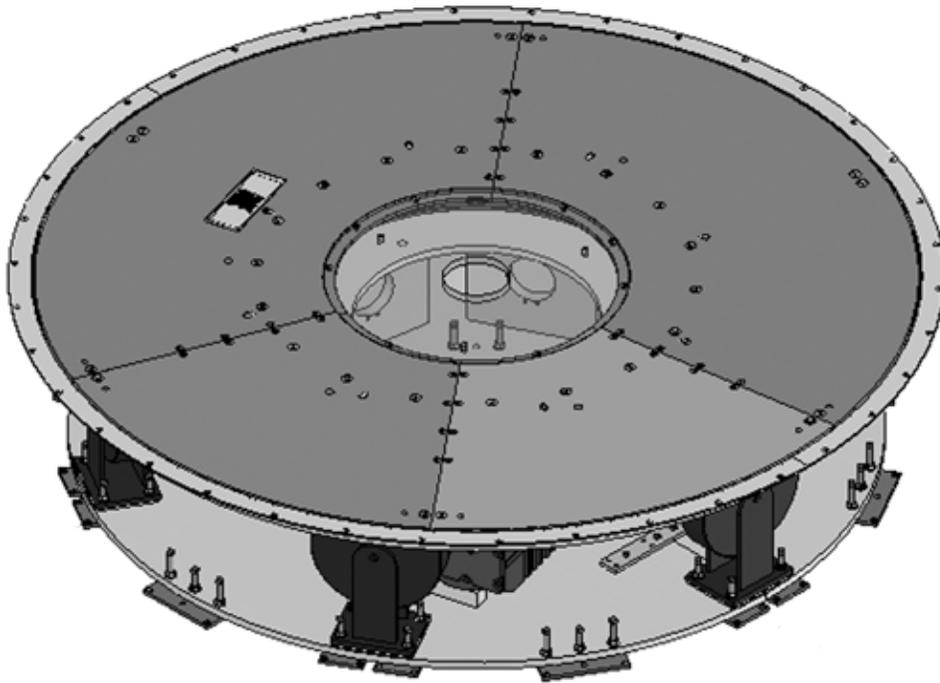


Model 2181
Electric-Powered Turntable
**2-Meter, 3-Meter,
4-Meter, 5-Meter**
User Manual



Model 2181 2.0-meter turntable

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Revision Record

MANUAL,2181 Turntable Series | Part #399289, Rev. E

Revision	Description	Date
A	Initial Release	February, 2007
B	Added 2-meter turntable; updated 3-meter turntable specifications	September, 2007
C	Updated 3-meter turntable drawing; added 4-meter turntable drawings/updated specifications	November, 2007
D	Added 5-meter turntable information and drawings; rebranding	June, 2008
E	Changed 2090 to EMCenter™	January, 2018

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Notes, Cautions, and Warnings

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



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 Model 2181 Turntable** is an electric-powered turntable platform system designed for use with the EMCenter Modular RF Platform for EMI compliance testing. The Model 2181 is designed for indoor or outdoor use, and is available in 2-meter, 3-meter, 4-meter, and 5-meter sizes.

The top of the turntable is conductive with a continuous ground brush to electrically couple it to the ground plane. The ground brushes are attached directly to the chamber floor by the floor flange, and are in continuous contact with the turntable top. The brushes point downward from the floor flange.

All models utilize a pinion and gear drive with a gear reducer and electric motor located beneath the platform. The bearing on which the turntable rotates has the drive teeth cut directly on the outside and will easily support most Equipment Under Test (EUT). Support for the turntable includes casters that aid in the support of cantilevered loads on the outside of the turntable.

The turntable top is sectional to provide easy access if service is required. On standard models, a 15-cm hole is provided in the center of the turntable to accommodate customer supplied cabling to and from the EUT.

To prevent over-travel of the turntable in either direction of movement, hard limits are provided in the form of pins that actuate switches located below the tabletop. These pins allow limits to be set and allow as much as two full rotations. Rotation speed can be varied from the front panel of the EMCenter or through the IEEE-488 interface bus.

Model 2181 Standard Configuration

TURNTABLE ASSEMBLY

Featuring continuous or non-continuous operation, the turntable assembly includes:

- 3-phase electric motor unit
- Heavy-duty variable speed drive system
- Conductive sectional top for easy service access
- Convenient rotational limit adjust switches

- Limit override feature
- Ground ring assembly with ground brush and floor flange
- 10-meter fiber optic control cables

Additionally, the turntable is infrared compatible, and can be used with an optional ETS-Lindgren Infrared Remote Controller (IR remote). For more information on using an IR remote, see *Infrared Remote Controller* on page 9.

SHIELD ROOM FEED-THROUGH

The feed-through routes the fiber optic control cable from the control room to the shield room, maintaining satisfactory shielding attenuation. The unit is made of brass for conductivity and provides attenuation of greater than 100 dB at 10 GHz. A single 22.25-mm (.875-in) hole is required for mounting.

EMCenter Modular RF Platform

The ETS-Lindgren EMCenter™ Modular RF Platform (with EMControl™ Positioner Controller Plug-In Card) may be used to control the Model 2181 Turntable. For information on connecting and using the EMCenter, see the *EMCenter Modular RF Platform User Manual*, available for download at ets-lindgren.com.

The EMCenter replaces the 2090 Controller, which has been discontinued. The basic controller configuration is an EMCenter with an EMControl card. This assembly is ETS part number 125241.

Check ets-lindgren.com or contact ETS-Lindgren to ensure that your EMCenter, the EMControl card, the backplane, and display all have the current firmware versions.

