2 Display Elements

2.1 Background: Signal Flow and Displays

To understand the requirements for on-screen displays in the Digital Module, it may be worthwhile to summarize the inputs and signal paths of all formats as the pass through the Module en route to the EMG* Host processor and then the physical display. The following diagram shows the architecture from AV viewpoint.
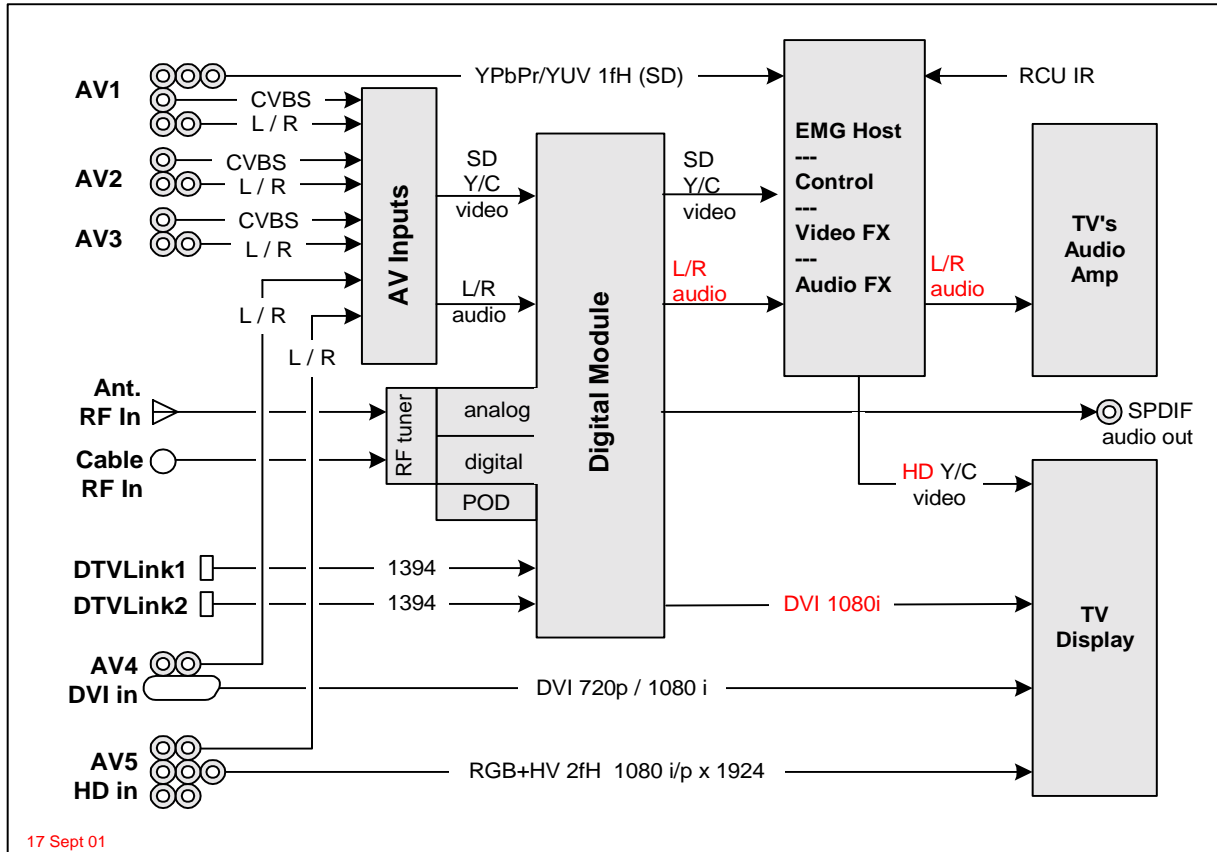

Figure 1. Audio and Video Signal Flow for the Integrated DTV

Based on the architecture described in the CRS [section 2.2], the diagram illustrates several key points affecting the user interface:

- One hybrid RF tuner can tune antenna or cable, but not both at the same time.
- The RF tuner can demodulate analog or digital, but not both at the same time.
  Only one RF channel can be displayed at one time.
- The Module downconverts AC-3 to Dolby Prologic.
- Two-channel inputs, with or without Prologic encoding, are passed through the Module unchanged.
- Most signals pass through both the Module and the Host, with 3 exceptions:
- The YPbPr video option for AV1 bypasses the Module and flows directly into the Host, while its associated audio follows the normal route through the Module.
- AV4 and AV5 video skirts both the Module and the Host, passing directly to the display, while their associated audio inputs go through the Module.

