

VIM-303

Settings Manual



For Firmware Release 2.6.0

Scope and other documentation

This manual covers the configurable settings of VIM-303. Other relevant manuals include:

- Unboxing and Hardware Assembly Manual
- User Interface Manual
- Blockly Programming Manual
- First Picks with VIM-303 Manual

What are Settings?

The VIM-303 camera has many configurable parameters (called **Settings**) that allow its behavior to be modified. Many of these parameters are used and set by various menus (such as the **Waypoints** tab) without the user's specific knowledge. The design intent of VIM-303 is to make configuring the camera straightforward and not require the user to directly modify settings. However, as the user interface evolves, some settings may need to be modified by the user directly.

Modules

The settings are divided into different modules. Settings can be modified in the **Settings** tab in the Configuration menu (Figure 1). Select the desired module in the pulldown menu (Figure 2) then select the desired setting in the pulldown menu below that. The **Settings** tab shows the current, default, and allowable values for each setting. Refer to the User Interface Manual for details on how to change settings.

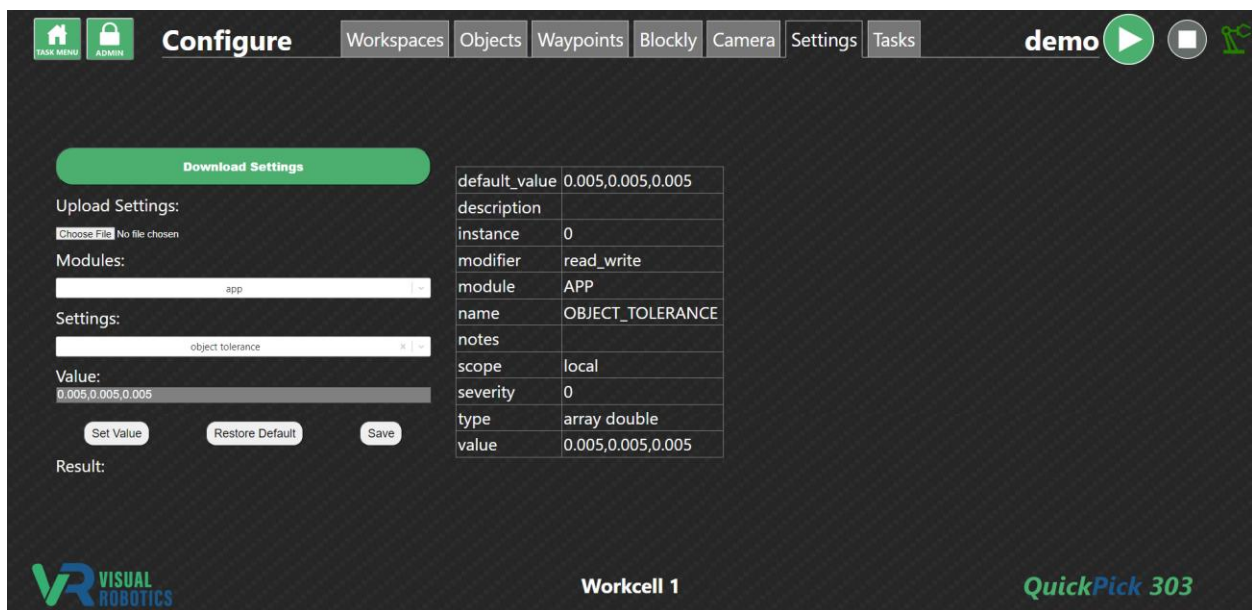


Figure 1 - Settings Tab

Name	Description
APP	Application level
CAMERA	Stereo, Color camera, LED Illumination, and Projector control
CORE	Log level, software version
DEBUG_IMAGE	Change how the annotated image appears (in Objects and Waypoints tabs)
DEPTH_FINDER	Depth finder settings for locating objects
FINDER_CONTROLLER	List of available finders and active finders
MESSAGE_SERVER	Restart app
ROBOT	Robot controller settings
TRACKER	Object tracker settings

Figure 2 - Settings Modules

Module Settings

The following sections tabulate the settings for each module.

