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TN1Ue
SDH Multiplexer

86412 VIDEO I/O UNIT

Technical Practice and Installation Manual

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TABLE OF CONTENTS

SECTION PAGE

SECTION PAGE

SECTION | *PAGE*

SECTION PAGE

SECTION PAGE

SECTION PAGE

SECTION PAGE

1. INTRODUCTION

The 86412 Video I/O unit is one of the family of units in the GE Power Management's TN1Ue digital transport/access system designed specifically for the requirements of the utility (Power, Transportation, Pipelines, Oil & Gas, etc.) industry using optical fibre transmission.

This manual explains how to operate, install and maintain the 86412 Video I/O unit. A unit description and block diagram are included as well as detailed description of the unit's operation.

Engineering documentation includes EAS schematics for all unit circuitry.

Related Publication and Documentation Support

Additional information is provided in the TN1Ue Technical Overview and Reference Manual for system planning and engineering. The user may also find useful information in Technical Practice and Installation Manuals (TPIMs) for other TN1Ue units.

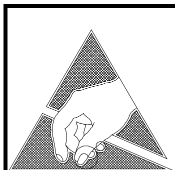
Customer inquiries for information contained in this manual should be directed to TN1U Product Line Management. GE Power Management appreciates notification of any possible errors or omissions contained herein.

Shipped with all purchased TN1Ue nodes is a Node Assignment Drawing (NAD), which provides necessary configuration details for the units and shelf location. Channel, TU and TIFport are some of the assignments that are shown on the NAD.

Handling and Packing

Equipment with Electrostatic Discharge Sensitive (ESDS) devices or components must be shipped in protective containers and necessary handling precautions observed otherwise all warranties, expressed or implied, will be considered null and void.

The following Electronic Industries Association (EIA) attention label appears on all GE Power Management EAS schematics and should be attached on all containers used for ESDS items to alert personnel that the contents requires special handling.



ATTENTION

OBSERVE PRECAUTIONS FOR HANDLING ELECTROSTATIC SENSITIVE DEVICES

HANDLE & ASSEMBLE PER 562-48043-01

THIS UNIT CONTAINS STATIC SENSITIVE DEVICES

2. UNIT OVERVIEW

The 86412-0X Video I/O unit allows the transport of PAL or NTSC video signal over a TN1Ue network. The unit provides the interface between analogue video signals and the Video WAN on TN1Ue system via a VMapper unit's Vport.

The 86412-01 unit option supports transport of video signals only. In addition to video, the unit option 86412-02 allows transport of audio, data and digital telemetry (contact I/O circuits) over a TN1Ue network. These additional features, specific for 86412-02 unit option, are addressed later in this section.

The 86412-01 Video I/O unit occupies one shelf slot while the 86412-02 Video I/O unit occupies two shelf slots in an 86430-21 Common Equipment Shelf or 86430-22 Expansion Shelf. Both Video I/O unit options use the same paddleboard assembly, which is two-shelf-slot-positions wide.

Front panel LEDs provide various indications on the status of received Vport and video signals and the unit's internal status. The unit set-up, status and port activity are reported via the TLCI software.

Video Features

Video-IN and Video-OUT Units

The Video I/O unit may be configured as a Video-IN unit or a Video-OUT unit.

The **Video-IN** unit can accept video signals from sources such as cameras, VCRs, DVD players or broadcast signal sources. The Video-IN unit provides one composite video (BNC) and one S-video (Y/C) interface. If a splitter cable on the Y/C connector is used, two separate composite video signals may be accepted on the Y/C connector. Thus, at a Video-IN unit, a maximum of three video sources can be connected with the transmission to a far end from any one video source at a time. The selection of the source that feeds the unit input can be done dynamically and remotely.

The **Video-OUT** unit can generate video to devices such as monitors, VCRs or broadcast feeds. The unit provides both composite video (BNC) and S-video (Y/C) interfaces.

Video Circuits

The video signal between the Video-IN unit at one end and the Video-OUT unit at the other end of the video circuit is transported in a compressed digitised form, packetized into the VMapper's 25-byte-packet format requirement. The bit-rate for each video signal is dynamically user-configurable from 10Mb/s down to 25kb/s to provide video qualities from full-motion high-quality video transport down to low-scan surveillance monitoring. With an external controller (e.g. Camera Cameleon™[1]) an "intelligent bandwidth allocation" can be implemented in order to quickly assign more bandwidth to specific video sources/cameras, allowing incident management, a higher resolution and more frames/sec for what is actually being viewed.

Both point-to-point and point-to-multipoint video circuits are supported. The Video I/O units supporting the same video circuit can reside at the same or different TN1Ue nodes.

Motion Detection

The unit's motion detection feature may be used in surveillance applications such as:

- Detection of intruders
- Detection of vehicles
- Detection of stalled machinery (e.g. conveyor belts)
- Detection of lack of activity

Motion detection is sensitive to both colour and brightness movements. An adjustable threshold may be set and should this threshold be exceeded the following actions may be independently enabled:

- Alarm to local node's summary alarm, and NMS (TNCI) alarm engine
- Alert message to one or more 86412-02 Video I/O unit data ports (i.e. to external monitoring computers connected to them)

Note that, as opposed to PIR sensors, the above threshold doesn't depend on the objects temperature (PIR sensors are "blind" to objects at ambient temperature).

[1] Camera Cameleon is a trademark of "360 Surveillance Networks" (www.360surveillance.com).

On-Screen Information Display

If the Video Monitor supports a "Closed Caption" display[1], the on screen information display may be used for:

- Displaying the name of the camera location
- Warning of an alarm condition

If the monitor does not support closed-capture, an external decoder box can be used.

<u>Displaying the name of the camera location</u>

The camera location may be entered using TLCI in two lines of text with each line supporting up to 32 characters. This information may be displayed on local monitors connected to the Video-IN unit or monitors connected to the Video-OUT unit. The text may be placed anywhere on the screen; however, using TLCI the text may be placed either at the top or at the bottom.

<u>Warning of an alarm condition</u>

This is a flashing message centred at the top of the screen. Refer to the maintenance section for information on these messages.

Features Specific to 86412-02 Video I/O Unit ("Multiservice Unit")

The 86412-02 Video I/O unit ("Multiservice Unit") supports transport of one video circuit with accompanied mono or stereo audio signal and provides two full-duplex asynchronous RS-232 data ports plus four optional "multiservice ports" (sub-boards) each supporting one of the following:
- four contact I/O circuits (Code C sub-board)
- one full-duplex asynchronous RS-422/RS-485 data port (Code D sub-board)
- one full-duplex asynchronous RS-232 data port (Code F sub-board).

The contact I/O functions may be used for applications such as alarm monitoring or control of PTZ motors, lamps, bells, relays etc. The data functions are provided for the remote control of camera PTZ functions, and other data applications such as SCADA and Variable Message Signs. A data port can also be used as an interface for an external PC running video network management software such as Camera Cameleon™.

[1] Currently, the support of closed-caption services in countries using PAL standard is very poor.

All signals (video, audio, data, contact I/O) are transported in a packetized form sharing the same bandwidth in the TN1Ue Video Network.

An audio signal is routed through the network along with the video (from the same unit), while the data and contact I/O information is routed independently. The packets used for data and contact I/O functions are checked for integrity before use and packets with errors are rejected.

Audio Features

The 86412-02 unit is configurable for mono or stereo audio signals, with a selection of sampling rates and quantizing resolutions, for a flexible trade-off between audio quality and transmission bandwidths. An AGC (Automatic Gain Control) circuit can be configured for either fixed gains, or variable gains (up to 42dB) for better signal-to-noise performance.

Contact I/O Features

The 86412-02 unit can be equipped with up to four contact I/O sub-boards. Each contact I/O sub-board is configurable for either IN mode (provides four contact inputs) or OUT mode (provides four contact outputs). The contact inputs can be replicated at the far-end unit's contact outputs and/or monitored by an external PC. Contact outputs can also be controlled by a PC so having the associated contact inputs at a far-end is not mandatory.

Contact-IN Features

Input to the circuit is an external contact closure. One input lead on the Contact I/O unit is connected to ground and the other input lead is internally connected to 5V through a resistor. (Contact closure causes about 5 mA to flow through the contact loop.)

The Contact-IN sub-board can be configured for *"deglitching" so* the unit will ignore spurious changes (i.e. the input conditions must be steady for user-configured time before they are considered valid). This parameter can be set for a value in range of 2 ms to 3 minutes and is applicable to all four contacts on the sub-board.

Each input is individually configurable to generate an alert if contact is open, to generate an alert if contact is closed, or not to generate an alert at all. The alert condition causes flashing red LED on the unit's front panel, Minor Alarm on the node's Service unit, and a report to be sent to the system NMS (network management software).

The contact inputs can be replicated at one or more far-end Contact-OUT sub-board(s) and/or monitored by an external PC connected to any Video I/O unit's data port.

An update packet is sent upon a far-end port's request but also (user-configurable options):

- Whenever any (of the four) deglitched inputs changes state, and/or
- At regular intervals (configurable from 4 ms to 16 hours)

<u>Contact-OUT Features</u>

The solid-state output contacts are opto-isolated and floating, capable of switching up to 100 mA/350V AC/DC. Each output may be configured through software for normally-open or normally-closed operation, i.e. the meaning of the input information can be inverted.

Each output is individually configurable to generate an alert if contact is open, to generate an alert if contact is closed, or not to generate an alert at all. The alert condition causes flashing red LED on the unit's front panel, Minor Alarm on the node's Service unit, and a report to be sent to the system NMS (network management software).

Upon loss of signal from the far-end, each of the four outputs can be automatically forced to the condition pre-selected by the user. The options are: contact open, contact closed, or holdover (maintain the last received state).

Note: *LOS is asserted if no update from the far end has been received for a specified period of time (user configurable).*

Common Data Port Features

(Applicable to RS-232 and RS-422/485 ports)

Each data port supports asynchronous serial data transport (8 bits plus optional parity bit) at an individually configurable rate of 300, 1200, 2400, 4800, 9600, 19,200, 38,400, or 115,200 b/s.

Parity is configurable for none, even, or odd. Received errors are detected, but not propagated to the far-end. Status of the parity violation count can be monitored through software.

The port can be set to output a data signal with one or two stop bits. Any number of stop bits (1, 1.5, 2 or more) in the Data-IN signal is acceptable (they are not propagated through the TN1Ue network).

RS-232 Data Port Features

Each RS-232 data port supports a serial full-duplex asynchronous (start/stop) data signal (see *Common Data Port Features* above). In addition, the RS-232 data ports on the Code F sub-boards provide one Control-Out line[1].

This control line can be configured to be ON or to operate in "Auto-enable" mode (it is ON only when data is outputted on local DATA-OUT port i.e. from the start of start-bit to the end of stop-bit + configurable “hold-time”).

RS-422/485 Data Port Features

Each RS-422/485 data port[2] supports a serial full-duplex asynchronous (start/stop) data signal (see *Common Data Port Features* above).

In addition, an RS-422/485 data port's output driver is also configurable for:

RS-422 full-duplex mode: The DATA-OUT driver is permanently enabled regardless of whether data is outputted or not ("auto-enable" feature is disabled). This mode is used when the port is connected to either a single MTU/RTU station or multiple RTU stations via a 4-wire bus.

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[1] Depending on the actual application (DCE/DTE, usage of auto-enable feature etc.), the Control-OUT line may be used to provide various control signals (e.g. RTS, CTS, RLSD).

[2] The difference between RS-422 and RS-485 interfaces is that RS-422 only supports point-to-point data links, whereas RS-485 interfaces disable their drivers when not outputting data to the line, thereby allowing the “multidrop” interconnection of many devices on a data bus.

Furthermore the RS-485 interface can be either 2-wire or 4-wire, providing either half-duplex or full-duplex communication.

In general, RS-485 interface drivers do not have the luxury of a control signal from the data source to enable its driver; the algorithm usually employed is to enable the driver at the leading edge of a “start” bit, and disable the driver some “hold” time after the end of the “stop” bit. Each RS-485 bus must also be “biased”, to keep it idle when all drivers are off.

RS-485 full-duplex mode: The local DATA-OUT driver is enabled only when data is outputted (i.e. from the start of start-bit to the end of stop-bit + configurable “hold-time”) otherwise it is disabled (tri-stated). This mode is used when the port is connected to an MTU and one or more RTUs via a 4-wire bus.

RS-485 half-duplex mode: The "auto-enable" operates the same as in RS-485 full-duplex mode. In addition, the unit mutes the local DATA-IN while transmitting characters on DATA-OUT. This mode is used for 2-wire applications to prevent data corruptions due to echoed data.

Note*: A 2-wire RS-485 port is created by connecting DATA-IN and DATA-OUT terminals together.*

Port Interconnections

Data and Contact I/O ports can be configured for point-to-point or point-to-multipoint communication, with the latter being either "to all ports" (broadcast) or "to a group of ports" (multicast). Up to 255 different “groups” can be assigned within a system. Any unit can have each of its ports configured to “subscribe” to a “group”. This allows each of the unit's 6 ports to be assigned to a different group with a restriction that only one of the unit's ports can be in a specific group.

A port configured to “echo” sends its packets to the source (unit and port) of the last packet received at the port. A port configured for "echo" may be assigned to a group.

Port interconnections are not constrained to being between the same interfaces (e.g. RS-232 interfaces can connect to RS-485 interfaces, or even contact-IN, or contact-OUT interfaces). Also, the data bit-rates do not have to match either; however, caution should be exercised if the data is outputted at a lower rate (this is OK for data messages shorter then 17 bytes).

A fast “DYNamic” addressing mode (applicable to data ports only) allows a single PC (connected to the port) to be used to send control information to any of the six ports (two main-board ones and four sub-board ones) on any Video I/O unit in a system, interrogate the status of any input contact, receive autonomous alarms from security sensors, and/or conduct data communication sessions with any remote devices. The PC can also read and write memory bytes of any remote Video I/O units, e.g. for video-path switching.

The following are the circuits (paths) that can be established between data and/or contact I/O ports.

Fixed Point-to-Point Paths

1. Contact-IN to Contact-OUT

This application is for a contact-closure at one site being replicated at another site (to turn on a lamp, bell, relay etc.).

2. Data to Data

This application is for a dedicated data link between two sites.

3. Contact-IN to Data

This application is for a dedicated link between two sites, with a computer at one site monitoring the status of contacts at the other site. The computer will receive packets of data and must process the data to recover the status of the four Contact Inputs.

4. Data to Contact-OUT

This application is for a dedicated link between two sites, with a computer at one site controlling the status of contacts at the other site. The computer will transmit one byte of data to control the status of the four Contact Outputs.

Fixed Point-to-Multipoint Paths

1. Contact-IN to several Contact-OUT sites

This application is for a contact-closure at one site being replicated at several other sites (to turn on lamps, bells, relays etc.).

2. Point-to-Multipoint Data: Master unit polling Remote units

This application is for a Control and Data acquisition network comprising several sites.

3. Point-to-Multipoint Unidirectional Data

This application is for a multicast point-to-multipoint unidirectional data circuit comprising several sites (e.g. PTZ camera controls).

4. Point-to-Multipoint Data: "Data Partyline" Circuits

This is for applications where any unit in a group simultaneously sends data to all other units in a group (a “peer-to-peer”, rather than a “master-slave” network).

Note that such an application must incorporate a collision-recovery algorithm (like Ethernet provides).

5. Contact-IN to Data at several sites

This application is for the monitoring of contacts at one site, by more than one other site (e.g. when a backup monitoring site is used).

The computers will receive packets of data and must process the data to recover the status of the four Contact Inputs.

6. Data to several Contact-OUT sites

This application is for a computer at one site to control contacts at several other sites.

The computer will transmit one byte of data to control the status of the four Contact Outputs.

Dynamic (Computer-Controlled) Paths

This application is for systems comprising a Control-Centre Computer (CCC) monitoring and/or controlling a group of remote devices, such as:

- Video surveillance systems with controllable (PTZ) cameras (e.g. Camera Cameleon™ system)
- Security systems with intrusion and alarm sensors (e.g. PIR)
- SCADA systems (an MTU with many RTUs)
- VMS (Variable Message Sign) systems for highways
- Municipal Traffic Light Monitoring and Control systems

A Video I/O unit data port in "DYN" mode may be used to interface a CCC supporting any (or all) of the above-mentioned applications. The user is referred to Appendix L for more details.

Test Features

Video Tests

The Video-IN unit can provide the incoming video signal to either or both of its video output ports (BNC and Y/C). Thus, by connecting a monitor to one of these ports, the user can locally monitor the quality of the input video signal.

Both Video-IN and Video-OUT units have a video test mode. In the test mode the unit provides an internally generated colour-bar test signal to both local video output connectors (BNC and Y/C). During this mode, the Video-IN unit will also send a Colour-Ramp test signal to the far-end Video-OUT unit.

Audio Tests

(Applicable to 86412-02 units only)

The 86412-02 Video-IN unit feeds its audio output connector with the input audio signal.

The 86412-02 Video I/O unit supports an Audio Channel Test mode, which allows the user to override the Video-IN unit's audio input with a tone from the unit's built-in tone generator or to mute its audio input. This test can be enabled from the far-end (Video-OUT) unit or forced locally.

The 86412-02 Video-OUT unit supports a Local Test mode, which allows the user to test the audio portion of the unit locally. The unit can be programmed to override the audio signal from the far end with a tone from the unit's built-in tone generator, to loopback a tone that may be locally provided at its audio input, or to mute its audio output.

Data Tests

(Applicable to 86412-02 units only)

Any data port can be set for the Loopback mode. In this test mode, data from a far-end Video I/O unit is looped back to the configured destination (unit and port).

Any data port can be muted, to ensure that no data is outputted to the local port.

Contact I/O Tests

(Applicable to 86412-02 units equipped with Code C sub-board(s))

Any input circuit can be "forced" to emulate a closed or open external contact.

Any output circuit can be "forced" open or closed.

3. FRONT PANEL FEATURES

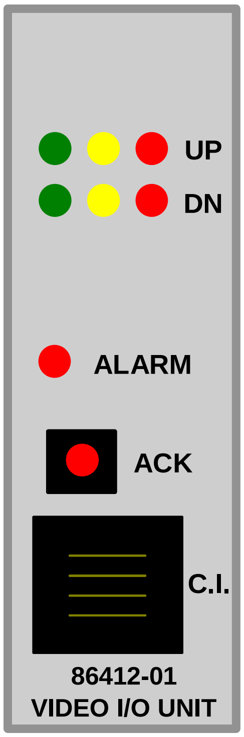


Figure 1: Front Panel Layout

LED Indications

UP and DOWN

The upper row (UP) displays the status of the received signals on the Vport. The Vport DN and associated LEDs are unused (except for the factory testing).

Green

A green LED ON indicates the received signal is assigned and OK (no LOS or BER).

Yellow

The Yellow LED is ON when the received Vport signal is OK, but the transmitted is not (as received at the VMapper unit).

Red

A red LED ON indicates the received signal is bad (LOS or BER).

ALARM (Red)

A steady red ALARM LED indicates an "alarm" (abnormal condition within the unit) i.e. one of the following conditions has been detected:

- The paddleboard is missing
- One or more of the four sub-boards is expected but missing (or wrong type)
- The VCXO control voltage is out of range
- The unit's temperature is excessive (>93ºC)
- Either of the two Xilinx FPGAs did not boot

A flashing red ALARM LED indicates that the unit is OK (no reason for steady red ALARM LED) but one of the following "alerts" (external abnormal conditions) exists:

Video-IN units:

- Video LOS (loss of video input, and this feature enabled); disabled if in TEST mode
- Video format mismatch (e.g. unit configured for NTSC, PAL signal being received).
- Motion (above user threshold, and this feature enabled)

Video-OUT units:

- Video LOS (loss of far-end video input, and this feature enabled)
- Video format mismatch at the far-end video input.
- Video bit-stream dead (and this feature enabled)
- Bad received audio packets (and this feature enabled)

Both Video-IN and Video-OUT units (applicable to 86412-02 unit with Code C sub-boards installed):

- A Contact I/O sub-board (IN or OUT) has one or more of its four contacts in an “alert” state (and this feature enabled)
- A Contact-OUT sub-board is not being updated as expected (“LOS” state)

Note that an alarm/alert condition is also sent to the node’s Service unit (turns Minor alarm LED ON), and to the system’s NMS.

Push-button (ACK)

The push-button is used for a LED and microprocessor test. If the Video I/O unit is operating normally, holding the front panel pushbutton down causes all the LEDs to light. The main use for this test is to determine that the front panel LEDs are functional and that the microprocessor firmware code is running normally (microprocessor is not locked up).

Note*: The microprocessor test does not cause any disruption in traffic.*

Craft Interface (C.I.) Jack

The Craft Interface allows a user to connect a PC computer serial (COM) port to the unit. The CI is an RJ-11 connector, which transmits and receives a 9600 b/s RS-232 signal. The supplied DOS-based TLCI (TN1U Local Craft Interface) software allows the user to configure the unit and monitor its status through the CI port.

The craft interface also provides visibility of the entire TN1Ue Video Network. An external computer may be used to control the Video Network. Features like assigning any monitor on the system to any source, changing the bandwidth and frame rate may be carried out using the video network management software. Note that it is preferable to use an 86412-02 unit data port for this function as it provides more features (see Appendix L).

4. UNIT DESCRIPTION

The 86412-01 Video I/O unit provides the interface between a PAL or NTSC video signal and a Vport on a VMapper unit. In addition to the video interface, the 86412-02 unit provides the interface to an audio signal, RS-232/RS-422/RS-485 data signals and/or contact inputs/outputs.

The 86412-01 unit occupies one shelf slot while the 86412-02 unit occupies two shelf slots in a TN1Ue equipment shelf. The paddleboard occupies two shelf slots.

The 86412-01 comprises the main assembly board (087-86412-01) only. The 86412-02 unit, in addition to the main assembly board 087-86412-01, includes the 087-86412-02 board which provides audio features as well as two full-duplex asynchronous RS-232 data interfaces and four sub-board locations, each of which can be optionally equipped with one of the following sub-boards:
- Code C (supports four Contact I/O circuits)
- Code D (supports one full-duplex asynchronous RS-422/RS-485 data port),
- Code F (one full-duplex asynchronous RS-232 data port).

The 087-86412-01 board houses the microprocessor (U3), the Field Programmable Logic Gate Array (U7), Video Input Processor (U13), Video Wavelet Compressor/Decompressor (U12), Video D/A converter (U17), SRAM (U11), VCXO (U9), DC/DC Converter (U1). The 087-86412-02 board houses the Field Programmable Logic Gate Array (U1), Audio CODEC (U3), and RS232 Data Interface (U2).

The following unit description is for the 86412-02 unit option. The information that is not related to audio, data and contact I/O features is applicable to 86412-01 unit as well.

The 86412-02 unit performs the following functions:

- Converting the analogue video signal to packetized digital video (or vice versa);
- Converting the analogue audio signal to packetized digital audio (or vice versa);
- Converting contact input states and various data into packetized digital data stream (and vice versa);
- Digital Video Compression and Decompression;
- Buffering the incoming packets between the FPGA and video compressor;

- Attends to incoming packets and transmits outgoing packets;
- Converts digital video back to analogue video for monitoring at the OUT connector at a Video-IN unit;
- Monitoring of the temperature sensor;
- Control of the front panel LEDs and monitoring of the ACK push-button;
- Reporting the unit status and responding to configuration requests from the Craft Interface;
- Communication of the unit status and alarm information to the VMapper unit for the Network Management System (TNCI);
- Providing communication links for visibility of the entire Video Network.

All user connections are made on the 86412-73 paddleboard assembly.

A simplified Functional Block Diagram of the 86412-02 unit is included at the end of this section and can be used for reference to follow the signal paths; however, the user should refer to schematics EAS-86412-M2 and EAS-86412-7X for complete circuit details.

Packets

For information on the packet types used in the TN1Ue video system please refer to the 86410 VMapper-40 TPIM or 86411 VMapper-10 TPIM.

VIDEO-IN Mode Functions

Video Input

The Video inputs from the paddleboard connectors are fed via zap-buster protectors to the video processor IC U13. This chip, with 24.576 MHz crystal Y1, extracts the luminance and two chrominance components in the video input signal, digitises them at 13.5 MHz and 6.75 MHz sampling frequency respectively with 8-bit quantization, and places the 216 Mb/s total on the UV[7:0] bus, at 27 MBytes/s, in the CCIR-656 standard format for digitised video signals.

Audio Input

The Audio inputs from the paddleboard connectors are fed via the R11,R12, R13,R14,C7,C8 6dB attenuator/anti-aliasing filter to the AD1849K audio CODEC

IC U3. This chip, digitises both inputs, with 16-bit resolution, at a sampling rate determined by clock signals from the U1 FPGA; the user can chose from 4 sampling rates, from 32kHz to 11 kHz, providing cut-off frequencies from 15 to 5 kHz. The FPGA selects either 7 or 14 bits from each sample, for either the left or both channels, and with linear or μ-law coding, according to the user-configured setting, for transmission to the main board for packetizing into audio packets.

For test purposes, the input signal can be replaced by synthesized sinusoidal test signal. This originates from a digital pattern generator in the FPGA feeding the CODEC's DACs, and replace the input signal by setting the CODEC to its analogue loopback mode.

Video Compression

The 216 Mb/s digitised video signal on UV[7:0], with its 27 MHz clock CLK27A, feeds the video compression IC U12. This chip stores each received field's 3.6 Mb of data in the 4-Mb DRAM U14, analysing the information by breaking it into 42 sub-bands using a "wavelet" transformation. As the next field is read in, the previous field's data is compressed by reducing the quantization encoding in each sub-band from 8-bits to a lower value (the values for all 42 sub-bands are updated for each field to optimise the compression and maintain the desired bit-rate). A further compression is implemented by using Huffman run-length encoding before outputting the data, 16 bits wide, on CV[15:0].

Video Buffering

The video compression IC's data output is very "bursty" and so must be buffered to the required unit-output bit-rate. Also, for slow-scan low bit-rate modes, a field must be held for the actual time required for its transmission. The 1 Mb SRAM U11 provides these functions, data being written from the video compression IC, and read by the U7 FPGA.

Bit-Rate Management

Using the requested bit rate, frame rate, and interlacing mode, the micro calculates the field size needed.

For example, for 6 Mb/s, 30 frames/s, interlaced:

Actual packet bit-rate for nominal 6 Mb/s = 6.4 Mb/s
For 23-byte payload per 25-byte packet, payload bit-rate = 5.89 Mb/s
For 4% margin, we design compression for 5.65 Mb/s;
30 frames/sec interlaced = 60 fields/sec, so field size = 5650/60 = 94 kbits.

The micro then monitors the size of each field and adjusts (60 times per second) the "Bin-Width" of each of the video compression IC's 42 sub-bands accordingly. (The micro also has to calculate and load the reciprocals of these values as well, for the video decompressor).

The 4% margin means that at 60 fields/s, the SRAM buffer is always being emptied; this is done on purpose to avoid the excessive latency that would accrue if the buffer started filling up (thereby storing more fields of data). At lower field rates, we cannot do this and a 1.5-frame limited-buffer-size algorithm is used instead.

Frame-Rate Management

If, for the video input scene, the micro can adjust the compression to maintain the calculated field size, the specified frame rate will be implemented. However, if with the minimum compression setting the actual field size is still too low, a higher frame rate will be implemented.

For interlaced modes lower than the normal 25/30 frames/s (PAL/NTSC), the FPGA must read two contiguous fields from the SRAM (to avoid a blur at the monitor); this may take awhile so the SRAM write is controlled to not corrupt these fields; then when these fields are completed, the latest written two fields are read.

Outputting Video "Payload" Packets

Because video packets use 23 bytes per packet, and the data format is 32 bits, the unit always sends these packets four at a time (i.e. no other packet types in between).

The 12.96 Mb/s Vport has a 12.8 Mb/s payload, so can handle eight 25-byte packets per 125 µs frame.

