GMW

USER'S MANUAL

MODEL: 5501

250MM ELECTROMAGNET

Date Sold: _____

Serial number: _____

File No: M5501c.407 Revision Date: July, 2009

GMW *955 Industrial Road, San Carlos, CA 94070 Tel: (650) 802-8292 Fax: (650) 802-8298*
Email: sales@gmw.com Web site: http://www.gmw.com

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SPECIFICATIONS
Table 1. Model 5501 Specifications

Pole Diameter	250mm (10 inch)
Pole Gap	204mm (8.0 inch)
Coils (series connection)	
coil resistance (20°C)	0.160 Ohm
max resistance (hot)*	0.180 Ohm
max power (air)	60A/10V (0.60kW)
max power (water)	212A/36V (7.63kW)
Self Inductance	80mH (measured at 5Hz)
Water Cooling (18°C)	10 liters/m (2.75 US gpm) 0.8 bar (12 psid)
Overtemperature Interlock	Elmwood 3450G thermal sensor part number 3450G 611-1 L50C 89/16 mounted on each coil and wired in series. Contact rating 120Vac,0.5A. Closed below 50^{O}C.
Water Flow Interlock	Johnson Controls flow switch part number F61KD mounted on outlet side of water circuit. Contact rating 120Vac/16A, 240Vac/8A non inductive Set to open at a flow of less than 8 l/min (2.1 USgpm)
Dimensions	Drawing 11910000 828mm W x 558mm D x 754mm H (33.0 inch W x 22.0 Inch D x 30.0 inch H)
Weight	1800 kg (3968 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 5501 Electrical and Water Connections

DC Current (Refer to Drawing 11910000 Sheet 1)
Right hand terminal Negative
Left Hand terminal Positive

Ground
An M6 screw is provided alongside the interlock connections 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 11910000 Sheet 1)

1	Water flow	Normally open. Closed when flow
2	Water flow	over 8 l/min (2.1 USgpm)
3	Overtemperature	Normally closed. Open when coil
4	Overtemperature	temperature exceeds 50^{O}C.
5	No connection	
6	No connection	
7	No connection	
8	Control ground	

Water (Refer to Drawing 11910000 Sheet 1)
outlet 3/8 inch NPT
inlet 3/8 inch NTP
(mating couplings for 1/2 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 Personnel Safety

In operation, the magnet fringing field is 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 should be restricted to qualified personnel

2 Ferromagnetic Objects

During operation the magnet exerts strong magnetic attraction towards ferromagnetic objects in the near vicinity of its pole gap or coils. Loose objects can be accelerated to sufficient velocity to cause severe personnel injury or damage to the coils or precision pole faces if struck. 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 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 pole gap 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.

Section 3

INSTALLATION

Caution: This is a heavy system. The magnet mass is approximately 1310 kg (2880 lb) so lifting equipment of this capacity should be used to shift the magnet. Two lifting brackets are provided. Flexible lifting slings of at least 4000kg (9,000 lb) lifting capacity are recommended to avoid damage to the magnet. All movement, lifting and installation of the 5501 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.

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. Use one person on each side of the shipping crate grip the side panels of the Crate Top Cover. Lift "Crate Top Cover" high enough to clear top of electromagnet, walk cover sideways to 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 M16 Hex Bolts that secure the magnet to the steel shipping angle brackets.
6. Remove the hex lag bolts that secure the steel "shipping angle brackets" to shipping crate base, and remove shipping angle brackets.
8. The magnet is now prepared for final installation.

Direct Mounting

1. With suitable lifting equipment (e.g. 4000kg (9000 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 secure using the steel shipping angle brackets. The brackets can be modified to suit installation space needs.

Section 3

INSTALLATION

Electrical Circuit (Refer to drawing 11910000 Sheet 1).
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 or equipment damage.

The magnet has two coils which are connected in series. The power supply cables should be connected directly to the DC current terminals marked + and -. Recommended current cable is stranded copper of 85mm² cross section (3/0 AWG) standard copper current cables.

Because the magnet stores a significant amount of energy in its magnetic field, 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.

Interlocks
Six thermal sensors Elmwood 3450G Part Number 3450G611-1 L50C 89/16 are wired in series and terminated in positions 3 and 4 on the Interlock Terminal block. They are normally closed, opening when the coil central cooling plate temperature exceeds 50^{o}C +/3^{o}C.

The flow switch is connected to terminals 1 and 2. The contacts are normally open, closing when the water flow exceeds approx. 10 l/min.

Cooling
The Model 5501 can be operated to an average coil temperature of 70^{o}C. Assuming an ambient laboratory temperature of 20^{o}C and a temperature coefficient of resistivity of 0.00393, the hot resistance of the coil should not exceed 20% more than the ambient temperature "cold" resistance.
The coil thermal sensor will open when the coil cooling plate temperature exceeds approximately 50^{o}C Clean, cool (12^{o}C - 20^{o}C) water at 15 l/min and 2.0 bar (30 psid) should be used to cool the magnet. The cooling tubes are not electrically connected to the coils so no electrochemical corrosion will occur. If the water supply contains particulates, a 50 micron filter should be placed before the input to the magnet to avoid unreliable operation of the flow switch.

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 5501 Electromagnet alone a suitable chiller is the Neslab HX-300 with PD-2 pump. 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.

Cooling (continued)
At currents of below 60A for coils that are series connected or 80A for series/parallel connected coils the Model 5501 can be operated safely without water cooling. However the coil temperature will vary with the power dissipation. This results in dimensional and permeability changes of the magnet yoke. 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 magnet operates as a conventional electromagnet.

1. Adjust the cooling water flow to about 10 liters/min (2.75 US gpm). For operation at less than maximum power the water flow may be correspondingly reduced.
2. Turn on the power supply and increase the current until the desired field is reached.

Calibration

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 air 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 of course 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 digital gaussmeter and by making a numerical table. This table used with an interpolation routine will eliminate the error associated with reading a graph.

In any event, 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).

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 is clean, properly lubricated and free of grit and dirt which may cause binding of the mechanism. Otherwise no particular maintenance is required. Be very careful not to damage the relatively soft pole surface since this may degrade the magnetic field uniformity in the gap.

Note that surface treatments used provide good corrosion protection but in order to maintain the inherent mechanical precision of the magnet, heavy build-up of plating materials is deliberately avoided.

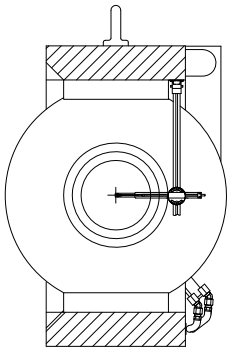
As a result, high humidity or otherwise seriously corrosive atmospheres can defeat the protection mechanisms. Check the equipment periodically and use an appropriate corrosion protection when the magnet is stored for an extended period.

Section 6

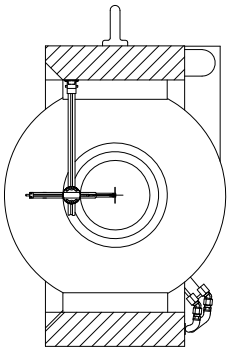
STANDARD OPTIONS

REVISIONS

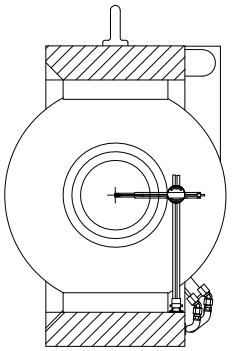
REV	DESCRIPTION	DRAFT	DATE	APPROVED
A	RELEASE		09/11/98	G.DOUGLAS
B	ADD 5451 TO SELECTION TABLE		10/07/03	G.DOUGLAS