Given the many picture formats in the ASTC standard, it may be helpful to outline the pathways of each picture resolution format, as shown in the following diagram:
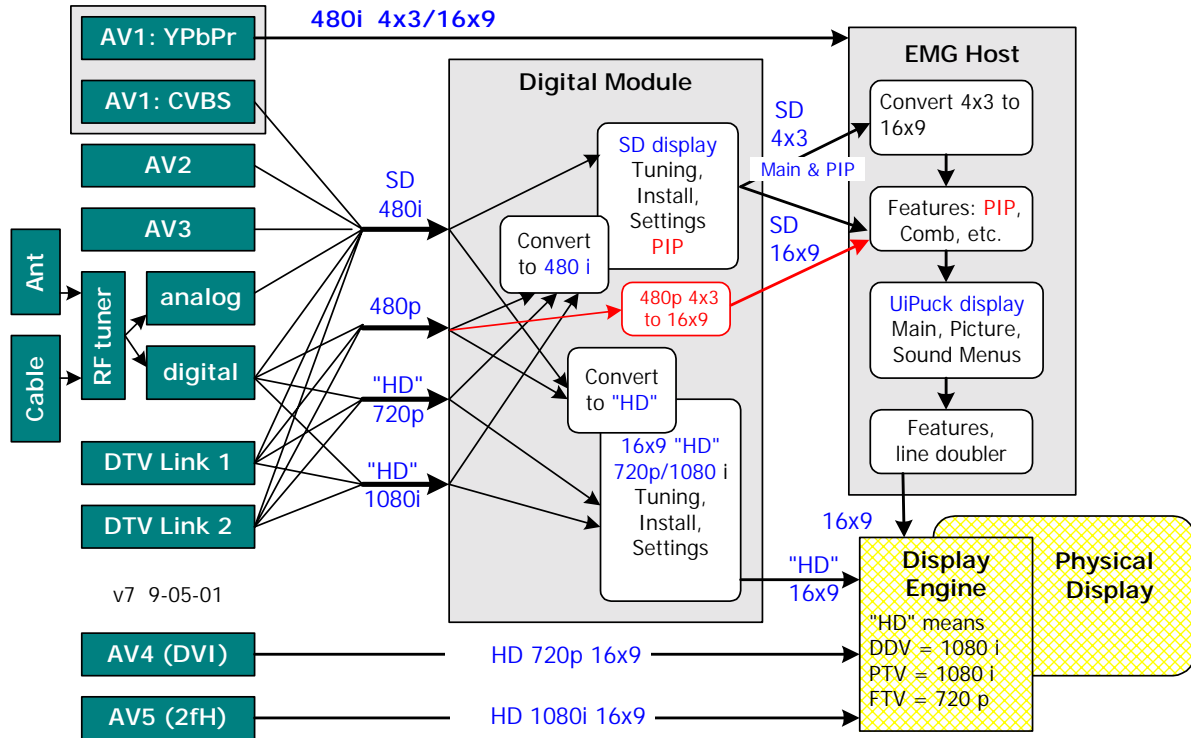
AV1: YPbPr

AV1: CVBS

480i 4x3/16x9

EMG Host

Digital Module

Convert 4x3 to 16x9

AV2

AV3

SD 480i

SD display
Tuning, Install, Settings
PIP

SD 4x3
Main & PIP

Features: PIP, Comb, etc.

Ant

Cable

RF tuner

analog

digital

480p

SD 16x9

480p 4x3 to 16x9

UiPuck display
Main, Picture, Sound Menus

"HD" 720p

Convert to 480 i

Convert to "HD"

Features, line doubler

DTV Link 1

DTV Link 2

"HD" 1080i

16x9 "HD" 720p/1080 i
Tuning, Install, Settings

16x9

"HD" 16x9

v7 9-05-01

Display Engine
"HD" means
DDV = 1080 i
PTV = 1080 i
FTV = 720 p

Physical Display

AV4 (DVI)

HD 720p 16x9

AV5 (2fH)

HD 1080i 16x9

Figure 2. Video Format Flow in the Integrated DTV

This diagram highlights a few additional important background details affecting UI design:

- The Module downcoverts to 480i, or upconverts to 1080i, as necessary for every signal, in order to output both 480i and 1080i. The Host must "decide" which output is likely to be better.

- 720p and 1080i signals from broadcast or DTV Link (1394) are processes the Module, but those from DVI and the 2fH "HD" input go directly to the display.

- Any OSD or PIP applied in the Module becomes "glued" to that signal; if the image is transformed in the Host, the OSD or PIP will be transformed as well.

- The main signal including PIP and Module-generated OSD appears on the monitor output to the VCR in its native aspect ratio (before 16x9 conversion).

- Menus are divided between the Module and the Host. Settings that apply to both (e.g., menu language preference, current time, input signal, etc.) must be updated by communication between the two sides.

- In the diagram, "HD" (in quotes) refers to the highest output resolution of the display device: 1080i for direct-view and projection televisions; 720p for liquid-crystal devices

- If the output display is 1080i, "convert to HD" means upconverting from 480i and 480p signal inputs.

- If the output display is 720p, "convert to HD" includes upconverting from 480i and 480p, and downconverting from 1080i signal inputs.

- At this writing it is officially undecided which path for 480p would yield better quality: direct routing to the display, or downconverting for the Host, performing picture enhancements, and upconverting back to the display.

- If 480p is direct-routed to the display, the OSD assets designed for 720p will be used for menus and messages.

2.2   Spatial Resolution

The Module shall have the following video spatial display characteristics.

2.2.0 r1   The Module shall display output video at three resolutions:

- 640 x 480 interlaced
- 640 progressive
- 1080 x 1920 interlaced

2.2.0 r2   The Module shall generate on-screen displays in an active area of roughly 4x3 proportions.

2.2.0 r3   The OSD active area shall be at least 15% smaller in vertical and horizontal dimensions than the video resolution in which it will appear.