APP

Application level settings, not otherwise categorized.

Name	Description
OBJECT_TOLERANCE	Tolerance (in m) of length, width, height for objects
ROBOT_POSE_XXX	6DOF pose of waypoint xxx (created by Waypoints tab)
WORKCELL_NAME	Not used (workcell name is defined in the Core module)

Figure 3 - APP module settings

The **APP** module is typically modified by the QuickPick-303 software itself, not normally modified by the Programmer. In v2.6.0, modification of OBJECT_TOLERANCE must be done by the Programmer from the Settings tab.

CAMERA

Stereo Camera, Inspection Camera, LEDs, and Stereo Projector settings.

Name	Description
AUTOFOCUS_MODE	Auto / manual focus for Color camera (default 0 manual focus) 0: Off, 1: Auto, 2: Macro, 3: Continuous Video, 4: Continuous Picture, 5: EDOF
AUTOFOCUS_TRIGGER *	Set to 1 to initiate autofocus
CENTER_EXPOSURE	Auto / manual exposure for Color camera and exposure value (default 0 autoexposure) Values in microseconds 0 (autofocus) - 33000 (33ms)
CENTER_GAIN *	Color camera ISO value (default 100) 100 - 1600
CENTER_RESOLUTION	Color camera resolution (default 720p) 720p, 1080p, 4K
DEPTH_BRIGHTNESS_FILTER_MAX *	Depth brightness filter maximum value. Pixels with brightness values greater than or equal to this will have their depth invalidated. (default 255) 0 - 255
DEPTH_BRIGHTNESS_FILTER_MIN *	Depth brightness filter minimum value. Pixels with brightness values less than or equal to this will have their depth invalidated. (default 1) 0 - 255
DEPTH_CONFIDENCE_THRESHOLD *	Depth confidence threshold. Lower values filter out low confidence depth values. (default 200) 0 - 255
FPS *	Frames per Second (default 15FPS) 1 - 30 FPS
ILLUMINATOR_MODE	Illumination LED mode (default 0) 0: off, 1: PWM (for color camera), 2: pulsed (for stereo cameras)
ILLUMINATOR_PWM	LED brightness in PWM mode (default 10) 0 - 26 (values greater than 26 current limit to 26)
ILLUMINATOR_SEGMENTS	Selective enable of LED segments (default left, right, top, bottom) Zero or more of: left, right, top, bottom
ILLUMINATOR_STROBE	Maximum LED pulse width for pulse mode with stereo cameras (default 100) Values in microseconds from 1 - 3000
MANUAL_FOCUS	Focus position for manual focus for Color camera (default 128) 0 - 255
MONO_EXPOSURE	Auto / manual stereo camera exposure time (default 1000) Values in microseconds from 0 (autofocus) - 33000 (33ms)
MONO_GAIN *	Stereo camera ISO value (default 100) 100 - 1600
MONO_RESOLUTION	Stereo camera resolution (default 400p) 400p or 720p
PROJECTOR_MODE	Turn IR stereo projector on/off 0: Off, 1: On
PROJECTOR_STROBE	Maximum IR projector pulse width for stereo cameras (default 1000) Values in microseconds from 1 - 1000
REINIT	Reinitialize camera subsystem (set to 1 to reinit)
SOURCE_LIST	Camera images available to be processed or displayed (default right, center, disparity) One or more of: center, left, right, disparity, confidence
STATUS	Camera status 0: not initialized, 1: initialized, 2: error

Figure 4 - CAMERA module settings

Some setting changes to the **CAMERA** module require a camera **REINIT**:
CENTER_RESOLUTION, MONO_RESOLUTION, SOURCE_LIST

* These parameters are unlikely to be changed from default.

