

TEKVOX Technology Overview

TEKVOX manufactures comprehensive technology solutions for audio visual applications in modern classrooms, conference rooms and specialty spaces. From a single AV-equipped room to thousands spread across multiple campuses, TEKVOX's solutions are powerful, economical, easy to use and reliable. TEKVOX's Drop-In AV® products are the only whole-room ProAV systems that are entirely manufactured and programmed in a factory environment. Drop-In AV solutions range in complexity from a simple huddle station to collegiate classrooms to commercial conference centers and highly specialized spaces such as courtrooms and council chambers.

Compared to traditional integrator-produced that are site-built, Drop-In AV systems:

- Are built, configured and tested in a factory before being broken down for shipping,
- Heavily reuse proven software,
- Are precisely customized for a specific room and ready to operate when installed,
- Feature built-in remote management and monitoring, and
- Have an extensive full-system warranty and life-time software warranty.

With proper installation, a Drop-In will be fully operational when powered on. The genesis of Drop-In AV is TEKVOX's unique control system technology that drastically increases software reuse while also reducing development time for a new system: the TekMonitor.



TEK 4 and TEK 4 Pro TekMonitors

TEKMONITOR

A TekMonitor is member of a multi-generation family of network-based appliances that run the TekMonitor application for operating audio-visual systems and their associated peripheral devices. The TEK 1 was introduced in 2006 with the primary function of providing a multi-campus occupancy-based projector and lighting power management.

It is important to note that the TekMonitor is much more than a 'blank slate' control system. Along with TekManager and TekEnterprise, the TekMonitor is part of a comprehensive hardware / firmware

/ software solution to control¹, monitor² and manage³ a constellation of AV-equipped rooms. And unlike many other control systems, the control software is not added in the field by a technician: it is created by software development professionals and permanently embedded in the TekMonitor at the completion of its manufacturing. Easy-to-use and understand templates are applied to personalize a TekMonitor during the process of manufacturing the Drop-In AV system.

In this scheme, the core control application is embedded in the TekMonitor and every unit in the field is running the same base software: all day, all year. This results in many tens of millions of accumulated hours of in-field operation leading to well-proven software and highly reliable operation. A marked difference from in-field programming that may have no operating history while also providing precise customization at the final stage of manufacturing where templates are implanted.

Each successive generation of TekMonitor has extended the capabilities of the family while maintaining seamless compatibility with the TekManager and TekEnterprise management and monitoring tools. A brief summary of the timeline and key capabilities is presented below.

	TEK 1	TEK 2	TEK 3	TEK PC	TEK 4	TEK 4 Pro
	2006	2010	2014	2019	2024	2024
OS	Proprietary	Proprietary	Proprietary	Win IoT	Linux	Linux
Serial IO	1	2	3	6	3	6
Scripting				JS	JS	JS
TekSecurity	-	1	1	-	1	2
Occupancy Sensing	Y	Y	Y	-	Y	Y
Firewall	-	-	-	WinDef	Iptables	Iptables
CPU	MCHP	MCHP	MCHP	Intel I5	NXP i.MX 6	NXP i.MX 6
Memory	256 KB	1 MB	256 MB	16 GB	16 GB	16 GB
Dual LAN	-	-	-	Yes	-	Yes
Control Schemes	Serial Logic I/O IR	Serial Logic I/O IR	Serial Logic I/O IR	Serial IP	Serial Logic I/O IP	Serial Logic I/O IP
Fab site	USA	USA	USA	China or USA	USA	USA
Status	EOL	EOL	EOL 2024	Production	Production	Production
Applications	TekMon	TekMon	TekMon	TekMon DHCP Router WIn apps	TekMon Linux apps	TekMon DHCP Router Linux apps

TekMonitor Generations and Timeline

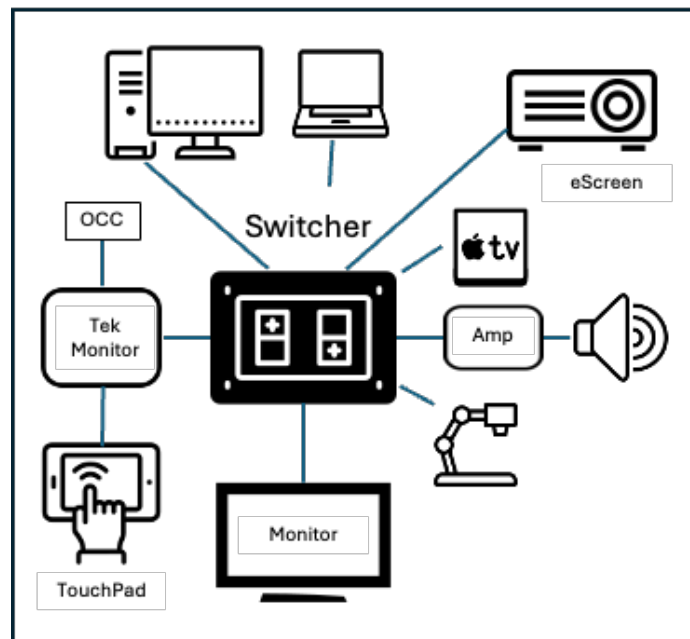
¹ **Control:** manipulating the state of devices of information based on an input from the user or a management process. Example: user has pressed the 'On' button. The control system turns on projector, lowers screen, changes switcher to default source (e.g. PC), sets internal room status to 'On', starts cumulative 'On' timer, sets active source variable to 'PC'.

² **Monitoring:** process of remotely reading and displaying the status of a room or rooms. Example: monitoring program periodically polls 200 on-campus AV systems, log results and displays current state on a graphical dashboard.

³ **Managing:** process of analyzing operational results and producing analytical reports on usage, capacity, uptime, maintenance needs and similar data. Example: enterprise management system produces real-time display of KPIs with ability to analyze on a timeline and create reports.

Over the lifetime of the TekMonitor, ProAV technical and market requirements have been in a state constant change. In 2006, VGA and analog inputs were the standard along with 4:3 aspect ratio projectors. User input was made via mechanical buttons and audio subsystems were frequently ad hoc afterthoughts. Today's hybrid classrooms feature sleek color touchscreens for user input and a move towards multiple displays per room. Cameras and high-end microphones for web-connected conferencing are common and expectations are high for supporting a presenter's laptop with all the AV tech capabilities that the installed PC has. REST, JSON, SOAP and SSL where not found in the classroom where today they are a must.

A simple classroom as depicted below can serve to highlight in-room control requirements. In this example, a TekMonitor has a serial connection to a small color touch screen for user input and provides 12V power to the device. There is an AV switcher with inputs for a PC (HDMI), a laptop (USB-C), a document camera (HDMI), an Apple TV (HDMI) and outputs for a confidence monitor (HDMI), a projector (HDBaset) and an audio amplifier with speakers.



Simple Classroom with TekMonitor

The TekMonitor is only in direct communication with the switcher, the TouchPad and the amplifier (connection not shown) via serial ports but also needs to control the projector⁴ and the AppleTV⁵. Since the switcher was designed for this type of application, it has specialized internal pathways to support 'passthrough' control. For example, when the User presses the 'Power On' button on the touch pad, a string of ASCII characters is sent to the TekMonitor that will decode the string and follow the logic specified in its templates⁶. In highly simplified form, this may include:

- Log the command received

⁴ If an electrically operated screen was present, there would be a direct connection to the TekMonitor for control

⁵ In general, there no control requirements for document cameras, PCs or Laptops (but that can change!).

