HD9010TM
HDTV Time Code Master
Instruction Manual

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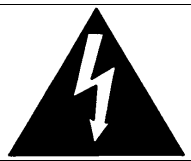
IMPORTANT SAFETY INSTRUCTIONS

	The lightning flash with arrowhead symbol within an equilateral triangle is intended to alert the user to the presence of uninsulated “Dangerous voltage” within the product’s enclosure that may be of sufficient magnitude to constitute a risk of electric shock to persons.
	The exclamation point within an equilateral triangle is intended to alert the user to the presence of important operating and maintenance (Servicing) instructions in the literature accompanying the product.

- Read and keep these instructions
- Heed all warnings.
- Follow all instructions.
- Do not use this apparatus near water
- Clean only with dry cloth.
- Do not block any ventilation openings. Install in accordance with the manufacturer’s instructions.
- Do not install near any heat sources such as radiators, heat registers, stoves, or other apparatus (including amplifiers) that produce heat.
- Do not defeat the safety purpose of the polarized or grounding-type plug. A polarized plug has two blades with one wider than other. A grounding-type plug has two blades and a third grounding prong. The wide blade or the third prong is provided for your safety. If the provided plug does not fit into your outlet, consult an electrician for replacement of the obsolete outlet.
- Protect the power cord from being walked on or pinched particularly at plugs, convenience receptacles and the point where they exit from the apparatus.
- Only use attachments/accessories specified by the manufacturer
- Unplug this apparatus during lightning storms or when unused for long periods of time.
- Refer all servicing to qualified service personnel. Servicing is required when the apparatus has been damaged in any way, such as power-supply cord or plug is damaged, liquid has been spilled or objects have fallen into the apparatus, the apparatus has been exposed to rain or moisture, does not operate normally, or has been dropped.

WARNING
TO REDUCE THE RISK OF FIRE OR ELECTRIC – SHOCK, DO NOT EXPOSE THIS APPARATUS TO RAIN OR MOISTURE

WARNING
DO NOT EXPOSE THIS EQUIPMENT TO DRIPPING OR SPLASHING AND ENSURE THAT NO OBJECTS FILLED WITH LIQUIDS ARE PLACED ON THE EQUIPMENT

WARNING
TO COMPLETELY DISCONNECT THIS EQUIPMENT FROM THE AC MAINS, DISCONNECT THE POWER SUPPLY CORD PLUG FROM THE AC RECEPTACLE

WARNING
THE MAINS PLUG OF THE POWER SUPPLY CORD SHALL REMAIN READILY OPERABLE

INFORMATION TO USERS IN EUROPE

NOTE

This equipment with the CE marking complies with bother the EMC Directive (89/336/EEC) and the Low Voltage Directive (73/23/EEC) issued by the Commission of the European Community.

Compliance with these directives implies conformity to the following European standards:

- EN60065 Product Safety
- EN55103-1 Electromagnetic Interference Class A (Emission)
- EN55103-2 Electromagnetic Susceptibility (Immunity)

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to the European Union EMC directive. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

INFORMATION TO USERS IN THE U.S.A.

NOTE

FCC CLASS A DIGITAL DEVICE OR PERIPHERAL

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

WARNING

Changes or Modifications not expressly approved by Evertz Microsystems Ltd. could void the user's authority to operate the equipment.

Use of unshielded plugs or cables may cause radiation interference. Properly shielded interface cables with the shield connected to the chassis ground of the device must be used.

REVISION HISTORY

REVISION	DESCRIPTION	DATE
0.1	Preliminary Version	Oct 03
1.0	First Release - Fix typos – manual updated to conform to firmware version 1v1 Build 66	Mar 04
1.1	Fix Typos - manual updated to conform to firmware version 1v1 Build 214	Mar 04
1.2	Manual updated to conform to firmware version 1v2 Build 44 Added Tri-level sync support	Aug 04
2.0	Manual updated to conform to Hardware Revision 2 and firmware version 2v0 Build 1 Corrected GPI pin out, added new info for upgrading Rev 2 hardware at 115200 baud. Added new info for serial port baud rate menu items.	May 05
2.1	Manual updated to conform to firmware version 2v0 Build 1 Added GPI Remote Control Encoding, and GPI and COM Port status displays	Jul 05
2.2	Manual updated to conform to firmware version 2v0 Build 37 Added ON AIR Tally and reassigned default GPI functions	Oct 05
2.3	Add description for Drop Frame Conversion mode, document changes to Preset Save and Preset Load functions	Dec 05
2.3.1	Fix Typos in Special Indicators section	Feb 06
2.3.2	Add note that unit required Video Input for normal operation	Jul 06
2.3.3	Updated overview and Specifications	Dec 06
2.3.4	Fixed typos and formatting errors	May 07
2.4	Manual updated to conform to firmware version 2v0 Build 285 Added ‘Double Height” character size feature, Remove VANC Line & On/Off control	Nov 09
2.4.1	Minor edits to overview and sections 3.5.2, 3.7.1	Jan 14

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TABLE OF CONTENTS

1. OVERVIEW 1-1

1.1. HOW TO USE THIS MANUAL 1-2

1.2. DEFINITIONS 1-3

2. INSTALLATION 2-1

2.1. REAR PANEL 2-1
2.1.1. Video Connections 2-1
2.1.2. GenLock Reference Connections 2-1
2.1.3. Linear Timecode 2-1
2.1.4. Parallel I/O Connections 2-2
2.1.5. Serial I/O Connections 2-2
2.1.6. Power Connections 2-3

2.2. MOUNTING 2-3

2.3. POWER REQUIREMENTS 2-3

2.4. CONNECTING THE VIDEO 2-4
2.4.1. High Definition Video Input 2-4
2.4.2. High Definition Video Output 2-4

2.5. CONNECTING THE LINEAR TIME CODE 2-5
2.5.1. Connecting the Primary LTC Generator 2-6
2.5.2. Connecting the Primary LTC Reader 2-6

2.6. CONNECTING THE AUXILLIARY TIME CODE 2-6
2.6.1. Connecting the Auxiliary LTC Generator 2-6
2.6.2. Connecting the Auxiliary LTC Reader 2-6

2.7. CONNECTING THE HD9010TM TO A COMPUTER 2-7
2.7.1. Physical Connections 2-7

3. HOW TO OPERATE THE TIME CODE MASTER 3-1

3.1. AN OVERVIEW OF KEY AND DISPLAY FUNCTIONS 3-1
3.1.1. The Setup Menu Pushbutton Group 3-1
3.1.2. The Display Button Group 3-2
3.1.3. Panel Lock Key Functions 3-2
3.1.4. The Character Window Pushbutton Group 3-2
3.1.5. The Function Button Group 3-3
3.1.6. The Preset Button Group 3-3
3.1.7. An Overview of the SHIFT Key functions 3-4
3.1.8. Shaft Encoder Knob 3-4
3.1.9. An Overview of the Status Indicators 3-5

3.2. FRONT PANEL DISPLAY FUNCTIONS 3-6
3.2.1. Front Panel Displays 3-6
3.2.2. Special Front Panel Indicators 3-6

3.3. AN OVERVIEW OF THE SETUP MENU SYSTEM 3-6

3.4. CONFIGURING THE GENERATOR 3-8
3.4.1. Configuring the Generator Mode 3-9
3.4.2. Setting the Generator Time 3-10
3.4.3. Setting the Generator User Bits 3-10
3.4.4. Jam Syncing the Generator to the Primary reader 3-11
3.4.5. Turning the ATC Generator On 3-12
3.4.6. Setting the ATC Packet Type 3-12
3.4.7. Selecting the Generator Drop Frame Mode (29.97 and 59.94 FPS video standards only) 3-13
3.4.7.1. Conversion Between Drop Frame and Non Drop Frame Counting Modes 3-13
3.4.8. Generator LTC Parity Mode Selection 3-15
3.4.9. Configuring how the Continuous Jam Sync Mode Works when there is no Primary Reader Code 3-16

3.5. CONFIGURING THE READERS 3-16
3.5.1. Setting the Primary reader 3-17
3.5.2. Setting the ATC Reader Packet Type. 3-17
3.5.3. Selecting the Format of the ATC Reader Time and User Bit Data 3-18
3.5.4. Selecting the Format of the LTC Reader Time and User Bit Data 3-18
3.5.5. Selecting the Format of the Auxiliary LTC Reader Time and User Bit Data 3-18

3.6. CONFIGURING THE CHARACTER GENERATOR FUNCTIONS 3-18
3.6.1. Selecting the Character Style 3-19
3.6.2. Selecting whether the Frames, Fields and Symbols will be displayed on the VCG 3-19
3.6.3. Selecting and Positioning the Individual Character Inserter Windows 3-20
3.6.4. Positioning the Overall Character Display and Turning it On and Off 3-20
3.6.5. Special VCG Indicators 3-21

3.7. GENERAL CONFIGURATION ITEMS 3-21
3.7.1. Selecting the Video Standard 3-22
3.7.2. Selecting the Generator Framing Reference 3-23
3.7.3. Adjusting the Output Level of the LTC Generators 3-23
3.7.4. Adjusting the Baud Rate of the Serial Ports 3-23
3.7.5. Working with System Parameters 3-24
3.7.6. Viewing the Hardware Version 3-24
3.7.7. Viewing the Firmware Version 3-24
3.7.8. Upgrading the Firmware 3-25
3.7.9. Resetting the HD9010TM to its Factory Defaults 3-25

3.8. CONFIGURING THE GENERAL PURPOSE INPUTS AND OUTPUTS 3-25
3.8.1. GPI Remote Control Mode 3-25
3.8.2. Assigning the Functions of the General Purpose Inputs 3-26

4. TECHNICAL DESCRIPTION 4-1

4.1. SPECIFICATIONS 4-1
4.1.1. HDTV Serial Digital Video Input 4-1
4.1.2. HDTV Serial Digital Video Outputs 4-1
4.1.3. Reference Input 4-1
4.1.4. LTC Generators 4-1
4.1.5. LTC Readers 4-1

4.1.6. Serial Ports 4-2
4.1.7. System Latency 4-2
4.1.8. Physical 4-2
4.1.9. Electrical 4-2

4.2. UPGRADING THE FIRMWARE 4-2
4.2.1. Overview 4-2
4.2.2. Terminal Program Setup 4-3
4.2.3. Initiating Firmware Upgrade Mode Via The Front Panel 4-3
4.2.4. Initiating Firmware Upgrade Mode From The Terminal Program 4-3
4.2.5. Uploading the New Firmware 4-4
4.2.6. Completing the Upgrade 4-5

4.3. SERVICING INSTRUCTIONS 4-5
4.3.1. Changing the Fuses 4-5
4.3.2. Changing DIP Switch Settings 4-6
4.3.2.1. Enabling the Time Code Broadcast Data Output 4-6

Figures

Figure 1-1: HD9010TM Block Diagram 1-2
Figure 2-1: HD9010TM Rear Panel 2-1
Figure 3-1: HD9010TM Front Panel Layout 3-1
Figure 3-2: Overview of the Setup Menu 3-7

Tables

Table 2-1: Parallel I/O Connector Pin Definitions – Normal GPIO Functions 2-2
Table 2-2: Parallel I/O Port Pin Definitions – Time RCTL Mode 2-2
Table 2-3: COM1 Pin Definitions 2-3
Table 2-4: AUX COM Pin Definitions 2-3
Table 2-5: High Definition Video Input Formats 2-5
Table 3-1: Top Level of the Generator Setup Menu 3-8
Table 3-2: Top Level of the Reader Setup Menu 3-16
Table 3-3: Top Level of the VCG Setup Menu 3-19
Table 3-4: Top Level of the Utility Setup Menu 3-21
Table 3-5: Remote Control Mode GPI I/O Mapping 3-26
Table 3-6: Parallel I/O Connector Pin Definitions – Normal GPIO Functions (Rev 2 Versions) 3-26
Table 3-7: Parallel I/O Connector Pin Definitions – Normal GPIO Functions (Rev 1 Versions) 3-27
Table 4-1: DIP Switch Functions 4-6

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CHAPTER 1
TABLE OF CONTENTS

1. OVERVIEW 1-1

1.1. HOW TO USE THIS MANUAL 1-2

1.2. DEFINITIONS 1-3

Figures

Figure 1-1: HD9010TM Block Diagram 1-2

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1. OVERVIEW

The HD9010TM HDTV Time Code Master is a full function time code reader/generator system for high definition serial digital video. The HD9010TM is a combination dual generator/ dual reader for SMPTE 12M Linear Time Code (LTC) and RP188 Ancillary Time Code (ATC), and contains a high resolution character inserter which can burn the generator or reader numbers directly into the high definition serial digital program output.

The HD9010TM requires a SMPTE 292M (1.5 Gb/s) high definition serial digital video for normal operation. The HD9010TM time code generators can be referenced to the input video or to an analog colour black reference to provide stable output timing during momentary disruptions of the input video. When generating 24Fps time code it will also lock the generator count sequence to a 6 Hz pulse

The HD9010TM generators can be slaved to incoming LTC or ATC or can be set to free run. The generators may also be momentarily synchronized to one of the readers, and then it continues to increment normally regardless of the reader code. The second LTC output normally follows the primary output, however the two generators can be operated at different frame rates to supply both 24Fps and 30Fps time code when shooting in a 1080p/24 environment.

The high-resolution character inserter provides independently positional windows to show time and user bits for the generator and readers simultaneously. The choice of white or black characters with or without contrasting background mask is available.

