VICON

information invocation

Go Further with Vicon MX T-Series

T-Series

Go Further with Vicon MX T-Series Revision 1.3 August 2010

For use with Vicon MX T-Series systems.

Vicon Motion Systems is an OMG Plc company.

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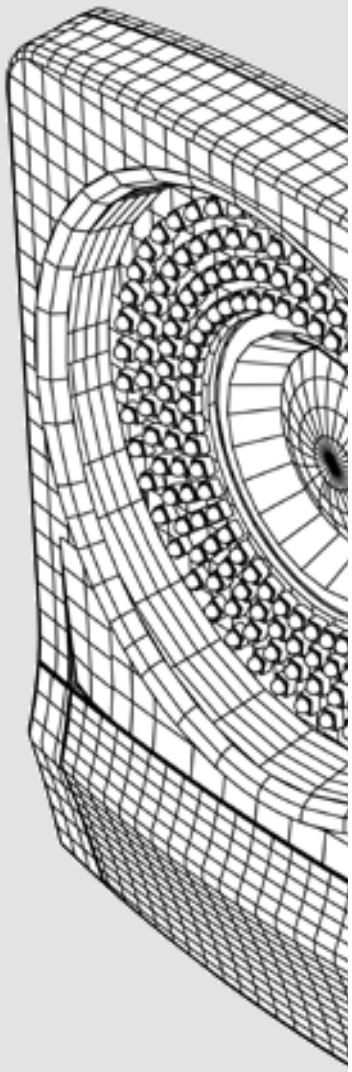
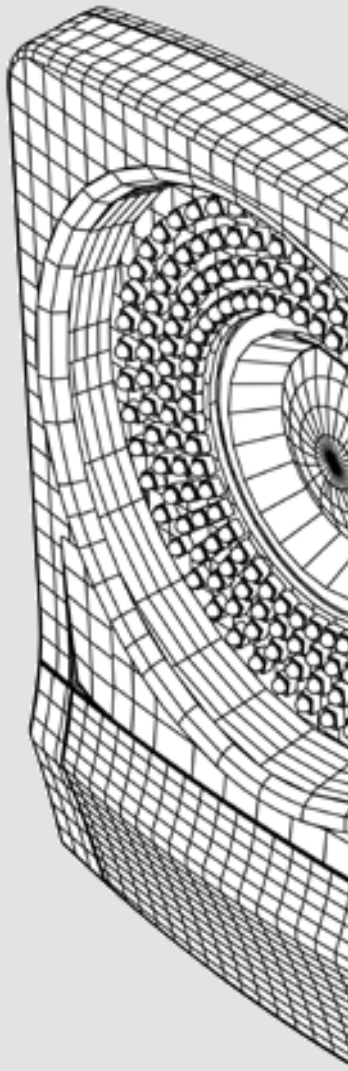
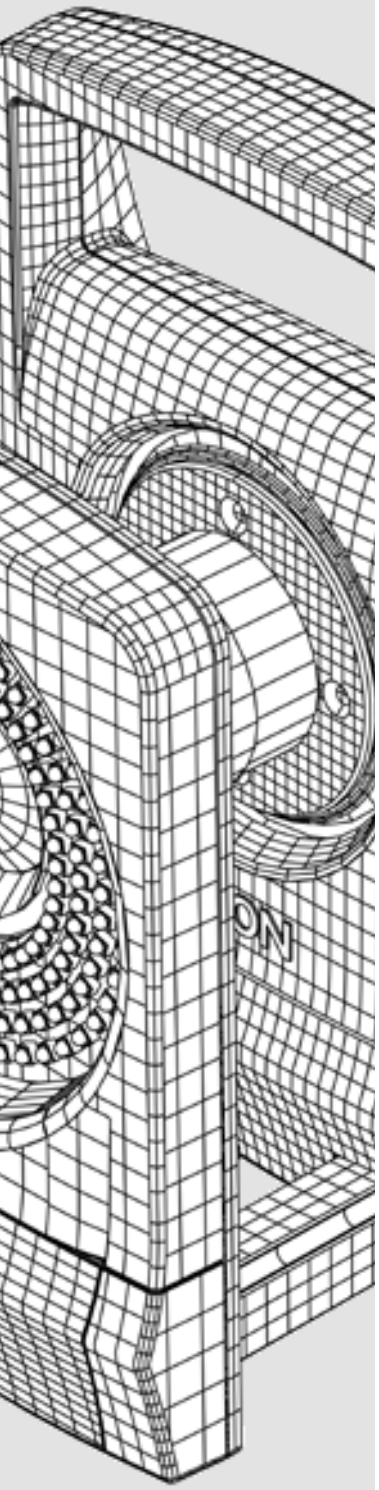
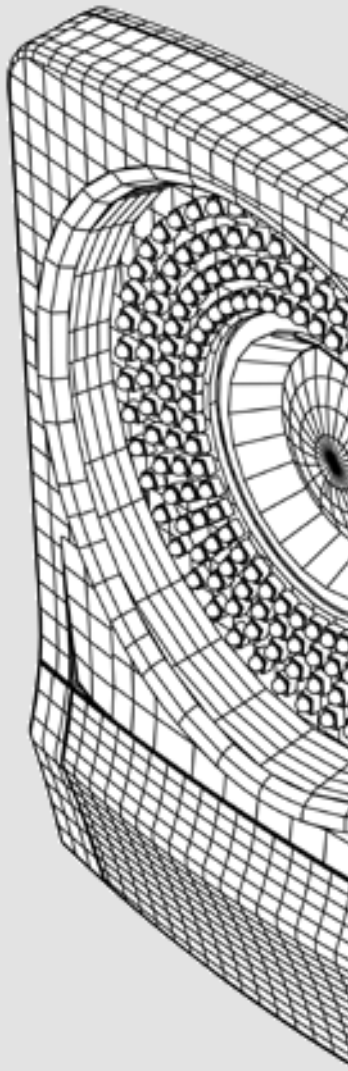


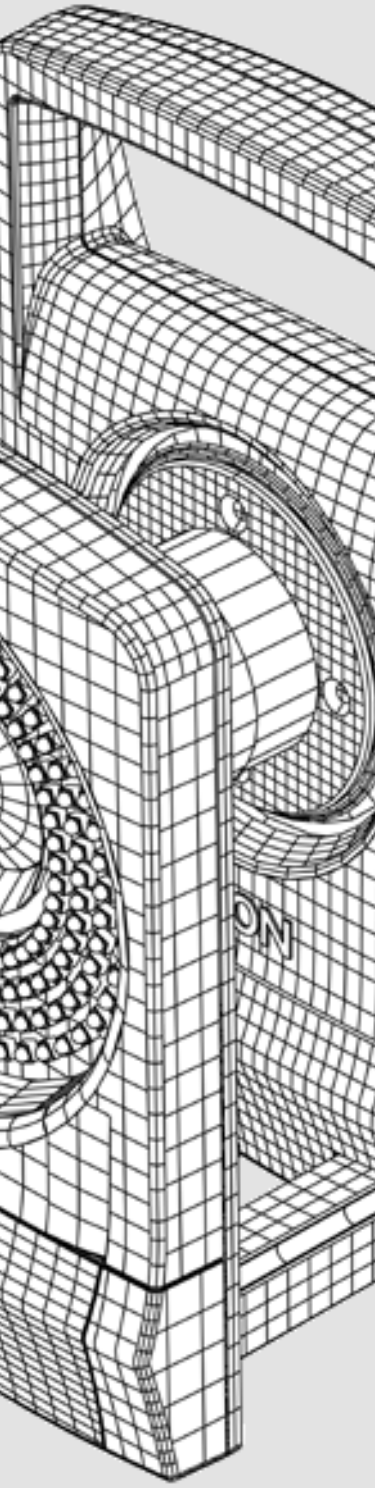
Contents

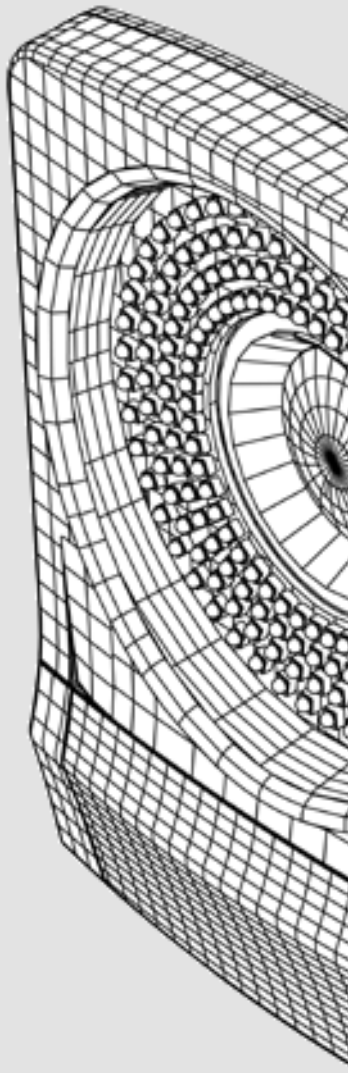




II Advanced Usage

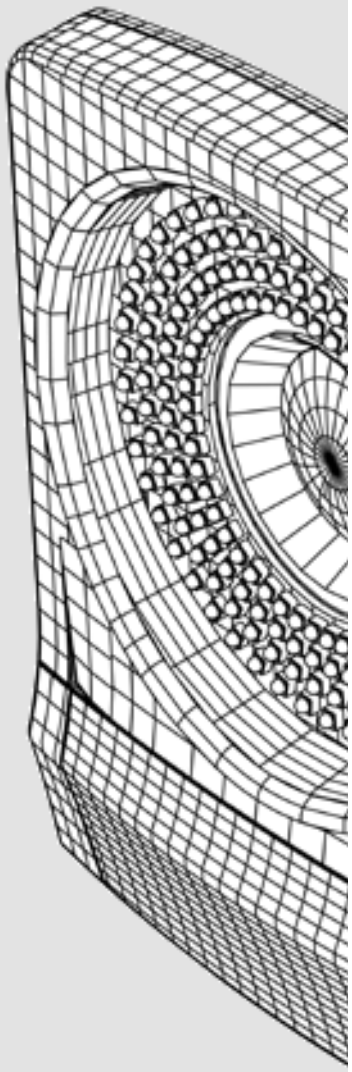






Preface

This book provides reference, advanced usage, technical specifications, regulatory information, and support details for the specialized MX cameras, units, and supplies that make up a Vicon MX T-Series system.



In This Preface

Audience

This book is intended for those who will be using the Vicon MX T-Series 3D optical marker based technology to track and analyze movement in a variety of locations in the following types of applications:

- **Life Sciences**, in clinical and research laboratories, sports performance centers, universities and other institutions for gait analysis and rehabilitation; biomechanical research; posture, balance, and motor control; sports performance; and animal science applications.
- **Animation**, in visual effects houses and games companies for games, film and TV production, and education applications.
- **Engineering**, in engineering companies for ergonomics and human factors, and simulation and visualization applications.

This book assumes you have already read the Get Going with Vicon MX T-Series booklet, and have installed your T-Series system. For details on the Get Going booklet, see Related Documentation on page x.

This book does not assume that you have any previous experience with Vicon products. If you have used a previous Vicon MX system, you will notice some differences in components and terminology between previous systems and the Vicon MX T-Series system.

Structure

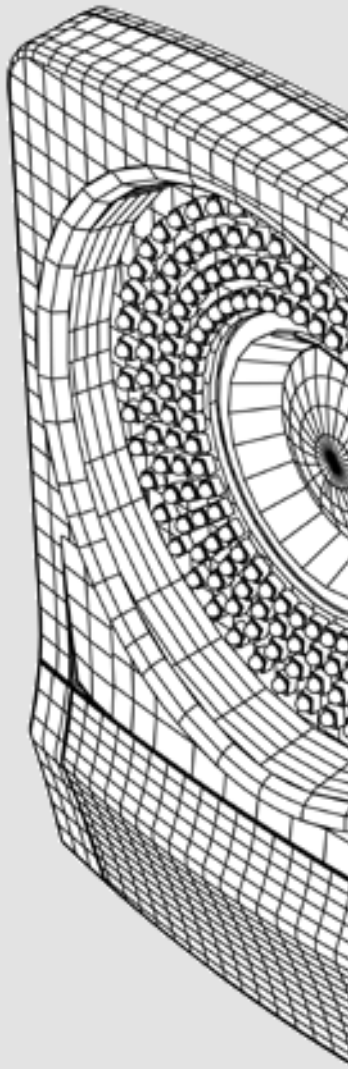
This section describes how the information in this book is organized.

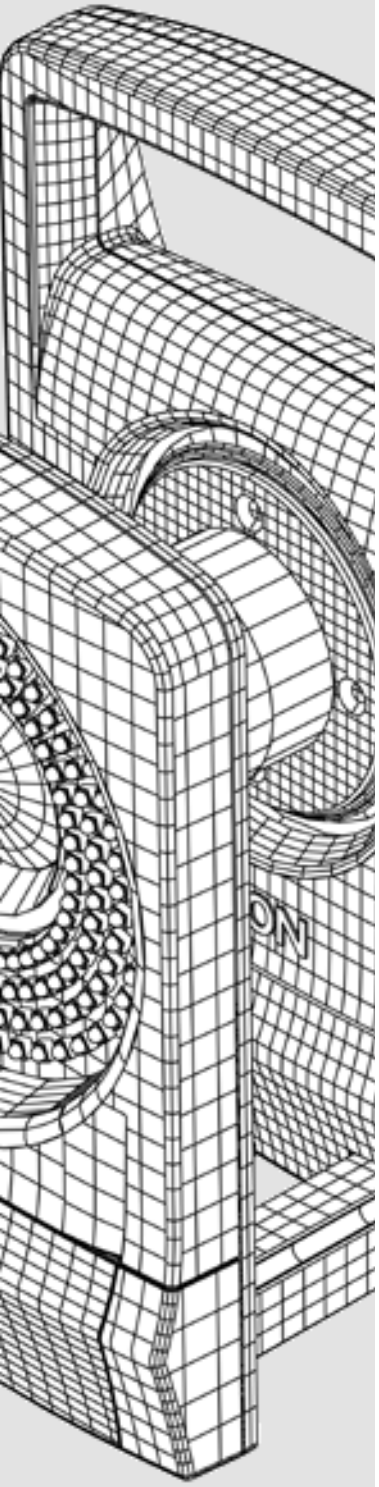
PART I **Reference Information** contains chapters describing the components of the Vicon MX T-Series system and how they fit together.

Chapter 1 **MX System Architecture** provides sample architecture models, showing how you can put together a Vicon MX T-Series system including Vicon MX cameras, controlling hardware units, MX Host PC, connecting cables, and application software, as well as supported external devices. It also describes these major system components.

Chapter 2 **MX T-Series Cameras** describes the role of the MX T-Series cameras in a Vicon MX T-Series system, lists the available types of cameras, describes their physical structure (including lenses, controls and connectors, and associated strobe units) and explains their functional characteristics.

Chapter 3 **MX Giganet** describes the role of the MX Giganet in a Vicon MX T-Series system, describes its physical structure (including controls and connectors), and explains its functional characteristics.





Chapter 4 **MX Host PC** describes the role of the MX Host PC in a Vicon MX T-Series system and describes the ports used to enable communications between the Vicon software installed on this PC and other components in the Vicon MX T-Series system.

Chapter 5 **MX T-Series System Cables** describes the cables used to connect hardware components in a Vicon MX T-Series system.

Chapter 6 **MX Calibration Device** describes the calibration device used to prepare your Vicon MX T-Series system for motion capture.

Chapter 7 **MX Accessories** describes the motion capture accessories available for use in your Vicon MX T-Series system.

PART II **Advanced Usage** contains chapters describing advanced how-to directions for using your MX T-Series system.

Chapter 8 **Put Together a Simple Vicon MX System** shows you how to put together a Vicon MX system, based on the simple architectural model described in Chapter 1 MX System Architecture.

Chapter 9 **Extend MX System with Additional MX Giganets** shows you how to connect additional MX Giganets to scale your Vicon MX T-Series system to meet your application needs, based on the extended architectural model described in Chapter 1 MX System Architecture.

Chapter 10 **Extend MX System with Additional MX T-Series Cameras** shows you how to connect additional MX T-Series cameras to your MX system, based on the extended architectural model described in Chapter 1 MX System Architecture.

Chapter 11 **Extend MX System with Reference Video Cameras** shows you how to connect external GigE, DCAM, and DV cameras to an MX Giganet to provide reference video for your Vicon MX T-Series system, based on the extended architectural model described in Chapter 1 MX System Architecture.

Chapter 12 **Extend MX System with Analog Capture Devices** shows you how to connect third-party analog capture devices, such as force plates, electromyography (EMG) equipment, potentiometers, and accelerometers, to your Vicon MX T-Series system, based on the extended architectural model described in Chapter 1 MX System Architecture.

Chapter 13 **Extend MX System with Synchronized Output Devices** shows you how to connect and synchronize third-party devices with output your Vicon MX T-Series system, based on the extended architectural model described in Chapter 1 MX System Architecture.

Chapter 14 **Extend MX System with Remote Triggering Devices** shows you how to connect external devices to an MX Giganet to remotely trigger capture by your Vicon MX T-Series system, based on the extended architectural model described in Chapter 1 MX System Architecture.

Chapter 15 **Extend MX System with Timecode/Genlock Devices** shows you how to connect third-party external video devices that provide HD and SD compliant timecode and that genlock to an external EBU, SMPTE, or HD video source to your Vicon MX T-Series system, based on the extended architectural model described in Chapter 1 MX System Architecture.

Chapter 16 **Integrate Earlier MX Components into MX System** shows you how to incorporate earlier selected MX hardware units and their associated previous ranges of MX Cameras into your Vicon MX T-Series system, based on the integrated architectural model described in Chapter 1 MX System Architecture.

Chapter 17 **Focus an MX T-Series Camera Lens** shows you how to focus a Vicon MX T-Series camera lens.

PART III **Technical Specifications** contains chapters providing technical details on the components of the Vicon MX T-Series system.

Chapter 18 **MX T-Series Cameras Technical Specifications** provides technical specifications for the Vicon MX T-Series cameras, including their lenses and strobe units.

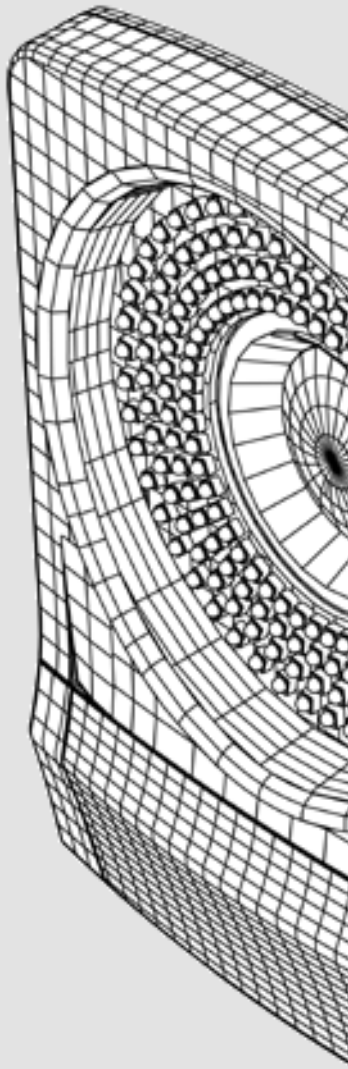
Chapter 19 **MX Giganet Technical Specifications** provides technical specifications for the MX Giganet.

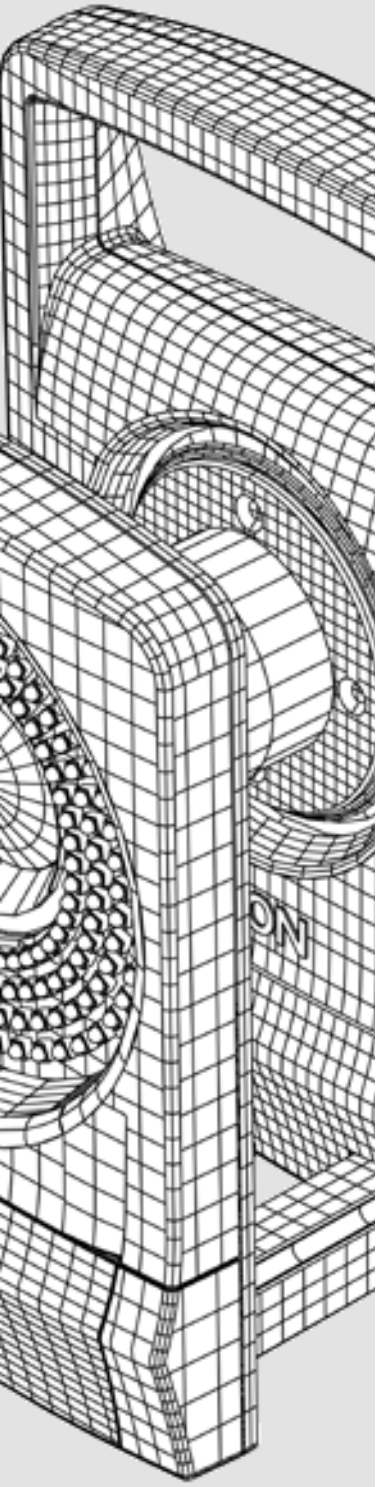
Chapter 20 **MX T-Series Cables Technical Specifications** provides technical specifications for the cables used to pass power, Ethernet communication, synchronization signals, video signals, and data between hardware components in a Vicon MX T-Series system.

PART IV **Regulatory and Guidance Information** contains chapters describing the international standards of quality achieved by the Vicon MX T-Series system.

Chapter 21 **Regulatory Compliance** provides important and required consumer information on how Vicon MX T-Series hardware complies with regulatory standards, including product recycling.

Chapter 22 **Conformity and Certification** provides information on the certification Vicon MX T-Series systems have achieved for meeting stated international standards.





Chapter 23 **Regulatory Notices** provides regulatory notices and incident report forms to complete in the event of an adverse event involving the use of Vicon MX systems in the United Kingdom and the United States of America.

Chapter 24 **Safety and Warranty** provides guidance to help you ensure the safe operation of your Vicon MX T-Series system, as well as information regarding the system warranty.

PART V **User Assistance and Support** contains chapters explaining the user assistance materials available and how to get support for your use of the Vicon MX T-Series system.

Chapter 25 **Support Resources** explains the resources you can use to obtain support for your Vicon MX T-Series system.

Chapter 26 **Documentation Feedback** explains how you can provide Vicon with your comments or suggestions on improving the product documentation.

Chapter 27 **Customer Satisfaction Survey** requests your feedback on our products and services to help us improve future offerings.

Conventions

This table illustrates the typographical conventions used in this book.

Convention	Description
This type	Menus, commands, buttons, and options displayed in the software user interface. Terms in a definition list or emphasis for important introductory words in a paragraph.
`This type`	Text displayed by the system or extracts of program code.
This type	Path names, file names, and extensions. Commands or text you are to enter in files or dialog boxes.
This type	Cross-references to related information in another section or document.
This type	A URL for a site on the World Wide Web.
Caution	A note alerting you to actions that could result in the loss of data.
Important	A note giving information that emphasizes or supplements important points in the text or information that may apply only in special cases.

Convention	Description
Tip	A note helping you to apply the techniques and procedures in the text to your specific use or to suggest an alternative method.
Warning	A note advising you of actions that could result in physical harm to yourself or damage to the hardware.

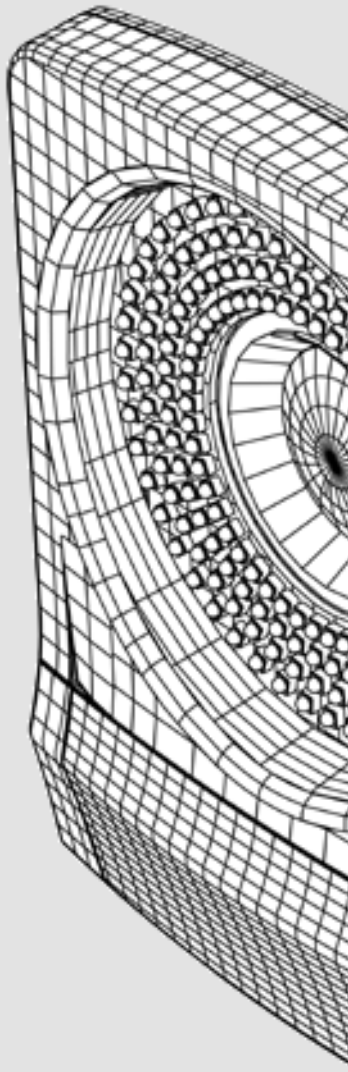
Related Documentation

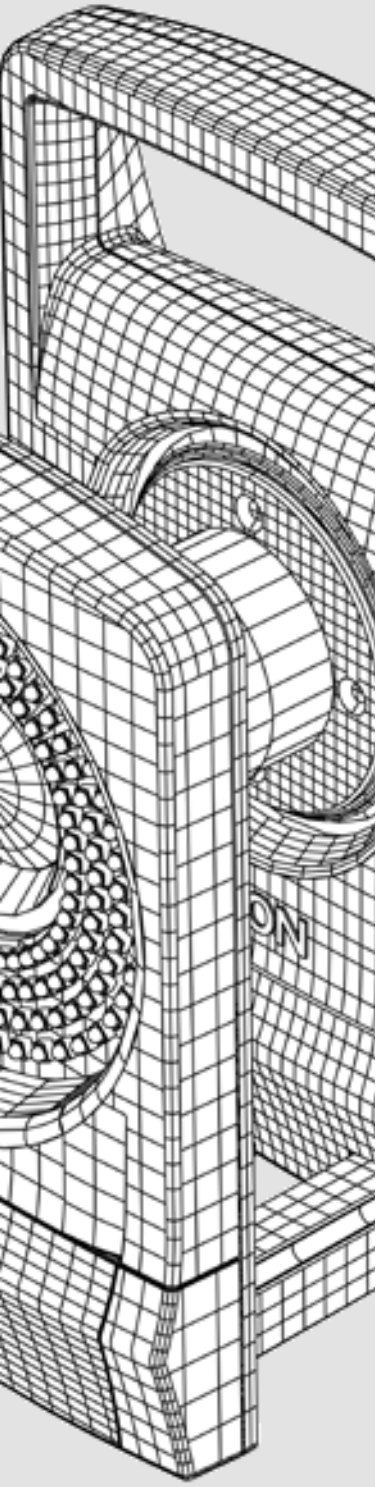
This Go Further with Vicon MX T-Series book is designed to be used in conjunction with the additional documentation providing information related to your Vicon MX T-Series system.

Vicon MX T-Series Documentation

The new Vicon MX T-Series documentation is designed to take you from initial set up through to advanced usage. Use this document road map to find the information you're looking for.

Document	Description
Get Going	Getting started booklet. Provides system descriptions, installation instructions, an end-to-end workflow overview, and initial capture steps.
	New through Advanced users.
	You'll probably only need to use this document for initial system setup and familiarization.
	Available on your T-Series software DVD, and a printed copy is included in your product box, so you can choose the format you want to use.
Keep Going	System usage document. Contains how-to tasks on system usage based on the Get Going workflow, to keep you going at your own pace.
	New through Advanced users.
	You'll probably refer to this document frequently as you perform your daily mocap.
	Available on your T-Series software DVD; may be installed with the software.





Document	Description
Go Further	This Reference document. Provides hardware data, advanced usage, technical specs, regulatory info, and user assistance to let you take things further. Advanced users (or those curious about what makes the system tick). You'll probably only dip into this document occasionally as needed. Available on your T-Series software DVD.
Take Note	Release note. Describes new features, any known problems, and compatibility info you should take note of to keep your system running smoothly. Users updating from previous releases. You'll probably only look at this document once when you receive product updates. Available on your T-Series software DVD.

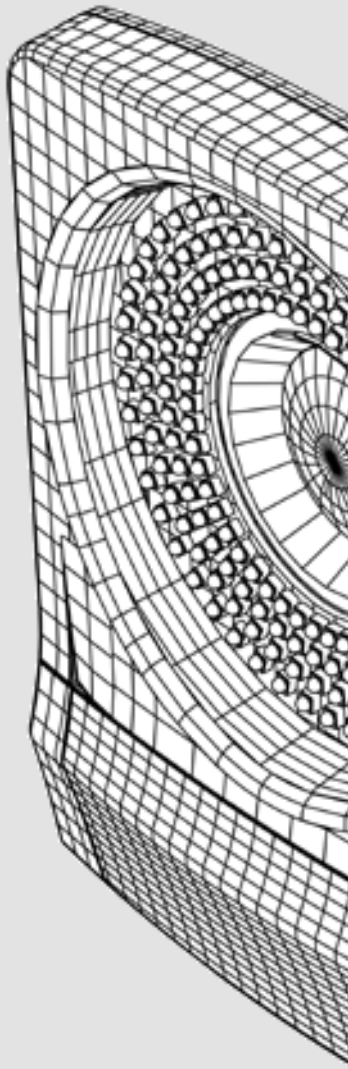
Earlier Vicon MX Systems Documentation

The new Vicon MX T-Series documentation described in the previous section is in the process of being phased in. You may still have some of the earlier Vicon MX documentation types shown in the following table.

Document	Description
Product Guides	These release documents provide the information you need to know about the current release of your Vicon MX system. The first type of note is always provided; one or more of the second type of notes may also be provided: • **Foundation Notes** Essential product information: describes the current release, provides prerequisites, installation, licensing, startup, and basic usage instructions; details new features; and identifies any known issues. • **Advanced Notes** Advanced technical information: provides more detailed technical information for users who want to gain a deeper understanding of the implementation of

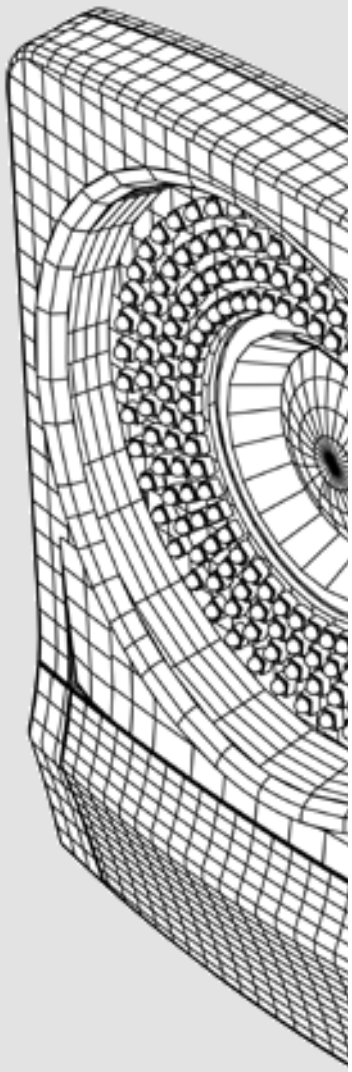
Document	Description
	some specific advanced features and functionality in Vicon MX T-Series This additional information is not essential for the basic use of the product.
Books	These documents provide more detailed information on the features and functionality in your Vicon MX system.
The following types of books make up the Vicon product documentation set:	
System Reference	System Reference books describe the features and functionality of a component of T-Series.
System Tutorial	System Tutorial books provide step-by-step instructions on the intended way of using Vicon application software.
System Option	System Option books describe the general features and operation of a system option or plug-in that can be used with the Vicon application software.
Foundation Guide	Foundation Guide books, such as *The Vicon Manual*, describe the general features and operation of the hardware and application software in Vicon V-series systems (V460, V6, V612, V624, and V8i). Those books may be supplemented by the System Reference, System Tutorial, and System Option books, which describe more recent features and functionality.
Vicon Online Support	Vicon Online Support (at http://www.vicon.com/support) is a Web-accessible knowledge base that enables customers to view previously answered product queries, submit new questions, and download updates to Vicon software and documentation.

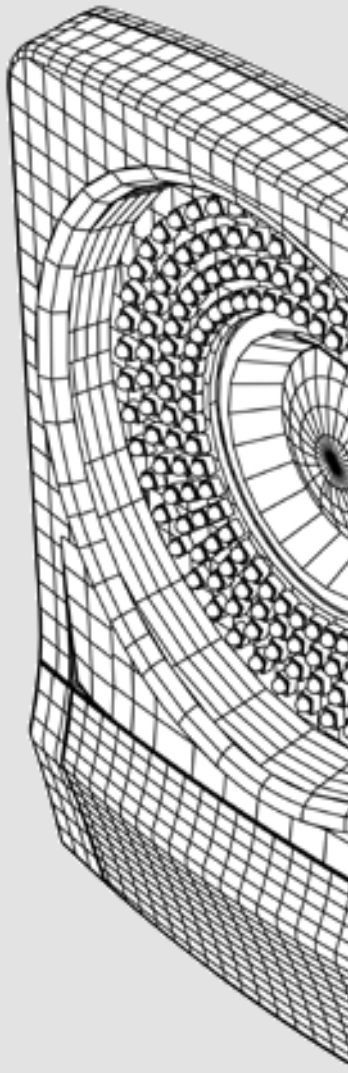
Product Guides and books are supplied in PDF format (requires Adobe Acrobat version 5.0 or later). You can obtain them from the product DVD or from the Downloads section of the Vicon Online Support site (for details, see Vicon Online Support on page 198). Be sure to check online for any updates to documents supplied with your product release.



Reference Information

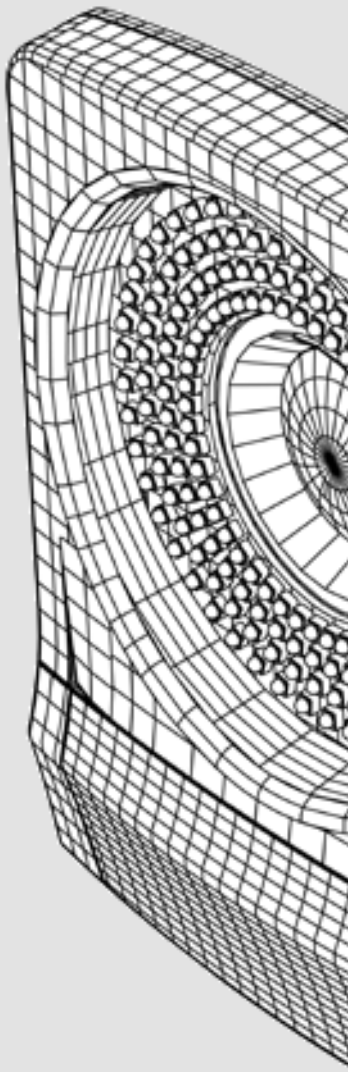
Find out more about the components of your Vicon MX T-Series system and how they fit together.





1 MX System Architecture

This chapter provides sample architecture models, showing how you can put together a Vicon MX T-Series system including Vicon MX cameras, controlling hardware units, MX Host PC, connecting cables, and application software, as well as supported external devices. It also describes these major system components.



In This Chapter

Vicon MX T-Series System Architecture Models

The Vicon MX T-Series is a suite of networked MX T-Series motion capture cameras, hardware devices, and software applications that provide real-time and offline digital-optical motion capture data. The motion capture data can be applied to life sciences, animation, and engineering applications.

Vicon MX T-Series systems are flexible, expandable, and easy to integrate into your working environment. You can combine Vicon MX and supported third-party devices (such as force plates, HD and SD compliant time code, genlock to external video, EMG, and many other digital devices) to create an architecture that meets your application requirements. This modular approach enables you to expand your Vicon MX T-Series system as needed.

The Vicon MX Giganet is the core of the Vicon MX T-Series system, connecting your Vicon MX T-Series cameras(T160, T40, T20, and T10) and your MX Host PC, as well as any remote PCs, subordinate Giganets, and other, supported third-party devices. With an MX Giganet, you can also incorporate earlier ranges of MX cameras (F-series, MX+, and MX) through earlier hardware units (MX Ultranet HD, MX Ultranet, and MX Net) into one system.

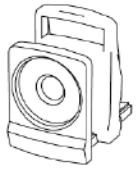
Important
A Vicon MX system runs on its own dedicated network, rather than being integrated into a general communications network. Routers are not supported for connecting elements in a Vicon MX architecture.

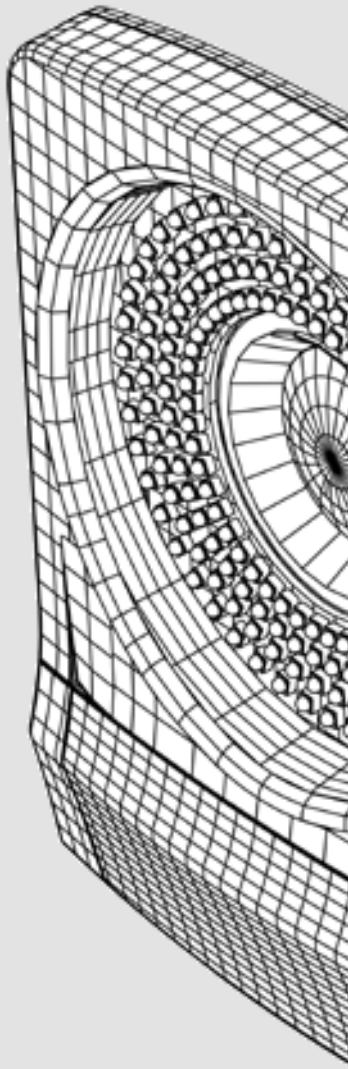
The following sections illustrate the Vicon MX T-Series architecture models:

- Simple System Architecture Model (T-Series Hardware Only) on page 6
- Extended System Architecture Model (Additional T-Series Hardware and Third-Party Devices) on page 7
- Integrated System Architecture Model (T-Series and earlier MX Hardware) on page 9

Table 1 identifies the components illustrated in the architecture diagrams in the following sections.

Table 1: Key to T-Series Architectural Figures

Component	Description	For details, see
	MX T-Series camera	Chapter 2 MX T-Series Cameras and Chapter 18 MX T-Series Cameras Technical Specifications



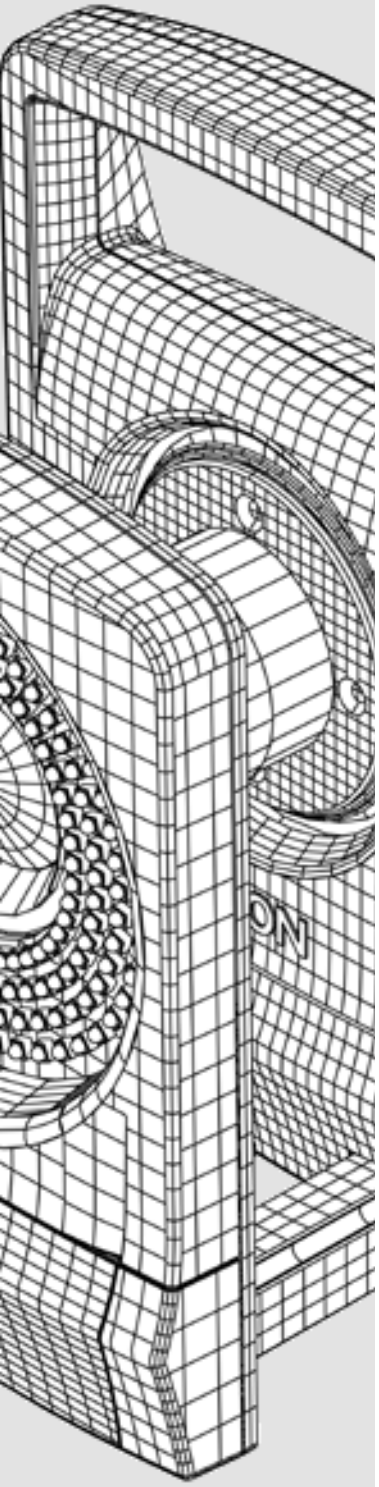
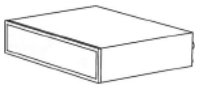
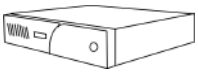
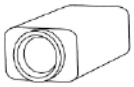


Table 1: Key to T-Series Architectural Figures

Component	Description	For details, see
	MX F-series camera	Vicon MX Hardware System Reference book supplied with your earlier Vicon MX system.[a]
	MX Giganet (plugged into mains socket)	Chapter 3 MX Giganet and Chapter 19 MX Giganet Technical Specifications
	MX Ultranet HD	Vicon MX Hardware System Reference book supplied with your earlier Vicon MX system.[a]
	MX Host PC (with Vicon application software, Vicon Giganet Ethernet card, and network Ethernet card)	Chapter 4 MX Host PC
	Third-party device (e.g. Basler GigE Reference Video camera)	Chapter 11 Extend MX System with Reference Video Cameras Vicon Nexus Product Guide—Advanced Notes: Basler Camera Support supplied with Vicon Nexus software[b]
	MX Gigacable	Chapter 5 MX T-Series System Cables and Chapter 20 MX T-Series Cables Technical Specifications
	RJ-45 Ethernet cable	Chapter 5 MX T-Series System Cables and Chapter 20 MX T-Series Cables Technical Specifications

a. You can access the hardware system reference book for earlier Vicon MX Series systems online. Log on to Vicon Online Support, then follow the appropriate path: Downloads > Animation/Engineering/Life Sciences > Vicon Hardware > Vicon MX Hardware System Reference (Rev 1.7)

b. You can find the Nexus product documentation in your Vicon Documentation folder on your MX Host PC (by default, *C:|Program Files|Vicon|Documentation*), or you can access it online. Log on to Vicon Online Support, then follow the appropriate path: Downloads > Life Sciences > Vicon Nexus > Documentation, Videos and Tutorials

If your particular application requires a more complex configuration than is illustrated in this book, Vicon Support can help you to design a suitable Vicon MX T-Series architecture (for details on contacting Vicon support, see Technical Support on page 198).

Simple System Architecture Model (T-Series Hardware Only)

The simplest Vicon MX T-Series architecture model consists of from 1-10 MX T-Series Cameras, an MX Giganet, and the MX Host PC (for descriptions of these system elements, see Vicon MX System Architecture Components on page 10).

This MX Giganet-based architecture is illustrated in Figure 1.

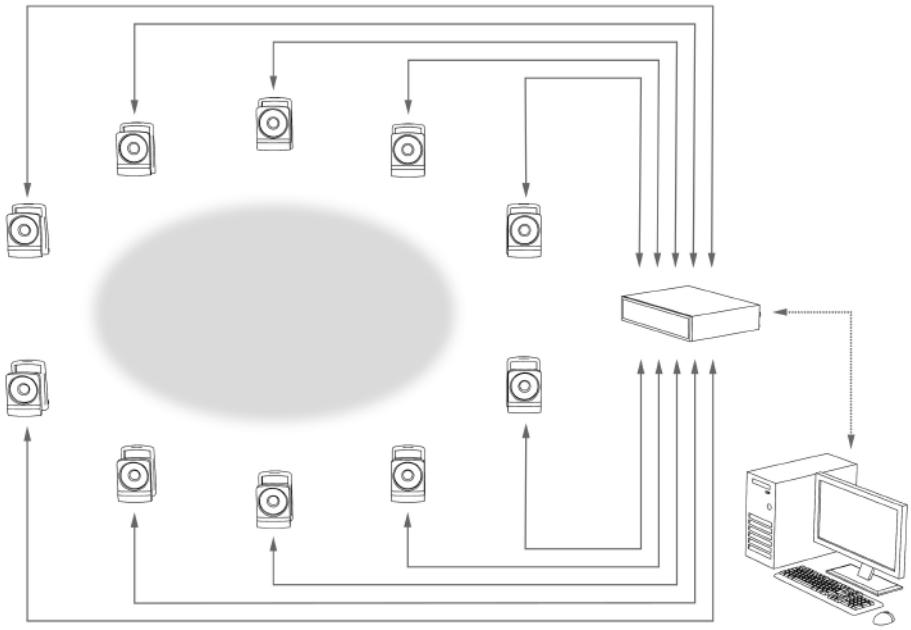
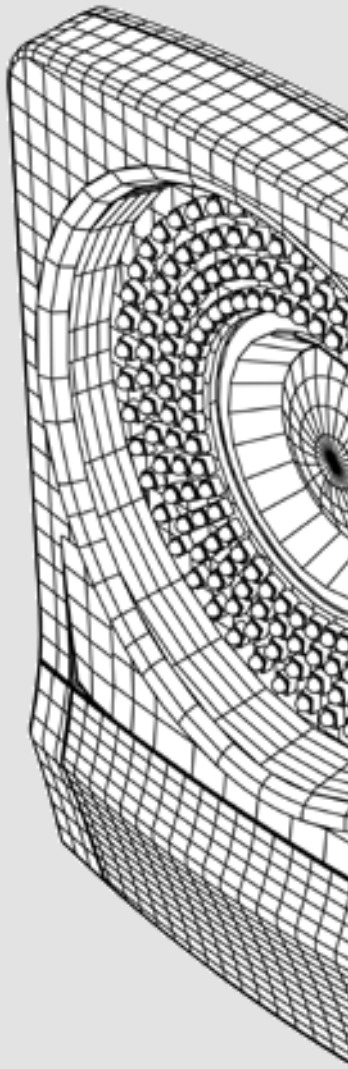
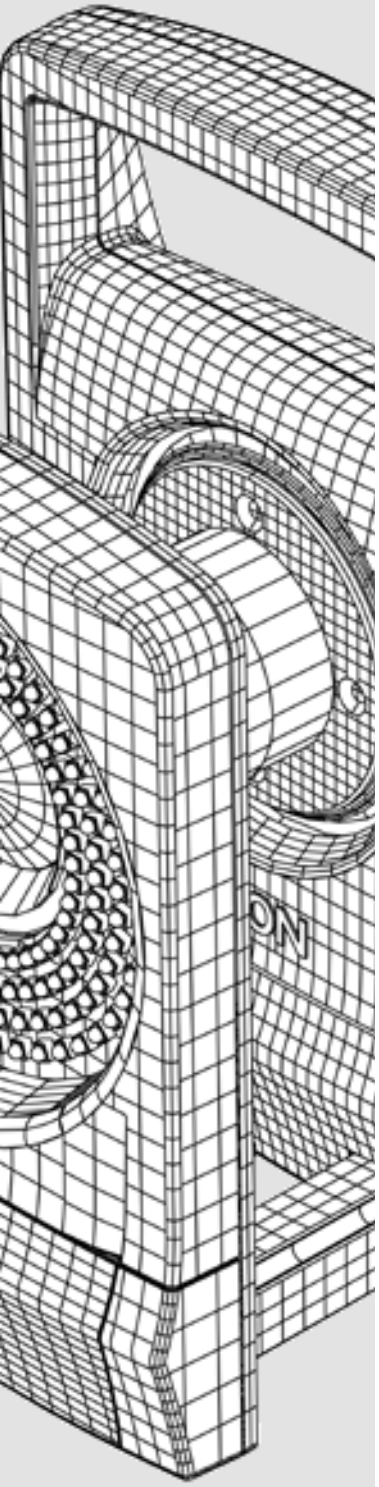


Figure 1: Simple Vicon MX system architecture model

For details on setting up a basic Vicon MX system based on this architecture model, see Chapter 8 Put Together a Simple Vicon MX System.





Extended System Architecture Model (Additional T-Series Hardware and Third-Party Devices)

An extended Vicon MX T-Series architecture model consists of a basic model with MX T-Series Cameras, a primary MX Giganet, and the MX Host PCto which you add subordinate MX Giganets, additional MX T-Series Cameras, third-party devices such as reference video cameras, analog capture devices, synchronized output devices, remote triggering devices, or timecode/genlock video devices (for descriptions of some of these, see Vicon MX System Architecture Components on page 10).

You use the MX Giganet to scale your MX system to expand the number of MX T-Series cameras and third-party devices to meet your needs. You need one Giganet for every 10 Vicon MX T-Series cameras in your system. Only one MX Giganet in any system is connected to the MX Host PC. In this book, this unit is referred to as the primary MX Giganet. Additional MX Giganet units connected to this primary MX Giganet are referred to as subordinate MX Giganet units.

The primary MX Giganet provides power and data communication with the MX cameras and other devices, such as GigE cameras, in your MX system architecture. It provides only data communications with any subordinate MX Giganets, which have their own power supply. The primary MX Giganet also manages the data flow to the MX Host PC running the MX software you use to process, visualize, and analyze your data. One MX Giganet (not necessarily the primary MX Giganet) provides the master synchronization for the Vicon MX T-Series system. If your application integrates third-party analog capture, genlock to external video, and timecode devices, the MX Giganet can also provide analog input, direct sync out, or remote control functionality.

This extended architecture is illustrated in Figure 2.

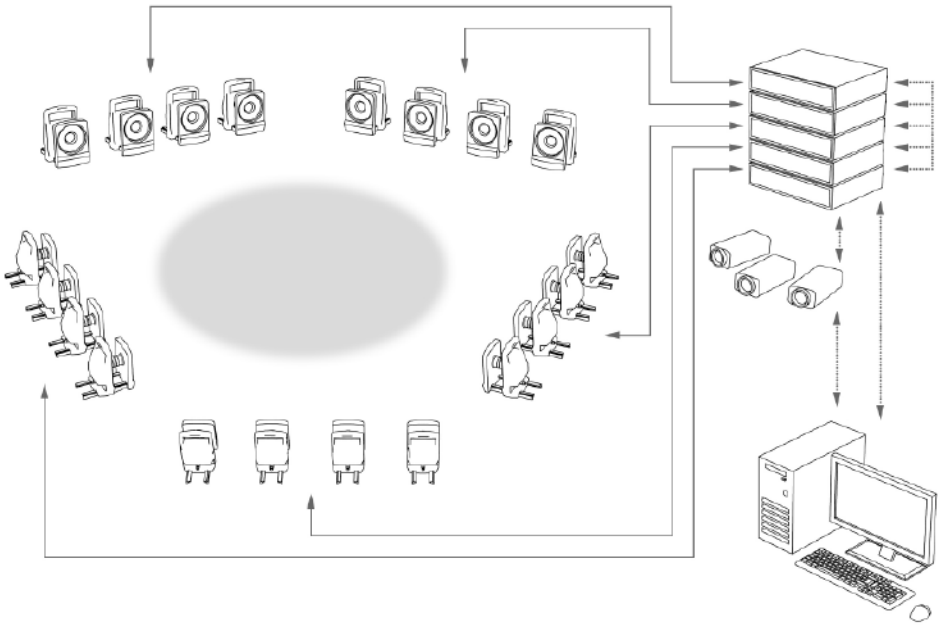
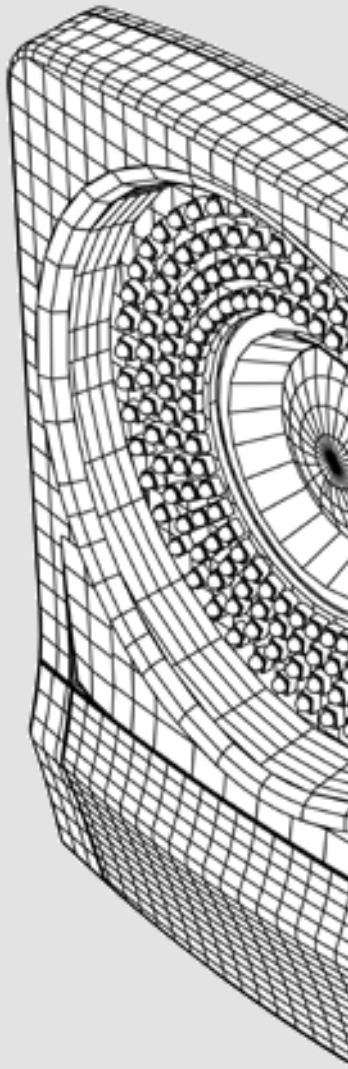
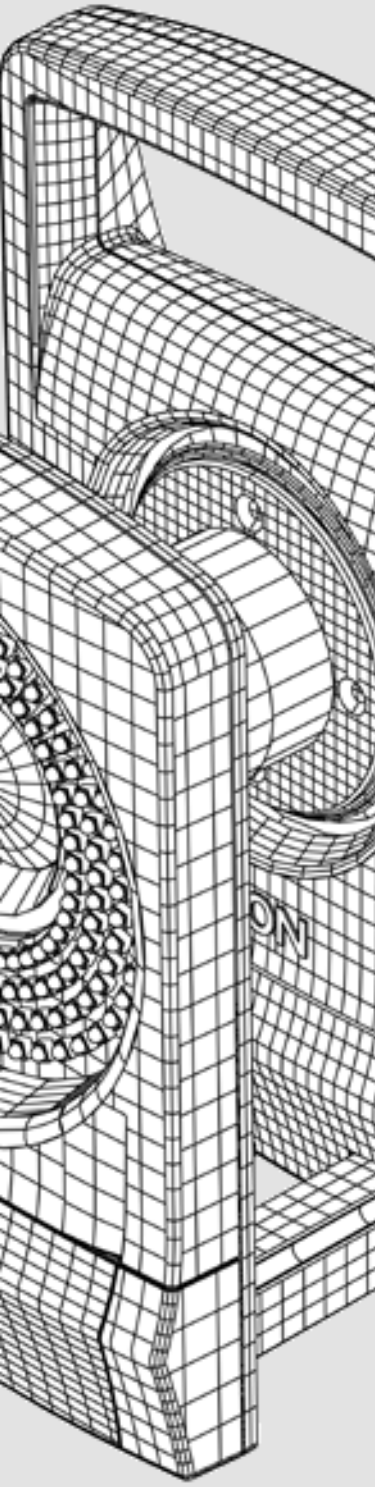


Figure 2: Extended Vicon MX system architecture model

For details on setting up an extended Vicon MX T-Series system based on this architecture model, see:

- Chapter 9 Extend MX System with Additional MX Giganets
- Chapter 10 Extend MX System with Additional MX T-Series Cameras
- Chapter 11 Extend MX System with Reference Video Cameras
- Chapter 12 Extend MX System with Analog Capture Devices
- Chapter 13 Extend MX System with Synchronized Output Devices
- Chapter 14 Extend MX System with Remote Triggering Devices
- Chapter 15 Extend MX System with Timecode/Genlock Devices





Integrated System Architecture Model (T-Series and earlier MX Hardware)

An integrated Vicon MX T-Series architecture model consists of a basic or extended model that contains components from earlier MX systems (for descriptions of these system elements, see Vicon MX System Architecture Components on page 10). In these configurations, you connect any earlier MX cameras to the appropriate hardware unit, connect the hardware unit to an MX Giganet, and connect the MX Giganet to the MX Host PC. For example, if you have an MX Ultranet HD, connect your MX F-series, MX+, or MX cameras to the MX Ultranet HD. Then connect the MX Ultranet HD to an MX Giganet. If you are using an MX Net, connect your MX F-series, MX+, or MX cameras to the MX Net, and then connect it to an MX Giganet.

The primary MX Giganet provides only data communications with any subordinate MX Giganets or some earlier MX units such as MX Ultranet HDs.

An example of this type of integrated Vicon MX system architecture, containing an MX Ultranet HD and F-series cameras, is illustrated in Figure 3.

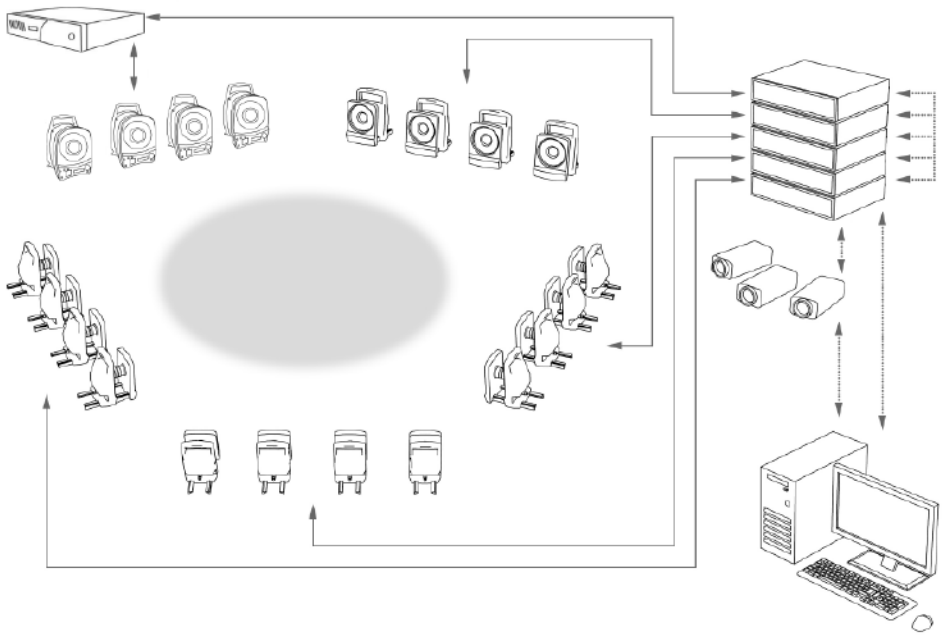


Figure 3: Integrated Vicon MX system architecture model

For details on setting up an integrated Vicon MX system based on this architecture model, see Chapter 16 Integrate Earlier MX Components into MX System.

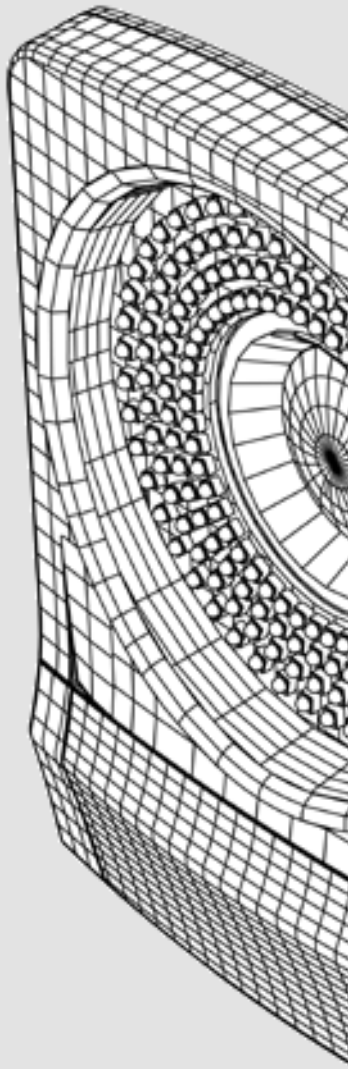
Vicon MX System Architecture Components

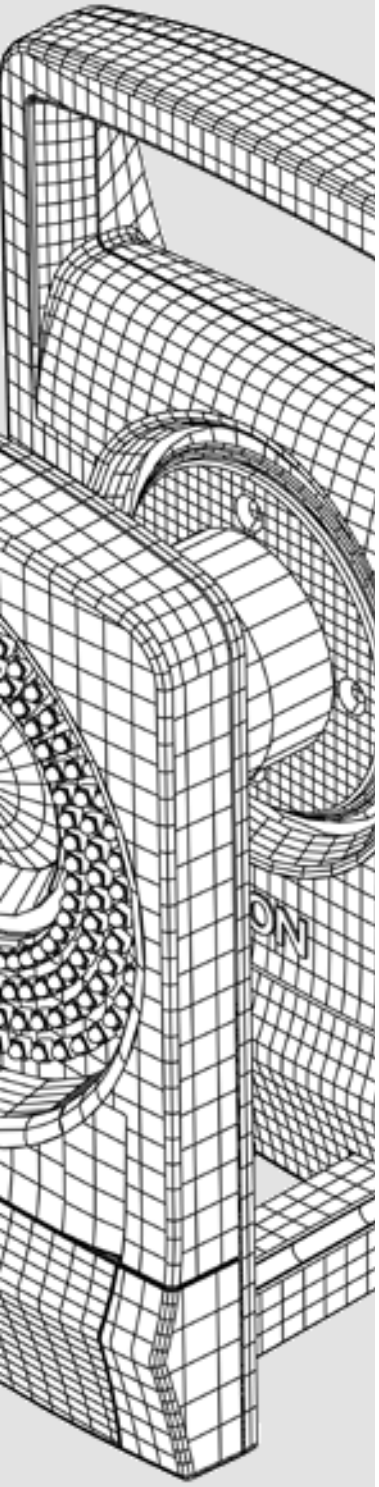
The major components of a Vicon MX system are the cameras, the controlling hardware unit, the software to analyze and present the data, and the host computer to run the software. It also contains specialized supplies for optical motion capture, including cables to connect the hardware devices, the MX calibration device, and motion capture accessories. You may also choose to include supported, third-party devices used in your studio, lab, or research unit.

As your motion capture needs evolve, you can expand and upgrade your MX system. The Vicon MX T-Series system is compatible with earlier MX cameras and certain hardware units, so you can build on your existing investment.

Tip
You can access the hardware system reference book for earlier Vicon MX Series systems online. Log on to Vicon Online Support, then follow the appropriate path:
Downloads > Animation/Engineering/Life Sciences > Vicon Hardware > MX Hardware System Reference (Rev 1.7)

This section identifies the components that can be included in a Vicon MX architecture:





Vicon MX Cameras

Vicon offers a wide choice of motion capture cameras which feature multiple high-speed processors that perform real-time proprietary image processing.

You can incorporate the following cameras in your Vicon MX T-Series system architecture:

- **T-Series Cameras**
  - **MX T160**, with a resolution of up to 16 megapixels and capture speed of 120 fps (at full frame 16MP resolution) to 2,000 fps
  - **MX T40**, with a resolution of up to 4 megapixels and capture speed of 370 fps (at full frame 4MP resolution) to 2,000 fps
  - **MX T20**, with a resolution of up to 2 megapixels and capture speed of 500 fps (at full frame 2MP resolution) to 2,000 fps
  - **MX T10**, with a resolution of up to 1 megapixel and capture speed of 250 fps (at full frame 1MP resolution) to 2,000 fps
- **Earlier MX Cameras**
  - **MX F-series Cameras:** MX-F40 (F40) and MX-F20 (F20)
  - **MX+ Cameras:** MX40+, MX20+, MX13+, and MX3+
  - **MX Cameras:** MX40, MX13, and MX3

The T-Series is the next generation of motion capture cameras; it is the primary focus of camera descriptions in this book. For details on these newest MX cameras, see Chapter 2 MX T-Series Cameras. For details on any earlier MX cameras incorporated in your Vicon MX T-Series system architecture, see the Vicon MX Hardware System Reference supplied with your original cameras.

Vicon MX Controlling Hardware Units

The controlling hardware unit in a Vicon MX system architecture connects the MX cameras to the MX Host PC running the MX software that enables you to capture and analyze your data.

- **MX Giganet (T-Series)**

  Every Vicon MX T-Series system includes at least one MX Giganet to provide power and data communication to MX cameras and other devices. The Giganet also manages the data flow to the MX Host PC running the software that enables you to capture and analyze your data.

  You can include multiple MX Giganets in your Vicon MX system architecture, enabling you to scale the number of MX cameras, supported third-party reference video cameras, and supported third-party devices in your MX system. Each MX Giganet can connect up to 10 Vicon MX T-Series cameras and up to four additional devices, such as Basler GigE cameras or other ethernet devices.

- **Earlier MX Hardware Units**

  You can include the following MX hardware units from earlier Vicon MX systems in your Vicon MX T-Series architecture, enabling you to incorporate earlier MX cameras and other hardware units into your MX T-Series system:

  - **MX F-series system:** MX Ultranet HD
  - **MX+ system:** MX Ultranet
  - **MX system:** MX Net

  Important
  MX Control and MX Bridge are not compatible with the Vicon MX T-Series system.If you are using these units in your existing MX system, for a new MX T-Series system you must remove them and use an MX Giganet instead. If you need assistance on replacing MX Control or MX Bridge units, or incorporating an MX Net, contact Vicon Support (see Technical Support on page 198).

The MX Giganet is the new core unit in the MX family; it is the primary focus of the hardware unit descriptions in this book. For details on this newest MX controlling hardware unit, see Chapter 3 MX Giganet. For details on any earlier MX controlling hardware units incorporated in your Vicon MX T-Series system architecture, see the Vicon MX Hardware System Reference supplied with your original unit.

Vicon MX Host PC

The MX Host PC runs the Vicon motion capture software which analyzes and presents the data captured by the MX cameras.

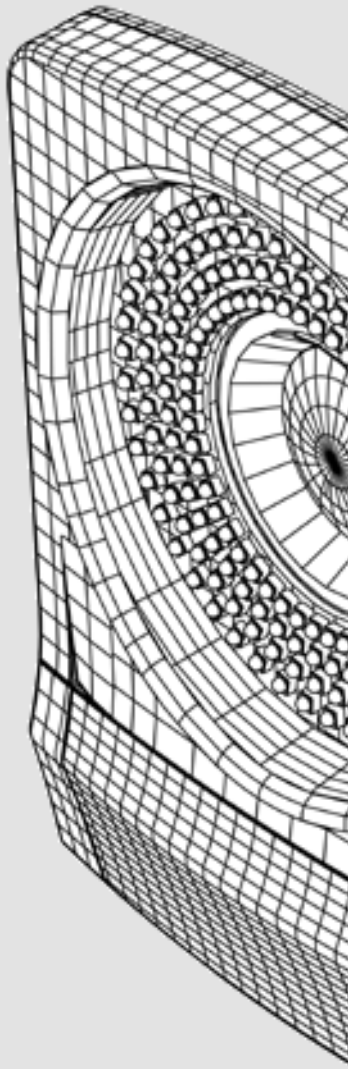
This computer contains a dedicated Gigabit Ethernet port to enable MX system communications between the Vicon application software installed on this computer and the MX Giganet. This port is in addition to any other network ports on the PC for connecting it to the rest of your network.

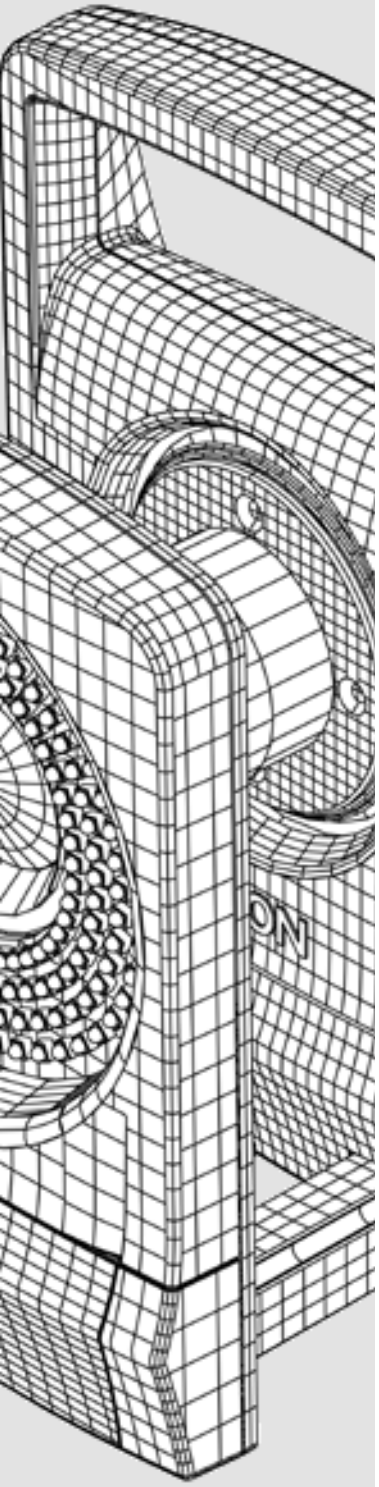
Any Vicon motion capture and analysis software to be used with Vicon MX T-Series is installed on this MX Host PC; for further details on this computer, see Chapter 4 MX Host PC. Remote PCs may be used for other Vicon software or supported third-party applications.

Vicon MX Software

Vicon MX T-Series supports the following versions of Vicon motion capture software for animation, engineering, and life sciences applications:

- Blade 1.5 and later
- Nexus 1.4 and later





This motion capture software is installed on the MX Host PC; for further details on this software, see Vicon Application Software on MX Host PC on page 40. Vicon also provides a range of data visualization, analysis, and manipulation software (for details, see the Software page of the Vicon Web site).

Vicon MX Cables

A combination of proprietary Vicon and commercially available cables are used to connect hardware devices in a Vicon MX system architecture. For details on these, see Chapter 5 MX T-Series System Cables.

MX Calibration Device

The proprietary MX 5-marker wand and L-frame device is used to calibrate the MX system. For details on these, see Chapter 6 MX Calibration Device.

MX Accessories

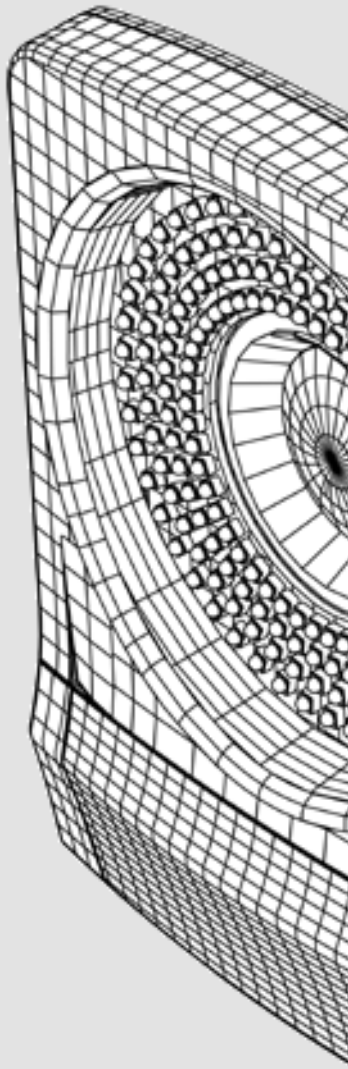
Motion capture supplies such as Vicon retroreflective markers, marker-fixing tape, Micropore and Gaffer tape, and Velcro are available. For details on these, see Chapter 7 MX Accessories.

Third-Party Devices (optional)

You can incorporate the following third-party devices in your Vicon MX T-Series system:

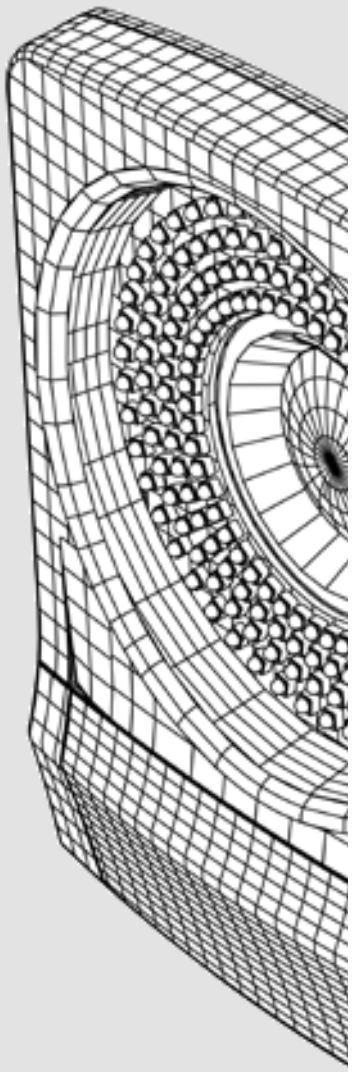
- External analog peripheral devices, such as force plates, electromyography (EMG) equipment, and accelerometers
- External digital peripheral devices, such as ZeroWire EMG devices
- External video devices supporting analog EBU, SMPTE, or HD video signals
- Gigabit Ethernet devices passing through the Giganet for connection to the MX Host PC
- FireWire (IEEE 1394 OHCI compliant) digital video capture card
- Video cameras that conform to the IEEE 1394 Digital Video (DV), such as Basler A600 series cameras, or the IIDC 1394 Digital Camera (DCAM) standards
- Gigabit Ethernet Video cameras, such as Basler GigE Vision cameras

For a list of currently tested and supported third-party devices, contact Vicon Support or your nearest agent or distributor (for details, see Technical Support on page 198).



2 MX T-Series Cameras

This chapter describes the role of the MX T-Series cameras in a Vicon MX T-Series system, lists the available types of cameras, describes their physical structure (including lenses, controls and connectors, and associated strobe units) and explains their functional characteristics.



In This Chapter

Warning
There are no internal operator adjustments inside any components of the MX T-Series cameras. Refer servicing to qualified personnel.

MX T-Series Cameras in a Vicon MX System Architecture

Vicon MX T-Series cameras are optical cameras with multiple high-speed processors that perform real-time proprietary image processing. Vicon cameras capture the movement of Vicon markers rather than the body to which they are attached.

Vicon markers are retroreflective spheres that reflect light from the camera strobe units back into the Vicon motion capture cameras. Vicon markers come in a range of sizes appropriate for different types of motion capture. The markers are attached to a subject, or object, whose motion is to be captured. To obtain accurate results, you must position the markers on the subject at specific anatomical locations. These locations are defined in a Vicon Skeleton Template (VST) file for a generic type of capture subject or in a calibrated Vicon Skeleton (VSK) file for a specific capture subject. Your Vicon software documentation describes these files and how you attach markers to your subjects for motion capture in accordance with these files.

You position the cameras around the capture volume to ensure full coverage of the subjects whose motion you will be capturing. Data from at least two cameras is required to produce 3D reconstructions of the Vicon markers, so ensure the placement and orientation of all cameras has multiple cameras aimed at the same region of the capture volume, as shown in Figure 4.

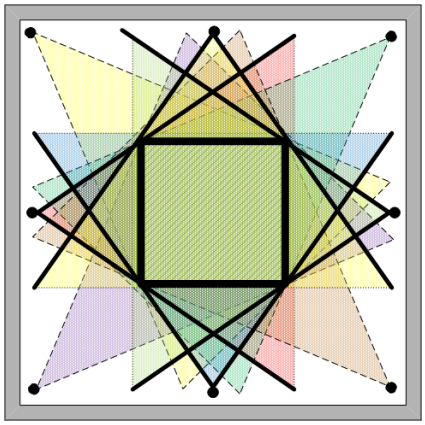
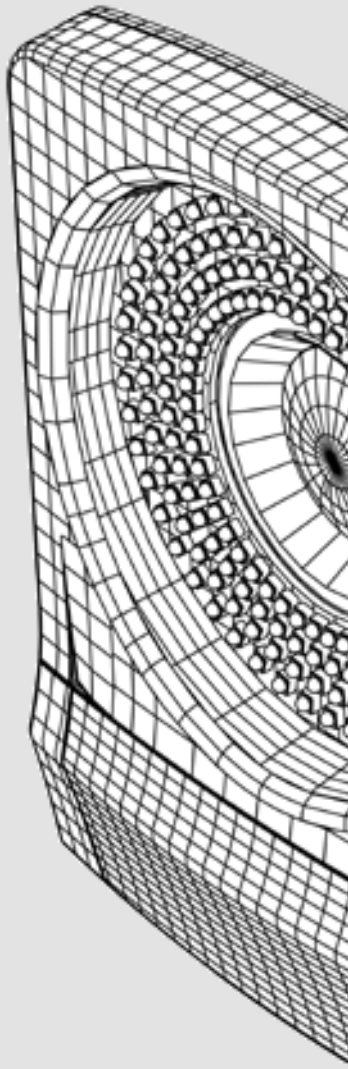
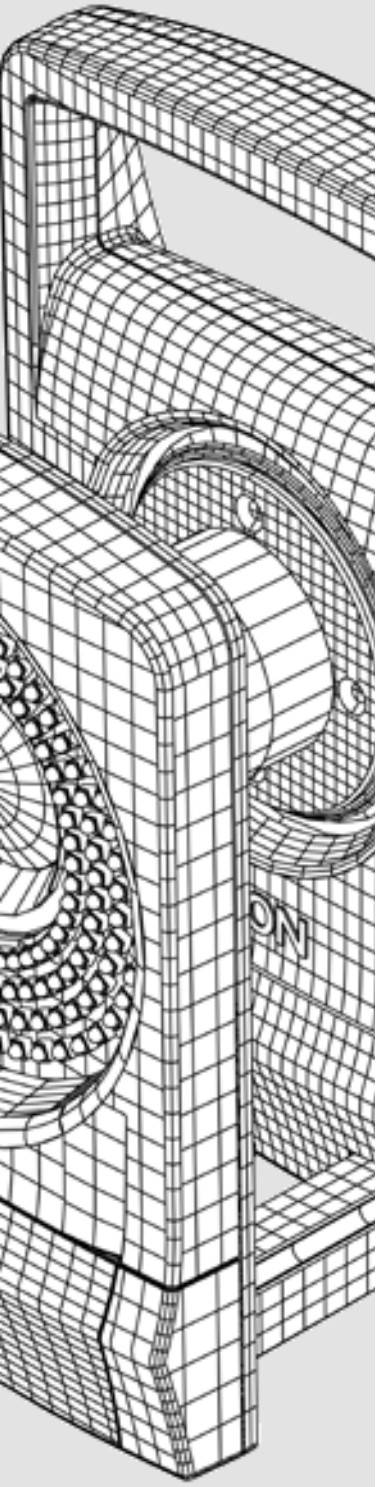


Figure 4: Multiple cameras viewing same region of capture volume

Actual positions will depend on your volume size and the camera lenses, but as a guideline, aim to offset cameras 2-3 meters from the edge of the volume, and space them evenly apart. For example, in a 12m x 12m lab or studio, you can expect a 6m x 6m capture volume. Remember, you'll need to include height as well as width and depth in your volume calculations. Depending on your capture requirements, you may choose to mount the cameras on tripods for floor-based cameras or on a clamp and truss on speed rails for raised cameras.





