LX700 - Modular Signal Processing System

Six years in planning and development, the LX700™ is the direct result of customer feedback for numerous features, capabilities, and performance requests. Designed to enable high flexibility and expandability, the LX700 provides a highly cost effective solution to a wide variety of applications.

Today, everyone wants more for less. Consumers want less costly products that deliver greater functionality. Likewise, instrumentation products must offer greater value and capabilities for today's demanding markets.

The LX700 system was designed to be highly generalized to cover many measurement application market segments including both lab R&D and production QC/QA testing. The software includes a Macro programming script capability to enable users to create custom automated test programs for production line testing.

The module family will be expanded over time and will include: analog, digital, and mixed mode measurements, analog/digital automation control, signal multiplexers, spectrum analyzers, signal generators, impedance analyzers, amplifiers, various metering, and DSP development tools. Numerous measurements can be performed including spectral analysis, distortion analysis, arbitrary waveform and signal generation, and much more.

Modular Flexibility

The modular architecture of the LX700 system enables the user to configure a measurement system with capabilities that exactly meet their needs, for a vast array of different kinds of applications. Moreover, the system can be easily expanded, changed, or reconfigured in the future at substantially reduced cost over stand alone instruments.

To conserve materials, labor, and overall cost, a highly efficient high density module design was created with maximum space and materials utilization. Each module is formed from a single PC board and a single metal front panel. The PC board employs a card edge connector pattern at the rear, and the front panel contains dual custom captive screw fasteners to secure the module. The module bays are individually shielded and contain card guides for self alignment and easy module insertion.

Features & Capabilities

- Modular System
- User Configurable
- User Expandable
- High Density Design
- Cost Effective Design
- Multiple Mainframe Support
- 7 Module Bays per Mainframe
- High Speed 32bit Internal Bus
- Ethernet Computer Interface
- USB Computer Interface
- GPIB/IEEE-488 Interface
- Large Scale Array Measurement
- Windows® Application Software
- Application Specific Features
- Worldwide Operation 85-265VAC
- Portable Operation 24VDC
- 2 Rack Space Chassis
- Lightweight 12lb Chassis
- Efficient Design & Construction

LinearX Systems Inc • 9500 SW Tualatin-Sherwood Rd. • Tualatin, OR 97062-8586 USA • TEL: (503) 612-9565 • FAX: (503) 612-9344

www.linearx.com • sales@linearx.com

USB Interface

USB is one of the two standard interface methods for controlling LX700 mainframes through the system software. USB is very common and highly useful as a short range desktop/benchtop bus. USB offers four different modes of data transfer. The LX700 system software employs only Control or Bulk transfer modes. These modes have full error checking and retransmission assuring reliable data.

Ethernet Interface

The Ethernet interface is the other standard means of controlling LX700 mainframes through the system software. Ethernet provides a very flexible and capable interface that allows for large distance between mainframes and the computer.

Each LX700 mainframe also contains a mini web server that can be accessed from any web browser application over the LAN. This is useful for verifying connections and status.

GPIB Interface

GPIB (HPIB or IEEE-488) is a short to medium range digital communications bus that has been in use for nearly 50 years. Originally created for use with automated test equipment, the standard is still in wide use today. This is due to the fact that it remains one of the very few methods of controlling, interfacing, and integrating various different types and brands of instrumentation in a uniform and generic fashion.

The GPIB interface is not a primary full function interface used by the LX700 system software. It is intended for use by 3rd party oe custom software created by the user.

The LX700 mainframe does not contain the GPIB Interface as a standard feature. It is provided as an optional interface which can be easily installed by the user. This is a special module installed in the left corner position of the chassis which plugs in directly to the system controller board.

Interface Capabilities

All of the three interface methods Ethernet, USB, and GPIB support multiple mainframes. However each interface differs in the number of mainframes it can support, and the distances which can be covered. The LX700 system software application operated from a single PC can address all of the mainframes and their modules using either the Ethernet or USB interface. The GPIB interface is not a primary interface used by the LX700 software, but intended to be controlled by a 3rd party or custom application.

