REPEATER SYSTEM 2 ADDENDUM

REPEATER SYSTEM 2.01 DEVELOPMENT

Summary:

This document provides a list of features implemented in Repeater System 2.01 and provides an addendum to the original Repeater manual. The descriptions in this document form source material for the forthcoming Repeater System 2.01 manual.

1   Summary of Changes

Repeater System 2.01 takes the functionality of Repeater to a new level of performance and sophistication. The Repeater 1.00 and 1.10 firmware broke new ground in the looping world on a hardware platform delivering ease of use with sophisticated looping functionality – it has become a standard in the looping community.

Repeater System 2.01 has built on this foundation and with the benefit of feedback from an active user community has produced a new release that addresses known issues and expands the available functionality to end users.

The following is a list of new features in Repeater 2.01:

- 'What-you-hear-is-what-you get' looping. Loop pan and routing applied to the input signal so that recording is completely predictable. May be bypassed if required
- Record direct into overdub for initial recordings
- 'Bumpless' looping – advanced control eliminates **all** loop end artifacts under a wide variety of conditions (ie. no crossfades)
- Unit wet/dry mix control
- Main output attenuation control
- Tape emulation control via MIDI
- Independent control of track play, stop and direction
- Persistent settings across power cycles
- Sticky settings for rapidly setting up new loops
- Utility menu for deeper control over (persistent) unit settings
- Setting up initial 'empty' loops of known size
- Over 25 new MIDI control features
- Improvements to MIDI Real-time outputs
- Improvement to quality of audio for small pitch/tempo shifts
- Programmable unit wet/dry mix
- Stop at loop boundary.
- Positive visual indication of track muting.
- Click loop end identification and routing via main outs or FX sends.

In the following, these features are outlined in detail with information on how to access them and basic examples of their use. In addition, the entire MIDI implementation is described in detail.

2 UI Control Updates

The new UI control functions implemented are detailed below.

2.1 UTILITY MENU

A first major change with System2 is the addition of a utility menu. In the original repeater, some complexity in setting up the unit was avoided as there was no easy way of presenting this to the user. This is solved in System2 by the addition of a utility menu.

To access the menu, press and hold STOP and press COPY. The display will briefly show 'MENU' and then the first of the set of choices will be shown.

On the left hand side of the display will be descriptive text for the menu parameter. On the right hand side the current value for that parameter will be shown. The left encoder will scroll through the list of menu parameters, stopping at the first and last items. The right encoder adjusts the value.

The following section describes the utility menu parameters and their effect on the behaviour of the unit, with examples illustrating the use of each.

2.1.1 MIDI Channel Select

The first menu item replaces the function of the rear-panel MIDI channel selector on original repeater units. The right encoder allows the unit MIDI channel to be selected from 1-16. On intial powerup the unit MIDI channel defaults to 16.

2.1.2 Main output attenuation

Using the Repeater with some downstream equipment has caused level mis-match issues. A programmable 0 to 30dB digital attenuator is included in the signal path to allow the main outputs to be reduced in level as required to match with offboard gear. This can also be used as a master attenuator effect.

Use the left encoder to select the 'Atten' menu item. On the right hand encoder, adjust the output level from 0 to 30dB. The effect will immediately be heard on any signal running through the unit.

2.1.3 Dry/Wet mix

This allows the signal generated by the unit (Loop) to be mixed with the dry signal coming through the unit.

Record a loop from the input signal by pressing the record button and a few seconds later pressing the play button. You will hear the input audio and the loop audio mixed at the output. Enter the menu (this will stop the track). Once the menu is active, press 'play' to re-start the loop audio.

Use the left encoder to select the 'Dry.Wet' menu item. Turn the right hand encoder to the left. The display will show the 'wet' signal reducing to zero. You will hear the loop signal diminish to zero leaving just the input audio. Now turn the encoder to the right. The display will move through the center '00.00' position and then will show the 'dry' signal diminishing leaving just the loop audio.

2.1.4   Track bypass

This menu item activates/de-activates the 'What-you-hear-is-what-you-get' audio routing functionality described in section 3.1. With 'TrkBypas' set to ON, the function is defeated; the default position is OFF, enabling this feature.

2.1.5   Sticky settings

Normally a blank loop is entered with zeroed pitch and pan positions and tracks will only be 'tentatively' stereo linked if that was the record routing on leaving the previous loop. With the 'Sticky' feature set on, then the stereo routing, pan settings and pitch settings will be pulled into the next blank loop selected from the current loop. This eases setup if similar settings are repeatedly used.

Select the 'Sticky' menu setting and set it to 'OFF' (default). Set the stereo linking, pan and pitch settings as desired and make an initial recording. Now move to a blank loop and note that all these settings have been cleared. Now go back to the original loop and set the 'Sticky' menu setting to ON. Repeat the experiment and this time see that all your settings come along to the new blank loop.

2.1.6   Record Real-time on/off

When syncing off-board gear to Repeater, an initial recording can throw it off as the timing of the new loop (user sync mode) will dictate the new MIDI clock rate. By setting the 'RecordRT' menu item to 'OFF', MIDI Real-time output is defeated during the initial recording to avoid confusing downstream gear syncing to MIDI RT.

