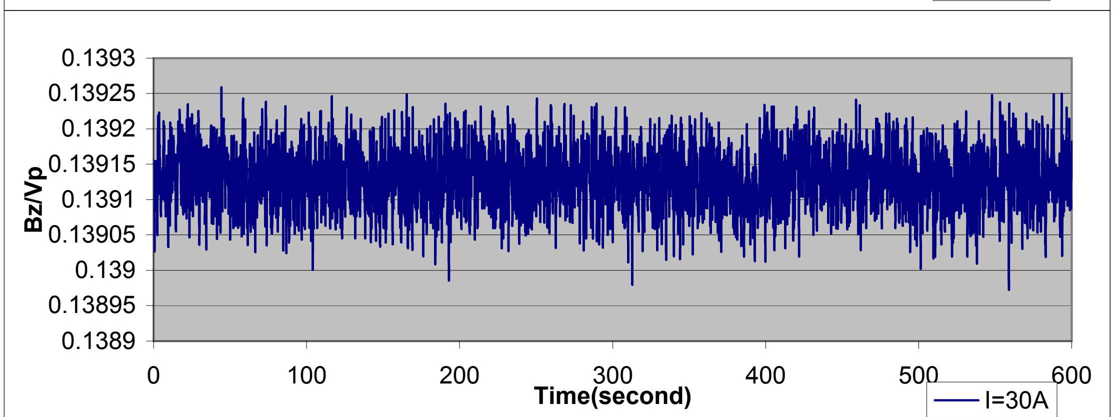


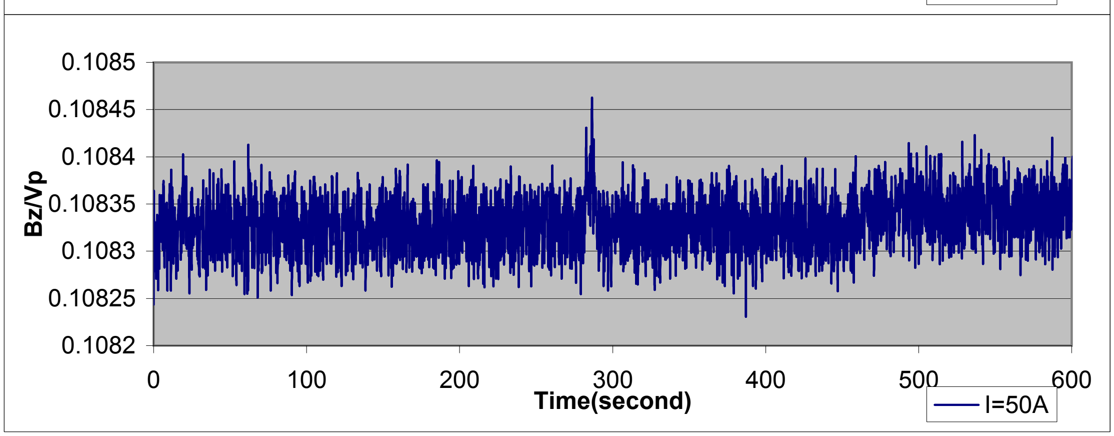


GMW ASSOCIATES
Electromagnet Stability Plot-Field over Vp

Model:	5403AC	Engr:	Y.Q.
Serial No:	1	Date:	10/4/2005
Pole Face:	32mmx32mm, square	Page:	3 of 3
Pole gap:	32mm		
Power Supply:	Copley 231P		
PS SN:	2905901		
Position:	X=Y=Z=0mm		
Current:	I=1A, 30A, 50A, DC		

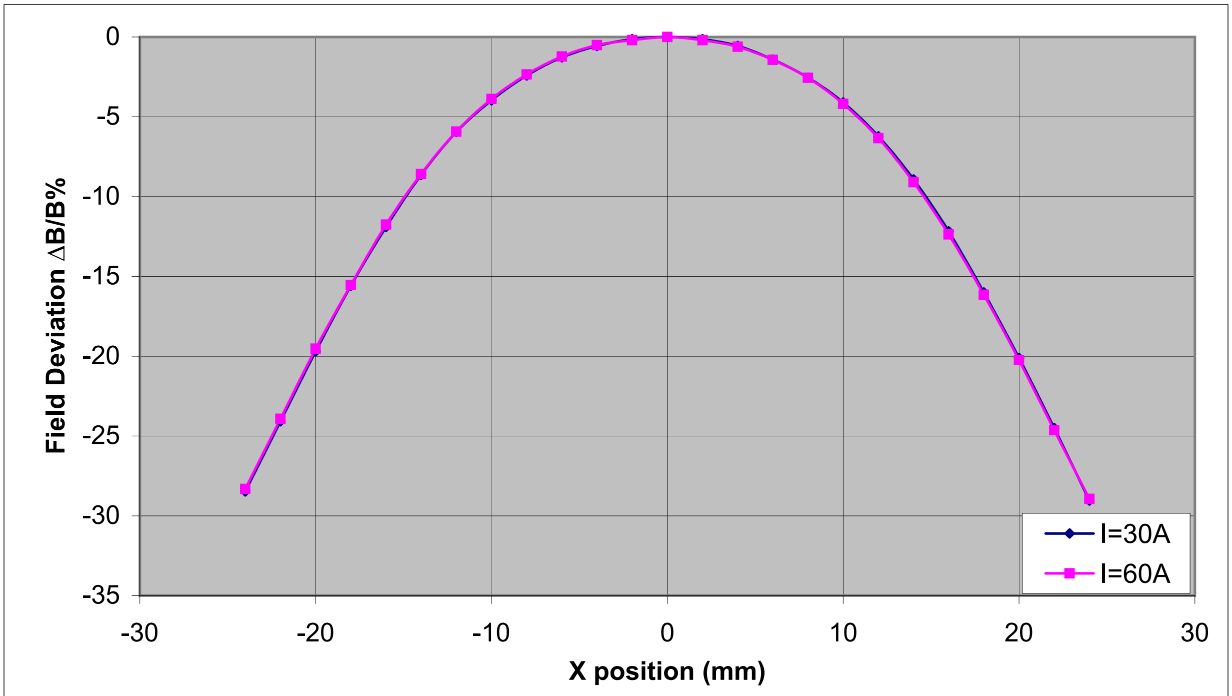


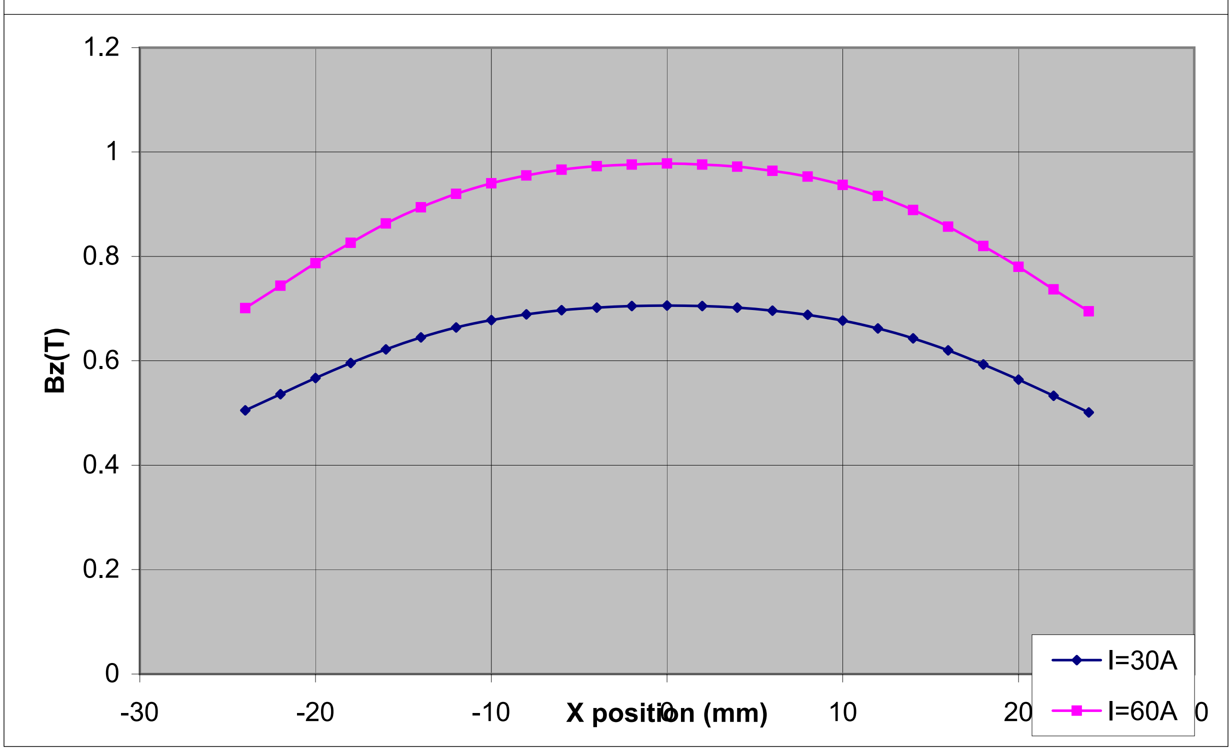




GMW ASSOCIATES
Electromagnet Uniformity Plot-DC field

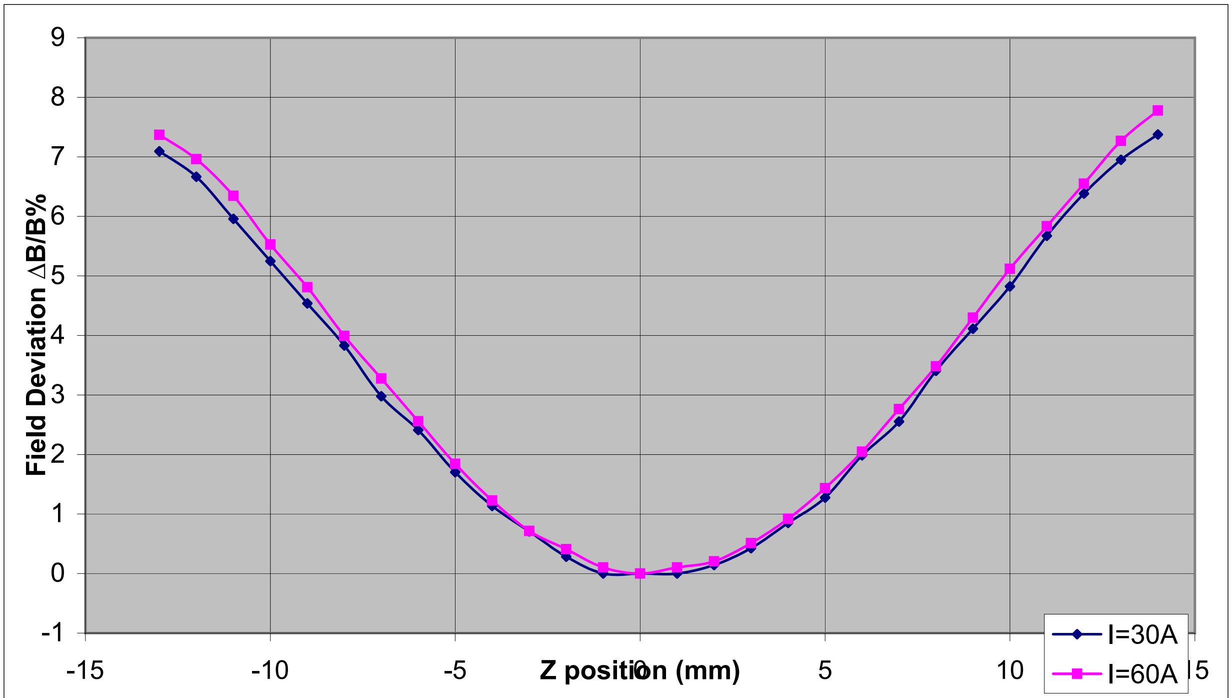
Model:	5403AC	Engr:	Y.Q.
Serial No:	1	Date:	10/4/2005
Pole Face:	32mmx32mm, square	Page:	1 of 2
Pole gap:	32mm		
Power Supply:	Copley 231P		
PS SN:	2905901		
Position:	Y=Z=0mm		
Current:	30A, 60A DC		

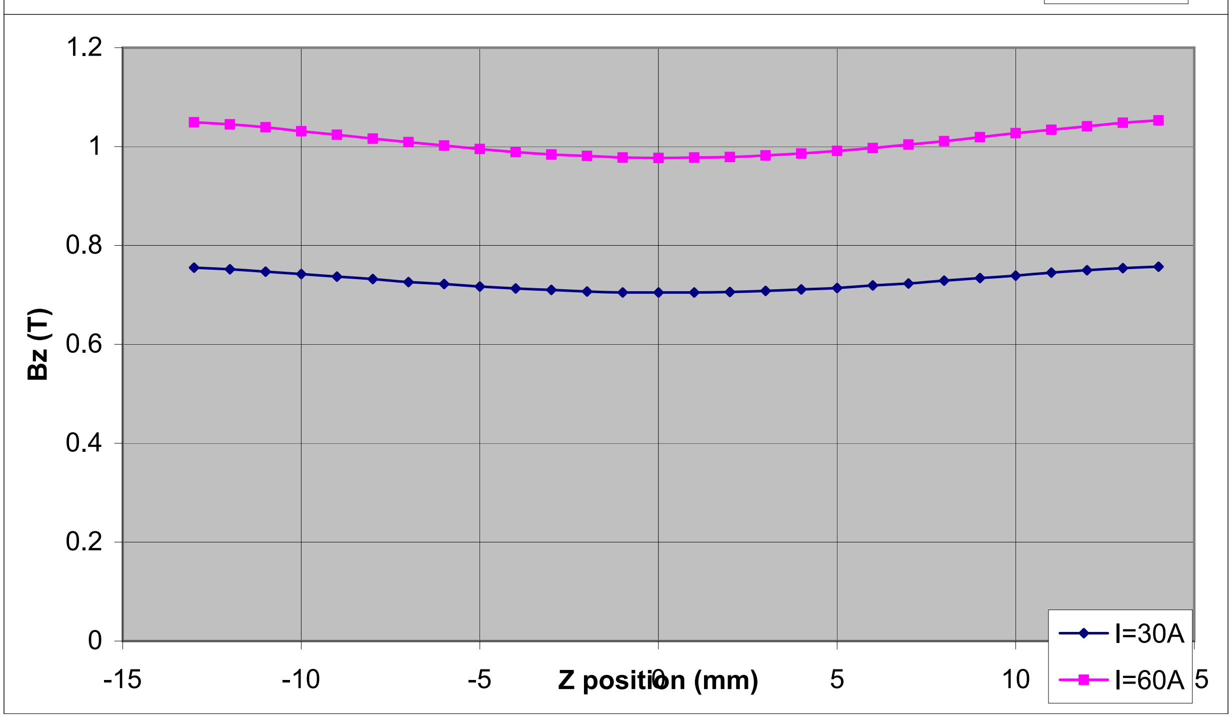




GMW ASSOCIATES
Electromagnet Uniformity Plot-DC field

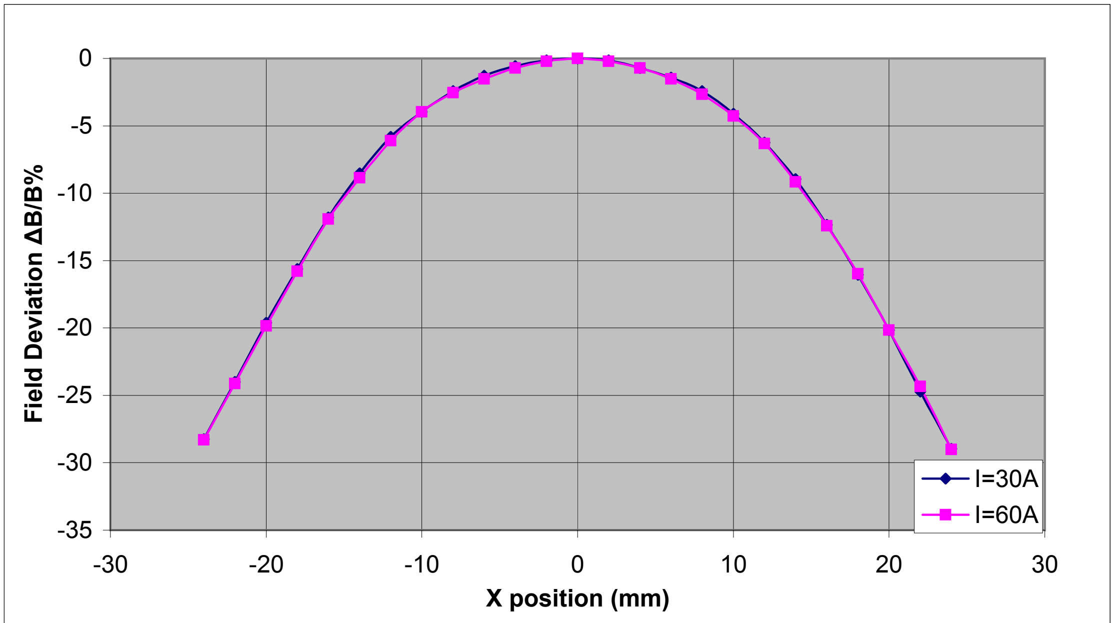
Model:	5403AC	Engr:	Y.Q.
Serial No:	1	Date:	10/4/2005
Pole Face:	32mmx32mm, square	Page:	2 of 2
Pole gap:	32mm		
Power Supply:	Copley 231P		
PS SN:	2905901		
Position:	X=Y=0mm		
Current:	30A, 60A DC		