• **Ethernet** is by far the most capable interface allowing up to 250 mainframes and spanning distances of 100 Meters. This interface is ideal for industrial use where the mainframes may be located in a production, warehouse, testing, manufacturing, or remote location, but yet can be controlled from any office workstation anywhere on a LAN (Local Area Network) separated by substantial distance.

• **USB** is a short range bus, typically 6 Meters, and is appropriate for desktop or benchtop use where the distance to the computer is relatively short. Up to 125 mainframes can be supported.

• **GPIB** is a medium range bus, typically 20 Meters, and up to 15 mainframes can be supported. However by using multiple GPIB interface cards in the computer more mainframes could be supported. Whether or not this is possible or practical is entirely a function of the software capabilities of the application used.

ETHERNET - 250 MAINFRAMES - 100 METERS   USB - 125 MAINFRAMES - 6 METERS   GPIB - 15 MAINFRAMES - 20 METERS
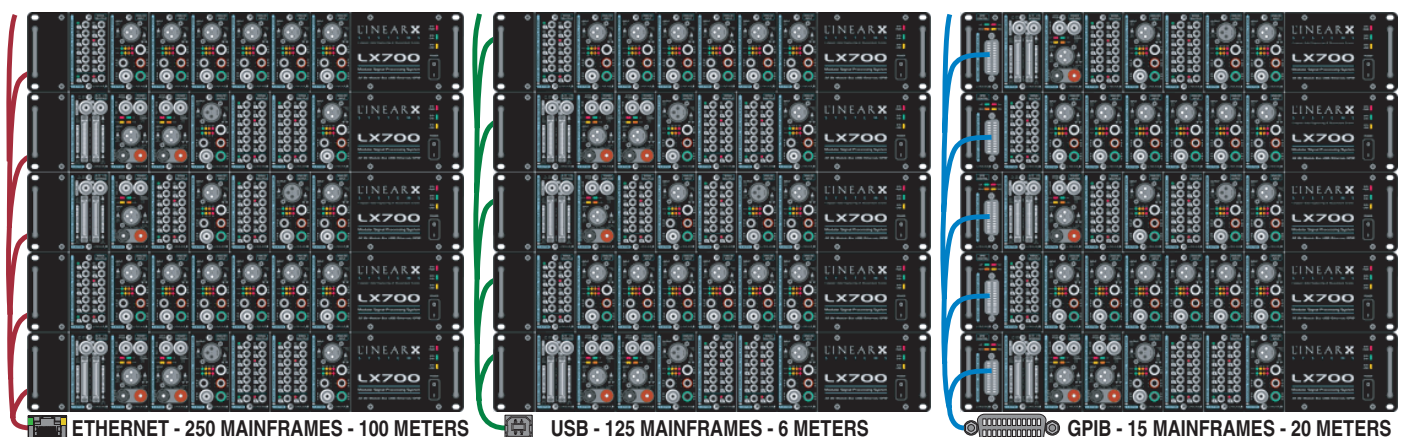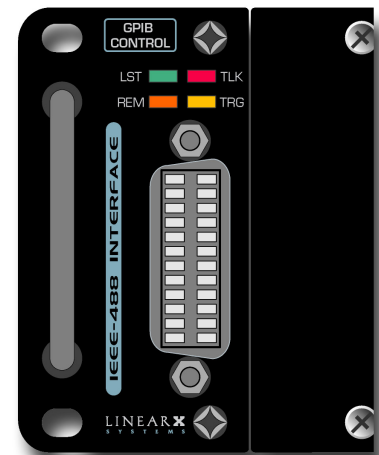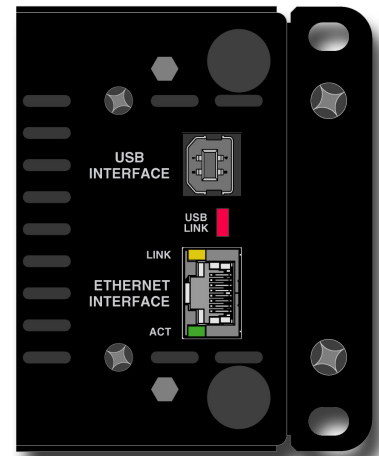
Large Scale Array Synchronous Sampling

Many applications require a large number of measurements to be performed synchronously. Since all of the LX700 data processing modules contain their own sample memory, data can be transferred back to the computer asynchronously for any number of modules. However, all of the modules involved in a synchronous measurement must be triggered at exactly the same time. All of the modules within a single mainframe can be triggered synchronously using any of the three interface methods. However, if more than a single mainframe is required, then triggering all of the modules involved across multiple mainframes demands special consideration.