Features:

- Video formats supported: 1080i/60, 1080i/50, 1080p/30sF, 1080p/25sF, 1080p/24sF, 720p/60, 720p/50 and the 1/1.001 divisor versions where applicable
- Reads RP188 LTC and VITC ancillary time code (ATC) from incoming video - read line auto detected
- Generates RP188 LTC and VITC ancillary time code on output video
- Two LTC readers and two LTC generators operate at 24, 25 or 30 Fps nominal rate in accordance with SMPTE 12M specification
- Generates 24 Fps and 30 Fps simultaneously
- RP-188 ATC ⇔ LTC translator
- Genlocks to NTSC/PAL colour black or HD Tri-level sync
- Locks to 6 Hz pulse when generating 24 Fps nominal rate code
- Drop frame ⇔ Non drop frame converter
- Character windows for the reader and generator time and user bit data. Windows can be positioned and turned off and on independently, Independent control of one of two character sizes
- White or black characters on contrasting background
- Front panel display and control using menu system
- Optional dual power supply configuration
- Parallel GPI/O control of common functions
- GPI Remote Control mode allows user to pass remote control contact closure information in RP188 user bits
- Field upgradeable firmware as new features become available
- Optional input relay bypass for power failure bypass protection

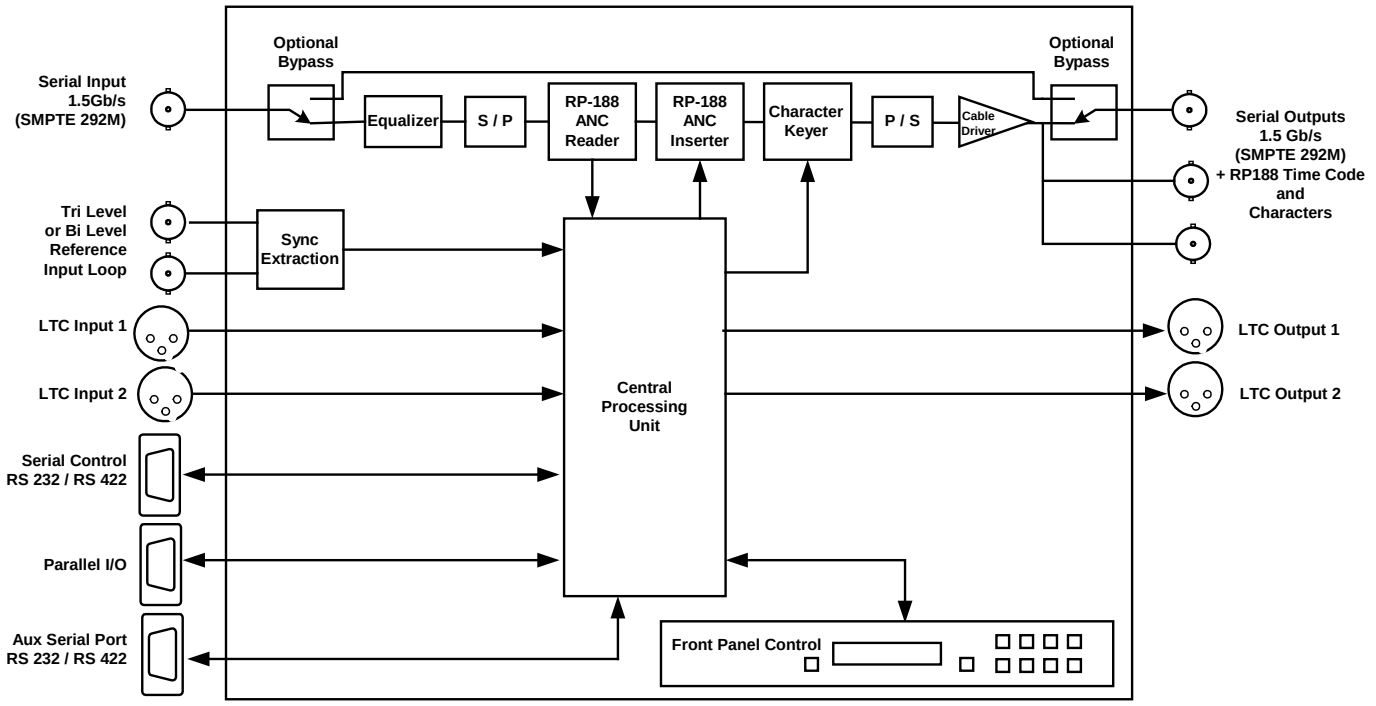

Figure 1-1: HD9010TM Block Diagram

1.1. HOW TO USE THIS MANUAL

This manual is organised into 5 chapters: Overview, Installation, Calibration, System Parameters, and Technical Description. The overview section contains a brief overview of the HD9010TM operation and features, and a glossary to define concepts and terms used throughout the remainder of the manual. We highly recommend taking the time to become familiar with the terms and concepts described here before proceeding into the rest of the manual.

Chapter 2 gives a detailed description of the rear panel connectors, and how the HD9010TM should be connected into your system.

Chapter 3 shows how to calibrate the system timing and verify that the HD9010TM is accurately numbering the film and video frames.

Chapter 4 gives a discussion of how the default operation of the HD9010TM can be changed using System Parameters. The system parameters can affect the system timing through the Afterburner, placement of characters on the raster, 2:3 cadence control, functions of parallel inputs and outputs to name a few.

Chapter 5 gives technical information such as the specifications and how to update the firmware in the HD9010TM.

This symbol is intended to alert the user to important operating instructions.

The exclamation point within an equi-lateral triangle is intended to alert the user to the presence of important safety related operating and maintenance (Servicing) instructions in this manual.

1.2. DEFINITIONS

24p: A progressively scanned high definition video format with 1920 pixels and 1080 lines. (See also description sF.)

4:2:2 The sampling ratio used in the HDTV digital video signal. For every 4 samples of luminance there are 2 samples each of R-Y (Red minus Luminance) and B-Y (Blue minus luminance).

4:4:4 A sampling ratio that has equal amounts of the luminance and both chrominance channels.

16x9 A wide screen television format such as HDTV in which the aspect ratio of the screen is 16 units wide by 9 high as opposed to the 4x3 of normal TV.

AES/EBU: (Sometimes abbreviated as AES) Refers to the digital audio standard (AES3-1992) set by the Audio Engineering Society and European Broadcast Union and used by most forms of digital audio from CDs to professional digital video.

Aspect Ratio: The ratio of width to height in a picture. Theatre screens generally have an aspect ratio of 1.85 to 1, widescreen TV (16x9) is 1.77 to 1, and normal TV (4x3) is 1.33 to 1.

CCIR (International Radio Consultative Committee) An international standards committee. (This organisation is now known as ITU.)

CCIR-601: See ITU-R601.

Cliff effect: (also referred to as the 'digital cliff') This is a phenomenon found in digital video systems that describes the sudden deterioration of picture quality when due to excessive bit errors, often caused by excessive cable lengths. The digital signal will be perfect even though one of its signal parameters is approaching or passing the specified limits. At a given moment however, the parameter will reach a point where the data can no longer be interpreted correctly, and the picture will be totally unrecognisable.

Component analog: The non-encoded output of a camera, video tape recorder, etc., consisting of the three primary colour signals: red, green, and blue (RGB) that together convey all necessary picture information. In some component video formats these three components have been translated into a luminance signal and two colour difference signals, for example Y, B-Y, R-Y.

Component digital: A digital representation of a component analog signal set, most often Y, B-Y, R-Y. The encoding parameters are specified by ITU-R709 for HDTV signals. SMPTE 274M and SMPTE 296M specify the parallel interface.

Composite analog: An encoded video signal such as NTSC or PAL video that includes horizontal and vertical synchronizing information.

Composite digital: A digitally encoded video signal, such as NTSC or PAL video that includes horizontal and vertical synchronizing information.

D1: A component digital video recording format that uses data conforming to the ITU-R601 standard. Records on 19 mm magnetic tape. (Often used incorrectly to refer to component digital video.)

D2: A composite digital video recording format that uses data conforming to SMPTE 244M. Records on 19 mm magnetic tape. (Often used incorrectly to refer to composite digital video.)

D3: A composite digital video recording format that uses data conforming to SMPTE 244M. Records on 1/2" magnetic tape.

D5: A component digital video recording format that uses data conforming to the ITU-R601 standard. Records on 1/2" magnetic tape.

HD-D5: A component digital video recording format that uses data conforming to the ITU-R709 standard. Records on 1/2" magnetic tape.

Drop frame: In NTSC systems, where the frame rate is 29.97002618 frames per second, the drop frame mode permits time of day indexing of the frame numbers by dropping certain frame numbers. Specifically, frames 0, and 1 at the beginning of each minute except minutes 0,10,20,30,40, & 50, are omitted, to compensate for an approximate timing error of 108 frames (3 seconds 18 frames) per hour. A flag bit is set in the time code to signal when the drop frame mode is in effect.

EBU (European Broadcasting Union): An organisation of European broadcasters that among other activities provides technical recommendations for the 625/50 line television systems.

Embedded audio: Digital audio is multiplexed onto a serial digital video data stream.

Gen lock: In order to derive the 6 Hz relationship between 23.98 Fps and 29.97 Fps frame boundaries, and to ensure that the timecode to 6 Hz relationship is fixed, an NTSC colour black video reference must be supplied to the HDHD9010TM Film Footage Encoder. Normally, the gen lock signal is the colour black system reference to which the 24p tri-level sync generator is gen locked. The gen lock reference is only necessary when the system video type is 1080p/23.98sF.

ITU: The United Nations regulatory body governing all forms of communications. ITU-R (previously CCIR) regulates the radio frequency spectrum, while ITU-T (previously CCITT) deals with the telecommunications standards.

ITU-R601: An international standard for standard definition component digital television from which was derived SMPTE 125M and EBU 3246-E standards. ITU-R601 defines the sampling systems, matrix values and filter characteristics for both Y, B-Y, R-Y and RGB component digital television signals.

ITU-R709: An international standard for High definition component digital television from which was derived SMPTE 274M and SMPTE 296M standards. ITU-R709 defines the sampling systems,

matrix values and filter characteristics for both Y, B-Y, R-Y and RGB component digital television signals.

Jam sync: Refers to the operation of slaving the generator to data coming from the reader. Jam sync should be used when dubbing time code from one tape to another, as the quality of the time code signal deteriorates with each generation, and will become unusable after the third generation.

In the jam sync mode, the generator and reader times are compared with each other during each frame, automatically compensating for the decoding offsets. If for any reason they are not equal, the jam is bypassed, and the generator substitutes the next frame number. If the number of consecutive jam bypass errors exceeds 5, the last valid reader time is jammed into the generator again. In the absence of valid reader data within the last 5 frames, the generator continues to increment normally until valid reader code resumes. At this time it will be re-jammed to the reader, thus repairing large dropouts on the reader tape.

Letterbox: Placing a wide screen image on a conventional TV by placing black bands at the top and bottom of the screen.

Linear time code: (Also known as Longitudinal Time Code) A digital code used for timing and control purposes on videotape and associated audio tape machines. It is recorded on a linear track with audio characteristics and is referred to as LTC. Each 80 bit code word is associated with one television frame, and consists of 26 time bits, 6 flag bits, 32 user bits and 16 sync bits. This time code may run at 24, 25 or 30 frames per second depending on the video format. See also SMPTE 12M

LTC: See Linear Time Code

NTSC: National Television Standards Committee established the television and video standard in use in the United States, Canada, Japan and several other countries. NTSC video consists of 525 horizontal lines at a field rate of approximately 60 fields per second. (Two fields equals one complete Frame). Only 487 of these lines are used for picture. The rest are used for sync or extra information such as VITC and Closed Captioning.

PAL: Phase Alternating Line. The television and video standard in use in most of Europe. Consists of 625 horizontal lines at a field rate of 50 fields per second. (Two fields equals one complete Frame). Only 576 of these lines are used for picture. The rest are used for sync or extra information such as VITC and Teletext.

Pixel: The smallest distinguishable and resolvable area in a video image. A single point on the screen. In digital video, a single sample of the picture. Derived from the words *picture element*.

Serial digital: Digital information that is transmitted in serial form. Often used informally to refer to serial digital television signals.

SMPTE (Society of Motion Picture and Television Engineers): A professional organisation that recommends standards for the film and television industries.

SMPTE 12M: The SMPTE standard for Time and address code. SMPTE 12M defines the parameters required for both linear and vertical interval time codes.

SMPTE 274M: The SMPTE standard for bit parallel digital interface for high definition component video signals with an active picture of 1080 lines x 1920 pixels.

SMPTE 291M: The SMPTE standard for encoding ancillary data packets in serial digital video signals.

SMPTE 292M: The SMPTE standard for high definition serial digital component interfaces.

SMPTE 296M: The SMPTE standard for bit parallel digital interface for high definition component video signals with an active picture of 720 lines x 1280 pixels.

SMPTE 299M: The SMPTE standard for embedding audio in serial digital high definition (SMPTE 292M) video signals.

SMPTE RP188: The SMPTE recommended practice for embedding SMPTE 12M timecode into ancillary data packets in serial digital video signals.

sF: (Also known as *segmented frame)* The picture is progressively scanned, however divided into two *segments*, containing the odd and even lines. The segments are then sent out the serial digital interface in the same way that the fields of an interlaced video signal are. This format is often used at nominal frame rates of 24, 25 or 30 frames per second.

TRS: Timing reference signals used in composite digital systems. (It is four words long).

TRS-ID: Abbreviation for "Timing Reference Signal Identification". A reference signal used to maintain timing in composite digital systems. (It is four words long.)

User bits: 32 bits in the time code are user assignable. They typically are used to contain reel numbers, scene and take numbers, or other user-oriented data.

CHAPTER 2
TABLE OF CONTENTS

2. INSTALLATION 2-1

2.1. REAR PANEL 2-1
2.1.1. Video Connections 2-1
2.1.2. GenLock Reference Connections 2-1
2.1.3. Linear Timecode 2-1
2.1.4. Parallel I/O Connections 2-2
2.1.5. Serial I/O Connections 2-2
2.1.6. Power Connections 2-3

2.2. MOUNTING 2-3

2.3. POWER REQUIREMENTS 2-3

2.4. CONNECTING THE VIDEO 2-4
2.4.1. High Definition Video Input 2-4
2.4.2. High Definition Video Output 2-4

2.5. CONNECTING THE LINEAR TIME CODE 2-5
2.5.1. Connecting the Primary LTC Generator 2-6
2.5.2. Connecting the Primary LTC Reader 2-6

2.6. CONNECTING THE AUXILLIARY TIME CODE 2-6
2.6.1. Connecting the Auxiliary LTC Generator 2-6
2.6.2. Connecting the Auxiliary LTC Reader 2-6

2.7. CONNECTING THE HD9010TM TO A COMPUTER 2-7
2.7.1. Physical Connections 2-7

Figures

Figure 2-1: HD9010TM Rear Panel 2-1

Tables

Table 2-1: Parallel I/O Connector Pin Definitions – Normal GPIO Functions 2-2
Table 2-2: Parallel I/O Port Pin Definitions – Time RCTL Mode 2-2
Table 2-3: COM1 Pin Definitions 2-3
Table 2-4: AUX COM Pin Definitions 2-3
Table 2-5: High Definition Video Input Formats 2-5

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2. INSTALLATION

2.1. REAR PANEL

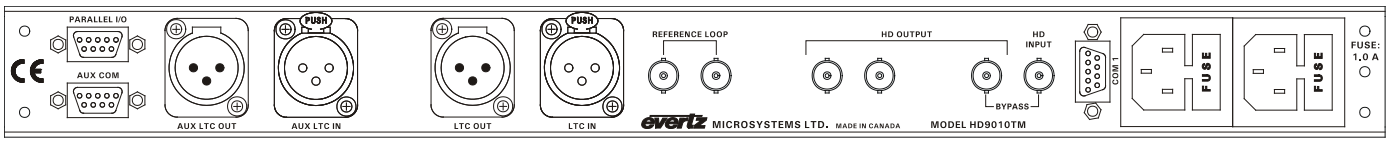

Figure 2-1: HD9010TM Rear Panel

The following sections describe the purpose of the rear panel connectors of the HD9010TM. Sections 2.1.1 to 2.1.6 describe the specific generator, reader, and video signals that should be connected to the HD9010TM.

