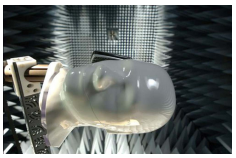
Model 2188 Series

Multi-Axis Positioning System (MAPS)

User Manual



ETS-Lindgren

An ESCO Technologies Company

Revision Record | MANUAL_MAPS_2188 | Part #399779, Rev. B

Revision	Description	Date
A	Initial Release	July, 2006
B	Revise Assembly Drawing 111040; rebrand	December, 2008

Table of Contents

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Notes, Cautions, and Warnings

	Note: Denotes helpful information intended to provide tips for better use of the product.
CAUTION	**Caution: Denotes a hazard. Failure to follow instructions could result in minor personal injury and/or property damage. Included text gives proper procedures.**
WARNING	**Warning: Denotes a hazard. Failure to follow instructions could result in SEVERE personal injury and/or property damage. Included text gives proper procedures.**

See the ETS-Lindgren *Product Information Bulletin* for safety, regulatory, and other product marking information.

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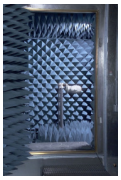
1.0 Introduction

The **ETS-Lindgren Multi-Axis Positioning System** (MAPS™) is designed to perform measurements of spherical antenna patterns as well as total and effective isotropic radiated power of wireless devices. The MAPS provides independent rotation in both azimuth and orthogonal axes.



Medium duty MAPS with optional SAM phantom head

MAPS Models

Three models of MAPS are available. Each model provides a vertical support column to support the Equipment Under Test (EUT).

MODEL 2110 LIGHT DUTY MAPS

The Model 2110 light duty MAPS can accommodate EUT up to 0.45 kg (1.00 lb), making it ideal for small devices.

Part Description	Part Number
Model 2110 Light Duty MAPS Includes: • MAPS Turntable Assembly, part #111040 • Light Duty Mast Assembly, part #111046-NNNN Specify height as –NNNN; for example, 72 inches is –7200 and 59.5 inches is –5950	2110-NNNN

Part Description	Part Number
Fiber optic cables, installation hardware, fiber optic feedthrough connectors	110084

MODEL 2115 MEDIUM DUTY MAPS

The Model 2115 medium duty MAPS is equipped with mounting plates to secure EUT or a Specific Anthropomorphic Mannequin (SAM) phantom head up to 11.3 kg (25.0 lbs). The SAM phantom head for testing wireless handsets is optional.

Part Description	Part Number
Model 2115 Medium Duty MAPS Includes: • MAPS Turntable Assembly, part #111040 • Medium Duty Mast Assembly, part #111047-NNNN Specify height as –NNNN; for example, 72 inches is –7200 and 59.5 inches is –5950	2115-NNNN
Fiber optic cables, installation hardware, fiber optic feedthrough connectors	110084

Standard Configuration

The MAPS includes a horizontal roll axis for mounting EUT. Each MAPS is built according to the customer-specified height by reducing the vertical support column to the appropriate length. The height of this axis must be specified when ordering the unit. A motor drive at the base of the vertical support column, in conjunction with the ETS-Lindgren Model 2090 Multi-Device Controller (or next generation ETS-Lindgren controller, if applicable), controls the movement of the unit.

Each MAPS is furnished with a 63-in (160-cm) diameter circular wood deck that is bolted onto a motorized turntable. The deck has an opening for the vertical support and access to the knobs that clamp the sliding carrier into a fixed position.

The MAPS is equipped with two motor bases, one to control each rotational axis. A 230 VAC 50 or 60 Hz single-phase receptacle is required to power each unit. Current draw is less than 4 amps per motor base. The drive power for both rotations is provided by the filtered 208–230 VAC, 50/60 Hz single-phase power inside the chamber. Therefore, there is no need for power drive cables to penetrate the shielded enclosure.

The following steps were taken to minimize potential radio frequency (RF) obstruction or distortions of RF signals from low-directive wireless transmit antennas:

- The use of minimum composite tube materials to fabricate the rotating shaft and EUT mounts.
- RF cable connection to the EUT is made through a 1.2-inch hole provided in the center of the roll axis shaft.

The resultant system test data shows virtually no RF interference from the light duty MAPS.

Model 2090 Multi-Device Controller

The Model 2090 Multi-Device Controller (or next generation ETS-Lindgren controller, if applicable) directs the motor drives for the upper (phi or x) roll axis and the rotation of the turntable (*theta* or *y* axis).

The x-axis motor drive mounts onto a rail system that is attached to the turntable. This system is positioned on the turntable so that the x-axis centerline projects through the center of the turntable. The rail system has a sliding carrier that allows the vertical support assembly to be moved in or out, in a six-inch (15.2 cm) range, from the center of the turntable. The sliding carrier enables the movement of the EUT in or out in the same range.

To minimize any potential RF obstruction or distortion of RF signals from low-directive wireless transmit antennas, each positioning system is provided with fiber optic control lines that enable the I/O signal between the motor base and the Model 2090 controller.

Masts

The MAPS mast is a dual-axis angular positioning system capable of rotating the EUT on the center of both rotation axes with 360° angular span while keeping the EUT on the center of both rotation axes. The angular accuracy is guaranteed within ± 0.25° for both axes. The two axes can be controlled independently through the controller or measurement software

Light Duty Mast

Medium Duty Mast (shown with optional mount)

Optional Items

The following items are available as options to the MAPS. Custom options are also available. Contact your ETS-Lindgren sales representative for additional information on custom options.

Optional Part Description	Part Number
SAM Phantom Head	107182
Phantom Hand, Left	110209
Phantom Hand, Right	110208
SAM Phantom Head Center Rotation Kit Places center of the phantom head at the center of rotation of the upper axis	107550
SAM Phantom Ear Rotation Kit Places the left or right ear of the phantom head at the center of rotation of the upper axis	107551

Optional Part Description		Part Number
Free-Space Mount Kit • Light duty free-space mount kit is included with all light duty mast assemblies • Not compatible with medium duty MAPS 2115 mast assembly		107549
Free-Space Mount Kit • Medium duty free-space mount kit is not included with medium duty mast assembly • Not compatible with light duty MAPS 2110 mast assembly		107559
Laptop Mount for medium duty MAPS 2115 • To mount laptop or similar device • EUT rotation axis is at center of EUT		108279
Mounting Adapters for Model 3160 Standard Gain Horn Antennas • To mount to medium duty MAPS 2115 • Requires antenna mount; also requires an extension to be attached to the rotating axis of the upper mast assembly • If mounting two antennas that require the same extension, only one extension is required		
	Antenna Mount	**Extension**
– 3160-05 Standard Gain Horn Antenna	110758	110759
– 3160-06 Standard Gain Horn Antenna	108416	108793
– 3160-07 Standard Gain Horn Antenna	108417	108793
– 3160-08 Standard Gain Horn Antenna	108418	108793
Dipole Mount Base		107505
CTIA Ripple Antenna Mount Kit • To mount loops and dipoles during the CTIA ripple test • Specify height as –NNNN For example, 72 inches is –7200 and 59.5 inches is –5950		107553-NNNN

ETS-Lindgren Product Information Bulletin

See the ETS-Lindgren *Product Information Bulletin* included with your shipment for the following:

- Warranty information
- Safety, regulatory, and other product marking information
- Steps to receive your shipment
- Steps to return a component for service
- ETS Lindgren calibration service
- ETS Lindgren contact information

2.0 Maintenance

WARNING **Before performing any maintenance, follow the safety information in the ETS-Lindgren Product Information Bulletin included with your shipment.**

CAUTION **Do not perform maintenance while MAPS is operating. During maintenance, disconnect power for safety.**

Only qualified individuals should conduct maintenance inspections or perform maintenance on the MAPS.

Regular maintenance will prolong the serviceable life of the turntable. Follow the recommended schedule and use the log on page 15 to keep a record of maintenance performed.

If you have any questions concerning maintenance, contact ETS-Lindgren Customer Service.

Routine Maintenance

Perform the following maintenance prior to each use:

- Visually inspect the Multi-Axis Positioning System (MAPS) and surrounding absorber.
- Attempt to rotate each axis by hand. Excessive rotation may indicate a loose drive component.

During MAPS operation, listen for excessive or unusual noise.

Bi-Annual Maintenance

Perform bi-annual maintenance every six months after the MAPS is placed into operation. Prior to maintenance, remove sufficient amounts of absorber to provide access to the MAPS casters.

Grease the casters every six months or after every 2000 hours of operation. Use a good quality bearing grease and a standard SAE grease gun to lubricate the casters.