MX T-Series Camera Types

Vicon MX T-Series systems can include any of the T-Series range of proprietary Vicon motion capture cameras: T160, T40, T20, and T10.

The camera hardware design consists of a distinct video camera, a strobe head unit, a suitable lens, optical filter, and cables as shown in Figure 5.

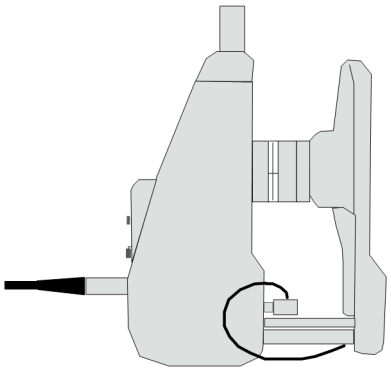


Figure 5: Vicon MX T-Series Camera

A single hardware design can be built with different types of sensors and lenses to create a range of cameras with different resolutions, as shown in Table 2.

Table 2: Vicon MX T-Series motion capture camera range

Camera	Sensor	Lens	Resolution
T160	Vicon AVALON-16	Vicon or SLR	16 Megapixels
T40	Vicon VEGAS-4	Vicon, SLR, or C-Mount	4 Megapixels
T20	Vicon VEGAS-2	C-Mount	2 Megapixels
T10	Vicon VEGAS-1	C-Mount	1 Megapixel

All MX T-Series cameras are high-quality devices, fitted with sensitive solid-state sensors, purpose-built for motion capture. All MX T-Series cameras provide high-speed and low-latency motion capture. Vicon subjects all of its cameras to stringent checks for linearity, sensitivity, and absence of jitter.

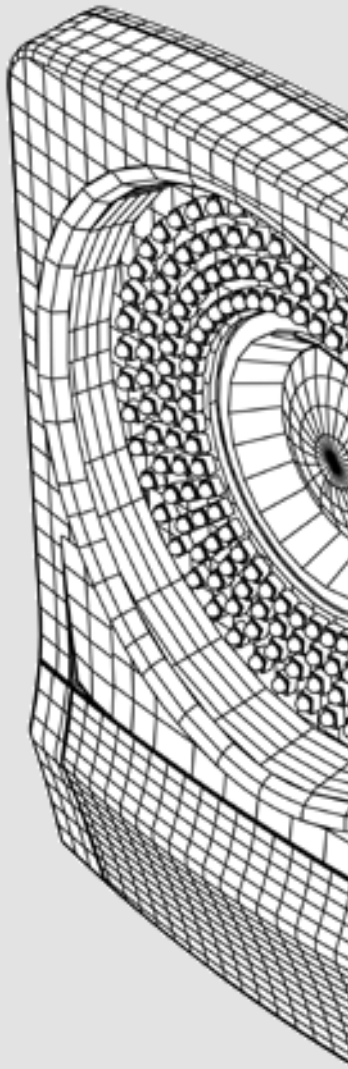
Different types of strobe units can be attached to cameras to suit specific studio, laboratory, or research unit lighting conditions. For further details, see MX T-Series Camera Strobe Units on page 20.

You can combine the various models of MX T-Series cameras within a single Vicon MX T-Series system to meet your application requirements for resolution and/or coverage. The MX T160 camera offers the highest resolution of the MX T-Series cameras. The MX T40 and MX T20 cameras can provide higher camera counts within a fixed budget, giving increased coverage, while the T10

is the economical replacement for the MX3+. Table 3 illustrates the performance of each MX camera type. For full details, see Chapter 18 MX T-Series Cameras Technical Specifications.

Table 3: T-Series camera performance

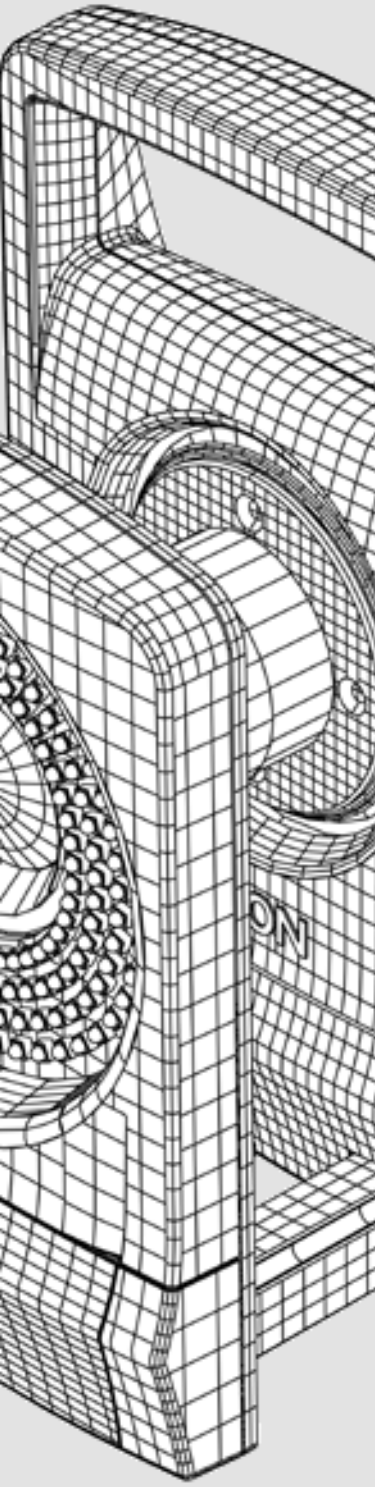
	Vicon MX T-Series Camera			
Performance	**T160**	**T40**	**T20**	**T10**
Sensor resolution (pixels)	4704 H x 3456 V	2352 H x 1728 V	1600 H x 1280 V	1120 H x 896 V
Sensor size (mm)	18.35 H x 13.48 V 22.77 (diagonal)	16.46 H x 12.10 V 20.43 (diagonal)	11.20 H x 8.96 V 14.34 (diagonal)	7.84 H x 6.27 V 10.04 (diagonal)
Maximum Frame Rate (fps) at full resolution	120	370	500	250



Each MX T-Series camera is programmed with firmware to control its operation and enable it to perform its own onboard grayscale processing. As all MX T-Series cameras use the same firmware, a mixture of T-Series cameras with different image sensors can be connected to and run on the same Vicon MX T-Series system. The Vicon MX T-Series system automatically recognizes cameras and their relevant characteristics when they are plugged in. A Vicon MX T-Series distributed architecture enables the camera software to be updated across the system network.

MX T-Series cameras evaluate an entire image in grayscale, rather than applying a black and white threshold. This provides more information and increases motion measurement accuracy over an equivalent resolution black and white camera. The MX T-Series cameras perform the majority of data processing. They generate grayscale blobs for reflections from objects in the capture volume and then use centroid-fitting algorithms to determine which of these objects are likely to be markers.Camera data is sent to Vicon application software for viewing and further processing. For details, see your Vicon software documentation.

Even with the elimination of background grayscale through thresholding, MX T-Series performance will be limited in real time by the number of cameras, number of markers, and the frame rate. Data capture to disk is limited by the time it takes to write the data to disk as no buffering outside the MX Host PC is available. However, you can configure the buffering of camera data at the time of capture. You do this in the Vicon software on the MX Host PC; for details, see your Vicon software documentation.



Vicon MX T-Series hardware components are automatically assigned master (controlling device) or subordinate (controlled device) status. Each Vicon MX T-Series system has only one master MX Giganet, which provides the synchronization to the rest of the system and is established automatically during system booting. For details, see MX Giganet in a Vicon MX System Architecture on page 28.

MX T-Series Camera Controls and Connectors

This section describes the physical structure of Vicon MX T-Series cameras and the connections and cables that are used to connect them to other system components.

Vicon MX T-Series cameras have been designed to consolidate all video and strobe functions in a single unit and to automatically set strobe durations and video frame rates directly from the Vicon software on the MX Host PC. The remote camera control functionality enables you to adjust the lens focus and aperture from your Vicon application software.

Camera Rear Panel

Figure 6 shows the camera controls on the rear panel of a MX T-Series camera.

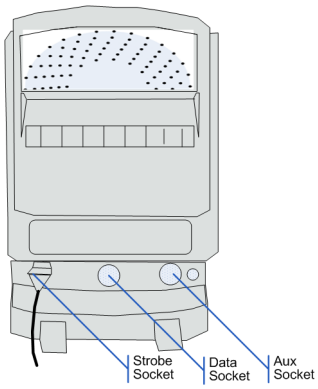


Figure 6: T-Series camera rear panel

The rear panel contains the following connection points:

- **Strobe Socket**

  6-pin Lemo socket. Connects the camera strobe unit to the back of the camera. For details on strobe units, see MX T-Series Camera Strobe Units on page 20.

- **Data Socket**

  8-pin Lemo socket. Connects MX T-Series camera to the MX Giganet using the MX Gigacable, which supplies power and synchronization signals to the

camera and carries the Ethernet control and data signals to and from it. For details on the MX Gigacable, see Chapter 5 MX T-Series System Cables.

- **Aux Socket**

  7-pin Lemo socket. Reserved for Vicon internal use.

These are dust-proof connectors, which extend the reliability of the cameras in dusty environments such as busy production studios, sports halls, and gymnasiums.

Camera Lens Mount

MX T40, T20, and T10 cameras have a C-Mount lens connection. The lens is secured in place by a locking ring that can be tightened and loosened using the lever rods protruding on either side. SLR lens types are attached to an MX camera using the supplied connection adapter. This adapter enables you to remotely adjust the lens aperture and focus. from your Vicon application software.

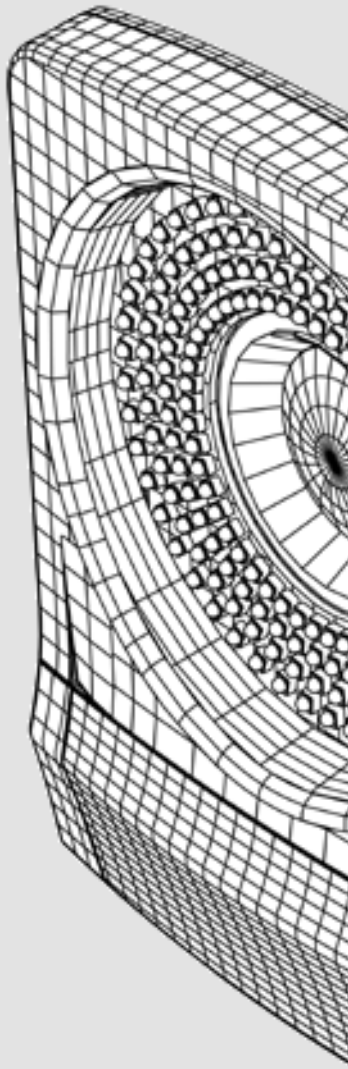
Tripod Mount

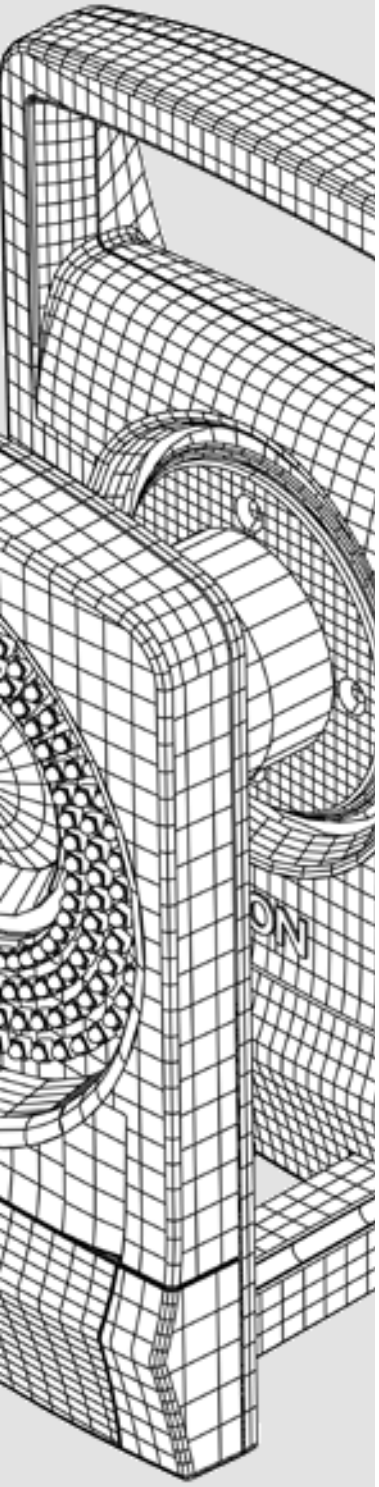
The underside of the camera body contains a mounting plate, which has a ¼"-20UNC threaded hole in its center. This is designed to match the common thread found on most tripod and wall mount fixing screws. For safety and optimum performance, Vicon strongly recommends that you use with Vicon MX cameras only tripods and wall mounts that Vicon Motion Systems has specified as suitable.

MX T-Series Camera Strobe Units

The strobe unit on the front of an MX T-Series camera contains hundreds of surface-mount LEDs (Light Emitting Diodes), which illuminate the capture volume. The strobe unit generates a bright flash of light, which illuminates the markers (coated with a highly retroreflective material) attached to the motion capture subject. The reflected strobe light passes through the lens and optical filter with a spectral response such that only light with the same characteristics as the strobe passes into the camera. The lens collects the light and forms a focused image of the markers on the camera's sensor plane. The camera electronically converts the pattern of light into data that represents the position and radius of each marker in the image. For details on the filters supplied with each strobe unit, see Camera Lens Filters on page 26.

The LED array for MX T-Series camera strobe units, shown in Figure 7 on page 21, have a wide illumination angle and are all aligned forwards, giving even illumination across the volume without the need to manually optimize the LEDs. This reduces the need to adjust camera parameters in the Vicon motion capture software during system setup.





These strobe units are available by default in Visible Red (VR) and Near Infrared (NIR) versions. If you require Infrared (IR), contact Vicon or your nearest agent or distributor. The VR T-Series strobe is 2.5 times brighter than the standard VR strobes and 5 times brighter than NIR strobes. The NIR T-Series strobe is about 2 times as bright as the previous MX NIR strobe. These improvements increase the camera range, so smaller markers can be used and more detail can be captured.The increased power means that the camera can be operated at faster speeds with reduced loss in quality of image.

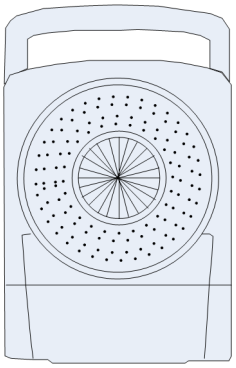


Figure 7: Strobe unit

Caution
Do not look directly at the source when an NIR or IR strobe unit is in operation.

Strobe Unit Mount

The strobe unit is mounted using a slide mechanism, which is secured to the camera body with a push-button release on the side. If you need to adjust the camera, you can easily remove the strobe unit from the camera body with one hand.

Strobe Unit Status LEDs

The blue status LEDs on the front of the strobe unit front panel provide feedback on the camera's operation:

- **Logo Light**

  The blue Vicon logo on the middle front of the strobe unit. When the MX Giganet starts up the connected T-Series cameras, this Vicon logo light glows blue.

- **Status Light**

  The blue status LED on the lower front of the strobe unit. Indicates the status of that camera and its state within the Vicon software on the MX Host PC.

When the MX Giganet starts up a connected T-Series camera, this blue LED is illuminated and remains on for 15-20 seconds and then turns off. When the Vicon software is started, this blue LED is illuminated until the camera is recognized and then the blue LED turns off. This status light is controlled by the Vicon motion capture software; for full details on its functionality see your software documentation.

MX T-Series Camera Lenses

The function of the camera lens is to collect reflected light from a scene and form a focused image on the camera's sensor plane. The type of lens that will provide optimum performance for a particular application depends on various factors, including the field of view (FOV), image circle, aperture and depth of field, and any lens filter fitted. For descriptions of these, see Camera Lens Characteristics on page 22.

The proprietary Vicon lenses designed for T-Series cameras have been custom-built for motion capture. They have a large image circle to ensure that the entire image—not just the center— is evenly illuminated. The SLR and C-Mount lenses recommended for T-Series cameras have been selected based on this criteria for image format size suitable for high-resolution sensors.

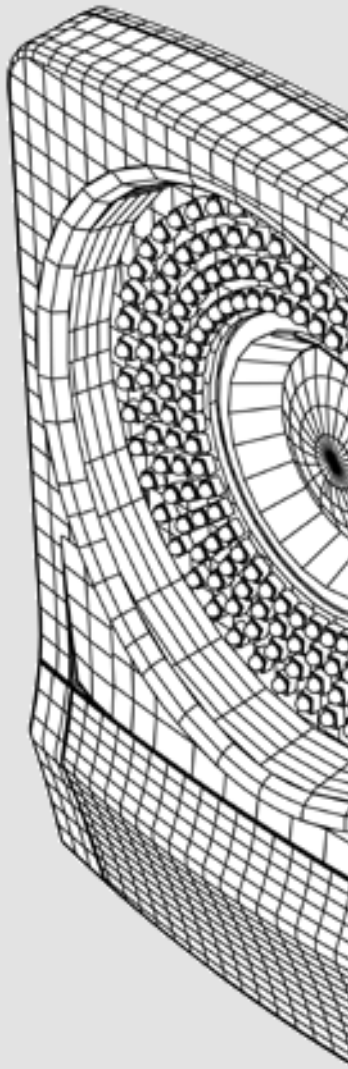
Other commercially available lenses are not designed to work with high resolution cameras; they tend to have a limited resolving power (the ability to measure differences of angles between markers) more suitable for sensors with a resolution of less than two megapixels. As a result, when capturing with small markers close together, the lens can have difficulty resolving the gap between the markers, causing merging even when the focus is optimal. For further details on MX camera lens specifications, see MX T-Series Cameras Technical Specifications on page 139.

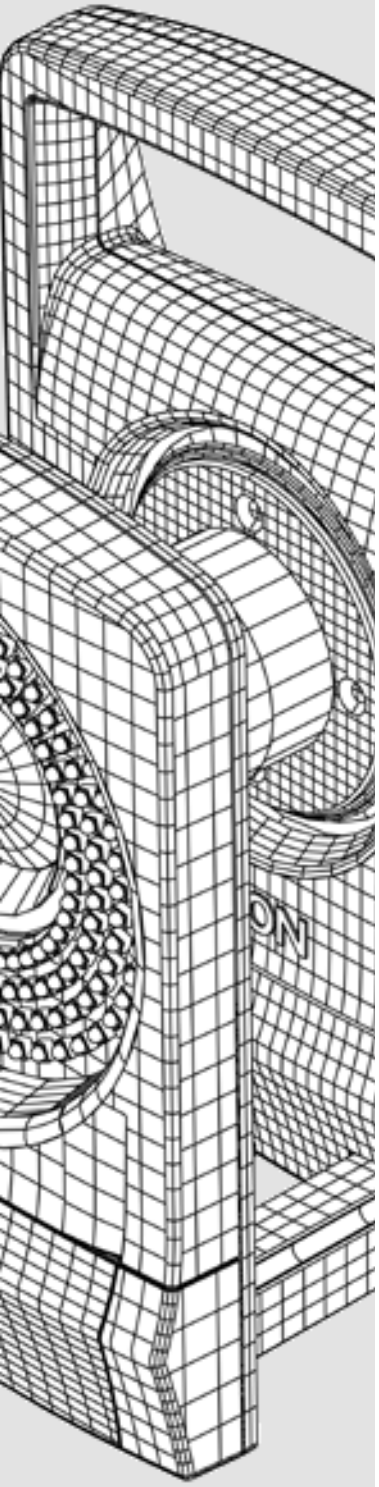
Important
Vicon has a policy of only using the best quality lenses with its cameras. Should you need to change lenses, please contact Vicon or your nearest agent or distributor for advice.

Camera Lens Characteristics

This chapter discusses factors to consider in choosing a lens type:

- Field of View on page 23
- Image Circle on page 24
- Aperture and Depth of Field on page 26
- Camera Lens Filters on page 26





Field of View

The most important factor in determining the lens to use with a Vicon MX T-Series camera is the total area the camera can see using a given lens. This is called the Field of View (FOV).

The scene that comprises the FOV has horizontal width (H) and vertical height (V). Knowing the distance (L) between the camera and a plane that defines the total FOV helps to select the type of lens to meet a particular application.

Lenses are described in terms of their focal length (f), defined as the distance in millimeters that the center of the lens must be from the sensor plane surface to project a sharp image on the sensor. The focal length of a lens is often given on the body of the lens or around the surround of the glass element at the front of the lens as well as in the lens documentation and packaging.

The focal length determines the angle of view (AOV) through the lens, as shown in Figure 8.

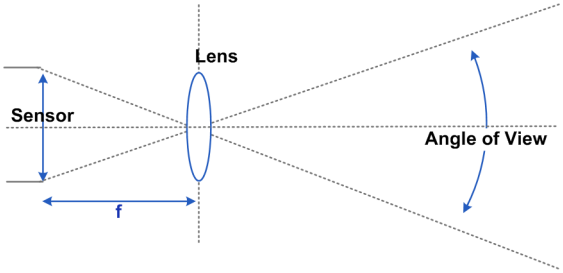


Figure 8: Angle of View calculation

Normally, the AOV is calculated based on the known focal length and sensor size. This in turn determines the FOV, based on the distance (L) to the object being captured. Figure 9 illustrates how the FOV is calculated.

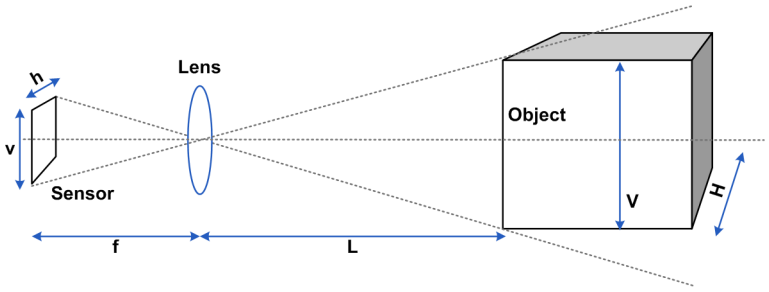


Figure 9: Field of View calculation

The sensor area used for capturing data through each MX T-Series camera determines the maximum FOV available for a particular combination of camera and lens. The area of the sensor is determined by its horizontal width (h) and vertical height (v).

The capture frame rate for each MX T-Series camera can be configured in the Vicon application software (for details, see your Vicon software documentation). The configured frame rate will also affect the field of view. Higher camera frame rates may make vertical windowing of the sensor necessary such that the sensor area used for capture is reduced in comparison to lower camera frame rates.

Image Circle

Another characteristic of the camera sensor is the image circle. This is the sharp circular image that the camera lens casts onto the sensor, as shown in Figure 10.

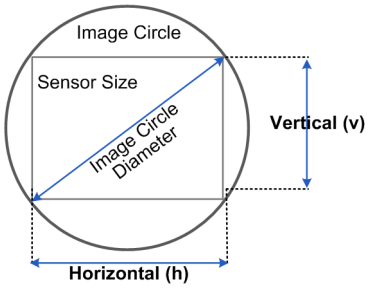
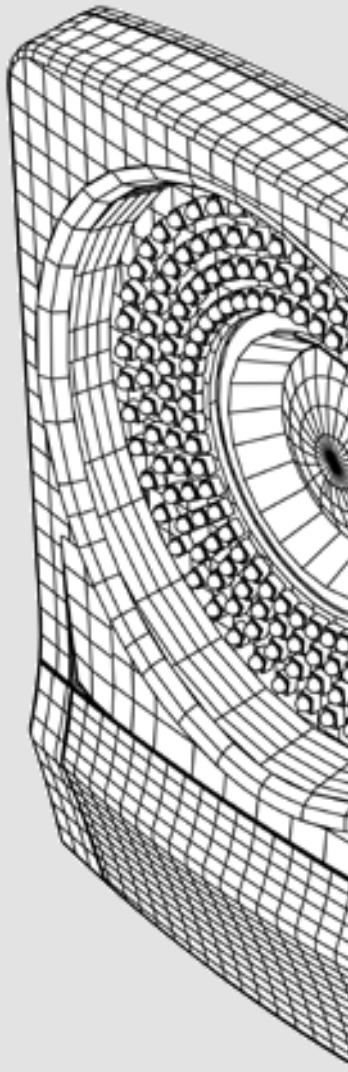


Figure 10: Image circle

The diameter of this image circle is the maximum area of usable quality image that the lens can produce. Most lenses produce their best image at the center of the lens, dropping off in performance towards the outer extremes of the lens. This results in a gradual darkening towards the edges of the image, known as vignetting. Theoretically, vignetting gets worse for wider angle lenses and for wider open apertures, but the area at which vignetting starts to occur depends on the lens.

Thus, for optimum performance, the image circle projected should be larger than the sensor area used by the camera. This ensures that the entire sensor is utilized and eliminates the fall-off of light that occurs towards the edge of the image circle. If the image circle of a lens is too small for the sensor size, then the camera image around the edges and corners is lost. MX T-Series cameras are fitted with lenses that have an appropriately-sized image circle for the sensor.

If you wish to change the supplied lens, you must consider the sensor size of the new lens. Even if the focal length of the new lens is the same, a different sensor size will produce a different field of view. For example, the sensor sizes of C-Mount lenses are specified in formats of 1", 2/3", 1/2", 1/3", and 1/4", which reflect a ratio of 1:0.69:0.5:0.38:0.25. Thus, a 1/2" format is 50% of a 1" format, a 1/3" format is 75% of a 1/2" format, and so on. For guidance on the necessary



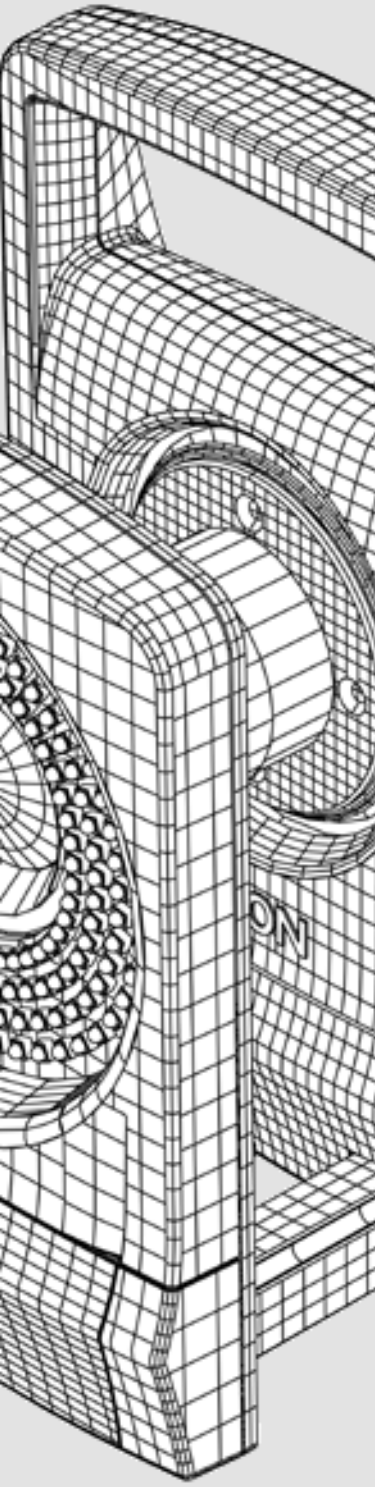


image circle diameter for a specific sensor format, see MX T-Series Cameras Lens Specifications on page 156.

Table 4 gives the formulae used to calculate the angle of view (AOV) and field of view (FOV) for camera and lens combinations. These formulae require the dimensions of the sensor area used for each of the MX Cameras at different frequencies.

Table 4: AOV and FOV formulae

Horizontal AOV (°)	Vertical AOV (°)	Horizontal FOV Width H (m)	Vertical FOV Height V (m)
2 x Tan^{-1} (h/2f)	2 x Tan^{-1} (v/2f)	h x L/f	v x L/f

where:

f = focal length of the lens (mm)

h = horizontal width of sensor (mm)

v = vertical height of sensor (mm)

L = distance from the lens to the object (m)

For sensor size details, see MX T-Series Camera Types on page 17.

As an example, consider an MX T160 camera with an 18 mm lens operating at 160 Hz at a distance of 9 m from the target markers. Given the T160 sensor size (18.35 mm(H), 13.48 mm(V)), you would calculate:

Horizontal AOV:	`2 x Tan-1 (18.4/2 * 18) = 54.1 °`
Vertical AOV:	`2 x Tan-1 (13.5/2 * 18) = 41.1 °`
Horizontal FOV at 9m:	`0.0184 x (9/0.018) = 9.2 m`
Vertical FOV at 9m:	`0.0135 x (9/0.018) = 6.75 m`

Important

These formulae take into account only the optical components of the camera and lens, thus they calculate the maximum possible theoretical Field of View from this combination. Poor illumination of the volume by camera strobes, less than optimal aperture or gain settings, or poor marker surface quality might all reduce the FOV in which a camera can recognize a marker below this maximum theoretical level.

When using these formulae, please note that for frequencies above the full-resolution frequencies given for MX T-Series in MX T-Series Cameras Lens Specifications on page 156, the sensor area is reduced due to vertical windowing, as described in Field of View on page 23.

Aperture and Depth of Field

Another significant factor in choosing a lens type is the aperture (also known as the f-stop value, f-number, and F#), which refers to the speed with which the lens can pass light in a given time.

The aperture is the ratio of the focal length of the lens to the diameter of the lens opening, which determines the amount of light that can pass through the lens in a given time. Smaller f-stop values (e.g. f2, f2.8) represent wider apertures that allow more light to pass through, while larger f-stop values (e.g. f11, f16, f22) represent narrower apertures that allow less light to pass through. Typically, faster lenses have larger diameter optics that can pass more light.

Each f-stop value changes the lens opening from the next f-stop by a factor of 2. For example, decreasing the aperture from f11 to f8 allows twice as much light to pass through. Increasing the aperture from f11 to f16 allows half as much light to pass through.

The aperture and magnification affect the depth of field, that is, the portion of the image that has sharp focus. Immediately surrounding this area, there is a region in which the image remains in focus. Outside of this area, moving towards or away from the lens, the focus becomes progressively less sharp and the image appears out of focus.

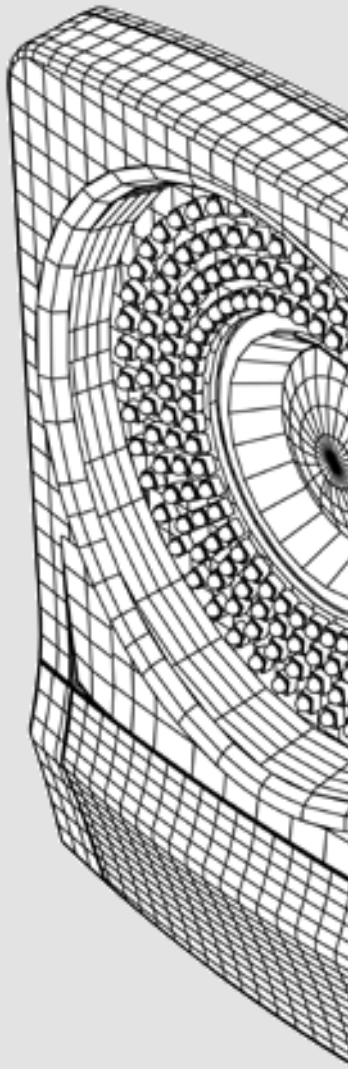
Thus, as the aperture and focal length decrease, the depth of field increases. Conversely, as the aperture and focal length increase, the depth of field decreases.

Camera Lens Filters

In order to optimize the performance of the MX T-Series cameras, each lens is fitted with an optical filter to attenuate wavelengths of light other than those emitted by the light emitting diodes (LEDs) in the MX strobe unit and reflected back from the markers to the camera.

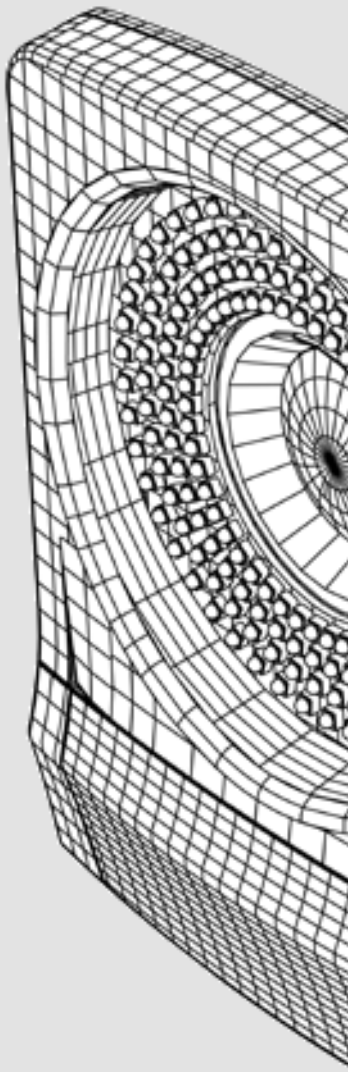
The T40, T20, and T10 cameras are fitted as standard with low-pass absorptive filters (allowing low-frequency light to pass) appropriate for the fitted strobe unit. These MX T-Series cameras are less susceptible to interference from background light levels. The T160 obtains better performance using a much sharper band-pass interference filter appropriate for the fitted strobe unit.

For details on MX T-Series camera shutters, see Chapter 18 MX T-Series Cameras Technical Specifications. For details on strobe units, see MX T-Series Camera Strobe Units on page 20.



3 MX Giganet

This chapter describes the role of the MX Giganet in a Vicon MX T-Series system, describes its physical structure (including controls and connectors), and explains its functional characteristics.



In This Chapter

MX Giganet in a Vicon MX System Architecture

The MX Giganet is the core unit for a Vicon MX T-Series system. Every Vicon MX T-Series system includes at least one MX Giganet to provide power and data communication to MX cameras and other devices. The Giganet also manages the data flow to the MX Host PC running the Vicon software that enables you to capture and analyze your data.

An MX Giganet provides the following functions in a Vicon MX T-Series system:

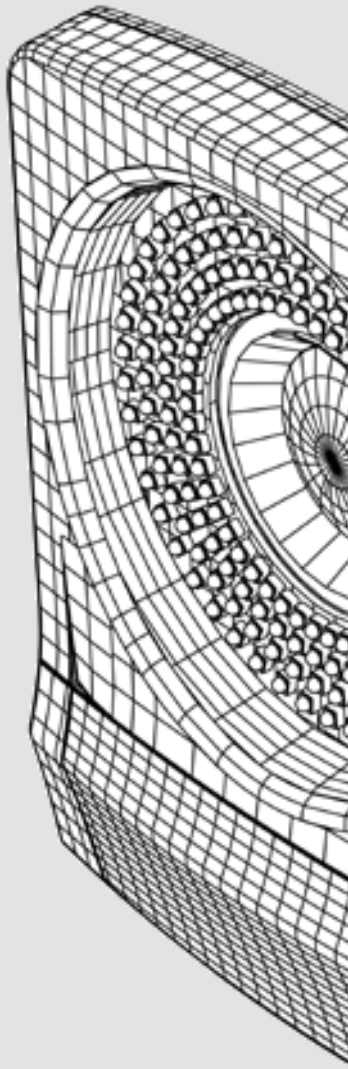
- Supplies power, synchronization, and communications for up to 10 connected MX T-Series cameras.
- Supplies direct synchronization out (sync out) functionality for up to eight third-party reference video cameras, and supplies power as well as synchronization for up to four of these.
- Provides the interface between Vicon MX T-Series and third-party analog capture devices, such as force plates, electromyography (EMG) equipment, and other digital devices.
- Provides the interface between Vicon MX and third-party external devices that either Vicon MX can trigger or that can remotely trigger data capture by the Vicon MX system or send synchronization signals.

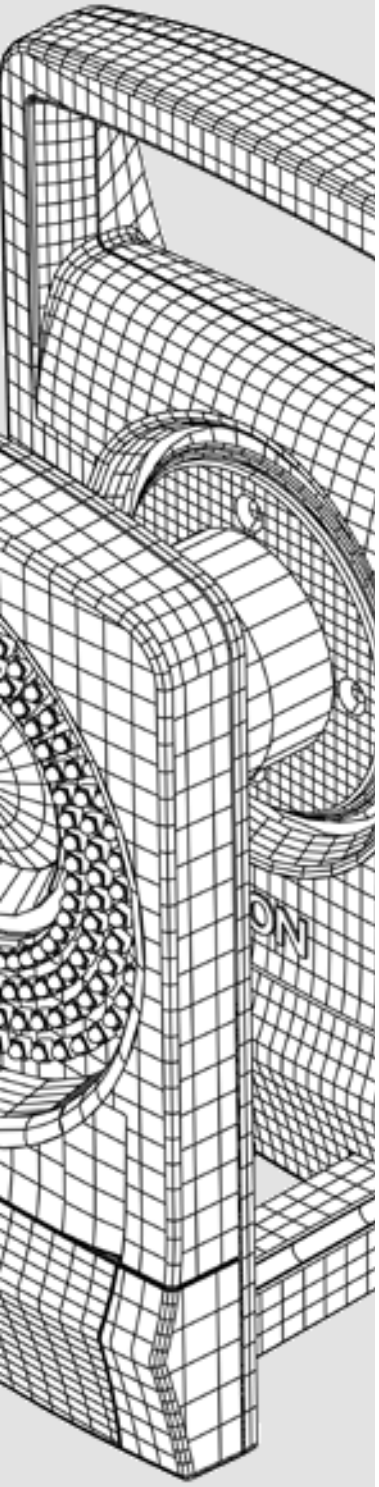
Important
Synchronization and remote triggering functionality are application dependent. For details on supported functionality, see your Vicon application software documentation.

The MX Giganet offers system scalability, enabling you to incorporate additional MX Giganet units in your Vicon MX T-Series system to meet your needs. Only one MX Giganet in any system will be connected to the MX Host PC. This unit is referred to as the primary MX Giganet. Additional MX Giganet units connected to this primary MX Giganet are referred to as subordinate MX Giganet units.

In a system incorporating multiple MX Giganet units, the primary MX Giganet can also connect to up to four subordinate MX Giganet units which enable additional cameras to be used. Gigabit Ethernet communication between the MX Giganet units in such a system ensures adequate data flow for high marker counts in real time.

Caution
The Vicon MX Giganet transfers data between MX units over the MX Ethernet network at rates of up to 1000 Mbps. This assumes that the MX Host PC is correctly configured with a Gigabit Ethernet network card. While Vicon MX is capable of transferring data over a 100 Mbps Ethernet network, Gigabit Ethernet communication is recommended. For details, see Chapter 4 MX Host PC.





The primary MX Giganet manages communication to and from the MX Host PC and the MX cameras connected to it, as well as to and from any subordinate MX Giganet units and their connected cameras. Using a fully populated primary MX Giganet in conjunction with four fully populated subordinate MX Giganet units enables a total of 50 MX cameras as well as reference video cameras, or alternative devices to be connected.

One MX Giganet (not necessarily the primary MX Giganet) is designated as the system synchronization master and routes timing and synchronization signals around the system.

The MX Giganet is a 2U unit that can be rack-, wall-, or floor-mounted and stacked either horizontally or vertically.

MX Giganet Front Panel

Figure 11 illustrates the front panel of the MX Giganet.

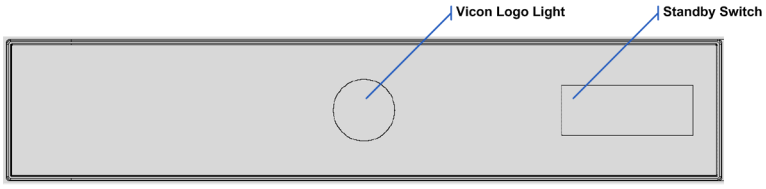


Figure 11: MX Giganet front panel

The front panel contains the following LED indicator and control:

- **Vicon Logo Light**

  The blue Vicon logo on the middle front of the Giganet for indicating status of unit startup. On starting the unit, glows a dim blue, pulsates at brief intervals, and then glows a steady, bright blue when the Giganet has finished booting up.

- **Standby Switch**

  The soft switch on the right front of the Giganet unit for managing standby mode.This switch is enabled after you turn the unit on using the On/Off switch on the back. You can then press the soft switch on the front of the unit to put the Giganet into standby mode. Press the soft switch again to turn the Giganet back on. The Giganet goes through its boot-up sequence with the Vicon logo.

  To turn the Giganet completely off, use the On/Off switch on the back of the unit. Even when fully switched off, power is still being supplied to the unit, though the LEDs are no longer illuminated.

MX Giganet Rear Panel

The rear panel of the MX Giganet contains all the connections for your MX T-Series system. Figure 12 illustrates the MX Giganet rear panel connectors.

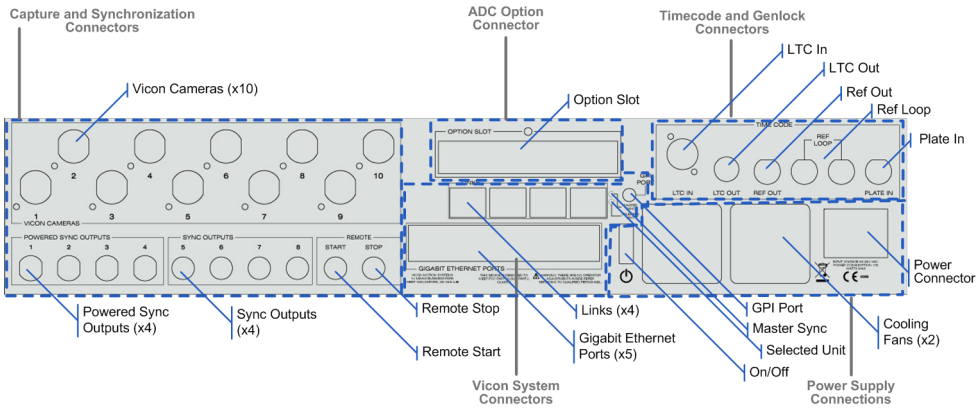


Figure 12: MX Giganet rear panel connectors diagram

You can connect other Vicon MX units and supported third-party devices included in your Vicon MX T-Series system architecture to the MX Giganet:

- Capture and Synchronization Connectors on page 30
- Option Slot on page 32
- Vicon System Connectors on page 33
- Timecode and Genlock Connectors on page 32

In this book, the terms socket and plug are used for female and male connectors respectively.

Capture and Synchronization Connectors

The Giganet rear panel contains the following connectors for capture and synchronization (from left to right and top to bottom of the unit):

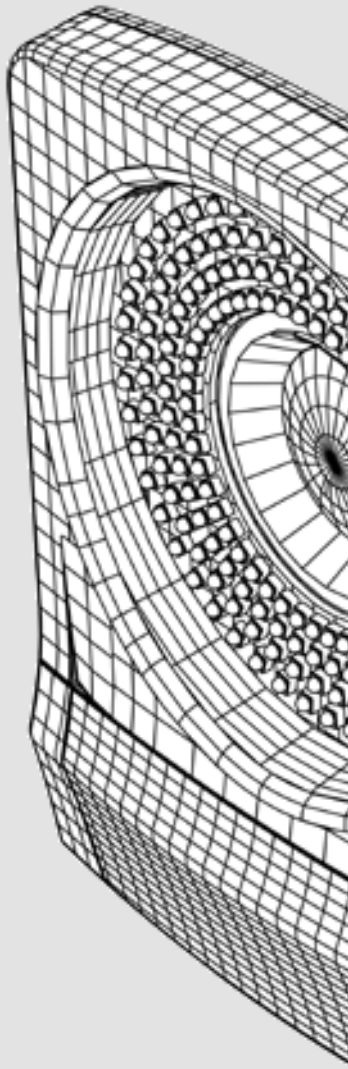
- **Vicon Cameras**

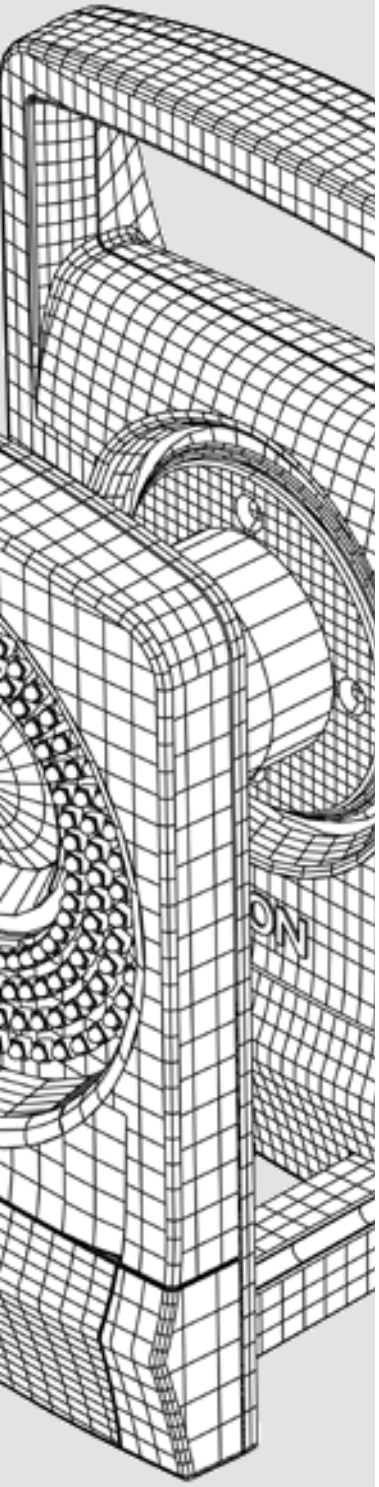
  10 sockets, in sequence 1-10 (from left to right, staggered top to bottom) and corresponding LED status indicators (on the bottom left of the sockets):

  - 8-pin Lemo sockets for connecting MX T-Series cameras.
  - Green status LEDs indicating whether or not there power to that port:

    On: The port is receiving power.

    Off: The port is receiving power.





Important
The MX Giganet boots the connected cameras in sequence from 1-10 in 0.5 second increments. If a T-Series camera is drawing too much current (which may indicate a short circuit), the MX Giganet automatically reboots all connected T-Series cameras in sequence starting from the camera connected to socket 1.

- **Powered Sync Outputs**

  Four 3-pin Lemo sockets for powering and synchronizing external Gigabit Ethernet (GigE) devices using General Purpose Output (GPO) signals like Gigabit Ethernet cameras (such as Basler GigE Vision) used for reference video.

- **Sync Outputs**

  Four standard RCA phono sockets for synchronizing external devices using General Purpose Output (GPO) signals, like DCAM cameras (such as Basler A600 series) used for reference video.

- **Remote**

  Two sockets:

  - **Start**

    Standard RCA socket for an external device using General Purpose Input (GPI) signals to activate the remote start functionality.

  - **Stop**

    Standard RCA socket for an external device using General Purpose Input (GPI) signals to activate the remote stop functionality.

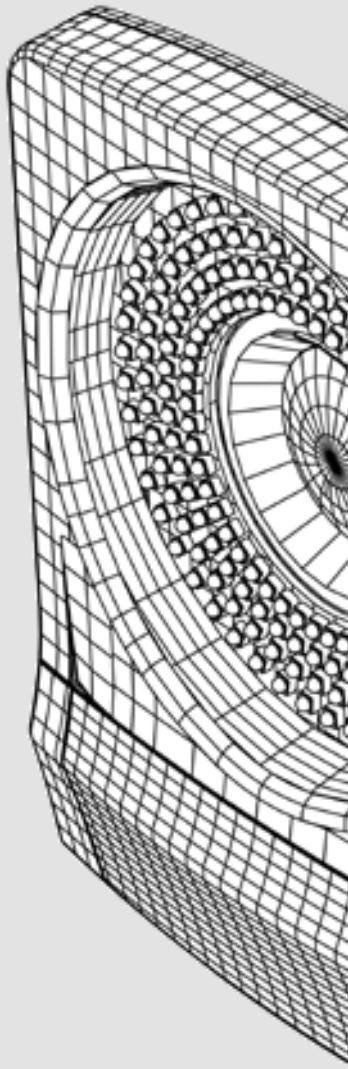
To synchronize devices, such as GigE cameras, connected to the **Powered Sync Outputs** sockets, you must configure the GPO properties for the MX Giganet in your Vicon MX software; for details on doing this, see the documentation for your Vicon software. For details on synchronizing, and optionally triggering, third-party devices with your Vicon system, see Chapter 13 Extend MX System with Synchronized Output Devices.

To trigger capture by the Vicon MX system from a remote control device, you must configure your Vicon MX software to use the device connected to the **Remote Start** and **Stop** sockets; for details on doing this, see the documentation for your Vicon software. For details on enabling third-party remote devices to trigger your Vicon system, see Chapter 14 Extend MX System with Remote Triggering Devices.

Option Slot

The **Option Slot** on the rear panel of the MX Giganet can contain the **Analog ADC** option card connector. This is a 100-way socket for a third-party devices for capturing analog data such as force plates, electromyography (EMG) equipment, potentiometers, and accelerometers.

This socket is present if a 64-channel analog ADC (Analog-to-Digital Converter) option card is installed in the MX Giganet. To use an analog device, you must connect the analog ADC card in the MX Giganet to the analog device via the Vicon patch panel using the supplied 100-way cable. You may need to create your own connector to plug your analog ADC device into the Vicon patch panel. For details, see Chapter 12 Extend MX System with Analog Capture Devices. For information on configuring your system for analog data capture, see the documentation for your Vicon software.



Timecode and Genlock Connectors

The rear panel of the MX Giganet contains the following Timecode and Genlock connectors (from left to right of the unit):

- **LTC In**

  Mini-XLR socket for connecting an external video or audio source that transmits LTC (Longitudinal Interval Time Code) to the MX Giganet.

- **LTC Out**

  Mini-XLR plug for connecting an external video or audio device that receives LTC timecode from the MX Giganet.

- **Ref Out (Composite Video)**

  BNC socket for connecting an external broadcast video source that receives outgoing video signals that have been modified by the Timecode functions from the MX Giganet.

- **Ref Loop (Composite Video)**

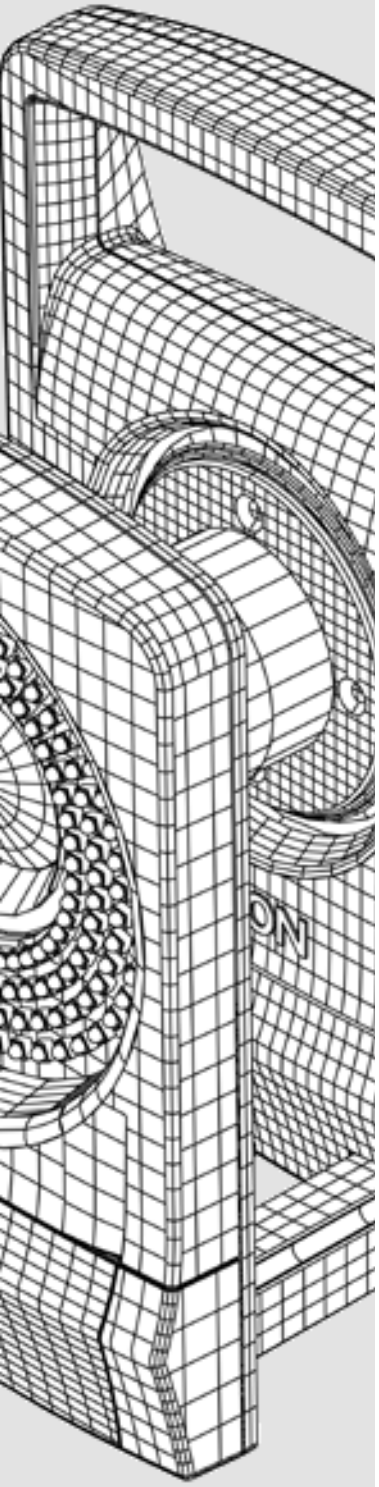
  BNC sockets for connecting an external video source that transmits a composite video signal—which may include VITC (Vertical Interval Timecode)—from the master video source to the MX Giganet and any other synchronized video or audio devices in a chain. The MX Giganet must be genlocked to this external video source.

  Important
  If the MX Giganet is the last device in the chain, the **Ref Loop** connection that is not being used for signal output must be terminated using a 75 Ω (ohms) terminator.

- **Plate In (Composite Video)**

  BNC socket for a video signal to allow overlaying of burn-in timecode and VITC on that signal, routed to **Ref Out**, instead of on to the video signal



received on the **Ref Loop**. The external video source must also be plugged into the **Ref Loop** socket, and the MX Giganet must be genlocked to this external source.

Important
This video burn-in functionality is reserved for future use.

For details on using external Timecode and Genlock devices to synchronize your Vicon MX system with a separate video system, see Extend MX System with Timecode/Genlock Devices on page 115.

Vicon System Connectors

The rear panel contains the following connectors and LED status indicators for connecting the MX Giganet to other Vicon MX components:

- **Links**

  Four device sockets and corresponding pairs of LED status indicators (located to the bottom left and right of the sockets), including:

  - 10-pin RJ-45 sockets for connecting to other MX Giganet units.

    Use these connections for systems whose number of MX cameras is greater than 10. Multiple, subordinate MX Giganets (or earlier MX units such as MX Ultranet HDs, MX Ultranets, or MX Nest) can be connected to a primary MX Giganet.

    - Green LED on lower left indicating which (if any) of the connected subordinate MX Giganets is receiving the master synchronization signal for the system.
    - Yellow LED on lower right not used.

- **Master Sync**

  A green LED indicating whether this MX Giganet is providing the master synchronization signal to the MX system.

On:	This unit is providing the master synchronization signal.
Off:	This unit is not providing the master synchronization signal or is a subordinate unit.

  Tip
  A designated MX Giganet provides synchronization signals to any other MX Giganets and cameras (this does not need to be the primary MX Giganet connected to the MX Host PC).
  In a system without external synchronization, the MX Giganet acting as the synchronization master boots up first regardless of where it is physically located in the system.
  With external synchronization from video (genlock), the

synchronization master is the MX Giganet to which the video source is connected. Because synchronization is independent of the MX Host PC and because data is transferred within the system by ethernet packets through the switches in the Giganets, it does not matter where the master Giganet is connected.

- **Selected Unit**

  A red LED indicating this MX Giganet unit's selection status in the controlling Vicon application software.

On:	This unit is selected.
Off:	This unit is not selected.

- **GPI Port**

  A single 3.5mm jack socket for General Purpose Input. This socket is reserved for future use.

- **Gigabit Ethernet Ports**

  Five 8-pin RJ-45 sockets for connecting the MX Host PC using the Vicon Host PC cable (for details, see Vicon MX T-Series System Cable Descriptions on page 42).

Power Supply Connectors

The rear panel contains the following connectors and controls for the power supply to the MX Giganet:

- **On/Off**

  Master power switch for the unit. There is also a soft/standby switch on the bottom right front of the unit (for details, see MX Giganet Front Panel on page 29).

- **Cooling Fans**

  Two fans to regulate the internal temperature of the unit.

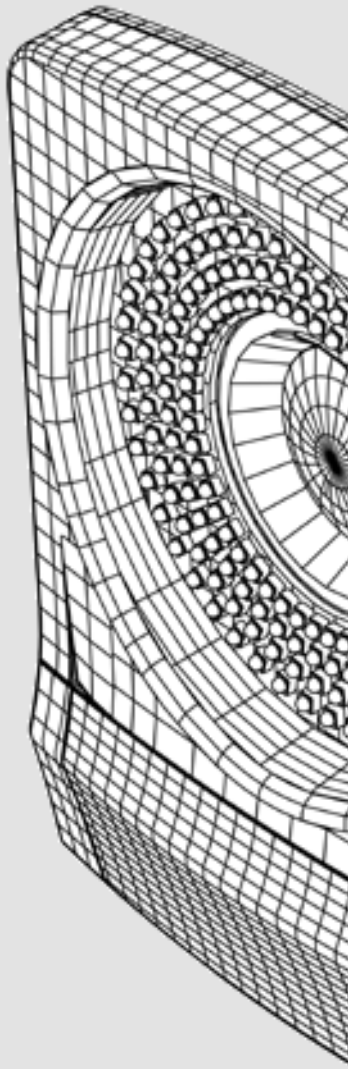
- **Power Connector**

  Power cable inlet for the unit. Fuses are integral to the power supply unit and are, therefore, not accessible from the exterior of the unit.

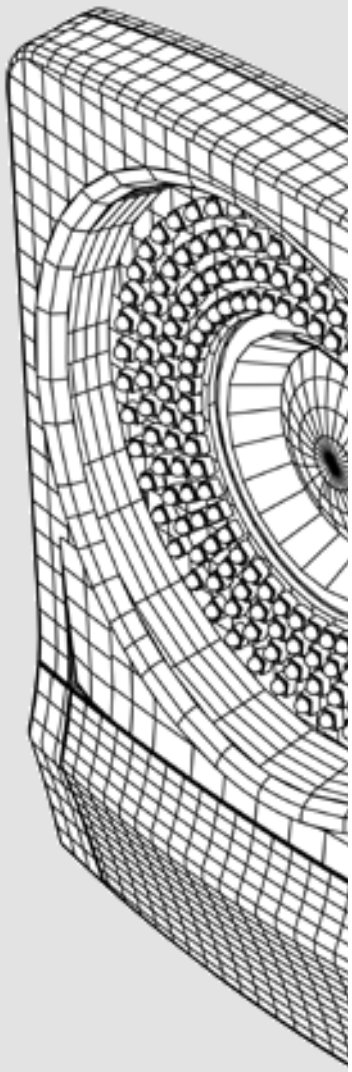
  Warning
  For full protection against electrical shock hazards, the unit must be connected to a grounded electrical supply.

For details on power supply ratings for the MX Giganet, see Chapter 19 MX Giganet Technical Specifications.



4 MX Host PC

This chapter describes the role of the MX Host PC in a Vicon MX T-Series system and describes the ports used to enable communications between the Vicon software installed on this PC and other components in the Vicon MX T-Series system.



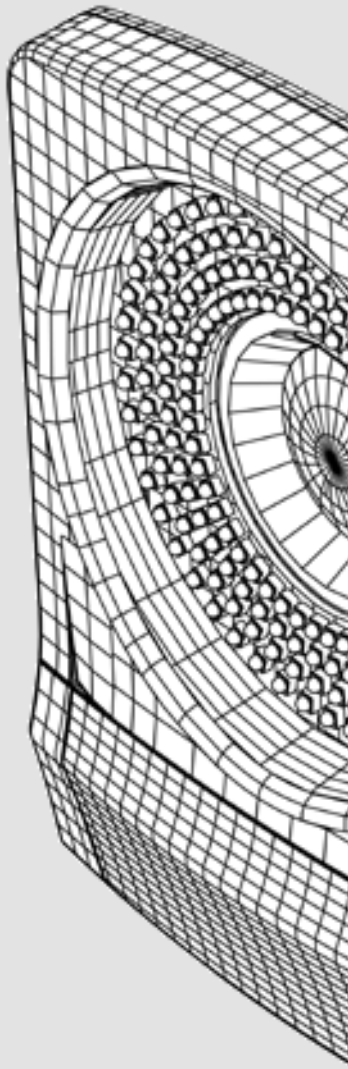
In This Chapter

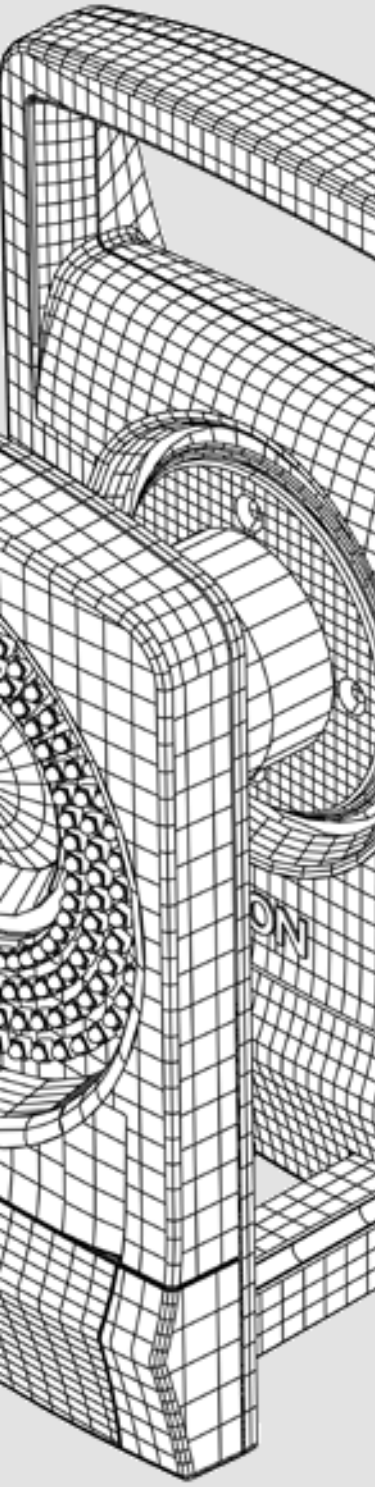
MX Host PC in a Vicon MX System Architecture

The MX Host PC runs the Vicon motion capture and analysis software, which analyzes and presents the data captured by the MX cameras and transmitted to the MX Host PC by an MX Giganet. If there is more than one MX Giganet included in your MX system architecture, the MX Giganet connected to the MX Host PC is the primary MX Giganet. Depending on your architecture model, you may also install additional Vicon application software or third-party applications on the same PC or on other, remote PCs in a distributed architecture. Vicon software is licensed on the MX Host PC.

The computer used as the MX Host PC in your Vicon MX T-Series system architecture may be supplied by Vicon, or it may be one that you provide yourself. If you are providing your own MX Host PC, the actual computer specification depends upon your Vicon MX T-Series system architecture and your application requirements. Processor speed and memory are the most important factors for system performance. Hard drive speed and RAM requirements are greater for high camera-count or high marker-count applications. A high-quality graphics card is required for any PC on which you have installed visualization software that makes high graphics demands. For details on minimum requirements for the MX Host PC and for your Vicon application software, see the release notes supplied with your Vicon software. Your Vicon Sales representative or your nearest agent or distributor can also help you identify the requirements for your specific needs.

Important
In all cases, Vicon application software requires a PC with an Intel processor. Since Intel processors are used in Vicon development and testing, Vicon applications are optimized for this processor type.





MX Host PC Connectors used in Vicon MX Systems

This section describes the connectors on your MX Host PC you use to connect to other components in your Vicon MX T-Series system architecture. It does not cover standard connectors for your mouse, keyboard, speakers, etc. Figure 13 illustrates a sample MX Host PC; the actual location of connectors depends on your PC. See the documentation supplied with your PC for details.

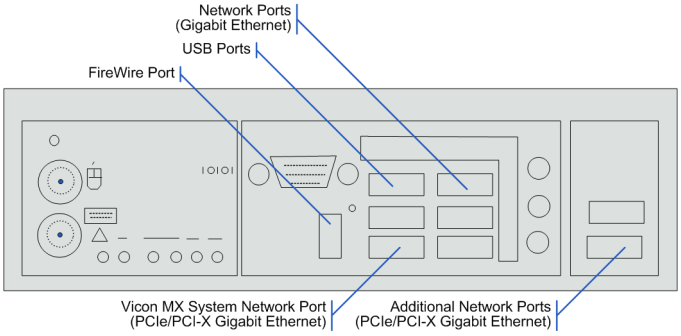


Figure 13: MX System Connectors on MX Host PC

You will typically use the following connectors on your MX Host PC:

- Vicon MX System Network Port
- Additional Network Ports on page 39
- FireWire Port on page 39

Vicon MX System Network Port

A Vicon MX T-Series system runs on its own dedicated network, rather than being integrated into a general communications network. This MX system network uses Gigabit Ethernet communications, so the MX Host PC requires an appropriate network adapter card.

Vicon MX T-Series systems transfer Ethernet data at a minimum of 100 Mbps, so you must use at least a 100Base-T Ethernet card. However, Vicon recommends that you use at least a Gigabit Ethernet card, supporting data transfer rates up to 1000 Mbps. To attain the high-performance Vicon MX T-Series systems are capable of, you should use a PCI, PCIe, or PCI-X network card. This is because most embedded network cards built into PC motherboards cannot manage the network traffic involved when performing measurements at high frame rates with analog at high speed, or capturing high marker counts with many cameras.

You will use this MX system network port to connect the MX Host PC to the primary MX Giganet, which controls the data flow between the MX Host PC and other devices in the MX system.

You must configure this network adapter card for the Vicon MX T-Series system. To do this, disable all protocols other than TCP/IP (Transmission Control Protocol/ Internet Protocol) for this network adapter card. Then use the following IP address settings for this network adapter card:

IP address:	192.168.10.1
Subnet mask:	255.255.254.0
	(Users of earlier Vicon MX systems, note that the subnet mask value has changed for the T-Series; previous MX systems used 255.255.255.0. This new T-Series value will work with earlier MX system components integrated into your T-Series system)
Default gateway:	Leave blank

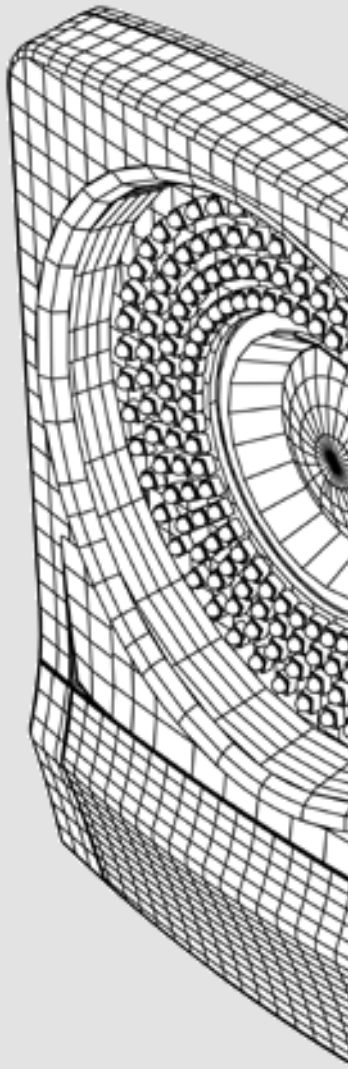
After setting the IP address, you must reboot the MX Host PC for the change to take effect. When the system is booted, an IP address in the range 192.168.10.10—192.168.10.254 is assigned to each camera via DHCP (Dynamic Host Configuration Protocol), which centrally manages the assignment of IP addresses.

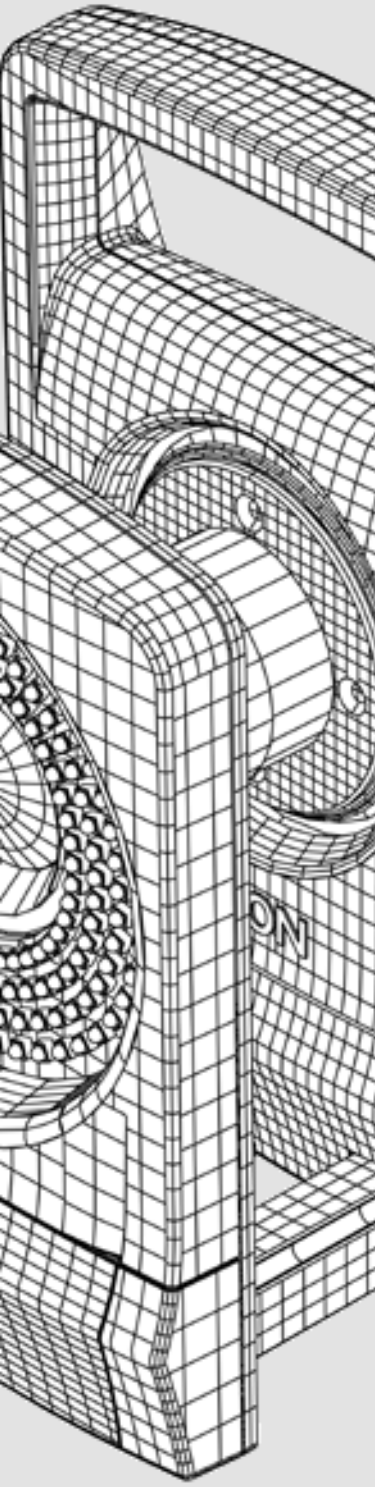
The Vicon MX system maintains an internal connection map, which uniquely identifies each IP address with a particular camera. This makes it possible for you to plug active cameras into different ports on the rear of the MX Giganet without having to recalibrate the cameras. Vicon DHCP will not interact with the DHCP on the local network. This IP address range does not go through routers, so Vicon data and communications traffic do not affect Internet or other network communications.

Data is streamed from the camera to the MX Host PC as User Datagram Protocol (UDP) packets. Commands are sent via Telnet to individual cameras or broadcast to all cameras using a proprietary protocol.

If you have installed a PCI, PCIe, or PCI-X card for this MX system network, you must increase the Receive Buffers parameter for each card to its maximum setting to optimize its performance when your Vicon MX T-Series system is running under high network load. For details on recommended network cards and instructions on setting the Receive Buffers parameter, see the release notes for your Vicon application software

Tip
If you obtained your MX Host PC from Vicon, an appropriate network card will already have been installed, the IP address set, and this parameter optimized.





Additional Network Ports

In addition to the MX system network card, you will need to install additional Ethernet network cards in the MX Host PC if you need to make the following optional connections:

- **Local area network (LAN):** A separate, dedicated Ethernet port is required to connect the MX Host PC to your LAN.
- **Subordinate MX Giganets:** A separate, dedicated Ethernet port is required to connect an additional, subordinate MX Giganet to the MX Host PC.
- **GigE Reference Video cameras:** A separate, dedicated Ethernet port is required to connect Basler GigE Vision cameras.

As the MX system is independent of your communications network, there is no guidance offered for your LAN network card, should you choose to install one. For subordinate MX Giganets or GigE cameras, as for the MX system network card, you are recommended to use a PCI, PCIe, or PCI-X network card rather than an embedded network card that may be built into PC motherboards in order to attain the high-performance Vicon MX T-Series systems are capable of.

Once you have installed any PCI, PCIe, or PCI-X network cards, you must increase the Receive Buffers parameter for each card to its maximum setting to optimize its performance when your Vicon MX T-Series system is running under high network load. For details on recommended network cards and instructions on setting the Receive Buffers parameter, see the release notes for your Vicon application software

FireWire Port

Vicon MX T-Series systems supports synchronous movie image capture on the MX Host PC, as well as on a remote PC incorporated into the MX system architecture.

To use a Basler DV camera as a reference video camera in your Vicon MX T-Series system, you must install a separate Open Host Controller Interface (OHCI) compliant IEEE 1394 FireWire serial interface add-on PCI card on the MX Host PC. You must install one of these OHCI compliant cards even if your MX Host PC has a FireWire port included on the motherboard. Cards that include the Texas Instruments chip set are OHCI compliant. Microsoft Windows 2000 and Windows XP automatically recognize the FireWire interface; if you are using another operating system, you may need to install additional drivers.

Movie capture requires considerable bandwidth and storage space. A stream of DV data is compressed (in the hardware onboard your camcorder) to give a data rate of 3.6 MB per second at 720 x 576 (PAL) (or 480 for NTSC). That means over 4.3 GB of data for every 20 minutes of video captured in raw DV format.

Your hard drive must be fast enough to handle this amount of data at a sustained rate in addition to the Vicon motion capture data. If the hard drive cannot sustain this rate, you will drop movie frames on capture, which will result in gaps in your movie on playback.

For minimum requirements for a remote PC to be used as a video server, contact Vicon Support (see Support Resources on page 197). For information on capturing movie images on the MX Host PC, see the documentation for your Vicon application software.

Vicon Application Software on MX Host PC

You install your Vicon motion capture and analysis application software on the MX Host PC:

- **Blade 1.5 and later**

  Integrated environment for the crucial elements of optical motion capture with Vicon MX systems. Blade is the core motion capture, processing, and analysis software for animation applications.

- **Nexus 1.4 and later**

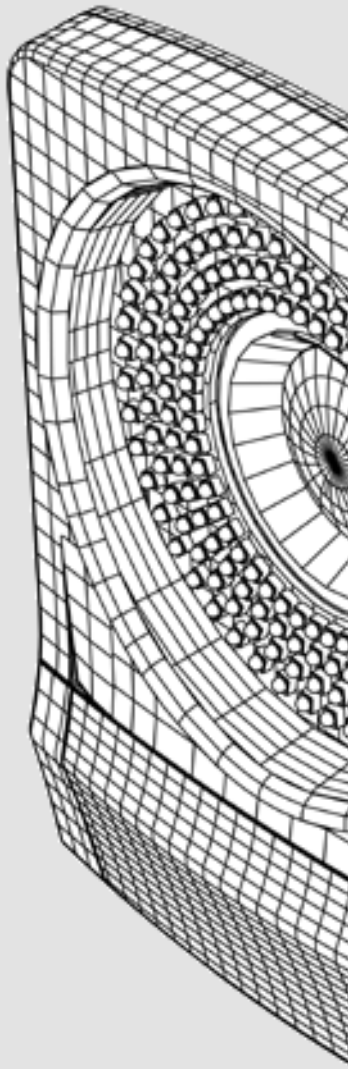
  Optical motion capture, processing, and analysis with Vicon MX systems. Nexus is the core motion capture and processing software for life sciences applications.

If you have implemented a distributed Vicon MX system architecture or client-server application, you may also have this Vicon motion capture and analysis software, or other Vicon or third-party data visualization, analysis, or manipulation software on a remote PC.

For further details on these Vicon software applications, including the versions providing support for specific Vicon MX hardware components, see the Vicon Web site. For details on configuring MX Cameras and data capture and processing through these Vicon software applications, see your Vicon software documentation.