EMCenter: V5.21 (or later)
EMControl (7006-001) Card: V2.5.6 (or later)
Backplane: V2.3.0 (or later)
Display: V1.4.10 (or later)

The EMCenter is also expandable with a variety of additional options available. Please contact ETS-Lindgren with any questions.



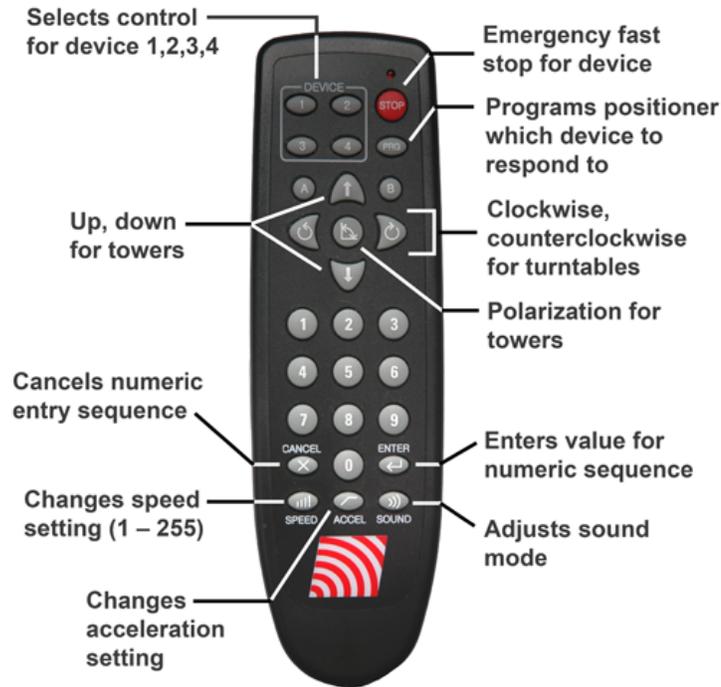
Note: If you are unfamiliar with the operation of the EMCenter, see the manual, available for download from ets-lindgren.com.

The EMCenter replaces the 2090 Controller, which has been discontinued.

The 2090 requires firmware revision V 3.21 or higher. It is available for download at ets-lindgren.com and requires the program Flash Upgrade Wizard V 4.0 (also available at ets-lindgren.com).

INFRARED REMOTE CONTROLLER

The Model 2181 is infrared compatible, and can be used with a universal remote control programmed to a specific protocol, such as the ETS-Lindgren Infrared Remote Controller (IR remote).



The IR remote communicates with an infrared receiver in the Model 2181 motor base through an IR repeater installed in the floor near the turntable. See *IR Repeater Installation* on page 25 for instructions on installing an IR repeater.

SLIP RING

Allows continuous rotation of the turntable through the latest technology in mercury slip rings, and either Schuko or NEMA connectors can be ordered with the slip ring. The current rating for the standard electrical assembly is 20 amperes. Contact ETS-Lindgren for custom requirements on slip rings.

EUT POWER OUTLETS

Receptacles are usually mounted on the base of the turntable at the center axis point. These receptacles can be custom mounted, flush with the tabletop on some turntables. Contact ETS-Lindgren for information.

MOUNTED LINE IMPEDANCE STABILIZATION NETWORK

A Line Impedance Stabilization Network (LISN) can be mounted to the underside of some turntables. This option is only practical on larger turntables with sufficient clearance.

ADDITIONAL FIBER OPTIC CABLES

Additional lengths of fiber optic cable may be ordered.

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.



Regularly inspect all equipment and conduct scheduled maintenance in accordance with the factory recommendations provided.



BEFORE SERVICING: CONTACT ETS-LINDGREN

(+1.512.531.6400)—Servicing or modifying the unit without ETS-Lindgren authorization may void your warranty. If an attempt to service the unit must be made, disconnect all electrical power prior to beginning. Voltages exist at many points within the instrument that could, if contacted, cause personal injury. Only trained service personnel should perform adjustments and/or service procedures upon this instrument. *Capacitors inside this instrument may still be charged even when the instrument is disconnected from the power source.*

Recommended Maintenance Schedule

Regular maintenance will prolong the effective operation and reliability of your turntable. Follow the recommended schedule for 6-month and 12-month service.

CAUTION

Do not perform maintenance while the turntable is operating.

6-MONTH SERVICE

Check the gearbox for fluid leakage. A collection of slight film is normal, but puddles of fluid are not normal. The gearbox is lubricated and sealed at the factory. Under normal conditions, the gearbox should not require servicing during its life.

12-MONTH SERVICE

- Lubricate the main bearing race with a grease gun containing good quality bearing grease. The grease fittings are located inside the race, 90 degrees apart, beneath the top. Three discharges from the grease gun in each fitting are adequate.
- Lubricate the gear teeth with good quality grease.

Replacement and Optional Parts

Following are the part numbers for ordering replacement or optional parts for the Model 2181 Turntable. For additional information on available replacement and optional parts, see *Model 2181 Standard Configuration* on page 7.

Part Description	Part Number
Turntable assembly	For a list of all turntable parts, see the drawings located in the back pocket of this manual.
EMCenter Modular RF Platform	125241
IR Remote Controller	707030
NEMA connectors for slip ring	103441
Schuko connectors for slip ring	103351



Note: If you are unfamiliar with the operation of the EMCenter, see the manual, available for download from ets-lindgren.com.

The EMCenter replaces the 2090 Controller, which has been discontinued.

The 2090 requires firmware revision V 3.21 or higher. It is available for download at ets-lindgren.com and requires the program Flash Upgrade Wizard V 4.0 (also available at ets-lindgren.com).