A "pacer" circuit in the FPGA paces the outputting of the 62.5 µs quad video packets, e.g.:

For 8 Mb/s, it allows 4 packets in each 6 packet period (94 µs)
For 4 Mb/s, it allows 4 packets in each 12 packet period (188 µs)
For 2 Mb/s, it allows 4 packets in each 24 packet period (375 µs)
For 1 Mb/s, it allows 4 packets in each 48 packet period (750 µs)
For 400 kb/s, it allows 4 packets in each 120 packet period (1.9 ms)
For 200 kb/s, it allows 4 packets in each 240 packet period (3.8 ms)

For 100 kb/s, it allows 4 packets in each 480 packet period (7.5 ms)
For 50 kb/s, it allows 4 packets in each 960 packet period (15 ms)
For 25 kb/s, it allows 4 packets in each 1920 packet period (30 ms)

Outputting Audio "Payload" Packets

Audio packets (if enabled) are also sent four packets at a time, i.e. in 800 bit bursts.

The highest stereo audio quality requires 31.6kHz*16*2*25/23 = 1100kb/s; the “bursts” therefore occur each 730µs.

The lowest monaural audio quality requires 10.5kHz*8*1*25/23 = 92kb/s; the “bursts” therefore occur each 9ms.

The audio samples are delayed in a buffer to match the unit’s video delay (for “lip-sync”).

Outputting "Hello" Packets

The unit must regularly output 200-bit "Hello" packets to:

(a) Allow the VMapper units’ packet routers to maintain a table mapping all of the system’s Video I/O units’ addresses to its 6 ports (so it can route all “wanted” and “message” packets to the packets’ destination addresses.

(b) Provide for the automatic set-up and teardown of switching for the desired video paths;

(c) Provide for the path-protection switching (for recovery from fibre failures);

(d) Inform monitoring units of the unit’s status.

For Video-OUT units, the period is set to 250 ms for a burden of 800 b/s per unit.

For Video-IN units, for video rates above 500 kb/s, a 120 ms period is used (1667 b/s). This is reduced for lower video rates (see Appendix E) down to a 1.8 s period at idle (100 b/s). This enables fast switching of full-motion (1 Mb/s and above) video paths, while avoiding consuming a significant bandwidth in systems with a large number of idle or low-update-rate cameras.

Processing "Wanted" Packets

Every Video-OUT unit receiving a video signal from a far-end Video-IN unit returns two "Wanted" packets per each received "Hello" packet from the far-end Video-IN unit (if none, the video path will be torn down).

Each "Wanted" packet contains the monitor unit’s request bytes:

(a) B&F byte for the desired Video Quality (per Appendix A)
(b) Video-Source byte for the desired signal source (per Appendix B)
(c) Audio-Quality byte for the desired Audio Quality (per Appendix C)

Unless locally "forced", the unit uses the highest B&F byte received. Also, unless locally "forced", the unit uses the highest Video-Source and highest Audio Quality bytes received.

"Colour-Ramp" Test Mode

For test purposes, the Video-IN unit may be configured to send a "colour-ramp" signal to the far end.

This substitutes the wavelet processor's (U12) data output with a bit-pattern from memory.

Motion Detection

After each field, the microprocessor calculates the mean squared sum of the wavelet processor's 42-sub-band “statistics”, adds the result to that of the previous field, and compares this new “frame” value with that of the previous frame. If the difference is greater than a user-set threshold two actions can be automatically initiated (independently enableable):

- Alarm to local node’s summary alarm, and NMS (TNCI) alarm engine
- Alert message to one or more 86412-02 Video I/O unit data ports (i.e. to external monitoring computers connected to them)

Video Output

The video output IC (U17) can be used to monitor the CCIR-656 27 MByte/s digitised video signal by converting it into an analogue PAL or NTSC video signal in both composite (for the BNC) and Y/C (for the 4-pin mini-DIN Y/C) formats. This loopback facility is useful for checking that the video signal is getting into the Video I/O unit OK.

For test purposes, the outputs can be fed from an internal colour-bar generator.

To save power, either or both outputs can be disabled (0.5W if both disabled).

Audio Output

The audio CODEC IC (U3) converts the analogue signal into digitised samples (16 bits per sample) and passes them over to the FPGA U1 for processing and compression (14-bit samples for Hi-Fi or 7-bit samples for Lo-Fi). The audio signal is packetized on the main board transported along with the video signal. Like the video, the audio is looped-back in the Video-IN unit (in audio CODEC IC) for local monitoring.

Test modes allow muting of the input and insertion of an audio tone (at 6dB below full-scale). This can be configured at the source (Video-IN) unit, or from any of the Video-OUT units receiving audio (and video) from the given Video-IN unit.

Video-OUT Mode Functions

Video and Audio Input Packets

If a Video-OUT unit is outputting "Wanted" packets with a VNA# for an alive Video-IN unit, Video and Audio (if enabled) "Payload" packets should be being received on the unit paddleboard's Vport.

This signal from the paddleboard feeds the U7 FPGA IC, which continuously writes the video and audio data (23 bytes per packet) into the 1Mb SRAM U11.

U7 also detects the start-of-field#1 (SOF1) data pattern and keeps a list of the RAM addresses for the last three SOF1s received.

Feeding Video Decompressor

The video decompressor (U12) is very intolerant, it must get correct compressed data at 60 fields per second, or it shuts down and must be reset.

U7 accommodates this as follows:

If SOF2 patterns are also received (interlaced data):

U7 continually supplies the video decompressor IC with the last two complete fields received (repeating them if necessary). The output is thus full resolution (525/625 lines for NTSC/PAL) video flicker free, but perhaps jerky when motion occurs at low frame rates.

If SOF2 patterns are not received (non-interlaced data):

U7 continually supplies the video decompressor IC with the last complete field received (repeating them if necessary). The output is thus 1/2 resolution (262/312 lines for NTSC/PAL) video flicker free, but perhaps less jerky (than interlaced) when motion occurs at low frame rates.

If the data feed is interrupted for any reason, the last frame is repeated for a few frames and then the unit reverts to a colour-bar display. This is to avoid a false sense of security in static-image applications; however, the last frame is kept in the unit and can be restored using TLCI if it is desired to change the "video failure mode" to display the "frozen" image of an event that happened just before the communication was lost. Note that if the units' closed-caption feature is enabled (can be utilized only if the monitor supports closed captioning), the "Loss Of Signal" message will be displayed so the colour-bar mode is not needed. Also note that the video can be "frozen" at any time (regardless of the video-failure mode setting) using a TLCI command.

The Video Decompressor

The video decompressor decompresses each field's data, using the 42 "Bin-Widths" (which are transmitted with the data) and stores the result in the 4 Mb DRAM U14. It then outputs this at 27 MByte/s in the CCIR-656 format on UV[7:0] to the video output chip.

Video Output

The U17 video output IC converts the CCIR-656 27 MByte/s digitised video signal into an analogue PAL or NTSC video signal in both composite (for the BNC) and Y/C (for the 4-pin mini-DIN Y/C) formats.

For test purposes, the outputs can be fed from an internal colour-bar generator.

To save power, either or both outputs can be disabled (0.5W if both disabled).

Communication with the video output IC for configuration (e.g. output selection, NTSC or PAL modes) and closed-caption injection is via a (European) standard "I^2C" 2-wire bus (SDA & SCL nets). The circuits to allow the micro to use this I^2C bus are in the unit's FPGA U7.

Audio Output

The audio signal received with the video signal is normally outputted at the Video-OUT unit's audio connector(s).

The audio CODEC IC (U3) converts the digitised samples back to analogue signal and feeds it to the audio-output jack (unbalanced outputs).

Test modes allow muting of the output, insertion of an audio tone (at 6dB below full-scale), and looping back a signal at the audio-input connector.

A special test mode generates a test-tone (synthesized) output (at 6dB below full scale).

Features Common to Both Video-IN and Video-OUT units

While Video-IN units can only accept video & audio inputs and Video-OUT units can only output video & audio signals, both units can be used to terminate either end of simplex or duplex data channels and/or contact I/O circuits.

Every 86412-02 Video I/O unit provides two “main-board” full-duplex asynchronous RS-232 data ports (each supporting 0.3, 1.2, 2.4, 4.8, 9.6, 19.2, 38.4 or 115.2 kb/s), and space for four sub-boards, each of which can provide (plug-in option):

- four Contact-inputs
- four Contact-outputs
- one RS-422/RS-485 2-wire/half-duplex or 4-wire/full-duplex data port (supporting the same data rates as the main-board RS-232 ports)
- one RS-232 full-duplex asynchronous data port (supporting the same data rates as the main-board RS-232 ports).

Addressing Modes

For each of the six Video I/O units’ ports (two RS-232 main-board ones and four sub-board ones), the destination (defined by the far-end unit's VNA# and port#) is determined by the user-configurable “Address Mode”:

"OFF": No destination defined, i.e. the port is disabled from sending any information to the far-end port(s).

“ASSIGNED”: The destination is determined by the associated user configurable VNA# and Port#. Alternatively, the destination may be configured as a Group# (all Video I/O units' ports configured for the same Group# are the destinations), or as “Global” (the specified port at all Video I/O units). Up to 255 different “Groups” can be assigned within a system.

“ECHO”: The destination is the source (port and VNA#) of the port’s last received packet.

“DYN”: The destination (port and VNA#) is provided “on the fly” by a local PC attached to the data port (so it is not applicable for Contact I/O sub-boards). This mode requires a 2-byte “escape” sequence to be configured (see "Computer Controlled Addressing" later in this section).

Message Packets

All data-port and Contact I/O data is transported in “Message” packets. (Note that the Message packets are also used for messages exchanged between the units' microprocessors.)

Each packet-source can be configured to have its packets sent to a specific Video I/O unit, to a “group” of specific Video I/O units, or to all Video I/O units as described above. In some cases, the packets can be sent to a Video I/O or VMapper unit's microprocessor to interrogate the unit status and/or configuration.

The user is referred to Appendix H for more information on the Message packet format.

Sourcing Message Packets

For the packets from each of the six ports, each Video I/O unit assigns the 13-bit user-configurable Destination VNA# (part of Address Mode field, entered along with the Port#, if applicable) as follows:

- Dest-VNA# = 1 to 6143 = 0001/h to 17FF/h

  Destination is the Video I/O unit with matching VNA# and the specified Port#.
- Dest-VNA# = 7168 = G0 = 1C00/h

  Destination is all Video I/O units. Denotes a “global” message (broadcast to the specified port at all Video I/O units in the system).
- Dest-VNA# = 7169 (G1) to 7423 (G255) = 1C01/h to 1CFF/h

  Destination is all Video I/O units having a port configured with the matching "Group" address. Denotes a message "to some units" (multicast).
  Note: *It is not possible to deliver the same group message to multiple ports on the unit.*
- Dest-VNA# = 7424 to 7679 = 1DXX/h

  The destination VNA# is the source unit. This is not a TLCI-configurable option. It is used by a computer connected to a data port in DYN mode to interrogate the local unit status/configuration (very useful when the PC does not know the connected unit’s VNA# address). Not applicable to Contact I/O sub-boards.

- Dest-VNA# = 7680 (m511) to 8190 (m1) = 1E00/h to 1FFE/h
  The destination VNA# is a VMapper unit. This is not a TLCI-configurable option, but may be used by a computer connected to a data port in DYN mode (or to the unit's CI port) to interrogate a VMapper unit status/configuration. Not applicable to Contact I/O sub-boards.
- Dest-VNA# = 0 (000/h) and 8191 (1FFF/h) are unused.
- Dest-VNA# = 6144 to 7167 = 1800/h to 1BFF/h are currently unused (spare).

For the packets from each of its 6 ports, each Video I/O unit also assigns a 3-bit Destination Port# (if applicable for the given VNA#, see above) based on the user selections as follows:

- Dest-Port# = '010' = MB#1 (main-board's RS-232 data port #1)
- Dest-Port# = '011' = MB#2 (main-board's RS-232 data port #2)
- Dest-Port# = '100' = SB#1 (sub-board #1)
- Dest-Port# = '101' = SB#2 (sub-board #2)
- Dest-Port# = '110' = SB#3 (sub-board #3)
- Dest-Port# = '111' = SB#4 (sub-board #4)
- Dest-Port# = '000' = MICX (far-end unit's microprocessor; no response required)
- Dest-Port# = '001' = MICY (far-end unit's microprocessor; response required)

Note: *Dest-Port# = '000' and '001' are not TLCI-configurable options. May be used by a computer connected to a data port in DYN mode (or to the unit's CI port) to interrogate a Video I/O or VMapper unit status/configuration. These port assignments are not applicable to Contact I/O sub-boards and are used for data-port-to-microprocessor and microprocessor-to-microprocessor inter-unit messages.*

Routing Message Packets

VMapper units route the Message packets, according to their 13-bit destination-VNA# fields as follows:

- For Dest-VNA# = 1 to 6143 (1 to 17FF/h), to the port (TUG/TIF Port or Vport) sourcing VNA#-matching Hello packets.
- For Dest-VNA# = 7168 to 7423 (1C00 to 1CFF/h), to all ports (TUG/TIF Ports and Vports) except the one sourcing the Message packet.

Receiving Message Packets

Video I/O units accept Message packets, according to their 13-bit destination-VNA# as follows:

- If Dest-VNA# = 1 to 6143 (1 to 17FF/h) AND this matches the unit's assigned VNA# **OR**
- If Dest-VNA# = 7168 (1C00/h) **OR**
- If Dest-VNA# = 7169 to 7423 (1C01 to 1CFF/h) AND the 8 lsb match one of the unit port's assigned Group#.

Note: *The Message packets are checked for integrity before use (the 25th byte of each packet is a checksum and packets with errors are rejected).*

Transport of Data Port Traffic

Characters (bytes) received from a data port are buffered for transmission in Message packets (one of the packet types routed by VMapper units). Up to 16 data bytes can be transported in each packet. The new packet is sent when it is full (16 data bytes have been mapped), but, to avoid excessive delays, unfilled packets are launched after a user-configurable idle "time-out" period has elapsed. This "time-out" is user-configurable to: 1, 3, 8, or 24 character-periods (e.g. 1 to 25 ms at 9600 b/s; assuming 1 start-bit + 8 data-bits + 1 stop-bit per character).

Each packet's header contains the desired destination address (which can be for point-to-point, multicast, or broadcast destinations), the desired port of the destination address, as well as the source unit's address and port (important for the far-end port set for ECHO addressing). (For more information on the Message packet format, the user is referred to Appendix H.)

At the destination Video I/O unit, packets are placed in an 8-packet buffer, which feeds the output serializer. This buffer also provides some accommodation for the transport of long strings of input data when the input data rate is higher than the output data rate (which is 0.9% fast). For example, with a source running 1.9% fast, the buffer must store one byte for every 100 bytes received; the 128 bytes would, therefore, accommodate a continuous string of 12,800 bytes (12 seconds at 9600 b/s).

If long strings of over-speed data are expected, in excess of the unit's buffer capacity (see above), the user can apply one of the following three solutions:

1) Set the data source to 2 stop-bits
2) Set the data source to even (or odd) parity, with the Video I/O data output set to no parity
3) Set the output port to a faster data rate than the input port. (e.g. 9600 b/s in; 19,200 b/s out)

Note: *The applications targeted for the data channels (camera PTZ, RTUs, etc.) use bursts of data for their communications, so the unit was designed accordingly. It is also very unusual for data sources to be more than 0.9% fast.*

RS-232 Data Ports

Each Video I/O unit has two main-board asynchronous RS-232 data ports and up to four (for a total of six) asynchronous RS-232 data ports (if all four sub-boards are equipped as RS-232 sub-boards).

The only difference between the main-board and sub-board RS232 ports is that each sub-board port supports one control-out line, whereas the main-board ports do not. For RS-232 data ports' features and specifications refer to the *Unit Overview* and *Specifications* sections respectively.

RS-422/485 Data Ports

Each Video I/O unit can be equipped with up to four RS-422/485 sub-boards, each providing one RS-422/485 data port.

For the RS-422/485 data port features and specifications refer to the *Unit Overview* and *Specifications* sections respectively.

Contact-IN Sub-boards

Each Video I/O unit can be equipped with up to four Contact-IN sub-boards. Each Contact-IN sub-board can monitor four external contacts. For the Contac-IN sub-board features and specifications refer to the *Unit Overview* and *Specifications* sections respectively.

The states of the four deglitched contacts are sent in the byte #9 of one Message packet (see Appendix H for Message Packet format) as follows:

Bit[7] = 1 for contact#1-closed, 0 for contact#1-open
Bit[6] = 1 for contact#2-closed, 0 for contact#2-open
Bit[5] = 1 for contact#3-closed, 0 for contact#3-open
Bit[4] = 1 for contact#4-closed, 0 for contact#4-open
Bits[3,2,1,0] = complements of bits [7,6,5,4]

A packet is sent when the port is polled (i.e. upon receipt of any Message Packet) but also (user-configurable options):

- Whenever any (of the four) deglitched inputs changes state, and/or
- At regular intervals (configurable from 4 ms to 16 hours)

Note: *No update on the sub-board status is sent until the deglitching time has expired for all four contacts.*

The packet can be sent to a specified far-end port, to a group of ports (for broadcast or multicast) or to the port that this sub-board received the last packet from (user-configurable options). The far-end port may be either a contact-out sub-board or a data port connected to a PC (see Appendix L for more information).

Contact-OUT sub-boards

Each Video I/O unit can be equipped with up to four Contact-OUT sub-boards. Each Contact-OUT sub-board provides four external contacts. For the Contact-OUT sub-board features and specifications refer to the *Unit Overview* and *Specifications* sections respectively.

Computer-Controlled Addressing (Address-mode = DYNamic)

This is a special mode used for a Video I/O unit's data port connected to the system's Control-Centre Computer (CCC) to allow CCC to dynamically send data to any destinations (for controlling cameras, monitoring RTUs, collecting MOTION alarms etc.) In other words, DYN mode allows the PC to dynamically select the destination(s) for data it has to send.

The CCC may be connected to any one of the six possible data ports of the co-located Video I/O unit (e.g. RS-232#1). Each of the (up to) six data ports is independent, so a unit can support up to six CCCs.

To set/change the destination PORT+VNA#, the CCC outputs the following four-byte escape sequence:

<pause> <DYN$[1]> <DYN$[2]> <DYN$[3]> <DYN$[4]>

where:

<DYN$[1]> <DYN$[2]> are two TLCI-configured “escape” bytes. They should be properly chosen to avoid having them emulated by expected data bytes. The factory default for these bytes is “AC DC” (hex). Allowed assignments are "01" (hex) to "FE" (hex).

and

<DYN$[3]> <DYN$[4]> are the destination PORT# (3 msb) + VNA# (13 lsb) where 3 msb for the PORT# may be:

000 if to micro (no response required)
001 if to micro (response required)
010 if to main-board RS-232#1 data port
011 if to main-board RS-232#2 data port
100 if to sub-board#1
101 if to sub-board#2
110 if to sub-board#3
111 if to sub-board#4

Notes:

(1) <pause> is an idle (no-characters) time which must be longer than the configured idle-timeout period (1, 3, 8 or 24 character periods).
(2) Any pause between the four bytes must be shorter than the idle-timeout period.
(3) Each of the Video I/O unit’s six ports can be connected to independent CCCs, each with its own configurable DYN$[1] and DYN$[2] bytes.
(4) A “broadcast” mode is enabled by setting the VNA# 1C00/h. In this case, the outgoing data is sent to all Video I/O units in the system (but only to the specified Port#).
(5) A “multicast” mode is enabled by setting the VNA# to one of the 255 possible Group addresses 1C01/h (G0) to 1CFF/h (G255). In this case the outgoing data is sent to all Video I/O units' ports configured to the specified Group#.
(6) If there is a concern that the two bytes, <DYN$[1]> <DYN$[2]>, may occur within a data stream, the integrity of the stream’s transport can be assured by having the CCC monitor for these two bytes and insert a <pause> before the byte preceding these two bytes.

The user is also referred to CCC application examples in Appendix L.

Sending Messages to Another Unit's Micro

In some situations it may be desirable for a PC connected to a data port to be able to communicate with remote Video I/O units in order to monitor and change their settings, e.g. to select which camera is feeding a particular monitor. (Up to now this has required a PC connection to a unit's front-panel "CI" port.)

(Note that this is very similar to the format that has been, and is still supported, used for CI-interface connections, but this mode returns 16 bytes per read instead of 20, and 4 bytes per write instead of 6.)

The PC must first configure the connected Video I/O unit to the "DYN" addressing mode (this is the only addressing mode which can assign a "micro" as a destination "port").

See the previous section for a description of the four bytes to precede the following.

To READ bytes in a unit's RAM or FLASH, the PC outputs the following 2 bytes:

Byte#1 = 00 for request to read 16 bytes of RAM (8000…)
01 for request to read 16 bytes of FLASH (0200…)
Byte#2 = ¼ offset from start of RAM (e.g. 02 for 8008..8017; 03 for 020C..021B)

To WRITE bytes in a unit's RAM or FLASH, the PC outputs the following 10, 12, 14 or 16 bytes (more than needed is OK):

Byte#1 = 02 for request to change bytes, with acknowledge
03 for request to change bytes, no acknowledge
Byte#2 = ls-byte of dest-VNA# (security check)
Bytes#3,4,5,6 = 16-bit address of first byte to change (F* below)
(currently only RAM changes are supported)
Bytes#7,8 = number (1..4) of bytes to change (see Note below)
Bytes#9,10 = new value for first of bytes to change (see NOTE below)
Bytes#11,12 = new value for second of bytes to change (see NOTE below)
Bytes#13,14 = new value for third of bytes to change (see NOTE below)
Bytes#15,16 = new value for fourth of bytes to change (see NOTE below)

NOTE: Each byte is preceded by its complement (security check).

"+Headers" Data Output Mode

This is a special mode that allows a connected PC to determine the source of any data packets received at the port.

If this mode is enabled for a port, a set of eight "header" bytes is appended to the start of each sequence of bytes taken from a received Message Packet (before outputting to the data port).

This allows a monitoring PC to determine the source of the data, and is an essential feature for situations like security-monitoring systems where autonomous packets can arrive from anywhere and at any time.

The header also tells the PC the number of bytes (from the Message packet) to follow (1 to 16). After these bytes have been received, the PC should wait for the next eight-byte header (next packet), and so on indefinitely.

The header comprises the following eight bytes (the first 8 bytes of the received Message packet[1]):

Byte#1[7:5] = 110 (type-ID for Message packets)

Byte#1[4:0] = 5 msb of VNA# for Message packet's destination field

Byte#2[7:0] = 8 lsb of VNA# for Message packet's destination field

> ***Note**: The Message packet's destination field is the connected unit's VNA#, unless the given packet is a global or group addressed packet.*

Byte#3[7:5] = Port-ID# of connected Video I/O unit (these bits are in reverse order to normal):

- 010 if main-board RS232#1 data port
- 110 if main-board RS232#2 data port
- 001 if sub-board#1
- 101 if sub-board#2
- 011 if sub-board#3
- 111 if sub-board#4

Byte#3[4:0] = 5 msb of VNA# of source

Byte#4[7:0] = 8 lsb of VNA# of source

Byte#5[7:5] = Port-ID for source (these bits are in reverse-order to normal):

- 000 if from micro (requested data or MOTION alert; see byte#6)
- 100 if from micro (response wanted, this is not expected!!!)
- 010 if from main-board RS232#1 data port

[1] See Appendix H for Message packet format.

110 if from main-board RS232#2 data port
001 if from sub-board#1
101 if from sub-board#2
011 if from sub-board#3
111 if from sub-board#4

Byte#5[4:3] = N = 0..3 for number (1..4) of bytes used in last quad (in packet)

Byte#5[2] = 0

Byte#5[1:0] = M = 0...3 for number (1..4) of quad-bytes to use (in packet)
So number of (payload) bytes following header = (4*M)+N+1

Byte#6[7:0] = Spare byte from source (for future use), if Byte#5[7:5] ≠ 000,
If Byte#5[7:5] = 000:
= 00 (flags packet as packet of requested data), **OR**
= 01 (flags packet as a “motion” message packet)

Bytes#7[7:0], #8[7:0] = unused (usually 'CA' 'FE')

The user is referred to Appendix L for examples on the usage of this feature.

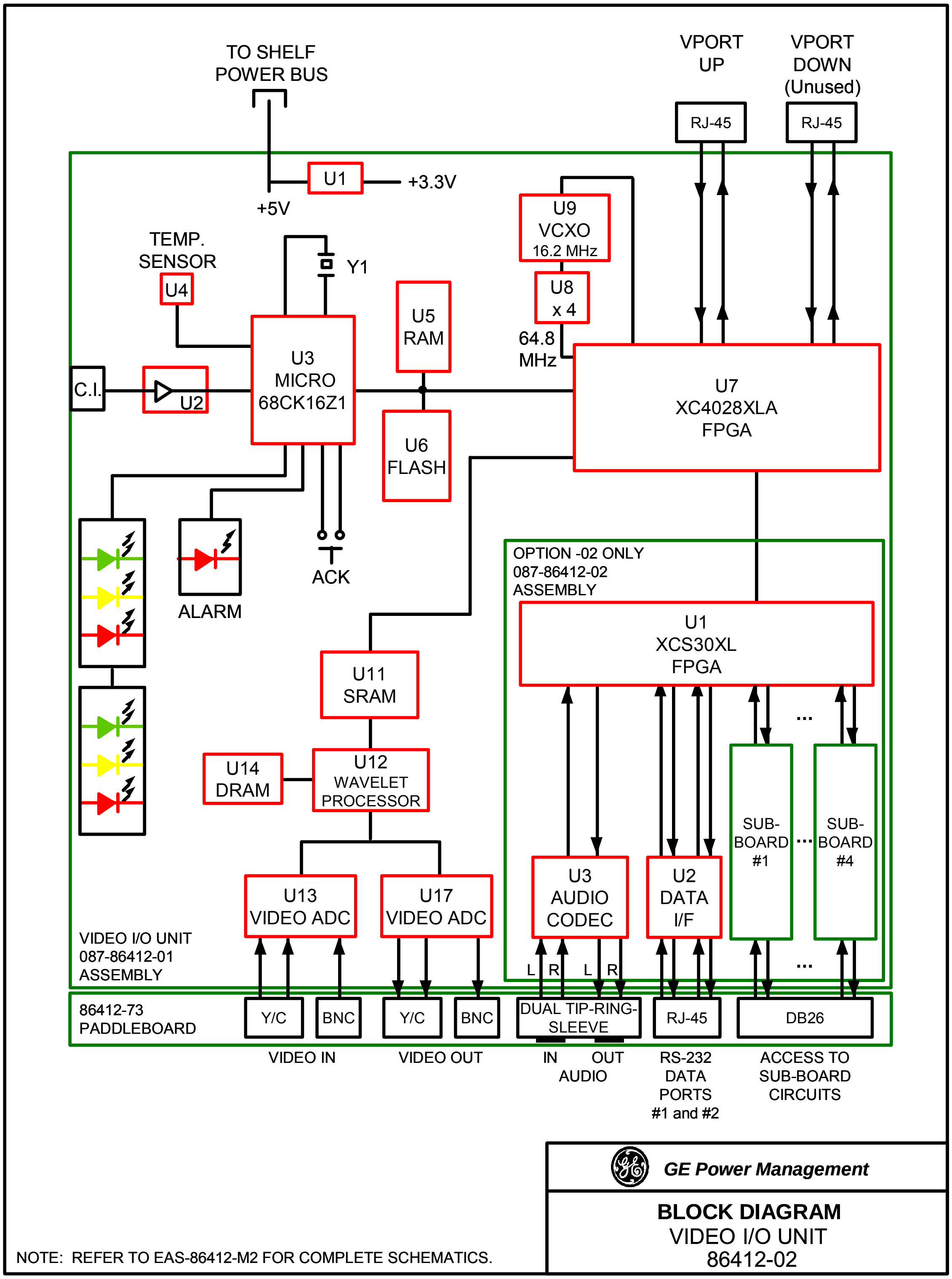


Figure 2: Functional Block Diagram Video I/O Unit

5. INSTALLATION

The following section provides information for installing an 86412 Video I/O unit. The unit is shipped from the factory configured as per the NAD for the purchased system. All spare units or loose units are shipped with factory default settings in memory.