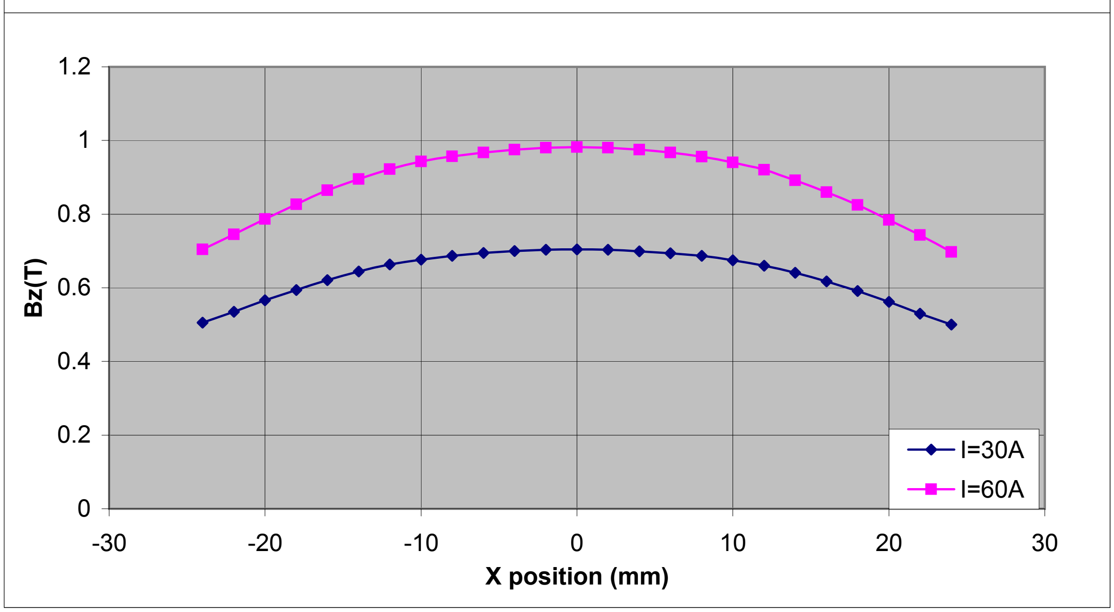




GMW ASSOCIATES
Electromagnet Uniformity Plot-1Hz sine wave

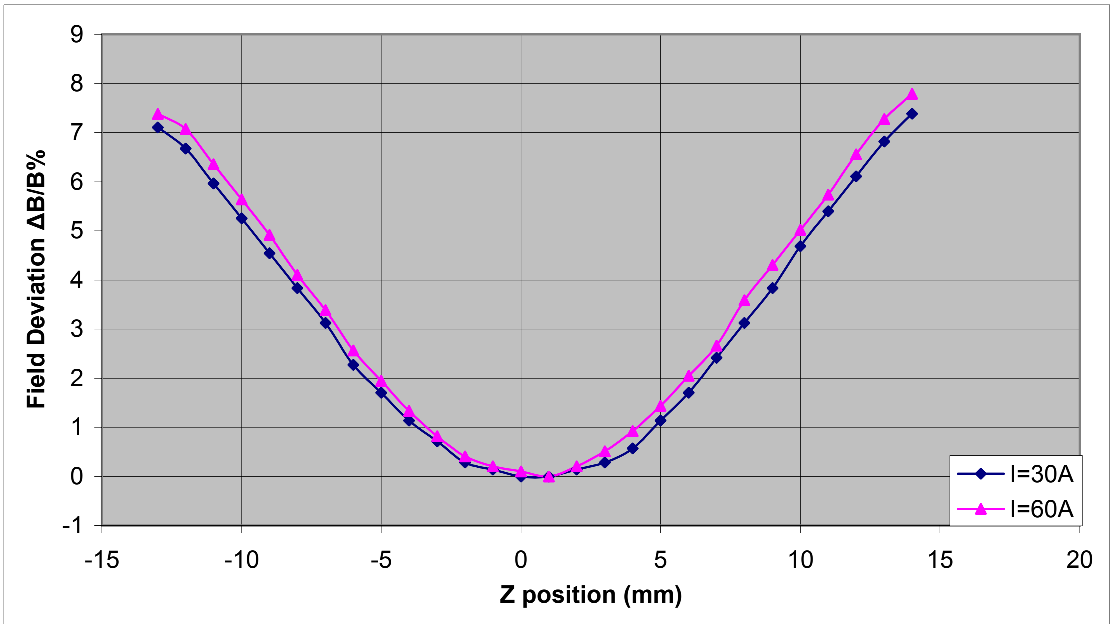
Model:	5403AC	Engr:	Y.Q.
Serial No:	1	Date:	10/4/2005
Pole Face:	32mmx32mm, square	Page:	1 of 2
Pole gap:	32mm		
Power Supply:	Copley 231P		
PS SN:	2905901		
Position:	Y=Z=0mm		
Current:	1Hz, sine		

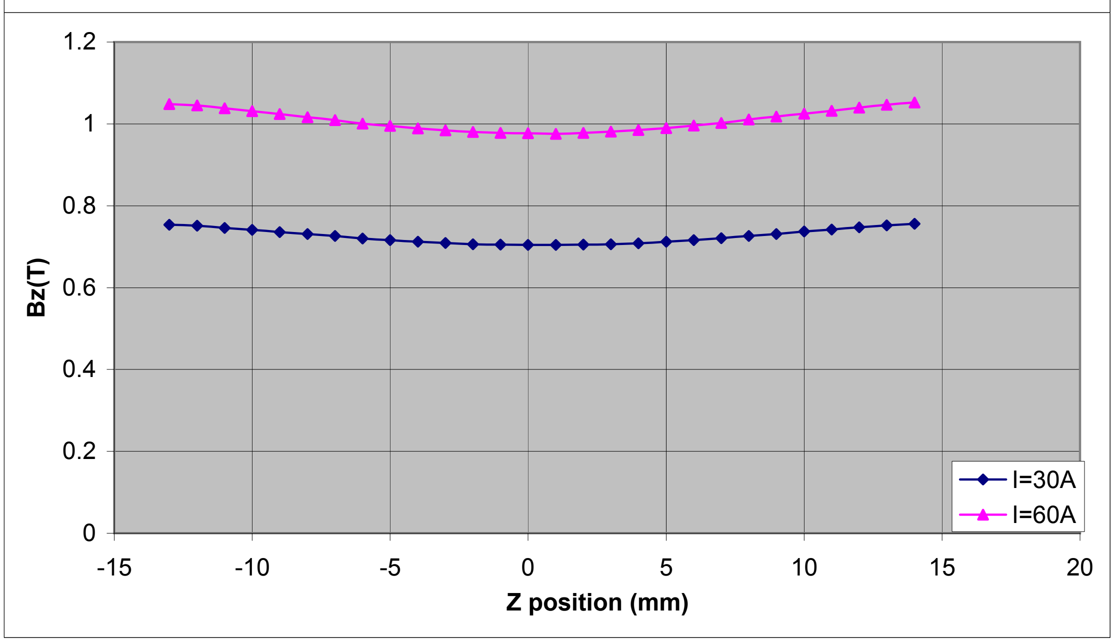




GMW ASSOCIATES
Electromagnet Uniformity Plot-1Hz sine wave

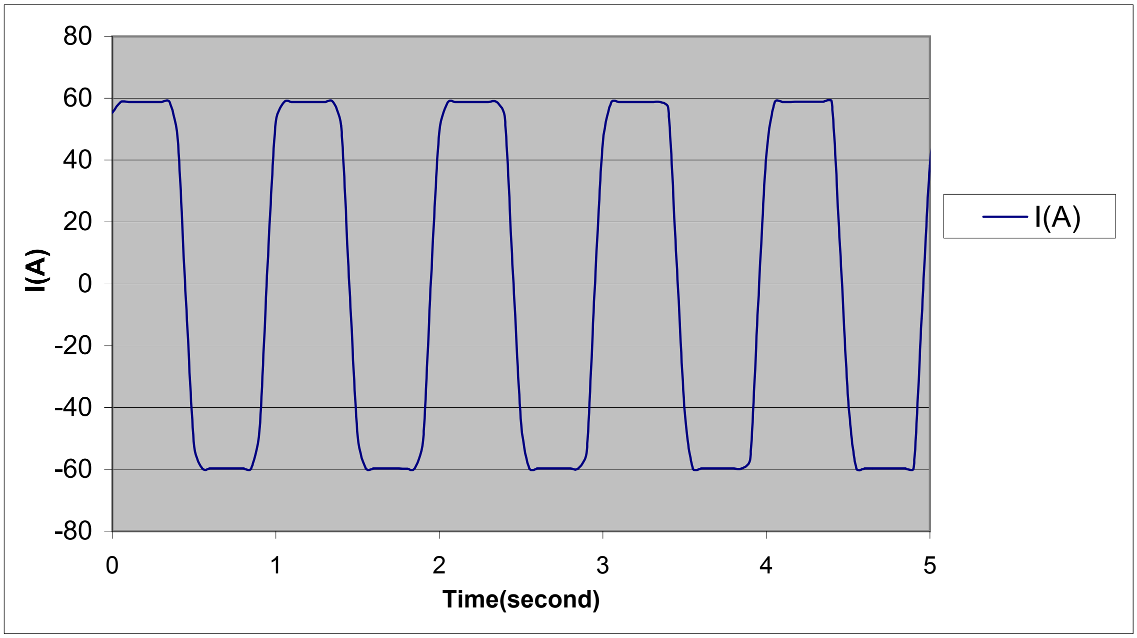
Model:	5403AC	Engr:	Y.Q.
Serial No:	1	Date:	10/4/2005
Pole Face:	32mmx32mm, square	Page:	2 of 2
Pole gap:	32mm		
Power Supply:	Copley 231P		
PS SN:	2905901		
Position:	X=Y=0mm		
Current:	1Hz, sine		

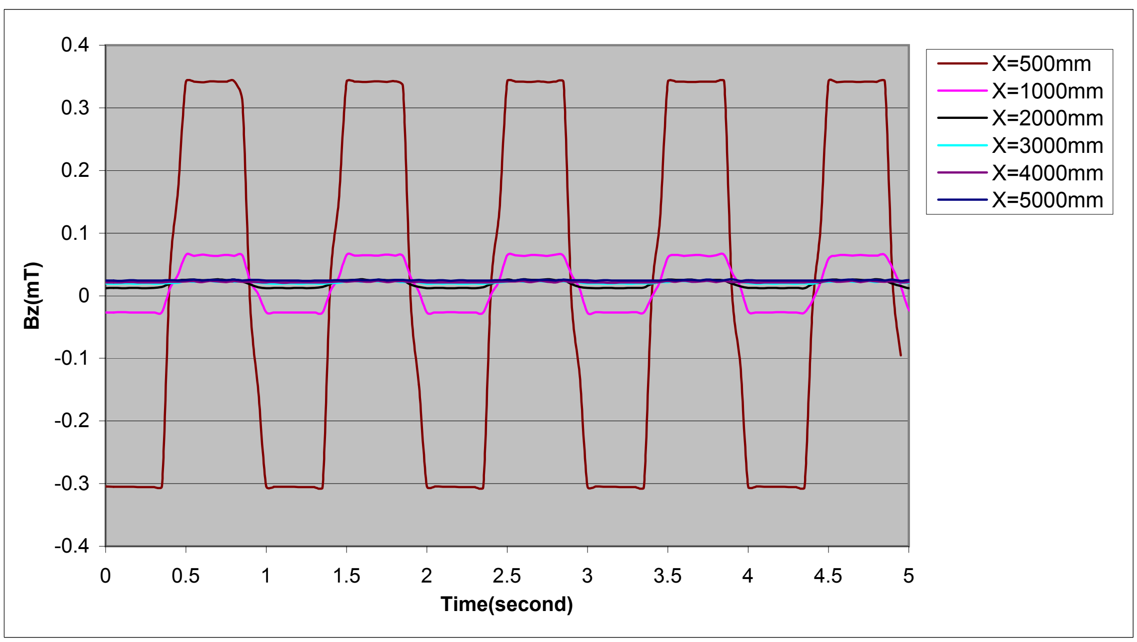




GMW ASSOCIATES
Electromagnet Fringe Field Plot-X axis

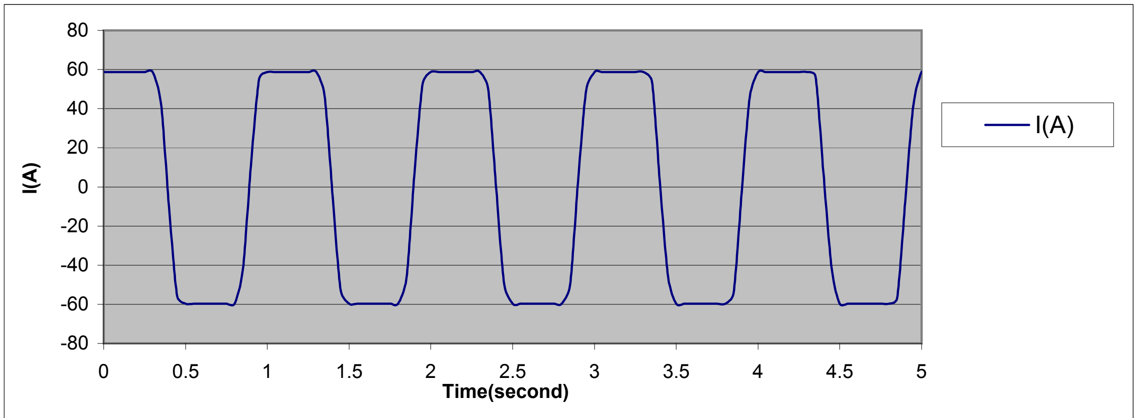
Model	5403AC	Engr	Y.Q.
Serial No	1	Date	10/4/2005
Pole Face	32mmx32mm, square	Page	1 of 3
Pole gap	32mm		
Power Supply:	Copley 231P		
PS SN:	2905901		
Current:	+/-60A, 1Hz, square		

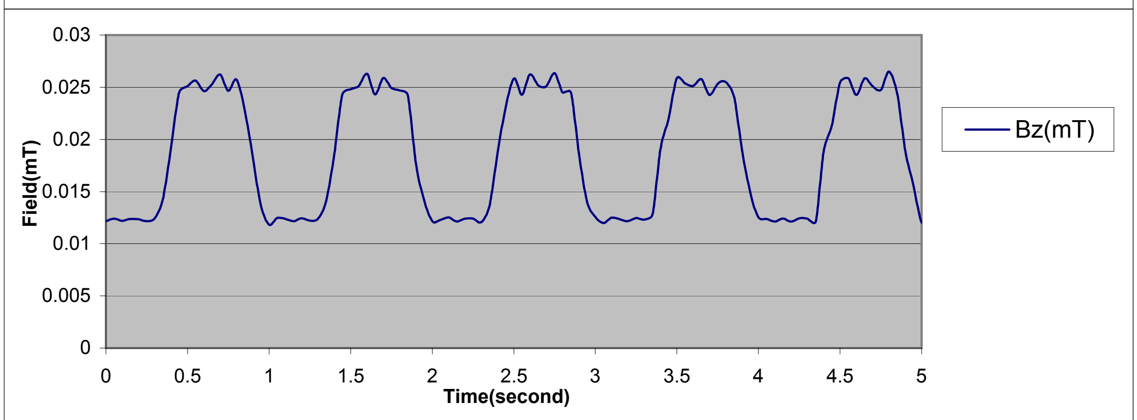


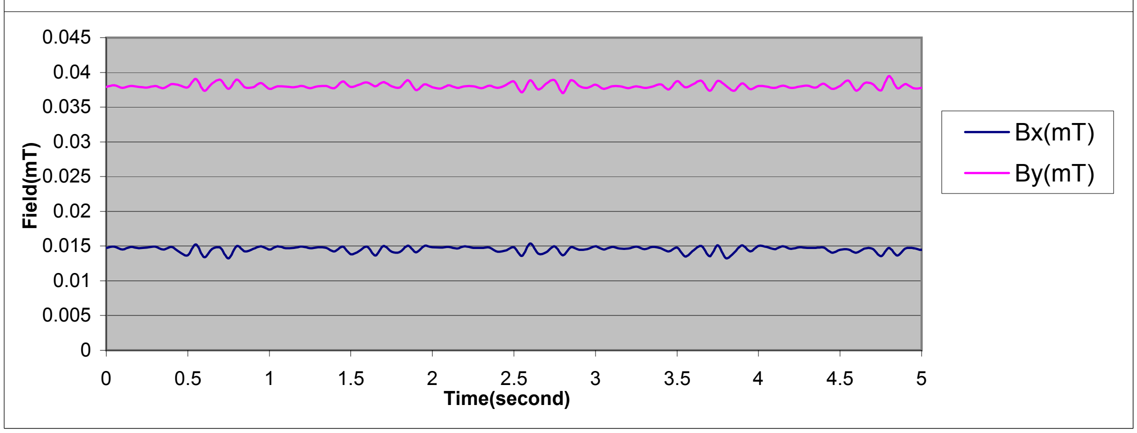


GMW ASSOCIATES
Electromagnet Fringe Field Plot-X axis

Model:	5403AC	Engr:	Y.Q.
Serial No:	1	Date:	10/4/2005
Pole Face:	32mmx32mm, square	Page:	2 of 3
Pole gap:	32mm		
Power Supply:	Copley 231P		
PS SN:	2905901		
Position:	X=2000mm, Y=Z=0mm		
Current:	+/-60A, 1Hz, square		



