NC1 IO™
Studio Input/Output Module
Operating Instructions
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This chapter explains how to connect power, monitors and audio visual devices to your NewTek NC1 Studio Input/Output Module. It also reviews the registration process. After completing this short section, you’ll be all set to begin using NC1 IO.

**SECTION 1.1 WELCOME**

Thank you for purchasing this NewTek™ product. As a company, NewTek is extremely proud of its record of innovation and commitments to excellence in design, manufacture, and superb product support. NewTek IP Series products are the most advanced live production tools available, and you will find them exceptionally powerful and versatile.

NewTek’s innovative live production systems have repeatedly redefined broadcast workflows, providing new possibilities and economy. In particular, NewTek has been a leader in introducing integrated devices providing a complete set of tools related to program creation and broadcast, along with web streaming and social media publishing. This tradition continues with the NewTek NC10 Studio Input/Output Module. Its implementation of NewTek’s innovative NDI (Network Device Interface) protocol places your new system squarely in the forefront of IP technology solutions for the video broadcast and production industries.

**SECTION 1.2 OVERVIEW**

Commitments and requirements can change from production to production. A powerful, versatile platform for multi-source production and multi-screen delivery workflows, the Studio I/O Module quickly pivots to accommodate additional cameras, devices, displays or destinations.

With NC1 IO’s turnkey installation and operation, you can easily assemble a network of modules to configure your own multi-system and multi-site workflows.

From increasing your available inputs and outputs, to merging established and emerging technologies, to linking locations across your network, the NewTek NC1 Studio I/O Module is a universal solution that adapts to your production needs.

- Translate up to 8 compatible video sources to SDI or NDI™ for input, output, or a combination of both
Configure for dual-channel 4K Ultra HD at 60 frames per second with support for 3G-SDI quad-link grouping
Integrate with compatible systems and devices across your network for switching, streaming, display, and delivery
Stack modules in a single location or station in multiple locations to meet the demands of your productions

SECTION 1.3 SETTING UP

1.3.1 COMMAND AND CONTROL

Hint: NC1 IO’s interface requires a monitor resolution setting of at least 1280x1024.

1. Connect an external computer monitor to the HDMI port on the backplate (see Input/Output Connections).
2. Connect the mouse and keyboard to USB ports also on the backplate.
3. Connect the power cord to NC1 IO’s backplate
4. Turn on the computer monitor.
5. Press the Power switch on NC1 IO’s faceplate (located behind the drop-down door).

At this point, the blue Power LED will illuminate, as the device boots up. (If this does not happen, check your connections and retry). Though not a requirement, we do strongly recommend that you connect NC1 IO using an uninterruptable power supply (UPS), as for any ‘mission critical’ system.

Likewise, consider A/C “power conditioning”, especially in situations where local power is unreliable or ‘noisy’. Surge protection is especially important in some locales. Power conditioners can reduce wear on NC1 IO’s power supplies and other electronics, and provide a further measure of protection from surges, spikes, lightning and high voltage.

A word about UPS devices:
‘Modified sine wave’ UPS devices are popular due to low manufacturing costs. However, such units should generally be viewed as being of low quality and possibly inadequate to fully protect the system from abnormal power events.

For a modest added cost, consider a "pure sine wave" UPS. These units can be relied on to supply very clean power, eliminating potential problems, and are recommended for applications demanding high reliability.

SECTION 1.4 INPUT/OUTPUT CONNECTIONS

External audio and video sources are connected to the appropriate inputs on NC1 IO's backplane.

FIGURE 1-1
1. HDMI – monitor port
2. Ethernet – network connections
3. USB – connect keyboard, mouse and other peripheral devices.
4. Motherboard audio connectors
5. Genlock and SDI In/Out – current generation units (designated ‘Mark M’) provide HD-BNC connectors (High Density BNC); earlier (Mark D) units employ DIN 1.0/2.3 (Mini BNC) connectors
6. Power

Note: For Mark M systems, SDI connectors are initially assigned as either inputs or outputs in the Configuration dialog (‘Admin panel’) at first launch, or later by using the “Exit to Admin” option to re-open it. For Mark D systems, the ‘Configure IO Connectors’ dialog can be opened directly from the System Configuration panel. See Section 2.2.1 for more detail. Also, please note that the ID numbering scheme for SDI connectors varies by model (Mark D or M).