CORE

Location of settings not otherwise assigned to other modules.

Name	Description
LOG_SEVERITY_LEVEL	Debug log verbosity level (default 2) 0: Trace, 1: Debug, 2: Info, 3: Warning, 4: Error, 5: Fatal
VERSION	Software version: Release.2.6.0
WORKCELL_NAME	The name of the workcell shown on the bottom of every screen
WORKSPACE	The name of the active workspace
WORKSPACE_NAMES	A list of all available workspaces

Figure 5 - CORE module settings

DEBUG IMAGE

Configures the debug image that is displayed with “show objects”. The debug image can be very helpful for verifying the performance of the vision system. By default, objects that are identified or “found” are shown in color with a purple outline, while the rest of the image is grayscale and dimmed, to enhance the visibility of the identified objects. By default the name of the object (its classification) is shown. The programmer can enable other annotation features, such as showing the object dimensions or location, which may be helpful when developing programs. It takes time to create the annotated debug image, especially if there are a lot of objects in the field of view. Since VIM-303 is a real-time system, it may be important to limit the amount of time that the camera spends annotating the image. This is the purpose of the ANNOTATION_MODE and PERFORMANCE_TIMEOUT settings.

Name	Description
ANNOTATION_MODE	Set to “performance” to stop drawing annotations in debug image if it takes longer than PERFORMANCE_TIMEOUT milliseconds. Set to “complete” to completely annotate the debug image no matter how long it takes (such as when there are many objects in the field of view). (default = “performance”)
DIM_BACKGROUND	Set True to dim the background of areas not containing objects (default)
ENABLE	Set True to enable creation of debug images (default)
ENABLE_ANNOTATION	Set True to enable annotation of debug images (default)
GRAY_BACKGROUND	Set True to gray areas not containing objects (default)
IMAGE_SOURCE	Sets which image is used for creating debug image (default 0) 0:Center/Color, 1:Left/Mono, 2:Right/Mono, 3:Depth, 4:Confidence
MAX_COLS	Sets number of columns of debug image (default 640 pixels)
MAX_ROWS	Sets number of rows of debug image (default 480 pixels)
PERFORMANCE_TIMEOUT	Maximum amount of time (in ms) to annotate debug image (default = 1000)
SHOW_FOUND_OBJECTS	Set True to show “found” objects (not yet tracked) (default False)
SHOW_FRAME_ID	Set True to show frame ID of source image (default False)
SHOW_OBJECT_CENTER	Set True to show center location of objects (default False)
SHOW_OBJECT_CLASSIFICATION	Set True to show object name for each object (default)
SHOW_OBJECT_CLASSIFICATION_CONFIDENCE	Set True to show confidence score based on object dimensions (default False)
SHOW_OBJECT_DIMENSIONS	Set True to show object dimensions (default False)
SHOW_OBJECT_ID	Set True to show unique object ID number (default False)
SHOW_OBJECT_ROTATION_ANGLE	Set True to show orientation angle of object (default False)
SHOW_OBJECT_ROTATION_VECTOR	Set True to show rotation vector for object (default False)
SHOW_OBJECT_VELOCITY	Set True to show measured object velocity (default False)
SHOW_TRACKED_OBJECTS	Set True to show “tracked” objects (default)
TEXT_SCALE	Scale factor for text size (default 0.6)

Figure 6 - DEBUG_IMAGE module settings

The default debug image is a 640x480 image from the Color camera with purple annotation around each tracked object with the object classification text indicated in yellow and the object shown in color. Other areas of the image are dimmed and gray.

DEPTH FINDER

The depth finder uses the 3D camera to detect objects in the field of view. The camera must be aimed straight down when using this finder. The finder can automatically detect a flat surface (known as the Table, whether or not it is an actual table) by detecting a surface that is a uniform distance from the camera and takes up a majority of the field of view. It can automatically detect objects that are on top of this surface. In some cases, the surface that objects are sitting on is relatively narrow. In that case AUTO_TABLE_HEIGHT can be set to false and the surface Z coordinate can be entered in the TRACKER module with the setting WORK_SURFACE_HEIGHT.

