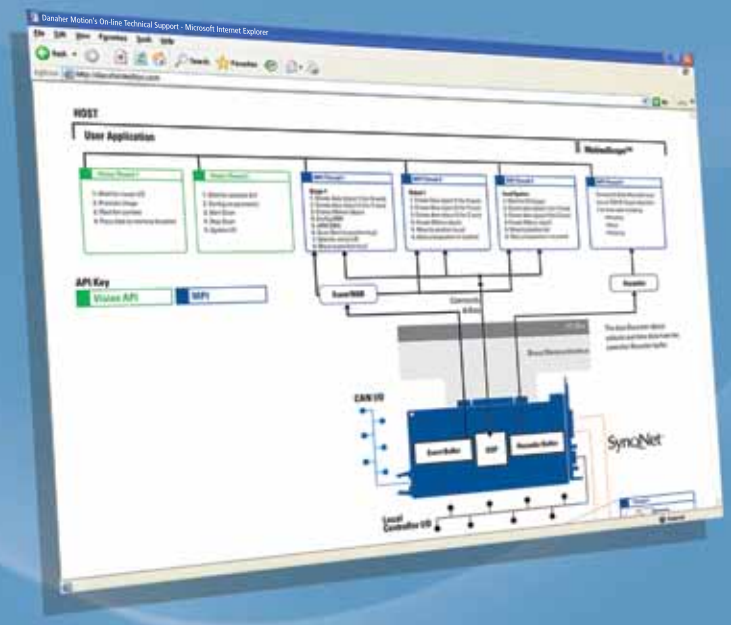


MPI 4.0

Motion Programming Interface

DANAHER MOTION

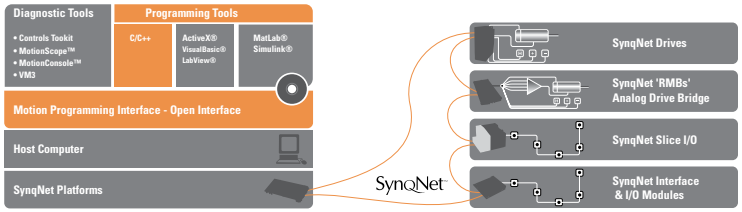
*Helping you build a better machine, **faster**.*

Key Features

- Integrated, object-oriented C library for controls, drive/motors and I/O
- Lowest latency command-to-motion execution, perfect for integration of real-time motion with vision or high-speed I/O
- High-reliability, deterministic network master with node self-enumeration, redundant fault tolerance and event management
- Complete, real-time data access to networked controls, drives and I/O
- Software field connectivity into all system components for upgrade and debugging
- Support for Windows XP/Vista , XPe, Linux and Real-time Operating Systems (VxWorks, RTX, InTime)

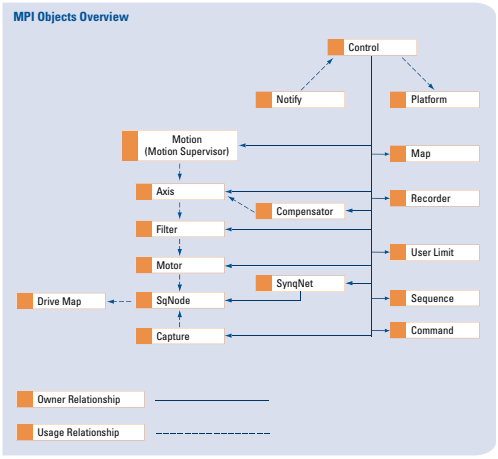
The Motion Programming Interface ("MPI") version 4.0 is an integrated object-oriented C/C++ API for Danaher Motion controls, drives, motors and I/O. System Engineers choose the Motion Programming Interface ("MPI") to achieve performance applications with demanding multi-axis motion move times, profiles, control kinematics, vision integration or I/O interaction. The MPI achieves performance via a direct memory-mapped, low-latency interface to the host processor with a modern object hierarchy. The architecture scales by axis count, I/O count and breadth of control filtering requirements, and also handles complex profiling and with tight I/O synchronization as well as simple point-to-point motion.