SECTION 1.5 NETWORKING

Generally, simply connecting a suitable cable from one of the two Gigabit Ethernet ports on NC1 IO’s backplane is all that is required to add it to a local area network (LAN). In some settings, additional steps may be required. You can access the system Network and Sharing control panel to accomplish more extensive configuration tasks. If further help connecting is required, please consult your system administrator.
This chapter explains the layout and options of the user interface, and how to configure NC1 IO audio and video input and output. It also introduces the various supplemental video production features NC1 IO provides, including Proc Amps, Scopes and capture.

SECTION 2.1 THE DESKTOP

The NC1 IO default Desktop interface is shown below, and provides very useful remote monitoring options in addition to configuration and control features.

FIGURE 2-1

The Desktop interface includes dashboards running across the top and the bottom of the screen. By default, the large middle section of the Desktop is divided into quadrants, each displaying one video ‘channel’. Beneath each channel’s viewport is a toolbar. (Note that additional viewport toolbar controls are hidden when not in use, or until you move the mouse pointer over a viewport.)

Continue reading for an overview of the NC1 IO Desktop features.
NC1 IO allows you to select different audio and video sources for each channel via the Configure panel (Figure 2-3). Click the gear next to the channel label below a viewport to open its Configure panel (Figure 2-2).

**INPUT TAB**

The tabbed Input pane allows you to select audio and video sources for this channel, and set their format. You can immediately choose any NDI or SDI connector configured as an input (the latter are shown in the Local group), a webcam or PTZ camera with compatible network output, or even an input from a suitable external A/V capture device. (Quad-link selections list the four associated SDI input numbers that will be used, for reference.)

Note that the Alpha Matte Source menu allows you to configure ‘key/fill’ inputs, where the transparency and fill color information are supplied via two separate SDI inputs (the video format of both sources must match).

See Appendix A: Key/Fill Connections for key/fill connection details.
A Delay setting is provided for both audio and video sources, allowing precise A/V synchronization where a/v source timing differs.

**Clips and IP Sources**

![Configure Channel 2](image1)

**FIGURE 2-4**

As mentioned in the previous section, an IP (network) source – such as a PTZ camera with NDI network video output – can be directly selected. The Video Source drop down menu contains an Add Media item to let you select a video file, and Add IP Camera menu item (Figure 2-4).

![NewTek IP Source Manager](image2)

**FIGURE 2-5**

Clicking the Add IP Camera entry opens the IP Source Manager. Adding entries to the list of sources shown in this panel causes corresponding entries for new sources to appear in the Local group shown in the Video Source menu of the Configure Channel panel (Figure 2-3).
To use, click the *Add New Camera* menu, select a source type from the dropdown list provided.

This opens a dialog suited to the particular source device you wish to add, such as one of the numerous supported PTZ camera brands and models.

**Note:** After adding an IP source, you must exit and restart the software for the new settings to be applied.

### OUTPUT TAB

The second tab in the *Configure Channel* pane hosts settings related to output from the current channel.
NDI Output

Output from channels assigned to local SDI input sources is automatically sent to your network as NDI signals. The editable Channel Name (Figure 2-8) identifies output from this channel to other NDI-enabled systems on the network.

Note: NDI Access Manager, included in NDI Tools (available without charge from NDI.newtek.com), can be used to control access to NDI source and output streams.

Hardware Video Destination

The Hardware Video Destination menu allows you to direct video output from the channel to an SDI connector on the system's backplane that is configured as an output (or another video output device connected to and recognized by the system). Video Format options supported by the device are provided in a menu at right. (Quad-link selections list the four associated SDI output numbers that will be used, for reference.)

See Appendix A: Key/Fill Connections for key/fill connection details.

Supplemental Audio Device

The Supplemental Audio Device allows you to direct audio output to system sound devices as well as well as any supported third part audio devices you may connect (typically by USB). As required, Audio Format options are provided in a menu at right.

Capture

This tab is also where you assign the path and filename for captured video clips and stills.

