Classic Organ Works

CMK-1
Classic MIDI Keyboard
User Manual

Version 1.00.05

Div. of:
ARTISAN CLASSIC ORGAN INC.

CLASSIC MIDI KEYBOARD
CMK-1

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LIMITED WARRANTY

Classic Organ Works warrants the Classic MIDI Keyboard (CMK) to be free from defects in materials and workmanship under normal use for a period of **ONE YEAR** from the delivery date. This warranty applies only if the product is owned by the original purchaser who has the bill of sale.

This warranty explicitly excludes any cables provided with the CMK, which may become defective as a result of normal wear and tear. The DC power adaptor is included in the warranty however.

In the event of a defect in materials or workmanship, please contact Classic Organ Works immediately. In particular, defects due to shipping should be reported within **15 days** for insurance claim purposes. For all other defects, Classic Organ Works agrees to repair or replace all defective parts of said products which are returned, transportation prepaid, for inspection at its service centre within the period of the warranty.

In the event that Classic Organ Works determines the product requires repair because of user misuse or regular wear, it will assess a fair repair or replacement fee. The customer will have the option to pay this fee and have the unit repaired and returned, or not pay this fee and have the unit returned un-repaired.

Classic Organ Works will not be liable for consequential, special, indirect, or similar damages or claims including loss of profit or any other commercial damage, and in no event will Classic Organ Works' liability for any damages to the purchaser or any other person exceed the price paid for the product, regardless of any form of the claim. Classic Organ Works specifically disclaims all other warranties, expressed or implied. Specifically, Classic Organ Works makes no warranty that the product is fit for any particular purpose.

This warranty shall be interpreted, and governed by applicable laws in the province of Ontario, Canada. If any provision of this warranty is found void, invalid or unenforceable, it will not affect the validity of the balance of the warranty, which shall remain valid and enforceable according to its terms. In the event any remedy hereunder is determined to have failed of its essential purpose, all limitations of liability and exclusion of damages set forth herein shall remain in full force and effect.

CLASSIC MIDI KEYBOARD
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INTRODUCTION

Description

Congratulations! You are now the proud owner of the CMK (Classic MIDI Keyboard). The CMK combines technology and classical church organ ideas into an innovative MIDI device. With the CMK, MIDI sound modules may be controlled as if they were part of the organ. Designed as a portable unit, it features a 'stackable' feature so that users may customize a complete practice organ to their specification. With a quality construction, various structural and electronic design elements, and user-friendly configuration software, the CMK will provide many years of worry-free musical enjoyment for all users.

The CMK is designed for organists, organ enthusiasts, and MIDI users. Key-switch information from the keyboard and pistons is converted into MIDI control data by the on-board micro-controller. For instance, a MIDI message defines whether a key was pressed or released, the MIDI channel that the information should be transmitted on and the key number pressed or released. As many as three CMK keyboards may be daisy-chained.

Each CMK keyboard also has 20 pistons to control features such as coupling and effects. The CMK can simultaneously drive up to four Ahlborn Archive Series™ modules that generate pipe-organ voices. In addition, any MIDI-controlled sound module or PC-based synthesizer software may be connected. These pistons are also used for programming the CMK. Combinations of pistons and keyswitches are used for functions such as a reboot, setting the MIDI output channel, turning on and off velocity sensing, and setting the volume output.

There are two analog inputs which can be configured as volume/expression and crescendo inputs. By adjusting the analog device, a unique voltage reading is produced on the analog input pin which is interpreted by the microprocessor. In the case of a volume adjustment, a MIDI message will send to the MIDI-controlled device the loudness level of the stop or sound. MIDI messages are also sent for a crescendo adjustment which will gradually add stops to a registration.

The CMK is completely customizable using the included 'CMKConfig' software. Up to 128 configurations may be programmed into the CMK. As many as three keyboards each with twenty pistons and two analog inputs may be configured for Ahlborn Archive modules, General MIDI sound modules, and MIDI-controlled PC-based synthesizer software. The software is capable of customizing the CMK for use with organ computer simulation software such as Hauptwerk and the Sound Canvas Pipe Organ Project (SCPOP).

Configurations are saved as computer files which may be stored in the user's home computer, or in the CMK. Configurations that are saved on the CMK will not be lost when power is turned off because the memory is non-volatile. These configurations may be selected using DIP-switches on the CMK. Eventually, users may inexpensively upgrade their software as well as configurations by visiting the Classic Organ Works website at http://www.organworks.com.

The following is a list of parts for each CMK setup.

Table 1: Parts/Components List

Setup	Items					
	A	B	C	D	E	F
	Manual(s)	2-Manual Side Bracket set (sold separately)	3-Manual Side Bracket set (sold separately)	12V DC adaptor	MIDI Cable(s)	Mounting Screws
One Manual	1	-		1	1	
One Manual and Wood Case	1	-		1	1	
Two Manuals	2	2		1	2	4
Three Manuals	3	-	2	1	3	6

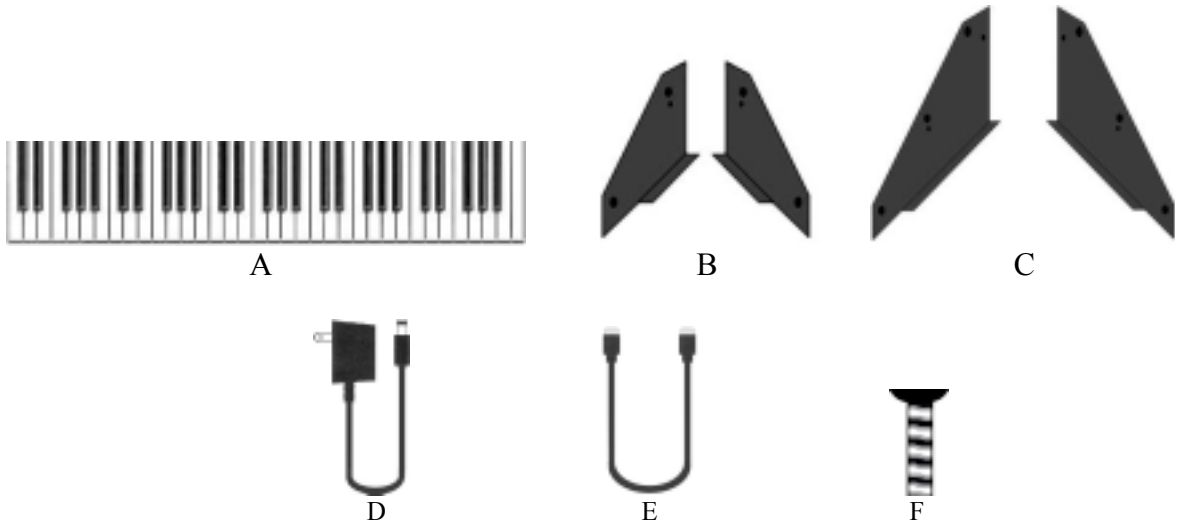

Figure 1: CMK components (from L-R, Top to Bottom):

A) Keyboard
B) 2-manual side mounting brackets (sold separately)
C) 3-manual side mounting brackets (sold separately)
D) 12V DC wall adaptor
E) 6-Ft. MIDI cable
F) Mounting screw.

