# RV2 Video Processor



## RV2 Overview

As part of a system is comprised of a machine vision color camera（VGAC）, and a dedicated video processor and collection device（RV2）. Video is streamed from the camera to the RV2 collection device where it is processed and stored. Camera triggering is precisely synchronized to the collection system（RZ）allowing frame by frame correlation between video data and other recorded system signals.

A number of methods support robust target tracking including red/green LEDs mounted on the ZIF-Clip® headstage or limb tracking. Positional information is available in real-time on the RZ device and can be processed and/or stored. Image data is stored on dedicated hard drives within the RV2 in DIVX encoded AVI files.

Access to the RV2 storage array can be provided through a LAN connection or direct connection to a PC.

The RV2 is recommended for use with TDT systems only.

### Power and Communication

A fiber optic port on the back panel of the RV2 is used to communicate with an RZ device. The RV2 receives timing pulses from a special DSP（RZDSP-V）and returns real-time frame and tracking information for further processing and storage.

Communication to the RV2 is provided through a touch screen user interface independent from the TDT system. Firmware updates for the RV2 interface are available online through the TDT web server. See "Config" on page 9-15, for more information.

Snapshots are sent from the RV2 over the network to the PC for laying out regions using RVMap software. Configuration files are sent from RVMap software to the RV2, also over the network.

The RV2 contains an integrated switched-mode power supply. The power supply auto-detects your region's voltage setting and no further configuration is needed. A switch located on the back panel of the RV2 is used to enable/disable the power supply.

# Software Control

Software control is implemented with circuit files developed using TDT's RP Visual Design Studio (RPvdsEx) on the RZ processor through TDT's OpenEx software package. A single RPvdsEx macro is provided to configure the RZ to send trigger information to the RV2 and receive frame and positional information.

See the "RZ Z-Series Processors", for more information on your RZ processor. For circuit design techniques and a complete reference of the RPvdsEx circuit components, see "MultiProcessor Circuit Design" and "Multi-Channel Circuit Design" in the *RPvdsEx Manual*.

RVMap software is used to define regions and tracks for the RV2 search algorithm and determine what data is returned to the RZ for real-time analysis and/or storage. See "RVMap Software for RV2" on page 9-21, for more information.

### Triggering the RV2

The Video_Access macro is provided for configuring video tracking and must be added to the circuit file used in OpenEx. The macro has settings for the frame control, rate, and storage. See the macro internal help for more information.



This macro also requires that the CoreSweepControl macro is present in the circuit to handle all circuit timing. The Video_Access macro stores timestamps when frame information is received. The PosData multi-channel stream contains tracker positions. Information for up to eight targets can be returned to the RZ for storage. RVMap is used to define the targets that are returned to the RZ. The Video_Access macro **must** be assigned to the DSP that is physically connected to the RV2.

The Video_Access macro controls when frame triggers are sent from the RZ to the RV2. The RV2 receives the trigger, retrieves an image from the camera, adds it into the video file, performs the tracking algorithm and prepares the tracking data to be sent to the RZ.

The RV2 waits until the next camera trigger from the RZ before returning the tracking data from the previous frame to the RZ. This ensures that there is always enough time to collect an image from the camera and run the tracking algorithm on it, and greatly reduces the likelihood that a frame is missed due to jitter in the collection process. However, because of this protection the data received by the RZ is always off by one frame.

When track data is sent to the RZ it is also written to the tracking.txt file. The timestamp in the tracking.txt file indicates when the data was collected from the camera and is relative to when the RV2 began recording.

### Recording Sessions

When OpenWorkbench is set to 'Record' mode and a Video_Access macro is present in the circuit, Workbench sends a UDP packet over the network to find RV2s. If Workbench doesn't receive a response within five seconds an error message is displayed and recording begins without video storage. The UDP packet contains the tank and block name so the RV2 can properly name its files. Once an RV2 responds, OpenEx begins sending frame triggers and recording data. When OpenEx switches modes to anything other than 'Record' a packet is sent to the RV2 to close the files it is currently writing to and wait for the next recording session.