2.1.7   Record CC on/off

On a recording start, Repeater can send a MIDI CC. In some situations this may not be desired as it could trigger a downstream Repeater unit on the same MIDI Channel. By Setting 'RecordRT' to OFF this can be defeated (default). By setting it to ON, external gear (including a PC) can monitor this important event at the Repeater UI.

2.1.8   Record-into-overdub on/off

A new DSP feature is 'record-into-overdub' in user-sync mode. This was not possible in Repeater1.0. The menu item 'Rec-Odub' allows this feature to be defeated to revert to Repeater1.0 behaviour. By default the feature is enabled which allows a user to make true seamless loops as described in sections 3.2 and 3.3.

2.1.9 Click level

Click level is editable when click is engaged (press and hold 'Tempo Lock' – and then whilst still holding adjust the level using the right hand encoder). The menu item 'Click' allows this level to be adjusted separately.

2.1.10 Click routing

Routing the Click via the main unit outputs is not always convenient as then the unit output signal is corrupted. By setting 'Click' between 'Main' and 'FX' the click can be re-routed to the FX Sends to allow it to be used without disturbing the main unit output signal.

2.1.11 Record trigger level

The 'Trig' menu item allows the audio-triggered record level to be set independently from the normal entry into triggered record (Hold **Stop**, press and hold **Record** and dial in trigger level using right hand encoder. Release **Record**).

2.1.12 Feedback level

The feedback level is normally adjusted by pressing and holding **Overdub**. The 'Feedback' menu item can also be used to make the same adjustment.

2.1.13 FX Return live on/off

To provide more audio routing freedom, the FX Returns can be used as an auxiliary input. Normally the FX returns are only 'live' when the fx sends are. This function allows the returns to be maintained in the live state independent of the activity of the FX Sends.

To control this feature, use the 'FX Live' menu item to switch the FX sends into the permanently ON state, or into the normal operation state.

2.2 PERSISTENCE

As there are many new settings available in the Repeater 2.0 firmware a mechanism has been introduced for making these settings persist even when the unit is powered down so that it comes back up in the same setup condition. The parameters that are stored when the power to the unit is cycled are:

- Tempo
- MIDI Channel
- FX Active state
- FX Routing state
- Overdub state
- Feedback level
- Click Level and routing
- Record trigger level
- Stereo linking state

- Sticky parameters setting
- Main attenuator setting
- Input mute state
- Track bypass state (What-you-hear-is-what-you-get defeat)
- Record-direct-into-overdub state
- FX Return activity state
- Track Pan settings

2.3 'EMPTY' LOOP SETUP

A useful feature is to be able to setup an empty loop that can then be used as if an initial recording of silence had already been made. To setup an empty loop of a certain length, press and hold **Sync** to activate the tempo edit. You can then use the left encoder to dial in the loop beats and the right encoder to select the loop time signature. Pressing **Sync** again will exit the tempo edit state and now the loop will be set to the beats and time signature you specified, even though no recording has been made.

The loop will now behave as if silence had been recorded.

Note: *the tempo at the time that the loop is set up is important as this will be the 'native' tempo of the empty loop. If the tempo changes when the recording is made, then time stretching will be used during the recording – this may not be desired.*

2.4 LOOP END STOP

When engaging a new loop, 'play', and 'record' can be automatically activated at loop end to seamlessly transition into the new loop. This function is now available for 'Stop' to allow a loop to be stopped exactly at the loop end and immediately cue up a new loop ready for use.

Playing a loop, select a second loop and then hit **Stop**. The stop LED will flash. A second press will immediately engage the new loop. Otherwise the new loop will be engaged when the loop end comes around.

2.5 INDEPENDENT LOOP TRACKS

This feature opens up possibilities for experimenting with rhythm, offsets and counter-directions that were inaccessible in Repeater 1 and remain inaccessible in all other looping products.

Repeater implements loops as four independent tracks. In Repeater1.0 these could be manipulated in terms of level and relative position (slip). The independent track functions allow tracks to be dynamically manipulated relative to one another. It can get pretty wild...

2.5.1 Independent Play

Record all four tracks into a loop and stop playback. Now holding track select 1, press 'play'. Track 1 will now start playing leaving tracks 2-4 stopped. If you press track select 1, the play LED will flash showing that this track is playing. Press track selects 2-4. All will cause the 'stop' LED to flash showing that these tracks are currently stopped. If you press 'play' with none of the track selects held – all tracks will restart.

2.5.2 Independent Stop

With all tracks playing, hold a track select and press 'stop' to stop just that track. Note that you can stop or play all the tracks that you hold down the track select buttons for at one time.

Note – you can stop all the tracks but leave the transport playing – no audio output but the display and MIDI output behave as if the unit were still going. Pressing stop with none of the track selects held will stop the transport.

2.5.3 Independent Reverse

With all tracks stopped, hold track select 1 and press 'Play'. Still holding track select 1 press reverse. Track 1 will reverse direction, but the transport will still keep going forwards. Now start track 2 by holding the track 2 select button and pressing play. Tracks1 and 2 are now playing in opposite directions. Experiment by re-triggering each of the tracks independently (track select plus play) to resynchronize the loops...