CAUTION
The 86412 Video I/O unit has ESDS components and therefore standard static protection precautions should be observed when handling, packing or shipping the unit.

Preinstallation

Visually check the unit for damage. Ensure that screws are firmly tightened and in place. Keep the shipping containers and packing materials for future use. If a unit is damaged, file a claim with the shipping agent or local GE Power Management representative.

Shelf Position

WARNING
Before inserting any Video I/O unit in the shelf, refer to the procedures *Adding Video I/O Unit to a System in Service* and *Replacing a Video I/O Unit in a System in Service* that are included in this section.

The Video I/O unit and associated paddleboard can be inserted in slots 2 to 11 of an 86430-21 Common Equipment Shelf or slots 2 to 14 of an 86430-22 Expansion Shelf.

Figure 3 shows a typical rack layout for a ring-configured system as it appears on a NAD.

Installation

Before installing the Video I/O unit in the shelf, verify that 087-86430-90 Subassembly (used to extend the CBUS on the Shelf back plane) is <u>not</u> present on either side and underneath the Video I/O paddleboard assembly.

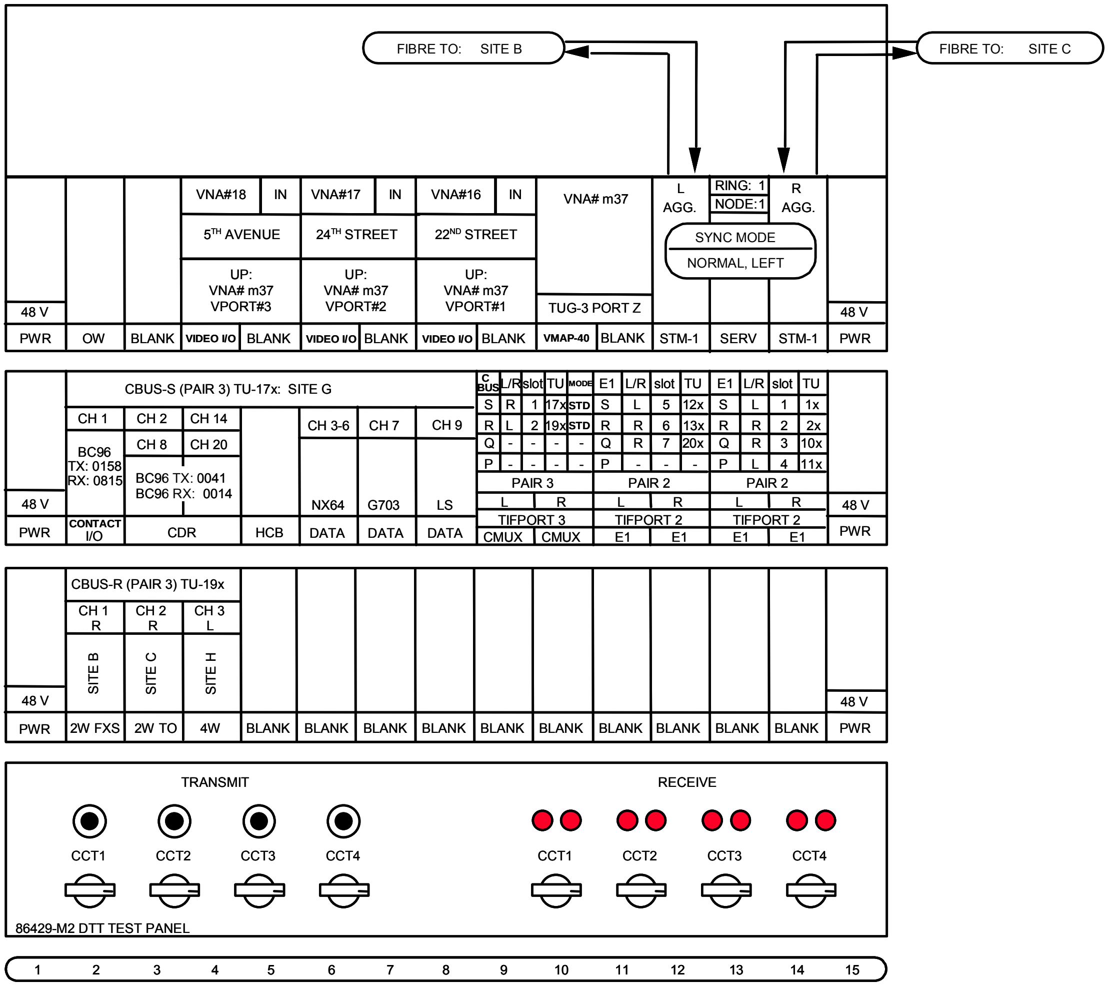


Figure 3: Typical Rack Layout

The shelf slot to the right of the 86412-01 Video I/O unit (one shelf slot wide) must be unequipped. The Video I/O unit paddleboard inserted to the back plane must cover both the equipped and unequipped shelf slot positions (the paddleboard is two shelf slot positions wide).

The Video I/O unit can be inserted and removed from the shelf with shelf power applied; however, certain precautions should be taken before inserting or removing the unit from a system in service. Refer to the sections *Adding Video I/O Unit to a System in Service* and *Replacing a Video I/O Unit in a System in Service* before taking any action.

Paddleboard Connections

The Video I/O Paddleboard Assembly (Figure 4) provides customer connections to the Video I/O unit.

Vport Connectors

The Video I/O paddleboard has two Vports, one labelled "UP" and the other labelled "DOWN". The Vport labelled "UP" is connected to a Vport (labelled "DOWN") on the VMapper paddleboard assembly using a straight-through CAT 5 cable. For this purpose, cables 035-86400-24 (30 cm), 035-86400-25 (60 cm), 035-86400-26 (90 cm) and 035-86400-22 (1.5 m) are used. The cable selection depends on the distance between the Video I/O unit and the respective VMapper unit.

On the paddleboard used with Video-IN unit, the Vport labelled "DOWN" may be used to monitor the signal on the Vport "UP" (if connected to another Video I/O unit configured for Video-OUT mode using a CAT 5 crossover cable, e.g. 035-86400-27) since the same signal is sent on both ports.

For more information on the cables used for Vport connections, refer to the *Cables and Accessories* section of the TN1Ue Equipment Shelf TPIM.

Video Connectors

<u>Inputs</u>

VIDEO IN (BNC) is the connector for the input of composite video signals.

Using a jumper accessible through the opening on the top side of the EMC cover (Figure 5), the Video IN connector can be strapped for either 75Ω termination or bridging.

VIDEO IN (4-pin mini DIN) connector may be used as:

(a) the input of Y/C (S-video) video signal **OR**

(b) the input of two composite video signals. The S-video to BNC splitter cable (135-86412-03) may be used. For these inputs, termination (75Ω) is always provided (regardless of the jumper position).

The selection of the above four sources can be done locally or remotely.

Outputs

VIDEO OUT (BNC) is the connector for the output of composite video signal.

VIDEO OUT (4-pin mini DIN) is the connector for the output of Y/C (S-video) signals.

Either or both VIDEO OUT connectors, can be disabled to save power (0.5 W if both disabled).

Audio Connectors

AUDIO IN and AUDIO OUT are the Miniature Tip-Ring-Sleeve connectors for the input and output of stereo audio signals respectively. (Requires 86412-02 unit.)

If an audio device with RCA connectors is to be connected, a miniature-tip-ring-sleeve-to-dual-RCA adapter may be used.

Connector for Main-Board RS-232 Data Ports 1 and 2

DATA PORTS 1&2 is the RJ-45 connector for the two Main-Board RS-232 data circuits. (Requires 86412-02 unit.) The pin assignments are as follows:

Pin 1: DATA-OUT (Port #1)
Pin 3: DATA-IN (Port #1)
Pin 5: DATA-OUT (Port #2)
Pin 7: DATA-IN (Port #2)
Pins 2, 4, 6, 8: GND

Contact I/O & RS-422/RS-485 Data Connector

CIRCUIT 1 TO 16 is a 26-pin D-connector providing access for up to 16 contact I/O circuits or four RS-422/RS-485/RS-232 data circuits or combinations of these. (Requires 86412-02 unit.) The pin assignments are provided in Table 1.

The Paddleboard Assembly consists of the bottom paddleboard, top paddleboard (which itself consists of two sub-boards: left and right) and EMC cover. The Paddleboard Assembly is considered one part (86412-73) even though it comprises multiple sub-assemblies.

Note: *The EMC cover must be installed to prevent excessive electromagnetic emissions.*

SUB-BOARD POSITION	DB26 Pin No.	Signal Name Contact I/O (Code C)	Signal Name RS-422/RS-485 (Code D)	Signal Name RS-232 (Code F)
1	22	CCT#1	Data-OUT A (-)	Control-OUT*
	14	CCT#1/2 COM	GND (Not Used)	GND
	5	CCT#2	Data-OUT B (+)	RD (Data-OUT)
	21	CCT#3	Data-IN A (-)	Control-IN**
	13	CCT#3/4 COM	GND (Not Used)	GND
	4	CCT#4	Data-IN B (+)	TD (Data-IN)
2	26	CCT#5	Data-OUT A (-)	Control-OUT*
	18	CCT#5/6 COM	GND (Not Used)	GND
	9	CCT#6	Data-OUT B (+)	RD (Data-OUT)
	24	CCT#7	Data-IN A (-)	Control-IN**
	16	CCT#7/8 COM	GND (Not Used)	GND
	7	CCT#8	Data-IN B (+)	TD (Data-IN)
3	19	CCT#9	Data-OUT A (-)	Control-OUT*
	11	CCT#9/10 COM	GND (Not Used)	GND
	2	CCT#10	Data-OUT B (+)	RD (Data-OUT)
	20	CCT#11	Data-IN A (-)	Control-IN**
	12	CCT#11/12 COM	GND (Not Used)	GND
	3	CCT#12	Data-IN B (+)	TD (Data-IN)
4	25	CCT#13	Data-OUT A (-)	Control-OUT*
	17	CCT#13/14 COM	GND (Not Used)	GND
	8	CCT#14	Data-OUT B (+)	RD (Data-OUT)
	23	CCT#15	Data-IN A (-)	Control-IN**
	15	CCT#15/16 COM	GND (Not Used)	GND
	6	CCT#16	Data-IN B (+)	TD (Data-IN)
-----	1	GND (Not Used)	GND (Not Used)	GND (Not Used)
-----	10	GND (Not Used)	GND (Not Used)	GND (Not Used)

* Depending on the actual application (DCE/DTE, usage of auto-enable feature etc.), the Control-OUT line may be used to provide various control signals (e.g. RTS, CTS, RLSD).

** Control-IN currently not supported.

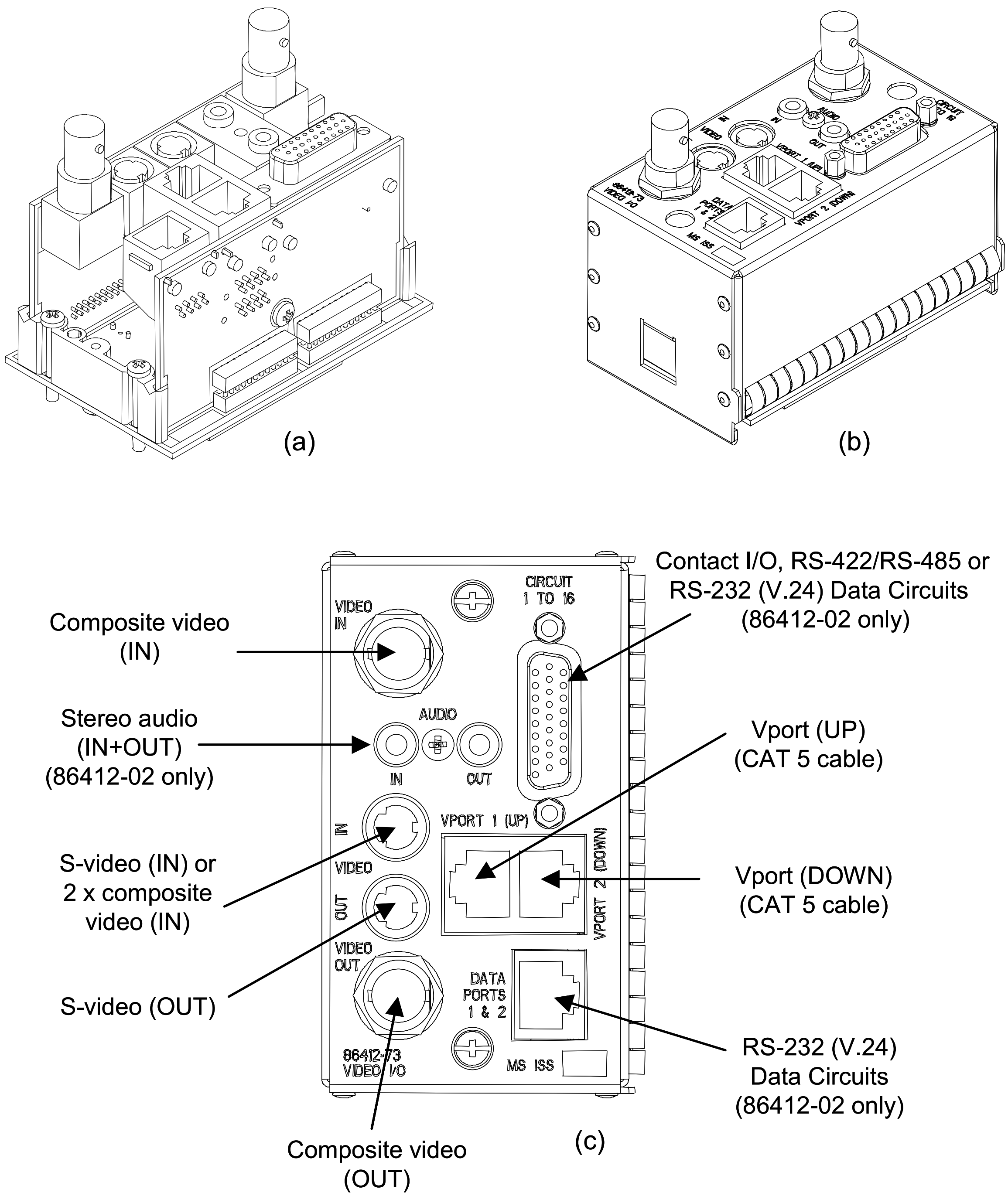
NOTE 1: A 2-wire RS-485 port is created by connecting Data-IN and Data-OUT terminals together i.e. Data-IN A (-) is bridged with Data-OUT A(-) while Data-IN B (+) is bridged with Data-OUT B(+).

NOTE 2: An external 150Ω resistor may be connected in parallel to the RS-485 port connected to the end of the RS-485 bus (for electrically-long cables).

Table 1: DB26 Connector Pin designations

WARNING

For correct operation, the Subassembly 087-86430-90 (CBUS jumper) must not be installed on either side and underneath the Video I/O Unit paddleboard.



Note: S-video IN port can be converted into two composite video IN ports using 135-86412-03 splitter cable.

Figure 4: Video I/O Paddleboard Assembly: (a) 3-D View without EMC Cover; (b) 3-D View with EMC Cover; (c) 2-D View

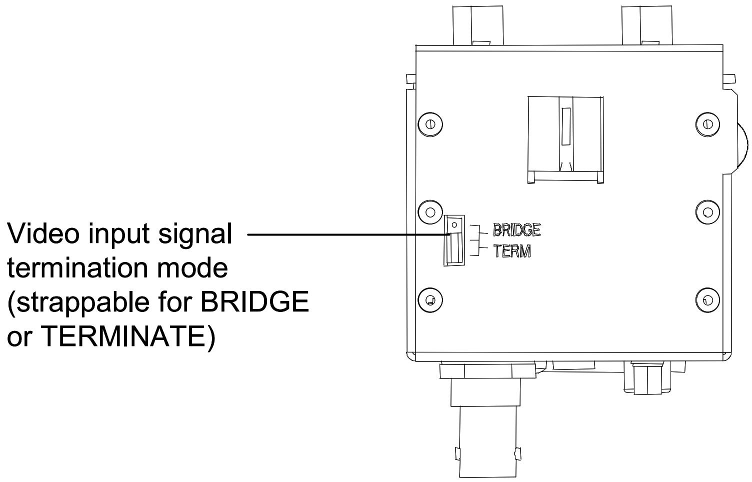


Figure 5: Video Input Signal Termination Mode Setting

Paddleboard Installation

1. Separate bottom and top paddleboards. Do not detach EMC cover from top paddleboard.
2. Insert bottom paddleboard into designated slot position ensuring that rear connectors are fully mated. Ensure correct orientation of bottom paddleboard prior to insertion.
3. Secure bottom paddleboard in position using fixing screws provided.
4. Insert top paddleboard (with attached EMC Cover) onto bottom paddleboard using guide grooves on bottom paddleboard to aid connector alignment. Ensure that connector pins are correctly aligned and fully mated. Ensure correct orientation of top paddleboard prior to insertion.
5. Secure top paddleboard and EMC Cover in position using integral retaining screws accessible through upper and lower apertures on EMC Cover.

Adding Video I/O Unit to a System in Service

Adding Video-IN Unit

WARNING
Before adding any new Video I/O units to the TN1Ue video system, the routing of the traffic in the video system must be carefully planned (refer to the VMapper unit TPIM). Otherwise, the total available bandwidth (48 Mb/s in VMapper-40 system and 11.2 Mb/s in VMapper-10 system) may be exceeded on some hops which will lead to the loss of traffic in the video system!

1. Ensure that the STM-1 Aggregate units, TUG-3 units (if applicable) and VMapper units are set up correctly (refer to the VMapper TPIM). Check that the VMapper unit's L & R LED rows have only green LEDs ON (these check the VMapper-to-adjacent-nodes' VMapper links).
2. If the Video-IN unit is added to a system in service, ensure the VMapper unit's Vport that is to be connected to the Video-IN unit is "Unassigned".
3. Install the Video I/O unit paddleboard on the shelf backplane. Ensure that the 087-86430-90 CBUS jumper is not installed in the backplane underneath and on either side of the paddleboard.
4. Connect the Video I/O unit paddleboard's Vport UP to the Vport ("unassigned" in Step 2) on the associated VMapper unit (using a straight-through CAT 5 cable). Refer to the *Paddleboard Connections* for information on different Vport cable options.

WARNING
Inserting the Video I/O unit into a working position while the corresponding Vport on the VMapper unit is set to "Enabled" may cause traffic disruption in an in-service system!

WARNING
Do not use the red tab to force the unit into the shelf as this could result in damage to the red tab.

5. (Optional, supported by 86412-02 only) Ensure that the unit is equipped with proper sub-board(s) as required for the given application (see NAD for the node).
6. Insert the Video I/O unit into the shelf.

7. Using TLCI, ensure the unit is configured for the Video IN (Camera) mode of operation. Select the Signal Format (PAL or NTSC).

   ***Note**: Although the Video Mode/Signal Format field is to be set first during the unit initial set-up procedure, it is the last configurable field in the TLCI screen.*

WARNING
If the unit's VNA# is set the same as an existing Video I/O unit's one, a disruption of the traffic in the video system is expected.

8. Use TLCI to program the unit's VNA#.
9. Ensure the SYNC-MODE is set to NORMAL.
10. Program the VMapper unit's Vport that is connected to the Video-IN unit paddleboard to "Assigned".
11. Use TLCI on the Video I/O unit to check that the Vport-UP status is "OK" & no errors (<1ppm), and that the displayed VNA# is that of the connected VMapper unit. In this case, the unit's UP row of LEDs should have only the green LED ON.
12. Use TLCI on the VMapper unit to check that the used Vport status is "OK" & no errors (<1ppm), and that the displayed VNA is that of the Video I/O unit. Check that the unit's red Alarm LED is not on steady (it may be flashing, e.g. if the Video I/O unit has an alert condition).
13. Connect a video source (camera, DVD etc.) to the unit's appropriate paddleboard connector (BNC or Y/C) and use TLCI to set the unit to use this port on power-up (VIDEO SOURCE BOOT field). If the original setting had to be changed, reseat the unit.
14. (Optional, supported by 86412-02 only) Connect an audio source to the unit's Audio IN connector (miniature tip-ring-sleeve jack).
15. On the TLCI screen, check that the VIDEO ALERTS LOS field displays "OK" (video present) and set the LOS-alert option to the desired mode (alert enabled or disabled). Note, if the LOS field displays "NO-INPUT" at this point, the far-end unit is in place and wants the signal from an unused source.
16. Check that the MOTION alerts are disabled (-), if the motion detection feature is not used. Otherwise, enter the desired motion threshold value and set the ALARM and MESSAGES fields to the desired modes.

17. If a local video monitor is available, it may be connected to either video output port (BNC or Y/C) to monitor that the video signal is getting into the unit OK. To use this mode, use TLCI to check that the used video output port is ON (VIDEO OUTPUTS section). Note, it is suggested that any unused video outputs be normally set OFF to save power. If the monitor supports "closed caption" display (available for NTSC mode of operation only), ensure the CC field is ON (unless closed caption signal from source is wanted).
18. The TLCI's VIDEO QUALITY IN-USE field shows the bit rate and frame rate being outputted (this will be zero if no VIDEO-OUT units are set to this unit, unless the overriding FORCE field is used).
19. (Optional, supported by 86412-02 only) The TLCI's AUDIO QUALITY IN-USE field shows the bit rate and frame rate being outputted (this will be zero if no VIDEO-OUT units are set to this unit, unless the overriding FORCE field is used).
20. Check that the actual video bit rate shown by TLCI (approximately) matches the IN-USE bit rate.
21. (Optional, supported by 86412-02 only) Enable and configure each of the used sub-boards (see Section 6). Wire the paddleboard's DB26 connector as required (see *Paddleboard Connections*).

Adding Video-OUT Unit

WARNING
Before adding any new Video I/O units to the TN1Ue video system, the routing of the traffic in the video system must be carefully planned (refer to the VMapper unit TPIM). Otherwise, the total available bandwidth (48 Mb/s in VMapper-40 system and 11.2 Mb/s in VMapper-10 system) may be exceeded on some hops which will lead to the loss of traffic in the video system! **In addition, note that if there is a 10 Mb/s video circuit established in a VMapper-10 network, there should not be more than 300 kb/s assigned to all audio and data circuits.**

1. Ensure that the STM-1 Aggregate units, TUG-3 units (if applicable) and VMapper units are set up correctly (refer to the VMapper TPIM). Check that the VMapper unit's L & R LED rows have only green LEDs ON (these check the VMapper-to-adjacent-nodes' VMapper links).
2. If the Video-OUT unit is added to a system in service, ensure the VMapper unit's Vport that is to be connected to the Video-IN unit is "Unassigned".

3. Install the Video I/O unit paddleboard on the shelf backplane. Ensure that the 087-86430-90 CBUS jumper is not installed in the backplane underneath and on either side of the paddleboard.
4. Connect the Video I/O unit paddleboard's Vport UP to the Vport ("unassigned" in Step 2) on the associated VMapper unit (using a straight-through CAT 5 cable). Refer to the Paddleboard Connections for information on different Vport cable options.

WARNING
Inserting the Video I/O unit into a working position while the corresponding Vport on the VMapper unit is set to "Enabled" may cause traffic disruption in an in-service system!

WARNING
Do not use the red tab to force the unit into the shelf as this could result in damage to the red tab.

5. (Optional, supported by 86412-02 only) Ensure that the unit is equipped with proper sub-board(s) as required for the given application (see NAD for the node).
6. Insert the Video I/O unit into the shelf.
7. Using TLCI, ensure the unit is configured for the Video OUT (Monitor) mode of operation. Select the Signal Format (PAL or NTSC).

   ***Note**: Although the Video Mode/Signal Format field is to be set first during the unit initial set-up procedure, it is the last configurable field in the TLCI screen.*
8. Use TLCI to set the VIDEO SOURCE (BOOT and WANTED), VIDEO QUALITY (BOOT and WANTED), and, if applicable, AUDIO QUALITY (BOOT and WANTED) fields to that desired. Alternatively, set the BOOT fields only and reseat the unit.
9. Use TLCI to set the REMOTE VNA# (Boot and Wanted) fields to that of the source to be viewed. Alternatively, set the Boot field only and reseat the unit.

   ***Note**: Audio signals follow the same path as the associated video signals, e.g. they cannot be routed through the video system independently.*

WARNING
If the unit's VNA# is set the same as an existing Video I/O unit's one, a disruption of the traffic in the video system is expected.

10. Use TLCI to program the unit's VNA#.

11. Program the VMapper unit's Vport that is connected to the Video-OUT unit paddleboard to "Assigned".
12. Use TLCI on the Video I/O unit to check that the Vport-UP status is "OK" & no errors (<1ppm), and that the displayed VNA# is that of the connected VMapper unit. In this case, the unit's UP row of LEDs should have only the green LED ON.
13. Use TLCI on the VMapper unit to check that the used Vport status is "OK" & no errors (<1ppm), and that the displayed VNA is that of the Video I/O unit.
14. Check that all the readings in the FAR-END fields agree with the settings in the WANTED fields. (If not, the "Wanted" could be overridden by another Video-OUT unit, with a higher video quality/source-code request, or by a "Force" at the far-end).
15. Connect a video monitor to the unit’s appropriate paddleboard connector (BNC or Y/C).
16. Use TLCI to check that the used video output port is ON (VIDEO OUTPUTS section). Note, it is suggested that any unused video outputs be normally set OFF to save power. If the monitor supports "closed caption" display (available for NTSC mode of operation only), ensure the CC field is ON (unless closed caption signal from source is wanted).
17. (Optional, supported by 86412-02 only) Connect an audio receiver to the unit’s Audio OUT connector (miniature tip-ring-sleeve jack).
18. Check that the indicated received video bit rate (approximately) matches the FAR-END video bit rate. If applicable, also check that the indicated received audio bit rate (approximately) matches the audio quality wanted (refer to the table in Appendix D).
19. Check the TLCI’s displayed VIDEO ALERTS:
    - Check that the received video BIT STREAM is OK and set the option to the desired mode (alert enabled or disabled).
    - Check that the far-end video input LOS is OK and set the alert option to the desired mode (alert enabled or disabled).

    Note that the MOTION alert can be enabled only through external software.
20. Set the Video Failure Mode (FAIL field in the ALERT BITSTREAM section) as desired. Note, with older unit firmware and TLCI software versions the video failure mode was not configurable and the unit would freeze the screen on loss of video bit-stream.
21. If applicable, check the status of the received audio signal (BUFFER STATUS field in the F8 screen) and set the ALERT field to the desired mode (enabled or disabled).

22. Check that the video monitor is displaying the video source signal as expected.
23. If applicable, check that the audio receiver is receiving the audio source tone as expected.
24. (Optional, supported by 86412-02 only) Enable and configure each of the used sub-boards (see Section 6). Wire the paddleboard's DB26 connector as required (see *Paddleboard Connections*).

Replacing a Video I/O Unit in a System in Service

Removing a Video I/O Unit

1. Run TLCI program and plug into the VMapper unit whose Vport is connected to the Video I/O unit to be removed. Program the Vport to "Disabled".
2. Use the red tab on the face plate of the Video I/O unit to ease the unit from the TN1Ue shelf.

Inserting a Replacement Video I/O Unit

WARNING
Inserting the Video I/O unit into a working position while the corresponding Vport on the VMapper unit is set to "Enabled" may cause traffic disruption in an in-service system!

WARNING
Do not use the red tab to force the unit into the shelf as this could result in damage to the red tab.

1. (Optional, supported by 86412-02 only) Ensure that the unit is equipped with proper sub-board(s) as required for the given application (same as the replaced unit).
2. Insert the Video I/O unit into the shelf.
3. Ensure the unit is configured for the proper mode of operation (Video-IN or Video-OUT). Select the Signal Format (PAL or NTSC).

   ***Note**: Although the Video Mode/Signal Format field is to be set first during the unit initial set-up procedure, it is the last configurable field in the TLCI screen.*
4. Use the TLCI program to set the unit parameters in the same way as they were configured in the replaced unit.