### Frame Rate

The maximum frame rate depends on the camera's exposure setting. This value can be adjusted using the 'Lighter' and 'Darker' buttons on the RV2 touch screen interface. The frame rate is overlaid on the camera image in the Live tab. The current maximum rate based on the camera settings is displayed when the camera is in free run mode.
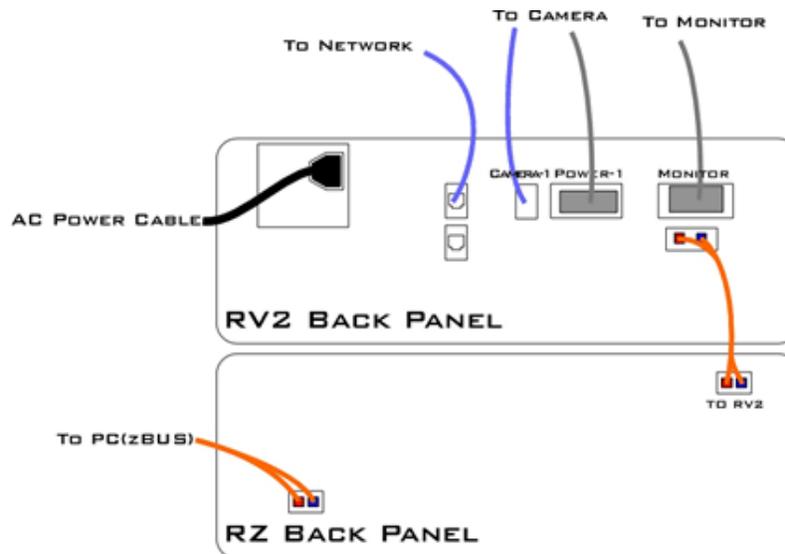
**Note:** When recording data it is important that the desired frame rate is no greater than the observed free run frame rate, otherwise frame loss will occur. A lost frame counter is overlaid on the lower right corner the camera image. To reset this counter, see the Status tab. A reboot will also reset the lost frame counter.

# Hardware Requirements

Basic requirements include a VGAC, an RV2, an RZ equipped with at least one video fiber optic port, one fiber optic cable for connection between the RV2 and RZ, the VGAC power cable, one Gigabit Ethernet cable to connect the VGAC to the RV2, a PC equipped with an Ethernet port or an Ethernet jack connected to a local area network, and an Ethernet cable.

# Setting-Up Your Hardware

**Important!** Make sure that all cables are connected before powering on the RV2.
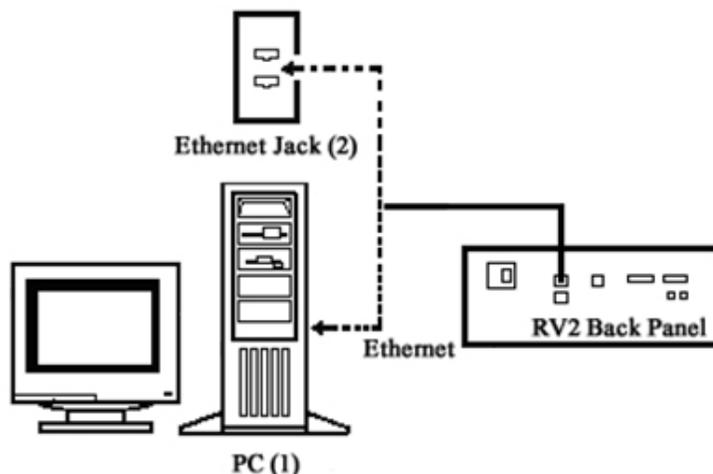


RV2 to RZ Connection Diagram

In the diagram above, a single RZ connects to the RV2. The fiber optic cables are color coded to prevent wiring errors.

The RV2 Video Processor connects to one RZ processor via orange fiber optic cables from the back of the RV2 to the dedicated RV2 port on the back of the RZ (labeled 'To RV2').

The gray camera power cable connects the 'Power-1' port on the RV2 to the VGAC camera. A GigE cable connects the 'Camera-1' port on the RV2 to the VGAC.

An Ethernet cable connects the 'Network' port on the RV2 to either a local area network or directly to the PC running OpenEx.

Optionally a VGA cable is connected from the 'Monitor' port on the RV2 to an external monitor.



**RV2 PC and Network Connection Diagram**

The diagram above illustrates possible connections from the RV2 to a PC (1) or network (2). Connect the Ethernet cable to the RV2 port labeled Network.

# Configuring the RV2

Default configuration settings allow the RV2 to begin streaming video immediately. The RV2 supports the DHCP (Dynamic Host Configuration) protocol for automatic configuration of network parameters. Once connected to an active network, the RV2 will attempt to lease an IP address.

### The DHCP Protocol

DHCP or "Dynamic Host Configuration Protocol" is a protocol used by networked devices (clients) to obtain various parameters necessary for the clients to operate in an IP (Internet Protocol) network. By using this protocol, system administration workload greatly decreases, and devices can be added to the network with minimal or no manual configuration.

