F160 Vision Sensor

HIGH-SPEED PERFORMANCE IN AN EASY-TO-USE, COMPACT, TWO-CAMERA MACHINE VISION PACKAGE

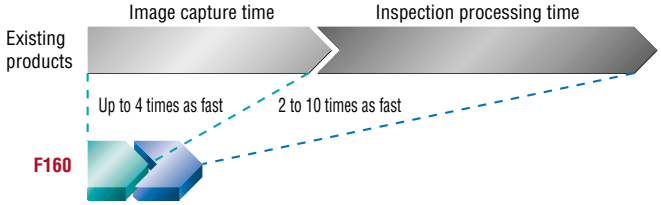
OMRON®
the problem solvers™

The First Vision Sensor to Offer High-speed, Mid-range Machine Vision Performance

The F160 is the industry's first high-speed vision sensor to deliver mid-range machine vision performance to meet more demanding vision applications. The F160 enlists high speed, two-camera image capture and vision algorithm processing to meet the needs of today's high-speed production lines. The on-screen set up and configuration system offers beginners or experts fast and easy set up. A wizard-like prompted menu option helps new users with auto setup routines, while the "expert" menu option lets those with more experience directly set configuration parameters. Several new and improved algorithms, like Omron's Quest OCR and "variable box" technology let users perform more precise and sophisticated applications. By using Flash-RAM memory cards, the memory capacity of the F160 can be expanded to handle multiple product lines. Choose from a selection of compact camera options to satisfy many inspection and measurement needs. The F160 also allows the customization of menus, "results" screen information and symbol and text colors to ensure optimum on-site operability. Omron's machine vision technology and know-how has come together to bring a new level of machine vision measurement and inspection capability.

Creating New Possibilities with High-speed Vision

The F160's specialized double-speed cameras can capture images up to 4 times faster than with previous cameras. In addition, cameras feature 8 user-selectable shutter speeds and an Intelligent Lighting Interface. The F160's high speed processing, inspection and measurement results are generated 2 to 10 times faster than before. In the Gray Search example image below, inspections can be completed at a rate of 5,000 inspections per-minute. Because each inspection is performed at high speed, the total inspection time for complex applications is dramatically reduced, leaving time for additional inspections that may not have been possible with previous products. This can lead to significant improvements in production line throughput and product quality.



Simple Gray Search Processing of one area – 12ms

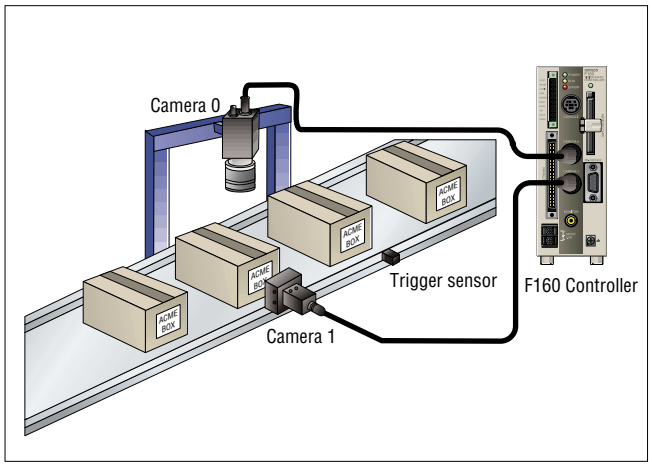
Gray Search Processing of multiple inspection areas – 11ms

Gray Search Processing of multiple inspection areas with position compensation enabled – 35ms

High-speed and Measurement Inspection Applications

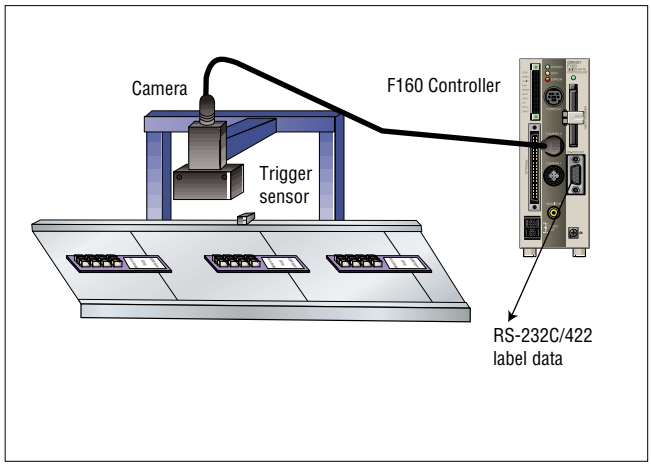
Product Sorting

Sort boxed product by size or labels and inspect seams.



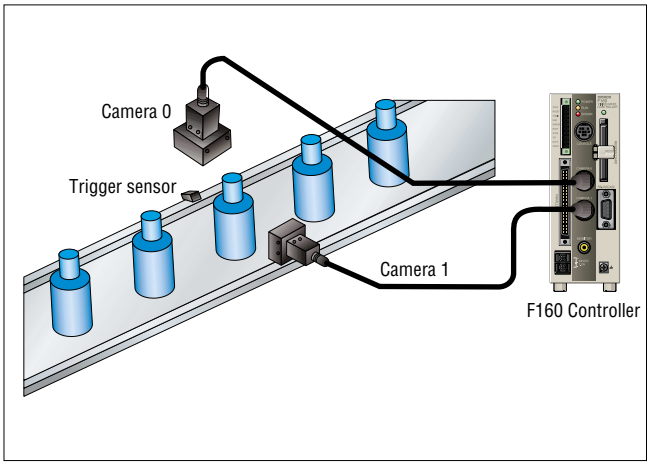
Optical Character Recognition

Pill presence/absence and Lot/Date code confirmation on blister packs.