5. Use the TLCI program to set the corresponding VMapper unit's Vport to "Enabled".

6. CONFIGURATION

To configure the 86412 Video I/O unit, connect a PC running the supplied TN1U Local Craft Interface (TLCI) software to the CI jack on the front of the unit. An 84910-05 RJ-11 cable and an 84910-06 (9 pin adapter) or 84910-07 (25 pin adapter) or equivalent is required.

The software displays programmable fields, information about the unit and the unit status. The unit will be shipped with the programmable fields set as per the NAD for the purchased system.

The Video I/O unit does not have any hardware adjustable options. All configurations are performed through the TLCI.

TLCI SCREEN INFORMATION

The 86412-01 unit option supports only the Main TLCI Screen, while the 86412-02 unit option supports the Main TLCI Screen, Audio Screen, Data Screen, and Contact I/O Screen. In the Main and Audio Screens, the TLCI information for Video-IN and Video-OUT units is different. Therefore, all the fields in these screens are explained separately for Video-IN and Video-OUT units. Data and Contact I/O Screens are the same for both Video-IN and Video-OUT units.

The user should refer to Figures 6 and 7 (Video-IN Main and Audio-IN TLCI Screens), Figures 8 and 9 (Video-OUT Main and Audio-OUT TLCI Screens), and Figures 10 and 11 (Data and Contact I/O Port Screens).

***Note**: Some older unit firmware and TLCI software versions may not support all TLCI features as described in this section.*

Video Mode and Signal Format

The Video I/O unit can be configured for either the Video-IN mode or the Video-OUT mode. In the Video-IN mode the unit can accept a signal from a video source (cameras, VCR or DVD). In the Video-OUT mode the unit provides a signal to a monitor or recording device. If the unit supports transmission of audio signals, the Video-IN unit can also accept an audio signal from an audio source (e.g. microphone) while the Video-OUT unit can provide an audio signal to an audio receiver (e.g. amplifier).

The Signal Format can be set for PAL or NTSC depending on the type of video signal the unit is supposed to support.

***Note**: A change in the configuration of the unit from one mode/format to another will cause the unit to reboot.*

***Note**: Audio signal follows the same path as the video signal it is associated to, e.g. it cannot be routed through the video system independently.*

***Note**: Although the Video Mode/Signal Format field is to be set first during the unit initial set-up procedure, it is the last configurable field in the TLCI screen.*

VNA

Each Video I/O unit must have its own unique Video Network Address (VNA). A VNA address for a Video I/O unit is in the range 1 – 6143. The factory setting is VNA# 0, and it must be changed for unit's normal operation.

VIDEO-IN UNIT

Main TLCI Screen

VIDEO SOURCE

The signals to the Video-IN unit can be from one of the following:

01 - BNC (composite video)
02 - Y/C #2 (composite video)
03 - Y/C #3 (composite video)
04 - Y/C (S-video)

To use Y/C #2 and Y/C #3 a splitter cable connected to the Y/C connector is required (135-86412-03). See Appendix B for Source Codes without colour (if useful, to conserve bandwidth).

If TEST is enabled, an internal colour-bar generator feeds both outputs and a colour-ramp test signal is sent to the far-end Video-OUT unit.

BOOT: On unit boot-up, video from the video source specified will be provided if no specific request (wanted) is received.

WANTED: Displays the video source from which video is wanted (request from a far-end monitor). Note, if two or more video source requests are received simultaneously (from multiple far-end Video-OUT units), the one with highest source code will be selected (see Appendix B).

FORCE: Allows the user to force the selection to a particular video source (overriding "wanted" source). Note, after unit power-up, the force is off (regardless of the setting before the power loss).

IN-USE: Displays the video source currently being used, which is:

- The FORCE field, if this field is not 00;
- Else, the WANTED field, if "wanted" packets are being received from a Video-OUT unit;
- Else, the BOOT field's value.

***Note**: If the unit is receiving "wanted" packets and then, for some reason, stops receiving them, it will revert to the BOOT field setting.*

VIDEO QUALITY

The Video-IN unit can be set for a specific video bit rate from 25kb/s to 10Mb/s. The frame rate can be set as well as the frame format which can be either interlaced (standard 525-line NTSC signal or standard 625-line PAL signal) or non-interlaced (one 262-line field for NTSC or one 312-line field for PAL). The present bit rate of the video source is displayed. The user can trade off frame rate vs. picture resolution (compression factor). The user is referred to Appendix A for Video Quality Codes.

WANTED: Displays the video quality wanted (request from the far-end Video-OUT unit). Note, if two or more quality requests are received simultaneously (from multiple far-end Video-OUT units), the one with highest quality will be displayed (in accordance to the table in Appendix A).

FORCE: Allows the user to force the selection to a particular video quality (overriding "wanted" selection).

IN-USE: Displays the video quality currently being used, which is:

- The FORCE field, if this field is not '00';
- Else, the WANTED field, if a "wanted" packet has been received from a Video-OUT unit;
- Else, '00' (the unit sends no video information).

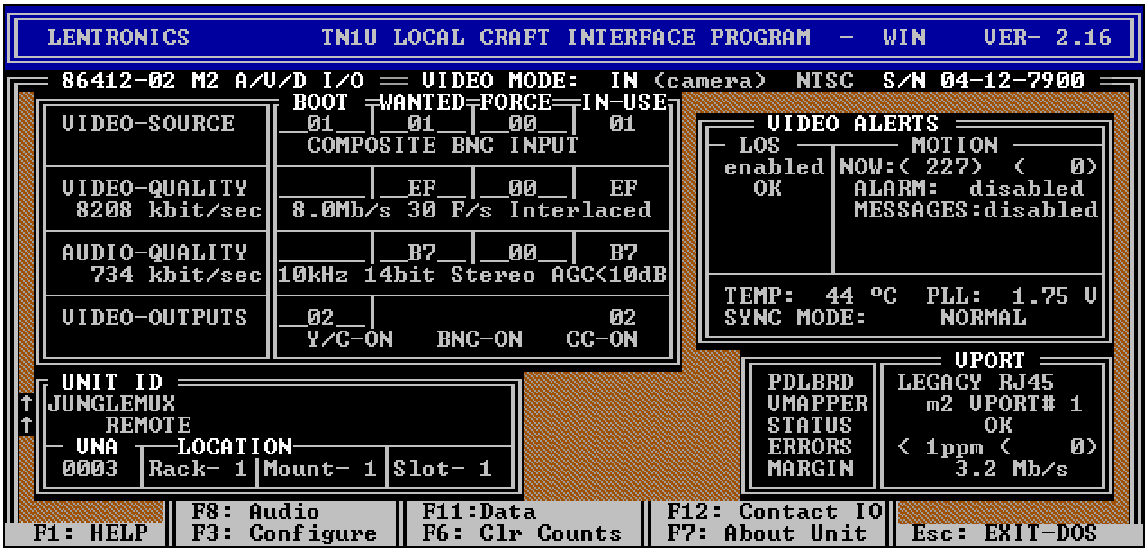


Figure 6: Video-IN Main TLCI Screen

Function Key	Description
F1	On-Line Help – provides definition and explanation of some of the fields used in this screen.
F3	Used to enter the configuration mode. The first programmable field is highlighted. The up and down arrow keys may be used to go through different fields. F5 is used to edit the fields. The left and right arrow keys may be used to display different options.
F6	Resets the internal error counter to zero on the Video I/O unit.
F7	Displays the unit serial number and firmware version.
F8	Selects the Audio Screen.
F11	Selects the Data Screen.
F12	Selects the Contact I/O Screen.

Table 2: Function Keys in Video-IN Main TLCI Screen

<u>AUDIO QUALITY (86412-02 unit only)</u>

The Video-IN unit can be set for a specific audio quality. It comprises Stereo/Mono selection, frequency response (audio channel bandwidth), quantizing method, and audio signal gain.

The frequency response can be set for 5kHz, 8kHz, 10kHz or 15kHz. Quantization may be of 14 bits (linear, HiFi) or 7 bits (μ-law, LoFi). The signal gains can be set for fixed (0dB, 3dB, 10dB) or variable (AGC<10dB, AGC<15dB, AGC<20dB, AGC<30dB and AGC<42dB). The user is referred to Appendix G for more information on input gain setting.

Depending on the above selections, the audio bit rate (after packetizing) can vary between 92 kb/s (Mono, 5kHz, 7 bits) to 1105 kb/s (Stereo, 15kHz, 14 bits). The present bit rate of the audio signal being sent to the far-end Video-OUT unit is displayed. The user is referred to Appendix D for more information on the audio bit rates that correspond to the available audio quality selections.

WANTED: Displays the audio quality wanted (request from the far-end Video-OUT unit). Note, if two or more quality requests are received simultaneously (from multiple far-end Video-OUT units), the one with highest quality will be provided (see Appendix C).

FORCE: Allows the user to force the selection to a particular audio quality (overriding "wanted" selection).

IN-USE: Displays the audio quality currently being used, which is:

- The FORCE field, if this field is not 00;
- Else, the WANTED field, if a "wanted" packet has been received from a Video-OUT unit;
- Else, '00' (the unit sends no audio information).

***Note**: If Mono is selected, only the signal from the "left channel" of the stereo tip-ring-sleeve jack is supported.*

***Note**: In an AGC mode, the AGC action may cause low-level clicks on some program material due to 1.5 dB gain steps.*

VIDEO OUTPUTS

There are two video outputs (BNC and Y/C). These outputs may be used to monitor the local Video-IN signal. If the outputs are not being used at the Video-IN unit, they may be turned off to conserve power.

The Closed Captioning feature may be turned ON or OFF. To get on-screen status information, Closed Captioning must always be turned ON. The user is referred to Appendix F for more information on the on-screen status information. Note that the PAL monitors typically do not support closed captioning.

BOOT: Displays the selections put in "IN-USE" field at unit power-up. The default selections are BNC=ON, Y/C=ON, CC=ON. Note that the changes in this field will not take effect until the unit's next power-up. Therefore, if the changes are to take effect while the unit is in service, they should be entered in the IN-USE field directly.

IN-USE: Displays the current selections.

***Note**: When the closed caption information that may be carried in the input video signal is to be displayed, the unit's Closed Captioning feature must be disabled.*

Unit ID

Camera ID

The user can define the camera ID, which is typically the name of the camera location. Two lines with up to 32 characters in each line can be used for this purpose. This information will appear on the far-end Video-OUT unit TLCI screen as well as on the monitor (at top or the bottom of the display). Note that the monitor (or the TV set) must support the closed captioning feature in order to view this information. The third line at the top of the screen will display error messages. The user is referred to Appendix F for more information on the on-screen status information.

***Note**: Note that PAL monitors typically do not support closed captioning.*

RACK NUMBER (use is optional)

Identifies rack or cabinet the unit is located in. This information may be utilized on the NMS (Network Management System).

RACK MOUNT POSITION (use is optional)

Identifies location of shelf the unit is located in. This information may be utilized on the NMS.

SHELF SLOT POSITION (use is optional)

Identifies slot position within the shelf (1 through 15) the unit is located in. This information may be utilized on the NMS.

Video Alerts

LOS

Consists of two fields. The upper one is programmable and sets the "alarm on LOS" (alarm on loss of video signal) to Enabled or Disabled. The lower field displays the status of the incoming video signal on the Video-IN unit regardless of the setting in the upper field. When the unit loses its video signal then an alarm on the local unit and an alarm in TNCI are generated. An on-screen message will also be generated, if closed captioning is enabled.

MOTION

The current amount detected is displayed first and the sensitivity threshold is displayed next. If the sensitivity threshold is exceeded, two independent actions may be enabled:

(a) alarm to the local node and to the TNCI

(b) alert message to a specific destination (VNA# and Port#, Group, or same port on all Video I/O units).

TEMPERATURE (Not Adjustable)

Displays the average temperature within the Video I/O unit with a ±2ºC accuracy. Normally the reading is about 15ºC above ambient temperature.

PLL VOLTAGE (Not Adjustable)

The Video I/O unit uses a Phase Lock Loop (PLL) to synchronize its Vport UP data input. The PLL voltage controls a VCXO to obtain a synchronous clock. The PLL voltage is normally 1.2 ± 0.5 V. The Video I/O unit will alarm when this voltage is <0.3V or >3.0V.

SYNC MODE

Typically set for Normal. For special applications, the unit can be configured to Internal sync (VCXO forced to nominal).

Vport

PDLBRD ID (Not Adjustable)

This field identifies the type of paddleboard present. The type of paddleboard is detected by means of a resistor divider feeding the units A-D converter on its main board.

VMAPPER (Not Adjustable)

Displays the VNA# and Vport# of the VMapper unit this Vport is connected to.

STATUS (Not Adjustable)

The incoming Vport signal is monitored for low level and BER (Bit Error Rate). If either is bad, an alarm is generated.

ERRORS (Not Adjustable)

Displays the current BER and CV (code violation) count in the incoming Vport signal.

MARGIN (Not Adjustable)

Each Vport has a maximum packet bandwidth of 12.8 Mb/s. This field displays the available (unused) bandwidth.

"F8" Audio-IN Screen

(Applicable to 86412-02 unit only)

The F8 key in the Video-IN unit Main TLCI Screen selects the Audio-IN Screen (Figure 7).

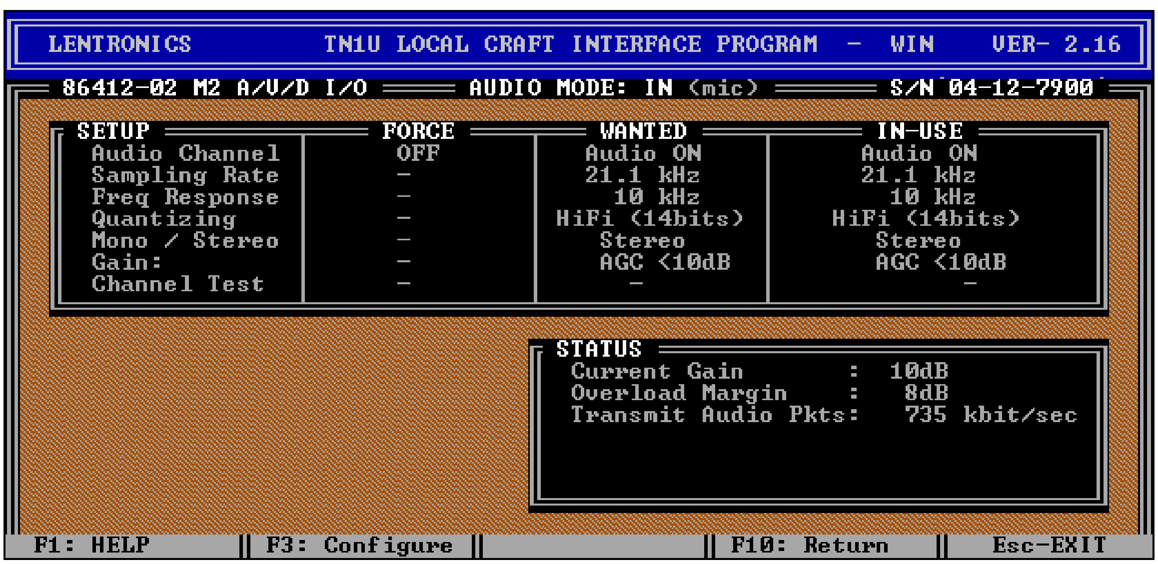


Figure 7: "F8" Audio-IN Screen

Function Key	Description
F1	On-Line Help – provides definition and explanation of some of the fields used in this screen.
F3	Used to enter the configuration mode. The first programmable field is highlighted. The up and down arrow keys may be used to go through different fields. F5 is used to edit the fields. The left and right arrow keys may be used to display different options.
F10	Return to the Main Screen.

Table 3: Function Keys in "F8" Audio-IN Screen

Audio Mode (Not Adjustable)

The unit's audio mode of operation (IN/OUT) is tied to the video mode selection in the Main screen, i.e. Audio Mode is IN on a Video-IN unit and is OUT on a Video OUT unit.

Setup

For the parameters listed in the most left column, the user can set the FORCE values only. The WANTED and IN-USE are read-only values.

WANTED: Displays the wanted value (request from the far-end Video-OUT unit).

FORCE: Allows the user to force the selection to a particular value (overriding "wanted" selection).

IN-USE: Displays the selection currently being used.

Audio Channel

The FORCE field can be set to OFF (Force disabled) or ON (audio quality is forced to selections made in other fields of the FORCE column).

Sampling Rate (Not Adjustable)

Displays the sampling rate that corresponds to the selected Frequency Response parameter in the same column.

Frequency Response

Displays the upper cut-off frequency (-3dB) for the audio channel. Can be set to 5kHz, 8kHz, 10kHz or 15kHz.

Quantizing

Displays the quantizing algorithm. Can be set to 14 bits (HiFi, linear coding) or 7 bits (LoFi, μ-law coding).

Mono/Stereo

Can be set to MONO (monaural) or STEREO. If Mono is selected, only the signal from the "left channel" of the stereo tip-ring-sleeve jack is supported.

Gain

The signal gains can be set for fixed (0dB, 3dB, 10dB) or variable (AGC<10dB, AGC<15dB, AGC<20dB, AGC<30dB, AGC<42dB). The user is referred to Appendix G for more information on input gain setting.

Channel Test

Displays the end-to-end test mode for the audio channel. Can be set for NORMAL (test disabled), ZERO (audio input is muted), or TONE (audio input is replaced with a tone from a built-in tone generator).

Status

Current Gain (Not Adjustable)

Displays the current audio signal gain. For a fix gain setting in the Gain field, the reading equals to the Gain selection. If an AGC setting is selected, the reading changes slowly and indicates the current signal gain.

Overload Margin (Not Adjustable)

This is an indicator of the audio headroom. The reading depends on the current input signal level and setting in the Gain field. To avoid audio signal distortion, the overload margin must be > 0 for all input signal amplitudes. The user is referred to Appendix G for more information on input gain setting.

Transmit Audio Packets (Not Adjustable)

Displays the current audio packet rate generated by the unit. The user is referred to Appendix D for information on the audio bit rates that correspond to the available audio quality selections.

VIDEO-OUT UNIT

Main TLCI Screen

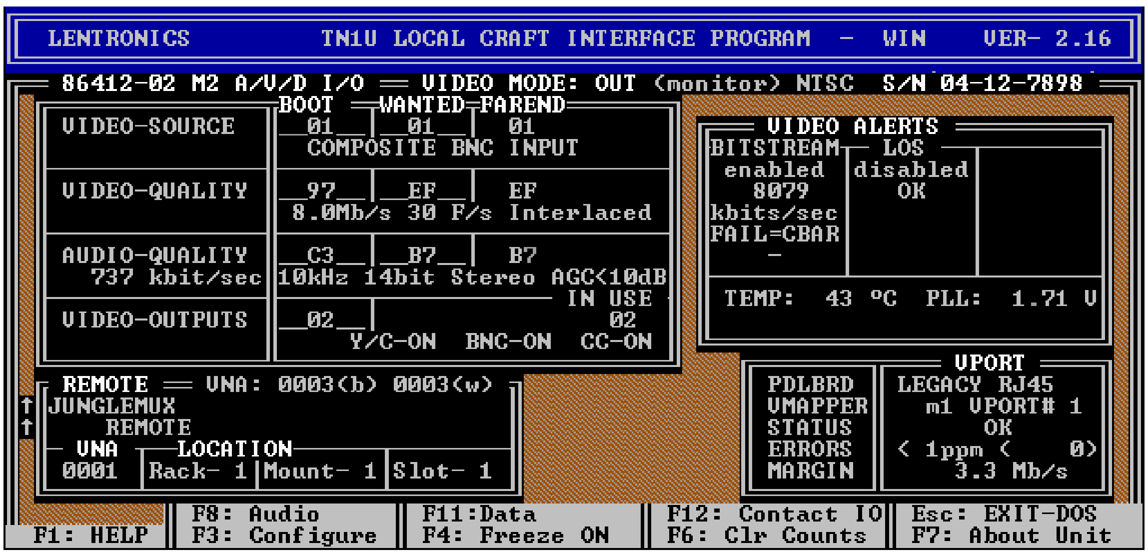


Figure 8: Video-OUT Main TLCI Screen

Function Key	Description
F1	On-Line Help – provides definition and explanation of some of the fields used in this screen.
F3	Used to enter the configuration mode. The first programmable field is highlighted. The up and down arrow keys may be used to go through different fields. F5 is used to edit the fields. The left and right arrow keys may be used to display different options.
F4	Freezes the video on the monitor.
F6	Resets the internal error counter to zero on the Video I/O unit.
F7	Displays the unit serial number and firmware version.
F8	Selects the Audio Screen.
F11	Selects the Data Screen.
F12	Selects the Contact I/O Screen.

Table 4: Function Keys in Video-OUT Main TLCI Screen

VIDEO SOURCE

The signals to the far-end Video-IN unit can be from one of the following:

01 - BNC (composite video)
02 - Y/C #2 (composite video)
03 - Y/C #3 (composite video)
04 - Y/C (S-video)

To use Y/C #2 and Y/C #3 a splitter cable connected to the Y/C connector is required (135-86412-03). See Appendix B for Source Codes without colour (if useful, to conserve bandwidth).

BOOT: Displays the video source put in "wanted" at power-up.

WANTED: Displays the video source "wanted" at the far end.

FAR END: Displays the video source actually in use at the far-end unit.

VIDEO QUALITY

The Video-OUT unit can be set for a specific video bit rate that is requested from the Video-IN unit. It can be from 25kb/s to 10Mb/s. The frame rate can be set as well as the frame format, which can be either interlaced (standard 525-line NTSC signal or standard 625-line PAL signal) or non-interlaced (one 262-line field for NTSC or one 312-line field for PAL). The user can trade off frame rate vs. picture resolution (compression factor). The user is referred to Appendix A for Video Quality Codes.

BOOT: Displays the video quality put in "wanted" field at power-up. The unit can also be set to request no video from the far-end unit upon boot-up (VIDEO=OFF).

WANTED: Displays the video quality wanted from the far-end unit. The unit can also be set to request no video from the far end (VIDEO=OFF).

FAR END: Displays the video quality actually in use at the far-end unit.

AUDIO QUALITY (86412-02 unit only)

The Video-OUT unit can be set for a specific audio quality that is requested from the Video-IN unit. It comprises Stereo/Mono selection, frequency response (audio channel bandwidth), quantizing method, and audio signal gain.

The frequency response can be set for 5kHz, 8kHz, 10kHz or 15kHz. Quantization may be of 14 bits (linear, HiFi) or 7 bits (μ-law, LoFi). The signal gains can be set for fixed (0dB, 3dB, 10dB) or variable (AGC<10dB, AGC<15dB, AGC<20dB, AGC<30dB and AGC<42dB). The user is referred to Appendix G for more information on input gain setting.

Depending on the above selections, the audio bit rate (after packetizing) can vary between 92 kb/s (for Mono, 5kHz, 7 bits) to 1105 kb/s (for Stereo, 15kHz, 14 bits). The present bit rate of the audio signal being sent to the far-end Video-OUT unit is displayed. The user is referred to Appendix D for more information on the audio bit rates that correspond to the available audio quality selections.

BOOT: Displays the audio quality put in "wanted" field at power-up. The unit can also be set to request no audio from the far-end unit upon boot-up (AUDIO=OFF).

WANTED: Displays the audio quality wanted from the far-end unit. The unit can also be set to request no audio from the far end (AUDIO=OFF).

FAR END: Displays the audio quality actually in use at the far-end unit.

Note*: If Mono is selected, only the signal from the "left channel" of the far-end stereo tip-ring-sleeve jack is supported.*

Note*: In an AGC mode, the AGC action may cause low-level clicks on some program material due to 1.5 dB gain steps.*

VIDEO OUTPUTS

There are two video outputs (BNC and Y/C). If an output is not being used it may be turned off to conserve power.

The Closed Captioning feature may be turned ON or OFF. To get on-screen status information, Closed Captioning must always be turned ON and a monitor (or TV set) with this feature must be used. Note that the PAL monitors typically do not support closed captioning.

If TEST is enabled, an internal colour-bar generator feeds both outputs.

BOOT: Displays the selections put in "IN-USE" field at unit power-up. The default selections are TEST=ON, BNC=ON, Y/C=ON, CC=ON. Note that the changes in this field will not take effect until the unit's next power-up. Therefore, if the changes are to take effect while the unit is in service, they should (also) be entered in the IN-USE field directly.

IN-USE: Displays the current selections.

Note*: When the closed caption information that may be carried in the input video signal is to be displayed, the unit's Closed Captioning feature must be disabled.*

Remote ID

VNA Wanted

This is the VNA# of the Video-IN unit from where video is wanted.

VNA Boot

At boot-up, unit receives video from the Video-IN unit at the far end whose VNA# is specified.

Camera ID

Displays the camera ID (closed caption text) from the Video-IN unit.

RACK NUMBER (use is optional)

Identifies rack or cabinet the unit is located in. This information may be utilized on the NMS (Network Management System).

RACK MOUNT POSITION (use is optional)

Identifies location of shelf the unit is located in. This information may be utilized on the NMS.

SHELF SLOT POSITION (use is optional)

Identifies slot position within the shelf (1 through 15) the unit is located in. This information may be utilized on the NMS.

Video Alerts

BIT STREAM

Consists of four fields. The top one is programmable and sets the "bit-stream alarm" (alarm on loss of bit stream) to enabled or disabled. If enabled, a local alarm on the unit and an alarm in TNCI are generated when the bit stream is lost. An on-screen message will also be generated if closed captioning is enabled.

The second field displays the bit-stream rate regardless of the setting in the top field. If the bit-stream from the far end is lost, "DEAD" is displayed.

The third field (FAIL) is programmable and sets the "video failure mode". This field determines what will be displayed on the monitor if the bit-stream from the far end is lost. May be set to CBAR (colour bar) or FRZ (freeze the last frame received). Note that this field has both BOOT and IN-USE settings. The BOOT setting is not displayed in the main screen but is editable in F3 (Configure) mode.

BOOT: Displays the selection put in "IN-USE" field at unit power-up. Note that a change in this field will not take effect until the unit's next power-up. Therefore, if the change is to take effect while the unit is in service, it should (also) be entered in the IN-USE field directly.

IN-USE: Displays the current selection.

The bottom field may display "–", "COL-BAR" or "FREEZE". COL-BAR and FREEZE indicate that the unit provides the monitor with colour bars and frozen picture respectively due to the loss of bit-stream. If FREEZE is flashing, the unit has been forced to freeze the picture using F4 key in which case it can be "unfrozen" if F4 is hit again.

LOS

Consists of two fields. The upper one is programmable and sets the "alarm on LOS" (alarm on loss of video signal at the far-end unit) to enabled or disabled. The lower field displays the status of the incoming video signal on the Video-IN unit regardless of the setting in the upper field. When the far-end (Video-IN) unit loses its video signal then an alarm on the local (Video-OUT) unit and an alarm in TNCI are generated. An on-screen message will also be generated, if closed captioning is enabled.

TEMPERATURE (Not Adjustable)

Displays the average temperature within the Video I/O unit with a ±2°C accuracy. Normally the reading is about 15°C above ambient temperature.

PLL VOLTAGE (Not Adjustable)

The Video I/O unit uses a Phase Lock Loop (PLL) to synchronize its Vport UP data input. The PLL voltage controls a VCXO to obtain a synchronous clock. The PLL voltage is normally 1.2 ± 0.5 V. The Video I/O unit will alarm when this voltage is <0.3V and >3.0V.

Vport

PDLBRD ID (Not Adjustable)

This field identifies the type of paddleboard present. The type of paddleboard is detected by means of a resistor divider feeding the units A-D converter on its main board.

VMAPPER (Not Adjustable)

Displays the VNA# and Vport# of the VMapper unit this Vport is connected to.

STATUS

The incoming Vport signal is monitored for low level and BER (Bit Error Rate). If either is bad, an alarm is generated.

ERRORS (Not Adjustable)

Displays the current BER and CV (code violation) count in the incoming Vport signal.

MARGIN (Not Adjustable)

Each Vport has a maximum packet bandwidth of 12.8 Mb/s. This field displays the available (unused) bandwidth.