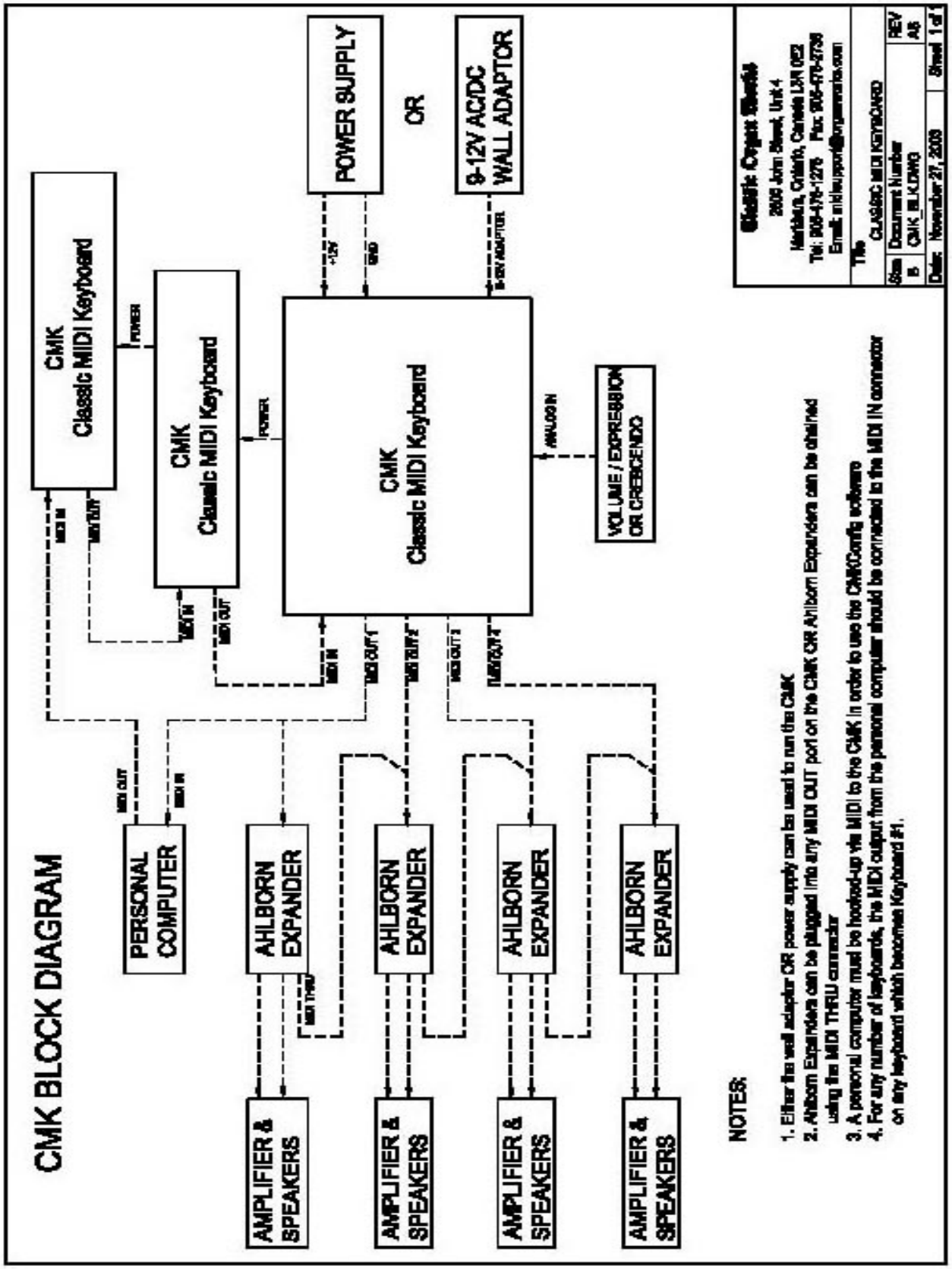

Figure 2: CMK connections

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INSTALLATION

IMPORTANT
READ THIS DOCUMENT BEFORE INSTALLATION

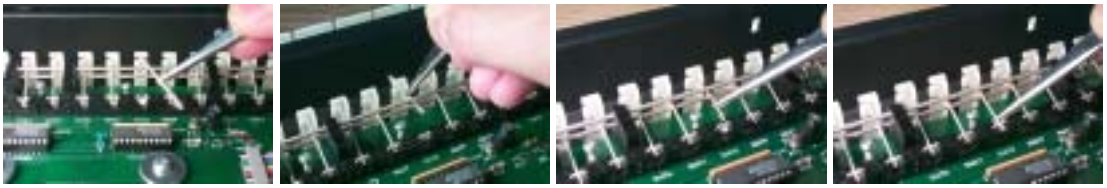
Upon receiving this unit, remove any packing material inside the unit that may have been included to prevent movement of components or wiring during shipping.
(For internal access, ensure the unit is disconnected from all power sources.)

Springs

The keyboard contact springs are installed at Classic Organ Works. However, the nature of these contacts makes them sensitive to movements during shipping. A visual inspection of the keyboard should be performed upon receiving to determine if any of these springs have become displaced. A package of five spare springs is included with every keyboard. To replace the missing springs you will need tweezers and gloves/paper towel. Then follow these directions:

NOTE: DO NOT HANDLE THE SPRINGS WITH YOUR BARE FINGERS. THE SPRINGS ARE COATED WITH A LAYER OF SILVER WHICH CAN DETERIORATE IF HANDLED.

1. Pick up the spring using tweezers to gently grip the middle of the spring.
2. Feed one end of the spring in between the two bus bars. Then slide the other end of the spring into the upper hole (with the keyboard circuit board facing up) of the keyboard keys plastic actuator.
3. With one end of the spring firmly positioned, use the tweezers to grasp the other end of the spring roughly 0.5cm from the end of the spring.
4. SLOWLY stretch this end and position it into the metal spring holder on the circuit board. **THE SPRINGS DEFORM EASILY. USE EXTREME CAUTION TO AVOID OVER-STRETCHING THE SPRINGS.**



1 2 3 4

Figure 3: Steps in replacing a dislocated spring

Mounting

Mounting of the CMK is specific to each customized setup. It can be mounted into a wooden case, into an existing console, or using metal brackets. In the single keyboard configuration, the CMK is a stand-alone unit. In this configuration, the keyboard is mounted using metal brackets. However, for a professional finish, an optional wooden

mounting box may be purchased. When mounted in the wooden mounting box, the electronics may be accessed by removing four screws on the bottom of the wooden case. The CMK keyboard then slides out easily. In both the single manual and wooden mounting box versions, the CMK is a ready-to-play keyboard requiring only power and MIDI connections.

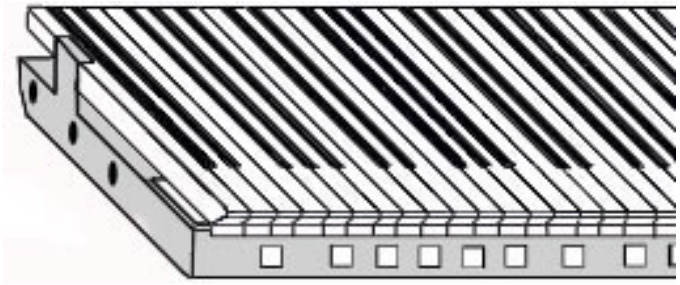


Figure 4: Single-manual stand-alone

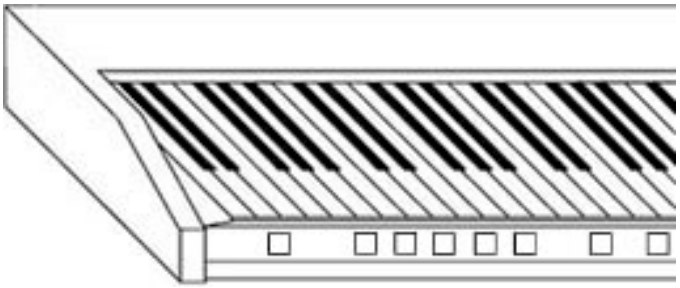


Figure 5: Single-manual with wooden case

If the CMK is to be mounted into an existing console, the metal pieces at the ends of the keyboard have holes of 0.156 inch diameter to allow the CMK to be fastened to wooden end cheeks using #6 screws.

In the two-keyboard and three keyboard configurations, a separate mounting bracket may be purchased. There are three threaded holes on the sides of the keyboards for mounting purposes. The holes permit mounting of the keyboards into the brackets either **level or tilted** as shown in Figures 8 and 9. The entire two/three keyboard configuration with mounting brackets may be installed in a console using #6 screws. The electronics are accessible by flipping the keyboards as shown in Figure 10.

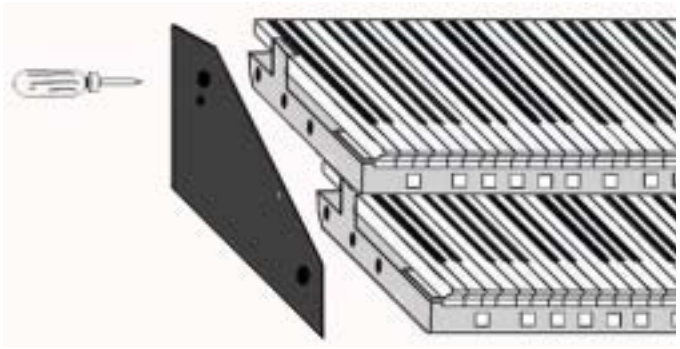


Figure 6: Two manual setup

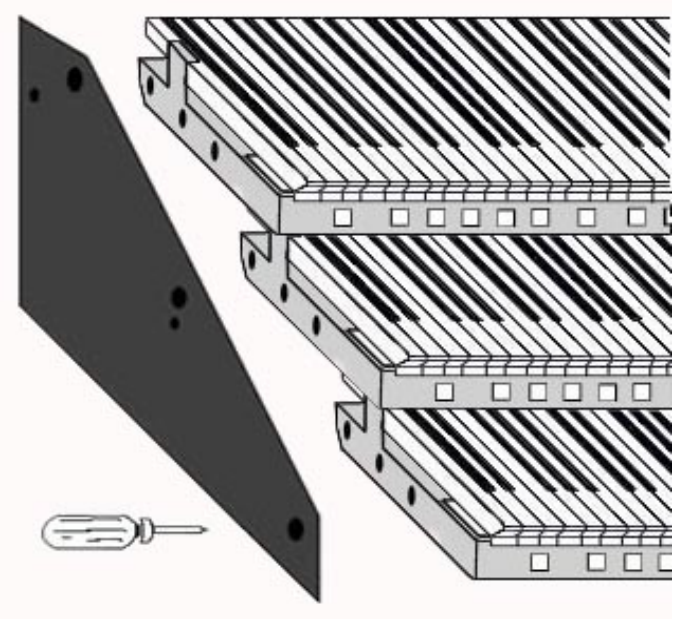


Figure 7: Three manual setup

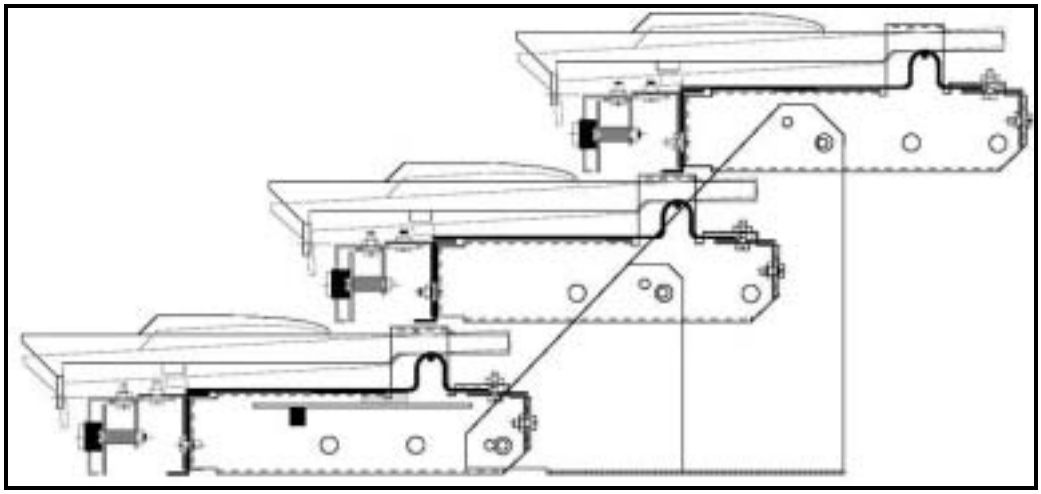


Figure 8: Two/Three-manual setup mounted level
(Note the pivoting screw positions on each end bracket are different)