⁶ For more information on Templates, please see Appendix A.

- Set *System Status* to 'On', enable *System On Timer*
- Send command to switcher to relay 'Power On' command to projector via serial channel embedded in HDBaseT stream and enable the *Projector On timer*
- Unmute audio amplifier
- Set switcher input to 'Default' Input (usually PC on input 1), set *Input Status* to '1' and enable *Input 1 Active* input timer

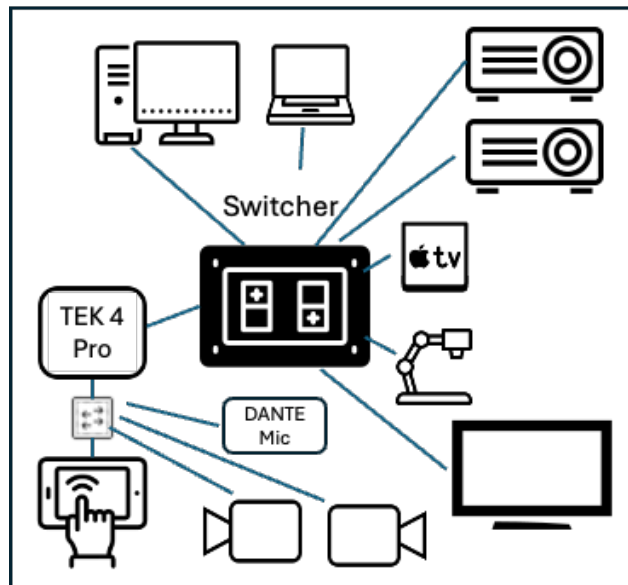
If, after some time, the User presses the 'AppleTV' button on the TouchPad, the TekMonitor might be configured to perform the following:

- Log command received
- Disable and store the accumulated value in the *Input 1 Active* timer
- Send command to switcher to switch to AppleTV input (e.g. input 4) and enable the *Input 4 Active* Timer
- Send *On* command to AppleTV via the switcher's CEC interface and enable AppleTV controls on the TouchPad.

The User will have control of the AppleTV via the TouchPad without requiring a handheld remote. If the User remembers to hit the Power Off when finished, the TekMonitor will close down the activity timers that it set above, store the values in its internal non-volatile memory and turn off the projector. If perhaps the User distractedly leaves the room without turning the system off, the TekMonitor continuously monitors its Occupancy Sensor input (OCC) and will automatically shut the system down after a pre-programmed period of measuring the room to be unoccupied.

This is AV control in a highly-simplified view that ignores a great deal of activity in projector management, device drivers, volume control and feedback, anti-theft monitoring, resolution management, device security, cabling and many other aspects of a well-controlled AV fixture. This example system is quite simple itself and uses only a fraction of the capability of the more advanced TekMonitors. Much more complex applications can be easily addressed. It is not unusual at all for a college classroom to have multiple projectors or displays, sophisticated array microphones, large color touch screen panels and dual cameras such as depicted below all controlled and coordinated by a single TekMonitor.

In this example, a TEK 4 Pro TekMonitor uses its dual LAN and on-board router to create a private AV LAN for the room. Conferencing devices such as PTZ cameras and Dante microphones would be controlled via the LAN while all digital audio traffic would remain inside the room's boundaries. Projectors would be controlled and protected against theft using serial commands tunneled over HDBaseT via the presentation switcher.



Advanced Classroom with TEK 4 Pro

The power of the TekMonitor is that all these capabilities, and much more, are built in and always available to harness via templates⁷ and their embedded drivers. Notice that no mention has been made yet of connection to or communication with anything outside of the classroom itself. A TekMonitor-based system can operate in complete isolation but cannot deliver its full value in Monitoring and Management. When connected to a campus LAN, the TekMonitor becomes the gateway into the AV devices of the room providing remote visibility, control and management.

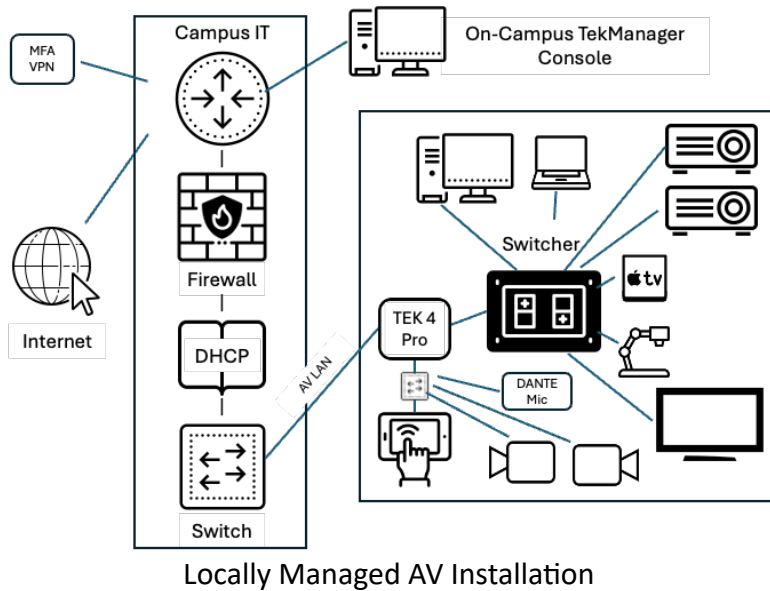
TEKMANAGER

TekManager is a multi-purpose Windows application that allows the AV administrator to monitor the health of a campus of TekMonitor-equipped classrooms over a local area network. When TekMonitor-based rooms are connected to a campus network, they leverage the existing infrastructure of switches, routers and firewalls to connect to administrator PC running the TekManager program.

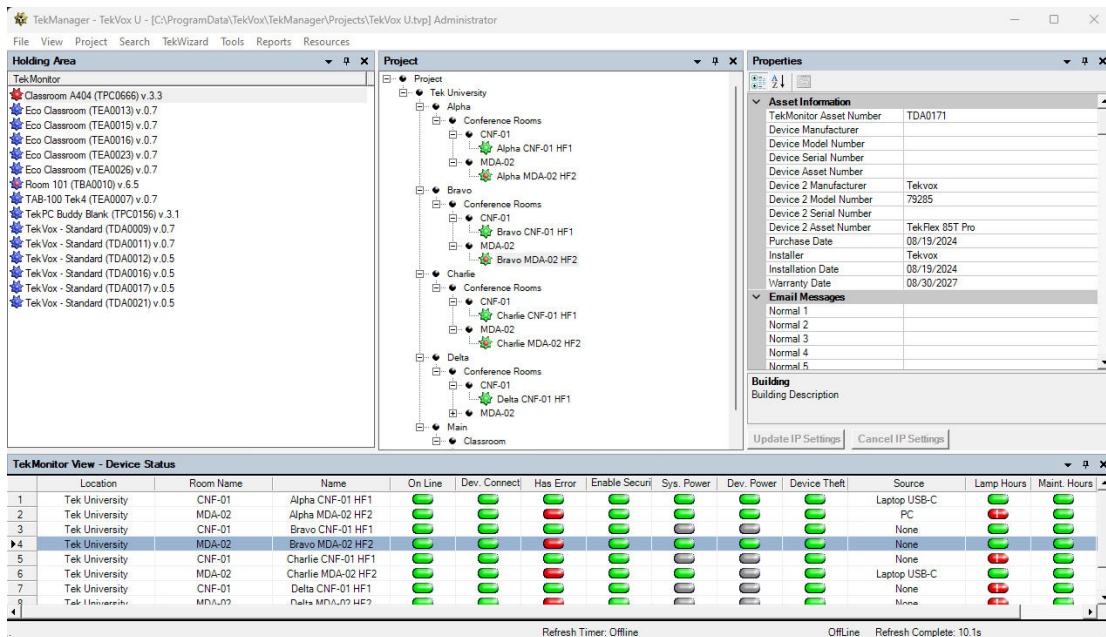
Following best practices, TekMonitors should be installed on VLANs that are dedicated to AV devices so that network traffic can be kept separate and private from other LAN users. These VLANs typically have internet access available for maintenance and update needs but it is practical to limit this to planned maintenance windows. It is highly recommended that these VLANs be provisioned for VPN access via a Multi-Factor-Authentication facility to allow for remote technical support either by institution support staff or by TEKVOX engineering staff⁸.