The initial Record and Grab Directories are the default Videos and Pictures folders on the system, but we strongly encourage you to use fast network storage volumes or an external drive connected to one of the (blue) USB3 ports on NC1’s rear panel for video capture especially.

Note: Recording NDI sources is not supported.
**Color Tab**

The Color tab provides an extensive set of tools for adjusting the color characteristics of each video channel.

Choosing Auto Color automatically adapts color balance as lighting conditions change over time.

*Note: Proc Amp adjustments follow Auto Color processing.*

By default, each camera with Auto Color enabled is processed by itself. Enable Multicam to process multiple cameras as a group.

To apply Multicam processing to a source without its own colors being evaluated, checkmark Listen Only.

Or enable Listen Only for all Multicam group members except one to make that source the ‘master’ color reference.

*Note: Custom settings in the Color tab trigger a COLOR notification message that appears in the footer below the viewport of the channel (Figure 2-12).*

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**SECTION 2.2 TITLEBAR & DASHBOARD**

NC1 IO’s Titlebar and Dashboard are home to a number of important displays, tools and controls. Prominently located at the top and bottom of the Desktop, the Dashboard occupies the full width of the screen.

The various elements presented in these two bars are listed below (starting from the left):

1. *Machine name* (the system network name supplies the prefix identifying NDI output channels)
2. *NDI KVM menu* – Options to control NC1 IO remotely via NDI connection
3. *Time Display*
4. *Configuration* (see Section 2.2.1)
5. Notifications Panel
6. Headphones Source and Volume (see Section 2.2.3)
7. Record (see Section 2.2.3)
8. Display (see section 2.2.3)

Of these items, some are so important that they rate their own chapters. Others are detailed in various sections of this guide (cross references to the relevant sections of the manual are provided above).

2.2.1 TITLEBAR TOOLS

NDI KVM

Thanks to NDI®, it is no longer necessary to configure complicated hardware KVM installations to enjoy remote control over your NC1 IO system. The free NDI Studio Monitor application for brings network KVM connectivity to any Windows® system on the same network.

To enable NDI KVM, use the titlebar NDI KVM menu to select an operating mode, choosing between Monitor Only or Full Control (which passes mouse and keyboard operations to the remote system). The Security option lets you apply NDI Group control to limit who can view the NDI KVM output from the host system.

To view the output from the remote system and control it, select [Your NC1 IO Device Name]>User Interface in the Studio Monitor application supplied with the free NDI Tool pack, and enable the KVM button overlaid at upper-left when you move the mouse pointer over the screen.

*Hint: Note that Studio Monitor’s KVM toggle button can be relocated to a more convenient spot by dragging.*

This feature gives you a great way to control the system around your studio or campus. With the User Interface running full-screen in Studio Monitor on a receiving system, it’s really hard to remember that you’re actually controlling a remote system. Even touch is supported, meaning you can run the User Interface output on a Microsoft Surface™ system for portable touch control over your entire live production system.

(Actually, many of the interface screengrabs shown in this manual – including those in this section – were grabbed from NDI Studio Monitor while controlling the remote system in the manner described above.)

**SYSTEM CONFIGURATION (MARK M)**

MARK M The System Configuration dialog is opened by clicking the ‘gear’ gadget next to the Titlebar time display, and appears as shown in Figure 2-14.

**LTC TIMECODE**

LTC timecode support can be activated by choosing an input using the LTC Source menu to choose almost any audio input to receive the timecode signal over, and enabling the checkbox at left.
**About**

The About box displays the current software version and hardware revision of the unit.

*Hint: There are several ways to determine which hardware revision your NC1 IO system (‘Mark M’, or ‘Mark D’). If the unit is operating, open the System Configuration panel by clicking the ‘gear’ in the Titlebar. The hardware revision is listed in this panel’s footer. Otherwise, note that the top row on the backplane of Mark M systems hosts even-numbered connectors, while Mark D systems show odd-numbered connectors above.*

**I/O Configuration**

Further configuration options, including controls to determine how the SDI connectors on the backplane are allocated (as either inputs or outputs) are hosted in Admin>Configure NC1 I/O Connectors (Figure 2-15).