Service Procedures

For the steps to return a system or system component to ETS-Lindgren for service, see the *Product Information Bulletin* included with your shipment.

3.0 Specifications

Electrical Specifications

Drive Speeds:	Variable
Nominal AC Voltage:	200–230 VAC
Input Frequency:	50/60 Hz
Current Rating:	15 amp service
Current Draw:	< 10 amps
RPM:	0.5 – 2.0
Phase:	Single (1)

Mechanical Specifications

Diameter:	2.0 m 6.56 ft	3.0 m 9.84 ft	4.0 m 13.12 ft	5.0 m 16.40 ft
Nominal Height				
Minimum:	44.78 cm 17.63 in	44.78 cm 17.63 in	44.78 cm 17.63 in	44.78 cm 17.63 in
Maximum:	46.99 cm 18.50 in	46.99 cm 18.50 in	46.99 cm 18.50 in	46.99 cm 18.50 in
Required Pit Diameter:	202.56 cm ± 0.64 cm 79.75 in ± 0.25 in	302.6 cm ± 0.64 cm 119.12 in ± 0.25 in	402.6 cm ± 0.64 cm 158.5 in ± 0.25 in	504.83 cm ± 0.64 cm 198.75 in ± 0.25 in
Top Construction:	Sectional aluminum	Sectional aluminum	Sectional aluminum	Sectional aluminum
Distributed Load Rating:	1500 kg 3300 lb	4000 kg 8800 lb	6000 kg 13200 lb	6800 kg 15000 lb



Distributed Load Rating applies when:

- Load is evenly distributed on top;
- No point loads under 0.19 sq m (2.0 sq ft) should exceed 100 kg (220 lb);
- And not over 28.5 kg (62.8 lb) should be applied to a 45-degree segment at the table outer edge.

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4.0 Turntable Installation Considerations

WARNING

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

Pre-planning is essential for a successful installation. Discuss your requirements with your sales representative and request dimensional drawings prior to site construction.

Before You Begin—Precautions



Read this manual completely before starting installation. This equipment should be installed and operated only by qualified personnel.

Do not attempt to service unless qualified to do so. As with any electrical equipment, make sure unit electrical power has been disconnected and secured when performing scheduled maintenance or adjustments.



Do not make any modifications to this unit without consulting the factory directly.

Regularly inspect all equipment and conduct scheduled maintenance in accordance with the factory recommendations provided.

Only use replacement parts and fasteners ordered directly from the factory.



Stay clear of all moving components on this equipment.

Do not operate turntable while someone is physically on the turntable top.



Do not, at any time, place hands or feet in the vicinity of the drive pinion on the turntable.

Power and Signal Lines

CONDUIT

Power and signal line paths should be planned in advance. Conduit should be in place before pouring concrete or installing the ground plane. Consider the size of the cable bundle when selecting conduit diameter.

ELECTRICAL CONSIDERATIONS

A qualified and licensed electrical contractor should install power lines, and the installation should comply with all applicable regulatory agencies. A dedicated circuit should be used, with the shortest distance possible between the power source and the turntable.

ACCESS

An access area beneath the turntable is advisable for large diameter installations. A service switch should be installed to deactivate the turntable during service.

Outdoor Installations

DRAINAGE

A centerline drain of at least 15 cm (6 in) must be installed to provide proper drainage during rainstorms and other moisture-collecting situations.

COLD CLIMATE CONDITIONING

The oil used in the gear assemblies will congeal at 2 degrees C (28 degrees F). Turntables operated in these temperatures should include a heat source or dehumidifier, or both.

5.0 Electrical Installation

WARNING

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

CAUTION

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

Model 2181 Electrical Installation

The Model 2181 Turntable is configured to operate using 200-230 VAC, single phase, 50/60 Hz service. It is recommended to operate at this voltage level to reduce the surge currents necessary to power an electric motor.

1. The branch circuit supplying power to the motor base should be protected from excess current according to local electrical codes. An integral circuit breaker is mounted inside the main bearing on one of the bearing support blocks. The circuit breaker is specifically designed for the inductive load presented by the electric motor.
2. Make sure 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.
3. The motor base assembly is provided with a non-terminated flexible conduit with input power leads exposed. The flexible conduit is to be terminated into a junction box fitted on or near the motor base. Terminate the power leads of the motor base assembly according to local electrical code requirements. Following is the conductor color code:

Brown: AC high

Blue: AC neutral

Green/Yellow: Protective earth/safety ground

Connect the fiber optic control cable and install the power connection according to local electrical code. See the *EMCenter™ Modular RF Platform User Manual*, available for download from ets-lindgren.com, for information on connecting the fiber optic cable. After the fiber optic cable is installed, secure it with a wire tie to one of the leveling screws.

To feed the fiber optic connectors through the waveguide in a chamber, it may be necessary to remove part of the protective sheath. This removal allows the connectors to fit through the hole without excessively bending the fiber optic cable. Find and mark the spot where you will need to remove the sheath. Use a sharp knife to carefully cut around the outside of the sheath at each end of the defined area. Cut very lightly to avoid cutting into the fiber optic cables, and then bend the sheath back and forth to expose the fiber optic cables.

Next, make a cut down the length of sheath area, being careful not to cut into fiber optic cable. Inside the sheath are two pieces of white string. Find the string and use it to split the sheath open. Insert the fiber optic cable into the waveguide.

Connecting the EMCenter Modular RF Platform



Note: If you are unfamiliar with the operation of the EMCenter, see the manual, available for download from ets-lindgren.com.

The EMCenter replaces the 2090 Controller, which has been discontinued.

The 2090 requires firmware revision V 3.21 or higher. It is available for download at ets-lindgren.com and requires the program Flash Upgrade Wizard V 4.0 (also available at ets-lindgren.com).