Name	Description
ANNOTATE_DEBUG_IMAGES	Set True to show object annotation in debug image (default)
AUTO_TABLE_HEIGHT	Set True to automatically estimate the work surface height. If False, the surface Z height is determined by TRACKER module setting WORK_SURFACE_HEIGHT (default = True)
BORDER_MARGIN	Ignore objects with BORDER_MARGIN pixels from the edge of the image. This may prevent inaccurate measurement of objects that are near the edge of the field of view. Set to -1 to include objects that extend outside the image. (default = 14)
DEBUG_IMAGE_TYPE *	No longer used (default 0) Use DEBUG_IMAGE module setting IMAGE_SOURCE to set which image is annotated.
MAX_CAMERA_HEIGHT	Maximum possible camera height above work surface, meters (default 1) Used to bound AUTO_TABLE_HEIGHT
MAX_OBJECT_HEIGHT	Objects taller than this height will be ignored, meters (default 0.5)
MAX_OBJECT_LENGTH	Objects longer than this length will be ignored, meters (default 0.5)
MAX_OBJECT_WIDTH	Objects wider than this width will be ignored, meters (default 0.5)
MIN_CAMERA_HEIGHT	Minimum possible camera height above work surface, meters (default 0.1) Used to bound AUTO_TABLE_HEIGHT
MIN_OBJECT_HEIGHT	Objects below this height will be ignored, meters (default 0.008)
MIN_OBJECT_LENGTH	Objects below this length will be ignored, meters (default 0.010)
MIN_OBJECT_WIDTH	Objects below this width will be ignored, meters (default 0.010)
MORPH_CLOSE_ITERATIONS *	Used in smoothing the depth map (default 1)
MORPH_CLOSE_KERNEL_SHAPE *	Used in smoothing the depth map (default 0)
MORPH_CLOSE_KERNEL_X *	Used in smoothing the depth map (default 2)
MORPH_CLOSE_KERNEL_Y *	Used in smoothing the depth map (default 2)
MORPH_OPEN_ITERATIONS *	Used in smoothing the depth map (default 1)
MORPH_OPEN_KERNEL_SHAPE *	Used in smoothing the depth map (default 0)
MORPH_OPEN_KERNEL_X *	Used in smoothing the depth map (default 2)
MORPH_OPEN_KERNEL_Y *S	Used in smoothing the depth map (default 2)
PLANE_TOLERANCE	Maximum deviation within a plane to consider it flat for auto table height measurement, in meters (default 0.005)

Figure 7 - DEPTH_FINDER module settings

The **Depth Finder** can automatically detect the surface height (also known as Table Height) by seeing a majority of the stereo field of view being measured at substantially the same Z distance. For more complicated scenes, the AUTO_TABLE_HEIGHT should be set to False and the WORK_SURFACE_HEIGHT (in TRACKER module) should be set to the Z value in the robot coordinate system (such as by joggng the end effector to the work surface and noting the Z value of the position).

* These parameters are unlikely to be changed from default.

FINDER_CONTROLLER

The Finder Controller contains a list of all the available finders and the ones that are actively looking for objects. The more finders that are enabled, the slower the frame rate will be, as the processor sequentially processes the incoming images with each finder.

Name	Description
ACTIVE_FINDERS *	Finders that are actively running (default depth)
AVAILABLE_FINDERS *	List of finders that could be loaded (default depth, ram)

Figure 8 - FINDER_CONTROLLER module settings

* The **FINDER_CONTROLLER** should not have its values changed from default in version 2.6.0.