2.1.1. Video Connections

HD INPUT Input BNC connector for 10-bit serial digital video signals, compatible with the SMPTE 292M standard. The HD9010TM is capable of working with the high definition video formats shown in Table 2-5.

HD BYPASS OUTPUT High definition serial digital video output, compatible with the SMPTE 292M standard, with the RP188 Ancillary Time Code and optional characters inserted. When the optional bypass relay (HBP option) is activated (on power failure or from the front panel) the HD BYPASS OUTPUT will be a direct relay connection to the HD INPUT.

HD OUTPUT High definition serial digital video output, compatible with the SMPTE 292M standard, with the RP188 Ancillary Time Code and optional characters inserted. When the optional bypass relay (HBP option) is activated (on power failure or from the front panel) the HD OUTPUT BNCs will not have any video signal on them.

2.1.2. GenLock Reference Connections

REFERENCE LOOP Input BNC loop for a genlock reference. The input can be either a 1 V p-p colour black or Tri-level reference. The **REFERENCE LOOP** is a high impedance input therefore, the reference signal must be properly terminated at the end of the line. The sync format must be one of the valid sync types for the video standard in use as shown in Table 2-5. See section 3.7.2 for information on selecting the *REFERENCE MODE* of the HD9010TM.

2.1.3. Linear Timecode

LTC OUT: A Male XLR connector for the output of SMPTE/EBU linear time code.

LTC IN: A Female XLR connector for input of SMPTE/EBU linear time code.

AUX LTC OUT: A Male XLR connector for the output of SMPTE/EBU linear time code.

AUX LTC IN: A Female XLR connector for input of SMPTE/EBU linear time code.

2.1.4. Parallel I/O Connections

PARALLEL I/O: A 9 pin female 'D' connector contains several other general purpose parallel remote control inputs and outputs. The inputs and outputs operate at TTL levels. There are two different versions of hardware that may be installed in the HD9010TM. The *HARDWARE VERSION* menu item will tell you whether you have Rev 1 (7700PB3) or Rev 2 (7700PH4) hardware installed. GPI3 and GPI4 inputs are not available on the Rev 1 hardware.

Table 2-1 shows the power up default functions of the **PARALLEL I/O** connector pins when the *GEN MODE* is NOT set to *time rctl* mode, however, the functions of pins 1, 4, 5, 8, and 9 may be changed using system parameter values. (See section 3.8.2 for information about the default function of the inputs.)

Pin #	Name	Description
1	GPI1	GPI0 1 Input/Output
2	GPI6	GPI 6 Input (Rev 2 versions only)
3	GPI8	GPI 8 Input (Rev 2 versions only)
4	GPI3	GPIO 3 Input/Output (Rev 2 versions only)
5	GPI5	GPIO 5 Input/Output
6	GND	Ground
7	GPI7	GPI 7 Input (Rev 2 versions only)
8	GPI2	GPIO 2 Input/Output
9	GPI4	GPIO 4 Input/Output (Rev 2 versions only)

Table 2-1: Parallel I/O Connector Pin Definitions – Normal GPIO Functions

Table 2-2 shows the functions of the **PARALLEL I/O** connector pins when the *GEN MODE* is set to *time rctl* mode. (See section 3.8.1 for a complete description of the operation of the *time rctl* mode.)

Pin #	Name	Description
1	GPI1	Controls UB GPI bit 1
2	GPI6	Controls UB GPI bit 6 (Rev 2 versions only)
3	GPI8	GPI 8 Input (Rev 2 versions only)
4	GPI3	Controls UB GPI bit 3 (Rev 2 versions only)
5	GPI5	Controls UB GPI bit 5
6	GND	Ground
7	GPI7	GPI 7 Input (Rev 2 versions only)
8	GPI2	Controls UB GPI bit 2
9	GPI4	Controls UB GPI bit 4 (Rev 2 versions only)

Table 2-2: Parallel I/O Port Pin Definitions – Time RCTL Mode

2.1.5. Serial I/O Connections

COM1: A 9 pin female 'D' connector for connection to a computer is used for firmware upgrades to the HD9010TM. See section 2.7 for a cable wiring diagram and more information on connecting the HD9010TM to the computer.

Pin #	Name	Description
1	GND	Chassis ground
2	TxD	RS-232 Transmit Output
3	RxD	RS-232 Receive Input
4		
5	Sig Gnd	RS-232 Signal Ground
6		
7	RTS	RS-232 RTS Input
8	CTS	RS-232 CTS Output
9		

Table 2-3: COM1 Pin Definitions

AUX COM: A 9-pin female 'D' connector for connection to auxiliary devices. This port is not used at this time.

Pin #	Name	Description
1	GND	Chassis ground
2	TxD	RS-232 Transmit Output
3	RxD	RS-232 Receive Input
4		
5	Sig Gnd	RS-232 Signal Ground
6		
7	RTS	RS-232 RTS Input
8	CTS	RS-232 CTS Output
9		

Table 2-4: AUX COM Pin Definitions

2.1.6. Power Connections

LINE: The HD9010TM Film Footage Encoder has a universal power supply operating on either 115v/60 Hz or 230v/50 Hz AC operation.

2.2. MOUNTING

The HD9010TM is equipped with rack mounting angles and fits into a standard 19 inches by 1.75 inches by 17.75 inches (483 mm x 45 mm x 451mm) rack space. The mounting angles may be removed if rack mounting is not desired.

2.3. POWER REQUIREMENTS

Power requirements are 115 or 230 volts AC at 50 or 60 Hz. The HD9010TM has a universal power supply that automatically senses the input voltage. Power should be applied by connecting a 3-wire grounding type power supply cord to the power entry module on the rear panel. The power cord should be minimum 18 AWG wire size; type SVT marked VW-1, maximum 2.5 m in length.

The power entry module combines a standard power inlet connector, two 5 x 20 mm fuse holders and an EMI line filter.

CAUTION - TO REDUCE THE RISK OF ELECTRIC SHOCK, GROUNDING OF THE GROUND PIN OF THE MAINS PLUG MUST BE MAINTAINED

2.4. CONNECTING THE VIDEO

2.4.1. High Definition Video Input

The high definition program video source should be connected to the HD INPUT BNC. The HD9010TM can be configured to auto detect one of the high definition digital video in the formats shown in Table 2-5 or set manually to match the incoming video type using the *Video Standard* Menu.

The Video LED indicator will be On when there is video present matching the selected video type. When it is blinking it indicates that there is video present but the VIDEO TYPE menu item does not match the input video format.

The HD9010TM requires a stable video input for normal operation.

2.4.2. High Definition Video Output

The HD BYPASS and HD OUTPUT outputs contain the input high definition video with RP215 ancillary data (VANC) and optional characters keyed in. Connect one of these outputs to any input on your system that accepts SMPTE 292M serial digital video. The three outputs are identical except that the HD BYPASS output may be protected by an optional bypass relay (+HBP option). When the relay is active, the HD BYPASS output is directly connected to the HD INPUT, and the other two HD OUTPUTS will have no video output.

Common Name	Pixels / Active Lines	Frame Rate	Progressive /Interlace	SMPTE Standard	Valid Genlock Types
1080i/60	1920 x 1080	30	I	274M	1080i/60 1080p/30sF 525i/30
1080i/59.94	1920 x 1080	29.97 (30/1.001)	I	274M	1080i/59.94 1080p/29.97sF NTSC
1080i/50	1920 x 1080	25	I	274M	1080i/50 PAL
1080p/30sF	1920 x 1080	30	P (sF)	274M	1080i/59.94 1080p/29.97sF 525i/30
1080p/29.97sF	1920 x 1080	29.97 (30/1.001)	P (sF)	274M	1080i/59.94 1080p/29.97sF NTSC
1080p/25sF	1920 x 1080	25	P (sF)	274M	1080i/50 PAL
1080p/24sF	1920 x 1080	24	P (sF)	274M	1080p/24sF 625i/48
1080p/23.98sF	1920 x 1080	23.98 (24/1.001)	P (sF)	274M	1080p/23.98sF 625i/47.96
720p/60	1280 x 720	60	P	296M	1080i/60 1080p/30sF 720p/60 525i/30
720p/59.94	1280 x 720	59.94 (60/1.001)	P	296M	1080i/59.94 1080p/29.97sF 720p/59.94 NTSC
720p/50	1280 x 720	50	P	296M	1080i/50 1080p/25sF 720p/50 625i/25

Table 2-5: High Definition Video Input Formats

2.5. CONNECTING THE LINEAR TIME CODE

The HD9010TM has two linear time code (LTC) inputs and two LTC outputs. The frame rate of the primary LTC output will be the same as the system video frame rate. The frame rate of the AUX LTC output will be the same as primary LTC output when the system video frame rate is 25 frames per second.

2.5.1. Connecting the Primary LTC Generator

The primary LTC Generator output is available on the LTC OUT XLR connector on the rear panel. The output level of the generator is factory set to 1 volt peak to peak, but may be adjusted using the level adjustment (labelled RTP1) located on the 9000TCIO circuit card.

The auxiliary LTC Generator output is available on the AUX LTC OUT XLR connector on the rear panel. The output level of the generator is factory set to 1 volt peak to peak, but may be adjusted using the level adjustment (labelled RTP2) located on the 9000TCIO circuit card.

The generator code output should be connected to the time code input of your video recorder. Pin 1 of the XLR is ground, and pins 2 and 3 provide a balanced output. When using a machine with an unbalanced input the signal should be connected to Pin 3 of the generator output XLR. Pin 2 should be left open.

2.5.2. Connecting the Primary LTC Reader

Connect the LTC output from your video recorder to the HD9010TM's LTC IN XLR connector. When using an unbalanced input to the reader, the signal should be applied to pin 3 of the reader input connector. Normally, the unused input, (pin 2) should be connected to ground (pin 1). This input is used to jam sync the HD9010TM's Video LTC generator to the code previously recorded on tape. This mode is used when the Record VTR is generating its own time code and the HD9010TM needs to read it to insert the VTR's timecode into the RP188 Ancillary time code packets.

2.6. CONNECTING THE AUXILLIARY TIME CODE

The frame rate of the auxiliary time codes may be different than the system video frame rate. Specifically, in applications where the video rate is 23.98 frames per second the auxiliary time code frame rate will usually be 29.97 frames per second.

2.6.1. Connecting the Auxiliary LTC Generator

The auxiliary LTC output Generator is available on the AUX LTC OUT XLR connector at the rear panel. The output level of the generator is factory set to 1 volt peak to peak, but may be adjusted using the level adjustment (labelled RTP2) located on the 9000TCIO circuit card.

Pin 1 of the XLR is ground, and pins 2 and 3 provide a balanced output. When using a machine with an unbalanced input the signal should be connected to Pin 3 of the generator output XLR. Pin 2 should be left open.

2.6.2. Connecting the Auxiliary LTC Reader

Connect the auxiliary LTC to the AUX LTC IN XLR connector. When using an unbalanced input to the reader, the signal should be applied to pin 3 of the reader input connector. Normally, the unused input, (pin 2) should be connected to ground (pin 1). This input is used to read timecode from the audio player when it is being controlled externally, so that the audio time code can be properly logged.

2.7. CONNECTING THE HD9010TM TO A COMPUTER

2.7.1. Physical Connections

A 9 pin sub-miniature 'D' connector **(COM 1)** is provided for connection to a computer. This serial port provides a bi-directional RS-232-C data link for upgrading firmware. It also provides a serial data stream containing the time and user bit data. In order to connect your HD9010TM to your computer use standard 9 pin 'straight through' cable. See section 4.2 for a complete description of how to upgrade the firmware. Contact the factory for further information about the serial data output. The baud rate of this port is set using the *COM 1 BAUD RATE* menu item.

A second 9 pin sub-miniature 'D' connector **(AUX COM)** is provided for future use. In order to connect your HD9010TM to your computer use standard 9 pin 'straight through' cable. The baud rate of this port is set using the *AUXCOM BAUD RATE* menu item.

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CHAPTER 3
TABLE OF CONTENTS

3. HOW TO OPERATE THE TIME CODE MASTER 3-1

3.1. AN OVERVIEW OF KEY AND DISPLAY FUNCTIONS 3-1
3.1.1. The Setup Menu Pushbutton Group 3-1
3.1.2. The Display Button Group 3-2
3.1.3. Panel Lock Key Functions 3-2
3.1.4. The Character Window Pushbutton Group 3-2
3.1.5. The Function Button Group 3-3
3.1.6. The Preset Button Group 3-3
3.1.7. An Overview of the SHIFT Key functions 3-4
3.1.8. Shaft Encoder Knob 3-4
3.1.9. An Overview of the Status Indicators 3-5

3.2. FRONT PANEL DISPLAY FUNCTIONS 3-6
3.2.1. Front Panel Displays 3-6
3.2.2. Special Front Panel Indicators 3-6

3.3. AN OVERVIEW OF THE SETUP MENU SYSTEM 3-6

3.4. CONFIGURING THE GENERATOR 3-8
3.4.1. Configuring the Generator Mode 3-9
3.4.2. Setting the Generator Time 3-10
3.4.3. Setting the Generator User Bits 3-10
3.4.4. Jam Syncing the Generator to the Primary reader 3-11
3.4.5. Turning the ATC Generator On 3-12
3.4.6. Setting the ATC Packet Type 3-12
3.4.7. Selecting the Generator Drop Frame Mode (29.97 and 59.94 FPS video standards only) 3-13
3.4.7.1. Conversion Between Drop Frame and Non Drop Frame Counting Modes ... 3-13
3.4.8. Generator LTC Parity Mode Selection 3-15
3.4.9. Configuring how the Continuous Jam Sync Mode Works when there is no Primary Reader Code 3-16

3.5. CONFIGURING THE READERS 3-16
3.5.1. Setting the Primary reader 3-17
3.5.2. Setting the ATC Reader Packet Type. 3-17
3.5.3. Selecting the Format of the ATC Reader Time and User Bit Data 3-18
3.5.4. Selecting the Format of the LTC Reader Time and User Bit Data 3-18
3.5.5. Selecting the Format of the Auxiliary LTC Reader Time and User Bit Data 3-18

3.6. CONFIGURING THE CHARACTER GENERATOR FUNCTIONS 3-18
3.6.1. Selecting the Character Style 3-19
3.6.2. Selecting whether the Frames, Fields and Symbols will be displayed on the VCG ... 3-19
3.6.3. Selecting and Positioning the Individual Character Inserter Windows 3-20
3.6.4. Positioning the Overall Character Display and Turning it On and Off 3-20
3.6.5. Special VCG Indicators 3-21

3.7. GENERAL CONFIGURATION ITEMS 3-21
3.7.1. Selecting the Video Standard 3-22

3.7.2. Selecting the Generator Framing Reference 3-23
3.7.3. Adjusting the Output Level of the LTC Generators 3-23
3.7.4. Adjusting the Baud Rate of the Serial Ports 3-23
3.7.5. Working with System Parameters 3-24
3.7.6. Viewing the Hardware Version 3-24
3.7.7. Viewing the Firmware Version 3-24
3.7.8. Upgrading the Firmware 3-25
3.7.9. Resetting the HD9010TM to its Factory Defaults 3-25

3.8. CONFIGURING THE GENERAL PURPOSE INPUTS AND OUTPUTS 3-25
3.8.1. GPI Remote Control Mode 3-25
3.8.2. Assigning the Functions of the General Purpose Inputs 3-26

Figures

Figure 3-1: HD9010TM Front Panel Layout 3-1
Figure 3-2: Overview of the Setup Menu 3-7

Tables

Table 3-1: Top Level of the Generator Setup Menu 3-8
Table 3-2: Top Level of the Reader Setup Menu 3-16
Table 3-3: Top Level of the VCG Setup Menu 3-19
Table 3-4: Top Level of the Utility Setup Menu 3-21
Table 3-5: Remote Control Mode GPI I/O Mapping 3-26
Table 3-6: Parallel I/O Connector Pin Definitions – Normal GPIO Functions (Rev 2 Versions) 3-26
Table 3-7: Parallel I/O Connector Pin Definitions – Normal GPIO Functions (Rev 1 Versions) 3-27

3. HOW TO OPERATE THE TIME CODE MASTER

The HD9010TM HDTV Time Code Master is a full function time code reader/generator system for high definition serial digital video. The HD9010TM is a combination dual generator/ dual reader for Linear Time Code (LTC) and RP188 Ancillary Time Code (ATC), and contains a high resolution character inserter which can burn the generator or reader numbers directly into the serial digital program output. The HD9010TM combines the latest LSI technology with sophisticated embedded micro-controller firmware to provide a powerful, flexible high definition master time code reader and generator system.