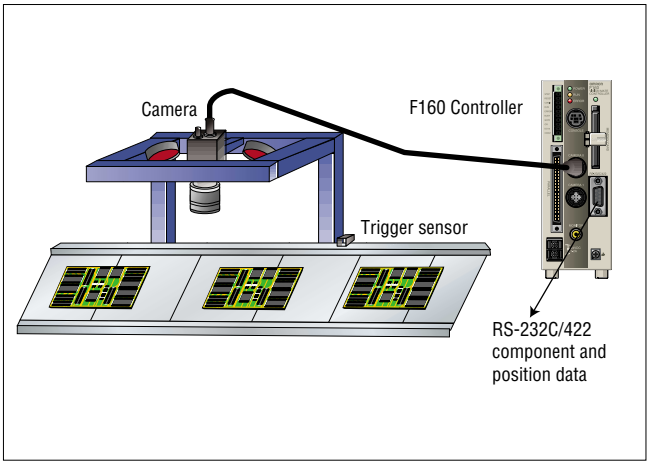
High Speed Bottle Inspection

Inspect dimensions, conformance and date code.



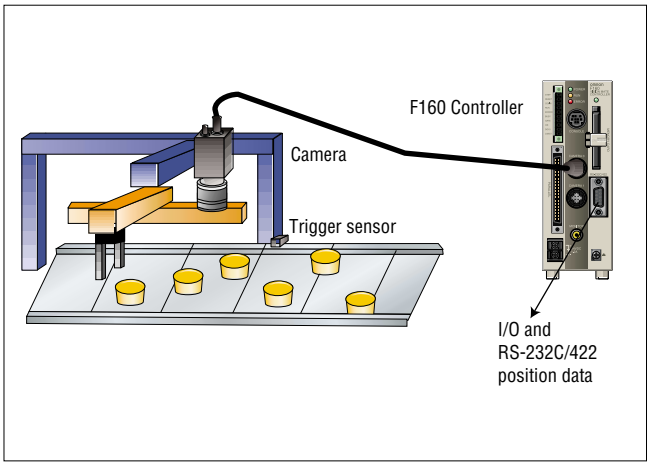
PCB Inspection

Electronic component inspection/board position measurement.



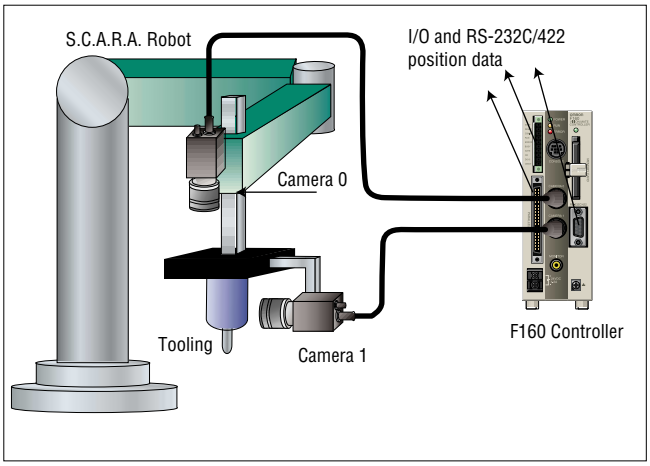
Position Reference

Identify random, odd-shaped product positioning on a conveyor.



High Speed Robotic Tool Guidance

Communicate tool and part alignment and tool wear to robotics.

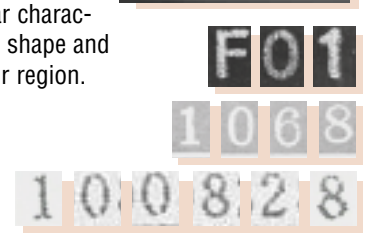


Advanced Algorithms and Functions

New and improved visual inspection algorithms are available in the F160. All of the algorithms take advantage of the high-speed processing and two-camera capability to maximize your visual inspection capability and functionality.

QUEST Optical Character Recognition

Quest is an Omron original OCR algorithm. No character teaching required. Quest has a high level of discrimination between similar characters and adapts to changes in shape and size. OCR of one character per region.



"Variable Box" Measurements

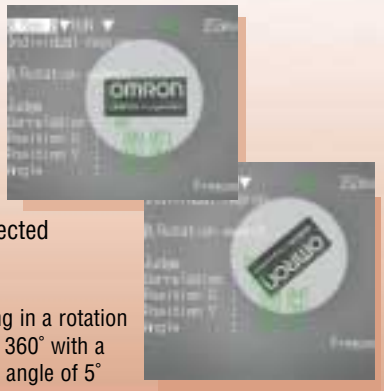
The box measurement region can be setup to change automatically when performing Area or Defect inspections on objects of varying sizes. This ensures that the optimum measurement region is always used for inspection.

