GMW Associates

USER'S MANUAL

MODEL: 5204

Projected Vector Electromagnet

Date Sold: _____

Serial number: _____

File No: M5204_REV_A-Projected_Vector_Electromagnet_8_15_2019.pdf Revision Date: August, 2019

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CONTENTS

1. SAFETY

1.1. Symbols Used In This Manual

Important information. This label indicates important information that must be read and understood prior to operation.

Warning relating to the presence of magnetic field.

Warning relating to a trip hazard.

Warning relating to hot surfaces.

Warning relating to the potential for electrical shock.

Warning relating to the potential of injury due to lifting heavy weight.

1.2. Installation, Operation and Service Precautions

During installation or servicing this magnet must be locked out following the Lockout/Tagout procedure defined in section 1.3.

Hazardous voltages are present within this product during normal operation. The product should never be operated with any of the covers removed.

When operated at peak direct current of 100A the surface temperature of the coils of the electromagnet can rise as high as 65°C. Care must be taken not to touch the coils for extended periods.

1.3 Lockout/Tagout Procedures

Purpose:

To protect personnel and ensure that machines and equipment are isolated from potentially hazardous electrical energy. Lockout or tagout must occur before employees perform service, maintenance, or renovation. This is important where unexpected start-up could cause personal injury, fire, or equipment damage.

Policy:

All equipment shall be locked out where possible. Where such control is not possible, equipment may be tagged out-of-service. In all instances, equipment shall be made inoperable to protect against possible operation where such operation may cause personal injury or damage. Employees must not attempt to operate any switch or source of energy which is locked out or tagged out.

Procedures:

1. **When working on systems which could accidentally be activated, the system shall be locked out or tagged out by use of a safety lockout device and padlock. In addition, a tag shall be used to identify the purpose of the shutdown, the employee involved, the date the unit was removed from service, and when the system may operate again.**

2. **If more than one source of energy is present, all such sources must be locked out or tagged out. Special procedures must be followed to ensure that the equipment is disconnected from an energy management system or emergency generator system that may start or energize the equipment.**

3. **A lockout is required on all systems where possible. A tagout is an acceptable means of protection on systems which are less hazardous. An example of less hazardous is a device, if started accidentally, would not cause personal injury.**

4. **If more than one person is involved in the repair, each person shall install a lock and or tag to the equipment energy source. An employee may not use the tag or lock of another employee.**

5. **After servicing, renovation, or maintenance is complete, the area must be checked for tools, parts, removed guards, and assurance that no personnel are in the danger zone. Then the lockout or tagout will be removed by the same employee who initially locked it out so energy may be restored to the equipment.**

6. **If the employee who locked out or tagged out the equipment is unavailable, the supervisor may remove the lock or tag if the following conditions are met:**
    1. **Verification that the employee who applied the device has left for the duration of the shift and is not at the job site.**
    2. **Made reasonable efforts to reach the employee.**
    3. **Inform the employee that the lock or tag has been removed and the system is no longer de-energized, before the employee resumes work.**

7. **Employee's using lockout/tagout devices shall have training about this program, and shall have annual retraining to ensure that the employee understands and follows this program. The training and retraining shall be documented with the training records maintained by the training coordinator.**

8. **Outside contractors are required to follow this policy or provide a similar policy that is in compliance with Occupational Safety and Health Administration (OSHA) Standard 1910.147. Under no circumstances are outside contractors authorized to remove a lockout/tagout device nor are they allowed to energize a locked out/tagged out system.**

Lockout/Tagout Procedures Checklist:

The following steps must be followed in sequence to properly lockout/tagout and re-establish energy:

I. Understand the hazard:

Electrical

Electrical Shock and or burn could result from contact with the exposed conductors line voltage or high voltage equipment. Flying parts or fire could result if this circuit were shorted. Electricity should be controlled at the circuit breaker, main switch, or fuse box.

Mechanical

Equipment or machinery can inflict tissue or skeletal injury through crushing, laceration or impalement. This can be controlled through the main electrical switch, plug, circuit breaker or anti-motion pin.

Thermal

Can cause burns or fires. It can be controlled by the main electrical switch, electrical plug control, electrical circuit breaker, electrical fuse box, steam valve, fluid line valve or shielding.

II. Shutdown:

Know what type of energy the machine uses.
Identify its potential hazards.
Find the switches or other devices that control energy and need to be locked out.
Let employees know that you will be locking or tagging out the equipment and why.
Turn off the machine or equipment.

III. Isolate the source of energy

Electrical

- **Locate the main switch box or circuit breaker.**
- **Open the breaker, open the switch or remove the plug.**

- **Attach a lockout enabling device if the circuit cannot otherwise accommodate a padlock.**
- **Place plug in a plug lock box.**

Mechanical/Storage Potential Energy

- **Lockout enabling device.**
- **Secure the energy controlling lockout by attaching a personal lock and completed tag to the lockout enabling device. If more than one person will be performing the work, each must apply their own lock to a multiple lock device.**
- **Release all stored energy.**
- **If there is a heat exposure, allow to cool.**

Release from Lockout/Tagout

1. **Inspect the surrounding area following completion of work for loose tools, parts, correct valve settings, system integrity, exposed conductors.**
2. **Check that all machine guards are in place and reconnected if applicable.**
3. **Notify others in the area that the equipment is about to be made operational and returned to service.**
4. **Remove personal lock, tag, and lockout enabling device. This step must be performed by the same person who applied the tag and lock.**

Lockout/Tagout Training

The lockout/tagout program is designed to train employees on disabling powered equipment from their power sources before beginning any servicing or maintenance work. Lockout/tagout training is required for all employees who may possibly need to lockout and tagout equipment.

Employees will receive annual training in the following areas:

1. **Recognition of applicable hazardous energy sources.**
2. **Methods and Means necessary for energy isolation and control.**
3. **Restrictions and limitations of lockouts.**

2. SPECIFICATIONS

2.1. General Specifications

Maximum Excitation per coil	
Max DC current	**63A, 238W**
Max sinusoidal wave current	**90A_{peak}, 238W**
Max triangle wave current	**100A_{peak}, 238W**
Coils (series connection)	
Coil Resistance (20°C)	**45 mOhm/coil**
Max Resistance (60°C)	**60 mOhm/coil**
Max Continuous Power (water cooled @ 8 lpm)	**63A/3.8V (238W)/coil**
Self Inductance	**127μH/coil**
Water Cooling (18°C)	**3.6 bar (52 psid), 8 liters/min (2.1 US GPM)** **Pressure measured between magnet inlet and outlet**
Over-temperature Interlock	**Selco UP62-80C thermostat** **Contact rating 250VAC, 2.5A. Closed below 80°C**
Dimensions	**Drawing 11907-0290-0_A** **74 mm W x 74 mm D x 123.5 mm H** **(2.91 inch W x 2.91 inch D x 4.86 inch H)**
Mass	**2.5 kg (5.5 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.

2.2. Model 5204 Electrical and Water Connections

DC Current

The 5204 electromagnet includes a junction box that connects to the magnet at a length of 500mm. Refer to Figure 1 for an image of the packaged unit and Section 11.3 for wiring and connection diagram. The magnet is shipped with the power and water connections to the junction box connected. Further, the power lead is also shipped connected to the junction box. The connections for the power supplies are made according to the particular power supply being used. Refer to section 11 for wiring diagrams and connection details.