3.1. AN OVERVIEW OF KEY AND DISPLAY FUNCTIONS

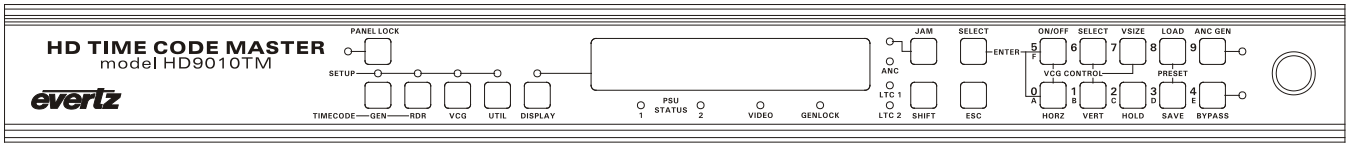

Figure 3-1: HD9010TM Front Panel Layout

The front panel controls consist of a 16 digit alphanumeric display, 10 LED status indicators, a 20 pushbutton keypad, and a shaft encoder knob.

The keypad is used to control the front panel *Setup* menu system, to enter numeric data such as the time and date, and to provide control of the front panel display. The shaft encoder knob is used to navigate the front panel menu system and to adjust the phasing of the sync pulse outputs.

A front panel *Setup* menu provides a quick and simple method of configuring the HD9010TM for your application. Sections 3.3 to 3.7 give detailed information on the specific operations required to control the HD9010TM.

3.1.1. The Setup Menu Pushbutton Group

The Setup pushbutton group consists of the **GEN, RDR, VCG, UTIL, SELECT** and **ESC** keys and the **SHAFT ENCODER** knob and is used to navigate the *Setup menu* system. The **GEN, RDR, VCG** and **UTIL** keys allow you to quickly go to various parts of the menu while the **SELECT, ESC** and **SHAFT ENCODER** knob are used to navigate the menu.

GEN Enters the *GENERATOR SETUP* menu that is used to set up various items related to the LTC and Ancillary Time Code generators. (See section 3.4)

RDR Enters the *READER SETUP* menu that is used to set up various items related to LTC and Ancillary Time Code readers. (See section 3.5)

VCG Enters the *VCG SETUP* menu that is used to set up various items related to character generator windows. (See section 3.6)

UTIL Enters the *UTILITIES SETUP* menu that is used to set up various items related to the overall operation of the HD9010TM. (See section 3.7)

SELECT When in one of the *Setup* menus the **SELECT** key is used to move to the next lower sub-menu levels or to select a menu parameter that is to be changed. The **SELECT** key is also used in combination with the numeric keys to enter numeric data.

ESC When in one of the *Setup* menus the **ESC** key is used to move to the next lower sub-menu levels or to select a menu parameter that is to be changed. The **ESC** key is also used to cancel the process of entering numeric data.

SHAFT ENCODER When in one of the *Setup* menus, the **SHAFT ENCODER** knob is used to move to various items in the menu system. (See also section 3.3)

3.1.2. The Display Button Group

The Display pushbutton group consists of the **DISPLAY** key and is used to select the information being displayed on the front panel when you are not in one of the *Setup* menus. After you press the **DISPLAY** key, you can use the **SHAFT ENCODER** knob to select the *Status* or *Display* items.

DISPLAY Allows you to quickly view the various times of the readers and generators, as well as other display data. (See section 3.2.1)

3.1.3. Panel Lock Key Functions

PANEL LOCK Pressing this key while holding down the **SHIFT** key will lock the front panel. The LED beside the **PANEL LOCK** key will come on indicating that the front panel keys are disabled. Pressing the **PANEL LOCK** key while holding down the **SHIFT** key again will return the front panel keys to their normal functions and the PANEL LOCK LED will go Off.

When the PANEL LOCK GPI has been activated, you cannot unlock the front panel using the SHIFT+PANEL LOCK keys. The front panel display will show LOCKED BY REMOTE.

3.1.4. The Character Window Pushbutton Group

SELECT Initiates *VCG Window Select Mode* and highlights the Generator time VCG window. Hold the **HORZ** or **VERT** keys down while turning the **SHAFT ENCODER** to move the window, use the **CHAR GEN ON/OFF** key to turn the window on or off. Rotate the **SHAFT ENCODER** without holding any keys down to select the next window and so on. Press The **SELECT** key to return to the normal VCG display mode.

ON/OFF Turns the character generator ON and OFF. When in the *VCG Window Select Mode* the **CHAR GEN ON/OFF** key is used to turn individual windows ON and OFF.

HORZ When in the *VCG Window Select Mode*, press this key and turn the **SHAFT ENCODER** knob to position the highlighted character window horizontally on the screen. (See also section 3.6.3.)

When not in the *VCG Window Select Mode*, press this key and turn the **SHAFT ENCODER** knob to position all the character windows horizontally on the screen. (See also section 3.6.4.)

VERT When in the *VCG Window Select Mode*, press this key and turn the **SHAFT ENCODER** knob to position the highlighted character window vertically on the screen. (See also section 3.6.3.)

When not in the *VCG Window Select Mode*, press this key and turn the **SHAFT ENCODER** knob to position all the character windows vertically on the screen. (See also section 3.6.4.)

VSIZE When in the *VCG Window Select Mode* the VSIZE key is used to select whether the selected window will be displayed in normal vertical size or double vertical size. When not in the *VCG Window Select Mode,* this key has no function. On Older units this button is labelled **INFO.**

The Double Height character function is only available with firmware version 2.0 build 285 and later.

3.1.5. The Function Button Group

ANC GEN Is used to turn the RP188 ancillary generator on and off. The ANC GEN indicator is ON when the RP188 generator is enabled. The time and user bits of the RP188 generator are the same as for the primary LTC generator.

JAM Is used to momentarily jam the primary reader's time into the generator time. When the SHIFT + JAM keys are pressed the HD9010TM generator will be put into continuous jam sync mode. (See section 3.5.1 for information about selecting the primary reader).

HOLD When the generator time (GTM) is displayed on the front panel, pressing the **HOLD** key stops the generator time from incrementing. A special character (H) appears to the left of the numeric display on the front panel, indicating that the display is in Hold mode. Pressing the **HOLD** key again starts the generator incrementing.

When one of the readers is displayed on the front panel, pressing the **HOLD** key freezes the reader display data on the front panel and in the VCG. A special character (F) appears to the left of the numeric display on the front panel, indicating that the display is in Freeze mode. Press the **HOLD** key again to return to normal update mode.

3.1.6. The Preset Button Group

SAVE Is used to save the current configuration of the HD9010 into one of the user preset memories. The Front panel prompts you to enter the preset number you want to load

```
Save Preset   #?
```

Use the numbered keys to select the preset memory to save into. The front panel shows the preset memory to save to, and the current video standard.

```
Sv 3 AUTO-I/60 ?
```

To select another preset memory press one of the numbered keys. To confirm saving the preset press the **SELECT** key. The front panel shows:

```
Sv 3<AUTO-I/60
```

LOAD Is used to load one of the saved user presets into the HD9010TM. The Front panel prompts you to enter the preset number you want to load:

```
Preset load   #?
```

Use one of the numbered keys to select the preset to load. The Front panel shows the preset number and the video standard of the preset:

```
Ld 3 AUTO-I/60 ?
```

To select another preset to load press one of the numbered keys. To confirm the preset load press the **SELECT** key. The front panel shows:

```
Ld 3 AUTO-I/60 >
```

When you load a user preset you will overwrite all the settings of the HD9010.

3.1.7. An Overview of the SHIFT Key functions

When the **SHIFT** key is held down, the meanings of some of the keys are modified, gaining quick access to a wider variety of functions. Following is a summary of the shifted key functions.

When you are entering user bits into the Generator, holding the **SHIFT** key while you press the numeric keys 0 through 5 will change their entered values to the hexadecimal values A through F.

When you are selecting values in the menus, holding the **SHIFT** key while you turn the **SHAFT ENCODER** knob will advance the values faster.

SHIFT+JAM Enters or cancels the continuous jam sync mode.
SHIFT+PANEL LOCK Enters or cancels the panel lock mode.

3.1.8. Shaft Encoder Knob

The shaft encoder's function is to select various menu items or change the value of a menu item's parameter value.

SHAFT ENCODER When in one of the *Setup* menus, the **SHAFT ENCODER** knob is used to move to various items in the menu system or change a menu item's parameter value. (See section 3.3)

When in *VCG Window Select Mode*, the **SHAFT ENCODER** knob in conjunction with the **HORZ** and **VERT** keys is used to position the individual character windows. (See section 3.3) When not in *VCG Window Select Mode*, the **SHAFT ENCODER** knob in conjunction with the **HORZ** and **VERT** keys is used to position all the character windows. (See section 3.3)

When the *DISPLAY* LED is On, the **SHAFT ENCODER** knob is used to select what is displayed on the front panel display.

3.1.9. An Overview of the Status Indicators

There are 15 status indicators located on the front panel that show operational status of the HD9010TM at a glance.

PANEL LOCK This green LED indicates that the Front Panel is locked against accidental changes.

GEN This green LED indicates that the *GENERATOR SETUP* menu mode is active.

RDR This green LED indicates that the *READER SETUP* menu mode is active.

VCG This green LED indicates that the *VCG SETUP* menu mode is active.

UTIL This green LED indicates that the *UTILITY SETUP* menu mode is active.

DISPLAY This green LED indicates that the *Normal* front panel display mode is active.

PSU STATUS 1, 2 These green LEDs indicate that the corresponding power supply is functioning normally. On units fitted with a single power supply the PSU STATUS 2 LED will be Off all the time.

VIDEO This green LED indicates that valid video signal is present.

GENLOCK This green LED indicates that a valid genlock reference is present and the HD9010TM has locked to it.

JAM This green LED indicates that continuous jam sync mode is active.

ANC This green LED indicates that RP188 ancillary timecode is present on the video input.

LTC 1 This green LED indicates that linear timecode is present on the LTC input.

LTC 2 This green LED indicates that linear timecode is present on the AUX LTC input.

ANC GEN This green LED indicates that RP188 ancillary timecode is being inserted on the video output.

BYPASS This green LED indicates that optional bypass relay is active. The HD video input is directly connected to the HD BYPASS output and the HD9010TM will have no effect on the video signal.

3.2. FRONT PANEL DISPLAY FUNCTIONS

3.2.1. Front Panel Displays

The **DISPLAY** key is used to select what data is being displayed in the alphanumeric display. After you press the **DISPLAY** key, you can use the shaft encoder knob to select the various *Display* items. The leftmost characters of the display indicate what is being displayed as follows:

`GTM  12:34:56.00`	Generator time information
`GUB  12 34 56 78`	Generator user bit information
`LTM  12:34:56.00`	LTC Reader time information
`LUB  12 34 56 78`	LTC Reader user bit information
`XTM  12:34:56.00`	AUX LTC Reader Time information
`XUB  12 34 56 78`	AUX LTC Reader user bit information
`ATM  12:34:56.00`	RP188 Ancillary Reader Time information
`AUB  12 34 56 78`	RP188 Ancillary user bit information
`COM1: ?????`	Com 1 status information
`COM2: ?????`	AUX COM status information
`GPI: 111111111`	GPI Input status information
`OFS  12:34:56.00`	Jam Sync Offset Register
`SYN  12:34:56.00`	Drop Frame Conversion Sync Point
`VID  AUTO I/60`	Current video standard

3.2.2. Special Front Panel Indicators

The following special indicators are used between the seconds and frames digits of the front panel time display to identify non-drop frame and drop frame code when the time code is counting at 29.97 frames per second.

Non Drop Frame	Colon (:)
Drop Frame	Period (.)

3.3. AN OVERVIEW OF THE SETUP MENU SYSTEM

The key to the operational flexibility of the HD9010TM lies in the *Setup* menu system. The *Setup* menu system uses the 16 digit alphanumeric display and provides a quick, intuitive method of configuring HD9010TM, guiding you to the correct setup for your application.

The HD9010TM menu system consists of four main menus with several choices for each menu item. The **GEN, RDR, VCG** and **UTIL** keys allow you to quickly go to various parts of the menu while the **SELECT, ESC** and **SHAFT ENCODER** knob are used to navigate the menu. See Figure 3-2.