Any combination of primary devices (towers, turntables, reverberation paddles, MAPS, and so on) can be connected to the two device interface ports located on the rear panel of the EMCenter Modular RF Platform. For easy set up of an EMC facility, it is recommended that the turntable be connected to the **Device 2** port. The default settings for the controller are for a tower connected to the **Device 1** port and a turntable connected to the **Device 2** port.

Primary device connection is accomplished with a dual fiber optic cable included with the device. This cable terminates into two ST connectors that are identical at both ends. The cable is symmetrical, so either end can be connected to the controller. A fiber optic cable connected to the IN port of a device should be connected to the primary OUT port of the motor base at the other end. Similarly, a fiber optic cable connected to the OUT port of the device should be connected to the primary IN port of the motor base at the other end. Older motor base designs have only one fiber optic connector pair, but the newer motor base interface provides a secondary interface reserved for future expansion.



Fiber optic cabling for each device should not hang unsupported from the rear panel of the controller. The fibers and connectors are easily broken if twisted or bent. Keep the fiber optic cables as straight as possible from the connector to the protective sheath.

Using the EMCenter or optional Infrared Remote Controller (IR remote), rotate the motor base shaft to verify proper operation. Run the motor base down to the lower limit counterclockwise, and then back it off from the lower limit a small amount. The previous step will help when it is time to set the rotation limits for the turntable.

CAUTION

The soft rotational limits in the EMCenter must be set. Make sure the travel limit settings will not cause damage to user installed cables and equipment mounted on the table.

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6.0 Assembly and Installation

WARNING

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



Prior to assembly and installation, see the drawings located in the back pocket of this manual.

Proper installation of the turntable directly affects performance. The installation of turntables two meters and larger will be performed by factory installation specialists or individuals authorized by ETS-Lindgren to perform such work. The following installation information is included only to provide an informational overview of the installation process.



Do not discard any packing material until the turntable is fully installed and operational.

Assembly Instructions

1. Uncrate all parts and check for shipping damage. Create a clear area to safely assemble the turntable unit. Do not discard any packing material until unit is fully assembled.
2. Remove the bolts that attach the top onto the turntable drive assembly. Make note of the placement of each top section as it is removed. See the assembly drawings in the back of this manual.

CAUTION

Only qualified personnel should use a forklift or other lifting machinery.

3. Using a forklift or other appropriate lifting machinery, place the turntable bottom or bearing support section into position. If the turntable is to be installed in a pit, center and level the assembly.

CAUTION

Make sure power is off and secured before proceeding.

4. The drawings in the back pocket of this manual show the placement of floor plates and leveling screws to anchor and level the turntable. Anchor the turntable through the attachment holes using the concrete expansion bolts provided. After installing the floor plates and leveling screws, level the entire turntable by adjusting all the leveling screws between and under the casters, and in the center section of the turntable.
5. Tighten all lock nuts accompanying the leveling screws to lock the height of the turntable into place.
6. Connect the fiber optic control cable and install the power connection according to local electrical code. The standard power configuration is 230 VAC 50/60 Hz.

CAUTION

Electrical connection is subject to local electrical codes, and should only be performed by a qualified electrician.

CAUTION

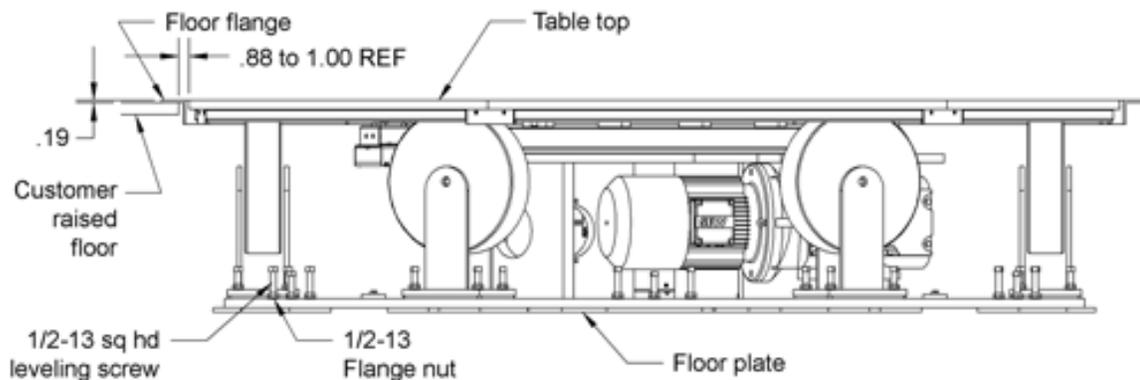
Keep all body parts away from the drive pinion when the turntable is energized.