Annual Maintenance

Perform the following maintenance every 12 months after the MAPS is placed into service:

- Use a good quality bearing grease to lubricate the main bearing race. The grease fittings are located inside the race, 90° apart, under the top. Three discharges from the grease gun in each fitting are adequate.
- Use a good quality grease to lubricate the chain and sprocket of the chain drive.

MAPS Maintenance Log

Item	Routine	Bi-Annual	Annual	Routine	Bi-Annual	Annual	Routine	Bi-Annual	Annual
Routine Maintenance									
Check absorber for loose or damaged pieces									
Check for excess rotation in each axis									
Check MAPS for loose or damaged parts									
Bi-Annual Maintenance									
Grease the casters									
Annual Check									
Lubricate the main bearing race									
Lubricate chain and sprocket and check tension of the chain drive.									

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3.0 Specifications

MAPS Electrical Specifications

Nominal AC Voltage:	208–230 VAC
Input Frequency:	50/60 Hz
Current Rating:	10 amp service
Phase:	Single

MAPS Physical Specifications

See the assembly drawings located in the back pocket of the manual for additional dimensions.

Unit Diameter:	160.02 cm 63 in
Typical Turntable Platform Height:	36.96 cm 14.55 in
Approximate Installed Unit Weight:	453.59 kg 1000 lb

Contact your ETS-Lindgren sales representative for shipping container dimensions and weight.

Mast Specifications

Mast Type	Mast Height	Maximum EUT Size
Light Duty (Including free-space mount part #107549)	Customer-specified	0.45 kg (1 lb) Within the area of the provided mount
Medium Duty	Customer-specified	11.3 kg (25 lb) Within the area of the optional mount

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4.0 Installation

WARNING

Before connecting any components, follow the safety information in the ETS-Lindgren Product Information Bulletin included with your shipment.

Proper installation of the MAPS directly affects performance. The installation of the MAPS must be performed by factory installation specialists or individuals authorized by ETS-Lindgren to perform installation. This information provided in this manual is intended to be used only by those installation specialists.

See the assembly drawings located in the back pocket of the manual to assist with installation.

If you have any questions concerning installation, contact ETS-Lindgren Customer Service for Customer Service contact information.

The installation of the Multi-Axis Positioning System (MAPS™) will take approximately eight hours and will require a minimum of two people.

Required Tools

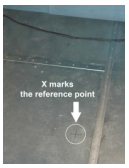
The following tools are required to install the MAPS:

- Power hand drill, 3/8-in chuck
- Drill bit, 3/16-in diameter
- Drive bit, square (provided)
- Drive bit, #2 Phillips
- SAE hex key wrench set (maximum 1/2-in)
- Permanent marker
- Laser level, 5-beam, and stand
- Bubble level (36-in minimum)
- 10-in adjustable, open-ended wrench

Reference Point

If installing the MAPS in an existing chamber: Remove the absorber from the floor and lower wall areas prior to installation to avoid damage to the absorber.

1. Locate the reference point. It is generally located along the bore sight axis of the range antenna. See *Bore Sight and Leveling* on page 23 for additional information regarding bore sight.
2. With permanent marker, place an **X** on the floor of the chamber at the reference point.



3. Draw a 47-in (1.19-m) diameter circle to represent the turntable perimeter.

The diameter is larger than the actual perimeter of the circular anchor plates for the turntable, and should only be used as a guide in centering the turntable portion of the MAPS.

System Installation

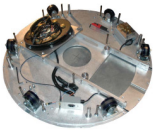
CAUTION

Fiber optic cables must be connected correctly for motor base function. Before removing fiber optic cables from the motor base, label the replacement locations for accurate reconnection.

4. Remove the wood deck. See assembly drawing 110073 located in the back pocket of the manual for details.

5. The MAPS drive units are designed to move from the shipping container to the chamber floor as a single unit. If you cannot move it as a single unit without causing damage, separate the upper drive unit. See *Upper Drive Unit Removal* on page 22.

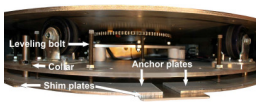
6. Place on the chamber floor within the drawn circle.



When installing the turntable on modular shielding, do not drill anchor holes through the floor joint strips. Use the shim plates provided.

7. Insert the shim plates to level the turntable over the vault seams.

Anchor Plate Installation



8. The anchor plates are held in place by 1/4–20 screws and set collars. Screw the anchor plates to the floor using 14x1 square socket flat head screws.

   Drill pilot holes for these screws, and make sure to vacuum shavings to provide good contact with the floor. Continue mounting the remainder of the plates.

9. When all anchor plates are securely mounted, remove the 1/4–20 screws that hold the anchor plates to the base. Discard the screws.

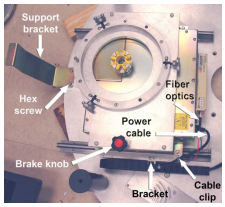
10. Use a bubble level to verify the turntable unit is flat. This is a preliminary check only; final leveling of the turntable will be completed in a later step.

11. Use shim plates to level the table. The shim plates will remain in place after the installation.

Upper Drive Unit Removal

When installing the MAPS in an existing chamber, it may be necessary to remove the upper drive unit to avoid damage to the chamber or to the MAPS.

Following are the steps to separate the upper and lower drive units. See assembly drawings 111040, 109987, and 110073 located in the back pocket of the manual for details.



12. Prior to disconnecting the fiber optic cables from the upper drive unit, label and mark the locations for reconnection.

13. Verify the fiber optic cables to the upper motor base are not switched.

14. Remove the bracket mounted on the drive unit that is attached to cable carrier. Two #6 screws hold the bracket to the unit.

15. Remove the cable clip holding the power cable.

16. Remove the bracket on the opposite side of the unit that ties the drive unit to the turntable top. This temporary bracket holds the unit in place for shipping.

17. Turn the brake knob to release the drive unit and allow it to move toward center of table.

When the turntable top is in place, use the brake knob to adjust the EUT to the center of rotation (middle of the quiet zone) by sliding the mast assembly back and forth.

18. Remove the two 1/4–20 hex head screws that hold the wood top support bracket, and then remove the bracket.

19. Slide the drive unit carrier out.

20. Reinstall in reverse order.

The brake knob must be in the upper position to allow the drive unit to slide onto the rail system. Verify all hardware is secured.

Bore Sight and Leveling

If the MAPS unit was ordered with multiple masts, you must bore sight each mast.

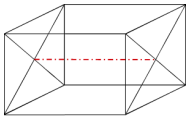
Bore Sight

LASER WARNING. Denotes a laser is part of the operating system of the device.

Bore sight of the MAPS is critical to the accuracy of measurements, and is the most important step of the installation process. Take the time to verify all measurements are accurate.

To make sure the MAPS is level with the antennas in the chamber and is accurately centered in the chamber, install the mast(s). Bore sight of the MAPS requires a five-beam laser level.

Following are the typical installation steps used to achieve bore sight for a MAPS unit.



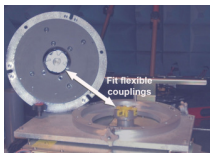
Locate center of chamber

1. Locate and mark the center of the chamber wall opposite the range antenna mounted in the chamber end wall. Marking may require the removal of absorber.

   This applies for both rectangular and tapered chambers. In tapered chambers the antenna is mounted in the far end of the antenna apex. In both cases the typical installation of the antenna is parallel to the cross section of the opposite end wall.

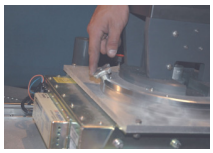
   If the range antenna is mounted elsewhere in the chamber, then the bore sight line exists normal to the middle of the range antenna.

2. With the laser mounted on a tripod, mark the end of the bore sight line to the end wall for reference.



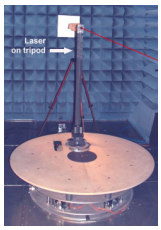
Fit the flexible couplings of the mast and turntable together

3. Install the MAPS mast(s). Line up the flexible couplings and slide the mast into position.



Slide the aluminum knobs over the collar of the mast

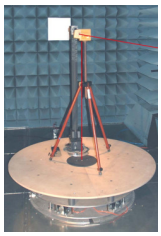
4. After the couplings are aligned and the mast is fitted securely to the turntable top, slide the aluminum hand knobs over the collar and tighten.



Align laser through the mast mount to the center of the chamber

5. When the knobs are securely in place, place the MAPS system so that the center of the horizontal axis is aligned with the laser beam.