⁷ See Appendix A for a summary of TekMonitor templates

⁸ Remote factory technical support is included in the purchase price of TEKVOX Drop-In AV systems. This is most-easily facilitated by providing MFA VPN credentials to designated engineering staff. Interactive screen sharing sessions with an on-premise TekManager-equipped PC is potentially less secure but can work.



When a new Drop-In AV system is installed, TekManager is used first to ‘discover’ the new TekMonitor(s) on the network using a unique auto-discovery process. The administrator simply enters the AV VLAN range(s) and the TekMonitor passcode⁹ and TekManager will locate all TekMonitors in that range that match that passcode.



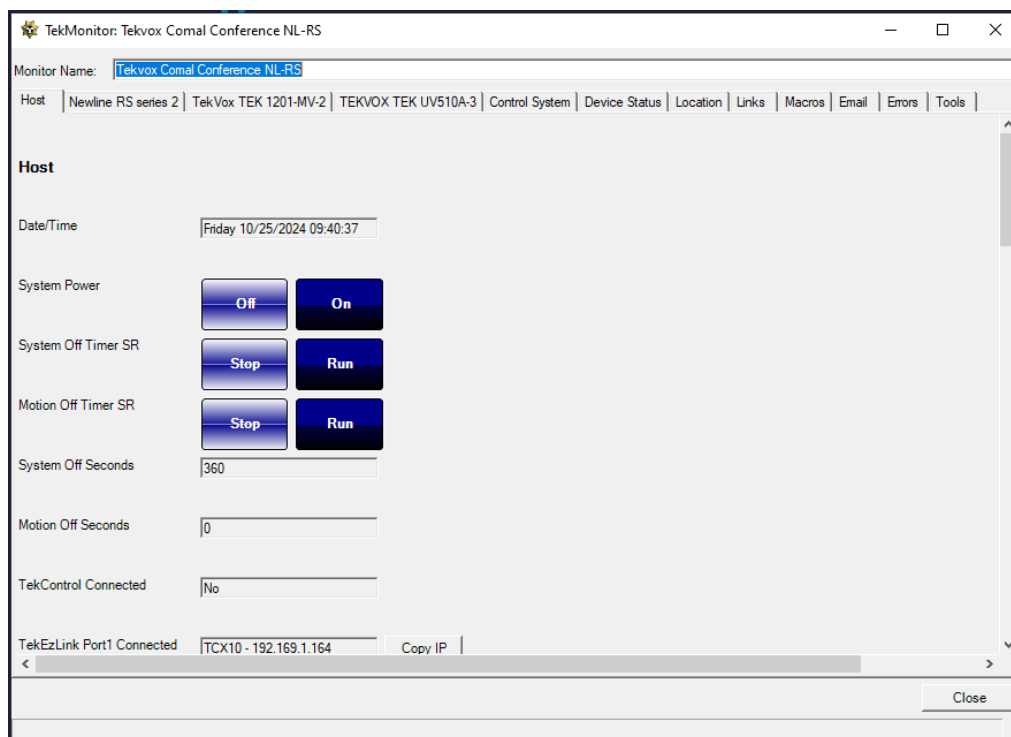
Typical TekManager Project View

TekManager operates around the concept of *projects*. A project is a file containing a logical grouping of TekMonitors and associated settings. A project can represent a floor, a building or an entire

⁹ TekMonitors are configured with a numeric passcode that is unique to a campus or physical plant. A TekMonitor will not respond to LAN communication unless its stored passcode matches the query’s passcode.

campus¹⁰. When loaded in TekManager, a project provides a multi-pane visual dashboard for monitoring and managing the members of that project. TekMonitors that have been added to the project are shown in the Project window with a color-coded status indication. TekMonitors that are not currently associated with the Project but match the passcode and are in the preset LAN range, are shown in the Holding window, also color-coded. An unclaimed TekMonitor is added to the project with a simple drag and drop. Internal TekMonitor template information is shown in the Properties window by highlighting the associated TekMonitor icon. Finally, a status dashboard is displayed in the View menu.

Whether in the Holding Area or a Project, the real-time state of a TekMonitor can be examined and modified by double-clicking on the TekMonitor icon which activates the TekManager multi-tab *Control View* as below. Information about both the TekMonitor and Driver templates is displayed across the tabs.