2.5.4 Persisting 'hidden' slip values

When tracks are independently set to play and go into reverse, a hidden 'slip' value is set so that the track knows its position relative to the transport position. These values are independent of the track 'slip' positions. If you have come up with something you like and want to save, you can convert these 'hidden' slip values into real 'slip' values by pressing 'resample' whilst holding the track select buttons for the tracks you wish to store the slips for. The display will momentarily show '**slip stored**' to show the operation has successfully completed. Displaying the slips (press '**slip**') will now show the stored slip value for the track(s) selected.

2.6 MULTIPLY FACTOR SHOWN AS FRACTION

The means of displaying 'fractional' loop multiply values in repeater1 was a little confusing. These are now shown as fractions.

Multiply your loop up by a factor of 6 by pressing and holding **multiply** and then dialing in '6' using the right-hand encoder – then release **multiply**.

Now press **multiply** again. Notice that you can dial multiply values of 1, 5/6, 4/6, 3/6, 2/6 and 1/6. Select 1/6 to get back to the original (un-multiplied) loop.

3   DSP and Real-time Updates

This section summarizes the feature updates in System2 that you can immediately hear in unit operation.

3.1 'WHAT-YOU-HEAR-IS-WHAT-YOU-GET'

The unit audio routing has been modified so that 'What-you-hear-is-what-you-get' – after making a recording, the loop audio sounds exactly as it did when you made the recording. In Repeater1, there

could be a drastic change as audio switched from full stereo to hard-panned flat mono on completion of a recording.

Select track 1 for record. Press the **Pan** button to select track pan positions. Select only track 1 and pan it hard left and right. You will hear the audio out of the unit as a mono version of the unit input following the track pan position. Leave track 1 panned hard left and then select track 2 and pan it hard right. Exit from the pan edit by pressing the **Pan** button again. Now select between tracks 1 and 2 and hear the audio following the track pans.

Now press track3 and track4's buttons together to stereo link them. As you switch between track1, track2 and track3/4 as the record selected tracks, listen as the signal changes pan position and becomes full stereo when routed to the linked tracks.

Now, route track1 to the FX Send by pressing the track 1 record select whilst holding the '**FX Insert Engage**' button. When track 1 is selected for record and the FX Send is active (press '**FX Insert Engage**'), the input audio will be routed direct to the FX Send and not the main outputs.

If the menu item '**TrkBypas**' is set to 'On', this function is defeated, and the input signal is always routed to the main outputs.

3.2 RECORD-DIRECT-TO-OVERDUB

In user sync mode, the default behaviour is now to move directly from record into overdub by pressing **record**. This allows a seamless transition from initial loop-length-setting into overdubbing that was not previously possible with Repeater. Pressing **play** will exit the initial record and continue playing the loop. This function can be defeated via the utility menu.

3.3 BUMPLESS LOOP END

Record direct into overdub allows loop-end crossfades to be dispensed with – as audio can be kept continuous from loop end to loop start. This allows loops to be created that are loop-end artefact free; an ambient looper's dream come true (we hope you like it folks...).

3.4 SMALL PITCH-SHIFT IMPROVEMENTS

The DSP engine has been updated to improve the quality of pitch shifting over small (<1 semitone) increments.

3.5 CLICK FIRST BEAT ID

The click track now features a distinctive downbeat click to allow a user to easily discern the loop point when working with a click track.

3.6 MIDI CLOCK OUTPUT QUALITY

Repeater 1.0 had some MIDI clock output jitter issues that have been resolved in System2.

4 MIDI Implementation

The Repeater System 2.00 firmware significantly extends the MIDI implementation of the Repeater 1.10 firmware giving additional feedback via MIDI over the state of the unit and expressive control over all unit functions.

The control set is split into MIDI CC messages and MIDI ~~CC~~ *PC* messages. Repeater does not implement SysEx or RPN.

Note that Repeater must be set to receive MIDI on the correct MIDI channel before any of these controls will work. Access the utility menu by holding stop and pressing copy to bring up the menu. Use the left encoder to select the 'MIDI CH' option and ensure the channel number is correct before proceeding.

4.1 FUNCTION GROUPS

The following sections list the functions accessed via CC and PC messages and how they are used to control and monitor Repeater.

4.1.1 Loop Select

There are two ways to select the current loop via MIDI; via the loop number or by a relative jump from the current loop.

The loop number is selected via a bank and an index within the bank. Bank#0 is reserved for the internal memory (loops 1-16). The remaining banks are reserved for loops contained on a CFC card if present. To select a loop, send the bank number and then the loop number. If the bank number is not sent it is assumed to be zero.

Bank is selected by CC#0. Loop number is selected by CC#32.

For example; send CC#0 with value 0 to select internal memory. Send CC#32 with value 5 to select internal loop number 6 (note, numbering starts at zero for CC control value). To select CFC loop 48, send CC#0 value 1 and CC#32 value 47.

A particular loop number can also be selected by sending MIDI Program Change (PC) numbers above 48. The set of numbers 48 and above index internal loops 1-16 and then external loops 1-112.

It is also possible to select the *next* or *previous* loop in sequence by sending CC#74 with a value of 64 or greater to step to the next loop, or CC#75 with a value of 64 or greater to step to the previous loop. The same functions are duplicated by PC#4 (next loop) and PC#5 (previous loop).

An absolute loop number can also be selected using PC#48 and above to select first the internal 16 loops and then the low numbered loops on the CFC card – if available.

4.1.2 Beats

The number of beats in a loop can be programmed using CC#2 to select high portion of the value above 64 and CC#1 to select the remainder.