   Small height corrections may be necessary. For information, see *Leveling and Height Adjustment* on page 28. After the system is leveled, additional height corrections may be required.



Laser and tripod on turntable top
(Shown with optional dipole mount plate)

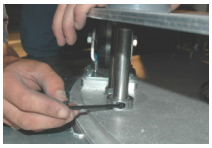
6. Mount the laser onto a tripod, and then place it on the turntable top.
7. Sight one horizontal laser in line with the antenna mounted in the end wall of the chamber.

   Align the opposite side of the horizontal laser through the mounting gear of the MAPS to the center of the opposite end wall and to the reference point previously marked.

   Align the vertical laser with the center of the dipole pole mount plate (optional) or the MAPS deck to the center axis of the bore sight line. The center of the deck is located between the two closest screws attaching the plywood deck to the bottom spacers.
8. Verify that the laser beam is visible through the horizontal axis of the MAPS while the MAPS mast is moved back and forth in the slidar system.
9. Achieve bore sight for each mast to be used with the MAPS system.

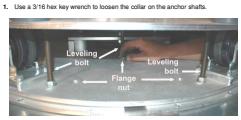
Leveling and Height Adjustment

If during the bore sight process it is determined that the MAPS system must be leveled or the height adjusted, follow these steps.



Loosen collar on the anchor shafts

1. Use a 3/16 hex key wrench to loosen the collar on the anchor shafts.



Remove flange nuts, then raise or lower leveling bolts

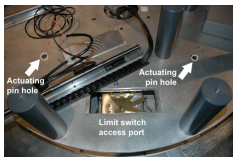
2. Use an open-ended wrench to loosen the flange nuts on all leveling bolts.
3. Lower or raise the leveling bolts to set the turntable to the correct height. Begin leveling from two opposing sides.
4. When the level is accurate, move the remaining leveling bolts into the correct position.

If installing the MAPS in a pit, mark the amount required to raise the unit up to level. Remove the top of the turntable and begin leveling.

5. Verify that the unit is level.

Attach the wooden turntable top
(Shown with optional dipole mount base)

6. Position the wooden turntable top on the turntable base.
7. Use a 5/16 Allen wrench to tighten the bolts.
8. Secure the turntable top seams in place with a Phillips screwdriver.



Position the actuating pins on each side of the limit switch access port

9. Verify the access port is located over the limit switch.
10. Position the actuating pins in the holes on each side of the access port.

Controller Interface

For information about connecting fiber optic cables from the MAPS to the Model 2090 Multi-Device Controller (or next generation ETS-Lindgren controller, if applicable), see the controller manual.

Electrical Interface

CAUTION **Electrical installation must be performed by a qualified electrician, and in accordance with local and national electrical standards.**

Only qualified personnel may install the electrical interface from the chamber to the MAPS.

The MAPS is designed to operate using 208–230 VAC single-phase 50 or 60 Hz power.

The branch circuit supplying power to the motor bases must be protected from excess current according to local electrical codes. Integral circuit protection is provided in the motor base assembly.

Check that the conductor size is adequate for the motor load and the distance from the mains source. Improperly-sized conductors will lead to a high voltage drop in the power conductors and cause reduced starting torque and premature motor failure.

The motor base assembly is provided with an IEC-320 power inlet for connecting to the mains.

WARNING **Prior to servicing the turntable or the turntable motor base, remove the power connection for safety.**

1. Connect the fiber optic control cable and install the power connection per local electrical code. See the controller manual for information on connecting fiber optic cables.
2. After the fiber optic cable is installed, secure it with a wire tie to one of the leveling screws.

Absorber Installation

After the MAPS and mast(s) are leveled and bore sight is achieved, position the absorber that surrounds and covers the unit. For absorber locations, see the *Top View of Wood Deck with Absorber Locations* assembly drawing located in the back pocket of the manual.

Light duty MAPS with deck absorber

5.0 Operation

WARNING **Before placing into operation, follow the safety information in the ETS-Lindgren *Product Information Bulletin* included with your shipment.**

If you are unfamiliar with the operation of the Model 2090 Series Multi-Device Controller (or next generation ETS-Lindgren controller, if applicable), see the manual included with the controller. The manual is also available for download from www.ets-lindgren.com.

With the installation of the Multi-Axis Positioning System (MAPS™) complete, the controller must be connected to the unit and power applied to both the motor base and controller. See the controller manual for information on connecting the fiber optic cable.

Use the controller to check the clockwise (CW) and counterclockwise (CCW) rotation in both directions by a few degrees. The position in degrees increases (+) in the CW direction and decreases (-) in CCW direction.

Parameter Settings

Parameter	Device 1–Turntable Theta Axis	Device 2–Mast Upper Rotation Phi Axis
P1	0	0
P2	0	0
P3	000	000
P5	1	1
P8	0.1	0.1
P9	8	9
B1	000	000
C	3600	3600
S0	-1	-1
S1	31	31
S2	63	63
S3	95	95
S4	127	127
S5	159	159

Parameter	Device 1–Turntable Theta Axis	Device 2–Mast Upper Rotation Phi Axis
S6	191	191
S7	223	223
S8	255	255
Ac	2.0	2.0
OC	OFF	OFF

Appendix A: Warranty

See the *Product Information Bulletin* included with your shipment for the complete ETS-Lindgren warranty for your MAPS.

Duration of Warranties for MAPS

All product warranties, except the warranty of title, and all remedies for warranty failures are limited to two year.

Product Warranted	Duration of Warranty Period
Multi Axis Positioning System (MAPS™)	2 Years

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Appendix B: Assembly Drawings

The following assembly drawings are located in the back pocket of the manual:

- 111045
- 109987
- 110073
- 111040
- 111041
- Top View of Wooden Deck with Absorber Locations

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Appendix C: EC Declaration of Conformity

ETS·LINDGREN
An ESCO Technologies Company

CE 05

European Community Declaration of Conformity
(In accordance with EN 45014:1998)

We, ETS-Lindgren, L.P., 1301 Arrow Point Drive, Cedar Park, TX, 78613, USA, declare that:

Model 2110, 2115, 2120 Series MAPS with 2188 style motor base

to which this declaration relates, meets the requirements and conforms with the relevant EC Directives listed below using the relevant section of the following EC standards and other normative documents;

Directive(s):

EEC/73/23	The Low Voltage Directive (and its amending directives)
EEC/89/336	The Electromagnetic Compatibility Directive (and its amending directives)

Standard(s):

EN 55011	Group1, Class B
EN 61000-4-2:1995	Level 2/3 (4/8kV)
EN 61000-4-3:1997	Level 2 (3V/m)
EN 61000-4-4	Level 2 (1/0.5kV)
ENV 50204:1996	Level 2 (3V/m)
EN 61000-4-5:1995	Level 3 (2/1kV)
EN 61000-4-11:1994	2 kV
EN 61010-1	Safety requirements for electrical equipment for measurement, control, and laboratory use

I hereby declare that the equipment named above has been designed to comply with the relevant sections of the above referenced specifications. The unit complies with all essential requirements of the Directives. The CE marking has been affixed on the device according to article 10 of the EC directive 89/336/EEC

Authorized Signatory

Bryan Sayler
General Manager, ETS-Lindgren, L.P.

22 June 2006
Date of Declaration:

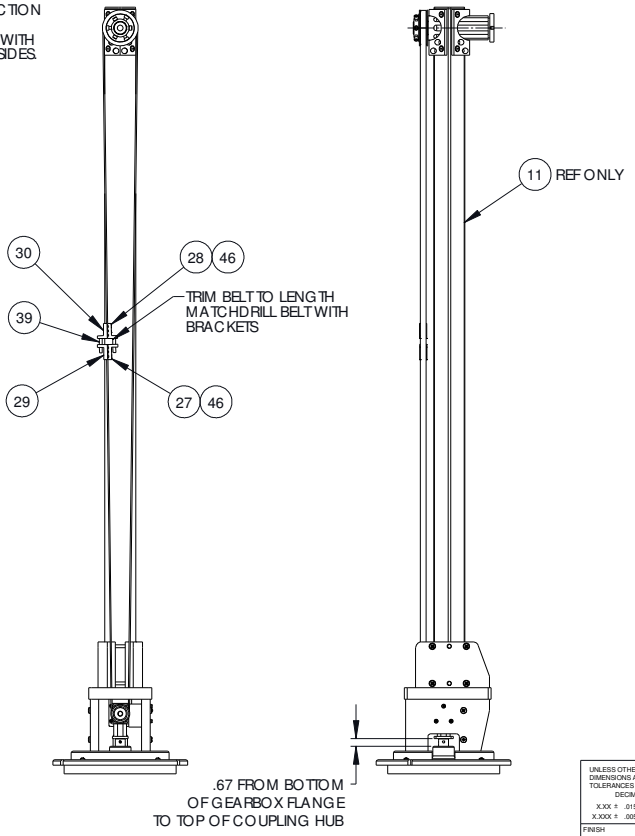
The authorizing signature on the EC Declaration of Conformity document authorizes ETS-Lindgren, L.P. to affix the CE mark to the indicated product. CE marks placed on these products will be distinct and visible. Other marks or inscriptions liable to be confused with the CE mark will not be affixed to these products.