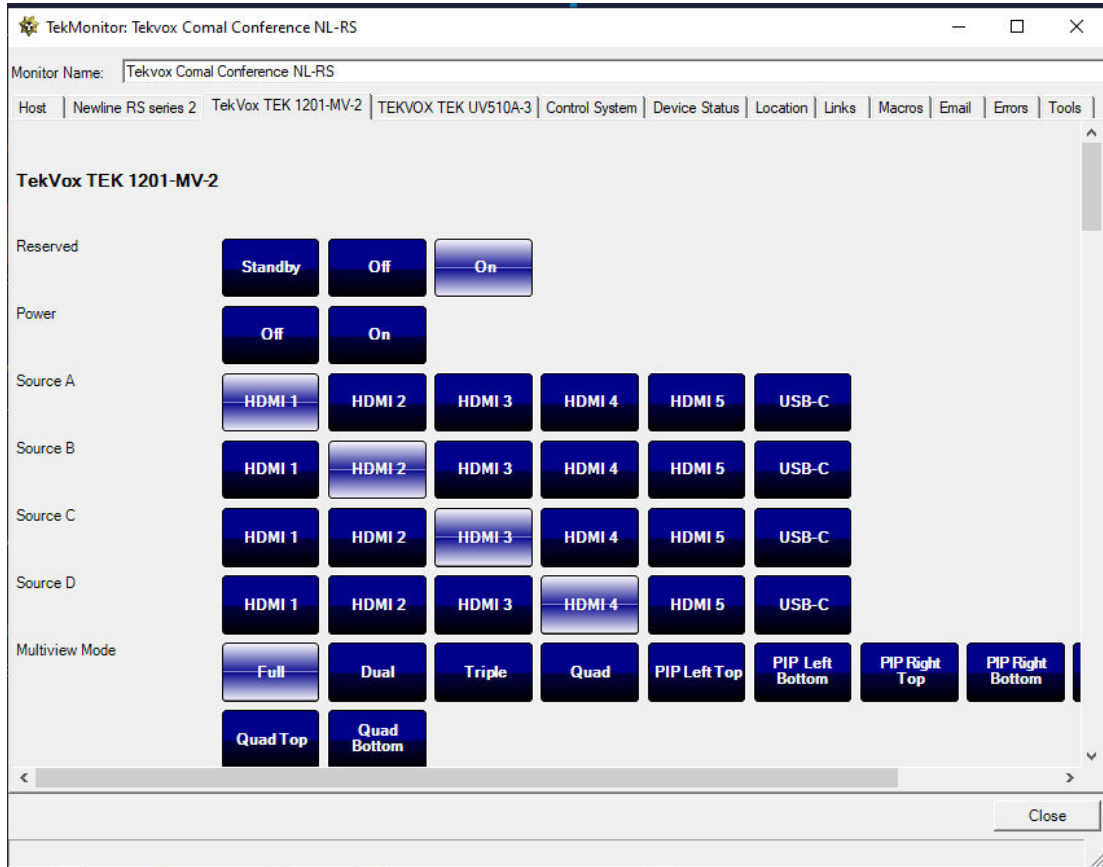


TekManager Control View

The *Host* tab provides a summary of the overall TekMonitor and its external connections. As can be seen in the adjacent tabs, this TekMonitor is loaded with drivers for a Newline RS series intelligent display, a TEK 1201-MV Universal switcher, a standard TEKVOX PTZ camera, of course, the relevant TekMonitor hardware driver (TEK 3, TEK 4, ...). Finally, the contents of the TekMonitor Templates described above are accessible in tabs. Note that these controls are both real-time and interactive. For example, pressing the System Power 'Off' button will turn the controlled system off.

¹⁰ See <https://www.youtube.com/watch?v=CfG0krb3pUY> for more information.

Similarly, the tab for the TEK 1201-MV universal switcher provides a copious real-time view of all accessible settings and controls of this powerful switcher. This provides an example of the power of a TekMonitor driver in that the display below is automatically rendered with no foreknowledge of the device itself. All information is read from the driver. In this way, new drivers for new devices are easily deployed without constant need to update the management tool.



TEK 1201-MV Control View

Without the need to enumerate the contents of all tabs, it is simple to view and, if need change, the status of a TekMonitor from any location that can access it with the proper access credentials. A simple use-case is managing a display change. If projector or display is being changed to a different make/model, an administrator can easily 'pull' the device template from the TekMonitor, update the reference in the driver template from the old model to the new model and restore the template to the TekMonitor. TekManager will automatically load the new driver¹¹. For the life of a TEKVOX system, owners never pay for software costs to change or replace a display.

With very little effort, a newly installed AV system is operating and under management. All key information needed for control, asset tracking and monitoring has been preloaded during manufacturing. The administrator can instantly see the status of any room in a project and, if needed,

¹¹ In-production drivers are sourced from a TEKVOX FTP site that retains drivers for hundreds of different devices and is frequently updated. The experienced TekManager user hits the 'Update Drivers' button routinely.

quickly navigate to any room, double-click and have access to the real-time state and controls of the room. The administrator has access to error indicators, current room settings and logs. Instead of having to physically visit a room, significant diagnosis and corrective action can be taken from the administrator's desk. If needed, the administrator can contact TEKVOX for remote analysis. Note that, other than creating an initial project file¹² and populating it, there is no in-field configuration or programming required to manage a TEKVOX Drop-In.

In addition to its monitoring functions, TekManager has sub-tools for locating TekMonitors (Search), device configuration (TekWizard), management reporting (Reports) and other administrative functions (Tools). TekManager can be configured for administrative (all rights) use or monitoring (read only). Multiple instances of TekManager are supported but there should be only a single 'master' project file for a campus that includes all managed rooms. It is this master instance that will synchronize all TekMonitor clocks and will be the data source for enterprise-level management.

Institutions employing TekManager can respond quickly and proactively to AV issues and in many cases prevent them from becoming loss of operational capability. The integrated tools provide a wealth of time-saving capabilities to the administrator of an AV-rich campus. A modest staff can efficiently support several hundred classrooms on a campus.

TEKENTERPRISE II

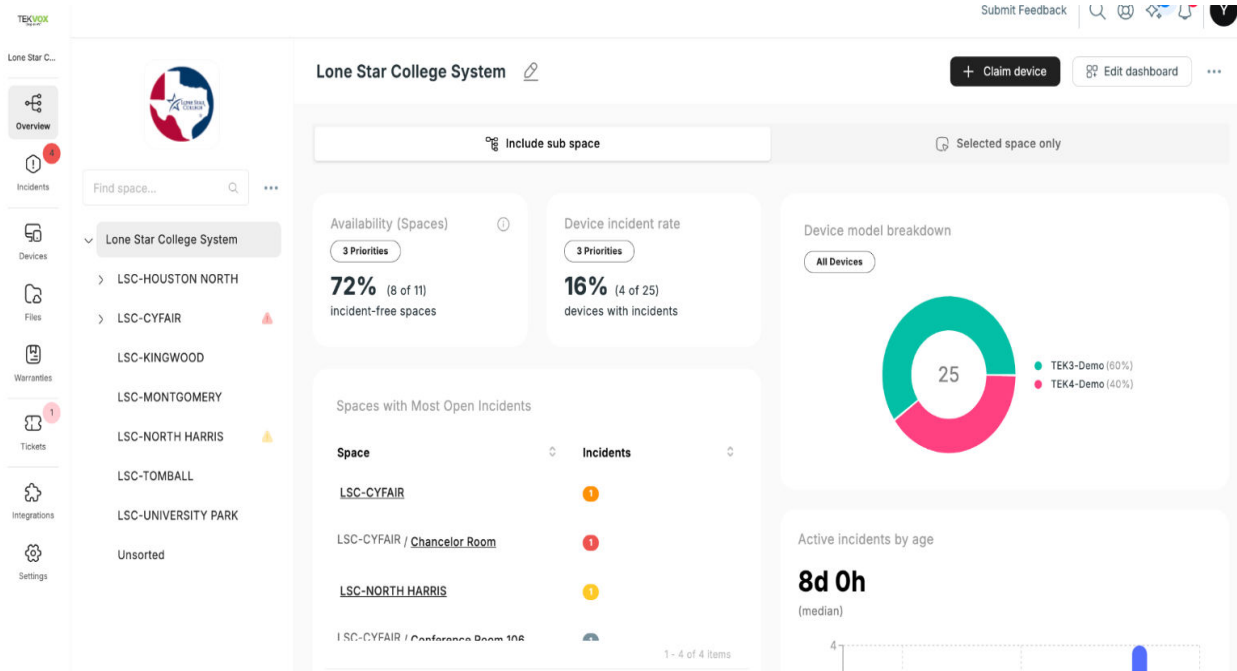
TekEnterprise is a secure cloud-based enterprise management package that leverages the information contained in a TekManager Project and adds a hierarchical multi-campus visualization, processing of real-time telemetry streams and a dashboard of Key Process Indicators.

Following the 'no coding necessary' principle of TEKVOX technology, TekEnterprise will periodically read the contents of a campus project and automatically populate its data set. In the case of multiple campuses, TekEnterprise will show a hierarchy that aggregates a management view at each level and can be rapidly navigated by the executive user. Although it does provide control and update features, most of these needs will continue to be met at a local level by TekManager.