• **Ethernet** provides extensive ability to perform simultaneous triggering across multiple mainframes. The LX700 software uses the *Multicast* protocol to trigger all mainframes at the same instant. Timing precision between the mainframe triggers is very precise, with typical variations less than 100nSec.

• **GPIB** also provides the means to perform simultaneous triggering across multiple mainframes. This is provided by the *GET (Group Execute Trigger)* command. Timing precision between the mainframe triggers is therefore very precise, with variations less than 100nSec.

• **USB** inherently lacks the ability to address multiple devices simultaneously. In this case, each mainframe will receive the trigger command at different times. The exact amount of latency between commands is unknown and impossible to predict or control. Values range from 1-100 mSec. The USB interface is not a good choice if precision sampling across multiple mainframes is required.

System Controller

The system controller facilitates data flow through four major pipelines: Ethernet, USB, GPIB, and the LXBUS module backplane. It also handles a large variety of supervisory functions within the mainframe. These include voltage, temperature, and fan monitoring in additional to audio, LED, and fan drive. The system board can be upgraded by the user.
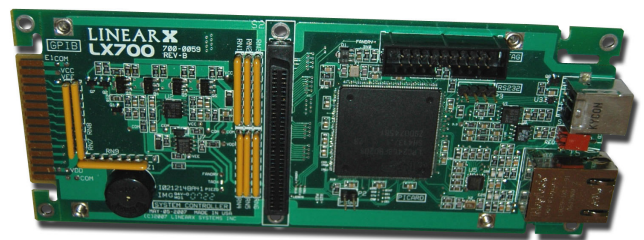
The first generation controller provides Ethernet-100/10 and USB-FullSpeed(12MHz) PC connections, using an ARM7 32 bit embedded microprocessor. The second generation controller will enable a 10 fold increase in link performance providing Ethernet-1000/100 and USB-HiSpeed(480MHz), using an ARM9 32 bit embedded microprocessor. To handle all of the various tasks required with high performance, a multi-tasking preemptive real time operating system is used within the firmware. The system controller also includes a mini web server which enables access to the mainframe parameters by any web browser.

LXBUS Backplane

The LXBUS backplane was designed from the ground up to be highly cost effective and provide direct operation with modern bus protocols which stream data. Data transfer speeds beyond 50M Bytes/Second are readily capable. The high speed LXBUS supports a 32 bit parallel word size for multiplexed data and address, with burst and auto addressing capability. Each module plugs into a robust low cost standard 50 pin 2.54mm edge card connector.

LX BUS

CHASSIS	2	GND
COMMON	2	COM
+18VDC		VCC
-18VDC		VEE
+3V3DC	2	VDD
SLOT POS 0		SP0
SLOT POS 1		SP1
SLOT POS 2		SP2
INT RQST 0		IRQ0
INT RQST 1		IRQ1
BUS MAS RQT		BRQT
BUS MAS ACK		BACK
SEL ADR/DATA		SAD
STROBE WR		STW
STROBE RD		STR
ADDR/DATA	32	AD

The LXBUS provides three main power supply voltages for analog and digital circuitry. Many modules also include local DC/DC converters which provide additional voltage supplies and/or isolation. The LXBUS features bus mastering allowing any module to take control of the backplane, as well as two IRQ lines for interrupt capability and high performance triggering.
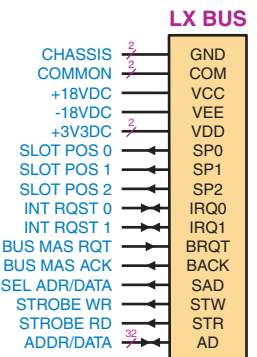
Powered by Universal AC or Portable DC Power

The LX700 can be powered from worldwide universal AC voltage from 85-265VAC. It can also be powered for portable applications by 24VDC.