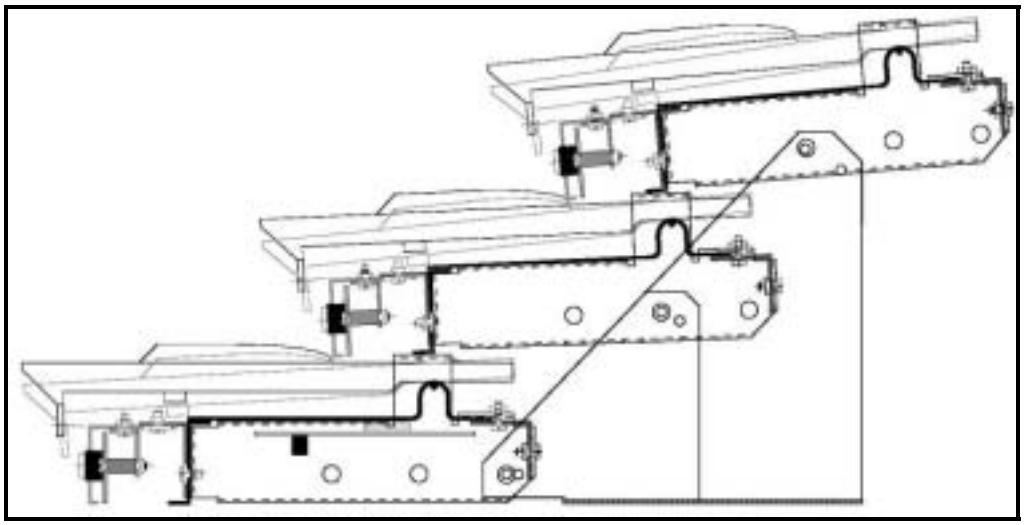


Figure 9: Two/Three-manual setup mounted ‘tilt-up’

Figure 10: Accessing keyboard electronics

Connections

Power

The user must connect Power and MIDI for each keyboard. There are several ways to provide power to the CMK which will depend on the application. The CMK requires **between +9V and +15V** DC power at a minimum current of **400mA**. If the CMK is to be used as a standalone unit, the most convenient method of providing power would be to use the supplied 2.1mm Co-axial DC adaptor.

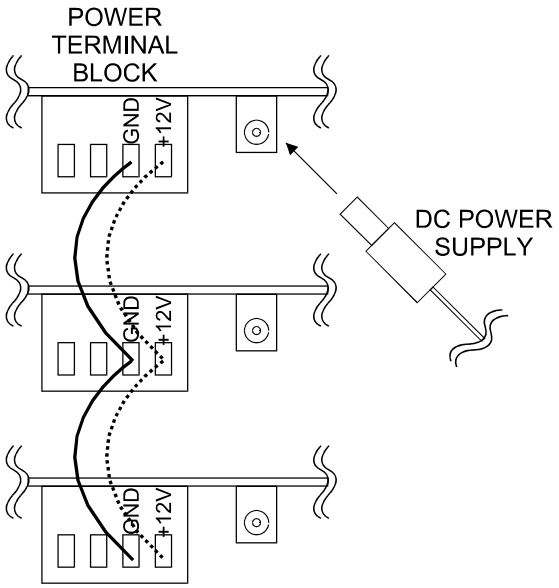


Figure 11: Connecting Multiple CMK Keyboards, Rear View, Using Parallel Wiring and Included Power Supply

However, if multiple keyboards are used or if the CMK is to be mounted inside an organ console, the 4-input terminal block can be connected to an existing organ power supply. Power and ground are connected to terminal block inputs 1 and 2 respectively. Terminal block inputs 3 and 4 are for grounding the case. One power supply can power up to three CMK keyboards by paralleling the terminal block connections.

The CMK has a number of safety features. For easy operation, an isolated +12 Volt, DC adaptor of **either** positive or negative polarity may be used. It must have a 2.1mm co-axial power jack. A bridge-rectifier is present within the CMK to ensure the proper polarity. A 500mA self-resetting Polyfuse provides over-current protection from the common power supply.

MIDI

The CMK has one MIDI input and four paralleled MIDI outputs so that it can be connected to several MIDI devices and/or a personal computer. All four MIDI OUT connectors produce the same messages and can be used for long distance applications. The MIDI IN connector allows another MIDI source to be merged with the MIDI signal from this unit.

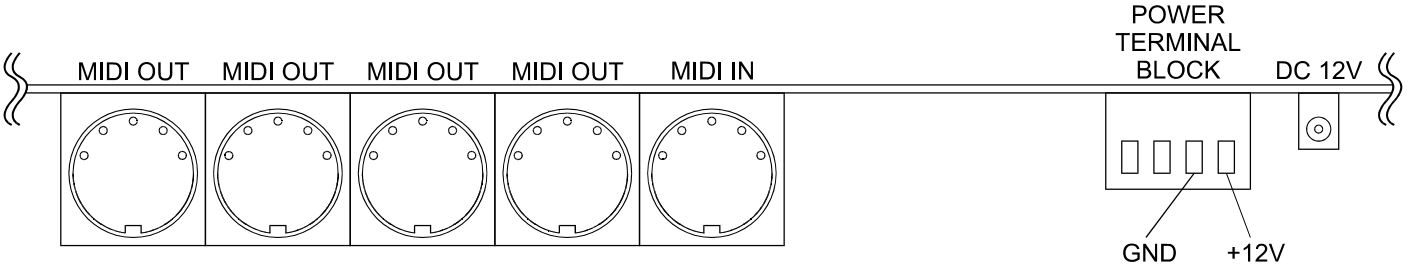


Figure 12: MIDI Connection Jacks, Rear View

The CMK has the capability to simultaneously drive up to four different Ahlborn Archive Series™ modules. These can be controlled through the general pistons on the CMK. Thus, additional stops and sounds on multiple Ahlborn Archive modules may be controlled as though they were part of the organ.

Analog Inputs

Two analog inputs are present on the CMK. The user must ensure that there is one connection to Ground on pin '3', one connection to an appropriate positive voltage (usually +5V) on pin '1', and one connection to an analog input pin. Analog inputs are used for crescendo and volume/expression adjustment as shown in Figure 13.

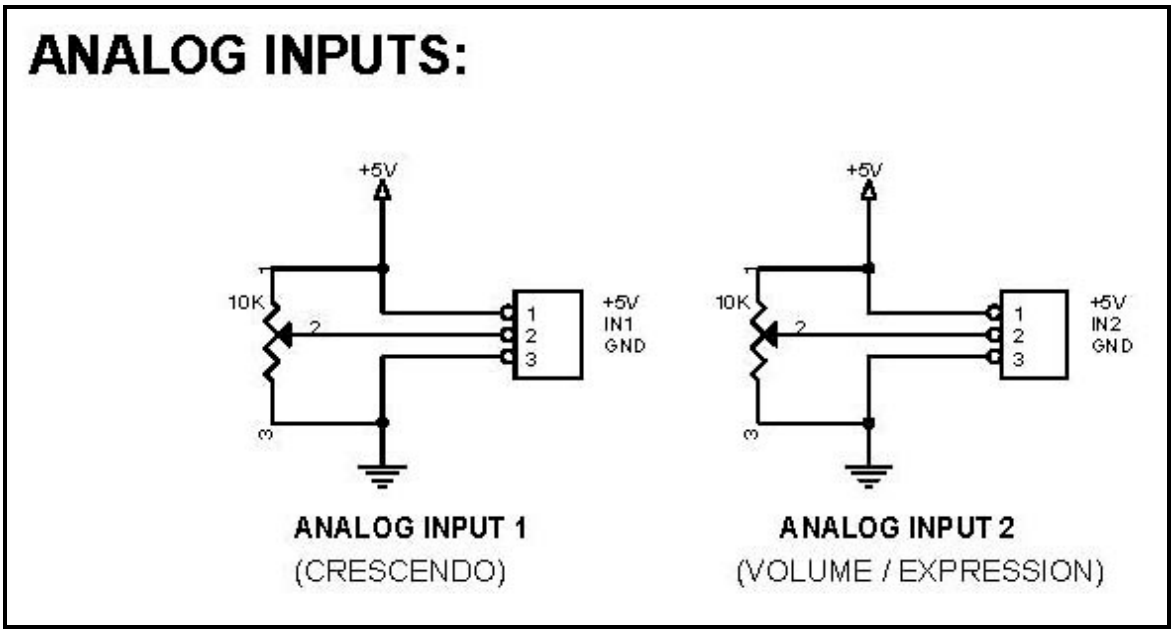


Figure 13: Wiring Schematic for Analog input

The CMK has provision for up to four extra input functions on the circuit board. These inputs are reserved for future use.