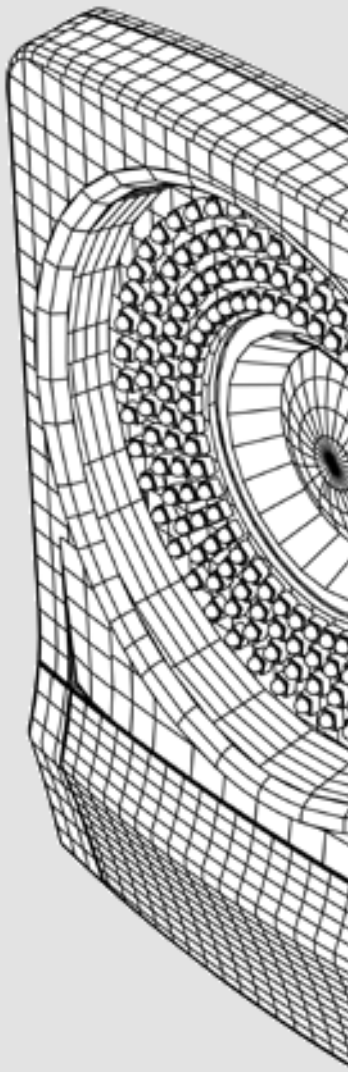
Vicon License on MX Host PC

Vicon software is licensed on the MX Host PC. For example, Vicon software may be licensed by activating the Sentinel software manager or by installing and plugging in a HASP licensing dongle (hardware/software) in an appropriate port on the MX Host PC. For details on the software licensing method, see the documentation supplied with your Vicon software.



5 MX T-Series System Cables

This chapter describes the cables used to connect hardware components in a Vicon MX T-Series system.



In This Chapter

MX Cables in a Vicon MX System Architecture

A number of proprietary cables are supplied with Vicon MX T-Series systems to connect MX hardware components in your system architecture. These cables provide a combination of power, Ethernet communication, synchronization signals, video signals, and data to Vicon MX hardware and supported third-party devices.

Depending on your Vicon MX T-Series system architecture, you may also require some commercially available cables to connect MX hardware components to third-party devices.

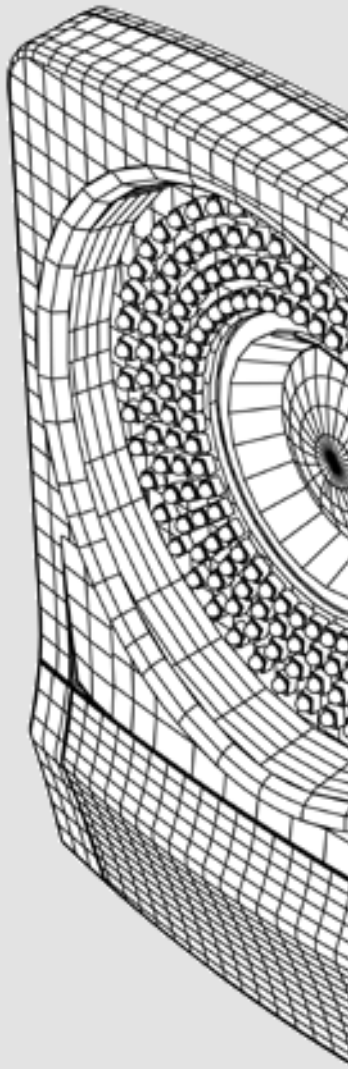
Important

For details on the cables actually supplied with your Vicon MX T-Series system, see the bill of materials accompanying your product shipment. If any cables are missing on receipt, or if you require additional cables later, please contact Vicon or your nearest agent or distributor.

If you are integrating external devices into your Vicon MX T-Series system, you will need specialist cables to connect these third-party devices to the appropriate MX hardware, such as the MX Giganet or the MX Host PC. Such cables may be:

- supplied by your third-party device manufacturer (such as for force plates)
- obtained from specialist film/audio stores (such as for timecode and genlock devices)
- created by you (such as for remote triggering devices)

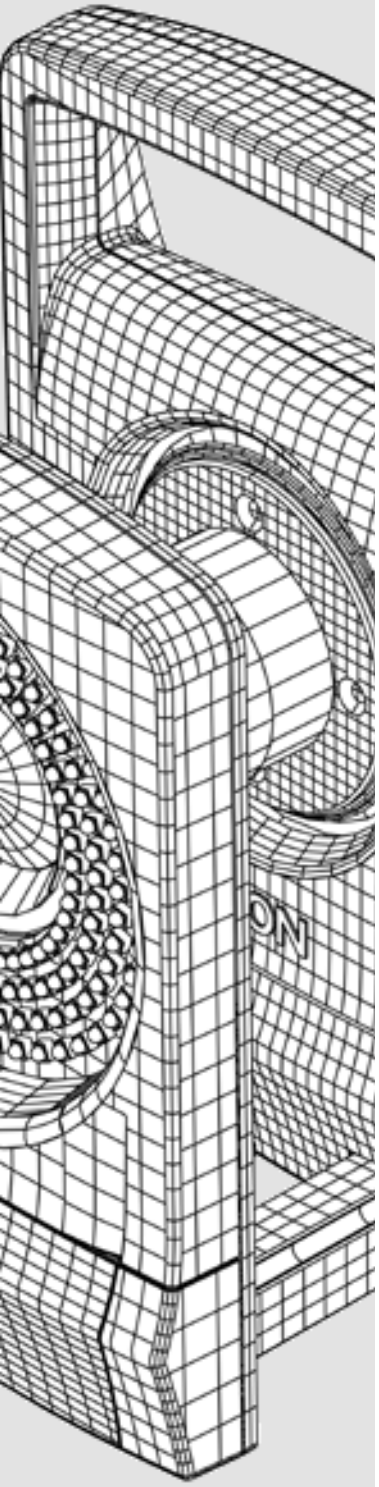
This chapter describes the cables you will need for a Vicon MX T-Series system. It does not describe all the cables supplied with earlier MX systems; this book assumes that any earlier MX system cameras or MX controlling hardware units are already connected with the originally supplied cables. For descriptions and uses of these earlier MX cables, see the Vicon MX Hardware System Reference book supplied with your earlier Vicon MX system.



Vicon MX T-Series System Cable Descriptions

The following sections describe the cables used for the specified Vicon MX system architecture model:

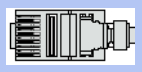
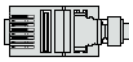
- Simple System Architecture Model Cables on page 43
- Extended System Architecture Model Cables on page 44
- Integrated System Architecture Model Cables on page 46



Simple System Architecture Model Cables

Table 5 describes the function of the cables that can be used in a simple Vicon MX T-Series system architecture. For details on this architecture model, see Simple System Architecture Model (T-Series Hardware Only) on page 6.

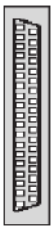
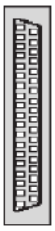
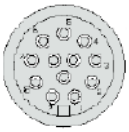
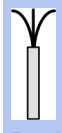
Table 5: Cable Descriptions—Simple System Architecture Model

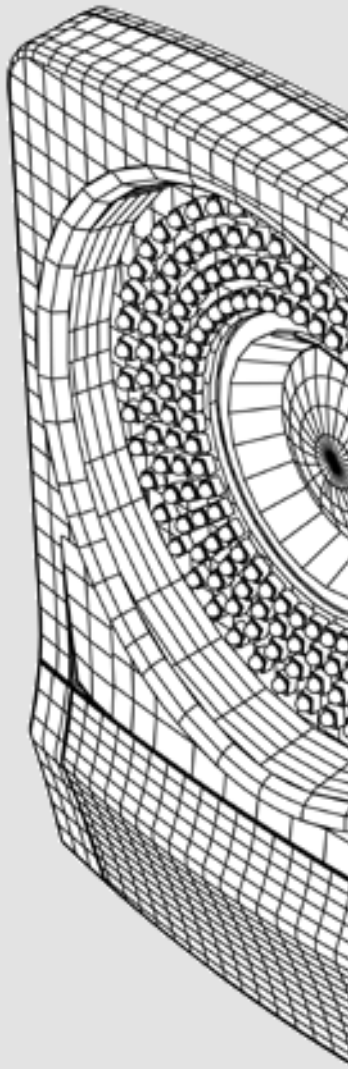
Vicon Cable		Function
End 1	**End 2**	
MX Gigacable  8-pin Lemo plug	 8-pin Lemo plug	Proprietary Vicon Cat5e Giganet Ethernet cable that connects the MX Giganet to Vicon MX T-Series cameras. Carries power, synchronization, and communications signals from the MX Giganet to Vicon MX T-Series cameras. Blue in color to distinguish it from other cables in your system.
MX Giganet to MX Giganet  10-pin RJ-45 plug	 10-pin RJ-45 plug	Proprietary Vicon cable that connects the primary MX Giganet to a subordinate MX Giganet (or MX Ultranet HD or MX Ultranet) Carries synchronization signals from the primary MX Giganet to a subordinate unit. Carries data between the primary MX Giganet and subordinate units. One of these cables is required for each subordinate MX Giganet (or MX Ultranet HD or MX Ultranet) connected to the primary MX Giganet.
MX Host PC Cable  8-pin RJ-45 plug	 8-pin RJ-45 plug	A Vicon-supplied or commercially available RJ-45 Standard 1000Base-T Gigabit Ethernet network cable that connects the MX Giganet to the MX Host PC. Carries Ethernet communications between the MX Host PC and an MX Giganet. You can order this cable from Vicon or obtain a commercially available RJ-45 cable. **Important** Only a single primary MX Giganet can be connected to an individual Ethernet port on the MX Host PC. Each additional primary MX Giganet requires an additional Ethernet port in either the same MX Host PC or a second computer, depending on CPU consumption and hard disk performance.

Extended System Architecture Model Cables

Table 6 describes the function of the additional cables that can be used in an extended Vicon MX T-Series system architecture. For details on this architecture model, see Extended System Architecture Model (Additional T-Series Hardware and Third-Party Devices) on page 7.

Table 6: Cable Descriptions—Extended System Architecture Model

Cable		Function
End 1	End 2	
ADC Patch Panel  100-way plug	 100-way plug	Proprietary Vicon cable that connects a Vicon ADC patch panel to an MX Giganet. Passes analog data from a third-party analog capture device (such as force plates or EMG equipment) to the Vicon ADC patch panel, which forwards it to the ADC option card in an MX Giganet. For details on supported devices, see Third-Party Devices (optional) on page 13.
Basler DCAM Camera  10-pin RJ-45 plug	 RCA phono plug	Proprietary Vicon cable that connects the MX Giganet to a Basler DCAM camera. Supplies synchronization signals from the MX Giganet to a Basler DCAM reference video camera. For details on supported devices, see Third-Party Devices (optional) on page 13.
Basler GigE Camera  3-pin Lemo plug	 12-pin Hirose micro plug	Proprietary Vicon cable that connects the MX Giganet to a Basler GigE camera. Supplies power and synchronization signals from the MX Giganet to a Basler GigE reference video camera. For details on supported devices, see Third-Party Devices (optional) on page 13.
Third-party Analog Capture Device  Device dependent	Device dependent	Cable that connects a third-party analog capture device to the Vicon patch panel. The wires on end 1 are connected to appropriate screw terminals inside the Vicon ADC patch panel. The number of wires and their terminal connections depend on your device. For details on cable wiring and the plug type on end2, see the documentation supplied with your third-party device. For details on the Vicon ADC patch panel, see Understand ADC Option Card Functionality on page 88. For details on supported devices,



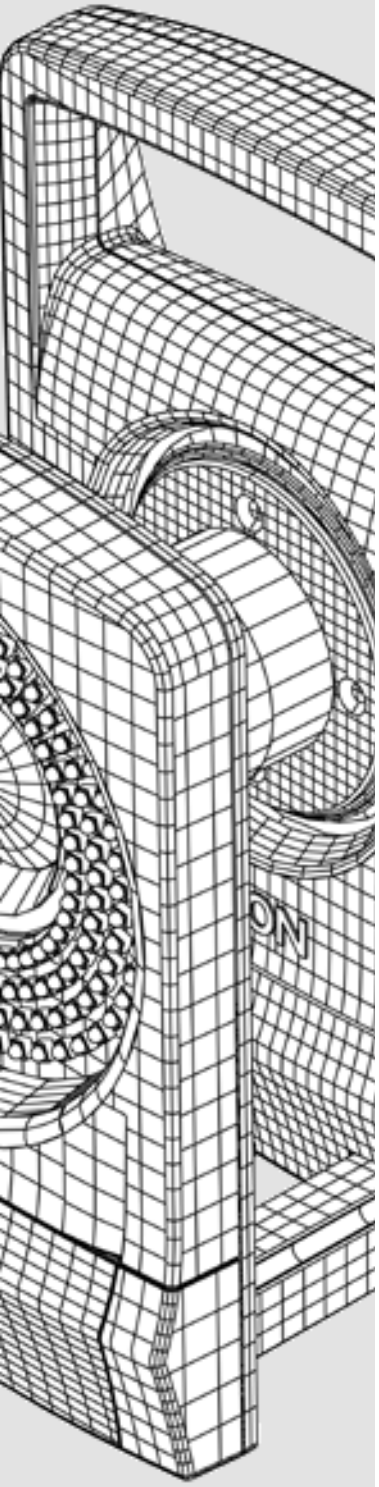


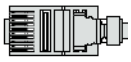
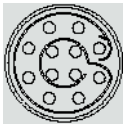
Table 6: Cable Descriptions—Extended System Architecture Model

Cable		Function
End 1	**End 2**	
		see Third-Party Devices (optional) on page 13.
Third-party Genlock Device  BNC plugs	 XLR socket	Cable that connects a third-party genlock to external video device to the MX Giganet. Carries VITC composite video signals between the MX Giganet, a third-party Genlock device, and any other devices being synchronized. For details on supported devices, see Third-Party Devices (optional) on page 13.
Third-party Remote Triggering Device  RCA phono plug	Device dependent	Cable that connects a third-party device that can remotely trigger capture by your Vicon MX T-Series system. Carries input signals from the third-party device to the MX\ Giganet. For details on supported devices, see Third-Party Devices (optional) on page 13.
Third-party Synchronized Output Device  3-pin Lemo plugs (Powered Sync Outputs) OR  RCA phono plug (Sync Outputs only)	Device dependent	Cable that connects a third-party device to be synchronized with the Vicon MX T-Series system. Carries synchronization data between the MX Giganet and the synchronized device. For details on supported devices, see Third-Party Devices (optional) on page 13.
Third-party Timecode Device  Mini-XLR plug	 XLR socket	Cable that connects a third-party LTC timecode device to the MX Giganet. Carries LTC timecode data between the MX Giganet and the timecode device. For details on supported devices, see Third-Party Devices (optional) on page 13.

Integrated System Architecture Model Cables

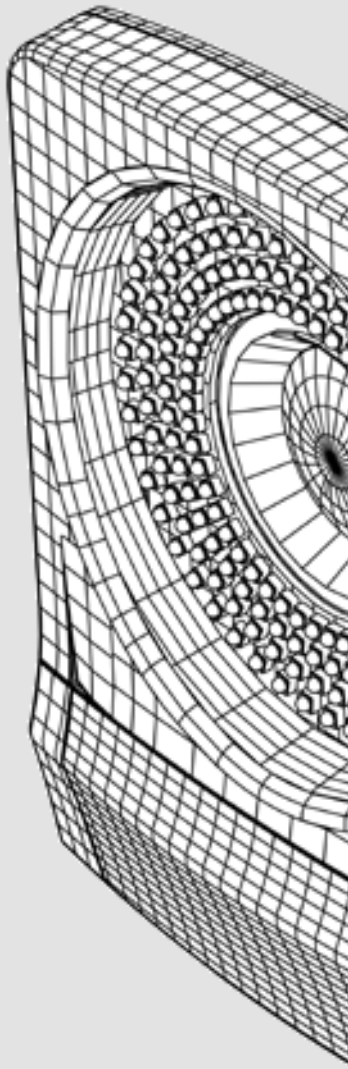
Table 7 describes the function of the additional cable that can be used in an integrated MX T-Series system architecture. For details on this architecture model, see Integrated System Architecture Model (T-Series and earlier MX Hardware) on page 9.

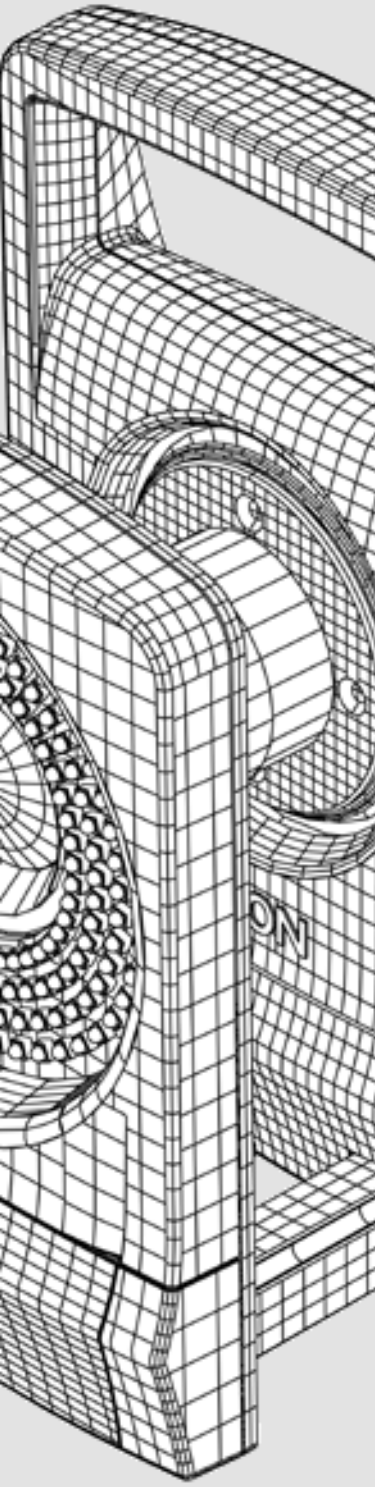
Table 7: Cable Descriptions—Integrated System Architecture Model

Cable		Function
End 1	End 2	
MX Giganet to MX Net  10-pin RJ-45 plug	 12-pin Lemo plug	Proprietary Vicon cable that connects the MX Giganet to earlier Vicon MX hardware, such as the MX Net. Carries synchronization and communications signals.

If you are integrating a previous range of Vicon MX cameras and hardware into a T-Series system, you will use cables from your existing architecture. For descriptions and uses of these other cables, see the Vicon MX Hardware System Reference book supplied with your earlier Vicon MX system.

Tip
You can access the hardware system reference for your Vicon MX system from Vicon Online Support under Downloads > Animation/ Engineering/Life Sciences > Vicon Hardware > MX Hardware System Reference (Rev 1.7)





MX T-Series Cable Order Information

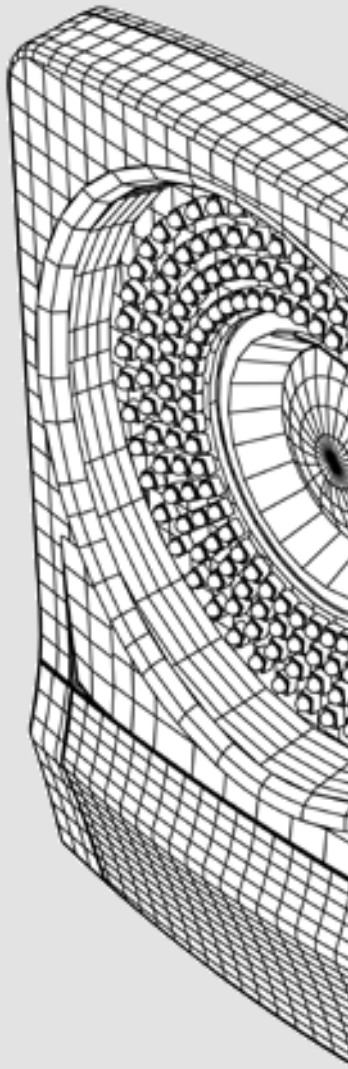
Table 8 lists the Vicon cables used in simple, extended, and integrated Vicon MX T-Series systems in alphabetical order, and provides their product order codes and any notes. Use these details if you need to obtain additional Vicon cables from Vicon or your nearest agent of distributor.

Table 8: Vicon MX T-Series Cable order information

Cable Description	Product Order Code	Notes
ADC Patch Panel Cable	VACC-V210	2.1 meters long
Basler DCAM Camera Cable	Contact Vicon Sales	20 meters long
Basler GigE Camera Cable	AQH002AB	20 meters long
MX Gigacable	ASH013AA-100-25 ASH013AA-100-50 ASH013AA-100-100	25 meters long 50 meters long 100 meters long
MX PC Cable	VACC-V195 MX	5 meters long
MX Giganet to MX Giganet Cable	ALH028AC ALH036AB	20 meters long 500 mm long
MX Giganet to MX Net cable	VACC-V219 Giganet	500 mm long

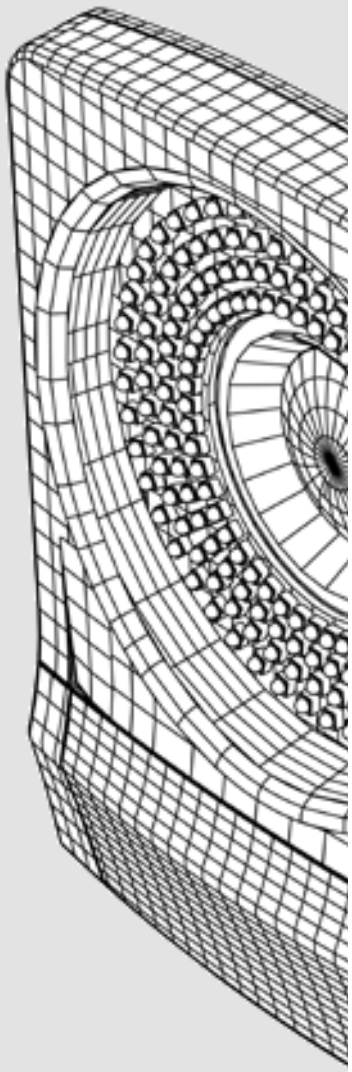
For further details on these cables, see Chapter 20 MX T-Series Cables Technical Specifications.

If you are integrating external devices into your Vicon MX T-Series system, you will need obtain the necessary specialist cables to connect these third-party devices to the appropriate MX hardware.



6 MX Calibration Device

This chapter describes the Vicon MX calibration device used to prepare your Vicon MX T-Series system for motion capture.



In This Chapter

MX Calibration Device in a Vicon MX System Architecture

You use the MX Calibration device to calibrate your Vicon MX T-Series system. This enables the MX cameras to capture the subject's movements throughout the volume. You use the MX Calibration device in your capture volume to identify the volume origin and axes, so the virtual cameras and volume in your Vicon application software reflects the actual positions of the cameras in relation to the capture volume and to one another.

Vicon MX Calibration Device Description

The Vicon MX calibration device is a single static calibration object and dynamic calibration wand (called an MX Calibration Wand or a 5-marker wand & L-frame), as shown in Figure 14 and described in Table 9.

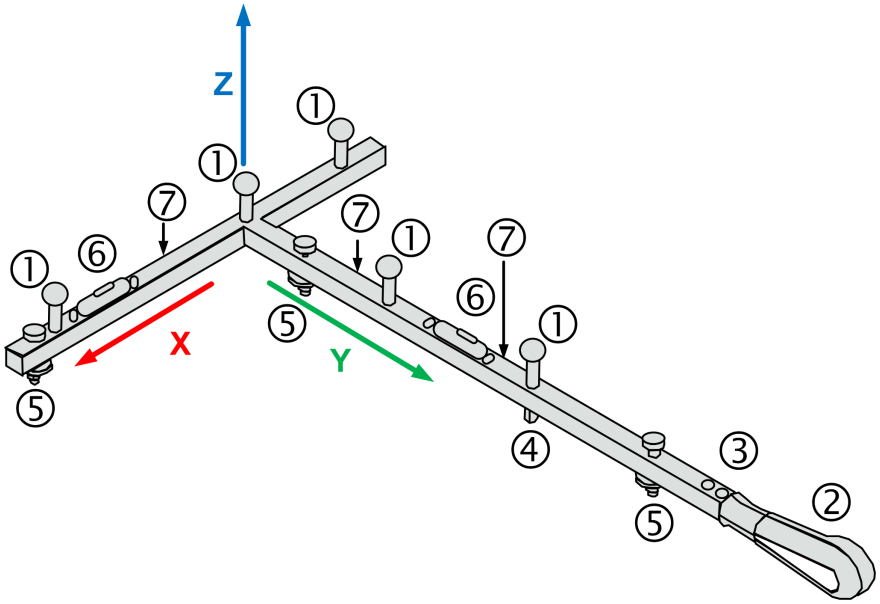


Figure 14: MX T-Series Calibration Device

Table 9: Vicon MX Calibration Device Part Descriptions

Key	Part	Description
1	Marker pillars	Attach one of the supplied 14 mm markers to each of these pillars.
2	Handle	Hold this end when using as a dynamic calibration wand.

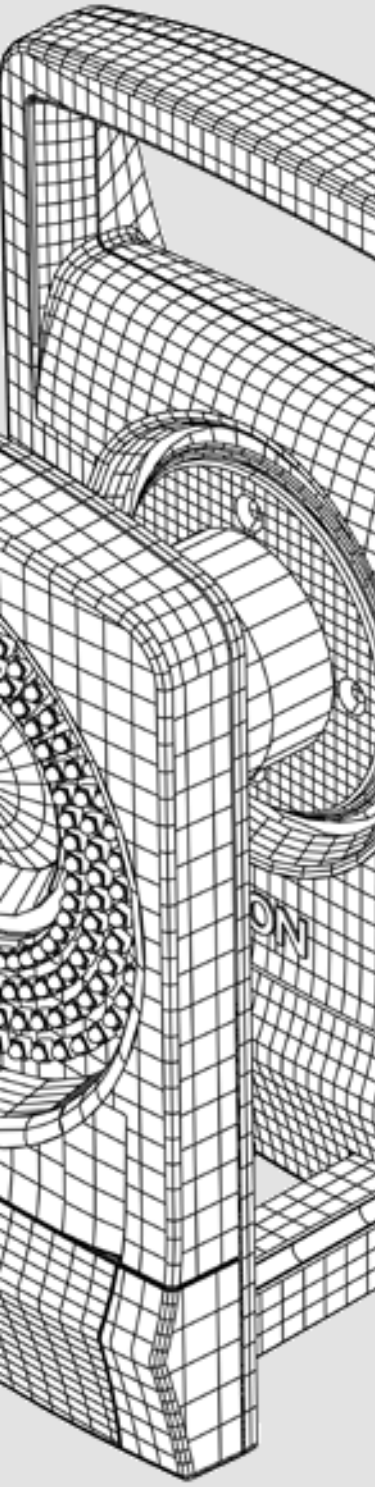


Table 9: Vicon MX Calibration Device Part Descriptions

Key	Part	Description
3	Handle extension (not shown in Figure 14)	Attach this to the handle to lengthen the wand.
4	Fixed foot	Align the adjustable feet with this fixed point when using as a static calibration object.
5	Adjustable feet	Turn the adjuster screw for each foot to position flat on the floor when using device for static calibration.
6	Spirit levels	Check the bubbles when adjusting the feet to ensure device is flat on the floor.
7	Alignment plate screw holes	Screw each alignment plate into a set of holes and align the plates with the edge of a force plate if you are placing it at the global origin during the static calibration stage.

This single calibration device is used for both the dynamic and static phases of the calibration process, as described in Calibration Process.

Important
The calibration device is the instrument used to define system accuracy. Please take care of it. For more information, see Calibration Device Care and Maintenance Guidelines on page 53.

Calibration Process

Vicon system performance depends on the accuracy with which the cameras and the capture volume are calibrated during a two-stage system calibration process:

1. Dynamic Stage (Camera Calibration)
2. Static Stage (Capture Volume Calibration) on page 52

Both the dynamic and static stages of the system calibration process depend on the Vicon application software knowing the dimensions and relative marker positions of a specified calibration device. This definition of a calibration device is contained in a Vicon Skeleton (VSK) file. When you configure the calibration process in your Vicon application software, you load the VSK file for it.

The following sections provide a general overview of these two stages of the calibration process. For details on calibrating your Vicon cameras and the

capture volume, see the Get Going with Vicon MX T-Series book and the documentation for your Vicon application software.

Important
Vicon MX T-Series systems use the supplied 5-marker wand & L-frame calibration device. However, you may use other calibration devices in your Vicon system if such devices exist as entries in your Vicon application software (that is, depending on the VSK file). For details on which calibration devices can be used, see the documentation for your Vicon software.

1. Dynamic Stage (Camera Calibration)

During the dynamic stage of the calibration process, the Vicon application software calculates the physical position and orientation of each Vicon camera in the capture volume based on the movement of a calibration wand. This stage, called the Dynamic Calibration (DYNACAL) process, calculates internal (focal length and image distortion) and external (position and orientation) camera parameters in two simultaneous phases:

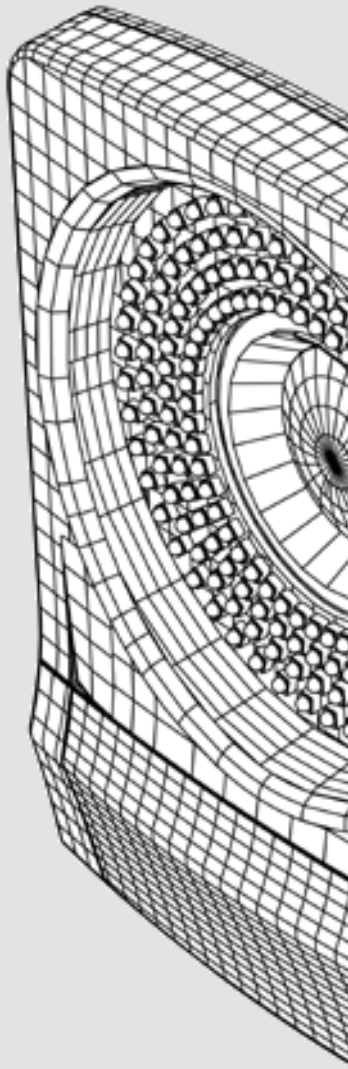
- **Linearization phase**

  The optical distortion of the camera lenses and any other non-linearity in the system are measured, and a correction matrix is calculated. Corrections are applied to every frame of data subsequently acquired by each camera.

- **Photogrammetric Calibration phase**

  The physical locations and orientations of the cameras are calculated, referring to a user-defined set of coordinates.

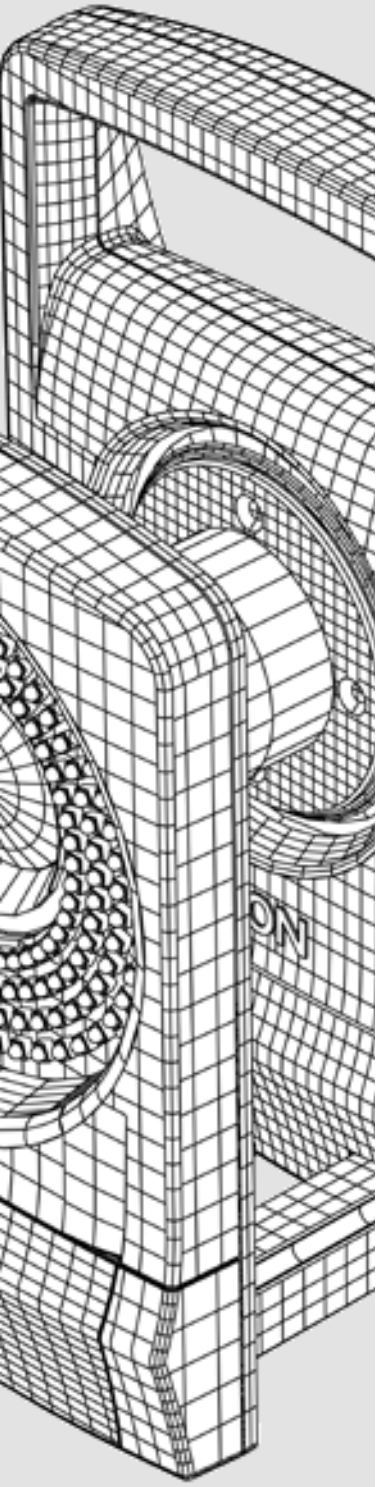
The objective of the dynamic stage is to describe the capture volume to the MX system. Wave the calibration wand throughout the empty capture volume, ensuring that the markers on the wand are visible to the cameras, until a good number of wand frames are spread evenly across the field of view for each camera. Your Vicon application software provides feedback to help you determine when enough wand data has been acquired to calibrate each camera. For details, see the documentation for your Vicon software.



2. Static Stage (Capture Volume Calibration)

During the static stage of the calibration process, the Vicon application software measures the position of a calibration device in the capture volume and sets the global coordinate system.

The objective of the static stage is to set the global coordinate system so that subjects are displayed the right way up and so that you can change the way data is visualized in the Vicon application software workspace. Place the static calibration device flat on the floor to identify the coordinates of the global origin (0,0,0), which represents the center of the capture volume, and the global axes (X,Y,Z), which represent the horizontal and vertical axes of the capture volume.



If you are using force plates, you are recommended to choose one of the force plate corners to be the position of the origin of the global coordinate system. This enables your force places and the Vicon capture volume to share a common coordinate system.To do this, attach the supplied alignment plates to the Vicon MX calibration device. The alignment plates ensure that you place the MX calibration device on the same position on top of one of the force plate corners each time you perform a calibration.

If you are not using force plates, adjust the feet of the Vicon MX calibration device to ensure that they are all flat on the floor. Start with the handle and adjust the foot between the fixed foot and the hand grip, and then adjust the other foot until the bubble in the spirit level is in the center. Next on the top edge of the wand, adjust the foot on the left end until the bubble in the spirit level is in the center. To adjust the feet, first loosen the locking nut next to the metal frame and then turn the screw left to lower the calibration device or right to raise it. Then tighten the locking nuts to fix the feet in position.

Next place the Vicon MX calibration device either on top of the force plates or flat on the floor in the center of the capture volume in the field of view of at least three cameras. Position the left corner of the static calibration device where you would like the volume origin to be and in the orientation that you would like the horizontal X and Y axes to be (for details on the Vicon MX calibration device, see Figure 14 on page 50). The calibration process will calculate the vertical Z axis from the positions of the X and Y axes, as shown in Figure 15.

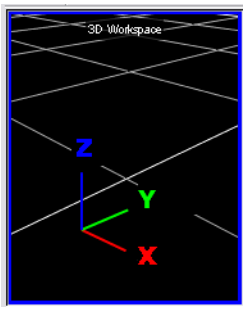


Figure 15: Global Axis orientation

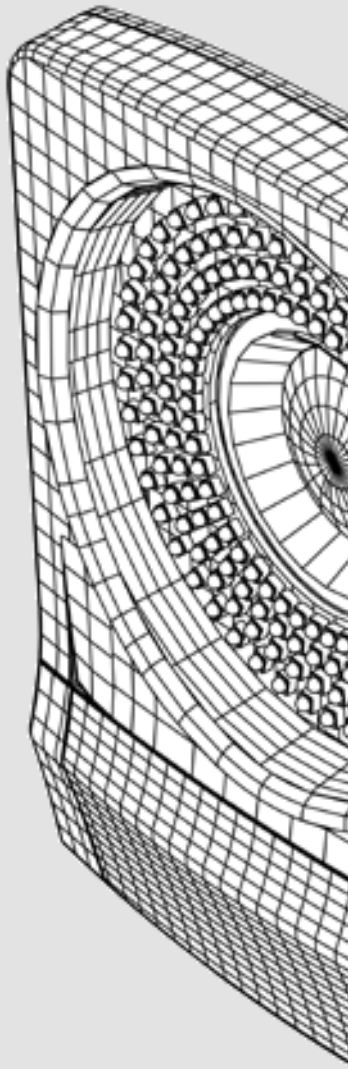
Calibration Device Care and Maintenance Guidelines

Follow these guidelines to keep your MX calibration device in good working order:

- Store the MX calibration device safely when not in use. For example, hang it on a wall hook from the hole in its handle.
- Take care not to damage the Vicon markers attached to the MX calibration device. For example, do not lay objects on top of the markers, lay the device

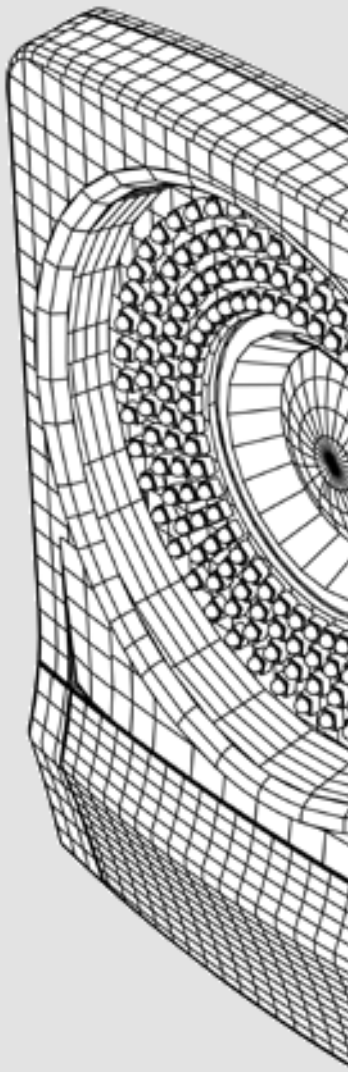
upside down with the markers on the floor, or scrape the markers against other objects.

- Recoat or replace the markers if they become severely scratched or damaged.
- Ensure all of the markers are the same size. For example, if you need to replace the originally attached markers, or if you need to use a different size marker for your particular motion capture application, make sure all markers are the same size. You may also need to change the marker definition (VSK) file to reflect a changed marker size.



7 MX Accessories

This chapter describes the motion capture accessories available for use in your Vicon MX T-Series system.



In This Chapter

MX Accessories in a Vicon MX System Architecture

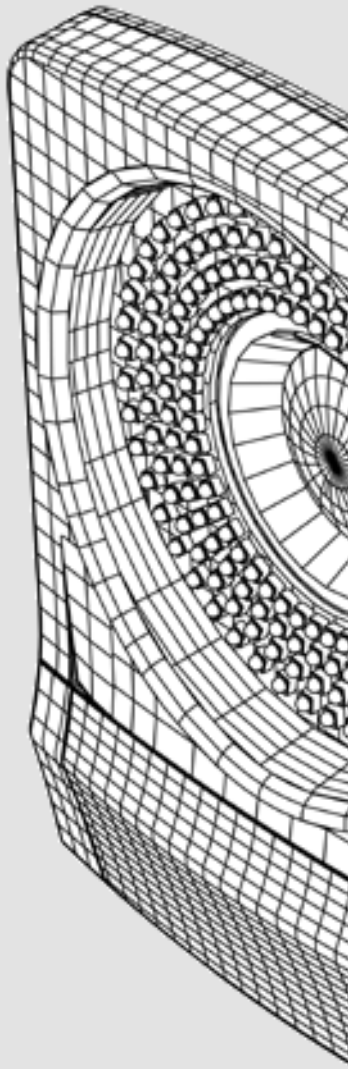
Vicon MX accessories are motion capture consumables that you will use and replace as required for your type and frequency of system use.

Vicon MX Accessories Descriptions

Table 10 describes the accessories available for Vicon MX T-Series systems.

Table 10: Accessories

Accessory	Description
HASP licensing dongle	Licenses Vicon application software for use and enables the system to operate if this is the licensing method for your Vicon software (for details, see Vicon License on MX Host PC on page 40).
Retroreflective paint	Applies directly to miniature subjects too small to attach markers.
Scissors	Cut tape.
Tape	
• Marker-fixing tape	Secure markers directly to a subject's skin. This double-sided tape is specially designed to adhere well to human skin without creating an allergic reaction. It can only be used once. The tape does not perform well if the skin becomes very wet with sweat. Under these circumstances, Vicon Motion Systems recommends the use of medical grade elastic strips.
• Micropore tape	Temporarily secure smaller markers to fingers. Some studios cut a small hole in a strip to poke the marker through, then wrap the remainder of the tape around a finger.
• Gaffer tape	Secure marker bases to objects or props, mark out the edges and origin of the capture volume in the lab or studio to help capture subjects visually identify the perimeter.
Tweezers	Carefully apply markers to avoid transfer of fingerprints and smudges to the retroreflective markers.



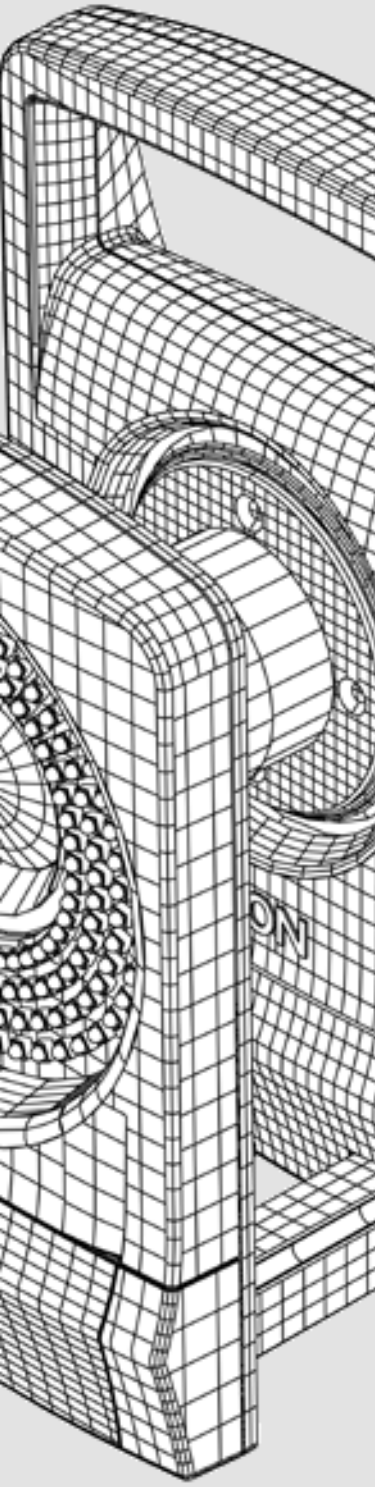
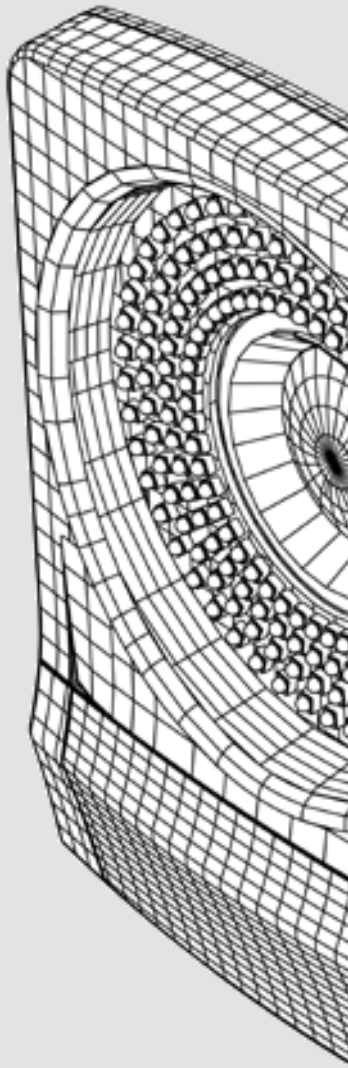


Table 10: Accessories

Accessory	Description
Velcro roll/strips/dots	Secure marker bases to objects or props. Many studios keep these on props and then add/detach markers as required.
Vicon retroreflective markers in various sizes, such as: • 3.0 mm • 4.0 mm • 6.0 mm • 9.0 mm • 14.0 mm • 25.0 mm	Smaller markers are typically used for facial, finger, or small object/prop capture. Larger markers are typically used for general body or object/prop capture. Additional marker sizes may be available.
Vicon PECS suit	3x3 Motion Capture Suit, including hat, gloves, and booties

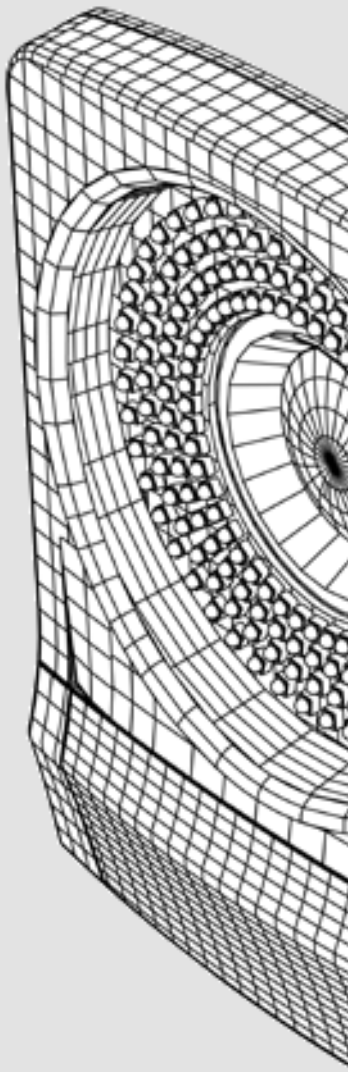
The actual number and type of accessories supplied depend upon the specific Vicon application you have ordered.

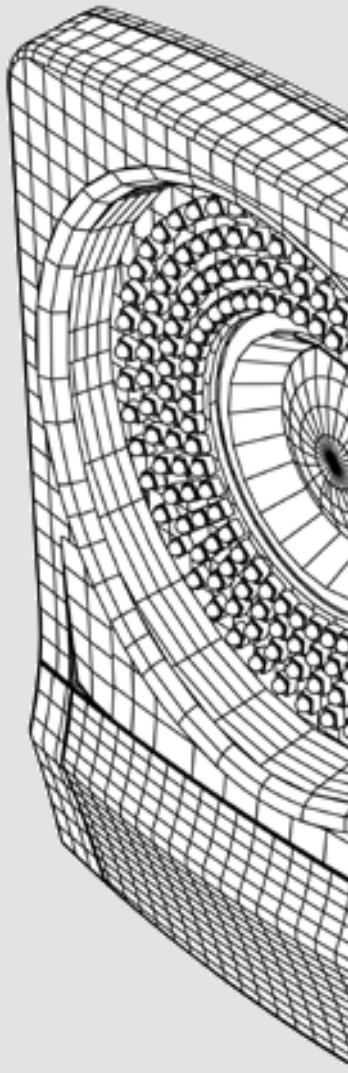
Important
For details on the type and number of items actually supplied with your Vicon MX T-Series system, see the bill of materials accompanying your product shipment. If any items are missing on receipt, or if you require additional accessories later, please contact Vicon Motion Systems or your nearest agent or distributor.



II Advanced Usage

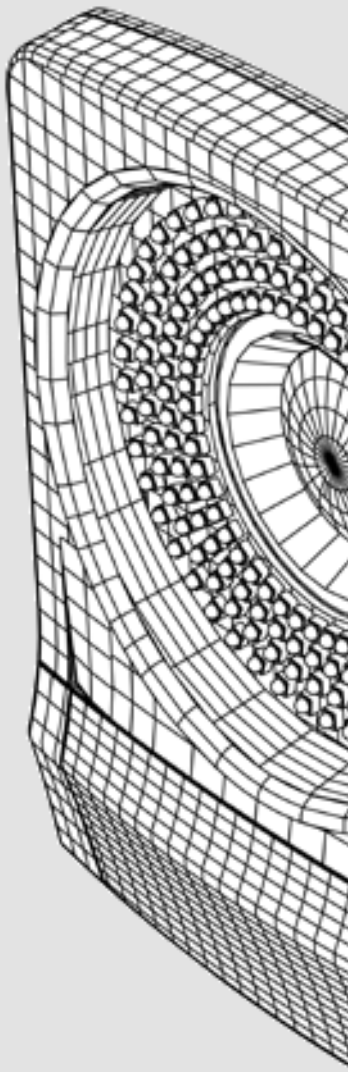
Find out how to get even more from your Vicon MX T-Series system.





8 Put Together a Simple Vicon MX System

This chapter shows you how to put together a Vicon MX system, based on the simple architectural model described in Chapter 1 MX System Architecture.



In This Chapter

Important

Once you have set up a simple Vicon MX system with MX T-Series cameras and an MX Giganets as shown in this chapter, you can:

- Extend the system to incorporate additional MX T-Series cameras and subordinate MX Giganets as well as supported third-party devices such as reference video cameras, analog capture devices, synchronized output devices, remote triggering devices, and timecode/genlock video devices.
- Integrate earlier ranges of MX Cameras and selected hardware units you may have into your new MX T-Series system.

For details on the earlier Vicon MX components and third-party devices a you can incorporate in your Vicon MX T-Series system, see Vicon MX System Architecture Components on page 10. Information on extending or integrating your MX T-Series system is provided in the following chapters in this part.

Understand a Simple Vicon MX System

A simple Vicon MX system consists of a primary MX Giganet, up to 10 MX T-Series cameras, and an MX Host PC as illustrated in Figure 16. For details on these elements, see Vicon MX System Architecture Components on page 10.

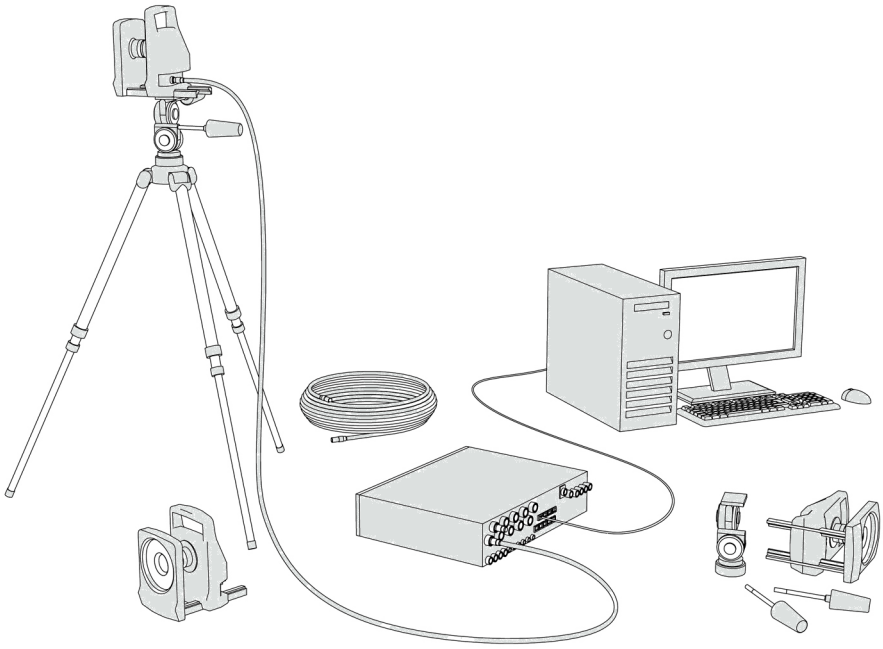
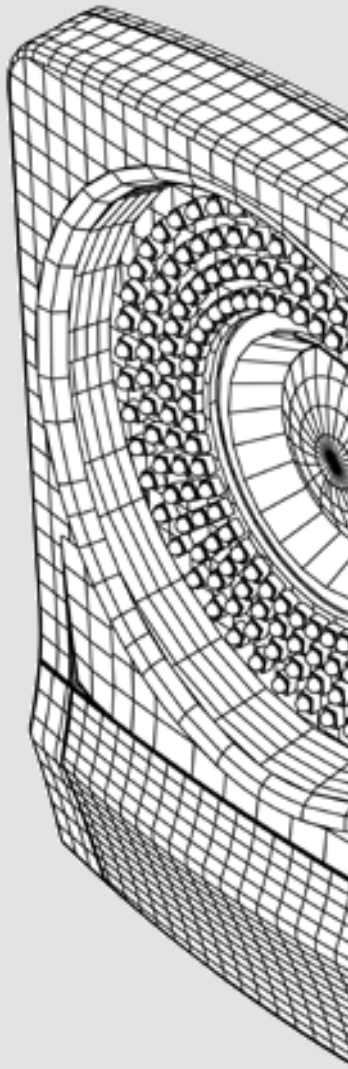
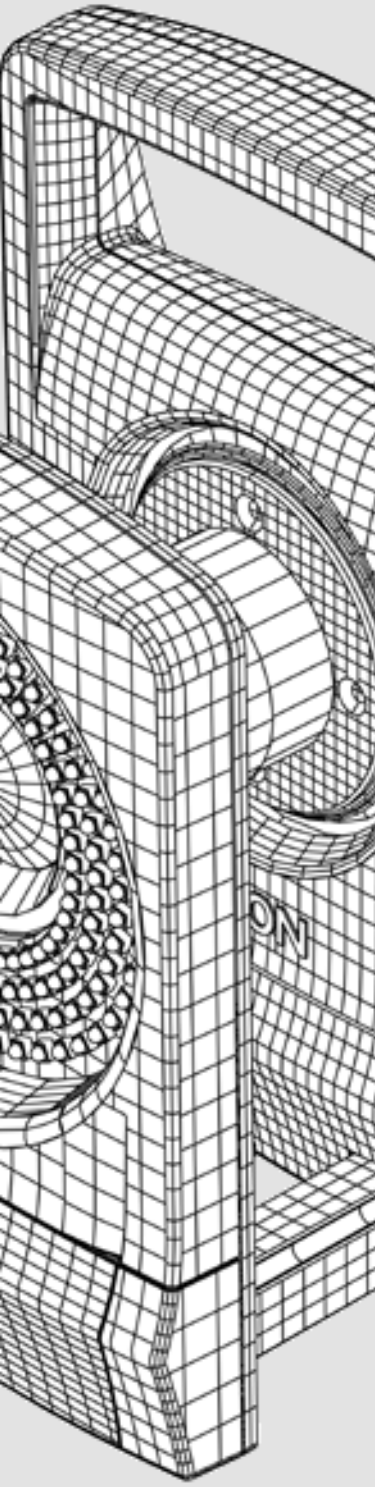


Figure 16: Setting Up a Simple MX System

The Get Going with Vicon MX T-Series booklet provides complete instructions on setting up a simple MX T-Series system. A printed version of the Get Going booklet is included in your product box, and a PDF version is included on the Vicon software installation DVD. For your convenience, these steps are outlined here.





Put Together the Hardware

First, set up your MX hardware. Gather the hardware components, supplies, product DVD, and documentation for your Vicon MX T-Series system For details of the components actually supplied with your system, see the Bill of Materials that accompanied the shipment.

Assemble and connect the MX hardware components:

1. For each MX Camera, assemble the head block and connect the camera and base plate to it.

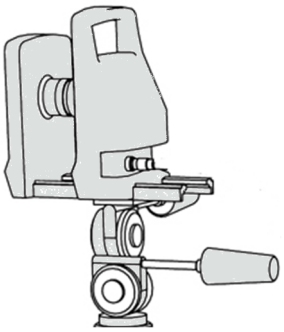


Figure 17: Assemble camera head blocks

2. Mount MX camera and head block assemblies on tripods or on a clamp and truss on a speed rail, and then position them around the capture volume.

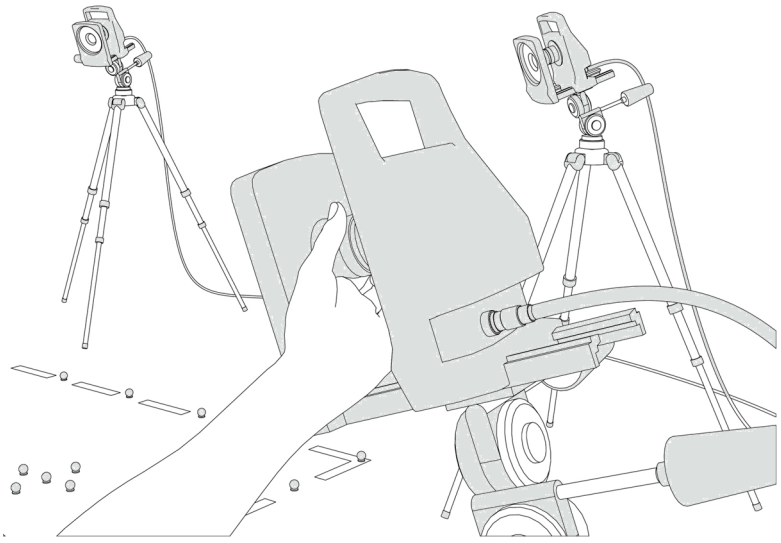


Figure 18: Mount and position cameras

3. For each T-Series camera, plug one end of the blue MX Gigacable into one of the10 **Vicon Cameras** sockets on the rear of the primary MX Giganet.

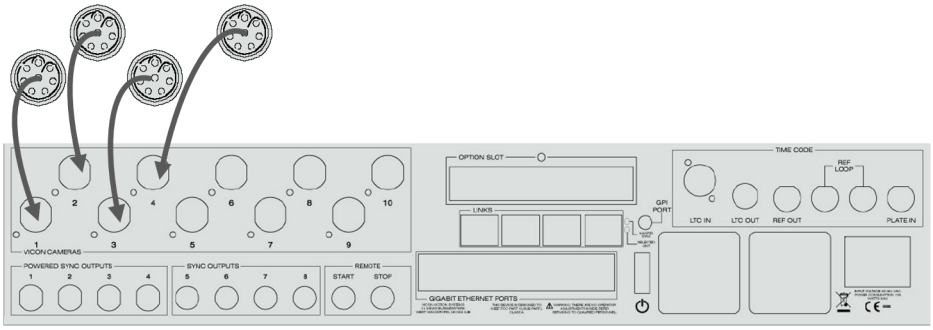


Figure 19: Plug Gigacables into primary MX Giganet

4. Plug the other end of the cable into the **Data** socket on the rear of each T-Series camera.

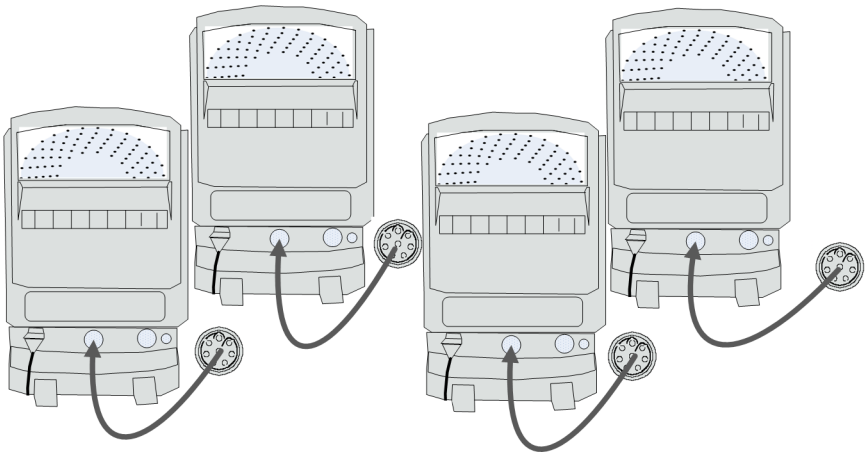
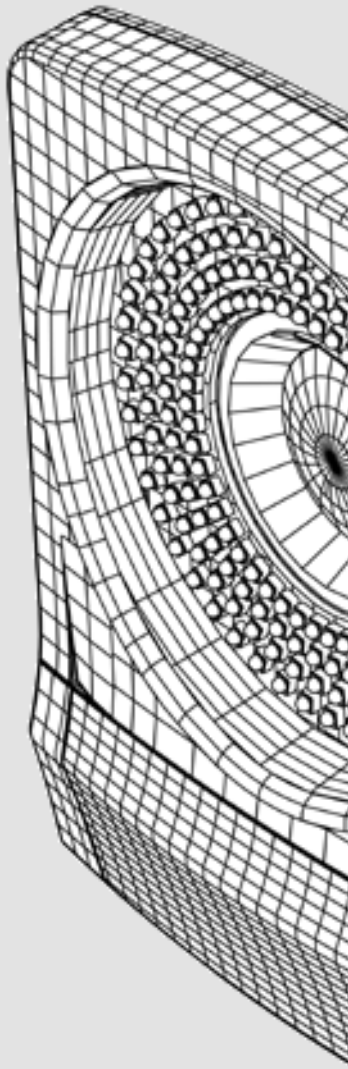
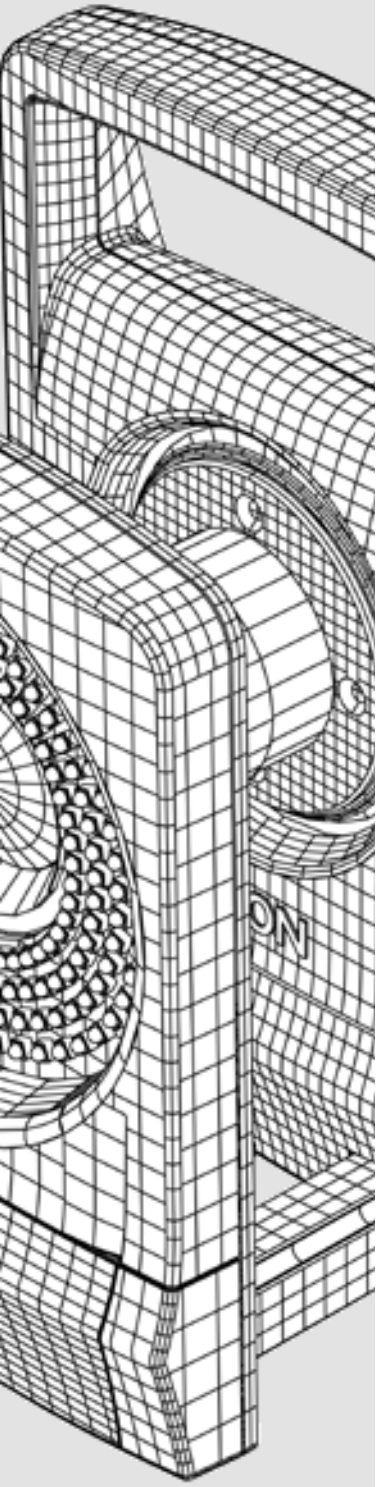


Figure 20: Plug Gigacables into T-Series cameras

For details on these connectors, see Capture and Synchronization Connectors on page 30. For details on the MX Gigacable, see Vicon MX T-Series System Cable Descriptions on page 42.





5. Plug one end of the MX Host PC cable (or a commercially available RJ-45 Ethernet cable) into one of the five sockets in the **Gigabit Ethernet Ports** group on the rear of the MX Giganet.

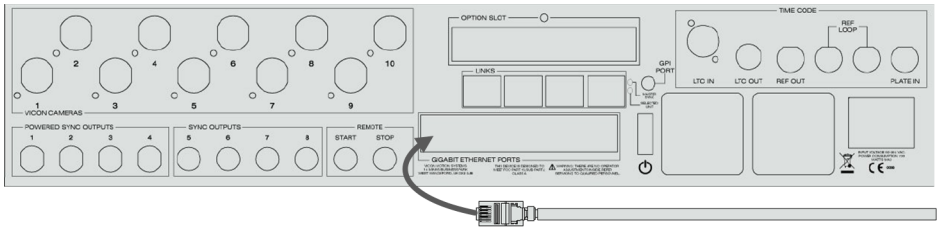


Figure 21: Plug RJ-45 Ethernet cable into MX Giganet

6. Plug the other end of the cable into the PCIe or PCI-X network Gigabit Ethernet port for the MX system network on the rear of the MX Host PC (for details, see Vicon MX System Network Port on page 37).

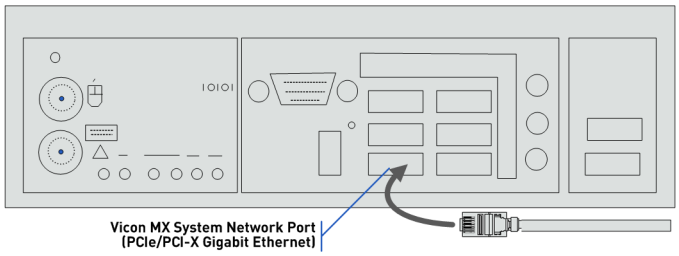


Figure 22: Plug RJ-45 Ethernet cable into MX Host PC

For details on these connectors, see Vicon System Connectors on page 33. For details on the MX Host PC cable, seeVicon MX T-Series System Cable Descriptions on page 42.

7. Press the power switch on the MX Host PC to turn it on. and allow it to fully boot up.

Figure 23: Press button to turn on MX Host PC

8. Press the On/Off switch on the rear of the MX Giganet to turn the unit on.

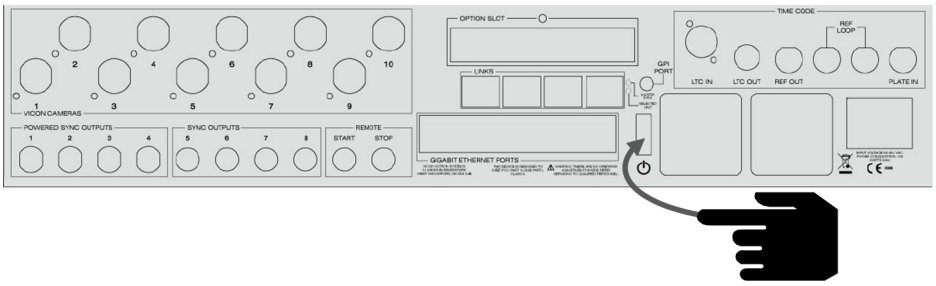
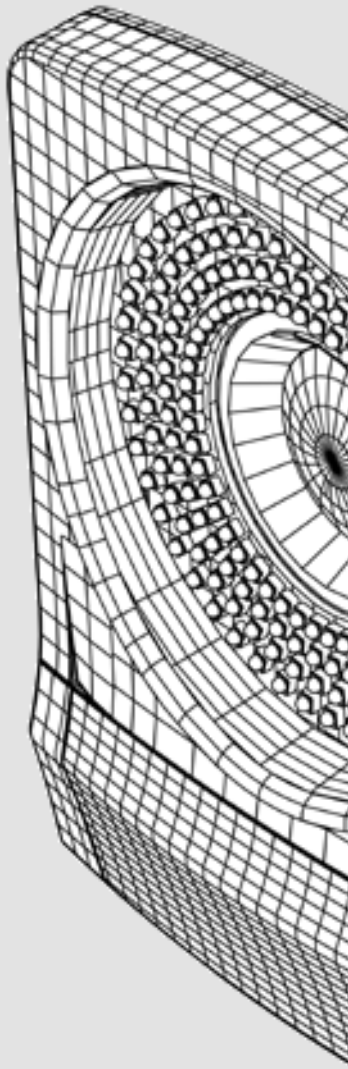
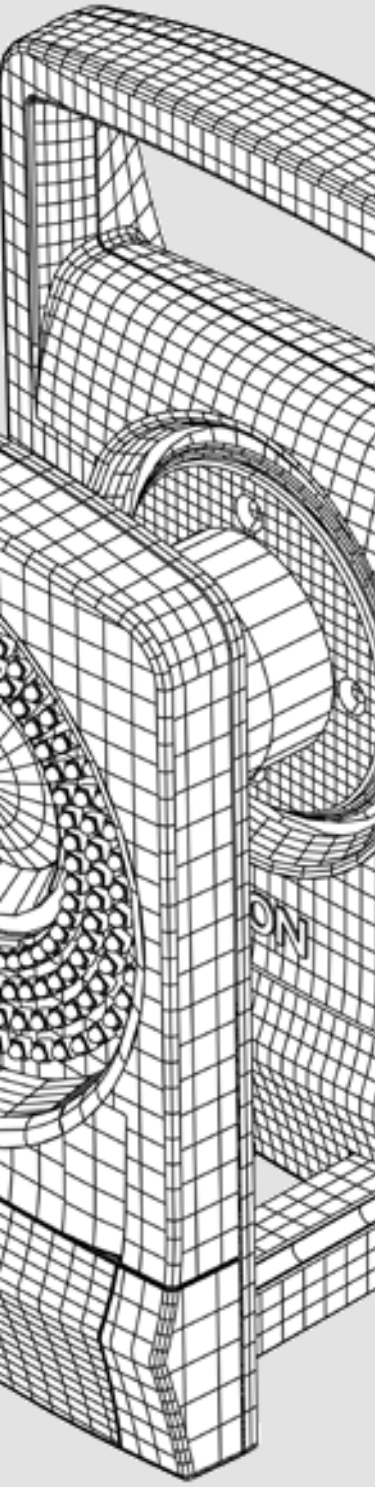


Figure 24: Press power switch to turn on MX Giganet

You can subsequently use the standby switch located on the right front of the Giganet unit.This soft switch is enabled after you turn the unit on using the power switch on the back. You can then press the soft switch on the front of the unit to put the Giganet into standby mode. Press the soft switch again to turn the Giganet back on. The Giganet goes through its boot-up sequence with the Vicon logo. For details, see MX Giganet Front Panel on page 29.





Set Up the Software

Next, you install, configure, and start your chosen Vicon application software: Vicon Blade or Vicon Nexus. You generally install your Vicon MX system software from the product DVD supplied in your product package. You must install your Vicon application software as a clean installation. If you try to install it over a previously installed release or an evaluation version, the installer issues a message instructing you to remove the previous version.

Important
If you purchased your MX Host PC from Vicon, the software will have been installed for you. You do not need to install the software again. You can check that the Vicon software folders and icons have been added to the standard locations on the Windows desktop or Start menu.

To set up the software:

1. Run the software installation DVD.

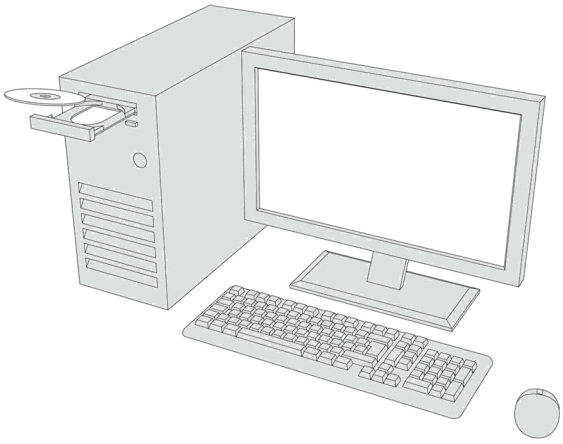


Figure 25: Install software

After your Vicon application software has been installed, program folders and icons are added to the standard Windows locations, according to the installation options you selected.

2. Activate the software license. The method depends upon your software. For example, you may need to plug a HASP licensing dongle into an appropriate

port (USB or parallel) on the MX Host PC or activate the software license. For details, see the documentation for your Vicon software.

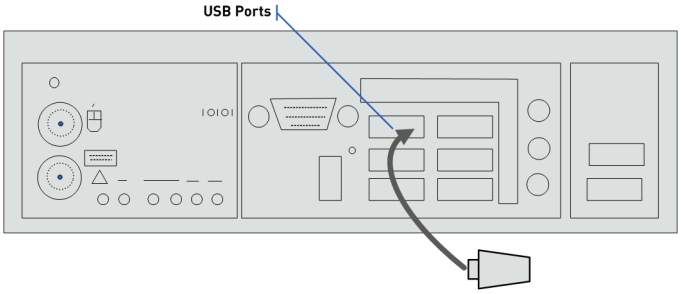


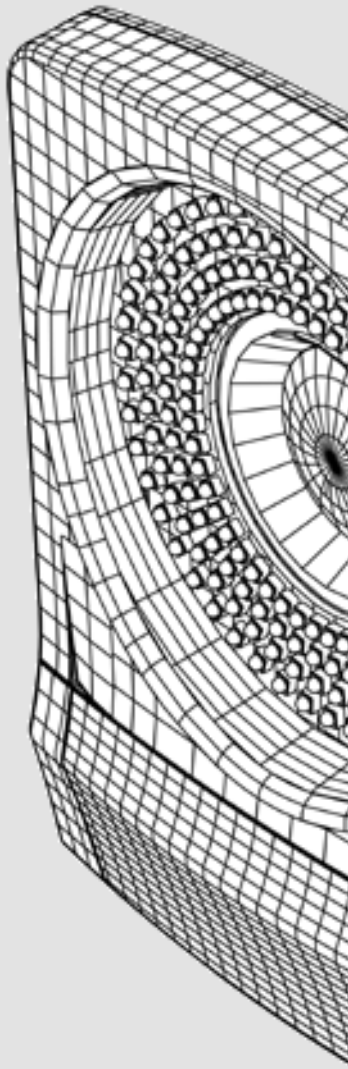
Figure 26: Plug in HASP licensing dongle

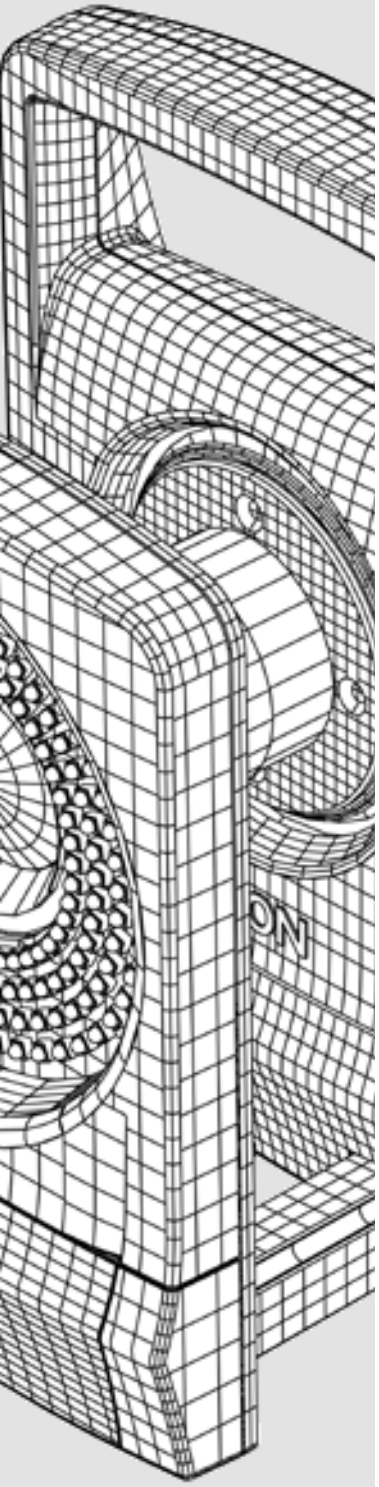
3. Configure the Vicon MX system IP address:

IP address:	192.168.10.1
Subnet mask:	255.255.254.0 (Users of earlier Vicon MX systems, note that the subnet mask value has changed for the T-Series; previous MX systems used 255.255.255.0. The new T-Series value will work with earlier MX system components integrated into your T-Series system.
Default gateway:	Leave blank

4. Start the Vicon application software:
   - From the Windows desktop, double-click the program shortcut for the Vicon application software (Vicon Blade or Vicon Nexus).

     OR





- From the Windows **Start** menu, point to **All Programs**, then point to **Vicon**, then click the Vicon application software program (Vicon Blade or Vicon Nexus).

Figure 27: Start Vicon software

The application software splash screen is displayed. For Vicon Blade, specify the user profile to be used (you can leave the *Default.ini* profile selected) and click **OK**.