With seamless integration into Microsoft Visual Studio™ and other leading compilers, the MPI offers full step-by-step debug capability. To speed debugging and process optimization, programs built with the reentrant MPI library can execute in parallel with Motion Scope and other system tools, allowing full system transparency via graphical display and data capture.

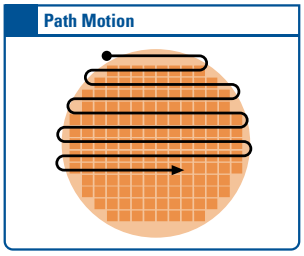


Key Objects in the MPI

- **Data Recorder** – Gain full transparency to your system. Deterministically collect, time stamp and stream any system data value from Controls, Drives or I/O for graphical display or tab-delimited export.
- **Axis/Motor** – Quickly and logically configure and access information on single motors, or axes comprised of multiple motors (such as a Y0, Y1 Gantry Configuration) with 64-bit position resolution.
- **Motion Supervisor** – Configure and execute single axis motion, multi-axis motion, or mixed coordinate groups of single and multi-axis moves. Move types include S-curve, PT/PVT Path Motion, Splines, etc… Individual axis events can be transferred easily to coordinate groups.
- **Filter** – Utilize common PID or PIV filtering, add simple low-pass or notch-filters, or choose from a wide-array of multi-stage biquad filter objects. With flexible control pointers, build your ultimate MIMO axis filter.
- **Control Event Service** – Why waste time polling? Achieve efficient host utilization and event arbitration through the Event Service. Wake or sleep motion tasks based on single or independent conditions and assigned priority level.
- **On-Board Program Sequencer** – Preload motion and I/O sequences to trigger based on events or conditions without host intervention.



Motion Examples & Capabilities

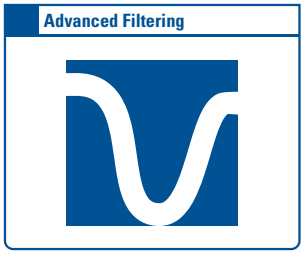


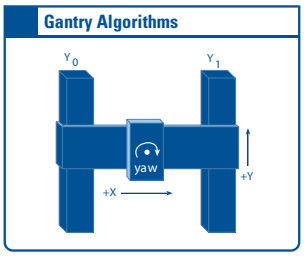
Path Motion

The MPI supports a variety of path motion types including PT, PVT, SPLINE, BESSEL, BSPLINE, and BSPLINE2 algorithms. Path motion is used when the trajectory through space is important and does not fit point to point motion trajectories. Several different algorithms can be applied to convert the linear and arc segment path into an interpolated trajectory.

Advanced Filtering

The MPI supports the ControlsToolkit that contains BodeTool™, a powerful utility that allows the machine designer to characterize and compensate for mechanical resonances and implement custom Bi-Quad Filters, High/Low pass, Leadlag, Resonator, and other types of filters. Advanced filtering allows for advanced tuning beyond PID and PIV algorithms, and integration is seamless with Danaher Motion motion controllers.



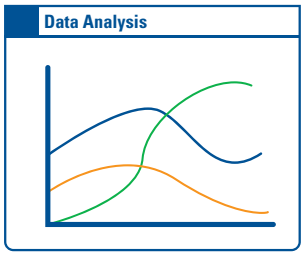


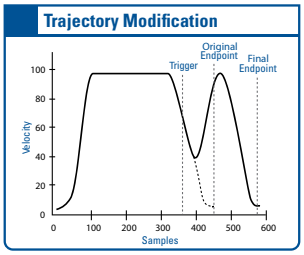
Gantry Algorithms

The MPI has implemented gantry drive support for systems where two motors control a single linear axis. For systems that also incorporate a transverse X axis, yaw control is also supported. The MPI simplifies gantry support and makes configuring gantry systems much more convenient.