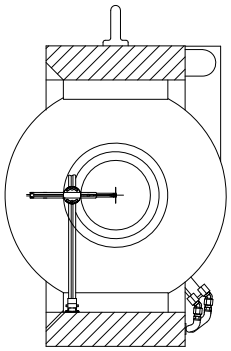
TOP/REAR INSTALLATION



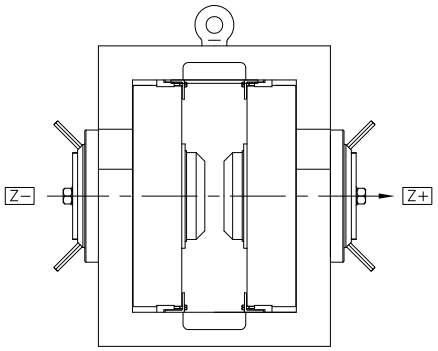
TOP/FRONT INSTALLATION



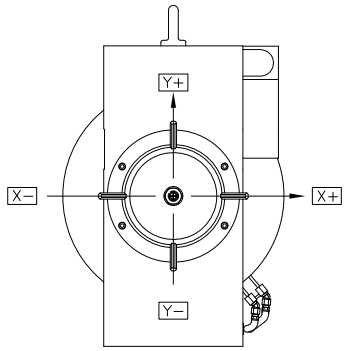
BOTTOM/REAR INSTALLATION



BOTTOM/FRONT INSTALLATION



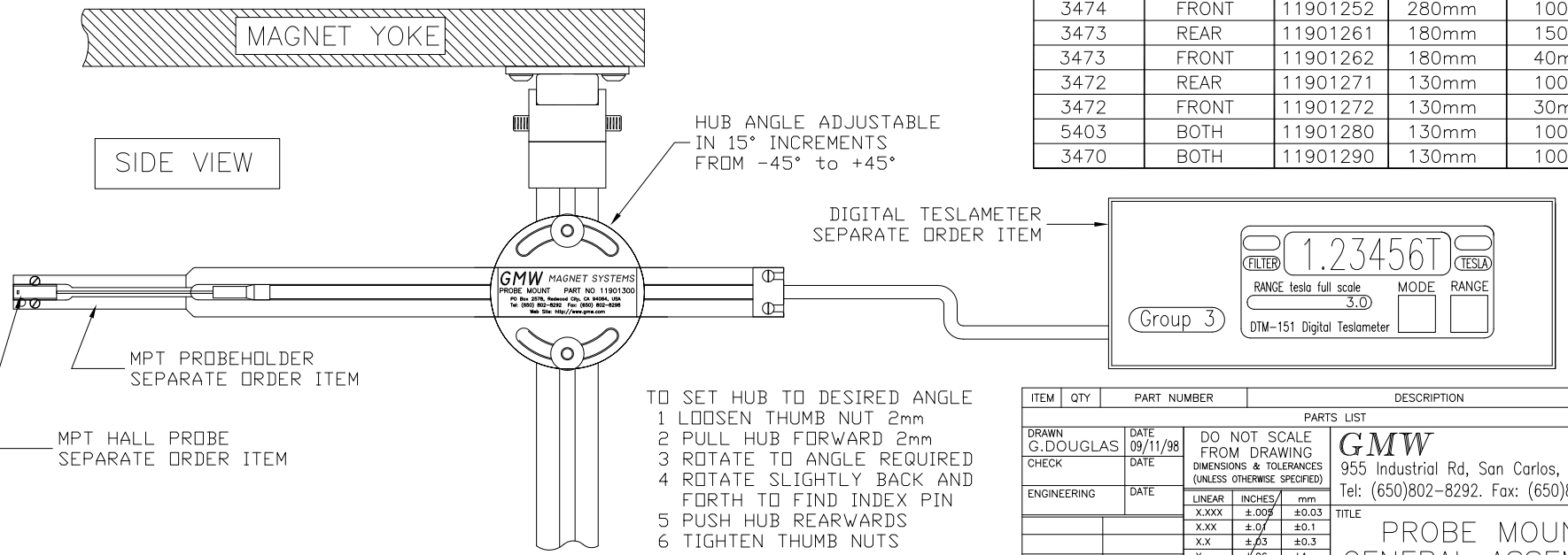
MAGNET FRONT VIEW



MAGNET SIDE VIEW

MAGNET MODEL	INSTALLATION POSITION	ASSEMBLY NUMBER	VERTICAL TRAVEL "Y"	HORIZONTAL TRAVEL "Z"
3474/5451	REAR	11901251	280mm	200mm
3474	FRONT	11901252	280mm	100mm
3473	REAR	11901261	180mm	150mm
3473	FRONT	11901262	180mm	40mm
3472	REAR	11901271	130mm	100mm
3472	FRONT	11901272	130mm	30mm
5403	BOTH	11901280	130mm	100mm
3470	BOTH	11901290	130mm	100mm

SIDE VIEW



TO SET HUB TO DESIRED ANGLE
1 LOOSEN THUMB NUT 2mm
2 PULL HUB FORWARD 2mm
3 ROTATE TO ANGLE REQUIRED
4 ROTATE SLIGHTLY BACK AND FORTH TO FIND INDEX PIN
5 PUSH HUB REARWARDS
6 TIGHTEN THUMB NUTS

NOTE: ABOVE PROBE MOUNT SHOWN INSTALLED ON MODEL: 3474 ELECTROMAGNET.
OTHER CONFIGURATIONS AND MOUNTINGS ARE AVAILABLE. CONSULT TABLE FOR GMW ELECTROMAGNETS.

ITEM	QTY	PART NUMBER	DESCRIPTION	NOTE

PARTS LIST

DRAWN G.DOUGLAS DATE 09/11/98
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 MOUNT GENERAL ASSEMBLY

SIZE A2 | DRAWING NO. 11901300 | REV B
SCALE 1:1 | WT kg | SHEET 1 OF 1

Section 7

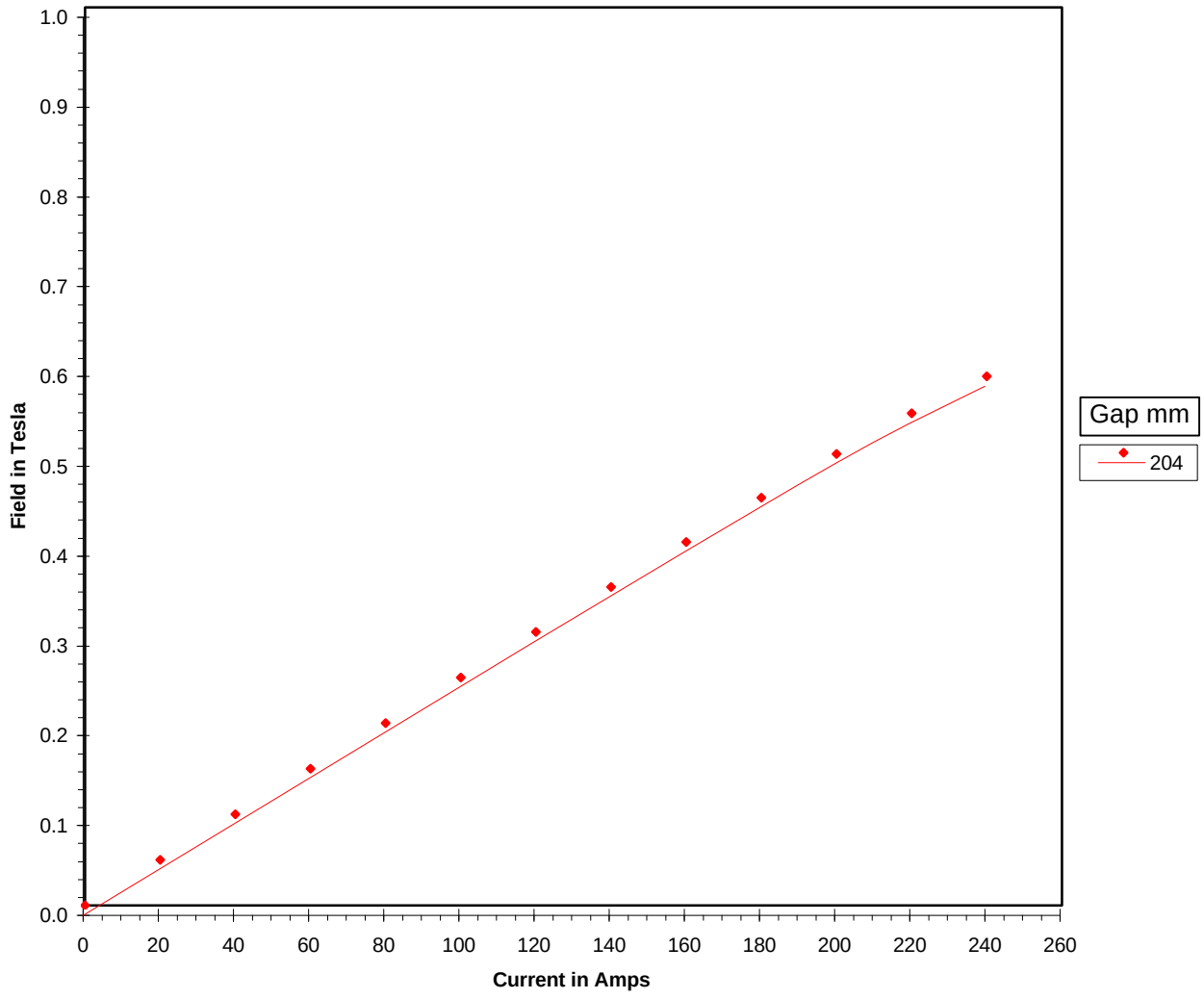
CUSTOM OPTIONS

Section 8

EXCITATION CURVES

GMW Associates
Electromagnet Excitation Plot
Field Vs Current

Contract No:		Page: 1 of 1		Date:	Feb 23, 2000
Customer:				Engr:	G.Douglas
Model:	5501	Power Supply:		Set Current:	
Serial No:	01	Serial No:		Target Field:	
Pole Face:	250 mm	Position:	X=0, Y=0, Z=0		
Serial No:	None	Notes:			
Pole Gap:	204				
Pole Spacers:	None				