2.2.0 r4   at the following resolutions, with the OSD resolution or "active area" estimated at roughly 85% of the video resolution of a 4 x 3 image:

Table 2. OSD Resolutions

Video Resolution	OSD Resolution	Safety	Post-Processing	Comments
640i	408 x 544	15%	Normal 4x3 or Expanded 33% to 16x9	SD resolution fed into Host.
640p	816 x 544	15%	none	Double vertical resolution of SD.
1080i	928 x 1216	24%	none	Double vertical and horizontal resolution of SD.

2.2.0 r5   In 480i resolution, the OSD shall appear within the area normally occupied by a 4x3 SD image. When a 4x3 SD image is expanded in the Host, the OSD will be expanded horizontally by 33%, as shown in the following diagram:
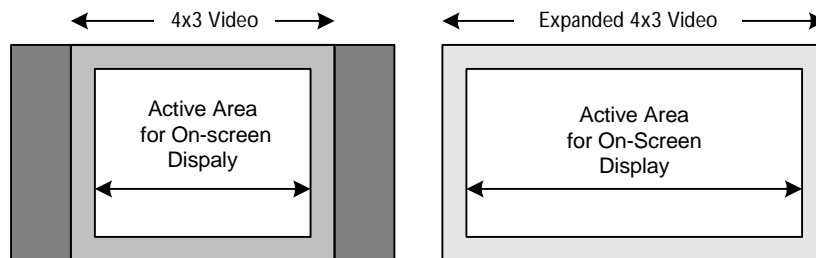

Figure 3. OSD Active Area for a 4x3 SD image, before and after expansion.

2.2.0 r6   In 480p resolution, the OSD active area stays within a 4x3 rectangular area, which may appear over a 4x3 video image or a 16x9 video image:
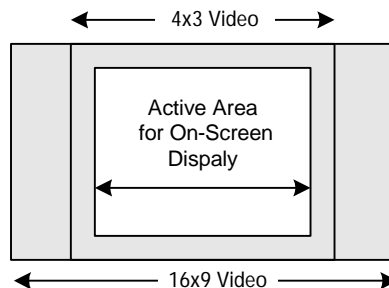

Figure 4. OSD Active Area for 640p resolution.

2.2.0 r7   For convenience the OSD Active Area for 1080i is defined as double the pixel dimensions of the Active Area for 480i, or 928 x 1216. This results in a more generous "safety" area around the Active Area:
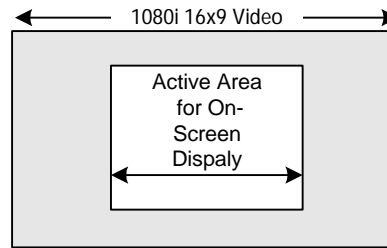

Figure 5. OSD Active Area for 1080i resolution

2.3   Display Performance

2.3.0 r1   All on-screen displays should be perceived by users as "instantaneous."

2.3.0 r2   The Module shall be able to draw, refresh, or dismiss an on-screen display within 200 milliseconds.

2.4   Color Resolution

2.4.0 r1   The Module shall display all colors of an 8-bit clut of 256 colors on-screen.

2.4.0 r2   The Module's 256 colors shall be selectable from an RGB-888 colorspace (16 million colors).

2.4.0 r3   The Module shall support at least four (4) levels of alpha blending (transparency).

2.4.0 r4   The Module shall be able to display fully opaque text characters over a background panel that is alpha-blended with the video background.

2.5   Text Fonts

2.5.0 r1   The Module shall support the character sets specified for OpenCable [Host_PODc6] and Digital Closed Captions [EIA-708].

2.5.0 r2   The display shall be capable of displaying a minimum of:

- 42 characters per line [EIA-708, section 9.5];
- 16 lines of text per screen [Host_PODv6].

2.5.0 r3   The Module shall display the text format described as "Style 3" in [EIA-708, 8.5.3] for the display of closed captions:

- sans-serif style
- proportionally spaced
- displayed in 3 sizes: Small, Medium, and Large

2.5.0 r4   In addition to the EIA-708 required fonts, the Module shall display ONE proportionally-spaced font that can be scaled to accommodate the following transformation:

- horizontal expansion by 33% (4x3 to 16x9)
- vertical doubling (for 640p)
- doubling in vertical and horizontal dimension (for 1080i)

2.5.0 r5   The Module shall be able to display any character or group of characters in any of four visual states (corresponding to logical states in the program).

1. Normal (blue)
2. Highlighted (pointed at - the "current" item - yellow)
3. Selected (after the user presses OK - checkbox checked?)

4. Disabled or downlighted - "grayed out" when temporarily unavailable.

2.6 Menu Format

In the final product, users will be exposed to the intermingling over time of displays generated by the Module and displays generated by the Host. To promote a unified user experience, therefore…

2.6.0 r1 The Digital Module shall present a "look and feel" that is acceptably consistent with the Analog Host ("MG" series) upmarket television system.

The OSD elements can be divided into 4 groups:

1. Navigation (Menus)
2. Messages (temporary displays not requiring interaction)
3. Dialogs (display expecting user response, but not accessed via the menus)
4. Tuning Displays - a special case of "Messages"

2.6.1 UI Puck

The analog Host of the MG chassis features a unique animated interface known as "UI Puck," in which a hierarchical menu is represented as set of orthogonal "pipes" with labeled "balls" representing the user's options. The user's current position is shown as a "puck" or donut-shaped ring.