Data Analysis

The Data Recorder allows critical real-time information to be captured and graphed using MotionScope™ or other 3rd party analysis tools. The Data Recorder allows for dynamic memory size configuration and the circular buffer allows data to be logged continuously to an external hard drive or other storage device. The Data Recorder, coupled with MotionScope, provides a powerful data analysis and debugging tool.



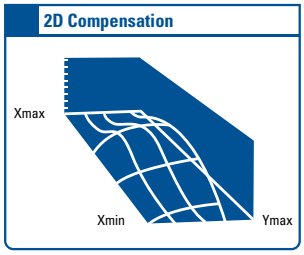


Trajectory on-the-fly Modification

Motion trajectory can be changed at any time and as often as needed by updating acceleration, velocity, and/or position. MPI features also allow for the ability to call a motion modify at any time during a move and change any trajectory parameter. This type of move is ideal for making very fine adjustments to a move as it draws closer to its final target and for making smooth transitions from one motion to the next.

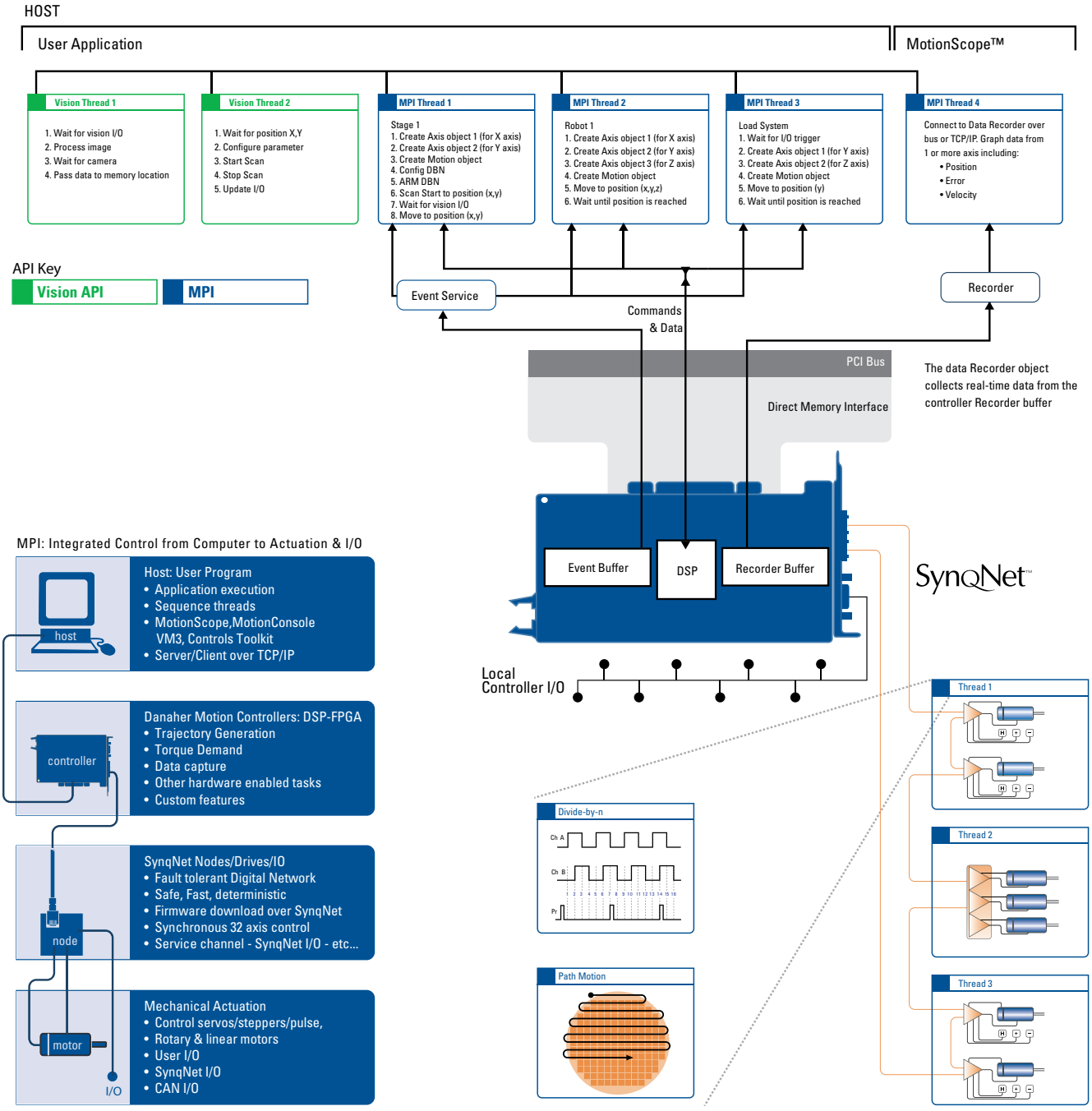
2D Compensation

The mechanical tolerances and non-ideal encoders can create small errors between the measured and true position of even the most precise stages. To compensate for these errors, the MPI supports 2D compensation tables that yield accuracy as good as the repeatability of the encoder and the quality of the error map allow.



Multi-Threaded Applications

Controller objects are managed by host software using the MPI. The MPI provides direct access to all controller memory, delivering higher performance than competing systems that use command-based controllers or ASCII interfaces. Designed for multitasking environments, the MPI can access one or more motion controllers at maximum bus bandwidth, while efficiently handling controller interrupts.



MPI Features