MESSAGE_SERVER

The Message Server module is used for internal inter-process communication. It has only one setting that a Programmer should ever modify. Setting RESTART_APP to 1 will restart the QuickPick application and underlying processes. This may be required to resolve unexpected camera behavior.

Name	Description
MAX_SUBSCRIPTIONS *	Maximum number of subscriptions to on-board web server (default 6)
PORT *	TCP port for inter-process communication (default 5565)
RESTART_APP	Restarts the entire VIM-303 application (set value to 1)
TEST_SETTING *	Not used

Figure 9 - MESSAGE_SERVER module settings

The only setting to be changed by a Programmer is RESTART_APP.

* These settings should not be changed from default.

ROBOT

The Robot module contains settings that affect the robot performance and also specifies the Host IP address of both the camera (HOST_IP) and the robot (IP). The connection from the camera to the robot may be reinitialized by setting REINIT = 1. The robot is controlled via a “command processor” PolyScript program that runs on the Universal Robot. This is typically initiated from the VIM-303 camera. If a Programmer is running their own PolyScope program on the robot’s pendant, the command processor program must be run as a thread in that program and the LOAD_UR_COMMAND_PROC setting should be set to False.

Name	Description
ACCELERATION	Linear acceleration, m/s ² (default 3)
DEFAULT_POSE	Camera location if fixed mounted, not hooked to a robot (default 0,0,0,0,0)
HOME	Home pose of the robot (default should be changed to match desired home pose)
HOST_IP *	IP address of the camera, see table below (default auto)
IP **	IP address of the robot (default = "")
JOINT_ACCELERATION	Joint acceleration, rad/s ² (default 3.14)
JOINT_VELOCITY	Joint velocity, rad/s (default 1.57)
LOAD_UR_COMMAND_PROC	If true, a command processor PolyScript program is loaded onto the robot to allow the VIM-303 camera to control it. If false, it is assumed that the command processor is being run as a thread via a PolyScope program or that the camera is fixed mounted and is not being used to control a robot. (default true)
MESSAGE_PORT ***	TCP port for communicating with the command processor (default 5575)
METADATA_DELAY ***	Used for dynamic processing (default 0)
PICK_GRIP_TIME	Time to wait after actuating gripper, seconds (default 0.5)
PICK_RETRACT_DISTANCE	Distance to move upward after picking an object, meters (default 0.050)
PORT ***	Robot telemetry port (default 30003)
REINIT	Reinitialize robot subsystem (set to 1 to reinitialize connection to robot)
SERVO_BOUNDARY	Boundary rectangle servoing is allowed to traverse (default 0,0,0,0,0) Format x1,y1,x2,y2,x3,y3 of lower left, lower right, upper right. Set to all 0s to disable.
SERVO_PORT ***	TCP port for communicating with the command processor (default 10000)
SERVO_TIME_OFFSET ***	Used for dynamic processing (default 0.11)
SERVO_UPDATE_INTERVAL ***	Used for dynamic processing (default 50)
TYPE	Type of robot, used to set reach boundaries or disable robot (default NONE) UR3, UR5 (for robots UR10, UR16, and larger, set value to UR5)
VELOCITY	Linear velocity, m/s (default 0.1)
VERSION ***	Version of the robot driver library (default Release.2.54.202307171544.b914dd1a)

Figure 10 - ROBOT module settings

* The HOST_IP table (Figure 11) shows the IP address of the camera based on the setting of HOST_IP and whether there is a DHCP server on the network. The camera HOST_IP defaults to **auto** which will get a DHCP address from a server or will set the camera’s address statically to 192.168.1.47 if there is no DHCP server.

** The robot’s IP address is set with the IP setting and must be reachable (on the same subnet) as the camera. The robot must be set to a static IP address.