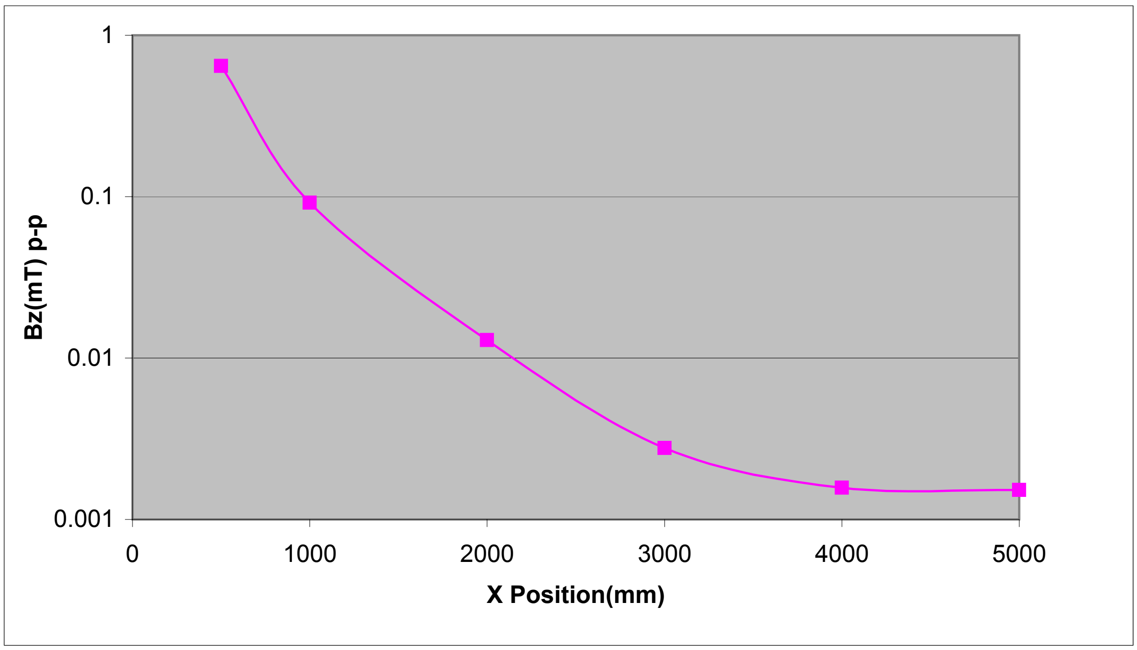




GMW ASSOCIATES
Electromagnet Fringe Field Plot-X axis

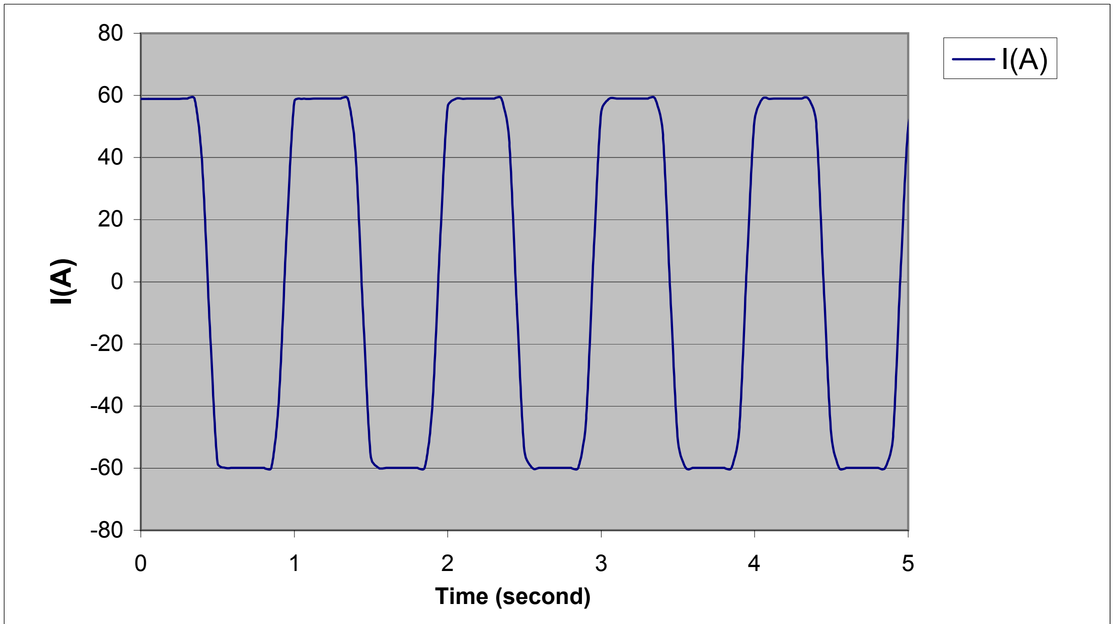
Model	5403AC	Engr	Y.Q.
Serial No	1	Date	10/4/2005
Pole Face	32mmx32mm, square	Page	3 of 3
Pole gap	32mm		
Power Supply:	Copley 231P		
PS SN:	2905901		
Current:	+/-60A, 1Hz, square		

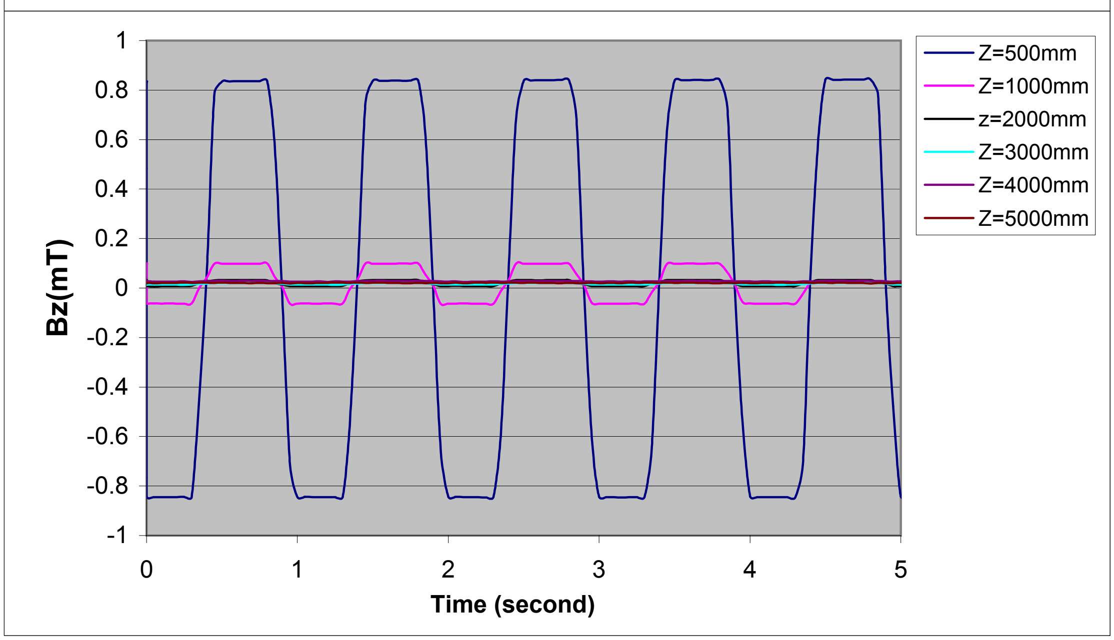
X Position(mm)	Bz(mT) p-p
500	0.64618
1000	0.09152
2000	0.01293
3000	0.00277
4000	0.00157
5000	0.00152



GMW ASSOCIATES
Electromagnet Fringe Field Plot-Z axis

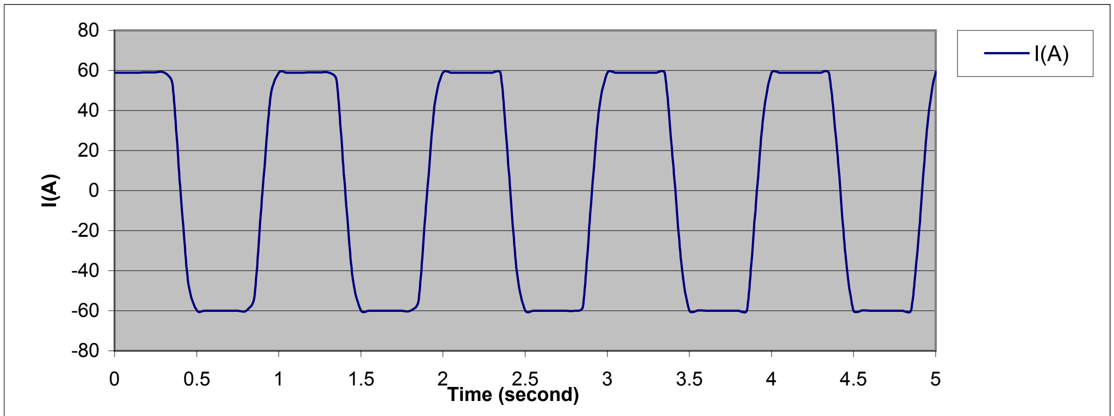
Model	5403AC	Engr	Y.Q.
Serial No	1	Date	10/4/2005
Pole Face	32mmx32mm, square	Page	1 of 3
Pole gap	32mm		
Power Supply:	Copley 231P		
PS SN:	2905901		
Current:	+/-60A, 1Hz, square wave		

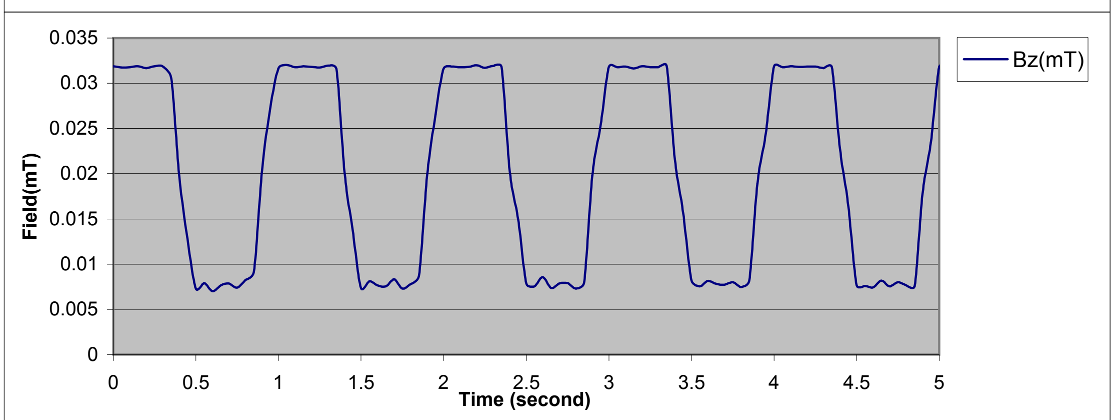


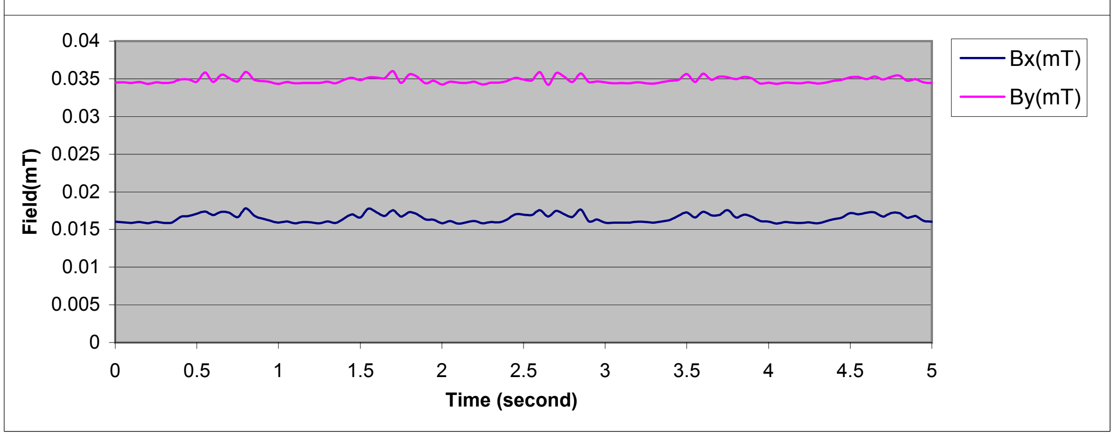


GMW ASSOCIATES
Electromagnet Fringe Field Plot-Z axis

Model	5403AC	Engr	Y.Q.
Serial No	1	Date	10/4/2005
Pole Face	32mmx32mm, square	Page	2 of 3
Pole gap	32mm		
Power Supply:	Copley 231P		
PS SN:	2905901		
Position:	X=Y=0mm, Z=2000mm		
Current:	+/-60A, 1Hz, square wave		



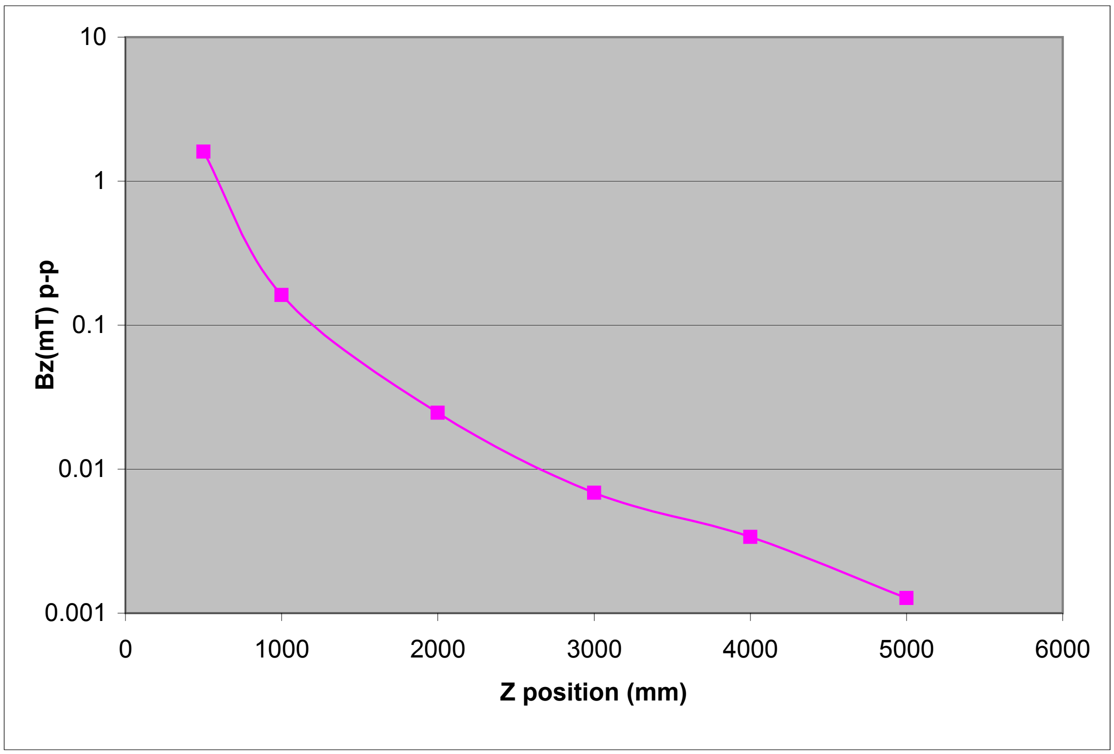




GMW ASSOCIATES
Electromagnet Fringe Field Plot-Z axis

Model	5403AC	Engr	Y.Q.
Serial No	1	Date	10/4/2005
Pole Face	32mmx32mm, square	Page	3 of 3
Pole gap	32mm		
Power Supply:	Copley 231P		
PS SN:	2905901		
Current:	+/-60A, 1Hz, square wave		

Z Position(mm)	Bz(mT) p-p
500	1.60098
1000	0.16155
2000	0.02457
3000	0.00684
4000	0.00338
5000	0.00127