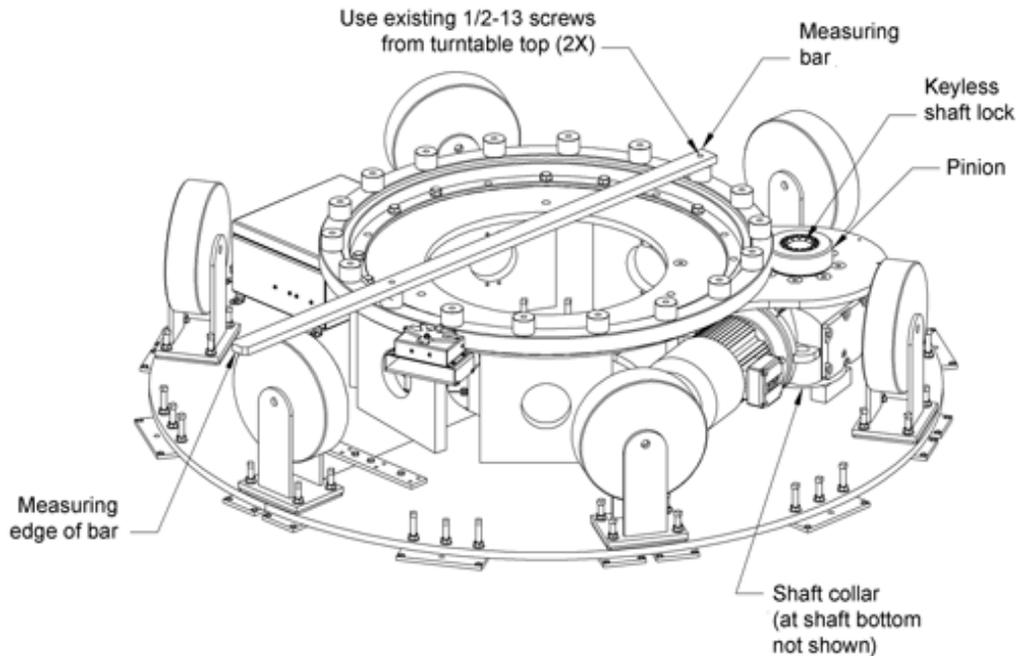
7. Follow the instructions in the next section, *Floor Flange Installation in a Paneled Floor*, to install the ground ring assembly.
8. Reinstall the top section removed in step 3 of these instructions.

Floor Flange Installation in a Paneled Floor



A 2-meter Model 2181 Turntable is depicted in the following illustrations.





When the turntable is positioned as close as possible to the center, attach the measuring bar to the brass spacers mounted onto the bearing. Appropriate hole-mount locations correspond to the size of the turntable. Rotate the bearing and make sure approximately 7/8-in to 1-in spacing exists between the edge of the outer measuring bar and the diameter of hole cut into the pit. Adjust as required.

The ground ring assembly includes a floor flange with a mounted brush ring that interfaces with the contact ring mounted beneath the turntable top. The floor flange provides constant electrical contact with the ground plane.

Mounting methods vary according to user specifications. Clearance holes are provided at evenly spaced intervals along the outside perimeter of the floor flange to attach to a customer supplied ground plane. These instructions describe installation for a paneled floor. For concrete pit mounting instructions see *Floor Flange Installation in Concrete Pit* on page 25.

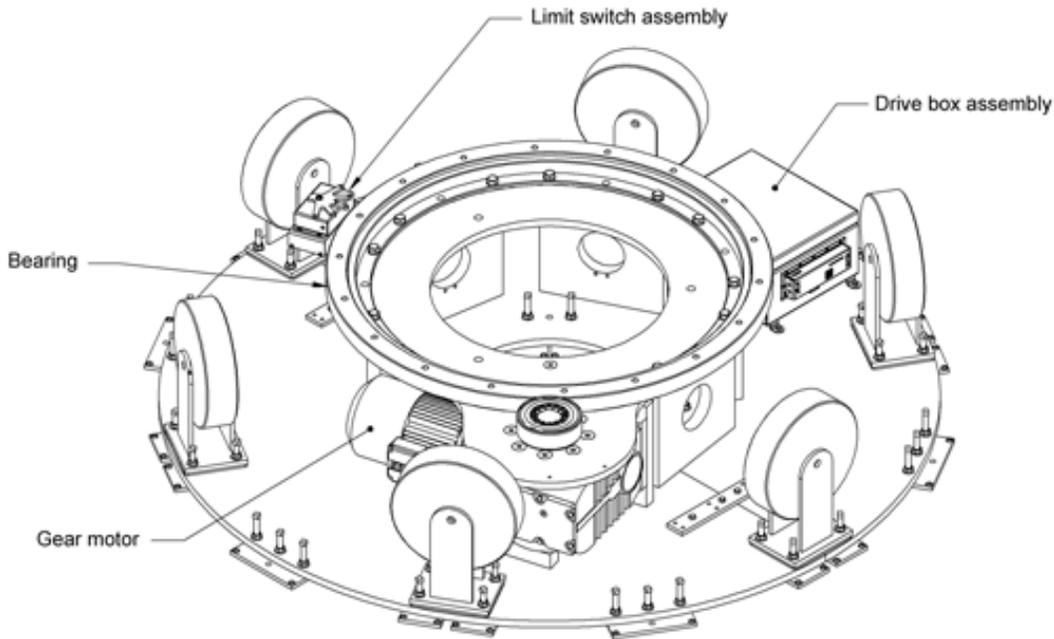
Installing the ground ring assembly requires these tools:

- 1/4-in spacers (3)
- Hand drill
- 5/32-in drill bit
- #3 Phillips drive bit
- Small square
- #14 x 1 wood/metal screws

The turntables have a quantity of floor flange pieces depending on the size of the turntable. All flanges are pre-cut at the factory for a drop-in fit.



A 2-meter Model 2181 is depicted in the following. The turntable top is shown as a partial cut-away to provide a view of internal components.



1. Lay the floor flange into the opening of the raised floor and push outward to the diameter of the opening.
2. Attach the turntable top onto the center bearing with the hardware provided.
3. Using a pipe clamp and 1/4-in Allen wrenches or 1/4-in pin, place a spacer between the turntable and floor flange starting in three places in the center or on the flange.
4. Once tension is placed on all three wrenches, drill a 5/32-in hole through the counter-sunk holes in the floor flange. Drill completely through the panel and place screws into the holes.
5. Continue working around the floor flange, completing two or three holes at a time.