ETS-Lindgren, L.P. has ensured that appropriate documentation shall remain available on premises for inspection and validation purposes for a period of no less than ten (10) years

REF DRAWING

NOTES:

1. SEE SHEET 2 FOR DETAILS
2. INSTALL PULLEY ON OUTPUT SHAFT THAT TURNS IN THE SAME DIRECTION AS THE INPUT SHAFT
3. MATCH DRILL ITEM 11 AND 12 WITH ITEMS 9 AND 10 Ø.375 BOTH SIDES. INSTALL ITEM 15 4 PLACES



REVISIONS				
ECO#	REV	DESCRIPTION	DATE	APPROVED
5022	A	RELEASED	6/28/06	RBG

ITEM NO.	QTY.	PART NUMBER	DESCRIPTION
48	4	910274	FLAT WASHER #8 SS .375 O.D. X .032 THK
47	6	910735	SCREW, MACH, PH PAHNEAD, 1/4-20 X 1.5
46	4	910332	SCREW BINDING HEAD NYLON 10-32 X 1/2
45	.10	920081	LOCTITE THREAD LOCKING #242 31 50l
44	1	107337	ADAPTER,UPPER,PULLEY,MAPS.2015
43	.01	920173	EPOXY,GRAY ADHESIVE DP-190 3M
42	3	930418	SCREW,1/4-20 X 3/ 4,SLOT,FLAT,NYLON BLK
41	2	910466	SCREW SET SOCKETHEAD SS 1/4-20 X 3/ 8
40	4	910767	SCREW, MACH, PHD PHIL , 1/4-20 X 3",SST
39	2	910756	SCREW,1/4-20 X 1.5,FL HD SLOT,NYLON
38	4	910270	NUT,8-32,HEX,SS
37	2	910634	SCREW,10-32X.1/4,HEX,SET,SS
36	6	910738	SCREW SKTSET 3/ 8-16 X .75 SS
35	3	910740	SCREW,8-32 X 1 3/ 4,PHIL,PAN,SS
34	18	910737	SCREW,1/4-20 X 1- 1/ 4,PHIL,BIND,SS
33	10	910228	WASHER,SPLIT LOCK,SS,# 8
32	7	910277	SCREW,8-32 X 1 1/ 4,PHIL,PAN,SS
31	1	109973	RING,LOCKING,MOUNT,MAST ASSY
30	1	107117	BELT CLAMP THRU HOLE,MAPS.2015
29	1	107115	BELT CLAMP THREADED, MAPS.2015
28	1	107116	TOOTH CLAMP THRU HOLE,MAPS.2015
27	1	107114	TOOTH CLAMP THREADED,MAPS.2015
26	14"	880261	BELT TIMING,A6R4-C050
25	1	107161	PULLEY 12T MOD 2015 MAPS
24	3	107353	SCREW MODIFIED, WEDGE TIP
23	3	930420	SCREW,1/4-20X1/ 2,SH,CAP,NYLON
22	8	910641	SCREW,1/4-20 X 1/ 2,PHIL,FLAT,,NYLON
21	3	930417	MACH SCREW 2-56 X1/4 PHL FLAT HD
20	2	107341	BRACE,BEARING TUBE
19	1	107343	PULLEY,MODIFIED 2015 MAPS
18	1	107336	SHAFT,UPPER
17	1	107342	CAP,VERTICAL SUPPORT
16	1	107335	BEARING TUBE,UPPER SHAFT
15	4	107112	DOWEL PIN 3/ 8" X 1",MAPS.2015
14	1	110336	KEY,HUB,3/ 16 X 1.20
13	4	910357	SCREW,10-32 X 3/ 4,PHIL,PAN,SST
12	1	107507	PLUG, MAST BASE
11	1	REF ONLY	MAST,MEDIUM DUTY MAPS.... VERTICAL
10	1	107345	BRACKET,RIGHT 2015 MAPS
9	1	107344	BRACKET,LEFT 2015 MAPS
8	1	107108	GEARBLOCK,MAPS.2015
7	1	110306	TOP PLATE,GEARBOX HOUSING,MAST.2115
6	2	110307	SIDE PLATE,GEARBOX HOUSING,MAST.2115
5	1	880302	HUB,COUPLING, AL,7/ 8" BORE
4	1	110303	ADAPTER,SHAFT,GEARBOX
3	1	880271	GEARBOX,WORM,.2-1,PRECISION
2	1	110305	MOUNT PLATE,GEARBOX MT,2110/2115
1	1	109970	MOUNT,BASE,MAST ASSY

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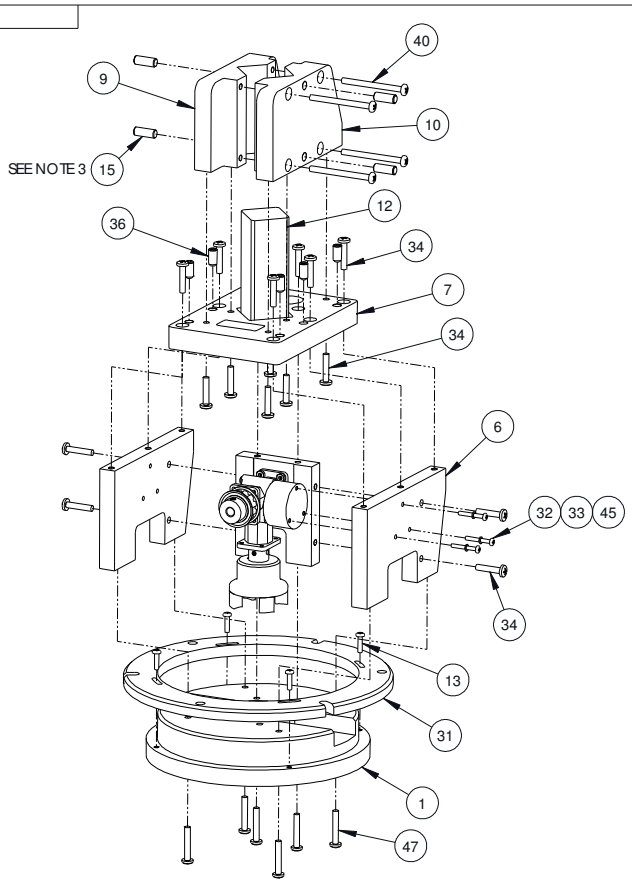
	DRAWN RBG	10/20/05
	CHECKED	
FINISH: NONE	MATERIAL: SEE BOM	

TITLE: PARTS,COMMON,MEDIUM DUTY MAPS ASSY

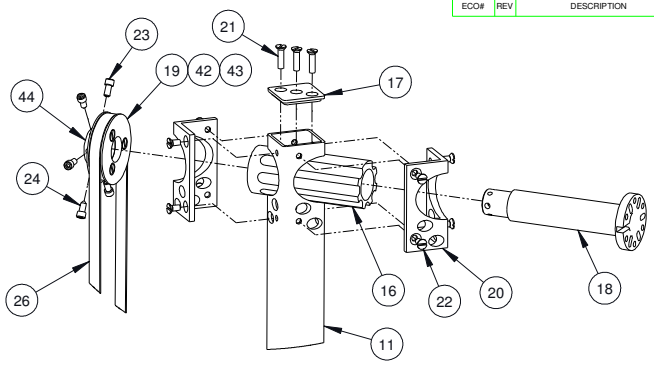
SIZE	SCALE	DWG. NO.	REV.
D	1:4	111045	A
DO NOT SCALE DRAWING		SHEET 1 OF 2	

REF DRAWING

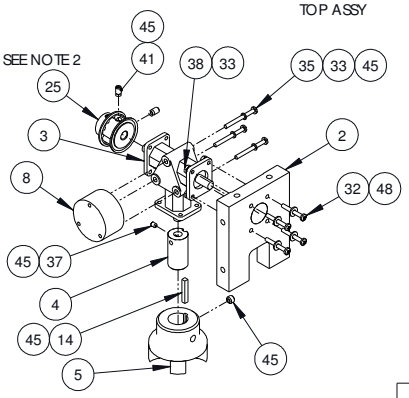
NOTES:



BOTTOM ASSY



TOP ASSY



GEARBOX ASSY

REVISIONS				
ECO#	REV	DESCRIPTION	DATE	APPROVED

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APPROVALS DATE
DRAWN RBG 10/20/05
CHECKED
FINISH: NONE
MATERIAL: SEE BOM

TITLE: PARTS,COMMON,MEDIUM DUTY MAPS ASSY

PROPRIETARY INFORMATION
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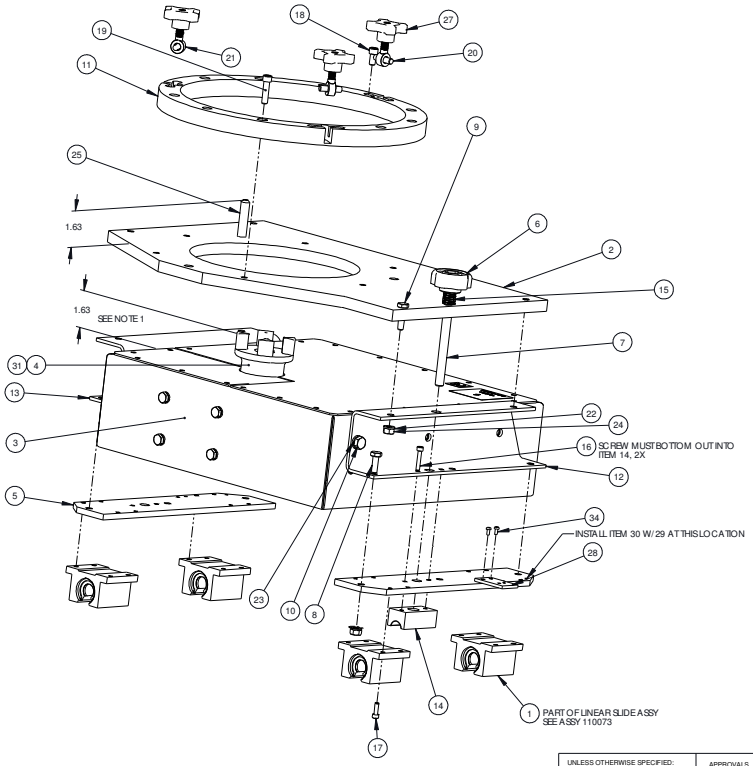
SIZE D | SCALE 1:2 | DWG. NO. 111045 | REV. A
DO NOT SCALE DRAWING | SHEET 2 OF 2

REF DRAWING

NOTES:
1. DIMENSION IS FROM MOTORBASE COVER TOP TO COUPLING HUB TOP.

REVISIONS				
ECO#	REV	DESCRIPTION	DATE	APPROVED
5068	A	RELEASED	3/23/06	RBG



ITEM #	QTY.	PART NUMBER	DESCRIPTION
31	1	880301	INSERT,SPIDER,92 SHORE A
30	1	890687	CABLE CLAMP P-CLIP 1/4" PLASTIC (NOT SHOWN)
29	3	910159	SELF TAPPING SCREW, PAN HEAD ZN6-32X3/8
28	1	110747	MOUNT,CHAIN,CABLE
27	3	110765	KNOB,HAND,ALUM,5/16 THRD,MODIFIED
26	1	105012	KEY,.187" X .875"
25	1	109980	PIN,LOCATING,MAST ASSY
24	10	910664	HEX NUT,STAINLESS 1/4-20
23	6	910393	WASHER,5/16,LOCK,STL,ZINC,SPLT
22	10	910762	LOCKWASHER,SPLIT,1/4,.SS
21	3	891020	ROD END,5/16-18 FULL THRD
20	3	890694	DOWEL PIN 1/4 X 1.0 SS
19	6	910777	SCREW,1/4-20 X 1,SH,CAP,SS
18	6	910437	SCREW SOCKET HEAD ALLEN 1/4-20 X 1/2
17	16	910136	SCREW ALLEN HEAD 8-32 X .5
16	2	910801	SCREW,8-32 X 7/8,SH,GR8
15	1	891016	SPRING,WAVE,3/8ID X 9/16OD X .715FL
14	1	109975	STOP,SHAFT
13	1	109979	SUPPORT,CHANNEL,MOTORBASE MOUNT
12	1	109977	SUPPORT,CHANNEL,BRAKE SIDE
11	1	109967	RING,MOUNT MAST ASSY
10	6	910386	BOLT,5/16-18 X 3/4,HEX,GR5
9	4	910447	BOLT,1/4-20 X 1,HEX,SS
8	6	910441	BOLT,1/4-20 X 3/4,HEX,SS
7	1	910931	SCREW,3/8-16 X 4 1/2,HEX,CAP,SS,FULL THRD
6	1	890912	KNOB,3/8 HEX BOLT
5	2	109978	MOUNT,BEARING, CHANNEL SUPPORT
4	1	880302	HUB,COUPLING,AL,7/8" BORE
3	1	109040	ASSY,MOTORBASE,2188
2	1	109984	CROSSPLATE,CHANNEL MOUNT
1	4		PILLOW BLOCK & BEARING, PART OF LINEAR SLIDE ASSY

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X.XX ± .015 / ± .5	DRAWN RBG	7/7/05
X.XXX ± .005	CHECKED	
FINISH: NONE	MATERIAL: SEE BOM	

TITLE: ASSY,SLIDER,MAPS

PROPRIETARY INFORMATION	SIZE	SCALE	DWG. NO.	REV.
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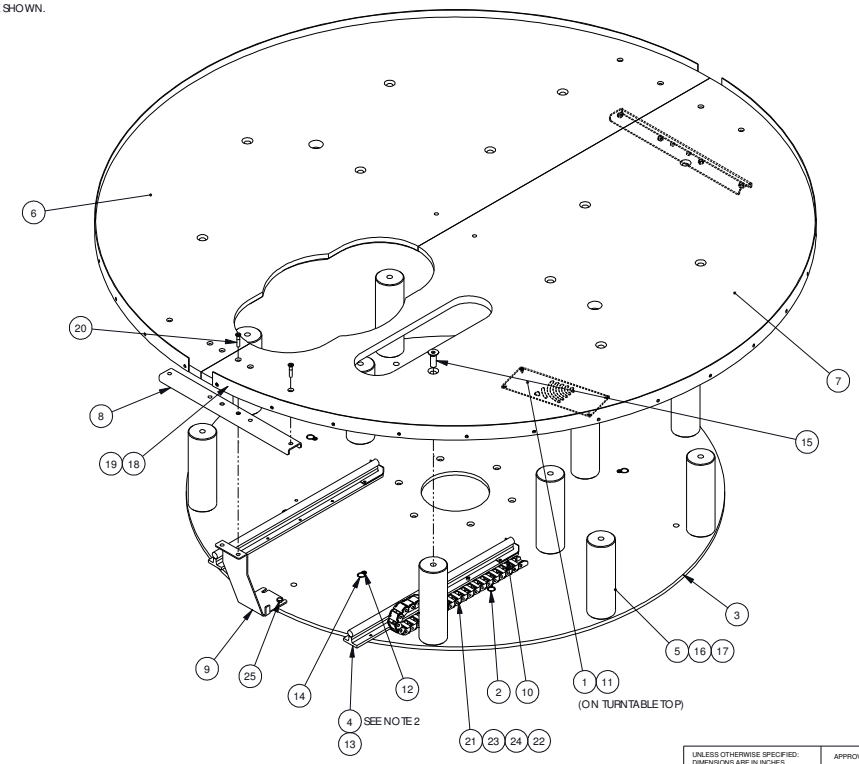
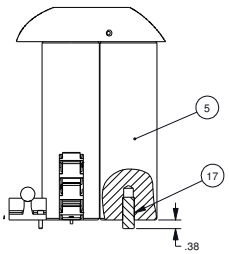
	DO NOT SCALE DRAWING		SHEET 1 OF 1	

REF DRAWING

NOTES:
1. SOME PARTS SHOWN IN EXPLODED VIEW FOR PART CLARITY.
2. LINEAR SLIDES TO BE SET WITH MOTORBASE ATTACHED TO THEM FOR PROPER ALIGNMENT AND ADJUSTMENT TO ITEM 3 PRIOR TO FINAL ASSY.
3. NOT ALL HARDWARE SHOWN.