Table 2: Connection Chart

Connection Name	Connection Type	Hardware	Description
Required Connections			
Power	Input	1. Co-ax 2.1mm (either polarity) **OR** 2. 4-input Terminal Block Input 1 for +12V, Input 2 for GND	9-12V, 400mA minimum
MIDI IN	Input	DIN 5-pin socket 180°	Standard MIDI signals
MIDI OUT 1-4	Output	DIN 5-pin socket 180°	Standard MIDI signals
Optional Connections			
Analog	Input	Pins, 0.025" Square, 0.3" long, 0.1" pitch	'Analog Input 1' is used for crescendo and 'Analog Input 2' is used for volume/expression.

Software Installation (*Windows[1] users only*)

Software installation instructions are described in the 'CMK Configuration Software' section of the manual.

*Note: To use the software, the CMK **must** be connected to a computer via **MIDI**. If a MIDI port is not available on your computer, a commercial MIDI adapter for the game port, USB port, or parallel port may be used.*

[1] Windows is a registered Trademark of the Microsoft Corporation.

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MIDI SPECIFICATION

MIDI (**M**usic **I**nstrument **D**igital **I**nterface) is a communication system between computer-controlled music instruments and describes all the actions of a musical performance. It was originally developed for music synthesizers but, a few years ago, organ-builders began adding MIDI capabilities to pipe organs. However, as MIDI was not designed for a complex musical instrument such as the organ, its standards are subject to organ-builders preferences.

MIDI is composed of three components which are the language (protocol), hardware (MIDI connector), and distribution format (MIDI file) [1]. The MIDI language is in binary format and is a uni-directional asynchronous stream of bits at 31.25 Kbits per second with 10 bits transmitted per byte. The 10 bits per byte consist of a start bit, 8 data bits, and a stop bit. In the hardware domain, the MIDI 1.0 Specification (maintained by the MIDI Manufacturers Association) recommends the 5-pin DIN 180° connector. The 5-pin DIN connector is standard and allows MIDI equipment from differing manufacturers to be connected together. MIDI cables transmit information in a uni-directional manner so connectors are designated as either input or output. MIDI files are the standard distribution format. They capture all the details of MIDI onto a hardcopy medium. MIDI files are similar to the MIDI language except that they add a time-stamp for each event so that MIDI equipment can replicate the timing required to generate accurate performances. [1] MIDI Message information can be found in Appendix B and Appendix C.

MIDI Sound Sets

General MIDI [2]

The MIDI Manufacturers Association (MMA) developed General MIDI (GM) to provide a standard relationship between commands and sounds generated by synthesizers. A serious problem developed as the number of MIDI device manufacturers grew. Every manufacturer associated different commands with different sounds. Users were confused when they used a command to play a piano sound but ended up with some other instrument. To alleviate the confusion, the MIDI Manufacturers Association dictated that commands termed ‘Patch numbers’ would be the standard reference to a sound. A ‘Patch Map’ shows Patch numbers and their respective sounds. In addition, since MIDI transmits using MIDI channels, every MIDI sequence begins by assigning a MIDI channel for each sound that is transmitted. This assignment is termed ‘Program Change’.

In addition to standardizing the mapping of patch numbers to their respective sounds, the General MIDI protocol defines a set of capabilities for General MIDI instruments. Included are a General MIDI Sound Set (patch map), a General MIDI Percussion map (maps percussion sounds to note numbers), and a set of General MIDI performance capabilities (number of voices, MIDI messages recognized, etc.).

MIDI channels 1-9 and 11-16 are used for chromatic instrument sounds, while MIDI channel 10 is used for ‘key-based’ percussion sounds. Furthermore, the 128 program numbers are grouped into 16 related sets. For example, program numbers 1-8 are for piano sounds, 25-32 are guitar sounds, etc. (a chart is shown on the next page). The pitch of the sound is indicated by a note number. Note numbers on the ‘key-based’ percussion sounds of MIDI Channel 10 represent different percussion instruments. It should be noted that although sounds may have the same label, they may

not necessarily produce the same sound. The sound output depends on the recorded sound source which is not standard (an 'Acoustic Grand Piano' will sound different depending on the instrument used to produce the sound). Only the patch numbers and their labels are standardized.

Table 3: Sound Set Groups [3]

Set	Sound
1-8	Piano
9-16	Chromatic Percussion
17-24	Organ
25-32	Guitar
33-40	Bass
41-48	Strings
49-56	Ensemble
57-64	Brass
65-72	Reed
73-80	Pipe
81-88	Synthesizer Lead
89-96	Synthesizer Pad
97-104	Synthesizer Effects
105-112	Ethnic
113-120	Percussive
121-128	Sound Effects

Table 4: General MIDI Program Numbers for MIDI Channels 1-9 and 11-16 [3]

Patch Number	Name	Patch Number	Name	Patch Number	Name
1	Acou Grand Piano	44	Contrabass	87	Lead 7 (fifths)
2	Bright Acou Piano	45	Tremolo Strings	88	Lead 8 (bass+lead)
3	Electric Grand Piano	46	Pizzicato Strings	89	Pad 1 (new age)
4	Honky-tonk Piano	47	Orchestral Harp	90	Pad 2 (warm)
5	Electric Piano 1	48	Timpani	91	Pad 3 (polysynth)
6	Electric Piano 2	49	String Ensemble 1	92	Pad 4 (choir)
7	Harpsichord	50	String Ensemble 2	93	Pad 5 (bowed)
8	Clavinet	51	SynthStrings 1	94	Pad 6 (metallic)
9	Celesta	52	SynthStrings 2	95	Pad 7 (halo)
10	Glockenspiel	53	Choir Aahs	96	Pad 8 (sweep)
11	Music Box	54	Voice Oohs	97	FX 1 (train)
12	Vibraphone	55	Synth Voice	98	FX 2 (soundtrack)
13	Marimba	56	Orchestra Hit	99	FX 3 (crystal)
14	Xylophone	57	Trumpet	100	FX 4 (atmosphere)
15	Tubular Bells	58	Trombone	101	FX 5 (brightness)
16	Dulcimer	59	Tuba	102	FX 6 (goblins)
17	Drawbar Organ	60	Muted Trumpet	103	FX 7 (echoes)
18	Percussive Organ	61	French Horn	104	FX 8 (sci-fi)
19	Rock Organ	62	Brass Section	105	Sitar
20	Church Organ	63	Synth Brass 1	106	Banjo
21	Reed Organ	64	Synth Brass 2	107	Shamisen
22	Accordion	65	Soprano Sax	108	Koto
23	Harmonica	66	Alto Sax	109	Kalimba
24	Tango Accordion	67	Tenor Sax	110	Bagpipe
25	Acoustic Guitar (nylon)	68	Baritone Sax	111	Fiddle
26	Acoustic Guitar (steel)	69	Oboe	112	Shanai
27	Electric Guitar (jazz)	70	English Horn	113	Tinkle Bell
28	Electric Guitar (clean)	71	Bassoon	114	Agogo
29	Electric Guitar (muted)	72	Clarinet	115	Steel Drums
30	Overdriven Guitar	73	Piccolo	116	Woodblock
31	Distortion Guitar	74	Flute	117	Tailo Drum
32	Guitar Harmonics	75	Recorder	118	Melodic Drum
33	Acoustic Bass	76	Pan Flute	119	Synth Drum
34	Electric Bass (finger)	77	Blown Bottle	120	Reverse Cymbal
35	Electric Bass (pick)	78	Shakuhachi	121	Guitar Fret Noise
36	Fretless Bass	79	Whistle	122	Breath Noise
37	Slap Bass 1	80	Ocarina	123	Seashore
38	Slap Bass 2	81	Lead 1 (square)	124	Bird Tweet
39	Synth Bass 1	82	Lead 2 (sawtooth)	125	Telephone Ring
40	Synth Bass 2	83	Lead 3 (calliope)	126	Helicopter
41	Violin	84	Lead 4 (chiff)	127	Applause
42	Viola	85	Lead 5 (charang)	128	Gunshot
43	Cello	86	Lead 6 (voice)		

Table 5: General MIDI Percussion Key Map for MIDI Channel 10 [4]

MIDI Key	Drum Sound	MIDI Key	Drum Sound
35	Acoustic Bass Drum	59	Ride Cymbal 2
36	Bass Drum 1	60	Hi Bongo
37	Side Stick	61	Low Bongo
38	Acoustic Snare	62	Mute Hi Conga
39	Hand Clap	63	Open Hi Conga
40	Electric Snare	64	Low Conga
41	Low Floor Tom	65	High Timbale
42	Closed Hi-Hat	66	Low Timbale
43	High Floor Tom	67	High Agogo
44	Pedal Hi-Hat	68	Low Agogo
45	Low Tom	69	Cabasa
46	Open Hi-Hat	70	Maracas
47	Low-Mid Tom	71	Short Whistle
48	Hi-Mid Tom	72	Long Whistle
49	Crash Cymbal 1	73	Short Guiro
50	High Tom	74	Long Guiro
51	Ride Cymbal 1	75	Claves
52	Chinese Cymbal	76	Hi Wood Block
53	Ride Bell	77	Low Wood Block
54	Tambourine	78	Mute Cuica
55	Splash Cymbal	79	Open Cuica
56	Cowbell	80	Mute Triangle
57	Crash Cymbal 2	81	Open Triangle
58	Vibraslap		

Ahlborn [5]:

The Ahlborn Archive modules allow additional pipe organ sounds to be played on an existing organ. There are four separate Ahlborn Archive modules of 20 different stops each over three separate divisions. For more information on Ahlborn Archive modules, please visit: http://www.ahlbornorgans.com/archive. The messages for controlling Ahlborn Archive modules can be found in Appendix D. The stop list for each module is shown below.