Ground

The coil cooling plates and magnet body are all earthed through the power supply earth.

Interlocks (refer Section 8)

The Model 5204 is fitted with one thermostat, Selco part no UP62-80C. The thermostat is normally closed, opening when the coil heatsink temperature exceeds 80°C, ± 5°C. Further a flow switch is included in the junction box so that the power supply will only activate if all interlock conditions are satisfied. The magnet coils must be below 80°C and water must be flowing in the cooling circuit.

Water

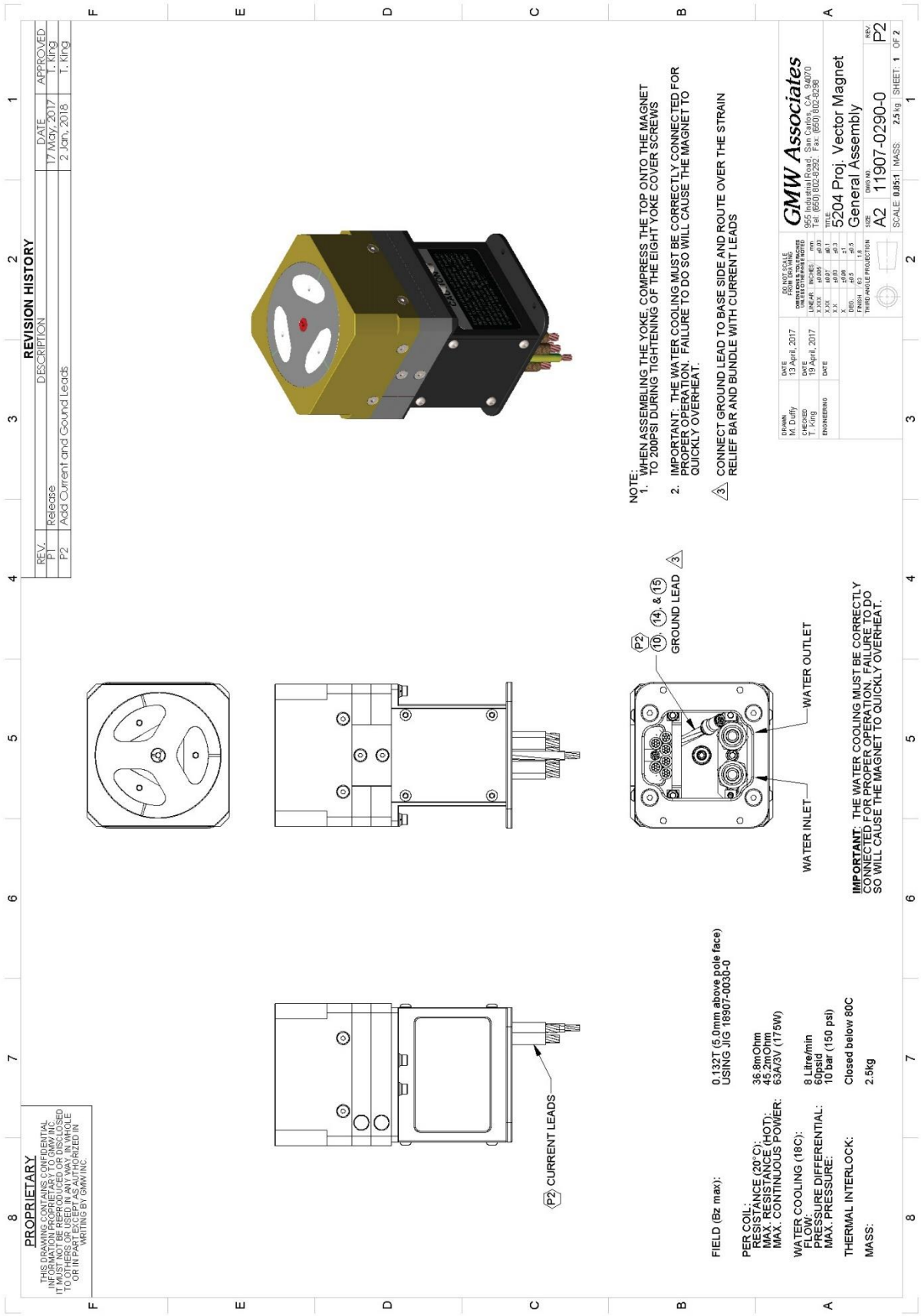
Clean, cool (16°C - 20°C) water at 8.0 lpm at 3.6 bar (52 psid) should be used to cool the 5204 magnet. This can be provided by house water supply or from a recirculating chiller. An appropriate recirculating chiller is the TF900 from Thermofisher for 900W of time-averaged power dissipation or the TF1400 for 1400W of time-averaged dissipated power. If house water supply is used, an in-line 5 micron water filter should be used for the supply line to the magnet. Also, 5m of hose is provided to give two 2.5m lengths for connection between the junction box and the recirculating chiller (if ordered), brass fittings on the chiller are already provided. Note that 4 hose clamps have also been provided for fitting these water hoses.

Chiller Connections:
½ inch NPT thread with hose barb to fit hose of ½ Inch Inner Diameter

Junction Box Connections:
⅜ inch NPT thread with hose barb to fit hose of ½ Inch Inner Diameter

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.

2.3. Drawing 11907-0290-0_S1_P2_5204_General_Assembly



3 WARNINGS

REFER TO WARNINGS BELOW BEFORE OPERATING ELECTROMAGNET

1 Personnel Safety

The Model 5204 has a low level of fringe field. In operation the magnet fringing field can be in excess of 0.5mT (5G). 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 of higher field should be restricted to qualified personnel.

2 Ferromagnetic Objects

During operation the magnet exerts strong magnetic attraction towards ferromagnetic objects in the near vicinity. Loose objects can be accelerated to sufficient velocity to cause severe personnel injury or damage to the coils. Keep ferromagnetic tools clear.

3 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.

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 Interlocks

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

6 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 magnet during operation. Credit cards, and magnetic disks are affected by magnetic fields as low as 0.5mT (5G).

7 Trip Hazards

Caution must be taken when moving around the magnet as there are potentially cables on the floor that will present a trip hazard. It is highly advised that floor conduit be purchased that will cover the cables. This will also protect the cables from potential damage.

4 INSTALLATION

4.1. Unpacking Instructions and Damage Inspection

To unpack the electromagnet please follow the procedure below.

1. **Inspect the shipping crate for obvious signs of damage or mishandling. 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 has occurred proceed with uncrating and installation.**

2. **First remove the steel banding and tek screws from the shipping crate cover. Lift the cover clear of the magnet and set aside.**

3. **Take care in lifting the magnet from the crate for installation. The magnet is delivered with the junction box and electrical cable fully connected. Be careful when removing the magnet from the crate as these components will have to be removed together. Please refer to Figure 1 for the contents of the crate**

4. **If the system is ordered with a recirculating chiller, the crate will also be opened observing the same process as for the magnet crate. Refer Figure 2.**

Caution: Take care when handling chiller. All movement, lifting and installation of the recirculating chiller must be under the supervision of an experienced person to prevent the possibility of serious injury or damage to the unit.