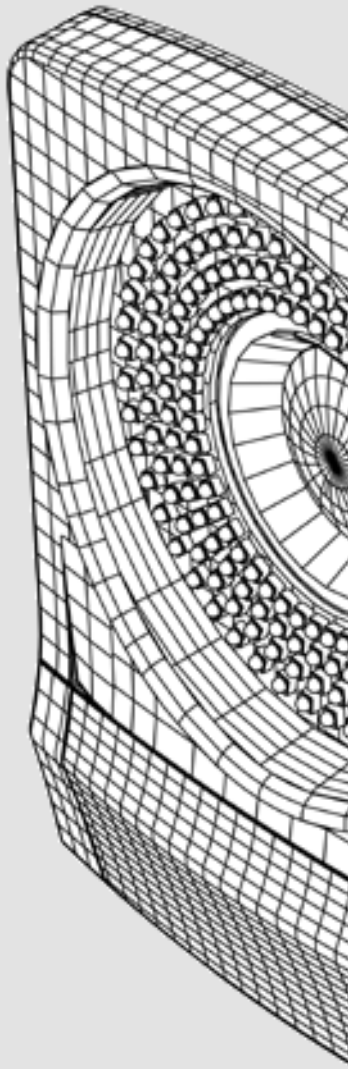
5. Connect the Vicon application software to the MX system to start real-time streaming of data from the MX cameras:

   - **Blade**

     From the **Studio Activities** tag, in the **Go Live** group, click the **Connect** button. The main Blade button at the top left of the window turns red when the system is connected.

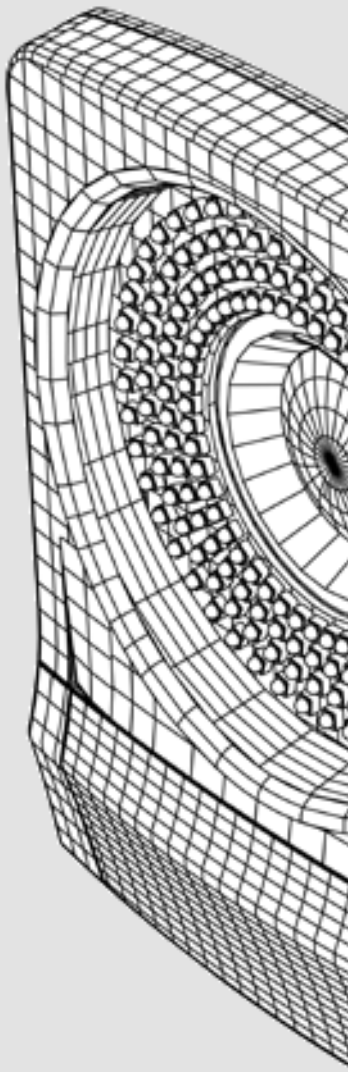
   - **Nexus**

     From the **Resources** pane, click the **Live** button. The button label changes to **Connected** and turns a bright blue color when the system is connected.



9 Extend MX System with Additional MX Giganets

This chapter shows you how to connect additional MX Giganets to scale your Vicon MX T-Series system to meet your application needs.



In This Chapter

Understand When Additional MX Giganets are Required

If your motion capture application requires more than 10 MX T-Series cameras, 4 GigE or 4 DCAM reference video cameras, or 64 channels per third-party analog device, you must include additional MX Giganets in your Vicon MX T-Series system.

Incorporate Subordinate Giganets

The MX Giganet connected to the MX Host PC is the primary MX Giganet; additional MX Giganets connected to the primary are referred to as subordinate MX Giganets. You can connect up to four subordinate MX Giganets to a primary MX Giganet. You can create a chain, by connecting further subordinate MX Giganets to subordinate Giganets connected to the primary MX Giganet.

For quickest connection and best Ethernet communications performance in large MX systems using multiple MX Giganets, you are recommended to first connect four subordinate MX Giganets to the rear of the primary MX Giganet. You can then connect up to four subordinate MX Giganets to one of those connected the primary MX Giganets. You can continue to chain MX Giganets together in this way, ensuring you use the units closest to the primary MX Giganet first and fill all four sockets in one MX Giganet before connecting any further subordinate MX Giganets. This avoids the transport delay that could otherwise result. Figure 28 compares these methods.

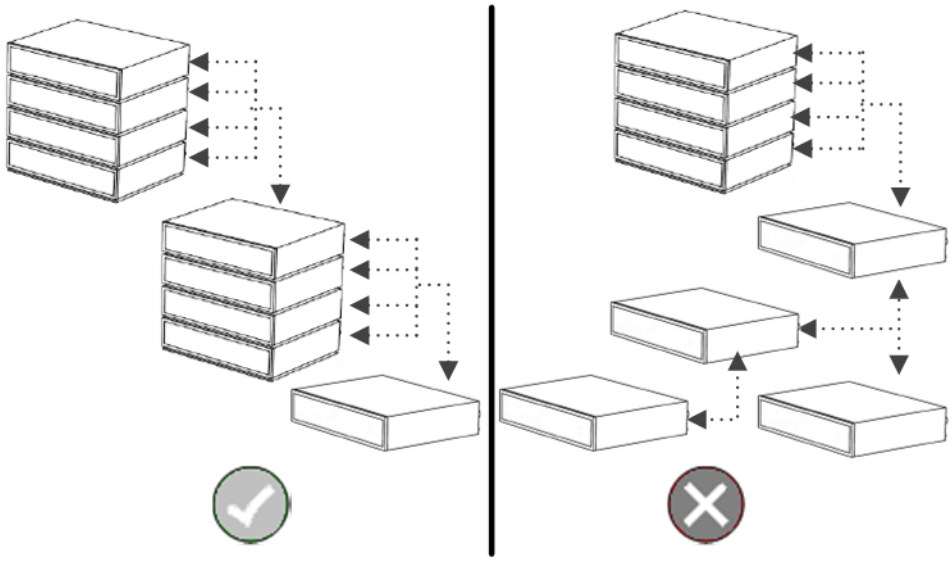
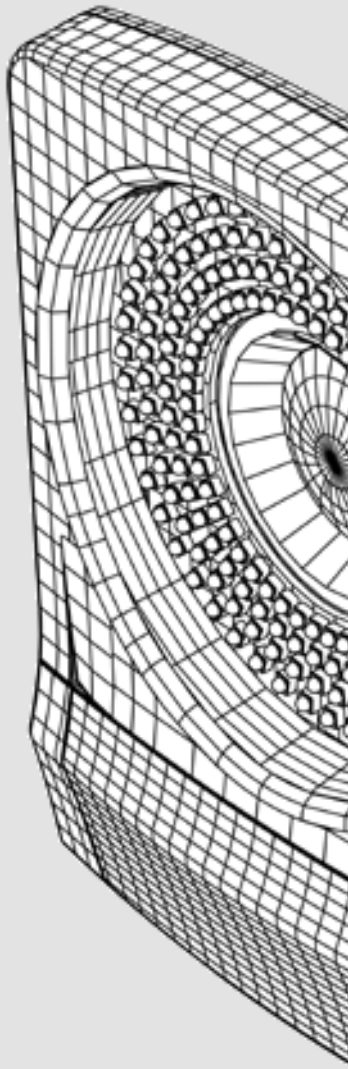
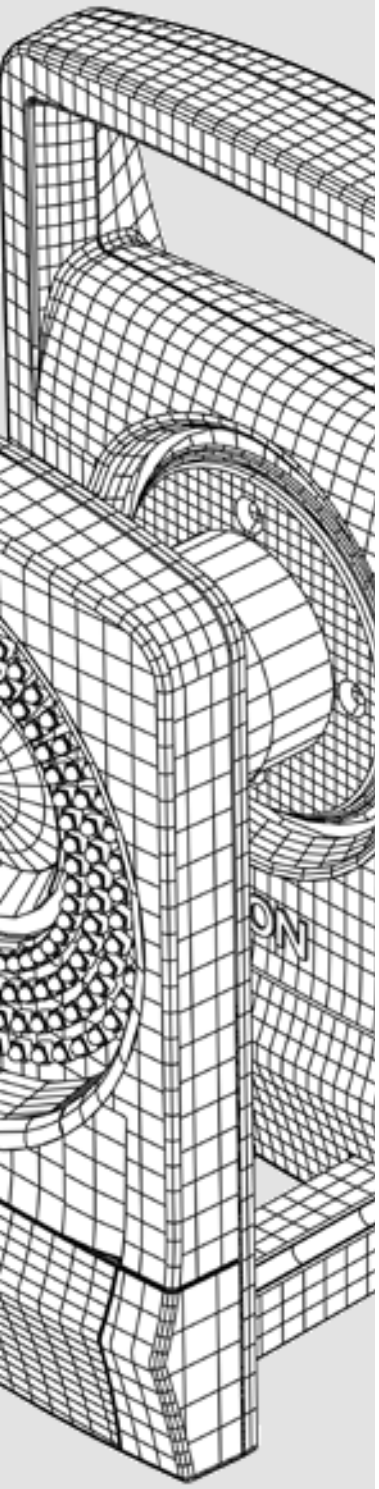


Figure 28: Recommended method for chaining MX Giganets





To incorporate subordinate MX Giganets in a T-Series system:

1. For each subordinate MX Giganet, plug one end of the MX Giganet to MX Giganet cable into one of the four **Links** sockets on the rear of the subordinate MX Giganet.

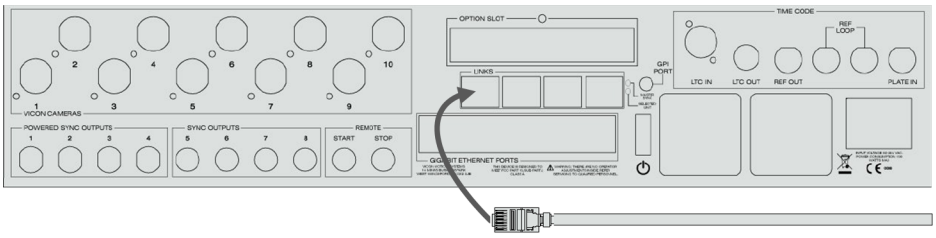


Figure 29: Plug MX Giganet cable into subordinate MX Giganet

2. Plug the other end of the cable from each subordinate MX Giganet into one of the four **Links** sockets on the rear of the primary MX Giganet.

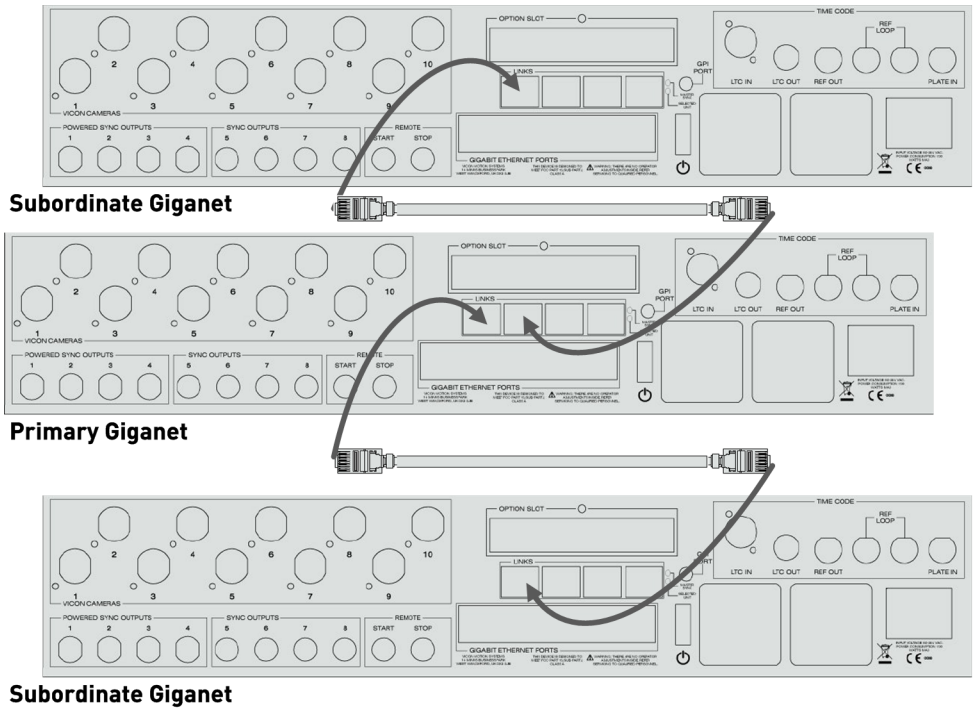


Figure 30: Plug subordinate MX Giganet cables into primary MX Giganet

3. Press the power button on the MX Host PC to turn it on and allow it to fully boot up.

Figure 31: Press button to turn on MX Host PC

4. Press the On/Off switch on the rear of the primary MX Giganet (the one connected to the MX Host PC) to turn the unit on.

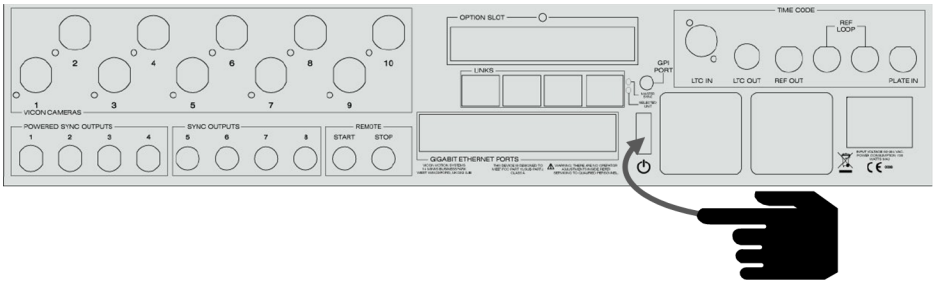


Figure 32: Press power switch to turn on primary MX Giganet

5. Press the On/Off switch on the rear of each subordinate MX Giganet to turn the unit on.

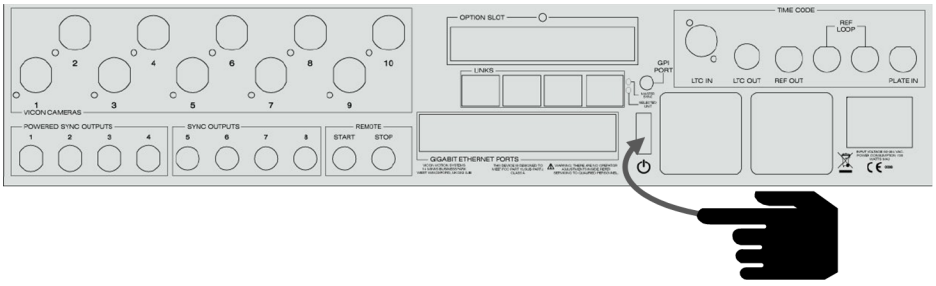
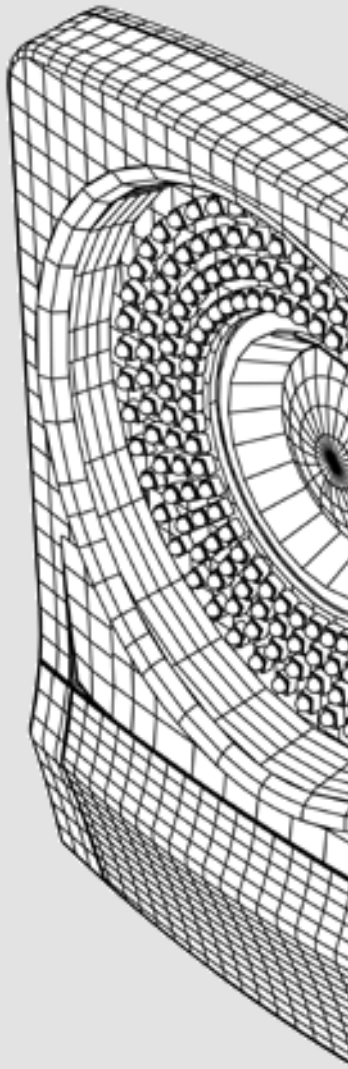


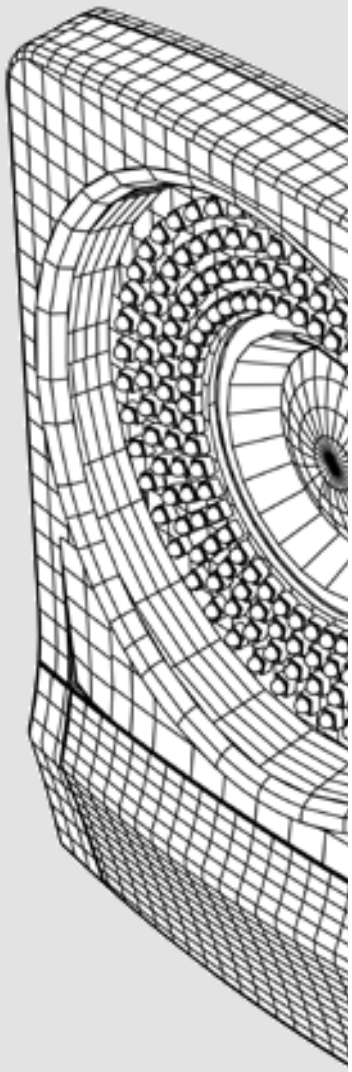
Figure 33: Press power switch to turn on each subordinate MX Giganet

For details on these connectors, see Vicon System Connectors on page 33 and for the cable, see Vicon MX T-Series System Cable Descriptions on page 42.



10 Extend MX System with Additional MX T-Series Cameras

This chapter shows you how to connect additional T-Series cameras to your Vicon MX T-Seriessystem.



In This Chapter

Understand Adding MX-T-Series Cameras

You can include up to 10 MX T-Series cameras in a simple Vicon MX T-Series system with a single, primary MX Giganet. You can extend the number of MX T-Series cameras in your Vicon MX T-Series system to meet your needs. You can mix the types of MX T-Series and earlier ranges of MX cameras in your system.

Incorporate Additional MX T-Series Cameras

For large systems that require more than the 10 cameras that can be connected to the primary MX Giganet, you can connect up to 10 cameras to each additional, subordinate MX Giganet (for details on adding MX Giganets, see Chapter 9 Extend MX System with Additional MX Giganets). You can chain multiple MX Giganets together to connect the number of MX T-Series cameras you need.

To incorporate additional MX T-Series Cameras:

1. For each additional MX T-Series camera, plug one end of a blue MX Gigacable into the one of the10 **Vicon Cameras** sockets on the rear of a subordinate MX Giganet.

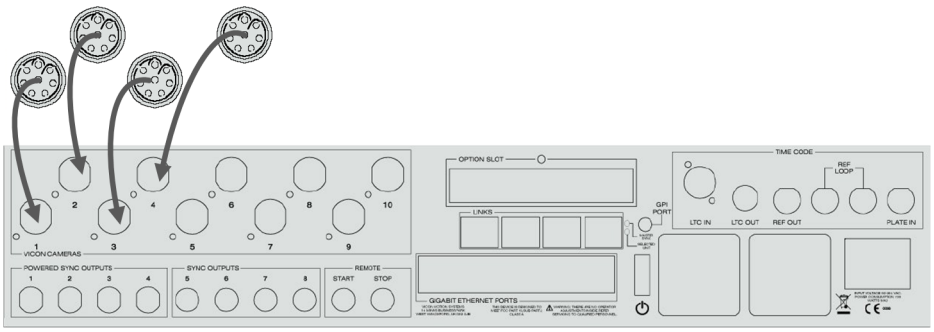
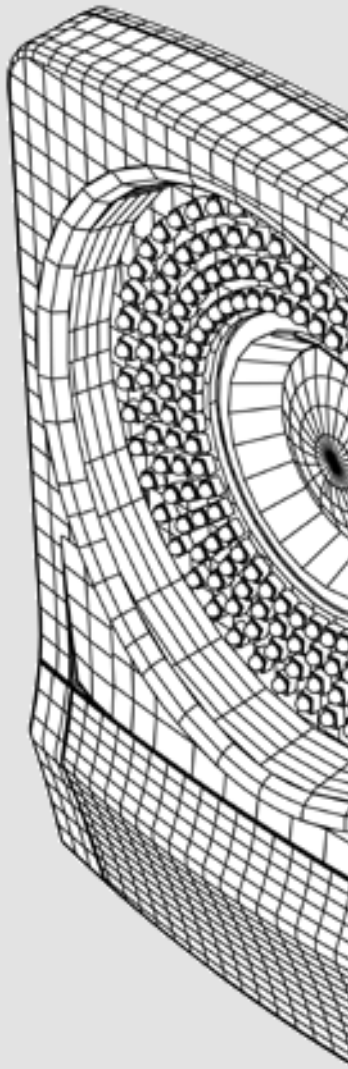
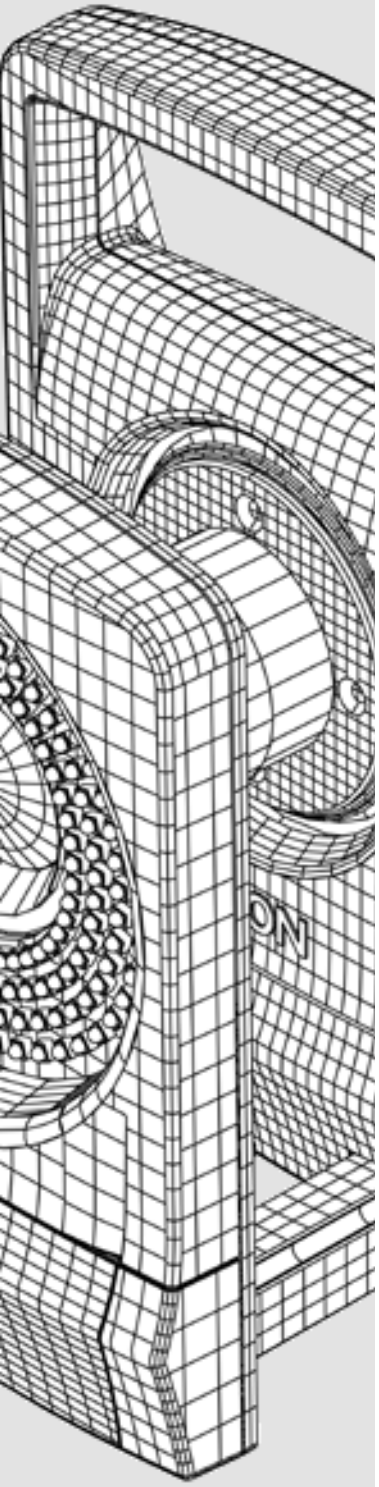


Figure 34: Plug Gigacables into subordinate MX Giganet





2. Plug the other end of the cable into the **Data** socket on the rear of each MX T-Series camera.

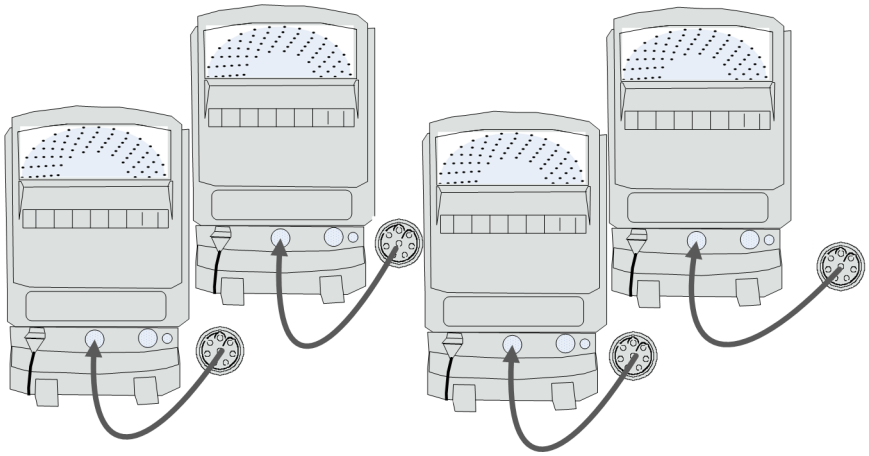
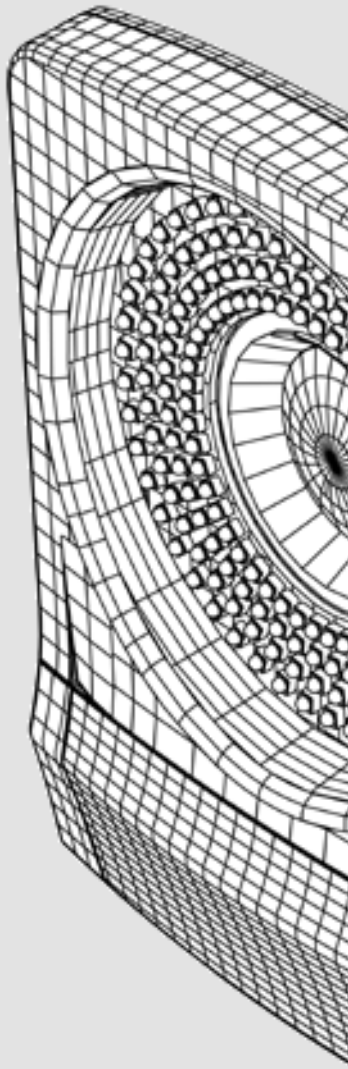


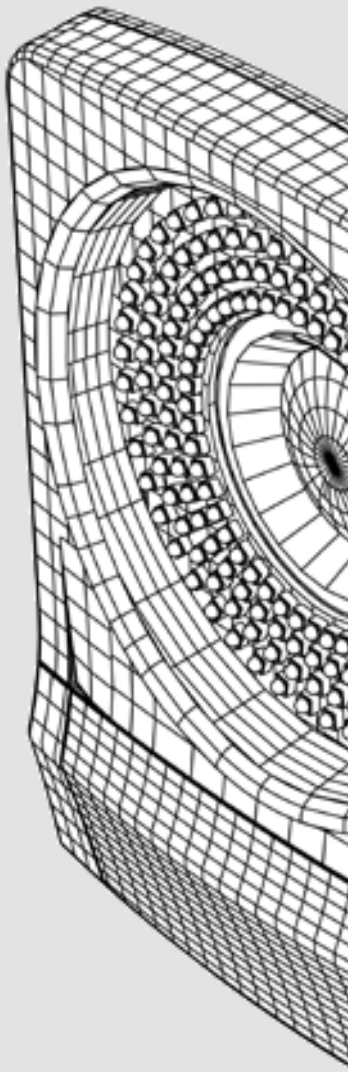
Figure 35: Plug Gigacables into T-Series cameras

For details on these connectors, see Capture and Synchronization Connectors on page 30. For details on the MX Gigacable, seeVicon MX T-Series System Cable Descriptions on page 42.



11 Extend MX System with Reference Video Cameras

This chapter shows you how to connect external GigE, DCAM, and DV cameras to an MX Giganet to provide reference video for your Vicon MX T-Series system.

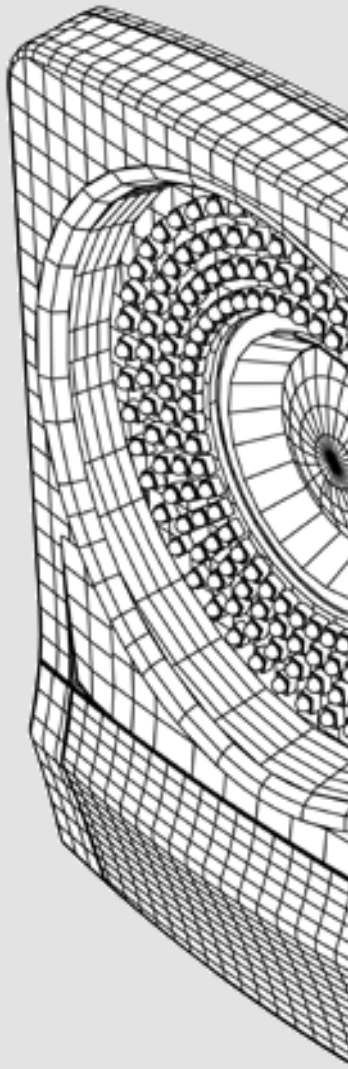


In This Chapter

Understand Reference Video Cameras

You can connect up to four third-party Gigabit Ethernet (GigE) and up to four Digital CAMera (DCAM) cameras to a single MX Giganet to provide reference video for your Vicon MX T-Series system. You can include Digital Video (DV) cameras in your Vicon MX T-Series system up to the number of FireWire controller chips on the MX Host PC or a remote PC. You can extend the number of reference video cameras in your Vicon MX T-Series system to meet your needs.

Important
This section describes only the physical connections for incorporating Basler GigE, DCAM, and DV cameras in your Vicon MX T-Series system. For full details on what you must do to prepare and configure Basler reference video cameras for use with Vicon Nexus, see the Vicon Nexus Product Guide—Advanced Notes: Basler Camera Support release document. If you wish to use Basler reference video cameras with Vicon Blade, contact Vicon Support (for details, see Chapter 25 Support Resources).



Incorporate Reference Video Cameras

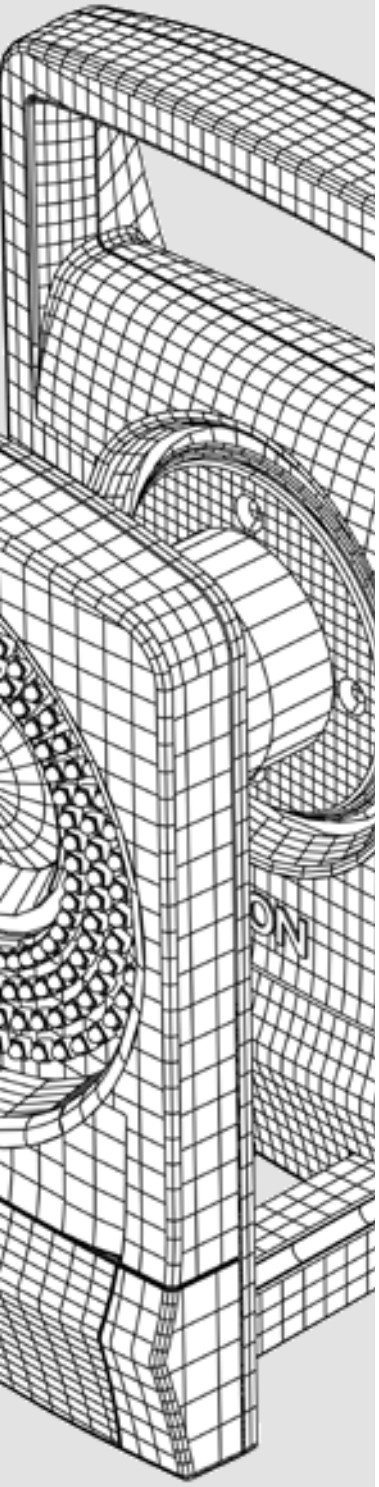
The way you incorporate your reference video cameras into your Vicon MX T-Series system depends on the camera type, as shown in Table 1.

Table 1: Reference Video Camera Types

Camera Type	Description	Transmission Method
Gigabit Ethernet	Basler GigE Vision format	Gigabit Ethernet (see page 81)
DCAM	Basler A600 series Digital CAMera format	IEEE 1394 FireWire (see page 83)
DV	Standard definition PAL or NTSC video camera	IEEE 1394 FireWire (see page 83)

Important
For details of reference video cameras supported by your Vicon application software, see your software release notes.

In all cases, you synchronize the capture speed between your reference video cameras and Vicon MX cameras by specifying a GPO file in your Vicon application software (for details, see Chapter 13 Extend MX System with Synchronized Output Devices).



The following sections describe how to incorporate a given type of reference video camera:

- Incorporate GigE Cameras
- Incorporate DCAM Cameras on page 83
- Incorporate DV Cameras on page 84

Incorporate GigE Cameras

You connect Gigabit Ethernet cameras, such as Basler GigE Vision cameras, to the primary MX Giganet for power and synchronization and to the MX Host PC (or a remote PC in your Vicon system architecture) for data connection and flow. For large systems that require more than the four GigE reference video cameras that can be connected to the primary MX Giganet, you can connect up to four more cameras to each additional, subordinate MX Giganet (for details on adding MX Giganets, see Chapter 9 Extend MX System with Additional MX Giganets). You use a Vicon Basler GigE camera cable for connecting each Basler GigE camera to an MX Giganet (for details, see Extended System Architecture Model Cables on page 44).

You also connect each GigE camera to a dedicated Ethernet port on your MX Host PC or on a remote PC in your Vicon system architecture (for details, see Additional Network Ports on page 39). You must obtain a standard RJ-45 Gigabit Ethernet cable (shielded CAT-6 or CAT-5E) to connect each Basler GigE camera to a PC.

To incorporate a Basler GigE camera in a T-Series system:

1. Plug one end of a Basler GigE Camera cable into one of the four **Powered Sync Outputs** sockets on the rear of a MX Giganet.

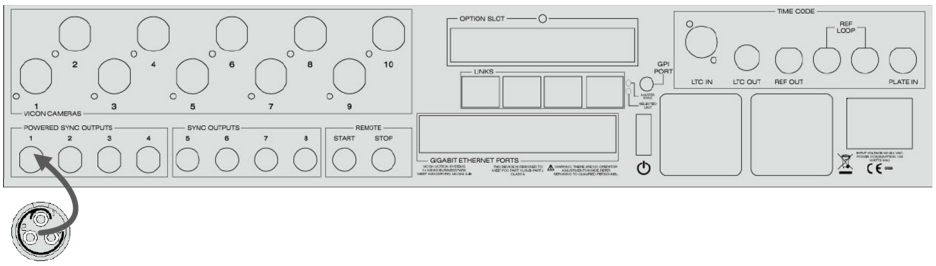


Figure 36: Plug Basler GigE cable into MX Giganet

2. Plug the other end of each cable into the round 12-pin receptacle on the rear of each GigE camera.

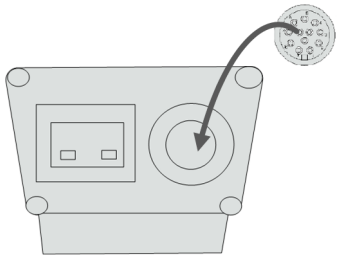


Figure 37: Plug Basler GigE cable into Basler GigE camera

3. Plug one end of an Ethernet cable into the Ethernet port on the rear of the Basler GigE camera.

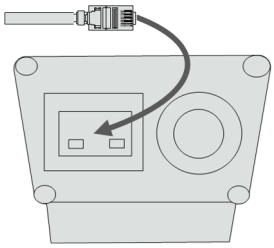


Figure 38: Plug Ethernet cable into Basler GigE camera

4. Plug the other end of the Ethernet cable into one of the PCI, PCIe or PCI-X Ethernet ports for GigE cameras on the rear of the MX Host PC (for details, see Additional Network Ports on page 39).

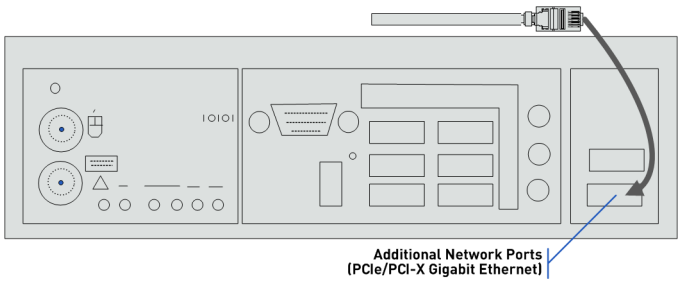
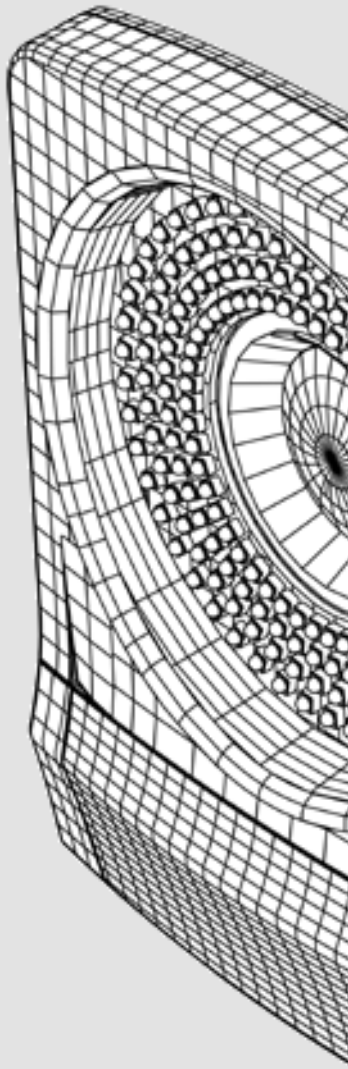
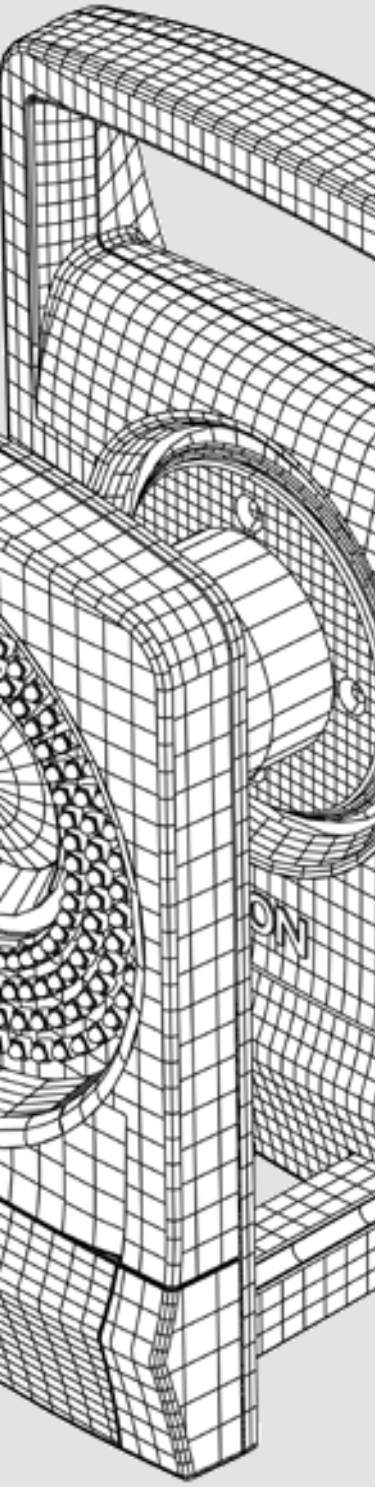


Figure 39: Plug Ethernet cable into MX Host PC

For details on these connectors, see Capture and Synchronization Connectors on page 30. For details on the Basler GigE Camera cable, seeVicon MX T-Series System Cable Descriptions on page 42.





Incorporate DCAM Cameras

You connect DCAM cameras, such as Basler A600 series cameras, to the primary MX Giganet for synchronization and to the MX Host PC (or a remote PC in your Vicon system architecture) for power, camera control, and video transmission. For large systems that require more than the four DCAM reference video cameras that can be connected to the primary MX Giganet, you can connect up to four more cameras to each additional, subordinate MX Giganet (for details on adding MX Giganets, see Chapter 9 Extend MX System with Additional MX Giganets). You use a Vicon Basler DCAM camera cable for connecting each Basler DCAM camera to an MX Giganet (for details, see Extended System Architecture Model Cables on page 44).

You also connect each DCAM camera to a dedicated FireWire port on your MX Host PC or on a remote PC in your Vicon system architecture (for details, see Additional Network Ports on page 39). You must obtain a standard 6-pin to 6-pin FireWire cable to connect each Basler DCAM camera to a PC.

To incorporate a Basler DCAM camera in a T-Series system:

1. Plug one end of a Vicon Basler DCAM camera cable into one of the four **Sync Outputs** sockets on the rear of a MX Giganet.

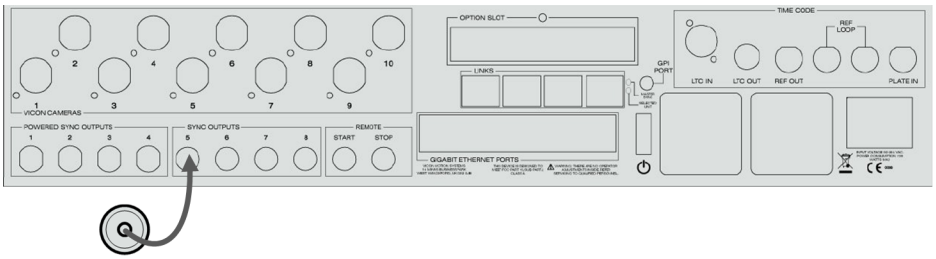


Figure 40: Plug Vicon Basler DCAM cable into MX Giganet

2. Plug the other end of the Vicon cable into the RJ-45 10-pin connector on the rear of each DCAM camera.

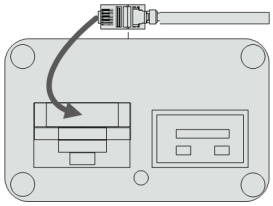


Figure 41: Plug Vicon Basler DCAM cable into Basler DCAM camera

3. Plug one end of a standard 6-pin FireWire cable into the IEEE 1394 socket on the rear of each DCAM camera.

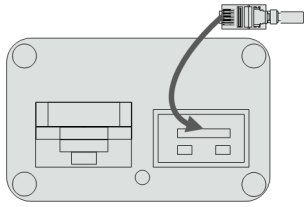


Figure 42: Plug standard FireWire cable into Basler GigE camera

4. Plug the other end of the standard FireWire cable into the FireWire port on the rear of the MX Host PC (for details, see FireWire Port on page 39).

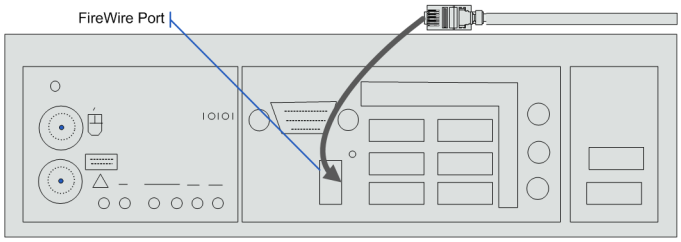
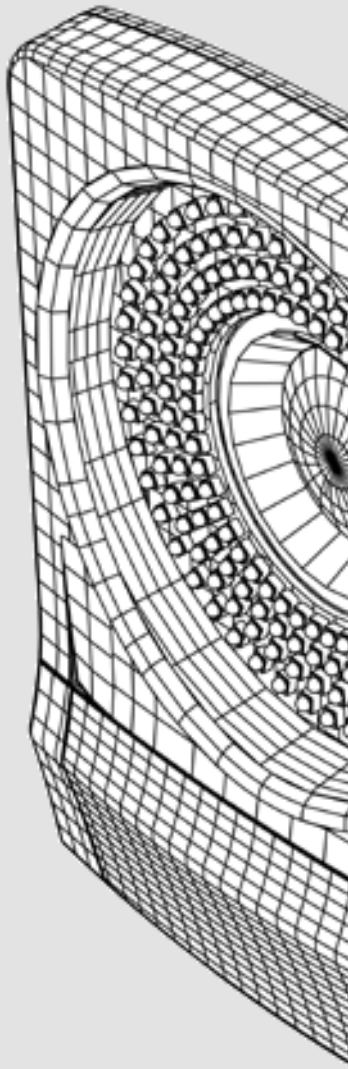


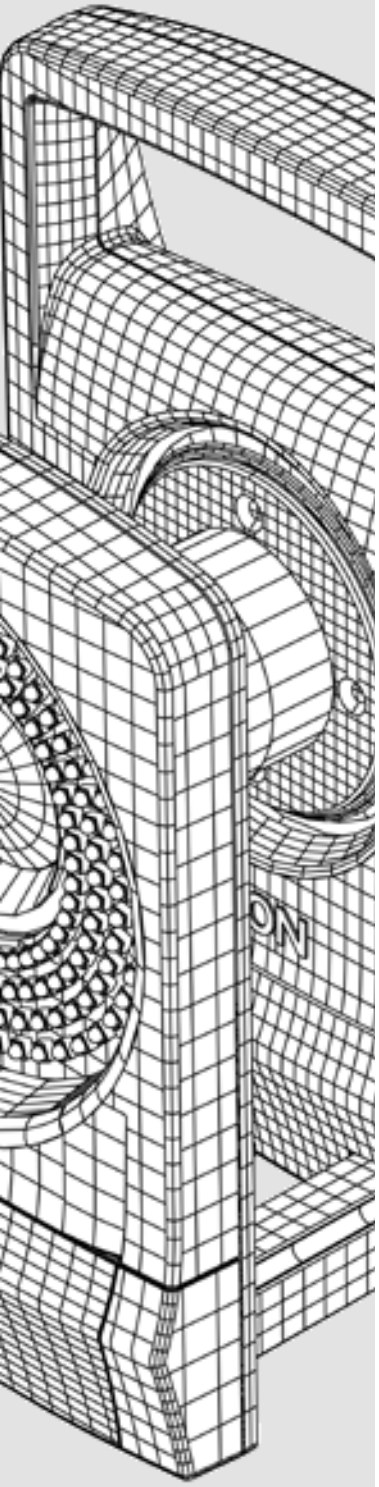
Figure 43: Plug standard FireWire cable into MX Host PC

Incorporate DV Cameras

You connect DV cameras, such as Canon, JVC, Panasonic, and Sony consumer camcorders, to the MX Host PC (or a remote PC in your Vicon system architecture) for video transmission.

You connect each DV camera to a dedicated FireWire controller on your MX Host PC or on a remote PC in your Vicon system architecture (for details, see Additional Network Ports on page 39). Note that a FireWire board may have multiple ports that pass through a single controller chip, or it may have multiple controllers with corresponding ports. You must connect only one DV camera per controller on your MX Host PC.





To incorporate a DV camera in a T-Series system:

1. Plug one end of a standard FireWire cable into the IEEE 1394 socket on each DV camera. Note that the connector on the camera end may either be a 4-pin or a 6-pin connector depending on the camera.

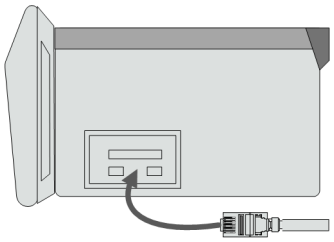


Figure 44: Plug standard FireWire cable into DV camera

2. Plug the other end of the cable into a FireWire port on the rear of the MX Host PC. You need a separate FireWire controller chip for each DV camera (for details, see FireWire Port on page 39).

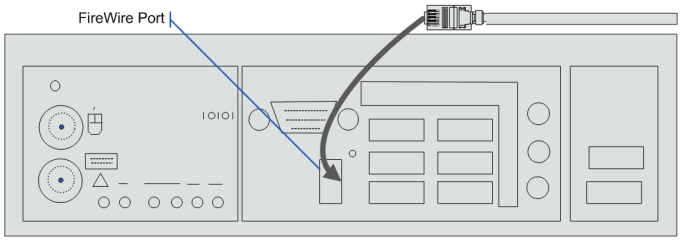
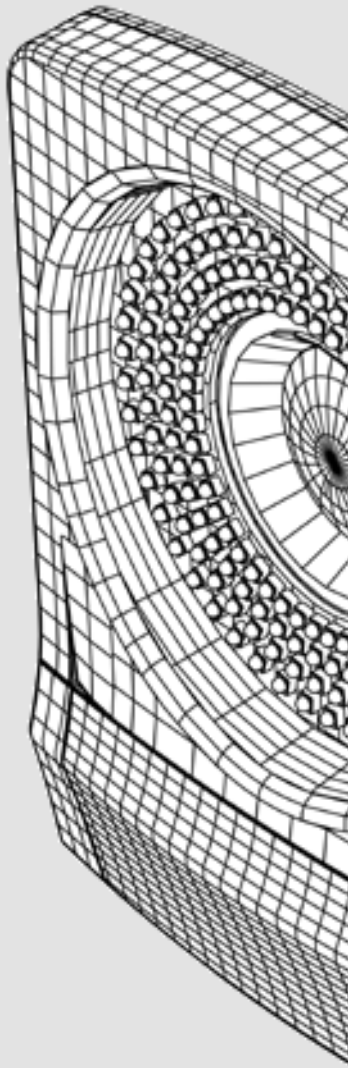
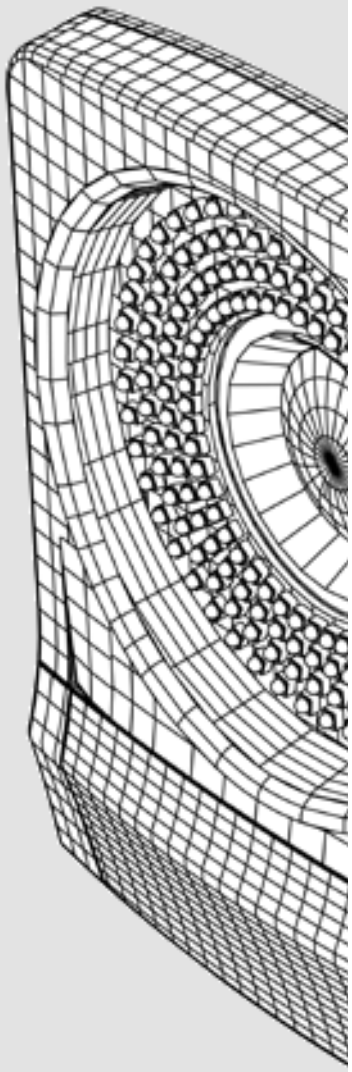


Figure 45: Plug standard FireWire cable in MX Host PC



12 Extend MX System with Analog Capture Devices

This chapter shows you how to connect supported third-party analog capture devices, such as force plates, electromyography (EMG) equipment, potentiometers, and accelerometers, to your Vicon MX T-Series system.



In This Chapter

Important

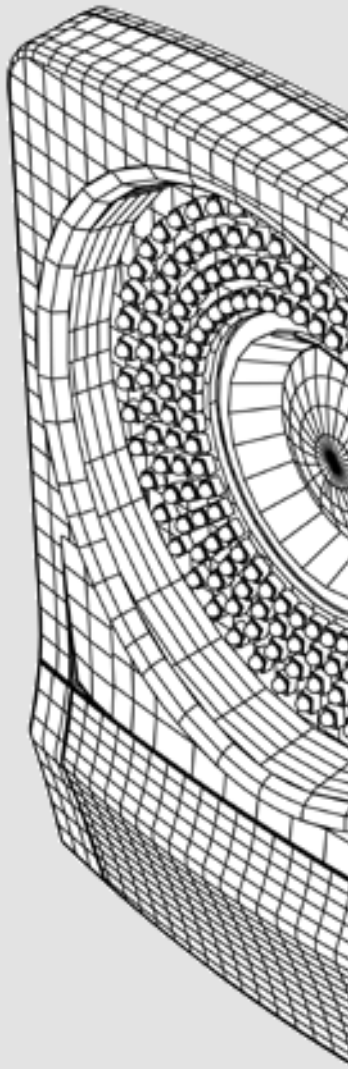
In order to incorporate supported third-party analog capture devices in your Vicon MX T-Series system, you must have the 64-channel analog ADC (Analog-to-Digital Converter) option card installed in the MX Giganet, with a Vicon ADC screw terminal patch panel connected to it.

The ADC Option card must be factory installed in your MX Giganet. If you did not order this option with your Vicon MX T-Series system, the slot is covered with a blank panel. If you later want to have an ADC Option card installed, contact Vicon or your nearest agent or distributor.

Understand Adding Analog Capture Devices

You can include supported third-party devices with up to 64 analog channels in a simple Vicon MX T-Series system with a single, primary MX Giganet. You can extend the number of analog channels in your Vicon MX T-Series system to meet your needs.

For large systems that require more than the 64 analog channels that can be provided by the primary MX Giganet, you can obtain up to 64 more analog channels by incorporating a subordinate MX Giganet (for details on adding MX Giganets, see Chapter 9 Extend MX System with Additional MX Giganets).



Understand ADC Option Card Functionality

This section explains the analog ADC option card in the MX Giganet that provides analog capture functionality for the Vicon MX T-Series system:

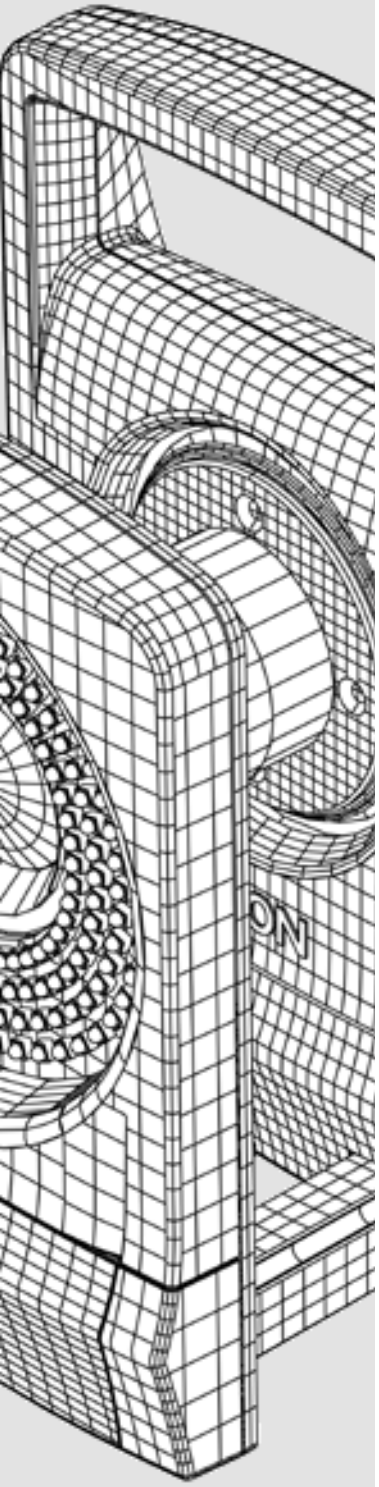
Analog ADC Option Card

The analog ADC card is a 64-channel device for generating 16-bit offset binary conversions from analog sources. The input impedance is 1 MΩ. The data sampling frequency is common to all channels; while it is independent of the MX Camera frame rate, it is affected by the camera frame rate specified in the Vicon application software. The maximum rate at which you can sample data via the ADC card is 192,000 samples/second (192 KHz). The actual capture frequency you can specify depends on the total number of channels to be sampled, as shown in Table 11.

Table 11: Maximum ADC throughput

No. of Channels	Max. Capture Frequency (KHz)
1	192
4	48
8	24
16	12
32	6
64	3

As illustrated in Table 11, the fewer analog channels there are, the higher the sampling frequency you can specify. Each channel has a programmable gain, which can be set to +/- 10 volts, +/- 5 volts, +/- 2.5 volts, or +/- 1.25 volts. For details on specifying these settings, see your Vicon software documentation.



Analog ADC Socket

The **Analog ADC** option card connector is a 100-way socket used to connect the MX Giganet to the Vicon ADC Patch Panel, which then connects to third-party devices for capturing analog data such as force plates, electromyography (EMG) equipment, potentiometers, and accelerometers. The Analog ADC socket is located on the rear of the MX Giganet. For details on the connector, see Option Slot on page 32; for details on the patch panel, see Vicon ADC Patch Panel on page 90.

On both the ADC option card 100-way edge socket and the corresponding 100-way interface plug, Pin 1 is indicated with a triangular symbol (▼) and Pin 51 is indicated with a circular symbol (●), as shown in Figure 46.

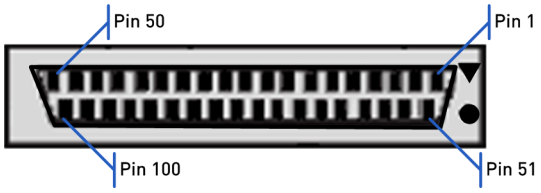


Figure 46: Analog ADC card in MX unit

Analog Pin Allocations

Table 12 shows the pin allocations for the 100 pins in the Analog ADC socket.

Table 12: Analog ADC 100-way socket pin allocation

Pin	Channel	Pin	Channel	Pin	Channel	Pin	Channel
1	Ground	15	Ground	29	19	43	28
2	1	16	10	30	Ground	44	29
3	Ground	17	11	31	20	45	Ground
4	2	18	Ground	32	21	46	30
5	3	19	12	33	Ground	47	31
6	Ground	20	13	34	22	48	Ground
7	4	21	Ground	35	23	49	32
8	5	22	14	36	Ground	50	Ground
9	Ground	23	15	37	24	51	Ground
10	6	24	Ground	38	25	52	33
11	7	25	16	39	Ground	53	Ground
12	Ground	26	17	40	26	54	34
13	8	27	Ground	41	27	55	35
14	9	28	18	42	Ground	56	Ground

Table 12: Analog ADC 100-way socket pin allocation

Pin	Channel	Pin	Channel	Pin	Channel	Pin	Channel
57	36	68	Ground	79	51	90	58
58	37	69	44	80	Ground	91	59
59	Ground	70	45	81	52	92	Ground
60	38	71	Ground	82	53	93	60
61	39	72	46	83	Ground	94	61
62	Ground	73	47	84	54	95	Ground
63	40	74	Ground	85	55	96	62
64	41	75	48	86	Ground	97	63
65	Ground	76	49	87	56	98	Ground
66	42	77	Ground	88	57	99	64
67	43	78	50	89	Ground	100	Ground

Vicon ADC Patch Panel

To incorporate a third-party analog capture device in your Vicon MX T-Series system, you must connect the analog ADC option card in the MX Giganet to the third-party device via the Vicon ADC screw terminal patch panel, shown in Figure 47. The patch panel is contained in a gray plastic case measuring 259 mm x 157 mm x 61mm.

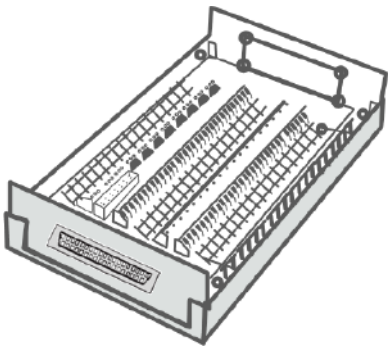
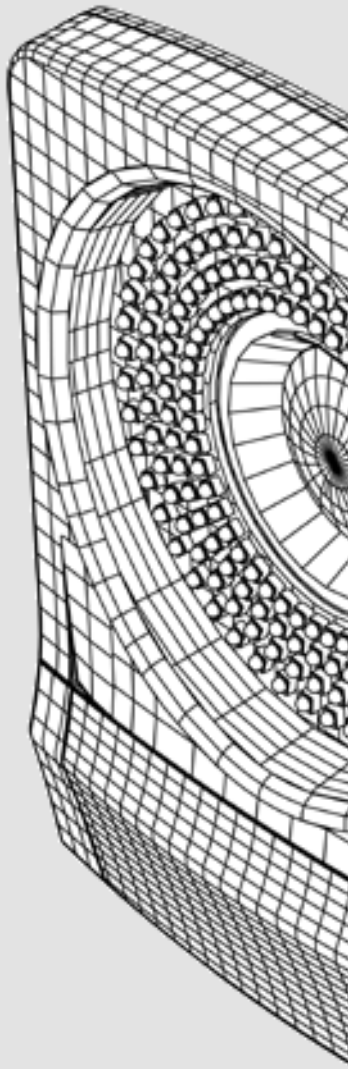
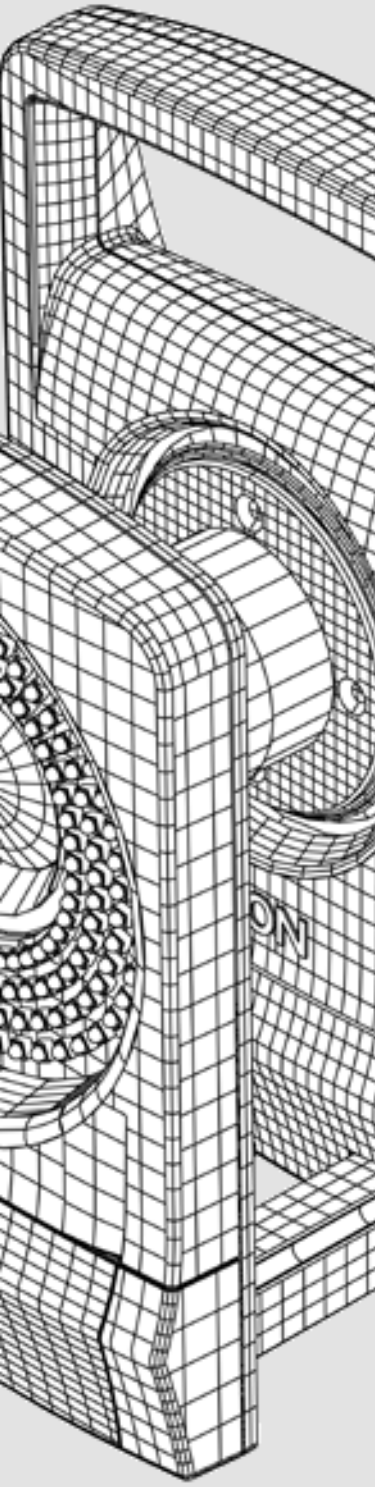


Figure 47: Vicon patch panel





Connect an Analog Capture Device to the Patch Panel

Each MX Giganet supports only one Vicon ADC patch panel. Before you connect the patch panel to an MX Giganet, you must first connect the signal cables for your analog capture device to the Vicon patch panel. You can connect more than one analog device to a single Vicon ADC patch panel as long as the total number of analog channels does not exceed 64.Channel 64 must be connected to ground (GND). MX Giganets are supplied by Vicon with this connection; you do not change this factory setting.

To connect a third-party analog capture device to the patch panel:

1. Ensure all equipment is switched off and the power cables are removed.
2. Remove the four dark plastic screw covers on the top of the Vicon ADC Patch Panel plastic box using the flat screwdriver blade.
3. Remove the four M3 Pozidrive screws on the lid of the box to expose the patch panel.
4. Pass the cables through the inlet on the side of the box with the cable grip flanges.
5. Install the signal cables into the screw terminal marked CH1-CH64. For details on these, see Analog Pin Allocations on page 89.
6. Install the braided and ground cables into any screw terminals marked SGND (Signal Ground). For details on these, see Analog Pin Allocations on page 89
7. When complete, clamp the cables using the grip flanges.
8. Align the lid and box grooves and rims, and then replace the lid, screws, and screw covers.

Incorporate an Analog Capture Device

Once you have connected your third-party device for capturing analog data to the Vicon ADC patch panel, you can then incorporate it into your Vicon MX T-Series system.

To incorporate an analog capture device:

1. Plug one end of the 100-way cable into the **Option Slot** socket on the rear of an MX Giganet, shown in Figure 48, ensuring that it clicks firmly into place.

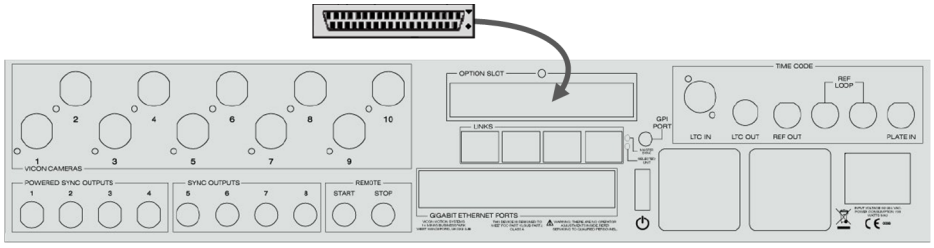


Figure 48: Plug 100-way cable into MX Giganet

2. Plug the other end of the supplied 100-way cable into the Vicon ADC patch panel, ensuring that it clicks firmly into place.

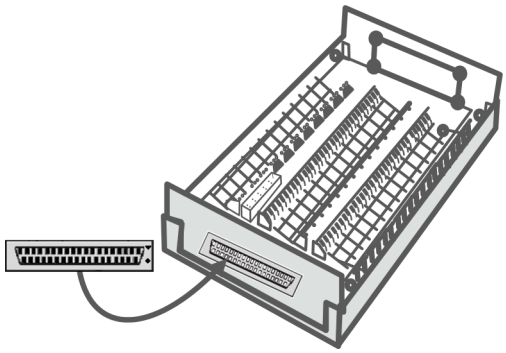
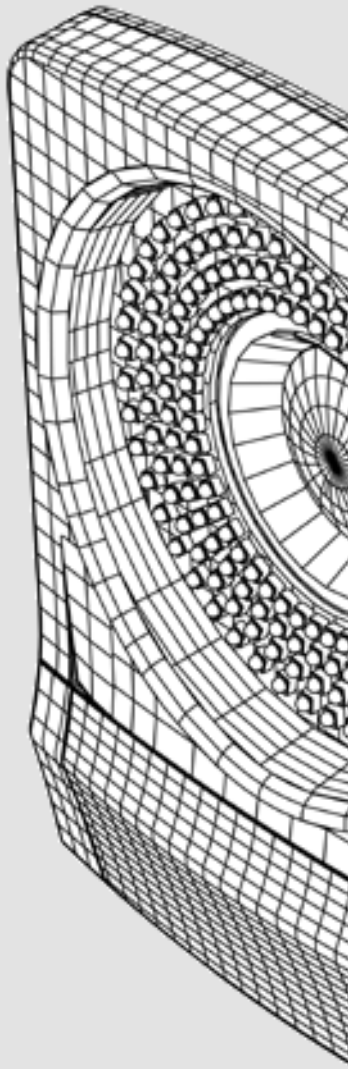
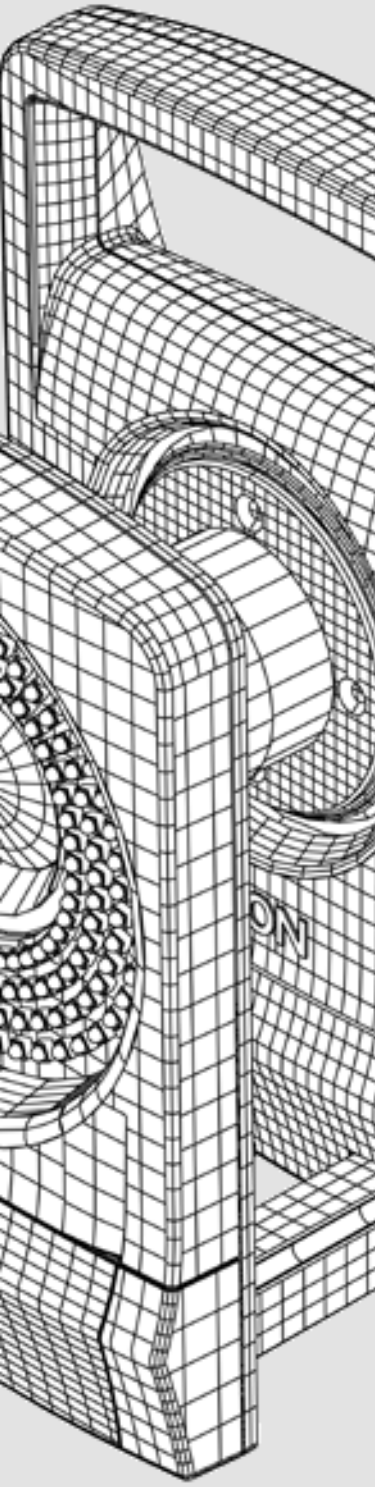


Figure 49: Plug 100-way cable into the Vicon patch panel





3. Ensure the wires on one end of your analog capture device cable are connected to the terminals inside the Vicon ADC patch panel (for details, see Connect an Analog Capture Device to the Patch Panel on page 91).

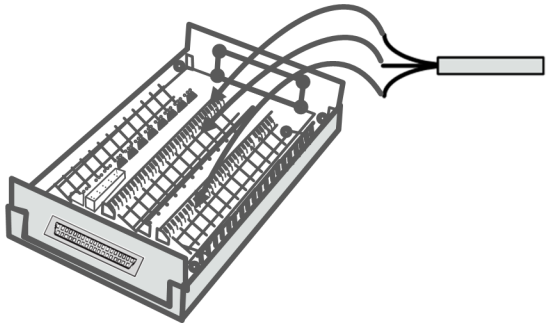


Figure 50: Connect device cable to Vicon ADC patch panel

4. Plug the other end of your analog capture device cable into the appropriate socket in your device (for details, see the documentation supplied with your device).

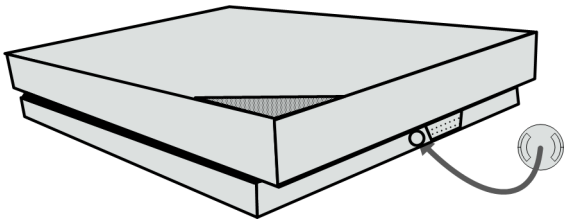
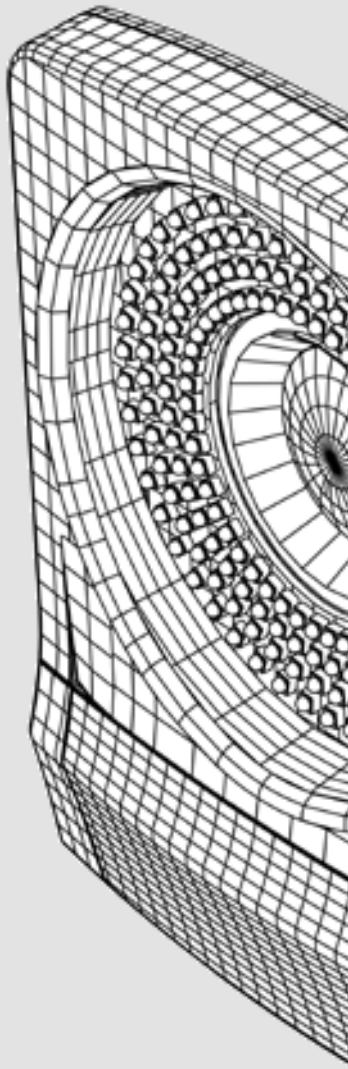


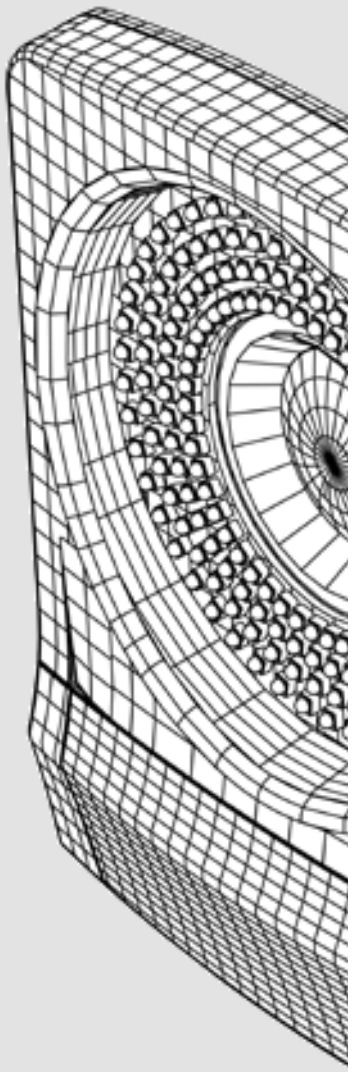
Figure 51: Plug device cable into analog capture device

For details on the MX Giganet connectors, see Option Slot on page 32. For details on the 100-way cable, see Vicon MX T-Series System Cable Descriptions on page 42. For details on the Vicon ADC patch panel, see Vicon ADC Patch Panel on page 90.



13 Extend MX System with Synchronized Output Devices

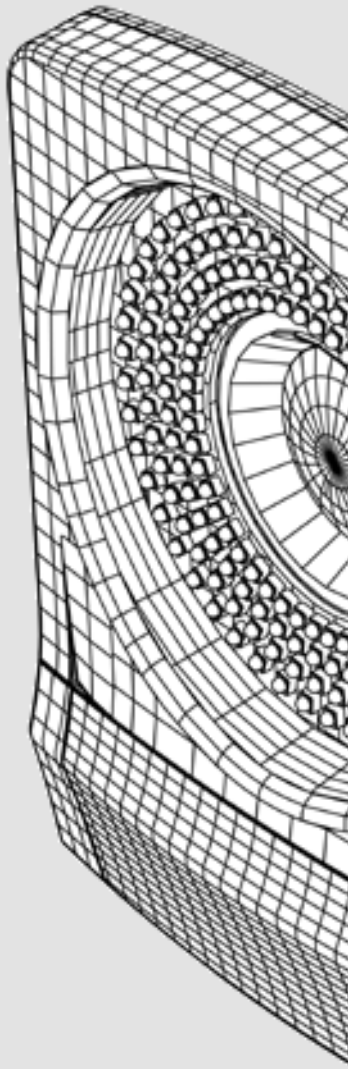
This chapter shows you how to connect and synchronize third-party devices with output from your Vicon MX T-Series system.



In This Chapter

Understand Synchronization Output Functionality

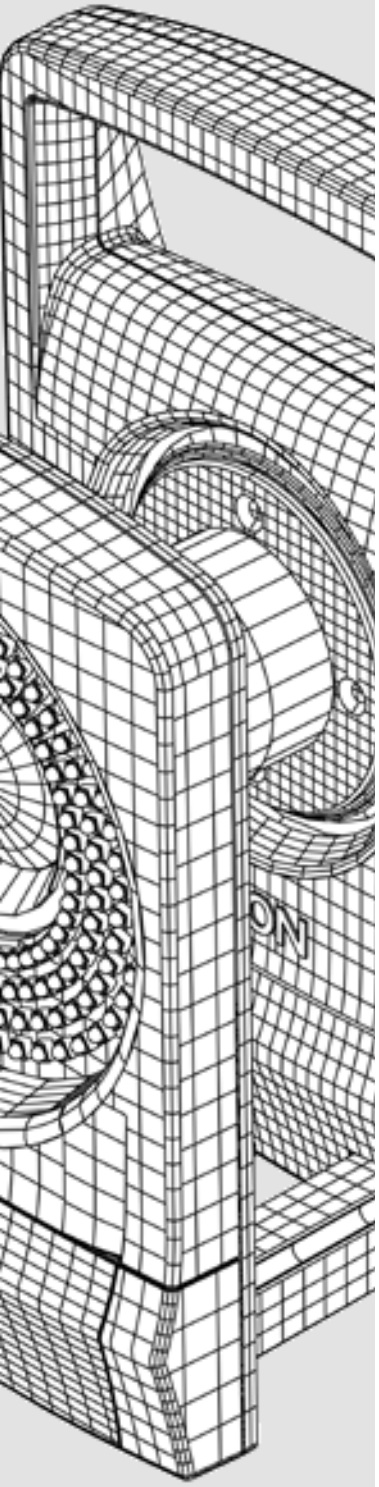
The **Powered Sync Outputs** and **Sync Outputs** sockets on the rear panel of an MX Giganet can output synchronization signals that can be used by supported third-party devices, such as reference video cameras. With this functionality, you can synchronize all MX and supported third-party devices in your Vicon MX T-Series system to the master system frame rate. Some third-party devices do not run at as high a speed as the Vicon optical cameras, so you can specify what fraction or multiple of the master frame rate will be used for connected devices. You can also use these output signals to trigger third-party devices based on MX system events.



You use the Vicon Basler GigE camera cable to connect your device to the **Powered Sync Outputs** sockets using a 3-pin Lemo plug. You use the Basler DCAM camera cable to connect your device to the **Sync Outputs** sockets, using an RCA plug. For details on these cables, see Extended System Architecture Model Cables on page 44. If you did not obtain your Basler GigE or DCAM camera from Vicon, you must obtain your own cable to plug into the appropriate socket.

To activate the synchronization output signals, you must specify a synchronization configuration file (GPO) in your Vicon application software. You will need to know what type of output signal your third-party device expects, so that you can activate the required signal type.

The following sections explain what you need to know to synchronize your external device with the Vicon MX T-Series system:



System Events and Synchronization Output Signals

You can configure the MX Giganet to output a particular synchronization signal for a third-party device connected to one or more of the **Powered Sync Outputs 1-4** or **Sync Outputs 5-8** sockets on the rear of the MX Giganet based on MX system events. MX system events relevant to GPO are identified in Table 13 .