Table 6: Classic Module [6]

Division A	Division B	Pedal
Description	**Description**	**Description**
Gemshorn 8’	Principal 8’	Contre Basse 32’
Gemshorn Celeste 8’	Holzgedackt 8’	Contre Gambe 16’
Flûte à cheminée 8’	Flûte Harmonique 8’	Contre Bombarde 32’
Koppelflöte 4’	Flûte Octaviante 4’	Bombarde 16’
Plein Jeu IV-V	Octave 2’	Div. A to Ped.
Bombarde 16’	Cymbale III	Div. B to Ped.
Harmonic Trumpet 8’	Tremulant	
Corno di Bassetto 8’	Div. A to Div. B	
Festival Trumpet 8’		
Clarion 4’		
Tremulant		
Div. B to Div. A		

Table 7: Romantic Module [6]

Division A	Division B	Pedal
Description	**Description**	**Description**
Cello 8’	Open Diapason 8’	Contre Violone 32’
Cello Celeste 8’	Flauto Mirabilis 8’	Contre Gambe 16’
Cornet des Bombardes IV	Concert Flute 4’	Contre Bassoon 32’
Cornopean 16’	Quint Flute 2 2/3’	Ophicleide 16’
Clarinet 8’	Piccolo 2’	Div. A to Ped.
Orchestral Oboe 8’	Vox Humana 8’	Div. B to Ped.
French Horn 8’	Tremulant	
Cor Anglais 8’	Div. A to Div. B	
Tuba Mirabilis 8’		
Clarion 4’		
Tremulant		
Div. B to Div. A		

Table 8: 201 Module [6]

Division A	Division B	Pedal
Description	**Description**	**Description**
Bourdon 16’	Gedackt 8’	Subbass 16’
Principal 8’	Gamba 8’	Octave 8’
Flûte à cheminée 8’	Nachthorn 4’	Bourdon 8’
Unda Maris 8’	Cymbale III	Posaune 16’
Octave 4’	Cornet III	Div. A to Ped.
Spitzflöte 2’	Oboe 8’	Div. B to Ped.
Nasard 2 2/3’	Tremulant	
Superoctave 2’	Div. A to Div. B	
Mixture IV		
Trompete 8’		
Tremulant		
Div. B to Div. A		

Table 9: 202 Module [6]

Division A	Division B	Pedal
Description	**Description**	**Description**
Contregambe 16’	Bourdon 8’	Soubasse 32’
Diapason 8’	Flûte harmonique 8’	Violone 16’
Quintadena 8’	Flûte octaviante 4’	Contrebombarde 32’
Terz 1 3/5’	Larigot 1 1/3’	Bombarde 16’
Septime 1 1/7’	Corno di bassetto 8’	Div. A to Ped.
Scharff III	Clarion 4’	Div. B to Ped.
Bombarde 16’	Tremulant	
Trompette 8’	Div. A to Div. B	
Tuba Mirabilis 8’		
Chimes		
Tremulant		
Div. B to Div. A		

HAUPTWERK™ [7]

Hauptwerk (German for 'Great Organ') is a computer simulation of a pipe organ. It produces a realistic organ sound by use of a 'virtual sampler' technique. Traditionally, synthesizers used a small number of samples by recording keys at intervals across the keyboard. In order to simulate all the keys, the samples were time-stretched. Hauptwerk uses a three-to-five second sample of every pipe in the organ. To accommodate the intensive requirement for memory, a high-speed personal computer must be used. With current technology, thousands of individual sample sounds can be stored and recalled when a key is pressed. Thus, the software is able to capture many different and customizable organ configurations and sounds which can be loaded via '.organ' files. The '.organ' file contains information regarding number of stops, pistons, and keyboards in addition to other organ-related details.

Hauptwerk was initially designed for use with one MIDI keyboard which would be connected to the personal computer through the sound card game port. If numerous keyboards were required, a MIDI merge box would have to be purchased. However, the CMK not only performs the MIDI merge function but, also provides an interface for volume controls, expression controls, and pistons. MIDI messages will then be sent through the MIDI out port to the personal computer where Hauptwerk software will translate the MIDI message commands into actions on the organ. A table listing the types of messages sent for the individual functions is shown below.

Table 10: MIDI messages relevant to Hauptwerk

Function	MIDI command
Keyboards	1. Note on/off 2. Channel number 3. Key number
Pedalboard	1. Note on/off 2. Channel number 3. Key number
Stops	Note on/off
Pistons	Program change
Volume	Program change
Expression	Program change
Crescendo	Program change

For more information or to download a shareware version of Hauptwerk software, please visit:
http://www.hauptwerk.co.uk

SCPOP™ (not supported on the current version of the CMK)

Sound Canvas Pipe Organ Project (SCPOP) is a computer program that emulates organ features like stop changes, keyboard coupling, tremolo, assignable memories, temperament changes, and the ability to choose different reverb settings. All of the features can be accessed using the computer keyboard's keys like a true organ console. **[8]**

SCPOP requires a Roland Sound Canvas MIDI Expander module and is only compatible with Roland hardware containing the 'Sound Canvas' label **[9]**. The messages used to control SCPOP can be found in Appendix E.

MIDI Hardware Specification [1]

The only MIDI connector approved by the MIDI Manufacturers Association is a 5-pin 180º DIN connector. There are other ways of connecting devices to send MIDI messages but, it is easier to have compatibility between different MIDI devices if there is a standard connector. In connecting a MIDI device to a personal computer, the simplest way is through the MIDI ports of a computer (MIDI connectors are uni-directional from the 'OUT' connector to the 'IN' connector). Due to space limitations of computer circuit boards, most computers are not equipped with a MIDI port. Thus, adapters must be used which connect the MIDI device to another port. The most common port is the computer's game port which is found on most soundcards. Adapters are also available for the serial port, parallel port, and USB port.

A schematic of the 5-pin DIN connector typical interface is shown below:

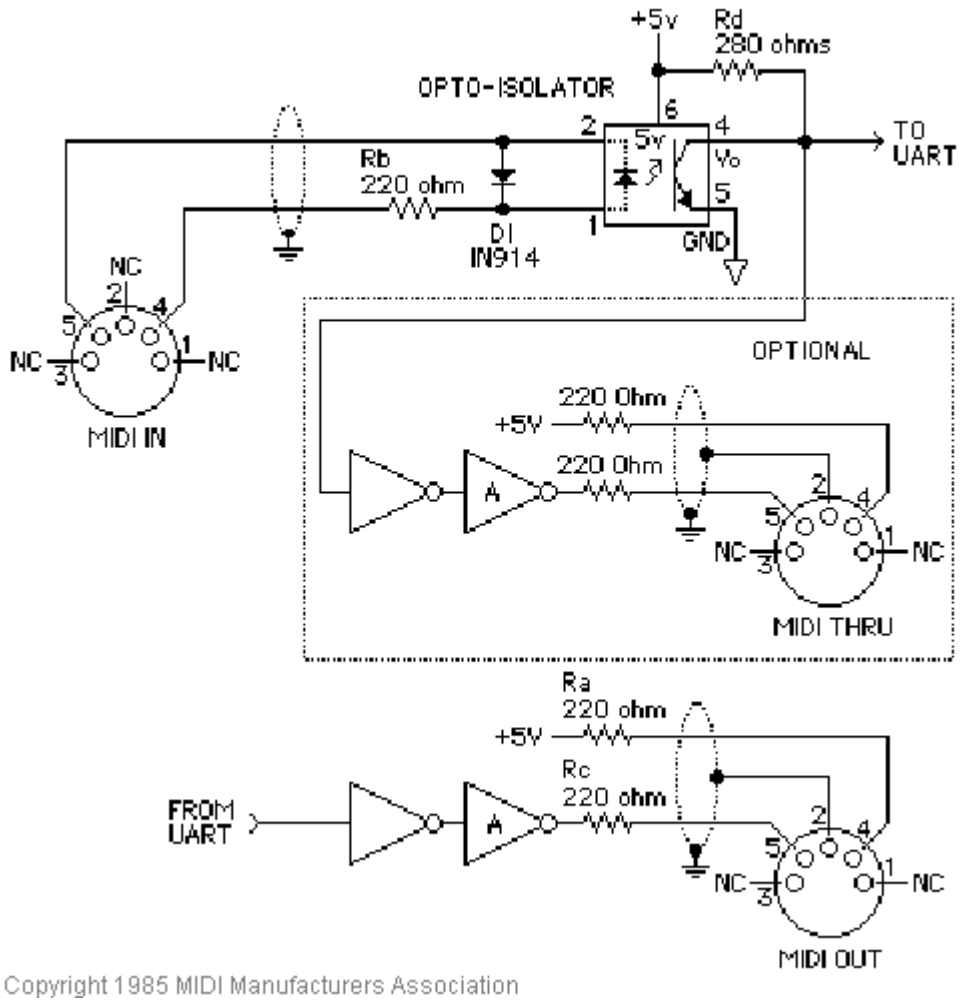

Figure 14: Schematic of 5-pin DIN connector

MIDI Hardware NOTES:

1. Opto-isolator shown is Sharp PC-900. HP 6N138 or other types can be used with changes.
2. Gates "A" are Integrated Circuit or transistor; Resistors are 5%.
3. **Maximum cable length** is fifty feet (15 meters), terminated at each end by a 5-pin 180º DIN male plug (e.g. SWITCHCRAFT 05GM5M).
4. Cable is shielded twisted-pair, with shield connected to pin 2 at both ends.