In the MG analog products, users navigate the menu structure, animated effects show the puck opening, moving to the next ball, and closing on it, while the "pipes" expand or collapse to reveal or conceal portions of the menu hierarchy.

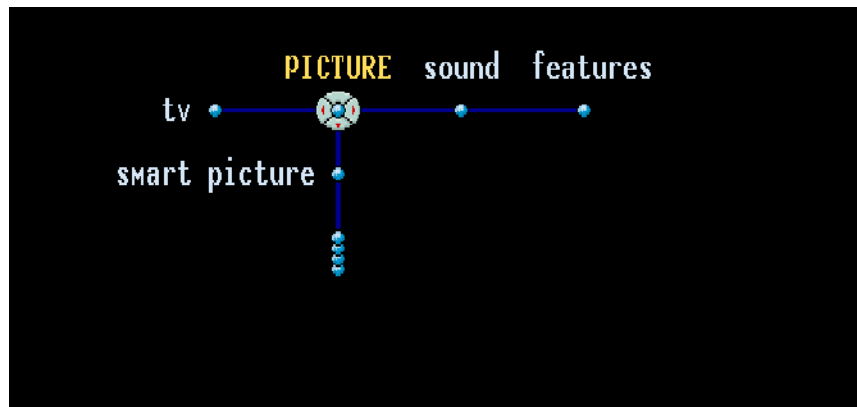A sample UI-Puck menu appears below:

Figure 6. Sample menu from the "UI-Puck" analog Host on-screen menu.

In Figure 6, the yellow text of "Picture" indicates the user's current position. (The figure also shows the highlighted name changing to ALL-CAPS format, but this behavior has been discarded.) Also, notice the tiny red arrows in the puck: each arrow indicate a direction currently available for navigation.

A **perfect** visual and behavioral match between the MG Analog Host and Digital Module's user interface is not strictly possible, due to some fundamental differences:

Table 3. Analog Host/Digital Module Display Difference

Analog Host	Digital Module
Complex animation	Limited animation
Monospaced fonts	Proportional fonts

Within these limitations, however, the Digital Module interface will share certain visual and behavioral characteristics with the Analog Host.

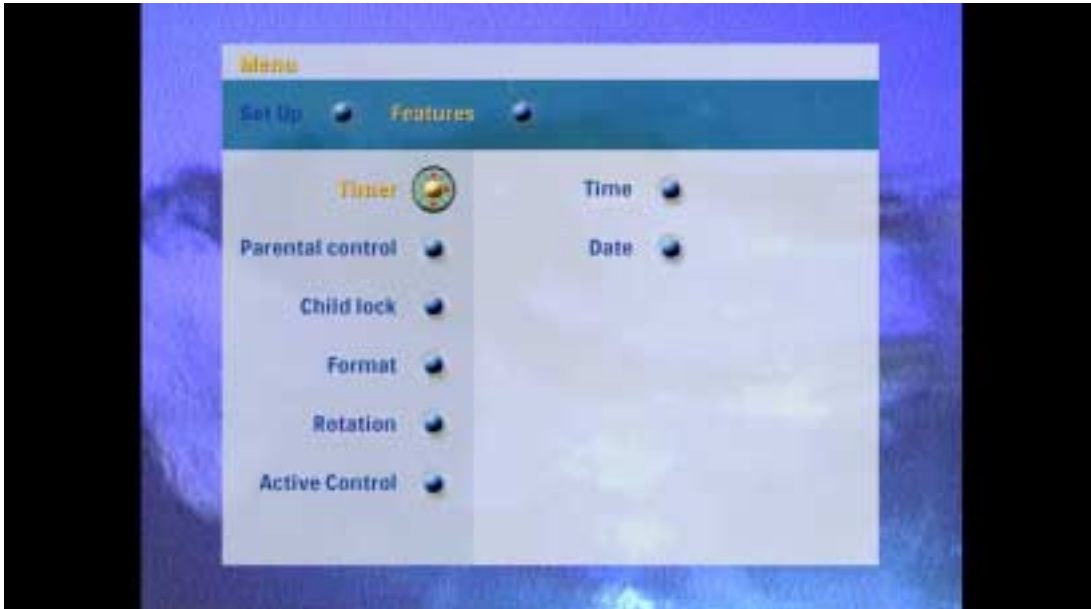The concept screen in Figure 7 illustrates several key features of the Digital Module interface design:

Figure 7. Concept drawing for the Digidtal Module visual design (Philby Design).

2.6.2 Display Elements for UI-Puck Compatibility

The following requirements are illustrated in Figure 7.

2.6.2 r1   Text displays are presented over alpha-blended background panels that may include up to 3 tones of blue, each with a different level alpha-blending.

2.6.2 r2   The background panel may extend to the edge of the "safe" display area. It will not extend beyond it.

In Figure 7, the display area is the same size it would be for a 4x3 "pillarbox" display. Limiting menus and non-tuning messages to this area is acceptable.

2.6.2 r3   Text is presented in upper and lower case, with first-letter capitalization.

2.6.2 r4   The text font includes a "shadow" to the lower right.

2.6.2 r5   In a menu, options are presented as a text string associated with a 3-D ball.

2.6.2 r6   In Normal state, text and ball are blue.