Table 13: Vicon MX System and GPO Events

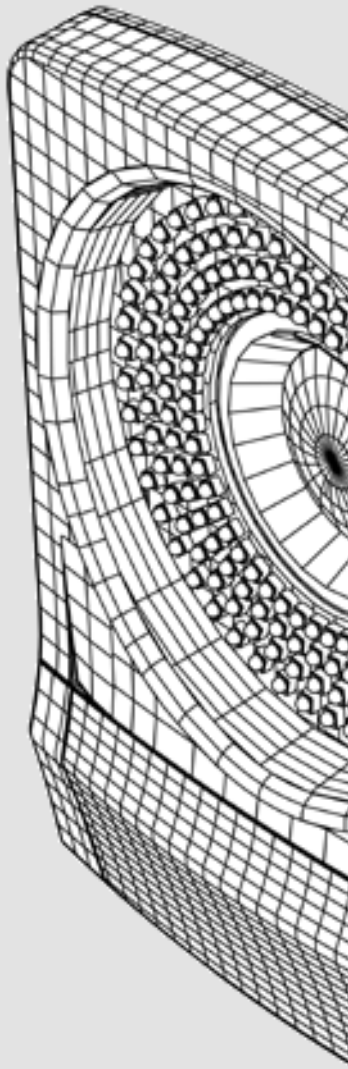
System Event	Description
Start System	Synchronously start data flow from Vicon hardware devices. This Vicon System event can be used to activate the GPO file using the GPO StartEvent **MXDVStart**. For details, see StartEvent Section on page 107.
Start Capture	Start capture with the MX cameras and any optional reference video cameras. This Vicon System event can be used to activate the GPO file using the GPO StartEvent **StartCapture**. For details, see StartEvent Section on page 107.
Stop Capture	Stop capture with the MX cameras and any optional reference video cameras. This Vicon System event can be used to activate the GPO file using the GPO StopEvent **StopCapture**. For details, see StopEvent Section on page 107.
Stop System	Stop data flow from Vicon hardware devices (either to resynchronize or shut down the system). This Vicon System event can be used to activate the GPO file using the GPO StopEvent **MXDVStop**. For details, see StopEvent Section on page 107.

When one of these system events occurs, the specified General Purpose Output (GPO) configuration file is activated, and the defined synchronization signal is produced (for details, see Synchronization Output (GPO) Configuration Files). The devices connected to these sockets can then respond to the synchronization signal (for details of the type of signal expected to trigger an action, see the documentation for your device).

The types of synchronization signal that can be produced are described in Table 14.

Table 14: Synchronization Signal Types

Signal Type	Description
Duration (event-based)	A single signal that is either on or off. When on, the signal can either stay high or low. This signal changes state based on a specified event and then changes state back based on another specified event, independent of frames or times.
Repeating (frame or time based)	Repetitive signal that can be locked to either a frame-based (synchronous) or time-based (asynchronous) period. This signal uses rectangular waves with a mark-space ratio determined by the settings in the GPO file. Frame-based periods will have their edges referenced to frame boundaries with any offsets from these specified in the GPO file. The pulse period for frame-based signals can be set as either a multiple or fraction of the frame length and for time-based signals in microseconds or clock ticks. This signal type can be used to synchronously align supported devices that respond to a clock pulse, such as Basler GigE and DCAM cameras.



Synchronization Output (GPO) Configuration Files

A General Purpose Output (GPO) configuration file specifies the characteristics of a synchronization signal to be output from the **Powered Sync Outputs** and **Sync Outputs** sockets on the rear panel of the MX Giganet.

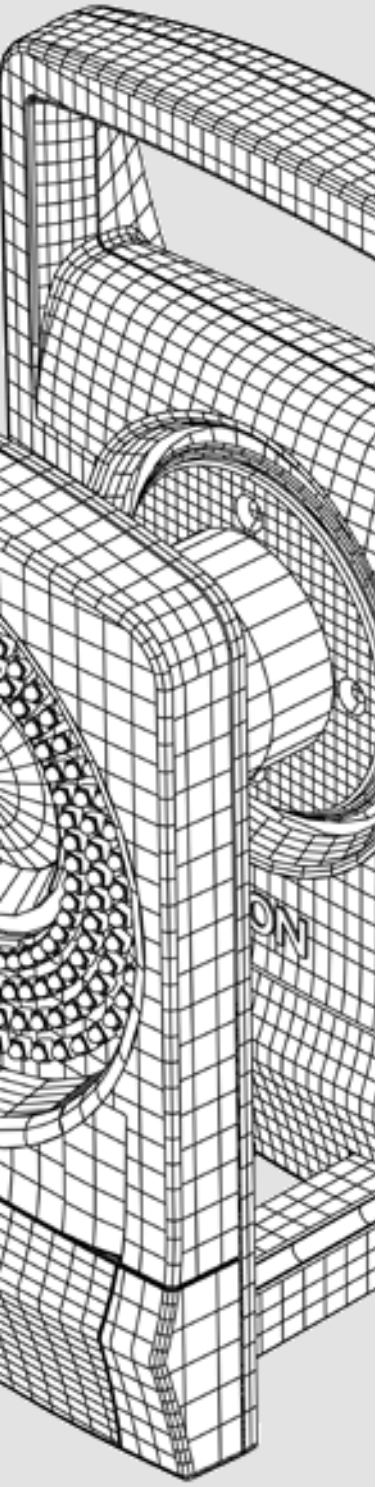
You specify in your Vicon application software the GPO configuration file you want to use:

- **Supplied GPO file**

  The GPO files supplied with your Vicon application software specify the relationship of the frame rate of a connected device with that of MX cameras. For details, see Supplied Synchronization Configuration (GPO) Files on page 99.

- **Custom GPO file**

  You can write a GPO file to specify the type of signal to have the MX Giganet produce when a specified MX system event occurs. For details, see Custom



Synchronization (GPO) Files on page 100.

Your connected device can then perform the action it is defined to do on receipt of that type of signal (for details, see the documentation supplied with your device).

For details on specifying a GPO file, see your Vicon software documentation.

Supplied Synchronization Configuration (GPO) Files

Some synchronization configuration files may be supplied with your Vicon application software. For example, the GPO files supplied with Vicon Nexus are used to synchronize the frame rates of connected reference Video cameras to the frame rate used by the MX system as shown in Table 15. For details on the installation location of these file, see your Vicon Nexus documentation.

Table 15: Supplied GPO Files

Synchronization Configuration File	Description
Duration Signals	
Duration.gpo	On a StartCapture event, the synchronization output latches high for the duration of the capture. On a StopCapture event, the output latches low.For details, see StartEvent Section and StopEvent Section on page 107. This GPO file is used to power and synchronize (if using the **Powered Sync Outputs** sockets), or just synchronize (if using the **Sync Outputs** sockets) supported third-party devices connected to your MX system.
SyncDuration.gpo	On an MXDVStart event the synchronization output latches high until an MXDVStop event is received. For details, see StartEvent Section and StopEvent Section on page 107. This GPO file is for use with ZeroWire Digital devices.
Repeating Signals	
DV_Double.gpo	On an MXDVStart event produces two high and two low pulses for each Vicon frame. The pulse period is one-half of a Vicon frame, and the pulse width is one-quarter of a Vicon frame. For details, see StartEvent Section on page 107 and PulsePeriod Section on page 109. This GPO file is used to align reference video cameras with MX cameras at twice the Vicon MX system frame rate.

Table 15: Supplied GPO Files

Synchronization Configuration File	Description
DV_Half.gpo	On an MXDVStart event sends a high pulse followed by a low pulse on every other Vicon frame. The pulse period is two Vicon frames, and the pulse width is one Vicon frame. For details, see StartEvent Section on page 107 and PulsePeriod Section on page 109. This GPO file is used to align reference video cameras with MX cameras at half the Vicon MX system frame rate.
DV_Normal.gpo	On an MXDVStart event sends a high pulse followed by a low pulse within every Vicon frame. The pulse period is one Vicon frame, and the pulse width is one-half of a Vicon frame. For details, see StartEvent Section on page 107 and PulsePeriod Section on page 109. This GPO file is used to synchronize reference video cameras to the Vicon MX system at the same frequency as the MX cameras.
DV_Quarter.gpo	On an MXDVStart event sends a high pulse followed by a low pulse on every fourth Vicon MX system frame. The pulse period is four Vicon frames, and the pulse width is two Vicon frames. For details, see StartEvent Section on page 107 and PulsePeriod Section on page 109. This GPO file is used to align reference video cameras with MX cameras at one-quarter of the Vicon MX system frame rate.

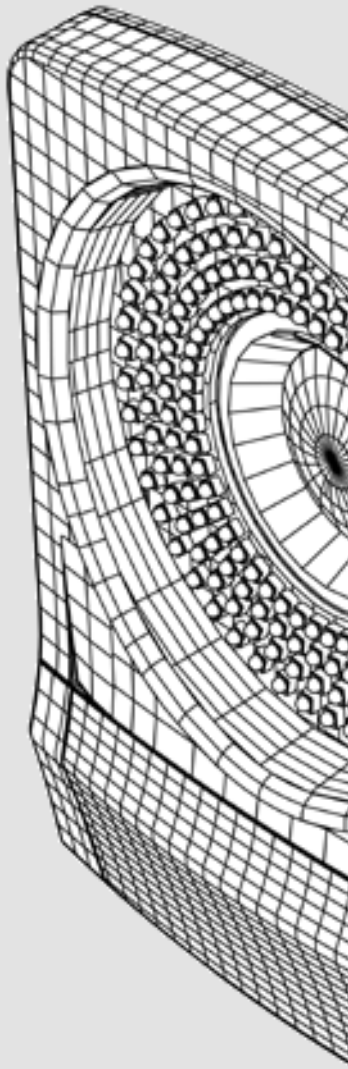
Custom Synchronization (GPO) Files

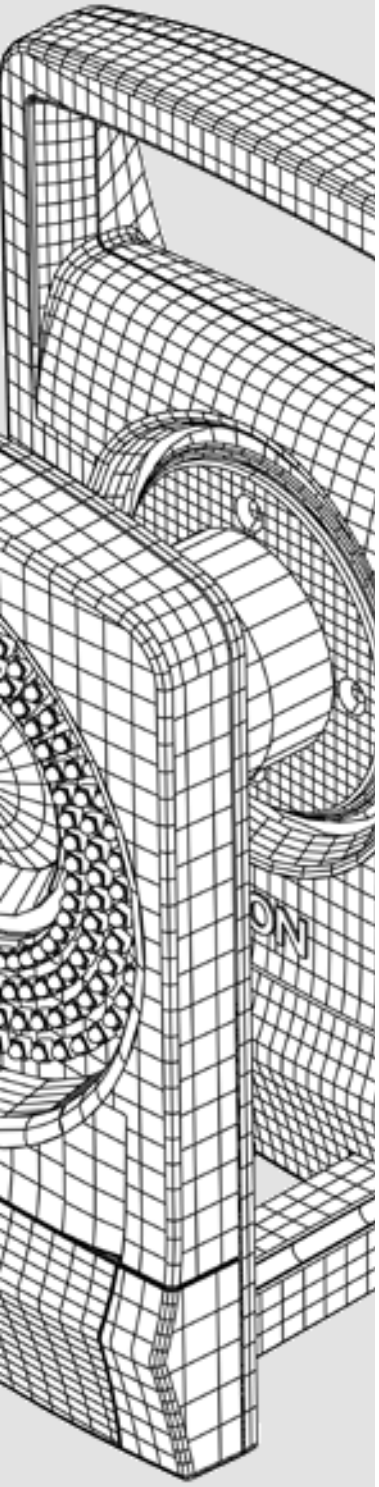
You can write your own GPO file to specify the type of synchronization signal to be output from the **Powered Sync Outputs** and **Sync Outputs** sockets for a specified MX system event.

The following sections illustrate the two types of synchronization signals that can be output and show how you can specify each in a GPO file:

- Custom GPO File for a Fixed Duration Synchronization Signal on page 101
- Custom GPO File for a Repeating Synchronization Signal on page 102

The examples use wave form diagrams to illustrate the signal characteristics and provide cross-references to the relevant GPO file syntax sections.





Custom GPO File for a Fixed Duration Synchronization Signal

Figure 52 illustrates the characteristics of a fixed duration synchronization signal and a custom GPO file that would generate this signal.

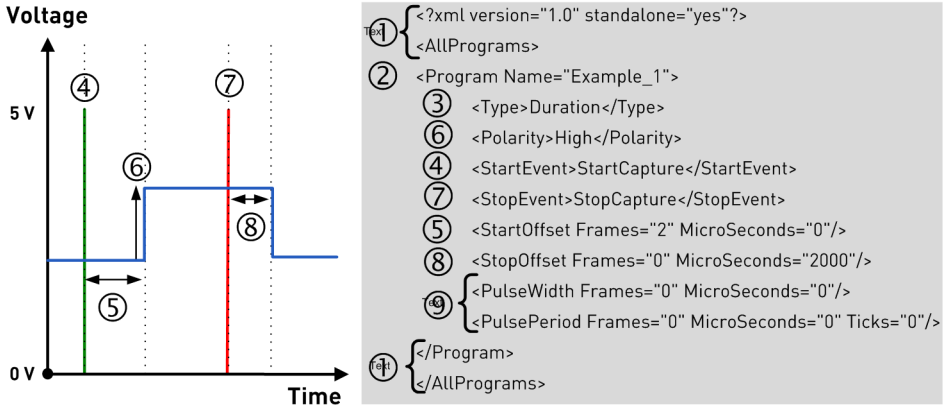


Figure 52: Fixed Duration Synchronization Signal

where:

1 are lines of code required to maintain full XML conformity for starting and ending a program. For details, see XML Header and AllPrograms Section on page 105.

2 are lines of code required to maintain full XML conformity. Note that Vicon software uses the GPO filename rather this program name. In this example, the Program Name is Example_1. For details, see Program Name Section on page 105.

3 specifies the type of synchronization signal the GPO is to produce. In this example, it is a signal with a defined start and stop rather than a repeating signal. For details, see Type Section on page 106.

4 is the system event that has been defined to start the GPO program.In this example, it sets the signal to be active referenced to the start of capture. For details, StartEvent Section on page 107.

5 is the amount of time to wait after the start event has occurred before sending the signal to its specified polarity. In this example, it sets the delay of signal activation to two frames after the start of capture. For details, see StartOffset Section on page 108.

6 is the direction the synchronization signal moves when started. In this example, it sets the signal to start low, go high on activation, and then reset low on completion. For details, see Polarity Section on page 106.

7 is the event that has been defined to end the GPO program. In this example, it sets the signal to stop being active referenced to the end of capture. For details, see StopEvent Section on page 107.

8 is the stop offset to be applied in the GPO file. In this example, it resets the signal 2 milliseconds (2000 microseconds) after the end of capture. For details, see StopOffset Section on page 108.

9 are the length and frequency of the signal to be produced. In this example, they are set to 0 (zero) as they are not required for duration signals. For details, see PulseWidth Section and PulsePeriod Section on page 109.

Custom GPO File for a Repeating Synchronization Signal

Figure 53 illustrates a custom GPO file that sends a repetitive signal from the time the system becomes synchronized after boot up. The signal is not locked to the video frame rate but to time and is, therefore, described as asynchronous. For examples of synchronous signals refer to the supplied GPO files (*DV_ *.gpo*) (for details, see Supplied Synchronization Configuration (GPO) Files on page 99).
The repeating synchronization signal GPO file described here will be active until the system reboots or is resynchronized. After resynchronization, the GPO will restart in the same way it does after system boot.

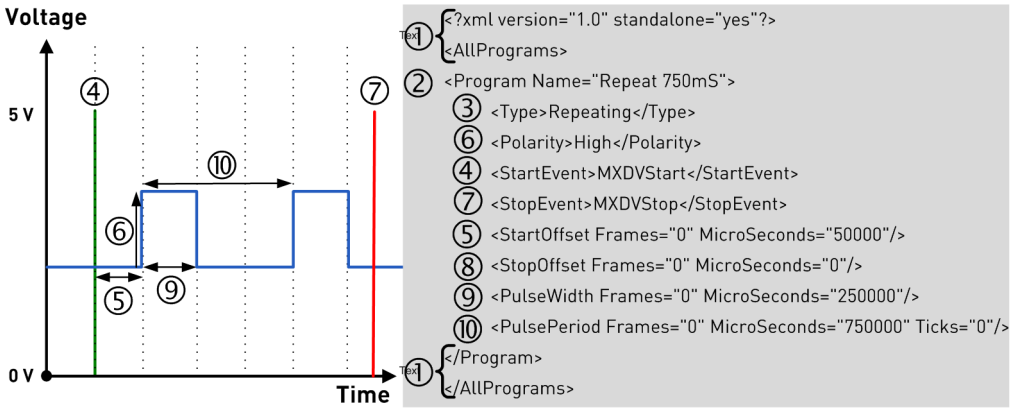
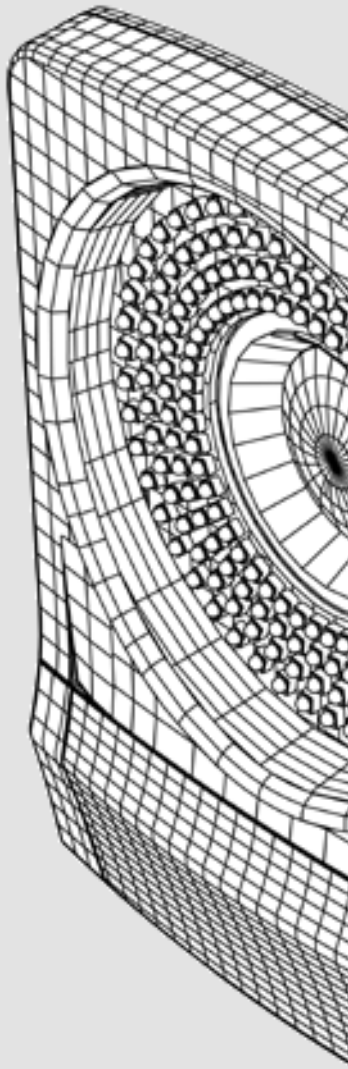
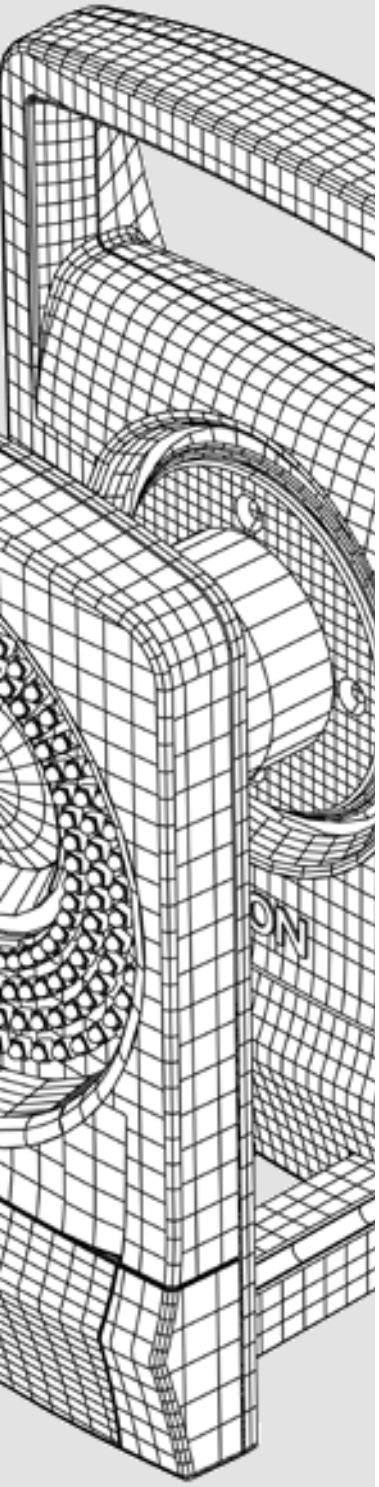


Figure 53: Repeating Synchronization Signal

where:

1 are lines of code required to maintain full XML conformity for starting and ending a program. For details, see XML Header and AllPrograms Section on page 105.





2 are lines of code required to maintain full XML conformity. Note that Vicon software uses the GPO filename rather this program name. In this example, the Program Name is Repeat 750mS. For details, see Program Name Section on page 105.

3 specifies the type of synchronization signal the GPO is to produce. In this example, it is a repeating signal that will be active as long as the system is running and is not booting up, resynchronizing, or shutting down, rather than a duration signal. For details, see Type Section on page 106.

4 is the system event based on which you want to start the GPO program. In this example, the signal is set to start as soon as the system has finished synchronizing after it has booted up. For details, StartEvent Section on page 107.

5 is the amount of time to wait after the start event has occurred before sending the signal to its specified polarity. In this example, it sets the delay of signal activation to 50 milliseconds (50000 microseconds) after the start event. For details, see StartOffset Section on page 108.

6 is the direction the synchronization signal moves when started. In this example, it sets it to start low and go high when active. For details, see Polarity Section on page 106.

7 is the event that has been defined to end the GPO program. In this example, it is set to the system suspending dataflow pending either a resynchronization being performed or the software shutting down. For details, see StopEvent Section on page 107.

8 is the stop offset to be applied in the GPO file. In this example, it sets the stop offset to zero. For details, see StopOffset Section on page 108.

9 is the width of the active part of the signal. In this example, it sets it to 0.25 seconds (250000 microseconds). For details, see PulseWidth Section on page 109.

10 is the period between two pulse signals. In this example, it sets the cycle period of the signal to 0.75 seconds (750000 microseconds). The ratio of 0.75 to 0.25 means that the rectangular waveform produced will have a 3:1 (33 1/3%) mark-space ratio. Also by defining the cycle period in terms of seconds instead of frames, the signal is asynchronous with respect to the system frequency. For details, see PulsePeriod Section on page 109.

Synchronization Configuration (GPO) File Format

General Purpose Output (GPO) configuration files are written in eXtensible Markup Language (XML) file format. These XML files are used to store structured information and to enclose or encapsulate information so that it can be passed between different computing systems. As in any XML file, GPO file sections are delimited with start and end section tags, and subsections are nested beneath main sections to reflect their hierarchical relationship, for example:

```
<XML header>
<SectionStart>
<SubsectionStart ATTRIBUTE="value">
   <Keyword>Value</Keyword>
   <Keyword ATTRIBUTE="value"/>
</SubsectionEnd>
</SectionEnd>
```

The GPO file can be viewed in most Web browsers or standard text editors like any other XML file. You may find it helpful to view the examples in Custom Synchronization (GPO) Files on page 100 or one of the sample GPO files provided with your Vicon application software while you read this chapter describing the general format and content of a GPO file. This chapter assumes you have a basic understanding of the use and presentation of XML files.

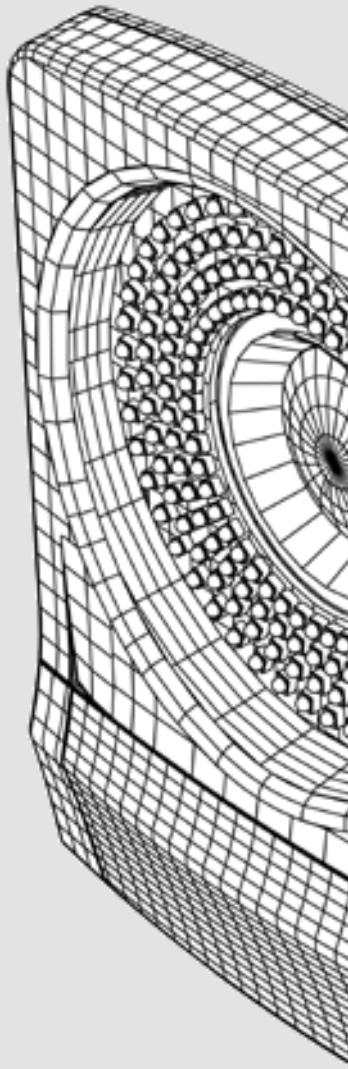
Synchronization Configuration (GPO) File Structure

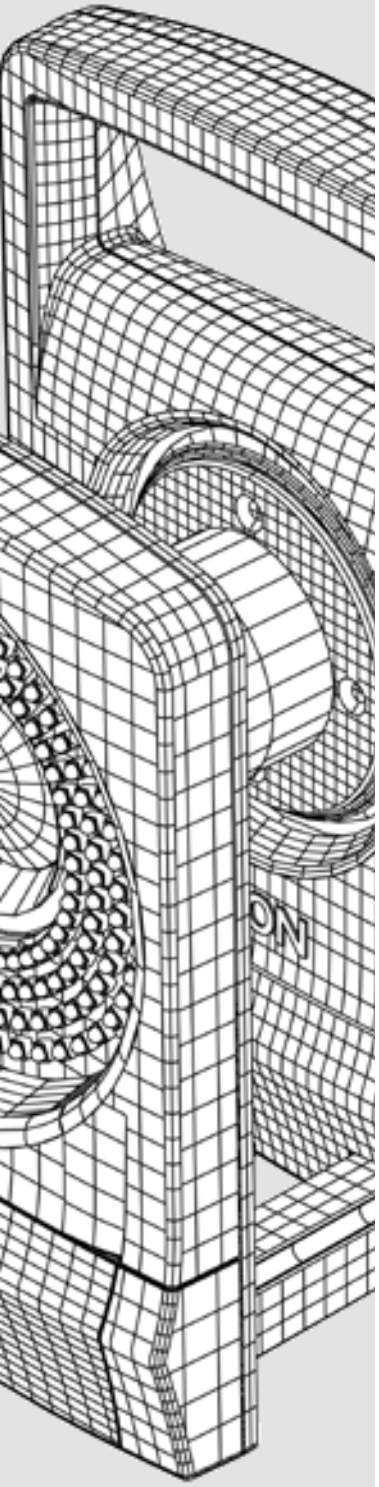
The full structure of a GPO file is outlined below:

```
<?xml version="1.0" standalone="yes"?>
<AllPrograms>
<Program Name="gpo_name">
   <Type>signal_type</Type>
   <Polarity>signal_direction</Polarity>
   <StartEvent>gpo_start</StartEvent>
   <StopEvent>gpo_stop</StopEvent>
   <StartOffset Frames="" MicroSeconds=""/>
   <StopOffset Frames="" MicroSeconds=""/>
   <PulseWidth Frames="" MicroSeconds=""/>
   <PulsePeriod Frames="" MicroSeconds="" Ticks=""/>
</Program>
</AllPrograms>
```

XML Header

The header `<?xml version="1.0" standalone="yes"?>` is essential for the file to be recognized as XML format by Vicon applications and other XML file viewing packages. You must include this section at the top of your GPO file.





AllPrograms Section

The program start and end section tags `<AllPrograms>` and `</AllPrograms>` delimit the details of the synchronization signal to be sent. You must include the start section immediately after the XML header and the end section at the end of your GPO file.

Each option in a given section within the `<AllPrograms>` section consists of a keyword and a single value or one or more `attribute="value"` pairs, which are written in the following ways in an XML file:

```
<Keyword>value</Keyword>
<Keyword ATTRIBUTE="value"/>
```

The `Keyword` identifies the element with which the Vicon application is to be concerned, the `ATTRIBUTE` is a characteristic of the specified keyword, and the `value` is the actual data that the Vicon application is to use. For most options, you must specify the value required for your specific implementation of the GPO file. To help you understand how to construct these definitions in your GPO file, when giving the syntax for a section, this chapter provides the `Keyword` and any `ATTRIBUTE` words, and describes the type of data you must supply for the `value`.

Program Name Section

The syntax for the Program Name section is:

```
<Program Name="gpo_name">
```

where:

`gpo_name` is the name for your GPO program.

Tip
The base of the GPO file name is used as the program display name in your Vicon application software. Therefore, Vicon recommends that you use the file name base as the GPO program name. For example, the sample GPO program *Duration.gpo*, has the display name *Duration* in the Vicon application software.

Type Section

The syntax for the Type section is:

```
<Type>signal_type</Type>
```

where:

`signal-type` specifies the type of synchronization signal the MX Giganet is to produce, one of:

`Duration`	A single signal that lasts from a given start event until a given stop event.
`Repeating`	A repetitive pulse signal that begins on a given start event and ends on a given stop event.
`Start`	A type of duration signal that occurs on a given start event; no signal occurs on a given stop event.
`StartStop`	A type of duration signal that occurs on a given start event and then again on a given stop event.
`Stop`	A type of duration signal that occurs on a given stop event; no signal occurs on a start event.

Polarity Section

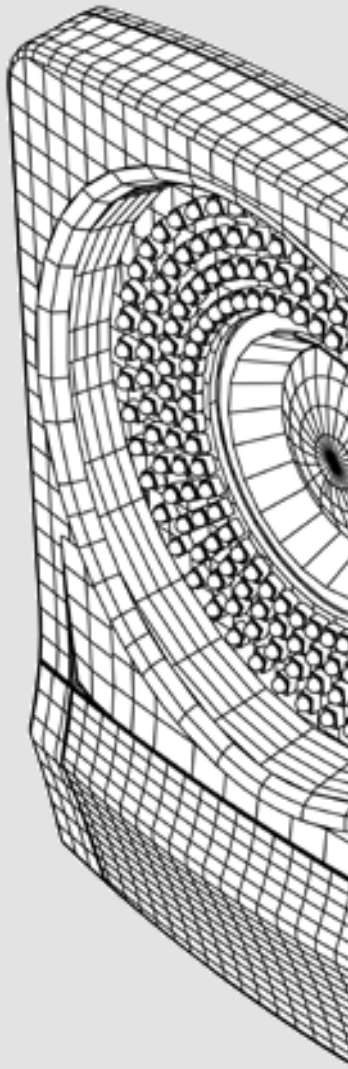
The syntax for the Polarity section is:

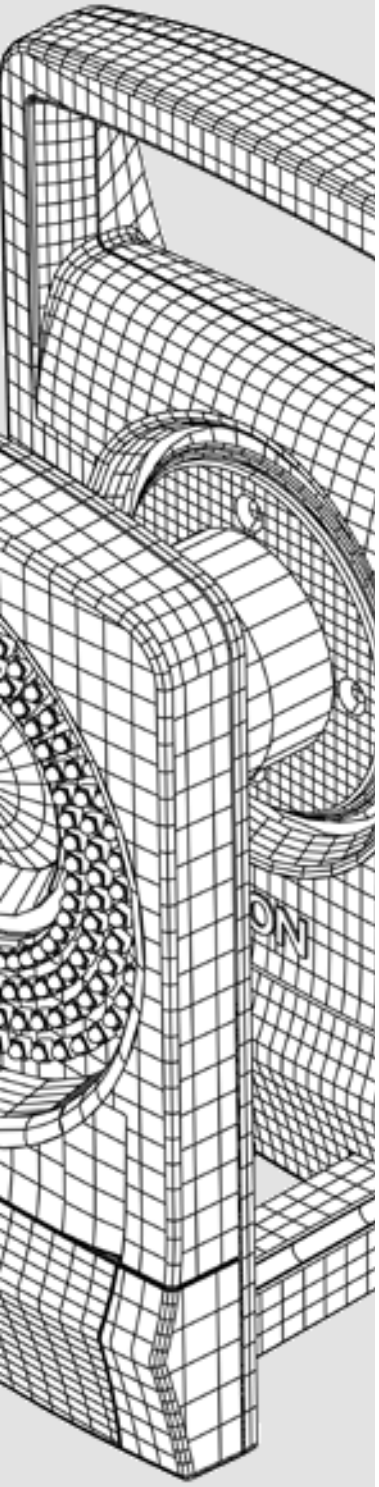
```
<Polarity>signal_direction</Polarity>
```

where:

`signal_direction` specifies the direction the synchronization signal is to start and then move when the GPO file is activated:

`High`	Starts low (0 V) and moves high (5 V). For a duration signal type, the signal latches high until the start event occurs, whereupon the signal starts with a positive-going edge. When the stop event occurs, the signal is latched low. For details, see StartEvent Section and StopEvent Section on page 107) For a repeating signal type, the signal starts its repetitive cycle in this direction.





`Low` Starts high (5 V) and moves low (0 V).

For a duration signal type, the signal latches low until the start event occurs, when the signal starts with a negative-going edge. When the stop event occurs, the signal is latched low. For details, see StartEvent Section and StopEvent Section on page 107).

For a repeating signal type, the signal starts its repetitive cycle in this direction.

StartEvent Section

The syntax for the StartEvent section is:

```
<StartEvent>gpo_start</StartEvent>
```

where:

`gpo_start` specifies the MX system event that activates the GPO file:

`StartCapture` The Start Capture event.

`MXDVStart` The Start System event.

For details of these events, see Table 13 on page 97.

Important
The `StartCapture` event type does not synchronize reference video cameras or the ZeroWire EMG system. Use the `MXDVStart` event to synchronize such external devices.

StopEvent Section

The syntax for this StopEvent section is:

```
<StopEvent>gpo_stop</StopEvent>
```

where:

`gpo_stop` specifies the MX system event that stops the GPO file:

`StopCapture` The Stop Capture event.

`MXDVStop` The Stop System event

For details of these events, see Table 13 on page 97.

StartOffset Section

The syntax for the StartOffset section is:

```
<StartOffset Frames="" MicroSeconds=""/>
```

where:

`StartOffset` specifies how long to wait after the start event (see StartEvent Section on page 107) has occurred before sending the signal to its desired polarity:

`Frames`	A specified number of frames.
`MicroSeconds`	A specified number of microseconds

Important
If you specify both `Frames` and `MicroSeconds`, the two values are added together to determine the offset.The maximum time-based offset you can define is 65 milliseconds (16 bits times microseconds). Frame-based offsets are unlimited.

StopOffset Section

The syntax for the StopOffset section is:

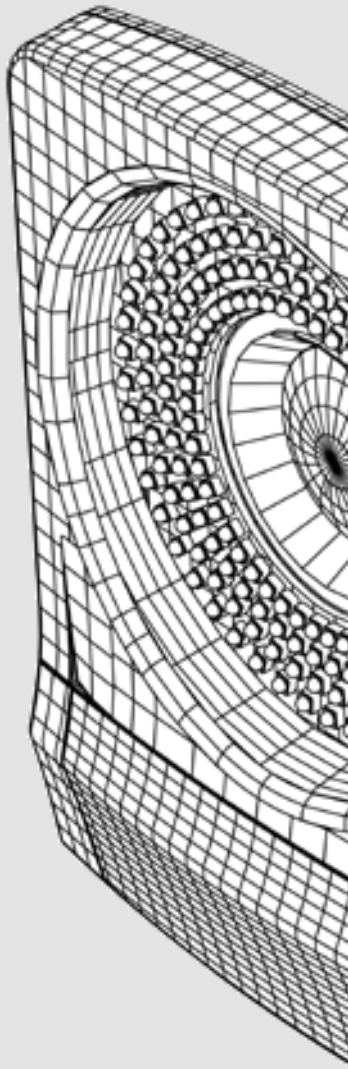
```
<StopOffset Frames="" MicroSeconds=""/>
```

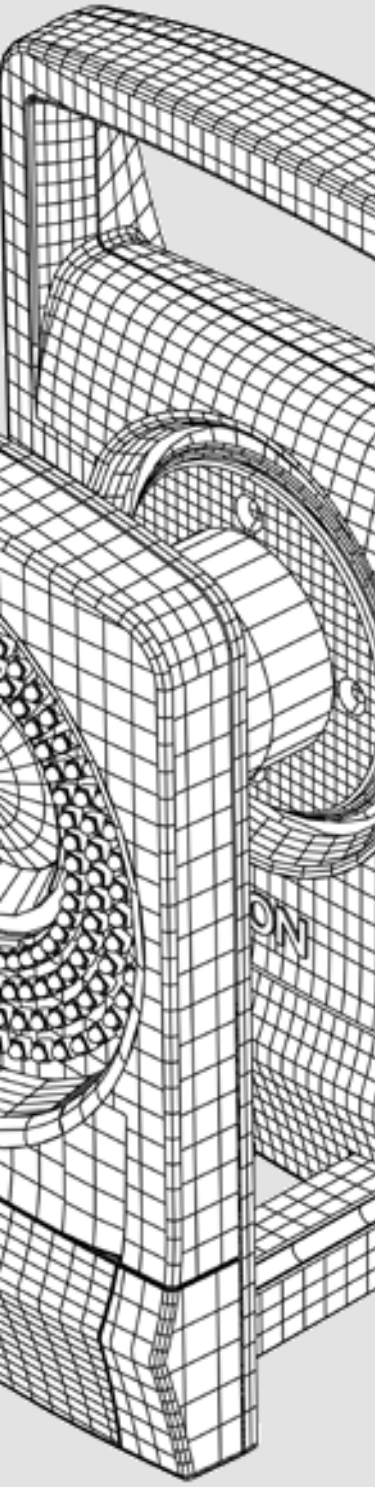
where:

`StopOffset` specifies how long to wait after the stop event (see StopEvent Section on page 107) has occurred before sending the signal to its desired polarity:

`Frames`	A specified number of frames
`MicroSeconds`	A specified number of microseconds.

Important
If you specify both `Frames` and `MicroSeconds`, the two values are added together to determine the offset.The maximum time-based offset you can define is 65 milliseconds (16 bits times microseconds). Frame-based offsets are unlimited.





PulseWidth Section

The syntax for the PulseWidth section is:

```
<PulseWidth Frames="" MicroSeconds=""/>
```

where:

`PulseWidth` specifies the fixed duration of the pulse for a repeating synchronization signal as either one or the sum of both the following:

- `Frames` The number of frames the pulse signal is to last.
- `MicroSeconds` The number of microseconds the pulse signal is to last.

Important
If you specify both `Frames` and `MicroSeconds`, the two values are added together to determine the pulse width; however, you are recommended to use either `Frames` and `MicroSeconds` rather than adding these values.

PulsePeriod Section

The syntax for the PulsePeriod section is:

```
<PulsePeriod Frames="" MicroSeconds="" Ticks=""/>
```

where:

PulsePeriod specifies the total period of the pulse for a repeating synchronization signal, that is, the time from one rising edge to the next rising edge, as either one or the sum of two or more of the following values converted to 27 Mhz:

- `Frames` The number of frames after which the pulse is to be repeated.
- `MicroSeconds` The number of microseconds after which the pulse is to be repeated.
- `Ticks` The number of 27 Mhz clock ticks of the MX timing reference after which the pulse is to be repeated.

Important
If you specify `Frames`, `MicroSeconds`, and `Ticks`, all values are added together to determine the offset; however, you are recommended to add either `MicroSeconds` or `Ticks` to frames rather than adding all three values.

Incorporate a Synchronized Device

You can incorporate supported third-party devices whose operation is to be synchronized with your Vicon MX T-Series system, such as Basler reference video cameras. This section provides general instructions for connecting synchronization devices; for specific instructions on connecting reference video cameras, see Chapter 11 Extend MX System with Reference Video Cameras.

To incorporate third-party synchronized devices in a T-Series system:

1. Plug one end of your synchronized device cable into the **Powered Sync Outputs** or **Sync Outputs** socket (depending on whether or not your device has its own power supply) on the rear of an MX Giganet.

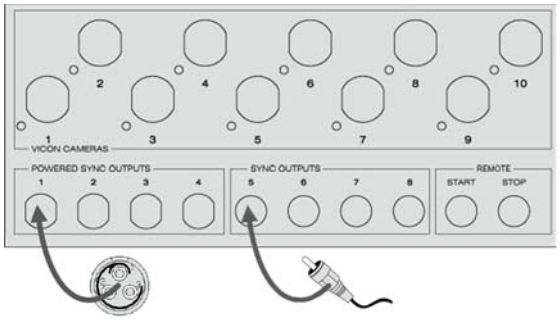
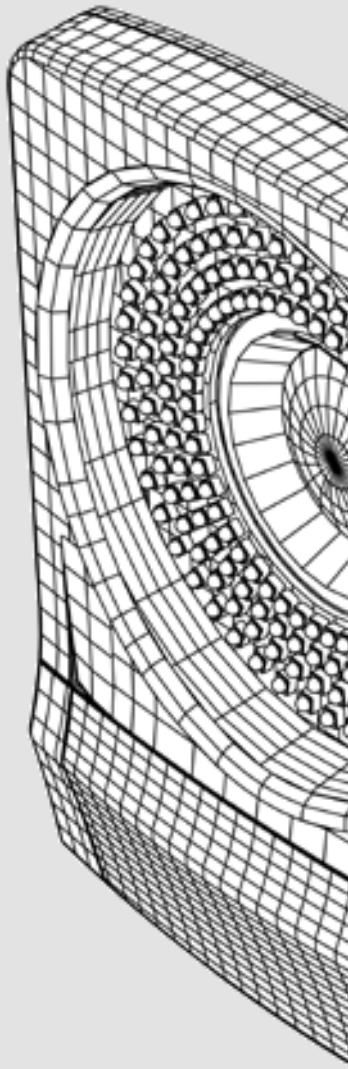


Figure 54: Plug synchronized device cable into MX Giganet

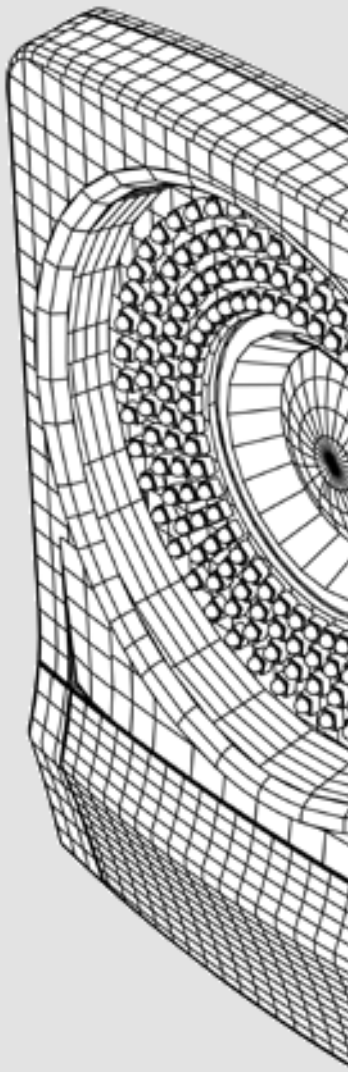
2. Plug the other end of the cable into the appropriate socket in your synchronized device.
3. To manage the synchronization of your external devices, or to trigger your external devices based on MX system events, identify an appropriate GPO configuration file supplied with your Vicon application software or create a GPO file of your own. For details on these, see Supplied Synchronization Configuration (GPO) Files on page 99 and Custom Synchronization (GPO) Files on page 100.
4. In the Vicon application software, specify this GPO configuration file for your external device. For details on doing this, see your Vicon software documentation.

For details on these connectors, see Capture and Synchronization Connectors on page 30. For details on the synchronized device cable, see Extended System Architecture Model Cables on page 44.



14 Extend MX System with Remote Triggering Devices

This chapter shows you how to connect external devices to an MX Giganet to remotely trigger capture by your Vicon MX T-Series system.



In This Chapter

Important
In earlier Vicon MX systems, this functionality was provided by the MX Control. If you have an MX Control unit in your earlier Vicon MX system architecture, you must replace this with an MX Giganet for a T-Series system. For information on replacing an MX Control with an MX Giganet, see Chapter 16 Integrate Earlier MX Components into MX System. If you need additional assistance, contact Vicon Support (see Chapter 25 Support Resources.

Understanding Remote Functionality

You can remotely trigger the Vicon MX T-Series system to capture data based on input signals an MX Giganet receives from a supported third-party device connected to the **Remote Start** or **Stop** sockets.

Before you can remotely start or stop your T-Series system, you must first arm it for capture and activate the start/stop functionality in your Vicon application software. For example, to do this in Vicon Nexus you select the **Start/Stop On Remote Trigger** check box and click the **Arm** button in the **Auto Capture Setup** section of the **Capture** tools pane (for details, see the Nexus documentation).

You must create your own cable to plug into the **Remote Start** or **Stop** sockets in the rear of an MX Giganet, using RCA plugs. To activate the start or stop trigger, you must force the pin to the outer GND (that is, short circuit it) in the **Remote Start** or **Stop** socket. You can do this with a relay that you could connect to a photosensor or wire to a foot pressure switch. Figure 55 illustrates how this relay would force the center pin to GND to send an input signal to the MX Giganet to start or stop the capture. As illustrated, the Remote Start and Stop functions can be activated either by plugging in a standard TTL gate-to-ground signal or by using a simple mechanical switch, normally open, wired across the pin and ground of the RCA plug.

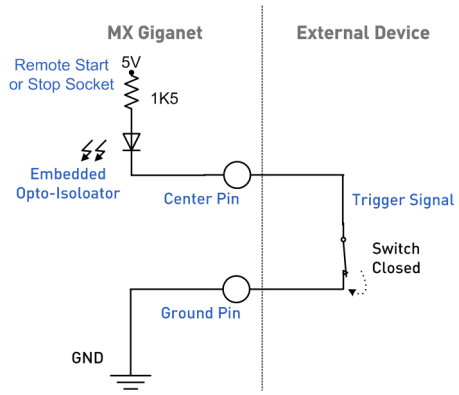
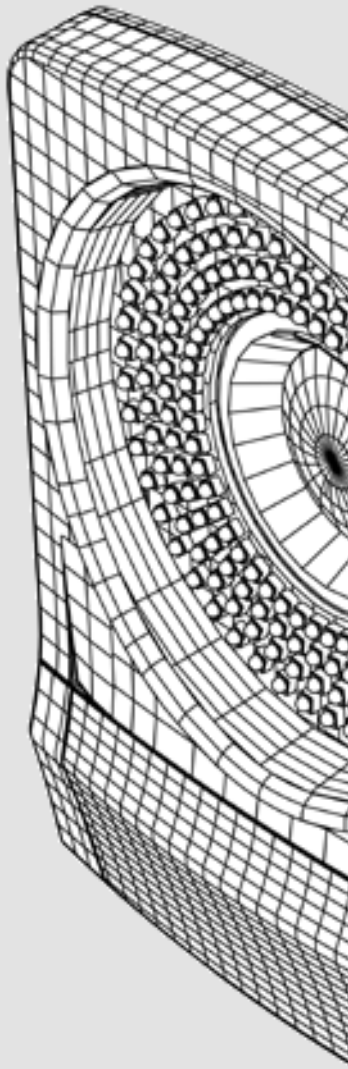


Figure 55: Example of Remote Switch



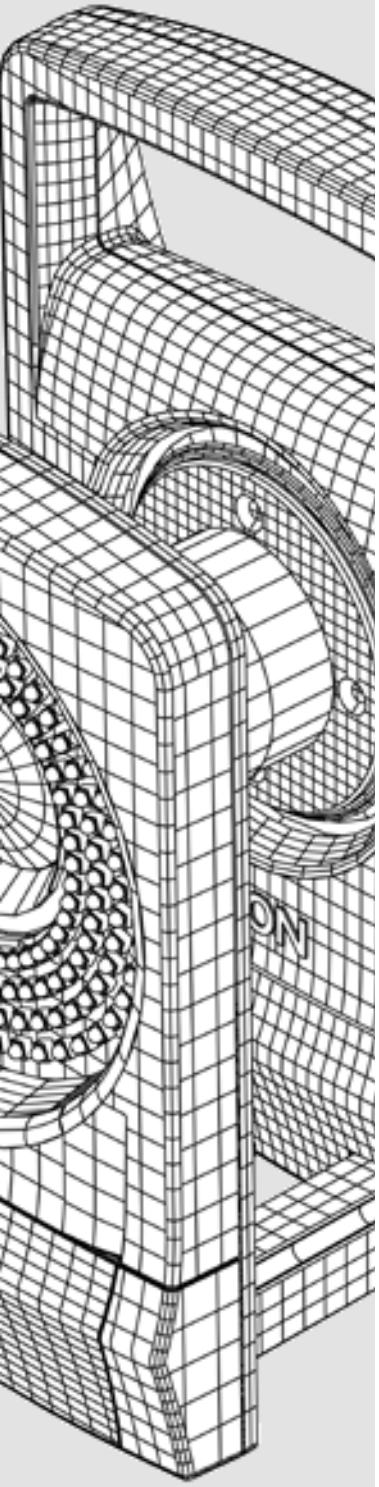


Table 16 shows the TTL settings to which your external switch must pull the **Remote Start** or **Stop** input pins in order to trigger the remote capture.

Table 16: Remote input controls

Input Signal		Trigger Action
Remote Start	**Remote Stop**	
High	High	Signal held high until the pin in pulled to GND. This is also the default system setting when no device is connected.
Low	High	Remote Start pin is pulled to GND and capture starts at next video frame.
High	Low	Remote Stop pin is pulled to GND and capture stops at the next video frame.
Low	Low	Undefined (do not use).

For details on the circuitry involved and electrical specifications for the connector, contact Vicon Support (for details, see Chapter 25 Support Resources).

Incorporate a Remote Triggering Device

You can incorporate supported third-party devices to trigger your Vicon MX T-Series system to start capture, stop capture, or both. You can also have the MX Giganet trigger the external device. You must obtain your own cable to plug into the **Remote Start** or **Stop** connectors on the rear of the MX Giganet and into your remote triggering device (for details, see Understanding Remote Functionality on page 112).

Tip

You can configure in your Vicon application software a buffer to capture for a specified amount of time before the start is triggered (for details, see your software documentation). The data from that buffer is added to your raw data (X2D) file.

You can also configure the software to stop capture after a specified duration, rather than using a remote stop trigger.

To incorporate remote triggering devices in a T-Series system:

1. For a device to remotely trigger capture to start, plug your device cable into the **Remote Start** connector on the rear of an MX Giganet.

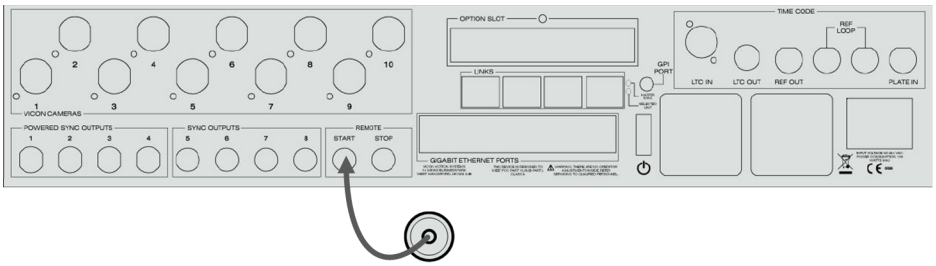


Figure 56: Plug device cable into Start socket in MX Giganet

2. For a device to remotely trigger capture to stop, plug your device cable into the **Remote Stop** input connector on the rear of an MX Giganet.

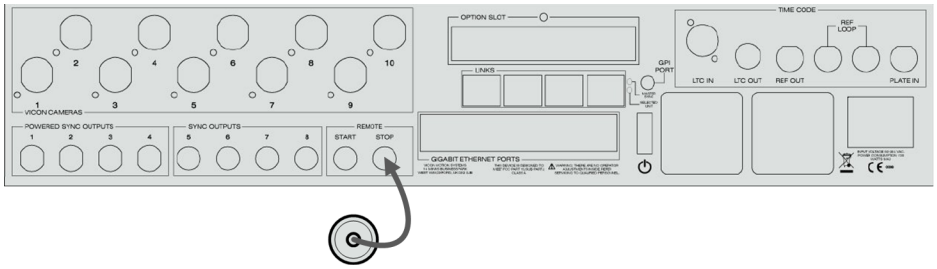
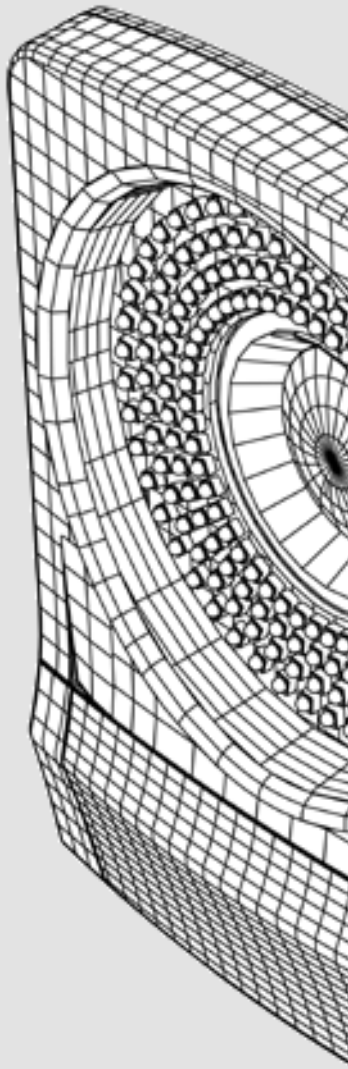


Figure 57: Plug device cable into Stop socket in MX Giganet

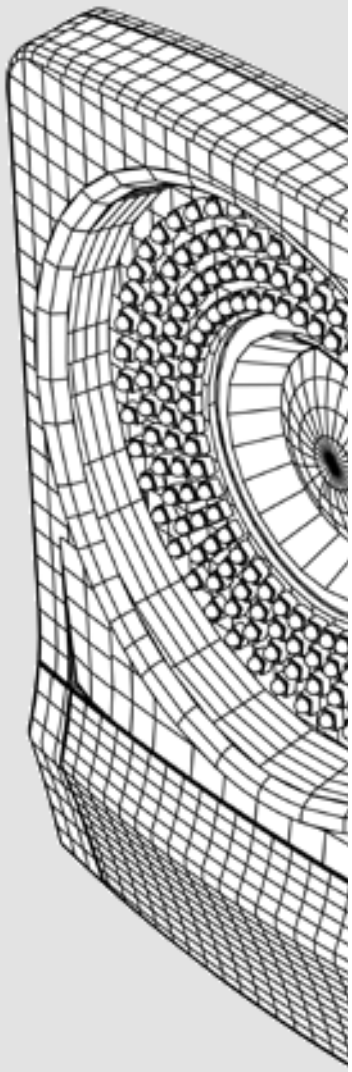
3. Plug the other end of your device cable into your remote triggering device.

For details on these connectors, see Capture and Synchronization Connectors on page 30.



15 Extend MX System with Timecode/ Genlock Devices

This chapter shows you how to connect third-party external video devices that provide HD and SD compliant timecode and that genlock to an external EBU, SMPTE, or HD video source to your Vicon MX T-Series system.



In This Chapter

Understand Timecode and Genlock Functionality

The following sections describe the Timecode functionality for connecting external video sources to an MX Giganet:

- Genlock
- Timecode

Genlock

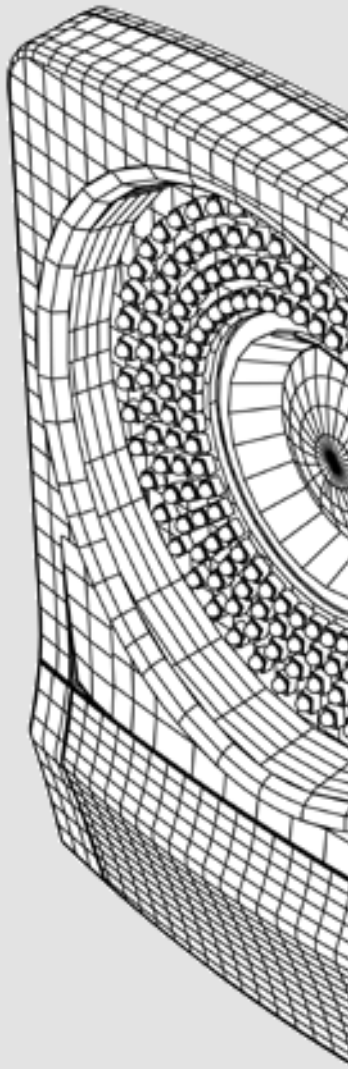
From the Vicon software on the MX Host PC, you can configure the MX Giganet to genlock to an external PAL, SECAM, NTSC, or HD video source that is plugged in to a **Ref Loop** socket. Genlock synchronizes the T-Series cameras to the scan rate of the incoming video signal. This includes support for the automatic uplock from lower-speed broadcast cameras to Vicon's higher-speed motion capture cameras. You configure whether this Genlock functionality is enabled in your Vicon application software.

If no external video sources are connected, one of the MX Giganets assumes that it is to act as the synchronization master for the system.

Caution
Video sourced from a non time-base corrected VCR may cause problems due to the wide jitter bandwidth necessary to reliably lock the MX Giganet.
The signal quality is affected if the loop is not terminated using a 75 Ω (ohms) terminator. If the MX Giganet is the last device in the chain, the **Ref Loop** connection that is not being used for signal output must be terminated. Alternatively, the loop could go into the MX Giganet and then out to a VTR, where it must be terminated.

Timecode

Timecode is a time signature that is present in video or audio signals to provide positional information (i.e. time and frame details). Each frame has its own unique timecode number. From the Vicon software on the MX Host PC, you can configure the MX Giganet to trigger from or be time-stamped from a connected VITC (Vertical Interval Timecode) or LTC (Longitudinal Timecode) timecode source.



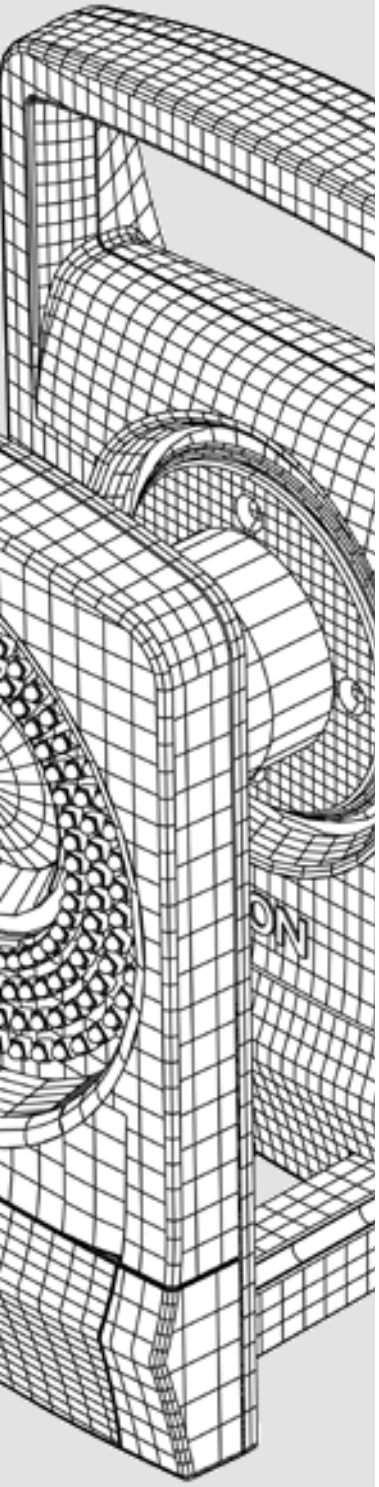


Table 17 shows the forms of timecode that correspond with the different frame rate requirements around the world, which Vicon MX T-Series supports.

Table 17: Supported Timecode Formats

Format	Description
EBU (European Broadcasting Union): Based on cameras operating at a multiple of 25 Hz. In this Go Further with Vicon MX T-Series book, the term EBU is used interchangeably with the following terms:	
PAL (Phase Alternating Line)	The color standard used in Europe, except France.
SECAM (Sequential Couleur avec Mémoire)	The color standard used in France, the Middle East, and most of Eastern Europe.
CCIR (Consultative Committee for International Radio)	The black and white standard.
SMPTE (Society of Motion Picture & Television Engineers): Based on cameras operating at a multiple of 29.97 Hz. In this Go Further with Vicon MX T-Series book, the term SMPTE is used interchangeably with the following terms:	
NTSC (National Television System Committee)	the color standard used in the United States.
EIA (Electronic Industry Association)	the black and white standard.
HD (High Definition film): Based on cameras operating at a multiple of 24 fps or 23.97 fps.	

For each of the EBU and SMPTE formats, the MX Giganet supports the use of both LTC and VITC forms of timecode:

- LTC signal characteristics are compatible with standard audio channels so that they can be recorded onto audio tape tracks or to an audio track on video tape.
- VITC is encoded directly into the video tracks, picked up by the helical scan heads on a Video Cassette Recorder (VCR), and then output on the video signal. This means that even if the VCR is in a pause or slow mode, the VITC can still be read.

For the HD film format, the MX Giganet supports the use of LTC timecode.

The MX Giganet can synchronize timecode with LTC devices plugged in to the **LTC In** socket or for VITC devices plugged in to a **Ref Loop** socket. The

MX Giganet also can act as a master timecode generator for LTC devices connected to the **LTC Out** plug or to VITC devices plugged in to the **Ref Out** socket.

For each video frame, timecode is encoded into the video signal as a unique 8-digit code number based on a 24-hour clock in hours, minutes, and seconds along with a frame number.

Standard timecode format is:

`hh:mm:ss:ff`

where:

`hh`	=	hours	00-23
`mm`	=	minutes	00-59
`ss`	=	seconds	00-59
`ff`	=	frames	00-23 for HD (FILM) 00-24 for EBU (PAL) 00-29 for SMPTE (NTSC)

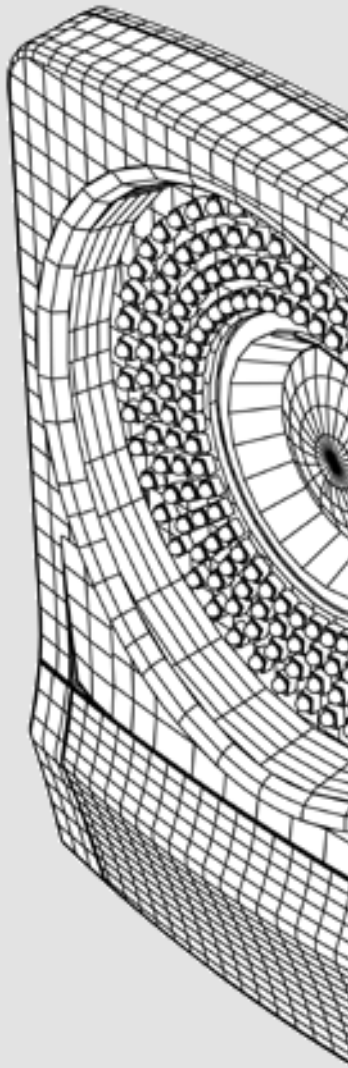
For NTSC, the separator character changes between a colon (:) for non-drop frames and a semicolon (;) for drop frames.

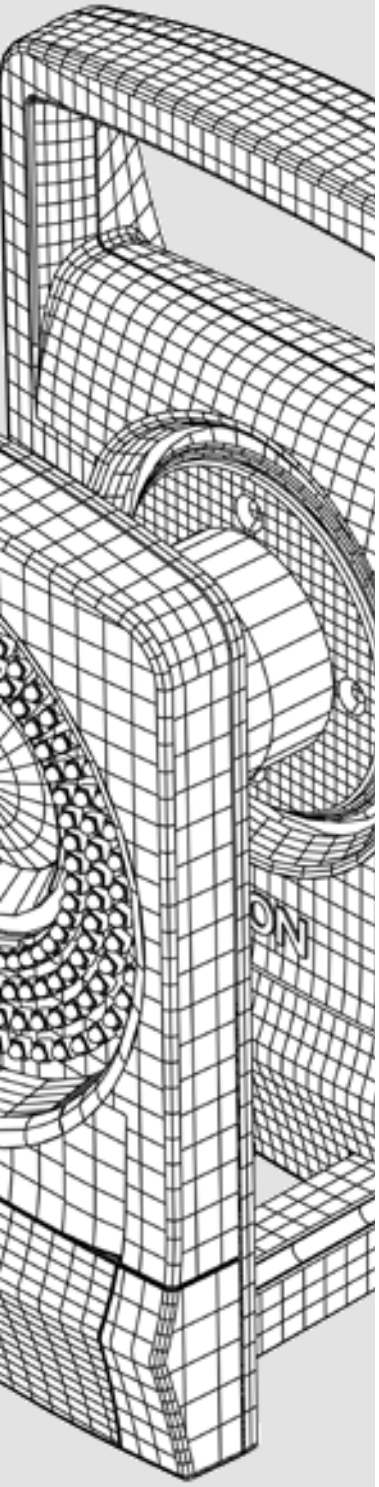
The Vicon MX T-Series system reads the sequential timecode along with video and Vicon raw (X2D) data, which you can use to locate a precise reference point for editing your data. This timecode information also can be used to synchronize the Vicon MX T-Series system with external recording equipment.

Timecode Triggering

From the Vicon software on the MX Host PC, you can configure Timecode triggering to automatically have the MX Giganet start and/or stop data capture based on the timecode.

This is typically used for an application that uses a background plate (film scene) that requires a specific movement of a computer-generated character to be accurately timed relative to that plate. You can set the data capture start time to the same timecode as the plate's Action time and trigger the capture process. The MX Giganet then starts the capture when the specified timecode is reached.





Incorporate a Timecode and/or Genlock Device

You can incorporate in your Vicon MX T-Series system supported third-party external video devices that provide HD and SD compliant timecode or genlock to an external PAL, SECAM, NTSC, or HD video source. For details on timecode and genlock support, see Understand Timecode and Genlock Functionality on page 116.

You can incorporate such devices to synchronize signals for your Vicon MX system using either:

- Internal timecode (MX Giganet acts as the master timecode generator)
- External timecode (a third-party device acts as the master timecode generator)

If no external video sources are connected, one of the MX Giganets assumes that it is to act as the synchronization master for the Vicon MX system.For details on timecode support, see Understand Timecode and Genlock Functionality on page 116.

In order to synchronize your Vicon MX system with external timecode, you must have a Genlock device connected to the system to generate a synchronization signal. You can use a single timecode/genlock device or separate timecode and genlock devices. You will need specialist cables to connect these third-party devices to the MX Giganet. For details, see Vicon MX T-Series System Cable Descriptions on page 42.

The connections you use depend on the type of timecode device you are using and whether you are using separate genlock device:

- Connect a Combined Genlock and LTC Timecode Device (External Timecode Master) on page 120
- Connect Separate Genlock and LTC Timecode Devices (External Timecode Master) on page 121
- Connect a Single Genlock Device (Internal Timecode Master) on page 123
- Connect a VITC Timecode/Genlock Device (External or Internal Timecode Master) on page 124

For details on MX Giganet connectors, see Timecode and Genlock Connectors on page 32. For details on timecode and genlock cables, see Vicon MX T-Series System Cable Descriptions on page 42. For details on connectors on your timecode/genlock device, see the documentation supplied by the device manufacturer.

Connect a Combined Genlock and LTC Timecode Device (External Timecode Master)

This section shows you how to connect a single genlock and LTC timecode device to your Vicon MX T-Series system.

To incorporate a combined Genlock and LTC Timecode device:

1. Plug the end of your timecode cable with the mini-XLR plug into the **LTC In** socket on the rear of an MX Giganet.

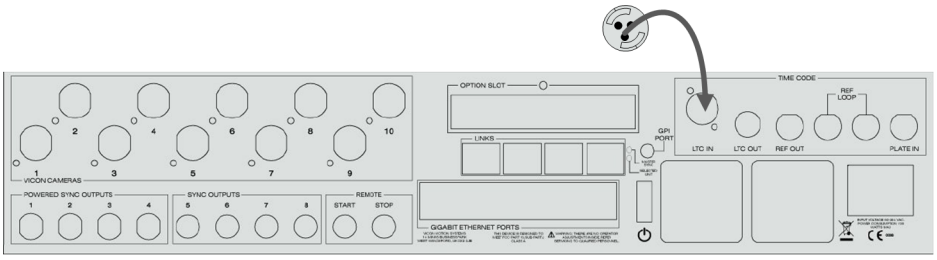


Figure 58: Plug timecode cable into MX Giganet

2. Plug the other end of the timecode cable with the XLR socket into an LTC output plug on the timecode/genlock device.

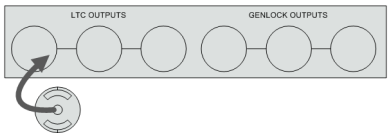


Figure 59: Plug timecode cable into timecode/genlock device

3. Plug the end of a genlock device cable with a BNC plug into the left **Ref Loop** socket on the rear of an MX Giganet.

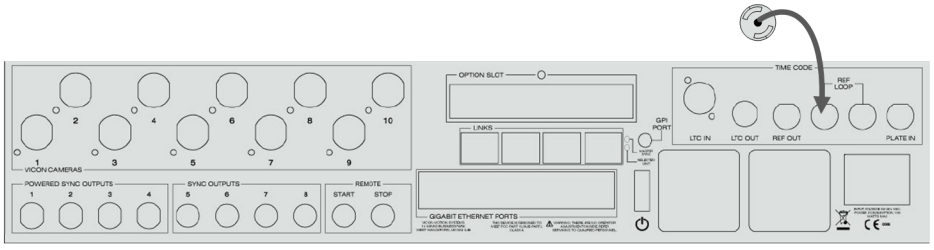
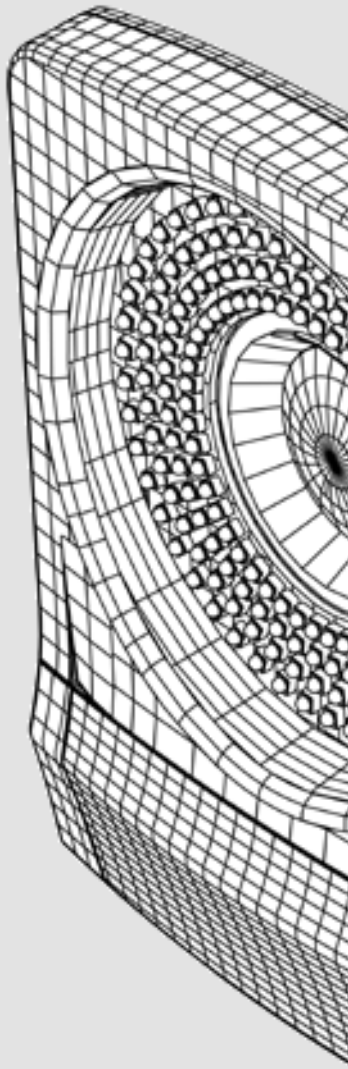
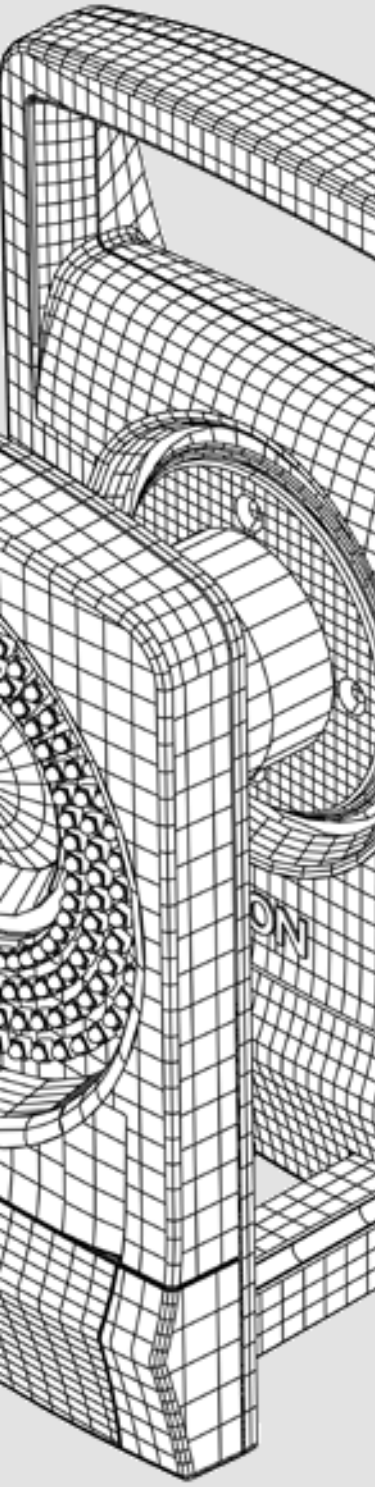


Figure 60: Plug genlock cable into MX Giganet





4. Plug the other end of the genlock device cable with the XLR plug into a Genlock output socket in the timecode/genlock device.

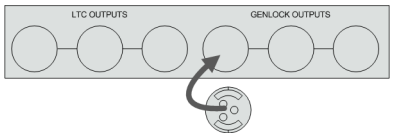


Figure 61: Plug genlock cable into timecode/genlock device

5. For any other third-party audio or video playback devices in your Vicon MX T-Series system architecture whose timecode is to be synchronized:
   a. Plug the end of another timecode device cable with an XLR socket into another LTC output socket in the timecode/genlock device.
   b. Plug the other end of this timecode device cable into an LTC In socket in third-party device.
   c. Plug the end of a genlock device cable into a Genlock output socket in the third-party device.
   d. Plug the other end of this genlock device cable into a Genlock in socket in the third-party device.

Connect Separate Genlock and LTC Timecode Devices (External Timecode Master)

This section shows you how to connect separate genlock and LTC timecode devices to your Vicon MX T-Series system.

To incorporate separate Genlock and LTC Timecode devices:

1. Plug the end of a timecode device cable with the mini-XLR plug into the **LTC In** plug on the rear of the MX Giganet.

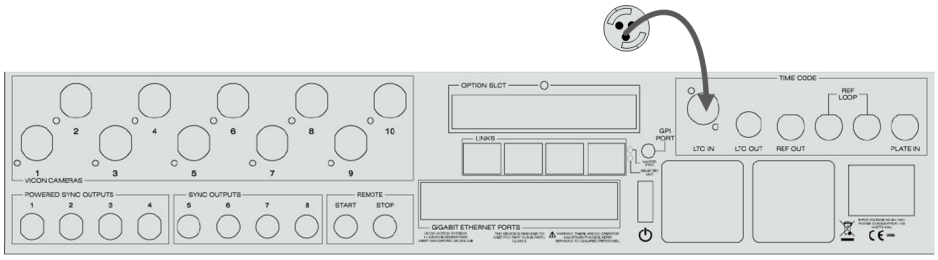


Figure 62: Plug timecode device cable into MX Giganet

2. Plug the other end of the timecode device cable with the XLR socket into an LTC output plug on the timecode device.

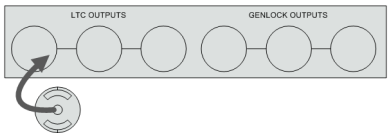


Figure 63: Plug timecode device cable into timecode device

3. Plug the end of a genlock device cable with a BNC plug into the left **Ref Loop** socket on the rear of the MX Giganet.

