

SPI CORP M2D TRIP EOIR GIMBAL SYSTEM

SBE1 Recording, Tracking + IP Conversion Module User Manual



Ver 2.0

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1. Introduction

The document includes the user manual of SPI's Recording, Tracking and IP conversion (SBE1) OEM board.

Note: The SBE1 board supports M2D protocols.

2. Architecture

The architecture of the SBE1 Module is depicted in the following:



3. Physical connectivity

The SBE1 board includes the following connectors:

Designation	Connect to	Type	Pin Description																						
J1	M2D camera	Molex PicoBlade ^T M 10 pin	<table border="0"> <thead> <tr> <th>Pin</th> <th>Function</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Camera Power IN (12-32V) *max voltage depends on camera</td> </tr> <tr> <td>2</td> <td>GND</td> </tr> <tr> <td>3</td> <td>RS232 RX (TRIP Out, Camera In)</td> </tr> <tr> <td>4</td> <td>RS232 TX (TRIP In, Camera out)</td> </tr> <tr> <td>5</td> <td>GND</td> </tr> <tr> <td>6</td> <td>NC</td> </tr> <tr> <td>7</td> <td>NC</td> </tr> <tr> <td>8</td> <td>NC</td> </tr> <tr> <td>9</td> <td>Analog Video In</td> </tr> <tr> <td>10</td> <td>Analog Video Return (VIDEO_GND)</td> </tr> </tbody> </table>	Pin	Function	1	Camera Power IN (12-32V) *max voltage depends on camera	2	GND	3	RS232 RX (TRIP Out, Camera In)	4	RS232 TX (TRIP In, Camera out)	5	GND	6	NC	7	NC	8	NC	9	Analog Video In	10	Analog Video Return (VIDEO_GND)
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7	NC																								
8	NC																								
9	Analog Video In																								
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J2	Host Serial Port, Analog Display, Power	Molex PicoBlade ^T M 10 pin	<table border="0"> <thead> <tr> <th>Pin</th> <th>Function</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>External Power IN (12-32V) *max voltage depends on camera</td> </tr> <tr> <td>2</td> <td>GND</td> </tr> <tr> <td>3</td> <td>RS232 RX (Host Out, TRIP In), Dual function (External RS232 Control or GPS)</td> </tr> <tr> <td>4</td> <td>RS232 TX (Host In, TRIP out)</td> </tr> <tr> <td>5</td> <td>GND</td> </tr> <tr> <td>6</td> <td>DBG_RX (for factory use only, leave unconnected)</td> </tr> <tr> <td>7</td> <td>DBG_TX (for factory use only, leave unconnected)</td> </tr> <tr> <td>8</td> <td>DBG_GND</td> </tr> <tr> <td>9</td> <td>Analog Video Out</td> </tr> <tr> <td>10</td> <td>Analog Video Return (VIDEO_GND)</td> </tr> </tbody> </table>	Pin	Function	1	External Power IN (12-32V) *max voltage depends on camera	2	GND	3	RS232 RX (Host Out, TRIP In), Dual function (External RS232 Control or GPS)	4	RS232 TX (Host In, TRIP out)	5	GND	6	DBG_RX (for factory use only, leave unconnected)	7	DBG_TX (for factory use only, leave unconnected)	8	DBG_GND	9	Analog Video Out	10	Analog Video Return (VIDEO_GND)
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J3	Input (HDMI)	MicroHDMI	Standard Micro HDMI Connector																						
J4	Digital Display (HDMI)	MicroHDMI	Standard Micro HDMI Connector																						

J5	Host USB Port	M o l e x PicoBlade ^T M 4 pin	Pin 1 2 3 4	Function USB_HOST_VCC (+5V) Supplied from TRIP to Target USB_HOST_DATA+ (DP) USB_HOST_DATA- (DM) GND
J6	Host Ethernet Port	Molex PicoBlade ^T M 5 pin	Pin 1 2 3 4 5	Function ETH_TX+ ETH_TX- ETH_RX+ ETH_RX- ETH_GND (optional)
J7	Memory card	MicroSD slot	Standard MicroSD slot	

3.1. Wire Harness

P.N	Connector	Description
2042	J1	Connecting SBE1 to Camera The wire harness includes two Molex 51021-1000 connectors and 50cm [19.5"] long ultra flexible wires.
2042	J2	Connecting SBE1 to PIB The wire harness includes two Molex 51021-1000 connectors and 50cm [19.5"] long ultra flexible wires.
2081	J5	Connecting SBE1 to USB Host The wire harness includes a Molex 51021-0400 connector and USB Receptacle Connector (Female) and 50cm [19.5"] long ultra flexible wires.