CMK HARDWARE CONFIGURATION

Introduction

The CMK is customizable to suit many organ applications. Up to three CMK keyboards may be stacked level or tilted if the optional mounting brackets are purchased. Each keyboard has 61-keys which serve programming purposes as well as musical purposes. Two analog inputs are available (for volume/expression and crescendo adjustment).

Power-On Self Test

The CMK has a built-in self test that executes upon power up. This power-on self test serves to detect the presence of hardware for velocity sensing. The test also checks that all 61 key-switch contacts are functioning properly. If hardware is not present or is malfunctioning, velocity sensing is automatically disabled. The user can also disable velocity sensing manually by pressing any keyboard key before connecting power.

Analog Input Pins

There are two analog inputs which can be configured for volume/expression and crescendo. Analog devices must be connected to the analog input pin, a positive voltage (+5V) on pin '1', and ground potential (0V) on pin '3'. Depending on the position of the analog device, a unique voltage will be read by the processor which will determine the setting. In the case of a volume control, the position of the analog device will determine the loudness level. See Figure 13.

MIDI Crescendo

A MIDI program change message is sent to gradually add stops to a registration. 'Analog Input 1' is used for Crescendo.

MIDI Volume

A MIDI program change message is sent to change the loudness level of the stop or sound. The MIDI volume analog input must be configured to transmit on one or more MIDI channels as outlined in Table 11. 'Analog input 2' is used for Volume but can also be used for Expression.

MIDI Expression

A MIDI program change message is sent to set the loudness level within the preset volume range. 'Analog Input 2' is used for Expression but can also be used for Volume. Expression messages adjust the loudness within a range not exceeding the maximum set by volume. The MIDI Expression analog input must be configured to transmit on one or more MIDI channels as outlined in Table 11. In multi-manual CMK setups, the range for the Expression control can be set by attaching a Volume control to one of the keyboards and attaching an Expression control to another keyboard.

If the volume and expression controls are set to produce messages on the same MIDI channels, the volume control will set the maximum range while the expression control will change the loudness level in the volume range.

Programming

The following chart lists different functions achievable using the piston pushbuttons and keyboard key-switches.

Table 11: Piston programming functions

Name	Steps	Function
SOFT REBOOT	Press the 1st piston from the left (SET) and 1st piston from the right (CANCEL) simultaneously	Performs a soft reboot. This will restart the keyboard and reload configuration data from the on-board EEPROM.
SET MIDI CHANNELS FOR THE KEYBOARD	Hold the 1st piston from the left (SET) and the 1st black key from the left (C#1). Then select any combination of the 1st 16 white keys from the left (C1 to D3). Afterwards, release the SET piston.	Sets the output MIDI channels for the keyboard. For example, if we configure the keyboard to output on channels 1, 3 and 5, then all MIDI events originating from that keyboard will produce MIDI messages transmitted on these three channels.
CLEAR MIDI CHANNELS FOR THE KEYBOARD	Hold 1st piston from the left (SET) and 2nd black key from the left (D#1). Afterwards, release the SET piston.	Clears the output MIDI channels for the keyboard.
DEFAULT VELOCITY (if keyboard is in non-velocity mode)	Hold the 1st piston from the left (SET) and 3rd black key from the left (F#1). Then press one of the white keys and release the SET piston.	If the keyboard is set to non-velocity mode, the default velocity output of the keyboard can be selected. This is accomplished by using the white keys select a velocity level between 0 (bass end: softest) and 127 (treble end: loudest). Keys pressed in between will produce a velocity level between 0 and 127 depending on the location of the key relative to the extremes. The change in velocity level between adjacent white keys is approximately 3. Note that in the event multiple keys are pressed, only the last one released will be registered by the software.

Table 11: Piston programming functions (cont'd)

Name	Steps	Function
VELOCITY SENSING ON/OFF	Hold 1st piston from the left (SET) and 4th black key from the left (G#1) to turn off velocity sensing. Hold 1st piston (SET) and 5th black key from the left (A#1) to turn on velocity sensing. Afterwards, release the SET piston.	Velocity sensing produces a different volume level corresponding to the force with which a key is pressed. To conform to traditional organ consoles which are not velocity sensitive, the CMK permits users to disable velocity sensing in the keyboard.
ANALOG INPUT – VOLUME SETUP	Hold the 1st piston from the left (SET) and the 6th black key from the left (C#2). Then select any combination of the 1st 16 white keys from the left (C1 to D3). Afterwards, release the SET piston.	Sets the output MIDI channels for the volume analog input. For example, if we configure the analog input to produce General MIDI volume information on channels 1, 3 and 5, then all MIDI events originating from that analog input will produce MIDI messages transmitted on these three channels. Please note that the crescendo input does not require setup because it produces messages for the Ahlborn Archive modules.
DISABLING ANALOG INPUT – VOLUME	Hold the 1st piston from the left (SET) and the 6th black key from the left (C#2). Afterwards, release the SET piston.	MIDI messages describing volume information from the analog input will not be transmitted on any MIDI channel.
ANALOG INPUT – EXPRESSION SETUP	Hold the 1st piston from the left (SET) and the 7th black key from the left (D#2). Then select any combination of the 1st 16 white keys from the left (C1 to D3). Afterwards, release the SET piston.	Sets the output MIDI channels for the expression analog input. For example, if we configure the analog input to produce General MIDI expression information on channels 1, 3 and 5, then all MIDI events originating from that analog input will produce MIDI messages transmitted on these three channels. Please note that the crescendo input does not require setup because it produces messages for the Ahlborn Archive modules.
DISABLING ANALOG INPUT - EXPRESSION	Hold the 1st piston from the left (SET) and the 7th black key from the left (D#2). Afterwards, release the SET piston.	MIDI messages describing expression information from the analog input will not be transmitted on any MIDI channel.

CLASSIC MIDI KEYBOARD
CMK-1

CMK SOFTWARE CONFIGURATION
(PC Windows™ USERS ONLY)

Introduction

Users with access to a personal computer running Windows ™ [1] operating system can use the 'CMKConfig' software (contained in the compact disc) to program additional configurations. These configuration files describe the features of each keyboard such as output MIDI channel and the function of each piston. The software allows users to create configuration files, change existing configuration files, and use existing configuration files.

Software Installation

The CMK includes a compact disc (CD) with software allowing users to create custom configurations. To use the software, the CMK **must be connected to a personal computer running Windows operating system** software (Windows 98, 2000, XP). The CMK **must be connected to a computer using MIDI**. If a MIDI port is not available on your computer, commercial MIDI adapters for the game port, USB port, and parallel port may be used. When the installation CD is placed in the optical drive of your computer (CD drive), the software installation wizard should automatically run. If however, the software installation wizard does not automatically run follow the steps below:

1. Open the 'Start' menu and click on 'Run'.
2. Click on 'Browse' and select the optical drive (CD drive) from the 'Look in:' drop down menu.
3. Locate and click on a file named 'CMK_Setup.exe'.
4. Follow the instructions in the software installation wizard (screen captures are shown below).

[1] Windows is a registered Trademark of the Microsoft Corporation.

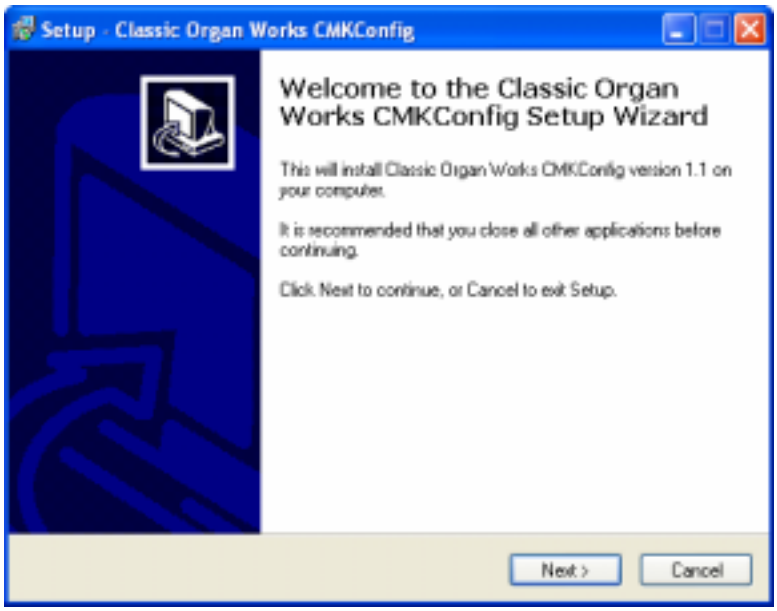

Figure 15: Upon clicking on the 'CMK_Setup.exe' file, the above window will appear.