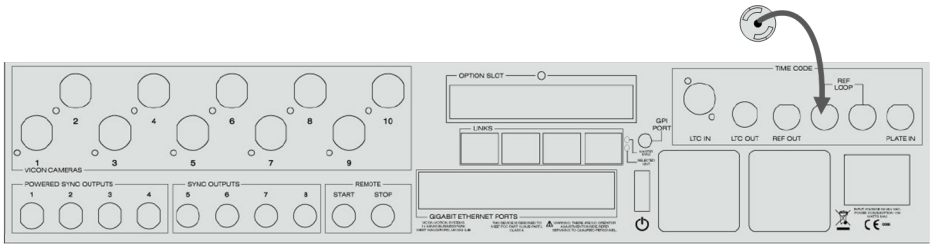


Figure 64: Plug genlock device cable into MX Giganet

4. Plug the other end of the genlock device cable into a Genlock output socket on the genlock device.

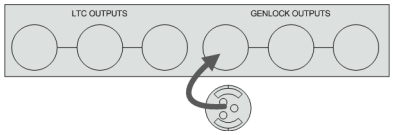
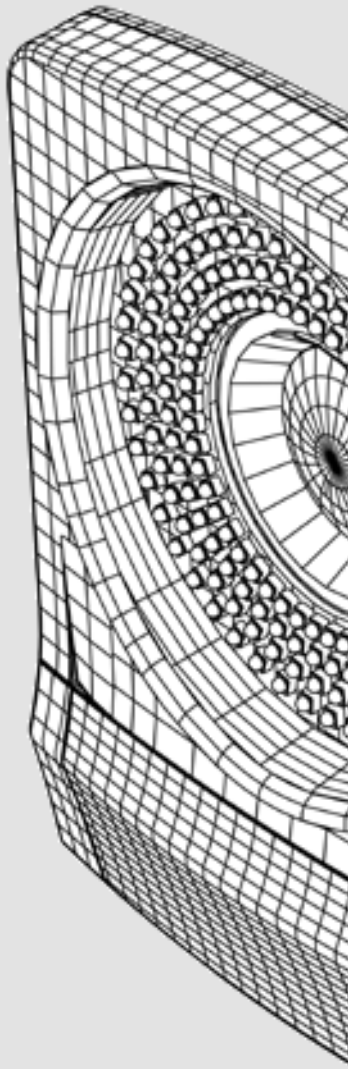
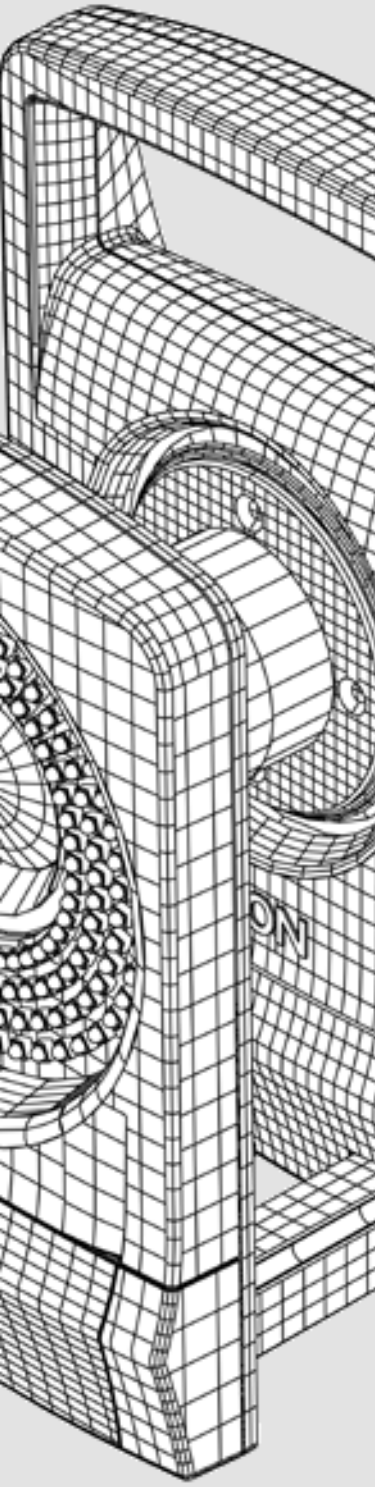


Figure 65: Plug genlock cable into genlock device

5. Plug the end of a genlock device cable into a Genlock output socket in the genlock device.
6. Plug the other end of this genlock device cable into a Genlock in socket in the timecode device.





Connect a Single Genlock Device (Internal Timecode Master)

This section shows you how to connect a single genlock device to your Vicon MX T-Series system.

To incorporate a Genlock device:

1. Plug the end of a genlock device cable with a BNC plug into the left **Ref Loop** socket on the rear of the MX Giganet.

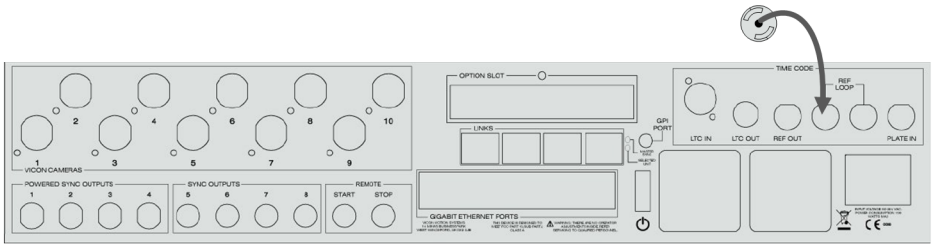


Figure 66: Plug genlock device cable into genlock device

2. Plug the other end of the genlock device cable into a Genlock output socket on the genlock device.

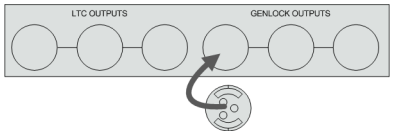


Figure 67: Plug cable into genlock device

Connect a VITC Timecode/Genlock Device (External or Internal Timecode Master)

This section shows you how to connect a VITC timecode device with genlock functionality to your Vicon MX T-Series system.

To incorporate a VITC Timecode/Genlock device:

1. Plug the end of a genlock device cable with a BNC plug into the left **Ref Loop** socket on the rear of an MX Giganet.

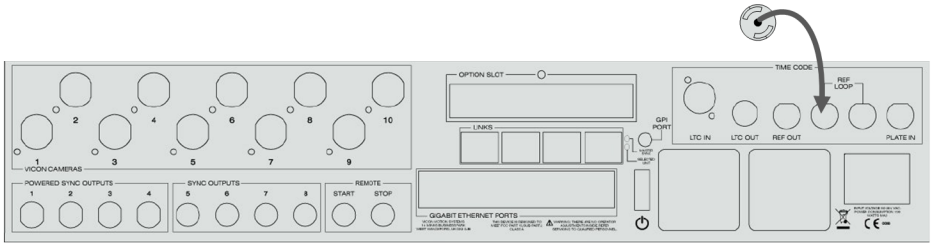


Figure 68: Plug timecode cable into MX Giganet

2. Plug the other end of the cable into a VITC output socket on the VITC timecode/genlock device.

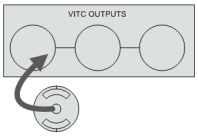
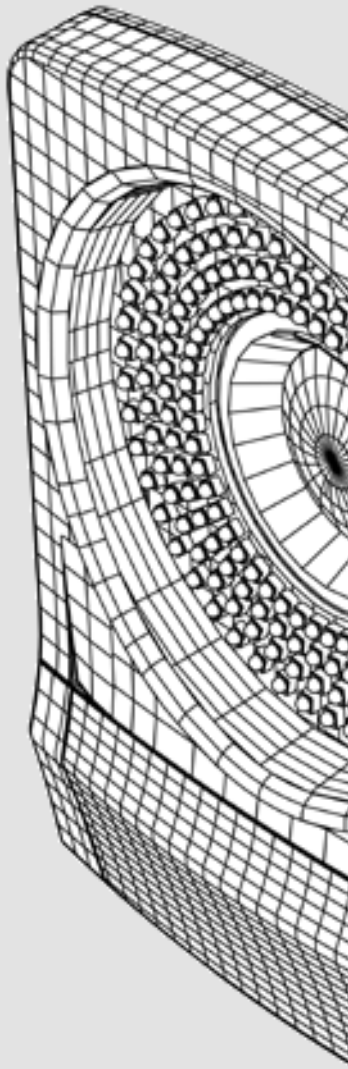
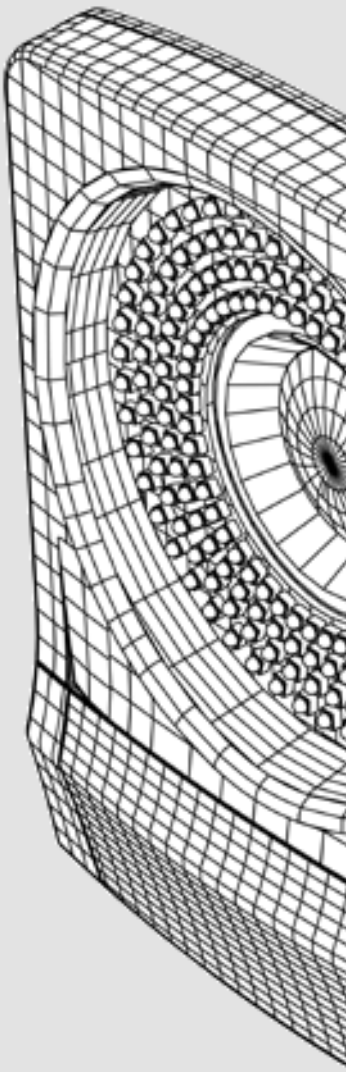


Figure 69: Plug cable into timecode/genlock device



16 Integrate Earlier MX Components into MX System

This chapter shows you how to incorporate selected earlier MX hardware units and their associated previous ranges of MX Cameras into your Vicon MX T-Series system.



In This Chapter

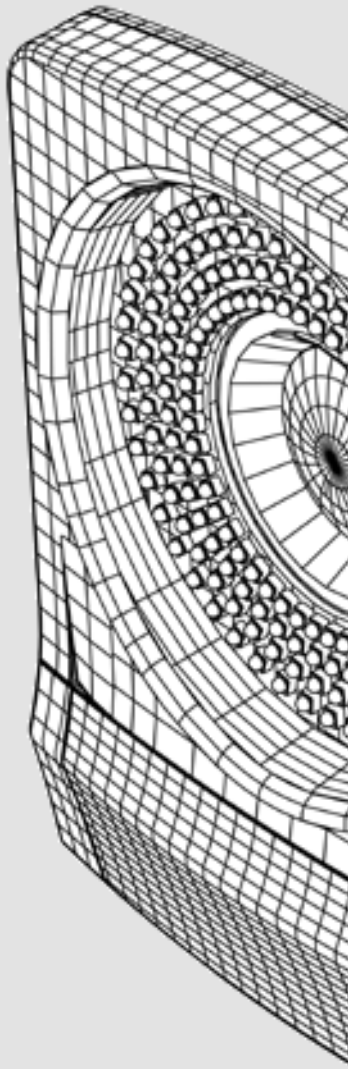
Understanding Integrated Vicon MX Systems

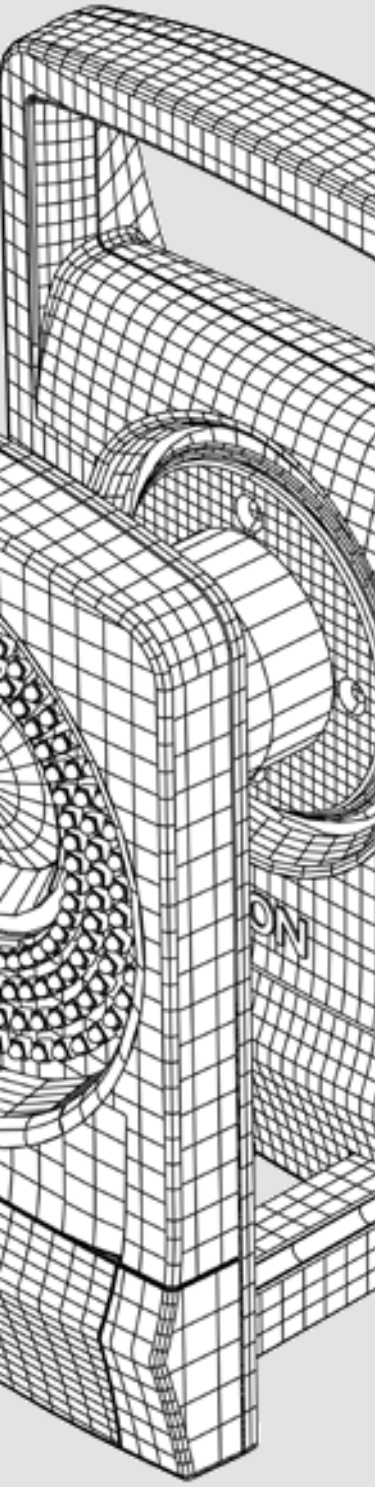
If you are incorporating components from an earlier MX system into a new Vicon MX T-Series system, this book assumes that your earlier MX system cameras are already set up and connected to an MX controlling hardware unit. It also assumes that you have already set up your MX T-Series cameras and MX Giganet as described in Chapter 8 Put Together a Simple Vicon MX System.

You must use an MX Giganet as the primary controlling unit in your Vicon MX T-Series system architecture. You can include existing MX Ultranet HD, MX Ultranet, or MX Net units in your Vicon MX T-Series system. This chapter describes how to incorporate an MX Ultranet HD, MX Ultranet, or MX Net unit.

Important
MX Control and MX Bridge are not compatible with the Vicon MX T-Series system.If you are using these units in your existing MX system, for a new MX T-Series system you must remove them and use an MX Giganet instead.
If you need assistance on replacing MX Control or MX Bridge units, or incorporating an MX Net, contact Vicon Support (see Technical Support on page 198).

If you are integrating earlier MX hardware units, use all four of the **Links** sockets in the primary MX Giganet before connecting any further units to any subordinate MX Giganets or earlier controlling units. For quickest connection and best Ethernet communications performance, you are recommended to incorporate new MX units closer to the MX Host PC, so for a very large system with a variety of units from earlier MX systems connect them in the order MX Host PC, MX Giganet, MX Ultranet HD, MX Ultranet, MX Net.





Incorporate an Earlier MX Hardware Units

This section shows you how to incorporate an MX Ultranet HD, MX Ultranet, or MX Net unit in a Vicon MX T-Series system.

To incorporate an earlier MX hardware unit in a T-Series system:

1. Plug one end of an MX Giganet to MX Net cable into one of the four **Links** sockets on the rear of the primary MX Giganet.

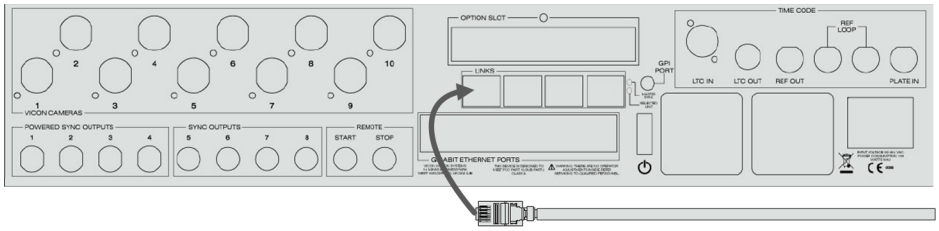


Figure 70: Plug MX Giganet to MX Net cable into MX Giganet

2. Plug the other end of the cable into the appropriate sockets on the rear of your earlier MX unit:
   - MX Ultranet HD: one of the four **Ultranet Links** sockets.

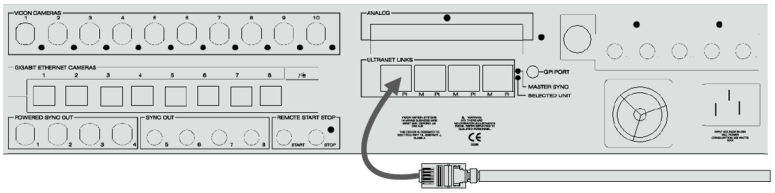


Figure 71: Plug cable into MX Ultranet HD

   - MX Ultranet: one of the four **Links** sockets.

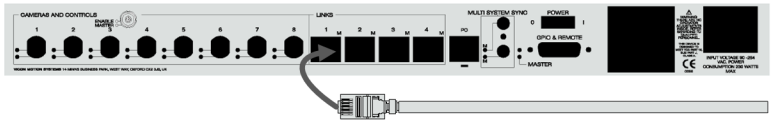


Figure 72: Plug cable into MX Ultranet

- MX Net: the **Link** socket on the rear.

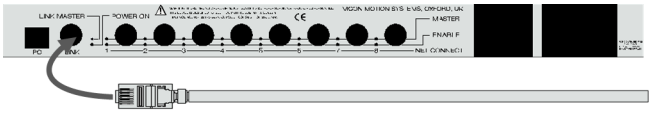
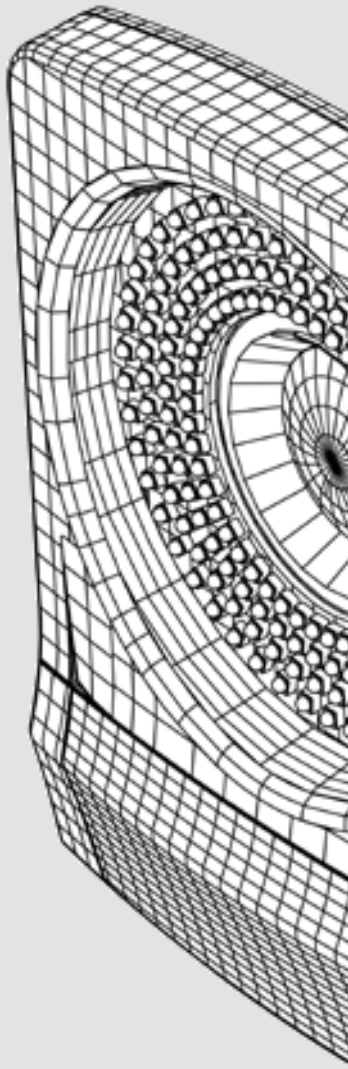


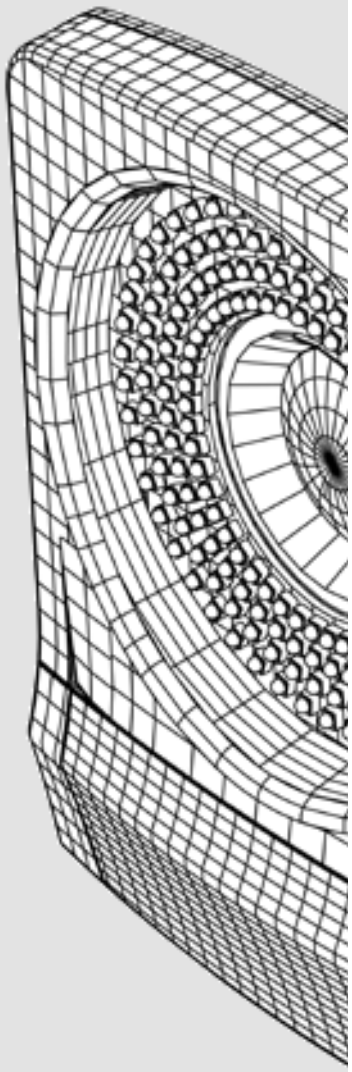
Figure 73: Plug cable into MX Net

For details on these connectors, see Vicon System Connectors on page 33. For details on the MX Giganet to MX Giganet cable, see Vicon MX T-Series System Cable Descriptions on page 42.



17 Focus an MX T-Series Camera Lens

This chapter shows you how to focus a Vicon MX T-Series camera lens.



In This Chapter

Understand Lens Focus Methods

MX T-Series cameras are in focus when the images of markers seen by the camera at a distance representative of the capture distance (that is, the distance between subject and camera) are clear and sharp. The degree of focus of the lens on an MX T-Series camera can be controlled by altering two characteristics of the lens:

- **Front (or forward) focus**

  This is set by adjusting the focus ring at the front of the lens. This type of adjustment is typically made when initially configuring and subsequently checking your cameras for capture.

  This procedure is described in section Adjust Camera Lens Focus with Front Focus Ring on page 131.

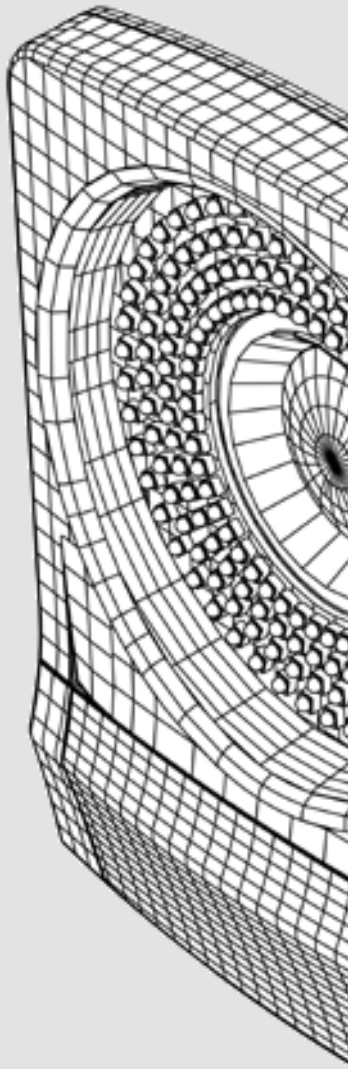
- **Back focus**

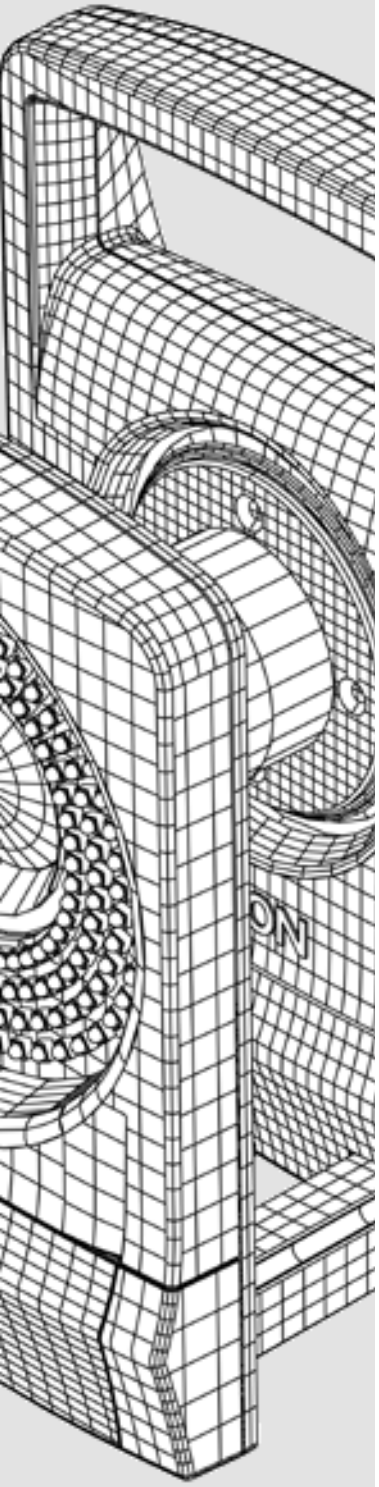
  This is set by adjusting the position of the entire lens closer to or further away from the camera sensor along the axis of the lens. This sets the distance between the rear lens element and the sensor. This type of adjustment is required only to ensure that the lens focus ring matches what is actually in focus. Vicon makes this adjustment when initially setting the camera up; you may need adjust this yourself if the lens has undergone any movement during shipping or if you subsequently replace the lens.

  This procedure is described in section Adjust Camera Lens Focus through Back Focus on page 132.

You can see the results in real time while you are focusing the camera by viewing the marker images in your Vicon application software. For example, in Nexus, you can view the camera data in a **Camera** view pane; in Blade, you can view it in a **Capture** workspace.

Caution
All cameras supplied by Vicon Motion Systems are back focused as part of system testing in the factory; this should not normally need to be repeated in the field. If small adjustments (trimming) of focus are necessary in the field, generally you should use the lens front focus method. However, if a supplied camera lens has been loosened, removed, or swapped for another lens, it may be necessary to perform a back focus adjustment for maximum performance.





Adjust Camera Lens Focus with Front Focus Ring

You can sharpen the camera lens focus by adjusting the focus ring at the front of the lens. The procedure in this section applies to both fixed-focus and zoom lenses.

You can see the results while you are focusing the camera by viewing the marker images in your Vicon application software. For example, in Blade, you can view the camera data in a **Capture** workspace. In Nexus, you can view the camera data in a **Camera** view pane. The procedure in this section contains examples outlining how to view the live camera data in Nexus and Blade. For full details on the software steps, see the Blade or Nexus documentation.

To adjust camera lens focus with the front focus ring:

1. Mount the camera on a tripod within reach of the MX Host PC on which the Vicon application software is installed.
2. Ensure that you can view the camera data from the Vicon application software on the MX Host PC. For details on doing this, see the documentation for your Vicon application software.
3. Place a pair of 25 mm retroreflective markers with centers 50 mm apart central to the camera Field of View and at a distance from the camera representative of the capture distance.
4. If focusing a zoom lens, set the zoom to the desired level.
5. Ensure that the lens aperture is at its most open setting, that is, it is set to the lowest numerical value on the aperture ring.

   This lets more light into the camera and minimizes the depth of field (for details, see Aperture and Depth of Field on page 26).
6. In the Vicon software, check the marker images from this camera (for details, see Check Camera Lens Focus on page 134).
7. In the Vicon software, observe the sharpness of the image of the two 25 mm markers; slowly adjust the front focus ring of the camera lens until the two markers appear in sharp focus in the software, as shown in Figure 74.

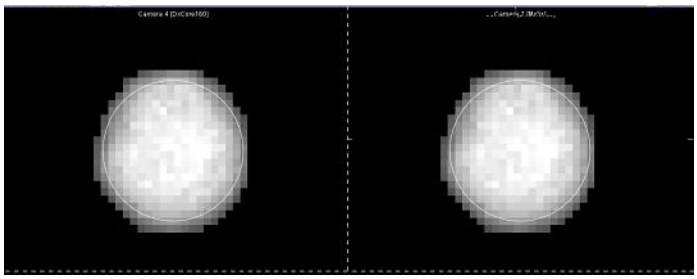
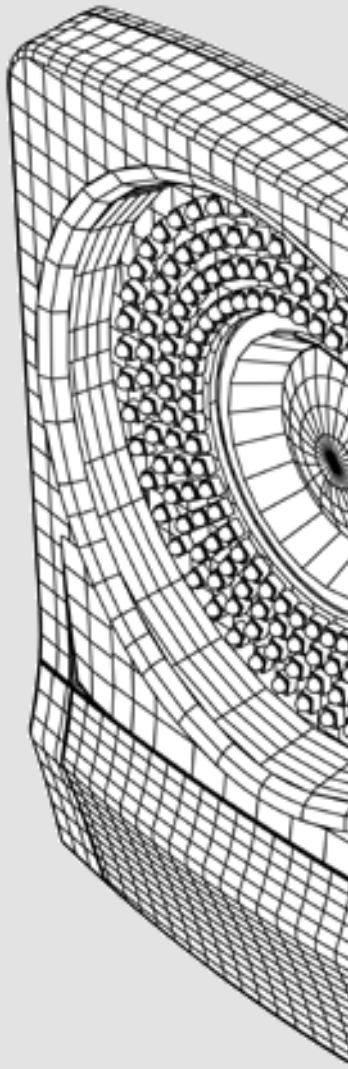


Figure 74: Marker view in Vicon software

8. In the Vicon software, zoom out and check that other markers of interest distributed around the volume are also in focus.
9. Once front focusing is complete, if your lens has a mechanism for engaging and disengaging the front focus ring, disengage it to ensure the focus stays at the desired level.
10. Return the Vicon software to the default capture settings (for details, see Check Camera Lens Focus on page 134).

Adjust Camera Lens Focus through Back Focus



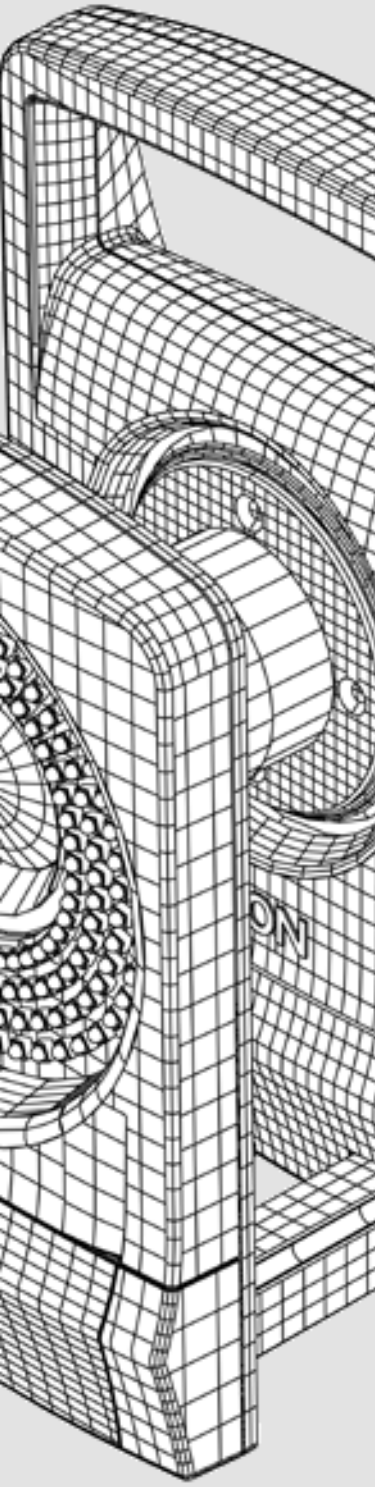
You can sharpen the camera lens focus by adjusting the focal length of the lens to position the entire lens closer to or further away from the camera sensor along the axis of the lens. The latter is achieved by screwing the lens mount into or out of the front of the camera. The way you do this depends upon whether you are using a fixed-focus or zoom lens. Any differences are described in the following procedure.

You can see the results while you are focusing the camera by viewing the markers in your Vicon application software. For example, in Blade, you can view the camera data in a **Capture** workspace. In Nexus, you can view the camera data in a **Camera** view pane. The procedure in this section contains examples outlining how to view the live camera data in Nexus and Blade. For full details on the software steps, see the Blade or Nexus documentation.

Warning
Back focusing is a delicate operation that must be performed only by qualified and experienced persons. If this operation is not properly carried out, the sensor can be damaged.

To adjust camera lens focus through back focus:

1. Mount the lens on the camera.
2. Mount the camera on a tripod (for floor-based cameras) or a clamp and truss on a speed rail (for raised cameras).
3. Ensure that any aperture locking screws are removed.
4. Open the aperture as wide as possible (that is to the lowest numerical value on the lens aperture ring). This lets more light into the camera and minimizes the depth of field (for details, see Aperture and Depth of Field on page 26).
5. Ensure that you can view the camera data from the Vicon software on the MX Host PC. For details on doing this, see the documentation for your Vicon application software.
6. Adjust camera settings for threshold and strobe intensity to obtain good images to adjust from.



7. Set the front focus of the lens to infinity (∞) (for details, see Adjust Camera Lens Focus with Front Focus Ring on page 131).
8. On the base of the lens, slacken the three Allen grub screws.
9. In the capture volume, place a pair of 25 mm retroreflective markers with centers 50 mm apart central to the camera Field of View and at as great a distance as possible (ideally between 10 and 25 m) from the camera.
10. Lower the lighting in the capture volume.
11. On the camera, rotate the ring in which the grub screws are located relative to the camera body until correct focus is achieved when viewing the maker pair in the volume:

    If you are using a fixed-focal length lens:

    - Rotate the lens and adapter assembly until the two markers appear in sharp focus.

    If you are using a zoom lens, focus the zoom setting using the zoom control as follows:

    a. Zoom IN fully (lens focal length at its maximum) on the markers and adjust the front focus to obtain a sharp image of the markers.

    b. Zoom OUT fully and slowly loosen the back focus locking ring and rotate the lens and adapter assembly until the two markers appear in sharp focus.

    c. Repeat steps a and b until the focus stays sharp throughout the zoom range and no adjustment is necessary at either extreme of the zoom range.
12. Gently retighten the back focus locking ring in a clockwise motion and recheck the focus of the marker pair in the Vicon software.
13. If necessary, trim the focus using the front focus ring (for details, see Adjust Camera Lens Focus with Front Focus Ring on page 131).
14. Once back focusing is complete, tighten the 3 grub screws.
15. Return the Vicon software to the default capture settings (for details, see Check Camera Lens Focus on page 134).

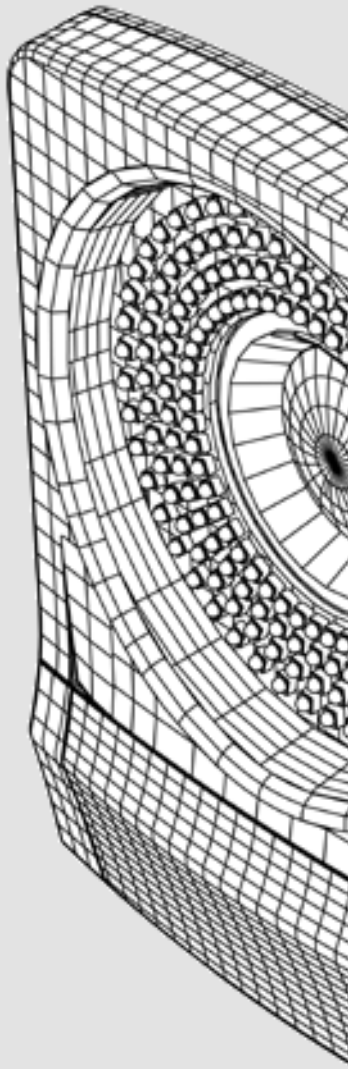
Check Camera Lens Focus

You can check the focus of your camera in your Vicon application software while adjusting it either through front focus or back focus. To optimize your focusing, adjust your camera settings to get clear, bright images of the markers.

This section provides a summary of the procedure in each software application:

- Check Camera Lens Focus in Vicon Blade
- Check Camera Lens Focus in Vicon Nexus on page 134

For further details, see your Blade or Nexus documentation



Check Camera Lens Focus in Vicon Blade

You can check the image of the markers from the camera you are focusing in real time in Vicon Blade.

To adjust camera settings for checking camera focus in Blade:

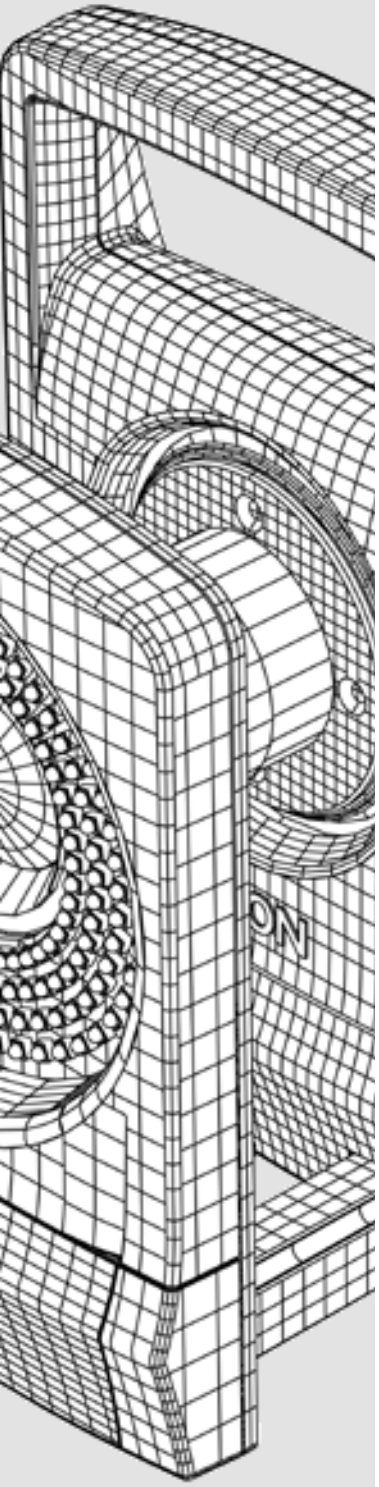
1. From the **Studio Activities** tab, in the **Camera Setup and Calibration** group, click **Grayscale mode** and select **All Data**.
2. In the **Capture** workspace tool bar, click the **Show Settings** button to turn on the **Settings** sliders and then pull the **Strobe Intensity** slider up to its maximum level.
3. Right-click and drag in the **Capture** workspace to zoom in on the target marker pair.
4. If the image of the markers is not bright enough to allow confidence in the level of focus achieved, increase the intensity of the grayscale from the camera. In the **Capture** workspace, pull the **Gain** slider up to a level above 1.
5. In the **Capture** workspace, observe the sharpness of the image of the two 25 mm markers.
6. After focusing the lens, return Blade to its default capture settings. From the **Studio Activities** tab, in the **Camera Setup and Calibration** group, click **Grayscale mode** and select **Automatic**.

Check Camera Lens Focus in Vicon Nexus

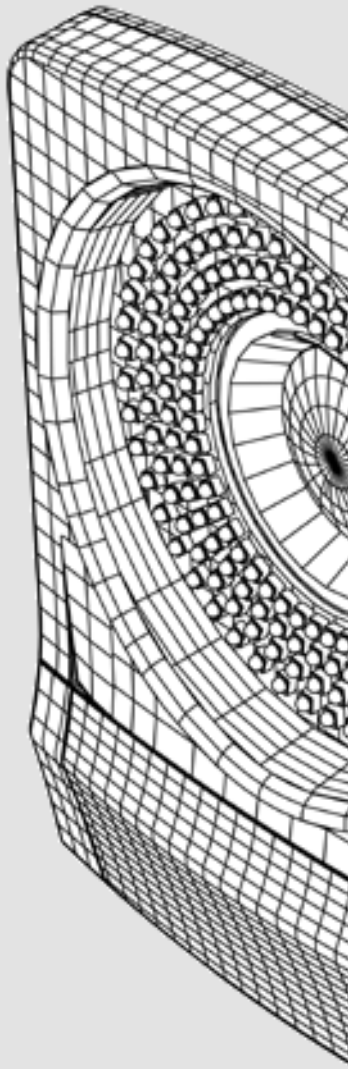
You can check the image of the markers from the camera you are focusing in real time in Vicon Nexus.

To adjust camera settings for checking camera focus in Nexus:

1. In the **View** pane, click the **Camera** view type.
2. In the **Resources** pane, ensure Nexus is in **Live** mode.
3. In the **System** resources pane, expand the **MX Cameras** node in the data tree and select the desired MX Camera entry.

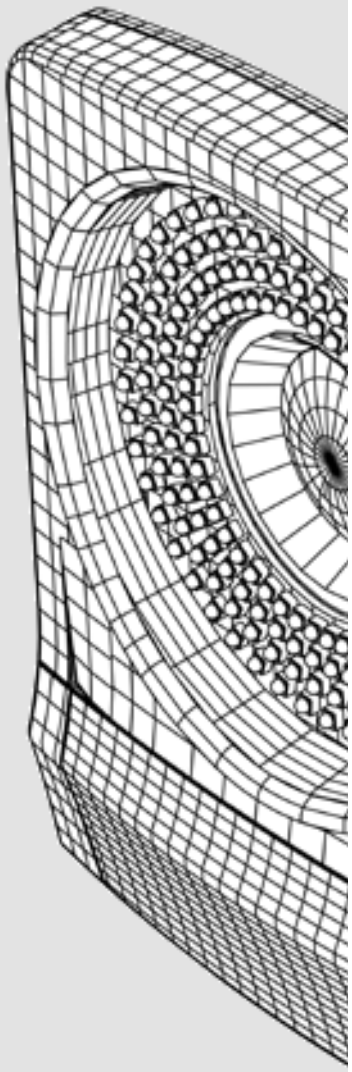


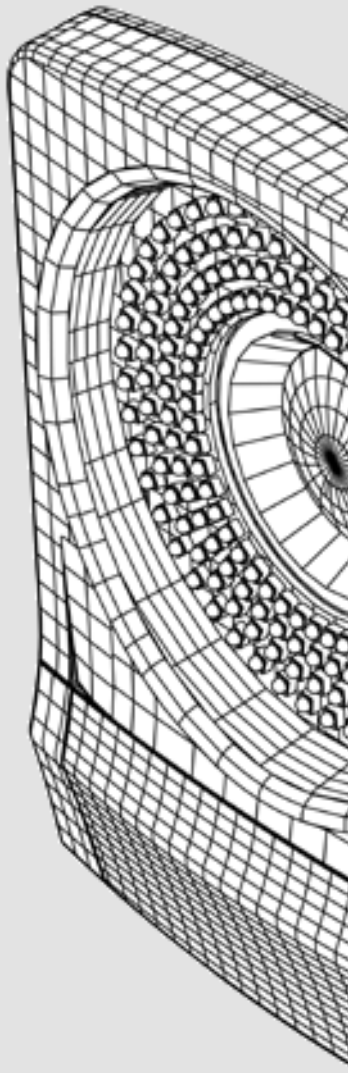
4. In the **Properties** section at the bottom of the **System** resources pane, set **Grayscale mode** to **All**.
5. Right-click and drag in the **Camera** view pane to zoom in on the target marker pair.
6. If the image of the markers is not bright enough to allow confidence in the level of focus achieved, increase the intensity of the grayscale from the camera. In the **Properties** section, increase the value for **Gain** to a level above x1.
7. In the **Camera** view pane, observe the sharpness of the image of the two 25 mm markers.
8. After focusing the lens, return Vicon Nexus to its default capture settings. In the **Properties** section at the bottom of the **System** resources pane, set **Grayscale mode** to **Auto**.



III Technical Specifications

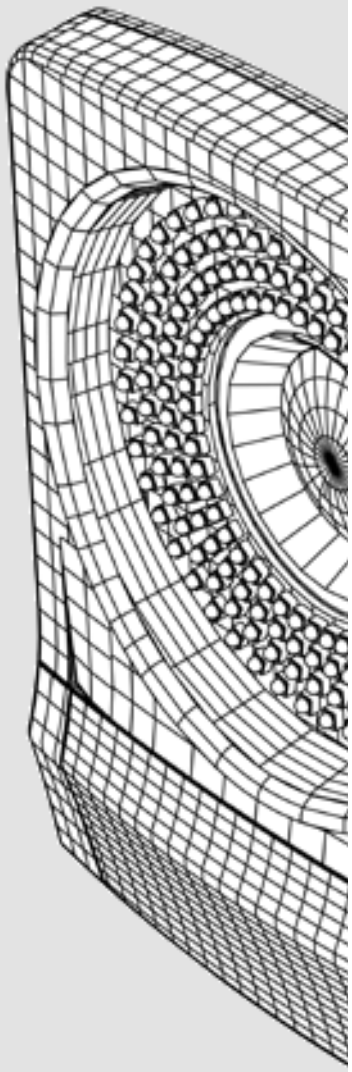
Find out more about the technical details on the components of your Vicon MX T-Series system.





18 MX T-Series Cameras Technical Specifications

This chapter provides technical specifications for the Vicon MX T-Series cameras, including their lenses and strobe units.



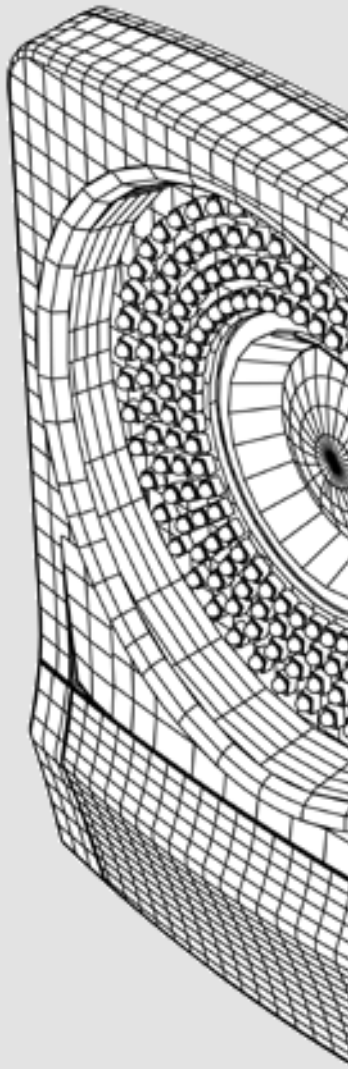
In This Chapter

MX T-Series Cameras Specifications

The following sections provide technical specifications and performance indicators for the different types of Vicon MX T-Series cameras:

- T160 Camera Specifications
- T40 Camera Specifications on page 144
- T20 Camera Specifications on page 148
- T10 Camera Specifications on page 152

For further details on the use of these MX Cameras in a Vicon MX system, see Chapter 2 MX T-Series Cameras.



T160 Camera Specifications

Table 18 provides technical specifications and performance indicators for the T160 camera. Superscripted numbers indicate additional information provided in the Table Notes on page 143.

Table 18: T160 camera specifications

Component	Specification
Performance	
Maximum frame rate (fps) at full resolution	120[a]
Maximum frame rate (fps) at partial scan	2,000[a]
Frame rates (fps)	30-2,000
Sensor	
Sensor type	CMOS
Sensor	Proprietary Vicon AVALON-16
Sensor resolution (pixels)	4704 H x 3456 V
Number of pixels	16,257,024
Pixel size	3.9 microns x 3.9 microns
Physical sensor size (mm)	18.35 mm (H) x 13.48 mm (V), 22.77 mm (Diagonal)
Optical format	Proprietary Vicon >1 inch
Shutter type	V-Shutter[b]
Aspect ratio	4:3
On Camera Processing	
256 shades and grayscale processing	Yes[c]

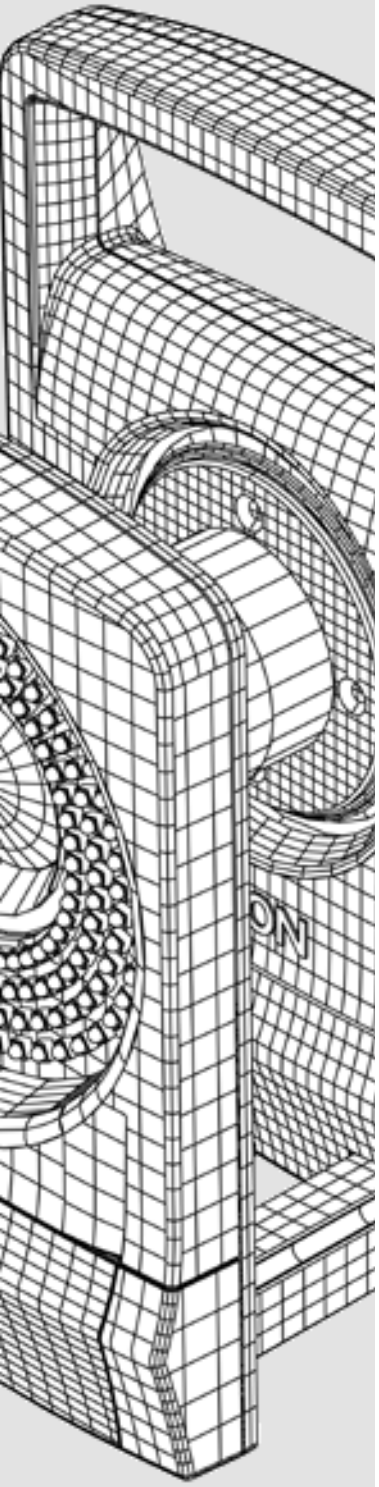
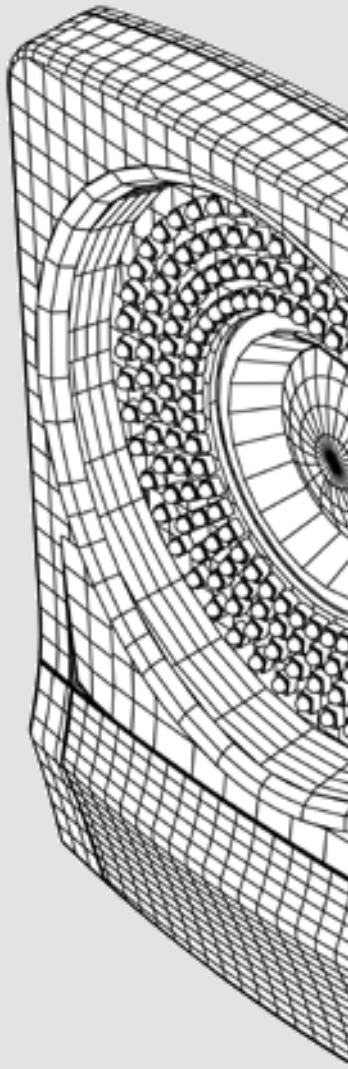


Table 18: T160 camera specifications

Component	Specification
Grayscale depth	10 bit
Sub pixel resolution	1,200,000 x 880,000 (1/256 pixel resolution)
On-board processors	3 processors[d]
On-camera masking	Yes[e]
In-camera dynamic large blob eliminator	Yes[f]
Software masking	Yes
Auto masking	Yes
On-camera thresholding	Yes
Threshold grid size (tiles)	294 x 108
Threshold grid tile dimensions (pixels)	16 x 32
2D tracking	Yes[g]
Camera output modes	5[h]
Full frame preview output	Yes[i]
Back focus mode	Yes (using Preview mode)
Strobe/Ringlight	
Types available	780 nm (Near Infrared (NIR)) 623 nm (Visible Red (VR))[j]
Number of LEDs	252 (NIR) 320 (VR)
Cover types available	Not required
Strobe electronics	Integrated, software reprogrammable and controlled
Adjustable illumination	Yes
Adjustable levels	1,000 (software controlled)
View angle	56° (NIR) 60° (VR)
Physical	
Camera housing	Complex mold custom die-cast aluminum
Camera body dimensions	207 mm (H) x 130 mm (W) x 75 mm (D)

Table 18: T160 camera specifications

Component	Specification
Weight (including strobe, excluding lens)	1.8 kg
Number of mount points	1
Camera Architecture	
Software and firmware upgradable	Yes
Upgrade methods	Through the Vicon application software. Firmware files can be placed on the MX Host PC using any standard transmission method (e.g. FTP, e-mail, CD, USB stick). The files are then uploaded from the MX Host PC to the other MX system hardware through the Reprogram Firmware function in the software.
Cabling	Cat5e (Gigabit Ethernet with power and sync over Ethernet)
Connectors	A single connection between camera and an MX Giganet. Single connector to strobe. Two serial ports in a single auxiliary connector.
Power supply	All power to the cameras from the power supply within the MX Giganet (450 Watts maximum per MX Giganet)
Maximum number of cameras supported with each hub/net	Up to 10 cameras per MX Giganet
Lens type supported	Vicon Lens/Digital SLR
Zoom lens supported	Yes
C-Mount lenses available	None
Digital SLR lenses available	Canon/Sigma (Canon EF mount)
Remote-controlled optics	Aperture and focus remotely adjustable with Canon/Sigma lens (18-50 mm Sigma lens available, others on request)
Plug and play compatibility	Yes
Mixed camera system compatibility	Interoperable with MX-F40, MX-F20, MX-40+, MX-20+, MX-13+, MX-3+, MX-40, MX-13, MX-3
System connectivity/ communication	Gigabit Ethernet



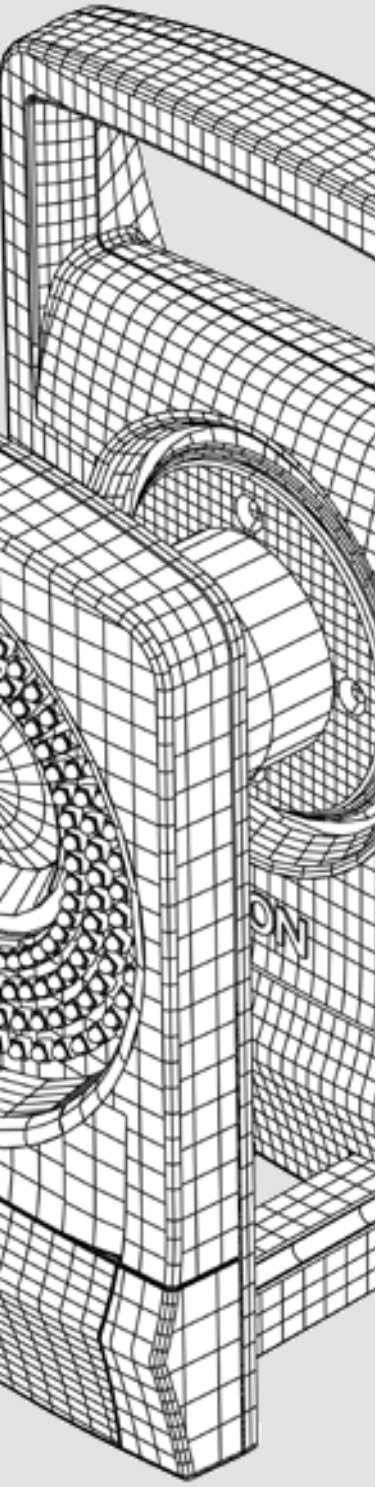


Table 18: T160 camera specifications

Component	Specification
Maximum number of cameras in system	Unlimited
Custom control interface	Yes
Communication status indicators	Yes
Camera number indicator	Optional
Camera status indicators	On strobe unit and in software
IP addressable	Yes
IP reconfigurable	Yes
Cooling	Advanced thermal design
RoHS compliant	Yes

Table Notes

a. **Increased Frame Rates:** You can specify higher frame rates than those shown in the appropriate table for your camera type. However, at higher frequencies, the MX Cameras automatically reduce the image size (vertical windowing).
You can specify the capture frame rate of each MX Camera in the Vicon application software. MX Cameras are capable of capturing up to a maximum of 2,000 fps, but the actual frame rate you can specify depends on the Vicon application software you are using. For details, see your Vicon software documentation.

b. **Shuttering:** The Vicon AVALON sensor uses a proprietary V-Shutter to reduce the time over which light is integrated into electrical current in the sensor's pixels. The V-Shutter overcomes the negative effects of using rolling shutters for motion capture.

c. **Full marker grayscale:** Marker centers are calculated based on every pixel of grayscale available for the marker, not just the detected marker edges. An on-camera circularity test ensures merged or partially occluded markers which need high-level processing are sent in full grayscale to the MX Host PC.

d. **On-boarding processing:** a) Scalable multiprocessor extracts grayscale markers from sensor image. Although one physical device, it provides parallel processing of the data stream. b) Digital Signal Processor (DSP) locates markers in 2D and calculates centers and radii.
c) High performance and highly configurable soft-processor streams grayscale and marker center data over Ethernet to MX Host PC. Also handles housekeeping and configuration tasks.

e. **On-camera masking:** This removes areas of the sensor where undesirable static light sources are recorded, for example strobes from other cameras.

f. **Blob elimination:** Camera firmware automatically removes undesirable image data including both large blobs (e.g. sunlight reflections) and/or an unusually large number of blobs.

g. **2D tracking:** The 2D tracking algorithms allow for the markers' movement to be tracked from frame to frame on the camera. This allows even fast motion of close markers to be easily processed.

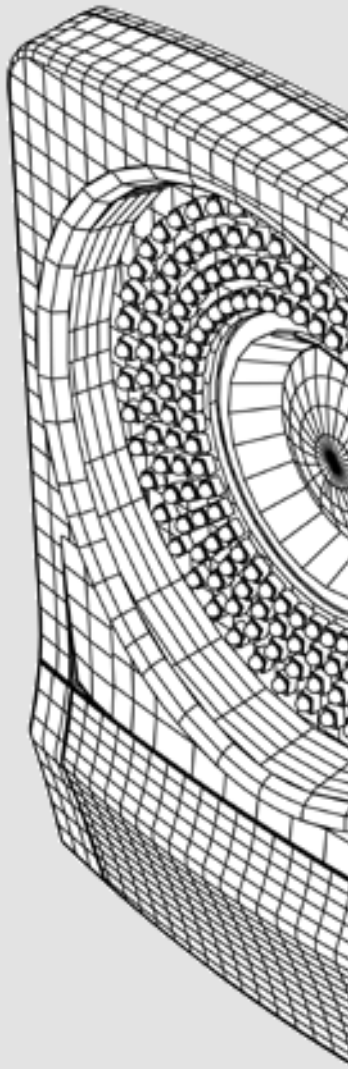
h. **Output modes:** Automatic (centers for circular markers, grayscale for overlapping/partially occluded markers), Centers Only, Grayscale Only, Centers/Grayscale, and Preview (the entire sensor image).
i. **Preview mode:** Significantly faster than previous generations of Vicon cameras and takes full advantage of the Gigabit Ethernet connection to the MX Host PC.
j. **Strobe types:** Near Infrared (780 nm) and Visible Red (623 nm) surface mount LED strobes. No requirement for secondary optics or strobe covers. This new generation of strobe is twice as bright as previous generations making set up in awkward environments easier. If you require Infrared (IR) strobes, contact Vicon Motion Systems or your nearest agent or distributor.

T40 Camera Specifications

Table 19 provides technical specifications and performance indicators for the T40 camera. Superscripted numbers indicate additional information provided in the Table Notes on page 147.

Table 19: T40 camera specifications

Component	Specification
Performance	
Maximum frame rate (fps) at full resolution	370[a]
Maximum frame rate (fps) at partial scan	2,000[a]
Frame rates (fps)	30-2,000
Sensor	
Sensor type	CMOS
Sensor	Proprietary Vicon VEGAS-4
Sensor resolution (pixels)	2352 H x 1728 V
Number of pixels	4,064,256
Physical sensor size (mm)	16.46 mm (H) x 12.10 mm (V), 20.43 mm (Diagonal)
Optical format	Proprietary Vicon >1 inch
Pixel size	7 microns x 7 microns
Shutter type	Electronic freeze frame shutter[b]
Aspect ratio	4:3
On Camera Processing	
256 shades and grayscale processing	Yes[c]
Grayscale depth	10 bit
Sub pixel resolution	600,000 x 440,000 (1/256 pixel resolution)



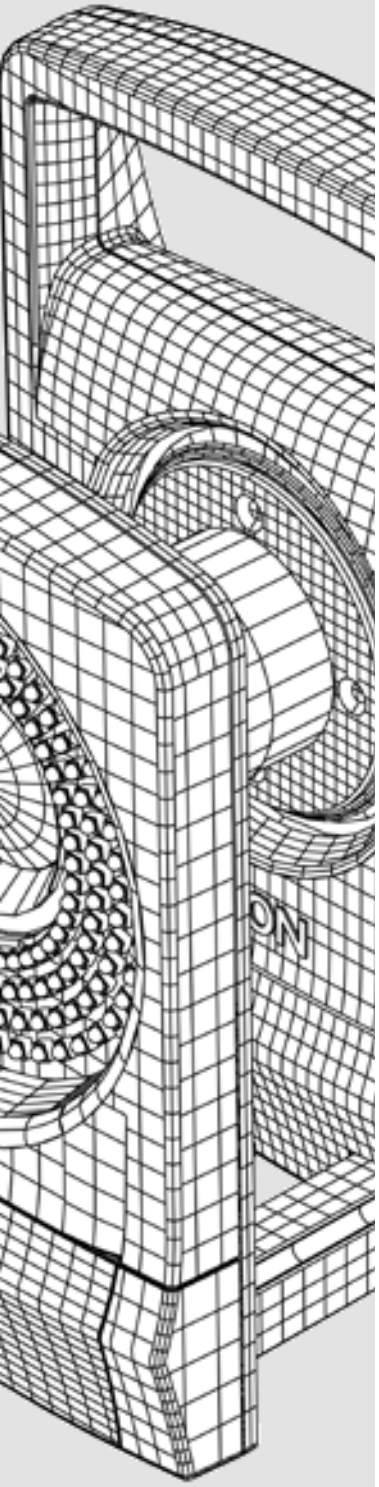
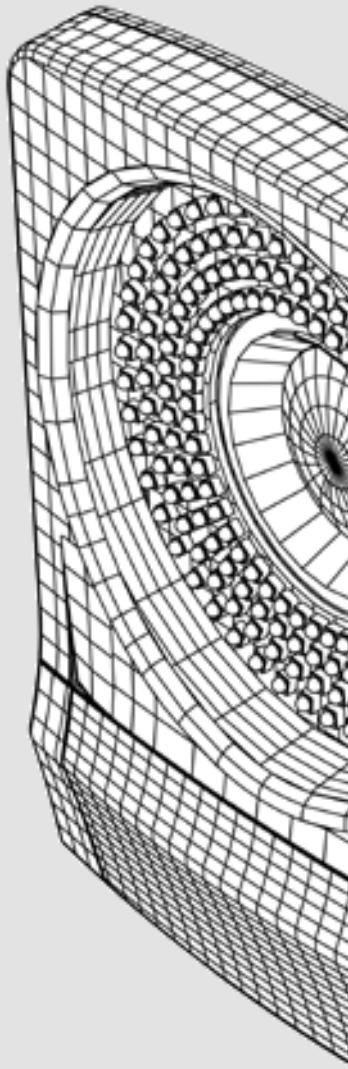


Table 19: T40 camera specifications

Component	Specification
On-board processors	3 processors[d]
On-camera masking	Yes[e]
In-camera dynamic large blob eliminator	Yes[f]
Software masking	Yes
Auto masking	Yes
On-camera thresholding	Yes
Threshold grid size (tiles)	294 x 108
Threshold grid tile dimensions (pixels)	8 x 16
2D tracking	Yes[g]
Camera output modes	5[h]
Full frame preview output	Yes[i]
Back focus mode	Yes (using Preview mode)
Strobe/Ringlight	
Types available	780 nm (Near Infrared (NIR)) 617 nm (Visible Red (VR))[j]
Number of LEDs	252 (NIR) 320 (VR)
Cover types available	Not required
Strobe electronics	Integrated, software reprogrammable and controlled
Adjustable illumination	Yes
Adjustable levels	1,000 (software controlled)
View angle	56°(NIR) 60° (VR)
Physical	
Camera housing	Complex mold custom die-cast aluminum
Camera body dimensions	207 mm (H) x 130 mm (W) x 75 mm (D)
Weight (including strobe, excluding lens)	1.8 kg
Number of mount points	1

Table 19: T40 camera specifications

Component	Specification
Camera Architecture	
Software and firmware upgradable	Yes
Upgrade methods	Through the Vicon application software. Firmware files can be placed on the MX Host PC using any standard transmission method (e.g. FTP, e-mail, CD, USB stick). The files are then uploaded from the MX Host PC to the other MX system hardware through the Reprogram Firmware function in the software.
Cabling	Cat5e (Gigabit Ethernet with power and sync over Ethernet)
Connectors	A single connection between camera and MX Giganet. Single connector to strobe. Two serial ports in a single auxiliary connector.
Power supply	All power to the cameras from the power supply within the MX Giganet (450 Watts maximum per MX Giganet)
Maximum number of cameras supported with each hub/net	Up to 10 cameras per MX Giganet
Lens type supported	C-Mount/Vicon Lens/Digital SLR
Zoom lens supported	Yes
C-Mount lenses available	Yes
Digital SLR lenses available	Canon/Sigma (Canon EF mount)
Remote-controlled optics	Aperture and focus remotely adjustable with Canon/Sigma lens (18-50 mm Sigma lens available, others on request)
Plug and play compatibility	Yes
Mixed camera system compatibility	Interoperable with MX-F40, MX-F20, MX-40+, MX-20+, MX-13+, MX-3+, MX-40, MX-13, MX-3
System connectivity/ communication	Gigabit Ethernet
Maximum number of cameras in system	Unlimited
Custom control interface	Yes



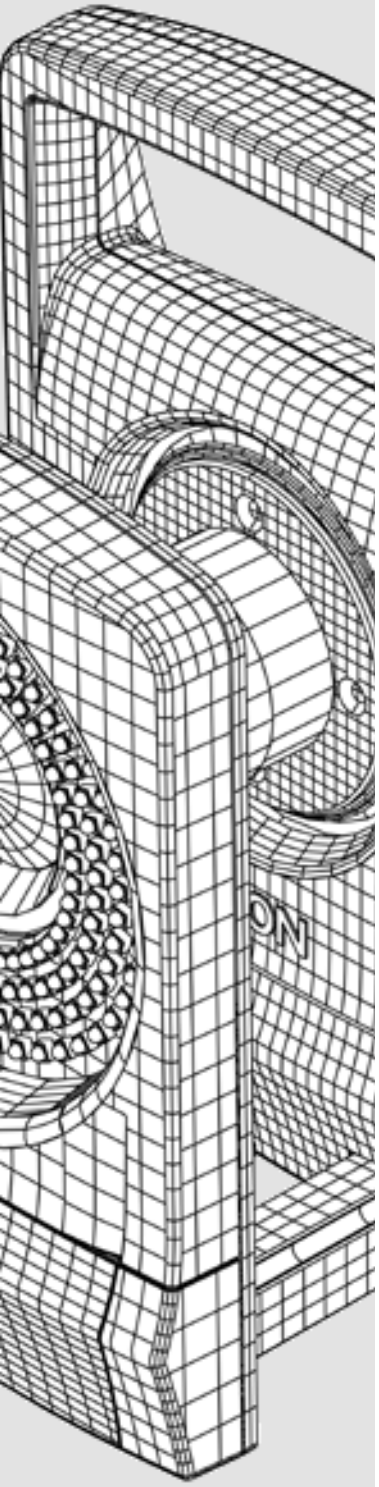


Table 19: T40 camera specifications

Component	Specification
Communication status indicators	Yes
Camera number indicator	Optional
Camera status indicators	On strobe unit and in software
IP addressable	Yes
IP reconfigurable	Yes
Cooling	Advanced thermal design
Environmental Regulations	
RoHS compliant	Yes

Table Notes

a. **Increased Frame Rates:** You can specify higher frame rates than those shown in the appropriate table for your camera type. However, at higher frequencies, the MX Cameras automatically reduce the image size (vertical windowing).
You can specify the capture frame rate of each MX Camera in the Vicon application software. MX Cameras are capable of capturing up to a maximum of 2,000 fps, but the actual frame rate you can specify depends on the Vicon application software you are using. For details, see your Vicon software documentation.

b. **Shuttering:** The image quality from a shuttered camera is constant across all frame rates. For an unshuttered camera, which is more susceptible to background light levels, narrow bandwidth interference filters are used to provide a signal to noise ratio performance comparable to the shuttered cameras. Factors such as strobe illumination, field of view, and depth of field also affect the image quality.

c. **Full marker grayscale:** Marker centers are calculated based on every pixel of grayscale available for the marker, not just the detected marker edges. An on-camera circularity test ensures merged or partially occluded markers which need high-level processing are sent in full grayscale to the MX Host PC.

d. **On-boarding processing:** a) Scalable multiprocessor extracts grayscale markers from sensor image. Although one physical device, it provides parallel processing of the data stream. b) Digital Signal Processor (DSP) locates markers in 2D and calculates centers and radii.
c) High performance and highly configurable soft-processor streams grayscale and marker center data over Ethernet to MX Host PC. Also handles housekeeping and configuration tasks.

e. **On-camera masking:** This removes areas of the sensor where undesirable static light sources are recorded, for example strobes from other cameras.

f. **Blob elimination:** Camera firmware automatically removes undesirable image data including both large blobs (e.g. sunlight reflections) and/or an unusually large number of blobs.

g. **2D tracking:** The 2D tracking algorithms allow for the markers' movement to be tracked from frame to frame on the camera. This allows even fast motion of close markers to be easily processed.

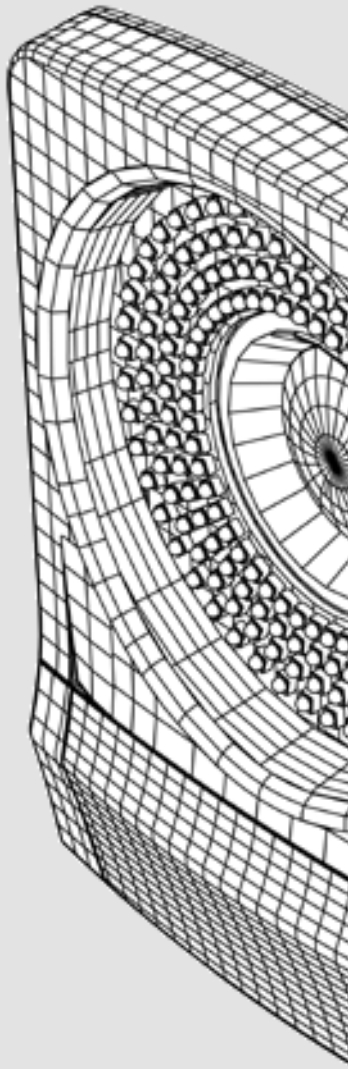
h. **Output modes:** Automatic (centers for circular markers, grayscale for overlapping/partially occluded markers), Centers Only, Grayscale Only, Centers/Grayscale, and Preview (the entire sensor image).
i. **Preview mode:** 10 times faster than previous generations of Vicon cameras and taking full advantage of the Gigabit Ethernet connection to the MX Host PC.
j. **Strobe types:** Near Infrared (780 nm) and Visible Red (623 nm) surface mount LED strobes. No requirement for secondary optics or strobe covers. This new generation of strobe is twice as bright as previous generations making set up in awkward environments easier

T20 Camera Specifications

Table 20 provides technical specifications and performance indicators for the T20 camera. Superscripted numbers indicate additional information provided in the Table Notes on page 151.

Table 20: T20 camera specifications

Component	Specification
Performance	
Maximum frame rate (fps) at full resolution	500[a]
Maximum frame rate (fps) at partial scan	2,000[a]
Frame rates (fps)	30-2,000
Sensor	
Sensor type	CMOS
Sensor	Proprietary Vicon VEGAS-2
Sensor resolution (pixels)	1600 H x 1280 V
Number of pixels	2,048,000
Pixel size	7 microns x 7 microns
Physical sensor size (mm)	11.20 mm (H) x 8.96 mm (V), 14.34 mm (Diagonal)
Optical format	Proprietary Vicon 1 inch
Shutter type	Electronic freeze frame shutter[b]
Aspect ratio	5:4
On Camera Processing	
256 shades and grayscale processing	Yes[c]
Grayscale depth	10 bit
Sub pixel resolution	410,000 x 325,000 (1/256 pixel resolution)
On-board processors	3 processors[d]



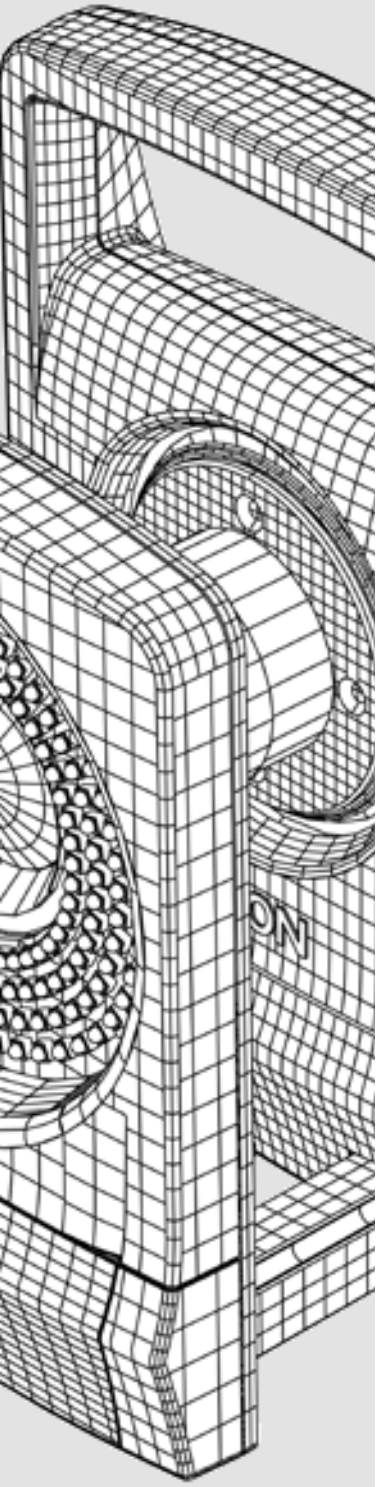
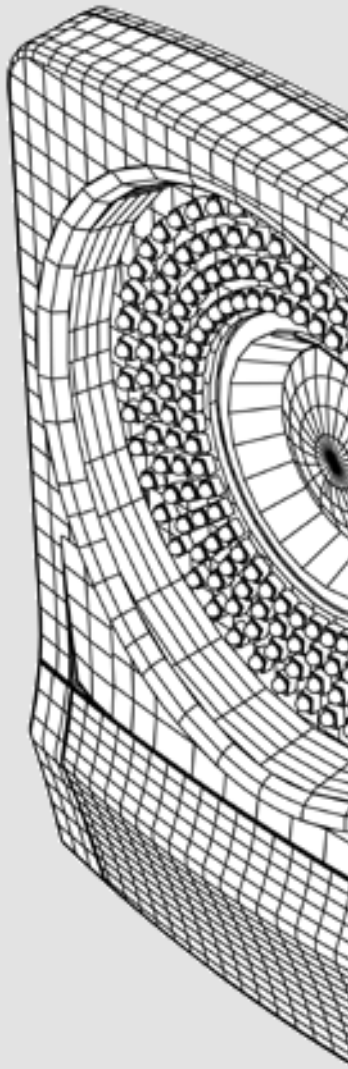


Table 20: T20 camera specifications

Component	Specification
On-camera masking	Yes[e]
In-camera dynamic large blob eliminator	Yes[f]
Software masking	Yes
Auto masking	Yes
On-camera thresholding	Yes
Threshold grid size (tiles)	200 x 80
Threshold grid tile dimensions (pixels)	8 x 16
2D tracking	Yes[g]
Camera output modes	5[h]
Full frame preview output	Yes[i]
Back focus mode	Yes, using Preview mode
Strobe/Ringlight	
Types available	780 nm (Near Infrared (NIR)) 617 nm (Visible Red (VR))[j]
Number of LEDs	252 (NIR) 320 (VR)
Cover types available	Not required
Strobe electronics	Integrated software reprogrammable and controlled
Adjustable Illumination	Yes
Adjustable levels	1,000 (software controlled)
View angle	56° (NIR) 60° (VR)
Physical	
Camera housing	Complex mold custom die-cast aluminum
Camera body dimensions	207 mm (H) x 130 mm (W) x 75 mm (D)
Weight (including strobe, excluding lens)	1.8 kg
Number of mount points	1

Table 20: T20 camera specifications

Component	Specification
Camera Architecture	
Software and firmware upgradable	Yes
Upgrade methods	Through the Vicon application software. Firmware files can be placed on the MX Host PC using any standard transmission method (e.g. FTP, e-mail, CD, USB stick). The files are then uploaded from the MX Host PC to the other MX system hardware through the Reprogram Firmware function in the software.
Cabling	Cat5e (Gigabit Ethernet with power and sync over Ethernet)
Connectors	A single connection between camera and MX Giganet. Single connector to strobe. Two serial ports in a single auxiliary connector.
Power supply	All power to the cameras from the power supply within the MX Giganet (7450 Watts maximum per MX Giganet)
Maximum number of cameras supported with each hub/net	Up to 10 cameras per MX Giganet
Lens type supported	C-Mount
Zoom lens supported	No
C-Mount lenses available	Yes
Digital SLR lenses available	None
Motorized optics	No
Plug and play compatibility	Yes
Mixed camera system compatibility	Interoperable with MX-F40, MX-F20, MX-40+, MX-20+, MX-13+, MX-3+, MX-40, MX-13, MX-3
System connectivity/ communication	Gigabit Ethernet
Maximum number of cameras in system	Unlimited
Custom control interface	Yes
Communication status indicators	Yes



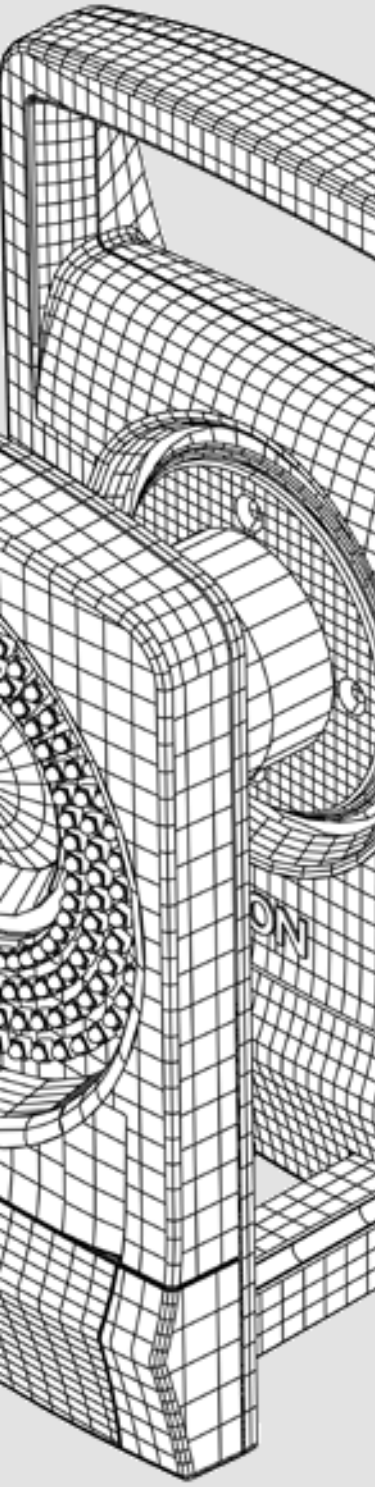


Table 20: T20 camera specifications

Component	Specification
Integrated camera display panel	Optional
Camera number indicator	Optional
Camera status indicators	On camera and in software
IP addressable	Yes
IP reconfigurable	Yes
Cooling	Advanced thermal design
Environmental Regulations	
RoHS compliant	Yes

Table Notes

a. **Increased Frame Rates:** You can specify higher frame rates than those shown in the appropriate table for your camera type. However, at higher frequencies, the MX Cameras automatically reduce the image size (vertical windowing).
You can specify the capture frame rate of each MX Camera in the Vicon application software. MX Cameras are capable of capturing up to a maximum of 2,000 fps, but the actual frame rate you can specify depends on the Vicon application software you are using. For details, see your Vicon software documentation.

b. **Shuttering:** The image quality from a shuttered camera is constant across all frame rates. For an unshuttered camera, which is more susceptible to background light levels, narrow bandwidth interference filters are used to provide a signal to noise ratio performance comparable to the shuttered cameras. Factors such as strobe illumination, field of view, and depth of field also affect the image quality.

c. **Full marker grayscale:** Marker centers are calculated based on every pixel of grayscale available for the marker, not just the detected marker edges. An on-camera circularity test ensures merged or partially occluded markers which need high-level processing are sent in full grayscale to the MX Host PC.

d. **On-boarding processing:** a) Scalable multiprocessor extracts grayscale markers from sensor image. Although one physical device, it provides parallel processing of the data stream. b) Digital Signal Processor (DSP) locates markers in 2D and calculates centers and radii. c) High performance and highly configurable soft-processor streams grayscale and marker center data over Ethernet to MX Host PC. Also handles housekeeping and configuration tasks.

e. **On-camera masking:** This removes areas of the sensor where undesirable static light sources are recorded, for example strobes from other cameras.

f. **Blob elimination:** Camera firmware automatically removes undesirable image data including both large blobs (e.g. sunlight reflections) and/or an unusually large number of blobs.

g. **2D tracking:** The 2D tracking algorithms allow for the markers' movement to be tracked from frame to frame on the camera. This allows even fast motion of close markers to be easily processed.

h. **Output modes:** Automatic (centers for circular markers, grayscale for overlapping/partially occluded markers), Centers Only, Grayscale Only, Centers/Grayscale, and Preview (the entire sensor image).

i. **Preview mode:** Significantly faster than previous generations of Vicon cameras and taking full advantage of the Gigabit Ethernet connection to the MX Host PC.
j. **Strobe types:** Near Infrared (780 nm) and Visible Red (623 nm) surface mount LED strobes. No requirement for secondary optics or strobe covers. This new generation of strobe is twice as bright as previous generations making set up in awkward environments easier

T10 Camera Specifications

Table 21 provides technical specifications and performance indicators for the T10 camera. Superscripted numbers indicate additional information provided in the Table Notes on page 151.