The MPI was designed for multi-threaded environments and supports Windows XP/Vista, and Linux, and real-time operating systems including VxWorks, RTX, InTime, and others. MPI applications can be readily developed in Integrated Development Environments such as Microsoft Visual Studio. Other compilers can be used depending on the operating system, such as a Linux general GNU compiler.

MPI Features Include:
- Up to 64 Axes per Controller
- User Programmable Logic Blocks (User Limits)
- Memory Map Translation (Address/String)
- 64-bit Trajectory and Position
- Position Capture
- On-the-fly Trajectory Modification
- Onboard Settling Detection
- 2D Compensation Tables
- Backlash Compensation
- Simultaneous and Synchronized Motion
- Custom Motion Profiles
- Coordinated Motion
- PID and PIV Control Algorithms
- Filtering (post-filters) with up to 6 cascaded Biquads
- Acceleration Blending and Cubic Splining
- Circular Interpolation
- Electronic Gearing
- Feed-speed Override
- Pause on Path
- Dual-loop Control
- High-speed Registration

Optional Tools & Utilities:
- MechaWare™
- ControlsToolkit™ [with BodeTool]
- MotionConsole™
- MotionScope™
- VM3 (View Memory)
- SynqNet Management Utilities

SynqNet Specific Features
- Up to 64 Nodes per Network
- HotReplace™
- Mixed Torque or Velocity Mode
- Network Fault Recovery (Ring Topology)
- String or Ring Topology
- Plug 'n' Play Nodes - Drive Setup, Configuration
- Support up to 32 Coordinated Axes/Nodes
- Service Channel
- Remote Upgrade of Node FPGA and Drive Firmware.
- Automatic Network Configuration and Integrity Check
- Remote Diagnostics for Nodes and Drives
- Bad Feedback Packet Compensation
- Time-based Capture
- Cable Length Compensation
- User Configurable Packets
- String, Ring or Dual-String Topology

Motion Types/Functions:
- Trapezoidal
- S-Curve
- Specify Acceleration and Deceleration Jerks
- Velocity
- PVT
- PT
- Linear & Circular Interpolation
- Spline
- BSpline
- BSpline2
- Bessel