2.6.2 r7   In Pointed state, text and ball are yellow.

2.6.2 r8   In a menu, when a target is "pointed" or "the point of user focus" (the Timer option in this example) the options for that target are displayed to the right ("Time" and "Date" in the example), This concept is known as "Feed Forward."

2.6.3 UI-Puck Menu Behavior

This section summarizes behaviors of a UI-Puck menu, which are intimately related to visual design.

In Figure 7, the green donut-shaped "puck" surrounds the "ball" where the user is "pointing." On the puck, tiny red arrows indicate which actions are available. From this point shown, user can move the puck up, left, or down:

- Pressing the **Up Arrow** key on the remote returns to the higher menu level.
- Pressing the **Down Arrow** moves the users current "pointing" position to the next option (Parental control). (This not the actual text.)

- Pressing the **RIGHT ARROW** or pressing **OK** selects the current option (Timer) and moves the puck the next level inward (Time and Date):

Figure 8. Concept drawing of a menu with user focus on a submenu (Time).

As illustrated in Figure 8, from one menu level to the next, the following events occur:

2.6.3 r1   The original text ("Timer") remains yellow.

2.6.3 r2   The original ball (for "Timer") turns blue.

2.6.3 r3   The text associated with the other original menu options (on left) disappear.

2.6.3 r4   The puck moves and closes around the destination ball ("Time").

2.6.3 r5   The puck's red arrows indicate the directions users can move (**LEFT** to return to Timer, **DOWN** to Date, or **RIGHT** to edit the time setting).

2.6.3 r6   When the puck moves, the transition to the next ball animates in four (or six) stages:

1. Puck is closed on starting ball, colored yellow. Text is also yellow
2. Puck is spread open around ball, which turns blue. Text turns blue.
3. Puck is open around destination ball. It and its text are blue.
4. Puck is closed around destination ball. It and its text are now yellow.

2.6.4 Summoning and Dismissing Module Menus

The Digital Module displays 3 menus (Settings, Content, and Time), and the Install sequence. The following behaviors apply to all:

2.6.4 r1   A Module menu shall be summoned by a message from the Host (originating from a menu selection or a button press).

2.6.4 r2   Users may navigate within the Module menu until a terminal condition is reached:

- A higher-priority event intervenes (e.g., user pressing "Info/Status" button).
- Users select a menu option that dismisses the entire Module menu.
- Users select the "Exit" option on the Module menu.
- When the Module menu has been dismissed, the Module shall send a message to the Host to that effect.

5 Tuning Operations

5.1 Tuning Sources

5.1.0 r1   Due to the potential for duplication in the numbering schemes of the two RF sources, the Digital Module shall treat the Antenna and Cable inputs as separate Sources.

5.2 Channel Maps

5.2.0 r1   For the two installed sources, the Module shall maintain two *Master Channel Maps,* comprising all channels found during Autoprogramming.

5.2.0 r2   Also for the two sources, the Module shall maintain two *Active Channel Maps,* consisting of the Master Channel Map minus blocked channels.

5.2.0 r3   The CHANNEL UP and CHANNEL DOWN buttons on the remote control tune to the next or previous channel in the Active Channel Map of the current Source.

5.2.0 r4   With direct (digit-entry) tuning, users can summon a blocked channel on the Master Channel Map, but it is presented with a request for PIN entry.

5.2.0 r5   Each detected subchannel of a digital multiplex channel is treated as a separate entry in the channel maps. By this means, users can CHANNEL UP or DOWN from one subchannel to the next or previous subchannel, and on to the nearest subchannel of the next or previous major channel.

5.3 Tuning Display

For a description of the Tuning Display, see section 2.7.3 on page 16.

The variations may be summarized as follows:

Table 5. Signal Inputs and Tuning Display formats

Signal Input	Tuning Display
analog broadcast	2-digit channel number
analog cable	3-digit channel number
digital cable	3 digits, station, program title
digital broadcast	XX.X channel, station, program title

5.4 Direct Tuning

Direct tuning is accomplished when users enter a channel number directly, using the digit keys, which may be augmented by the DOT key as well as the OK key.

5.4.1 "Normal" Cases

5.4.1 r1   After a numeric keypress, the Module always displays the tuning prompt, which echoes the digit entered. If additional digits arrive within the time-out, the new digits are added to the display.
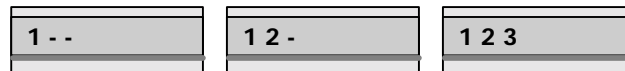
1 - -		1 2 -		1 2 3

Figure 49. Tuning Prompt for Cable Source

5.4.1 r2   The OK button acts as a terminator, stimulating immediately the action that would normally occur after a time-out period.

5.4.1 r3   The "Dot" key acts as a special terminator in Digital mode: pressing it identifies the preceding digits as a digital channel.

5.4.1 r4   If another digit "y" is pressed before the time-out, the Module tunes to the major channel, subchannel "y."

5.4.1 r5   If the time-out is reached, the Module tunes to the lowest-numbered subchannel of the major channel.

5.4.1 r6   The standard time-out for digit entry in tuning mode shall be [3] seconds.

The table below describes the tuning behavior after each keypress in the four signal modes of the Digital Module. For signal mode, the cell describes (1) the immediate action following the keypress, and (2) the action after **OK** has been pressed or the time-out has elapsed. Note that "suspend" means both (a) dismiss the display and (b) remain on the current channel.