Advanced Model Search

Flexible search allows the use of several reference models for a gray scale search. This method allows objects with modestly changing features and varying shapes to be inspected with one tool.

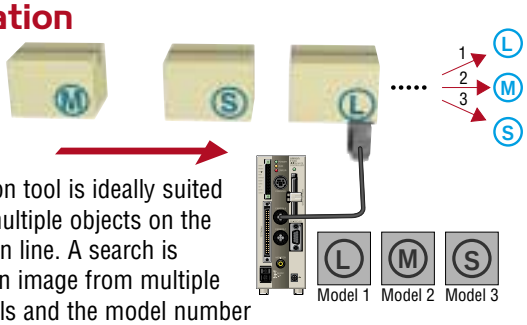
Rotation Search

Rotation Search can be performed on an object to detect rotation up to 360º. The F160 performs this measurement 10 times faster than before and, using angle interpolation, detection angles can be detected with a degree of precision.



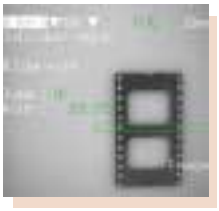
Searching in a rotation range of 360˚ with a skipping angle of 5˚

Classification



The classification tool is ideally suited for sorting of multiple objects on the same production line. A search is preformed on an image from multiple reference models and the model number with the highest correlation is output.

Object Width Measurement



Omron's Edge Width measurement function works like a caliper tool. Two edges of an object are detected to sub-pixel accuracy and from this the width of the object is calculated.

Labeling

Objects with unusual shapes (blobs) can be detected and counted inside a measurement region. Detected objects are then sorted according to area or center of gravity and measurement data for specific labels is output.

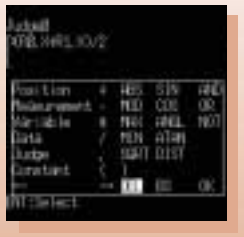
Counting gears

Position Compensation

The F160 can compensate for an object's position by using only the outline or feature of an object or by two reference points from an object. Setting priorities for the compensation direction are also possible.

Compensation in the X direction followed by compensation in the Y direction

Result Expressions



Expressions using up to 32 inspection variables or constants each can be used to produce judgement or data output. Expressions allow for complex calculations based on inspection data to determine output results.

User-friendly Operation

The F160 offers many features to increase its ease-of-use and make its operation as convenient as possible. These features assist in the setup, operation and use of data and images produced by the F160.

I/O Monitor

The status of the input and output terminals can be displayed on-screen. The I/O monitor can be used for checking wiring when setting up or making adjustments to the F160.

Shortcut Keys

Frequently used F160 operations, like result display changes, can be assigned to specific console keys. Menus can also be switched at the touch of a single console button.

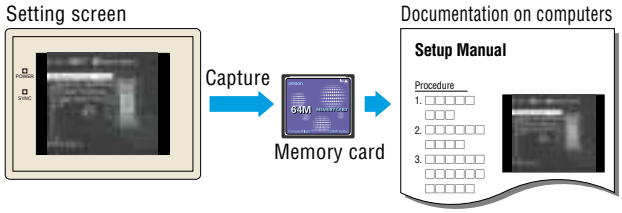
On-screen Figures and Display Colors

Figures such as lines, boxes, circles and crosses can be drawn and positioned on the screen at measurement positions or user set coordinates. Text message and figure colors can be set for best viewing.

Password Option

To prevent unauthorized use or changes to the F160, passwords can be set to restrict access to operation levels. This function will help to improve security and reduce incorrect operation.

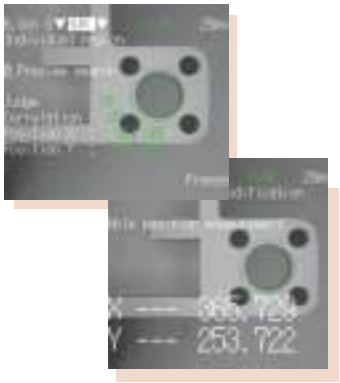
Screen Capture



Images of menu settings, measurement screens, and camera images can be captured and stored in the memory card. This feature is very useful for creating setup and operation documentation.

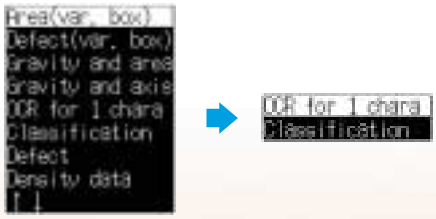
Manageable Screen Text

Screen text messages can be changed to best suit the operating environment. Message position, character size and color and background can also be changed.



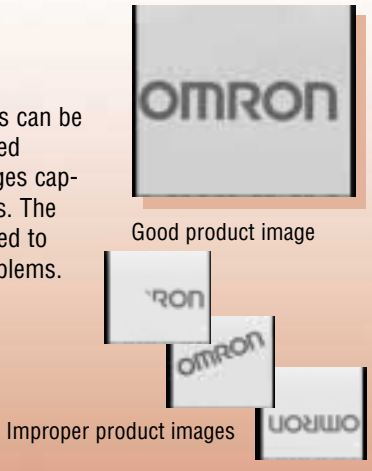
Menu Masking

To save time and simplify setup, menus can be masked off from view to help minimize setup operations. Masking menus can also help prevent unauthorized use of menu operation.