Figure 1: Shown here is packing configuration for the magnet head, the junction box and the electrical cable. These are all connected and ready to install. Also included is 5m of water hose, not connected, and four hose clamps.

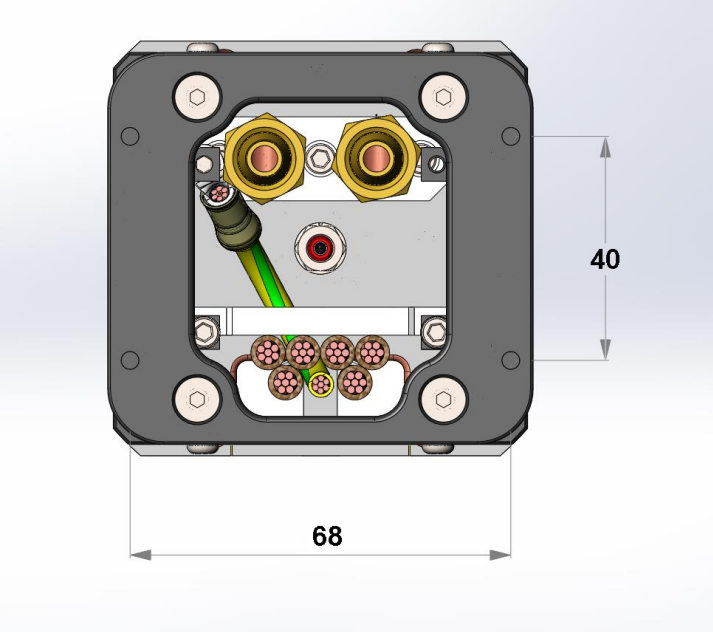
Figure 2: Shown here is the contents of the chiller crate, if ordered. This Eaton Power Distribution Module and EMO.

4.2. Siting Considerations

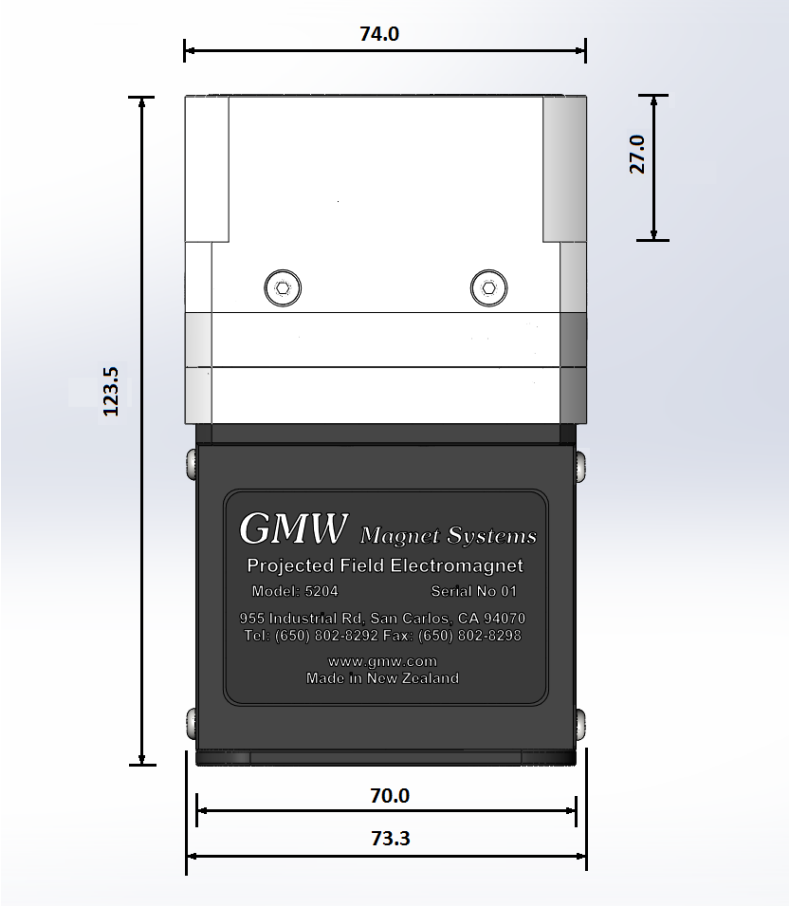
The Model 5204 is not magnetically shielded. Ferro-magnetic material in the vicinity of the magnet will modify the magnitude and uniformity of the central region magnetic field. As a general rule avoid magnetic material closer than approximately 1 meter of the central region.

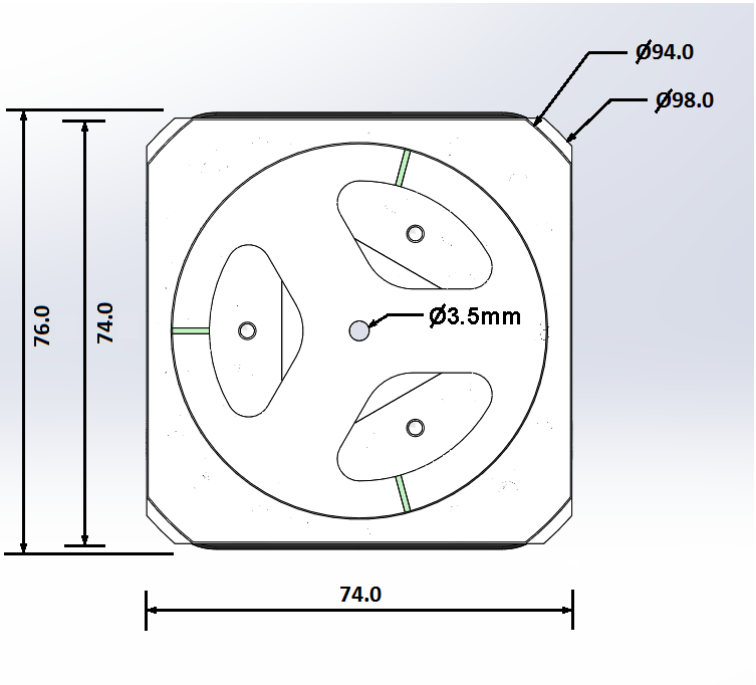
Background fields such as the geomagnetic field and alternating field from 50Hz and 60Hz power sources are not shielded by the magnet and will add to the field produced by the magnet. If possible these background fields should be measured and their effects evaluated before the Model 5204 magnet is installed. It may be necessary to orient the Model 5204 axis to minimize the effects of external fields, to relocate ac power sources or to install suitable magnetic shielding.