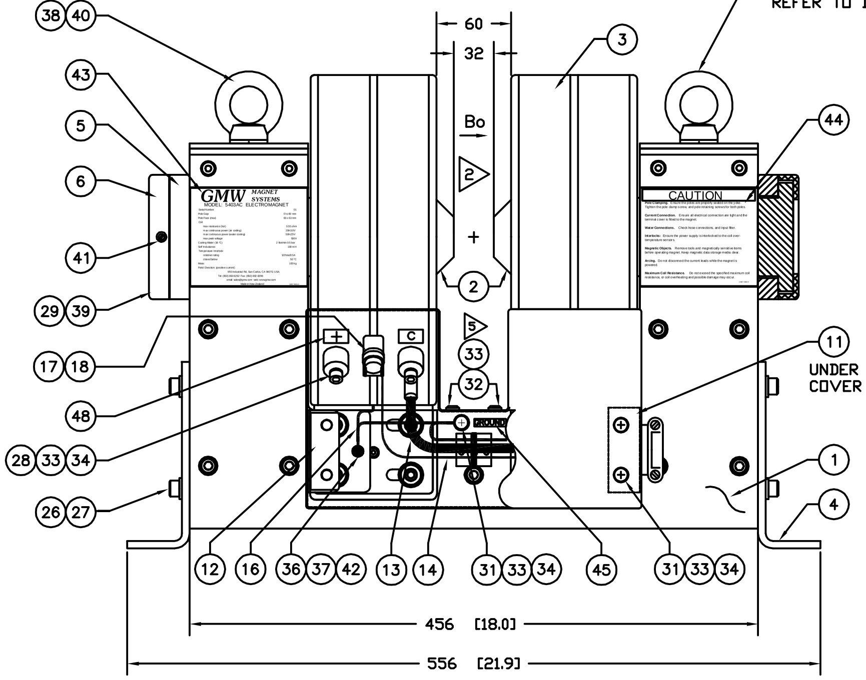
Section 10

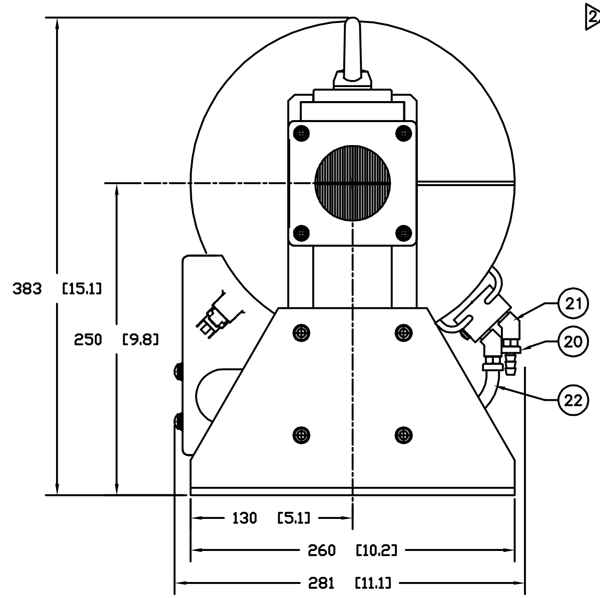
DRAWINGS

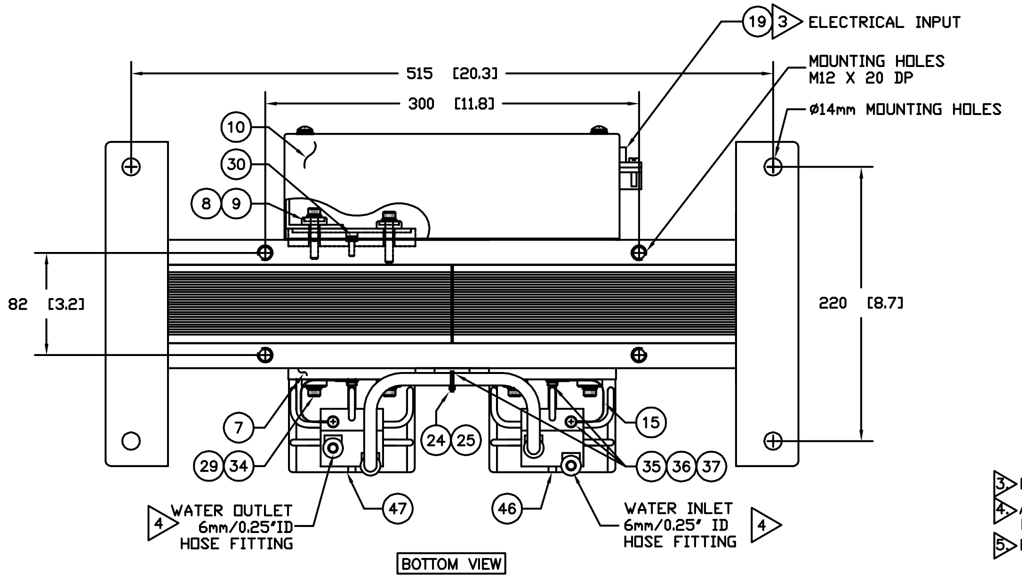
PROPRIETARY
THIS DRAWING CONTAINS CONFIDENTIAL INFORMATION PROPRIETARY TO GMW INC. IT MUST NOT BE REPRODUCED OR DISCLOSED TO OTHERS OR USED IN ANY OTHER WAY, IN WHOLE OR IN PART EXCEPT AS AUTHORIZED IN WRITING BY GMW INC.

LH TERMINAL COVER ITEM 19 OMITTED FROM THIS VIEW

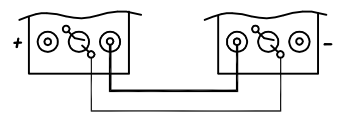
REMOVE POLE CLAMP BOLTS AND INSTALL ITEM 38 AND ITEM 40 TO LIFT ELECTROMAGNET. AFTER LIFTING OPERATION IS COMPLETE, REMOVE ITEM 36 AND ITEM 37 AND REINSTALL POLE CLAMP BOLTS. REFER TO DWGS NO: 11907-0009-0 AND 11907-0010-0







MAGNET WIRING SCHEMATIC



MAGNET SPECIFICATIONS

POLE FACE	63mm SQUARE [2.5"]
POLE GAP	0-60mm [0-2.5"]
POLE TYPES:	SQUARE 63mm [2.5"] TAPERED 38, 32 & 12mm [1.5, 1.3 & 0.5"]
COILS [series connected]	
MAX RESISTANCE	0.55 Ohm
MAX CONTINUOUS POWER [air]	20A/10V
MAX CONTINUOUS POWER [water]	50A/25V
MAX PEAK VOLTAGE	500V
SELF INDUCTANCE :	220 mH
COOLING:	2 l/min [0.6 GPM] @ 0.5 BAR [8 PSID]
TEMPERATURE INTERLOCK:	
RESISTIVE RATING	120Vac/0.5A
CLOSED BELOW	50°C [122°F]
MASS:	125 kg [275 lbs]

NOTE: DO NOT EXCEED THE MAXIMUM SPECIFIED COIL RESISTANCE OR COIL OVERHEATING AND POSSIBLE DAMAGE MAY OCCUR.

NOTE:

3. RH SIDE CABLE ENTRY SHOWN. LH ENTRY OPTIONAL.
4. AFTER FINAL TEST BLOW OUT WATER LINES, AND FIT PLASTIC SEALING CAP [ITEM 23] ONTO HOSE FITTINGS.
5. ITEM 32 AND ITEM 33 USED FOR PROBE MOUNT

REVISIONS

REV	DESCRIPTION	DRAFT	DATE	APPROVED
A	RELEASE		03/08/05	G.DOUGLAS
B	UPDATE MASS SPEC, CHG ITEM 2, 10, 21,32 & 48		10/06/05	G.DOUGLAS

NOTE

1. POLE MOUNTING SCREWS SHOULD BE 20mm LONGER THAN SPACER THICKNESS. FOR 30mm THICK SPACER MOUNTING SCREW SHOULD BE 50mm LONG
2. POLE GAP FIXED BY POLE SPACERS [ITEM 5] MIN GAP 0.0mm MAXIMUM GAP 60mm. SUFFIX ON MAGNET DWG NO REFERS TO POLE GAP. 11907-0008-0-50 = 50mm POLE GAP. POLE SHOWN WITH 32x32 FACE. OTHER POLE TYPES AVAILABLE

ITEM	QTY	PART NUMBER	DESCRIPTION	NOTE
48	4		LABEL, COIL + − C	
47	1	10900880	LABEL, MANIFOLD [LH Side]	
46	1	10900890	LABEL, MANIFOLD [RH Side]	
45	1	10900720	LABEL, GROUND [Fitted under Cover]	
44	1	10907-0009-0	LABEL, CAUTION [RH Side]	
43	1	10907-0008-0	LABEL, SPECIFICATION [LH side]	
42	2	DIN 934	HEX NUT, M4 S/S	
41	4	SBM8	BALL PLUNGER, M8 VLIER	
40	2	DIN 580	EYEBOLT, M12	
39	8	DIN 6797	WASHER, M6 EXTERNAL LOCK	
38	2	DIN 125 A	WASHER, M12 FLAT x 2.5 Thick S/S	
37	12	BN 737	WASHER, M4 X 8 X 0.5 FLAT S/S	
36	12	DIN 6797	WASHER, M4 X 0.7 INT LOCK, S/S	
35	10	DIN 7985A	SCREW, M4 X 8 PAN S/S	
34	25	DIN 1780	WASHER, M6 X 1.6 SPRING LOCK, S/S	
33	13	BN 737	WASHER, M6 X 16 X 1.6 FLAT S/S	5
32	4		M6 X 25 SHCS BUTTON HD S/S	5
31	5	DIN 7985A	SCREW, M6 X 12 PAN S/S	
30	4	DIN 912	SHCS, M4 X 12 S/S	
29	24	DIN 912	SHCS, M6 X 35 S/S [See note 1 & 2]	
28	4	DIN 912	SHCS, M6 X 12 S/S	
27	8	BN 737	WASHER, M8 X 15 X 1.6 FLAT S/S	
26	8	DIN 912	SHCS, M8 X 20 S/S	
25	2		CABLE TIE 5mm WIDE T & B	
24	2	MB4A	MOUNTING PAD TYTON	
23	2		PLASTIC SEALING CAPS, 6.0mm ID	
22	A/R		HOSE, 1/4" ID RUBBER [Black] SWAGELOCK	
21	4	BFW335002	ELBOW 45°, BRASSFIT 1/8" NPT	
20	4	KA04-02MB	HOSE COUPLING 6.0mm HOSE 1/8 NPT I/E	
19	1	3304	CABLE COUPLING 1" T & B	
18	2		WASHER, M5 X 15 X 3, NEOPRENE	
17	2	3450G611.1L50C	TEMPERATURE SENSOR, 50°C ELMWOOD	
16	1	16907-0002-0	CABLE [TERMINAL COVER GROUND]	
15	2	16907-0001-0	CABLE [COIL GROUND]	
14	1	16900610	CABLE [INTERLOCK]	
13	1	16900600	CABLE [HIGH CURRENT]	
12	1	17907-0024-2	TERMINAL COVER BRACKET [Without Hole]	
11	1	17907-0024-1	TERMINAL COVER BRACKET [With Hole]	
10	1	11907-0011-0	TEMINAL COVER ASSEMBLY [with label fitted]	
9	16	17907-0022-0	COIL MOUNT WASHER	
8	16	17907-0021-0	COIL INSULATOR BUSH	
7	4	17907-0020-0	COIL INSULATOR PAD	
6	2	17907-0018-0	POLE RETAINER	
5	2	17907-0017-0-16	POLE SPACER [16mm Thick]	
4	2	17901450	ANGLE BRACKET	
3	2	11901110	COIL ASSEMBLY	
2	2	11907-0016-0	POLE ASSEMBLY [32mm Pole Face]	
1	1	11907-0009-0	MAGNET YOKE ASSEMBLY	

PARTS LIST

DRAWN	G.DOUGLAS
DATE	02/08/05
CHECK	
ENGINEERING	
NEXT ASSY	
SYSTEM	
SOFTWARE	AUTOCAD 2000

DO NOT SCALE FROM DRAWING
DIMENSIONS & TOLERANCES (UNLESS OTHERWISE SPECIFIED)

LINEAR	INCHES	mm
X.XXX	±.005	±0.03
X.XX	±.01	±0.1
X.X	±.03	±0.3
X	±.06	±1
DEG.	±.5	±0.5
FINISH	63	1.6

THIRD ANGLE PROJECTION

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

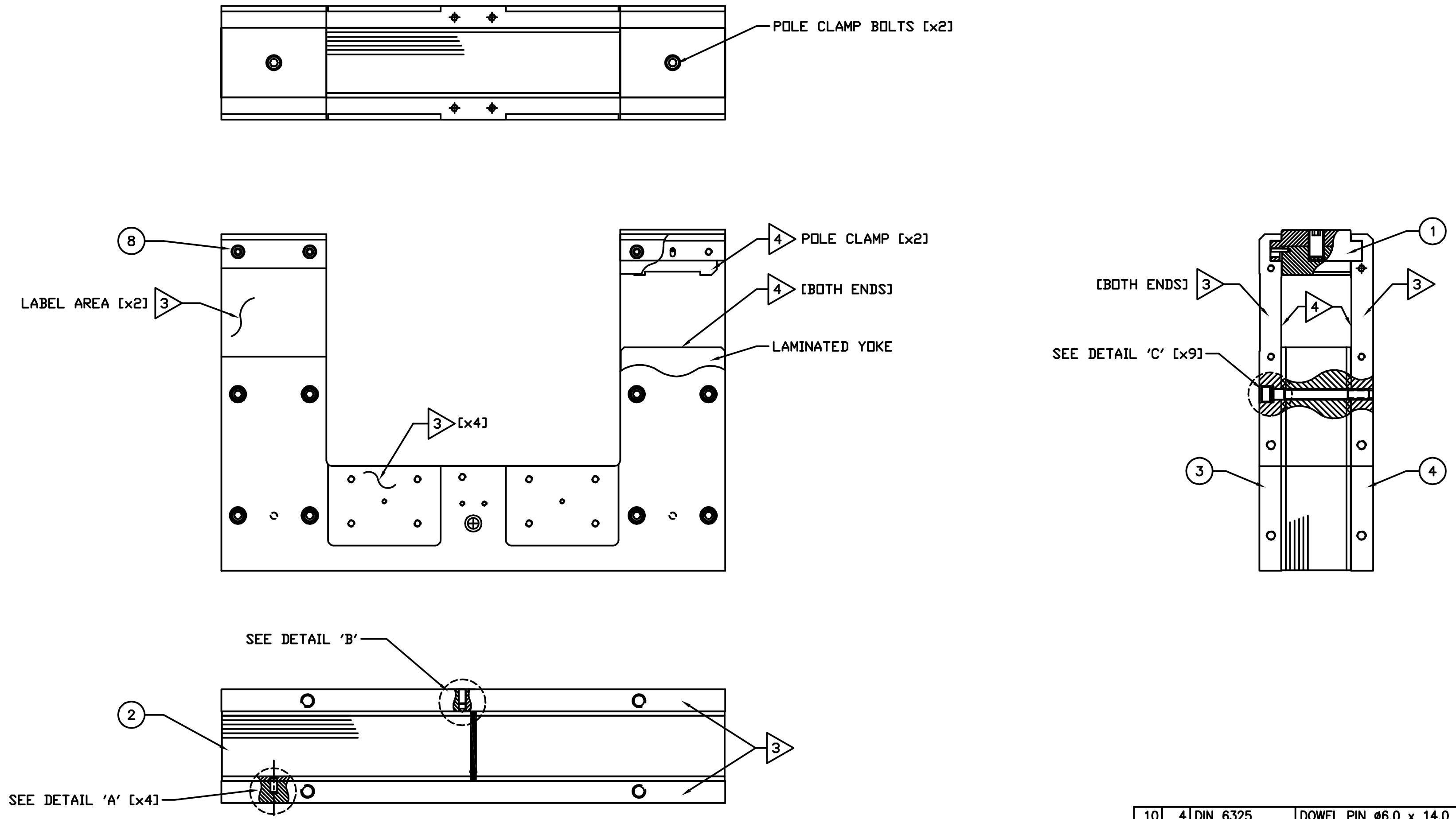
TITLE: MAGNET ASSEMBLY MODEL: 5403AC

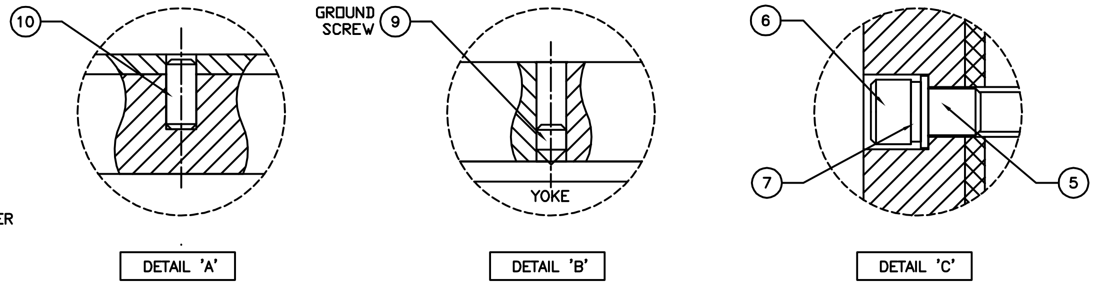
SIZE: A1 | DRAWING NO. 11907-0008-0 | REV B
SCALE 1:2 | WT kg | SHEET 1 OF 1

PROPRIETARY
THIS DRAWING CONTAINS CONFIDENTIAL INFORMATION PROPRIETARY TO GMW INC. IT MUST NOT BE REPRODUCED OR DISCLOSED TO OTHERS OR USED IN ANY OTHER WAY, IN WHOLE OR IN PART EXCEPT AS AUTHORIZED IN WRITING BY GMW INC.

REVISIONS

REV	DESCRIPTION	DRAFT	DATE	APPROVED
A	RELEASE		03/08/05	G.DOUGLAS





NOTES

1. ASSEMBLE YOKE AS SHOWN.
2. PAINT ASSEMBLED YOKE WITH POLANE T PRECISION TAN TEXTURED TO TP 85800010
3. NO TEXTURE IN AREAS SHOWN.
4. NO PAINT REQUIRED IN AREA SHOWN.
5. REMOVE OVERSPAY FROM YOKE FASTENERS AFTER PAINTING IS COMPLETE.