DHCP automates the assignment of IP addresses, subnet masks, default gateway, and other IP parameters. Three modes for allocating IP addresses exist: Dynamic, Reserved, and Manual. The RV2 relies on Dynamic mode for its IP configuration. If no DHCP server responds, enable manual configuration mode with the following static IP configuration:

**IP Address:**          10.1.0.42

**Netmask:**          255.255.255.0

You can configure the IP address manually through the touchscreen interface. See "To enable manual configuration:" below or "Status" on page 9-14.

### Dynamic mode

In dynamic mode a client is provided with a temporary IP address for a given length of time. The duration is dependent on the server configuration and may range from several hours to months.

The RV2 will automatically renew the current IP address as needed. This renewal is used by properly functioning clients to maintain the same IP address throughout their connection to a network.

## Accessing the RV2

**There are two methods provided for accessing the RV2:**

- Directly connecting to a PC
- Connection to a local area network

### Direct Connection to a PC

Direct connection to a PC allows data on the RV2 to be viewed and modified through the standard Microsoft Windows file sharing protocol.

**Important:**          When using a Static IP, the RV2 Current IP must be set to "Configure Manually" using the touch screen interface.

**To enable manual configuration:**

1. Touch the **Status Tab and then** touch the **Current IP field,** to display the Network Configuration window.



Network Configuration
☐ Configure Manually
IP Address: 10.1.0.42
Subnet Mask: 255.255.255.0
Gateway: 10.1.0.1
Name Server: 10.1.0.1
MAC Address: 00:25:90:52:47:66
OK   Cancel

2. Touch the **Configure Manually** check box and click OK to accept the default value.
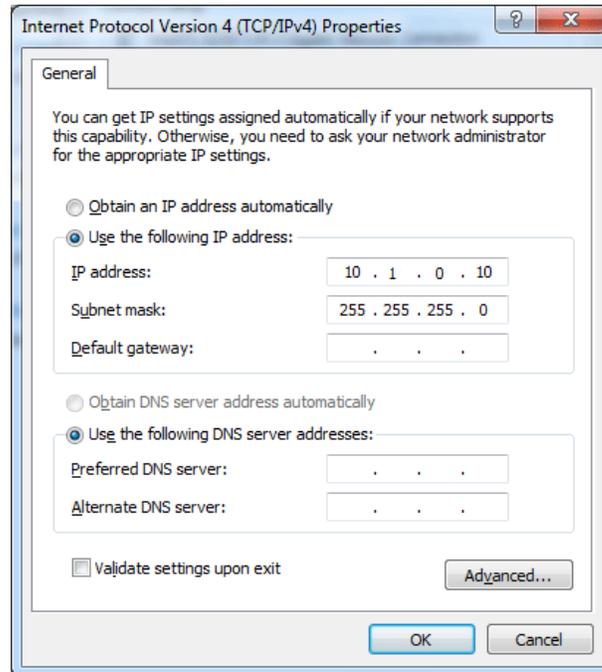
### Using Windows 7

**To access the RV2 file system through a PC, running Windows 7:**

3. You will have to configure the PC TCP/IP settings. Open **Control Panel** then double-click **Network and Sharing Center.**
4. Click the desired connection link (this is usually a Local Area Connection).
5. In the status dialog, click the **Properties** button.

6. In the item list, select **Internet Protocol (TCP/IP)** or if there are multiples, select **Internet Protocol (TCP/IPv4).**

7. Click the **Properties** button.

8. Select **Use the following IP address** and enter these values:

   **IP address:** 10.1.0.x, where x can be any value from 1 to 254 except 42.
   **Subnet mask:** 255.255.255.0
   **Default gateway:** Leave empty



9. Click **OK.** The RV2 can now be accessed by the PC.

10. Obtain the RV2 device address.

    a. Press the **Live** tab on the RV2 interface.

    b. The device address is displayed at the top of the page to the right of **Device Name** field.

11. Enter the device address as shown in a windows address bar to access the RV2 file system.



    Typically, the path \\RV2-XXXX\ is used to access the RV2 storage array, where XXXX is the device serial number, but the name should be verified on the Live tab.