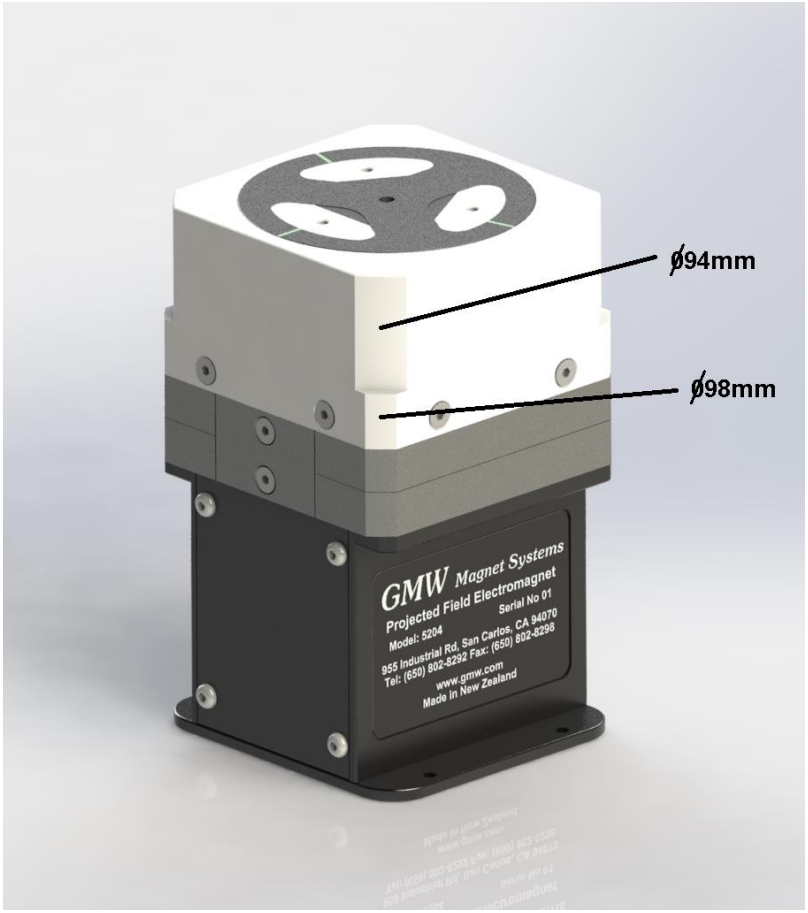
The 5204 Electromagnet features four mounting holes Ø3.2mm on the base plate. Refer to the diagram below.



Overall dimensions are shown here. Note that the magnet head has been rounded so as to fit in a circular aperture such as those found on standard probe cards. The magnet can be inserted into a circular hole of Ø94mm to a depth of 27mm, and completely through a hole of Ø98mm.




Ø94.0
Ø98.0
76.0
74.0
Ø3.5mm
74.0


ø94mm
ø98mm
GMW Magnet Systems
Projected Field Electromagnet
Model: 5204
Serial No 01
955 Industrial Rd, San Carlos, CA 94070
Tel: (650) 802-8292 Fax: (650) 802-8296
www.gmw.com
Made in New Zealand

4.3. Electrical Circuit

Never connect or remove cables from the magnet with the power supply connected. The stored energy in the magnet can cause arcing resulting in severe injury to personnel or equipment damage.

Because the magnet stores a significant amount of energy in its magnetic field, special care should be taken to ensure 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.

4.4. The 5204 Interlocks

5972 LEDs water flow.

The Model 5204 has an integrated Selco UP62-80C thermostat. This is mounted internally and is in contact with the hottest point in the magnet. The thermostats are normally closed, opening when the coil temperature exceeds 80°C, ± 5°C.

In the event of any one of these interlocks open, the power is cut from the Kepco power supplies and the system is de-energized. The temperature switches automatically reset once the proper operating conditions have been met.

In the event of an interlock tripping it is strongly recommended that the root cause of the trip be determined. In the event that the root cause cannot be determined please contact Tom King (tom@gmw.com) for technical support.

4.5. Cooling

The Model 5024 can be operated up to an average coil temperature of 80°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 25% more than the ambient temperature "cold" resistance. The coil thermostat will open when the coil temperature exceeds approximately 80°C. Clean, cool (16°C - 20°C) water at 8 l/min and 3.6 bar (52 psid) must be used to cool the 5204 magnet.

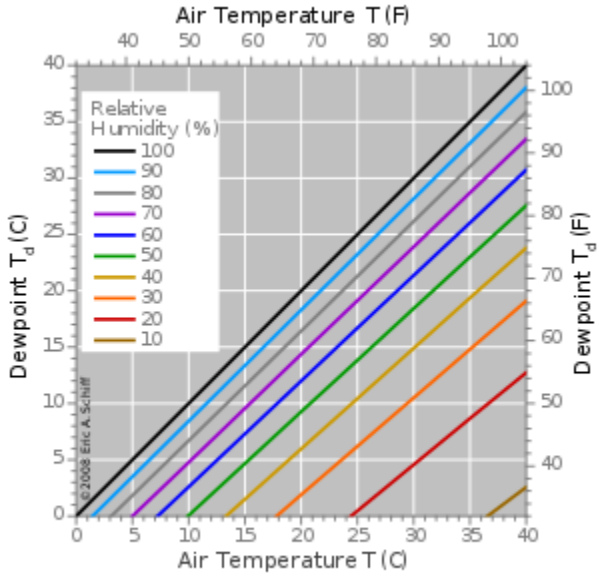
The copper cooling tubes are electrically isolated from the coils to avoid electrochemical corrosion. A 5 micron filter should be placed before the input to the magnet to trap particulates.

Configuration Suggestion: 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 5204 Electromagnet with 3x Kepco BOP10-100 power supplies a suitable chiller is the Thermofisher TF900 recirculating water chiller (900W) or TF1400 (1400W).

For concern on buildup of corrosion and/or algae in a recirculating cooling system, GMW recommends using Thermofisher Algaecide/Corrosion Inhibitor, Nalco Kit (Thermofisher PN: 610000000005) or premixed solution (Thermofisher PN: 610000000007).

During operation the resistance can be checked using a voltmeter across the magnet. 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.

Avoid cooling the magnet below the dew point of the ambient air. Condensation may cause electrical shorts and corrosion. Refer to the chart below to determine the dew point for the humidity level that the electromagnet will be operating in.



5. OPERATION

5.1. General

The 5204 electromagnet is water cooled and should not be operated without water. Attempts to operate the magnet as an air cooled system will most likely result in irreversible damage to the magnet.

This product is an electromagnet and creates significant magnetic fields both within the magnet and in the surrounding area. Make sure that there are no ferromagnetic items, tools or components loose in a 1 meter radius surrounding the magnet.

The Model 5204 is not a shielded electromagnet. In operation the magnet fringing field can be in excess of 0.5mT (5G). 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 of higher field should be restricted to qualified personnel

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 magnet during operation. Credit cards, and magnetic disks are affected by magnetic fields as low as 0.5mT (5G).

The magnet operates as a conventional water cooled electromagnet.

1. **Adjust the cooling water flow to approximately 8 liters/min (2.1 US gpm). 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.**
2. **Please refer to the user manual of the selected power supply. Field control of a vector magnet is complex. The software provided is the best option for attaining a desired field.**

5.2. 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 and software (Labview) (sales@gmw.com).

6. MAINTENANCE

Whenever performing maintenance on this magnet all electrical plug socket disconnects must be disconnected and a plug lockout device used to properly shut down the electrical system. Refer to Lockout/Tagout procedure defined in section 1.3.

6.1. Cooling Circuit

Check the cooling water circuit to ensure the water is clean and free of debris and bacterial growth. If an in-line water filter is used, ensure the filter is clean. If this magnet is used in conjunction with a closed cycle chiller please refer to the Chiller User Manual for details specific to that chiller for cleaning and maintenance.