For example, to set the current loop to be 120 beats, send CC#2 with value 1 (1x64) and then CC#1 with value 56 (64+56 = 120).

Note that this can lead to some wild behaviour during playback as repeater tries to hold the real tempo constant.

4.1.3 Time signature

The time signature is largely a convenience for display purposes to show the progress of the loop in a musically-reasonable fashion. Send CC#3 with the number of beats to appear on the top of the time signature up to 8. Send CC#4 to set the number of beats on the bottom of the time signature; 2, 4 or 8.

For example, to set the time signature to 7/4, send CC#4 with value 4 and CC#3 with value 7.

4.1.4 Editor transitions

The user interface of Repeater can be set into different states and controlled by using CC#5. The following table gives the states that Repeater can be put into using different values for CC#5. This facility is provided for the expert user and editor writer to control all functionality of the unit.

Editor Transition (CC#5)	Value
Exit current edit state	0
Enter trim edit	1
Enter trim cut	2
Enter multiply edit	3
'Undo'	4
'Redo'	5; output only
Memory info display	6
Overdub level display	7
Enter erase edit	8
Menu enter	9

Edit tempo	10
Enter slip edit	11
Enter pan edit	12
Enter pitch edit	13
Enter FX Insert edit	14
Enter resample edit	15
Enter format prompt	16
Enter copy edit	17
Enter sleep state	18
Trim seconds entry	24; output only
Memory info; CFC entry	25
Menu item 1 selected	32
Last menu item #	63
Track 1 select toggle	64; Input only
Track 2 select toggle	65; Input only
Track 3 select toggle	66; Input only
Track 4 select toggle	67; Input only

Table 1: Editor Transitions (CC#5)

4.1.5 Tempo

Loop tempo is programmed using CC#9 for the tempo in BPM times 2. For example – to set the unit to 64BPM send CC#9 with value 32. CC#41 programs the fractions of a BPM over the range 0..127. For example to make the tempo 127.2BPM, send CC#9 with value 63 and then CC#41 with value 80.

Note that the tempo can also be programmed by using the right encoder delta CC when the unit is in the top-level editing state (CC#43).

4.1.6 Metronome

The metronome provides an audible cue to a user of the beat and loop end position. The metronome output is switched on and off using CC#10. Values above 64 for this CC switch the metronome on at a level determined by the remainder below 64. This remainder is doubled to provide a percentage level for the metronome. For example to set the metronome on at level 50% requires CC#10 to be sent with a value of 64 (on) + 25 (50%) to give a total of 89. To switch the metronome off, send CC#10 with a value of 25. This will leave the level at 50% which will be the level the metronome will return at if toggled on from the front panel (press and hold tempo lock).

The metronome output can be routed to the main outputs or to the FX sends. This is controlled using CC#12. Values of 63 or less will cause the metronome to be routed to the main outputs. Values of 64 and above will cause the routing to be via the FX Sends.

4.1.7 Overdub

Repeater works in either overdub or replace mode. Overdub is the default where the current signal will be combined, during recording, with the existing signal on the track. The mixing of these signals is controlled by the feedback parameter. Via MIDI the feedback is controlled using CC#11. The value in the range 0-127 controls feeback in the range 0-100%. Replace is equivalent to overdub with a feeback of 0%.

Switching from overdub to replace mode is controlled via CC#105. Sending CC#105 with a value of 63 or less will switch into replace mode. Values 64 or above will switch into overdub mode. The same effect can be achieved by sending PC#13 which will toggle overdub mode on and off.

4.1.8 Dry fade bypass

In Repeater System 2 the audio routed through the unit is subject to conditioning via the track parameters of level and pan – and will also be converted to mono if passed through a single track. This may not be desired in all cases – although it provides the user with the best feedback as to what a recording will sound like. To defeat this behaviour and allow input audio to be passed directly to the outputs, the dry fade bypass control can be used. CC#13 with a value of 63 or less will switch the bypass off which will provide the default 'What-you-hear-is-what-you-get' audio routing. Values of 64 and above will bypass the channel controls and send the input audio direct to the unit outputs.

4.1.9 Tape emulation

Repeater combines pitch shifting and time stretching to allow pitch and playback speed to be controlled independently. This control allows both to be affected together providing the effect of a tape being sped up or slowed down. The value passed by CC#14 controls the 'playback rate' in the range 25% to 150% of the loop native speed. This control will reprogram any pitch currently applied to individual tracks. The mid-range value is 76. CC#46 provides a fractional control between steps of the CC#14 control.

4.1.10 Output level and wet/dry mix

Output level from the unit can be attenuated from the nominal 0dB level using CC#15. The value passed is the requested attenuation in dB up to 30dB. Values of 30 and above are interpreted as minus 30dB.

Wet/dry mix affects the balance at the output of the input signal (dry) to the Repeater-generated signal (wet). Also the signal passed through the FX loop is classed as 'wet'. CC#36 allows the wet/dry balance to be changed from 0 (full dry) to 127 (full wet). The value 64 represents the mid-point where wet and dry are in even balance.

4.1.11 Track level controls

Track levels are controlled using CC#16 – CC#19 for tracks 1-4 in the conventional manner with 0 being a level of 0 and 127 being a level of 100%.