REVISIONS				
ECO#	REV	DESCRIPTION	DATE	APPROVED
5068	A	RELEASED	3/23/06	RBG





CUT VIEW OF WOOD DECK VERTICAL SUPPORT AND THREADED STUD

ITEM NO.	QTY.	PART NUMBER	DESCRIPTION
25	2	910436	BOLT,1/4-20 X 1/2,HEX,SS
24	2	910713	SCREW,4-40 X 1/4" TYPE T,PAN HD SELF TAP
23	2	910114	MACHINE SCREW,FLAT HEAD 4-40 X 3/8
22	1	891055	BRACKET,REMALE,BUS CHAIN (2 PER PACK)
21	1.65	891054	CHAIN,CABLE CARRIER,IGUS
20	10	910074	MACH SCREW FH 1/4-20 X 1.25 SS
19	35	910219	WOOD SCREW PHL #6 X 5/8
18	2	107254	WOOD DECK STRIP, MAPS
17	12	109989	STUD,THREADED, VERTICAL SUPPORT
16	.01	920081	LOCTITE THREAD LOCKING #242 31 50ML
15	12	910536	SCREW FLAT HEAD SOCKET 1/2-13 X 1-1/2
14	7	110059	PLUG,HOLE,TABLE TOP
13	20	910500	CAP SCREW SOCKET HEAD SS 8-32 X 5/8
12	8	910930	SCREW,10-32 X 3/8,PHIL,FLAT,SS
11	4	910241	SCREW FLAT HEAD 8-32 x 3/8
10	2	109969	STOP,TRAVEL,CARRIER,MAPS/MAST
9	1	109981	BRACKET,SUPPORT,WOOD TOP
8	2	109976	CROSSBRACE,WOOD DECK
7	1	109986	DECK,LOWER HALF,WOOD,MAPS
6	1	109985	DECK,UPPER HALF,WOOD,MAPS
5	12	109974	SUPPORT,VERTICAL,WOOD DECK
4	2	880300	SLIDE,LINEAR,5/8 SHAFT
3	1	109983	TOP,TURNTABLE,MAPS
2	2	880280	PIN,CLEVIS,SS,1/2"O.D. X 1" LONG
1	1	108925	COVER,ACCESS

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X.XX ± .015 / ± .5	DRAWN RBG	5/14/04
X.XXX ± .005	CHECKED	
FINISH: NONE	MATERIAL: SEE BOM	

TITLE: SUB-ASSY,TOP,TURNTABLE,MAPS

PROPRIETARY INFORMATION	SIZE	SCALE	DWG. NO.	REV.
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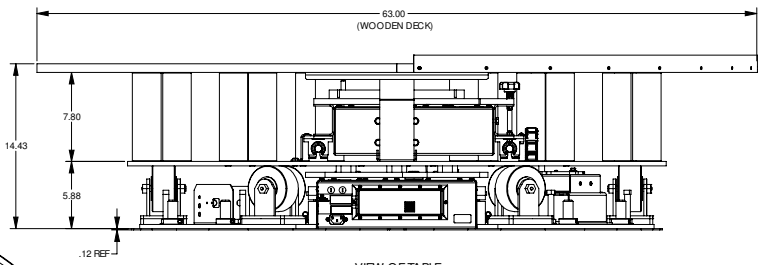
	DO NOT SCALE DRAWING		SHEET 1 OF 1	

REF DRAWING

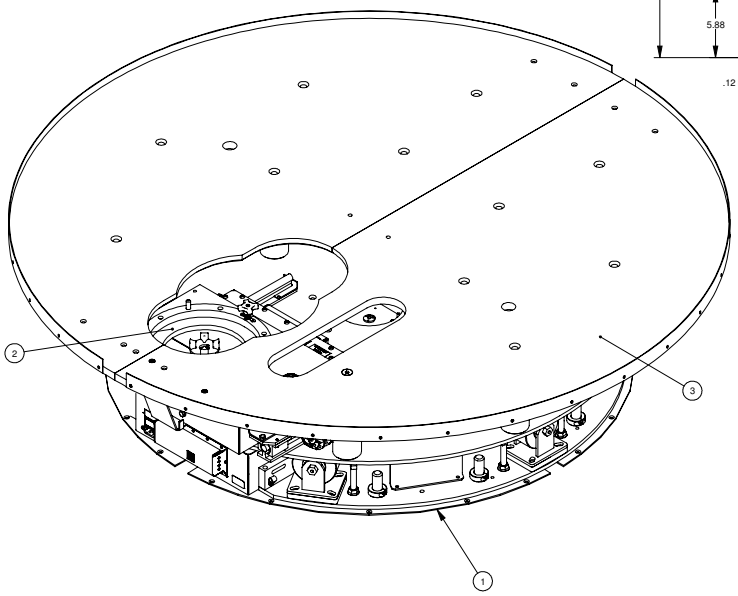
NOTES:

1. REFER TO ASSY'S, SUB-ASSY'S, AND KITS FOR OTHER NOTES AND HARDWARE NEEDED FOR FINAL ASSY AND INSTALLATION REQUIREMENTS.

REVISIONS				
ECO#	REV	DESCRIPTION	DATE	APPROVED
5122	A	RELEASED	6/28/06	RBG
5294	B	P/N 910159 WAS 910714, UPDATED HW PER VAULT HARDWARE	4/20/07	RBG
5600	C	ADDED 506179,506180,675319. P/N 910713 QTY WAS 3	12/12/08	RBG



VIEW OF TABLE
FROM MOTORBASE SIDE



ITEM NO	QTY	PART NUMBER	DESCRIPTION
22	2	910714	SCREW,6-32 X 1/4,PHIL,BIND,TAPTITE
21	13	675319	CABLE,HMZD,3X1.50mm2,16A,450/750V (N/S)
20	1	506180	FRAME,CONVEX,WHT
19	1	506179	RECEPTACLE,UNIVERSAL,FEMALE,WHT,20A,250V
18	1	891073	SLEEVING,SLIT-CONVOLUTED,PE-3/4" I.D. (N/S)
17	2	891072	CLAMP,CABLE,P-CLIP,7/8" (N/S)
16	1	110809	BRACKET,HOLD DOWN,SLIDER ASSY
15	.67	890748	SBR STRIP Mc MASTER 8510K14 (N/S)
14	7	910159	SCREW,6-32 X 3/8,PHIL,BIND,TT
13	7	890166	CLAMP,CABLE 3/8 8944 HH SMITH 7629 KEYS (N/S)
12	13	670027	CABLE,POWER,3 X 16 AWG (N/S)
11	1	109533	KIT, MAPS ABSORBER (N/S)
10	1	890817	ROTARY JOINT,SMA BULKHEAD,KEVLIN 1102SS
9	4	910246	SCREW,8-32 X 1/2,PHIL,FLAT,SS
8	5	910713	SCREW,4-40 X 1/4,PHIL,BIND,TAPTITE
7	5	910436	BOLT,1/4-20 X 1/2,HEX,SS
6	1	107561	ELECTRICAL JUNCTION BOX ASSY,MAPS TT
5	1	109968	MOUNT,ROTARY JOINT
4	1	109982	PASS THRU,CABLE,TURNTABLE,MAPS
3	1	110073	SUB-ASSY,TOP,TURNTABLE,MAPS
2	1	109987	ASSY,SLIDER,MAPS
1	1	108912	TURNTABLE,ASSY,2168-1.23

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X.XX ± .015 / ± .5	DRAWN RBG	5/14/04
X.XXX ± .005	CHECKED	
FINISH: NONE	MATERIAL: SEE BOM	

TITLE: ASSY,TURNTABLE,MAPS

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SIZE	SCALE	DWG. NO.	REV.
D	1:4	111040	C

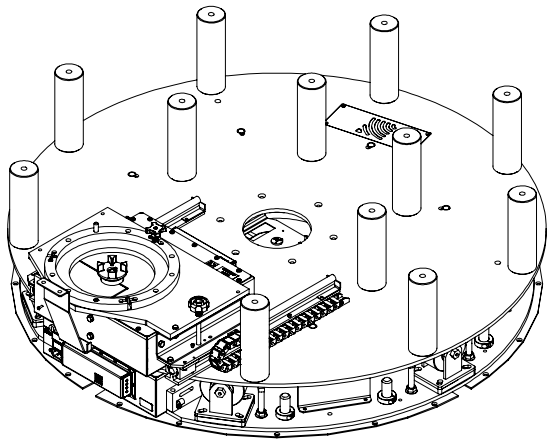
DO NOT SCALE DRAWING — SHEET 1 OF 2

REF DRAWING

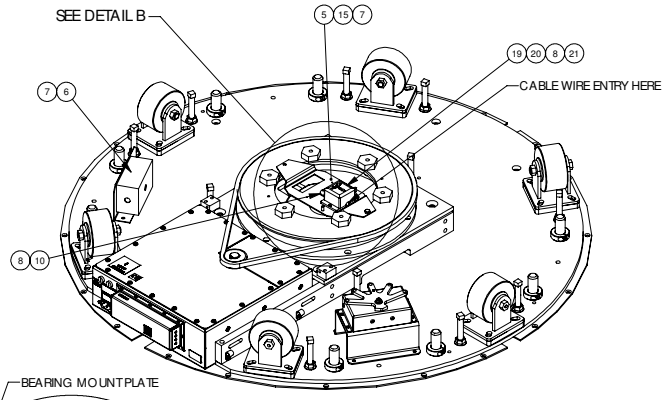
NOTES:

1. BRACKET ALONG WITH HARDWARE IS USED TO TIE SLIDER ASSY DOWN PRIOR TO CRATING AND BEFORE SHIPPING. MOVE SLIDER ASSY INTO POSITION AND APPLY 6-32 SCREWS INTO APPROPRIATE HOLES IN SLIDER ASSY. APPLY BREAK ON OPPOSITE SIDE TO ENSURE SLIDER ASSY STAYS IN FORWARD POSITION.

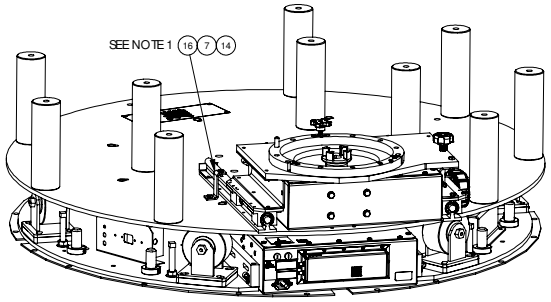
REVISIONS				
ECO#	REV	DESCRIPTION	DATE	APPROVED

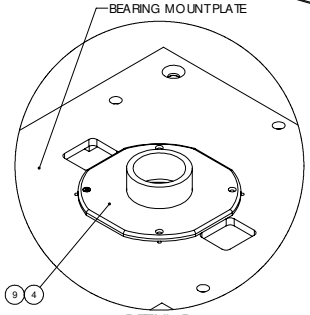


VIEW OF TABLE
W/O WOOD TOP



VIEW OF TABLE
W/O TABLE TOP





DETAIL B
SCALE 1 : 2
SOME PARTS HIDDEN FOR CLARITY

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X.XX ± .015 / ± .5	DRAWN RBG	5/14/04
X.XXX ± .005	CHECKED	
FINISH: NONE	MATERIAL: SEE BOM	

TITLE: ASSY,TURNTABLE,MAPS

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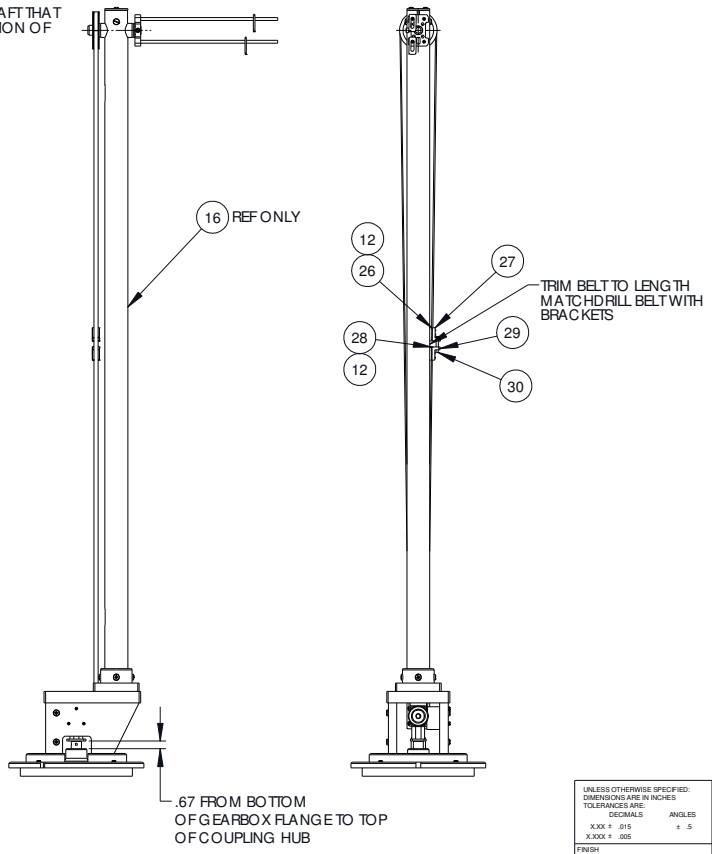
SIZE	SCALE	DWG. NO.	REV.
D	1:4	111040	C

DO NOT SCALE DRAWING — SHEET 2 OF 2

REF DRAWING

NOTES:
1. SEE SHEET 2 FOR DETAILS
2. INSTALL PULLEY ON OUTPUT SHAFT THAT TURNS IN THE OPPOSITE DIRECTION OF THE INPUT SHAFT



REVISIONS				
ECO#	REV	DESCRIPTION	DATE	APPROVED
5022	A	RELEASED	6/28/06	RBG

ITEM NO.	QTY.	PART NUMBER	DESCRIPTION
46	.10	920081	LOCTITE THREAD LOCKING #242 31 50MI
45	2	890835	RUBBER BAND,S,BLACK (NOT SHOWN)
44	2	910466	SCREW SET SOCKET HEAD SS 1/4-20 X 3/8
43	2	930420	SCREW,1/4-20 X 1/2,SH,CAP,NYLON
42	1	110336	KEY,HUB,3/16 X 1.20
41	2	910634	SKT SET SCREW SS 10-32 X .25
40	6	910738	SCREW SKTSET 3/8-16 X .75 SS
39	1	107059	NUTBLOCK TUBE BTM,MAPS.2010
38	4	910274	FLAT WASHER #8 SS..375 OD, .032 THICK
37	4	910270	NUT,8-32,HEX,SS
36	3	910740	SCREW,8-32 X 1 3/4,PHIL,PAN,SS
35	10	910228	WASHER SPLIT LOCK SS #8
34	2	910332	SCREW BINDING HEAD NYLON 10-32 X 1/2
33	2	910435	SCREW BINDING HEAD NYLON 1/4-20 X 1/2
32	4	910736	SCREW,1/4-20 X 1,PHIL,BIND,SS
31	14	910737	SCREW,1/4-20 X 1-1/4,PHIL,BIND,SS
30	2	910734	SCREW, BIND HEAD, NYLON, 10-32 X 1 1/4
29	1	107120	BRACKET STRAP 4, MAPS.2010
28	1	107119	BRACKET STRAP 3, MAPS.2010
27	1	107118	BRACKET STRAP 2,MAPS.2010
26	1	107087	BRACKET STRAP 1,MAPS.2010
25	12.5	880254	BELT 1/5P X 3/8 LL037XL GATES
24	2	107565	SLIDER,ADJUSTMENT,PHONE HOLDER
23	1	107560	PHONE HOLDER,2010 MAPS SYSTEM
22	1	107090	SHAFT BLOCK,MAPS
21	1	109720	COVER,VERTICAL SUPPORT TUBE
20	2	880256	BEARING, LHMW .75 #57785K27
19	1	107072	SHAFT SPACER,MAPS.2010
18	1	107088	SHAFT TUBE,MAPS.2010
17	1	109888	SUB-ASSY,SHAFT/ PULLEY,2010 MAPS
16	1	REF ONLY	TUBE,VERTICAL SUPPORT,....MAPS
15	1	107065	MOUNT,BTM TUBE,MAPS
14	7	910277	SCREW,8-32 X 1 1/4,PHIL,PAN,SS
13	6	910735	SCREW, MACH, PH PAHNEAD, 1/4-20 X 1.5
12	4	910741	SCREW,6-32 X 1/2,PHIL,PAN,SS
11	4	910357	SCREW,10-32 X 3/4,PHIL,PAN,SS
10	1	109973	RING,LOCKING,MOUNT,MAST ASSY
9	1	107108	GEARBLOCK,MAPS.2015
8	1	107070	PULLEY 24 T MOD, MAPS.2010
7	1	110304	TOP PLATE,GEARBOX HOUSING,MAST,2110
6	2	110302	SIDE PLATE,GEARBOX MT,MAST,2110
5	1	880302	HUB,COUPLING,.AL,7/8" BORE
4	1	110303	ADAPTER,SHAFT,GEARBOX
3	1	880271	GEARBOX,WORM,2:1 PRECISION
2	1	110305	MOUNT PLATE,GEARBOX MT,2110/ 2115
1	1	109970	MOUNT,BASE,MAST ASSY