"F8" Audio-OUT Screen

(Applicable to 86412-02 unit only)

The F8 key in the Video-OUT unit Main TLCI Screen selects the Audio-OUT Screen (Figure 9).

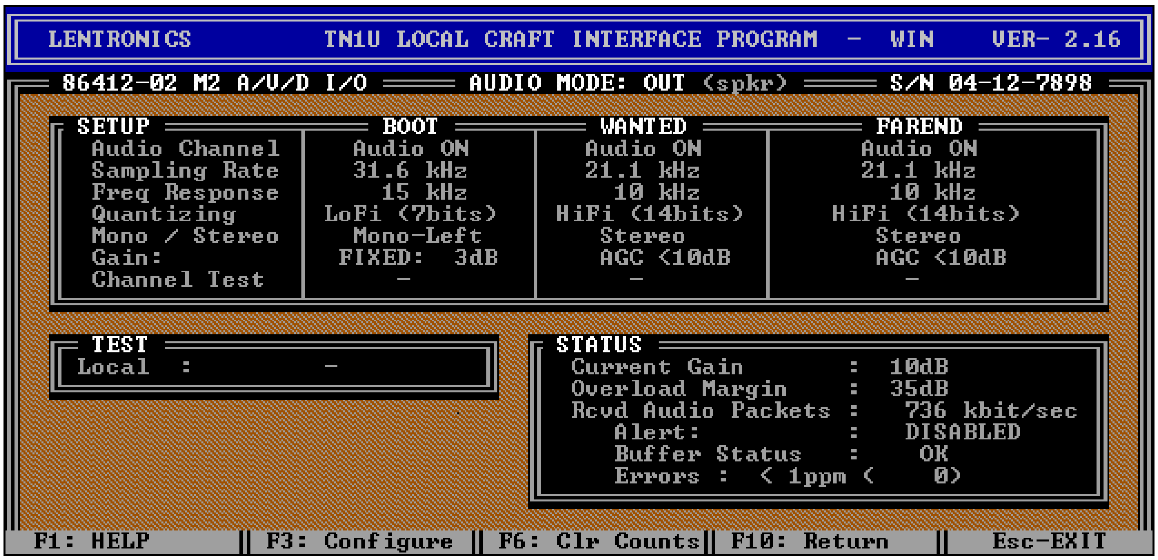


Figure 9: "F8" Audio-OUT Screen

Function Key	Description
F1	On-Line Help – provides definition and explanation of some of the fields used in this screen.
F3	Used to enter the configuration mode. The first programmable field is highlighted. The up and down arrow keys may be used to go through different fields. F5 is used to edit the fields. The left and right arrow keys may be used to display different options.
F6	Resets the error counter to zero on the Video I/O unit.
F10	Return to the Main Screen.

Table 5: Function Keys in "F8" Audio-OUT Screen

Audio Mode

The unit's audio mode of operation (IN/OUT) is tied to the video mode selection in the Main screen, i.e. Audio Mode is IN on a Video-IN unit and is OUT on a Video OUT unit.

Setup

For parameters listed in the most left column the user can set up the BOOT and WANTED values. The FAREND is a read-only value.

BOOT: Displays the value put in "wanted" field at unit power-up.

WANTED: Displays the value wanted from the far-end Video-IN unit.

FAR END: Displays the value actually in use at the far-end unit.

Audio Channel

The BOOT field can be set to Audio ON (audio disabled) or Audio OFF (audio enabled).

Sampling Rate (Not Adjustable)

Displays the sampling rate that corresponds to the selected Frequency Response parameter in the same column.

Frequency Response

Displays the upper cut-off frequency (-3dB) for the audio channel. Can be set to 5kHz, 8kHz, 10kHz or 15kHz.

Quantizing

Displays the quantizing algorithm. Can be set to 14 bits (HiFi, linear coding) or 7 bits (LoFi, μ-law coding).

Mono/Stereo

Can be set to MONO (monaural) or STEREO. If Mono is selected, only the signal from the "left channel" of the stereo tip-ring-sleeve jack is supported.

Gain

The signal gains can be set for fixed (0dB, 3dB, 10dB) or variable (AGC<10dB, AGC<15dB, AGC<20dB, AGC<30dB, AGC<42dB). The user is referred to Appendix G for more information on input gain setting.

Channel Test

Displays the end-to-end test mode for the audio channel. Can be set for NORMAL (test disabled), ZERO (audio input is muted), or TONE (audio input is replaced with a tone from a built-in tone generator).

Test

Local

This sets the local test for the unit's audio output. Can be set to "–" (normal operation, test is turned off), "LOCAL LOOPBACK" (digital loopback; the output is fed with the tone from the local audio input), "LOCAL TONE" (the output is fed with a tone generated by the unit's built-in tone generator), or "OUTPUT MUTED".

Status

Current Gain (Not Adjustable)

Displays the current audio signal gain at the far-end. For a fix gain setting in the Gain field, the reading equals to the Gain selection. If an AGC setting is selected, the reading changes slowly and indicates the current signal gain.

Overload Margin (Not Adjustable)

Displays the Overload Margin at the far-end. This is an indicator of the audio headroom. The reading depends on the current input signal level and setting in the Gain field. To avoid audio signal distortion, the overload margin must be > 0 for all input signal amplitudes. The user is referred to Appendix G for more information on input gain setting.

Received Audio Packets (Not Adjustable)

Displays the current audio packet rate received by the unit. The user is referred to Appendix D for information on the audio bit rates that correspond to the available audio quality selections.

Alert

Can be set do Disabled or Enabled. If enabled, a bad audio signal received generates a local unit alarm and alarm to the NMS.

Buffer Status (Not Adjustable)

BAD indicates the overflow in the audio packet buffer. This typically happens if garbage data is received.

Errors (Not Adjustable)

Displays the current BER and CV (code violation) count in the incoming audio signal. F6 resets the CV counter.

VIDEO-IN AND VIDEO-OUT UNITS

"F11" Data Screen

(Applicable to 86412-02 unit only)

The F11 key in the Video I/O unit Main TLCI Screen selects the Data Screen (Figure 10). This screen is applicable to data ports only (i.e. MB#1, MB#2, and every sub-board position equipped with Code D or Code F sub-board). The user is referred to "F12" Contact I/O screen to configure Contact-IN and Contact-OUT ports (if any Code C sub-boards equipped).

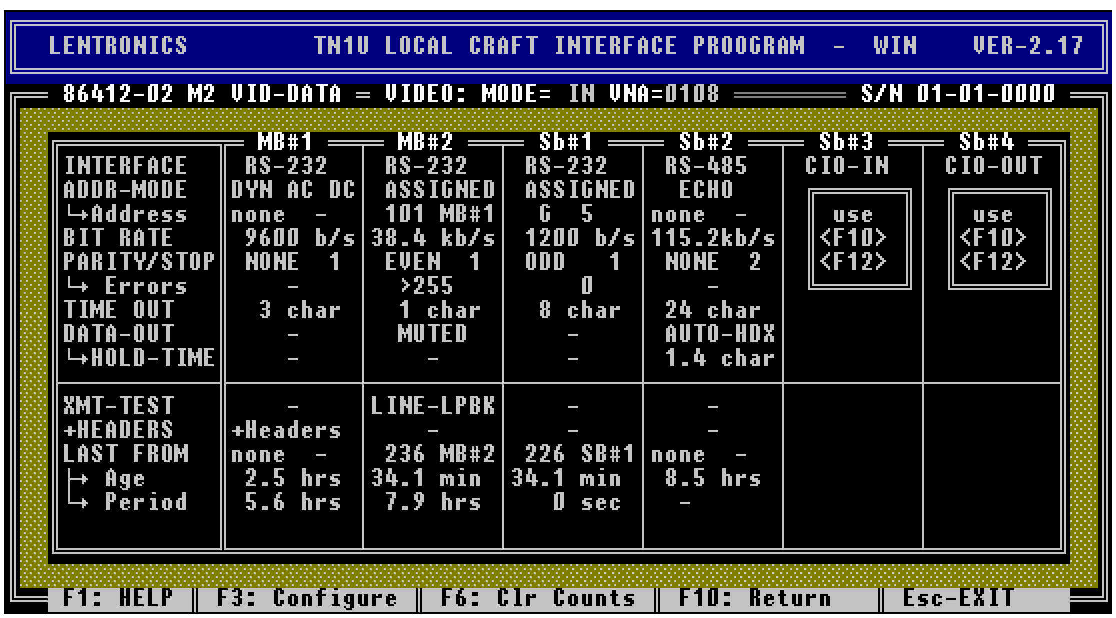


Figure 10: "F11" Data Screen

Function Key	Description
F1	On-Line Help – provides definition and explanation of some of the fields used in this screen.
F3	Used to enter the configuration mode. The first programmable field is highlighted. The up and down arrow keys may be used to go through different fields. F5 is used to edit the fields. The left and right arrow keys may be used to display different options.
F6	Resets the parity error counter to zero on the unit.
F10	Return to the Main Screen.

Table 6: Function Keys in "F11" Data Screen

INTERFACE

Must be set to the type of sub-board installed in the given sub-board position. It is set to EMPTY (-) if a sub-board is not in place for the given port. The unit will be in alarm (and the field is highlighted) if a mismatch exists.

***Note**: This screen can be used to program the interface type for all four sub-board ports regardless of their type.*

ADDR-MODE

This field, in conjunction with ADDRESS field, determines the destination for data sent from this port as well as the originating port(s) that this port will be "open" for receiving data from (see table below). May be set to ASSIGNED, ECHO, DYNAMIC or OFF.

If set to ASSIGNED, the destination is:

a) A specific Video I/O unit and its port (VNA# with prefix 'V' and Port# are entered in the Address field). This sets up a point-to-point circuit.

b) Specific port at all Video I/O units in the system (G0 and Port# are entered in the Address field). This is a "broadcast" point-to-multipoint circuit.

c) All Video I/O units' ports set for the same group (a specific group number with prefix 'G' is entered in the Address field). This sets a "multicast" point-to-multipoint circuit.

If set to ECHO, the destination is the source (VNA# and Port#) of the port’s last received packet.

A port set to ECHO may also be assigned to a group (a specific group number with prefix 'G' is entered in the Address field). This configures the port to receive not only the data packets specifically destined for this VNA# and Port# but also the packets destined for the Group# assigned to this port in the Address field.

If set to “DYN”, the destination (VNA# and Port#, G0 and Port#, or Group number) is assigned “on the fly” by a local PC attached to the port. This mode requires a 2-byte “escape” sequence to be configured (refer to *Computer-Controlled Addressing* in Section 4).

If set to OFF, the port is not capable of sending any data, but it can still receive data.

ADDRESS MODE	**ADDRESS**		**Sends data to…**	**Can receive data from…**			
	VNA#	**Port#**	**(destination)**	**Ports set for this VNA#, Port#**	**Ports set for G0 and this Port#**	**Ports set for this Group #**	**Ports set for ECHO**
ASSIGNED	V1 to V6143 (VNA# is entered with prefix 'V')	MB#1, MB#2, SB#1, SB#2, SB#3 or SB#4	Video I/O unit with this VNA# and this Port# (point-to-point)	√	√		√
ASSIGNED	G0	MB#1, MB#2, SB#1, SB#2, SB#3 or SB#4	This Port# at all Video I/O units in the system ("broadcast" point-to-multipoint)	√	√		√
ASSIGNED	G1 – G255	N/A	All Video I/O unit ports configured for this Group# ("multicast" point-to-multipoint)	√	√	√	√
ECHO	none ('E1' is entered)	Defined by far end	Video I/O unit's port sourcing last message packet received	√	√		
ECHO	G1 – G255	Defined by far end		√	√	√	
OFF	N/A	N/A	N/A	√	√		√
DYN	N/A (Assigned by local computer" on the fly". Requires 2-byte “escape” sequence to be configured. See Section 4.)		Determined by local computer. May be: - Video I/O unit with matching VNA# and Port# (point-to-point) - Given Port# at all Video I/O units in the system (broadcast) - All Video I/O unit ports configured for same "Group" address (multicast)	√	√		√

Table 7: Address Mode Options for Data Ports

WARNING
At a unit, it is not allowed to have two or more ports configured to receive the same Group messages (only the first port will get them).

General rules for selecting proper Address Mode:

a) Use Group feature for all point-to-multipoint circuits;
b) Use a separate Group# for each such service;
c) If there is more than one "RTU" at a remote site (for the same point-to-multipoint circuit, and not on one RS-485 multi-drop cable), use another Video I/O unit;
d) For the "MTU" unit, set its port to ASSIGNED and Group#;
e) For the "RTU" units, set the connected port to ECHO and Group#.

Note that, in the above list, terms "MTU" and "RTU" refer not only to data ports but also to Contact-IN and Contact-OUT sub-boards respectively (if used in a similar manner).

BIT RATE

Sets the bit rate for the port. May be 300, 1200, 2400, 4800, 9600, 19,200, 38,400, or 115,200 b/s.

***Note**: The data rate setting does not need to match the data rate at the far end. However, certain precautions are needed. See "Transport of Data Port Traffic" in Section 4 for details.*

PARITY/STOP

Sets the parity option for the port (odd, even, none) and number of stop bits at the data output (one or two).

The parity selection must match the parity of the data received on the port's input. When parity is set to odd or even, the number of parity errors detected is reported in the field below.

***Note**: The parity information is not propagated to the far end. That is, the parity check is originated at each data port's output.*

Errors (Not Adjustable)

Displays the number of parity errors detected in the data signal received from the drop equipment. May display '–' (parity in the field above set to "none"), 0, 1, 2 … 255, or >255.

TIME OUT

Data is transmitted in message packets. Each message packet can transport from 1 to 16 characters (bytes). A message packet is launched either when the packet is filled with data (16 characters) or when the idle time-out (set in this field) has expired. In other words, this field sets the time that the unit waits, with no input characters, until sending a partially filled packet. Idle time-out may be set to 1, 3, 8 or 24 character periods. Default setting is 3 chars.

***Note**: A message packet is not launched if there is no data received from the drop equipment regardless of the setting in this field.*

***Note**: If the sum of the bit rates for all data circuits in simultaneous use in this video system is lower that 300 kb/s, there is no reason to increase the idle time-out setting (i.e. there is no overload issue). However, if the latency is to be improved (see data latency calculation in the Unit Parameters section), the user may consider reducing idle time-out to 1 char.*

DATA-OUT

(Not applicable to MB#1 and MB#2 ports.)

An RS-422/485 sub-board port can be set to:

NORMAL: This is RS-422 mode ("auto-enable" feature is disabled). The DATA-OUT driver is permanently enabled regardless of whether data is outputted or not. This mode is used when the port is connected to either a single MTU/RTU station or multiple RTU stations via 4-wire bus.

AUTO-FDX: This is RS-485 full-duplex mode. The "auto-enable" feature is enabled which means the DATA-OUT driver is disabled (tri-stated) during idle, and enabled from the start of an outputted character's start-bit to the end of a "hold-time" after the end of the stop-bit. The hold-time is configurable from 0 to 1.4 character-periods in 0.1 char steps (see HOLD-TIME field below). This mode is used when the port is connected to an MTU and one or more RTUs via 4-wire bus.

AUTO-HDX: This is RS-485 half-duplex mode. The "auto-enable" operates the same as in AUTO-FDX mode. In addition, the unit mutes the local DATA-IN while transmitting characters on DATA-OUT (plus the "hold-time"). This mode is used for 2-wire applications to prevent data corruptions due to echoed data.

***Note**: A 2-wire RS-485 port is created by connecting DATA-IN and DATA-OUT terminals together.*

MUTED: Data on DATA-OUT is killed.

An RS-232 sub-board port can be set to:

NORMAL: Full-duplex data transmission with Control-OUT[1] always ON. ("Auto-enable" feature is disabled.)

AUTO-FDX: Full duplex data transmission with Control-OUT ON only when data is outputted on DATA-OUT. In fact, the Control-OUT is ON from the start of start-bit to the end of stop-bit + “hold-time” where the hold-time is configurable from 0.0 to 1.4 character-periods in 0.1 char steps (see HOLD-TIME field below).

AUTO-HDX: Although selectable, this option is normally not used for RS-232 ports.

MUTED: Data on DATA-OUT is killed.

<u>HOLD-TIME</u>

May be set to OFF (0), 0.1, 0.2, … 1.4 character periods. Used in conjunction with the DATA-OUT field (see above). It determines how long the port's DATA-OUT driver (for RS-422/485 port) or Control-OUT line (for RS-232 port) remains ON after the stop bit is completely outputted. This is a feature often requested by users, although the purpose is obscure.

<u>XMT TEST</u>

May be '–' (end-to-end data communication is supported) or LINE-LPBK (line loopback).

In the LINE-LPBK mode, the incoming data from the far-end data port is looped back. The data from the far end will still be received at the near end.

<u>+HEADERS</u>

May be set to '–' (feature disabled) or '+Headers' (feature enabled).

The '+Headers' mode is used for applications using a local computer to receive messages from more than one remote location. Messages may be from data sources, contact-inputs, or Video-IN unit's motion alerts.

In the '+Headers' mode, data received from multiple far-end ports is prefixed with headers providing the computer connected to the near-end port with information on what far-end port is sourcing the data following the header and information on the number of data bytes following the header (1 to 16).

[1] Depending on the actual application (DCE/DTE, usage of auto-enable feature etc.), the Control-OUT line may be used to provide various control signals (e.g. RTS, CTS, RLSD).

The user is referred to *"+Headers" Data Output Mode* in Section 4 for more information.

LAST FROM (Not adjustable)

Displays the source (VNA# and Port#) of the last message packet received at the port. The Port# may be MB#1, MB#2, Sb#1, Sb#2, Sb#3, Sb#4, MICX, or MICY (MICX and MICY refer to the microprocessor).

***Note**: This field is useful for system troubleshooting when unexpected data is received at the port. A change in VNA# and/or Port# indicates that multiple ports are sending data to this port.*

Age (Not adjustable)

Displays the elapsed time since the last message packet was received.

***Note**: If no message was ever received, this time is the time since the unit booted.*

Period (Not adjustable)

Displays the elapsed time between the last two received message packets.

"F12" Contact I/O Screen

(Applicable to 86412-02 unit only)

The F12 key in the Video I/O unit Main TLCI Screen selects the Contact I/O Screen (Figure 11). This screen is applicable to Contact-IN and Contact-OUT ports only (i.e. every sub-board position equipped with Code C sub-board). The user is referred to "F11" Data screen to configure data ports (MB#1, MB#2, and every sub-board position equipped with either Code D or Code F sub-board).

INTERFACE

Must be set to the type of sub-board installed in the given sub-board position. It is set to EMPTY (-) if a sub-board is not in place for the given port. The unit will be in alarm (and the field is highlighted) if a mismatch exists.

***Note**: This screen can be used to program the interface type for all four sub-boards regardless of their type.*

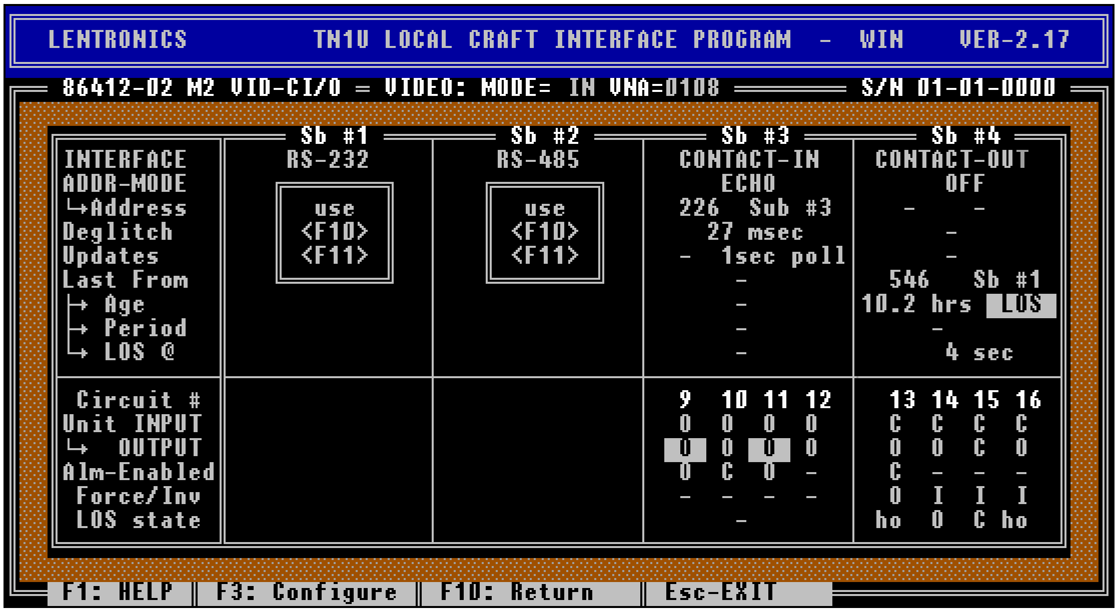


Figure 11: "F12" Contact I/O Screen

Function Key	Description
F1	On-Line Help – provides definition and explanation of some of the fields used in this screen.
F3	Used to enter the configuration mode. The first programmable field is highlighted. The up and down arrow keys may be used to go through different fields. F5 is used to edit the fields. The left and right arrow keys may be used to display different options.
F10	Return to the Main Screen.

Table 8: Function Keys in "F12" Contact I/O Screen

ADDR-MODE

This field, in conjunction with ADDRESS field, determines the destination for data sent from this port as well as the originating port(s) that this port will be "open" for receiving data from (see table below).

Contact-IN ports can be set to ASSIGNED, ECHO or OFF while the Contact-OUT ports may be set to ECHO or OFF.

If set to "ASSIGNED", the destination will be:

a) A specific Video I/O unit and its port (VNA# with prefix 'V' and Port# are entered in the Address field). This sets up a point-to-point circuit.

b) Specific port at all Video I/O units in the system (G0 and Port# are entered in the Address field). This is a "broadcast" point-to-multipoint circuit.

c) All Video I/O units' ports set for the same group (a specific group number with prefix 'G' is entered in the Address field). This sets a "multicast" point-to-multipoint circuit.

If set to “ECHO”, the destination is the source (VNA# and Port#) of the port’s last received packet.

A port set to ECHO may also be assigned to a group (a specific group number with prefix 'G' is entered in the Address field). This configures the port to receive not only the data packets specifically destined for this VNA# and Port# but also the packets destined for the Group# assigned to this port in the Address field.

***Note**: Regardless of its address mode setting, a Contact-OUT port will always return a packet with its current contact states to the sender to confirm that the sender's message has been received (note that there may not be a match if the Contact-OUT port is in the Force state). This can be utilized in applications where the sender is a computer (connected to a data port). However, if the sender is a Contact-IN port, the return packet will not be processed but will not cause any harm either.*

If set to OFF, the port is not capable of sending any data, but it can still receive data.

WARNING
At a unit, it is not allowed to have two or more ports configured to receive the same Group messages (only the first one will get them).

ADDRESS MODE	ADDRESS		Sends data to… (destination)	Can receive data from…			
	VNA#	Port#		Ports set for this VNA#, Port#	Ports set for G0 and this Port#	Ports set for this Group #	Ports set for ECHO
ASSIGNED	V1 to V6143 (VNA# is entered with prefix 'V')	MB#1, MB#2, SB#1, SB#2, SB#3 or SB#4	Video I/O unit with this VNA# and this Port# (point-to-point)	√	√		√
ASSIGNED	G0	MB#1, MB#2, SB#1, SB#2, SB#3 or SB#4	This Port# at all Video I/O units in the system ("broadcast" point-to-multipoint)	√	√		√
ASSIGNED	G1 – G255	N/A	All Video I/O unit ports configured for this Group# ("multicast" point-to-multipoint)	√	√	√	√
ECHO	none ('E1' is entered)	Defined by far end	Video I/O unit's port sourcing last message packet received	√	√		
ECHO	G1 – G255	Defined by far end		√	√	√	
OFF	N/A	N/A	N/A	√	√		√

Table 9: Address Mode Options for Contact I/O Ports

General rules for selecting proper Address Mode for Contact I/O ports:

a) Use Group feature for all point-to-multipoint circuits;
b) Use a separate Group# for each such service;
c) If there is a need for more than one Contact-OUT sub-boards at a remote site (for the same point-to-multipoint circuit), install them in separate Video I/O units;
d) For the Contact-IN sub-board, set the port to ASSIGNED and Group#;
e) For the Contact-OUT sub-board, set the port to ECHO and Group#.

Deglitch

Contact-OUT: Not applicable

Contact-IN: The Contact-IN sub-boards are equipped with a variable deglitch timer. Its function is to delay the transfer of input activity for a period programmable from 2 ms to 192 sec in 16 steps. In other words, this field specifies how long a new contact state must be presented to the input before it is considered valid.

The configured deglitch time is used for all four Contact-IN circuits on the sub-board. Note that all four contact circuits on a sub-board must be stable for this period before an update message (for all four circuits) is transmitted.

***Note**: Deglitch time selection also affects the update period! See the Updates field below.*

Updates

Contact-OUT: Not applicable

Contact-IN: Determines whether the messages carrying status of the four contact circuits will get sent on every input state change (after deglitch time expiration) and/or periodically (user selectable to 2 × Deglitch_Time, 68 × Deglitch_Time, 2200 × Deglitch_Time, 69000 × Deglitch_Time, or OFF) regardless of whether any contact changes have occurred. This is in addition to the messages sent upon receipt of the poll messages that may be issued by Contact-OUT units or computers connected to data ports.

In summary, a message carrying the status of the four input circuits is sent:

1) When the Contact-IN port is polled; or
2) On any input state change (after deglitch time expiration), if the feature is enabled; or
3) Periodically (user selectable from 4 ms to 21.5 weeks, depending on deglitch time set), if the feature is enabled.

LAST FROM (Not Adjustable)

Contact-IN: Not applicable

Contact-OUT: Displays the source (VNA# and Port#) of the last message packet received at the port. The Port# may be MB#1, MB#2, Sb#1, Sb#2, Sb#3, Sb#4, MICX, or MICY (MICX and MICY refer to the microprocessor).

***Note**: This field is useful for system troubleshooting when unexpected contact-OUT states are observed. A change in VNA# and/or Port# indicates that multiple ports are sending updates to the same Contact-OUT port.*

Age (Not Adjustable)

Contact-IN: Not applicable

Contact-OUT: Displays the elapsed time since the last message packet was received.

***Note**: If no message was ever received, this time is the time since the unit booted.*

Period (Not Adjustable)

Contact-IN: Not applicable

Contact-OUT: Displays the elapsed time between the last two received message packets.

LOS@

Contact-IN: Not applicable

Contact-OUT: This feature is used if an alert is desired upon loss of communication from the far-end. This field may be set to '–' (feature disabled) or to one of the 26 pre-selected time periods ranging from 0 sec to 27.7 weeks. If no updates are received from the far end for the specified time, all four circuits will go in the LOS state (see "LOS state" field below).

Circuit# (Not Adjustable)

For each Contact I/O port, displays the numbers associated with its four contact circuits: 1,2,3,4 for Sb#1; 5,6,7,8 for Sb#2; 9,10,11,12 for Sb#3; and 13,14,15,16 for Sb#4.

INPUT (Not Adjustable)

Contact-IN: Displays the actual state of the four external contacts. May be C(losed) or O(pen).

Contact-OUT: Displays the last state received from the far end.

OUTPUT (Not Adjustable)

Contact-IN: Displays the deglitched state of the four external contacts.

Contact-OUT: Displays the actual state of the four output contacts.

***Note**: The displayed contact state is highlighted and the unit is in alarm if the circuit's state matches the state selected in the Alm-Enabled field for the circuit (see below).*

Alm-Enabled

May be set to O(pen), C(losed) or OFF (no alert). Each of the port's four contacts can be independently configured for the condition (open or closed) that will be considered an alert state in which case the local unit is in alarm and an alarm in TNCI is generated.

Force

Contact-IN: May be set for O(pen), C(losed), or '–' (none).

Contact-OUT: May be set for O(pen), C(losed), I(nverted), or '–' (none).