Tracks may also be muted without affecting the track level using CC#77. Values above 16 will toggle the mutes implied by the remainder value 0-15. Track 0 is given the value 1, track 1 is valued at 2, track 3 is valued at 4 and track 4 is valued at 8. For example, to mute tracks 1 and 4 the value will be 16 (mute) + 1 (track1) + 8 (track4) = 25. Sending CC#77, 25 the first time will set the mutes – indicated on the front panel by the red clip LEDs on the affected tracks flashing. Sending the same message again will clear these mutes. Values less than 16 will set the respective mutes. For example – to clear all mutes send CC#77 with value 0. To mute tracks 1 and 2 send CC#77 with value 3. Sending CC#77, 3 again will have no effect.

The joint levels of tracks 1 and 2 or 3 and 4 (for stereo effects) can be set using CC#110 and CC#111 respectively.

Track muting can be toggled using PC#16-PC#19 for tracks 1-4 respectively, and PC#25 and PC#26 to mute tracks 1 and 2, or tracks 3 and 4 respectively.

4.1.12 Track slip control

Track slip allows the relative playback position of tracks to be adjusted relative to the master transport position – advancing or retarding. Slip is set using CC#20-CC#23 for the beat slip for tracks 1-4 respectively. A value of 64 represents a zero beat slip. Values lower represent negative beat slips down to −64 beats. Values higher represent positive beat slips up to +63 beats. The additional CCs #52-CC#55 allow fractions of a beat of slip to be be programmed for tracks 1-4 in the range 0-99 hundredths of a beat.

4.1.13 Track pan control

Track pan is controlled by CC#24-CC#27 for tracks 1-4 respectively. Conventionally the value 64 is center pan with 0 as full left and 127 as full right.

4.1.14 Track pitch control

Track pitch is controlled by CC#28-CC#31 in semitones in the range –24 to +12. The value 64 is a zero semitone shift. Values below 40 give a –24 semitone shift. Those above 88 give a +12 semitone shift. Fractions of a semitone (cents, or 100ths of a semitone) may be programmed using CC#60-CC#63.

4.1.15 MIDI RT control

Repeater normally sends out MIDI real-time clock continuously and song position pointer messages on forced loop restarts. CC#112 allows MIDI output to be inhibited by sending a value of 64 or above. Normal MIDI RT output is set by a value of 63 or less.

During initial recording, MIDI RT output can be defeated to avoid confusing downstream sync'd units before the actual tempo is known. This control is set by sending CC#33 with a value of 64 or greater to defeat realtime output. Normal behaviour is restored by sending CC#33 with a value of 63 or less.

4.1.16 Record CC output

Normally repeater will not send a CC#86 when a recording is started – however under some circumstances this behaviour may be required. CC#34 can be used to toggle this behaviour on using a value of 64 or greater, or off using a value of 63 or less.

4.1.17 Record-into-overdub

In a change from Repeater 1 functionality, in user sync mode a second press of record when recording into an empty loop will set the loop point and continue recording. To defeat this behaviour, CC#35 will set record into overdub off with a value of 63 or less, and on with a value of 64 or greater.

4.1.18 Tracks and loop erase

To erase a track or combination of tracks, CC#37 with a value in excess of 64 selects the tracks to be erased. Track 1 has an additional value of 1, track 2 – 2, track 3 – 4 and track 4-8. For example to erase tracks 3 and 4, send CC#37 with a value of 64 (erase) + 4 (track3) + 8 (track4) = 76. If all tracks are erased, then this is equivalent to a loop erase (CC#108 with value 123).

When tracks are erased from the front panel, CC#39 will be sent with a value corresponding to the set of tracks that have just been erased with values: track1 – 1, track 2 – 2, track 3 – 4, track 4 – 8. For example if tracks 1 and 3 are erased the value will be 1 (track1) + 4 (track3) = 5.

4.1.19 FX Return toggle

The FX Return can be used as an auxiliary unit input. Normally the return is only live when the FX insert is in the engaged state. The FX return can be made live all the time by sending CC#40 with a value of 64 or greater. Default behaviour is restored by a value of 63 or less.

4.1.20 Encoder delta

The equivalent action of the front panel encoders can be achieved using CC#42 and CC#43. The function achieved will be dependent on the state of the unit user interface. Values of less than 60 translate to a

delta of –4. Values between 60 and 68 translate to –4 to +4. Values in excess of 68 translate to a delta of +4.

4.1.21 Tap tempo

Sending value #68 with a value in excess of 64 is equivalent to pressing the unit tap tempo button. Sending PC#12 has the same effect.

4.1.22 Panic Button

Under some circumstances, resetting the unit may be a fast means to recover unit operation in the unlikely/rare event that the unit does not respond as desired. Sending CC#73, 42 followed immediately by CC#73 with value 112 will cause the unit to reset. The reset cycle takes about 5 seconds to complete.

4.1.23 Reset to native tempo

Sending CC#76 with a value in excess of 64 will reset the transport to the loop-native tempo.

4.1.24 Record selection

Tracks can be selected for record using CC#80-CC#83 or tracks 1-4 respectively. If tracks are stereo-paired, then the record selection of tracks 1 or 2 will select both; similarly for tracks 3 and 4. To select tracks 1 and 2 if not paired, use CC#90. For tracks 1 and 3 use CC#91. In all cases a value of 64 or greater is required.