ITEM	QTY	PART NUMBER	DESCRIPTION	NOTE
10	4	DIN 6325	DOWEL PIN ø6.0 x 14.0 STEEL	
9	1	DIN 914	SHSS M6 x 8 CONE POINT S/S	
8	8	DIN 912	SHCS, M6 x 12, S/S	
7	9	BN 739	WASHER, 12 x 8 x 2 FLAT BOSSARD	
6	9	DIN 912	SHCS, M8 x 90, S/S	
5	9	17907-0025-0	YOKE INSULATOR	
4	1	17907-0013-0	CHEEK PLATE, REAR	
3	1	17907-0012-0	CHEEK PLATE, FRONT	
2	1	11907-0014-0	YOKE ASSEMBLY	
1	2	11907-0010-0	POLE CLAMP ASSEMBLY	

PARTS LIST

DRAWN G.DOUGLAS DATE 02/14/05
CHECK DATE
ENGINEERING DATE
NEXT ASSY SYSTEM
SOFTWARE AUTOCAD 2000

DO NOT SCALE FROM DRAWING
DIMENSIONS & TOLERANCES (UNLESS OTHERWISE SPECIFIED)

LINEAR	INCHES	mm
X.XXX	±.005	±0.03
X.XX	±.01	±0.1
X.X	±.03	±0.3
X	±.06	±1
DEG.	±.5	±0.5
FINISH	63	1.6

THIRD ANGLE PROJECTION

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

TITLE MAGNET YOKE ASSEMBLY MODEL: 5403AC

SIZE A1 DRAWING NO. 11907-0009-0 REV A
SCALE 1:2 WT kg SHEET 1 OF 1

PROPRIETARY
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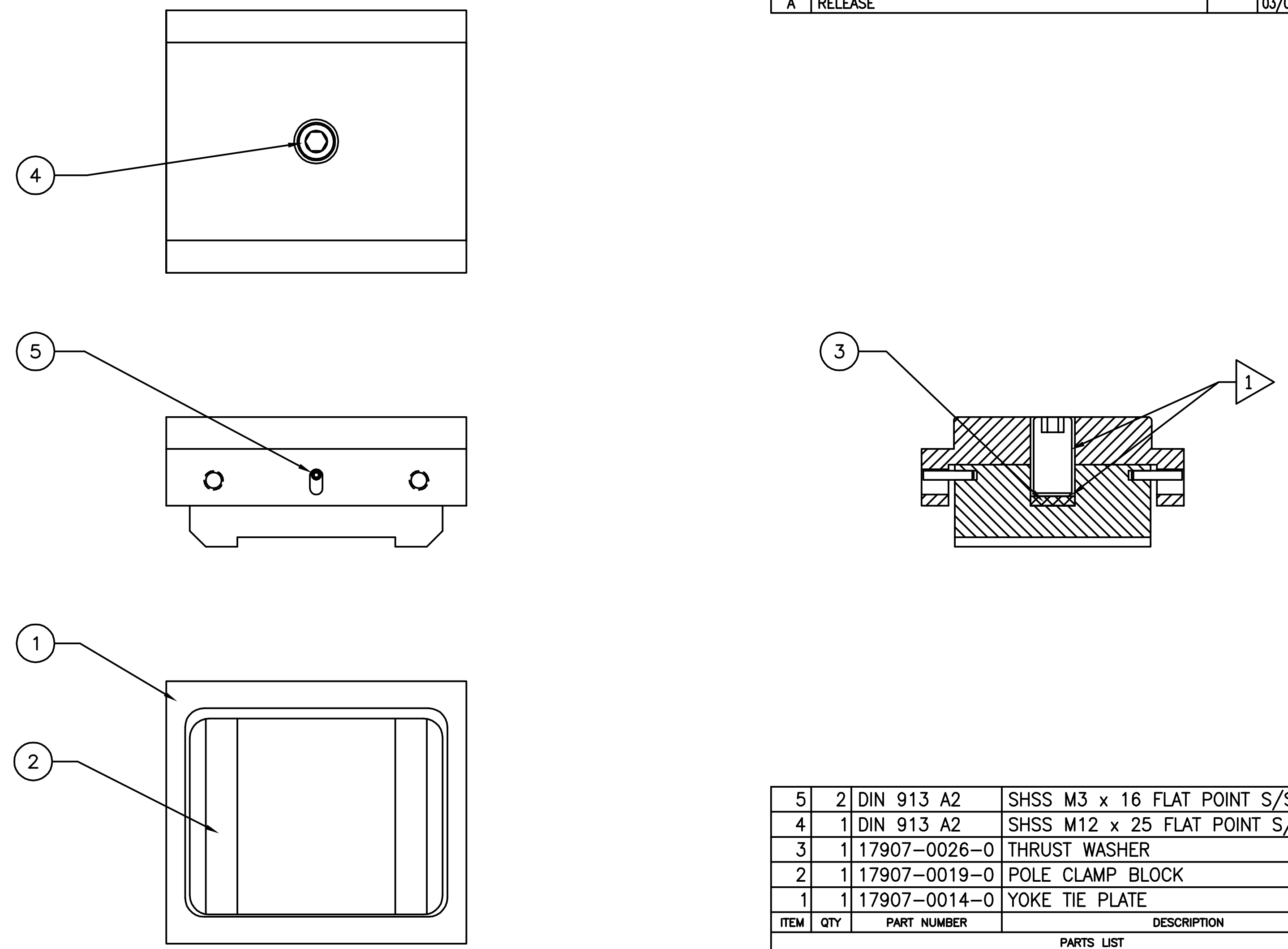
REVISIONS

REV	DESCRIPTION	DRAFT	DATE	APPROVED
A	RELEASE		03/08/05	G.DOUGLAS



5	2	DIN 913 A2	SHSS M3 x 16 FLAT POINT S/S	
4	1	DIN 913 A2	SHSS M12 x 25 FLAT POINT S/S	
3	1	17907-0026-0	THRUST WASHER	
2	1	17907-0019-0	POLE CLAMP BLOCK	
1	1	17907-0014-0	YOKE TIE PLATE	
ITEM	QTY	PART NUMBER	DESCRIPTION	NOTE

PARTS LIST

NOTES:

1. APPLY ANTISEIZE GREASE TO AREAS SHOWN
2. NO REQD: 2 PER MAGNET.

DRAWN	DATE
G.DOUGLAS	02/16/05
CHECK	DATE
ENGINEERING	DATE
NEXT ASSY	SYSTEM

SOFTWARE AUTOCAD 2000

DO NOT SCALE FROM DRAWING
DIMENSIONS & TOLERANCES (UNLESS OTHERWISE SPECIFIED)

LINEAR	INCHES	mm
X.XXX	±.005	±0.03
X.XX	±.01	±0.1
X.X	±.03	±0.3
X	±.06	±1
DEG.	±.5	±0.5
FINISH	63	1.6

THIRD ANGLE PROJECTION

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

TITLE
POLE CLAMP ASSEMBLY
MODEL: 5403AC

SIZE	DRAWING NO.	REV
A2	11907-0010-0	A

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

PROPRIETARY
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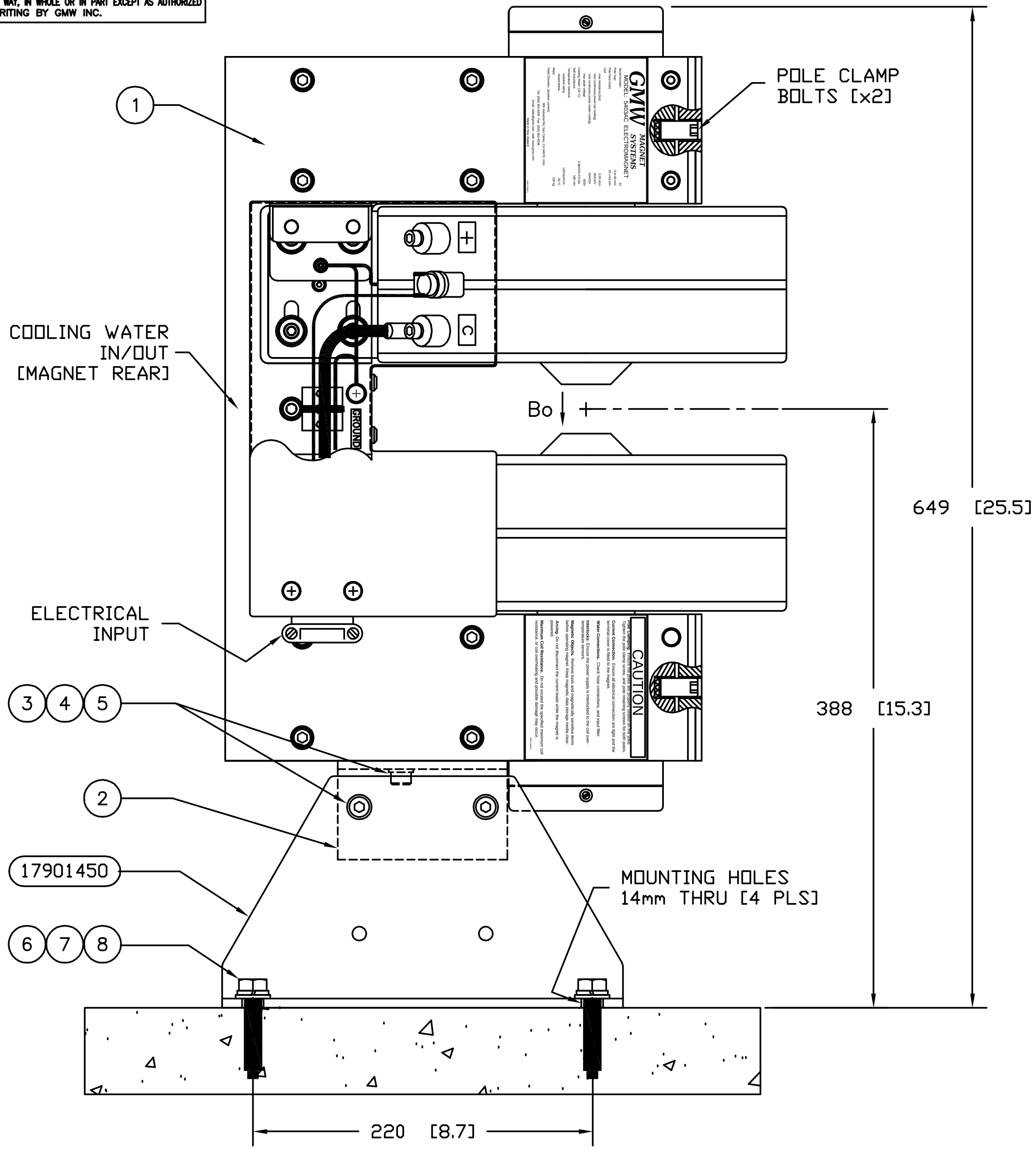
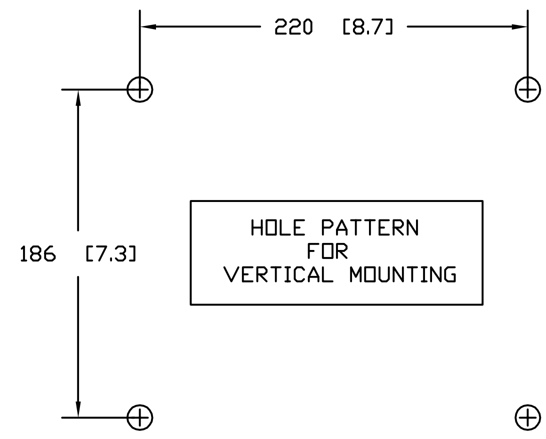
REVISIONS				
REV	DESCRIPTION	DRAFT	DATE	APPROVED
A	RELEASE		10/05/05	G.DOUGLAS





*** WARNING ***
WHEN THE 5403AC ELECTROMAGNET IS VERTICALLY MOUNTED IT MUST BE BOLTED TO THE FLOOR SECURELY AS SHOWN.

ITEM	QTY	PART NUMBER	DESCRIPTION	NOTE
8	4		BOLT, M12 or 1/2" EXPANSION	
7	4	DIN 127 B	WASHER, M12 SPRING LOCK, S/S	
6	4	DIN 125 A	WASHER, M12 FLAT, S/S	
5	6	DIN 912	SHCS, M8 X 16 S/S	
4	6	DIN 127 B	WASHER, M8 SPRING LOCK, S/S	
3	6	DIN 125 A	WASHER, M8 FLAT, S/S	
2	1	17901610	VERTICAL MOUNTING BRACKET	
1	1	5403AC	ELECTROMAGNET	

PARTS LIST

DRAWN G.DOUGLAS — DATE 10/05/05
CHECK — DATE
ENGINEERING — DATE
NEXT ASSY — SYSTEM
SOFTWARE AUTOCAD 2000

DO NOT SCALE FROM DRAWING
DIMENSIONS & TOLERANCES (UNLESS OTHERWISE SPECIFIED)

LINEAR	INCHES	mm
X.XXX	±.005	±0.03
X.XX	±.01	±0.1
X.X	±.03	±0.3
X	±.06	±1
DEG.	±.5	±0.5
FINISH	63	1.6

THIRD ANGLE PROJECTION

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

TITLE VERTICAL MOUNT ASSEMBLY MODEL: 5403AC

SIZE A2 — DRAWING NO. 11907-0018-0 — REV A
SCALE 1:1 — WT kg — SHEET 1 OF 1

PROPRIETARY

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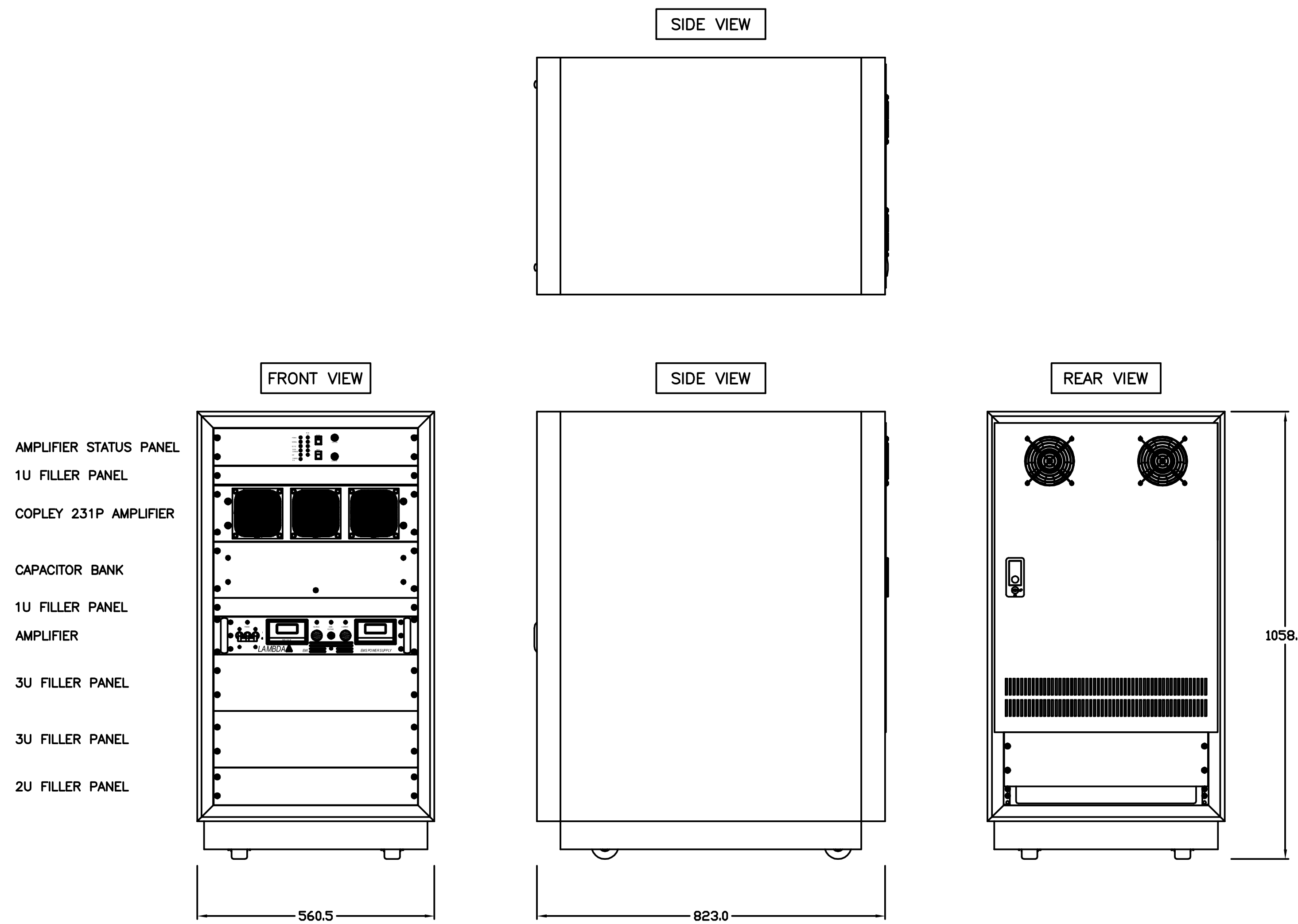
REVISIONS

REV	DESCRIPTION	DRAFT	DATE	APPROVED
A	RELEASE		05 Oct, 2005	M. Duffy



RACK MODEL: OPTIMA RC-351930

APPROX. WEIGHT: 110kg

ITEM	QTY	PART NUMBER	DESCRIPTION	NOTE

PARTS LIST

DRAWN M. Duffy	DATE 05 Oct, 2005	
CHECK M. Duffy	DATE 05 Oct, 2005	
ENGINEERING M. Duffy	DATE 05 Oct, 2005	
NEXT ASSY	SYSTEM	

SOFTWARE AUTOCAD 2000

DO NOT SCALE FROM DRAWING

DIMENSIONS & TOLERANCES (UNLESS OTHERWISE SPECIFIED)

LINEAR	INCHES	mm
X.XXX	±.005	±0.03
X.XX	±.01	±0.1
X.X	±.03	±0.3
X	±.06	±1
DEG.	±.5	±0.5
FINISH	63	1.6

THIRD ANGLE PROJECTION

GMW

955 Industrial Rd, San Carlos, CA 94070

Tel: (650)802-8292. Fax: (650)802-8298.