Increased Image Storage

Up to 35 measurement images can be stored in memory. These stored images can consist of all images captured or only the failed images. The stored images can then be used to help diagnose production problems.



RS-232C Output Formatting

The output format of RS-232C data can be set to suit control system requirements. Settings include output format, number of data digits, field and record separators and zero suppression.

The Right Lights & Camera For Your Action

Omron's compact shutter camera is perfect for high-speed inspection applications and can be fitted with several different light sources, including those that support the Intelligent Light Source specification, depending on the application.

Unique, Intelligent Light Sources (ILS)

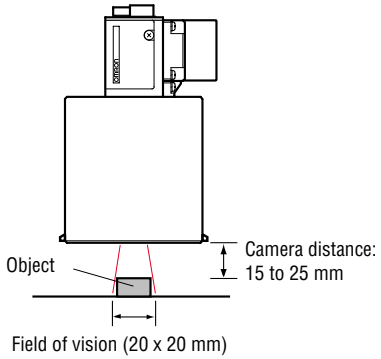
Omron's ILSs and ILS integrated cameras are designed to enhance and simplify your vision applications. The ILSs use a hood shape that reduces external interference, making conditions ideal for highly accurate inspections. The combination of red and green LEDs also enables the F160 to inspect a wide range of objects. One ILS version offers the ability of adjustable coaxial vertical lighting in addition to the adjustable ring light. The adjustable ring light lets the user adjust brightness and light direction based on the application requirements.

Maximize Lighting Control

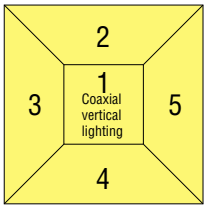
With an Intelligent Light Source camera, the F160's controller menus take all of the guesswork out of proper lighting. Operators can control the illuminated area and light intensity from the controller menus. The settings are easily changed without direct adjustment to the light source. Lighting positioning is stored with other scene data so operators can change the lighting conditions to match different operating environments. Because the settings are numeric data, it is possible to recreate the lighting conditions from machine to machine.

Sensing Distance & Field of Vision

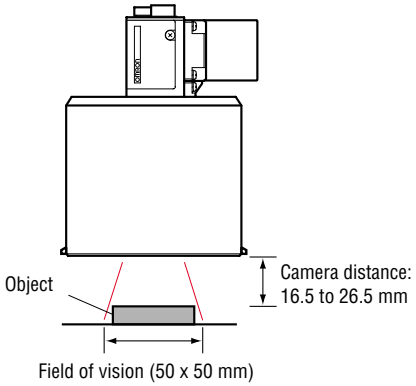
F160-SLC20



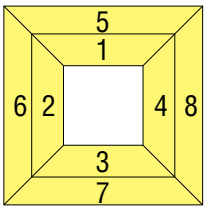
Field of vision: 20 mm
Light intensity can be set separately to one of 8 levels for 5 illuminated areas.