Table 6.   Direct Tuning Behavior in Four Signal Modes

Remote Key	Broadcast Analog Station	Broadcast Digital Station	Cable Analog	Cable Digital
One digit (X)	Show OSD & wait…	Show OSD & wait…	Show OSD & wait…	Show OSD & wait…
X + time-out X + OK X + DOT key	Suspend Tune channel 0X Tune channel 0X	Suspend Tune channel 0X Tune channel 0X	Suspend Tune channel 0X Tune channel 0X	Suspend Tune channel 0X Tune channel 0X
Number "1" plus a second digit (1 + Y)	Tune to channel 1X.	Wait…	Wait…	Wait…
1 + Y + time-out 1 + Y + OK 1 + Y + DOT		Tune to Channel 1X lowest-numbered subchannel (1X.1*)	Suspend Suspend Suspend	Suspend Suspend Suspend
Any 2 digits X + Y	Tune to channel XY.	Tune to XY lowest subchannel (XY.1*)	Wait…	Wait…
X + Y + time-out X + Y + OK	Tune channel XY. Tune channel XY.	Tune chan XY.1* Tune chan XY.1*	Suspend Suspend	Suspend Suspend
X + Y + DOT	Tune channel XY.	Wait…	Ignore	Ignore
X + Y + DOT + Z		Tune chan XY . Z	Tune chan XYZ	Tune chan XYZ
X + Y + Z		Tune chan XY . Z	Tune chan XYZ	Tune chan XYZ

Normally the lowest subchannel would be numbered XY.1, although it could be 2 or 3 or any other number. The Module shall capture the lowest subchannel and tune to it.

5.4.2 Exceptional Cases

When users directly tune a blocked channel, the Module presents a PIN dialog:

Channel [xxx] is blocked.
Enter your PIN to unlock.
[Cancel] [PIN entry dialog]

Selecting "Cancel" (or failing to enter the proper PIN) returns to the previous channel users had been viewing before attempting to tune the blocked channel.

Successfully entering a PIN number unblocks the channel and presents the UnLock Dialog:

Unlock Channel:
[ ] Until end of program.
[ ] For four hours.
[ ] Until power off.

The behaviors for options 2 and 3 are obvious.

For the first option, "Until end of the program," the set checks various sources of information to determine when the current program will end:

5.4.2 r1   Program Guide information from PSIP, OOB, or XDS, if available. Based on the program guide, the time is set when the lock will be re-instated.

5.4.2 r2   If only "current program" name is available, the Module checks every [60?] seconds to see whether the text for the current program has changed. When it has, the channel is re-locked.

5.4.2 r3   If no current program information is available, the Module sets the relock time to [the next hour on the hour].

5.5   Surf Ring

The "Surf" function allows users to identify and quickly tune up to **10** favorite sources and/or channels. The set of surf items is the "surf ring."

Surf

5.5.0 r1   Pressing the **SURF** button tunes the next Surf channel in the surf ring.

5.5.0 r2   If the Surf Ring is empty, pressing Surf or Surf Next causes the Module to display a message:

Surf Ring is empty.

Surf +/- Button

5.5.0 r3   The **SURF ADD** button adds or removes the current channel (from either tuner) or external source to the surf ring.

5.5.0 r4   If the current channel or source is **not** in the surf ring, and the user presses the **SURF +/-** button, the Module (a) adds the current channel or source to the surf ring and (b) displays a message to this effect:

**Channel [x] has been added
to your Surf Ring.**

5.5.0 r5   If the current channel or source **is** already in the surf ring, and the user presses the **SURF +/-** button, the Module (a) **removes** the current channel or source from the surf ring and (b) displays a message to this effect:

**Channel [x] has been removed
from your Surf Ring**

5.5.0 r6   The Surf Ring shall be able to store and mix channels from ~~both the Antenna and Cable~~ all sources. (The Surf Ring thus enables "seamless zapping.")

5.5.0 r7   The Surf Ring shall contain up to [10] channels or sources.

5.5.0 r8   When the maximum number is exceeded by the addition of one channel too many, the oldest item added to the ring is automatically removed.

Surf Tuning Display

5.5.0 r9   When a channel or source has been added to the surf ring, the text "surf" (or a visual symbol) appears in the tuning display whenever that channel is tuned:

102 HGTV	surf		4.2 WNBC	surf
Decorating Disasters				

Figure 50. Tuning Displays with "surf" indicator

6 Picture Formats

This chapter discusses the formats for rendering 4x3 picture inputs on the Module's 16x9 screen, and the formats and behaviors for the PIP (Picture in Picture) feature.

6.1 4x3 Picture Formatting

SD images are formatted by the EMG Host (see Section 7.4.1, "4x3 Picture Formats," on page 50).

6.1.0 r1   The Module shall support 4x3 aspect ratio transformations (as described in section through section 6.1.5) in HD 1080i resolution.

6.1.0 r2   The names of the supported formats (as given below) shall match those used in the MG user interface of the Host.

6.1.1 Screen Protection

6.1.1 r1   Several formats include "black" curtains left and right or "black" bands above and below the video picture.

6.1.1 r2   The value for "black" curtains and bands shall be capable of being reset at the Factory.