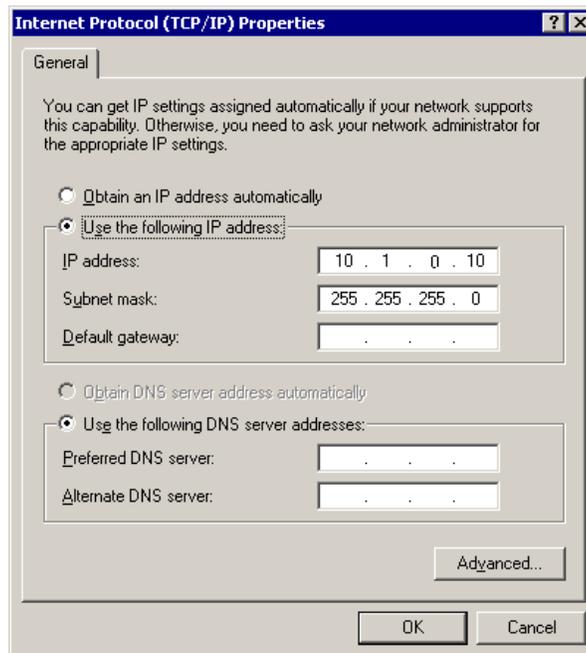12. Access the files on the RV2 by reading or writing.

    ⚠ WARNING! Do not attempt to write to the RV2 at any time while data is actively recording Doing so may corrupt data currently being stored.
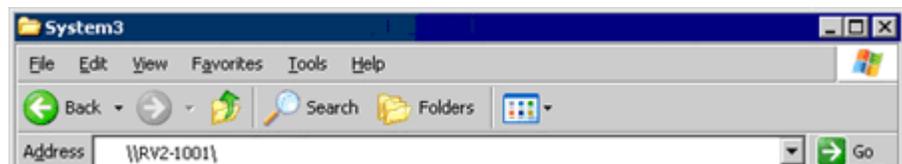
**RV2 Video Processor**

**Using Windows XP**

**To access the RV2 file system through a PC:**

1.  You will have to configure the PC TCP/IP settings. Open **Control Panel** then double-click **Network Connections.**

2.  Right-click the desired connection (this is usually a Local Area Connection) and select **Properties.**

3.  Select Internet Protocol (TCP/IP) or if there are multiples, select Internet Protocol (TCP/IPv4).

4.  Click the **Properties** button.

5.  Select **Use the following IP address** and enter these values:
    **IP address:** 10.1.0.x, where x can be any value from 1 to 254 except 42.
    **Subnet mask:** 255.255.255.0
    **Default gateway:** Leave empty



6.  Click **OK.** The RV2 can now be accessed by the PC.

7.  Obtain the RV2 device address.

    a.  Press the **Live** tab on the RV2 interface.

    b.  The device address is displayed at the top of the page to the right of **Device Name** field.

8.  Enter the device address as shown in a windows address bar to access the RV2 file system.



    Typically, the path \\RV2-XXXX\ is used to access the RV2 storage array, where XXXX is the device serial number, but the name should be verified on the Live tab.

9.  Access the files on the RV2 by reading or writing.

⚠ WARNING! Do not attempt to write to the RV2 at any time while data is actively recording. Doing so may corrupt data currently being stored.

## Connecting Through a Network

Connection to a local area network also allows data to be viewed and modified through the standard Microsoft Windows file sharing protocol from any PC connected to the same network as the RV2.

**To access the RV2 file system through a network:**

1. DHCP must be enabled on the network in order to access the RV2. If DHCP is disabled or not supported, you can connect the RV2 directly to a PC.

2. Obtain the RV2 device address.

   a. Press the **Status** tab on the RV2 interface.

   b. The device address is displayed in the middle of the page just under the **Fan Speeds**.

3. Enter the device address in a windows address bar to access the RV2 file system.

4. Access the files on the RV2 by reading or writing.

⚠ WARNING! Do not attempt to write to the RV2 storage array at any time while data is actively streaming. Doing so may corrupt data currently being stored.

### Finding the MAC Address

In some labs, the network administrator may require RV2 users to provide the device's MAC address.

To determine the address, follow the instructions below:

1. On the touchscreen interface, press the Status tab. Press in the Current IP field.

2. A Network Configuration dialog is opened and the MAC address is displayed at the bottom of the pop-up window.

**Note:** If the RV2 does not automatically identify on a network, you can force it to reset its IP address by unplugging the Ethernet cable the plugging it in again.

# RV2 Storage Format

The RV2 has three main storage folders – configs, recordings, snapshots.