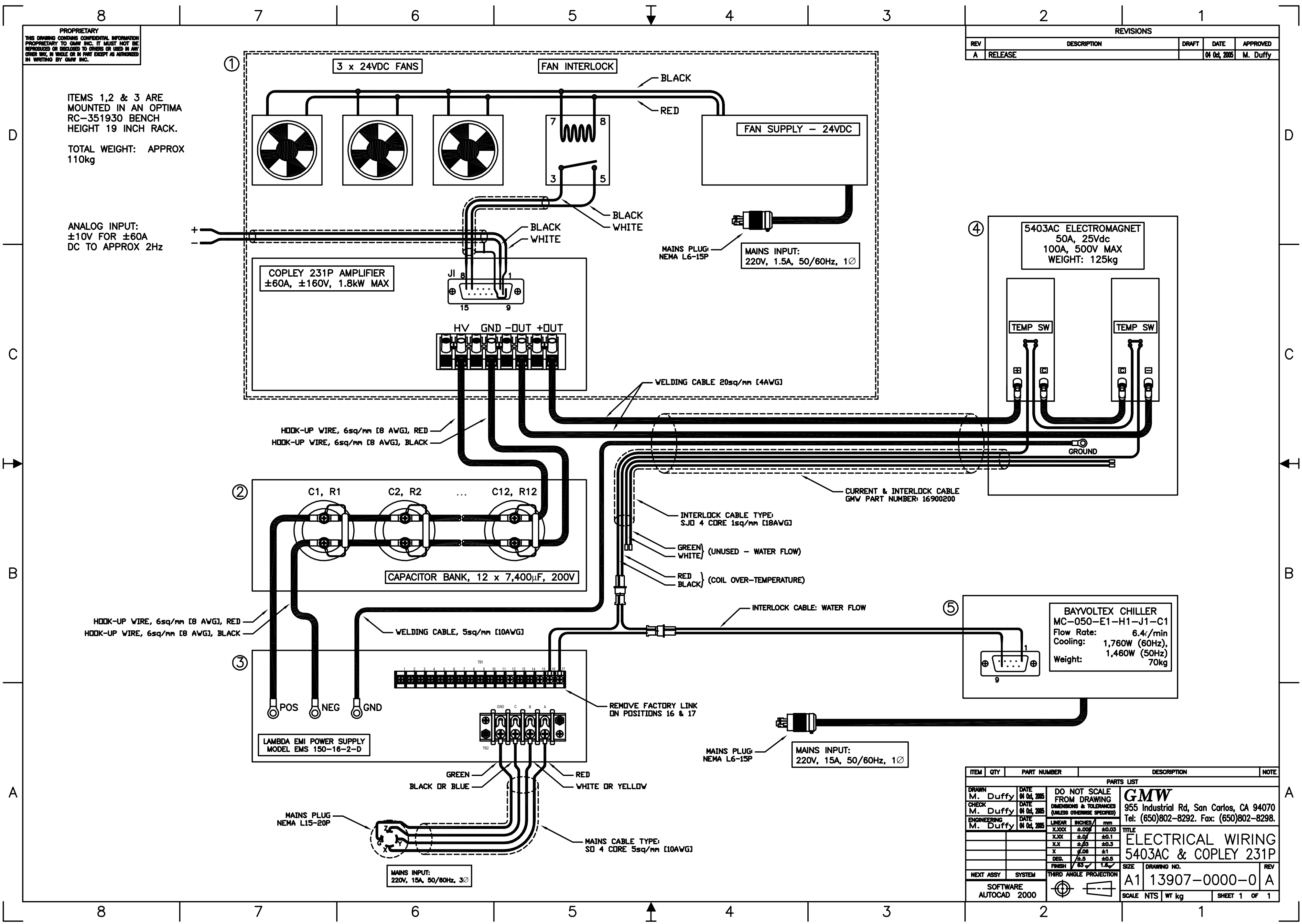
TITLE

RACK ASSEMBLY

COPLEY 231P AMPLIFIER

SIZE	DRAWING NO.	REV
A1	11907-0046-0	A

SCALE 1:5 WT kg SHEET 1 OF 1


PROPRIETARY
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ITEMS 1,2 & 3 ARE MOUNTED IN AN OPTIMA RC-351930 BENCH HEIGHT 19 INCH RACK.
TOTAL WEIGHT: APPROX 110kg
ANALOG INPUT: ±10V FOR ±60A DC TO APPROX 2Hz
3 x 24VDC FANS
FAN INTERLOCK
BLACK
RED
FAN SUPPLY – 24VDC
BLACK
WHITE
BLACK
WHITE
MAINS PLUG: NEMA L6-15P
MAINS INPUT: 220V, 1.5A, 50/60Hz, 1∅
COPLEY 231P AMPLIFIER ±60A, ±160V, 1.8kW MAX
J1
HV GND -OUT +OUT
WELDING CABLE 20sq/mm [4AWG]
HOOK-UP WIRE, 6sq/mm [8 AWG], RED
HOOK-UP WIRE, 6sq/mm [8 AWG], BLACK
5403AC ELECTROMAGNET
50A, 25Vdc
100A, 500V MAX
WEIGHT: 125kg
TEMP SW
TEMP SW
GROUND
CURRENT & INTERLOCK CABLE GMW PART NUMBER: 16900200
INTERLOCK CABLE TYPE: SJO 4 CORE 1sq/mm [18AWG]
GREEN WHITE (UNUSED – WATER FLOW)
RED BLACK (COIL OVER-TEMPERATURE)
C1, R1
C2, R2
C12, R12
CAPACITOR BANK, 12 x 7,400µF, 200V
HOOK-UP WIRE, 6sq/mm [8 AWG], RED
HOOK-UP WIRE, 6sq/mm [8 AWG], BLACK
WELDING CABLE, 5sq/mm [10AWG]
INTERLOCK CABLE: WATER FLOW
BAYVOLTEX CHILLER
MC-050-E1-H1-J1-C1
Flow Rate: 6.4ℓ/min
Cooling: 1,760W (60Hz), 1,460W (50Hz)
Weight: 70kg
POS
NEG
GND
TB1
REMOVE FACTORY LINK ON POSITIONS 16 & 17
LAMBDA EMI POWER SUPPLY MODEL EMS 150-16-2-D
TB2
MAINS PLUG: NEMA L6-15P
MAINS INPUT: 220V, 15A, 50/60Hz, 1∅
GREEN
BLACK OR BLUE
RED
WHITE OR YELLOW
MAINS PLUG NEMA L15-20P
MAINS CABLE TYPE: SO 4 CORE 5sq/mm [10AWG]
MAINS INPUT: 220V, 15A, 50/60Hz, 3∅
REVISIONS
REV | DESCRIPTION | DRAFT | DATE | APPROVED
A | RELEASE | | 04 Oct, 2005 | M. Duffy
ITEM | QTY | PART NUMBER | DESCRIPTION | NOTE
PARTS LIST
DRAWN M. Duffy DATE 04 Oct, 2005
CHECK M. Duffy DATE 04 Oct, 2005
ENGINEERING M. Duffy DATE 04 Oct, 2005
DO NOT SCALE FROM DRAWING
DIMENSIONS & TOLERANCES (UNLESS OTHERWISE SPECIFIED)
GMW
955 Industrial Rd, San Carlos, CA 94070
Tel: (650)802-8292. Fax: (650)802-8298.
TITLE
ELECTRICAL WIRING
5403AC & COPLEY 231P
NEXT ASSY
SYSTEM
THIRD ANGLE PROJECTION
SOFTWARE AUTOCAD 2000
SIZE A1
DRAWING NO. 13907-0000-0
REV A
SCALE NTS
WT kg
SHEET 1 OF 1

PROPRIETARY
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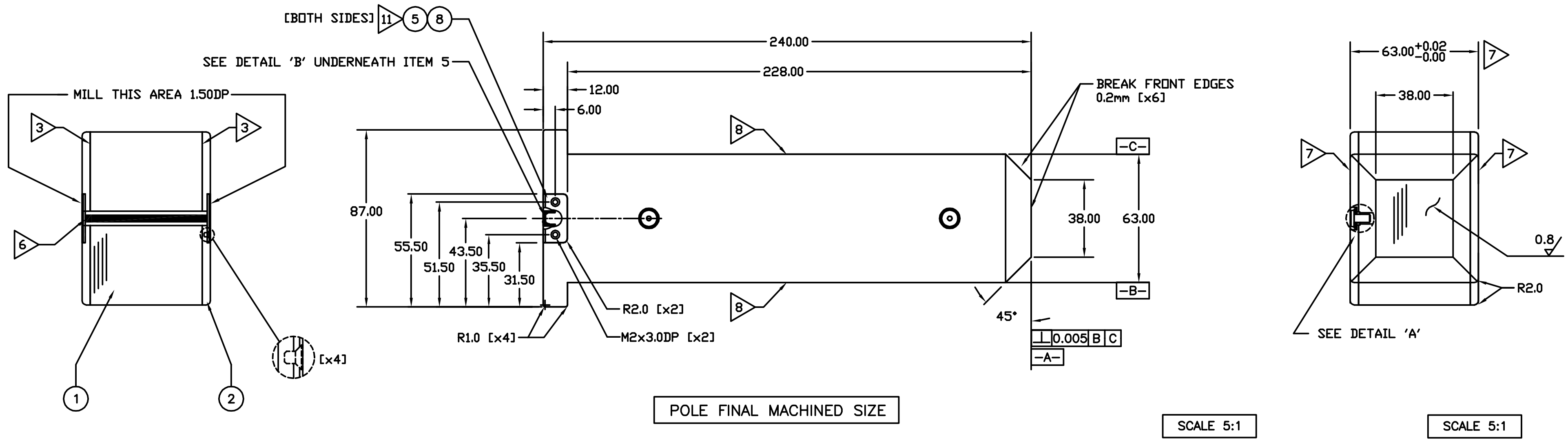
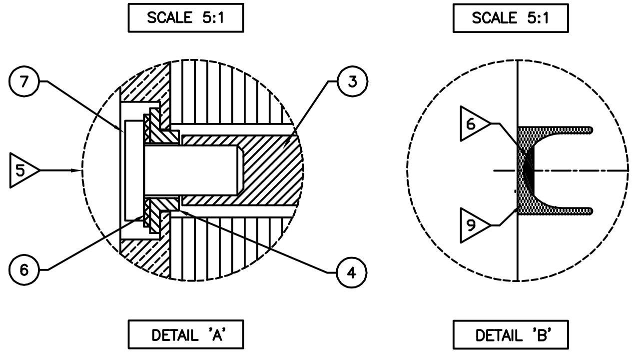
REVISIONS

REV	DESCRIPTION	DRAFT	DATE	APPROVED
A	RELEASE		09/06/05	G.DOUGLAS





NOTES

1. BEAD BLAST REAR SURFACES OF [ITEM 2] POLE SIDE PLATES [x2].
2. DEGREASE BOTH SIDE SURFACES OF [ITEM 1] POLE CORE.
3. APPLY ARALDITE K106 TO BOTH ITEM 1 AND ITEM 2 ADHESIVE SURFACES.
4. ALIGN POLE CORE AND BOTH SIDE PLATES, AND CLAMP IN SUITABLE PRESS JIG. ALLOW ARALDITE K106 ADHESIVE TO SET FOR 24 HOURS.
5. ASSEMBLE POLE WITH ITEMS 3, 4, 6, AND 7 BEFORE MACHINING AND TIG WELDING. REMOVE THESE ITEMS FOR PAINTING.
6. TIG WELD ALL POLE CORE LAMINATIONS AND SIDE PLATES TOGETHER. DO NOT ENCROACH INTO RECESS AREA.
7. MACHINE ALL ROUND TO FINAL SIZE DIMENSIONS SHOWN. MACHINE POLE PLATES EQUAL AMOUNTS TO ACHIEVE FINAL POLE THICKNESS.
8. FILLET EDGES SHOWN R2.0 [x8]. BREAK REMAINING SHARP EDGES 0.2mm
9. ETCH PRIME ALL SURFACES. APPLY 3M FLOWABLE FINISHING PUTTY TO AREA SHOWN ON REAR OF POLE. SAND UNTIL FLUSH.
10. FINISH COAT POLANE T PRECISION TAN MAX PAINT THICKNESS 0.30mm [NO TEXTURE] TO TP 85800010.
11. AFTER PAINTING CLEAN M2 HOLES. THEN FIT ITEM 3 THRU TO ITEM 8
12. 2 x POLES REQD PER MAGNET.

PARTS LIST

ITEM	QTY	PART NUMBER	DESCRIPTION	NOTE
8	4	DIN 7991	SHCS, M2 x 3 FLAT HD S/S	
7	4	BN 1206	SHCS, M4 x 8 LOW PROFILE HD, BOSSARD	
6	4	DIN 137 B	WASHER, WAVY 4.3 x 9.0 x 0.5 thick S/S	
5	2	17907-0031-0	POLE GROUND PLATE	
4	4	17907-0030-0	POLE INSULATOR	
3	2	17907-0029-0	POLE CLAMP BAR	
2	2	17907-0016-0	POLE SIDE PLATE	
1	1	17907-0015-0	POLE CORE	

DRAWN G.DOUGLAS DATE 09/06/05
CHECK DATE
ENGINEERING DATE

DO NOT SCALE FROM DRAWING
DIMENSIONS & TOLERANCES (UNLESS OTHERWISE SPECIFIED)

LINEAR	INCHES	mm
X.XXX	±.005	±0.03
X.XX	±.01	±0.1
X.X	±.03	±0.3
X	±.06	±1
DEG.	±.5	±0.5
FINISH	63	1.6

THIRD ANGLE PROJECTION

NEXT ASSY | SYSTEM

SOFTWARE AUTOCAD 2000

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

TITLE POLE ASSEM [38mm Sq Face]
MODEL: 5403AC

SIZE A1 DRAWING NO. 11907-0013-0 REV A

SCALE 1:1 WT kg SHEET 1 OF 1

PROPRIETARY
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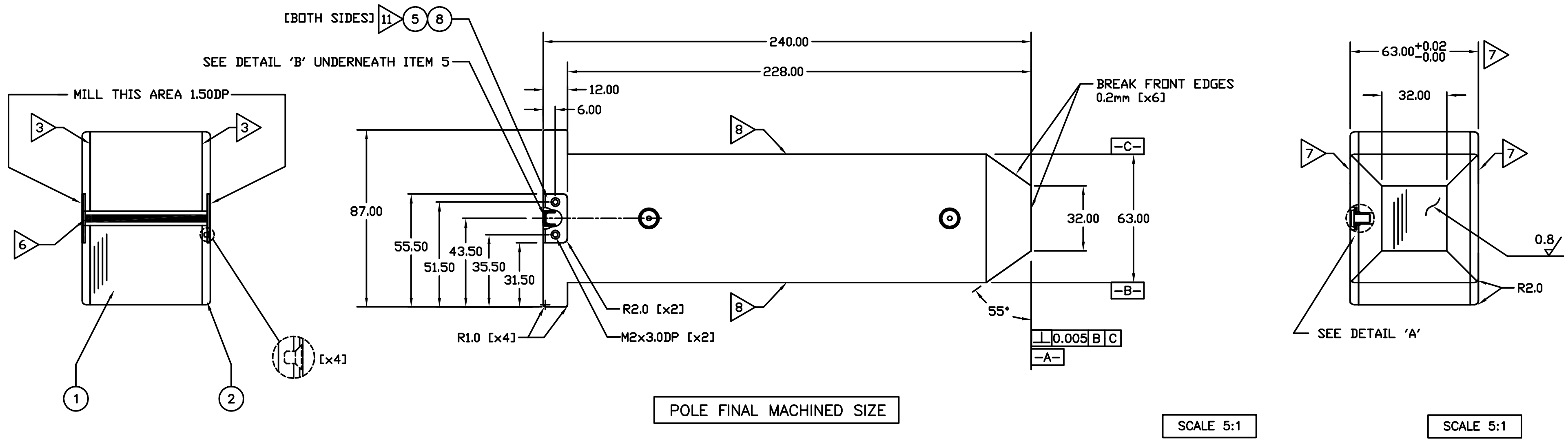
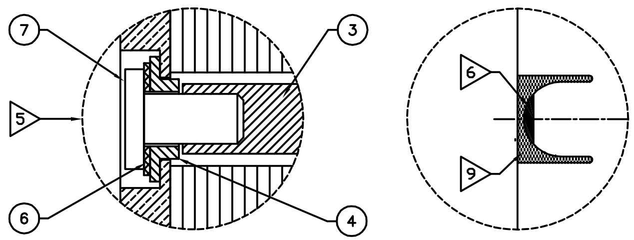
REVISIONS

REV	DESCRIPTION	DRAFT	DATE	APPROVED
A	RELEASE		09/06/05	G.DOUGLAS





NOTES

1. BEAD BLAST REAR SURFACES OF [ITEM 2] POLE SIDE PLATES [x2].
2. DEGREASE BOTH SIDE SURFACES OF [ITEM 1] POLE CORE.
3. APPLY ARALDITE K106 TO BOTH ITEM 1 AND ITEM 2 ADHESIVE SURFACES.
4. ALIGN POLE CORE AND BOTH SIDE PLATES, AND CLAMP IN SUITABLE PRESS JIG. ALLOW ARALDITE K106 ADHESIVE TO SET FOR 24 HOURS.
5. ASSEMBLE POLE WITH ITEMS 3, 4, 6, AND 7 BEFORE MACHINING AND TIG WELDING. REMOVE THESE ITEMS FOR PAINTING.
6. TIG WELD ALL POLE CORE LAMINATIONS AND SIDE PLATES TOGETHER. DO NOT ENCROACH INTO RECESS AREA.
7. MACHINE ALL ROUND TO FINAL MACHINE SIZE DIMENSIONS SHOWN. MACHINE POLE PLATES EQUAL AMOUNTS TO ACHIEVE FINAL POLE THICKNESS.
8. FILLET EDGES SHOWN R2.0 [x8]. BREAK REMAINING SHARP EDGES 0.2mm
9. ETCH PRIME ALL SURFACES. APPLY 3M FLOWABLE FINISHING PUTTY TO AREA SHOWN ON REAR OF POLE. SAND UNTIL FLUSH.
10. FINISH COAT POLANE T PRECISION TAN MAX PAINT THICKNESS 0.30mm [NO TEXTURE] TO TP 85800010.
11. AFTER PAINTING CLEAN M2 HOLES. THEN FIT ITEM 3 THRU TO ITEM 8
12. 2 x POLES REQD PER MAGNET.