6.1.1 r3   In particular, Modules intended for projection TVs must be able to use a "gray" value to prevent screen burn-in.

The Module shall support the following 4x3 picture format conversions:

6.1.2 4:3 Format (Pillarbox)

The "4:3" format shows a normal 4x3 picture, undistorted, cropped only at the top and bottom, with dark gray "curtains" left and right of the undistorted image:

Figure 51.   4:3 image in 4:3 Format

6.1.3 Movie Expand 14:9

The Movie Expand 14:9 format strikes a compromise: it crops a small amount of the image top and bottom, applies smaller black curtains left and right, and preserves image proportions:

Figure 52.   Movie Expand 14:9 Format

6.1.4 Movie Expand 16:9

6.1.4 r1   The Movie Expand 16:9 format enlarges the image somewhat (with some cropping top and

bottom) and stretches it horizontally to fill the screen.

Figure 53. Movie Expand 16:9 Forma

6.1.5 Widescreen

6.1.5 r1   The Widescreen format fills the width of the screen by stretching the image laterally. This format omits "black bars," but it also severely distorts the proportions of the image:

Figure 54. Widescreen Format

6.2   Picture-in-Picture (PIP)

The Digital Module shall have the ability to display Picture-in-Picture, or PIP, in which a second video source appears in a window, superimposed over the Main Video window. The PIP function is handled entirely within the Module, before being output to the Host.

6.2.1 General PIP Features

6.2.1 r1   Whenever a PIP is displayed, the audio associated with the Main Video is sent to the SPDIF output and the L/R output directed to the TV's built in speakers.

6.2.1 r2   When PIP is first invoked, the "last used source" is used as the PIP source..

6.2.1 r3   The factory default for Last Used Source is [AV1].

6.2.2 PIP Button

6.2.2 r1   Pressing the **PIP** button summons the PIP display, in the size and position selected in the Settings/General menu, using the last selected source.

6.2.2 r2   When the PIP first appears, its border is gray, indicating that it is not the "current" window.

6.2.2 r3   Pressing PIP when the PIP is displayed, but not current, causes the PIP window to become the current window.

6.2.2 r4   When PIP is current, users can cycle through sources or, if the PIP is tunable, tune to another channel.

6.2.2 r5   If there is no input after [7] seconds, the PIP returns to non-current-window state.

6.2.2 r6   Pressing the **PIP** button while the PIP window is current dismisses the PIP.

6.2.3 PIP Swap Button

6.2.3 r1   The **PIP SWAP** button exchanges the video and audio content of the main window and the PIP

window. *(Works the same regardless of which window is "current.")*

6.2.3 r2   Audio always follows the main video window.

6.2.3 r3   If there is no current PIP, pressing the **PIP SWAP** button displays a PIP (that is, it acts as equivalent to the initial pressing the **PIP** button).

6.2.4 PIP Image Formats

Within the Module, the main video may be 4x3 or a 16x9, and the PIP source may be 4x3 or 16x9. If the Main video is 4x3, it may be expanded to 16x9 in the Host (see Figure 2, "Video Format Flow in the Integrated DTV," on page 9).

6.2.4 r1   When the Main screen in the Module is 4x3, the PIP shall also be formatted 4x3.

6.2.4 r2   When the Main screen is 4x3 and the PIP Source is 16x9, the PIP Source shall be horizontally compressed ("squeezed") to fit into a 4x3 PIP, as shown below:
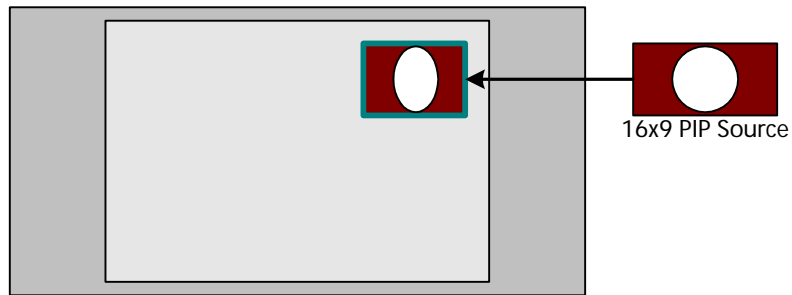

16x9 PIP Source

Figure 55. 16x9 source image "squeezed" for 4x3 PIP

Note that when the 4x3 Module output is expanded by the Host, the content of the squeezed PIP will return to its normal proportions.

Note to Host: If the host is using anamorphic expansion, and the Module menu is summoned, the Host must automatically change to simple Widescreen before displaying the Module menu.

6.2.4 r3   When the Module-output Main screen is in 16x9 format, and the PIP source is also 16x9, the PIP retains its 16x9 proportions:
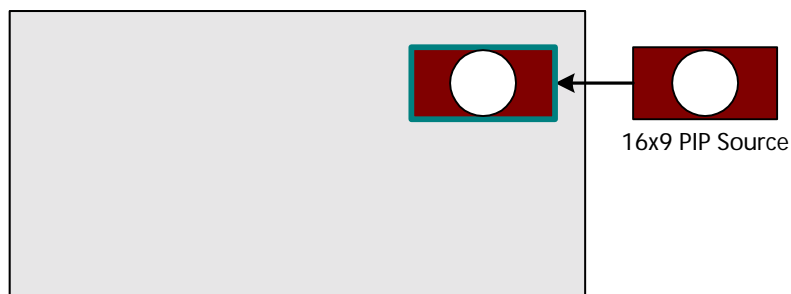

16x9 PIP Source

Figure 56. 16x9 Main video with 16x9-source PIP.