The power supply module employs very high frequency converters to move any switching noise above the critical 200kHz bandwidth. Dual shielding of the EMI filter and converter circuitry is included.

The power supply features high performance Power Factor Correction, utilizing a multi-phase flyback topology, yielding high power factor from 0.900 to 0.995 across the entire load range.

Additional filtering is employed on the secondary convertors to reduce switching noise on the DC outputs. Overvoltage protection is included on all supplies. Three LED indicators are provided for: System Power, System Check, and System Link. The power supply module can be replaced by the user directly through the front panel for easy servicing.
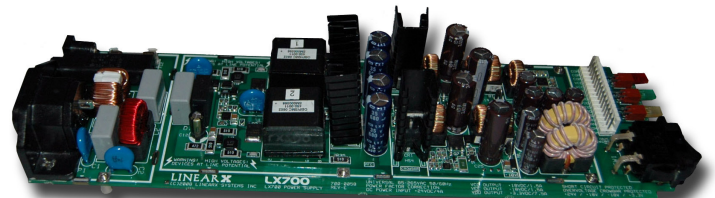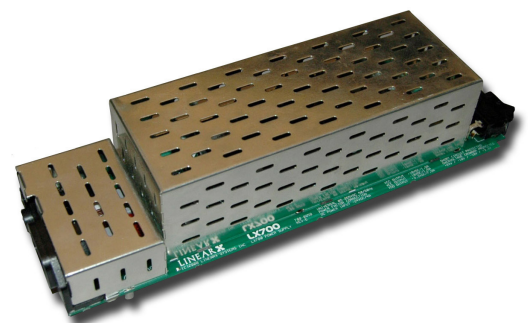
Software

The LX700 system software is provided as a Windows® 32 bit application. It is likely that future versions may also include a Windows® 64 bit version, and possibly a Linux version if demand develops. Not only does it include all of the necessary features and capabilities to control the LX700 mainframes and modules, but it also includes a substantial complement of data processing, post processing, specialized utilities, and extensive 2D & 3D graphics capabilities.

The software provides a large array of powerful computer based features ideal for both R&D and production QC/QA testing requirements:

• LX7 Data File Format with standard waveform import/export
• Curve library for multiple curve operations, display, and printing
• Multicurve Copy/Paste through Clipboard for transfer
• Linear/Log Frequency/Resolution Translation
• Linear, Quadratic, and Cubic data Interpolation routines
• Transducer definition setup support
• Macro Script Programming for automated testing
• Macro Editor with syntax highlighting
• Curve Capture, distill actual numeric curve data from raster images
• Curve Editor, create/modify curves by graphical editing
• Enhanced capabilities for Post Processing Math operations
• Enhanced capabilities for Polar Plot processing and resolution
• Extensive Vector and Raster Graphics Export
• Specialized application utilities, such as loudspeaker parameter derivation
• 2D & 3D curve and waveform graphics display and printing
• Data Import & Export routines
• Graphics export including raster and vector image formats
• Operating Systems: Win2000, WinXP. Vista-32.

LX7 Data File Format

The LX7 data file format was created for the LX700 software, and is the native data file format. The file structure approach chosen for LX7 was inspired by the TIFF - Tagged Image File Format, one of the most well known and successful raster image graphics file formats.

The LX7 file format is a multi waveform format, since each file may contain any number of channels or measurements as defined by the internal tags. The file consists of a variety of known tag structures, and each tag points to the next tag as a chain. The structure can contain both text and numeric array information efficiently, as well as uncompressed or compressed data.

Graphics Processing

The rich graphical user interface provides a host of features which greatly enhance the ease of operation and power of the system. All graphics are designed on a generalized artboard layout, rather than screen specific fashion. The screen display is identical to the printed output. The user has full control over many of the design elements of the artwork including fonts, colors, and line styles. Custom graph documentation is also provided for project name, person, and company. Note and comment areas are also included in the graph layouts. Full high resolution color printing is supported through any standard Windows® printer driver.