ITEM	QTY	PART NUMBER	DESCRIPTION	NOTE
8	4	DIN 7991	SHCS, M2 x 3 FLAT HD S/S	
7	4	BN 1206	SHCS, M4 x 8 LOW PROFILE HD, BOSSARD	
6	4	DIN 137 B	WASHER, WAVY 4.3 x 9.0 x 0.5 thick S/S	
5	2	17907-0031-0	POLE GROUND PLATE	
4	4	17907-0030-0	POLE INSULATOR	
3	2	17907-0029-0	POLE CLAMP BAR	
2	2	17907-0016-0	POLE SIDE PLATE	
1	1	17907-0015-0	POLE CORE	

PARTS LIST

DRAWN G.DOUGLAS DATE 09/06/05
CHECK DATE
ENGINEERING DATE
NEXT ASSY SYSTEM
SOFTWARE AUTOCAD 2000

DO NOT SCALE FROM DRAWING
DIMENSIONS & TOLERANCES (UNLESS OTHERWISE SPECIFIED)

LINEAR	INCHES	mm
X.XXX	±.005	±0.03
X.XX	±.01	±0.1
X.X	±.03	±0.3
X	±.06	±1
DEG.	±.5	±0.5
FINISH	63	1.6

THIRD ANGLE PROJECTION

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

TITLE POLE ASSEM [32mm Sq Face] MODEL: 5403AC

SIZE A1 DRAWING NO. 11907-0016-0 REV A
SCALE 1:1 WT 7.0 kg SHEET 1 OF 1

PROPRIETARY
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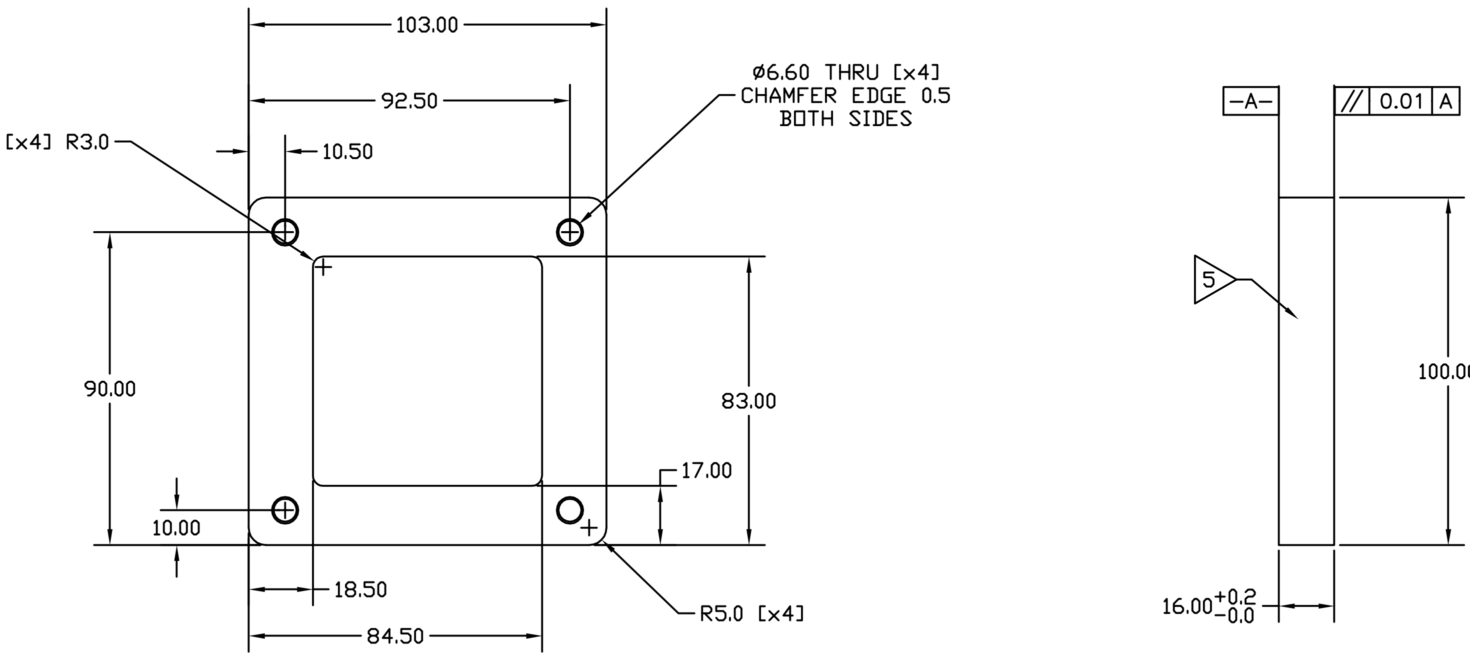
REVISIONS

REV	DESCRIPTION	DRAFT	DATE	APPROVED
A	RELEASE		03/08/05	G.DOUGLAS



NOTES:

1. MATERIAL: 6061-T6 AL PLATE
2. FINISH: ANODIZE [CLEAR]
3. NO REQD: 2 PER MAGNET.
4. BREAK ALL SHARP EDGES 0.2mm.
5. FINE MACHINE FINISH ON EXTERIOR EDGES
6. PART NO SUFFIX DENOTES SPACER THICKNESS. [E.G. -16 SPACER IS 16mm THICK]
7. SPACER THICKNESS IS HALF THE REQUIRED MAGNET POLE GAP, 16mm SPACER=32mm MAGNET POLE GAP.

ITEM	QTY	PART NUMBER	DESCRIPTION	NOTE

PARTS LIST

DRAWN	DATE
G.DOUGLAS	02/16/05
CHECK	DATE
ENGINEERING	DATE
NEXT ASSY	SYSTEM

SOFTWARE
AUTOCAD 2000

DO NOT SCALE FROM DRAWING
DIMENSIONS & TOLERANCES (UNLESS OTHERWISE SPECIFIED)

LINEAR	INCHES	mm
X.XXX	±.005	±0.03
X.XX	±.01	±0.1
X.X	±.03	±0.3
X	±.06	±1
DEG.	±.5	±0.5
FINISH	63	1.6

THIRD ANGLE PROJECTION

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

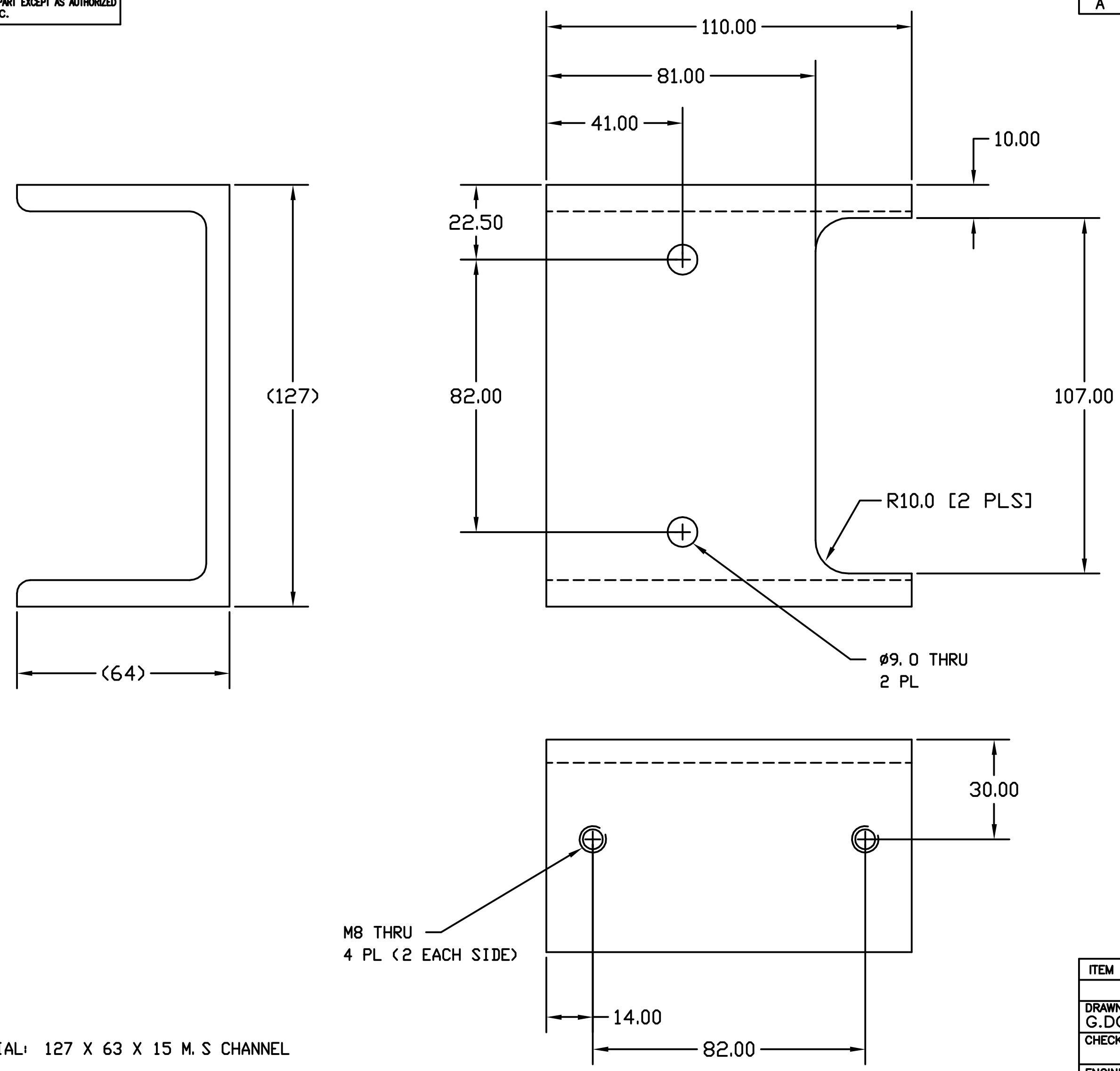
TITLE
POLE SPACER
MODEL: 5403AC

SIZE	DRAWING NO.	REV
A2	17907-0017-0-16	A

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

PROPRIETARY
THIS DRAWING CONTAINS CONFIDENTIAL INFORMATION PROPRIETARY TO GMW INC. IT MUST NOT BE REPRODUCED OR DISCLOSED TO OTHERS OR USED IN ANY OTHER WAY, IN WHOLE OR IN PART EXCEPT AS AUTHORIZED IN WRITING BY GMW INC.

REVISIONS				
REV	DESCRIPTION	DRAFT	DATE	APPROVED
A	RELEASE, REDRAWN FROM DWG NO 17612640		07/01/03	G.DOUGLAS



NOTES

1. MATERIAL: 127 X 63 X 15 M.S CHANNEL
2. DE BURR & BREAK SHARP EDGES
3. FINISH: PAINT PRECISION TAN TO BSL: TP85800010

ITEM	QTY	PART NUMBER	DESCRIPTION	NOTE

PARTS LIST

DRAWN	DATE
G.DOUGLAS	07/01/03
CHECK	DATE
ENGINEERING	DATE

NEXT ASSY	SYSTEM
11901050	5403EG-20
11901080	5403EG-50
11901100	5403

SOFTWARE
AUTOCAD 2000

DO NOT SCALE FROM DRAWING
DIMENSIONS & TOLERANCES (UNLESS OTHERWISE SPECIFIED)

LINEAR	INCHES	mm
X.XXX	±.005	±0.03
X.XX	±.01	±0.1
X.X	±.03	±0.3
X	±.06	±1
DEG.	±.5	±0.5
FINISH	63	1.6

THIRD ANGLE PROJECTION

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

TITLE
VERT MTG BRK
MODEL:5403/5403EG

SIZE	DRAWING NO.	REV
A2	17901610	A
SCALE 1:1	WT kg	SHEET 1 OF 1

PROPRIETARY
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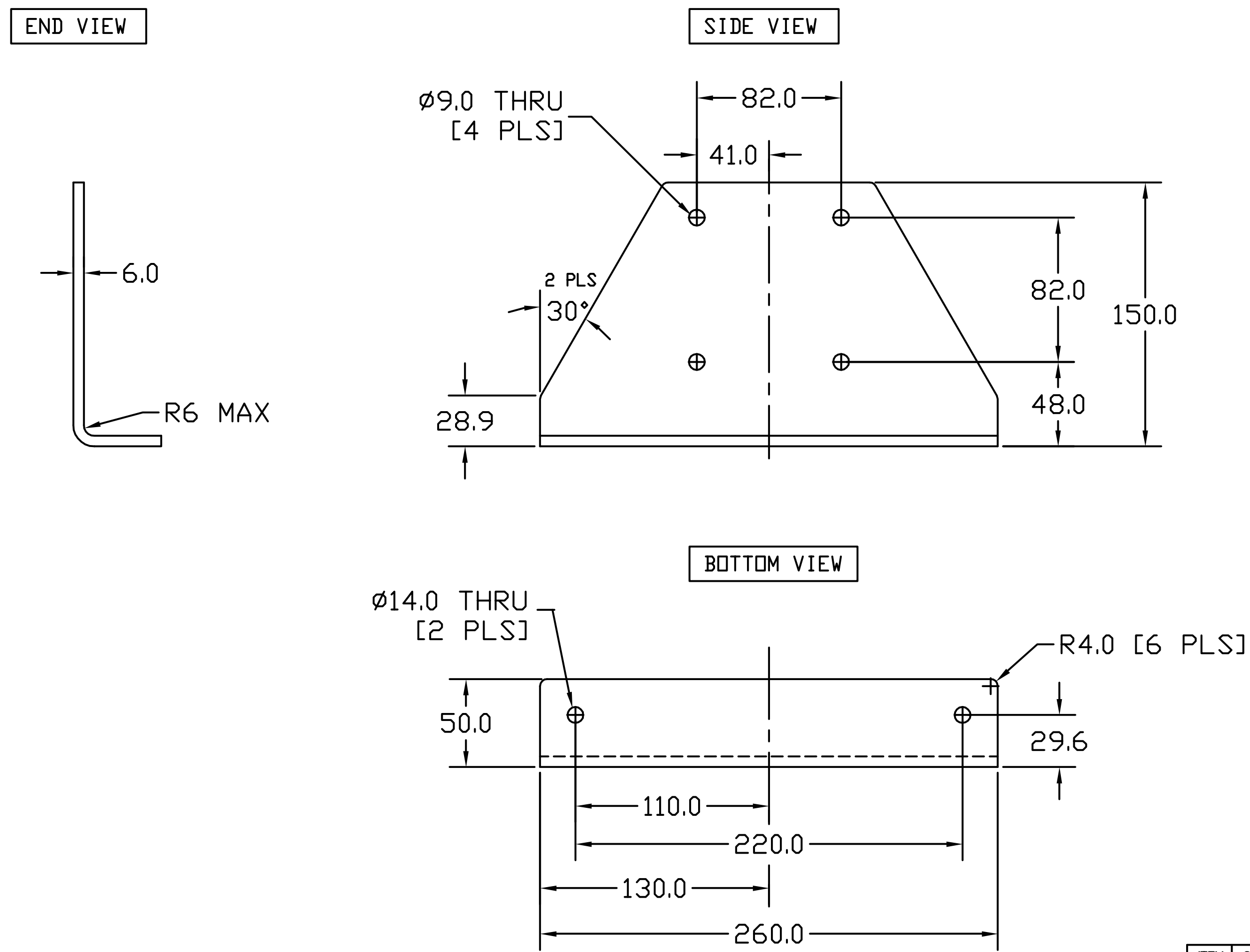
REVISIONS

REV	DESCRIPTION	DRAFT	DATE	APPROVED
A	RELEASE, REDRAWN FROM DWG NO 1761250		11/25/97	G.DOUGLAS



NOTES

1. MATERIAL: M/S PLATE 6MM THICK
2. DE BURR & BREAK SHARP EDGES 0.2MM
3. FINISH: PAINT PRECISION TAN TO BSL: TP85800010
4. NO REQD: 2 PER MAGNET.