Make sure that a 1/4-in gap between the turntable top and the mounted brush ring be held as close as possible so that the grounding brushes seat properly. Also, make sure the flange ends are flush with each other.

6. Continue mounting until all screws are installed. Some screws may fall between the floor panel joints. Try to position the flanges, making sure as few screws hit these points as possible, and making sure that the first or last hole in the flange is not too close to one of these joints. Trim the top floor joint strips to fit up against the flange.

Floor Flange Installation in a Concrete Pit

Installing in a concrete pit is the same as a paneled floor, with the exception of the mounting hardware. Instead of the #14 x 1-in square socket flat head screws, use 1/4 x 1-3/4-in Phillips flat head concrete anchors.

These tools are required for the next stage of installation:

- 1/2-in hammer drill
- 3/16 x 3 1/2-in hammer drill bit, at minimum
- Vacuum to clean inside the drilled holes for maximum thread engagement



When drilling holes, be aware of buried conduit and pit drainpipes. Drill 3/16-in holes, two inches minimum depth.

IR Repeater Installation

INSTALLATION ASSEMBLY COMPONENTS

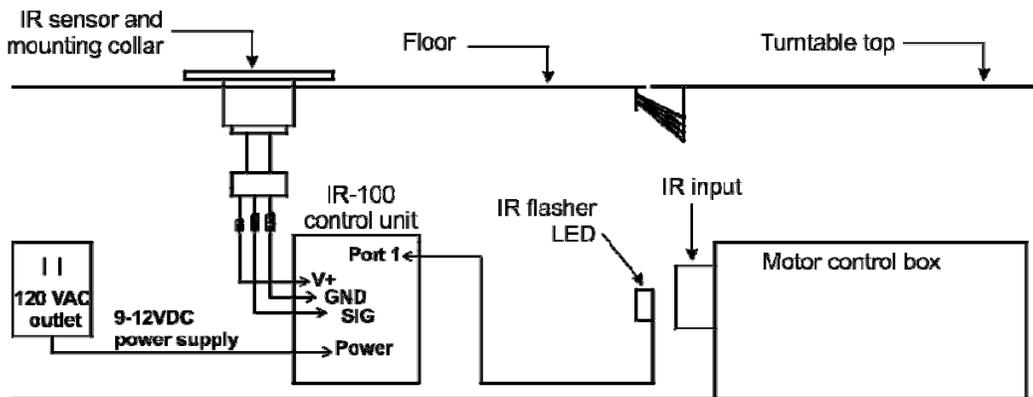
- Infrared sensor
- Mounting collar
- IR-100 control unit
- IR flasher LED
- 9-12VDC power supply
- Connection cable
- Flathead mounting screws

REQUIRED TOOLS FOR INSTALLATION

- Electric drill
- 1-in hole saw to create a
- 1/16-in drill bit

- Small flat blade screwdriver
- Phillips #2 bit driver
- Adhesive tape

INSTALLATION STEPS



1. Choose a location for the IR infrared sensor that is away from traffic.
2. Using a 1-in hole saw, cut an opening in the floor for the IR sensor.
3. Connect the **V+**, **GND**, and **SIG** wires to the IR sensor as shown in the diagram, and feed the cable through the hole.
4. Use the 1/16-in drill bit and four flathead mounting screws to mount the IR sensor collar.
5. Connect the **V+**, **GND**, and **SIG** wires from the IR sensor to the IR-100 control unit as shown in the diagram.
6. Using adhesive tape, attach the IR flasher LED directly over the IR input on the motor control box.
7. Connect the IR flasher to port 1 on the IR-100 control unit.
8. Plug the 9-12VDC power supply into the power connector on the IR-100 control unit, and then plug the power supply into a 120 VAC outlet.

7.0 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 controller, see the *EMCenter™ Modular RF Platform User Manual*. A manual is included with each positioning controller shipment and is also available for download from ets-lindgren.com.

With the assembly of the turntable complete, the EMCenter Modular RF Platform must be connected to the unit and power applied to both the motor base and controller in order to continue. See the *EMCenter Modular RF Platform User Manual* for information on connecting the fiber optic cable.

Use the EMCenter 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.

The turntable is calibrated in the factory to read out 360 degrees (plus or minus 1 degree) for one complete revolution. If the turntable is not within this range, the unit can be re-calibrated using the instructions in *Turntable Encoder Calibration* on page 30.



Note: If you are unfamiliar with the operation of the EMCenter, see the manual, available for download from ets-lindgren.com.

The EMCenter replaces the 2090 Controller, which has been discontinued.

The 2090 requires firmware revision V 3.21 or higher. It is available for download at ets-lindgren.com and requires the program Flash Upgrade Wizard V 4.0 (also available at ets-lindgren.com).

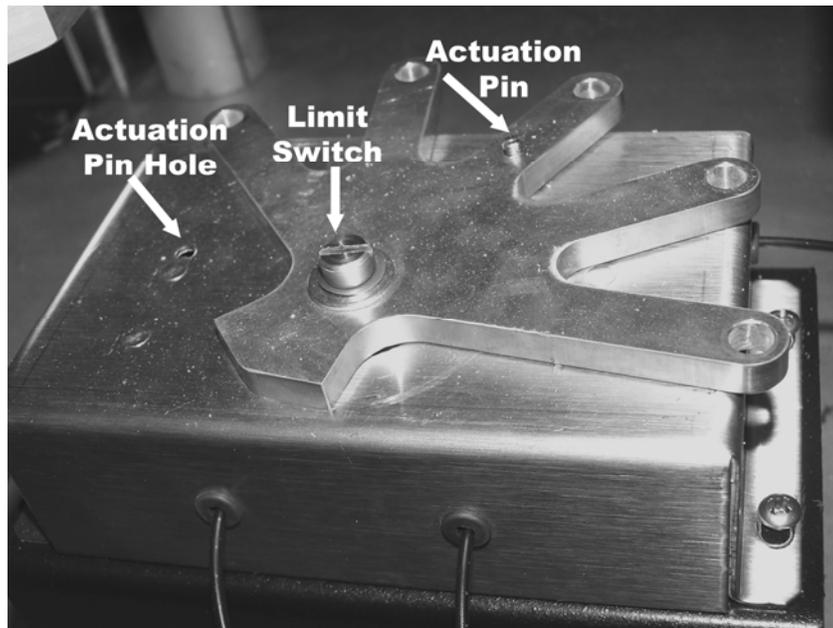
Editing Positioning Controller Configuration Parameters