Each input/output circuit can be independently “forced” to emulate a closed or open external contact (used for maintenance or test purposes). Each output circuit can also be set to "Inverted" (the input contact condition is reversed at the output).

LOS state

Contact-IN: Not applicable

Contact-OUT: Each output switch can be configured for the condition it will go to upon a loss of signal from the far end (i.e. no update received for the time specified in the LOS@ field described above). May be configured for C(losed), O(pen) or ho ("holdover" = hold the last received state).

***Note**: When the contact output is in a forced condition, the forced condition will be reflected at the output regardless of whether the circuit is in the LOS state or not.*

7. MAINTENANCE and TROUBLESHOOTING

F1 Help

The "F1" key is a useful tool for explaining the capabilities and options of both programmable fields and display fields of the unit. The user selects "F1" from the TLCI screen and then chooses the topic he/she wishes information on.

Configuration

The 86412 Video I/O unit must be correctly configured as per the NAD. All software adjustable fields are detailed in the Configuration Section of this manual. The user must ensure that all external connections to the paddleboard are correct.

Key Fields to Monitor using the TLCI program

Field	Typical Range	Cause for Concern
PLL Voltage	1.2 ± 0.8 V	<0.3V and >3.0V
Temperature	15º C above ambient.	Excessive high temperature

Table 10: Key Fields to Monitor

Loopbacks

The Video-IN unit can provide the incoming video signal to both of its video output ports (BNC and Y/C). Thus, by connecting a monitor to one of these ports, the user can locally monitor the quality of the input video signal. By default, both unit's video output ports are enabled; however, in order to save power, it is recommended to disable unused output port(s).

The 86412-02 Video-IN unit normally feeds its audio output with the input audio signal with quality equal to the quality of the signal being sent to the far end (Figure 10a). Note that the local audio output cannot be disabled.

Each 86412-02 Video I/O unit data port can be independently configured for line loopback mode. In this mode, the incoming data from the far-end port is looped back to the far end. Note that the incoming data is still received at the near end.

Video Test Modes

Both Video-IN and Video-OUT units have a video test mode. In the test mode the unit provides an internally generated colour-bar test signal to both local video output connectors (BNC and Y/C) on the Video I/O paddleboard. During this mode, the Video-IN unit will also send a Colour-Ramp test signal to the far-end Video-OUT unit.

Audio Test Modes

The 86412-02 Video I/O unit supports an Audio Channel Test mode, which allows the user to override the Video-IN unit's audio input with a tone from the unit's built-in tone generator or to mute its audio input (Figure 13). This test can be enabled from the far-end (Video-OUT) unit or forced locally.

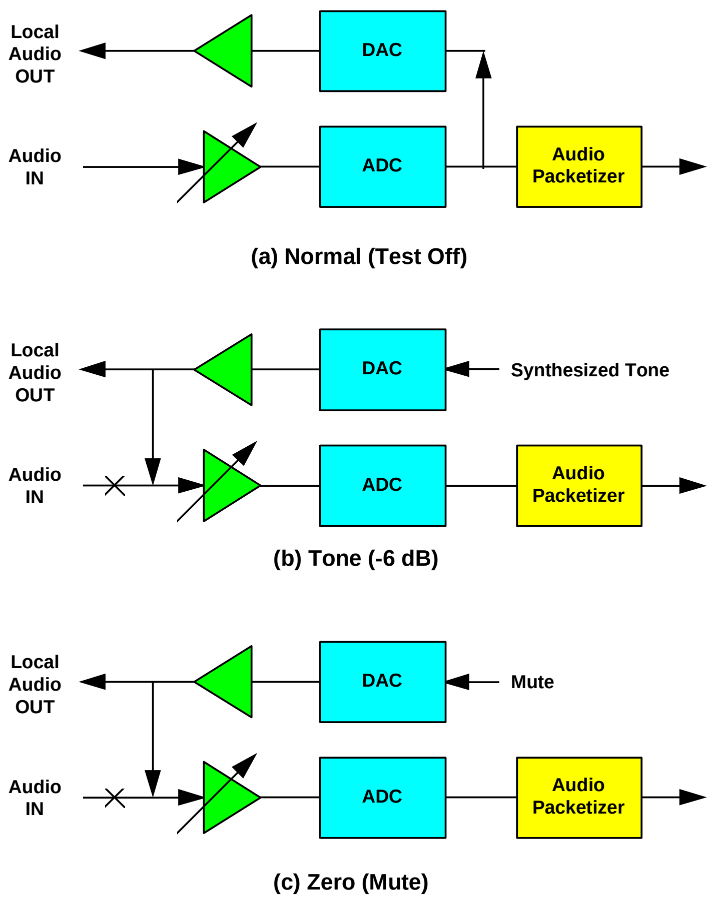


Figure 12: Video-IN Unit Channel Test Mode

The 86412-02 Video-OUT unit supports a Local Test mode, which allows the user to test the audio portion of the unit locally. The unit can be programmed to override the audio signal from the far end with a tone from the unit's built-in tone generator, to loopback a tone that may be locally provided at its audio input, or to mute its audio output (Figure 13).

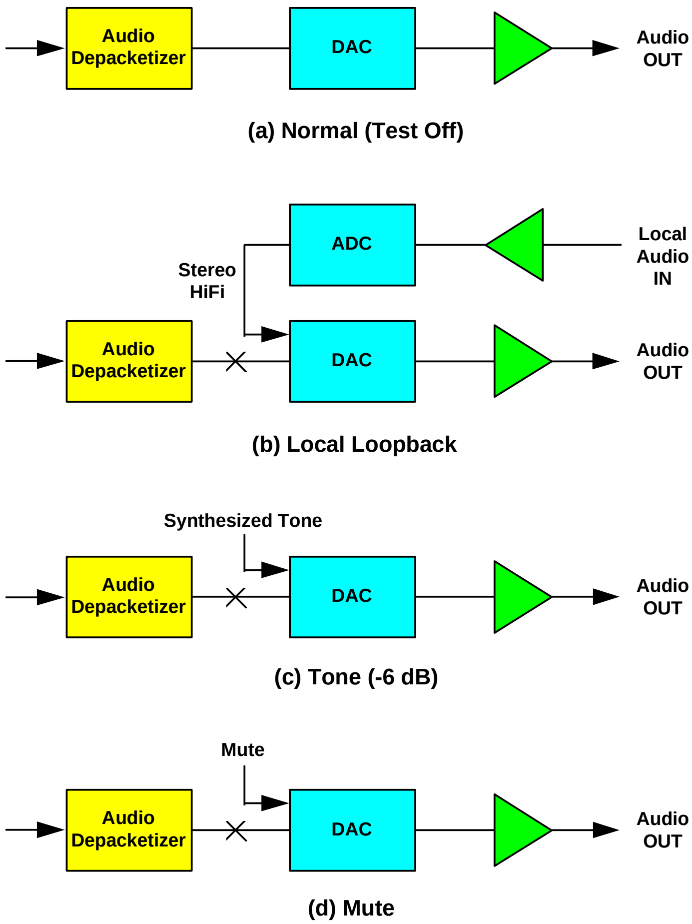


Figure 13: Video-OUT Unit Local Test Modes

Data Test Modes

Any 86412-02 Video I/O unit data port can be set for the Loopback mode. In this test mode, data from a far-end Video I/O unit is looped back to the configured destination (unit and port).

Any data port can be muted, to ensure that no data is outputted to the local port.

Monitoring the Video-IN Unit Vport-UP Signal

The Video-IN unit sends the same signal on both "UP" and "DOWN" Vports. Thus, if an unused (spare) Video I/O unit is available, it may be configured for Video-OUT mode and installed to the local node in order to monitor the signal being sent to the far-end Video-OUT unit. In such set-up, the Vport "UP" of the "local" Video-OUT unit paddleboard should be connected to the Vport "DOWN" of the Video-IN unit paddleboard. Since the local Video-OUT unit is not a part of the video system, its VNA# setting is irrelevant. However, its REMOTE VNA# (Wanted) must be set for the Video-IN unit's VNA#.

Troubleshooting

If an 86412 Video I/O unit is suspected of being defective, substitute a known-good 86412 unit for it and if the unit functions properly, return the original to GE Power Management for repair or replacement. Ensure that the substitute unit is configured correctly. For unit removal and insertion, refer to the procedure *Replacing a Video I/O Unit in a System in Service* in the Installation section.

The following table is intended to provide the user with possible solutions to problems that may be encountered during normal unit operation.

Symptom	Probable Cause / Solution

Loss of multiple video circuits	- In an unprotected (linear) system, this may be caused by a failure.
	- In a protected (ring) system, the maximum traffic margin may be exceeded on certain video hops.
	    - Ensure your video (plus audio) traffic matrix has been carefully planned. Refer to the VMapper manual.
	    - Ensure there is no video hops with exceeded traffic margin for all ring failure scenarios.
	- Ensure that each Video I/O unit in the system has unique VNA#.

Vport Status "Dead" or BER	- Indicates Vport signal is bad;
	    - Verify the unit's Vport UP is properly connected to a VMapper unit's Vport DOWN. Verify the Vport DOWN is assigned.
	    - Verify that VMapper RJ45 connector is OK. Adjacent RJ 45 DOWN connector may be used.
	    - Verify proper continuity on straight-through RJ45 cable.
	    - Verify that Video I/O UP RJ45 connector is OK. Adjacent RJ45 DOWN connector may be used (in conjunction with another Video I/O unit).

Video-IN unit No video is displayed on the local monitor	- Verify the video source is connected to the input port which is displayed in the IN-USE field. - Verify the monitor is properly connected to an output port (BNC or Y/C) and the port is turned ON (the VIDEO OUTPUTS section in TLCI). - Use TLCI to output a COLOUR-BARS test signal to test the monitor (the COLOUR-BARS choice is in the VIDEO-SOURCE FORCE field).

Video-OUT unit
No video displayed on the monitor
	- Verify the monitor is properly connected to an output port (BNC or Y/C) and the port is turned ON (the VIDEO OUTPUTS section in TLCI).
	- Check if the Video-IN unit's input signal is present (no NO-INPUT message reported on either end). Otherwise, use TLCI and do the following:
	  - Verify the video source is connected to the Video-IN unit's input port specified in its VIDEO SOURCE WANTED field.
	  - Verify the Video-IN unit is not forced to select an improper video input (VIDEO SOURCE FORCE field).
	  - Verify the readings in VIDEO SOURCE WANTED fields are same at both ends. Otherwise, another Video-OUT unit in the system requests a higher priority source from the same Video-IN unit, which is itself not connected to a video source.
	- Use TLCI to cause the Video-IN unit to send a COLOUR RAMP test signal to the far-end (the COLOUR-RAMP choice is in the VIDEO-SOURCE FORCE field).
	- Check the Video-OUT unit by forcing it to output COLOUR BARS test signal.

Video-OUT unit Monitor displays unwanted video source	- Verify the monitor is connected to the correct Video-OUT unit - Check the Wanted VNA# - Check if VIDEO SOURCE FORCE is used at the far-end. - Verify the readings in VIDEO SOURCE WANTED fields are same at both ends. Otherwise, another Video-OUT unit in the system requests a higher priority source from the same Video-IN unit.
Video-OUT unit Monitor displays colour bars	- Verify the unit is not in the TEST mode (VIDEO OUTPUTS IN-USE field). Otherwise, the FAIL field is set to CBAR and the bit stream from the far end is lost.
Video-OUT unit Display is frozen	- If the TLCI displays flashing FREEZE message in the BITSTREM section, hit F4 to unfreeze. Otherwise, the FAIL field is set to FRZ and the bit stream from the far end is lost.
Video-OUT unit Monitor displays unwanted video resolution/frame rate	- Verify that the readings in VIDEO QUALITY WANTED fields are same at both ends. Otherwise, another Video-OUT unit in the system requests a higher video quality/frame rate from the same Video-IN unit.

Video is washed out	- At the Video-IN unit if J2 BNC connector is used, verify that the jumper J12 on P12 is placed in extreme right position (so that the incoming video signal is terminated).
Video has blur when motion is fast (at low frame rate)	- Change interlace setting to non-interlaced. Note, this may reduce the video resolution.
Video-OUT unit No signal on the audio output	- Verify the audio source is connected to the Video-IN unit's Audio IN port. - Verify the settings in the AUDIO QUALITY WANTED field are correct (AUDIO is not turned OFF). - Verify the audio is available at the far-end Audio OUT port - Use audio test features at both ends.
Video-OUT unit Improper audio quality	- Verify the settings in the AUDIO QUALITY WANTED field are correct. - Verify the Audio Force is not used at the far end. - Verify the audio at the far-end Audio OUT port has the quality specified in the IN-USE field. - If audio is distorted, check the Overload Margin. If the field displays 0 (more or less frequently), decrease the gain setting or select an appropriate AGC option. See Appendix G. - If audio is noisy, the gain may be too low (Overload Margin may be > 20dB). Use appropriate AGC setting. See Appendix G. - Use audio test features at both ends.
Video-IN unit No signal on the local audio output	- Verify the audio source is connected to the Audio IN port. - Use Audio Channel Test feature at the near end.
Data and/or Contact I/O circuits not working properly	- Verify that the correct sub-board options are used and properly inserted to the main board (if applicable) - Ensure all ports are properly configured - Ensure that there is no multiple ports at the same Video I/O unit set for the same group number - Monitor LAST FROM, AGE and PERIOD fields to determine source and frequency of packets received - Use Line Loopback feature for data ports - Use Force feature for Contact I/O ports

Table 11: Troubleshooting Table

Dumb Terminal Mode

The standard TLCI program provides the necessary information to the user to locate problems; however, the user may use commands in the Dumb Terminal Mode to get more information on the status of unit or the operation of the system. To enter the Dumb Terminal mode and communicate directly with the microprocessor at the DOS Prompt run Access program.

<u>To establish a Dumb Terminal session</u>

1. Connect the TLCI cable to the craft interface port on the Video I/O Unit
2. At the DOS Prompt type CD TLCI (or enter the directory in which Access program resides)
3. Type *ACCESS*
4. Enter <return>
5. Receive a confirmation that a connection is established
6. Enter <return>
7. Receive the prompt *Ok*

The following table lists some of the commands used in Access program for the Video-IN unit.

Command	Displays
Z1	- The unit's mode (Video-IN or Video-OUT) - VNA# assignment (in decimal and hexadecimal) - Supposed Hello-xmt packet period (# in hex * 8 ms) - Actual Hello-xmt packet rate (per 4 seconds) (# in hex) - Hello-xmt packet string - Wanted-rcv packet rate (per 4 seconds); expect two per each Video-OUT unit wanting signal from this Video-IN unit - Wanted-rcv packet string including header address bytes (this unit's VNA#) - The bandwidth/frame bytes for Force, Wanted, and In-Use - The Video Source bytes for Boot, Force, Wanted and In-Use - The audio rate bytes for Force, Wanted and In-Use - The "Min-Free" byte received (* 0.2 Mb/s) - The actual transmitted bit rate for the video packets - The actual transmitted bit rate for the audio packets - Video LOS (input present or not) - The configured unit's location text lines (for closed-caption on-screen display)
Z2	- The unit's VNA# assignment For Vport-UP: - The far-end unit's VNA# (in decimal and hexadecimal) - The received signal status (OK, Loss of Signal, High BER) - BER code violations (cumulative count and current rate)
Z3	Six used ADC signal levels and if in alarm
Z4	- Count of received frames (Vport-UP) with failed check byte - Byte; Bit-0=Link-OK, bit-1=Interlaced, Bit-2=video on-hold - 8 bytes for bad-packet counts for: Unknown, Wanted, Messages, Hello, Link, Video, Audio, Idle - 8 bytes for good-packet counts for:

	Unknown, Wanted, Messages, Hello, Link, Video, Audio, Idle - Final byte for RAM offset address to write next packet.
Z6	- Last two message packets received by the unit - Last two link packets received on the Vport
Z7	Compression information: - Bandwidth and Frame rates In-Use - Binwidth Compression Table in Use - The target per-field compressed size, in words (32-bit words) - The current per-field compressed size, in words (32-bit words) - The current compression multiplier
Z9	The current motion detection information: - The threshold setting - The current motion value - “MOTION-MESSG” after message packet sent, until timed-out - Cumulative count of “MOTION-MESSG” packets - "Alarm" – if enabled and present (until timed-out)
XX14	Displays unit’s SAA7113 Video-IN ADC register bytes.
XX15	Displays unit’s ADV7176 Video-OUT DAC register bytes.
Y1	Displays unit’s ADV601 Video CODEC’s status.
DVER	Displays unit’s firmware version (e.g. 1.09).
DCHK	DCHK calculates & displays the checksums for the flash bytes for the two FPGAs and the two micro codes (Video-IN & Video-OUT). It also checks that the executable Forth code in RAM is identical to the source in ROM.

Table 12: Dumb Terminal Commands for Video-IN Unit

The following table lists some of the commands used in Access for the VIDEO-OUT unit.

Command	Displays
Z1	- The unit’s mode (Video-IN or Video-OUT) - VNA# assignment (in decimal and hexadecimal) - WANTED VNA# assignment (in decimal and hexadecimal) - Hello-xmt packet rate (per 4 seconds) (# in hex) - Hello-xmt packet string - Hello-rcv packet rate (per 4 seconds) (# in hex) - Hello-rcv packet string - Wanted-xmt packet rate (per 4 seconds) (this should be twice the Hello-rcv rate) - Wanted-xmt packet string - Bandwidth/frame bytes for Boot, Wanted, and In-Use (at far end)

	- Video Source bytes for Boot, Wanted and In-Use (at far end) - Audio-Rate bytes for Boot, Wanted, & In-use (at far end) - The current received Video bitstream data rate; should match that transmitted - The current received Audio bitstream data rate; should match that transmitted - A message if loss of video input at far end, or dead video bitstream (above rate=0) - The far-end unit's location text lines (for closed-caption on-screen display)
Z2	- The unit's VNA# assignment (in decimal and hexadecimal) For Vport-UP: - The far-end unit's VNA# (in decimal and hexadecimal) - The received signal status (OK, Loss of Signal, High BER) - BER code violations (cumulative count and current rate)
Z3	Six used ADC signal levels and if in alarm
Z4	- Count of received frames (Vport-UP) with failed check byte - Byte; Bit-0=Link-OK, bit-1=Interlaced, Bit-2=video on-hold - 8 bytes for bad-packet counts for: Unknown, Wanted, Messages, Hello, Link, Video, Audio, Idle - 8 bytes for good-packet counts for: Unknown, Wanted, Messages, Hello, Link, Video, Audio, Idle - Final byte for RAM offset address to write next packet.
Z6	- Last two message packets received by the unit - Last link packet received on the Vport
Z7	- Current frame size (repetitively, until <any key>) (It can be used to detect errors, if used with colour ramp test. For example, 0261 is the NTSC colour-ramp size, so there is an error if 0261 is not received.)
XX14	Displays unit's SAA7113 Video-IN ADC register bytes.
XX15	Displays unit's ADV7176 Video-OUT DAC register bytes.
Y1	Displays unit's ADV601 Video CODEC's status.
DVER	Displays unit's firmware version (e.g. 1.09).
DCHK	DCHK calculates & displays the checksums for the flash bytes for the two FPGAs and the two micro codes (Video-IN & Video-OUT). It also checks that the executable Forth code in RAM is identical to the source in ROM.

Table 13: Dumb Terminal Commands for Video-OUT Unit

8. UNIT PARAMETERS

Vport (electrical)

Connector:	RJ45
Cable type:	CAT 5 (8 conductors)
Cable Max. Length:	50’ or 15m
Line Rate:	16.2 MHz
Format:	Serial Bits, full duplex
Coding Format:	5B:4B
Data Bit Rate:	12.96 Mb/s
Packet Bit Rate:	12.8 Mb/s
Frame Rate:	8 kHz
Packet Rate:	64k packet/s
Packet Size:	25 bytes

Video Input Ports

BNC Input:	Composite PAL or NTSC video Termination Impedance 75Ω or bridging
4-pin mini-DIN INPUT:	Y/C (S-Video) PAL or NTSC Termination Impedance 75Ω OR Two Composite PAL/NTSC video inputs Termination Impedance: 75Ω
Input Level:	Nominal 1Vpp AGC Range +10%,-40%

Video Output Ports

BNC OUTPUT:	Composite PAL or NTSC video Source Impedance 75Ω
4-pin mini-DIN OUTPUT:	Y/C (S-Video) PAL or NTSC Source Impedance 75Ω
Output level:	Nominal 1Vpp (75Ω load)

Latency (end-to-end delay)

At 25 and 30 frames/s:	typical 90 ms ± 15 ms
At 12 and 15 frames/s:	typical 200 ms
At 4 and 5 frames/s:	typical 500 ms
At 1 frame/s:	typical 2 s
At ¼ frame/s:	typical 8 s

Video Frequency Response

Y/C Input:	> 4.2 MHz (for NTSC) Typical ±1dB to 4.5 MHz
BNC Composite Inputs:	> 4.2 MHz except for 3.58 MHz chroma notch 3dB notch bandwidth typ 3.1 to 4.0 MHz

Audio Input Port

Channels:	One (for mono), or two (for stereo), user configurable
Connector:	Miniature Tip-Ring-Sleeve
Input Level:	Maximum (at minimum gain): 5.6 Vpp (2.0 V rms sinewave)
Input Impedance:	10 kΩ unbalanced
Gain choices:	Fixed: 0dB, 3dB, 10dB AGC with max gains: 10dB, 15dB, 20dB, 30dB, 42dB AGC stiffness: gain adjusts so margin(dB) = gain(dB)

Audio Output Port

Channels:	One (for mono), or two (for stereo)
Connector:	Miniature Tip-Ring-Sleeve
Output Level:	Full Scale: 4.0 Vpp (1.4 V rms sinewave)
Output Impedance:	10 Ω unbalanced Minimum load impedance: 50 Ω

Audio Latency

100ms ± 15ms (for "lip-sync" with unit's 30 frame/s video)

Audio Frequency Response

±0.5dB, 20Hz to 0.45*F_s (20 Hz to: 14.5kHz, 9.7kHz, 7.2kHz, 4.8kHz)

Audio Distortion

Linear (14-bit) coding:	<0.05% (< -66dB)
μ-law (7-bit) coding:	approximately 1%

Audio Signal/Noise

Dynamic range, 0 to 10 dB gain: 77 dB A-Weighted (typ)
20 dB gain: 74 dB
30 dB gain: 66 dB
40 dB gain: 56 dB

Audio Test-Tone

Linear Coding:	Sine Wave, 2.0 Vpp, 750mV rms
μ-law Coding:	Pseudo Sine-Wave, 2.0 Vpp, 550mV rms
Frequency:	(=$F_{sampling}$/32): 988Hz, 658Hz, 494Hz, 329Hz

Common Data Port Specifications

(Applicable to RS-232 and RS-422/485 ports)

Data rate: 300, 1200, 2400, 4800, 9600, 19,200, 38,400, 115,200 b/s
Input Tolerance: ±5% for up to 2000-byte bursts;
±0.9% indefinitely.
Output rate is 0.9% fast (to tolerate normal sources indefinitely).

Data Format: Asynchronous serial data
Start bit, 8 data bits, optional parity bit, stop bit(s)
Parity bit: even, odd, or none (Note: received errors are detected at XMT-IN, but not propagated to RCV-OUT)
Stop bits: 1, 1.5, 2 or more accepted at XMT-IN; 1 or 2 transmitted to RCV-OUT

Latency:

a) *Packetizing Delay*

For a message comprising N bytes:

Delay = M + “Timeout” time

Where: M = duration of N bytes for N = 1 to 16, and
M = duration of 16 bytes for N greater than 16.

For example, for a 41-byte packet at 38.4 kb/s, no parity, 1 stop-bit, “Timeout” = 1 char:
Packetizing delay = 17 char periods = 17 * 10 / 38.4k = 4.4 ms.

b) *Transport Delay*
Normally negligible, but could be a few milliseconds per node if the inter-node VMapper bandwidth usage is over 90%.

"Main-Board" RS-232 Data Ports

(See *Common Data Port Features* above)

Control lines: None

"Sub-Board" RS-232 Data Ports (Code F)

(See *Common Data Port Features* above)

Control lines: Control-IN: Unused
Control-OUT[1]: Configurable for "ON" or "Auto-enable". In Auto-enable mode, it is normally OFF but ON from start of start-bit to end of stop-bit + "hold-time") with configurable hold-times: 0, 0.1, 0.2 …1.4 char.

RS-422/485 Data Ports (Code D)

(See *Common Data Port Features* above)

Control lines: None

Interface Mode: RS-422 (4-wire)
RS-485 FDX (4-wire)
RS-485 HDX (2-wire)

Data-input mute: For 2-wire RS-485 interfaces, transmitted characters will normally be "echoed". To avoid this echo, the unit can be configured to "HDX" which mutes the receive path during transmitted characters (and for the configured "hold-time").

Data-output enable: Configurable for "Enabled" or "Auto-enable"
"Auto-enable" mode means that the driver is tri-stated during idle, and enabled from the start of a character's start-bit to the end of a "hold-time" after the end of the stop-bit. Each channel hold-time is configurable from 0.0 to 1.4 char (in 0.1 char steps).

Idle-state: In order to hold a tri-stated connection at "idle", weak resistors are provided on the data output pair:
10k to ground on the A(-) output
10k to +5V on the B(+) output

[1] Depending on the actual application (DCE/DTE, usage of auto-enable feature etc.), the Control-OUT line may be used to provide various control signals (e.g. RTS, CTS, RLSD).

Contact-IN Sub-board (Code C configured for 'Inputs')

Number of inputs:	4
Resistance for ON:	<300 Ω @ 5mA
Resistance for OFF:	> 50 kΩ @ 5 V
External contacts:	Floating, < 100 Ω (contact must be able to sink 7 mA from +5 V source, or, if grounded, external ground must be within 1V of unit ground)
Input deglitching:	Configurable from 2 ms to 3 minutes Note 1: Only one time value is set per sub-board and it is applied to all four inputs. Note 2: No update is sent until all 4 inputs are stable (for this deglitch time.

Contact-OUT Sub-board (Code C configured for 'Outputs')

Number of outputs: 4

Internal contacts:	Floating
On Resistance:	<40 Ω
Max Load Current (continuous):	100 mA
Max Load Current (momentary):	250 mA
Off Resistance:	>10 MΩ
Max Load Voltage:	350V DC or peak AC

C. I. Port

Connector:	RJ11
Rate:	9600 baud
Format:	RS-232
Character length:	1 start bit, 8 data bits, 1 stop bit

Pin connections:	Pin-1 Unused output (-9V) Pin-2 Ground Pin-3 Data output Pin-4 Data input Pin-5 Unused (input) Pin-6 Unused output (-9V)
Handshaking:	HC16 CPU's tasker routine polls the SCI register for received bytes. The SCI does not buffer the bytes. Therefore, the user must wait for each byte to be echoed.

9. SPECIFICATIONS

Physical

The Video I/O unit is housed in a standard TN1Ue shelf (Common or Expansion) and occupies a single shelf slot with the following dimensions:

1)	Height:	89 mm	(3.5 inches)
2)	Width:	58 mm	(2.27 inches)
3)	Depth:	203 mm	(8 inches)
4)	Weight:	210 grams	(7 oz)

Electrical

The input power requirements for the Video I/O unit are:

1) Voltage: 5.2 VDC ±5%
   This voltage is supplied from the 86430 Equipment Shelf.