ETS-LINDGREN™
EMC Test Systems, L.P. Cedar Park, TX
An ESCO Technologies Company
Lindgren-RF Enclosures Glendale Hts, IL

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES TOLERANCES ARE: DECIMALS ANGLES X.XX ± .015 ± .5 X.XXX ± .005	APPROVALS	DATE
	DRAWN RBG	10/10/05
	CHECKED	
FINISH: NONE	MATERIAL: SEE BOM	

TITLE: PARTS,COMMON,LIGHT DUTY MAPS ASSY

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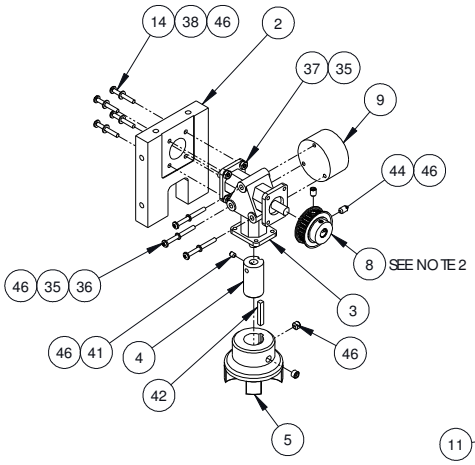
	D	1:4	111041	A
	DO NOT SCALE DRAWING		SHEET 1 OF 2	

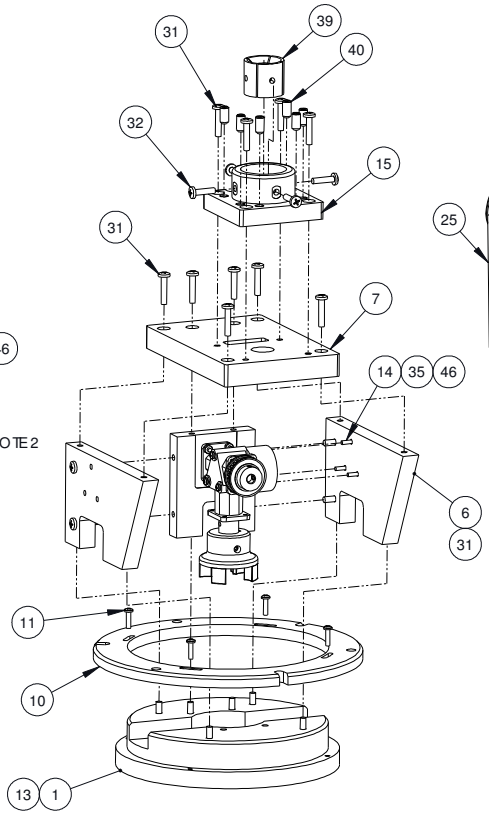
REF DRAWING

NOTES:

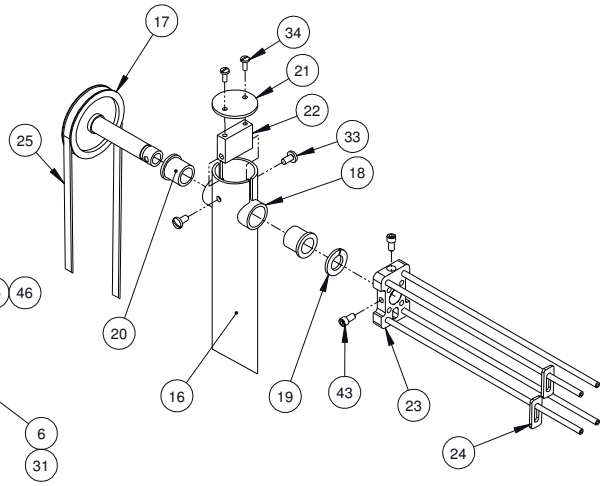
REVISIONS				
ECO#	REV	DESCRIPTION	DATE	APPROVED



GEARBOX ASSEMBLY



LOWER ASSEMBLY



UPPER ASSEMBLY

ETS-LINDGREN™
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UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES TOLERANCES ARE: DECIMALS ANGLES X.XX ± .015 ± .5 X.XXX ± .005	APPROVALS	DATE
	DRAWN RBG	10/10/05
	CHECKED	
FINISH: NONE	MATERIAL: SEE BOM	

TITLE: PARTS,COMMON,LIGHT DUTY MAPS ASSY

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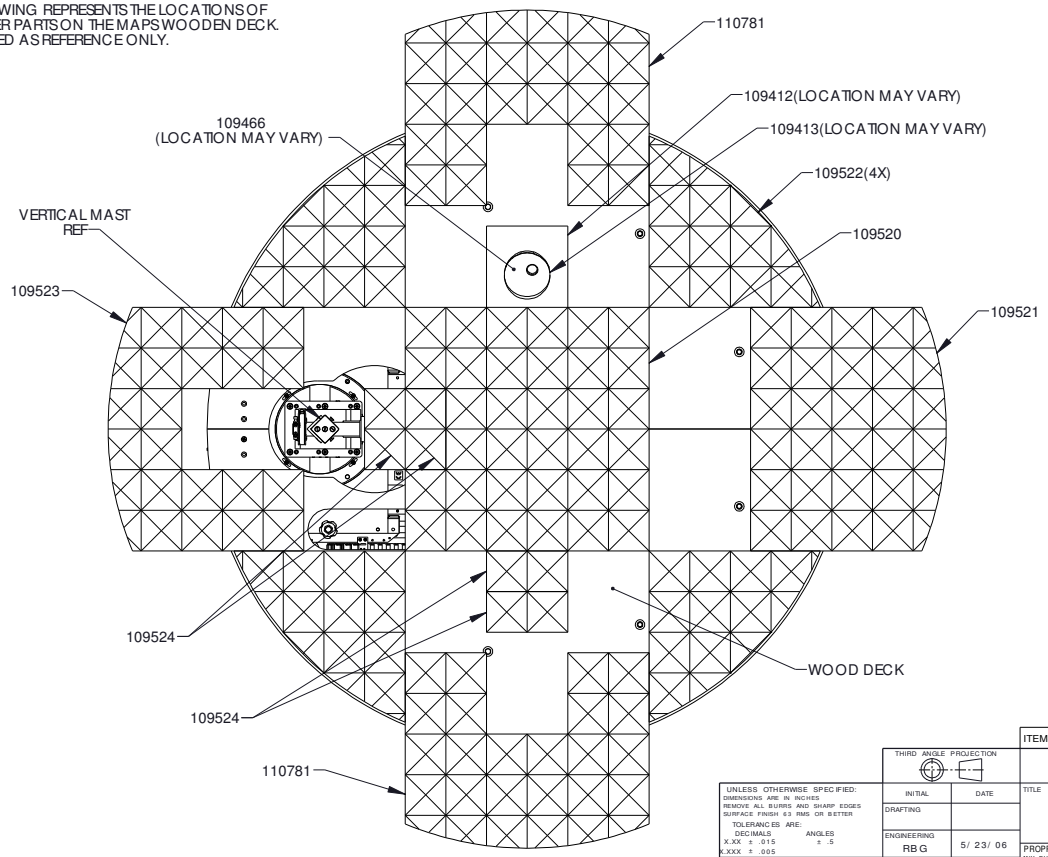
REF DRAWING

NOTES:
THIS DRAWING REPRESENTS THE LOCATIONS OF ABSORBER PARTS ON THE MAPS WOODEN DECK. TO BE USED AS REFERENCE ONLY.

REVISIONS				
ECN	REV	DESCRIPTION	DATE	APPROVED



ITEM#	QTY	PART#	DESCRIPTION

THIRD ANGLE PROJECTION

ETS•LINDGREN ™
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UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES
REMOVE ALL BURRS AND SHARP EDGES
SURFACE FINISH 63 RMS OR BETTER
TOLERANCES ARE:
DECIMALS ANGLES
X.XX ± .015 ± .5
X.XXX ± .005
FINISH

	INITIAL	DATE
DRAFTING		
ENGINEERING	RBG	5/23/06

TITLE
TOP VIEW OF WOODEN DECK
W/ ABSORBER LOCATIONS

SIZE	SCALE	DWG. NO.	REV.
D	NONE	-	-

DO NOT SCALE DRAWING

SHEET 1 OF 1