Numerical Processing

All digital signal processing algorithms such as FFTs are performed in the LX700 software using 80x87 floating point algorithms. Both single precision (32 bit) and double precision (64 bit) foating point algorithms are utilized. All of the intensive numeric functions are hand coded in 80x87 assembler for high performance. Extensive profiling was also conducted on the algorithms using the Intel VTune® Analyzer to further optimze and tune algorithm performance for maximum speed with hyperthreaded processors.

Macro Scripting

For production testing applications the LX700 software can be controlled by user written Macro script programs. The Macro programming language allows for messages to be written to the screen to prompt operators, control test sweeps, run utilities, control printing of graphs, export data, and conduct Pass/Fail tests. A custom macro editor is also provided featuring syntax highlighting and color printing.

Post Processing

The software also provides post processing mathematical functions, data processing functions, and other specialized curve processing capabilities which can be applied to measured data or imported data. Smoothing, scaling, splicing, and other dsp operations give the user complete control over the measured data without the need for using external data processing programs. The post processing features in the software enhance the user's ability to derive maximum use of the measured data.

Utility Tools

LX700 provides a rich set of utilities for manipulating data and graphics. Numerical data can be imported and exported from the program as simple ASCII text files. The graphic artwork can be exported as either vector or raster image files in many different formats including: PDF, AI, EPS, WMF, EMF, BMP, TIF, PNG.

A powerful *Curve Capture* utility can distill numerical curve data from raster images. These can be pictures from books, manuals, or scanned images of plotter output. The *Curve Editor* utility allows you to graphically create your own curves, or edit the data of any curve in the library. Specialized computational and control utilities are also provided. Examples include: advanced derivation of loudspeaker parameters, polar plot data processing and conversion, and *LT360 Turntable* control.