Instead, TekEnterprise leverages a set of real-time telemetries from an arbitrarily large array of TekMonitors (and their controlled devices) that measure the health, usage and demographics of the AV plant. TekEnterprise will provide both instantaneous and historical information on room availability, usage, aging, issues and connectivity with the goal of ensuring that AV assets are available for use 99.999% of the time. This figure, the magical 'Five Nines', allows for less than 9 hours of down time in a *year* for an AV system.

To meet this very aggressive goal, the hierarchical nature of TekEnterprise allows the customer to directly include TEKVOX in the monitoring process and allows TEKVOX to proactively measure telemetry for issues early in their evolution to help jointly chart resolution before a loss of usability is experienced.

¹² An easily customizable generic project file is provided by TEKVOX



TekEnterprise Prototype Dashboard

TekEnterprise is first and foremost a Management Information System that allows leadership at all levels of an institution to view and review the health of their mission-critical AV plant. The real-time view can direct attention of both institution and manufacturer resources to issues before they are reported. Over time, as operating history of the institution grows, TEKVOX will apply learning techniques to predict operational failures and resolve them before they happen.

As a data aggregator for an institution, TekEnterprise also provides easy report generation of uptime, usage, system stability, asset aging and other key factors for operational and governance reporting.

While dedicated to uptime, a key value of TekEnterprise is providing a comprehensive positive accountability for the AV plant.

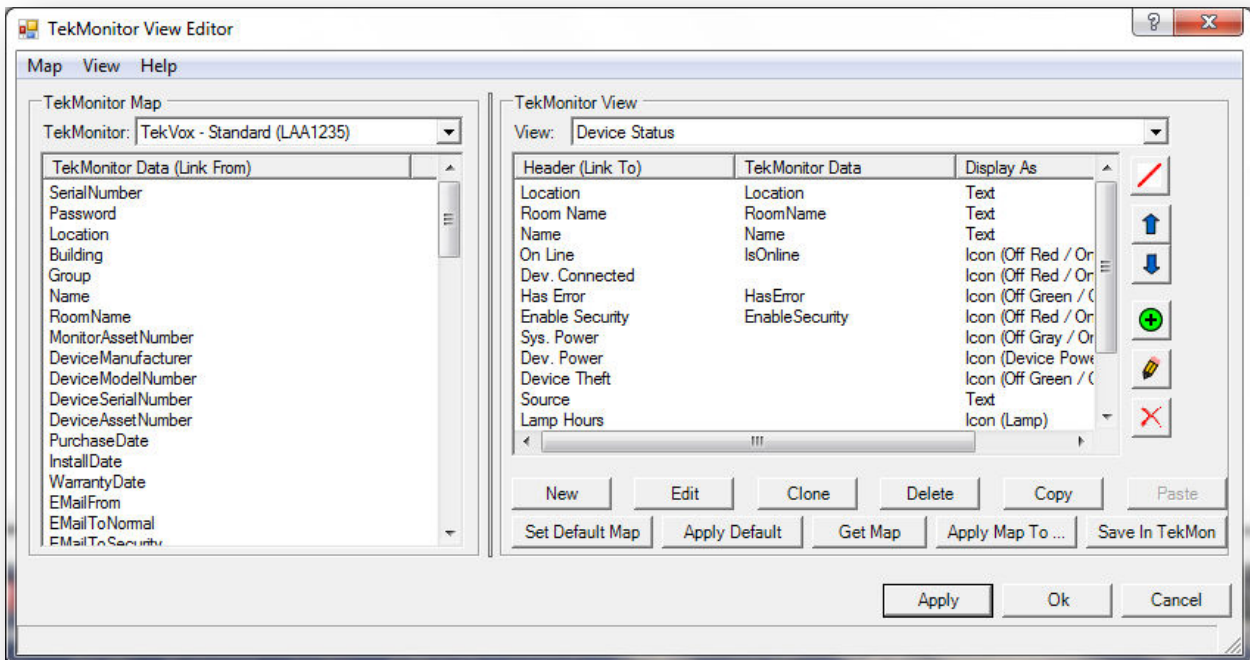
Appendix A – TekMonitor Templates

TEMPLATES

TekMonitor templates are information blocks that personalize and direct the operation of the underlying TekMonitor firmware without needing to write any software. At a high level, there are two primary templates: the *TekMonitor* template containing management information and the *Device* template containing operational information.

The TekMonitor template includes information about the identity of the device including:

- Logical device name and location (campus, building, room, ...),
- Network settings,
- Email settings, credentials and messages,
- Warranty information such as installation date, installer, warranty date,
- Asset information including serial numbers of the TekMonitor, projector, ...
- Security information including the five-digit device passcode



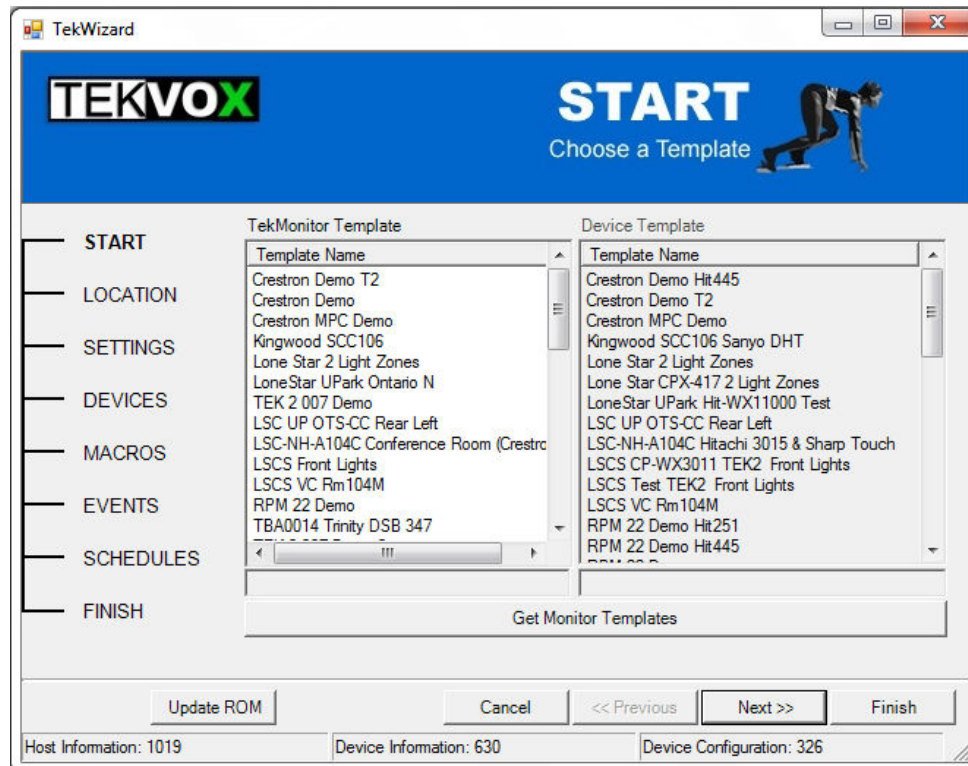
TekMonitor Template Partial View

The Device template contains information that directs the operation of the underlying TekMonitor firmware and includes:

- The software driver associated with each connected device (drawn from a TEKVOX server). Adding a driver for a device makes its internal commands accessible to the control program,
- Feedback, status and log mapping,

- Macros which are logical sequences of commands (e.g. 'Proj. On') that can include conditionals and branching logic,
- Events allow macros to be triggered by the occurrences of events such as power on, timer expiration, input level change and many other conditions, and
- Schedules which can launch a macro based on a precise time or time period.