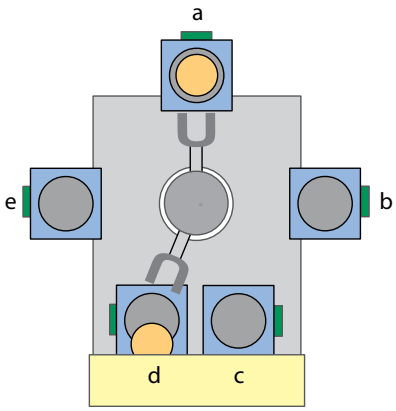
Danaher Motion Software & Utilities

In addition to the MPI, Danaher Motion also offers the MPX: Develop your own custom motion interface using LabView®, VisualBasic®, Excel®, XML, and other environments that support .NET extensions. MotionConsole: Exercise motors, tune & configure all axes in your system. MotionScope allows full graphing and analysis of real-time motion data. Position, velocity, and numerous other critical motion parameters are displayed with the click of the mouse. Run all utilities locally or over a TCP/IP connection. Controls Toolkit: Analyze machine mechanical response, develop notch filters, and custom algorithms to tune and optimize machine performance. Controls Toolkit includes the BodeTool. MechaWare™: Use MatLab® & Simulink® with the Danaher Motion MechaWare library that allows you to quickly model a system and download appropriate code directly to any SynqNet controller. MechaWare provides a flexible environment to develop custom control schemes and features a wide variety of filters, state observers/ feedback, coordinate transformations, complex gearing & following methods, gain switching, and vibration control methods. Create sophisticated MIMO plant models and easily define gantry control topology.

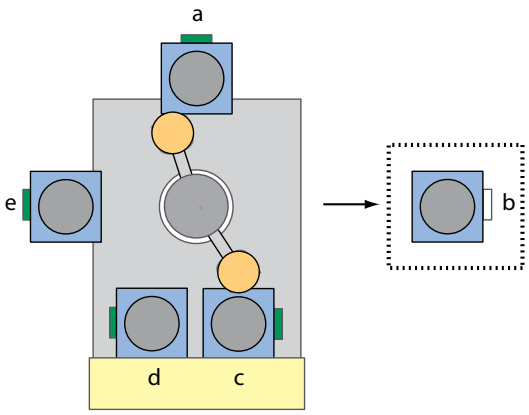
SynqNet HotReplace™: No Machine Shutdown... Service on Your Schedule

HotReplace™
The SynqNet HotReplace feature allows one or more consecutive nodes to be shut down, serviced, and then reattached to the system without affecting the operation of the other nodes. The HotReplace feature is supported in the 3.04 software release and later.

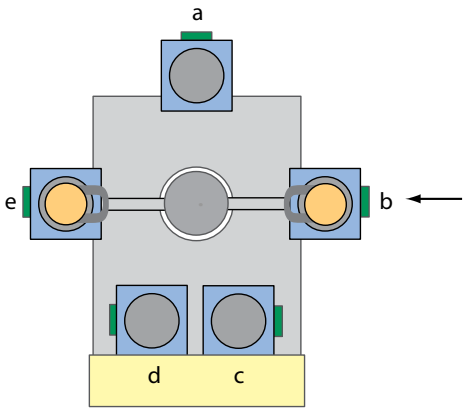
No Machine Shutdown - Service on your Schedule
The SynqNet HotReplace feature is especially useful for modular systems where modules are occasionally taken offline for regular maintenance or replacement. Many high performance systems would require entire system shut down in order to service a module. But, on a SynqNet network, you can use the HotReplace feature to safely take a module offline, service it, and then replace it while the rest of the system remains fully operational.



Normal Operation
SynqNet® connects all nodes, and I/O in the system.



Node b taken off-line for Service
Axes & I/O associated with Node b Taken off-line.
All other nodes in the machine remain operational.



HotRestart™
When the HotRestart function is called, the motion controller searches the SynqNet network for any and all nodes that have been replaced or are faulted, and restores them to normal cyclic communication.