- **GEN**
  - **GEN MODE**
    - *Gmode: time data*
    - *Gmode: time rtime*
    - *Gmode: time rub*
    - *Gmode: time rctl*
  - **GEN ATC TYPE**
    - *Atc gen: ltc*
    - *Atc gen: vitc*
    - *Atc gen: ltc+vitc*
  - **GEN DROP FRAME**
    - *Drop frame: off*
    - *Drop frame: on*
    - *Drop frame: convert*
    - *Drop frame: jamming*
    - *Not applicable*
  - **GEN LTC PARITY**
    - *Ltc parity: off*
    - *Ltc parity: on*
  - **GEN NO CODE JAM**
    - *No code jam: run*
    - *No code jam: hold*
    - *No code jam: mute*
- **RDR**
  - **PRIMARY READER**
    - *Primary rdr: atc*
    - *Primary rdr: ltc*
    - *Primary rdr: aux*
  - **ATC RDR TYPE**
    - *Atc rdr:ltc+vitc*
    - *Atc rdr:ltc*
    - *Atc rdr:vitc*
    - *Atc rdr:vanc*
  - **ATC RDR MODE**
    - *Atc time data*
    - *Atc data data*
  - **LTC RDR MODE**
    - *Ltc time data*
    - *Ltc data data*
  - **AUX LTC RDR MODE**
    - *Aux time data*
    - *Aux data data*
- **VCG**
  - **VCG STYLE**
    - *Vsty: white/none*
    - *Vsty: white/black*
    - *Vsty:white/20%*
    - *Vsty:white/50%*
    - *Vsty:white/80%*
    - *Vsty: black/none*
    - *Vsty: black/white*
    - *Vsty:black/20%*
    - *Vsty:black/50%*
    - *Vsty:black/80%*
  - **VCG FRAMES**
    - *Vcg frames: off*
    - *Vcg frames: on*
  - **VCG FIELDS**
    - *Vcg fields: off*
    - *Vcg fields: on*
  - **VCG SYMBOLS**
    - *Vcg symbols: off*
    - *Vcg symbols: on*
- **UTIL**
  - **VIDEO STANDARD**
    - *Vstd: auto*
    - *Vstd: 1080i/60*
    - *Vstd: 1080i/50*
    - *Vstd: 720p/60*
    - *Vstd: 720p/50*
    - *Vstd: 1080p/24sF*
  - **REFERENCE MODE**
    - *Ref: input*
    - *Ref: tri-lvl*
    - *Ref: bi-lvl*
  - **LTC LEVEL**
    - *Ltc level =xx*
  - **AUX LTC LEVEL**
    - *Aux ltc level =xx*
  - **COM 1 BAUD RATE**
    - *Com 1 =xx*
  - **AUXCOM BAUD RATE**
    - *Aux com =xx*
  - **SYS PARM CLASS**
    - *Sys prm class=0*
  - **SYS PARM NUMBER**
    - *Sys prm num=0*
  - **SYS PARM VALUE**
    - *Sys prm value=0*
  - **HARDWARE VERSION**
    - *Rev 1 (7700PB3)*
    - *Rev 2 (7700PH4)*
  - **FIRMWARE VERSION**
    - *TM 2.0 build 66*
  - **FIRMWARE UPGRADE**
    - *Upgrade*
      - *no*
      - *yes*
  - **FACTORY RESET**
    - *Fact reset?*
      - *no*
      - *yes*

Figure 3-2: Overview of the Setup Menu

To enter the *GENERATOR SETUP* menu, press the **GEN** key. Similarly you can enter the *READER SETUP,* the *VCG SETUP* or *UTILITY SETUP* menus by pressing the **RDR, VCG** and **UTIL** keys respectively. Once you are in one of the four main menus, the top level menu items are shown in UPPER CASE. Turn the **SHAFT ENCODER** knob to display the desired item within the top level menu and press the **SELECT** key. The displayed parameters to be adjusted will be shown in Title Case (The First Letter Of Each Word Is Capitalized). The active value for that parameter will be shown blinking.

Turn the **SHAFT ENCODER** knob to change the value of the displayed parameter. When the value shown is not the active value the display will stop blinking. When you have selected the desired parameter value press the **SELECT** key to make that value the active value. (The display will start blinking again). Press the **ESC** key when the display is blinking to move back up the menu to the top saving your selection. You can press the **ESC** key when the display is not blinking to move back up the menu to the top level without saving your selection. You can select other menu items from the top level by turning the **SHAFT ENCODER** knob, followed by the **SELECT** key. Alternately you can exit the setup menu and return to the normal *DISPLAY* mode by pressing the **ESC** key.

Figure 3-2 gives an overview of the setup menu. Sections 3.4 to 3.7 provide detailed descriptions of the *GENERATOR, READER, VCG* and *UTILITY SETUP* menus. The tables in these sections are arranged in an indented structure to indicate the path taken to reach the control.

3.4. CONFIGURING THE GENERATOR

The *GENERATOR SETUP* menu is used to set up various generator modes such as selecting Drop Frame, Jam Sync Modes, ATC Generator Line number, whether user bits contain static numbers or time information, etc. The chart below shows the items available in the *GENERATOR SETUP* menu. Sections 3.4.1 to 3.4.9 give detailed information about each of the sub-menus.

GEN MODE	Sets the operating mode of the LTC and ATC generators
GEN ATC TYPE	Selects whether LTC or VITC or both ATC packets will be inserted
GEN DROP FRAME	Configures the generator drop frame mode
GEN LTC PARITY	Configures the parity of the LTC generator
GEN NO CODE JAM	Configures the action when input code is missing and the HD9010TM is in continuous JAM sync mode

Table 3-1: Top Level of the Generator Setup Menu

3.4.1. Configuring the Generator Mode

GEN MODE
- *Gmode: time data*
- *Gmode: time rtime*
- *Gmode: time rub*
- *Gmode: time rctl*

The *GEN MODE* menu item is used to select the type of information that is contained in the time and user bits of the generator. When the HD9010TM is not in the *Continuous Jam Sync* mode, the generator Time bits contain time information entered from the front panel. When the HD9010TM is in the *Continuous Jam Sync* mode, the time bits are slaved to the primary reader's time.

Gmode: Time Data configures the user bits for entering numeric data entered from the front panel.

Gmode: Time Rtime transfers the primary reader's time bits to the generator user bits. (See section 3.5.1 for information on selecting the primary reader) Transferring reader time is useful when you want to record new continuous time code numbers and still retain the original time code numbers for future reference.

Gmode: Time Rub transfers the primary reader's user bits to the generator time bits. (See section 3.5.1 for information on selecting the primary reader) Transferring the reader user bits is used when reader time data previously transferred to user bits as above, or other user bit information must be retained when recording new code. When used in conjunction with the Continuous Jam Sync mode, both the time and user bits will be transferred to the new tape.

Gmode: Time RCTL sets the HD9010TM into a user bit remote control mode. In this mode six of the input pins on the parallel remote control port are used to control the setting of the six remote control user bits. When the 7721DD4-HD+GPI decoder module reads the RP188 ancillary time code, these encoded user bits directly control six contact closure outputs. When the HD9010TM is placed into the *TIME RCTL* mode, special binary group flags are set, signalling the remote control mode to the decoder. This allows an extra level of security at the decoder and ensures that random user bit patterns do not inadvertently activate the contact closure outputs of the decoder.

When the user selects the remote control mode, the generator user bits will be set to:

```
XX 80 80 93
```

Where the value of XX depends on the states of the remote control input pins. See Table 3-5.

3.4.2. Setting the Generator Time

When the HD9010TM generator is not operating in the *Continuous Jam Sync* mode, the user can set the generator time using the following procedure. (In the continuous jam sync mode, the generator will be slaved to incoming code from the reader.) Press the **DISPLAY** key and turn the **SHAFT ENCODER** *k*nob to display the generator time if it is not already displayed. The display prompt will show GTM when generator time is being displayed. Press **GEN HOLD** key (when the Generator is being displayed on the front panel) to start or stop the generator clock. The **ENTER (SELECT)** and **ESC** keys are used in conjunction with the numeric keys to set the generator time.

When entering time data make sure that the generator is not in the continuous JAM SYNC mode (indicated when the JAM LED is on). If it is, press SHIFT + JAM to return to free run mode.

Press the **ENTER** key to recall the last time that you entered into the generator. The display prompt at the left of the display will blink while data entry mode is active, and the dual functioned keys are now changed to their numeric values. If you want to re-enter this time press the **ENTER** key to complete the data entry into the generator time.

Pressing any numeric key will clear the previous value and place the new value into the numeric display, starting at the right. Un-entered digits are assumed to be zero, hence leading zero digits are not required. When the required number of digits are entered, then press the **ENTER** key to complete the data entry into the generator time.

Attempts to enter too many digits, or make illegal entries, i.e. 65 minutes, will result in the display returning to the last valid time entry made. Re-enter the correct value and press the **ENTER** key. Pressing the **ESC** key will cancel the data entry mode without changing any data.

The numeric keys return to their normal display functions when the data entry has been completed by pressing **ENTER** or cancelled by pressing the **ESC** key. The display prompt will return to its steady On state when data entry mode has been completed.

Numeric entry mode must be terminated (GTM will be On steady) before any of the front panel keys will resume normal operation.

3.4.3. Setting the Generator User Bits

When the HD9010TM generator is operating in the *Time Data* mode, the user can set the generator user bits using the following procedure. Press the **DISPLAY** key and turn the **SHAFT ENCODER** *k*nob to display the generator user bits if they are not already displayed. The display prompt will show GUB when user bits are displayed.

When the HD9010TM is in the *Time Rtime* or *Time Rub* modes, the user bits are being transferred from the primary reader. Attempts to enter user bits manually from the front panel will not be allowed.

The **ENTER (SELECT)** and **ESC** keys are used in conjunction with the numeric keys to set the generator user bits.

Press the **ENTER** key to recall the last User Bits that you entered into the generator. The display prompt at the left of the display will blink while data entry mode is active, and the dual functioned keys are now changed to their numeric values. If you want to re-enter these User Bits press the **ENTER** key to complete the data entry into the generator.

Pressing any numeric key will clear the previous value and place the new value into the numeric display, starting at the right. Pressing the **SHIFT** key and the numeric keys 0 to 5 will enter the corresponding hexadecimal values A to F. Un-entered digits are assumed to be zero. When the required number of digits are entered, press the **ENTER** key to complete the data entry into the generator User Bits.

Attempts to enter too many digits will result in the display being blanked. Re-enter the correct value and press the **ENTER** key. Pressing the **ESC** key will cancel the data entry mode without changing any data.

The numeric keys return to their normal functions when the data entry has been completed by pressing the **ENTER** key or cancelled by pressing the **ESC** key. The display prompt will return to its steady On state when data entry mode has been completed.

Numeric entry mode must be terminated (GUB will be On steady) before any of the front panel keys will resume normal operation.

3.4.4. Jam Syncing the Generator to the Primary reader

Pressing the **JAM** key transfers the primary reader's time into the generator clock, and then releases the clock to run on its own. This mode is known as *Momentary Jam Sync*. (See section 3.5.1 for information about selecting the primary reader.)

The generator time may be continuously slaved, or 'Jam synced' to data coming from the primary reader by pressing the **SHIFT+JAM** keys. This mode is known as *Continuous Jam Sync*. The JAM LED will be on when *Continuous Jam Sync* mode is enabled. Pressing the **SHIFT+JAM** keys again terminates the *Continuous Jam Sync* mode.

Jam sync mode should be used when you need to generate ancillary time code that follows an LTC source time code. In this mode the HD9010TM will function as an LTC to ATC translator.

Jam sync mode should also be used when dubbing longitudinal time code from one tape to another, as the quality of the time code signal deteriorates with each generation, and will become unusable after the third generation.

When the time information is being jammed the generator and primary reader's times are compared with each other during each frame, automatically compensating for the value programmed into the *OFFSET* register. If for any reason they are not equal, the jam is bypassed, and the generator substitutes the next frame number. The *JAM* indicator will blink off when a jam error is encountered. If the number of consecutive jam bypass errors exceeds 5, the last valid primary reader's time is jammed into the generator again with the programmed *OFFSET*. In the absence of valid reader data within the last 5 frames, the generator operates according to the programmed *NO CODE JAM* mode (*HOLD* = generator stops; *RUN* = generator increments normally; or *MUTE* = generator turns off) until valid reader code resumes. At this time it will be re-jammed to the reader, thus repairing large dropouts on the reader tape. (See section 3.4.9 for a full description of the *NO CODE JAM* modes.)

The drop frame and colour frame modes of the code being read are transferred to the generator during jam sync. The formatted modes return when the Jam sync mode is terminated.

When the GEN DROP FRAME mode is set to Convert, the drop frame mode of the generator operates in a special way. See section 3.4.7.1.

The *OFFSET* register for the *Continuous Jam Sync* mode allows you to apply a continuous offset between the generator and reader numbers when you are in *Continuous Jam Sync* mode. The value entered into the Offset register will be added to the reader time before it is jammed into the generator. Offset values other than 00:00:00:00 usually indicates that the generator is leading the reader. In order for the generator to lag behind the reader, enter a value equal to 24:00:00:00 minus the lag offset desired. To access the *OFFSET* register press the **DISPLAY** buttons one or more times or press the **DISPLAY** button and turn the **SHAFT ENCODER** until the display prompt shows 0FS.

3.4.5. Turning the ATC Generator On

The **ANC GEN ON/OFF** key is used to turn the Ancillary Time code (ATC) inserter on and off. (You must exit the Setup menu to turn the ATC generator on or off.) When the ATC generator is Off, the program video passes through the ATC keyer with nothing added. When the ATC generator is On, the RP188 ancillary time code and the VANC data packet will be added to the program video.

3.4.6. Setting the ATC Packet Type

GEN ATC TYPE
ATC gen:ltc
ATC gen:vitc
ATC gen:ltc+vitc

The SMPTE RP188 recommended practice for Ancillary Timecode (ATC) identifies two types of ATC packets. The *GEN ATC TYPE* menu item is used to select whether the ATC generator will insert LTC, VITC or both types of ancillary timecode packets.

Select *ATC gen:ltc* to insert LTC type ATC packets.

Select *ATC gen:vitc* to insert VITC type ATC packets.

Select *ATC gen:ltc+vitc (default)* to insert both LTC and VITC type ATC packets.

3.4.7. Selecting the Generator Drop Frame Mode (29.97 and 59.94 FPS video standards only)

In the 29.97 and 59.94 frames per second video standards, the time code frame rate of approximately 29.97 frames per second causes an error between real time and 'video time'. To overcome this problem, the drop frame mode was created. This mode compensates for the approximate 86 seconds per day error by dropping the first two frame counts (0, 1) at the start of each minute, except minutes 0, 10, 20, 30, 40, and 50. A drop frame flag bit is set in the code when the drop frame format is used. When the HD9010TM is operating in the 29.97 and 59.94 frames per second video standards, the generator may be programmed to count in either the drop frame or non-drop frame mode.

GEN DROP FRAME
Drop frame: off
Drop frame: on
Drop frame: convert
Drop frame: jamming
Not applicable

The *GEN DROP FRAME* menu item is used to the desired drop frame mode for the generator.