2082	J6	Connecting SBE1 to Ethernet The wire harness includes a Molex 51021-0500 connector and RJ-45 Jack (Female) and 50cm [19.5"] long ultra flexible wires.
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J3 cable can be sourced from any video store

4. Functionality

The SBE1 is available in two different flavors:

SD – Standard Definition

HD – High Definition

Common functions that are supported by both flavors:

- IP Streaming of captured video using the following format:
Mpeg2Ts over RTP with H264 compression.
- Receiving protocol commands from the user through RS232 (J2 connector) or through IP over Ethernet (J6 connector)
- Sending protocol commands to the camera through J1 connector
- Recording the video on the SD card upon protocol command.
Adding GPS meta data to stored frames.
- Tracking object in the video upon protocol command.
- Notify loss of object tracking through protocol.
- Detecting motion in the video upon protocol command.
- Notify motion detection through protocol.

The SBE1-SD board performs the following additional functions:

- Autodetection of PAL/NTSC video from the camera through J1 connector
- Outputting digital video on J4 HDMI connector,
When the input video is PAL than the HDMI output transmits: 576p@50Hz format.
When the input video is NTSC than the HDMI output transmits: 480p@60Hz format.

The SBE1-HD board performs the following additional functions:

- Capture digital video from the camera through J3 HDMI connector, the captured format is 720p@60Hz
- Outputting digital video on J3 HDMI connector,
The HDMI output transmits: 720p@60Hz.

5. IP Setting

The SBE1 board default IP address is: 192.168.0.201 with the following subnet mask: 255.255.255.0

In cases that there is no possible way to update the host IP address due to lack of administrative rights the SBE1 Discovery Tool offers a way to find units and update their IP settings from any network transcending subnet settings.

Open the discovery tool:

In order to display all the units that are available on network Press on the Find Boards button on the Discovery Units:

Update the configuration of the unit that you wish to update and make sure to select yes in the set column.
It is necessary to highlight the V unit required to change IP.

Press on the update button in order to configure the selected IP

6. SBE1 Board Setting

In order to configure several parameters of the SBE1 board make sure that the controlling PC station is configured with the same class & subnet mask as the SBE1 board.

Access the SBE1 website with any standard web browser, when prompted for a user & password use:

User: admin Password: microcam

The Network tab allows the configuration of network related parameters:

- IP address
- Subnet mask
- Default gateway
- MTU – maximum transmission unit

The Channel tab allows the configuration of the video and encoding related parameters:

- Input Format – defines which video signal will be processed by the platform:
SD – Standard Definition:

TRIP will use the analog video signal from J1 connector, this mode supports auto detection of PAL & NTSC.

HD – High Definition:
SBE1 will use the digital video signal from J3 HDMI connector, this mode supports 720p only.
- Destination IP Address – video will be transmitted to this IP address, both unicast and multicast addresses are supported

- Destination IP Port – video will be transmitted to this Port
- Enable Bandwidth Limit – Enable/Disable Bandwidth limiting
- Bandwidth Limit – Bandwidth limit value in kbps, in affect only when bandwidth limit is enabled
- NTSC Field Order – When the captured input video standard is NTSC this parameter defines which field is captured first: Odd or Even.
- Encoding Mode:
 - CBR – Constant BitRate: bit rate will never exceed this value even when the video quality decreases due to fast changes in the video
 - ConstQ – Constant Quality: bit rate will be modified according to the video frames in order to keep the quality constant, with ConstQ the bitrate field is ignored
- Bitrate – bitrate in kbps to use, only relevant when encoding mode is set to CBR
- Quantization Value – defines the relation between the quality of the compressed stream and its size, a low value dictates more quality with larger compressed size where a high value dictates the opposite.
The value range is: 0 – 51.
If not sure it is highly recommended to leave this value at 25
- Algorithm – defines which algorithm will be used on the input video: Tracker or VMD

The Protocol tab allows the configuration of protocol related parameters:

- Protocol Type – defines which protocol will be processed by the SBE1 board:

AutoDetect – Automatic detection of the protocol,
In this mode the SBE1 detects the protocol that is arriving from the host and uses the same protocol to control the camera,
The SBE1 is able to detect M2D protocols.
will be able to process tracking & recording commands

- Protocol Medium – defines the physical layer that the protocol will use: Serial (RS232) or IP.
When Serial is used the standard serial configuration of the protocol is in affect: 19200bps, 8 bit width, 1 stop bit, even parity
When IP is used all other settings are in affect
- Remote IP – the IP of the host or controlling station
- Remote Port – the Port number of the host or controlling station
- Local Port – the Port number that SBE1 listens to for incoming host protocol messages.