Record selection is also possible using PC#6 through PC#9 to select tracks 1-4, and using PC#14 to select tracks 1 and 2 as a pair, and PC#15 to select tracks 3 and 4 as a pair.

4.1.25 Transport Controls

In System 2, all tracks can be controlled independently and hence the transport controls allow the set of tracks to be controlled to be specified using a 'bit vector' format. In this format tracks have different values associated; track 1 has value 1, track 2 has value 2, track 3 – 4 and track 4 – 8. In the following these values are combined to specify a set of tracks. For example to operate on all tracks, the value used should be the sum of all track values – ie. 1 + 2 + 4 + 8 = 15. Tracks 2 and 4 would have the value 2 + 8 = 10.

4.1.25.1 Play

CC#85 with a value between 65 and 80 specifies a bit vector of tracks to play. Values 81 and above apply the play command to all tracks.

If a new loop is cued, the play command will cause the new loop to be played (if there is any content) when the current loop ends. A second play command will cause an immediate switch.

Play can also be triggered using PC#20.

4.1.25.2 Stop

CC#87 with a value between 65 and 80 specifies a bit vector of tracks to stop. Values 81 and above apply the command to all tracks.

If a new loop is cued, the stop command will cause the new loop to be selected in the stopped state when the current loop ends. A second stop command will cause an immediate switch.

Stop can also be caused by sending PC#21.

4.1.25.3 Reverse

CC#87 with a value between 65 and 80 specifies a bit vector of tracks to stop. Values 81 and above apply the command to the transport.

In the case of reverse, the new direction of a track depends on its current direction. Note that reversing the transport leaves the 'reverse' state of all tracks the same – however they will change direction as they are 'reversed' relative to the transport.

The transport may also be reversed using PC#10.

4.1.25.4 Play/Stop

CC#88 toggles the transport between the play and stop states when a value of 64 or greater is sent. The same result is achieved by sending PC#2.

4.1.25.5 Record

CC#86 with a value of 64 or greater will cause the input to be recorded to the currently selected record target track.

If a new loop is cued, the record command will cause the new loop to be switched to and recorded into when the current loop ends. A second record command will cause an immediate switch.

Record can also be triggered by sending PC#3.

4.1.25.6 Armed Record

A recording can be triggered by an audio signal at a predetermined level. CC#92 with a value from 0 to 40 will set the unit to wait for a trigger in the input range –40dB to 0dB. A value in excess of 40 will set the trigger level to –20dB.

Armed record at –20dB can also be selected using PC#23.

4.1.26 Undo

Repeater maintains one level of undo for all operations to allow a bad operation to be easily aborted. The front-panel undo button toggles between undoing and redoing which makes the 'undo buffer' useable in performance. CC#89 allows the same function with a value of 66 and greater. Value 64 will force into the 'undo' state, value 65 will force into the redo state (reversing a previous undo).

Toggling 'undo' and 'redo' is also achieved by sending PC#1.

4.1.27 MIDI Channel selection

Sending CC#93 on the current MIDI channel with a value of 0-15 will cause the unit MIDI channel to be changed in the range 1-16.

4.1.28 Status dump

Any value sent with CC#94 will cause the unit to dump all critical operating parameters out via MIDI. This is an advanced programming feature for power users and editor writers.

4.1.29 Loop multiply

Repeater allows loops to be multiplied and subsequently divided down within the limits of previous multiplication. Note that division is not possible once a multiplied loop has been overdubbed or had a track added. CC#102 allows the multiplication to occur. Values of 66-80 allow the loop to be multiplied by factors of 2-16 respectively. Values greater than 80 are interpreted as a multiply by 2.

Once multiplied up, then values 48-62 allow the set of divisors for the loop to be accessed. The set will depend on the previous multiplies that have occurred; ie. if the loop has been multiplied by 3 and then by 2, the divisors are 1/6, 2/6, 3/6 ...5/6.

The multiply factor applied is reported using CC#95 from the unit with the same encoding of values as used for CC#102.

A simple x2 multiply can be achieved by sending PC#0.

4.1.30 FX Insert

The FX insert is activated using CC#103. Values 0-16 select the tracks that are sent to the FX. Value 0 specifies that the input is sent to the FX.

The actual state of the FX send is only changed if a value of greater than 32 is sent. In this case the '16' value bit (bit 4) specifies the state of the send '1' for on, '2' for off.

For example, to select FX sends on tracks 1, 3 and 4 without changing the state of the send (on or off), send CC#103 with value 1 (track1) + 4 (track 3) + 8 (track 4) = 13. To switch the FX send on for the input only, send CC#103 with value 32 (set state) + 16 (on) = 48. To switch the FX send on for track 3, send CC#103 with value 48 + 4 (track 3) 52. To switch the FX send off, send CC#103 with value 32.

The FX insert state can also be toggled using PC#12.

4.1.31 Tempo lock

The tempo lock can be set using CC#104. Send a value in the range 0-15 to toggle the lock on and off. A value in the range 16-63 will set the lock off. A value 64 and greater will set the lock on.

4.1.32 Sync source select

The synchronization source is set using CC#106. A value from 0-15 will set the sync mode to 'user'. A value from 16 to 31 will set the sync mode to MIDI. A value from 32-47 will set the sync mode to 'beat detect'.