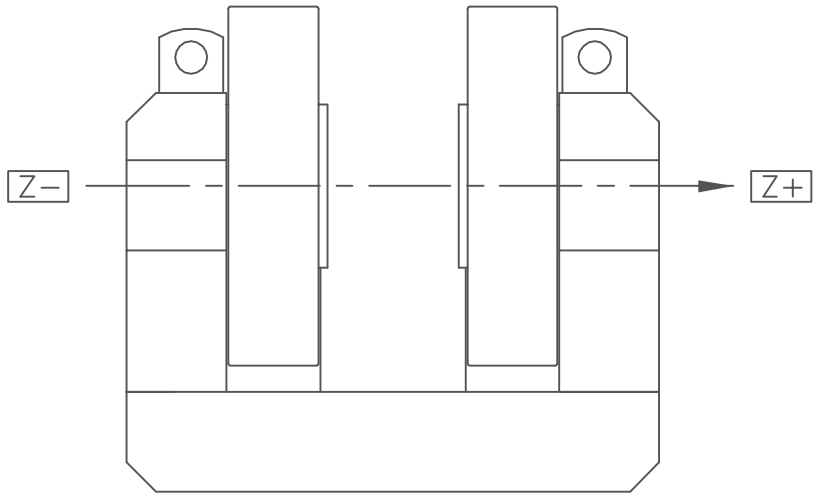


Filename: 5501 Sn 01 Ex 250-204

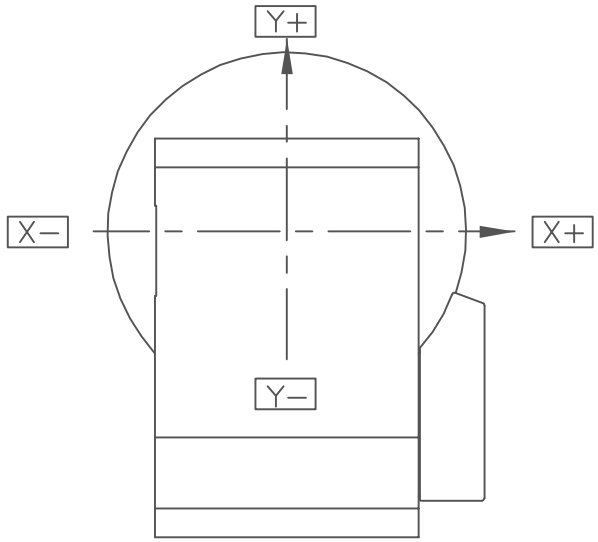
Section 9

TEST DATA

FRONT VIEW



SIDE VIEW

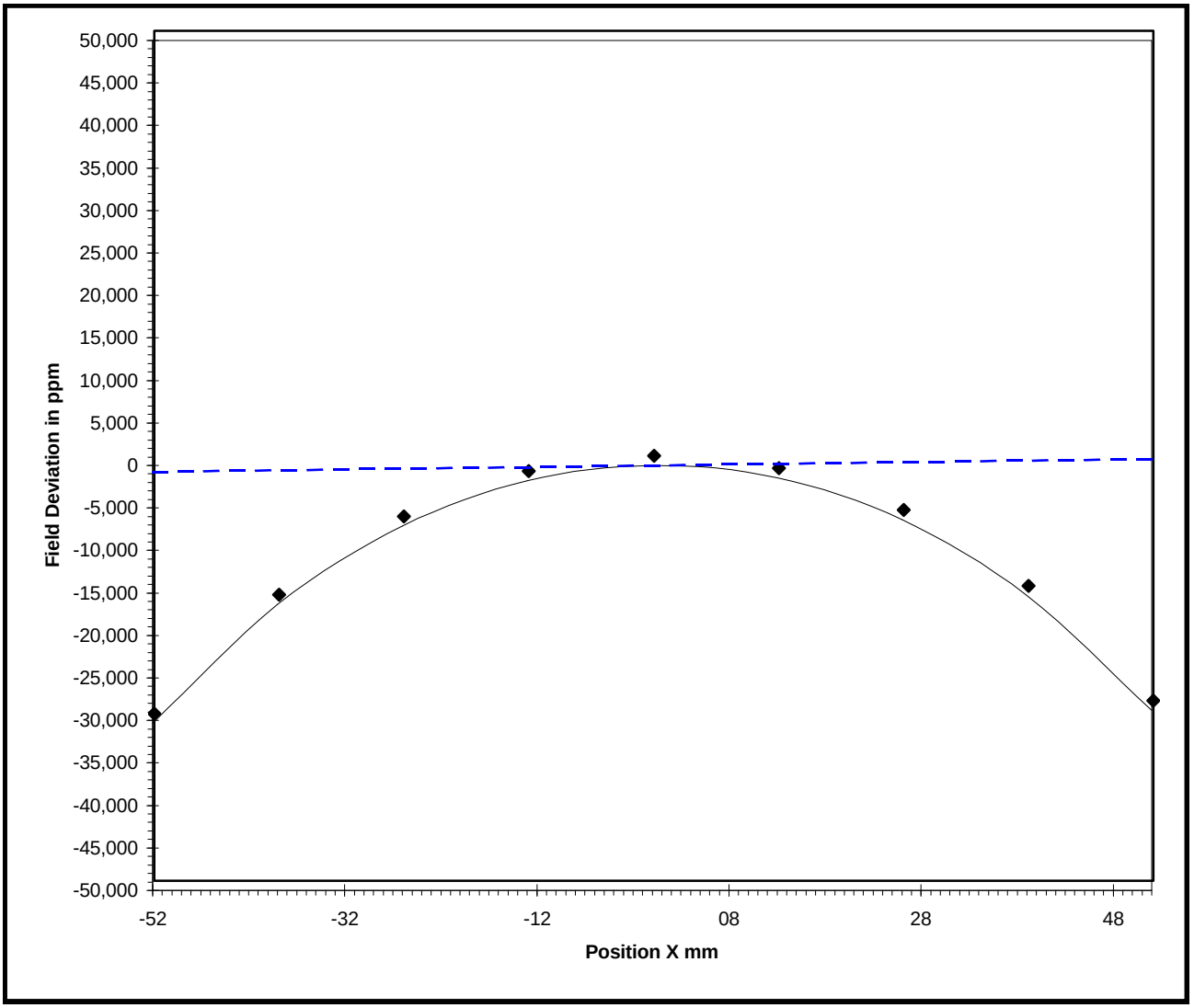


MAGNETIC PLOTTING AXIS

80900000	A	SHEET 1 OF 1

GMW Associates
Electromagnet Uniformity Plot
Field Vs Position

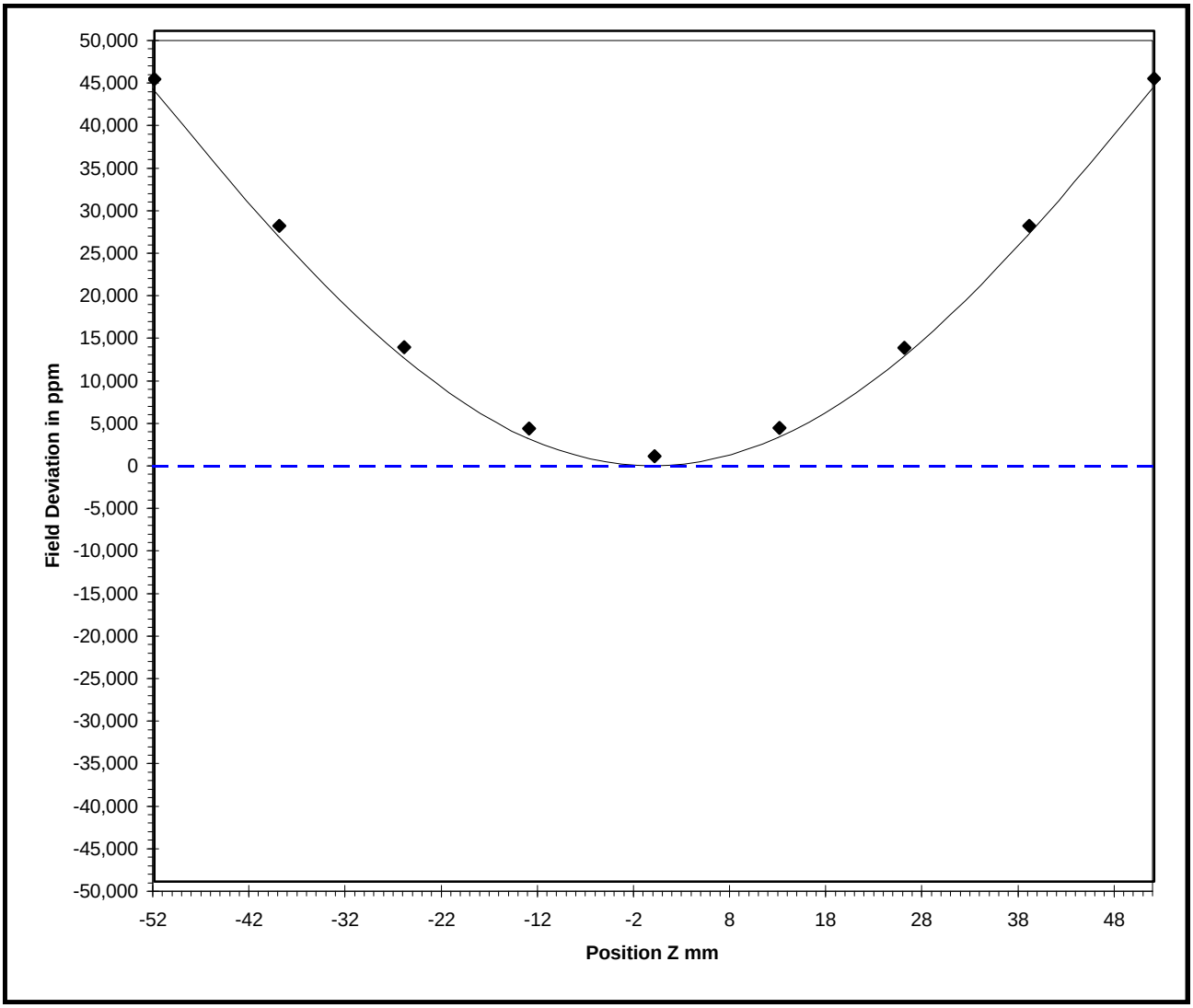
Contract No:		Page:	3 of 4	Date:	Nov 28, 1993
Customer:		**Fixed Axis:**	**Y=0, Z=0**	Engr:	H.Glavish
Model:	5501	Power Supply:	Waker 280V-280A	Set Current:	212 Amps
Serial No:	01	Serial No:		Target Field:	
Pole Face:	250	Teslameter:		Probe:	
Serial No:	None	Serial No:		Serial No:	
Pole Gap:	204	Notes:			
Pole Spacers:	None				
Dev Spec:					