Key	Function
PARAM	To edit a configuration parameter: <ul style="list-style-type: none">• Press PARAM key to display the current parameter.• Press PARAM key repeatedly to scroll through the parameter list, displaying each parameter.
STEP (INC/DEC)	To scroll up or down the parameter list while viewing a parameter. Reduces the effort necessary to scan through a long parameter list using the PARAM key.

Key	Function
LIMIT/POSITION	<p>Press any of the LIMIT/POSITION selection keys to return the display to that selection.</p> <p>Press any of the remaining motion keys to return the display to the current position and execute that motion.</p> <p>Press the PARAM key again to return to the last displayed parameter in the list, allowing easy transition between parameter adjustment and device operation.</p>
INCRM, DECRM, or ENTER	<p>Once the desired limit, position, or parameter is visible in the display window, press INCRM, DECRM, or ENTER to toggle into edit mode.</p> <p>The lowest adjustable digit will flash on and off.</p>
LOCAL	<p>Press the LOCAL key for that device to switch the flashing digit to the next higher digit. In this way, it is possible to rapidly adjust any digit of a multi-digit parameter or limit.</p>

Setting Travel Limits

The Model 2181 Turntable is fitted with mechanically actuated, or hard limit, switches. These switches are adjustable to allow for limited travel beyond zero and 360 degrees. Actuation pins are placed in the turntable top to engage the limit switch mechanism. The limit switch mechanism is designed so that the amount of travel is dictated by the pin position in the turntable top.



Turntable Limit Switch

The default configuration allows for travel between -45 degrees and +405 degrees.

1. Remove all pins around the turntable and the ETS-Lindgren logo access panel.
2. Move the turntable so that the access compartment is directly above the limit switch.
3. Set the mechanism to the CCW armed position and insert actuation pins in the holes on either side of the mechanism 45 degrees away.
4. Set the current position displayed by the controller to 000.0 degrees.
5. Test the lower limit by holding down the DEC key, which allows the turntable to travel past the soft limit. The turntable should engage the lower hard limit between -35 and -55 degrees. You can also test the upper limit by holding down the INC key until the upper limit is engaged between 395 and 415 degrees.



If non-continuous operation is desired, properly set the soft limits in the controller.

To set the CCW rotational limit for the turntable:

1. Press the DOWN/CCW key under LIMIT. The indicator above the key will illuminate.
2. Set the limit by pressing the INCRM and DECRM keys under LIMIT until the desired limit is shown on the display.
3. Press the ENTER key.

To set the CW rotational limit for the turntable:

1. Press the UP/CW key under LIMIT. The indicator above the key will illuminate.
2. Set the limit by pressing the INCRM and DECRM keys under LIMIT until the desired limit is shown on the display.
3. Press the ENTER key.

WARNING

Make sure the current travel limit settings will not cause damage to existing cables and equipment located beneath the turntable.

If continuous operation is desired, the EMCenter permits easy configuration to this type of operation from the front panel or through the IEEE-488 interface bus. For more information, see *EMCenter™ Modular RF Platform User Manual*, available for download from ets-lindgren.com. The limit pins should also be removed from the turntable top to allow for continuous operation.



Note: If you are unfamiliar with the operation of the EMCenter, see the manual, available for download from ets-lindgren.com.

The EMCenter replaces the 2090 Controller, which has been discontinued.

The 2090 requires firmware revision V 3.21 or higher. It is available for download at ets-lindgren.com and requires the program Flash Upgrade Wizard V 4.0 (also available at ets-lindgren.com).

Turntable Encoder Calibration

Parameter **C**, the encoder calibration parameter, calibrates the encoder counts to the rotation of the turntable. For the Model 2181, parameter **C** must be set to 3660. This setting is used to convert the encoder count values returned from a motor base into the corresponding centimeter or degree position reading. For turntables, this represents the number of encoder counts per revolution.

If the given value does not work correctly, the encoder calibration value can be determined using the following procedure:

1. Set the encoder calibration value to 3600.
2. Make sure the turntable is positioned to allow more than a full revolution of travel in the CW direction. Use the STEP keys to run the turntable CW a few degrees to remove any play in the turntable.
3. Using masking tape, mark the current location of the turntable against the ground ring, and set the current position reading to 000.0.
4. Using the STEP keys, rotate the turntable CW until it is again aligned with the mark on the ground ring. For best results, the last motion should always be in the CW direction to account for any play in the gearing between the motor and encoder.
5. Record the reading of the display, ignoring the decimal point. For example, **360.0** would be **3600**. This is the encoder calibration value.



If the value is below 3600, the resolution of the encoder is low and the controller will not provide 0.1-degree resolution, even though the display shows that digit. If the value is past 9999, the encoder has too many counts per meter and the controller cannot correct for it. In this case, contact ETS-Lindgren for assistance.