Altogether, the templates provide a simple but powerful way to configure a TekMonitor for a specific application without writing a single line of new software. Moreover, the creation of a template is guided step-by-step by the TekWizard tool in the TekManager application.



Using TekWizard, the AV developer has access to hundreds of production-quality drivers on the TEKVOX file server for virtually every commercial projector and flat panel ever made as well as switchers, processors, relay controls, third-party lighting products and much more.

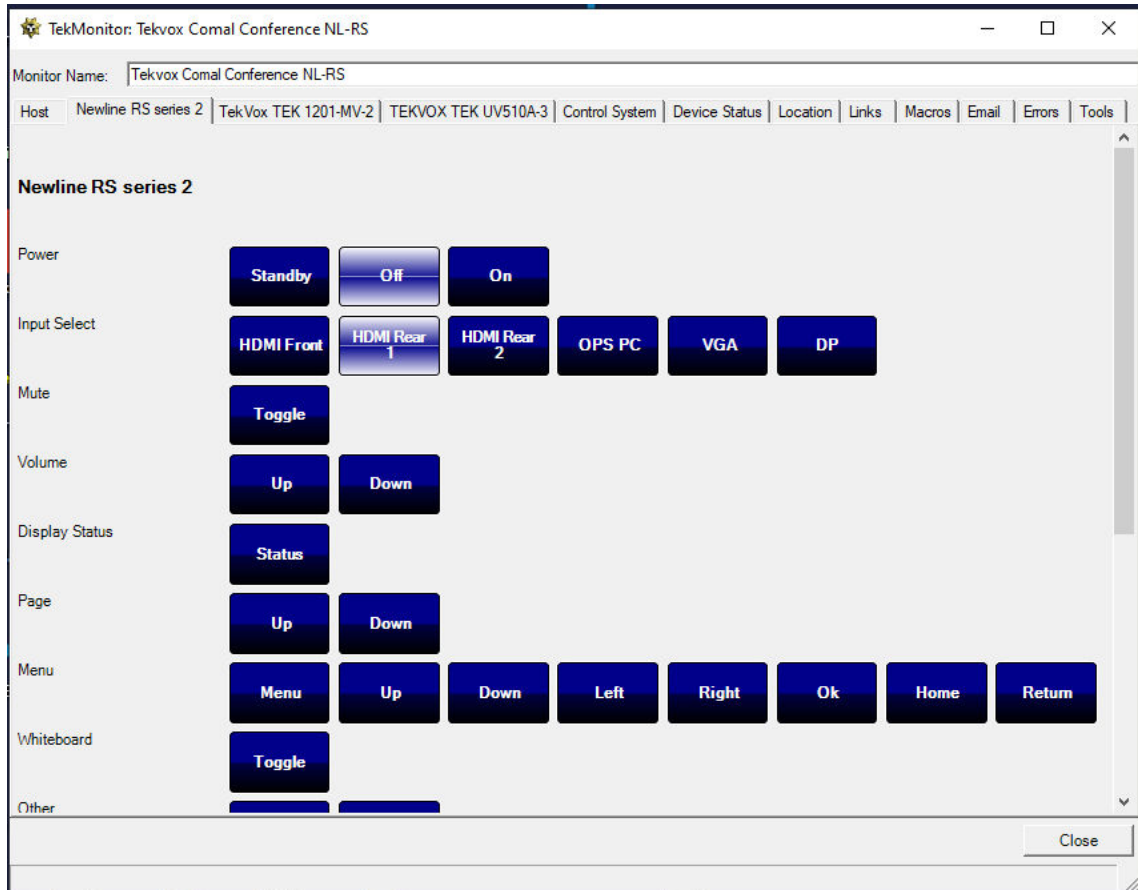
Template management is also greatly simplified. Once created, a template set can be implanted in a TekMonitor and also archived for future reference. A customer's base template is reused to create a range of comparable rooms with different names but identical behavior. Template can be easily reloaded in the field and, importantly, they can be 'pulled' from a TekMonitor, edited and then reloaded. For example, if a projector is replaced with a different brand/model, instead of creating a new template, the existing template is pulled from the Tekmonitor, the driver make/model is updated and the template is reloaded. This process requires only a few minutes and has very low operational risk.

Whether purchased as a stand-alone control system or as an element of a Drop-In AV system, TekMonitor templates with a room's full logical identity and operating logic are typically loaded by TEKVOX prior to shipment as a no-cost service. As such, when installed on premise and connected to the campus LAN, an unclaimed TekMonitor is ready to work and can immediately advertise its presence via a specialized discovery process. The local administrator can then add the TekMonitor to the appropriate project via point and click and the management and monitoring process is fully available with no complex configuration or specialized knowledge.

Templates provide rapid, fine-grain customization of a rich feature set while completely reusing the underlying control and communication software of the TekMonitor.

Appendix B - TekMonitor Drivers

TekMonitor Drivers are production-quality software modules that expose the controllable elements of a device to the TekMonitor process. Drivers also contain the information required for TekManager to visualize status and control information in the Control View.



Visualization of a Driver in TekManager

TEKVOX has developed drivers for hundreds of makes and models of projectors, flat panel displays, switchers, amplifiers, media players, wireless presentation systems, cameras, microphones, relays and other devices. TEKVOX has developed proprietary software tools to facilitate rapid creation of high-quality drivers for both internal and third-party devices. Drivers are maintained on a FTP site that is access via TekManager's 'Update Drivers' function.

The driver depicted above in the TekManager Control View is for a Newline RS Series interactive display with internal Open System (OPS) PC. In this partial view, the driver has exposed the Newline internal controls for power, input selection, volume, menuing and many other features. All controls shown are directly accessible by the TekMonitor and are exposed simply by adding the driver to the TekMonitor Driver template.

Appendix C - Security Considerations

Whether in a small office or on a large college campus, purchasers and administrators of Audio-Visual technology should review their characterization of threats versus countermeasures to mitigate the threats versus over all usability. The perfectly secure system is the one that is disconnected, unpowered and locked in vault. TEKVOX offers a broad range of solutions, both in technology and use-case that enhance security, privacy and asset protection without sacrificing usability and maintainability.

PRIVACY

Unless agreed in writing with the customer, TEKVOX systems are designed such that they cannot 'leak' audio or video from a room without instructor participation (e.g. starting a Zoom meeting). There are no data paths to either insert audio or video into a room or to extract it except through the room PC or laptop. In addition to ensuring privacy, the absence of this capability lowers the potential value of attempting to penetrate a TEKVOX system.

TEKVOX on-campus tools do not integrate with customer directory services and do not hold any user data.

DEVICE SECURITY

TekMonitors are typical embedded systems. The TEK PC uses a fanless, industrial grade Intel-based PC running the current release Windows IoT. OS access is protected by a strong customer-specific password. Network access is protected by Windows Defender. The hardware is commercially available and can be sourced from several regions (although not at the same cost).