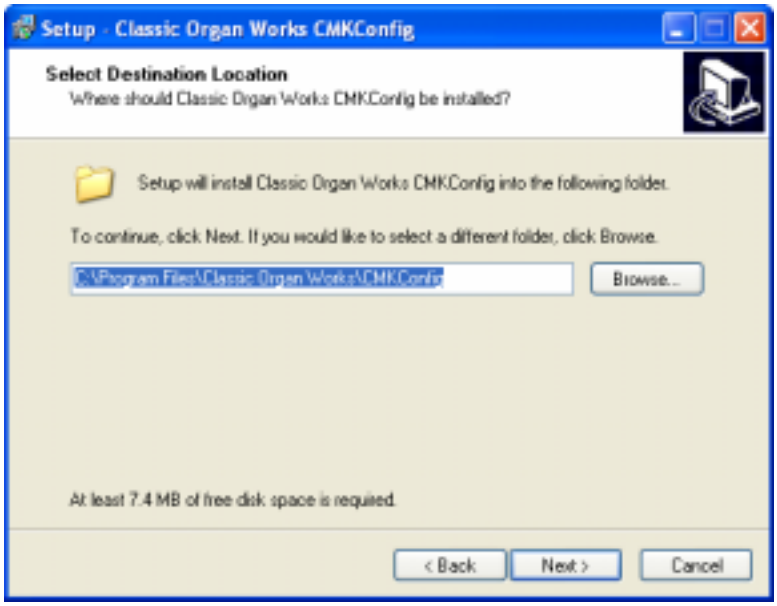

Figure 16: Allows the user to select a directory to install the CMK program file

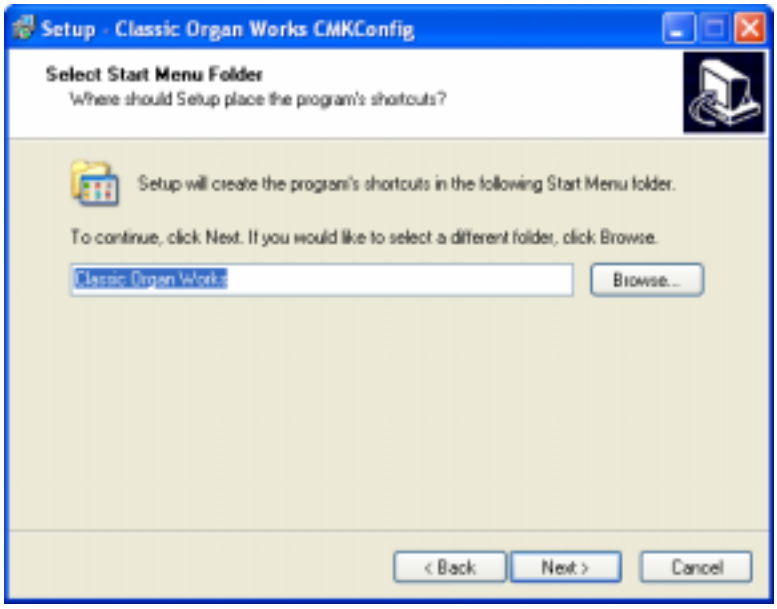

Figure 17: Setup adds an icon to the start menu for convenient access

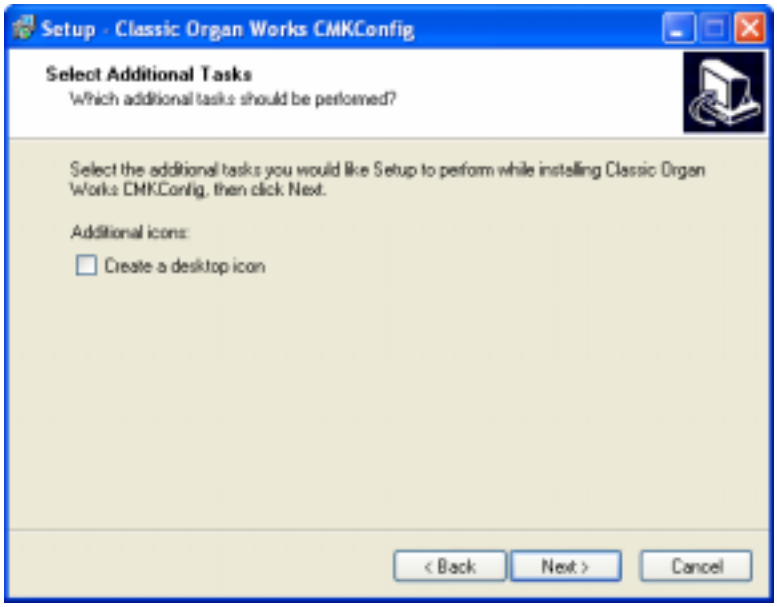

Figure 18: Setup provides the option of creating an icon on the Windows desktop

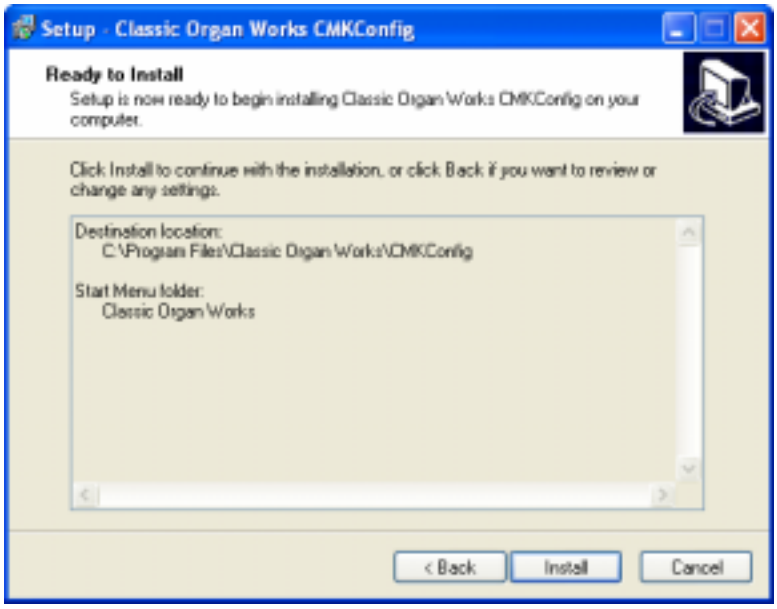

Figure 19: Confirmation window

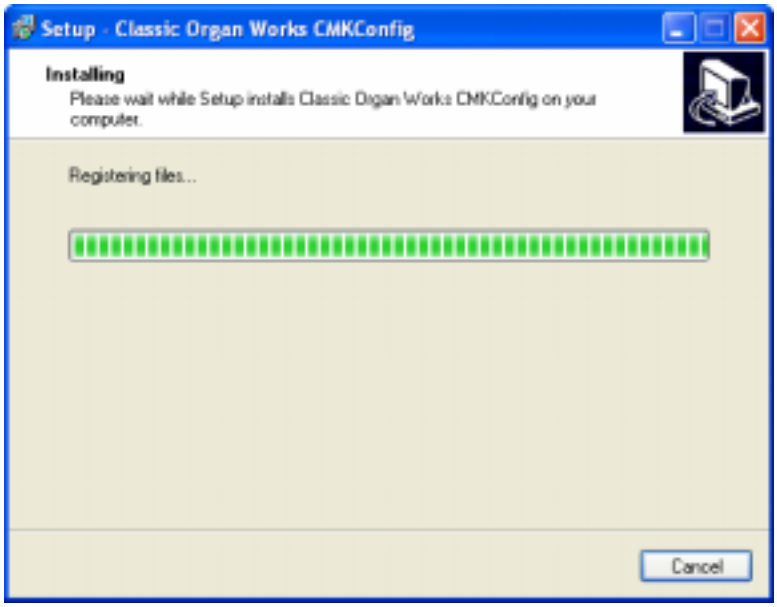

Figure 20: Setup progress window

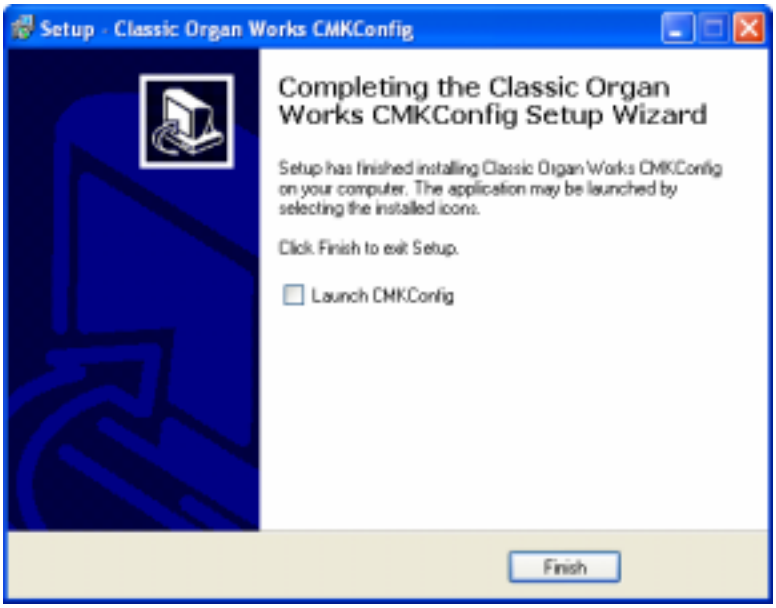

Figure 21: Confirms installation was successful

Software Startup

After installation, a shortcut titled 'CMKConfig' will be created in the 'Classic Organ Works' folder (Start menu→ Programs→ Classic Organ Works→ CMKConfig). To start using the software, click your left mouse button on this 'CMKConfig' shortcut. You should see a screen as shown below:

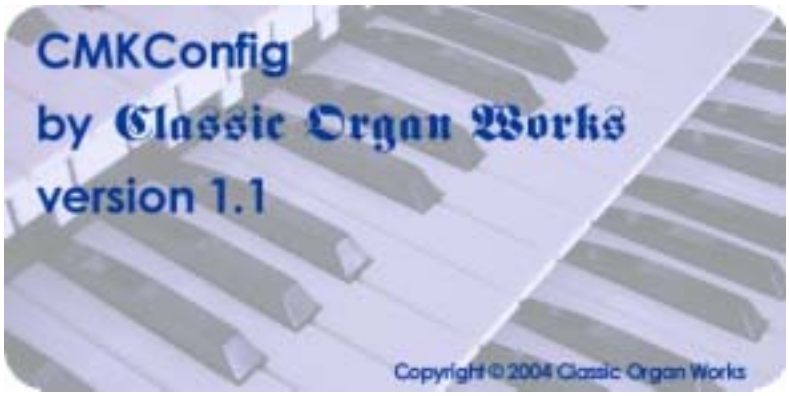

Figure 22: CMKConfig software startup screen.