4.1.33 Input mute

The input to the unit can be muted using CC#79 with a value of 64 or greater to toggle the mute on and off. From the front panel the mute is accessed by holding stop and pressing 'overdub'. CC#107 can also be used to set the mute state; 0-63 sets the state as 'unmuted'. A value of 64-127 will set the input to the muted state.

The input mute can also be toggled using PC#22.

4.1.34 Track selection

It is useful to be able to select the 'next' and 'previous' tracks for recording, allowing a user to easily select the target tracks using a single footswitch button. This selection will respect stereo pairing, selecting channel pairs correctly. Use CC#109 to select the next track or track pair 'upwards' in sequence. This will wrap from track 4 to track 1. A value of 64 or greater is required to cause the action to occur. The opposite selection direction is achieved using CC#113 in an analogous fashion.

PC#24 can also be used for the 'next track' function, and PC#27 for the 'previous track' function.

4.1.35 CFC Status Reporting

This feature is provided for the expert user and editor writer.

MIDI CC#7 is output to indicate the state of the CFC card. When a CFC card is inserted, expect to see CC#7 with value 1. When the card is removed expect to see CC#7 value 0. The other values are; 2-CFC formatting, 3-CFC reformatting, 4-CFC ready, 5-CFC unusable.

4.1.36 Transport Status

This feature is provided for the expert user.

CC#8 indicates the state of the transport 'pending' states. These are the transitional states of the transport when moving between loops. The reported values are; 0-none pending, 1-pending play, 2-pending record, 3-pending stop.

4.1.37 Tracks erased

4.2 MIDI IMPLEMENTATION TABLES

CC Message (symbolic)	CC#	Value Interpretation
CC_LOOP_SEL_BANK	0	0..8
CC_LOOP_BEATSLO	1	Low6bits
CC_LOOP_BEATSHI	2	Hi6bits
CC_LOOP_TIMESIGNUM	3	Range 1-8 only.
CC_LOOP_TIMESIGDEN	4	2,4,8
CC_EDIT_TRANSITION	5	See 'Editor Transition table'
<RPN data MSB>	6	
CC_CFC_PRESENT	7	0 - No CFC, 1 - CFC inserted, 2 - CFC formatting, 3 - CFC reformatting, 4 - available, 5 - unusable.
CC_PENDING_TRANSPORT	8	0 - none pending, 1 - pending play, 2 - pending record, 3 - pending stop
CC_TEMPO_MSB	9	BPM*2
CC_CLICK_CONTROL	10	Bit6: Active, Bits5-0: Level/2 (0-100)
CC_ODUB_FEEDBACK	11	0..127 (0..100%) Overdub feedback level
CC_CLICK_ROUTING	12	0..63 (main outs), 64..127 (FX Sends)
CC_DRYFADEBYPASS	13	0..63 (off), 64..127 (on)
CC_TAPE_EMULATION	14	0..125 (25%..150% of native tempo and pitch)
CC_OUTPUTATTENUATOR	15	0..30 attenuation in dB (0->-30dB), >30, -30dB
CC_TRK1_LEVEL	16	0..127
CC_TRK2_LEVEL	17	
CC_TRK3_LEVEL	18	
CC_TRK4_LEVEL	19	
CC_TRK1_SLIP_BEATS	20	0..127 (-64..+63 beats)
CC_TRK2_SLIP_BEATS	21	0..127 (-64..+63 beats)

CC_TRK3_SLIP_BEATS	22	0..127 (-64..+63 beats)
CC_TRK4_SLIP_BEATS	23	0..127 (-64..+63 beats)
CC_TRK1_PAN	24	1..127 (100% left to 100% right). PanPercent = (Midival-64)*100/63
CC_TRK2_PAN	25	
CC_TRK3_PAN	26	
CC_TRK4_PAN	27	
CC_TRK1_PITCH_SEMI	28	40..88 (-24..+12 semitones). Semitones = (MidiVal-64)
CC_TRK2_PITCH_SEMI	29	
CC_TRK3_PITCH_SEMI	30	
CC_TRK4_PITCH_SEMI	31	
CC_LOOP_SEL_LSB	32	0..15 (Bank 0), 0..127 (Banks 1..8)
CC_NORECORDRT	33	0..63 (off), 64..127 (on)
CC_RECORDCCOUTPUT	34	0..63 (off), 64..127 (on)
CC_RECORDINTOOVERDUB	35	0..63 (off), 64..127 (on)
CC_WETDRYMIX	36	0(full dry), 64 mid, 127 (full wet)
CC_ERASETRACK	37	0x4X to erase where X is bit vector of tracks.
<RPN data LSB>	38	
CC_TRACKSERASED	39	Bit vector of tracks just erased
CC_FXRETURNLIVE	40	0..63(off), 64..127(on)
CC_TEMPO_LSB	41	BPM/64
CC_LEFTENCODERDELTA	42	<60:-4 60-68:-4 to +4. >68 +4
CC_RIGHTENCODERDELTA	43	<60:-4 60-68:-4 to +4. >68 +4
CC_BPM_PITCH_LSB	46	0..127
CC_TRK1_SLIP_INTERBEAT	52	0..99
CC_TRK2_SLIP_INTERBEAT	53	0..99