Mechanical Specifications

The LX700 chassis includes rack mount ears and front handles as standard features for instant rack mount capability. Rubber feet are also provided for bench top or table top surface use. The rear feet and fan bracket enable the chassis to be easily transported or stand vertically without damage. Forced air cooling is provided for the power supply and all modules. Airflow entry and exit is via the rear panel, including an easy to clean external foam air filter.
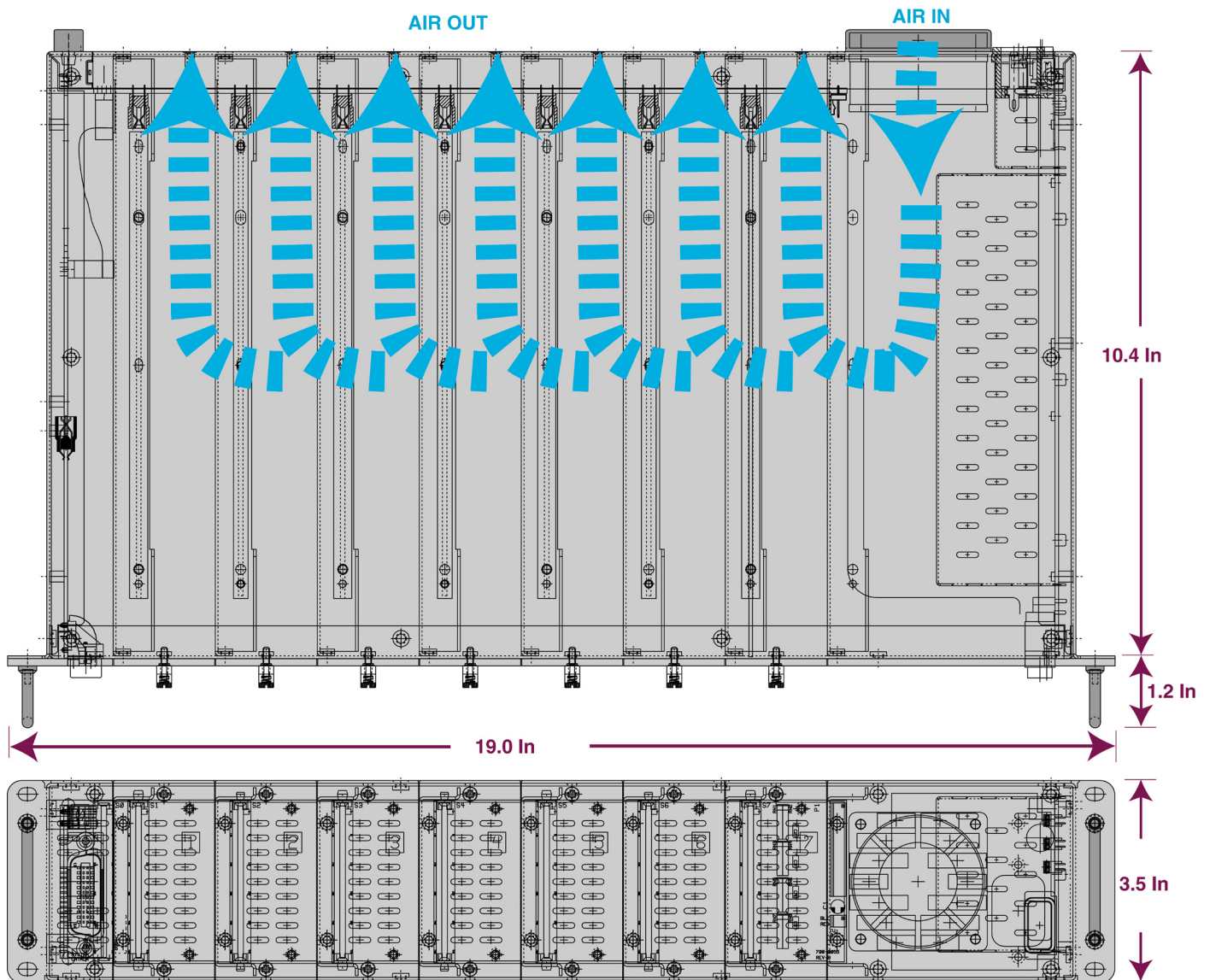
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Connectors
- Module Capacity   7 Module Slots
- Module Bus Connector   50 pin 2.54mm Card Edge
- AC Power Connector   IEC 3-Pin International Power
- DC Power Connector   2.5/5.5mm Power Jack, Center Pin Positive

System
- Controller (1stGen, ARM7/72MHz)   Ethernet-100/10, USB-12, GPIB/IEEE-488HS
- Controller (2ndGen, ARM9/600MHz)   Ethernet-1000/100, USB-480/12, GPIB/IEEE-488HS
- Forced Air Cooling   12V Fan, CPU Cntrl/Mon, Airflow Rear Entry/Exit
- Internal Voltage Monitor   DC Supplies & Fan Drive
- Internal Fan RPM Monitor   Low Noise Tachometer
- Internal Temperature Monitor   Yes

Power
- AC Line Voltage   85-265VAC / 50-60Hz / 1A max
- DC Supply Voltage   +24VDC / ±20% / 4A max
- Power Consumption   100 Watts Max
- AC Power Factor Correction Topology   Multiphase Flyback
- AC/DC & DC/DC Converter Frequency   300kHz
- AC Power Factor Full Load   0.995
- AC Power Factor No Load   0.900
- AC Inrush Current   0 Amps
- LXBUS VDD Supply   +3.3VDC / 7.5A
- LXBUS VCC Supply   +18.0VDC / 1.5A
- LXBUS VEE Supply   -18.0VDC / 1.5A
- Overvoltage Protection   +24V, +18V, -18V, +3.3V
- Short Circuit Protection   +18V, -18V, +3.3V

Physical
- Module Face Plate   3.5 x 1.75 x 0.125 Black Anodized Alum
- Chassis Height   3.50 Inches (8.9cm) 2-Rack Space
- Chassis Width   19.0 Inches (48.3cm)
- Chassis Depth   10.5 Inches (26.7cm)
- Chassis Weight Empty   12 lbs (5.45kg)
- Chassis Weight Loaded   15 lbs (6.80kg) Typical

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a list of International Dealers.