6.2. Strain Relief Check

During the scheduled maintenance it is recommended that cables at the base of the 5204 magnet, those leading to the junction box and those leading from the junction box to the power supply, be inspected for tight connection and absence of corrosion. In particular all strain relief should be checked to confirm that the cables are properly restrained from movement. The Lockout/Tagout procedure from section 1.3 should be followed during this procedure.

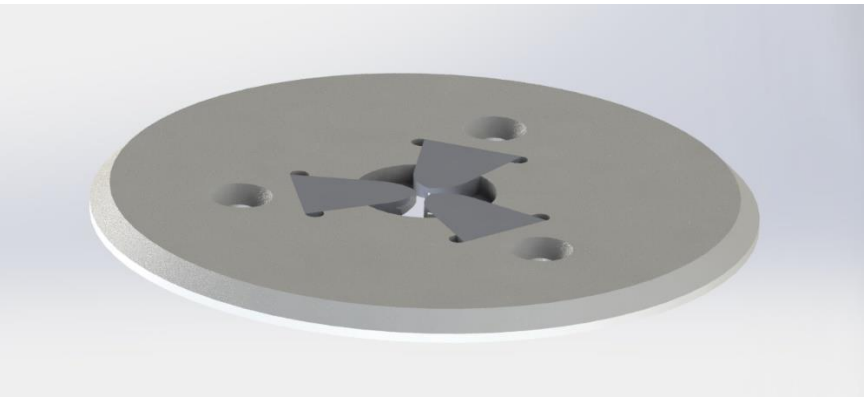
When inspecting cables to the magnet the magnet should be de-energized to zero amps and the power supply switched off.

Check the water hoses for aging or degradation. If the early stages of degradation are observed (small cracks in the hose, usually near the hose barbs) the water hoses should be removed and replaced. Be sure not to damage the hose barbs when removing old hose.

7. STANDARD OPTIONS

7.1. Standard Poles and Options

The 5204 electromagnet has three exposed pole stems on its top surface. Each magnet is supplied with a flux plate featuring three encapsulated pole extensions that have been optimized to generate the best field at 3mm above the flux plate. Note, the flux plate is itself 3mm thick and this should be allowed for when integrating the magnet.



Custom poles are also available. These can be designed to particular customer requirements. Please contact GMW for more information sales@gmw.com.

8. Pre-Installation Check List

Electrical Service:

Power Supply:	**Kepco 10-100GL (MG), 3 units.**
Voltage:	**200-240Vac, single phase**
Current:	**max 9.5Aac**
Circuit Breaker:	**15A**
Power Cable:	**3 conductor, 12AWG Min**
Mains Outlet:	**Nema L5-30R or equivalent**
Mating Plug:	**Mema L5-30P or equivalent**
Auxiliary Power for Rack:	
Voltage:	**115Vac or 208 Vac, as ordered**
Current:	**15A**
Chiller (if ordered):	
Voltage:	**115Vac or 208Vac, single phase, as ordered**
Current:	**10.5A**

Power Distribution Module:

1-Phase:	**3 x IEC C14 to IEC C19 cables for 3 x 1kW BOP supplies**
Voltage:	**208-240Vac**
Current:	**16A**
3-Phase:	**3 x IEC NEMA L6-20P to IEC C19 cables for 3 x 1kW BOP supplies**
Voltage:	**120-208Vac**
Current:	**24A**

Water Cooling:

Water Temperature:	**15 deg C to 20 deg C, non-condensing.**
Flow Rate:	**8 l/min**
Pressure:	**52 psid measured at the magnet**
Water Hose:	**½ inch ID**

Equipment Rack (If required and not provided by GMW)

Depth:	**760mm (30 “)**
Free Space:	**6 U (>10.5”) for two kepco power supplies.**
	3 U (5.25”) for Power Distribution Module if ordered.

Lifting Equipment:

5204 Weight:	**5.5 lb (2.5kg)**
Kepco 10-100GL (MG) Weight:	**53 lb (24 kg), each.**

9. EXCITATION CURVES AND FIELD UNIFORMITY

10. TEST DATA

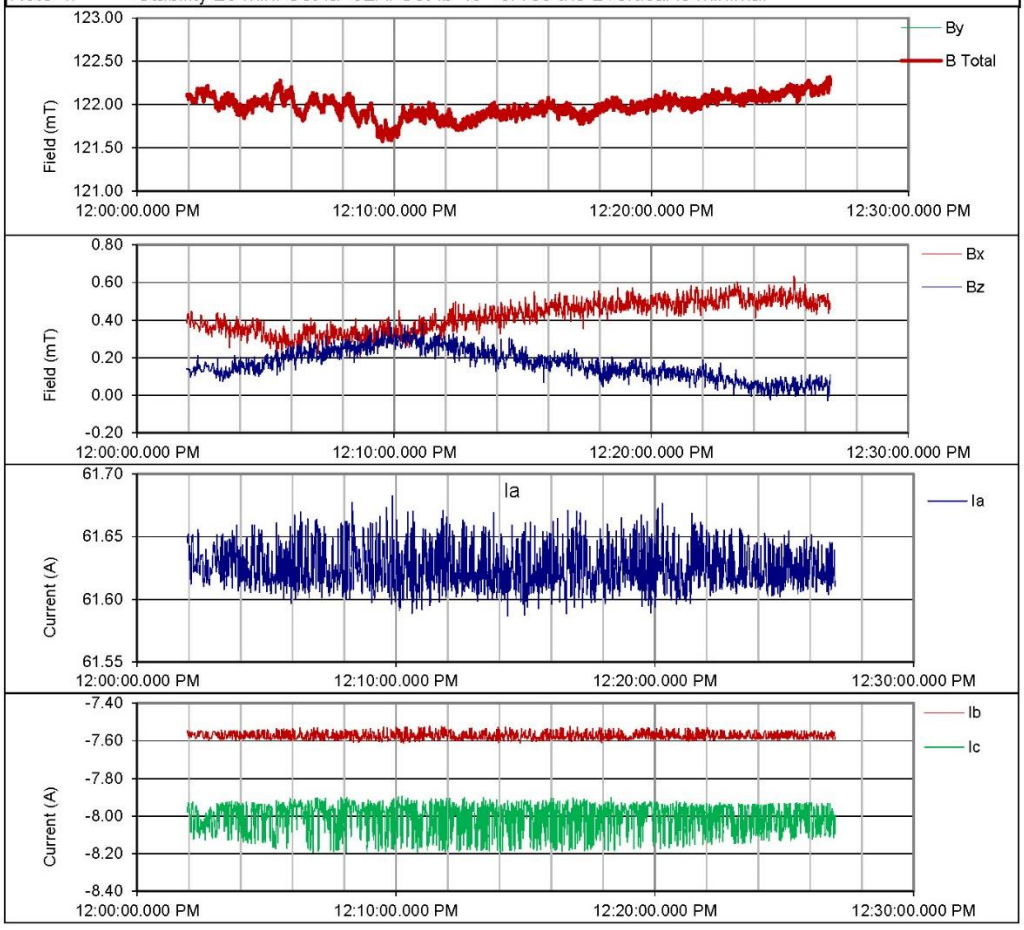
10.1 Field Stability

GMW Associates

Electromagnet Stability Plot

Contract No:		Page:	8 of 8	Test Date:	10/26/2018
Customer:				Engr:	Y.Qin
Model:	5204	Power Supply:	3x Kepoco 10V/100A MG		
Serial No:	2	PS Serial No:	SN:A108488, A109486, A109487		