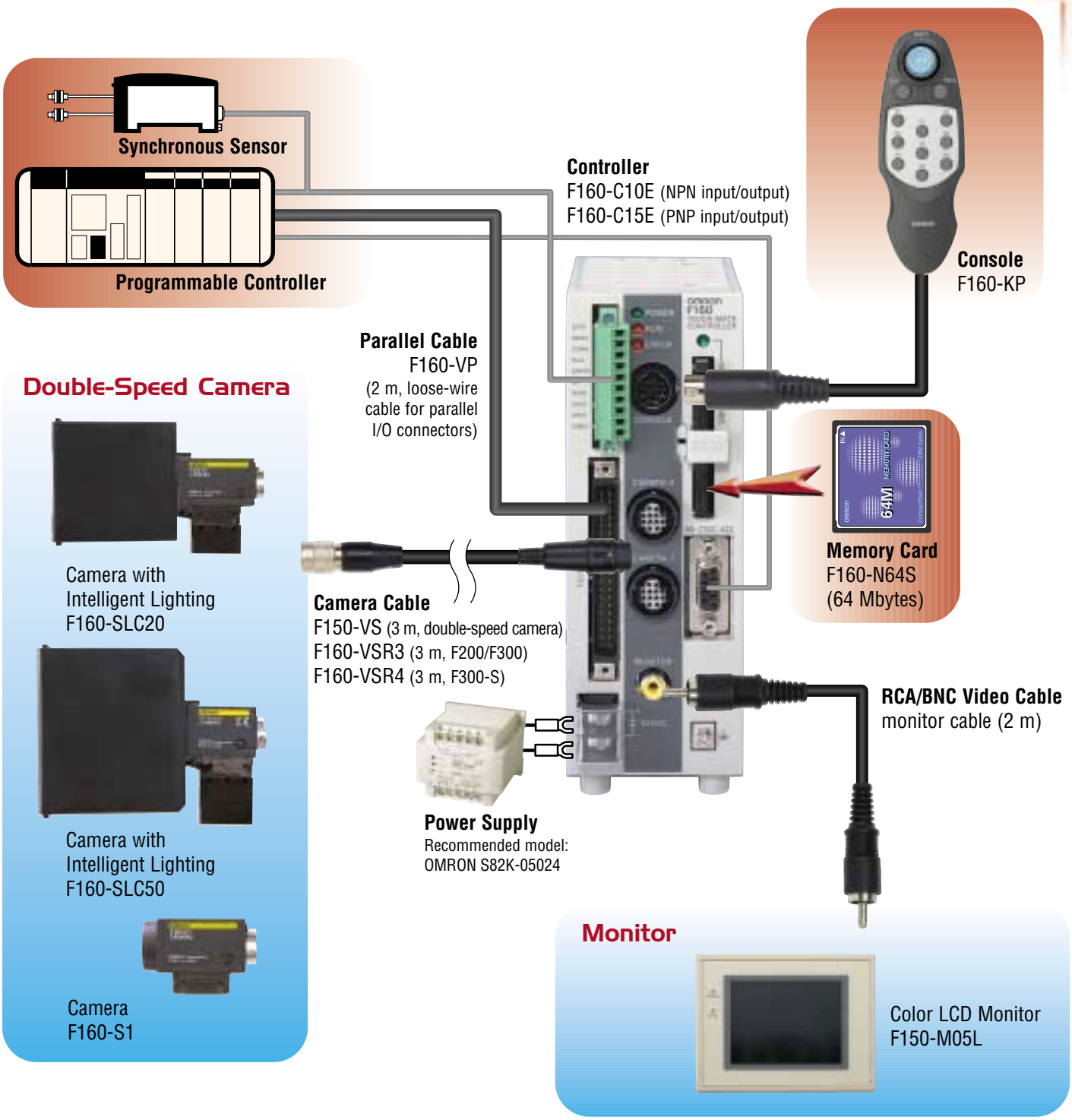
F160-SLC50



Field of vision: 50 mm
Light intensity can be set separately to one of 8 levels for 8 illuminated areas.



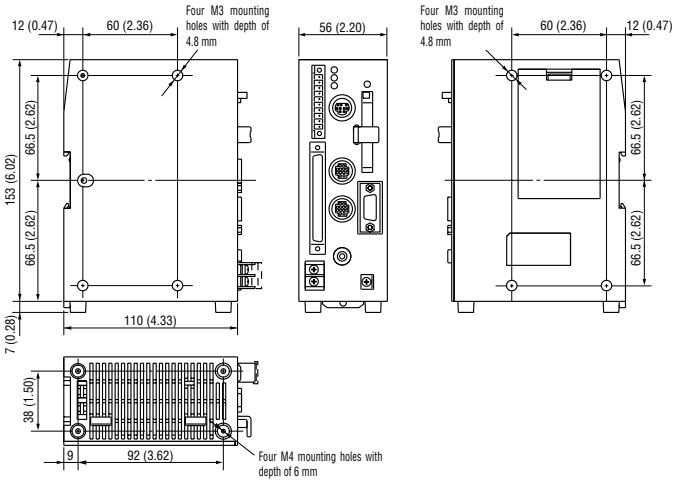
System Configuration



Dimensions Unit: mm (inches)