ITEM	QTY	PART NUMBER	DESCRIPTION	NOTE

PARTS LIST

DRAWN	DATE
G.DOUGLAS	11/25/97
CHECK	DATE
ENGINEERING	DATE

11901050	5403EG-20
11901080	5403EG-50
11901100	5403
NEXT ASSY	SYSTEM

SOFTWARE
AUTOCAD 2000

DO NOT SCALE FROM DRAWING
DIMENSIONS & TOLERANCES (UNLESS OTHERWISE SPECIFIED)

LINEAR	INCHES	mm
X.XXX	±.005	±0.03
X.XX	±.01	±0.1
X.X	±.03	±0.3
X	±.06	±1
DEG.	±.5	±0.5
FINISH	63	1.6

THIRD ANGLE PROJECTION

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

TITLE
ANGLE BRACKET
MODEL:5403/5403EG

SIZE	DRAWING NO.	REV
A2	17901450	A

SCALE 1:2 | WT kg | SHEET 1 OF 1

PROPRIETARY
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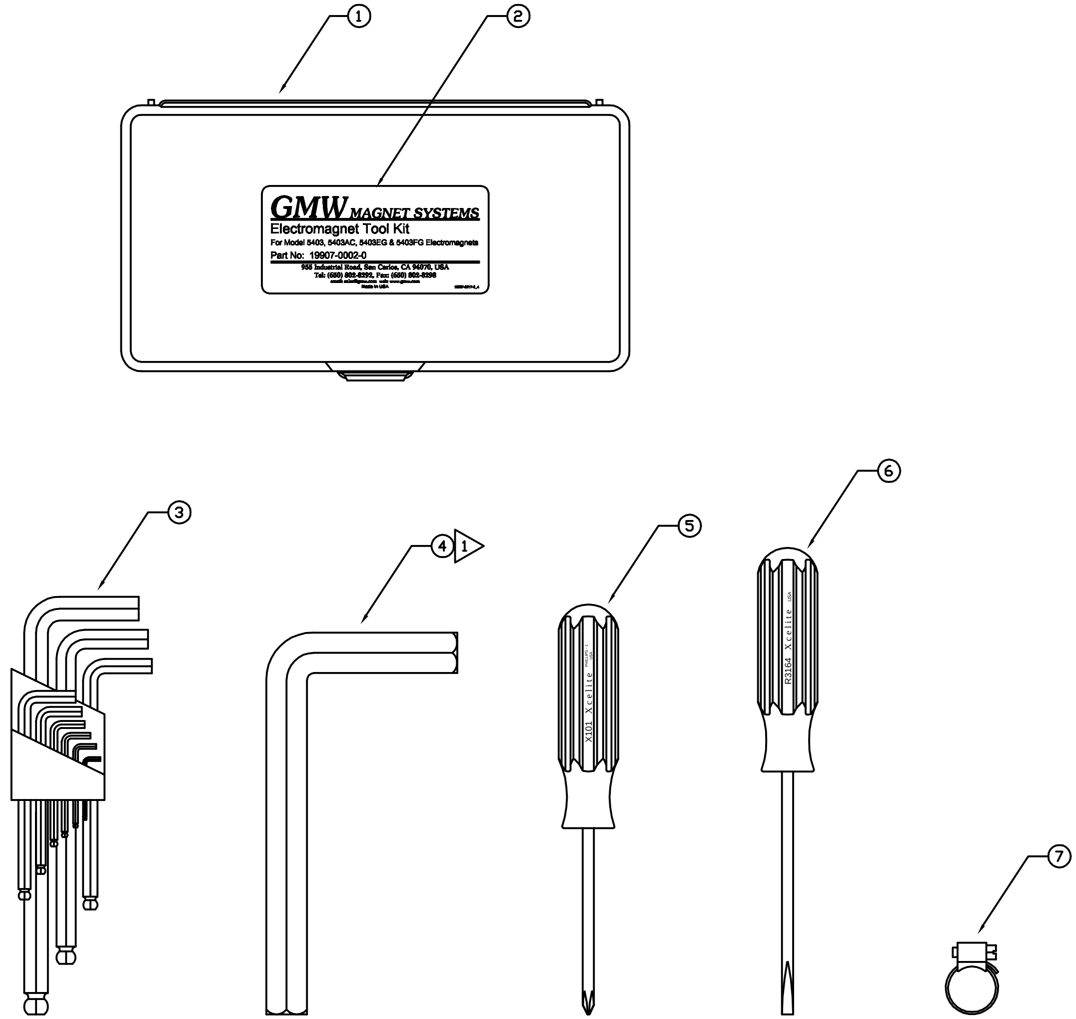
REVISIONS

REV	DESCRIPTION	DRAFT	DATE	APPROVED
A	RELEASE		31 Aug, 05	M. Duffy



NOTE:

1. NOT REQUIRED FOR MODEL: 5403AC MAGNET. USED ON MODEL: 5403 WITH VARIABLE POLE CAP MECHANISM ONLY.

ITEM	QTY	PART NUMBER	DESCRIPTION	NOTE
7	2	350-006	SCREW HOSE CLAMP, SMALL, SS TRIDON	
6	1	48561	SCREWDRIVER, SLOTTED, XCELITE	
5	1	48640	SCREWDRIVER, #1 PHILLIPS, XCELITE	
4	1	250017	HEX KEY WRENCH, 17mm, Mr. Metric	
3	1	BLX 9mm	HEX KEY WRENCH SET, BUNDHUS	
2	1	10907-0002-0_A	LABEL, IDENTIFCATION, 5403 & 5403AC	
1	1	V401	STORAGE BOX, PLASTIC, FLAMBEAU	

PARTS LIST

DRAWN	DATE
M. Duffy	31 Aug, 05
CHECK M. Duffy	31 Aug, 05
ENGINEERING M. Duffy	31 Aug, 05

DO NOT SCALE FROM DRAWING
DIMENSIONS & TOLERANCES (UNLESS OTHERWISE SPECIFIED)

LINEAR	INCHES	mm
X.XXX	±.005	±0.03
X.XX	±.01	±0.1
X.X	±.03	±0.3
X	±.06	±1
DEG.	±.5	±0.5
FINISH	63	1.6

THIRD ANGLE PROJECTION

NEXT ASSY | SYSTEM

SOFTWARE AUTOCAD 2000

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

TITLE
MAGNET TOOL KIT
MODEL 5403 / 5403AC

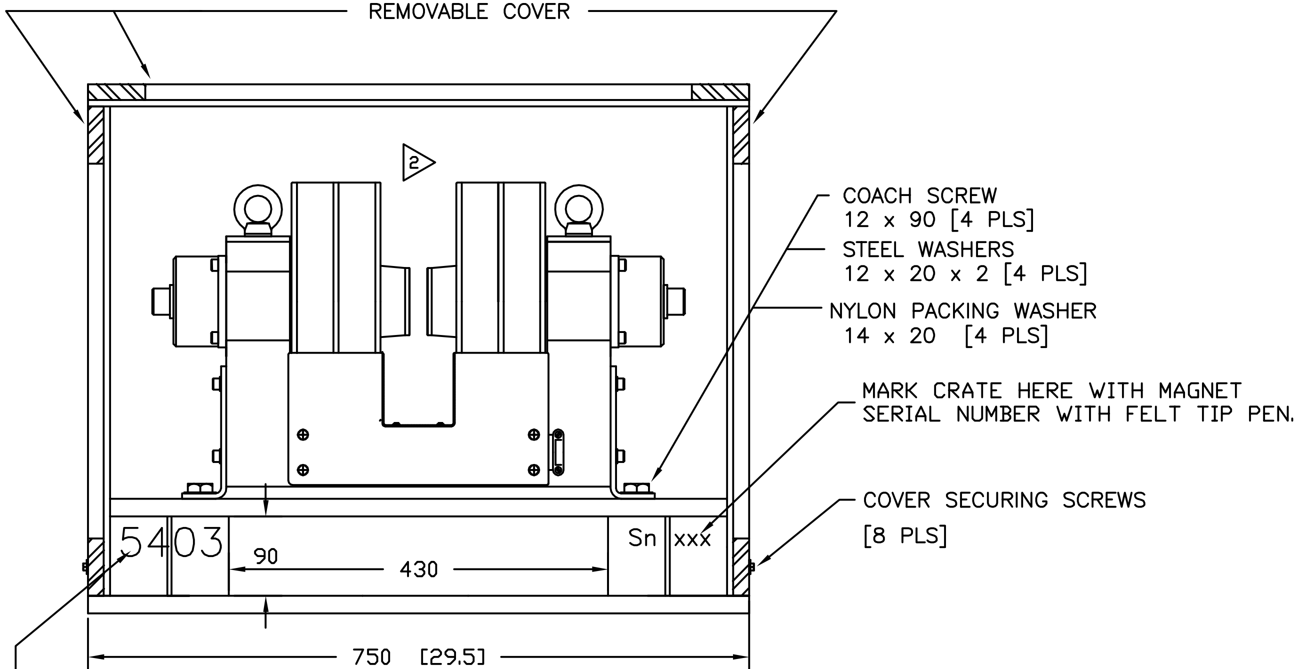
SIZE A1 | DRAWING NO. 19907-0002-0 | REV A

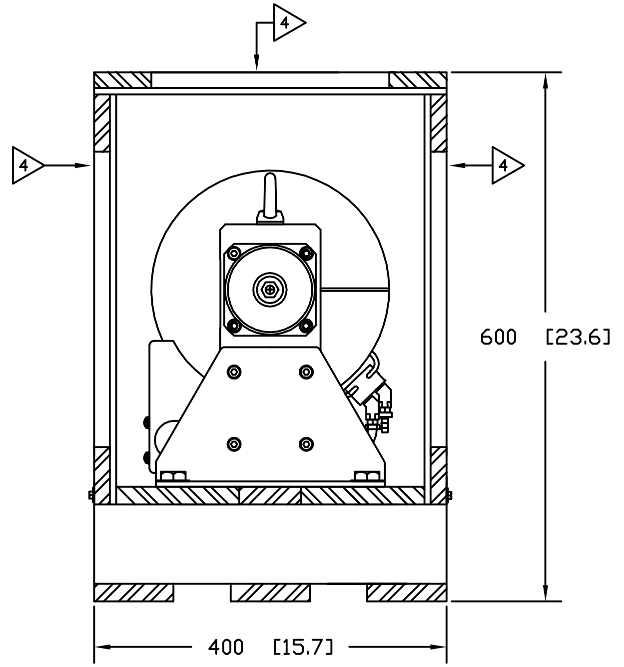
SCALE NTS | WT kg | SHEET 1 OF 1

PROPRIETARY
THIS DRAWING CONTAINS CONFIDENTIAL INFORMATION PROPRIETARY TO GMW INC. IT MUST NOT BE REPRODUCED OR DISCLOSED TO OTHERS OR USED IN ANY OTHER WAY, IN WHOLE OR IN PART EXCEPT AS AUTHORIZED IN WRITING BY GMW INC.

REVISIONS

REV	DESCRIPTION	DRAFT	DATE	APPROVED
A	REDRAWN FROM DWG NO: 18800281		06/08/04	G.DOUGLAS
B	ADD NOTE 3		04/13/05	G.DOUGLAS
C	INCREASE CRATE HEIGHT, 5403AC ADDED TO NOTE: 2		08/26/05	G.DOUGLAS





SHIPPING WEIGHT: 150 Kg [330 lbs]

NOTE:
1. THE 5403 SHIPPING CRATE HAS A ONE PIECE COVER
2. THIS DRAWING SHOWS MODEL 5403 ELECTROMAGNET SAME SHIPPING CRATE CAN BE USED FOR MODEL: 5403AC, 5403FG, 5403EG-20 & 5403EG-50
3. SEE DRAWING NO: 18900771 FOR CRATE CONSTRUCTION DETAILS
4. CRATE PLYWOOD TO BE MARKED ON SIDES AND TOP STATING TIMBER IS HEAT TREATED.

COVER REMOVAL:
1. REMOVE THE COVER SECURING SCREWS
2. GRIP THE COVER AT THE TOP LH AND RH CORNERS
3. LIFT THE COVER VERTICALLY HIGH ENOUGH TO CLEAR THE MAGNET
4. MOVE THE COVER SIDEWAYS AND PLACE ON FLOOR

ITEM	QTY	PART NUMBER	DESCRIPTION	NOTE

PARTS LIST

DRAWN: G.DOUGLAS — DATE: 04/21/04
CHECK — DATE
ENGINEERING — DATE

DO NOT SCALE FROM DRAWING
DIMENSIONS & TOLERANCES (UNLESS OTHERWISE SPECIFIED)

LINEAR	INCHES	mm
X.XXX	±.005	±0.03
X.XX	±.01	±0.1
X.X	±.03	±0.3
X	±.06	±1
DEG.	±.5	±0.5
FINISH	63	1.6

THIRD ANGLE PROJECTION

NEXT ASSY — SYSTEM

SOFTWARE AUTOCAD 2000

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

TITLE: SHIP CRATE ASSY MODEL: 5403

SIZE: A2 — DRAWING NO.: 18900770 — REV: C

SCALE 1:4 — WT kg — SHEET 1 OF 1

SERIES 3450/3450R/3455R/3455RBV 15 AMP THERMOSTATS

Typical Applications:

Power Supplies

Communication Equipment

Medical Equiopment

Computers (Where High AMP Loads are Present)

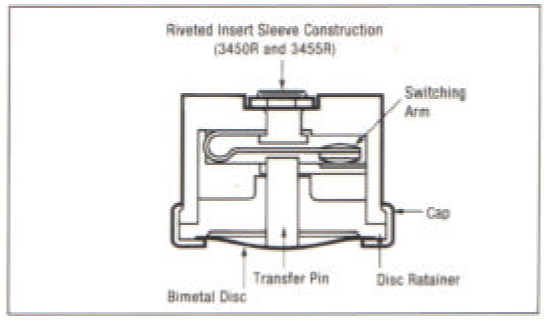
The Series 3450/3455R is a snap-acting, non-adjustable precision thermostat especially suited for industrial and electrical equipment.

The 3450 (.390" or 10mm overall) is ideal for applications that require precision control of high electric loads to 8 Amp resistive.

The 3450R and 3455R have a patented metal insert rivet construction.

The 3455R (.484" or 12.5mm) overall, has higher spacing as required by European approval agencies. Model 3455RBV is an epoxy overmold version of the 3455R, specifically designed for electrical insulation or protection in a high humidity environment. Consult factory for performance qualifications.

To insure that a safe combination of thermostat and application is achieved, the purchaser must determine product suitability for their individual requirements.



*Series 3450/3450R/3455R/3455RBV

MODEL	ELECTRIC LIFE CYCLES	120 VAC	240 VAC	277VAC
3450	100,000	8.0A	-	-
3450R/	100,000	15A	8.3A	7.2A
3455R	100,000	4.4FLA 26.4LRA	2.2FLA 13.2LRA	-
	6,000	5.8FLA 34.8LRA	2.9FLA 17.4LRA	-
3455RBV	100,000	15A	8.3A	-
	6,000	5.8A 34.8LRA	2.9A 17.4LRA	-

A: Amps
FLA: Full Load Amps
LRA: Locked Rotor Amps
Contacts are available for millivolt and milliamp applications.
*Includes UL and CSA ratings.
Consult Elmwood Sensors for additional ratings.

Key Features:

- *Electric Rating to 15 Amp 120 VAC Resistive*
- *Environmental Exposure 0° to 350° F (–18° to 177° C)*
- *UL recognized and CSA certified and European Approved*
- *Single-Pole, Single-Throw (SPST)*
- *Pre-set and Tamperproof*
- *Variety of Mounting Brackets and Terminals Available*

Standard Temperature Characteristics

Operating Temperature Range The tightest specification determines the group	**Tolerance Allowable°** ± at mean temperature set points				**Standard Mean Differential** Nominal degrees between opening and closing points		**Price Group***
	Open		Close				
	±°F	±°C	±°F	±°C	°F	°C	
32° to 79°F	5	2.8	8	4.4	30-50	16-28	I
0° to 25°C	5	2.8	7	3.9	25-29	14-16	II
	5	2.8	6	3.3	20-24	11-13	III
	5	2.8	6	3.3	15-19	8-11	IV
80° to 200°F	5	2.8	8	4.4	30-50	16-28	I
25° to 95°C	5	2.8	7	3.9	25-29	14-16	II
	5	2.8	6	3.3	20-24	11-14	III
	6	2.2	5	2.8	15-19	8-11	IV
201 to 250°F	6	4.4	8	4.4	30-50	16-28	I
96° to 120°C	6	3.9	7	3.9	25-29	14-16	II
	6	3.3	6	3.3	20-24	11-14	III
	6	2.8	6	2.8	15-19	8-11	IV
251 to 302°F	7	3.9	8	4.4	30-50	16-28	I
121.7° to 148.9°C	7	3.9	7	3.9	30-50	16-28	II
	7	3.9	7	3.9	20-29	11-16	III
	6	3.3	7	3.9	15-19	8-11	IV

*Grouped according to level of accuracy required. Group I with greatest latitude is less expensive than Group II, etc.
Please consult factory for temperature ranges, tolerances and differentials not noted. The operating temperature ranges include tolerances.
The ± tolerances shown have been established after careful review of many thermostat applications. Attempts should be made to establish the widest acceptable tolerance possible. For example, the chart may list a tolerance of ±5°F (±2.8°C); however, ±6°F (±3.3°C) may be acceptable for the application at reduced cost.
Note: Temperature checking methods may be slightly different, and allowance for a 1.8°F (1°C) variance should be considered.
See Section B of the Terminal and Bracket Guide for dimensional characteristics.

Operating Parameters

Dielectric Strength	Mil-STD-202 Method 301 -2000 VAC 60 Hz - Terminal to Case
Insulation Resistance	Mil-STD-202 Method 302 Cond. B - 500 Megohms - 500 Volts DC applied
Environmental Exposure	0° to 350°F (–18° to 177°C)
Operating Temp. Range	32° to 302°F (0° to 150°C)
Contact Resistance	Mil-STD-202, Method 307 - 50 Milohms
Marking	Mil-STD-1285
Weight	6 Grams (Brackets and wire leads not included)
Materials	Base: Phelonic Terminals: Plated Brass or Steel Closure: Aluminum, Stainless Steel, or Brass Brackets: Aluminum, Stainless Steel, or Brass Contacts: Silver

UL and CSA Listings

UL and CSA Listings are for use in equipment where the acceptability of the combination of the thermostat and equipment is determined by Underwriters' Laboratories, Inc. and/or the Canadian Standards Association.

UL File E36103, UL File SA4469 (3455RBV only), UL File MH8267 (3455R only), CSA File 21048.