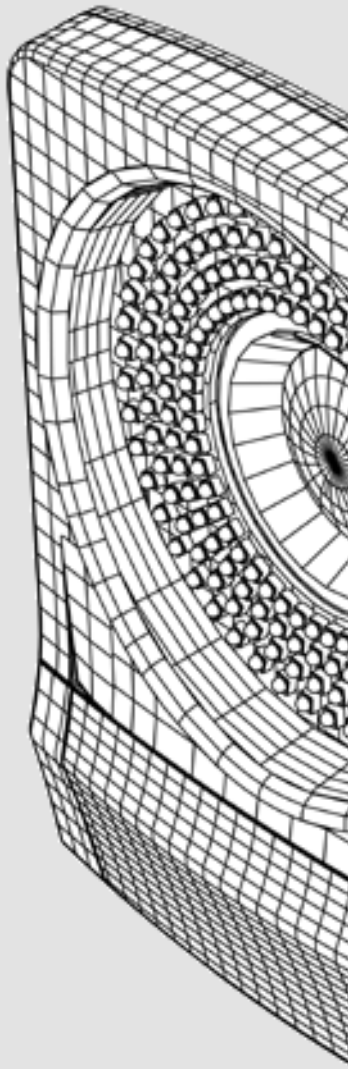


Table 21: T10 camera specification

Component	Specification
Performance	
Maximum frame rate (fps) at full resolution	250[a]
Maximum frame rate (fps) at partial scan	2,000[a]
Frame rates (fps)	30-2,000
Sensor	
Sensor type	CMOS
Sensor	Proprietary Vicon VEGAS-1
Sensor resolution (pixels)	1120 H x 896 V
Pixel size	7 microns x 7 microns
Number of pixels	1,003,520
Physical sensor size (mm)	7.85 mm (H) x 6.27 mm (V), 10.04 mm (Diagonal)
Optical format	Proprietary Vicon 2/3 inch
Shutter type	Electronic freeze frame shutter[b]
Aspect ratio	5:4
On Camera Processing	
256 shades and grayscale processing	Yes[c]
Grayscale depth	10 bit
Sub pixel resolution	287,000 x 229,000 (1/256 pixel resolution)
On-board processors	3 processors[d]
On-camera masking	Yes[e]

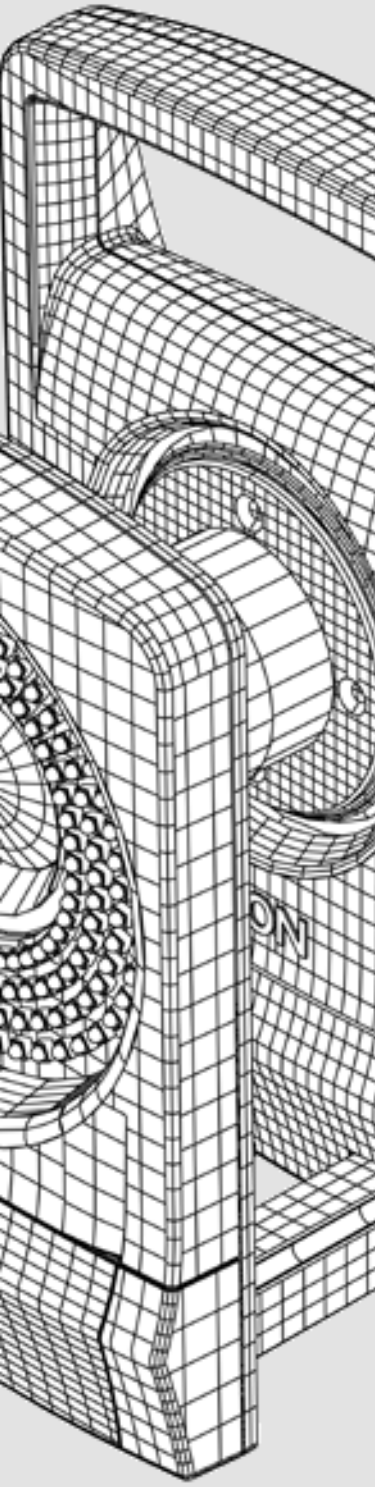
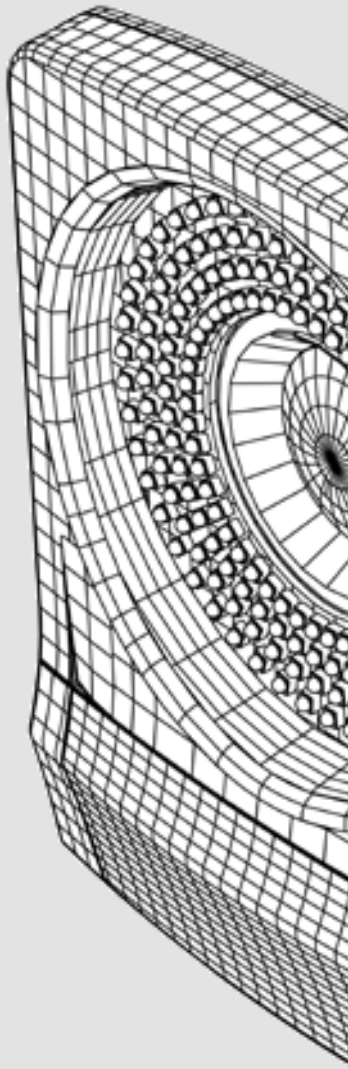


Table 21: T10 camera specification

Component	Specification
In-camera dynamic large blob eliminator	Yes[f]
Software masking	Yes
Auto masking	Yes
On-camera thresholding	Yes
Threshold grid size (tiles)	200 x 80
Threshold grid tile dimensions (pixels)	8 x 16
2D tracking	Yes[g]
Camera output modes	5[h]
Full frame preview output	Yes[i]
Back focus mode	Yes, using Preview mode
Strobe/Ringlight	
Types available	780 nm (Near Infrared (NIR)) 623 nm (Visible Red (VR))[j]
Number of LEDs	252 (NIR) 320 (VIR)
Cover types available	Not required
Strobe electronics	Integrated software reprogrammable and controlled
Adjustable Illumination	Yes
Adjustable levels	1,000 (software controlled)
View angle	56° (NIR) 60° (VR)
Physical	
Camera housing	Complex mold custom die-cast aluminum
Camera body dimensions	207 mm (H) x 130 mm (W) x 75 mm (D)
Weight (including strobe, excluding lens)	1.8 kg
Number of mount points	1
Camera Architecture	
Software and firmware upgradable	Yes

Table 21: T10 camera specification

Component	Specification
Upgrade methods	Through the Vicon application software. Firmware files can be placed on the MX Host PC using any standard transmission method (e.g. FTP, e-mail, CD, USB stick). The files are then uploaded from the MX Host PC to the other MX system hardware through the Reprogram Firmware function in the software.
Cabling	Cat5e (Gigabit Ethernet with power and sync over Ethernet)
Connectors	A single connection between camera and MX Giganet. Single connector to strobe. Two serial ports in a single auxiliary connector.
Power supply	All power to the cameras from the power supply within the MX Giganet (450 Watts maximum per MX Giganet)
Maximum number of cameras supported with each hub/net	Up to 10 cameras per MX Giganet
Lens type supported	C-Mount
Zoom lens supported	Yes
C-Mount lenses available	Yes
Digital SLR lenses available	None
Motorized optics	No
Plug and play compatibility	Yes
Mixed camera system compatibility	Interoperable with MX-F40, MX-F20, MX-40+, MX-20+, MX-13+, MX-3+, MX-40, MX-13, MX-3
System connectivity/communication	Gigabit Ethernet
Maximum number of cameras in system	Unlimited
Custom control interface	Yes
Communication status indicators	Yes
Integrated camera display panel	Optional
Camera number indicator	Optional



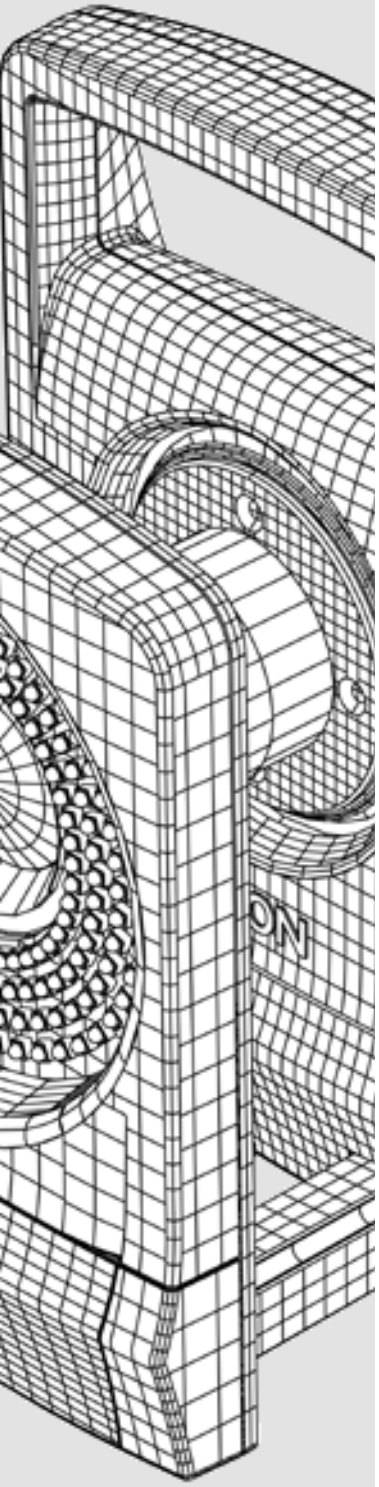


Table 21: T10 camera specification

Component	Specification
Camera status indicators	On camera and in software
IP addressable	Yes
IP reconfigurable	Yes
Cooling	Advanced thermal design
Environmental Regulations	
RoHS compliant	Yes

Table Notes

a. **Increased Frame Rates:** You can specify higher frame rates than those shown in the appropriate table for your camera type. However, at higher frequencies, the MX Cameras automatically reduce the image size (vertical windowing).
You can specify the capture frame rate of each MX Camera in the Vicon application software. MX Cameras are capable of capturing up to a maximum of 2,000 fps, but the actual frame rate you can specify depends on the Vicon application software you are using. For details, see your Vicon software documentation.

b. **Shuttering:** The image quality from a shuttered camera is constant across all frame rates. For an unshuttered camera, which is more susceptible to background light levels, narrow bandwidth interference filters are used to provide a signal to noise ratio performance comparable to the shuttered cameras. Factors such as strobe illumination, field of view, and depth of field also affect the image quality.

c. **Full marker grayscale:** Marker centers are calculated based on every pixel of grayscale available for the marker, not just the detected marker edges. An on-camera circularity test ensures merged or partially occluded markers which need high-level processing are sent in full grayscale to the MX Host PC.

d. **On-boarding processing:** a) Scalable multiprocessor extracts grayscale markers from sensor image. Although one physical device, it provides parallel processing of the data stream. b) Digital Signal Processor (DSP) locates markers in 2D and calculates centers and radii.
c) High performance and highly configurable soft-processor streams grayscale and marker center data over Ethernet to MX Host PC. Also handles housekeeping and configuration tasks.

e. **On-camera masking:** This removes areas of the sensor where undesirable static light sources are recorded, for example strobes from other cameras.

f. **Blob elimination:** Camera firmware automatically removes undesirable image data including both large blobs (e.g. sunlight reflections) and/or an unusually large number of blobs.

g. **2D tracking:** The 2D tracking algorithms allow for the markers' movement to be tracked from frame to frame on the camera. This allows even fast motion of close markers to be easily processed.

h. **Output modes:** Automatic (centers for circular markers, grayscale for overlapping/partially occluded markers), Centers Only, Grayscale Only, Centers/Grayscale, and Preview (the entire sensor image).

i. **Preview mode:** Significantly faster than previous generations of Vicon cameras and taking full advantage of the Gigabit Ethernet connection to the MX Host PC.

j. **Strobe types:** Near Infrared (780 nm) and Visible Red (623 nm) surface mount LED strobes. No requirement for secondary optics or strobe covers. This new generation of strobe is twice as bright as previous generations making set up in awkward environments easier

MX T-Series Cameras Lens Specifications

The following sections provide technical specifications for the different types of lenses available for Vicon MX T-Series cameras. For details of specific lenses, contact Vicon Motion Systems or your nearest agent or distributor.

T-Series cameras are fitted with lenses suitable according to the system use you specified on ordering. If you wish to change the supplied lens, you must consider various factors, including the Field of View (FOV), the aperture, and possibly any lens filter fitted. A significant factor in the field of view is the image circle that the camera lens casts onto the sensor. For optimum performance, the image circle projected should be larger than the sensor area used by the camera.

Table 22 shows the approximate diameter of the circular image projected onto the sensor by the C-Mount lens formats (4/3", 1", 2/3", and 1/2") and the Canon APS-C and digital SLR lens formats appropriate for use with Vicon MX T-Series cameras.

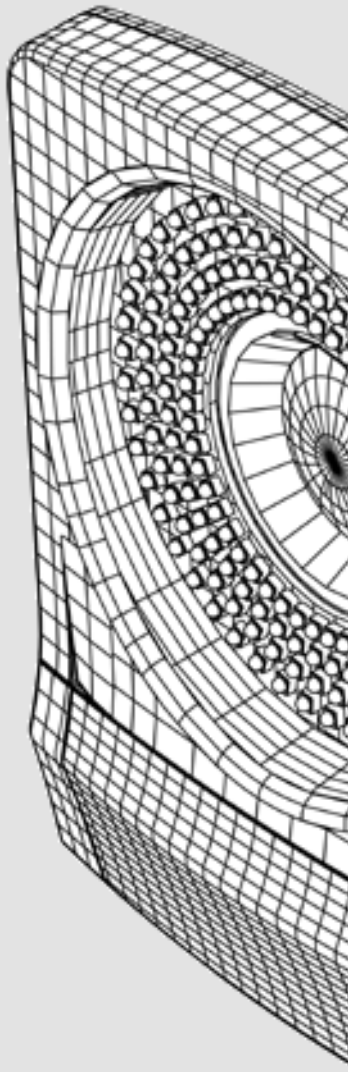
Table 22: Image circle diameter produced by sensor formats

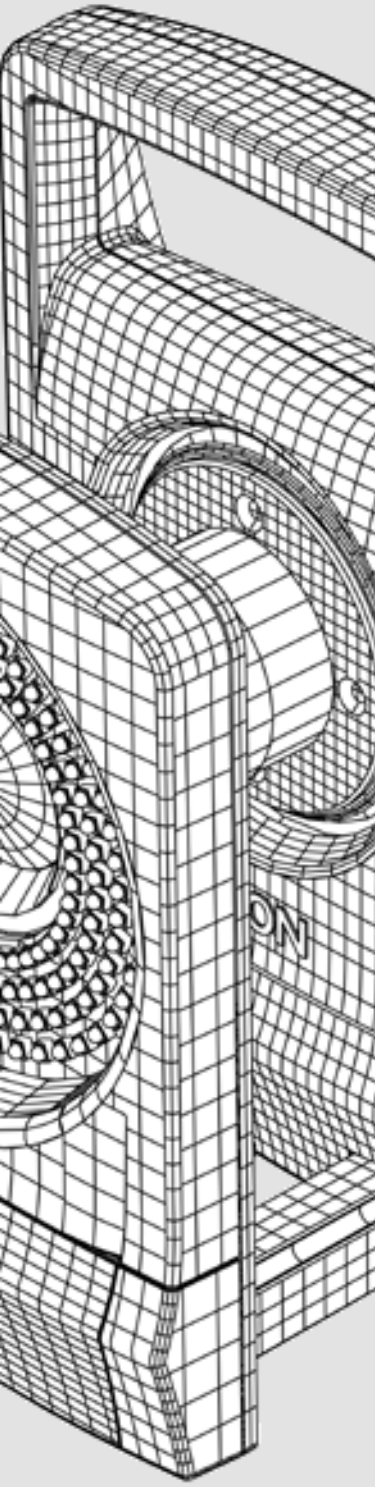
Sensor Format	Width (mm)	Height (mm)	Diagonal (mm)	Area (mm^2)
35 mm film	36.0	24.0	43.3	864.0
Canon APS-C	22.2	14.8	26.7	329.0
4/3" C-Mount	17.3	13.0	21.6	225.0
1" C-Mount	12.8	9.6	16.0	123.0
2/3" C-Mount	8.8	6.6	11.0	58.1
1/2" C-Mount	6.4	4.8	8.0	30.7

Table 23 lists the necessary image circle diameter for each T-Series camera at maximum resolution.

Table 23: Image circle diameter required by MX T-Series Cameras

T-Series Camera	Horizontal Dimension (mm)	Vertical Dimension (mm)	Required Image Circle Diameter (mm)
T160	18.35	13.48	22.77
T40	16.46	12.10	20.43
T20	11.20	8.96	14.34
T10	7.84	6.28	10.05





By comparing the image circle details in these two tables, you can use the information in the following sections to select a lens capable of producing the image circle diameter required for the specified type of MX T-Series camera. For example, you could use a 1" C-Mount on a T40 but the image circle projected would not be large enough to fully use the sensor (vignetting).

For the larger format T160 or T40 cameras, the Vicon lens or digital SLR format lenses are more suitable than C-Mount lenses. SLR lenses project a larger image circle than C-Mount lenses. As you can see from the tables above, lenses designed for these formats project an image circle large enough for the T160 and T40 cameras.

In some applications, a large field of view may be the overriding requirement. In such cases, it may be appropriate to use a wide angle C-Mount lens on a larger format T40 camera. However, be aware that such lenses project an image circle too small for the sensor. Therefore, you must determine whether the benefits of the wide angle lens outweigh the inability to use the full sensor area.

Table 24 shows the recommended lenses for the T-Series cameras. Vicon continually develops support for lenses, so additional lenses may become available after the publication of this document. For details on updates, check the Vicon Online Support site (for details, see Vicon Online Support on page 198).

Table 24: **Recommended lenses for MX T-Series cameras**

		T- Series Camera			
Lens Format	**Image Format Size**	**T160**	**T40**	**T20**	**T10**
18-50 mm Digital SLR	APS-C	•	•		
18 mm Vicon	~4/3"	•	•	•	
16 mm C-Mount	1"		•	•	
12.5 mm C-Mount	1"			•	•
9 mm C-Mount	2/3"				•
8.5 mm C-Mount	2/3"				•

Camera Lens Specifications

The tables in this section provide technical specifications for the physical characteristics of the lenses available for T160, T40, T20, and T10 cameras.:

- 18-50 mm Digital SLR Lens Specification on page 158
- 18 mm Vicon Lens Specification on page 158
- 12.5 mm C-Mount Lens Specification on page 159
- 9 mm C-Mount Lens Specification on page 160
- 8.5 mm C-Mount Lens Specification on page 160

For a summary of the lenses recommended for a particular T-Series camera, see Table 24 on page 157. For Angle of View details for these lenses, see Angle of View Information for T-Series Cameras on page 161.

18-50 mm Digital SLR Lens Specification

This lens is suitable for use with the T160 and T40.

Table 25: 18-50 mm digital SLR lens specifications

Component	Specification
Focal Length	18-50 mm
Format	Digital SLR Canon EF
Aperture range	2.8-22
Dimensions	80 mm (diameter) x 100 mm (length)
Weight	0.28 Kg

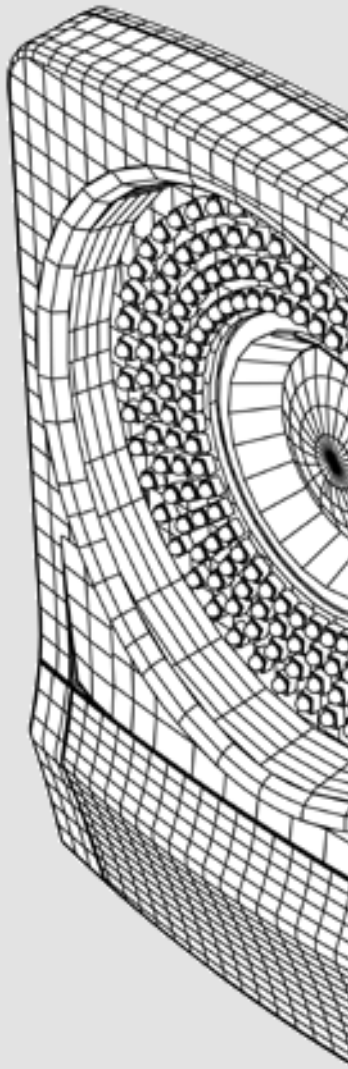
Caution
For best results, set the aperture of this lens to an f-stop value of f2 or larger. If maximizing light in a large capture volume is an overriding priority, it may be appropriate to set this lens to an aperture of f1.4, but be aware that marker distortion may result.

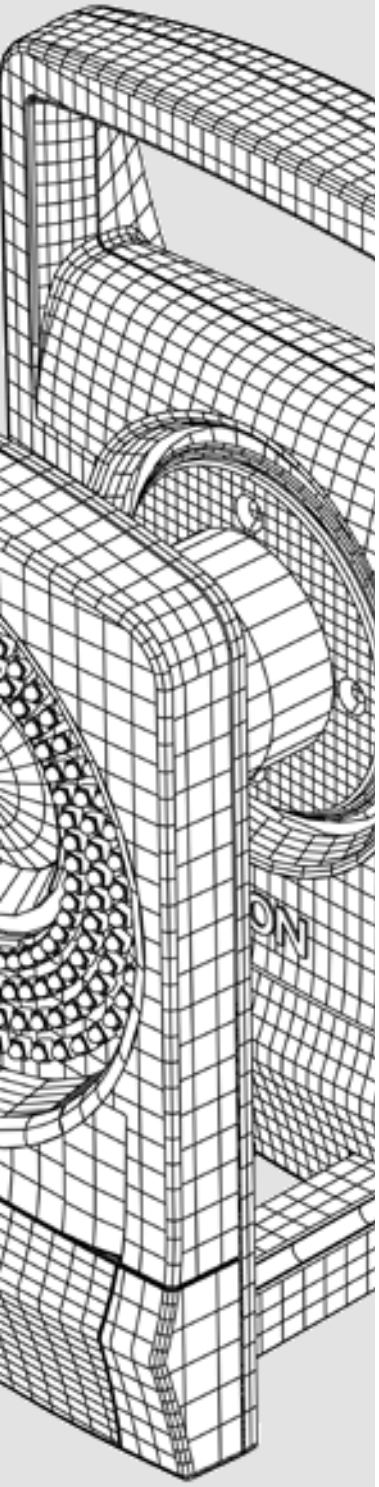
18 mm Vicon Lens Specification

This lens is recommended for use with the T160, T40, and T20.

Table 26: 18 mm Vicon lens specifications

Component	Specification
Focal Length	18 mm
Format	Proprietary Vicon ~4/3"
Aperture (f-stop) range	2-16
Dimensions	51 mm (diameter) x 75 mm (length)
Weight	0.28 Kg





16 mm C-Mount Lens Specification

This lens is recommended for use with the T160, T40, and T20.

Table 27: 16 mm Vicon lens specifications

Component	Specification
Focal Length	16 mm
Format	1"
Aperture (f-stop) range	1.4-22
Dimensions	51 mm (diameter) x 75 mm (length)
Weight	0.28 Kg

Caution
For best results, set the aperture of this lens to an f-stop value of f2 or larger. If maximizing light in a large capture volume is an overriding priority, it may be appropriate to set this lens to an aperture of f1.4, but be aware that marker distortion may result.

12.5 mm C-Mount Lens Specification

This lens is recommended for use with the T20 and T10. It causes significant vignetting on the T160 and T40.

Table 28: 12.5 mm C-Mount lens specifications

Component	Specification
Focal Length	12.5 mm
Format	1"
Aperture (f-stop) range	1.4-Closed
Dimensions	42 mm (diameter) x 58 mm (length)
Weight	0.135 Kg

9 mm C-Mount Lens Specification

This lens is recommended for use with the T10. It causes significant vignetting on the T160, T40, and T20.

Table 29: 9 mm C-Mount lens specifications

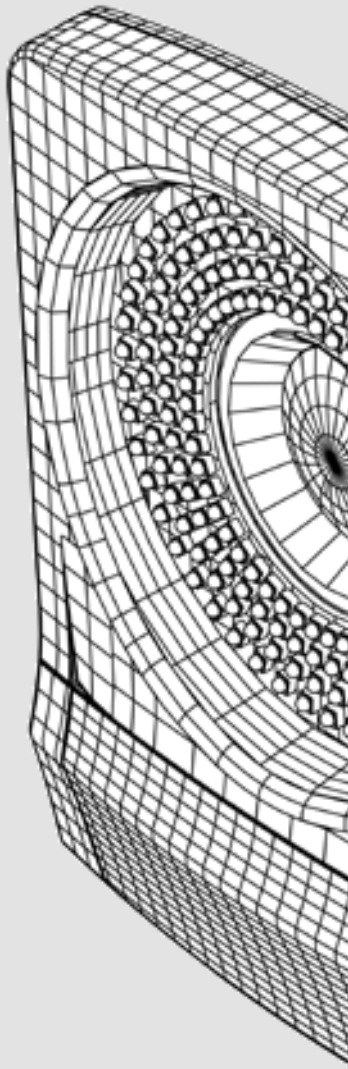
Component	Specification
Focal Length	9 mm
Format	2/3"
Aperture (f-stop) range	1.4-16
Dimensions	17.7 mm (diameter) x 35 mm (length)
Weight	0.055 Kg

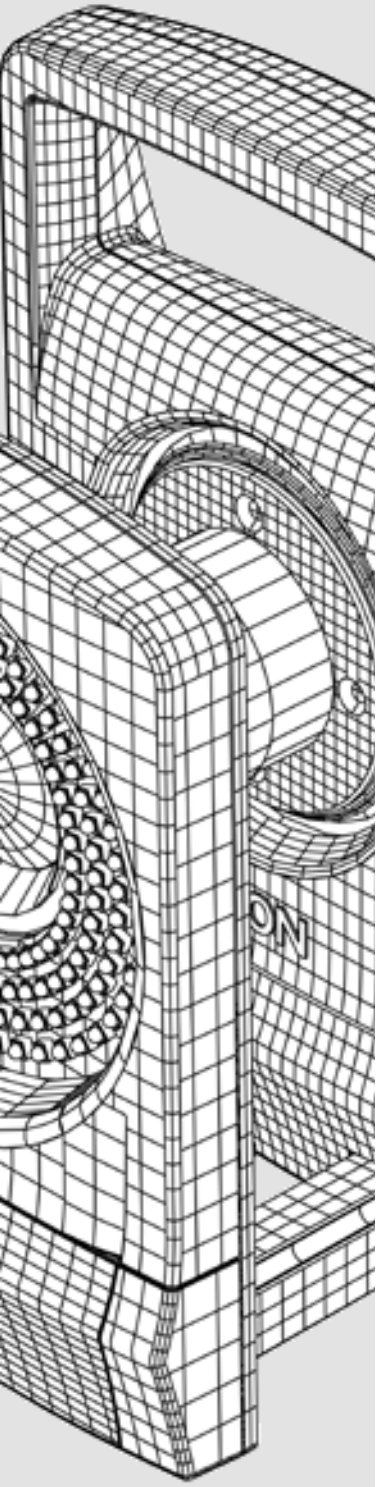
8.5 mm C-Mount Lens Specification

This lens is recommended for use with the T10. It causes significant vignetting on the T160, T40, and T20.

Table 30: 8.5 mm C-Mount lens specifications

Component	Specification
Focal Length	8.5 mm
Format	2/3"
Aperture (f-stop) range	1.4-16
Dimensions	17.7 mm (diameter) x 35 mm (length)
Weight	0.055 Kg





Angle of View Information for T-Series Cameras

The following table gives information on the Angle of View (AOV)—specified as horizontal width (H) x vertical height (V)—at full resolution for the T160, T40, T20,and T10 cameras. For details on Angle of View and Field of View (FOV), see Camera Lens Characteristics on page 22.

Table 31: AOV information

	Camera AOV (H FOV° x V FOV°)			
Lens Type	**T160**	**T40**	**T20**	**T10**
18-50 mm Digital SLR	54.02 x 41.06 to 20.80 x 15.35	49.15 x 37.14 to 18.70 x 13.79	—	—
18 mm Vicon	54.02 x 41.06	49.15 x 37.14	34.56 x 27.95	—
16 mm C-Mount	—	54.45 x 41.41	38.58 x 31.28	
12.5 mm C-Mount	—	—	48.26 x 39.44	34.82 x 28.17
9 mm C-Mount	—	—	—	47.07 x 38.42
8.5 mm C-Mount	—	—	—	49.52 x 40.50

Important
The Angle of View examples are specific to the referenced camera type. As you can see from the table, the angle of view will change if the lens is attached to a different camera type.

MX T-Series Cameras Strobe Unit Specifications

The following sections provide technical specifications for the Near Infrared, and Visible Red strobe units available for the Vicon MX T-Series cameras (T160, T40, T20, and T10):

- Camera Strobe Durations on page 162
- Near Infrared Strobe Specifications on page 162
- Visible Red Strobe Unit Specifications on page 162

All T-Series strobe units use surface-mount LEDs, have a built-in temperature monitor, and require no secondary optics or strobe covers. The new T-Series strobe units are twice as bright as previous MX strobes, making set up in awkward environments easier.

Camera Strobe Durations

Table 32: Camera strobe durations

Duration	Specification
1 ms	at 120 Hz progressive
0.5 ms	at 240 Hz progressive
0.25 ms	at 480 Hz progressive
0.125 ms	at 960 Hz progressive

Near Infrared Strobe Specifications

Near Infrared (NIR) strobes are not as powerful as Visible Red (VR) strobes. They are generally recommended for applications requiring short-range capture in smaller capture volumes as they disturb the motion capture subject less.

Table 33: Near Infrared strobe unit specifications

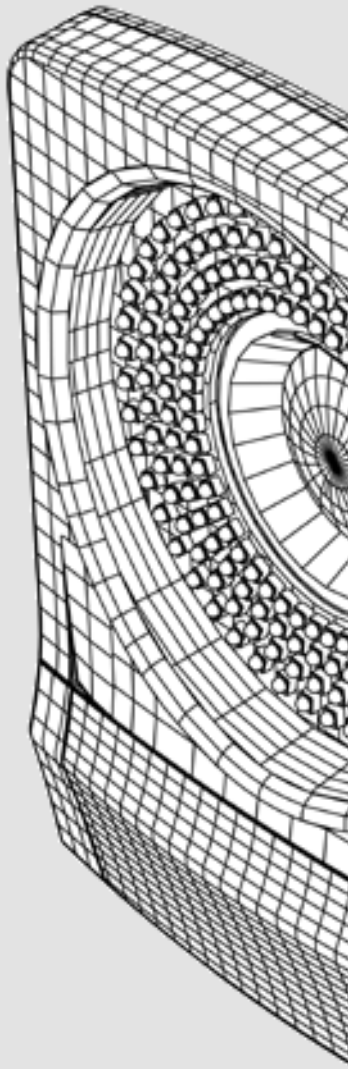
Component	Specification
Strobe active source (AlGaAs LEDs)	252
Wavelength	780 nm
Diode viewing angle (to half luminous intensity)	56°
Time averaged radiance (in Wm-2sr-1 per array)	40
Maximum lens diameter	56 mm
Power consumption (per camera)	18 W
RoHS compliant	Yes

Visible Red Strobe Unit Specifications

Visible Red (VR) strobes are more powerful than Near Infrared (NIR) strobes. They are generally recommended for applications requiring long-range capture with small markers in a larger capture volume.

Table 34: Visible Red strobe unit specifications

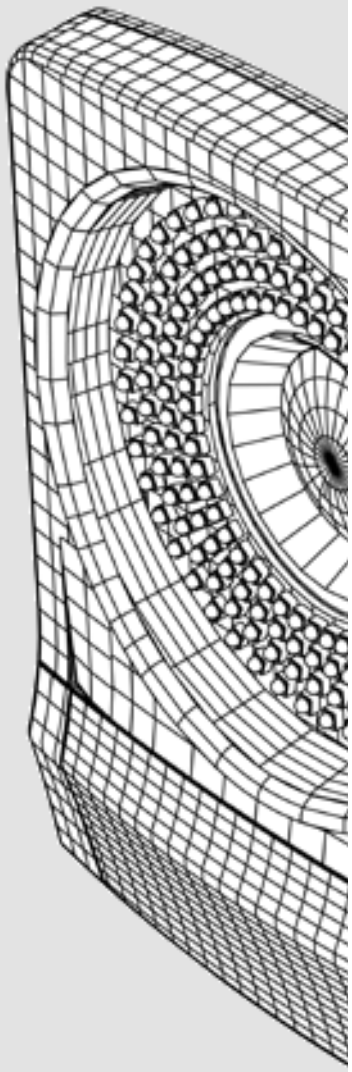
Component	Specification
Strobe active source (AlInGaP II LEDs)	320
Wavelength (Red-Orange)	623 nm
Diode viewing angle (to half luminous intensity)	60°
Time averaged radiance (in Wm-2sr-1 per array)	30
Maximum lens diameter	56 mm
Power consumption (per camera)	13 W
RoHS compliant	Yes



19 MX Giganet Technical Specifications

This chapter provides technical specifications for the MX Giganet.

In This Chapter

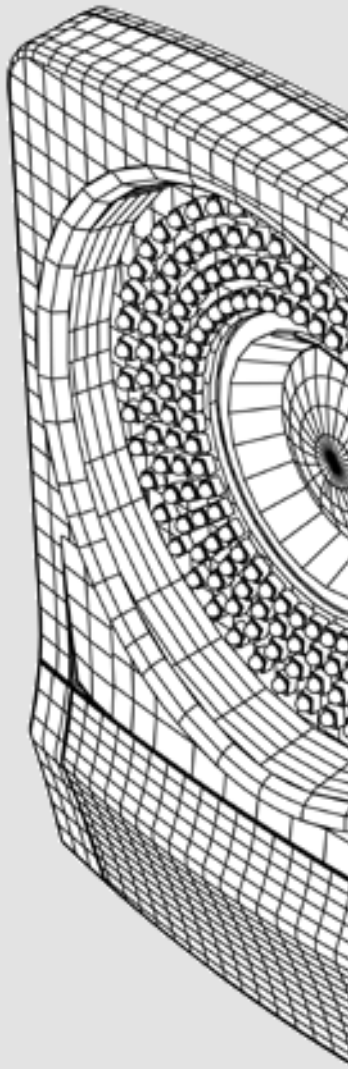


MX Giganet Specifications

Table 35 provides technical specifications for the MX Giganet.

Table 35: MX Giganet specifications

Component	Specification
MX 2U Dimensions	
Height	87.2 mm
Width	443.4 mm 482.4 mm (with Rack Mount Bracket)
Depth	348.2 mm
Weight	3.85 kg
Power Supply Ratings	
Input voltage	90-264 v AC
Input frequency	47-63 Hz (auto selectable)
Maximum input current	at 110 v: 6 Amps, at 230 v: 3 Amps
Input connector	IEC (International Electro-Technical Commission)
Output voltage	+54 v DC and 14 v DC
Cooling fan (x2)	40 mm[a]
Case size	260 mm x 129 mmx 39.7 mm (2 part case)
Fuse	No externally accessed fuses
Power rating (per unit)	20 W (With no cameras connected) 5 W (In standby mode)
Unit Architecture	
Genlock to external video source	Yes
Synchronize to general external signal	Yes
External sync output	Yes
External sync box needed	No
External VGA	Not required; in-built preview available
External A/D sync + clock	Yes[b]



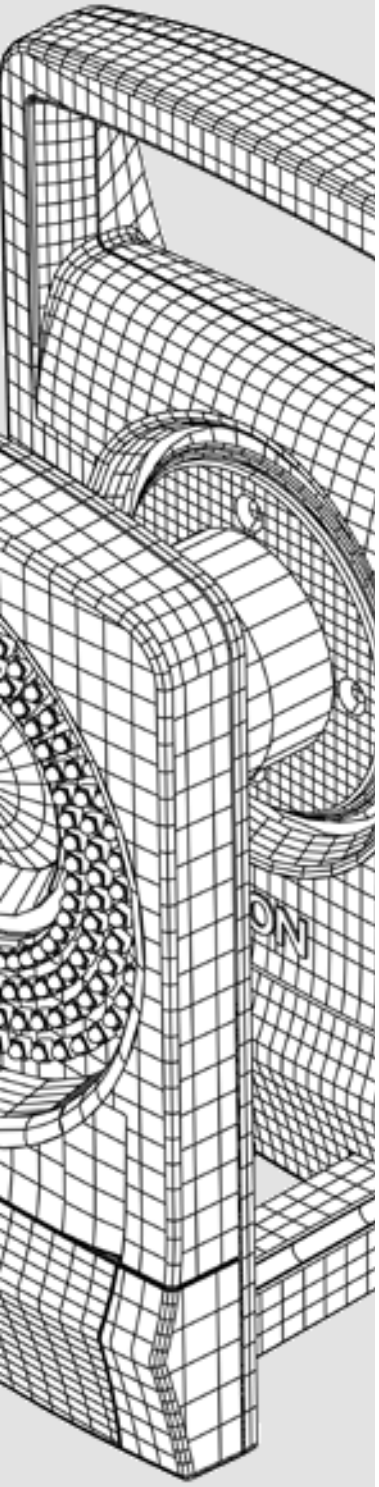
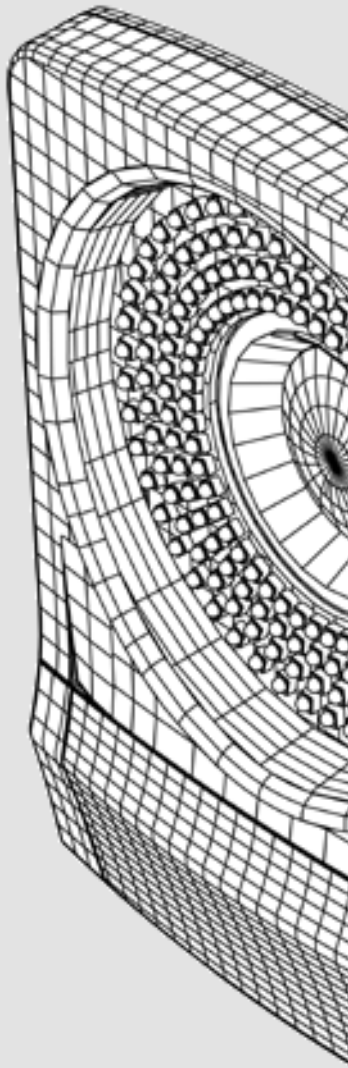


Table 35: MX Giganet specifications

Component	Specification
Environmental Regulations	
RoHS compliant	Yes

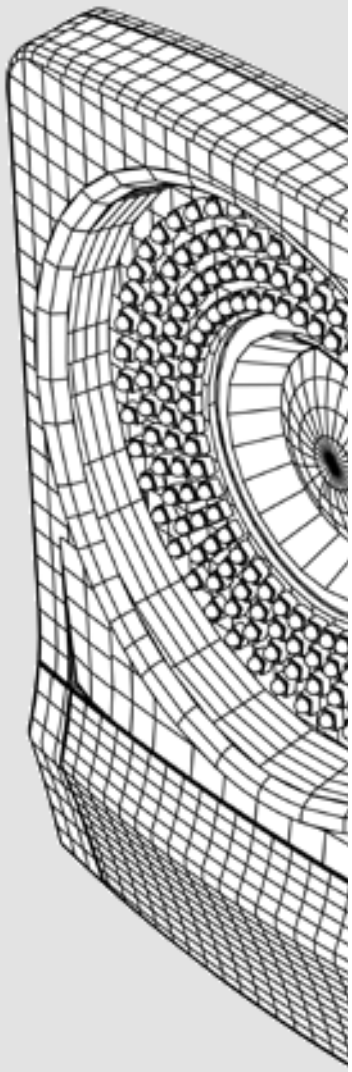
Table Notes

a. **Cooling fans:** Each MX Giganet unit contains two cooling vans. The fans are temperature sensitive, and will automatically adjust to changes in room temperature.
b. **A/D sync:** Internal A/D is synchronized to the cameras, but an external synchronization is programmable for third party equipment.



20 MX T-Series Cables Technical Specifications

This chapter provides technical specifications for the cables used to pass power, Ethernet communication, synchronization signals, video signals, and data between hardware components in a Vicon MX T-Series system.



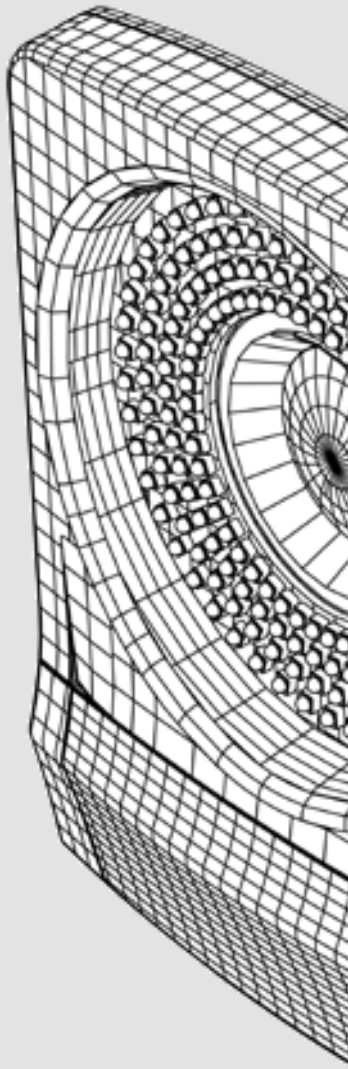
In This Chapter

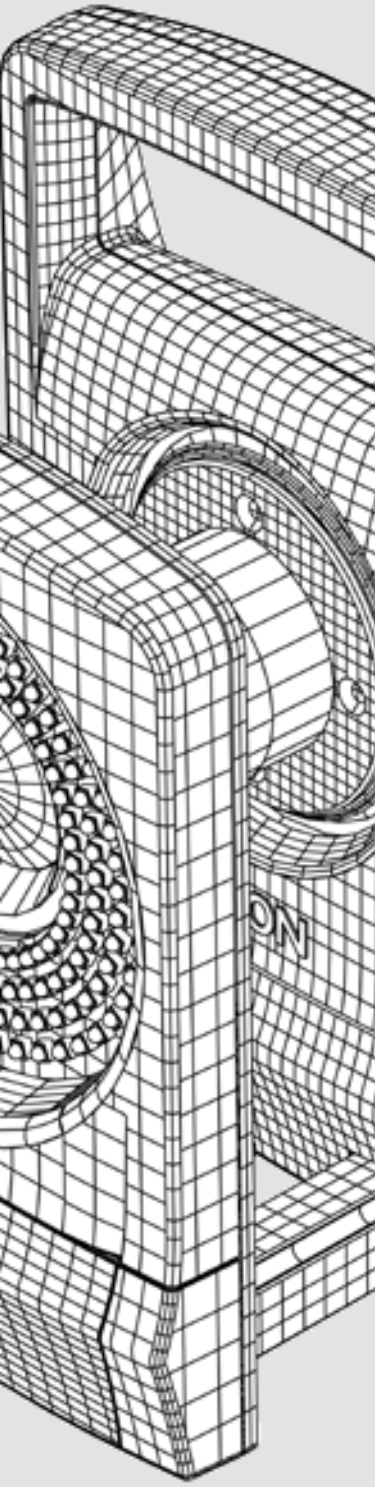
Simple System Architecture Model Cables Specifications

Table 36 describes the MX cables for connecting hardware components in a simple Vicon MX T-Series architecture model. You can use this information to identify the correct cables and connection points to use when setting up your Vicon MX T-Series system. For details on this architecture model, see Simple System Architecture Model (T-Series Hardware Only) on page 6. For details on the functions of these cables, see Vicon MX T-Series System Cable Descriptions on page 42.

Table 36: Cable Connections—Simple System Architecture Model

Cable	Terminator		Connection	
	End 1	End 2	End 1	End 2
MX Gigacable	8-pin Lemo plug	8-pin Lemo plug	MX Giganet (**Vicon Cameras** socket)	MX T-Series camera (**Data** socket)
MX Giganet to MX Giganet Cable	10-pin RJ-45 plug	10-pin RJ-45 plug	Primary MX Giganet (**Links** socket)	Subordinate MX Giganet (**Links** socket) OR Subordinate MX Ultranet HD (**Ultranet Links** socket) OR Subordinate MX Ultranet (**Connect** socket)
MX Host PC Cable	8-pin RJ-45 plug	8-pin RJ-45 plug	MX Giganet (**Gigabit Ethernet Ports** socket)	MX Host PC (**Ethernet** port)





Extended System Architecture Model Cables Specifications

Table 37 describes the MX cables for connecting hardware components in an extended Vicon MX T-Series architecture model. You can use this information to identify the correct cables and connection points to use when setting up your Vicon MX T-Series system to incorporate third-party devices such as reference video cameras, analog capture devices, synchronized output devices, remote triggering devices, and timecode/genlock video devices. For details on this architecture model, see Extended System Architecture Model (Additional T-Series Hardware and Third-Party Devices) on page 7. For details on the functions of these cables, see Vicon MX T-Series System Cable Descriptions on page 42.

Table 37: Cable Connections—Extended System Architecture Model

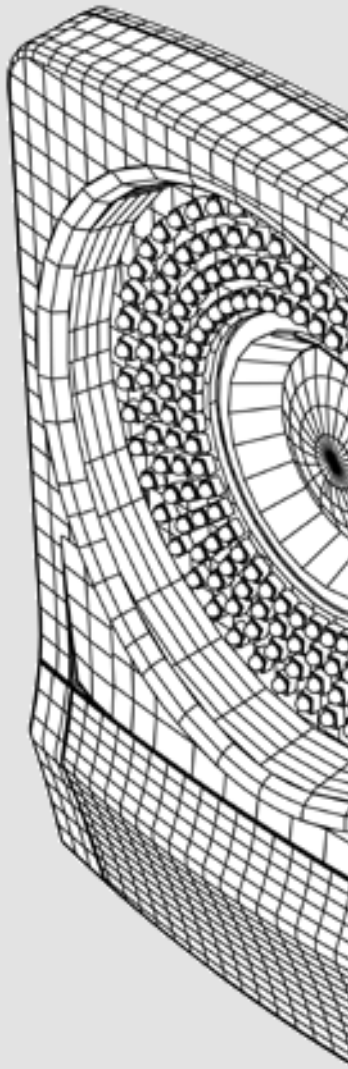
Cable	Terminator		Connection	
	End 1	End 2	End 1	End 2
ADC Patch Panel Cable	100-way plug	100-way plug	MX Giganet (**Option Slot** socket	Vicon patch panel
Basler GigE Camera Cable	3-pin Lemo plug	12-pin Hirose micro plug	MX Giganet (**Powered Sync Output** sockets)	Basler GigE Camera
Third-party analog capture device cable	wires (device dependent)	plug (device dependent)	patch panel screw terminals	third-party device
Third-party genlock device cable	BNC plugs (x2)	XLR socket	MX Giganet (**Ref Loop** sockets)	third-party device
Third-party synchronized output device cable	3-pin Lemo OR RCA phono	device dependent	MX Giganet (**Powered Sync Outputs**) OR MX Giganet (**Sync Outputs**)	third-party device
Third-party timecode device cable	mini-XLR plug	XLR socket	MX Giganet (**LTC In** socket)	third-party device

Integrated System Architecture Model Cables Specifications

Table 38 describes the MX cables for connecting hardware components in an integrated Vicon MX T-Series architecture model. You can use this information to identify the correct cables and connection points to use when setting up your Vicon MX T-Series system to incorporate components from earlier MX systems. For details on this architecture model, see Integrated System Architecture Model (T-Series and earlier MX Hardware) on page 9. For details on the functions of these cables, see Vicon MX T-Series System Cable Descriptions on page 42.

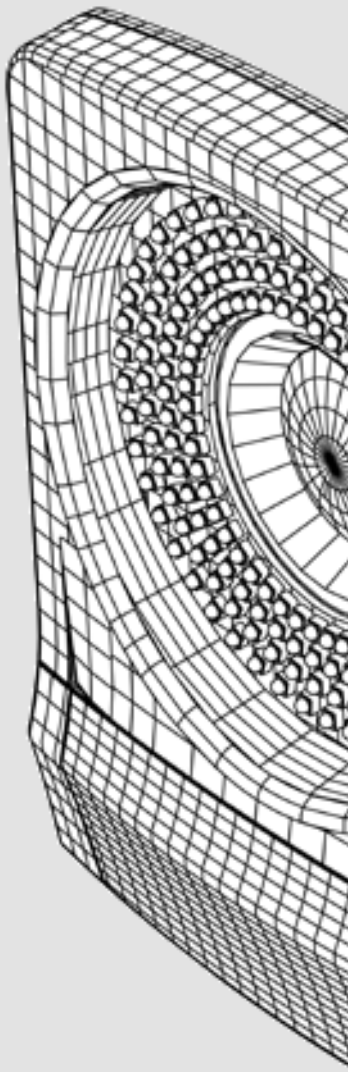
Table 38: Cable Connections—Integrated System Architecture Model

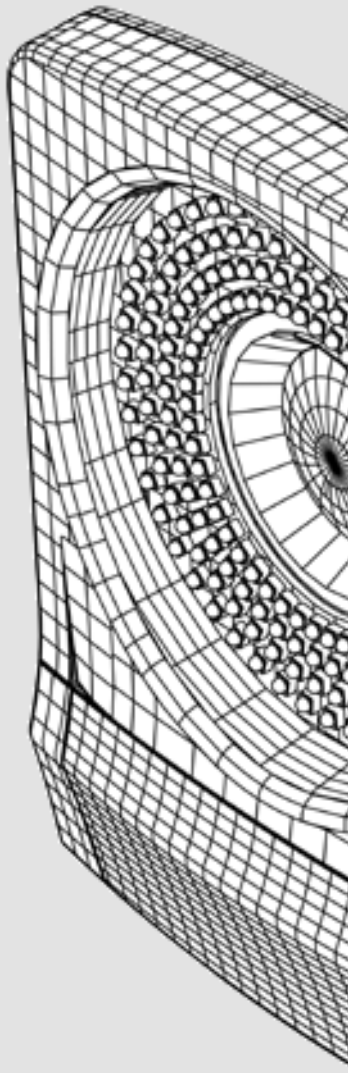
Cable	Terminator		Connection	
	End 1	End 2	End 1	End 2
MX Giganet to MX Net cable	10-pin RJ-45 plug	12-pin Lemo plug	MX Giganet (**Links** sockets)	MX Ultranet HD (**Ultranet Links** socket) OR MX Ultranet (**Links** socket)



IV Regulatory and Guidance Information

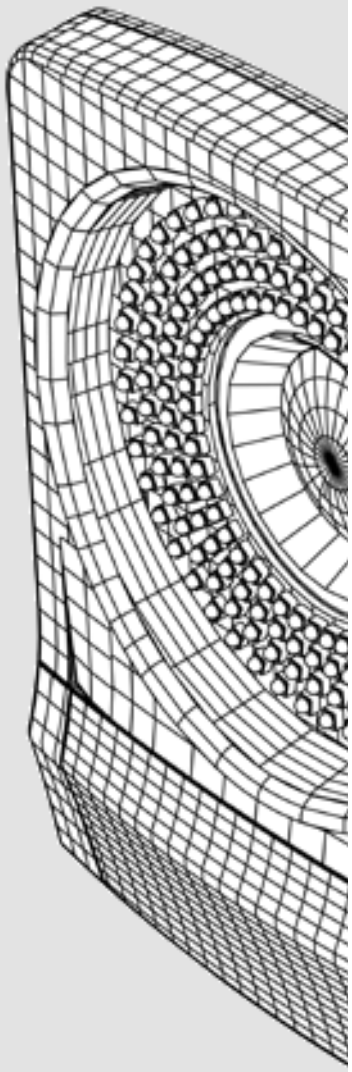
Find out more about the international standards of quality achieved by your Vicon MX T-Series system.





21 Regulatory Compliance

This chapter provides important and required consumer information on how Vicon MX T-Series hardware complies with regulatory standards, including product recycling.



In This Chapter

Radio and Television Interference

This equipment has been designed and tested to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC rules (FCC CFR 47: Part 15: B:2007). These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the user documentation, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case users will be required to correct the interference at their own expense.

Warning
Changes or modifications to the supplied system not expressly approved by the party responsible for FCC compliance could void the user's authority to operate the equipment.

Environmental Regulations

This section lists the directives that apply to Vicon MX T-Series.

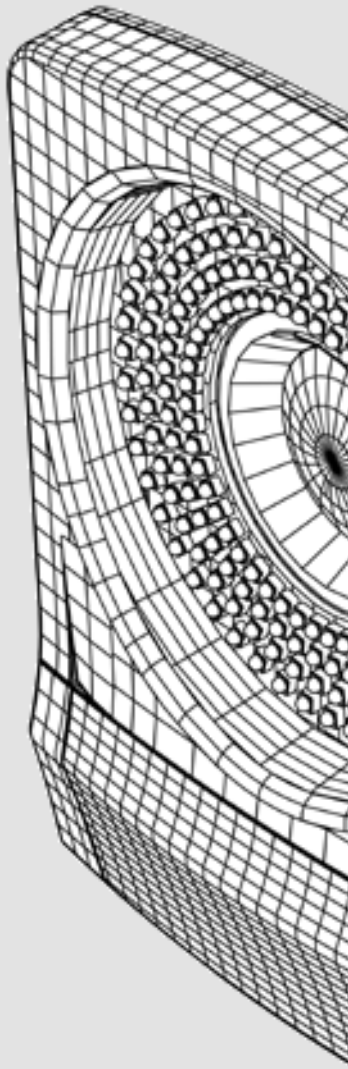
Important
This information applies only to European Union member states.

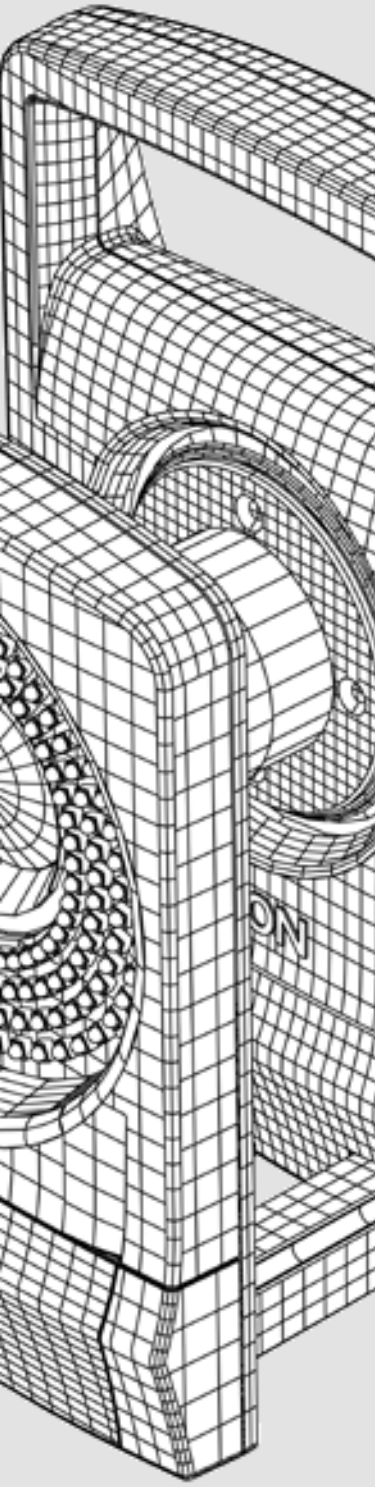
Vicon meets these European Commission directives concerning waste electrical and electronic equipment:

- Directive 2002/95/EC (for details, see Restriction of the Use of certain Hazardous Substances in Electrical and Electronic Equipment (RoHS) on page 175)
- Directive 2202/96/EC (for details, see Waste Electrical and Electronic Equipment (WEEE) on page 175)

You can find out more about these directives in the following Web sites:

- European Commission:
  - http://ec.europa.eu/environment/waste/weee_index.htm
  - http://ec.europa.eu/environment/waste/pdf/faq_weee.pdf
- UK Environment Agency:
  - http://www.environment-agency.gov.uk/business/1745440/444663/1106248/?version=1&lang=_e
  - http://www.netregs.gov.uk/netregs/275207/1631119/?version=1&lang=_e
- UK National Weights & Measure Laboratory (NWML): http://www.rohs.gov.uk





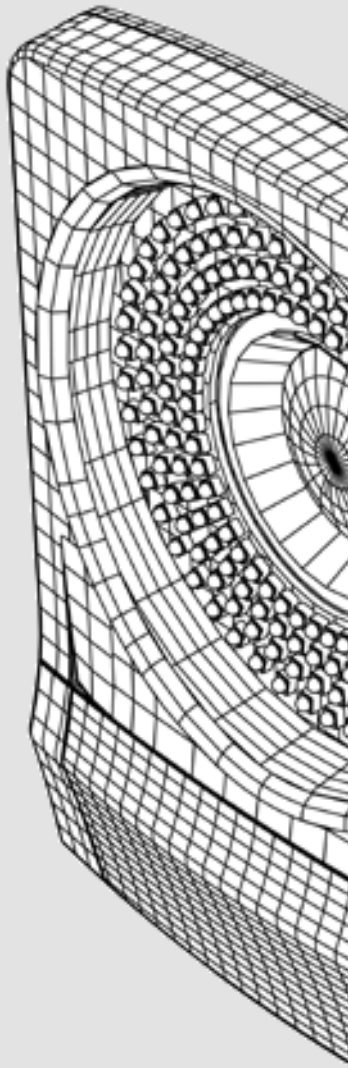
Restriction of the Use of certain Hazardous Substances in Electrical and Electronic Equipment (RoHS)

Vicon MX T-Series hardware is RoHS-compliant. The RoHS Directive provides that new electrical and electronic equipment put on the market for the first time from 1 July 2006 should not contain lead, cadmium, mercury, hexavalent chromium, polybrominated biphenyls (PBB), or polybrominated diphenyl ethers (PBDE).

Waste Electrical and Electronic Equipment (WEEE)

The use of the symbol indicates that this product may not be treated as household waste. By ensuring this product is disposed of correctly, you will help prevent potential negative consequences for the environment and human health, which could otherwise be caused by inappropriate waste handling of this product.

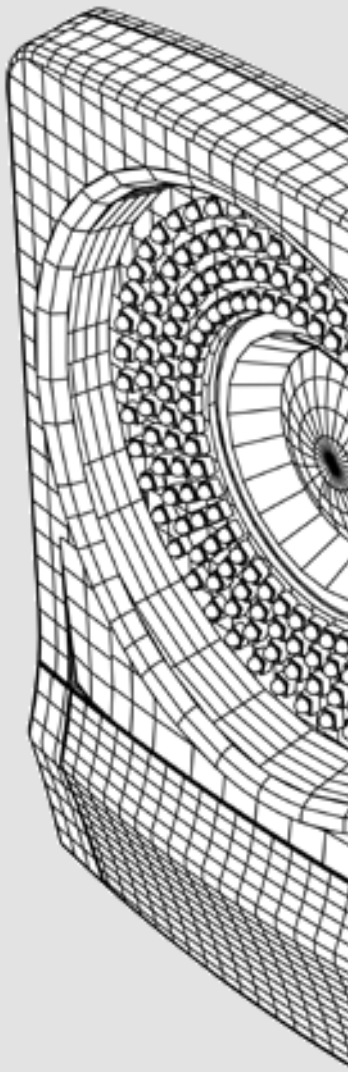
For more detailed information about the recycling of this product, please contact Vicon Motion Systems Limited or your nearest agent.



22 Conformity and Certification

This chapter provides information on the certification Vicon MX T-Series systems have achieved for meeting stated international standards.

In This Chapter



CE Declaration of Conformity

CE 0088

Declaration of Conformity

Medical Devices Directive 93/42/EEC 14th June 1993
Electromagnetic Compatibility as defined by the EMC Directive 89/336/EEC of the 1st of January, 1992

We, Vicon Motion Systems Limited
Unit 14 Minns Estate
Oxford OX2 0JB
United Kingdom

declare that the VICON MX T-Series motion capture system manufactured by VICON MOTION SYSTEMS LIMITED meets ANNEX V and VII Section 5 of Medical Devices 93/42/EEC in that the Quality Management System has been approved by Lloyd's Register Quality Assurance, a notified body of the European Union (Reg No. 0088) for the manufacture and support of the aforementioned CLASS 1 Medical device. Product Configurations and Software Options overleaf details the product configurations and software options that conform to the metrological requirements of the Directive.

VICON MOTION SYSTEMS LIMITED has tested and demonstrated that all products of its own manufacture meet 89/336/EEC:

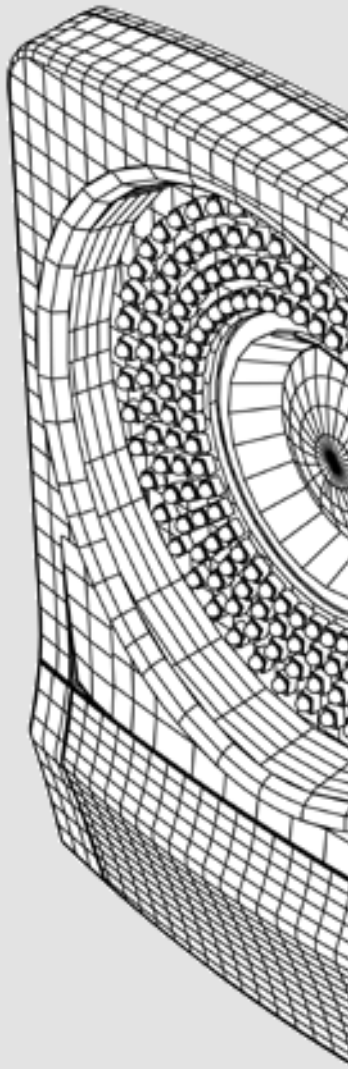
MX T-Series Systems (MX Giganet based)

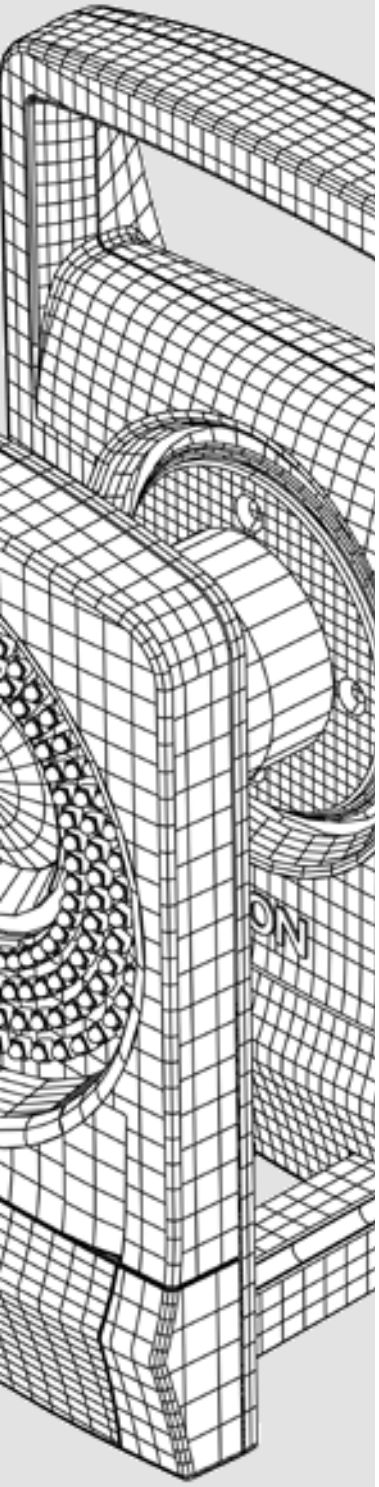
Electromagnetic Compatibility to:
EN60601-1-2:2007

Immunity to paragraph 6.2.3.1 to:
Immunity test level of 3V/m over 80 MHz-2.5 GHz

Not for use in an operating theater, anesthetic gas environment, or oxygen-rich environments. Not for use where there is a risk of compromising the essential performance of medical electrical equipment. Not suitable for use in high magnetic flux, ionizing radiation, sterile, or life- or safety-critical environments.

T.M.L. Shannon, TD, FIE (Aust), CPEng (Biomedical), FRSocMed, FRSA
Director of Regulatory Compliance
1st August 2008





Product Configurations and Software Options

This page provides information relating to the CE Declaration of Conformity on page 178.

Conformity of the Metrological Performance of CLASS 1 Products Manufactured in Accordance with Annex VII, Section 5 of the Medical Devices Directive 93/42/EEC 14th June 1993

We, Vicon Motion Systems Limited
Unit 14 Minns Estate
Oxford OX2 0JB
United Kingdom

declare that the VICON MX T-Series motion capture system manufactured by VICON MOTION SYSTEMS LIMITED has been tested prior to shipment and meets the following metrological performance:

- Resolution of the distance between the centers of two static 14 mm spherical markers located within a volume no less than 4 m x 4 m x 1.5 m to within 1 mm Mean; 1 mm Standard Deviation; sample size no less than 1,000
- Resolution of a given analog voltage to within +/-20 mV RMS within the following configurations and constraints:
  - No fewer than two cameras of any variant fully viewing static markers
  - Independent of lens and strobe variants fitted to each camera
  - Controlled lighting (no greater than 100 lux) and temperature (17-25° C)
  - Single termination for each analog input
  - Testing using the following Vicon application software: Nexus Version 1.4 or later

ISO 13485: 2003 Certificate of Approval

CERTIFICATE OF APPROVAL

This is to certify that the Quality Management System of:

Vicon Motion Systems Ltd t/a Vicon
14 Minns Business Park,
West Way,
Oxford OX2 0JB
United Kingdom

has been approved by Lloyd's Register Quality Assurance
to the following Quality Management System Standards:

ISO 13485: 2003

The Quality Management System is applicable to:

Design, manufacture and support of motion capture systems for life science applications, including development of related software.

This certificate forms part of the approval identified by certificate number LRQ 4003146

Approval
Certificate No: LRQ 4003146/C

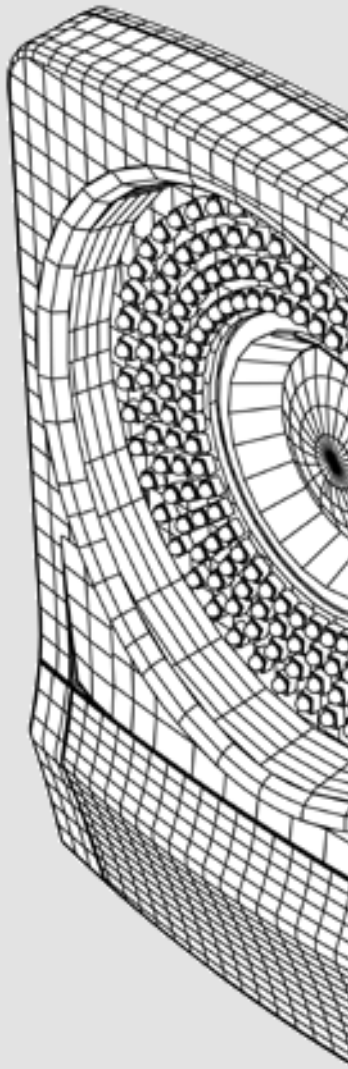
Original Approval: 17 August 2007
Current Certificate: 17 August 2007
Certificate Expiry: 16 August 2009

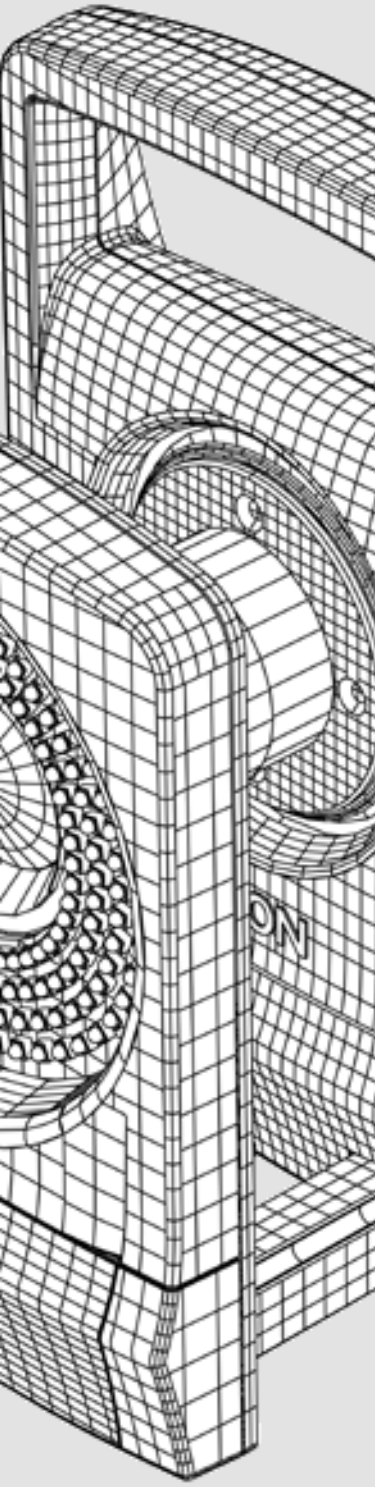
S Jamieson

Issued by: Lloyd's Register Quality Assurance Limited

UKAS QUALITY MANAGEMENT
001

This document is subject to the provision on the reverse
71 Fenchurch Street, London EC3M 4BS United Kingdom. Registration number 1879370
This approval is carried out in accordance with the LRQA assessment and certification procedures and monitored by LRQA.
The use of the UKAS Accreditation Mark indicates Accreditation in respect of those activities covered by the Accreditation Certificate Number 001
Macro Revision 13





Medical Devices Directive 93/42/EEC Approval of Conformity Certificate

APPROVAL OF CONFORMITY CERTIFICATE

In accordance with the requirements of the Medical Devices Directive 93/42/EEC and the Medical Devices Regulations 2002, UK Statutory Instrument 2002 No. 618

This is to certify that the Quality Management System of:

Vicon Motion Systems Ltd t/a Vicon
Oxford
United Kingdom

has been assessed against the requirements of Annex V of the Medical Devices Directive 93/42/EEC, and the Medical Devices Regulations 2002 and conforms to the requirements for the products shown on the attached schedule.

Approval is subject to the maintenance of the quality system in accordance with the requirements of the above Directive and Regulations.

Authorisation is hereby given to use the LRQA Notified Body Registration Number in accordance with the requirements of the specified Directives/Regulations in relation to the products as identified above.