This dialog is shown on first launch, but can be accessed later from the Live Desktop to make modifications to the configuration as follows:

- Since it is necessary to restart the application after changes to these configuration options, you must click the Exit gadget (x) at extreme right in the Titlebar of the Live Desktop.

- Select either the IO Configuration or Genlock tabs, according to your need.

The IO Configuration tab makes it a simple matter to select presets using graphic representations that depict the connector layout on the backplane.

*Note: Certain selections may require rebooting the system to re-initialize the SDI hardware.*

**Video Settings**

The second tab in this configuration panel is labeled Video Settings, and its controls are discussed next.
**Video Standard**

The *Video Standard* option is an important one, since it determines the framerate ‘family’ that the hardware is able to access, and thus what formats will be available for input and output. Options are NTSC and PAL.

**Genlock**

The *Genlock* input on NC1 IO’s backplane is for connection of a ‘house sync’ or *reference signal* (typically a ‘black burst’ signal intended specifically for this purpose). Many studios use this method to synchronize equipment in the video chain. Genlocking is commonplace in higher-end production environments, and genlock connections are typically provided on professional gear.

If your equipment allows you to do so, you *should* genlock all hardware sources supplying NC1 IO, and the NC1 IO unit. To connect the genlock source, supply the reference signal from the ‘house sync generator’ to the *Genlock* connector on the backplane.

*Note: The unit can use SD (Bi-level) or HD (Tri-level) reference. (If the Genlock switch is disabled, the unit operates in an internally managed ‘free running’) mode, instead.)*

In the *Genlock* control group, select the format of the reference signal you are supplying.

**System Configuration (Mark D)**

The *System Configuration* panel for Mark D systems is opened by clicking the configuration (gear) gadget found in the upper-right corner of the screen (Figure 2-17).

**Timecode**

LTC timecode support can be activated by choosing an input using the *LTC Source* menu to choose almost any audio input to receive the timecode signal over, and enabling the checkbox at left.

**Genlock**

The *Genlock* input on NC1 IO’s backplane is for connection of a ‘house sync’ or *reference signal* (typically a ‘black burst’ signal intended specifically for this purpose). Many studios use this method to synchronize equipment in the video chain. Genlocking is commonplace in higher-end production environments, and genlock connections are typically provided on professional gear.

If your equipment allows you to do so, you *should* genlock all hardware sources supplying NC1 IO, and the NC1 IO unit. To connect the genlock source, supply the reference signal from the ‘house sync generator’ to the *Genlock* connector on the backplane. The unit can auto-detect an *SD (Bi-level) or HD (Tri-level) reference*. After connection, adjust the Offset as necessary to achieve stable output.

*Hint: If the Genlock switch is disabled, the unit operates in internal or ‘free running’) mode.*
**Configure IO Connectors**

The SDI connectors on NC1 I/O’s backplane can variously be assigned as either inputs or outputs. This determination is made in the *Configure NC1 I/O Connectors* dialog, which you can open by clicking the *Configure IO Connectors* button.

*Note: There are two versions of this panel, based on whether the unit is a “Mark D” or “Mark M” system.*

This panel presents various input/output preset options, providing access to all possible connector configuration alternatives.

The presets graphically display various i/o configurations as viewed from the rear of the system. Simply click a configuration preset to select it.

*Note: Configuration changes require you to either reboot the system, or simply to restart the application.*

**Notifications**

The Notifications panel opens when you click the ‘text balloon’ gadget at right in the Titlebar. This panel lists any information messages the system provides, including any cautionary alerts.

*Hint: You can clear individual entries using by right-clicking to show the item’s context menu, or the Clear All button in the panel’s footer.*

The footer of the *Notifications* panel also features a Web Browser button, discussed next.

**Web Browser**

In addition to the remote control features provided for your NC1 IO system by the integrated NDI KVM feature, the unit also hosts a dedicated webpage.

The *Web Browser* button at the bottom of the *Notifications* panel provides a local preview of this webpage, which is served to your local network to let you control the system from another system on your network.