Filename: 5501 Sn 01 Un1 212A XY 250-204

GMW Associates
Electromagnet Uniformity Plot
Field Vs Position

Contract No:		Page:	4 of 4	Date:	Nov 28, 1993
Customer:		**Fixed Axis:**	**X=0, Y=0**	Engr:	H.Glavish
Model:	5501	Power Supply:	Waker 280V-280A	Set Current:	212 Amps
Serial No:	01	Serial No:		Target Field:	
Pole Face:	250	Teslameter:		Probe:	
Serial No:	None	Serial No:		Serial No:	
Pole Gap:	204	Notes:			
Pole Spacers:	None				
Dev Spec:					



Filename: 5501 Sn 01 Un1 212A XY 250-204

MSCAN_THINFILM OUTPUT 10/28/93 SERIAL # 01

Bz field at 212 A
Units are mm and Gs

GMW
955 Industrial Rd., San Carlos, CA 94070
Tel: (650) 802-8292 • Fax: (650) 802-8298
Email: sales@gmw.com • Web: www.gmw.com

Measurement Plane is Y = -5

X	Z=-52	Z=-39	Z=-26	Z=-13	Z=0	Z=13	Z=26	Z=39	Z=52
-52	5537.8	5383.4	5256.8	5183.4	5154.4	5179.4	5255.4	5375.6	5528.8
-39	5546.0	5420.4	5317.8	5252.2	5228.4	5249.4	5313.0	5412.6	5536.4
-26	5550.0	5444.0	5356.2	5298.6	5277.4	5295.8	5351.0	5437.0	5542.2
-13	5552.6	5457.6	5377.8	5325.2	5305.8	5322.2	5372.2	5450.0	5543.8
0	5553.6	5462.0	5385.4	5334.2	5315.2	5331.2	5379.6	5454.4	5544.6
13	5554.4	5459.4	5380.0	5327.2	5307.4	5323.6	5373.4	5450.4	5544.0
26	5553.2	5448.0	5360.8	5302.8	5281.2	5298.8	5353.2	5438.6	5541.8
39	5551.6	5427.0	5325.0	5259.0	5234.2	5254.2	5316.8	5414.0	5537.4
52	5546.6	5393.2	5270.6	5191.6	5162.6	5185.6	5258.6	5376.8	5526.6

Measurement Plane is Y = 0

X	Z=-52	Z=-39	Z=-26	Z=-13	Z=0	Z=13	Z=26	Z=39	Z=52
-52	5527.4	5372.8	5251.4	5178.8	5152.2	5179.8	5257.8	5376.2	5533.6
-39	5539.8	5413.4	5313.4	5248.2	5226.4	5249.4	5315.2	5417.2	5542.8
-26	5544.8	5438.6	5351.4	5294.8	5275.6	5295.6	5353.0	5440.6	5546.8
-13	5547.8	5453.0	5373.4	5321.8	5303.8	5321.8	5373.8	5452.4	5548.0
0	5548.8	5457.2	5381.4	5330.8	5313.4	5331.0	5381.0	5457.2	5549.2
13	5549.6	5454.4	5375.4	5323.6	5305.6	5323.4	5375.0	5453.6	5548.2
26	5548.0	5443.2	5355.4	5299.0	5279.4	5298.6	5355.0	5441.8	5546.6
39	5544.8	5421.0	5320.4	5254.6	5232.2	5254.2	5319.0	5418.8	5541.8
52	5538.2	5384.8	5264.4	5186.8	5160.4	5185.8	5261.6	5382.2	5533.8

Measurement Plane is Y = 5

X	Z=-52	Z=-39	Z=-26	Z=-13	Z=0	Z=13	Z=26	Z=39	Z=52
-52	5534.2	5384.8	5257.6	5179.8	5152.6	5176.4	5248.4	5368.2	5526.4
-39	5546.4	5420.8	5318.8	5251.4	5226.6	5247.0	5309.8	5409.6	5533.6
-26	5551.4	5444.6	5356.0	5297.6	5275.8	5293.4	5348.2	5434.2	5539.6
-13	5553.6	5457.8	5377.6	5324.2	5304.0	5319.8	5369.8	5447.4	5541.6
0	5554.6	5462.6	5385.2	5333.2	5313.6	5328.8	5377.0	5451.8	5542.4
13	5555.2	5459.8	5379.6	5326.2	5305.8	5321.4	5370.8	5447.8	5541.6
26	5555.0	5448.6	5360.4	5301.6	5279.6	5296.4	5350.4	5435.2	5539.2
39	5553.6	5427.8	5325.4	5257.8	5232.4	5251.6	5313.4	5411.6	5534.0
52	5548.4	5393.4	5270.2	5190.6	5160.4	5182.6	5255.2	5372.8	5523.4

MSCAN_THINFILM OUTPUT 9/28/93 SERIAL # 1 (11910000)

Measured Field Angle - arctan(Bx/Bz).
Units are mm and degrees

GMW
955 Industrial Rd., San Carlos, CA 94070
Tel: (650) 802-8292 • Fax: (650) 802-8298
Email: sales@gmw.com • Web: www.gmw.com

Measurement Plane is Y = -5 Angle Offset (deg) 0

X	Z=-52	Z=-39	Z=-26	Z=-13	Z=0	Z=13	Z=26	Z=39	Z=52
-52	3.76	3.52	2.88	2.06	1.13	0.20	-0.60	-1.18	-1.46
-39	2.87	2.72	2.34	1.79	1.15	0.50	-0.04	-0.42	-0.58
-26	2.19	2.11	1.88	1.54	1.14	0.75	0.42	0.18	0.10
-13	1.64	1.60	1.49	1.33	1.15	0.96	0.81	0.69	0.65
0	1.14	1.14	1.14	1.14	1.13	1.15	1.14	1.15	1.15
13	0.64	0.68	0.79	0.95	1.13	1.32	1.48	1.59	1.64
26	0.08	0.17	0.40	0.73	1.13	1.52	1.86	2.10	2.19
39	-0.60	-0.46	-0.08	0.47	1.11	1.75	2.31	2.71	2.87
52	-1.50	-1.26	-0.68	0.15	1.09	2.05	2.88	3.49	3.76

Measurement Plane is Y = 0 Angle Offset (deg) 0

X	Z=-52	Z=-39	Z=-26	Z=-13	Z=0	Z=13	Z=26	Z=39	Z=52
-52	3.86	3.62	3.03	2.24	1.32	0.37	-0.44	-1.06	-1.40
-39	2.98	2.84	2.47	1.93	1.30	0.64	0.08	-0.32	-0.49
-26	2.29	2.22	1.99	1.67	1.27	0.87	0.53	0.28	0.18
-13	1.74	1.70	1.60	1.44	1.26	1.06	0.90	0.78	0.74
0	1.23	1.24	1.24	1.24	1.24	1.23	1.23	1.23	1.22
13	0.74	0.77	0.87	1.03	1.21	1.39	1.56	1.67	1.72
26	0.18	0.25	0.47	0.80	1.18	1.58	1.92	2.16	2.27
39	-0.51	-0.38	-0.02	0.52	1.15	1.79	2.36	2.76	2.94
52	-1.42	-1.20	-0.64	0.17	1.12	2.07	2.91	3.53	3.83

Measurement Plane is Y = 5 Angle Offset (deg) 0

X	Z=-52	Z=-39	Z=-26	Z=-13	Z=0	Z=13	Z=26	Z=39	Z=52
-52	3.87	3.63	3.07	2.18	1.25	0.31	-0.50	-1.07	-1.35
-39	2.98	2.83	2.45	1.90	1.27	0.63	0.08	-0.32	-0.48
-26	2.30	2.22	1.98	1.65	1.26	0.87	0.53	0.29	0.20
-13	1.74	1.70	1.60	1.44	1.26	1.07	0.91	0.80	0.75
0	1.24	1.24	1.24	1.24	1.24	1.24	1.24	1.24	1.24
13	0.75	0.78	0.89	1.05	1.23	1.42	1.59	1.69	1.73
26	0.18	0.27	0.49	0.83	1.22	1.61	1.95	2.19	2.29
39	-0.50	-0.36	0.02	0.56	1.20	1.84	2.40	2.80	2.97
52	-1.40	-1.17	-0.59	0.23	1.18	2.13	2.97	3.58	3.86

MSCAN_THINFILM OUTPUT 9/28/93 SERIAL # 1

Measured Field Angle - arctan(Bx/Bz).
Units are mm and degrees

GMW
955 Industrial Rd., San Carlos, CA 94070
Tel: (650) 802-8292 • Fax: (650) 802-8298
Email: sales@gmw.com • Web: www.gmw.com