2) Current (typical):
   86412-01 (087-86412-01 board only):
   - Video Monitor outputs OFF: 570mA
   - BNC output ON: 595mA
   - Y/C output ON: 620mA
   - Both Outputs ON: 645mA

   86412-02:
   - Basic audio (087-86412-02) board: add 100mA, plus:
     - Per Closed contact (IN or OUT): 7mA (max 16x7=112mA)
     - Per Open contact (IN or OUT): 0mA
     - Per RS-232 sub-board: 1mA
     - Per RS-422/485 sub-board: 4mA

   86412-73 paddleboard: 50mA

3) Power Consumption: 3.0 to 4.1 W (typical); 4.5 W (max)

Environmental

1) Temperature:

Guaranteed Performance:	-10 to +60°C	(+14 to +140°F)
Storage:	-40 to +70°C	(-40 to +158°F)

2) Relative Humidity: 5 to 95% @ 40ºC, non-condensing, 10 days

3) Shipping Altitude: 15,000 meters (50,000 feet)

Mechanical

1) Vibration: per MIL-STD 810E and Bellcore TR-NWT-000063 (GR-63-CORE)

2) Bench Handling: per TS 1-00446.06, IEC 68-2-27 and IEC 68-2-55

EMC

Meets the following specifications:

ETSI EN 300386-2
CENELEC EN 50082-2

SWC transient protection (surge-absorption) devices on:

Video-inputs
Video-outputs
Data inputs
Data outputs

Safety

Meets IEC 60950:1991 including amendments A1, A2, A3 and A4.

Reliability

The calculated Mean Time Between Failure (MTBF) as per Bell technical advisory TR-NWT-000332 for the Video I/O unit is:

MTBF = 224,000 Hours (25 Years) for 86412-01
MTBF = 203,000 Hours (23 Years) for 86412-02

10. ORDERING INFORMATION

This section covers the ordering information for a single 86412 Video I/O unit and is not intended to replace standard engineering documentation or drawings.

Please contact the Account Manager for your area regarding ordering the 86412 Video I/O unit.

Equipment and Option Code List

Equipment	Option Code	Description
86412	-01	Provides encoding and decoding functions for transmission of one video signal through a TN1Ue network.
86412	-02	Provides the above plus two audio and two RS-232 data interfaces. May be optionally equipped with up to 4 sub-boards (Code C, Code D and/or Code F).
86412	Code C	Provides Contact I/O sub-board for 86412-02 unit.
86412	Code D	Provides RS-422/485 data sub-board for 86412-02 unit.
86412	Code F	Provides RS-232 data sub-board for 86412-02 unit.
86412	-73	Main Paddleboard Assembly. Provides customer connections to the unit.

Table 14: Equipment and Option Code Table

APPENDIX A

VIDEO QUALITY CODES

Video Data-Packet Rate			INTERLACED								NON-INTERLACED							
		Frames/s PAL	25	12	8	4	2	1	½	¼	25	12	8	4	2	1	½	¼
		Frames/s NTSC	30	15	10	5	2	1	½	¼	30	15	10	5	2	1	½	¼
nominal	Actual max	1st nib \ 2nd nibble	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
10 Mb/s	10.24 Mb/s	F																
8 Mb/s	8.53 Mb/s	E																
6 Mb/s	6.40 Mb/s	D																
5 Mb/s	5.12 Mb/s	C																
4 Mb/s	4.27 Mb/s	B																
3 Mb/s	3.20 Mb/s	A																
2.5 Mb/s	2.56 Mb/s	9																
2 Mb/s	2.13 Mb/s	8																
1.5 Mb/s	1.60 Mb/s	7																
1 Mb/s	1.06 Mb/s	6																
600 kb/s	640 kb/s	5																
400 kb/s	427 kb/s	4																
200 kb/s	213 kb/s	3																
100 kb/s	106 kb/s	2																
50 kb/s	53 kb/s	1																
25 kb/s	26 kb/s	0																Z

Notes:

Z = Zero bit-rate
White cells are preferred choices.
Black cells below these cannot be compressed enough to the specified frame-rate (no enough bandwidth).
Black Cells above these will run at a higher frame-rate (wasting bandwidth).
Blue cells are reserved (future choices).

Examples:

DF= 6 Mb/s interlaced 25 frames/s (PAL) (30 frames/s for NTSC)
87 = 2 Mb/s non-interlaced 25 frames/s (PAL) (30 frames/s for NTSC)
22 = 100 kb/s non interlaced 1 frame/s (both PAL and NTSC)

APPENDIX B

VIDEO SOURCE CODES

00 = No preference

01 = Composite Video using BNC input

02 = Composite Video using the Y/C connector's chroma input (red on Belden)

03 = Composite video using the Y/C connector's luma input (green on Belden)

04 = Y/C (S-Video) video using the Y/C input

05 = Composite Video using BNC input with no colour

06 = Composite Video using the Y/C connector's chroma input with no colour

07 = Composite Video using the Y/C connector's luma input with no colour

8X = Test Mode
Colour Bars to local output
Colour-Ramp (Video-IN unit only) to far-end Video-OUT unit.

APPENDIX C

AUDIO QUALITY CODES

The Audio Quality Byte consists of the following information:

Bits [7:6]	=	00	Fs=10.5kHz; Frequency Response=5kHz
		01	Fs=15.8kHz; Frequency Response=8kHz
		10	Fs=21.1kHz; Frequency Response=10kHz
		11	Fs=31.6kHz; Frequency Response=15kHz
Bit [5]	=	0	7-bit quantizing (μ-law, LoFi)
		1	14-bit quantizing (linear, HiFi)
Bit [4]	=	0	Mono (left channel only)
		1	Stereo
Bits [3:1]	=	000	Fixed Gain 0dB
		001	Fixed Gain 3dB
		010	Fixed Gain 10dB
		011	AGC with max gain 10dB
		100	AGC with max gain 15dB
		101	AGC with max gain 20dB
		110	AGC with max gain 30dB
		111	AGC with max gain 42dB
Bit [0]	=	0	Audio OFF
		1	Audio ON

Depending on the above selections, the equivalent audio bit rate (after packetizing) can be calculated using the following formula:

*Bit rate = [Fs] * [# of channels] * [# of quantizing bits] * [8/7] * [25/23]*

Where

Fs = Sampling frequency
# of channels = 1 (for Mono) or 2 (for Stereo)
# of quantizing bits = 7 (for LoFi) or 14 (for HiFi)

A table of typical bit rates (as per TLCI readings) is in Appendix D.

APPENDIX D

AUDIO BIT RATES

The following table provides typical audio bit rates (as per TLCI readings). For planning purposes, reserve 10% extra for the audio packet overhead bytes.

Frequency response	Quantization	Mono/Stereo	Audio bit rate (typical)
5 kHz	7 bits (LoFi)	Mono	92 kb/s
5 kHz	7 bits (LoFi)	Stereo	184 kb/s
5 kHz	14 bits (HiFi)	Mono	184 kb/s
5 kHz	14 bits (HiFi)	Stereo	368 kb/s
8 kHz	7 bits (LoFi)	Mono	138 kb/s
8 kHz	7 bits (LoFi)	Stereo	276 kb/s
8 kHz	14 bits (HiFi)	Mono	276 kb/s
8 kHz	14 bits (HiFi)	Stereo	552 kb/s
10 kHz	7 bits (LoFi)	Mono	184 kb/s
10 kHz	7 bits (LoFi)	Stereo	368 kb/s
10 kHz	14 bits (HiFi)	Mono	368 kb/s
10 kHz	14 bits (HiFi)	Stereo	736 kb/s
15 kHz	7 bits (LoFi)	Mono	276 kb/s
15 kHz	7 bits (LoFi)	Stereo	552 kb/s
15 kHz	14 bits (HiFi)	Mono	552 kb/s
15 kHz	14 bits (HiFi)	Stereo	1105 kb/s

APPENDIX E

HELLO PACKETS' BIT RATE

Video Data – Packet Rate		Hello Packets	
Nominal	**Actual max**	**Period**	**Bit Rate**
10 Mb/s	10.24 Mb/s	120ms	1667 b/s
8 Mb/s	8.53 Mb/s	120ms	1667 b/s
6 Mb/s	6.40 Mb/s	120ms	1667 b/s
5 Mb/s	5.12 Mb/s	120ms	1667 b/s
4 Mb/s	4.27 Mb/s	120ms	1667 b/s
3 Mb/s	3.20 Mb/s	120ms	1667 b/s
2.5 Mb/s	2.56 Mb/s	120ms	1667 b/s
2 Mb/s	2.13 Mb/s	120ms	1667 b/s
1.5 Mb/s	1.60 Mb/s	120ms	1667 b/s
1 Mb/s	1.06 Mb/s	120ms	1667 b/s
600 kb/s	640 kb/s	120ms	1667 b/s
400 kb/s	427 kb/s	250ms	800 b/s
200 kb/s	213 kb/s	500ms	400 b/s
100 kb/s	106 kb/s	1 s	200 b/s
50 kb/s	53 kb/s	1.8 s	110 b/s
25 kb/s	26 kb/s	1.8 s	110 b/s

Note: *The above table is applicable to Video-IN units only. For Video-OUT units, the period is set to 250 ms for a burden of 800 b/s per unit.*

APPENDIX F

ON-SCREEN INFORMATION

If the video monitor supports a "closed-caption" feature, this may be used for:

- *Displaying the name of the camera being viewed*

  Two lines (up to 32 characters in each line) can show the Camera ID on the top or the bottom of the display. The Camera ID is user defined in the Video-IN unit TLCI screen.

- *Displaying alarm messages*

  The messages appear flashing and centred in the third line of the screen.

For Video-IN units (on a local monitor), the following alarm messages may appear (in priority order):

(1) "VPORT-UP DEAD" – Link to the VMapper unit is bad.

(2) "LOSS OF VIDEO INPUT" – There is no signal on the selected video connector.

For Video-OUT units, the following messages may appear (in priority order):

(1) "[FROZEN]" – User has commanded the unit to freeze the display.

(2) "VPORT DEAD" – Link to the VMapper unit is bad.

(3) "NO HELLO PACKETS FROM FAR-END" – The far-end unit may be missing.

(4) "LOSS OF VIDEO BITSTREAM" – No video packets are received from the far-end unit.

(5) "LOSS OF VIDEO INPUT AT FAR-END" – There is no signal at the selected far-end unit's video input connector.

(6) "MOTION" – The motion threshold has been exceeded at the far-end unit, and far-end motion-alarm is enabled.

***Note**: Currently, the support of closed-caption services in countries using PAL standard is very poor.*

APPENDIX G

AUDIO LEVEL CONSIDERATIONS

Introduction

The 86412-02 Video I/O unit's audio circuits, when set for 0dB input "gain", provides its maximum input overload capability (of 5.6Vpp), its maximum output capability of 4.0Vpp, and an overall gain of -3dB.

The input "gain" may be configured to +3dB for an overall unity gain, with a lower input overload level of 4.0Vpp.

The input "gain" may be also configured to +10dB for an overall 7dB gain, with a lower input overload level of 1.8Vpp.

For lower input levels, the unit's "AGC" mode may be used; with maximum input "gain" limits configurable to 10, 15, 20, 30 or 42 dB.

The following is a guide to the levels that may be expected from various audio sources.

DVD Video-disk Players

DVD players seem to be consistent in having a maximum output of 2Vpp. It should therefore be safe to set the unit for a fixed 3dB input "gain" to provide an overall unity gain and a minimum overload margin of 6dB.

Alternately, in view of the wide dynamic range often found on DVD and CD disks, it may be preferred to engage the unit's AGC mode with a 10 or 15 dB max setting.

VCR Players

The levels on Videocassettes seems to be more variable. For example, the peak levels found from a Sony VCR during one 2-hour movie were 2.5Vpp; but prior to the movie the tape had a trailer promotion with peak levels of 4.0Vpp. A Panasonic VCR playing the same tape outputted levels about 10% higher.

With a fixed "gain" setting of 0dB, the 86412-02 Video I/O unit would handle all the above with no overload, and 3dB overall loss (which should not be of any concern). Alternately the AGC mode could be considered.

Surveillance Camera Microphones

The AGC mode, with its 42dB gain range makes sense to handle the wide range of levels encountered in these applications.

AGC Characteristics

The AGC circuit adjusts the input gain to maintain the average overload margin (in dB) in each measurement period (a few ms) at approximately one half the current "gain" setting (in dB). Note that this is not the same as the overload margin displayed on TLCI, the later is the worst-case overload margin with a slow (several second) decay time.

The acceptability of the sound with AGC enabled is very dependant on the audio material and the listener’s sensitivity to the resultant artifacts. The latter includes a "breathing" or "pumping" quality to the sound, plus low-level "clicks" caused by the instantaneous gain changes (of 1.5dB, being implemented digitally).

APPENDIX H

MESSAGE PACKET FORMAT

Message packets are used for communication between units in the TN1Ue video system. They comprise the following 25 bytes:

Bytes#1,2 = 110 + 13-bit VNA# of destination
Bytes#3,4 = abc + 13-bit VNA# of source, where abc = destination unit's port ID.

abc = 000 for messages to the destination unit's micro & needing a response
100 for messages to the destination unit's micro & not needing a response
010 for messages to the destination unit's main-board RS232#1 data port
110 for messages to the destination unit's main-board RS232#2 data port
001 for messages to the destination unit's sub-board#1 port
101 for messages to the destination unit's sub-board#2 port
011 for messages to the destination unit's sub-board#3 port
111 for messages to the destination unit's sub-board#4 port
(Note that the abc bits are in reversed order to normal.)

<u>For abc=000 messages</u> (request messages to a micro):

For Byte#5[7:5] = 111 (Source Port = micro):

Byte#5[4:3] = Unused

Byte#5[2:0] (Type) = 00 for request to read 20 bytes of RAM
01 for request to read 20 bytes of FLASH
02 for request to change bytes, with acknowledge
03 for request to change bytes, no acknowledge

For Type=00:
Byte#6 = ¼ offset from start of RAM (e.g. 02 for 8008..801B)
Bytes#7..20 unused

For Type=01:
Byte#6 = ¼ offset from start of FLASH (e.g. 03 for 020C..021F)
Bytes#7..20 unused

For Type=02,03:
Byte#6 = ls-byte of dest-VNA# (security check)
Bytes#7,8,9,10=16-bit address of 1st byte to change (*Note 1*)
(Currently only RAM changes are supported.)

Bytes#11,12 = number (1..6) of bytes to change (*Note 1*)
Bytes#13,14 = new value for 1st of bytes to change (*Note 1*)
Bytes#15,16 = new value for 2nd of bytes to change (*Note 1*)
Etc.
Bytes#23,24 = new value for 6th of bytes to change (*Note 1*)

Note 1: Each byte is preceded by its complement (security check).

For Byte#5[7:5] ≠ 111 (Source Port = data port):

Byte#5[4:3] = 00 (Unused)

Bytes#6,7,8 = Unused

Byte9[7:3] = Unused

Byte#9[2:0] (Type) = 00 for request to read 16 bytes of RAM
01 for request to read 16 bytes of FLASH
02 for request to change bytes, with acknowledge
03 for request to change bytes, no acknowledge

For Type=00:
Byte#10 = ¼ offset from start of RAM (e.g. 02 for 8008..801B)
Bytes#11..20 unused

For Type=01:
Byte#10 = ¼ offset from start of FLASH (e.g. 03 for 020C..021F)
Bytes#11..20 unused

For Types=02, 03:
Byte#10 = ls-byte of dest-VNA# (security check)
Bytes#11,12,13,14=(16-bit) address of 1st byte to change (*Note 2*)
(Currently only RAM changes are supported.)
Bytes#15,16 = number (1..4) of bytes to change (*Note 2*)
Bytes#17,18 = new value for 1st of bytes to change (*Note 2*)
Bytes#19,20 = new value for 2nd of bytes to change (*Note 2*)
Etc.
Bytes#23,24 = new value for 4th of bytes to change (*Note 2*)

Note 2: Each byte is preceded by its complement (security check).

<u>For abc=100 messages</u> (response messages to a micro):

- For responses to Type=00 & 01 requests:
  Bytes#5..24 = 20 bytes read from memory
- For responses to Type=02 requests:
  Bytes#5..24 = AA if request was received OK (all security checks passed)
  BB if not OK

- No responses are sent for Type=03 requests.
- For responses to Type=04…FF requests:
  Bytes#5..24 = DD (Unknown request type)

For other messages (abc=x10, xx1) (messages to a unit's port):

Byte#5[7:5] = source unit's port ID:

000 for messages from source unit's micro (requested data or MOTION alert; see byte#6)
100 for messages from source unit's micro (response wanted, this is not expected !!!)
010 for messages from source unit's main-board RS232#1 data port
110 for messages from source unit's main-board RS232#2 data port
001 for messages from source unit's sub-board#1 port
101 for messages from source unit's sub-board#2 port
011 for messages from source unit's sub-board#3 port
111 for messages from source unit's sub-board#4 port

(Note that the abc bits are in reversed order to normal.)

Message packets to a unit's port carry 16 information bytes arranged in 4 "quad"-byte groups. Byte#5[4..0] tells the receiving unit how many (1..16) information bytes to use:

Byte#5[4:3] = N = 0..3 for number (1..4) of bytes used in last "quad" in packet
Byte#5[2] = 0
Byte#5[1:0] = M = 0..3 for number (1..4) of "quad" bytes used in packet

(Number of information bytes used in the packet is 4M+N+1.)

For Byte#5[7:5] = 000:

Byte#6 = 00 (flags packet as packet of requested data), **OR**
= 01 (flags packet as a "motion" message packet)

For Byte#5[7:5] ≠ 000:

Byte#6 is unused (spare byte for future use; will encode some of the source's configuration fields).

Bytes #7,8 are unused (usually CA FE).

Bytes # 9..12, 13..16, 17..20, 21..24 comprise the 16 information bytes (the 4 quads).

Byte#25 is a checksum byte. (Packets received with errors are rejected.)

Note: *If a unit's data port is configured to the "+HEADERS" mode, Bytes#1..8 are outputted ahead of the information data bytes (so the recipient can determine the source of data).*

APPENDIX J

MOTION MESSAGE PACKETS

A Video-IN unit can be set to send an alert message (motion message) to one or more 86412-02 Video I/O unit data ports (i.e. to external monitoring computers connected to them).

Motion messages are sent in "Message" packets. The message is repeated approximately every two seconds until the motion ceases (drops below threshold).

Motion Message Packet Format

Byte#1[7:5] = 110
Byte#1[4:0] + Byte#2 = motion-message destination VNA#
Bytes#3,4 = motion-message destination PORT# and its source VNA#
Byte#5 = 1B (source=micro + use 16 bytes following the 8-byte header)
Byte#6 = 01 (message packet type=01 for “motion”)
Bytes#7,8 = unused (actually set to CA FE but ignore them)
Byte # 9 = motion-message repeat period (currently defaulted to 2 sec)
Byte # 10 = 77 (spare)
Bytes # 11,12 = motion threshold
Bytes # 13,14 = current motion value
Bytes # 15,16 = number of motion messages sent since last reset
Bytes # 17…24 = 99 (8 spare bytes)

(See Appendix H for generic message packet format.)

APPENDIX K

GUIDELINES FOR SELECTING PROPER ADDRESS MODE FOR DATA AND CONTACT I/O PORTS

The following is the information on proper selection of port Address Mode for some typical applications.

Fixed Point-to-Point Paths (TLCI-configured)

1. Contact-IN to Contact-OUT

This application is for a contact-closure at one site being replicated at another site (to turn on a lamp, bell, relay etc.).

The Contact-IN port is set to ASSIGNED and far-end VNA# and Port#.

The Contact-OUT port is set either to ASSIGNED and far-end VNA# and Port# or ECHO (with address set to "none").

2. Data to Data

This application is for a dedicated data link between two sites. Both ports are set to ASSIGNED and respective far-end VNA# and Port# (although, if one site is a “slave” device, it is easier to set that site to ECHO mode).

3. Contact-IN to Data

This application is for a dedicated link between two sites, with a computer at one site monitoring the status of contacts at the other site. The computer will receive packets of data and must process the data to recover the status of the four Contact Inputs.

Both ports are set to ASSIGNED address mode and respective far-end VNA# and Port#.

4. Data to Contact-OUT

This application is for a dedicated link between two sites, with a computer at one site controlling the status of contacts at the other site. The computer will transmit one byte of data to control the status of the four contact outputs.

The Contact-IN port is set to ASSIGNED and far-end VNA# and Port#. The Contact OUT port is set to OFF.

Fixed Point-to-Multipoint Paths (TLCI-configured)

General rules:

a) Use Group feature for all point-to-multipoint circuits
b) Use a separate Group# for each such service
c) If there is more than one "RTU" at a remote site (for the same point-to-multipoint circuit and not on one RS-485 multi-drop cable), use another Video I/O unit
d) For the "MTU" unit, set its port to ASSIGNED and Group#
e) For the "RTU" units, set the connected port to ECHO and Group#

Note that, in the above list, terms "MTU" and "RTU" refer not only to data ports but also to Contact-IN and Contact-OUT sub-boards respectively (if used in a similar manner).

1. Contact-IN to several Contact-OUT sites

This application is for a contact-closure at one site being replicated at several other sites (to turn on lamps, bells, relays etc.).

The Contact-IN port is configured to ASSIGNED and a "group" address while the Contact-OUT ports are configured for ECHO and the same group address.

Note*: Regardless of its address mode setting, a Contact-OUT port will always return a packet with its current contact states to the sender to confirm that the sender's message has been received (note that there may not be a match if the Contact-OUT port is in the Force state). This can be utilized in applications where the sender is a computer (connected to a data port). However, if the sender is a Contact-IN port, the return packet will not be processed but will not cause any harm either.*

2. Point-to-Multipoint Data: Master unit polling Remote units

This application is for a Control and Data acquisition network comprising several sites.

The Master unit's data port should be configured to ASSIGNED and a "group" address while the Remote units' ports should be configured for ECHO and the same group address.

3. Point-to-Multipoint Unidirectional Data

This application is for a multicast point-to-multipoint unidirectional data circuit comprising several sites.

The transmit unit's data port should be configured to ASSIGNED with a "group" address while the receive units' ports should be configured for ECHO and the same group address. Note that a data port in ECHO mode will not send any messages as long as there is no activity on its DATA-IN port. Therefore, in unidirectional applications, these ports will not generate any excessive traffic in the video system.

4. Point-to-Multipoint Data: "Data Partyline" Circuits

This is for applications where any unit in a group simultaneously sends data to all other units in a group.

The respective ports should be configured to ASSIGNED and the same "group" address.

Note that such system must be designed to handle any expected collisions (as in an Ethernet LAN).

5. Contact-IN to Data at several sites

This application is for the monitoring of contacts at one site, by more than one other site (e.g. when a backup monitoring site is used).

The Contact-IN port would be configured to ASSIGNED with a "group" address while the Data ports would be configured for ECHO and the same "group" address. The computers will receive packets of data and must process the data to recover the status of the four Contact Inputs.

Note that there may be some other (Data or Contact-IN) ports that are set for ASSIGNED and the same "group" address to report to the same Data ports the Contact-IN port is reporting to. In that case all "transmit" ports will be receiving messages from other "transmit ports" but this will not cause any problems since the receive paths of these circuits are not used.

6. Data to several Contact-OUT sites

This application is for a computer at one site to control contacts at several other sites.

The Data port would be configured to ASSIGNED with a "group" address while the Contact-OUT ports would be configured to ECHO and the same "group" address.

The computer will transmit one byte of data to control the status of the four Contact Outputs.

***Note**: A Contact-OUT port returns a packet with its current contact states to the sender (computer connected to the far-end data port) to confirm that the sender's message has been received. Note that there may not be a match if the Contact-OUT port is in the Force state.*

Computer-Controlled-Path Systems (DYNamic mode)

This application is for systems comprising a Control-Centre Computer (CCC) monitoring and/or controlling a group of remote devices, such as:

- Video surveillance systems with controllable (PTZ) cameras (e.g. Camera Cameleon™ system)
- Security systems with intrusion and alarm sensors (e.g. PIR)
- SCADA systems (an MTU with many RTUs)
- VMS (Variable Message Sign) systems for highways
- Municipal Traffic Light Monitoring and Control systems

A Video I/O unit data port in "DYN" mode may be used to interface a CCC supporting any (or all) of the above-mentioned applications. The user is referred to Appendix L for more details.

APPENDIX L

CONTROL CENTRE COMPUTER (CCC) APPLICATION EXAMPLES

(Using a Multi-Purpose Central Computer, e.g. Camera Cameleon™)

This appendix provides some application and configuration examples for establishing communication between a multi-purpose Control-Centre Computer (CCC) at one TN1Ue site and various remote devices (e.g. cameras, VMSes, RTUs, contact inputs, contact outputs) at remote TN1Ue sites using Data and Contact I/O ports on 86412-02 Video I/O units.

Depending on the application(s) it is supposed to support, a multi-purpose Control-Centre Computer (CCC) may be connected to either an 86412-02 Video I/O unit data port (preferred) or an 86412-0X Video I/O unit Craft Interface.

A CCC connected to an 86412-02 Video I/O unit data port can be used to:

- Support point-to-point and point-to-multipoint data applications
  - Send commands to, and receive responses from, one or more remote data ports (connected to cameras, VMSes, RTUs, etc.)
- Monitor/control contact inputs/outputs (e.g. traffic light monitoring and control)
  - Control local and/or remote contact-outputs
  - Read local and/or remote contact-inputs
  - Monitor changes at local and/or remote contact-inputs (e.g. PIR motion sensors)
- Monitor “MOTION” alerts at Video-IN units
- Read/write data from/to Video I/O units' RAM memory and read data from Video I/O unit's Flash memory (for video network management) in order to:
  - Determine the video network topology (location and ID of all Video I/O and VMapper units in the video network)
  - Determine status and configuration of any Video I/O or VMapper unit
  - Set any Video-OUT unit for a signal from a desired video input at any Video-IN unit, with desired video quality
  - Change the video quality for any video circuit
  - Change the video quality for any video circuit

The communication between the CCC and the local 86412-02 Video I/O unit data port can be through either RS-232 or RS-422/485 data port using an asynchronous data rate from 300 b/s to 115.2 kb/s.

A CCC connected to an 86412-0X Video I/O unit Craft Interface can be used to:

- Read/write data from/to Video I/O units' RAM memory and read data from Video I/O unit's Flash memory (for video network management) in order to:
  - Determine the video network topology (location and ID of all Video I/O and VMapper units in the video network)
  - Determine status and configuration of any Video I/O or VMapper unit
  - Set any Video-OUT unit for a signal from a desired video input at any Video-IN unit, with desired video quality
  - Change the video quality for any video circuit
  - Change the video quality for any video circuit

The communication between the CCC and the local Video I/O unit Craft Interface is fixed at 9.6 kb/s (asynchronous RS-232).

The information below is applicable only to applications where CCC connects to an 86412-02 Video I/O unit data port. For more information on data formats used for "CCC to Craft Interface" applications, please contact the vendor.

Communication Methods

In general, there are two methods used by a CCC for selecting the desired remote device, whether for control or interrogation (monitoring):

(a) Broadcast or Multicast

This method assumes that many remote devices receive the same outgoing messages. Each message has an address field. Each remote device has a unique address, and responds when polled.

Examples include:

- Control systems for cameras (or other devices) with configurable addresses
- SCADA systems using point-to-multipoint data links

(b) Point-to-Point

This method assumes that each remote device only receives messages for it. The network comprises switches so that an outgoing message can be delivered to a specific remote device.

The Control-Centre Computer can issue an “address” command to set up these switches appropriately for each message.

Examples include:

- Control systems for cameras (or other devices) without configurable addresses
- SCADA systems using point-to-point data links
- VMS systems for highways
- Municipal Traffic Light monitoring and control systems (using Contact I/O ports at far end)

A Video I/O unit data port in "DYN" mode may be used to interface a CCC supporting any (or all) of the above-mentioned applications.

Configuring CCC-to-Video-I/O-Unit Interface

To provide proper connection between a Control-Centre Computer and local Video I/O unit data port, do the following:

- Connect the desired Control-Centre Computer's COM port (e.g. Camera Cameleon™ COM1 port) to an RS-232 port (e.g. RS232#1) on a collocated Video I/O unit.