To visit the page externally, copy the IP address shown beside the *Web Browser* button in the *Notification* panel into the address field of a browser on any computer on your local network.
NC1 IO’s channels each have a toolbar beneath their respective viewports. The various elements comprising the toolbar are listed below from left to right:

1. **Channel name** – Can be changed by clicking on the label, and also in the *Configure Channel* panel.
   a. A *Configuration* gadget (gear) pops up next to the channel name when the mouse is over a viewport.

2. **Record and Record Time** – The record button below each viewport toggled recording that channel; the *RECORD* button in the bottom dashboard opens a widget enabling capture *from any SDI input*.

3. **Grab** – the base filename and path for still image grabs are set in the *Configure Channel* panel.

4. **Full screen**

5. **Overlays**

---

**FIGURE 2-20**

---

**FIGURE 2-21**

A *Grab Input* tool is located in the lower right corner below the monitor for each channel. By default, still image files are stored in the system *Pictures* folder. The path can be modified in the *Output* window for the channel (see the *Output* heading above).

---

**FULLSCREEN**

---

**FIGURE 2-22**

Clicking this button expands the video display for the selected channel to fill your monitor. Press ESC on your keyboard or click the mouse to return to the standard display.

---

**OVERLAY**

---

**FIGURE 2-23**

Found in the lower right corner of each channel, *Overlays* can be useful for visualizing safe zones, centering and more. To use an overlay, just click on an icon in the list (see Figure 2-24); more than one overlay can be active at the same time.
2.2.3 DASHBOARD TOOLS

Audio (Headphones)

You can connect a headset to the (green) audio output jack on the rear of NC1 IO’s motherboard.

![Headphone Audio Controls](image)

**FIGURE 2-25**

Controls for *Headphone audio* are found in the lower-left corner of the dashboard at the bottom of the screen (Figure 2-25).

1. The audio source supplied to the *Headphone* jack can be selected using the menu next to the *headphone icon* (Figure 2-26).

2. The *Volume* for the selected source can be adjusted moving the slider provided at right (double-click this control to reset it to the default 0dB value).

**FIGURE 2-26**

**RECORD**

![Record Button](image)

**FIGURE 2-27**

The *Record* button is also located in the lower-right corner of the dashboard (Figure 2-27). Click it to open a widget allowing you to begin or stop recording of individual channels (or start/stop all recordings.)

*Notes:* The destinations for recorded clips, their base file names and other settings are controlled in the *Configuration panel* (see Figure 2-8). Recording NDI sources is not supported. The *Share Local Recorder Folders* can be used to expose local folders assigned to capture duties on your network, making it easy to access captured files externally.
In the bottom-right corner of the Dashboard at the bottom of the (primary) screen, the Display widget offers a variety of layout options to let you viewing channels individually or in groups, as well letting you configure a second monitor (Figure 2-28).

**FIGURE 2-28**

Waveform and Vectorscope features are shown when you select the SCOPES option in the Display widget (Figure 2-29).

**FIGURE 2-29**
APPENDIX A: KEY/FILL CONNECTIONS

A.1 MARK M SYSTEMS

Key/Fill output using two SDI output connectors is supported as follows:

- SDI connectors numbered 1-4 show “video and alpha” options in their Configure Channel Format menu. Selecting this option sends ‘video fill’ from the source to the designated SDI connector.

- The SDI connectors numbered 5-8 can optionally serve as key channels to supply a grayscale matte from NC1 IO™ when the connector is configured as an SDI output. The ‘key matte’ is placed on the output whose connector is 4 index positions higher. (So, for example, if the fill is output on SDI output 1, the SDI output connector labeled 5 will supply the corresponding matte).

A.2 MARK D SYSTEMS

Key/Fill output using two SDI output connectors is supported as follows:

- Even-numbered output channels will show “video and alpha” options in their Configure Channel Format menu. Selecting this option sends ‘video fill’ from the selected source to the designated (even-numbered) SDI connector.

- The designated ‘key matte’ source is placed on the next lower-numbered connector. (So, for example, if the fill is output on SDI output 4, the SDI output connector labeled 3 will supply the corresponding matte).

APPENDIX B: NDI (NETWORK DEVICE INTERFACE)

For some, the first question may be “What is NDI?” In a nutshell, NewTek’s Network Device Interface (NDI) technology is a new open standard for live production IP workflows over Ethernet networks. NDI allows systems and devices to identify and communicate with each other, and to encode, transmit, and receive high quality, low latency, frame-accurate video and audio over IP in real time.