Measurement Plane is Y = -5 Angle Offset (deg) 1.24

X	Z=-52	Z=-39	Z=-26	Z=-13	Z=0	Z=13	Z=26	Z=39	Z=52
-52	2.52	2.28	1.64	0.82	-0.11	-1.04	-1.84	-2.42	-2.70
-39	1.63	1.48	1.10	0.55	-0.09	-0.74	-1.28	-1.66	-1.82
-26	0.95	0.87	0.64	0.30	-0.10	-0.49	-0.82	-1.06	-1.14
-13	0.40	0.36	0.25	0.09	-0.09	-0.28	-0.43	-0.55	-0.59
0	-0.10	-0.10	-0.10	-0.10	-0.11	-0.09	-0.10	-0.09	-0.09
13	-0.60	-0.56	-0.45	-0.29	-0.11	0.08	0.24	0.35	0.40
26	-1.16	-1.07	-0.84	-0.51	-0.11	0.28	0.62	0.86	0.95
39	-1.84	-1.70	-1.32	-0.77	-0.13	0.51	1.07	1.47	1.63
52	-2.74	-2.50	-1.92	-1.09	-0.15	0.81	1.64	2.25	2.52

Measurement Plane is Y = 0 Angle Offset (deg) 1.24

X	Z=-52	Z=-39	Z=-26	Z=-13	Z=0	Z=13	Z=26	Z=39	Z=52
-52	2.62	2.38	1.79	1.00	0.08	-0.87	-1.68	-2.30	-2.64
-39	1.74	1.60	1.23	0.69	0.06	-0.60	-1.16	-1.56	-1.73
-26	1.05	0.98	0.75	0.43	0.03	-0.37	-0.71	-0.96	-1.06
-13	0.50	0.46	0.36	0.20	0.02	-0.18	-0.34	-0.46	-0.50
0	-0.01	0.00	0.00	0.00	0.00	-0.01	-0.01	-0.01	-0.02
13	-0.50	-0.47	-0.37	-0.21	-0.03	0.15	0.32	0.43	0.48
26	-1.06	-0.99	-0.77	-0.44	-0.06	0.34	0.68	0.92	1.03
39	-1.75	-1.62	-1.26	-0.72	-0.09	0.55	1.12	1.52	1.70
52	-2.66	-2.44	-1.88	-1.07	-0.12	0.83	1.67	2.29	2.59

Measurement Plane is Y = 5 Angle Offset (deg) 1.24

X	Z=-52	Z=-39	Z=-26	Z=-13	Z=0	Z=13	Z=26	Z=39	Z=52
-52	2.63	2.39	1.83	0.94	0.01	-0.93	-1.74	-2.31	-2.59
-39	1.74	1.59	1.21	0.66	0.03	-0.61	-1.16	-1.56	-1.72
-26	1.06	0.98	0.74	0.41	0.02	-0.37	-0.71	-0.95	-1.04
-13	0.50	0.46	0.36	0.20	0.02	-0.17	-0.33	-0.44	-0.49
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13	-0.49	-0.46	-0.35	-0.19	-0.01	0.18	0.35	0.45	0.49
26	-1.06	-0.97	-0.75	-0.41	-0.02	0.37	0.71	0.95	1.05
39	-1.74	-1.60	-1.22	-0.68	-0.04	0.60	1.16	1.56	1.73
52	-2.64	-2.41	-1.83	-1.01	-0.06	0.89	1.73	2.34	2.62

MSCAN_THINFILM OUTPUT 10/28/93 SERIAL # 02

Bz field
Units are mm and Gs

GMW
955 Industrial Rd., San Carlos, CA 94070
Tel: (650) 802-8292 • Fax: (650) 802-8298
Email: sales@gmw.com • Web: www.gmw.com

Measurement Plane is Y = -5

X	Z=-52	Z=-39	Z=-26	Z=-13	Z=0	Z=13	Z=26	Z=39	Z=52
-52	5538.6	5385.4	5261.0	5182.2	5152.4	5175.2	5248.6	5365.2	5517.8
-39	5546.6	5421.6	5319.2	5251.6	5225.8	5244.8	5306.8	5405.2	5529.0
-26	5549.8	5443.8	5355.8	5297.0	5274.6	5291.2	5345.0	5430.0	5535.0
-13	5551.2	5456.2	5376.4	5322.8	5302.2	5317.6	5366.6	5443.4	5537.4
0	5552.0	5460.4	5383.2	5331.4	5311.6	5326.4	5373.8	5448.0	5538.2
13	5552.4	5457.2	5377.2	5323.8	5303.2	5318.6	5367.6	5444.0	5537.6
26	5552.2	5446.0	5357.6	5299.0	5276.6	5293.4	5347.0	5431.6	5535.2
39	5550.4	5424.8	5322.0	5254.6	5229.4	5248.6	5310.2	5408.0	5530.4
52	5544.6	5389.6	5266.2	5186.6	5157.2	5179.8	5252.6	5370.0	5520.2

Measurement Plane is Y = 0

X	Z=-52	Z=-39	Z=-26	Z=-13	Z=0	Z=13	Z=26	Z=39	Z=52
-52	5534.6	5376.4	5260.0	5179.2	5151.4	5175.4	5250.4	5368.8	5527.0
-39	5543.0	5418.4	5315.8	5249.4	5224.6	5244.8	5307.6	5407.6	5531.4
-26	5546.6	5440.6	5352.8	5294.8	5273.2	5291.0	5346.0	5431.6	5537.4
-13	5548.2	5453.2	5373.4	5320.4	5300.6	5317.0	5367.0	5444.8	5539.6
0	5549.0	5457.4	5380.4	5329.0	5309.8	5325.6	5374.2	5449.2	5540.2
13	5549.6	5454.0	5374.2	5321.0	5301.2	5317.8	5367.6	5445.2	5539.6
26	5548.8	5442.2	5354.2	5295.8	5274.4	5292.4	5347.2	5432.6	5537.6
39	5546.4	5420.4	5317.8	5250.8	5226.8	5247.2	5310.2	5409.4	5533.2
52	5539.8	5384.0	5261.0	5182.2	5154.0	5178.2	5252.4	5371.2	5523.4

Measurement Plane is Y = 5

X	Z=-52	Z=-39	Z=-26	Z=-13	Z=0	Z=13	Z=26	Z=39	Z=52
-52	5543.2	5387.6	5264.8	5182.0	5152.8	5174.2	5243.4	5363.6	5507.6
-39	5548.8	5423.8	5320.8	5252.4	5225.8	5243.6	5304.6	5402.0	5526.0
-26	5551.6	5445.8	5357.2	5297.4	5274.2	5289.8	5343.0	5427.0	5531.8
-13	5552.8	5458.0	5377.4	5323.0	5301.4	5316.0	5364.6	5440.6	5534.6
0	5553.6	5462.0	5384.2	5331.2	5310.6	5324.6	5371.4	5445.0	5535.4
13	5554.2	5458.8	5378.0	5323.4	5302.0	5316.6	5365.0	5441.0	5534.6
26	5554.2	5447.6	5358.4	5298.4	5275.2	5291.2	5344.2	5428.0	5532.0
39	5552.8	5426.6	5322.6	5253.8	5227.4	5245.6	5306.8	5404.0	5526.6
52	5547.8	5391.8	5266.6	5185.6	5154.8	5176.4	5248.4	5364.8	5515.6

MSCAN_THINFILM OUTPUT 9/28/93 SERIAL # 2

Measured Field Angle - arctan(Bx/Bz).
Units are mm and degrees

GMW
955 Industrial Rd., San Carlos, CA 94070
Tel: (650) 802-8292 • Fax: (650) 802-8298
Email: sales@gmw.com • Web: www.gmw.com

Measurement Plane is Y = -5 Angle Offset (deg) 0

X	Z=-52	Z=-39	Z=-26	Z=-13	Z=0	Z=13	Z=26	Z=39	Z=52
-52	3.35	3.08	2.52	1.73	0.83	-0.10	-0.99	-1.58	-1.82
-39	2.49	2.34	1.96	1.42	0.79	0.16	-0.38	-0.76	-0.93
-26	1.81	1.73	1.50	1.18	0.79	0.41	0.08	-0.16	-0.25
-13	1.26	1.23	1.12	0.98	0.79	0.61	0.45	0.35	0.31
0	0.77	0.77	0.77	0.78	0.79	0.80	0.80	0.80	0.81
13	0.27	0.31	0.43	0.59	0.79	0.98	1.15	1.26	1.30
26	-0.29	-0.20	0.04	0.38	0.78	1.18	1.53	1.77	1.86
39	-0.99	-0.83	-0.44	0.12	0.77	1.43	1.99	2.39	2.55
52	-1.90	-1.64	-1.04	-0.20	0.77	1.73	2.57	3.18	3.45