** both Remote IP/Port and Local Port must match the settings that are configured at the SPI Camera Control software

The Tracker tab allows the configuration of tracker related parameters:

- **Threshold** – the threshold value defines at which level to lose/retrack targets.
The value is between 0 – 100.
A higher number will make the tracking process more sensitive to fast changes in the video and may cause the tracker to lose or retrack the target while a lower value will do the exact opposite.
Typical range for most scenes is: 25 – 50
Its always best to start with the default value of 37.5 and see how the tracker copes with the scene, for example if its to sensitive than lower the value in decrements of 2.5 to 5 until the desired behavior is achieved.

On darker/shaded scenes a value of 25 – 30 will work better
On lighter/brighter scenes a value of 40 – 50 will work better
When unsure a value of 37.5 is recommended.
- **Enable Relocking** – when the relock option is enabled the tracker will attempt to relock the target after the Relock Time (parameter).
The process of the relock will keep a record of the trajectory of the target and in case of target loss the tracker will keep moving in the same direction of the object and attempt to relock after the defined relock time assuming that the disturbance has passed during the relock time and the target maintained the same trajectory.
- **Relock Time** – defines the amount of time to wait between target loss and a relock attempt
relock time is measured in milliseconds

- Graphics Color – defines what will be the color of the tracker graphics, black or white.
- Tracker Image – defines which icon will be used when the tracker is actively tracking a target.
- Crosshair Image – defines which icon will be used when the tracker has to display a crosshair image, for example when a user attempts to retrack to a new target this icon will be used for the crosshair.

The VMD tab allows the configuration of VMD related parameters:

- Detection Area Quadrilateral X0 – Y3 – Defines a quadrilateral area on the input frame, only moving target that are located within the quad will be marked with squares
- Draw Detection Area Quadrilateral – Defines if the quadrilateral detection area will be drawn on top of the frame

The Camera tab allows the configuration of Camera related parameters:

- Gimbal Mounting Orientation – Defines how the camera is mount on the aircraft:
Nose mount
Belly mount

The System Setting tab allows the configuration of system related parameters:

- Reset to default configuration button – reverts the system setting to their factory defaults

The System Status tab shows various statuses of the device:

- Video Standard – shows which video standard was detected by the system: PAL, NTSC, 720p or No Input Video.
This status may be used to verify that the analog/digital video from the camera is connected correctly to the SBE1 board
- Pressing on the REFRESH button will read the current statuses and display them on this tab

Pressing on the update button on the website will save the new setting and restart the SBE1 application using the new settings.

In case there is an invalid value on the website the corresponding item of the erroneous field will be marked in red color:

Pressing on the reboot button will restart the SBE1 board

7. SBE1 Board Firmware Update

Steps to update the version of the SBE1.

- Attach empty Micro SD card.
- make sure that the SBE1 version is up to date. If not, update to latest version.
- Attach the “update Img.gz” file to the Micro SD card.
- Turn off the SBE1 and insert micro SD card into trip.
- Turn on the SBE1 and refresh internet page.
- Re-check and see if there are any more updates to the SBE1 version.

8. SBE1 Video Preview

Use Spi Video Player to preview the video of the SBE1 board.

The following table defines the what will be seen in the Video Player and in the SBE1 System Status Tab in various system states:

Condition	Analog Video Connection	IP Link	Video Player Status Indication	TRIP System Status Tab	Remarks
First Power Up	Missing	Missing	Detection Failed	No Video Input	Video Player window is filled with green color, System Status Tab shows No Input Video Image #1 – Video Player when in this state Image #2 – Status Tab when in this state
	Missing	Present	Detection Ok	No Video Input	Video Player window is filled with blue color, System Status Tab shows No Input Video Image #3 – Video Player when in this state Image #2 – Status Tab when in this state