Select *Drop frame off* to configure the generator in the non-drop frame or 'full frame' mode.

Select *Drop frame on* to configure the generator in the drop frame mode.

Select *Drop frame convert* to configure the HD9010 to operate in a special Drop Frame conversion Mode. This mode is available in firmware version 2.0 build 138 or later. See section 3.4.7.1 for more information on using the Drop Frame Conversion Mode.

When the HD9010TM is in the continuous Jam Sync mode, the generator drop frame mode is the same as the incoming time code data. The Drop Frame sub-menu shows *Drop frame jamming*.

When the HD9010TM is operating in the 24, 25 or 50 frames per second video standards, the Drop Frame sub-menu shows *Not applicable*.

The AUX LTC output will normally output nominal 24 FPS time code that is concurrent with the nominal 30 FPS timecode on the main LTC. When the main LTC output is in the Drop Frame counting mode, the AUX LTC output will be muted as there is no 24 FPS equivalent.

3.4.7.1. Conversion Between Drop Frame and Non Drop Frame Counting Modes

In certain circumstances, it may be necessary to convert from the Non Drop Frame counting mode to the Drop Frame counting mode. For example, material that originated in a 1080p/23.98 format will have a 24 frame per second time code, which by definition is non drop frame time code. If that material is subsequently converted to a 1080i/59.94 format the recommended procedure for conversion of the time code (according to SMPTE 12M) will result in a 30 frame per second non drop frame time code where the hours, minutes and seconds are aligned with the 24 frame per second code. Some broadcast delivery specifications require Drop Frame time code. Because of the 'dropped frame counts' in Drop Frame time code, the time code count will diverge from Non Drop Frame time code, The Drop Frame and Non Drop Frame time codes will only be co-incident at one frame count which shall be called the "Sync Point'.

When the HD9010TM is operating with 1080i/59.94 or 720p/59.94 video standard, the HD9010TM can be placed in a special Drop Frame conversion mode by setting the *GEN DROP FRAME* menu item to *convert.* In this mode, the HD9010TM will be placed into a continuous jam sync mode, and the Drop Frame mode of the Generator will be set to be the *opposite* of the drop frame mode of the reader selected by the *PRIMARY READER* menu item.

For example, if the *PRIMARY READER* menu item is set to LTC, and there is Non Drop Frame time code connected to the main LTC reader input, the generator will be automatically set to the Drop Frame counting mode. The generator ATC and the main LTC output will be drop frame time code.

To use the Drop Frame Conversion mode, the user must first set the *SYNC POINT* register, which identifies the frame count where the Drop Frame and Non Drop Frame time codes will coincide. To access the *SYNC POINT* register press the **DISPLAY** buttons one or more times or press the **DISPLAY** button and turn the **SHAFT ENCODER** until the display prompt shows SYN. The **ENTER** and **ESC** keys are used in conjunction with the numeric keys to set the value stored in the *SYNC POINT* register.

The entered sync point will be rounded down to the nearest minute, as the dropped frames only occur on minute boundaries.

The HD9010TM *OFFSET* register can also be used to enter a frame offset to account for frame delays in a standards converter or other video processing device. To access the *OFFSET* register press the **DISPLAY** buttons one or more times or press the **DISPLAY** button and turn the **SHAFT ENCODER** until the display prompt shows 0FS. The **ENTER** and **ESC** keys are used in conjunction with the numeric keys to set the value stored in the OFFSET register.

The examples below show how the time code will be converted in the Drop Frame Convert mode of operation.

Example 1: Reader in Non Drop Frame, Generator will be in Drop Frame, Sync Point at 1 hour, no video processing delay between reader timecode and generator time code.

Sync Point: 01:00:00:00
Offset: 00:00:00:00

Reader	Generator
00:58:00:00	00;57;59;26
00:58:00:01	00;57;59;27
00:58:00:02	00;57;59;28
00:58:00:03	00;57;59;29
00:58:00:04	00;58;00;02
00:58:00:05	00;58;00;03
00:58:59:28	00;58;59;26
00:58:59:29	00;58;59;27
00:59:00:00	00;58;59;28
00:59:00:01	00;58;59;29
00:59:00:02	00;59;00;02
00:59:00:03	00;59;00;03

Reader	Generator
00:59:59:28	00;59;59;28
00:59:59:29	00;59;59;29
01:00:00:00	01;00;00;00
01:00:00:01	01;00;00;01
01:00:00:02	01;00;00;02
01:00:00:05	01;00;00;05
01:00:59:28	01;00;59;28
01:00:59:29	01;00;59;29
01:01:00:00	01;01;00;02
01:01:00:01	01;01;00;03
01:01:00:02	01;01;00;04
01:01:00:03	01;01;00;05

Example 2: Reader in Non Drop Frame, Generator will be in Drop Frame, Sync Point at 1 hour, 4 frame video processing delay between reader timecode and generator time code.

Sync Point: 01:00:00:00
Offset: 00:00:00:04

Reader	Generator
00:58:00:00	00;58;00;02
00:58:00:01	00;58;00;03
00:58:00:02	00;58;00;04
00:58:00:03	00;58;00;05
00:58:00:04	00;58;00;06
00:58:00:05	00;58;00;07
00:58:59:28	00;59;00;02
00:58:59:29	00;59;00;03
00:59:00:00	00;59;00;04
00:59:00:01	00;59;00;05
00:59:00:02	00;59;00;06
00:59:00:03	00;59;00;07

Reader	Generator
00:59:59:28	01;00;00;02
00:59:59:29	01;00;00;03
01:00:00:00	01;00;00;04
01:00:00:01	01;00;00;05
01:00:00:02	01;00;00;06
01:00:00:05	01;00;00;07
01:00:59:28	01;01;00;04
01:00:59:29	01;01;00;05
01:01:00:00	01;01;00;06
01:01:00:01	01;01;00;07
01:01:00:02	01;01;00;08
01:01:00:03	01;01;00;09

In order to convert the generator time exactly to the reader time at the SYNC POINT make sure the OFFSET is set 00:00:00:00

3.4.8. Generator LTC Parity Mode Selection

The purpose of the phase correction parity bit (LTC bit 27 in 30 FPS, 59 in 25 FPS) is to compensate for phase reversals in the LTC bi-phase mark modulation that could occur when code inserts are performed. Use of the bi-phase mark parity bit is optional, as some readers may not recognize its presence.

GEN LTC PARITY
Ltc parity: off
Ltc parity: on

The *GEN LTC PARITY* item controls the parity mode of the generator.

Select *Ltc parity off* to configure the generator for the non parity mode. The bi-phase mark parity bit will be always set to zero.

Select *Ltc parity on* to configure the generator for the parity mode. The bi-phase mark parity bit will be put in a state where every 80 bit word will contain an even number of logic zeros, in order that the magnetization transient between bit cell 79 of one word and bit cell zero of the next shall always be in the same direction.

3.4.9. Configuring how the Continuous Jam Sync Mode Works when there is no Primary Reader Code

GEN NO CODE JAM
No code jam: run *No code jam: hold* *No code jam: mute*

The *GEN NO CODE JAM* item controls the operation of the continuous jam sync mode when there is no incoming code to the primary reader.

Select *No code jam run* when you want the generator to free run when there is no incoming Reader code. When the reader code resumes, the generator will re-jam to the incoming code. Using this mode will allow the user to repair large dropouts in the incoming code. The generated code will be continuous if the incoming code is also continuous.

Select *No code jam hold* when you want the generator to stop when there is no incoming Reader code. When the reader code resumes, the generator will re-jam to the incoming code. Use this mode if you want the output of the generator to stop on the last number read when you stop the tape machine supplying the incoming code to the reader.

Select *No code jam mute* when you want to turn off the generator when there is no incoming Reader code. The generator time will stop at the last number read. When the reader code resumes, the generator will turn on and re-jam to the incoming code. Use this mode if you want the output of the generator to turn off completely when you stop the tape machine supplying the incoming code to the reader.

3.5. CONFIGURING THE READERS

The *READER SETUP* menu is used to set up various items related to the input references of the HD9010TM. The chart below shows the items available in the *READER SETUP* menu. Sections 3.5.1 to 3.5.5 give detailed information about each of the sub-menus.

PRIMARY READER	Sets the primary reader.
ATC RDR TYPE	Sets whether the ATC reader will read LTC or VITC RP188 packets or VANC data packets.
ATC RDR MODE	Sets the operating mode of the ATC reader.
LTC RDR MODE	Sets the operating mode of the main LTC reader.
AUX LTC RDR MODE	Sets the operating mode of the auxiliary LTC reader.

Table 3-2: Top Level of the Reader Setup Menu

3.5.1. Setting the Primary reader

PRIMARY READER
Primary rdr: atc
Primary rdr: ltc
Primary rdr: aux

The *PRIMARY READER* menu is used to select which reader will be used in the momentary and continuous Jam Sync modes. The primary reader will have an asterisk (*) displayed beside its name on the front panel display. The reader data from the other readers will still be visible from the front panel and VCG windows but will have no effect on the generator time in the jam sync modes, or user bits in the user bit transfer modes.

Select *Primary rdr: ATC* to configure the ancillary time code reader (ATC) as the primary reader.

Select *Primary rdr: LTC* to configure the main linear time code reader (LTC) as the primary reader.

Select *Primary rdr: Aux* to configure the auxiliary linear time code reader (Aux) as the primary reader.

3.5.2. Setting the ATC Reader Packet Type.

ATC RDR TYPE
Atc rdr:ltc
Atc rdr:vitc
Atc rdr:ltc=vitc
Atc rdr:ltc>vitc
Atc rdr:ltc<vitc
Atc rdr:vanc

The SMPTE RP188 recommended practice for Ancillary Timecode (ATC) identifies two types of ATC packets. The *ATC RDR TYPE* menu item is used to select whether the ATC reader will read LTC or VITC or both types of ancillary timecode packets. A fourth choice allows the HD9010TM to read time and user bit information from a special VANC packet inserted by the generator of another HD9010TM.

Select *Atc rdr:ltc* to read LTC type ATC packets.

Select *Atc rdr:vitc* to read VITC type ATC packets.

Select *Atc rdr:ltc=vitc (default)* to read either LTC or VITC type ATC packets. The HD9010TM will read whichever type is present giving priority to none.

Select *Atc rdr:ltc>vitc* to read either LTC or VITC type ATC packets. The HD9010TM will give priority to reading ltc packets and in their absence fallback to vitc packets.

Select *Atc rdr:ltc<vitc* to read either LTC or VITC type ATC packets. The HD9010TM will give priority to reading vitc packets and in their absence fallback to ltc packets.

Select *Atc rdr:vanc* to read the special VANC data packets inserted by another HD9010TM.

3.5.3. Selecting the Format of the ATC Reader Time and User Bit Data

ATC RDR MODE
Atc time data
Atc data data

The *ATC RDR MODE* menu item is used to select how the information that is contained in the time and user bits of the ATC reader is displayed.

Select *ATC time data* when the time bits contain normal time information and the user bits contain numeric data.

Select *ATC data data* when both the time and the user bits contain numeric data. In this mode the raw data from the time and user bits including the flag bits will be displayed

3.5.4. Selecting the Format of the LTC Reader Time and User Bit Data

LTC RDR MODE
Ltc time data
Ltc data data

The *LTC RDR MODE* menu item is used to select how the information that is contained in the time and user bits of the LTC reader is displayed.

Select *LTC time data* when the time bits contain normal time information and the user bits contain numeric data.

Select *LTC data data* when both the time and the user bits contain numeric data. In this mode the raw data from the time and user bits including the flag bits will be displayed

3.5.5. Selecting the Format of the Auxiliary LTC Reader Time and User Bit Data

AUX RDR MODE
Aux time data
Aux data data

The *AUX RDR MODE* menu item is used to select how the information that is contained in the time and user bits of the AUX reader is displayed.

Select *AUX time data* when the time bits contain normal time information and the user bits contain numeric data.

Select *AUX data data* when both the time and the user bits contain numeric data. In this mode the raw data from the time and user bits including the flag bits will be displayed

3.6. CONFIGURING THE CHARACTER GENERATOR FUNCTIONS

The HD9010TM has eight independently positional character windows to display the generator and LTC, AUX LTC and **ATC** reader time and user bits. The **SHAFT ENCODER** knob in conjunction with the **HORZ** and **VERT** keys control the position of the character windows. The **VCG CONTROL ON/OFF** key selects whether the video character generator (VCG) keyer is on or off. The **VSIZE** key (labelled **INFO** on earlier versions) selects whether the character window is displayed in the normal vertical size or double vertical size. (This feature is only available after firmware version 2.0 build 285) The use of these keys in combination with the **VCG CONTROL SELECT** key selects which windows are displayed and their position on the screen.

The *VCG SETUP* menu is used to configure the character style, and whether frames, fields and symbols should be displayed in the character generator. The following descriptions appear in the order they appear on the menu. The chart below shows the items available in the *VCG SETUP* menu. Sections 3.6.1 to 3.6.5 give detailed information about each of the sub-menus.

VCG STYLE	Sets the Character generator character colour and background style
VCG FRAMES	Turns the Character generator Time code Frames display on or off
VCG FIELDS	Turns the Character generator Time code Fields display on or off
VCG SYMBOLS	Turns the Character generator Window Symbols on or off

Table 3-3: Top Level of the VCG Setup Menu

3.6.1. Selecting the Character Style

VCG STYLE
- *Vsty: white/none*
- *Vsty: white/black*
- *Vsty: white/20%*
- *Vsty: white/50%*
- *Vsty: white/80%*
- *Vsty: black/none*
- *Vsty: black/white*
- *Vsty :black/20%*
- *Vsty :black/50%*
- *Vsty :black/80%*

The CHAR STYLE menu item is used to select whether the background mask will be used and whether the characters will be white or black. The on screen format menus are always white characters keyed into a black background mask.

Select *white/none* to disable the background and key white characters directly into the picture.

Select *white/black* to key white characters on a black background mask into the picture.

Select *white/20%, white/50%* or *white/80%* to key white characters on a transparent grey background mask into the picture.

Select *black/none* to disable the background and key black characters directly into the picture.

Select *black/white* to key black characters on a white background mask into the picture.

Select *black/20%, black/50%* or *black/80%* to key black characters on a transparent white background mask into the picture.

3.6.2. Selecting whether the Frames, Fields and Symbols will be displayed on the VCG

VCG FRAMES
- *Vcg frames: Off*
- *Vcg frames: On*

The *VCG FRAMES* menu item is used to select whether the frames will be shown when the time is displayed in the character inserter.

Select *Vcg frames off* to hide the time code frames.

Select *Vcg frames on* to show the time code frames.

VCG FIELDS
Vcg fields: off
Vcg fields: on

The *VCG FIELDS* menu item is used to select whether the fields will be shown when the time is displayed in the character inserter.