Measurement Plane is Y = 0 Angle Offset (deg) 0

X	Z=-52	Z=-39	Z=-26	Z=-13	Z=0	Z=13	Z=26	Z=39	Z=52
-52	3.43	3.24	2.61	1.82	0.91	0.02	-0.82	-1.46	-1.76
-39	2.55	2.43	2.07	1.54	0.91	0.28	-0.28	-0.68	-0.86
-26	1.88	1.81	1.59	1.27	0.89	0.50	0.16	-0.08	-0.18
-13	1.33	1.30	1.20	1.05	0.87	0.70	0.54	0.43	0.38
0	0.83	0.84	0.84	0.85	0.86	0.86	0.87	0.87	0.87
13	0.33	0.37	0.48	0.64	0.84	1.04	1.21	1.32	1.37
26	-0.23	-0.15	0.07	0.42	0.82	1.23	1.57	1.82	1.93
39	-0.93	-0.79	-0.41	0.14	0.79	1.45	2.02	2.43	2.61
52	-1.86	-1.62	-1.03	-0.20	0.76	1.73	2.59	3.21	3.51

Measurement Plane is Y = 5 Angle Offset (deg) 0

X	Z=-52	Z=-39	Z=-26	Z=-13	Z=0	Z=13	Z=26	Z=39	Z=52
-52	3.29	3.02	2.48	1.64	0.69	-0.26	-1.06	-1.59	-1.86
-39	2.42	2.27	1.89	1.34	0.72	0.10	-0.43	-0.82	-0.97
-26	1.75	1.67	1.44	1.11	0.73	0.35	0.02	-0.20	-0.29
-13	1.21	1.17	1.07	0.92	0.74	0.56	0.41	0.31	0.27
0	0.72	0.72	0.73	0.73	0.74	0.75	0.76	0.76	0.76
13	0.22	0.26	0.38	0.55	0.75	0.94	1.11	1.22	1.26
26	-0.34	-0.25	-0.01	0.34	0.75	1.15	1.50	1.73	1.82
39	-1.04	-0.87	-0.47	0.09	0.75	1.40	1.97	2.35	2.51
52	-1.95	-1.68	-1.06	-0.22	0.75	1.72	2.56	3.16	3.41

MSCAN_THINFILM OUTPUT 9/28/93 SERIAL # 2

Measured Field Angle - arctan(Bx/Bz).
Units are mm and degrees

GMW
955 Industrial Rd., San Carlos, CA 94070
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Email: sales@gmw.com • Web: www.gmw.com

Measurement Plane is Y = -5 Angle Offset (deg) 0.77

X	Z=-52	Z=-39	Z=-26	Z=-13	Z=0	Z=13	Z=26	Z=39	Z=52
-52	2.58	2.31	1.75	0.96	0.06	-0.87	-1.76	-2.35	-2.59
-39	1.72	1.57	1.19	0.65	0.02	-0.61	-1.15	-1.53	-1.70
-26	1.04	0.96	0.73	0.41	0.02	-0.36	-0.69	-0.93	-1.02
-13	0.49	0.46	0.35	0.21	0.02	-0.16	-0.32	-0.42	-0.46
0	0.00	0.00	0.00	0.01	0.02	0.03	0.03	0.03	0.04
13	-0.50	-0.46	-0.34	-0.18	0.02	0.21	0.38	0.49	0.53
26	-1.06	-0.97	-0.73	-0.39	0.01	0.41	0.76	1.00	1.09
39	-1.76	-1.60	-1.21	-0.65	0.00	0.66	1.22	1.62	1.78
52	-2.67	-2.41	-1.81	-0.97	0.00	0.96	1.80	2.41	2.68

Measurement Plane is Y = 0 Angle Offset (deg) 0.77

X	Z=-52	Z=-39	Z=-26	Z=-13	Z=0	Z=13	Z=26	Z=39	Z=52
-52	2.66	2.47	1.84	1.05	0.14	-0.75	-1.59	-2.23	-2.53
-39	1.78	1.66	1.30	0.77	0.14	-0.49	-1.05	-1.45	-1.63
-26	1.11	1.04	0.82	0.50	0.12	-0.27	-0.61	-0.85	-0.95
-13	0.56	0.53	0.43	0.28	0.10	-0.07	-0.23	-0.34	-0.39
0	0.06	0.07	0.07	0.08	0.09	0.09	0.10	0.10	0.10
13	-0.44	-0.40	-0.29	-0.13	0.07	0.27	0.44	0.55	0.60
26	-1.00	-0.92	-0.70	-0.35	0.05	0.46	0.80	1.05	1.16
39	-1.70	-1.56	-1.18	-0.63	0.02	0.68	1.25	1.66	1.84
52	-2.63	-2.39	-1.80	-0.97	-0.01	0.96	1.82	2.44	2.74

Measurement Plane is Y = 5 Angle Offset (deg) 0.77

X	Z=-52	Z=-39	Z=-26	Z=-13	Z=0	Z=13	Z=26	Z=39	Z=52
-52	2.52	2.25	1.71	0.87	-0.08	-1.03	-1.83	-2.36	-2.63
-39	1.65	1.50	1.12	0.57	-0.05	-0.67	-1.20	-1.59	-1.74
-26	0.98	0.90	0.67	0.34	-0.04	-0.42	-0.75	-0.97	-1.06
-13	0.44	0.40	0.30	0.15	-0.03	-0.21	-0.36	-0.46	-0.50
0	-0.05	-0.05	-0.04	-0.04	-0.03	-0.02	-0.01	-0.01	-0.01
13	-0.55	-0.51	-0.39	-0.22	-0.02	0.17	0.34	0.45	0.49
26	-1.11	-1.02	-0.78	-0.43	-0.02	0.38	0.73	0.96	1.05
39	-1.81	-1.64	-1.24	-0.68	-0.02	0.63	1.20	1.58	1.74
52	-2.72	-2.45	-1.83	-0.99	-0.02	0.95	1.79	2.39	2.64

Section 10

DRAWINGS

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

Typical Applications:

Power Supplies

Communication Equipment

Medical Equiopment

Computers (Where High AMP Loads are Present)

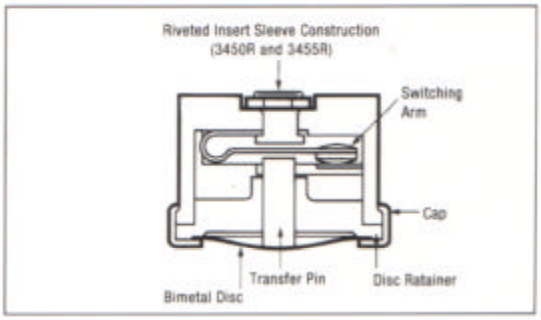
The Series 3450/3455R is a snap-acting, non-adjustable precision thermostat especially suited for industrial and electrical equipment.

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*

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

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 **0° to 25°C**	5	2.8	8	4.4	30-50	16-28	I
	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 **25° to 95°C**	5	2.8	8	4.4	30-50	16-28	I
	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 **96° to 120°C**	6	4.4	8	4.4	30-50	16-28	I
	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 **121.7° to 148.9°C**	7	3.9	8	4.4	30-50	16-28	I
	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 Milliohms
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.

F61 SERIES FLOW SWITCH

STANDARD FLOW RATE — SPDT

The F61 flow switch is designed for use on liquid lines using water, ethylene glycol solutions, or other liquids not injurious to the brass and phosphor bronze parts that come in contact with the liquid. The SPDT contacts make or break an electrical circuit when flow starts or stops.

F61KB-11: NEMA 1 type enclosure.

F61MB-1: This flow switch meets NEMA type 4 requirements and is UL listed as raintight. Use on indoor or outdoor applications in high humidity atmospheres, on liquid lines handling fluids below dewpoint or below 32°F (0°C).

Use on lines carrying well water, swimming pool water, sea water, brine or ethylene glycol. Not for use with hazardous fluids or in hazardous atmospheres.

The bronze paddle is of three segments for use in pipes from 1 in. to 3 in. diameter. Paddle segments may be removed or trimmed as needed. Catalog No. F61KB-11 and F61MB-1 include a 6 in. paddle for pipes 4 in. to 6 in.

Pipe Connection: 1 in. NPT.

Max Liquid Pressure: 150 PSIG (1034 kPa).

Max Liquid Temperature: 250°F (121°C).

Min Liquid Temperature, F61KB-11: 32°F (0°C)

F61MB-1: -20°F (-29°C).

Dimensions:
F61KB-11: 8⅜ in. H (3 in. paddle), 4 in. W, 2 13/16 in. D.

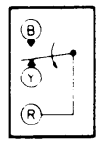
F61MB-1: 8 11/16 in. H (3 in. paddle), 4 51/64 in. W, 2 13/16 in. D.

TO ORDER: Specify F61KB-11 for NEMA 1 enclosure, F61MB-1 for NEMA 4 enclosure.