	Present	Missing	Detection Failed	PAL or NTSC	Video Player window is filled with green color, System Status Tab shows PAL or NTSC Image #1 – Video Player when in this state Image #4 – Status Tab when in this state
	Present	Present	Detection Ok	PAL or NTSC	Video Player window is filled with the video feed, System Status Tab shows PAL or NTSC Image #5 – Video Player when in this state Image #4 – Status Tab when in this state
After A Successful Connection	Missing	Missing	IP Link Loss	No Video Input	Video Player window is filled with the video feed and an IP Link Loss indication is present on the bottom of the frame in red color System Status Tab shows No Video Input Image #6 – Video Player when in this state Image #2 – Status Tab when in this state

	Missing	Present	Detection Ok	No Video Input	Video Player window is filled with blue color, System Status Tab shows No Input Video Image #3 – Video Player when in this state Image #2 – Status Tab when in this state
	Present	Missing	IP Link Loss	PAL or NTSC	Video Player window is filled with the video feed and an IP Link Loss indication is present on the bottom of the frame in red color System Status Tab shows PAL or NTSC Image #6 – Video Player when in this state Image #4 – Status Tab when in this state
	Present	Present	Detection Ok	PAL or NTSC	Video Player window is filled with the video feed, System Status Tab shows PAL or NTSC Image #5 – Video Player when in this state Image #4 – Status Tab when in this state