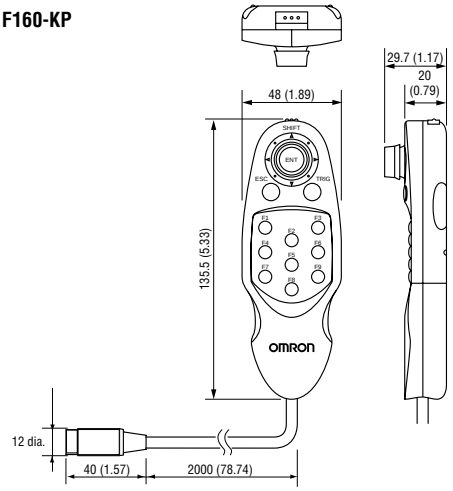
Controller

F160-C10E/C15E



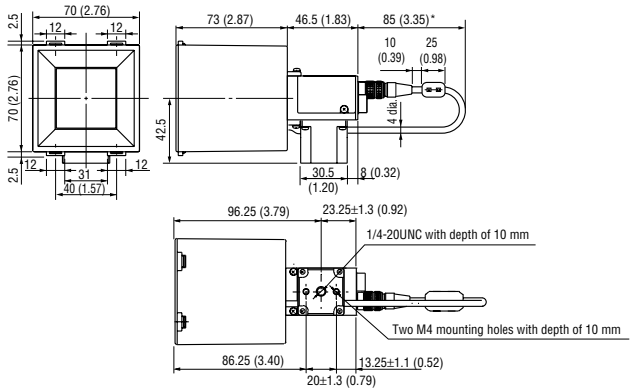
Console

F160-KP

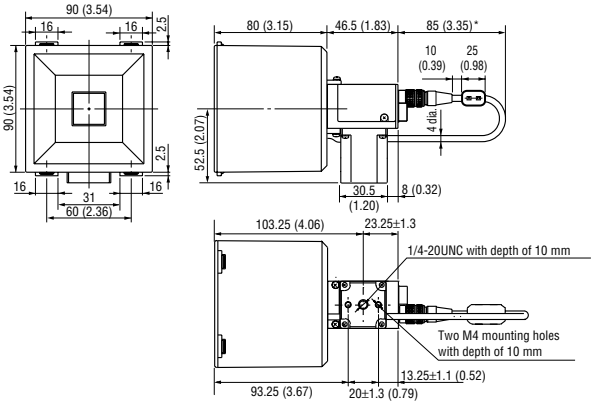


Double-speed Camera

F160-SLC20

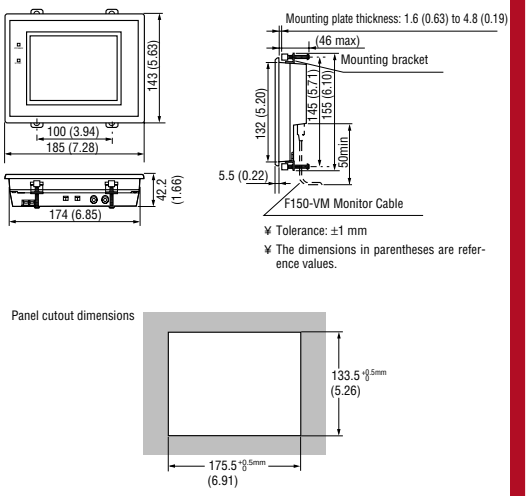


F160-SLC50

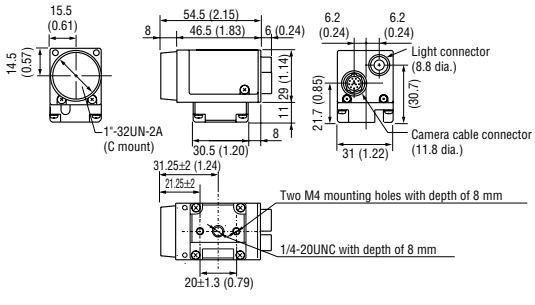


Liquid Crystal Monitor

F150-M05L



F160-S1



Specifications

Rating/Function

Controller: F160-C10E/C15E

Item	Conversational Menu Mode	Expert Menu Mode
Connectable cameras	F150-S1A/SL20A/SL50A/SLC20/SLC50, F160-S1/SLC20/SLC50, F300-S/S2R/S3DR/S4R etc.	
Number of cameras Connectable	1	2
Number of pixels	512 x 484 (H x V)	
Number of scenes	32 (Expansion possible using Memory Card.)	
Image storage function	Maximum of 35 images stored	
Filtering	——	Smoothing (strong, weak), edge enhancement, edge extraction (horizontal, vertical, both horizontal and vertical), dilation, erosion, median, background suppression
Position displacement compensation	Set either automatically or manually Compensation directions: X, Y, and θ (360°) directions	Compensation directions: X, Y, and θ (360°) directions Detection methods: Binary center of gravity, axis angle, labeling, rotation search, gray search, edge position
Number of measurement regions	32 regions per scene	
Applications	7 types available (presence, orientation, dimensions, defects, conformity, position, chips and burs)	——
Measurement data	Automatically selected according to the application.	Gravity and area, gravity and axis, gray search, precise search, rotation search, flexible search, relative search, defect, area (variable box), defect (variable box), edge position, edge pitch, edge width, density average, labeling, OCR for 1 character, classification
Data operation functions (expressions)	——	Number: 32 expressions can be set for judgements, data, and variables used in other expressions Operations: Arithmetic operations, square root, absolute value, remainder, distance, angle, maximum, minimum, SIN, COS, ATAN, AND, OR, NOT
Results output	Overall judgements, judgements for each measurement region	Overall judgements, judgements for each measurement region, expression results, measurement/expression data
Functions for customizing operations	——	Menu masking, password setting, shortcut keys
Functions for customizing screens	——	Display items: Character strings (measurement values, judgement results, times, user-specified characters, measurement region names) Figures (lines, boxes, circles, cross cursors) Specified parameters: Display color, position, size
Number of slots for memory cards	1	
Monitor interface	1 channel (color, monochrome)	
Serial communications	RS-232C/422A, 1 channel	
Parallel I/O	13 inputs and 22 outputs including control I/O points	
Input/output type — NPN	F160-C10E	
Input/output type — PNP	F160-C15E	
Power supply voltage	20.4 to 26.4 VDC	
Current consumption	Approx. 1.6 A (with two F160-SLC50 Cameras connected)	
Ambient temperature	Operating: 0 to 50°C (32 to 122°F) Storage: -25 to 65°C (52 to 149°F) with no icing or condensation	
Ambient humidity	Operating and storage: 35% to 85% (with no condensation)	
External dimensions	56 x 160 x 110 (W x H x D) mm (not including connectors and other protruding parts)	
Weight	Approx. 570 g (Controller only)	

Double-speed Camera: F160-S1

Item	Specifications
Picture element	1/3" Interline CCD
Effective pixels	659 x 494 (H x V)
Scanning method	1/60-s non-interlace (frame) mode, 1/120-s 2:1 interlace (field) mode
Shutter	Electronic shutter; select from 8 shutter-speed settings (1/120 to 1/20,000 s) using menu.
Camera with intelligent lighting	F160-SLC20 (field of vision: 20 mm), F160-SLC50 (field of vision: 50 mm)
External dimensions	31 x 40 x 54.5 (W x H x D) mm (not including connectors and other protruding parts)
Weight	Approx. 85 g (Camera only)

F150-M05L Color LCD Monitor

Item	Specifications
Size	5.5 inches; 111.36 x 83.52 mm (H x V)
Type	Liquid crystal color TFT
Resolution	320 x 240 dots
Input signals	NTSC composite video (1.0 V/75 Ω)
Power supply voltage	20.4 to 26.4 VDC
Current consumption	Approx. 700 mA
Ambient temperature	Operating: 0 to 50°C (32 to 122°F); Storage: -25 to 65°C (52 to 149°F) with no icing or condensation
Ambient humidity	Operating or storage: 35% to 85% (with no condensation)
Weight (monitor only)	Approx. 1 kg
Accessories	Instruction manual and 4 mounting brackets

F160 Vision Sensor Selection Guide

First: Start by selecting the controller part number with the correct input/output type, NPN or PNP, to meet the applications needs.