**Configs:** All of the rvm configuration files sent from RVMap are stored here.

**Recordings:** For each recording, a new folder is created that contains the avi file, the rvm used for that recording and a text file (tracking.txt) that contains the results of the tracking algorithm. The tracking.txt file contains a list of frame numbers and tracked point information for each frame. The total number of points may exceed the 8 tracked target limit of the RZ2

**Snapshots:**         Holds JPG images from when the Snapshot button was pressed on the Live tab of the RV2 interface.

## Naming Convention

When connected to an active network, TDT's OpenEx software sends information to the RV2 via a broadcast UDP packet allowing it to properly name the video file recorded on the RV2. This allows you to easily match up the video with data stored in the tank. For example, if you are recording for the event Vid0 in Block-3 of DemoTank2 the RV2 will store in the following location and format:

\recordings\DemoTank2\Block-3\DemoTank-Block-3_Vid0.avi

Without the OpenEx network information the RV2 falls back to the default data format:

\recordings\YYYY-MM-DD hh_mm_ss\YYYY-MM-DD hh_mm_ss.avi

**Note:**    The snapshots always store in the default format.

\snapshots\YYYY-MM-DD hh_mm_ss.jpg

# RV2 Features

## Power Button

A power button located on the front plate of the RV2 is used to turn the device on and off. Prior to powering on/off, the device will enter a brief boot/shutdown period.

**Important!**    Only power the RV2 down when it is not actively recording a video. Failure to do so may result in the RV2 performing a file system check during the next boot process and possible data loss.

**Note:**    If the RV2 becomes unresponsive and fails to shutdown normally, you can shut the device down by holding the power button for longer than five seconds. This will force the device to shutdown. After a forced shutdown, the RV2 may perform a file system check.
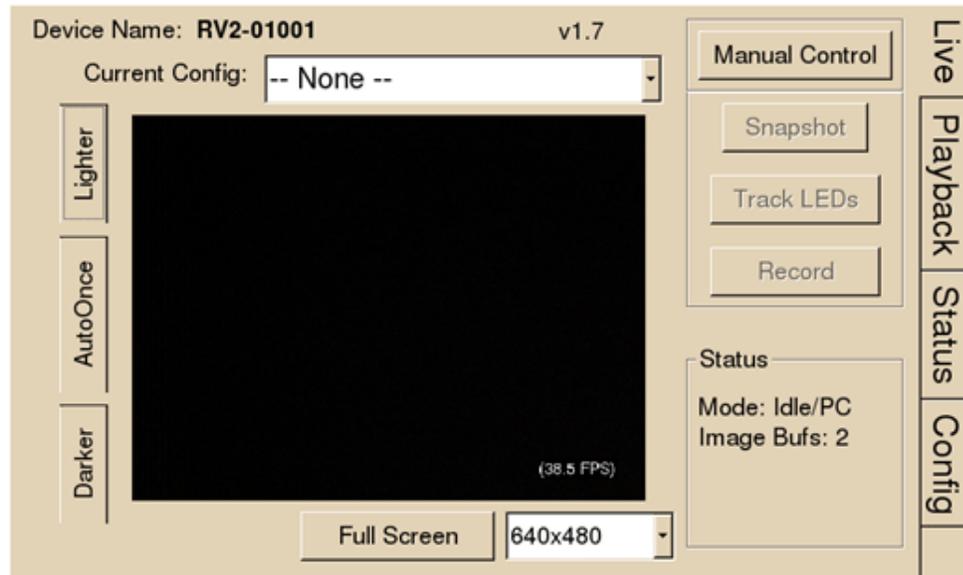
## LCD Touch Screen

The LCD touch screen allows navigation through the RV2 interface. To make a selection, gently press the touch screen on the desired item.

## Interface

The interface reports information and allows configuration of available options. A selection tab located on the right-side of the screen allows the user to select between the available pages. To navigate to the desired window, press the corresponding tab on the right side of the LCD screen.