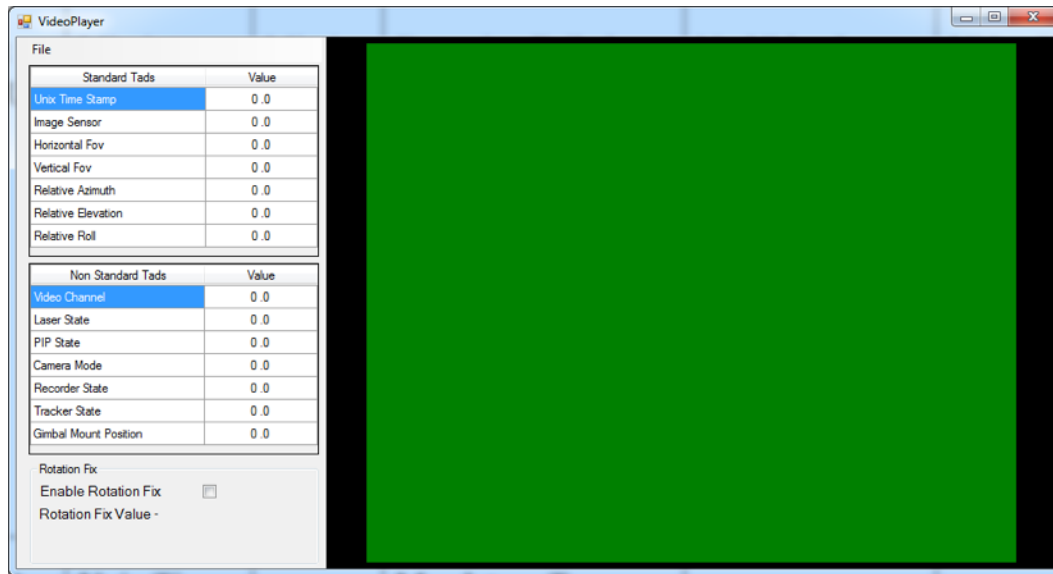


Image #1 – Detection Failed

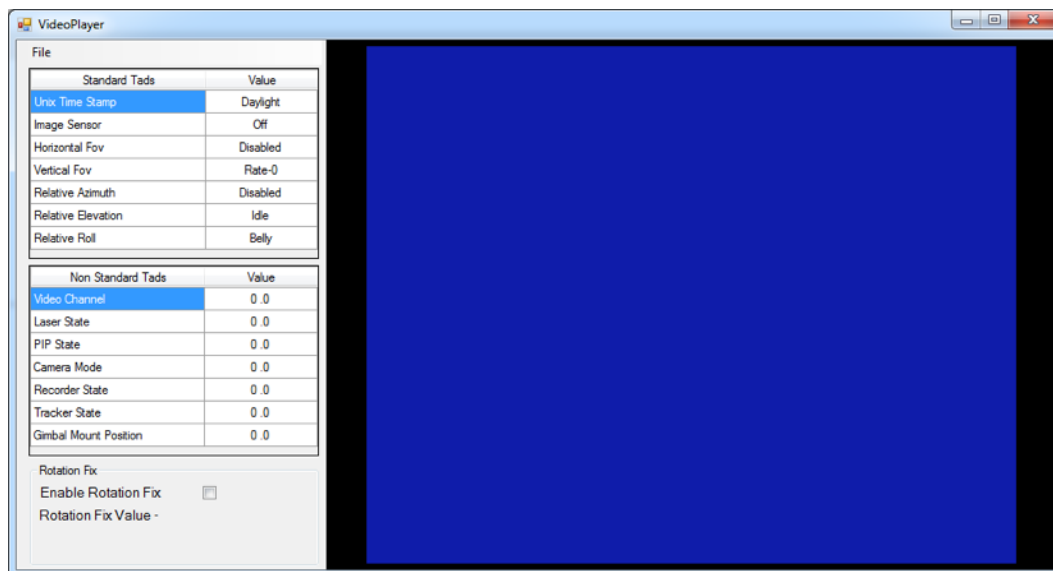


Image #3 – Analog Video is missing, IP link is Ok

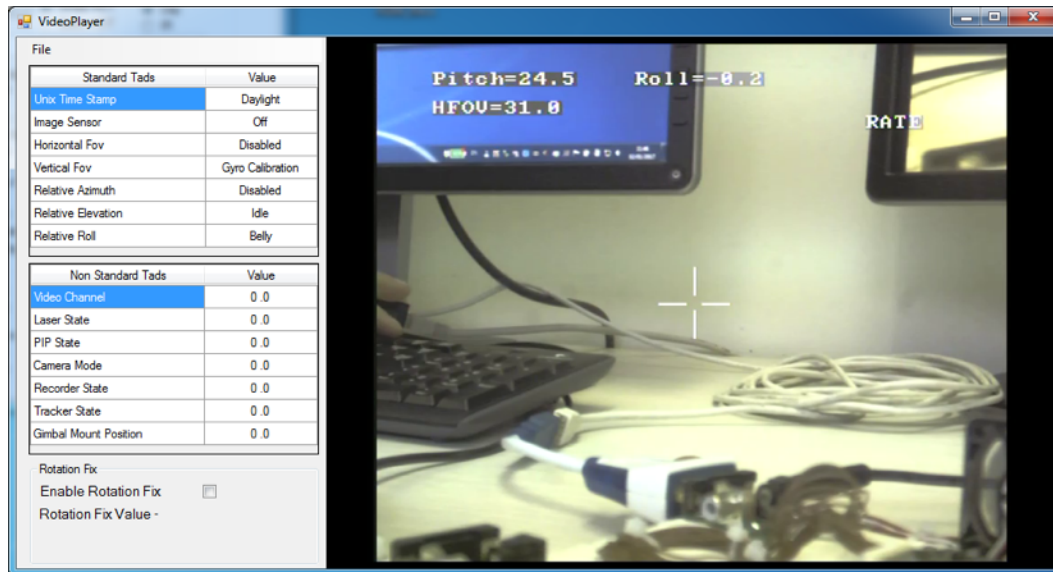


Image 5# - Video Player Displaying The SBE1 Video Feed

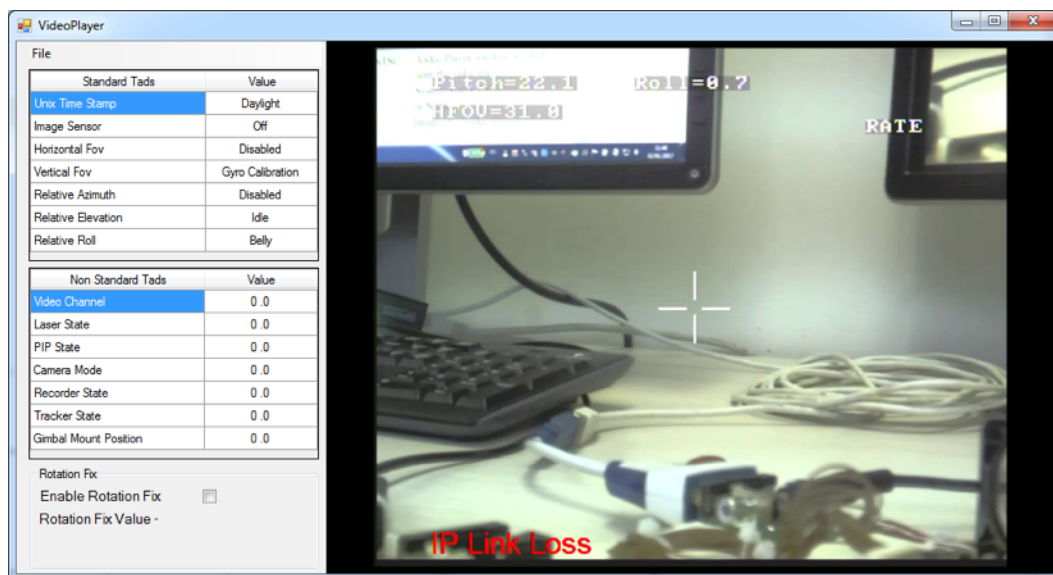


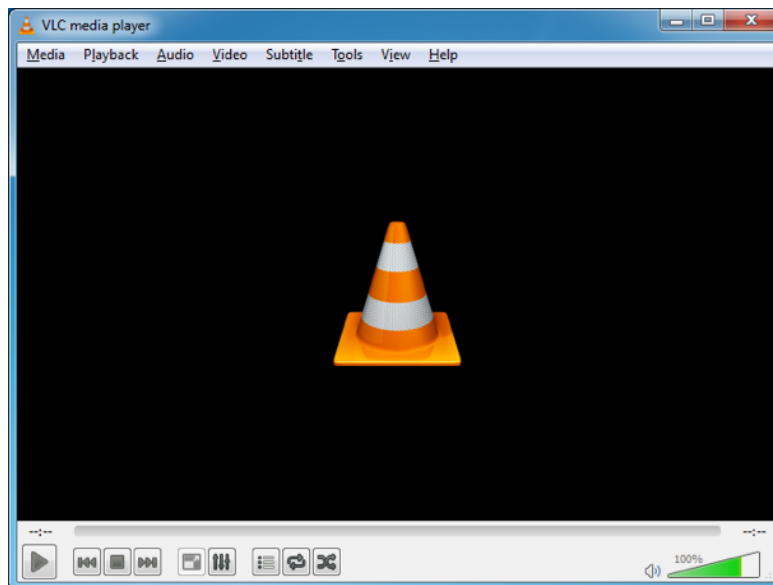
Image #6 – IP Link Lost After a Successful Video Lock

9. SBE1 Video Preview With VLC