CC_TRK3_SLIP_INTERBEAT	54	0..99
CC_TRK4_SLIP_INTERBEAT	55	0..99
CC_TRK1_PITCH_CENTS	60	0..99, mapped to 0..127 Midi range
CC_TRK2_PITCH_CENTS	61	0..99, mapped to 0..127 Midi range
CC_TRK3_PITCH_CENTS	62	0..99, mapped to 0..127 Midi range
CC_TRK4_PITCH_CENTS	63	0..99, mapped to 0..127 Midi range
CC_TAP_TEMPO	68	0..63 (off), 64..127 (tap) (momentary)
CC_PANIC	73	To reset unit send CC#73,42, CC#73,112 – causes reboot
CC_LOOP_SELECT_UP	74	0..63 (off), 64..127 (up)
CC_LOOP_SELECT_DOWN	75	0..63 (off), 64..127 (down)
CC_TEMPORESET	76	0..63 (off), 64..127 (do reset)
CC_TRK_MUTEUNMUTE	77	0x10 set; toggle. 0x10 clear; absolute.
CC_FX_INSERT_TOGGLE	78	64..127 (toggle)
CC_INPUT_MUTE_TOGGLE	79	0..63 (nop), 64..127 (toggle)
CC_TRK1_REC_SEL	80	0..63 (no effect), 64..127 (track selected)
CC_TRK2_REC_SEL	81	
CC_TRK3_REC_SEL	82	
CC_TRK4_REC_SEL	83	
CC_REVERSE	84	0..64 (nop), 65-80 (reverse tracks as bit vector), 81..127 (play)
CC_PLAY	85	0..64 (nop), 65-80 (play tracks as bit vector), 81..127 (play)
CC_RECORD	86	0..63 (off), 64..127 (rec) (momentary)
CC_STOP	87	0..64 (nop), 65-80 (stop tracks as bit vector), 81..127 (play)
CC_PLAYSTOP	88	0..63 (off), 64..127 (play/stop) (momentary)
CC_UNDO	89	0..63 (nop), 64(force undo), 65(force redo) 66..127 (toggle)
CC_TRK12_REC_SEL	90	

CC_TRK34_REC_SEL	91	
CC_ARMRECORD	92	0..40 (trigger -40->0dB) 40+ (trigger -20dB)
CC_MIDICHANNEL	93	Following 0x00-0x0F Channel 1-16.
CC_STATUSDUMP	94	Any message causes status dump
CC_MULTIPLYFACTOR	95	0..47 48->62 all available divisors, 63-65 no-op, 66->*2, 67->*3 .. 80->*16; >80, *2
<RPN data increment>	96	
<RPN data decrement>	97	
<NRPN gate LSB>	98	
<NRPN gate MSB>	99	
<RPN gate LSB>	100	
<RPN gate MSB>	101	
CC_LOOP_MULTIPLY	102	0..47 48->62 all available divisors, 63-65 no-op, 66->*2, 67->*3 .. 80->*16; >80, *2
CC_FX_INSERT	103	0..16 set active channels, if bit 5 set, bit 4 gives FX active state
CC_TEMPO_LOCK	104	0..15: Toggle, 16-63: Off, 64-127: On
CC_OVERDUB_REPLACE	105	0..63 (off), 64..127 (on)
CC_SYNC_SOURCE	106	0-15: User, 16-31: MIDI, 32-47: Beat detect
CC_INPUT_MUTE	107	0..63 (unmuted), 64..127 (muted)
CC_ERASE_LOOP	108	123 = erase the loop
CC_NEXT_TRACK	109	64+ => step
CC_TRK12_LEVEL	110	0..127
CC_TRK34_LEVEL	111	0..127
CC_INHIBITMIDIRT	112	0-63 off, 64-127 on.
CC_PREV_TRACK	113	64+ => step

Table 2: Repeater System 2 MIDI CC codes table

MIDI PC Symbolic	PC #	Meaning
PC_LOOP_MULTIPLY	0	acts like Multiply button
PC_UNDO	1	acts like Undo button
PC_PLAYSTOP	2	alternates Play and Stop
PC_RECORD	3	acts like Rec button
PC_LOOP_SELECT_UP	4	
PC_LOOP_SELECT_DOWN	5	
PC_TRK1_REC_SEL	6	These 4 must be contiguous numbers
PC_TRK2_REC_SEL	7	
PC_TRK3_REC_SEL	8	
PC_TRK4_REC_SEL	9	
PC_REVERSE	10	acts like Rev button
PC_FX_INSERT	11	toggles engaged/unengaged
PC_TAP_TEMPO	12	acts like Tap button (but can't be held)
PC_OVERDUB_REPLACE	13	acts like Overdub button (toggles mode)
PC_TRK12_REC_SEL	14	
PC_TRK34_REC_SEL	15	
PC_TRK1_MUTEUNMUTE	16	mute/unmute
PC_TRK2_MUTEUNMUTE	17	
PC_TRK3_MUTEUNMUTE	18	
PC_TRK4_MUTEUNMUTE	19	
PC_PLAY	20	Play press
PC_STOP	21	Stop press
PC_INPUT_MUTE	22	

PC_ADDRECORD	15	Anteger line
PC_NEXT_TRACK	19	
PC_TRACK_MULTCURRENTS	25	
PC_TRACK_MULTCURRENTS	26	
PC_PREV_TRACK	27	
PC_RANGEDOBJECT	40	Anothing about the line