# Live

The Live tab shows the current image captured by the camera, allows changes to the camera settings, and allows the user to choose the current tracking configuration.
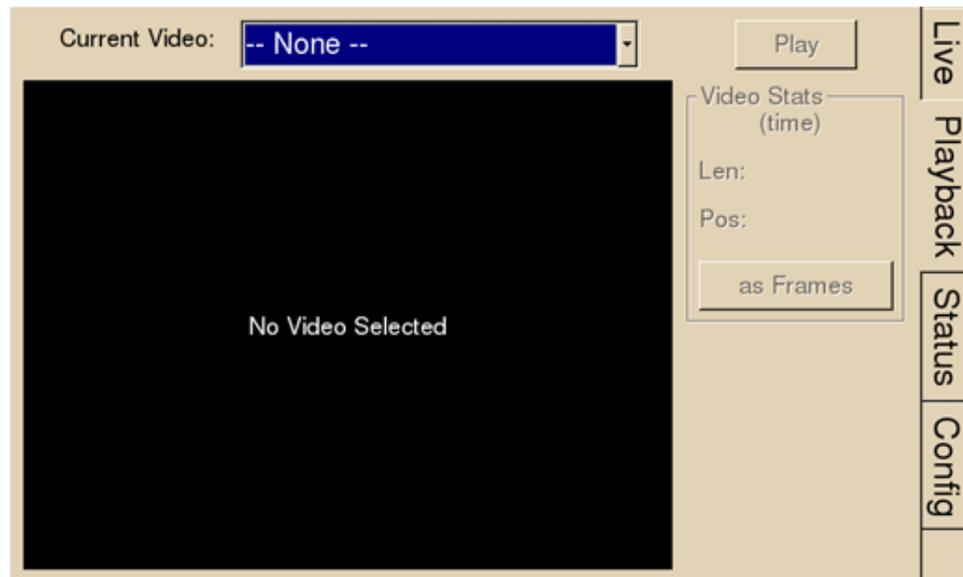


| | |
|---|---|
| **Device Name:** | The NetBIOS name of the device. |
| **Firmware Version:** | The currently installed firmware version number. This is useful for identifying the current firmware version and also to verify that a recent firmware update has been installed. See "Config" on page 9−15, for more information on updating the firmware. |
| **Current Config:** | A dropdown list of all available configurations. Tap a configuration to select it. |
| **AutoOnce:** | Tells the camera to perform its built−in auto−adjustment of exposure, gain and white balance. |
| **Lighter/Darker:** | Adjusts the exposure time longer and shorter, respectively. |
| **Full Screen:** | Displays the camera image over the entire screen. Tapping on the full screen image returns the interface to normal. |
| **Resolution:** | (v1.6b & above) A dropdown list at the bottom of the screen controls the camera resolution (640x480 or 320x240). Lower the resolution to achieve a higher frame count. |
| **Manual Control:** | Enables the Snapshot, Track LEDs and Record buttons. You cannot record from OpenEx while the RV2 is in Manual mode. When in Manual Control mode, tap the Manual Control button to disable Manual Control. |
| **Snapshot:** | Copies the current camera image to a JPG file on the RV2 hard drive, into the snapshots folder. |
| **Track LEDs:** | Applies the tracking specification in the currently selected configuration file to the live camera feed. If colored targets are tracked, dots will appear in the image where the algorithm is finding targets. Use this mode to |

preview the efficiency of the tracking algorithm and then modify the configuration and/or camera settings if needed.

**Record:**  Performs a manual recording. Since the camera is in free−run mode the frame rate will be maximized. Tap Record again to stop recording.

**Color:**  Switches between color and black−and−white modes.

### Playback

The Playback tab provides a list of video files currently stored on the RV2. Videos may be reviewed through this interface. The video's length is displayed, in time or in frames, as well as the current position.



**Current Video:**  A dropdown list containing all video files on the RV2. Tap a video name to select it.

**Play:**  Begin playing the currently selected video. Tap again to pause playback. To restart the video, you must select a different video and then select the original video.

**As Frames/As Time:**  Switch the Video Stats units from time to frames.

**Synchronized playback:**  When tank data is accessed by a TDT application（such as OpenExplorer or OpenScope）the application will detect epoch event names that begin with 'Vid'. When the TDT application retrieves data from that epoch, the TDT application will send a UDP packet containing the tank name, block name and current value of that epoch （which corresponds to the frame number）. An RV2 on the network will receive the packet, open the corresponding video file（if it exists）and jump to that frame. The RV2 must be on the Playback tab for this functionality.

**Rerun tracking algorithm:**  While playback is occurring on the RV2, the rvm file in the same directory as the avi file on the RV2 file system is used to run the tracking algorithm and overlay the results on the video image.

**RV2 Video Processor**

# Status

The Status tab provides system information such as processor usage rates, core temperatures, fan speeds, device IP address, array reformat progress, memory buffer allocation, and communication errors. Log information can also be retrieved from this tab.