- Configure the CCC COM port and this Video I/O unit's RS232#1 port for:
  - Same data rate (any rate supported by both CCC and Video I/O unit data port, from 300 b/s to 115.2 kb/s)
  - No parity (unless wanted)

- Configure the local Video I/O unit's RS-232#1 port for:
  - “Path-Address” = DYN
  - Bytes <DYN$[1]> <DYN$[2]> for desired “escape” bytes (see Section 4)
  - Idle-timeout (e.g. 8 char (0.7 ms for 9600 kb/s))

Message Format from CCC to Video I/O Unit Data Port

<pause> <DYN$[1]> <DYN$[2]> <DYN$[3]> <DYN$[4]> <DATA…>

where:

<pause> is an idle time (must be longer than the configured idle-timeout)

<DYN$[1]> <DYN$[2]> are the two TLCI-configured “escape” bytes
<DYN$[3]> <DYN$[4]> are the desired PORT+VNA# (3 bits + 13 bits)

(See *"Computer-controlled Addressing"* in Section 4 for specifications on these bytes.)

<DATA…> is a string of bytes to be sent to PORT+VNA#.

Message Format from Video I/O unit to CCC

The incoming messages (from the remote units) will be passed to the CCC in the order received.

If a camera, VMS, RTU etc. generates more than 16 bytes at a time, the data will be broken into 16-byte chunks for transport in the 25-byte packet format used in the Video network. It is thus possible that the CCC may receive messages interleaved with other messages, but should be able to separate them correctly using the accompanying header information (see “+Headers” in Section 4).

Also, the "+Headers" feature is essential for security-monitoring applications where autonomous packets (carrying input-contact changes or motion alerts) can arrive from anywhere and at any time.

Following are some examples illustrating the use of a CCC to control and monitor remote devices.

CCC "DYN" Example: Data Link

This is an example of using a CCC connected to RS232#1 port of the Video I/O unit with VNA#=4011(FAB/h) to send a command to, and receive a response from, a remote data terminal (e.g. camera, VMS, RTU etc.) connected to port RS232#2 at Video I/O unit with VNA#=4010 (FAA/h).

Configuration of Local Video I/O Unit (VNA# = FAB/h)

Flash bytes (TLCI-configurable):

0208,0209 = 0FAB	Unit’s VNA#
0220 = 63	RS232#1 to 9600 b/s, 3-char wait-timeout, no parity bit, +HEADERS
0226 = 00	RS232#1 normal data, i.e. no loopback, no mute, no auto-enable
022C = 20	RS232#1 addressing mode to “DYN” (so CCC can control destinations)

0238 = AC	first byte of 2-byte escape sequence (for DYN addressing)
023E = DC	second byte of 2-byte escape sequence (for DYN addressing)

Configuration of Remote Video I/O Unit (VNA#=FAA/h)

In this example, the remote data terminal needs 9600 b/s asynchronous data signal with no parity bits.

Flash bytes (TLCI-configurable):

0208,0209 = 0FAA	Unit's VNA#
0221 = 43	RS232#2 to 9600 b/s, 3-char wait-timeout, no parity bit, NO HEADERS
0227 = 00	RS232#2 normal data, i.e. no loopback, no mute, no auto-enable
022D = 00	RS232#2 Addressing mode to "ECHO", to respond to CCC

Byte strings from/to CCC

CCC initially sends the string "AC DC 6F AA" which sets the FAB's RS232#1 port's destination to be the RS232#2 port of VNA#=FAA. Hereafter, further bytes from the CCC will be outputted from FAA's RS232#1 port.

***Note**: Any further consecutive AC DC bytes could cause a problem in communication (see "Computer-controlled Addressing" in Section 4).*

Since FAA's RS232#1 port has been configured for a destination-addressing mode of "ECHO", the first packet received will set FAA's RS232#1-port destination address to FAB's RS232#1 port.

Bytes inputted to FAA's RS232#1 port will be sent to the CCC, with the +HEADERS' 8-bytes appended to the start of each packet.

***Note**: If no autonomous packets will be received, i.e. the CCC always knows the packets source, then +HEADERS can be turned off.*

CCC "DYN" Example: Contact-IN / Contact-OUT

This is an example of using a CCC connected to RS232#1 port of the Video I/O unit with VNA#=4011(FAB/h) to:

(1) Control a local Contact-OUT (Sub-board#4 at FAB)
(2) Control a remote Contact-OUT (Sub-board#2 at FAA)
(3) Read a remote Contact-IN (Sub-board#1 at FAA)

Configuration of Local Video I/O Unit (VNA# = FAB/h)

Needs Sub-board#4 to be Contact-OUT.

Flash bytes (TLCI-configurable):

0208,0209 = 0FAB	Unit's VNA#
0220 = 63	RS232#1 to 9600 b/s, 3-char wait-timeout, no parity bit, +HEADERS
0226 = 00	RS232#1 normal data, i.e. no loopback, no mute, no auto-enable
022C = 20	RS232#1 Addressing mode to "DYN" (so CCC can control destinations)
0231 = 00	Sub-board#4 Addressing mode to "ECHO" (to respond to CCC)
021F = B0	Sub-board#4 is contact-OUT
0238 = AC	First byte of 2-byte escape sequence, for DYN addressing
023E = DC	Second byte of 2-byte escape sequence, for DYN addressing

Configuration of Remote Video I/O Unit (VNA#=FAA/h)

Needs Sub-board#1 to be Contact-IN.
Needs Sub-board#2 to be Contact-OUT.

Flash bytes (TLCI-configurable):

0208,0209 = 0FAA	Unit's VNA#
022E = 00	Sub-board#1: Addressing mode to "ECHO", to respond to CCC
021C = 30	Sub-board#1: inhibit updates, both period & changes, 27 ms de-glitch time
022F = 00	Sub-board#2: Addressing mode to "ECHO", to respond to CCC
021D = B0	Sub-board#2 is contact-OUT

Byte strings from/to CCC

a) AC DC EF AB 3C — Turns ON contacts #1, #2 of FAB's Sub-board#4, and other two OFF.
Expect to receive: CF AB 4F AB E0 00 XX XX followed by status byte 3C.

b) AC DC EF AB C3	Turns ON contacts #3, #4 of FAB's Sub-board#4, and other two OFF.
Expect to receive:	CF AB 4F AB E0 00 XX XX followed by status byte C3.
c) AC DC AF AA B4	Turns ON contacts #1, #2, #4 of FAA's Sub-board#2, and other one OFF.
Expect to receive:	CF AB 4F AA A0 00 XX XX followed by status byte B4.
d) AC DC AF AA 4B	Turns ON contacts #3 of FAA's Sub-board#2, and other three OFF.
Expect to receive:	CF AB 4F AA A0 00 XX XX followed by status byte 4B.
e) AC DC 8F AA 00	Reads contacts of FAA's Sub-board#1.
Expect to receive:	CF AB 4F AA 20 00 XX XX followed by status byte: ls-nibble bit[0]=1 if contact#1 open, ls-nibble bit[1]=1 if contact#2 open, etc.; ms-nibble=complement of ls-nibble

CCC "DYN" Example: Monitoring Contact Changes

This is an example of using a CCC connected to RS232#1 port of the Video I/O unit with VNA#=4011(FAB/h) to:

(1) Monitor changes at a remote Contact-IN (Sub-board#3 at FAA)
(2) Monitor changes at a local Contact-IN (Sub-board#2 at FAB)

Configuration of Local Video I/O Unit (VNA# = FAB/h)

Needs Sub-board#2 to be Contact-IN.

Flash bytes (TLCI-configurable):

0208,0209 = 0FAB	Unit's VNA#
0220 = 63	RS232#1 to 9600 b/s, 3-char wait-timeout, no parity bit, +HEADERS
0226 = 00	RS232#1 normal data, i.e. no loopback, no mute, no auto-enable
022C = 20	RS232#1: Addressing mode to "DYN" so CCC can control destinations
022F = 00	Sub-board#2: Addressing mode to "ECHO", to respond to CCC
021D = 20	Sub-board#2: inhibit periodic updates, send changes, 27 ms de-glitch time

0238 = AC	First byte of 2-byte escape sequence, for DYN addressing)
023E = DC	Second byte of 2-byte escape sequence, for DYN addressing

Configuration of Remote Video I/O Unit (VNA#=FAA/h)

Needs Sub-board#3 to be Contact-IN.

Flash bytes (TLCI-configurable):

0208,0209 = 0FAA	Unit's VNA#
0230 = 00	Sub-board#3: Addressing mode to "ECHO", to respond to CCC
021E = 20	Sub-board#3: inhibit periodic updates, send changes, 27 ms de-glitch time

Byte strings from/to CCC

a) AC DC CF AA 00 — Reads contacts of FAA's Sub-board#3

Expect to receive: CF AB 4F AA 60 00 XX XX followed by status byte: ls-nibble bit[0]=1 if contact#1 open, ls-nibble bit[1]=1 if contact#2 open, etc.; ms-nibble=complement of ls-nibble

AND Any time any of the four FAA Sub-board#2 input contacts changes (for longer than the 27 ms de-glitch time), another (autonomous) packet
CF AB 4F AA 60 00 XX XX followed by status byte, will be received.

b) AC DC AF AB 00 — Reads contacts of FAB's Sub-board#2

Expect to receive: CF AB 4F AB A0 00 XX XX followed by status byte: ls-nibble bit[0]=1 if contact#1 open, ls-nibble bit[1]=1 if contact#2 open, etc.; ms-nibble=complement of ls-nibble

AND Any time any of the four FAB Sub-board#2 input contacts change (for longer than the 27 ms de-glitch time), another (autonomous) packet:
CF AB 4F AB A0 00 XX XX followed by status byte, will be received.

***Note**: The autonomous packets, launched by input-contact changes, cannot be subsequently turned off by the CCC.*

CCC "DYN" Example: Monitoring Motion Alerts

This is an example of using a CCC connected to RS232#1 port of the Video I/O unit with VNA#=4011(FAB/h) to monitor “MOTION” alerts at Video IN unit with VNA=2748(ABC/h). (e.g. for intrusion detection.)

Configuration of Local Video I/O Unit (VNA# = FAB/h)

Flash bytes (TLCI-configurable):

0208,0209 = 0FAB	Unit’s VNA#
0220 = 63	RS232#1 to 9600 b/s, 3-char wait-timeout, no parity bit, +HEADERS
0226 = 00	RS232#1 normal data, i.e. no loopback, no mute, no auto-enable

Configuration of Remote Video I/O Unit (VNA#=ABC/h)

Flash bytes (TLCI-configurable):

0208,0209 = 0ABC	Unit’s VNA#
020B,020C = 4FAB	Destination for motion messages = RS232#1 port of VNA#= FAB
020F = 85	Bit[2] = 1 to enable motion-messages feature

Byte strings from/to CCC

For each motion-alert at ABC, the FAB unit will output a 24 byte sequence:

CF AB 4A BC 1B 01 XX XX (these 8 bytes are missing if +HEADERS is off) followed by 16 bytes:

08 77 01 60 <ab> <cd> <ef> <gh> 99 99 99 99 99 99 99 99

where:
<ab> <cd> = current motion value (16-bit number), and
<ef> <gh> increments by 1 for each motion-message sent (rolls over at FFFF)

Notes: *08 is configured minimum time between messages (at 0217 in Flash)*
77 and 99 are spare bytes
0160 is configured threshold (at 0214,5 in flash)

CCC "DYN" Example: RAM/FLASH Read/Write

This is an example of using a CCC connected to RS232#1 port of the Video I/O unit with VNA#=4011(FAB/h) to:

(1) Read some RAM bytes, from the connected Video I/O unit.
(2) Read some FLASH bytes, from a remote Video I/O unit.
(3) Change some RAM bytes, in a remote Video I/O unit.

Configuration of Local Video I/O Unit (VNA# = FAB/h)

Flash bytes (TLCI-configurable):

0208,0209 = 0FAB	Unit's VNA#
0220 = 63	RS232#1 to 9600 b/s, 3-char wait-timeout, no parity bit, +HEADERS
0226 = 00	RS232#1 normal data, i.e. no loopback, no mute, no auto-enable
022C = 20	RS232#1 Addressing mode to "DYN" (so CCC can control destinations)
0238 = AC	First byte of 2-byte escape sequence (for DYN addressing)
023E= DC	Second byte of 2-byte escape sequence (for DYN addressing)

Configuration of Remote Video I/O Unit (VNA#=FAA/h)

Flash bytes (TLCI-configurable):

0208,0209 = 0FAA Unit's VNA#

Byte strings from/to CCC

a) AC DC 2F AB 00 08 Requests 16 bytes from FAB's RAM, from 8020 to 802F/hex
Expect to receive: CF AB 4F AB 1B 00 XX XX followed by requested 16 bytes

b) AC DC 2F AA 01 02 Requests 16 bytes from FAA's FLASH, from 0208 to 0217/hex
Expect to receive: CF AB 4F AA 1B 00 XX XX followed by requested 16 bytes

c) AC DC 2F AA 02 AA 7F 80 FC 03 FE 01 A8 57 Request changing FAA's byte at 8003 to 57/h

Expect to receive: CF AB 4F AA 1B 00 XX XX followed by sixteen “AA “ bytes.

APPENDIX M

VIDEO CONNECTOR STANDARDS

Composite Video Connectors

The term "Composite" video refers to a single coaxial interface carrying all the video and associated sync signals.

The signal format may be NTSC, PAL, or SECAM[1] (see Appendix N).

For industrial products, a BNC connector is commonly used. For consumer products, the RCA ("phono") connector is used in North America. (Called "chinch in Europe)

Y/C (S-Video) Video Connectors

Y/C and S-video terms are used interchangeably and refer to a dual coaxial interface carrying the luminance video and associated sync signals on one coax, and two chroma signals on the other.

The signal format may be NTSC, PAL, or SECAM[1] (see Appendix N).

A 4-pin mini-DIN connector is universally used.

Separating the chroma and luminance signals eliminates their mutual interference (their spectra overlap) and artifacts such as the infamous "chroma crawl" in "composite" displays.

Component Video Connectors

This recently-introduced term refers to a tri-coaxial interface carrying the luminance video and associated sync signals on one coax, and the chroma signals on the other two.

[1] Only NTSC and PAL are supported by the Video I/O unit.

Each of the three signals is similar to the traditional “luminance” signal; one of the three will also have the sync signal added.

For consumer products, three RCA connectors are used in North America.

Separating the two chroma components is accompanied by also increasing their bandwidth providing sharper edges on coloured objects.

This interface is available on DVD players and high-resolution video displays. (Video I/O unit paddleboard does not support this interface.)

APPENDIX N

VIDEO BROADCAST COLOUR STANDARDS

525-line/60Hz NTSC (NTSC-M)

NTSC refers to a technique, developed in 1953, used to add colour information to the monochrome video standard then in use in North America.

NTSC is an acronym for the National Television System Committee. It specifies that the colour components be encoded onto orthogonal subcarrier frequencies at 3.579545 MHz, and band limited to 4.2 MHz (equal to the upper luminance limit).

Some other specs for this standard:
- The horizontal line frequency = 15.73427 kHz
- The vertical field frequency = 59.94 Hz
- The frame rate = 29.97 Hz, comprising 525 lines over two interlaced fields.
- There are 240 “active” lines per field, numbers 22…261 and 285…524.

The above is denoted by NTSC (M), and specified in ITU-R BT.470-3 (1994).

<u>TN1Ue transports NTSC (M) video format</u> (with Video-Mode parameter set to “NTSC”).

NTSC (M) is believed to be in use for TV broadcasting in the following countries:

Antigua	Aruba	Bahamas	Barbados	Belize
Bermuda	Bolivia	Burma	Canada	Chile
Columbia	Costa Rica	Cuba	Curacao	Dominican Rep.
Ecuador	El Salvador	Guam	Guatemala	Honduras
Honduras	Jamaica	Japan*	Korea (South)	Mexico
Montserrat	Myanmar	Nicaragua	Panama	Peru
Philippines	Puerto Rico	St. Christopher & Nevis		Samoa
Suriname	Taiwan	Trinidad & Tobago		U.S.A.
Venezuela	Virgin Isles			

* Check before assuming TN1Ue can be used.

Other 525-line/60Hz Formats

Some other formats specified for 60 Hz environments:

- PAL type "M"

  Subcarrier at 3.57561149 MHz. PAL (M) is believed to be in use in Brazil.

- PAL 4.43 (60Hz)

  Subcarrier at 4.43661875 MHz.

- NTSC 4.43 (60Hz)

  Subcarrier at 4.43661875 MHz.

TN1Ue currently does **not** transport these video formats.

625-line/50Hz PAL

PAL refers to a technique, developed in 1967 for use in Europe, used to add colour information to the monochrome video standard.

PAL is an acronym for Phase Alternate Line. It specifies that the colour components be encoded into orthogonal subcarrier frequencies with a line-by-line reversal of the phase of one of these colour components.

PAL types "B,G,H,N" specify that the colour components be encoded onto orthogonal subcarrier frequencies at 4.43661875 MHz, and band limited to 5.0 MHz (equal to the upper luminance limit).

Some other specs:
- The horizontal line frequency = 15.625 kHz
- The vertical field frequency = 50.00 Hz
- The frame rate = 30.00 Hz, comprising 625 lines over two interlaced fields.
- There are 288 "active" lines per field, numbers 23…310 and 336…623.
- The above is specified in ITU-R BT.470-3 (1994).

PAL "I" is the same, but with its bandwidth extended to 5.5 MHZ.

PAL "D" is the same, but with its bandwidth extended to 6.0 MHz.

TN1Ue transports PAL video types "B,G,H,N,I" (with Video-Mode set to "PAL").

PAL "B,G,H,N" is believed to be used for TV broadcasting in the following countries:

Albania	Algeria	Argentina	Australia	Austria
Bahrain	Bangladesh	Belgium	Bosnia/Herz.	Brunei-Darussalem
Cambodia	Cameroon	Croatia	Cypress	Denmark
Egypt	Ethiopia	Equit-Guinea	Finland	Germany
Ghana	Gibraltar	Greenland	Iceland	India
Indonesia	Israel	Italy	Jordan	Kenya
Kuwait	Liberia	Libya	Luxembourg	Macedonia, F.Y.R.
MalaysiaMaldives		Malta	Monaco	Mozambique
Nepal	Netherlands	New Zealand	Nigeria	Norway
Oman	Pakistan	Paraguay	Pakistan	Papua-New-Guinea
Portugal	Qatar	Romania	Sao-Tome-&-Principe	
Saudi Arabia	Seychelles	Sierra Leone	Singapore	Slovenia
Somalia	Spain	Sri Lanka	Sudan	Swaziland
Sweden	Switzerland	Syria	Thailand	Tunisia
Turkey	Uganda	United-Arab-Emirates		Uruguay
Yemen	Yugoslavia	Zambia	Zimbabwe	

PAL "D" is believed to be used for TV broadcasting in China. Check before assuming TN1Ue can be used.

625-line/50Hz SECAM

SECAM refers to a technique, developed for use in France in 1967, used to add colour information to the monochrome video standard then in use in Europe.

SECAM is an acronym for Sequentiel Couleur Avec Memoire. It specifies that the colour components be frequency-modulated onto two subcarrier frequencies, one at 4.25 MHz and the other at 4.40625 MHz using alternate lines (one subcarrier per line). This requires the receivers to have a one-line storage capability.

Some other specs:
- The horizontal line frequency = 15.625 kHz
- The vertical field frequency = 50.00 Hz
- The frame rate = 30.00 Hz, comprising 625 lines over two interlaced fields.

SECAM types "B,G" specify that luminance be band limited to 5.0 MHz.

SECAM types “D,K,K1,L” specify that luminance be band limited to 6.0 MHz.

The above is specified in ITU-R BT.470-3 (1994).

TN1Ue currently does **not** transport these video formats.

SECAM “B,G” is believed to be used for TV broadcasting in the following countries:

Djibouti	Greece	Iran	Iraq	Lebanon
Mali	Mauritania	Mauritius	Morocco	Saudi Arabia

SECAM “D,K,K1,L” is believed to be used for TV broadcasting in the following countries:

Afghanistan	Armenia	Azerbaijan	Belarus	Benin
Bulgaria	Burkina Faso	Burundi	Chad	Cape Verde
Central-African Republic		Comorus	Congo	Czech Republic
Estonia	France	Gabon	Georgia	Hungary
Kazakhstan	Lithuania	Madagascar	Moldova	Niger
Poland	Russia	Russia	Rwanda	Senegal
Slovak Republic		Togo	Ukraine	Vietnam
Zaire				

Other 625-line/50Hz Formats

Some other formats specified for 50Hz environments:

- PAL type “combination-N”:

  Subcarrier at 3.58205625 MHz, and band limited to 4.2 MHz (= luminance limit). Usage is unknown.

- NTSC 4.43 (50Hz)

  Subcarrier at 4.43661875 MHz. Usage is unknown.

- NTSC (N)

  Subcarrier at 4.43661875 MHz. Usage is unknown.

TN1Ue currently does **not** transport these video formats.

APPENDIX P

FREQUENTLY ASKED QUESTIONS

How does "Wavelets" compare with "MPEG-2" compression?

MPEG-1 and MPEG-2 use DCT (Discrete Cosine Transform) compression. This is about half the efficiency as wavelets.

MPEG-2 uses inter-frame compression coding which typically gains a factor of 4 making it about twice the efficiency of wavelets. MPEG-2 does this by sending a complete frame once every 10 frames or so, with inter-frame differences sent for the receiver to interpolate the intermediate 9 frames. This process also requires the storage of several frames of the signal, both at the encoder and the decoder, thereby imposing perhaps a few hundred milliseconds of delay on the signal.

Multi-channel satellite services (e.g. Direct-TV), and DVD players, allow each video signal to get a fluctuating bit-rate according to the content's requirements (e.g. a car race needs more than a golf game); DVD disks also benefit from not requiring real-time encoding (a 2-pass compression compiler is used).

MPEG-2 requires much more signal processing power for encoding, making the chips more expensive and power hungry. (The decoders are much easier, on purpose as MPEG-2 was targeted for the consumer market requiring only decoders).

Note that only MPEG-2 decoders are standardized, the encoding is arbitrary and many different qualities (and prices) exist in the marketplace.

In summary:

a) MPEG-2 is more expensive and power consuming.
b) MPEG-2 is generally better looking.
c) MPEG-2 has problems with accurately depicting motion.
d) MPEG-2 does not keep its efficiency at low bit-rates (slow scans)
e) MPEG-2 is not allowed for some applications (requiring frame integrity)
f) MPEG-2 imposes a higher latency on the signal (a concern for camera controls)

How critical is the input data rate tolerance?

The data input is sampled by the unit's clock which runs about 0.93% fast. The data output uses the same clock.

So, the only problems are:

1) If the input data rate deviates enough so that by the last (10th) character it is being sampled close to the edge of the bit period. This means the rate should be < ± 3%.
2) If the input data rate is above +0.93%, and continuous so that the system is required to buffer more than its buffer capacity (approx 100 bytes).

Possible solutions are:

a) Set the source to send 1.5 or 2 stop bits.
b) Set the source to send parity.

What is "Auto-Enable" for an RS-485 interface?

This is a term used in the industry to describe a feature which allows an RS-485 to operate on a multi-point data bus.

The problem is that the driver must only be on when it is outputting data, as it must be tri-stated (high-impedance) at other times to allow other drivers to function; and there is no control signal available to do this (like the RTS signal from RS-232 interfaces).

The "auto-enable" feature comprises a circuit which enables the driver at the start of each START pulse, and holds it enabled throughout the character, with a small hold-over time to ensure that the STOP bit is received OK. It is common to make this hold-over time user-configurable as applications may vary.

How can I view the last received image?

Upon loss of communications, the default mode of a Video-OUT unit is to output a colour-bar test signal. This guarantees that an image is always "live".

The last received video frame is held in the unit's memory, and can be viewed by toggling the "FAIL – IN-USE" field from "CBAR" to "FRZ". (This should be toggled back to "CBAR" to restore the "CBAR" default mode.)

Note also that the <F4> function key (in TLCI) can be used to “freeze” an image (<F4> again to restore live video).

Can the "motion" feature detect loss of motion?

Yes, loss of motion (e.g. a stalled conveyer belt) can be detected if the Video-IN unit is configured to send messages, and another unit (-IN or -OUT) is connected to a PC programmed to generate an alert if it fails to receive these messages.

How much network bandwidth do data links consume?

Each message packet requires 200 bits (25 bytes), and can transport up to 128 bits (16 bytes) of payload data; this would come from 160 bits of serial input (with start & stop bits per byte) for a net overhead of a modest 25%.

A continuous 9600 b/s input would thus burden the network with 12 kb/s.

6 data ports, all at a continuous 115.2 kb/s would add 864 kb/s.

Normal camera controls typically comprise a few bytes perhaps several times a second so perhaps 1 to 10 kb/s.

Can the compressed digital signal be used outside TN1Ue?

No, there are no open standards for the transport of wavelet-compressed video.

By the way, there also does not appear to be any open standards for mapping MPEG-2 video into IP packets.

However the analogue video can be fed into another video system, e.g. a client-server network for distribution over a LAN.

Can a camera’s microphone be used directly?

Yes, the audio input can be directly connected to the microphone output of cameras with built-in microphones. It is recommended that the full 42 dB AGC range be enabled to handle the wide range of sound levels typically encountered.

Can the audio channel be used for "P.A." applications?

Not normally as the audio channel is unidirectional, always taking the same path(s) as the video signal from the (Video-IN) unit.

However, if a remote unit is only being used for data, it could be set to Video-OUT mode and used for a PA channel.

For such applications, one of the unit's data channels, set to 115.2 kb/s, could be used with an external MP3 type of audio codec.

Can a backup master-control site be used?

Yes. By setting the remote units' data/contact ports to the "echo" address mode, any number of controllers can be used, located anywhere, as polling responses are returned to the polling source (although simultaneous polls to the same destination should be avoided).

APPENDIX Q

LIST OF ILLUSTRATIONS

List of Figures

FIGURE	DESCRIPTION	PAGE

List of Tables

APPENDIX R

LIST OF ACRONYMS

- A-D Analogue to Digital
- ADC Analogue to Digital Converter
- AGC Automatic Gain Control
- ANSI American National Standards Institute
- BER Bit Error Rate
- CENELEC Comite Européen De Normalisation Electrotechnique (European Committee For Electrotechnical Standardization)
- CC Closed Captioning
- CD Compact Disc
- CI Craft Interface
- CPU Central Processing Unit
- CV Code Violation
- DAC Digital to Analogue Converter
- DC Direct Current
- DVD Digital Versatile Disk
- EAS Electronic Assembly Schematic
- EIA Electronic Industries Association
- EMC Electromagnetic Compliance
- ESDS Electrostatic Discharge Sensitive
- ETSI European Telecommunications Standards Institute
- FDX Full Duplex
- FPGA Field Programmable Logic Gate Array
- HDX Half Duplex
- IEC International Electrotechnical Commission
- IEEE Institute of Electrical and Electronics Engineers
- ITU-T International Telecommunication Union – Telecommunications Sector

APPENDIX R

LIST OF ACRONYMS
(CONTINUED)

- LAN Local Area Network
- LED Light Emitting Diode
- LOS Loss Of Signal
- LSB Least Significant Bit(s)
- MSB Most Significant Bit(s)
- MTBF Mean Time Between Failures
- NAD Node Assignment Drawing
- NMS Network Management System
- NTSC National Television System Committee
- PA Public Addressing/Announcement
- PAL Phase Alternate Line
- PC Personal Computer
- PIR Passive Infra Red
- PLL Phase Locked Loop
- POH Path Overhead
- PTZ Pan/Tilt/Zoom
- RAM Random Access Memory
- RCV Receive
- ROM Read-Only Memory
- RTU Remote Terminal Unit
- SDH Synchronous Digital Hierarchy
- SECAM Sequentiel Couleur Avec Memoire
- STM Synchronous Transport Module
- TLCI TN1U Local Craft Interface
- TIF TN1U Intermediate Format

APPENDIX R

LIST OF ACRONYMS (CONTINUED)

- TNCI TN1U Network Craft Interface
- TPIM Technical Practice and Installation Manual
- TU Tributary Unit
- TUG Tributary Unit Group
- UART Universal Asynchronous Receiver/Transmitter
- VC Virtual Container
- VCR Video Cassette Recorder
- VCXO Voltage Controlled Crystal Oscillator
- VMS Variable Message Sign
- VNA Video Network Address
- WAN Wide Area Network
- XMT Transmit