6. Enter the encoder calibration value and reset the limits and position information.
7. Test the turntable by moving it a complete revolution and comparing the alignment marks. It may be necessary to adjust the encoder calibration value up or down slightly depending on the result.



When scanning between limits, it is not uncommon to have a small discrepancy between the absolute position of the table and the display on the controller. This is because reversing the direction of rotation reverses any gear play between the encoder and the table top, allowing that play to be visible in the positioning accuracy.

TURNTABLE CALIBRATION EXAMPLE

- The turntable is set at the 0 degree position. A piece of tape is placed on the edge of the turntable to line up with the edge of the gearbox cover. The turntable is stopped when the tape travels exactly 360 degrees around. The display on the controller now reads 356.3 degrees, which is recorded.
- The table is rotated CCW back to zero. The parameter button is set on the **C** setting. The **C** digits display 3430. A new **C** setting is now calculated:

$$\text{New } \mathbf{C} = (356.3 / 360) \times 3430 = 3395 \text{ (rounded)}$$

- Decrement the **C** parameter to 3395 and press ENTER. Press the current position button to get back to operation mode.
- The table is rotated from 0 to 360 and the mark is now within one degree of being one full turntable revolution. Calibration is complete.

Changing Rotation Speed

The Model 2181 is equipped with a variable speed drive. Firmware revision 3.11 or higher must be installed in the EMCenter for proper operation of the Model 2181. The revision level is displayed on the front panel display during startup of the EMCenter. If the controller does not have this revision or a later revision installed, contact ETS-Lindgren for an upgrade.



Note: If you are unfamiliar with the operation of the EMCenter, see the manual, available for download from ets-lindgren.com.

The EMCenter replaces the 2090 Controller, which has been discontinued.

The 2090 requires firmware revision V 3.21 or higher. It is available for download at ets-lindgren.com and requires the program Flash Upgrade Wizard V 4.0 (also available at ets-lindgren.com).

To select one of the four speeds, use the POLAR/SPEED button to toggle through the speed options. It is necessary to set the controller parameters to configure the controller to properly control the motor base. See the *EMCenter™ Modular RF Platform User Manual*, available for download from ets-lindgren.com, for information on setting the parameters.

Variable Speed Settings

The EMCenter parameters S1-S8 control the variable speed settings for the turntable. These parameters are the continuous variable speed settings for each of the four speed selections described in the next section, *Speed Selection*. Each of these parameters can be set to any value from 1 to 255, with the resulting turntable speed being roughly an S/255 fraction of the maximum speed. For any variable speed drive, there is a minimum speed at which the motor will operate. For the Model 2181 this minimum speed setting is between 30 and 75, and should correspond to a value of 0.5 RPM or less. Below this setting, the motor will not be able to cause rotation, but will be active until a **Motor Not Moving** error (E002) occurs.

WARNING

Do not operate the turntable in a stalled condition. Doing so may cause damage to the drive unit and will void your warranty. Always make sure that the minimum speed setting specified in the S1-S8 parameters is above the minimum value at which your turntable will rotate under normal load.

Speed Selection

For the variable speed turntable, the Polarization/Flotation button provides the ability to cycle between eight preset speeds. For each press of the button, the turntable will change to the next speed setting. The polarization LEDs will light to indicate the speed selection as shown in the following:

Speed 1: Both off

Speed 2: Top on, bottom off

Speed 3: Top off, bottom on

Speed 4: Both on

Speed 5: Both off

Speed 6: Top on, bottom off

Speed 7: Top off, bottom on

Speed 8: Both on

Each speed setting has an individual overshoot compensation value to provide overshoot correction.

GPIB Commands

The following GPIB commands have been added or modified:

Sn: Select speed

- $n = 1-4$ for a variable speed turntable

S?: Query speed selection

- Returns 1-4 for a variable speed turntable

SSn: Set speed value

- $n = 1-4$
- Command is valid only for a variable speed turntable
- Valid speed values are 1-255
- Command Usage: $SSn <Speed>$
- Example: Output 708, SS1 196

SSn?: Query speed value

- $n = 1-4$
- Command is valid only for a variable speed turntable
- Returns a speed value 1-255
- Command Usage: *SSn?*
- Example: Output 708, SS2?

Appendix A: Warranty



See the *Product Information Bulletin* included with your shipment for the complete ETS-Lindgren warranty for your ETS-Lindgren Model 2181 Turntable.

DURATION OF WARRANTIES FOR MODEL 2181

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

Product Warranted	Duration of Warranty Period
ETS-Lindgren Model 2181 Turntable	2 Years

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Appendix B: EC Declaration of Conformity

The EC Declaration of Conformity is the method by which ETS-Lindgren, L.P. declares that the equipment listed on this document complies with the EMC Directive (EEC/89/336) and Low Voltage Directive (EEC/73/23), including applicable amending directives.

Factory

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

Issued by

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1301 Arrow Point Drive
Cedar Park, TX, USA 78613

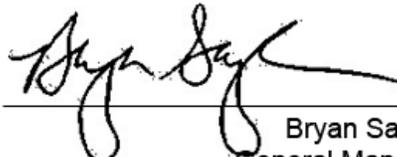
The products listed below are eligible to bear the CE mark:

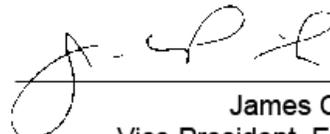
- Model 2181 Electric-Powered Turntable with 2088 style motor base

APPLICABLE REQUIREMENTS

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

AUTHORIZED SIGNATORIES


Bryan Saylor,
General Manager


James C. Psencik,
Vice President, Engineering

The authorizing signatures on the EC Declaration of Conformity document authorize 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 10 years.