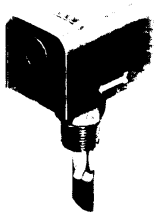
ELECTRICAL RATINGS

Motor Ratings VAC	120	208	240	277
Horsepower	1	1	1	—
AC Full Load amp	16.0	8.8	8.0	—
AC Locked Rotor amp	96.0	52.8	48.0	—
Non-Inductive or Resistance Load amp	16	16	16	16
Pilot Duty — 125 VA, 24/277 VAC				

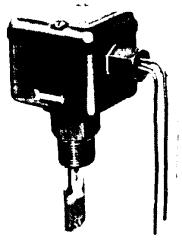
Series F61



ACTION ON INCREASE OF FLOW



F61KB-11
Replaces McDonnell & Miller FS4-3



F61MB-1
Replaces McDonnell & Miller FS8V-12

TYPICAL FLOW RATES — GPM (m³/hr) REQUIRED TO ACTUATE SWITCH

Line Pipe Size in.		1	1¼	1½	2	2½	3	4*	5*	6*	8*
Min Adj	Flow Increase R to Y Closes	4.2 (1.0)	5.8 (1.3)	7.5 (1.7)	13.7 (3.1)	18.0 (4.1)	27.5 (6.2)	65.0 (14.8) 37.0† (8.4)	125.0 (28.4) 57.0† (12.9)	190.0 (43.1) 74.0† (16.8)	375.0 (85.2) 205.0† (46.6)
	Flow Decrease R to B Closes	2.5 (0.6)	3.7 (0.8)	5.0 (1.1)	9.5 (2.2)	12.5 (2.8)	19.0 (4.3)	50.0 (11.4) 27.0† (6.1)	101.0 (22.9) 41.0† (9.3)	158.0 (35.9) 54.0† (12.3)	320.0 (72.7) 170.0† (38.6)
Max Adj	Flow Increase R to Y Closes	8.8 (2.0)	13.3 (3.0)	19.2 (4.4)	29.0 (6.6)	34.5 (7.8)	53.0 (12.0)	128.0 (29.1) 81.0† (13.4)	245.0 (55.6) 118.0† (26.8)	375.0 (85.2) 144.0† (32.7)	760.0 (172.6) 415.0† (94.2)
	Flow Decrease R to B Closes	8.5 (1.9)	12.5 (2.8)	18.0 (4.1)	27.0 (6.1)	32.0 (7.3)	50.0 (11.4)	122.0 (27.7) 76.0† (17.3)	235.0 (53.4) 111.0† (25.2)	360.0 (81.8) 135.0† (30.7)	730.0 (165.8) 400.0† (90.8)

* Flow rates for these sizes are calculated.
† These GPM figures are for switch with 6 in. paddle. For 4 in. and 5 in. line pipe the paddle is trimmed.

LOW FLOW RATE — SPDT

For use on liquid lines using water, ethylene glycol solutions, or other liquids not injurious to the brass and phosphor bronze parts. SPDT contact switch is activated by a low flow rate; however, it has a large flow capacity with minimum pressure drop. Typical applications include:

— Water purification and treatment systems.
— Booster pumps.
— Fast shut down on high input boilers to guard against circulation failure.
— Cooling systems for electronic tubes, bearings and compressors.

F61KD: NEMA 1 type enclosure.

F61MD: NEMA 4 (vaportight) enclosure.

Min Liquid Temperature, F61KD: 32°F (0°C)

F61MD: -20°F (-29°C).

Dimensions: 5 1/32 in. H, 4 in. W, 2 13/16 in. D.

TO ORDER: Specify Catalog Number only.

ELECTRICAL RATINGS

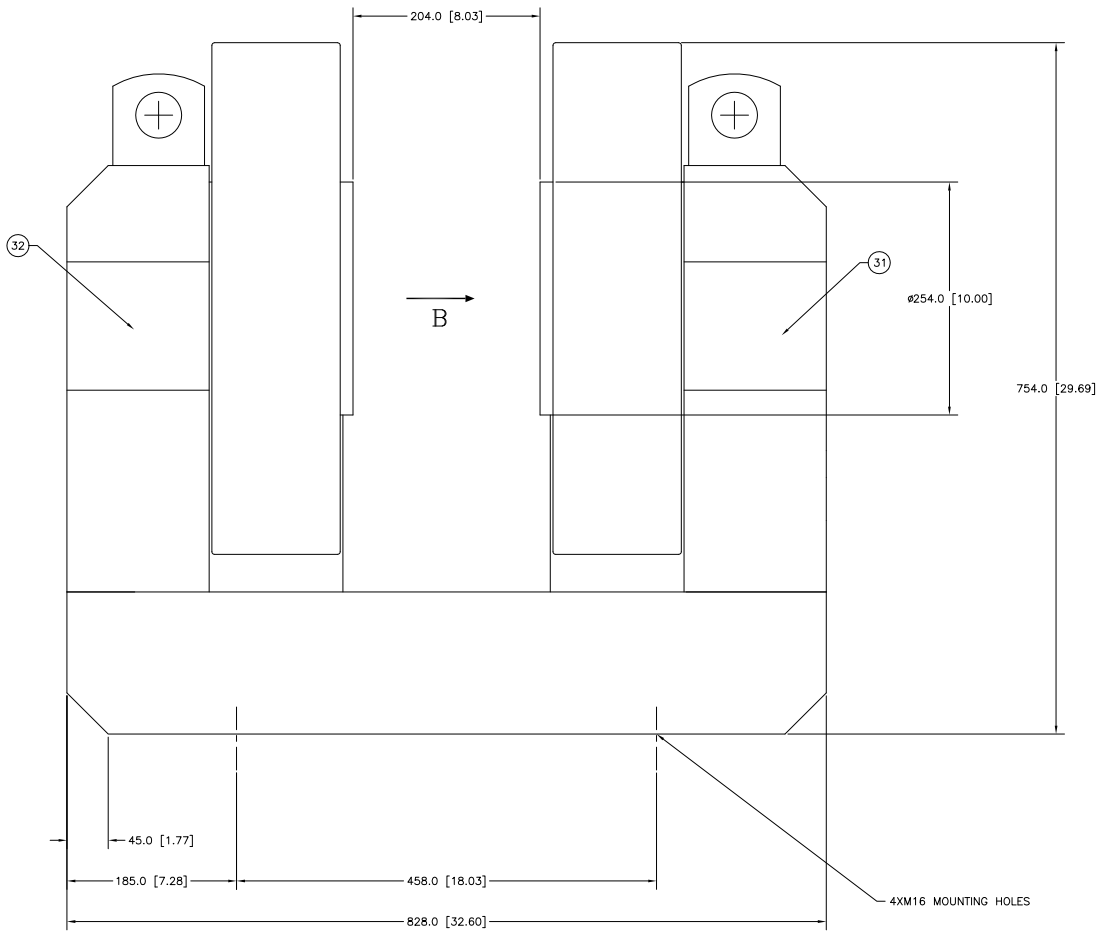
Motor Ratings VAC	120	208	240	277
Horsepower	1	1	1	—
AC Full Load amp	16.0	8.8	8.0	—
AC Locked Rotor amp	96.0	52.8	48.0	—
Non-Inductive or Resistance Load amp	16	16	16	16
Pilot Duty — 125 VA, 24/277 VAC				

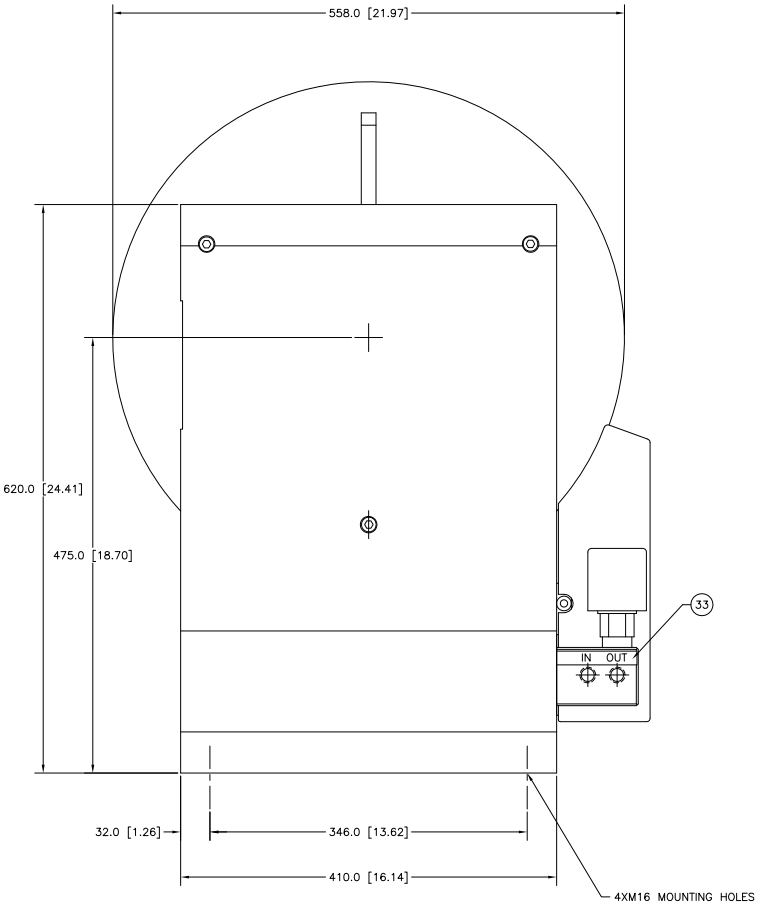
F61KD

	Catalog Number	Inlet and Outlet Size Female NPT	Enclosure NEMA Type	Adjustment Range — GPM (m³/hr) R to Y Closes Flow Increase	Adjustment Range — GPM (m³/hr) R to Y Opens Flow Decrease	Maximum Liquid Temp °F (°C)	Maximum Liquid Pressure PSIG (kPa)	Ship wt lb
	F61KD-3	½ in. × ½ in.	1	Minimum .6 (0.14) Maximum 1.1 (0.25)	Minimum .3 (0.07) Maximum 0.9 (0.2)	250 (121)	150 (1034)	2.2
	F61KD-4	¾ in. × ¾ in.	1					
★	F61MD-2	¾ in. × ¾ in.	4					