SPI video stream may also be previewed with VLC.

Follow these steps in order to preview the video using VLC:

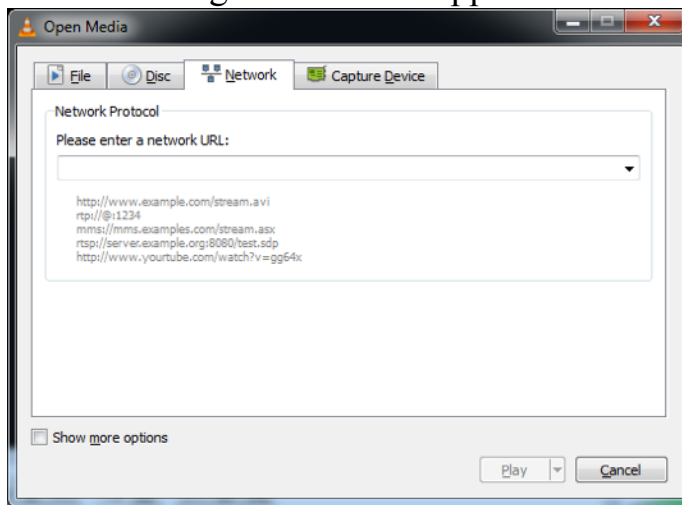
- Configure the SBE1 to transmit video to a unicast/multicast address, this may achieved be by following section 6 of this document
- Open the VLC player



- Select Media → Open Network Stream...

Alternately you may press Ctrl + N to open the network stream window.