6.2.4 r4   When the Main screen is 16x9 and the PIP source is 4x3, the Module displays a 4x3 PIP:
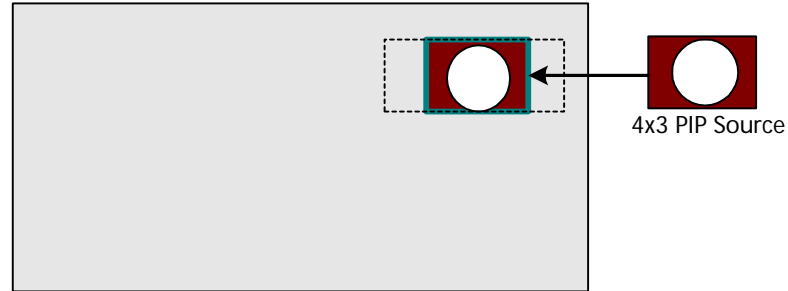

Figure 57.   16x9 Main video with 4x3-source PIP.

6.2.4 r5   On a 16x9 Module output, the 4x3 PIP is centered on the point where the 16x9 PIP is centered.

6.2.4 r6   The PIP image is surrounded by a border, several pixels thick on all sides.

6.2.4 r7   On its first appearance, or after **PIP** or **PIP SWAP** are pressed, the border is highlighted [yellow], indicating that the PIP is the "current window."

6.2.4 r8   After a time-out of [7] seconds, the PIP border changes to its [dark gray normal state.

Dual Window PIP

6.2.4 r9   In the PIP format "Dual Window," the Main video and PIP video are presented in equal windows, side by side, with black (or gray) bands above and below:
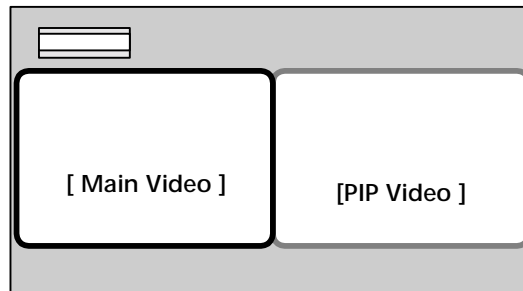

Figure 58.   Layout of PIP format "Dual Window"

6.2.4 r10   Dual Window PIP images are roughly the same size as the Medium 4x3 PIP image.

6.2.4 r11   If either source is 16x9, the image is horizontally "squeezed" to fit in the 4x3 window.

6.2.5 PIP General Behaviors

In ~~Dual Window~~ all PIP modes, the following behaviors apply:

6.2.5 r1   If a Small or Medium PIP is set for the Upper Left corner, the Tuning Prompt and Tuning Display appear in the upper right corner.

6.2.5 r2   If a Small or Medium PIP is set for the Lower Left or Lower Right positions, Messages are not repositioned: they may appear over the PIP image.

6.2.5 r3   Closed Captions appear in their normal position, ignoring any distinction between the two windows.

6.2.5 r4   Closed Captions are displayed only for the Main Video.

6.2.5 r5   System messages and dialogs similarly appear in their normal positions. (In Dual Window mode, it passes in front of both images.)

6.2.5 r6   Pressing the **4x3 FORMAT** button in Dual Window mode has no effect.

6.2.5 r7   Audio for the PIP channel is ignored. (Headphone audio follows the Main video pathway.)

6.2.5 r8 When any parental-control content ratings have been activated, PIP is disabled.[?]

6.2.6 PIP Source Selection

For PIP operation, all sources may be divided into three groups:

Table 7. Sources grouped by allowable PIP combinations.

	Group A	Group B	Group C
Sources	Tuner (Cable or Antenna) DTVLink1 and 2	AV1 CVBS/YC AV2 AV3	AV1 YPbPr AV4 DVI AV5 HD
PIP Behavior	May have PIP from Group B	May have PIP from Group A	Never have a PIP. Never be a PIP.

Given these severe restrictions, the following behaviors apply:

6.2.6 r1 There is no concept of "current window." If users wish to change sources or tune the source being played in the PIP pathway, they must first press the **PIP SWAP** button.

6.2.6 r2 When users press **PIP**, the PIP is displayed with the last used PIP source.

6.2.6 r3 When the PIP is the current window, pressing the **SOURCE** button cycles through the sources available for the PIP.

6.2.6 r4 The sources displayed for PIP are only those available under present conditions. Thus, if the main window is showing output from the tuner, the PIP Sources offered would be restricted to the AV sources the user has installed.

6.2.6 r5 The the Tuner is in the current main video, and the user has installed AV1 YPbPr but not connected a CVBS or YC cable in addition, AV1 will not appear in the source list.

6.2.6 r6 If an AV source is in the main window, and the tuner is the PIP, and the presses attempts a tuning maneuver (e.g., channel up or down), the Module will tune the PIP regardless of its currency state -- i.e., it will attempt to fulfill the users instructions. In this case, the PIP would be the only device that could be tuned.