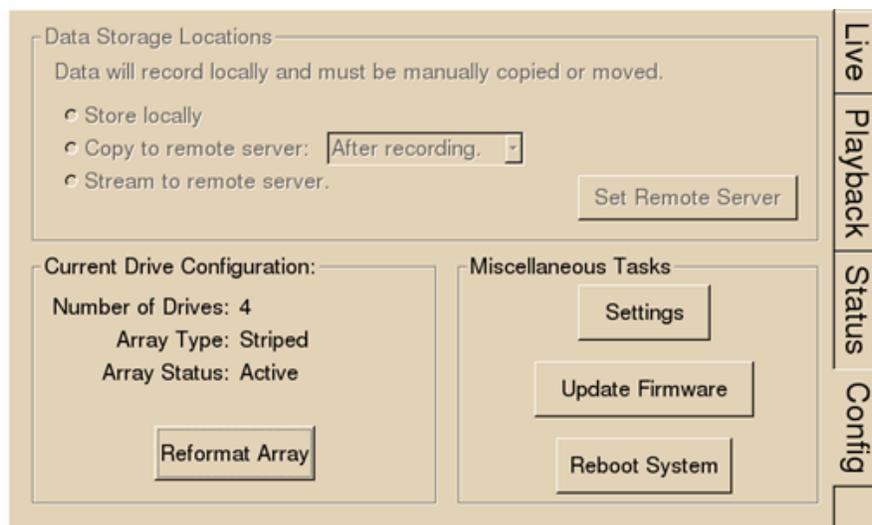| System: | Displays important system status information. |
|---|---|
| **Processor Usage:** | Displays the current percent usage for each processor core. |
| **Core Temperatures (F):** | Displays the current processor core temperatures measured in Fahrenheit. The text will turn yellow or red if the processor gets too hot. This can occur if there is an issue with the heatsink or internal fans. When this happens the RV2 will sound a warning and should be shut down immediately. |
| **Fan Speeds (RPM):** | Displays the approximate rpm for all three fans located inside of the RV2. |
| **Current IP:** | Displays the IP address currently assigned to the RV2. |
|  | Press to display Network Configuration Window. |



Configure Manually – select to enable manual configuration and make fields editable.

**Storage Array:** Displays information about the state of the current storage array.

**Active and mounted:** Storage array is available and ready to store data.

**Active and not mounted:** A support storage array is available but is not configured to store data.

**Array was not found!:** The system did not detect a supported storage array.

**Progress bar:** Displays progress for various processes which run on the RV2 including:

**Reformatting:** When reformatting a storage array, the progress completed (%) as well as the estimated amount of time remaining is displayed.

**Resyncing:** If a mirrored array type has been formatted, the progress completed (%) as well as the estimated amount of time remaining for the Resync process is displayed.

**File System Check:** The RV2 will perform a file system check during the boot process once every 30 boots. This ensures the integrity of the storage array and file system. If the RV2 is performing a file system check, the progress completed (%) and estimated amount of time remaining is displayed. During this time the Playback tab will be disabled and the RV2 cannot be triggered for storage.

**Memory Usage:** Displays current and maximum memory (RAM) usage since last reboot

**Memory Usage:** High Water Mark displays the most memory used by the system since last reboot. Current Size displays the currently used memory. Total System (free total) indicates how much memory is available vs how much total memory the system has.

**Clear Lost Counter:** Resets the lost frame counter.

**View Log Window:** A log stores relevant messages and any communication errors encountered while the RV2 is in use. Click to open and view the log window. The log.txt file can be copied from the storage array for transfer to a PC.

**Note:** Individual comments can be saved as well. Use a drag gesture to highlight the desired comment(s) and click Save to write the selection to the log.txt file.

## Config

The Config tab provides options for reformatting the currently installed storage array, updating the RV2 firmware, and rebooting the system.

**Data Storage Locations:**   Not currently implemented.

**Current Drive Configuration:** Displays information about the currently installed data drives.

**Number of Drives:**   Displays the number of drives currently installed.

**Array Type:**   Displays the currently configured array type and the status of the drives.

**Striped:**   Array type is currently configured as striped.

**Mirrored(UU):**   Array type is currently configured as mirrored. A U indicates that a drive is up and running. A _ indicates a drive failure.

**Missing:**   No array type is detected.

**Array Status:**   Displays the current status of the array.

**Preparing:**   Storage array is currently being reformatted.

**Resyncing:**   Storage array is being reformatted as a mirrored array and is currently resyncing the mirrored partitions.

**N/A:**   Storage array is not detected.

**Active:**   Storage array is detected and configured.

**Reformat Array:**   Press to prompt the reformat array dialog. This dialog will ask for confirmation as well as the desired array type: Striped or Mirrored. Reformatting an array will erase all data contained in the array. **Note:** When reformatting an array, the interface may become temporarily unresponsive.