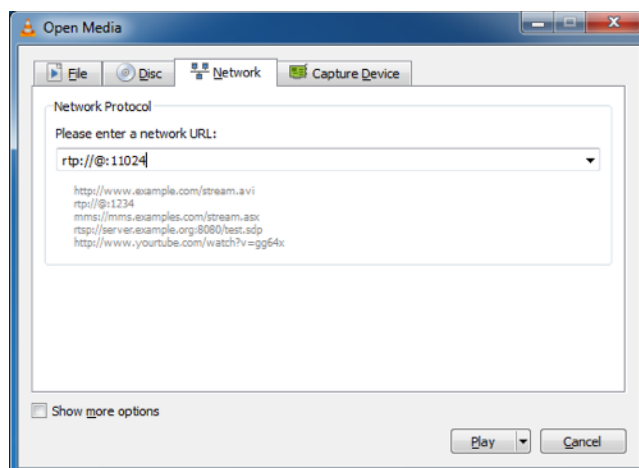
- The following window will appear



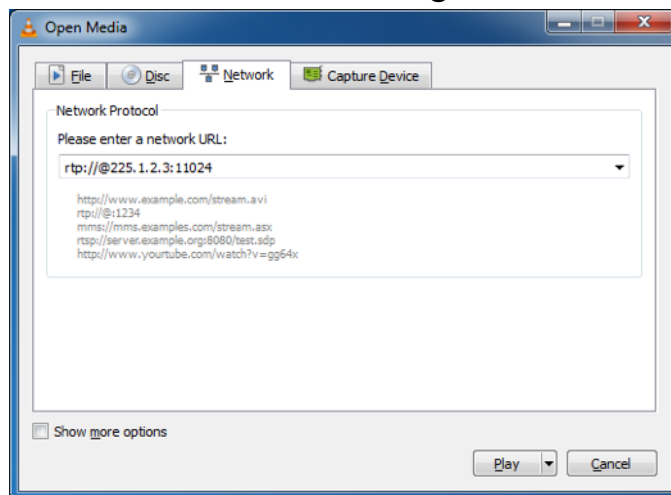
- In the network URL line please enter the following:
 - For Unicast
`Rtp://@:DestinationPort`
 - For Multicast
`Rtp://@DestinationIP:DestinationPort`
- Press the play button to start the video preview



- **Example:** Opening a unicast stream with VLC
 - Configure the SBE1 to transmit to a unicast address:
 - Note that the destination IP is configured to 192.168.0.4 which is a unicast address in our network
The destination port is set to 11024
 - Open the VLC player, Media → Open Network Stream
And enter the network configuration of the SBE 1



- Press Play the preview the video
- **Example:** Opening a multicast stream with VLC
 - Configure the TRIP to transmit to a multicast address (224.0.0.0 – 239.255.255.255):
 - Note that the destination IP is configured to 225.1.2.3 which is a multicast address, the destination port is set to 11024
 - Open the VLC player, Media → Open Network Stream
And enter the network configuration of the SBE1



- Press Play the preview the video

10.KLV Metadata

The video stream over IP includes KLV metadata in accordance with the following table:

TA	LDS Name	Remarks
G		

1	Checksum	Mandatory Tag						
2	Unix Time Stamp	Mandatory Tag						
11	Image Source Sensor	M2D						
16	Sensor Horizontal Field of View							
17	Sensor Vertica Field of View							
18	Sensor Relative Azimuth Angle	Gimbal roll and pitch angles converted in accordance with gimbal mounting						
19	Sensor Relative Elevation Angle	Gimbal roll and pitch angles converted in accordance with gimbal mounting						
20	Sensor Relative Roll Angle	Gimbal roll and pitch angles converted in accordance with gimbal mounting						
101	Video Channel	<p>Proprietary Tag, defines which video channel is transmitted. The following table defines the available values for this tag:</p> <table border="0"> <thead> <tr> <th colspan="2">Value Camera</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>Daylight Channel</td> </tr> <tr> <td>1</td> <td>Thermal Channel</td> </tr> </tbody> </table>	Value Camera		0	Daylight Channel	1	Thermal Channel
Value Camera								
0	Daylight Channel							
1	Thermal Channel							
102	Laser State	<p>Proprietary Tag, defines the laser state The following table defines the available values for this tag:</p> <table border="0"> <thead> <tr> <th colspan="2">Value Laser State</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>Off</td> </tr> <tr> <td>1</td> <td>On</td> </tr> </tbody> </table>	Value Laser State		0	Off	1	On
Value Laser State								
0	Off							
1	On							

103	PIP State	<p>Proprietary Tag, defines if PIP is enabled The following table defines the available values for this tag:</p> <table><thead><tr><th>Value</th><th>PIP Enable</th></tr></thead><tbody><tr><td>0</td><td>Disabled</td></tr><tr><td>1</td><td>Enabled</td></tr></tbody></table>	Value	PIP Enable	0	Disabled	1	Enabled
Value	PIP Enable							
0	Disabled							
1	Enabled							