*** Do not change from default values.

HOST_IP Table

IP Address Setting	DHCP Server?	DHCP Subnet	Static Address	DHCP Address
auto	Yes	192.168.1.xx	disabled	Yes
auto	Yes	not 192.168.1.xx	disabled	Yes
auto	No	N/A	192.168.1.47	No
static address	Yes	same as address	static address	Yes
static address	Yes	different from address	disabled	Yes
static address	No	N/A	static address	No

Figure 11 - HOST_IP Table

TRACKER

The Tracker creates a model of the location and motion of all objects that have been recently or currently seen. Various settings set the behavior of the model. Of particular interest to the Programmer are the settings BELT_VELOCITY, MAX_BELT_SPEED, STACKED_OBJECTS, TCP_CAMERA_OFFSET, VELOCITY_MODE, and WORK_SURFACE_HEIGHT. The behavior of the Tracker based on VELOCITY_MODE is shown in Figure 13. By default, the Depth Finder identifies objects by matching all of their dimensions (length, width, height) to the list of object templates. If STACKED_OBJECTS is set to True, then the height of the object will be ignored, allowing the Depth Finder to match a stack of objects.

Name	Description
APPEAR_THRESHOLD *	Number of frames an object is seen before added to the tracked list (default 3)
BELT_VELOCITY ***	Velocity vector for velocity mode = constant_known (default 0,0,0) Format vx,vy,vz in m/s
CORRELATION_THRESHOLDS *	Thresholds of max error when tracking objects (default 0.5,0.2,10,0.01,0.01,0.01,0.5) Format: 0: position[m], 1: speed[m/s], 2: rotation[deg], 3: length[m], 4: width[m], 5: height[m], 6: shape_consistency[0-1]
DEBUG_IMAGE_TYPE	Unused (default 0)
DISAPPEAR_THRESHOLD *	Number of frames an object is missing before removed from the tracked list (default 2)
DISPARITY_GAIN *	Calibration of conversion of disparity to depth (default 1)
ENABLED *	Enable the tracker (default true)
MAX_BELT_SPEED ***	Max speed of belt in velocity mode, m/s = constant_unknown or variable (default 0.5)
STACKED_OBJECTS	Set true to ignore upper height tolerance to allow stacked objects (default false)
TCP_CAMERA_OFFSET **	Extrinsic calibration from robot TCP to camera. Specified in Unboxing and Hardware Assembly manual per end effector. (default = VR suction gripper)
VELOCITY_MODE ***	Motion model used for tracking objects (stationary) Values: stationary, constant_known, constant_unknown, variable
WORK_SURFACE_HEIGHT	Work surface height in robot coordinate system Z, meters (default 0) Used with depth finder AUTO_TABLE_HEIGHT = false

Figure 12 - TRACKER module settings

* These settings should not be changed from default without careful consideration.

** This value depends on the camera mount and end effector. See the Unboxing and Hardware Assembly manual for values.

*** The VIM-303 tracks objects optically by observing their motion from frame to frame and by knowing the location of the camera when the picture was taken using the patent-pending **Vision-In-Motion** technology. The **Tracker** module uses the assumption from the VELOCITY_MODE setting to parameterize its motion model, described in Figure 13.

VELOCITY MODE	Description
stationary	Object is known to be stationary Scenario: object is sitting on a table Object velocity set to 0 Most accurate picking scenario (because no velocity measurement error)
constant_known	Object is known to be moving at a constant velocity Scenario: object is on a conveyor belt with a precision controlled and known speed Object velocity vector is specified in BELT_VELOCITY setting
constant_unknown	Object is moving at a constant velocity (which may be 0 for stationary) Scenario: object is stationary or moving on a conveyor or otherwise at speed Object velocity is measured optically by observing movement from frame to frame Maximum allowed velocity specified in MAX_BELT_SPEED setting
variable	Object is moving erratically (may be still or moving) Scenario: object is being held in a person's hands Object position is measured frame-by-frame Maximum allowed velocity specified in MAX_BELT_SPEED setting

Figure 13 - VELOCITY_MODE settings