TABLE OF CONTENTS

This page left intentionally blank

1. OVERVIEW

Because of small differences between UTC (Coordinated Universal Time) and time based on the rotational speed of the earth (UTCI), periodic adjustments to UTC are made in increments of 1 second. The International Earth Rotation and Reference Systems Service, the organization responsible for measuring the relationship between UTC (Coordinated Universal Time) and the rate of Earth's rotation announces these adjustments, known as leap seconds. Leaps seconds, when required, are usually made at the end of June 30, or December 31, universal time, so that UTC never deviates from UTCI by more than 0.9 second. The last minute of the day on which a leap second is made has 61 seconds or 59 seconds. It could happen that leap seconds would need to be removed (negative leap seconds); however, all leap seconds so far have been positive. Since many television facilities operate with their facility time code generator tied to an external time reference, such as GPS, leap second adjustments can affect broadcast operations.

The Evertz 5600MSC, 5601MSC and 5010−GPSII are commonly used as master time references in broadcast operations. This application note discusses various precautionary steps that you should take or be aware of as we approach a leap second event. These precautionary steps will depend on the product and configuration you are using.

If your particular use of the Evertz 5600MSC, 5601MSC or 5010−GPSII differs from the information provided here please contact Evertz customer service at service@evertz.com with your specific system details.

2. HOW THE 5600MSC AND 5601MSC HANDLE LEAP SECONDS

The operation of the 5600MSC and 5601MSC are very similar, and these devices will be referred to as MSC for the remainder of this app note.

2.1. Using the Modem as a Time Reference

If you are using the phone line method of updating the MSC time, you may need to check with the provider of this service to verify how they will be handling the leap second. Although the leap second technically happens at 12:00am UTC time on the announced day (usually June 30 or December 31), local reference clocks may choose to update at a more convenient local time to prevent disruptions. Depending on when your current time update is scheduled you may want to change it for this event. When the phone call is made, the MSC system time will be adjusted immediately for the leap second. The time of the phone call is set using the Modem Dial time register. If you want to have the leaps second take effect in the MSC at a different time, then you can adjust the Modem Dial time.

2.2. Using GPS as the Time Reference

If you are using GPS as the Time Reference, (e.g. when the MSC is operating as the station master) the MSC will rejam its system time according to the setting of the INPUT:LOCK CONTROL menu setting.

- When the LOCK CONTROL menu is set to *Always Jam,* the MSC will adjust for the leap second immediately when it sees the leap second occur (at midnight UTC).

- When the LOCK CONTROL menu is set to *Daily Jam,* the MSC will indicate that a System Time jam is required when it sees the leap second occur (at midnight UTC), and it will automatically adjust for the leap second at the UTC time programmed for the Daily Jam to occur. The user may do a manual System Time jam from the front panel at any time while the message is being displayed to immediately correct for the leap second.
- When the LOCK CONTROL menu is set to *User Jam,* the MSC will indicate that a System Time jam is required when it sees the leap second occur (at midnight UTC). The user must do a manual System Time jam from the front panel to correct for the leap second.

2.3. Using LTC or VITC as the Time Reference

If you are using LTC or VITC as the Time Reference, (e.g. when the MSC is operating as the station master) the MSC will rejam its system time according to the setting of the INPUT:LOCK CONTROL menu setting.

- When the LOCK CONTROL menu is set to *Always Jam,* the MSC will adjust for the leap second immediately when it sees the leap second occur on the incoming LTC or VITC.
  When the LOCK CONTROL menu is set to *Daily Jam,* the MSC will indicate that a System Time jam is required when it sees the leap second occur on the incoming LTC or VITC, and it will automatically adjust for the leap second at the System Time programmed for the Daily Jam to occur. The user may do a manual System Time jam from the front panel at any time while the message is being displayed to immediately correct for the leap second.
- When the LOCK CONTROL menu is set to *User Jam,* the MSC will indicate that a System Time jam is required when it sees the leap second occur on the incoming LTC or VITC. The user must do a manual System Time jam from the front panel to correct for the leap second.

2.4. General Considerations

If you are using MODEM as the Time Reference and you want the change to occur at a more convenient time (i.e. when your station is off air) then you should set the Modem Dial time to the desired correction time for the leap second.

If you are using GPS as the Time Reference and you want the change to occur at a more convenient time (i.e. when your station is off air) then you should use the *Daily Jam* setting of the LOCK CONTROL menu item.

If you are using LTC or VITC from a master MSC which is locked to GPS as the Time Reference, and the master MSC has its correction time deferred to the *Daily Jam Time* you want the likely want the change on the slave MSC to occur at the same time as the master. The same is true if your master MSC is locked to MODEM and the Dial time has be set to a more convenient update time. In both these cases you should use the *Always Jam* setting of the LOCK CONTROL menu item.

Whenever the MSC system time is adjusted (either manually through the front panel or from its time reference), each of the time code generators in the MSC (LTC1, LTC2, the VITC generators for each black output, etc.) will resynchronize to the new System Time, therefore adjusting for the leap second. Note that for PAL related time codes if the Colour frame mode of the generator is Off the jammed time code may be offset by 1 frame from the actual time to keep it in phase with the 4 field PAL sequence. For PAL related time codes if the Colour Frame mode is turned On the jammed time code may be offset by up to 3 frames from the actual time to keep it in phase with the 8 field PAL sequence.

3. HOW THE 5010−GPSII (AND 5010−VITC−GPSII) HANDLES LEAP SECONDS

When DIP switch 3 is CLOSED, the 5010−GPS re-syncs to the GPS at the time specified by the GPS@ register. At the first GPS@ time after the leap second occurs (at midnight UTC) then the 5010-GPSII will re-jam its generator clock and adjust for the leap second. Normally the 'GPS@' time would be set to occur when a station is off air so as not to disrupt the automation systems and other devices that are reading the time code.

When DIP switch 3 is OPEN (Default), the 5010−GPSII re-syncs to the GPS whenever the time difference is greater than one half second and at the time specified by the GPS@ register. In this mode the 5010−GPSII will re-sync right after the leap second occurs (at midnight UTC) then it will re-jam its generator clock and adjust for the leap second. If you want the change to occur at a more convenient time (i.e. when your station is off air) then you can change the menu settings in the 5010−GPSII to ignore the GPS time temporarily as follows.

1. On the day before the leap second will occur, set the GEN MODE to TIME DATE. This will allow the 5010−GPSII to continue counting without disruptions across the leap second change.

2. When the change will be convenient set the GEN MODE back to the original settings GPS TIME DATE. This will re-sync the 5010−GPSII time to the GPS time and cause the leap second adjustment to happen.

Note that for PAL related time code, if the Colour frame mode of the generator is set to '4 field' the jammed time code may be offset by 1 frame from the actual time to keep it in phase with the 4 field PAL sequence. For PAL related time code, if the Colour Frame mode is set to '8 field' the jammed time code may be offset by up to 3 frames from the actual time to keep it in phase with the 8 field PAL sequence.