Select *Vcg fields off* to hide the time code fields.

Select *Vcg fields on* to show the time code fields.

VCG SYMBOLS
Vcg symbols: off
Vcg symbols: on

The *VCG SYMBOLS* menu item is used to select whether the symbols will be shown when the time is displayed in the character inserter.

Select *Vcg symbols off* to hide the symbols.

Select *Vcg symbols on* to show the symbols.

3.6.3. Selecting and Positioning the Individual Character Inserter Windows

Separately positional character windows displaying the generator time and user bits are available. There are also separate windows for the ATC, LTC and auxiliary LTC reader time and user bits. The **SHAFT ENCODER** knob in conjunction with the **HORZ** and **VERT** keys controls the position of the character windows. The **VCG CONTROL ON/OFF** key selects whether the video character generator (VCG) keyer is on or off. The use of these keys in combination with the **VCG CONTROL SELECT** key selects which windows are displayed and their position on the screen.

Press **VCG CONTROL SELECT** to enable the *Window Select* mode. All the character windows will appear on the screen with the window for the generator time highlighted. Use the **CHAR GEN ON/OFF** key to turn the Time window on or off. Use the **VSIZE** key to turn set the vertical size of the character window. Use the **VCG CONTROL ON/OFF** key to turn the highlighted window on or off. Press and hold the **HORZ** key and turn the **SHAFT ENCODER** knob to move the window horizontally. Press and hold the **VERT** key and turn the **SHAFT ENCODER** knob to move the window vertically. Turn the **SHAFT ENCODER** knob without any keys held down to select the next window and then turn it on or off and move it to the desired location in the same way. The HD9010TM returns to the normal VCG display mode after the last window has been selected. Windows that were turned off in *Window Select* mode will disappear.

3.6.4. Positioning the Overall Character Display and Turning it On and Off

In the normal VCG display mode when none of the windows are highlighted, the **CHAR GEN ON/OFF** key turns the character keyer on and off.

When the VCG DISABLE GPI has been activated, you cannot turn the character windows on using the CHAR GEN ON/OFF key.

In the normal VCG display mode, when none of the windows are highlighted, the arrow keys (↑, ↓, ←, →) move all the displayed windows by the same relative amount. For example, to move the time and source ID/status windows both down by one line press the ↓ key.

3.6.5. Special VCG Indicators

The following special indicators are used between the seconds and frames digits of the time window in the character inserter to identify non drop frame and drop frame code (NTSC only)

Non Drop Frame Colon (:)
Drop Frame (NTSC) Period (.)

3.7. GENERAL CONFIGURATION ITEMS

The *UTILITY SETUP* menu is used to set up various items related to the overall operation of the HD9010TM such as Video standard, LTC output levels, genlock phasing, and firmware versions. Table 3-4 shows the items available in the *UTILITY SETUP* menu. Sections 3.7.1 to 3.7.6 give detailed information about each of the sub menus.

VIDEO STANDARD	Sets the video standard
REFERENCE MODE	Selects the generator framing reference
LTC LEVEL	Sets the amplitude level of the main LTC output
AUX LTC LEVEL	Sets the amplitude level of the auxiliary LTC output
COM 1 BAUD RATE	Sets the baud rate of the COM 1 serial port
AUXCOM BAUD RATE	Sets the baud rate of the AUX COM serial port
SYS PARM CLASS	Sets the system parameter class for the parameter value to change
SYS PARM NUMBER	Sets the system parameter number for the parameter value to change
SYS PARM VALUE	Sets the system parameter value
HARDWARE VERSION	Displays the current hardware version of the unit
FIRMWARE VERSION	Displays the current firmware version of the unit
UPGRADE FIRMWARE	Load new firmware into the unit
FACTORY RESET	Resets the unit to its Factory default condition

Table 3-4: Top Level of the Utility Setup Menu

3.7.1. Selecting the Video Standard

VIDEO STANDARD
- *Vstd: auto*
- *Vstd: 1080i/60*
- *Vstd: 1080i/50*
- *Vstd: 720p/60*
- *Vstd: 720p/50*
- *Vstd: 1080p/24sF*
- *Vstd: 1080p/30*

The *VIDEO STANDARD* menu item is used to set the video standard in use. The current video standard can be displayed using the VID front panel display.

When you select *auto* the HD9010TM will auto detect the video standard and automatically reconfigure itself. The front panel VID display will show the word AUTO followed by an abbreviation of the detected video standard.

You can also select the video standard manually.

Select *1080i/60* for operation with 1080i/59.94 or 1080i/60 video conforming to SMPTE 274M.

Select *1080i/50* for operation with 1080i/50 video conforming to SMPTE 274M.

Select *1080p/24sF* for operation with 1080p/23.98 or 1080p/24 video conforming to SMPTE 274M.

Select *720p/60* for operation with 720p/59.94 or 720p/60 video conforming to SMPTE 296M.

Select *720p/50* for operation with 720p/50 video conforming to SMPTE 296M.

Select *1080p/30* for operation with 1080p/29.97sF or 1080p/30sF video conforming to SMPTE 274M.

3.7.2. Selecting the Generator Framing Reference

REFERENCE MODE
Ref: input
Ref: tri-lvl
Ref: bi-lvl

The *REFERENCE MODE* menu item is used to set whether the internal timing of the HD9010TM will be locked to the input video or the External Reference input. The updating of the generator clock, character displays and LTC phasing, and output video timing reference signals (TRS) are in turn locked to the internal timing reference of the HD9010TM.

Select *input* to reference the HD9010TM to the input video. This setting will cause the internal timing reference of the HD9010TM to become disrupted and unlocked when an HD input signal is not present. This may cause disturbances in the output video, but is the preferred method when you cannot time the input video to the reference within one line.

Select *tri-lvl* to reference the HD9010TM to a tri-level sync signal applied to the GENLOCK input. Select *bi-lvl* to reference the HD9010TM to a bi-level sync signal applied to the GENLOCK input. These settings will allow the internal timing reference of the HD9010TM to remain locked to the reference when an HD input signal is not present, providing a stable video output. The input video must be timed to the sync reference within one horizontal line period for proper alignment of the picture content on the output video. The format of the reference sync signal must be in accordance with the standards shown in Table 2-5.

Regardless of the setting of this menu control the HD9010TM requires a stable video input for normal operation.

3.7.3. Adjusting the Output Level of the LTC Generators

LTC LEVEL
Ltc level =xx

The *LTC LEVEL* menu item is used to adjust amplitude of the main LTC output. Turn the shaft encoder to adjust. The recommended output level setting is 35, which is approximately 1 volt peak to peak.

AUX LTC LEVEL
Aux ltc level =xx

The *AUX LTC LEVEL* menu item is used to adjust amplitude of the auxiliary LTC output. Turn the shaft encoder to adjust. The recommended output level setting is 35, which is approximately 1 volt peak to peak.

3.7.4. Adjusting the Baud Rate of the Serial Ports

COM 1 BAUD RATE
Com 1 =xx

The *COM 1 BAUD RATE* menu item is used to set the baud rate of the COM 1 serial port. Turn the shaft encoder to adjust. This serial port is used to broadcast time and user bit data in a packed BCD format. Contact the factory for further information. Note that the setting of this menu item does not affect the firmware upgrade baud rate. See section 4.2.2.

AUXCOM BAUD RATE
Aux com =xx

The *AUXCOM BAUD RATE* menu item is used to set the baud rate of the AUX COM serial port. (On earlier versions of the HD9010TM this serial port was labelled COM 2.) Turn the shaft encoder to adjust. This serial port is not used at this time.

3.7.5. Working with System Parameters

The HD9010TM allows the user to control various seldom-used features and debug aids by the use of system parameters. These parameters are grouped according to classes. Within each class, parameters are identified by a parameter number. Each parameter has a 4 byte signed binary number value with the default value for each parameter being zero. There are two menus item used to set the System parameter class and number and a third menu item, to change its value. Contact the factory before changing any System parameters from their default values.

SYS PARM CLASS
Sys prm class=0

This menu sets the system parameter class for the parameter value you want to change.

SYS PARM NUMBER
Sys prm num=0

This menu sets the system parameter number for the parameter value you want to change.

SYS PARM VALUE
Sys prm value=0

This menu changes the value of the system parameter selected by the *SYS PARM VALUE* and *SYS PARM NUMBER* menu items.

3.7.6. Viewing the Hardware Version

HARDWARE VERSION
Rev 1 (7700PB3)
Rev 2 (7700PH4)

The Hardware Version menu item allows you to identify the revision of the main board that is installed in the HD9010TM. When you press the **SELECT** key, the display shows the hardware version which will be something like:

```
Rev 2(7700PH4)
```

3.7.7. Viewing the Firmware Version

FIRMWARE VERSION
TM 2.0 build 138

The Firmware Version menu item allows you to view the firmware version that is installed in the HD9010TM. When you press the **SELECT** key, the display shows the software version which will be something like:

```
Tm 2.0 build 138
```

3.7.8. Upgrading the Firmware

FIRMWARE UPGRADE
Upgrade?
no
yes

The Firmware Upgrade menu item allows you to initiate an upgrade of the firmware from the front panel. When you press the **SELECT** key, you are prompted to confirm that you really want to upgrade. Turn the shaft encoder knob to *yes* and then press the **SELECT** key to confirm. When you press the **SELECT** key the unit will be placed in programming mode and its serial port is opened to communicate with the terminal software program. The front panel display shows `UPGRADING...` See section 4.2 for complete instructions on upgrading the firmware.

3.7.9. Resetting the HD9010TM to its Factory Defaults

FACTORY RESET
Fact Reset?
no
yes

The *Factory Reset* menu item allows you to reset the HD9010TM to its factory default condition. When you press the **SELECT** key, you are prompted to confirm that you really want to reset the unit. Turn the shaft encoder knob to *yes* and then press the **SELECT** key to confirm. When you press the **SELECT** key the unit will be reset to its factory default condition. The front panel display shows `RESETTING...`

3.8. CONFIGURING THE GENERAL PURPOSE INPUTS AND OUTPUTS

A 9 pin D connector located on the rear panel labelled **PARALLEL I/O** provides control inputs for remote control of some of the model HD9010TM functions. Several of these inputs can also be configured as open collector outputs that can be assigned to a variety of functions. The pin out of the D connector when the HD9010TM is not in the *time rctl* mode is shown in Table 2-1.

The *GPI* front panel display (accessible by pressing the **DISPLAY** button one or more times) will show the status of the GPI inputs. The GPI status display (`GPI: 11111111`) is a group of 8 digits representing the GPI inputs (GPI 8 on the left, GPI 1 on the right) When the digit is showing a 0, the GPI input is low. When the digit is showing a 1 the input is high.

There are eight GPI inputs on Rev 2 units and three GPI inputs on Rev 1 units. Section 3.8.2 describes the operation of the GPI functions when the HD9010TM is not operating the *time rctl* mode.

When the HD9010TM is operating in the *time rctl* mode, the functions of these **PARALLEL I/O** port `GPI: 11111111` pins are reassigned to provide a method of inputting Remote Control contact closure information for encoding into the user bits. The pin out of the D connector when the HD9010TM is in the *time rctl* mode is shown in Table 2-2. Section 3.8.1 describes the operation of the *time rctl* mode.

3.8.1. GPI Remote Control Mode

On Revision 2 versions, when the *GEN MODE* is set to *time rctl* the HD9010TM allows the user to encode remote control contact closure information in the RP188 ATC user bits. This feature is not supported in Revision 1 units. This feature allows the user to use the six parallel remote control inputs to set one of the six remote control user bit patterns. At the decoder end the 7721DD4-HD+GPI ATC GPI Decoder module decodes the remote control user bits and outputs them on six open collector outputs. When the HD9010TM is operated in this mode the normal functions of all the parallel remote control inputs are disabled.

In the *time rctl* mode, the GPI1 to GPI6 inputs on the Parallel remote control port are used to control the remote control user bits while GPI 7 and GPI 8 retain their normal functions (ON AIR TALLY INPUT and GEN SET as shown in Table 3-5). When the *GEN MODE* is set to any of the other modes, then the GPI1 to GPI6 inputs revert to their normal functions as described in section 3.8.2. The parallel port pin designations in remote control mode are shown in Table 3-5 below. Table 3-5 also shows the corresponding output pins of the 7721DD4-HD+GPI decoder terminal block and the user bits that control them. If the video is downconverted using a 7710DCDA or similar downconverter that passes the timecode through to the downconverted output, the encoded GPI signals can be decoded by the 7721GPI-D SDI decoder, as shown in Table 3-5.

GPI	HD9010TM PIN (IN)	7721DD4-HD+GPI PIN (OUT)	7721GPI-D PIN (OUT)	GUB Data byte 1
1	1	11	4	81
2	8	12	8	82
3	4	13	3	84
4	9	14	1	88
5	5	15	13	90
6	2	16	14**	A0
7	7 (GEN SET)			
8	3 (VCG DISABLE)			

Table 3-5: Remote Control Mode GPI I/O Mapping

3.8.2. Assigning the Functions of the General Purpose Inputs

When the *GEN MODE* is **NOT** set to *time rctl* there are eight dedicated remote control inputs as shown in Table 3-6 for Revision 2 units. Note that not all of the GPI inputs are available in Revision 1 units as shown in Table 3-7.

Pin #	Name	Description
1	GPI1	Panel Lock
2	GPI6	GEN run/hold
3	GPI8	VCG Disable
4	GPI3	ATC Disable
5	GPI5	6 HZ Input
6	GND	Ground
7	GPI7	GEN Set
8	GPI2	Jam sync enable
9	GPI4	Bypass

Table 3-6: Parallel I/O Connector Pin Definitions – Normal GPIO Functions (Rev 2 Versions)

Pin #	Name	Description
1	GPI1	VCG Disable
2		Not used on Rev 1 versions
3		Not used on Rev 1 versions
4		Not used on Rev 1 versions
5	GPI5	6 HZ Input
6	GND	Ground
7		Not used on Rev 1 versions
8	GPI2	Jam sync enable
9		Not used on Rev 1 versions

Table 3-7: Parallel I/O Connector Pin Definitions – Normal GPIO Functions (Rev 1 Versions)

VCG DISABLE When closed to ground this input turns off the character inserter keyer. This input has higher priority than the front panel CHAR GEN ON/OFF key and the keyer will remain Off as long as the input is closed to ground.

ATC DISABLE Provides an alternate method of turning the VITC generator On and Off. The ATC generator is turned Off by a high to low transition on this input, and turned On by a low to high transition.

BYPASS When closed to ground this input activates the SDI bypass relay.

JAM SYNC Provides an alternate method of syncing the generator time of the active reader time when the unit is not in the *convert* mode. Momentarily closing this input to ground and releasing it will perform a synchronization to the reader time.