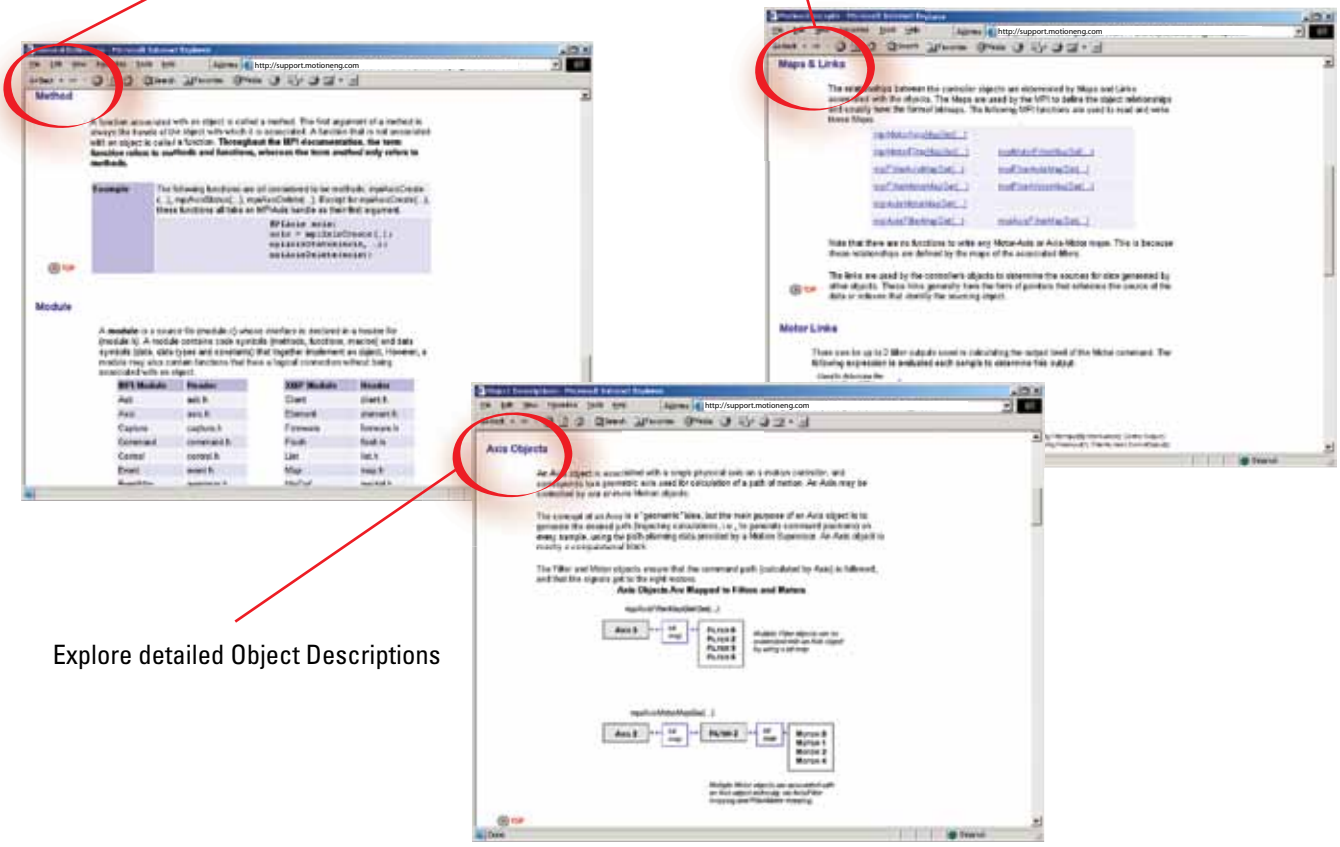
At this point the application performs homing and other initialization, and then resumes normal operation.

Online 24/7 Support

Access technical documentation at http://support.motioneng.com. Click on software > MPI > Topics. The online system features up-to-date documentation, dynamic hyperlinks, complete search functionality, sample code for easy copy and paste usage, and print friendly PDF documentation. For in-depth information on the MPI, such as data structures, sample applications, general definitions and much more, information is only a click away.

Learn more about General Definitions

Get details about Motion Concepts



Explore detailed Object Descriptions

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KM_B_0008_RevA_EN MPI 4.0 Motion Programming Interface

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