★ **Non-Stock Item. Built to Order.**

REVISIONS				
REV	DESCRIPTION	DRAFT	DATE	APPROVED
	SEE SHEET 2			





MAGNET SPECIFICATIONS

POLE GAP	204 mm
MAX INDUCTION	0.52 T
POLE DIAMETER	254 mm
TOTAL MASS	1310 kg
COIL POWER AT MAX INDUCTION	212 A @ 36 V
COOLING WATER AT MAX INDUCTION	10 liters/min @ 0.3 bar
MAX COIL CURRENT	230 A

ITEM	QTY	PART NUMBER	DESCRIPTION	NOTE
PARTS LIST				

DRAWN: H GLAVISH, DATE: 08/16/93
CHECK: , DATE:
ENGINEERING: , DATE:
NEXT ASSY: , SYSTEM:
SOFTWARE: AUTOCAD 13

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

	LINEAR INCHES	LINEAR 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

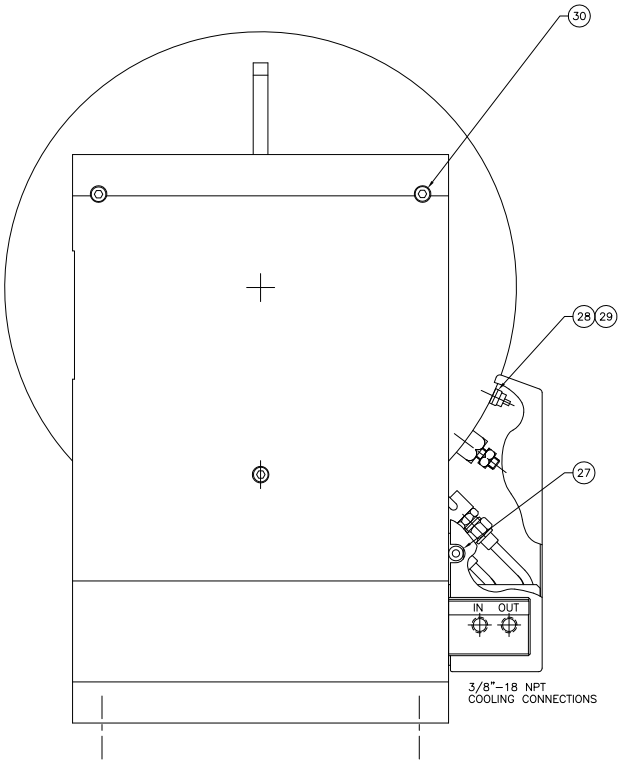
THIRD ANGLE PROJECTION

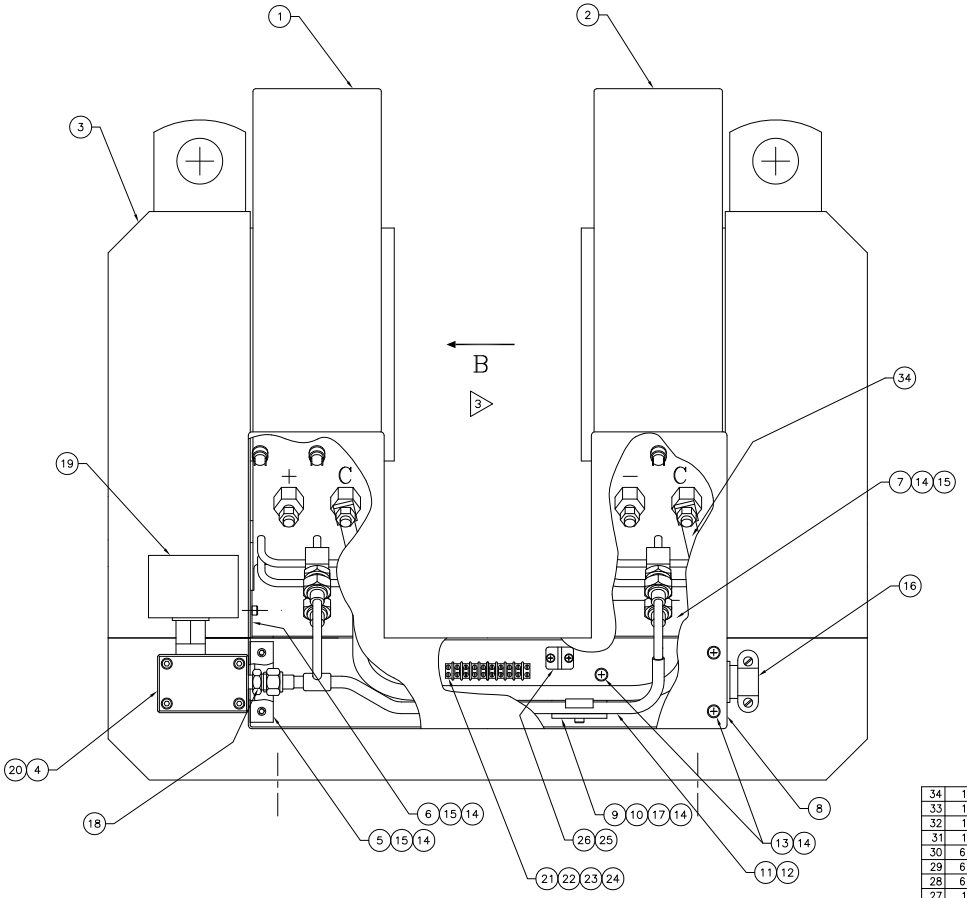
GMW
P.O. Box 2578, Redwood City, CA 94064
Tel: (415)368-4884. Fax: (415)368-0816

TITLE: THIN FILM MAGNET 200

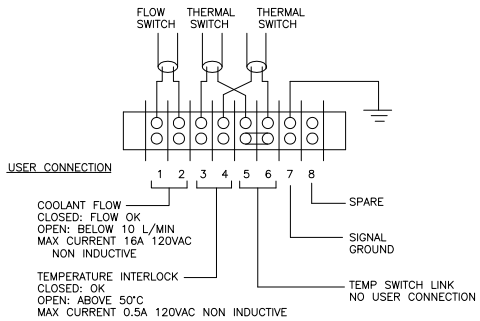
SIZE: E, DRAWING NO.: 11910000, REV: B
SCALE 1:2 | WT 1310 kg | SHEET 1 OF 2

REVISIONS				
REV	DESCRIPTION	DRAFT	DATE	APPROVED
A	RELEASE		08/16/93	HFG
B	ADDED FRONT VIEW, & ITEMS 31-34 ZONE H4,5: INTERCHANGED COIL ID'S	HFG	08/26/93	HFG





NOTES
1. REMOVE ALL LOOSE PARTICULATES FROM ASSEMBLY, INCLUDING HOLES.
2. VERIFY THERE ARE NO SHORTS TO CORES WITH OHM-METER TEST @ 300 V MINIMUM
3. MAGNETIC FIELD DIRECTION



INTERLOCK SCHEMATIC

ITEM	QTY	PART NUMBER	DESCRIPTION	NOTE
34	1	17910130	COIL LINK	
33	1		WATER CONNECTION LABEL	
32	1		CAUTION LABEL	
31	1		SPECIFICATION LABEL	
30	6		SHCS M10x100 SS	
29	6		WASHER NEOPRENE 4x16x4	
28	6	3450G611-1	SENSOR ELMWOOD 50', WITH STUD	
27	1		RUBBER GROMMET 8.0x16.0x1.5	
26	4		PH PHILLIPS M4x10 SS	
25	2	MB4A	TYTON SELF ADHESIVE CABLE TIE PAD	
24	4		WASHER 3.2x6x0.5 SS	
23	4		PH SLOTTED M3x16 SS	
22	1	MS 8-140	MARKER STRIP - CINCH	
21	1	8-140	TERMINAL BLOCK - CINCH	
20	4		SHCS M6x80 SS	
19	1	F 61 KB	JOHNSTON CONTROLS FLOW SWITCH	
18	2	B-8-VCO-1-6	CAJON MALE CONNECTOR	
17	7		SHCS M6x16 SS	
16	1		CABLE CLAMP T & B 3307	
15	4		SHCS M6x12 SS	
14	15		WASHER 11x6.4x1.6 SS	
13	5		PH PHILLIPS M6x12 SS	
12	1	11910022	COOLING TUBE OUTLET	
11	1	11910021	COOLING TUBE INLET	
10	1	17910100	TOE CLAMP	
9	1	17910090	BRACKET	
8	1	17910020	SERVICE COVER	
7	1	17910122	REAR COVER RIGHT	
6	1	17910121	REAR COVER LEFT	
5	2	17910030	SERVICE CHANNEL	
4	1	17910080	COOLANT COUPLING BLOCK	
3	1	11910030	YOKE & POLE SUB-ASSEMBLY	
2	1	11910012	COIL LH	
1	1	11910011	COIL RH	

PARTS LIST

DRAWN	H GLAVISH	DATE	08/16/93
CHECK		DATE	
ENGINEERING		DATE	
NEXT ASSY		SYSTEM	
SOFTWARE:	AUTOCAD 13		

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

	LINEAR INCHES	LINEAR 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	

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P.O. Box 2578, Redwood City, CA 94064
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TITLE: THIN FILM MAGNET 200

SIZE	DRAWING NO.	REV
E	11910000	B

SCALE 1:2 | WT 1310 kg | SHEET 2 OF 2