

Music Roll Punching Controller

Calibration Procedure

Introduction

When a music roll punching machine is first commissioned, the control software must be set up with parameters relating to the physical properties of the machine to ensure that holes in the music are punched at their intended positions.

The three critical parameters affecting hole placement accuracy are the travel per increment of the head traverse drive, the travel per increment of the roll drive and the datum position relative to the music roll edge. It is quite possible that initially, none of these parameters will be known to a high enough level of precision for immediate use in music roll punching. This document describes a set of procedures using the punch machine, controller and PC software together to enable the correct settings required for the machine to be determined.

Equipment Required

In addition to the punch machine, controller circuit and host computer, a length of blank music roll paper and a measuring tool such as a steel rule, vernier gauge or digital calipers will be required. The measurement precision should ideally be to within half a millimetre or less. A PC-based music notation/creation program and a text file editor program are also required for the production of test MIDI and scale files.

Procedure 1: Checking the Direction of Head Travel and Datum Sensing

The datum sensor must give a logic low output when the punch head position is greater than the datum point and high when the position is less than the datum. Here, 'greater than' and 'less than' are referring to the positions in millimetres as would be given in a scale file. Conventionally, the edge of the music roll given the position of zero is the bass end of the organ scale. When starting to punch a music roll, it must be ensured that the head carriage always moves towards the datum position during the initial seeking phase. If the carriage moves away, the head carriage motor connections must be reversed. The datum must be positioned within the range of movement of the head carriage, preferably where it will be crossed regularly as the punch head traverses the width of the roll during normal punching.

Procedure 2: Initial Setting of the Datum Position and Head Increment Distance

Create a test MIDI file containing just one crotchet pitched at MIDI note 60 with a tempo setting of 120 bpm. Also create a test scale file with a linear speed of 75.000, a row spacing of 4.000 and just one MIDI note of pitch 60 and position 0.000. In the PC software, set roll the head traverse increment size to 1 sixteenth of a whole motor step, the head traverse travel per increment to 0.01mm, the maximum speed to 1000 increments per second, the datum seek speed to 500 increments / second and the datum position to 0 increments.

With the roll drive disabled, the punch machine should be set up with a piece of blank music paper held securely and accurately against the machine's paper guides. Load the test MIDI and scale files into the punch program and commence roll punching. The head carriage will initially move until the datum position is found, then punch repeatedly at this point, which should be somewhere around the middle of the roll width. If, during the datum seeking phase, the head moves erratically or shows other signs of motor synchronism loss, reduce the datum seek speed in the PC software and re-run the punching on a new blank area of the music roll.

In the PC software, now change the datum position to 1000 increments without moving the paper and re-run the test punching. This time, the head carriage should move towards the reference (zero-position) edge of the music roll before making repeated punches at a single point. If, during the travel between the datum point and the punch point, the punch head goes beyond the zero-position edge of the roll or hits an endstop, the datum position setting in the PC program must be reduced and roll-punching re-started until the punched hole lands within the normal width of the paper. If loss of motor synchronism occurs between the datum location and the punch point, then the head traverse maximum speed setting must be reduced and the test punching repeated.

Adjust, by trial and error, the datum position setting in the PC software until a hole is punched within 10 mm of the edge of the paper. Now measure as accurately as possible the distance in millimetres perpendicular to the roll sides between the centres of the first hole punched when the datum position was set to zero and the hole now being punched towards the edge of the roll. Divide this distance measured by the number in the 'Datum position' box of the configuration dialog and enter the result into the 'Travel per increment' box of the 'Head Traverse Drive' section.

Measure the distance from the reference edge of the roll to the centre of the hole punched at the datum position and divide this distance by the distance measured earlier between two holes. The result should be a number greater than 1. Multiply this result by the value in the 'Datum position' box, then change the number in the 'Datum position' box to this new value, bearing in mind that the nearest whole number must be used.

The punch system should now have settings for the head traverse drive which are close to the exact values required.

Procedure 3: Final Setting of the Datum Position and Head Increment Distance

To verify that the head traverse is set up correctly, load a normal scale file and create a test MIDI file which contains just two notes played simultaneously, where these notes are at opposite ends of the tracker. Typically, these are the lowest and highest pitched notes of the organ scale. The length of the notes should be relatively short, a crotchet at 120 bpm should be appropriate. With the roll drive still disabled, punch this test MIDI file onto a blank area of music roll which should result in two holes being made.

Measure the distance between centres of these two holes and compare it to the difference between the given positions of the holes for those notes in the scale file. If the punched spacings are not sufficiently accurate, then the 'Travel per increment' parameter will need to be adjusted. To do this, divide the distance measured between the holes by the distance that they should be apart according to the scale file. Multiply this value by the current 'Travel per increment value' and enter the result back into the 'Travel per increment' box.

Once the travel per increment has been set to a sufficiently accurate value, the datum position can be checked and adjusted if necessary. Measure the distance from the reference edge of the music roll to the centre of the first hole and compare this to the position given for that note hole in the scale file. If adjustment is required, subtract the measured distance from the distance in the scale file to find the distance error, which may be positive or negative. Divide this distance error value by the travel per increment distance in the settings dialog and round the result to the nearest integer to get the error in terms of increments. Subtract the error in increments from the current datum position and make this final value the new datum position. Note that increasing the datum position value will move the holes closer to the reference edge and decreasing it will move them further away.

With the new parameters set, re-run the test MIDI file and verify that the spacing and offset of the punched holes is correct according to the values given in the scale file.

Procedure 4: Setting of the Roll Drive Travel per Increment

Create and load a MIDI test file consisting of a note from near the centre of the organ scale played for a semibreve at 120 bpm. Set up the machine with a blank music roll and load a standard scale file, ensuring that the 'Row spacing' parameter in the scale file is set to a distance in millimetres greater than the diameter of the punch tool, typically between 20 and 40% greater. Enable the music roll drive, deselect 'Punch Note Boundaries' in the PC program, and commence roll punching. After locating the datum position, the punch machine should produce a row of holes along the length of the music roll. If holes are produced so close together that they join, decrease the 'Travel per increment' parameter in the 'Roll drive' section of the PC program settings dialog and re-run until individual punchings are produced. If the roll drive motor indicates loss of synchronism or the roll drive slips when moving, reduce the maximum speed value for the roll drive in the settings dialog.

When a satisfactory row of holes have been punched along the roll, accurately measure the distance between centres of any two holes which have another 9 holes between them. Divide this measured distance by 10 to get the average distance between adjacent holes. Divide the calculated hole spacing distance by the 'Row spacing' value in the scale file then multiply this result by value in the roll drive 'Travel per increment' box. Enter the result of this calculation back into the roll drive 'Travel per increment' box and calibration is complete.

Issue 1
J D Wale
25th November 2004