GEN HOLD Provides an alternate method of selecting the Generator Hold function. The generator Hold function is selected by a high to low transition on this input, and deselected by a low to high transition.

GEN SET Provides an alternate method of selecting the Generator Set function. The generator Set function is selected by a high to low transition on this input, and deselected by a low to high transition. When this input is closed to ground the last entered time value is entered into the Generator again.

PANEL LOCK When closed to ground this input activates the Panel Lock function. The panel will remain locked as long as the input is closed to ground.

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CHAPTER 4
TABLE OF CONTENTS

4. TECHNICAL DESCRIPTION 4-1

4.1. SPECIFICATIONS 4-1
4.1.1. HDTV Serial Digital Video Input 4-1
4.1.2. HDTV Serial Digital Video Outputs 4-1
4.1.3. Reference Input 4-1
4.1.4. LTC Generators 4-1
4.1.5. LTC Readers 4-1
4.1.6. Serial Ports 4-2
4.1.7. System Latency 4-2
4.1.8. Physical 4-2
4.1.9. Electrical 4-2

4.2. UPGRADING THE FIRMWARE 4-2
4.2.1. Overview 4-2
4.2.2. Terminal Program Setup 4-3
4.2.3. Initiating Firmware Upgrade Mode Via The Front Panel 4-3
4.2.4. Initiating Firmware Upgrade Mode From The Terminal Program 4-3
4.2.5. Uploading the New Firmware 4-4
4.2.6. Completing the Upgrade 4-5

4.3. SERVICING INSTRUCTIONS 4-5
4.3.1. Changing the Fuses 4-5
4.3.2. Changing DIP Switch Settings 4-6
4.3.2.1. Enabling the Time Code Broadcast Data Output 4-6

Tables

Table 4-1: DIP Switch Functions 4-6

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4. TECHNICAL DESCRIPTION

4.1. SPECIFICATIONS

4.1.1. HDTV Serial Digital Video Input

Standard:	1.485 Gb/s nominal HDTV Serial component digital SMPTE 292M standards supported shown in Table 2-5 - software selectable or auto detect
Connector:	BNC per IEC 60169-8 Amendment 2.
Equalisation:	Automatic to 100m @ 1.5Gb/s with Belden 1694 or equivalent cable

4.1.2. HDTV Serial Digital Video Outputs

Standard:	SMPTE 292M, same as input
Outputs:	1 relay bypassed with +HBP option, 2 non bypassed Program video with RP188 Ancillary Time code embedded and optional characters
Connectors:	BNC per IEC 60169-8 Amendment 2.
Signal Level:	800mV nominal
DC Offset:	0V ±0.5V
Rise and Fall Time:	200ps nominal
Overshoot:	<10% of amplitude
Wide Band Jitter:	< 0.15 UI

4.1.3. Reference Input

Type:	HD Tri-level Sync, NTSC or PAL Colour Black 1 V p-p, or Composite bi-level sync (525i/59.94 or 625i/50) 300 mV (Table 2-5)
Connector:	BNC loop per IEC 60169-8 Amendment 2.
Termination:	High Impedance

4.1.4. LTC Generators

Standard:	SMPTE 12M
Number:	2
Frame Rate:	24, 25 and 30 Fps nominal
Connectors:	3 pin male XLR type connector.
Level:	Adjustable, 0.5V to 4.5V p-p

4.1.5. LTC Readers

Standard:	SMPTE 12M
Number:	2
Frame Rate:	24, 25 and 30 Fps nominal
Connectors:	3 pin female XLR type connector
Level:	0.2 to 4V p-p, balanced or unbalanced
Speed:	$1/30^{th}$ to 50x play speed, VTR dependent

4.1.6. Serial Ports

Standard: RS-232
Number: 2 ports
Baud Rate:
COM1: 115,200 baud (57600 for Rev 1 hardware) for firmware upgrades
Programmable for data broadcast applications
AUX COM: Programmable
Connectors: 9 pin female "D"
Control:
COM1: Firmware upgrades, time code data broadcast
AUX COM: Programmable - future use

4.1.7. System Latency

Input to output Delay:
Ref:Input: Approx. 1.8 µsec (136 samples)
Ref: Bi-Level: up to 1 HD line
Ref: Tri-Level: up to 1 HD line

4.1.8. Physical

Dimensions: 19" W x 1.75" H x 18.75" D.
(483mm W x 45mm H x 477mm D)
Weight: 8 lbs. (3.5Kg)

4.1.9. Electrical

Power: Auto ranging, 100 ⇔ 240 VAC, 50/60 Hz 40 Watts.
Safety: ETL listed.
Complies with EU safety directive
EMI/RFI: Complies with FCC Part 15 Class A,
EU EMC Directive

4.2. UPGRADING THE FIRMWARE

4.2.1. Overview

The firmware in the HD9010TM is contained on a FLASH EPROM. From time to time firmware updates will be provided to add additional features to the unit. There are two different versions of hardware that may be installed in the HD9010TM. The *HARDWARE VERSION* menu item will tell you whether you have Rev 1 (7700PB3) or Rev 2 (7700PH4) hardware installed. The baud rate for upgrading firmware is set differently for the different revisions of the hardware.

You will need the following equipment in order to update the Firmware:

- PC with available communications port. The communication speed is 57600 or 115200 baud, therefore a 486 PC or better with a 16550 UART based communications port is recommended.
- "Straight-thru" serial extension cable (DB9 female to DB9 male) or (DB25 female to DB9 male).
- Terminal program that is capable of Xmodem file transfer protocol. (such as HyperTerminal)
- New firmware supplied by Evertz.

4.2.2. Terminal Program Setup

1. Connect the serial cable to the COM1 DB9 connector on the rear panel.

2. Connect the 9 pin connector on the end of the serial update cable to the PCs' RS-232 communications port.

3. Start the terminal program.

4. Configure the port settings of the terminal program as follows:

	Rev 1 Hardware	**Rev 2 Hardware**
Baud	**57600**	**115200**
Parity	**no**	**no**
Data bits	**8**	**8**
Stop bits	**2**	**2**
Flow Control	**None**	**None**

5. Power up the HD9010TM unit.

4.2.3. Initiating Firmware Upgrade Mode Via The Front Panel

This is the recommended method of updating the software in the HD9010TM Time Code Master. It is activated through the *UTILITIES* Setup menu. If you cannot invoke the upload mode via the front panel as outlined in step 6 then follow the steps in section 4.2.4.

6. You can invoke the Firmware upgrade mode using the front panel Setup Menu. (See section 3.2 for information on how to operate the front panel menus.) Press the **UTIL** key to enter the *UTILITIES* Setup menu. Scroll to the *FIRMWARE UPGRADE* menu item by turning the **SHAFT ENCODER** knob and then press **SELECT**. If you want to upgrade the main operating firmware in the HD9010TM then turn the **SHAFT ENCODER** knob until the display shows *yes* and then press **SELECT** or press the **ESC** key if you want to abort the programming operation.

   When you press the **SELECT** key the unit will be placed in programming mode and its serial port is opened to communicate with the terminal software program. The front panel display shows `UPGRADING...` Proceed to section 4.2.5 for instructions on uploading the firmware using the terminal program.

4.2.4. Initiating Firmware Upgrade Mode From The Terminal Program

You may send commands to the HD9010TM Boot monitor in order to upgrade the HD9010TM application firmware.

7. Power up the HD9010TM. After the unit powers up, a banner with the boot code version information should appear in the terminal window. The cursor to the right of the word "BOOT>" should be spinning.

   For example:

```
EVERTZ MFC5407 MONITOR 2.1.3
COPYRIGHT 1997, 1998, 1999, 2000, 2001 EVERTZ MICROSYSTEMS LTD.
COLD BOOT |
```

8. The following is a list of possible reasons for failed communications:

   - Defective Serial Upgrade cable.
   - Wrong communications port selected in the terminal program.
   - Improper port settings in the terminal program. (Refer to step 4 for settings). Note that HyperTerminal will not change port settings while connected. Click on HyperTerminal's "Disconnect" Button then click the "Reconnect" button to activate changes to the port settings.

9. While the cursor is spinning press the <CTRL> and <X> keys, this should stop the cursor from spinning. The spinning prompt will only remain for about 5 seconds. You must press <CTRL-X> during this 5 second delay. If the unit continues to boot-up, simply cycle the power and repeat this step.

10. Hit the <ENTER> key on your computer once.

11. Type the word "upgrade", without quotes, and hit the <ENTER> key once.

12. The boot code will ask for confirmation. Type "y", without quotes.

4.2.5. Uploading the New Firmware

13. You should now see a prompt asking you to upload the file.

14. Upload the "*.bin" file supplied using the X-Modem transfer protocol of your terminal program. If you do not start the upload within 10 minutes the unit's Boot code will time out. You can restart the upgrade process by power cycling the unit.

    The HD9010TM application firmware is contained in a "bin" file that will have a name something like:

    HD9010TM_2v0_1.bin

    The version number usually follows the main file name (e.g. 2v0_1 is version 2.0 build 1).

Firmware version 2.0 Build 1 or later is compatible with both Rev 1 and Rev 2 hardware. Firmware versions 1.x are compatible only with Rev 1 hardware.

15. The boot code will indicate whether the operation was successful upon completion of the upload.

    For Example:

```
UPLOAD OKAY
MFC5407 WARM BOOT> |
```

16. The following is a list of possible reasons for a failed upload:

- If you get the message "transfer cancelled by remote" you must restart the terminal program and load the bin file, then remove and install the module again.
- The supplied “*.bin” file is corrupt.
- Wrong file specified to be uploaded.
- Wrong file transfer protocol used – make sure you specify Xmodem, not Xmodem 1K.
- The PCs’ RS-232 communications port cannot handle a port speed of 57600 or 115200.
- Noise induced into the Serial Upgrade cable.

4.2.6. Completing the Upgrade

17. Power cycle the unit. The unit should now reboot.

18. You can now close the terminal program and disconnect the RS-232 serial cable from the PC.

4.3. SERVICING INSTRUCTIONS

CAUTION – These servicing instructions are for use by qualified service personnel only. To reduce risk of electric shock do not perform any servicing instructions in this section of the manual unless you are qualified to do so.

4.3.1. Changing the Fuses

Check that the line fuse is rated for the correct value marked on the rear panel. Never replace with a fuse of greater value.

The fuse holder is located inside the power entry module. To change the fuses, pull out the fuse holder from the power entry module using a small screwdriver. The fuse holder contains two fuses, one for the line and one for the neutral side of the mains connection. Pull out the blown fuse and place a fuse of the correct value in its place. Use time delay 5 x 20 mm fuses rated for 250 Volts with a current rating of 1 amp. Carefully reinsert the fuse holder into the power entry module.

4.3.2. Changing DIP Switch Settings

At the front edge of the main module inside the unit there is an 8 position DIP switch, which is used to select various operational and diagnostic functions. The ON position is down or closest to the PCB. Most users will have no need to alter the factory switch settings. Section 4.3.2.1 describes the assigned DIP switch functions.

DIP Switch	Function
1	Not used – set to Off
2	Bypass Option installed
3	Metadata Slave type 1 (Factory use only) – set to Off
4	Enable data broadcast mode for COM 1
5	Not used – set to Off
6	Metadata Slave type 1 (Factory use only) – set to Off
7	Dual power supply option installed
8	Disable debug message output on COM 1

Table 4-1: DIP Switch Functions

To gain access to the DIP switches you will have to remove the top cover.

Before removing the top cover of the unit make sure that both power cords are disconnected from the mains.

4.3.2.1. Enabling the Time Code Broadcast Data Output.

When you set DIP switch 4 and 8 to the closed (down) position the HD9010TM COM 1 port will output a packed BCD serial data stream output with the following specifications.

Baud Rate: Selectable using the *COM 1 BAUD RATE* control
Data Format: 8 bits, even parity, 1 stop bit

Once per field (once per frame for 720p video formats) the HD9010TM will send the time and user bits most recently generated by the primary ATC generator in the following formatted packed BCD message:

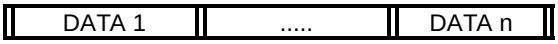
Each message starts with the STX character and ends with a checksum. The message blocks are structured as follows:

STX	BYTE COUNT	MESSAGE	CHECKSUM

STX Start of message character (02 hex)
BYTE COUNT Count of response message not including STX, BYTE COUNT or CHECKSUM.
MESSAGE 9 byte message consisting of the time and user bits data from the generator.
CHECKSUM The two's complement of the one byte sum of the MESSAGE and the BYTE COUNT.

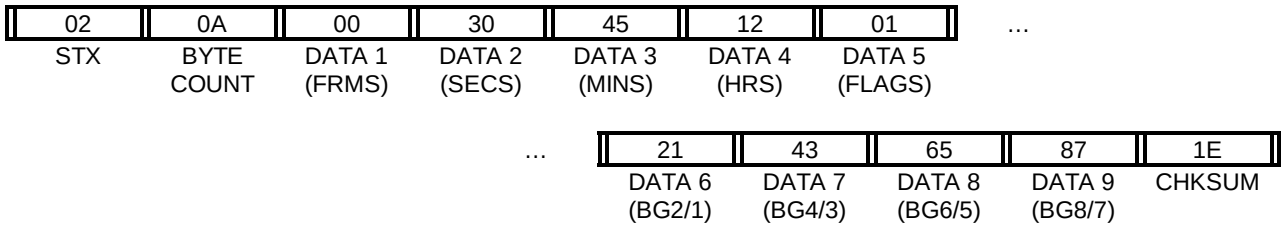
The purpose of the checksum is to verify that all the bytes in the message that contain variable data have been received properly. The STX is the only byte that has a fixed value, so it is the only byte not included in the checksum calculation. The checksum is calculated by adding all the variable bytes together. The least significant byte of this sum is then subtracted from 100 hex to compute the checksum. To verify that the checksum is computed correctly, add all the bytes including the checksum but excluding the STX together. The least significant byte of the sum should be zero if the checksum is computed correctly.

The MESSAGE is structured as follows:



DATA 1...DATA 9 9 Data bytes of the broadcast message

If the current generator time code was 12:45:30:00 Drop Frame and the user bits were 87 65 43 21 the data broadcast message would be received as follows (hexadecimal notation):



The Flags byte is a bitmapped byte of the timecode flag bits as follows:

Bit 0	Drop Frame Flag	0 = Non Drop Frame, 1 = Drop Frame
Bit 1	Colour Frame Flag	0 = Non Colour Frame, 1 = Colour Frame
Bit 2	VITC Field Flag	0 = Field 1, 1 = Field 2
Bit 3	Binary Group Flag 0	
Bit 4	Binary Group Flag 1	
Bit 5	Binary Group Flag 2	
Bit 6	LTC Flag	1 = LTC Active
Bit 7	VITC Flag	1 = VITC Active

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