Second: Choose from the three F160 double-speed cameras. Select one or two cameras based on the application. If a 20 or 50 mm field of vision can be used with the Intelligent Light Source, choose from the F160-SLC20 or F160-SLC50. (See page 6 for SLC20 & SLC50 setting information.) If different field of view and lighting is required, use the F160-S1 camera without lens and light source.

Third: Choose camera cables, Parallel I/O cable, monitor and monitor cable as required. For additional camera cable and parallel I/O cable lengths and monitor options, please consult your Omron vision representative.

Fourth: If F160-S1 camera option is used, refer to the Lens Selection Guide next to choose a lens for the application. The F160-S1 camera also offers the intelligent lighting interface to allow the use of controllable external lighting options. Please consult your Omron vision representative for additional assistance in lens selection and lighting options.

Ordering Information

Name	Model Number	Comments
Controller	F160-C10E	NPN Input/Output
	F160-C15E	PNP Input/Output
Double-speed camera		
with fixed lens &	F160-SLC20	20 mm field of view
intelligent lighting	F160-SLC50	50 mm field of view
Camera only	F160-S1	Without lens or light source
Console	F160-KP	Keypad with shortcut buttons
Color LCD monitor	F150-M05L	5.5 inch color LCD
Memory card	F160-N64S	Memory capacity: 64 Mbytes
Camera cable	F150-VS	For double-speed camera & compatible F150 cameras; Cable length: 3 m
	F160-VSR3	For compatible F200/F300 cameras; Cable length: 3 m
	F160-VSR4	For F300-S only; Cable length: 3 m
Monitor cable	RCA/BNC Video Cable	Cable length: 2 m
Parallel I/O cable	F160-VP	Loose-wire cable for parallel I/O connectors; Cable length: 2 m
Extension tubes	F150-EXT	A set of six extension tubes that are 40, 20, 10, 5, 1, and 0.5 mm in length respectively

Lens Selection Guide

First: Start by defining the field of view requirements for each camera. Refer to the diagram at bottom left. The field of view is considered to be the area or areas requiring inspection. This does not necessarily include the entire part or object in the field of view.

Second: Determine the camera distance, measured from the object surface to the camera. Refer to the lens setting illustration for additional information about setting distance. This distance can impose limitations on the field of view and lens choice. To get the greatest flexibility in lens selection, keep the camera setting distance as flexible as possible.

Third: Using the field of view and camera setting distance requirements, use the optical graph axis marked "Field of view L (mm)" to find the matching field of view size. Use the optical graph axis marked "Camera distance A (mm)" to find the approximate camera setting distance. Follow the values across the chart until they cross. Refer to the lens part reference on the right at the end of the graph line to find the correct lens size. (If a "t" value other than 0 is indicated, corresponding lens extension tubes will need to be added in between the camera and lens in order to properly focus the image. The "t" value indicates the thickness of the extension tubes required.)
Note: Extension tube length should not exceed 10% of the focal length of the lens. When looking at other manufacturers' lenses not referenced by Omron, please use a 1/3-inch CCD size as a selection value reference.

Fourth: If an appropriate lens cannot be found to satisfy your application, please consult your Omron vision representative for additional assistance in lens selection options.