104	Camera Mode	<p>Proprietary Tag, defines which camera mode is currently active The following table defines the available values for this tag:</p> <table border="0"> <thead> <tr> <th style="text-align: left;">Value</th> <th style="text-align: left;">Camera Mode</th> <th></th> </tr> </thead> <tbody> <tr> <td>0</td> <td>Rate (auto drift on)</td> <td></td> </tr> <tr> <td>1</td> <td>Point to coordinate</td> <td></td> </tr> <tr> <td></td> <td>Hold coordinate</td> <td>2</td> </tr> <tr> <td></td> <td>Pilot</td> <td>3</td> </tr> <tr> <td></td> <td>Stow</td> <td>4</td> </tr> <tr> <td></td> <td>Rate (auto drift off)</td> <td>6</td> </tr> <tr> <td></td> <td>Dynamic drift compensation</td> <td>7</td> </tr> <tr> <td></td> <td>Park</td> <td>8</td> </tr> <tr> <td></td> <td>Gyro Calibration (static) & BIT</td> <td>10</td> </tr> <tr> <td></td> <td>GRR</td> <td>11</td> </tr> <tr> <td></td> <td>Reserved 1 for internal compass calibration</td> <td>12</td> </tr> <tr> <td></td> <td>Reserved 2 for internal compass calibration</td> <td>13</td> </tr> <tr> <td></td> <td>Enter EXT Mode</td> <td>31</td> </tr> </tbody> </table>	Value	Camera Mode		0	Rate (auto drift on)		1	Point to coordinate			Hold coordinate	2		Pilot	3		Stow	4		Rate (auto drift off)	6		Dynamic drift compensation	7		Park	8		Gyro Calibration (static) & BIT	10		GRR	11		Reserved 1 for internal compass calibration	12		Reserved 2 for internal compass calibration	13		Enter EXT Mode	31
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	Reserved 2 for internal compass calibration	13																																										
	Enter EXT Mode	31																																										

105	Recorder State	<p>Proprietary Tag, defines the state of the recorder The following table defines the available values for this tag:</p> <table border="0"> <thead> <tr> <th style="text-align: left;">Value</th> <th style="text-align: left;">Recorder State</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">0</td> <td>Idle</td> </tr> <tr> <td style="text-align: center;">1</td> <td>Recording</td> </tr> </tbody> </table>	Value	Recorder State	0	Idle	1	Recording		
Value	Recorder State									
0	Idle									
1	Recording									
106	Tracker State	<p>Proprietary Tag, defines the state of the tracker The following table defines the available values for this tag:</p> <table border="0"> <thead> <tr> <th style="text-align: left;">Value</th> <th style="text-align: left;">Tracker State</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">0</td> <td>Idle</td> </tr> <tr> <td style="text-align: center;">1</td> <td>Tracking</td> </tr> <tr> <td style="text-align: center;">Target Lost</td> <td>2</td> </tr> </tbody> </table>	Value	Tracker State	0	Idle	1	Tracking	Target Lost	2
Value	Tracker State									
0	Idle									
1	Tracking									
Target Lost	2									
107	Gimbal Mounting Orientation	<p>Proprietary Tag, defines the gimbal mounting orientation. Gimbal mounting orientation is configured through web access The following table defines the available values for this tag:</p> <table border="0"> <thead> <tr> <th style="text-align: left;">Value</th> <th style="text-align: left;">Orientation</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">0</td> <td>Belly</td> </tr> <tr> <td style="text-align: center;">1</td> <td>Nose</td> </tr> </tbody> </table>	Value	Orientation	0	Belly	1	Nose		
Value	Orientation									
0	Belly									
1	Nose									

Appendix A : Version Control

Version	Date	Remarks
1.2	23 Nov 2016	Switching J1 and J2
1.3	24 Nov 2016	KLV
1.4	02 Jan 2017	VMD addition, Video Player / SBE1 System Status
1.5	19 Jan 2017	Revision of pictures and switches.
1.6	23 Jan 2017	Added section about SBE1 video preview using VLC
1.7	10 Feb 2017	Updated system architecture diagram Updated SBE1 IP Setting section (adding images of TRIP Discovery tool)
1.8	15 Mar 2017	Added SBE1 SD/HD flavors explanation Updated SBE1 website images Updated channel setting tab – New Input Format parameter Updated protocol setting tab – New protocol type & medium parameters