NDI enabled-devices and software have the potential to greatly enhance your video production pipeline, by making video input and output available anywhere your network runs. NewTek’s live video production systems and a growing number of third party systems provide direct support for NDI, both for ingest and output. Although NC1 IO provides many other useful features, it is purpose designed primarily to turn SDI sources into NDI signals.

For more extensive details on NDI, please visit http://www.newtek.com/ndi.html.

APPENDIX C: DIMENSIONS AND MOUNTING
NC1 IO is designed for convenient mounting in a standard 19" rack (mounting rails are available separately from NewTek Sales). The unit comprises a 1 Rack Unit (RU) chassis supplied with ‘ears’ designed to permit mounting in standard 19" rack architecture.

**FIGURE 2-30**

The units weigh nearly 14 pounds (6.35 KG). A shelf or rear support will distribute the load more evenly if rack-mounted. Good front and rear access is important for convenience in cabling should be considered.

In view of the top panel vents on the chassis, at least one RU should be allowed above these systems for ventilation and cooling. Please keep in mind that adequate cooling is a very important requirement for virtually all electronic and digital equipment, and this is true of NC1 IO as well. We recommend allowing 1.5 to 2 inches of space on all sides for cool (i.e., comfortable ‘room temperature’) air to circulate around the chassis. Good ventilation at the front and rear panel is important, and ventilated space above the unit (1RU minimum is recommended).

When designing enclosures or mounting the unit, supplying good free air movement around the chassis as discussed above should be viewed as a critical design consideration. This is especially true in fixed installations where NC1 IO will be installed inside furniture-style enclosures.

**APPENDIX D: ENHANCED SUPPORT (PROTEK)**

NewTek’s optional ProTek℠ service programs offer renewable (and transferable) coverage and enhanced support service features extending well beyond the standard warranty period.

Please see http://www.newtek.com/protek.html or your local authorized NewTek reseller for more details regarding ProTek plan options.

**APPENDIX E: RELIABILITY TESTING**
We know our products play vital roles in the productions of our customers. Durability and consistent, robust performance are much more than just adjectives for your business and ours.

For this reason, all NewTek products undergo rigorous reliability testing to ensure they meet our exacting test standards. For NC1 IO, the following standards are applicable:

<table>
<thead>
<tr>
<th>Test Parameter</th>
<th>Evaluation Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature</td>
<td>Mil-Std-810F Part 2, Sections 501 &amp; 502</td>
</tr>
<tr>
<td>Ambient Operating</td>
<td>0°C and +40°C</td>
</tr>
<tr>
<td>Ambient Non-Operating</td>
<td>-10°C and +55°C</td>
</tr>
<tr>
<td>Humidity</td>
<td>Mil-STD 810, IEC 60068-2-38</td>
</tr>
<tr>
<td>Ambient Operating</td>
<td>20% to 90%</td>
</tr>
<tr>
<td>Ambient Non-Operating</td>
<td>20% to 95%</td>
</tr>
<tr>
<td>Vibration</td>
<td>ASTM D3580-95; Mil-STD 810</td>
</tr>
<tr>
<td>Sinusoidal</td>
<td>Exceeds ASTM D3580-95 Paragraph 10.4: 3 Hz to 500 Hz</td>
</tr>
<tr>
<td>Random</td>
<td>Mil-Std 810F Part 2.2.2, 60 minutes each axis, Section 514.5 C-VII</td>
</tr>
<tr>
<td>Electrostatic Discharge</td>
<td>IEC 61000-4-2</td>
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<td>12K Volts</td>
</tr>
<tr>
<td>Contact</td>
<td>8K Volts</td>
</tr>
</tbody>
</table>
Acknowledgments: Tim Jenison, Jim Plant


This product uses the following libraries, licensed under the LGPL license (see link below). For the source, and the ability to change and recompile these components, please visit the links provided:

- FreeImage library http://freeimage.sourceforge.net/
- LAME library http://lame.sourceforge.net/
- FFMPEG library http://ffmpeg.org/

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