Certificate No:	LRQ 4003146/B
Original Approval:	18 December 2006
Current Certificate:	18 December 2006
Certificate Expiry:	16 August 2009

LRQA Notified Body Number 0088

Issued by: Lloyd's Register Quality Assurance Limited

This document is subject to the provision on the reverse
71 Fenchurch Street, London EC3M 4BS United Kingdom. Registration number 1879370

APPROVAL OF CONFORMITY CERTIFICATE
CERTIFICATE LRQ 4003146/B SCHEDULE

In accordance with the requirements of the Medical Devices Directive 93/42/EEC and the Medical Devices Regulations 2002, UK Statutory Instrument 2002 No. 618

Vicon Motion Systems Ltd t/a Vicon
Oxford
United Kingdom

Class I Measuring Products
Vicon MX+ System

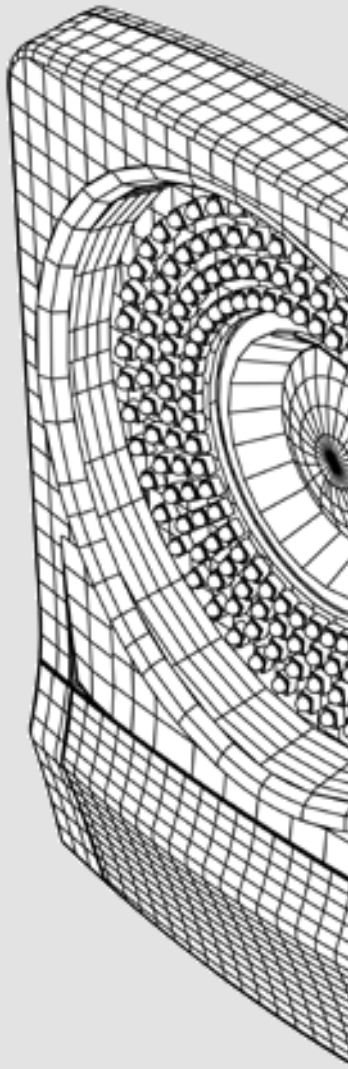
Schedule Issue: 01

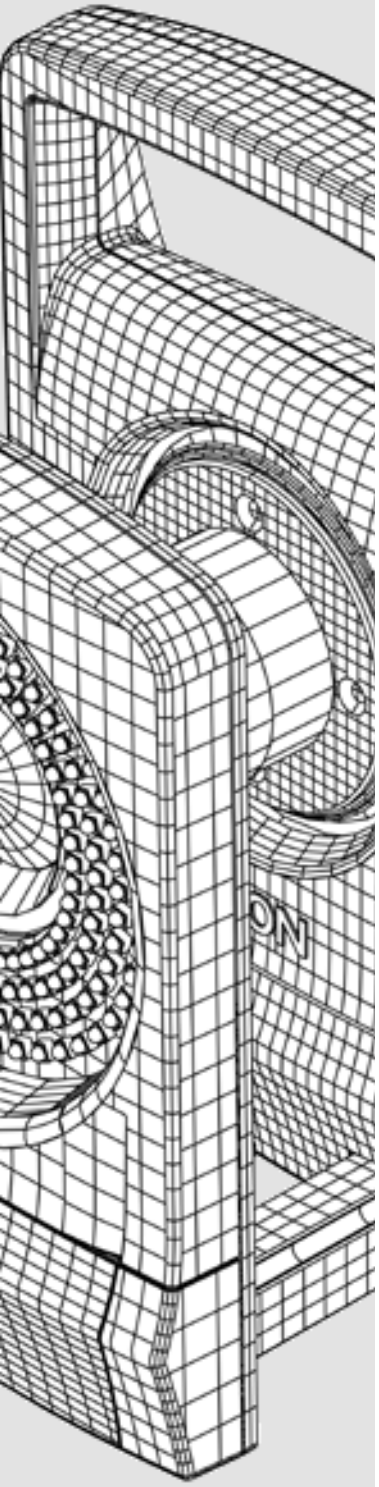
Date of Schedule Issue: 18 December 2006

LRQA Notified Body Number 0088

Issued by: Lloyd's Register Quality Assurance Limited

Page 1 of 1





ISO 9001:2000 Certificate of Approval

CERTIFICATE OF APPROVAL

This is to certify that the Quality Management System of:

Vicon Motion Systems Ltd t/a Vicon
14 Minns Business Park,
West Way,
Oxford OX2 0JB
United Kingdom

has been approved by Lloyd's Register Quality Assurance
to the following Quality Management System Standards:

ISO 9001:2000

The Quality Management System is applicable to:

Design, manufacture and support of motion capture systems, including development of related software.

This certificate forms part of the approval identified by certificate number LRQ 4003146

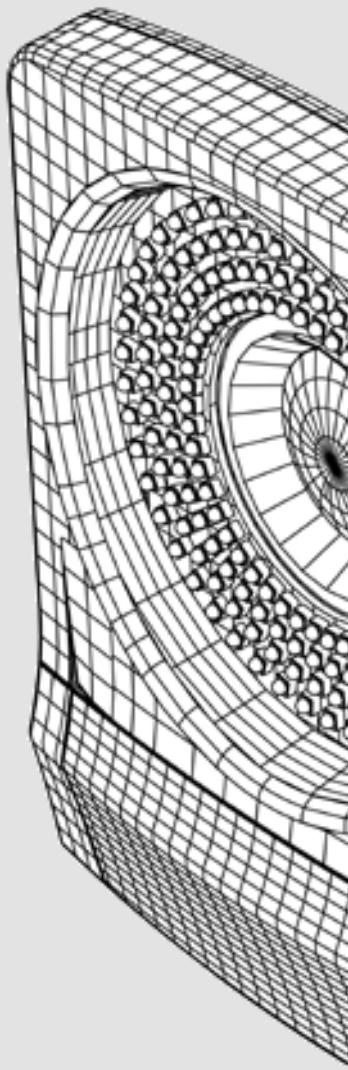
Approval
Certificate No: LRQ 4003146/A

Original Approval: 17 August 2006
Current Certificate: 17 August 2007
Certificate Expiry: 16 August 2009

J Jamieson
Issued by: Lloyd's Register Quality Assurance Limited

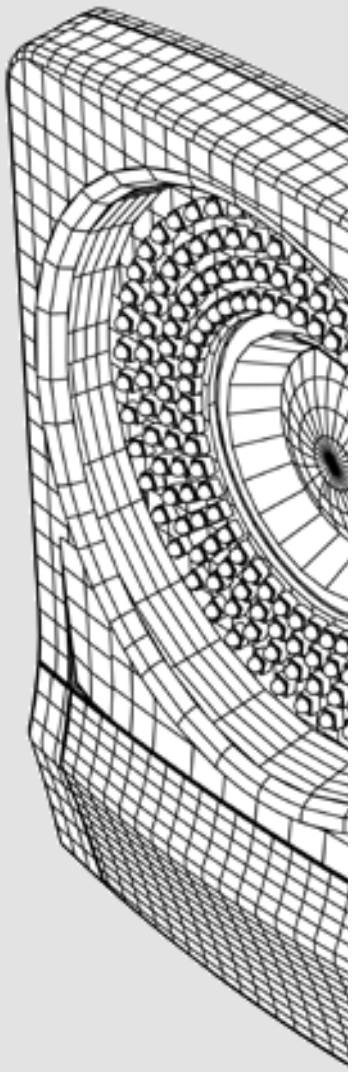
UKAS QUALITY MANAGEMENT
001

This document is subject to the provision on the reverse
71 Fenchurch Street, London EC3M 4BS United Kingdom. Registration number 1879370
This approval is carried out in accordance with the LRQA assessment and certification procedures and monitored by LRQA.
The use of the UKAS Accreditation Mark indicates Accreditation in respect of those activities covered by the Accreditation Certificate Number 001
Macro Revision 13



23 Regulatory Notices

This chapter provides regulatory notices and incident report forms to complete in the event of an adverse event involving the use of Vicon MX systems in the United Kingdom and the United States of America.



In This Chapter

Medical Device Adverse Event Reporting

Use the appropriate information and form to report any adverse events involving Vicon MX T-Series systems:

- MHRA Adverse Incident Reporting (UK) on page 186
- FDA MedWatch Adverse Event Reporting Program (US) on page 188

Should an adverse event occur, the appropriate form is to be completed and forwarded within one working day to Vicon Motion Systems Limited at one of the following addresses.

Oxford
14 Minns Business Park, West Way
Oxford OX2 0JB
UK

Tel: +44 (0)1865 261800
Fax: +44 (0)1865 240527

Los Angeles
5419 McConnell Avenue
Los Angeles, CA 90066
USA

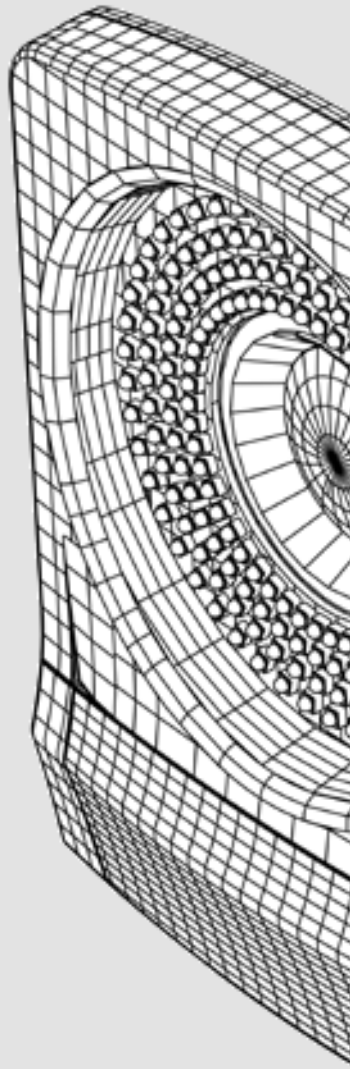
Tel: +1 310 306 6131
Fax: +1 310 437 4299

Denver
7388 S. Revere Parkway, Suite 901
Centennial, CO 80112
USA

Tel: +1 (303) 799 8686
Fax: +1 (303) 799 8690

Singapore
8 Cross Street # 11-00
PWC Building,
Singapore 048424

Tel: +65 6400 3500
www.vicon.com

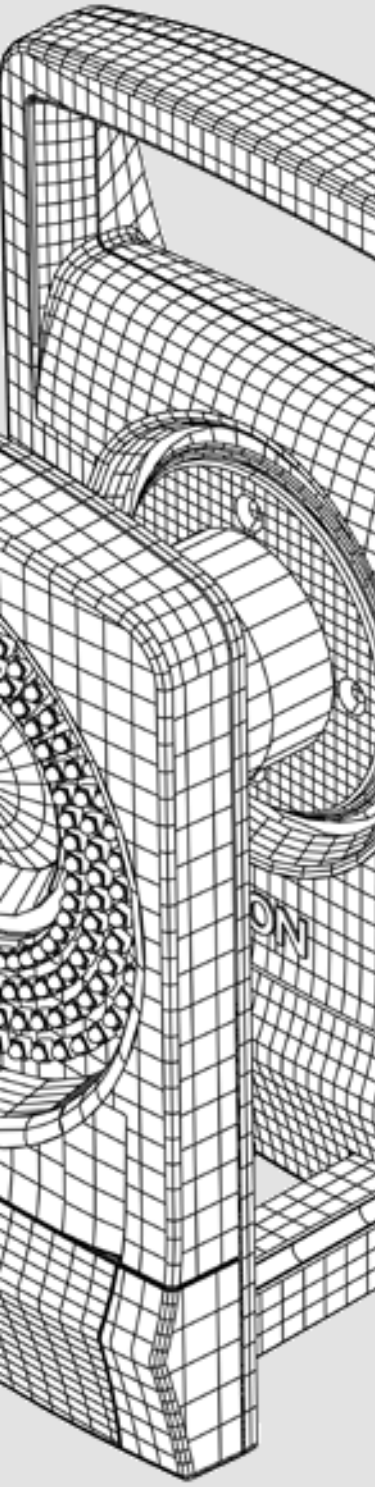


MHRA Adverse Incident Reporting (UK)

The information in this section covers the reporting of incidents involving medical devices to the UK Medicines and Healthcare products Regulatory Agency (MHRA).

Notice to Agents
For inclusion in all Vicon systems supplied from the United Kingdom for use outside of the United States of America (for supply and use in the US, see FDA MedWatch Adverse Event Reporting Program (US) on page 188).
The master Medicines and Healthcare products Regulatory Agency (MHRA) file is located at Vicon Motion Systems Limited. Should an adverse event occur, the MHRA Adverse Incident Report Form is to be completed and forwarded within one working day to Vicon Motion Systems Limited (see Medical Device Adverse Event Reporting on page 186).

The MHRA is a UK government agency which is responsible for ensuring that medicines and medical devices work, and are acceptably safe. Use the form specified in this chapter to report an adverse incident involving a medical device.



Full information and guidance on reporting Adverse Incidents is published in MHRA Device Bulletin DB 2008(01) Reporting Adverse Incidents and Disseminating Medical Advice Alerts. For details on reporting requirements, contact the MHRA:

Medicines and Healthcare products Regulatory Agency
Market Towers 1 Nine Elms Lane
London SW8 5NQ
UK

Tel: +44 (0)20 7084 2000
Fax: +44 (0)20 7084 2353
Web: www.mhra.gov.uk

Tip
For additional information and guidance, refer to the latest revision of MEDDEV 2.12-1 on The European Commission Web site (http://ec.europa.eu/enterprise/medical_devices/meddev).

MHRA Adverse Incident Report Form

You can obtain the MHRA Adverse Incident Report Form from the MHRA Web site (http://www.mhra.gov.uk/Safetyinformation/Reportingsafetyproblems/Devices/index.htm). Separate online and printed versions of the form are available on that Web site.

For your convenience, a copy of this MHRA form is supplied in printable format with this Go Further with Vicon MX T-Series book (by default, under *C:|Program Files|Vicon |Documentation|MHRA_Form_AdverseIncident.pdf*).

Important
This PDF version of the MHRA form is current as of publication of this Vicon book. To ensure that you have the latest version of the form, Vicon recommends that you check the MHRA Web site for any updates. If you have any difficulty obtaining the MHRA Adverse Incident Report Form, contact Vicon Support immediately to receive the form.

To complete the MHRA Adverse Incident Report Form:

- **Online:** Fill in the form on the MHRA Web site (http://aic.mhra.gov.uk/MDA/MDAFormsV3.nsf/formA?OpenForm).
- **Print:** Print out the form, fill it in, and then fax it to the nearest Vicon office (see Medical Device Adverse Event Reporting on page 186).

Tip
In section **Type of device**, select **Other** and specify your Vicon system.

FDA MedWatch Adverse Event Reporting Program (US)

This section covers the reporting of incidents to the US Department of Health & Human Services.

Notice to Agents
For inclusion in all Vicon systems supplied to the United States of America (for supply and use outside the US, see MHRA Adverse Incident Reporting (UK) on page 186).
The master Medical Device Reporting (MDR) file is located at Vicon Motion Systems Limited. Should an adverse event occur, MEDWATCH Form FDA 3500A (10/05) is to be completed and forwarded within one working day to Vicon Motion Systems Limited (see Medical Device Adverse Event Reporting on page 186).

Department of Health & Human Services,
US Food and Drug Administration

Medical Device Reporting System—Reportable Events

Code of Federal Regulations
Title 21, Volume 8
Revised as of April 1, 2006
Cite: 21CFG803.32

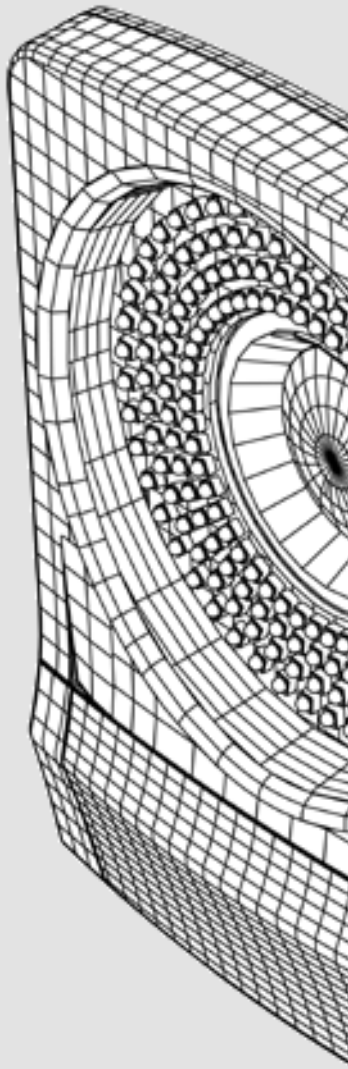
Under 803.1(a) device user facilities and manufacturers must report deaths and serious injuries that a device has or may have caused or contributed to. Should such an event occur, please complete the form specified in this section and forward it in accordance with the applicable regulations and time limits to your nearest Vicon office (see page 186).

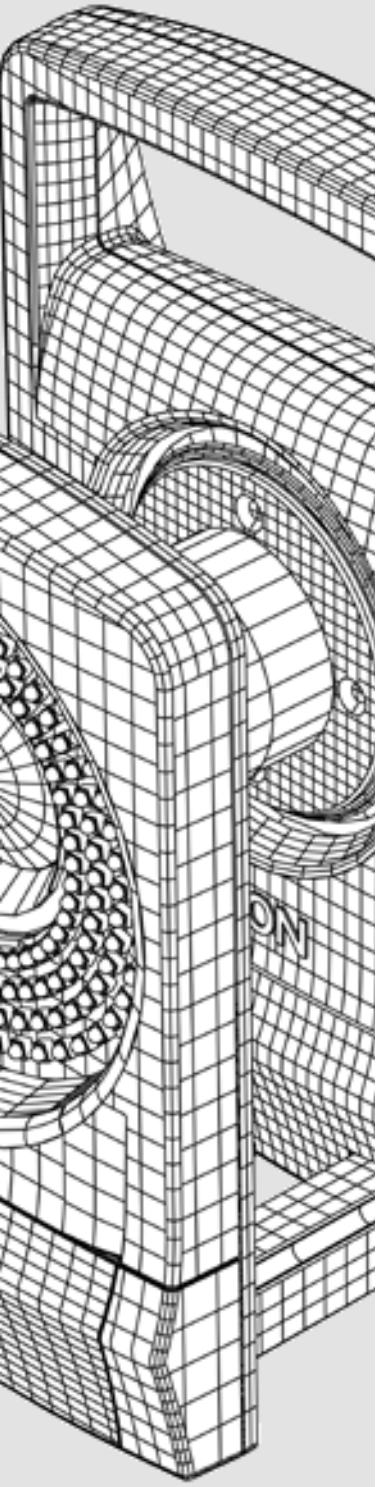
FDA Adverse Event Report Form

You can obtain the FDA Adverse Event Report Form (MEDWATCH form FDA 3500A) from the FDA's MedWatch Adverse Event Reporting program on their Web site (http://www.fda.gov/medwatch/safety/FDA-3500A_fillable.pdf). This PDF form can be completed online or printed out.

For your convenience, a copy of this FDA form is supplied with this Go Further with Vicon MX T-Series book (by default, under *C:|Program Files|Vicon|Documentation|USFDA_Form_FDA3500a(10.05)_Fillable.pdf*).

Important
This PDF version of the FDA form is current as of publication of this Vicon book. To ensure that you have the latest version of the form, Vicon recommends that you check the FDA Web site for any updates. If you have any difficulty obtaining the FDA Adverse Event Report Form, contact Vicon Support immediately to receive the form.



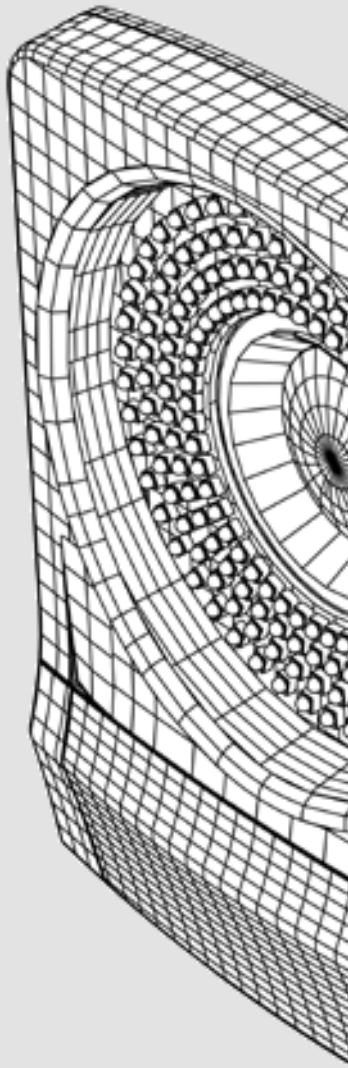


To complete the FDA Adverse Event Report Form:

- **Online:** Fill in the PDF form, save it, and then e-mail it to support@vicon.com. Include "Adverse Event Report" in your e-mail subject line.
- **Print:** Print out the form, fill it in, and then fax it to the nearest Vicon office (see Medical Device Adverse Event Reporting on page 186).

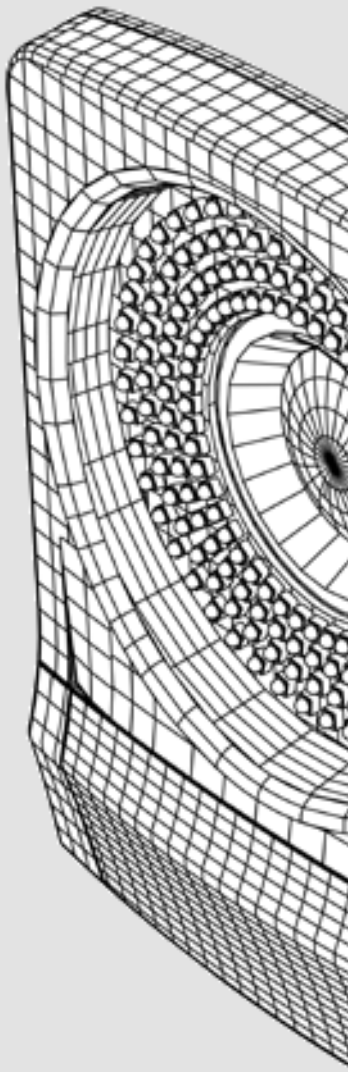
Tip

Section C. Suspect Product(s) is not applicable to Vicon systems. For further guidance on completing the form, see the instructions contained in the PDF form.



24 Safety and Warranty

This chapter provides guidance to help you ensure the safe operation of your Vicon MX T-Series system, as well as information regarding the system warranty.



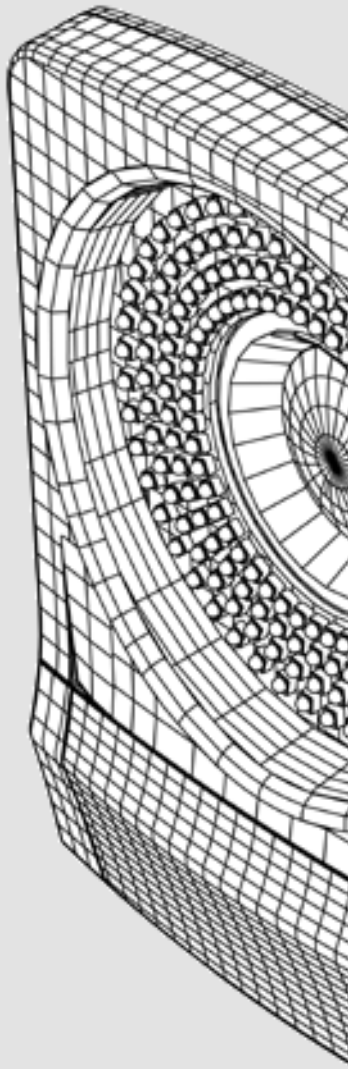
In This Chapter

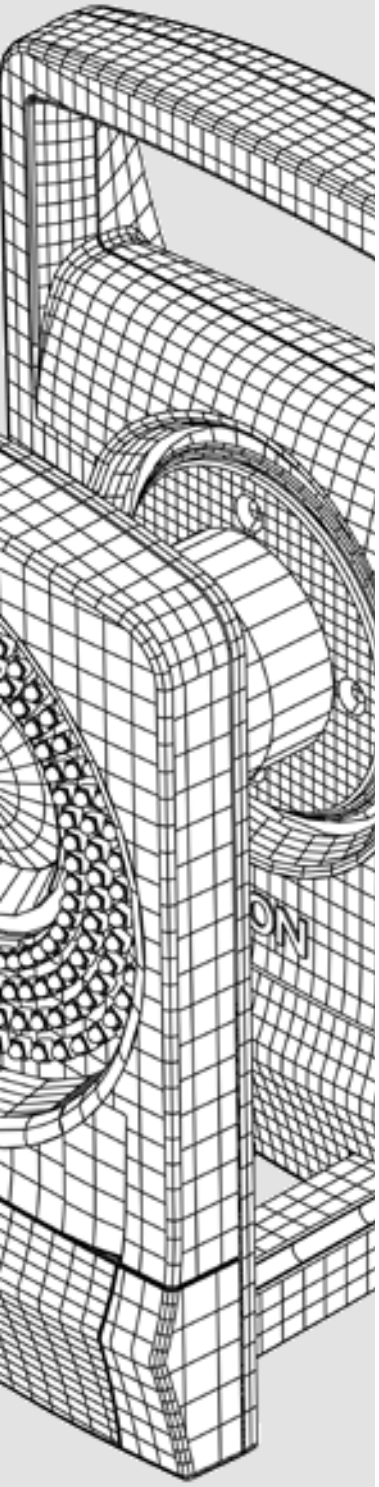
Safety Information

To avoid introducing a safety hazard and possibly damaging the system, please ensure that an adequate and good-quality alternating current (AC) power source is available. Please refer to the ratings statement on the rear of the relevant MX unit for guidance. Also ensure that any computers and peripheral devices are set to be electrically rated to operate with the AC power available in your location.

When working with Vicon MX T-Series systems, observe these safety precautions:

- To prevent electric shock, plug all system components into properly grounded power sources. These cables must be equipped with three-prong plugs to ensure proper grounding. Do not use adapter plugs or remove the grounding prong from a cable.
- Ensure nothing rests on the system cables and that cables are not located where they can be stepped on or tripped over.
- Do not spill food or liquids onto any electrical component of the system. If any component gets wet, immediately contact Vicon Motion Systems or your nearest agent or distributor for advice.
- Do not push any objects into the slots of any unit of the system. Doing so can cause fire or electric shock by shorting out internal components.
- Keep all system components away from radiators and heat sources, and do not block cooling vents. Avoid placing loose papers underneath any components. Do not place any components on closed-in units or on a bed, chair, etc.
- Replace fuses with the same type and rating for continued fire protection.
- Do not use outside, near water, in an environment exposed to anesthetic or other explosive gases, or in mobile applications.
- Use only hypoallergenic tape to affix Vicon markers to a subject's skin. Vicon supplies specially designed marker fixing tape; medical grade elastic strips are also suitable.
- Do not apply any products containing latex to the subject while using the Vicon system. Vicon products do not contain latex.



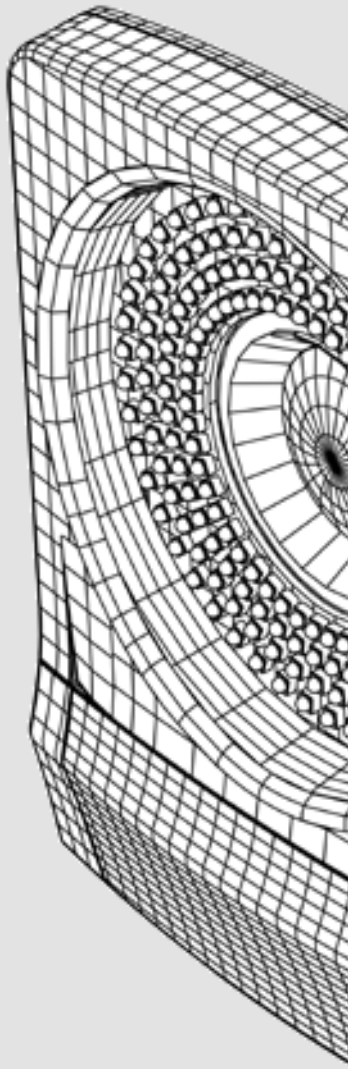


- Do not look directly at the source when a Near Infrared (NIR) or Infrared (IR) strobe unit is in operation.

Caution
Under a single fault condition where the strobe is permanently on and before internal fusing breaks, the Maximum Permissible Exposure defined by standard EN 60825-1:1994 to near infrared light may be exceeded if your eyes are within 100 mm of the Light Emitting Diodes.

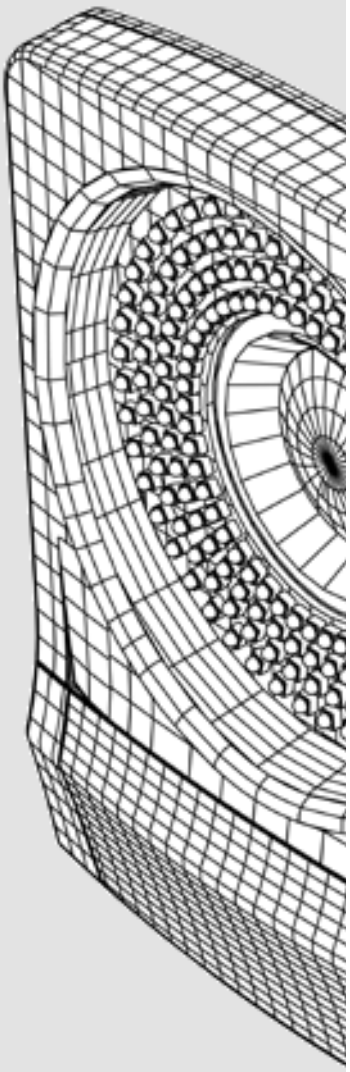
Warranty Information

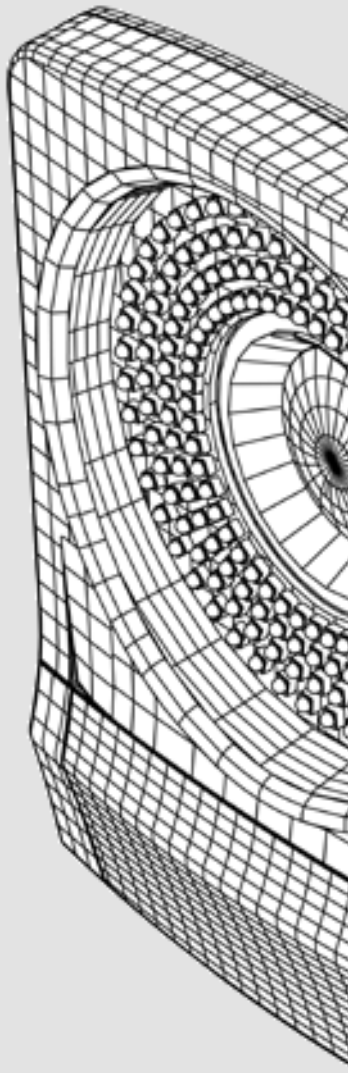
The warranty for your Vicon MX T-Series system begins after installation. For full details on warranty scope and conditions, refer to the Vicon Terms and Conditions of supply for your Vicon MX T-Series system.



V User Assistance and Support

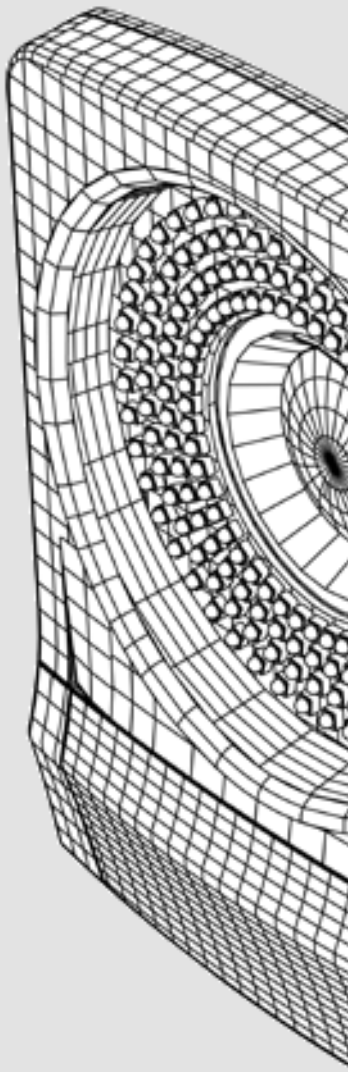
Find out what user assistance materials are available and how to get support for your use of the Vicon MX T-Series system.





25 Support Resources

This chapter explains the resources you can use to obtain support for your Vicon MX T-Series system.



In This Chapter

Technical Support

Vicon offers telephone, e-mail, and online technical support.

Telephone

You can speak with Support Engineers in the US and UK offices:

Oxford
+44 (0)1865 261 800
09:00 to 17:00 Greenwich Mean Time

Los Angeles
+1 310 306 6131
9:00 to 17:00 Pacific Time

Denver
+1 (303) 799 8686
09:00 to 17:00 Mountain Time

E-mail

You can raise feature requests, bugs, and support issues via e-mail:

support@vicon.com

World Wide Web

You can access support areas and FAQs on our Web-accessible knowledge base, Vicon Online Support:

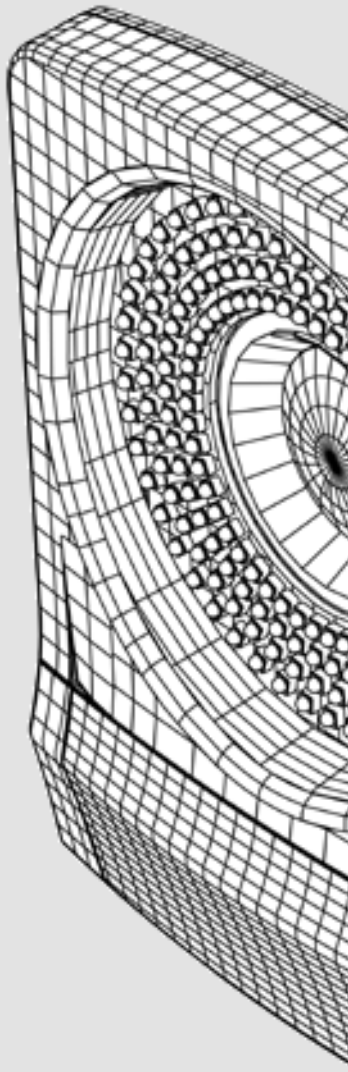
http://www.vicon.com/support

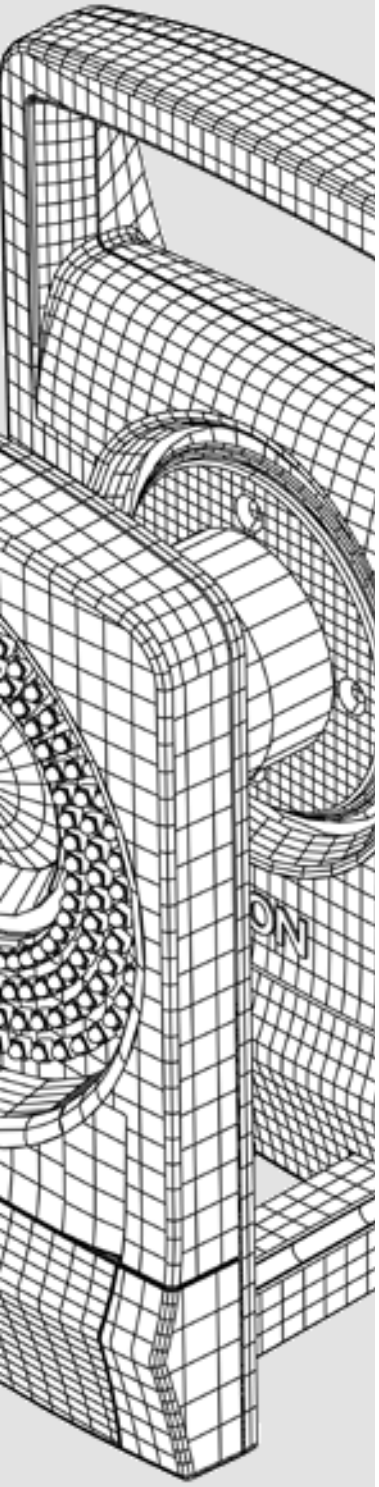
For further details on using this online Technical Support service, see Vicon Online Support.

Vicon Online Support

If you are a licensed Vicon user and have a valid Vicon System Maintenance Agreement, you can access the Vicon Online Support knowledge base at www.vicon.com/support.

Tip
To access Vicon Online Support on the Web, you must have a Vicon Online Support User ID and password.
If you do not have these details or need assistance with logging in to Vicon Online Support, contact Vicon Support at support@vicon.com
OR
Click the **Register** link on the Vicon Online Support page and complete the application to have a username and password e-mailed to you.





This section describes the support resources available from the Vicon Online Support knowledge base on the Web:

- **Downloads**

  Obtain latest firmware and other software patches, models and scripts, and product documentation.

- **FAQs**

  Locate topics providing answers to frequently asked questions about Vicon hardware, software, plug-ins, and licensing as well as third-party software.

- **Cases**

  Submit your own question or report a problem if you cannot locate the information you need in the FAQs, then track responses to your questions and updates to your problems.

To log in to Vicon Online Support:

1. From a Web browser, enter the URL for Vicon Online Support:

   http://www.vicon.com/support

   The **Vicon Support + Services** page is displayed.

2. In the **Log in** area, enter your Vicon Online Support **Username** and **Password**, agree to the Terms and Conditions by checking the **Agree to terms and conditions** box, and then click **Enter**.

   The **Online Support** page is displayed, with your account information below the available Vicon Online Support sections on the left side of the page.

3. When you are ready to exit Vicon Online Support, click the **Logout** link.

Vicon Error Reporting

The Vicon Error Reporting system provides a quick and convenient way for you to advise Vicon if your Vicon application software stops responding. Vicon uses these error reports to investigate problems users identify with the software. Vicon can not provide direct feedback to individual error reports, but we do value these contributions to our continued product development.

Using the Vicon Error Reporting System

If an error occurs that causes the Vicon application software to stop responding, two events are triggered:

- A Vicon error report file (named *OMG*.tmp*) is automatically created in the Temp directory (by default, *C:|Documents and Settings|<User_Name>|Local Settings|Temp*).

This file contains information including the operating system version and the state of the application when it stopped responding. It does not contain any personal information.

- The **Vicon Error Reporting** dialog box, shown in Figure 3, is displayed.

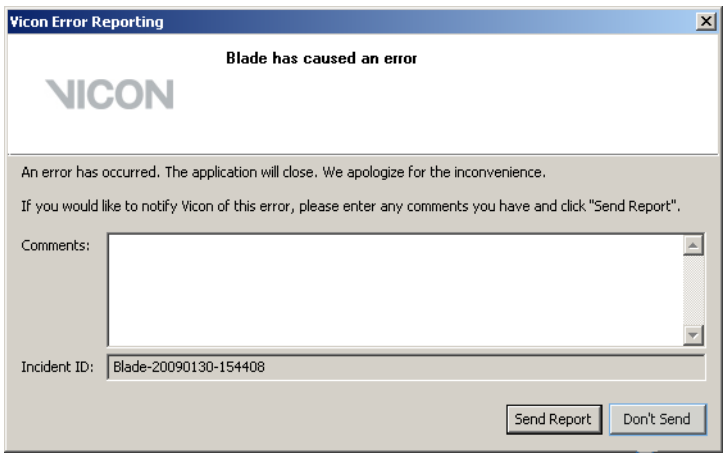


Figure 3: Vicon Error Reporting dialog box

You can choose to do one of the following:

- Ignore the error and continue with what you were doing. See Ignoring an Error on page 200.
- Automatically send an error report to Vicon. See Automatically Sending an Error Report on page 201.
- E-mail an error report to Vicon. This is useful if you decide to report the problem after closing the **Vicon Error Reporting** dialog box, or if you do not have an active Internet connection on the MX Host PC. See E-mailing an Error Report on page 201.

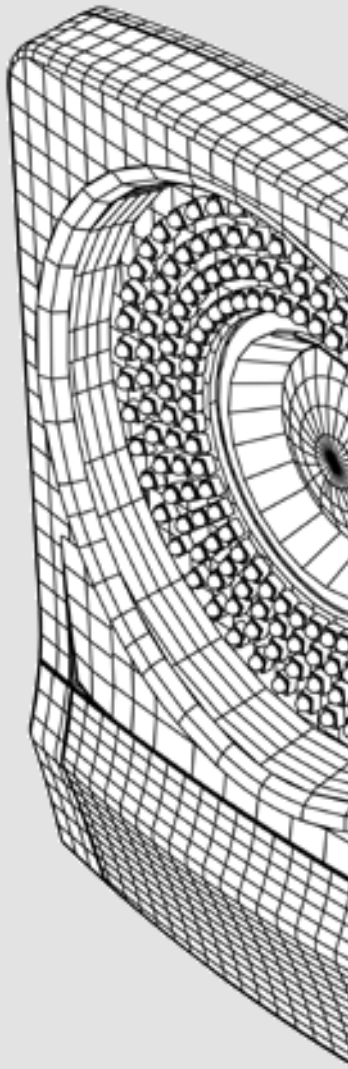
Ignoring an Error

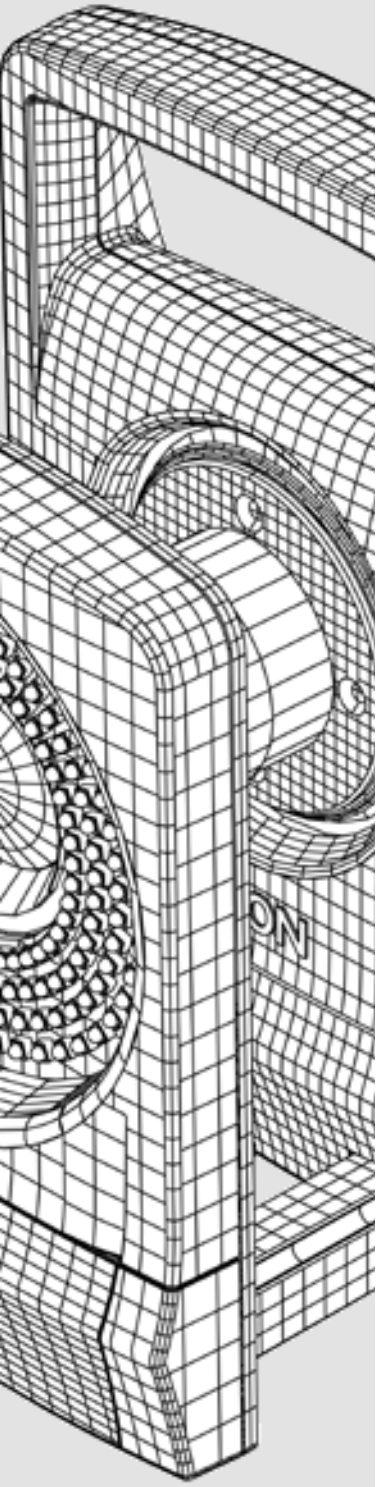
If the Vicon application software stops responding, you may decide to simply restart the software and continue with what you were doing.

To ignore an error:

1. In case you want to report the incident later, take a note of the number in the **Incident ID** field in the **Vicon Error Reporting** dialog box.
2. Click **Don't Send** to close the dialog box.

   After the Vicon software has completely closed, restart the application.





Automatically Sending an Error Report

Unless you do not have Internet access from the MX Host PC, we recommend that you report errors using the automatically generated report.

To automatically send an error report:

1. In the **Comments** field, enter the following details:
   - A brief description of the problem, including steps to reproduce the problem if possible.

     Clear step-by-step details on the actions leading up to the application closing helps Vicon to isolate the probable cause of the problem and identify a solution.
   - Your name and/or organization name to enable Vicon to contact you if additional information is needed to investigate the problem.
2. Make a note of the **Incident ID** for future reference.
3. Click **Send Report**.

   The automatically generated error report is sent to Vicon, where it is processed and forwarded to the appropriate engineer for investigation.

E-mailing an Error Report

If you do not have Internet access from the MX Host PC, you can e-mail an error report to Vicon.

To e-mail an error report to Vicon:

1. In the Subject line, include `Vicon Error Report`.
2. In the Body of your e-mail, include the following details:
   - Incident ID from the **Vicon Error Reporting** dialog box.
   - A brief description of the problem, including steps to reproduce the problem if possible.

     Clear step-by-step details on the actions leading up to the application closing helps Vicon to isolate the probable cause of the problem and identify a solution.
   - Your name and/or organization name to enable Vicon to contact you if additional information is needed to investigate the problem.
3. Attach the Vicon error report file (*OMG*.tmp*) to your e-mail.

   This file is automatically stored in the system Temp directory. By default, the Temp directory is *C:|Documents and Settings|<User_Name>|Local Settings|Temp*.

If your Temp directory is not in this default location, determine its location:

a. From the Windows **Start** menu, click **Run**.

b. In the **Open** field, type the command to open the **Command Prompt** window for your Windows operating system:

Windows XP, Windows 2000, or Windows NT 4.0:	`cmd`
Windows ME, Windows 98, or Windows 95:	`command.com`

c. At the command prompt, enter:

```
set
```

d. Make a note of the value for the TEMP entry.

4. Send your e-mail to support@vicon.com.

Useful References

Vicon 3D motion capture and analysis systems have been applied to technologies in the fields of human movement sciences, clinical analysis, computer animation, and engineering around the world.

You can use these resources to keep up-to-date with Vicon developments:

- **Vicon Newsletters**

  You can register to receive Vicon newsletters via email for your field of interest:

  - **Online:** Complete the form on the Contact page of our Web site:

    http://www.vicon.com/contact/

  - **Email:** Send a request to:

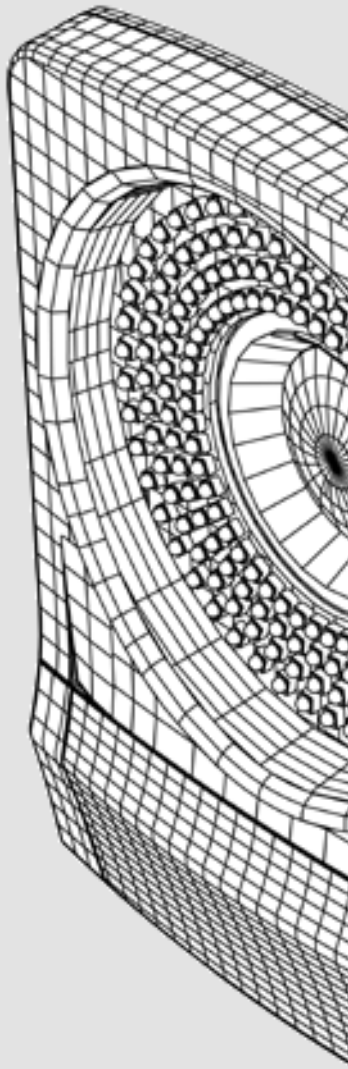
    moveme@vicon.com

- **The Standard**

  You can view the latest issue of The Standard online or subscribe to receive a printed copy from the Web site:

  http://www.vicon.com/standard/

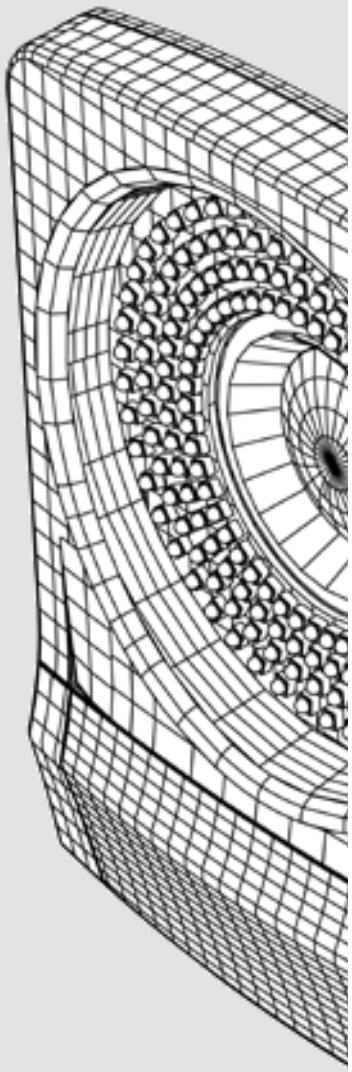
  This publication contains articles on motion analysis in science and engineering research and application projects. Articles are contributed by practicing experts and leading authorities in laboratories throughout the world.



26 Documentation Feedback

This chapter explains how you can provide Vicon with your comments or suggestions on improving the product documentation.

In This Chapter



Send Your Documentation Feedback

Please provide your documentation feedback using Vicon Online Support at http://www.vicon.com/support. For details on Vicon Online Support, see Chapter 25 Support Resources.

Please include "Documentation Feedback" in the Summary line and provide the following details in the body of your message:

- **Product details**

  Product name, version number, and build number

- **Document details**
  - Document title and revision number or copyright date
  - Document type and content location:

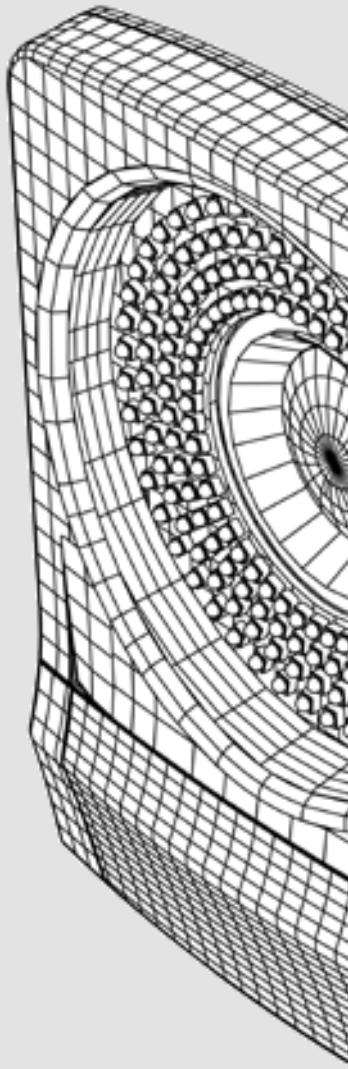
Book	Chapter title, section title, and page number
Help	Topic title and section title
Release document	Document title and section title

- **Problem description**

  Brief description of current content, identifying your concerns (e.g. specify any factual inaccuracies, errors, or omissions; grammatical errors; navigation or information location problems)

- **Feedback details**

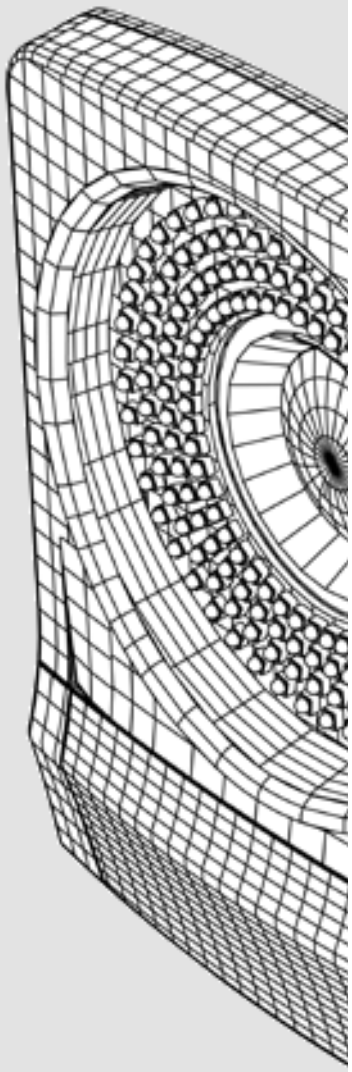
  Your suggestions for correcting or improving the documentation



27 Customer Satisfaction Survey

This chapter requests your feedback on our products and services to help us improve future offerings.

In This Chapter



Send Your Printed Satisfaction Survey

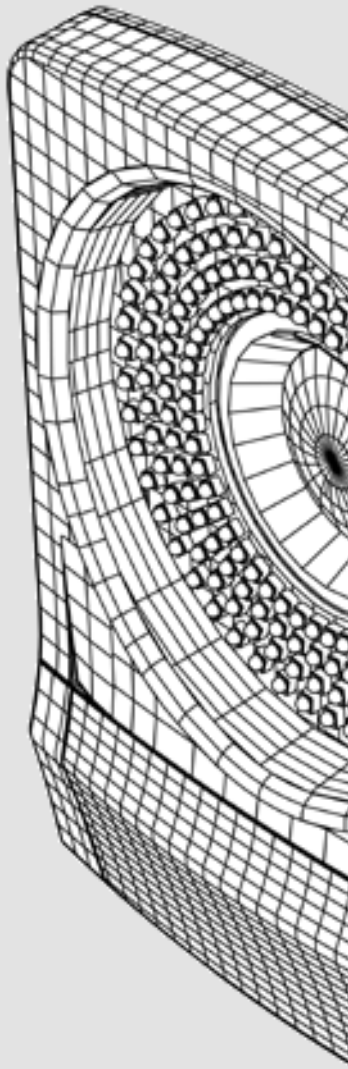
Please print out and complete this form to help Vicon improve our services. Send your completed survey by fax or post to your nearest Vicon office. See the back cover of this book for our contact details.

We value your honest opinion on the service you have received so far. We take your feedback into consideration when providing products and services in the future. If you have any questions or comments about this survey, please contact the Sales and Support Manager in our Oxford office.

Contact Name _____ **Title** _____

Organization _____ **Date** _____

For each question, check the box that most closely describes your opinion. Leave any that are not applicable blank.



How satisfied are you with the quality of your Vicon system? (1=Very, 5=Not at all)

❍ 1 ❍ 2 ❍ 3 ❍ 4 ❍ 5

How satisfied are you with the purchase experience of your Vicon system? (1=Very, 5=Not at all)

❍ 1 ❍ 2 ❍ 3 ❍ 4 ❍ 5

How satisfied are you with the value of your Vicon system? (1=Very, 5=Not at all)

❍ 1 ❍ 2 ❍ 3 ❍ 4 ❍ 5

How satisfied are you with the installation or your first usage of your Vicon system? (1=Very, 5=Not at all)

❍ 1 ❍ 2 ❍ 3 ❍ 4 ❍ 5

How often do you use your Vicon system? (1=Every day, 2= Every week, 3=Every 2-3 weeks, 4=Every month, 5=Every 2-3 months)

❍ 1 ❍ 2 ❍ 3 ❍ 4 ❍ 5

How satisfied are you with your continuing usage of your Vicon system? (1=Very, 5=Not at all)

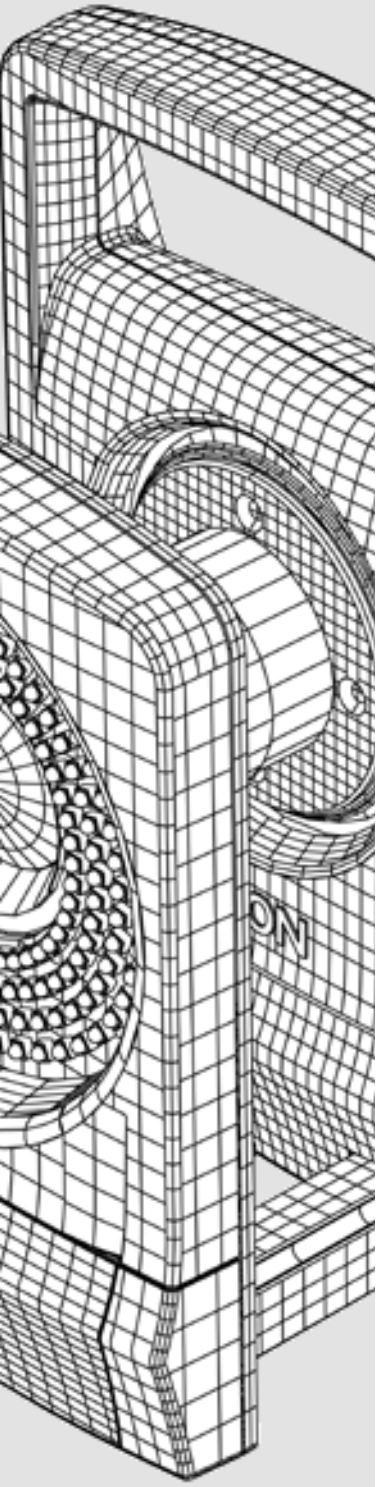
❍ 1 ❍ 2 ❍ 3 ❍ 4 ❍ 5

How satisfied are you with the after-purchase service (e.g. warranty, repair, customer service) of your Vicon system? (1=Very, 5=Not at all)

❍ 1 ❍ 2 ❍ 3 ❍ 4 ❍ 5

How satisfied are you overall with your Vicon system? (1=Very, 5=Not at all)

❍ 1 ❍ 2 ❍ 3 ❍ 4 ❍ 5



How likely are you to buy another Vicon product in the future? (1=Very, 5=Not at all)

❍ 1 ❍ 2 ❍ 3 ❍ 4 ❍ 5

How likely are you to recommend Vicon to others? (1=Very, 5=Not at all)

❍ 1 ❍ 2 ❍ 3 ❍ 4 ❍ 5

How completely were any problems you contacted Vicon customer services about resolved? (1=Fully, 5=Not at all)

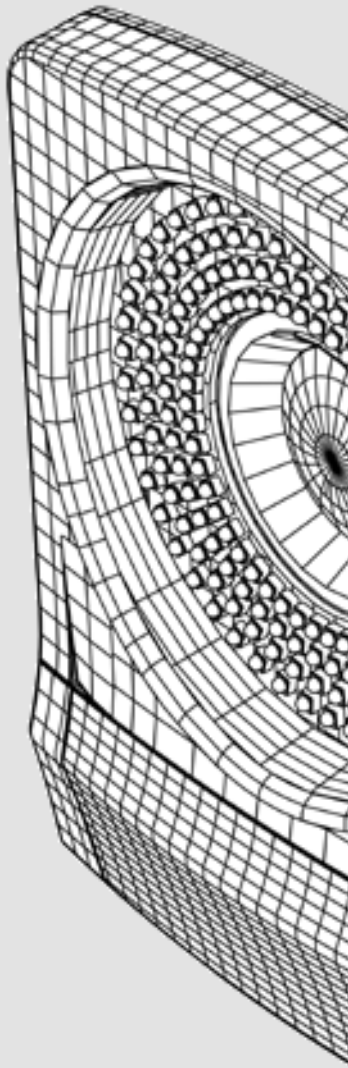
❍ 1 ❍ 2 ❍ 3 ❍ 4 ❍ 5

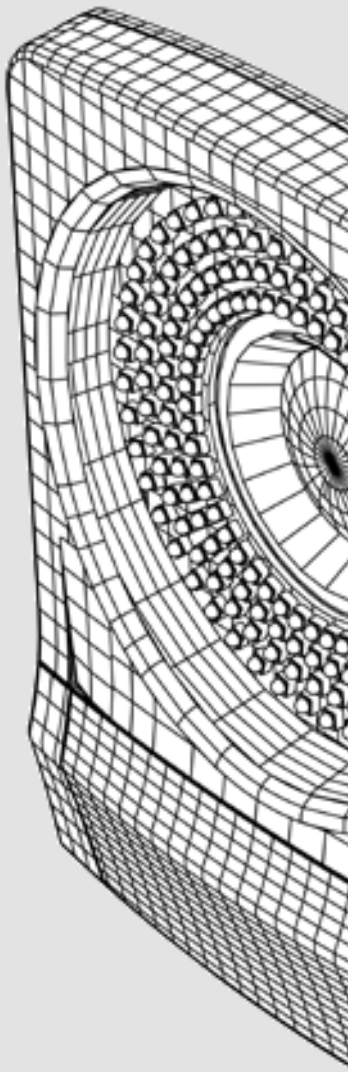
Please provide any additional information or comments

Take the Survey Online

If you prefer, you can complete this survey online. Log on to the Vicon Online Support page (for details, see Vicon Online Support on page 198), then follow the link from the Welcome to your Vicon Online Support account page.

27. Customer Satisfaction Survey
> Take the Survey Online





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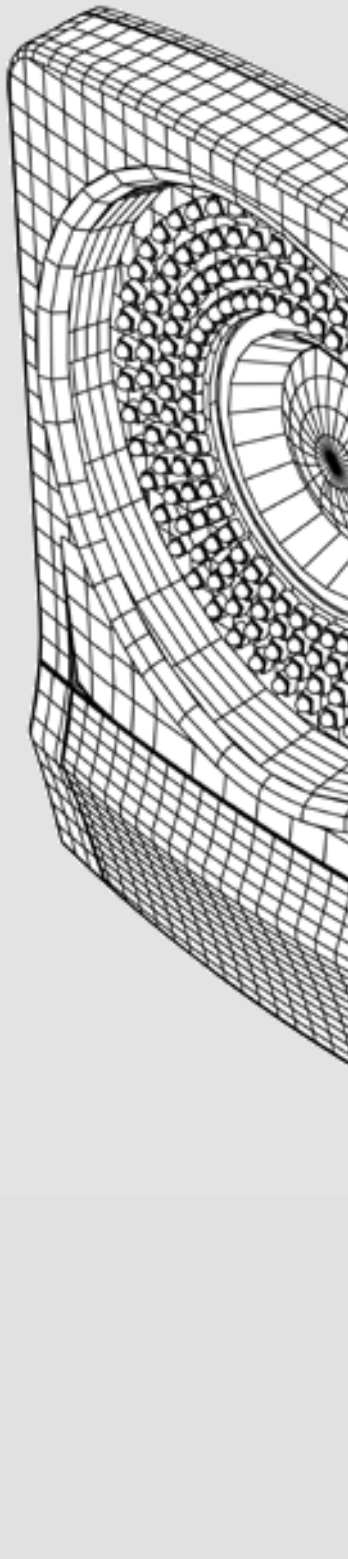

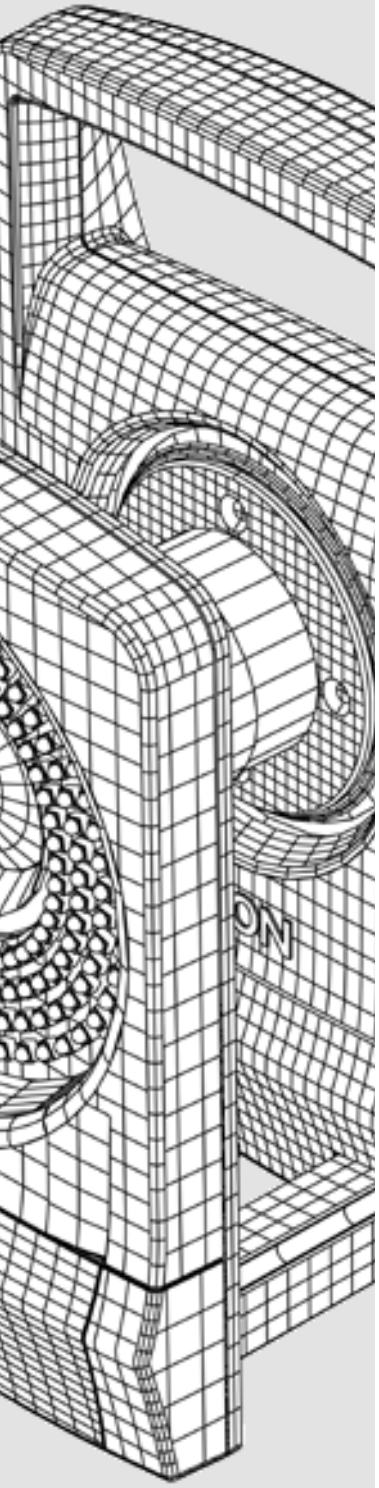

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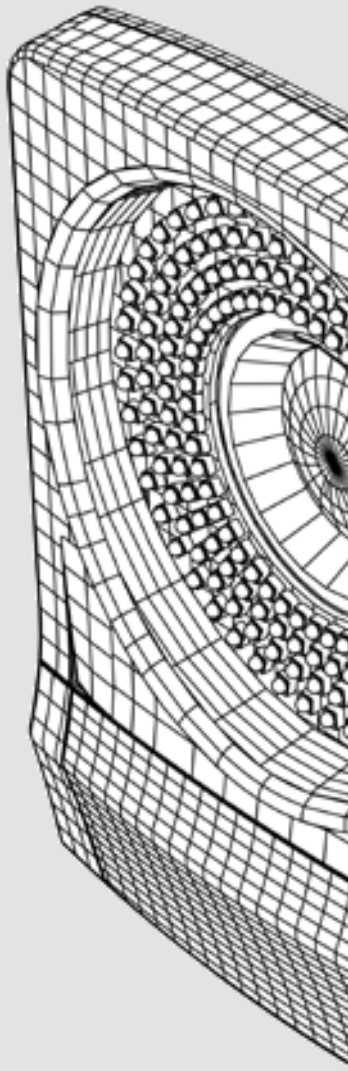

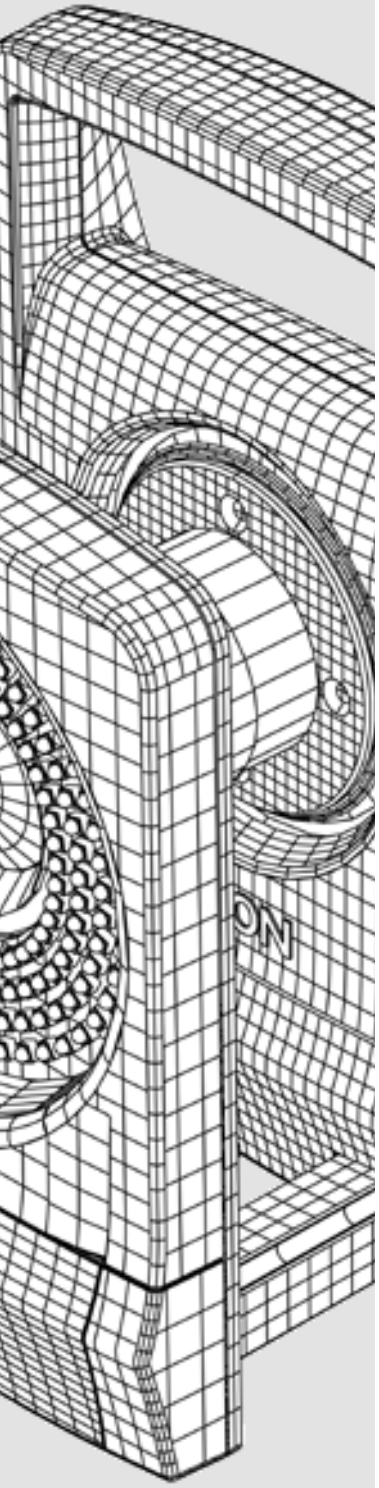

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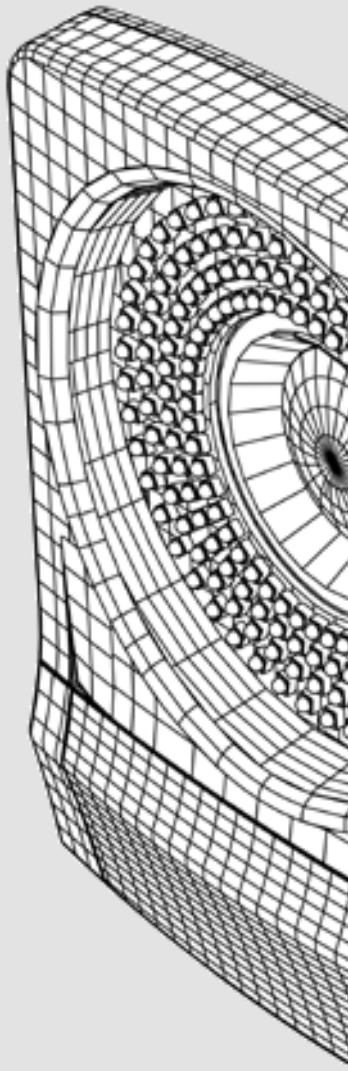

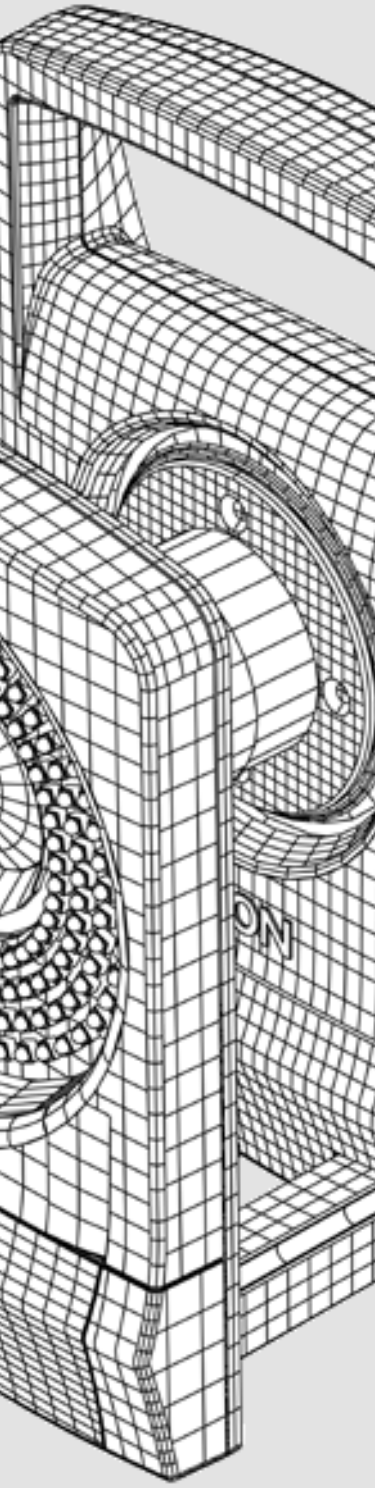

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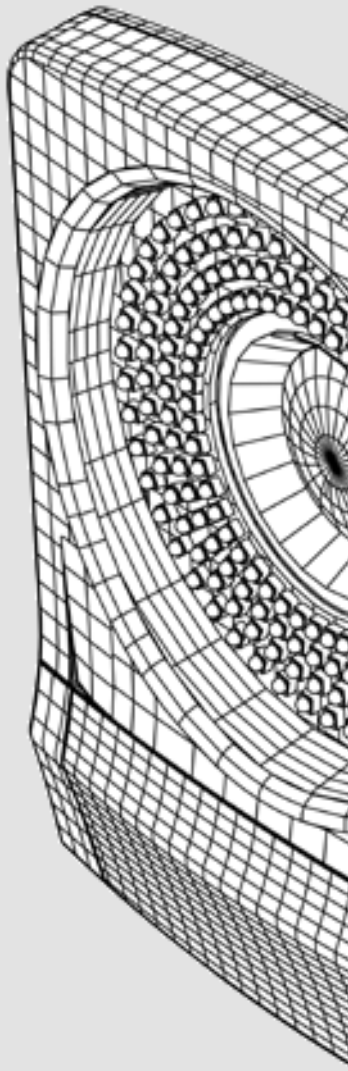

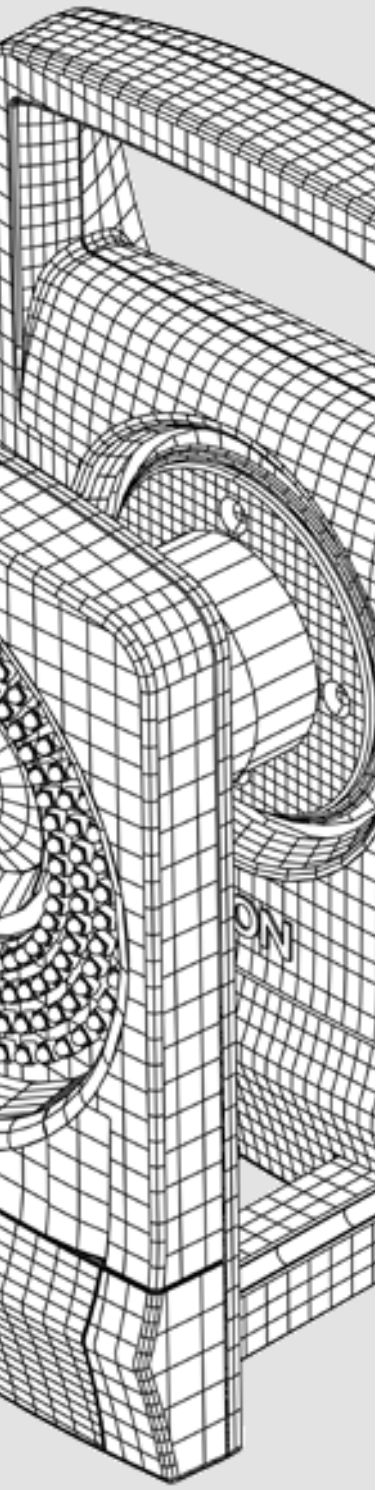

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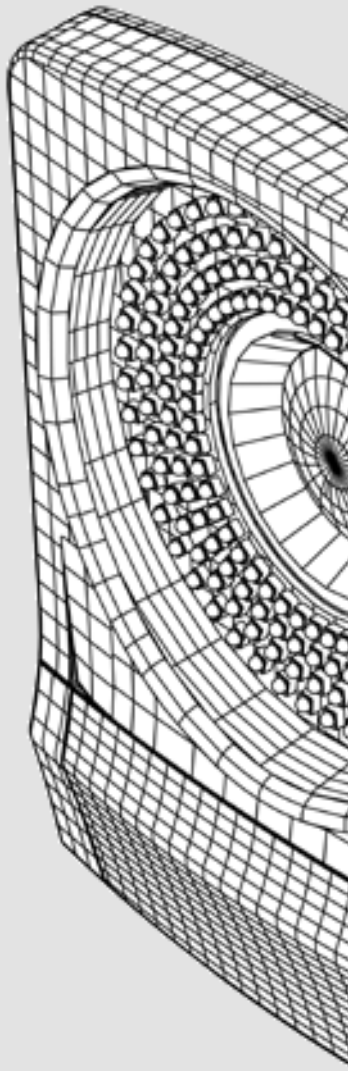

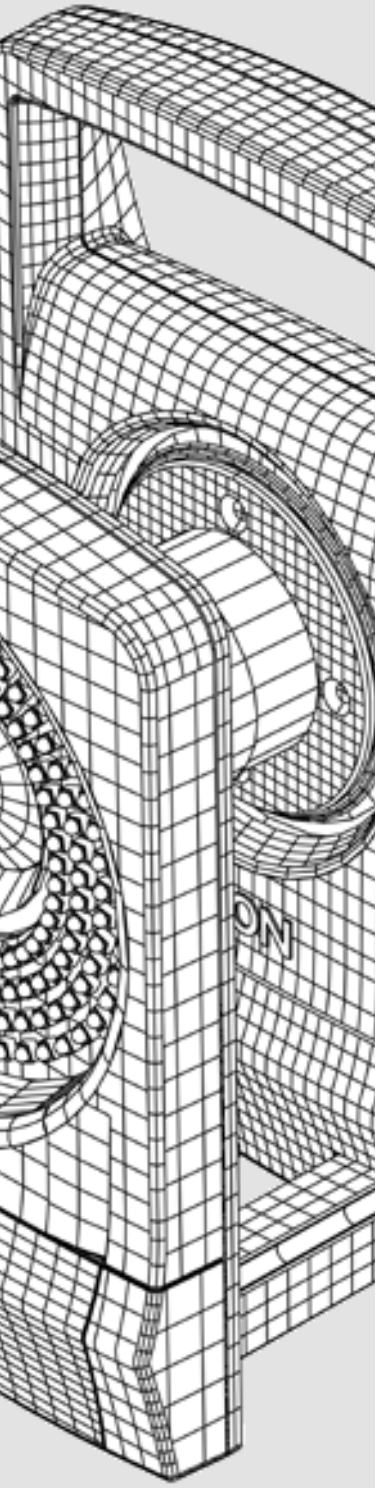

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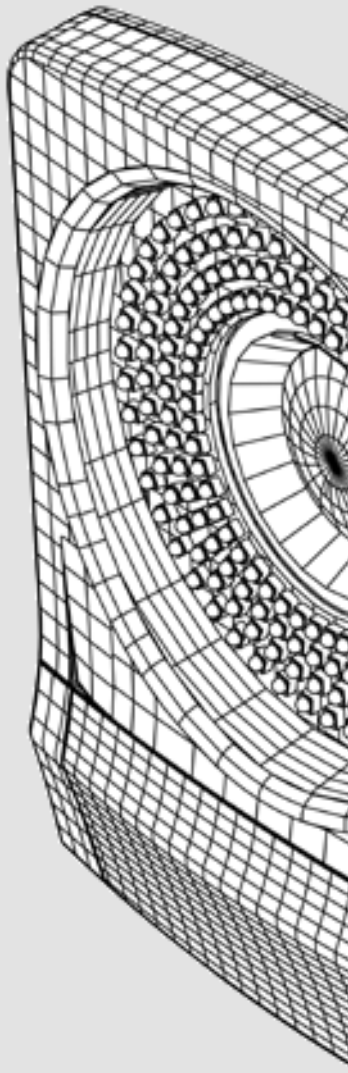

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