Chiller: ThermalFlex900, SN: 1111783801171004
Field Probe: Senis 2T F3A-03A02F-A02T2K5M SN:157-17
Note 1: X: horizontal, pole A on one side and pole B and C on the other side.
Y:horizonal, from pole A, go between pole B and C
Z: vertically up.
X=Y=Z=0mm located at the magnet center.
Note 2:
Note 3: Mu Metal shim glued.
Note 4: Stability 20 min. Set Ia=62A. Set Ib=Ic=-8A so the Bvertical is minimal



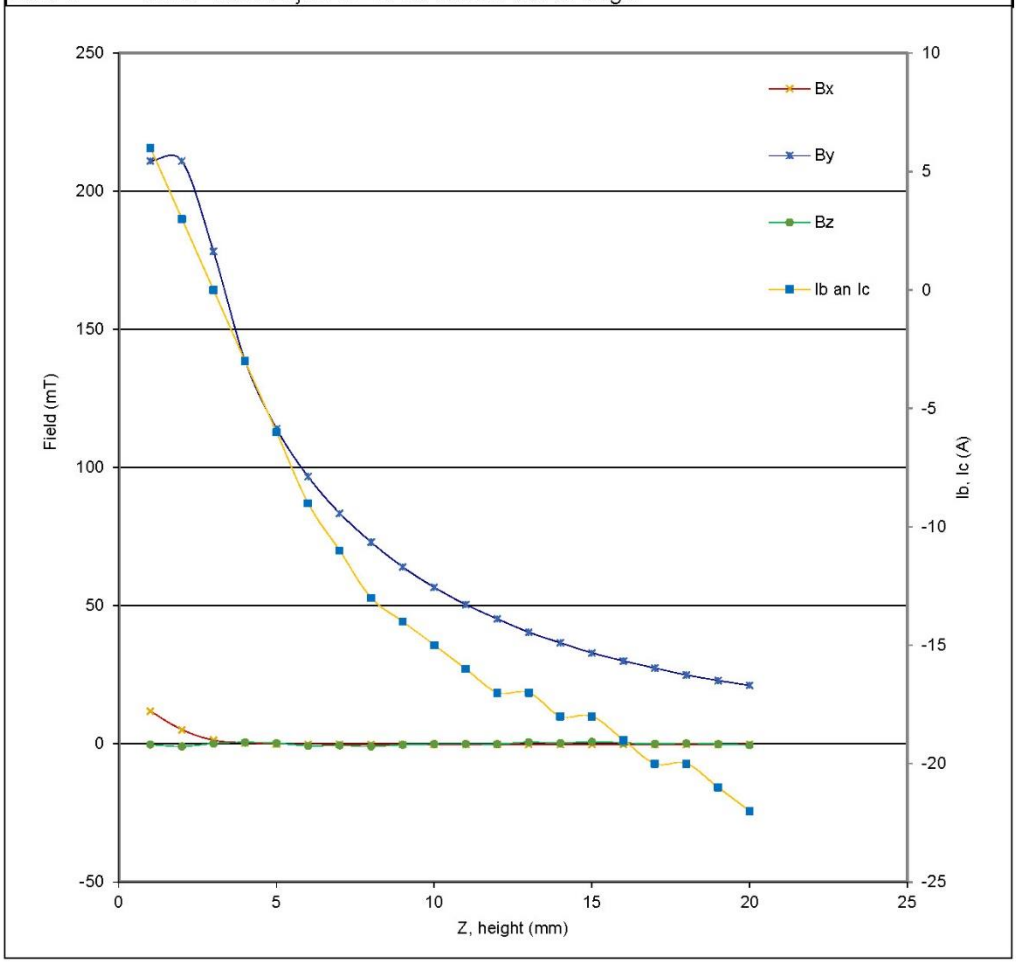
5204 SN002 Test Data.xlsx Print 10/26/2018

10.2 Vertical Field

GMW Associates

Electromagnet Uniformity Plot

Contract No:		Page: 5 of 10	Test Date: 9/18/2018
Customer:			Engr: Y.Qin
Model:	5204	Power Supply:	3x Kepoco 10V/100A MG
Serial No:	3	PS Serial No:	SN:A108488, A109486, A109487
Chiller:	ThermalFlex900, SN: 1111783801171004		
Field Probe:	Senis 0.2T F3A-03A02F-A.2T2K5M SN:041-17		
Note 1:	X: horizontal, pole A on one side and pole B and C on the other side.		
	Y:horizonal, from pole A, go between pole B and C		
	Z: vertically up.		
	X=Y=Z=0mm located at the magnet center.		
Note 2:	Field probe reading satuirated at 210mT		
Note 3:	Mu Metal shim glued.		
Note 4:	Set Ia=100A. Adjust Ib = Ic so that Bz=0 at all height		



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10.3 Rotating Field

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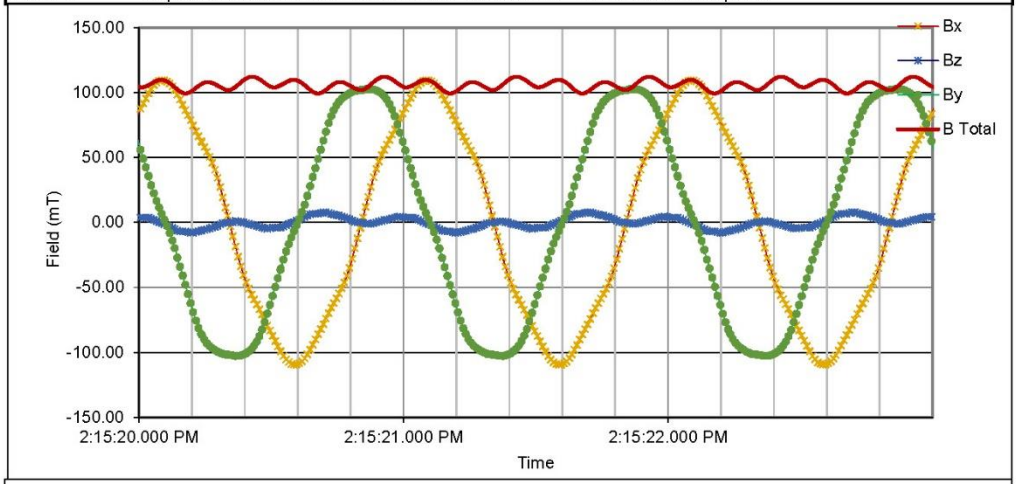
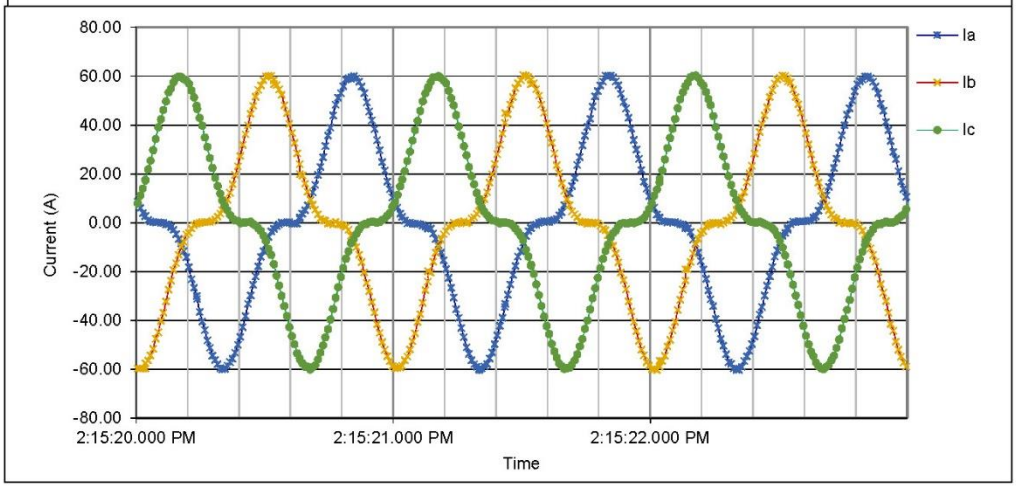
Electromagnet Waveform Plot