The TEK 4 and TEK 4 Pro are proprietary designs developed and manufactured in Texas. These devices utilize BuildRoot Linux managed by Linux security expert Thomas Petazonni. Mr. Petazonni personally reviews all check-ins to the BuildRoot base and utilizes the Buildroot Security Vulnerability tracking tool to identify Common Vulnerabilities and Exposures via NIST National Vulnerability Database. Buildroot allows for near-instantaneous response to newly identified vulnerabilities.

ASSET PROTECTION

Physical devices including PCs, displays, projectors, AV switchers, amplifiers and microphones may be considered targets for theft, tampering or vandalism in some environments. While corporate environments are generally considered safe due to controlled entry, school campuses are not.

TEKVOX recommends that easily accessible devices such as PCs and AV equipment be locked in lecterns or podiums with limited access. Many TEKVOX Drop-Ins use specially certified ceiling

equipment boxes for control systems and amplifiers that keep them out of reach. In addition to lockable mounts, displays and projectors can be protected against theft with TEKVOX TekSecurity modules that monitor the connection to a protected device and will immediately communicate a security event via email or text if the connection is broken. The TEK 4 has one TekSecurity port, the TEK 4 Pro has two. To date, there are no recorded incidents of TekSecurity-protected devices being successfully stolen.

NETWORK SECURITY

To deliver the benefits of remote monitoring and management, an AV system must be connected to the campus network. That connection can be constructed to minimize both external threats to the control system as well as campus threats from a theoretically compromised control system.

Best practice is to place AV devices on a VLAN that is dedicated to AV devices. With modern switches and routers the cost is no more than setting IT policies and ensuring that newly installed AV systems are migrated to the AV VLAN. TEKVOX provides advanced information for pending installations that simplifies this task. Further policies can be set to limit traffic into and out of the VLAN to specific addresses and ports. Outbound internet access can be limited when updates are not in progress and inbound traffic should be protected by MFA VPNs or, in the case of cloud services, pre-authorized and encrypted enterprise-grade processes.

In addition to policy, the TEK 4 and TEK 4 Pro employ the robust Linux “IP Tables” firewall and be configured at manufacturing time to communicate only with pre-approved IP addresses through preset ports. All other communication can be logged and reported or, more frequently, ignored. The TekPC employs Windows Defender firewall that is also well-proven.

At the device OS level, all TekMonitors are protected by strong, customer-specific passwords. TEKVOX recommends that this password be shared only when absolutely needed.

At the application level, all TekMonitors are protected by a four-digit customer/site-specific passcode. All modification requests not bearing this passcode will be ignored. TekMonitors will temporarily block communications after multiple connection attempts with incorrect passcodes. When using TekManager, the passcode is only entered in instantiations intended for administrator functions. Support instantiations can monitor systems without needing the passcode.

Since Drop-In AV systems are manufactured and programmed in the TEKVOX factory, an important value proposition is direct factory support. To support this, TEKVOX recommends providing remote access to the AV VLANs via MFA VPN. TEKVOX staff are familiar with common VPN and authentication technologies and will adopt customer terms and conditions.

For the extreme security, the AV VLAN can be logically separate from other VLANs and only accessible to internal personnel by MFA VPN as well. This technique ensures that all access is authenticated and logged at some trade-off in usability.

For improved isolation of AV devices communicating via IP protocol, the TEK 4 Pro and TEK PC both have dual network interfaces as well as on-board routers and DHCP services. In this scheme, network-based devices such as touch panels, DSPs and cameras are located on a private, in-room network with no direct path between the private AV LAN and the campus AV VLAN. This technique requires only a single connection to the campus LAN and greatly reduces exposure of the internal IP-based devices to external threats and while preventing any threat to the campus by the devices. There is an associated cost with this approach due to the increased effort to support and maintain the cordoned devices.

CLOUD-INTERACTIVE SERVICES

The second-generation TEKVOX enterprise management system, TekEnterprise II, is based on the Xyte (xyte.io) cloud services platform. TEKVOX chose Xyte over its internal product primarily due to the robust security and privacy framework. Xyte is certified to be compliant with the world's leading standards including AICPA SOC II, GDPR and CCPA. The Xyte cloud service is hosted on the AWS secure cloud platform employing encryption at-rest and in-flight. Additional information can be found at:

- <https://www.xyte.io/platform/security>
- <https://aws.amazon.com/security/>

Couple with TEKVOX device security and campus security policies, TekEnterprise II is the most secure AV enterprise management system available today.

SUMMARY

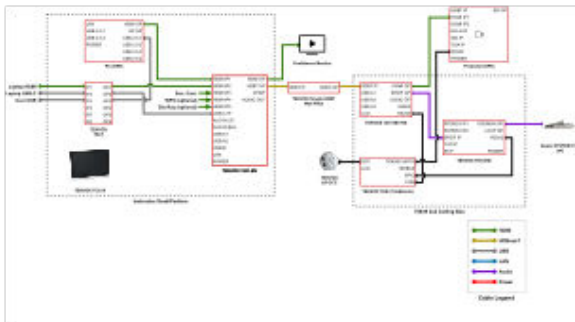
While no usable system can be perfectly secure, Drop-In AV systems employing TekMonitors procured from TEKVOX-authorized channel partners have been thoughtfully developed and represent very little threat to the customer campus when used under best-practices.

Appendix D – Drop-In AV®

Building on its framework of high software re-use via encapsulation in the TekMonitor appliance and the use of templates and drivers, TEKVOX offers the ProAV industry's only portfolio of complete, customizable whole-room systems that are manufactured, programmed and tested in a controlled factory environment. Drop-In's leave behind the ProAV legacy of site-built, custom-programmed systems creating a leap forward in customer value proposition including:

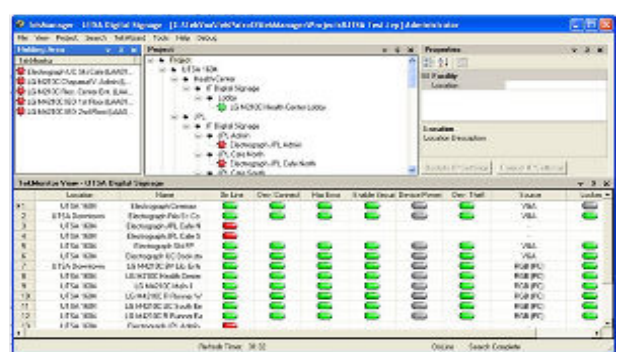
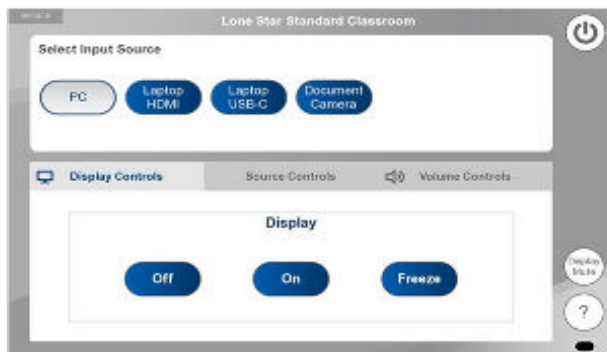
- End-stage customized for precise installation
- Network-managed at no additional cost
- Reliable and repeatable
- Life-time factory support with unique warranty
- No hidden costs

All the customer need do is provide their preferred input devices (e.g. PC, laptop, doc cam...) and output devices (e.g. projector & screen) and the Drop-In completes the system. Going well past the concept of 'kitted components', Drop-Ins are true products that are life-cycle managed with roadmaps and generational compatibility. A Drop-In has a base design, a customizable Bill of Materials (BOM), a standard User Interface and a management system.