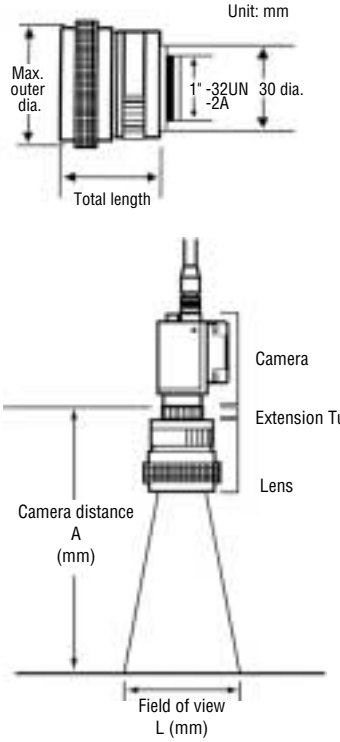
CCTV Lens

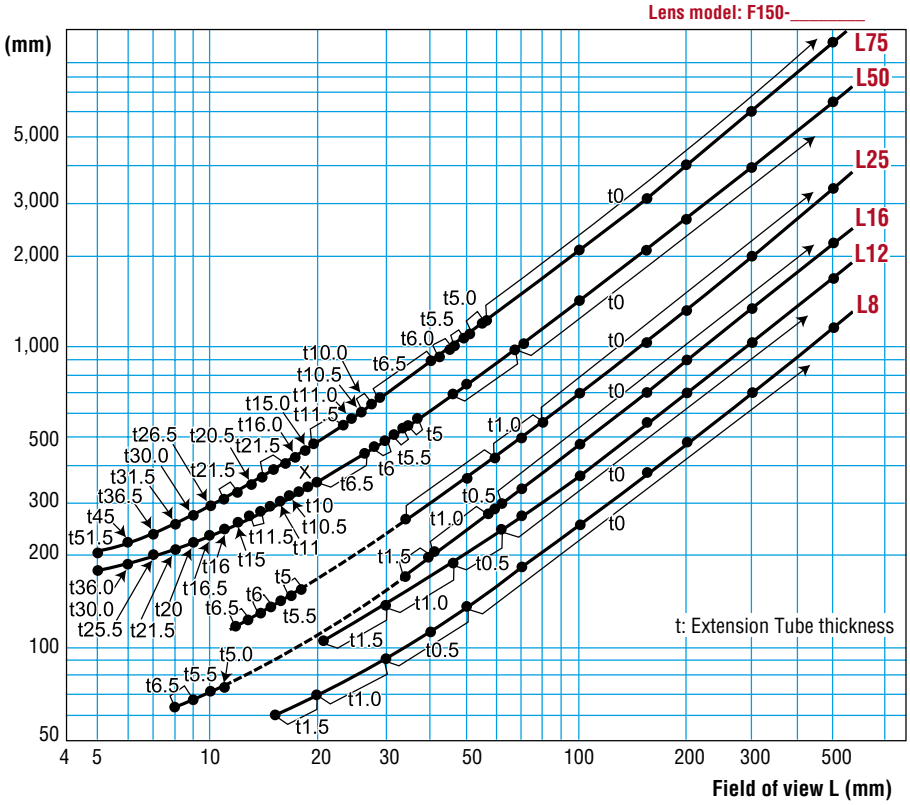
Model	F150-L8	F150-L12	F150-L16	F150-L25	F150-L50	F150-L75
Dimensions	29 dia. x 34.5 L*	30 dia. x 34.5 L*	30 dia. x 24.5 L*	30 dia. x 24.5 L*	32 dia. x 37 L*	32 dia. x 42.5 L*
Focal length	8.0 mm	12.5 mm	16.0 mm	25.0 mm	50.0 mm	75.0 mm
Brightness	F1.3	F1.4	F1.4	F1.4	F1.8	F2.7

* Lens diameter does not include lens ring lock screw height.

Note: Omron reserves the right to change lens suppliers and specifications without notification. Please verify all lenses with sales personnel.

Optical Graph





Note: All values are approximate values. It is recommended that the camera distance be adjusted by sliding the camera forward or backward in actual operation.

Vision Sensors and Support Software Solve Your Toughest Inspection Problems

F-10 Vision Sensor

The ultimate, easy-to-use, grayscale processing package for pattern and shape matching. Setup is ultra quick with no monitor required using a one button teach function and a visible target, integrated lens and light source. Four different camera choices are available, each with different sensing area sizes. One model even includes 8-model bank memory and RS-232C/422 communications capability.

F-30 Vision Sensor

Compact, self-contained vision sensor includes the camera, light source, lens and controller all in one unit. This easy-to-use menu driven binary vision sensor has a 256-level contrast setting and one inspection area that is perfect for most pixel counting applications.

F150-2 Vision Sensor

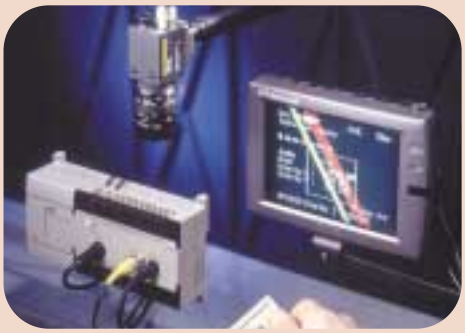
Uses drop down menus to setup functions including filtering, adjusting the shutter speed, background suppression, X, Y, and Theta position compensation, and image calibration. Measurement tools include center of gravity, area, edge position, edge pitch, degree of defect, and more with 16 setup scenes and up to 16 measurements per scene. Other features include a 23-image storage memory, RS-232C and DeviceNet communications.

F150-3 Vision Sensor

Delivers 2-camera performance and lighting control based on the F150-2's easy-to-use format. The camera splitter unit and built-in menus or PC software allows the controller to integrate images from two cameras and perform multi-angle inspections on a single object simultaneously.

Vision Composer Software

This optional Windows®-based Vision Composer software allows you to use more sophisticated functionality in a drag-and-drop flow chart environment with the F150-3 Vision Sensor. Vision Composer can also help collect and report the measurement results without specialized programming.



F400 Vision Sensor

The industries first color Vision Sensor using Hue, Saturation, and Intensity to combine Color Pickup and 5 color filters into an easy-to-use and powerful color vision solution at an affordable price. With Color Pickup, the F400 can be quickly configured to detect and measure up to 8 colors simultaneously or use the industry's first Colorgray filter to convert a color into 256 level grayscale to analyze and measure very fine differences in the isolated color's image, even in fluctuating lighting conditions.

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