Contract No:		Page:	8 of 10	Test Date:	9/18/2018
Customer:				Engr:	Y.Qin
Model:	5204	Power Supply:		3x Kepoco 10V/100A MG	
Serial No:	3	PS Serial No:		SN:A108488, A109486, A109487	
Chiller:	ThermalFlex900, SN: 1111783801171004				
Field Probe:	Senis 0.2T F3A-03A02F-A.2T2K5M SN:041-17				
Note 1:	X: horizontal, pole A on one side and pole B and C on the other side.				
	Y:horizonal, from pole A, go between pole B and C				
	Z: vertically up.				
	X=Y=Z=0mm located at the magnet center.				
Note 2:	Field probe reading satuirated at 210mT				
Note 3:	Mu Metal shim glued.				
Note 4:	In-plane rotation. 60A customized waveform. 4mm above flux plate				



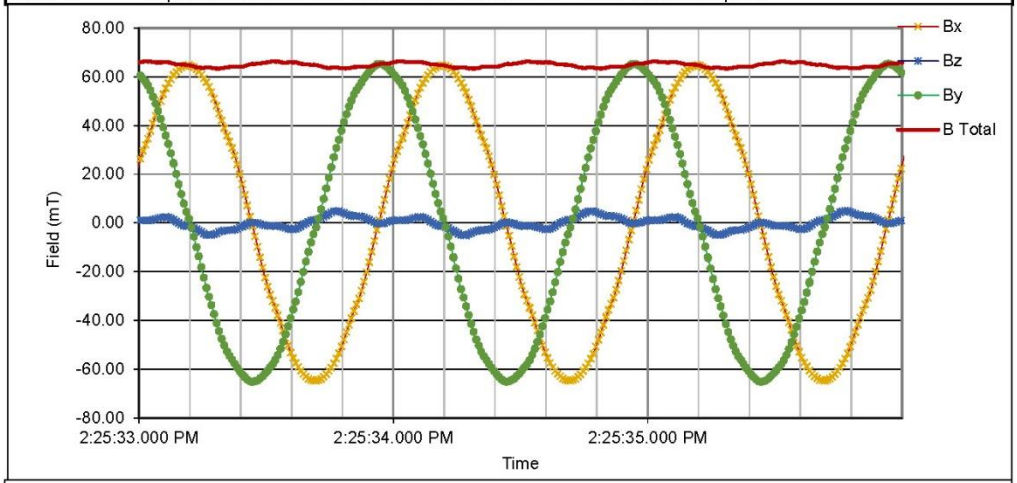


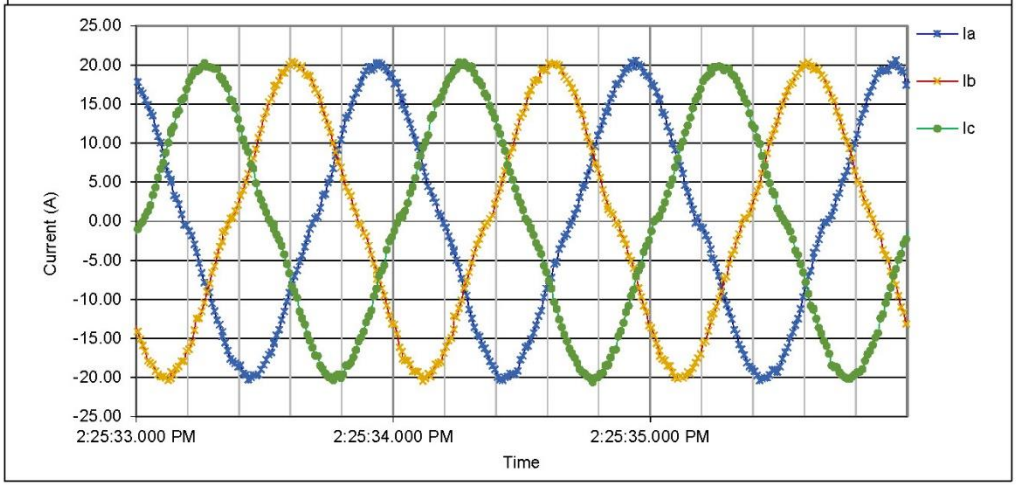
5204 SN003 Test Data-4.xlsx Print 9/19/2018