**Miscellaneous Tasks:**   Provides options for updating the current RV2 firmware and rebooting the system.

**Settings:**   Press to display the settings window, then set date and time and select unit of measure for temperature.

**Update Firmware:**   Press to update the RV2 firmware. Firmware is downloaded from the TDT server and automatically installed on the RV2. Connection to a DHCP enabled network that has Internet connectivity is required to retrieve any updates.

Reboot System:               Click to reboot the system.

## Device Status LEDs

The device status LEDs report streaming or network activity. The following tables display the status LED indicators.

| Video | Status | Information |
|---|---|---|
|  | Off | No video camera is detected. |
|  | Lit | Video camera has been found |
| **Network** | **Status** | **Information** |
|  | Off | No network traffic detected. |
|  | Lit | Network traffic is present and detected on the RV2. |
| **Storage** | **Status** | **Information** |
|  | Off | No storage access to the RV2 is detected. |
|  | Lit | Storage access to the RV2 is in progress |

## Ethernet Ports

Two Ethernet ports are provided on the back panel, Video and Network.

Camera-1          The Camera-1 port connects directly to the Ethernet port on the VGAC. **Important!** The cable connecting the RV2 to the VGAC MUST support gigabit Ethernet (e.g. Cat 5e, Cat 6).

Network           The Network port allows connections to either a PC or local area network via a standard Ethernet cable. The RV2 supports automatic DHCP protocol.

## Power Port

A 9-pin serial port is provided on the back panel, labeled Power. This port is connected to a special cable that provides power to the VGAC using the special gray cable provided with the system.

## VGA Port

A VGA port is provided on the back panel, labeled Monitor. This port can be connected to an external monitor that will show the current camera image or a video that is being played in the Playback tab.

Important!:    The external monitor must be connected before the RV2 is powered on.

## USB 2.0 Port

This port is currently not in use.

# Technical Specifications

| Processing Cores | 4 |
|---|---|
| Storage Array Size | 2 Terabytes |
| System RAM | 2 GB |
| Number of Video Inputs | 1 |
| Frame Rates (typical with standard VCAC) | 640x480 color -- 40 FPS<br>320x240 color -- 100 FPS (firmware v1.6b and above) |
| Video File Format | DIVX encoded AVI |

**VGAC Specifications:**

| Camera type | CCD |
|---|---|
| CCD sensor size | 1/3" |
| Aperture (f/#) | F1.4 |
| Focal Length | 4.0 - 8.0 mm |
| Resolution | 8-bit per channel (24-bit total) |
| Features | Auto Exposure<br>Auto Gain<br>Auto White balance |
| Field of View (degrees) | vertical = 57.2, horizontal = 70.6 |
| Spatial Resolution (minutes) | vertical = 16.3', horizontal = 15.7' |
| Resolutions | 640x480 color<br>320x240 color |
| Cables Provided | Power: 30 ft (9 m)<br>Ethernet: 30 ft (9 m) |

## Troubleshooting

The following section provides examples and solutions to some of the errors that could be encountered while using the RV2 Video Tracker.

### Device Will Not Power Up

Check the position of the power supply switch. If set to the "O" position the power supply is disabled. To enable, simply ensure that the switch is in the "1" position and attempt to power on the RV2. If the device does not power up after verifying that the power supply is enabled contact TDT.

### Can't Access the RV2 Storage Array

Check the Ethernet cable connection to ensure that the RV2 is connected to a network or PC using the Network Ethernet port located on the back panel of the RV2. If the Ethernet cable is connected to the Video Ethernet port, network traffic will cause the Network status LED to light up. See "Setting-Up Your Hardware" on page 9-5, for connection diagrams.

If you are attempting to access the RV2 through a network, ensure that the server supports DHCP. If not, the RV2 will default to its static IP address (10.1.0.42). If you encounter this issue, see "Direct Connection to a PC" on page 9-7, for information on how to access the RV2 using a direct connection to a PC.

### RV2 Interface Becomes Slow or Unresponsive

Every thirtieth time the RV2 is booted up, it performs a disk check. The length of time required to perform this check depends on how much video data is currently stored on the RV2. During this time, the Playback tab will be grayed out and you will be unable to record to the RV2. The Status tab. TDT recommends removing unnecessary data remaining on the storage array.

## RV2 Is Not Correctly Naming Data Folders

When connected to an active network, TDT's OpenEx software sends information to the RV2 via a broadcast UDP packet allowing it to properly name the video files stored on the RV2. If the RV2 is powered on before connecting the necessary network cables it may default to the basic naming format. Power off the RV2, connect all the necessary cables then power the RV.