71021-DI-BOM

Item Name/Num	Description	Qty
70040-5618	Audio Amplifier: 2 x 50W @ 8 Ohm with RS-232	1
70004	TEK 5: TekMaster 3 POE (Does not include 24v DC Power Supply)	1
17400	Speaker: 6 ohm, 2x2, in ceiling	4
70033-441+	TEK 1203-M41 Enhanced Presentation Switcher/Scaler with Multi-View	1
70039	TEK 7007 360° Box Hearing, Two 15 power plug	1
12802	Cable: IEC Y Cord, NEMA 5-15P to IEC C13, 10 Amp, Black	1
70040-184-2	TCX18 TelController HD Touchscreen Controller with podium mount/kit	1
70039-574P	TEK C82-A2x2 Ceiling Box with Star cover. Includes equipment tray and 2 pairs of safety cables.	1
70003	IR Occupancy Sensor	1
12320a-20-vel	Cable: HD BT, Cat 6A, shielded, stranded, yellow, 20 ft.	1
16411-K	Wall plate assembly, Single gang, Cat 6A shielded wall plate, with single-gang bracket and Cat 7 extender	1
12320a-75P-vel	Cable: HD BT, Cat 6A, shielded, plenum, yellow, 75 ft.	1
12200-15-8T	Cable: HDMI, black trim (30xw), 15 ft.	3
12118-15-UC	Cable: USB-C Power/Data cable, Active, 15 ft.	1
12201-06-R4-Pa	Cable: HDMI, black, 6 ft.	1
12201-03-R4	Cable: HDMI, black, 3 ft.	1
12015-70X3_2_amp-03	Cable: Serial, TelBus to audio control, 3 ft.	1
12032-0-CC	Cable: Control, OCC with 3-pin phoenix, plenum, 20 ft. Label: OCC	1
70001	TekSecurity Module	1
70006	TekSecurity Cable DB-4PM - Hitachi, Epson, Samsung, NEC, Sanyo	1
12018-TEK3_Con_2_R4a	Cable: Serial, TEK3 Cones port to HD BT Rx or Tx, 1.5 ft.	1
12000-26-R4a	Cable: Cat 6, blue, patch, 26 ft.	3
12300-07P-R4a	Cable: Cat 6, 7 ft, blue, Plenum	1
12003-0P	S/PDIF (Toslink) Digital Optical Audio Cable, 16 ft.	1
12013-sa2a	Cable: Audio, stereo, fork to tinned, 25 ft. plenum	4



71021-DI Drop-In

For example, the TEKVOX 71021-DI basic collegiate classroom Drop-In was introduced in 2014 and is still on the market today serving many customers as a basic collegiate classroom. Over ten years, this Drop-In has had its switching subsystem upgraded three times, its control and audio sub-systems

upgraded twice with minor accessory and cabling updates on an annual basis. This standard package today includes switching for six digital inputs including USB-C laptop power, a color touch screen for user control, support for a single projector or flat-panel display and 100 Watts of audio through included four ceiling tile speakers. All cabling, housings and fixtures are included in the Drop-In and pictorial installation and user guides are provided. Note that TEKVOX is manufacturer-agnostic concerning displays, projectors, screens and input devices. If it is supportable, TEKVOX supports it.

The 71021-DI can be modified based on customer preference and the User Interface (UI) always features the customer logo and color scheme. TEKVOX customers are assigned a three-letter customer code (e.g. "XYZ") and the customer attaches this prefix to a part number to specify their unique BOM, visuals and template configurations. For example, XYZ University can order a XYZ71021-DI and be assured of receiving a classroom Drop-In with their logo on the User-Interface, that is preprogrammed for their campus and contains the latest customer-approved Bill of Materials (BOM). The customer can include that part number in their standards and receive bids from multiple sources that will include the exact same content. The customer can also confidence in long-term availability of an up-to-date product as well as multi-generational support under a single management system.

Drop-Ins have unique warranty provisions including:

- Five years on all components
- Ten years on all mechanical components and plenum Cat cables
- Lifetime warranty on all programming

In addition to the above, Drop-In customers benefit from TEKVOX's unlimited remote technical support for customer technical staff. Since TEKVOX designed, built and programmed the Drop-In, factory technical support is both expedient and accurate.

The Drop-In AV portfolio is represented by three distinct families of products:

- Scholaris™ Teaching & Training Systems
- Concurro™ Meeting & Collaboration Systems
- Etalto™ Specialty and Custom Solutions

SCHOLARIS

The Scholaris family features conventional classrooms, classrooms that communicate, collaboration pods and connected collaboration classrooms. There are distinct products for small, medium and large rooms as well as options divisible/combine configurations. The principal platforms of the Scholaris family include:

- 71011-DI simple classroom
- 71021-DI standard classroom
- 71022-DI dual-display classroom
- 71028-DI Student collaboration pod/huddle station
- 71028-CC connected collaboration room with instructor station
- 71021-HF1 hybrid-flexible classroom
- 71021-HF2 dual-display hybrid-flexible classroom

- 71021-HF3 large multi-display hybrid-flexible classroom/teaching theatre

Most of these products are available in divisible configurations as designated by ‘-RCx’ where RC denote *Room Combine* and X denotes the number of divisible/combinable partitions. For example, a 71021-DI-RC2 specifies a product with two standard classrooms and a divide/combine unit for symmetric, push-button configuration control. Common order-time options include wireless presentation devices, support for additional displays, upgraded audio subsystems as well as specification of make and model of displays and projectors.

Typical TEKVOX customers draw from these Scholaris platforms to create a comprehensive, customized standard for their unique range of classroom types. A customer-specific line card can cover needs from a four-student huddle station to a thousand student theater with numerous displays, cameras and specialized audio system. All product management, manufacturing and sourcing issues are handled by TEKVOX.¹³

CONCURRO

Concurro solutions bring the Drop-In AV value proposition to owners, administrators and users of conference rooms, board rooms and small-group collaboration stations. As with the Scholaris family, there are dedicated solutions for small, medium and large conference rooms, with or without video communications capabilities and in single- and multi-partition configurations. The principal platforms of the Concurro portfolio include:

- 71021-TO Huddle Station
- 71021-T1 Basic conference room, with or without video communications
- 71021-T2 Medium conference room, with or without video communications
- 71021-T3 Executive conference / Board Room

Powering a range of installations from a student huddle station to an executive Board Room to a commercial conference center, Concurro Drop-Ins are available in divisible configurations of arbitrary large numbers of rooms.

ETALTO

While Scholaris and Concurro Drop-In are built with mass-customize production in mind, Etalto Drop-Ins are professionally designed for unique applications where TEKVOX’s platform technology is leveraged to produce a completely custom end-product without full-custom development cost. While there is no theoretical bound, example applications include:

- E-sports venues
- Counsel chambers
- Court rooms
- Civic emergency operating centers.

TEKVOX design consultations are generally quick, easy and complimentary.

¹³ Please see Scholaris Handbook for a detailed description of the family.

Appendix E. HDBaseT versus AV over IP

TEKVOX is agnostic with respect to the use of HDBaseT technology versus AV over IP solutions and supports both. Each technology has its unique advantages and, absent a strong customer preference, TEKVOX will work with the most economically attractive technology for a given application.