GMW Associates

Electromagnet Waveform Plot

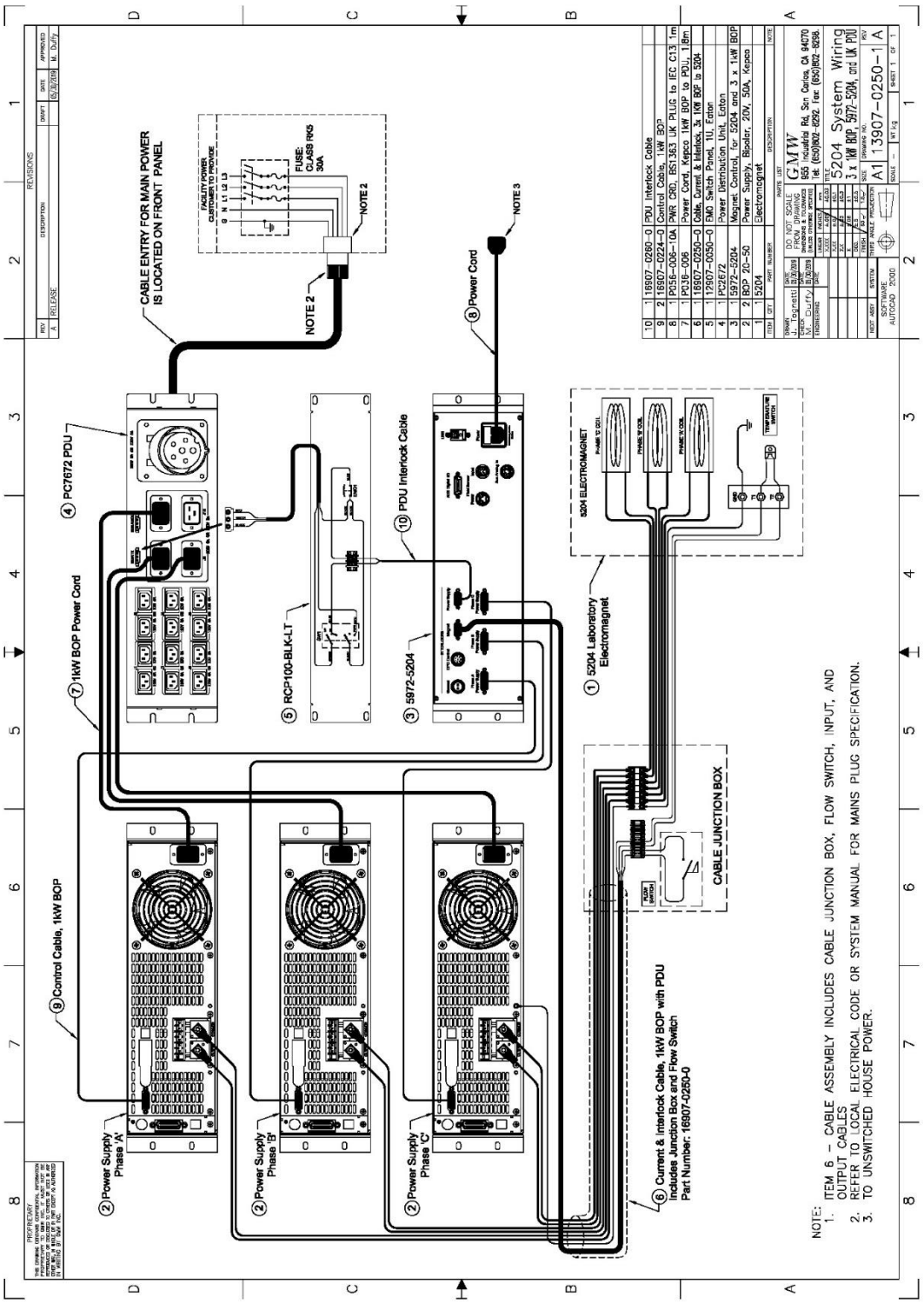
Contract No:		Page:	9 of 10	Test Date:	9/18/2018
Customer:				Engr:	Y.Qin
Model:	5204	Power Supply:	3x Kepoco 10V/100A MG		
Serial No:	3	PS Serial No:	SN:A108488, A109486, A109487		
Chiller:	ThermalFlex900, SN: 1111783801171004				
Field Probe:	Senis 0.2T F3A-03A02F-A.2T2K5M SN:041-17				
Note 1:	X: horizontal, pole A on one side and pole B and C on the other side.				
	Y:horizonal, from pole A, go between pole B and C				
	Z: vertically up.				
	X=Y=Z=0mm located at the magnet center.				
Note 2:	Field probe reading satuirated at 210mT				
Note 3:	Mu Metal shim glued.				
Note 4:	In-plane rotation. 20A customized waveform. 4mm above flux plate				



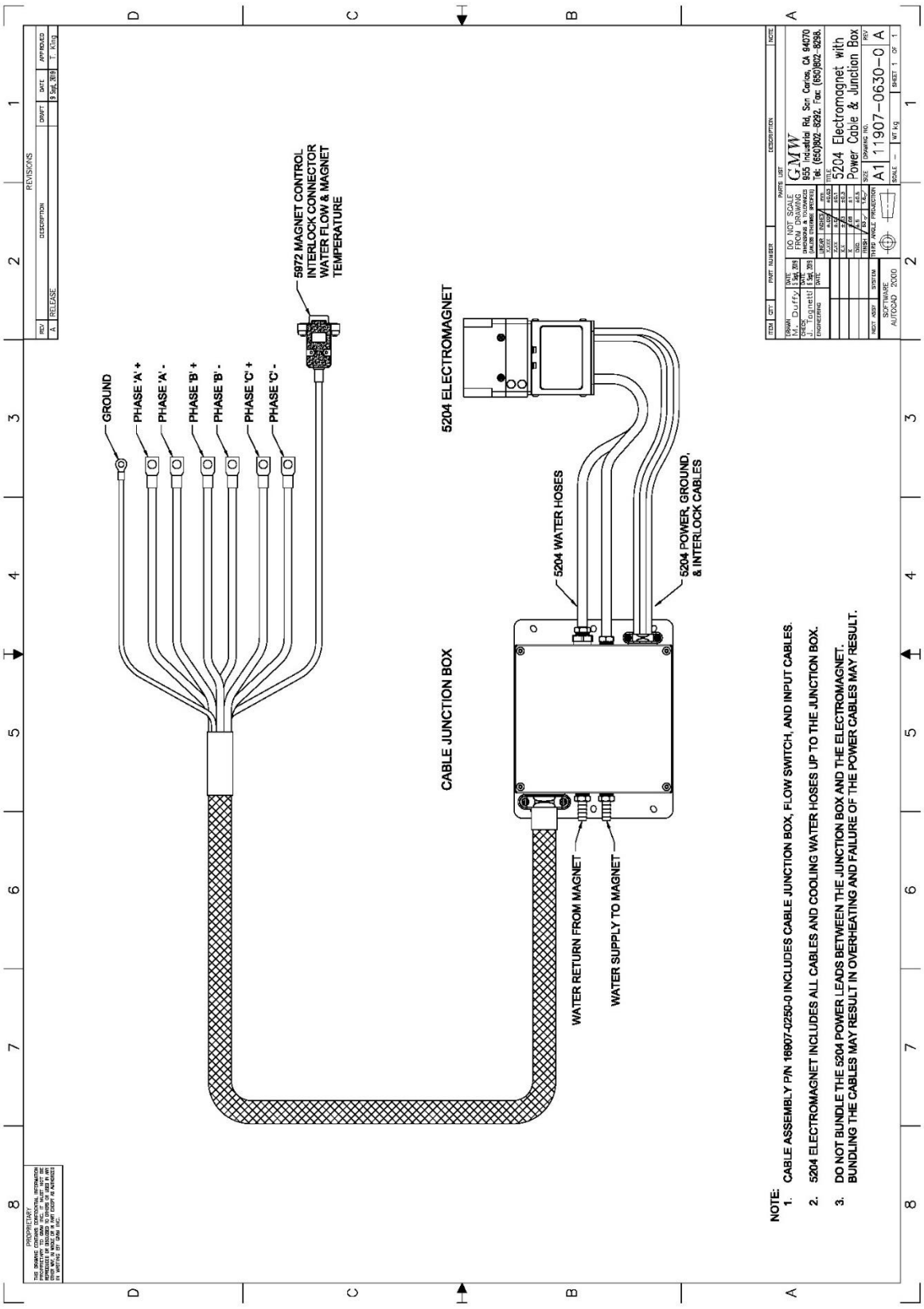


11 WIRING DRAWINGS

11.1 Drawing 13907-0250-1_A 5204 Electrical Wiring Kepco 3 x 1kW BOP



11.2Drawing 11907-0630-0 5204 with Power Cable and Junction Box



11.3 Drawing 16907-0250-0 Cable for 3xKepco BOP10-100