Press a key on your computer keyboard or click on any mouse button and the main menu selection will appear:

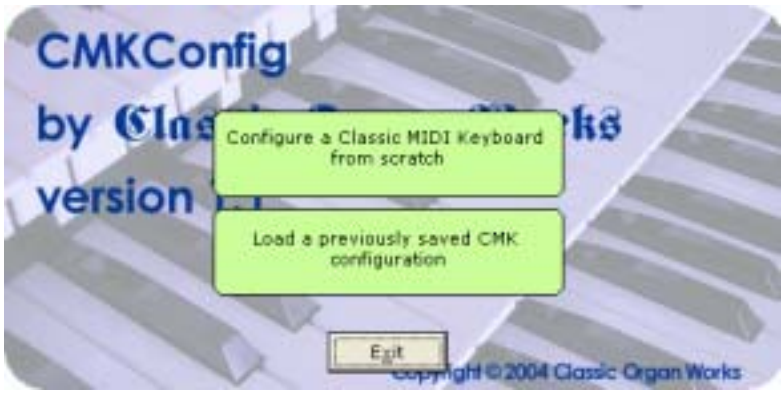

Figure 23: CMKConfig software main menu.

The main menu allows you to select one of two editing types:

1. **Configure a Classic MIDI Keyboard from scratch**: This mode allows you to create a new file for storing on the CMK memory or for generating a file on your PC.
2. **Load a previously saved CMK configuration**: This mode allows you to edit a file stored on your PC.

Configure a CMK from scratch

This editing mode allows the user to create a new configuration for the CMK. The user can then choose to save the new settings on a computer or transfer the file to the CMK memory as a new configuration. When a user selects the 'Configure a Classic CMK from scratch' option from the main menu, the software attempts to make a connection to the CMK as shown below. **Note:** If this is the first time you run CMKConfig, the software will prompt the user for the computer's MIDI configuration. See 'MIDI I/O Setup' on page 45.

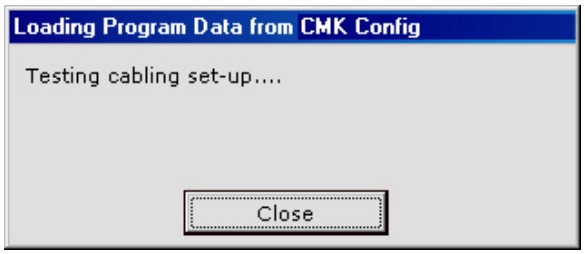

Figure 24: CMKConfig software attempting to connect with the CMK

If a connection is not made, the following window appears:

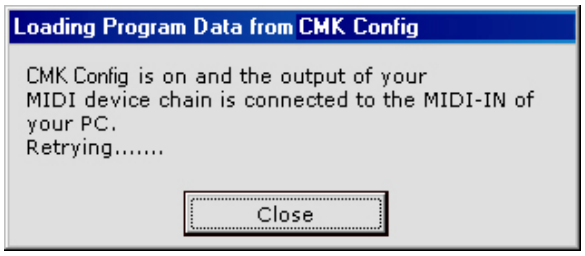

Figure 25: CMKConfig software unable to connect

If a connection is made, the CMKConfig software will indicate the number of keyboards connected.

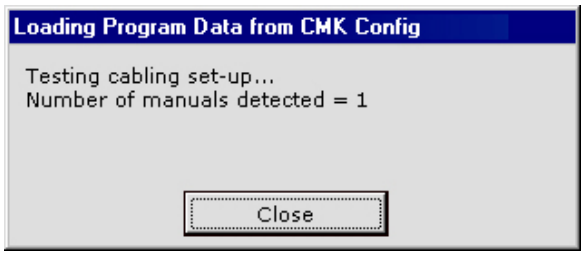

Figure 26: CMKConfig software successfully connected to the CMK.

Afterwards, the following window appears. The software defaults to reading the DIP switch. However, the user can specify another configuration number for the new configuration.

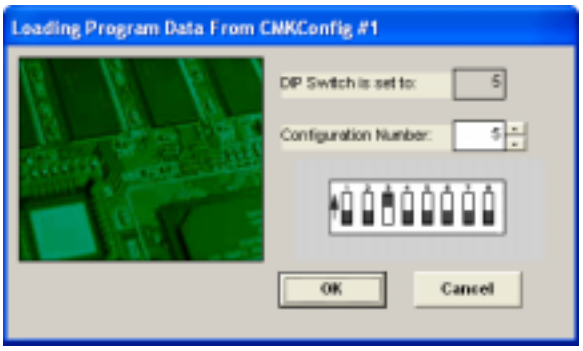

Figure 27: Successful connection between CMKConfig software and CMK.

When the user has specified the configuration number, CMKConfig software will load data from the CMK to start the configuration process.

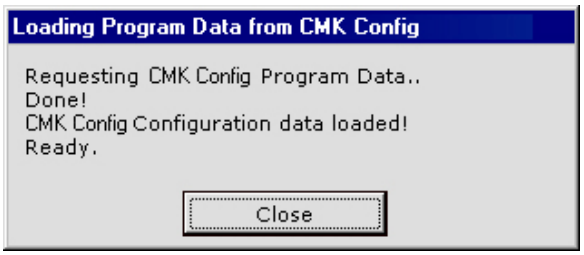

Figure 28: Window confirms the loading of pre-configuration data from the CMK to the PC.

The user can then design a custom configuration to the required specification.

Load a previously saved CMK configuration

CMK configuration files are saved on a PC in the format: *filename*.cmk. In this editing type, a configuration file that exists on your computer may be edited to the new specifications. The user can then choose to save the new settings on a computer or transfer the file to the CMK memory as a new configuration. When a user selects the 'Load a previously saved CMK configuration' option from the main menu, the software prompts for a filename through the following window:

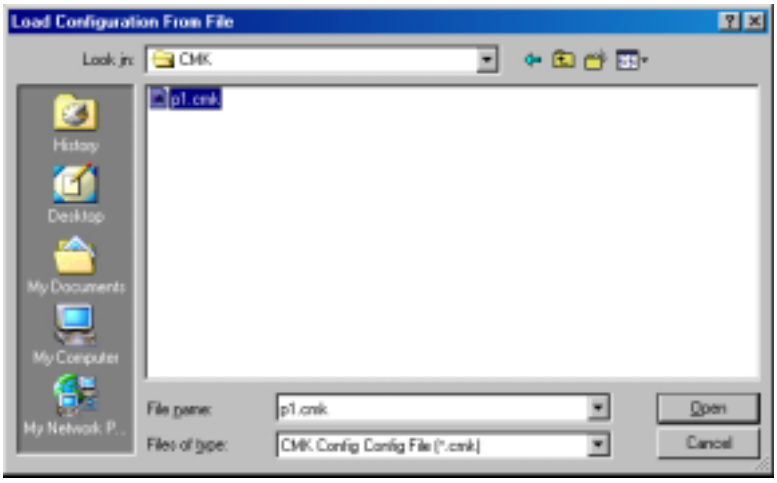

Figure 29: Configuration File selection window.

After selecting the appropriate file, click on the 'Open' button. A window should appear like the one shown below:

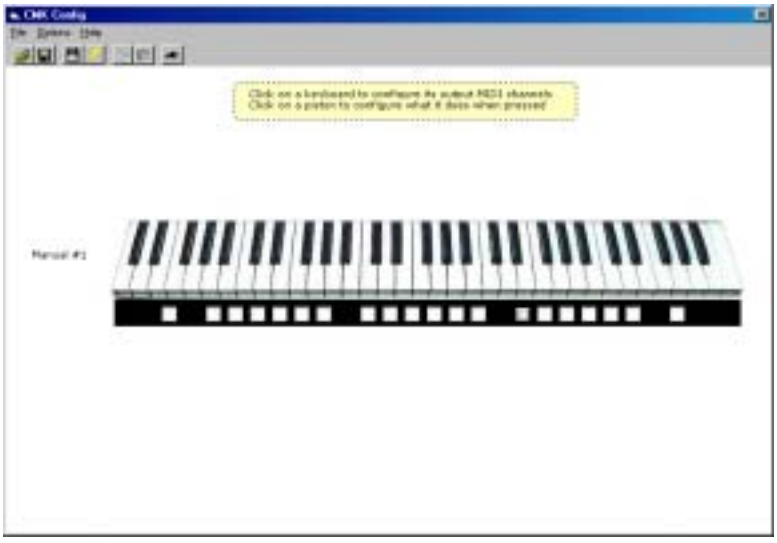

Figure 30: Program window

At this point, the user may customize each of the drop-down menus to their specifications.

Functions of the Toolbars

The software has toolbars which contain four main functions:

Figure 31: Toolbars in CMKConfig software

1. File Menu

- **Open Program Data File** – Loads a configuration file (with a '.cmk' extension) from the PC to the CMKConfig software. The user may then edit the file to their specifications.

Icon:  Keyboard shortcut: **Ctrl+O**

To begin loading a configuration go to File → Open Program Data File, or use the Keyboard shortcut, or icon shown above. A window prompting the user for a filename should appear:

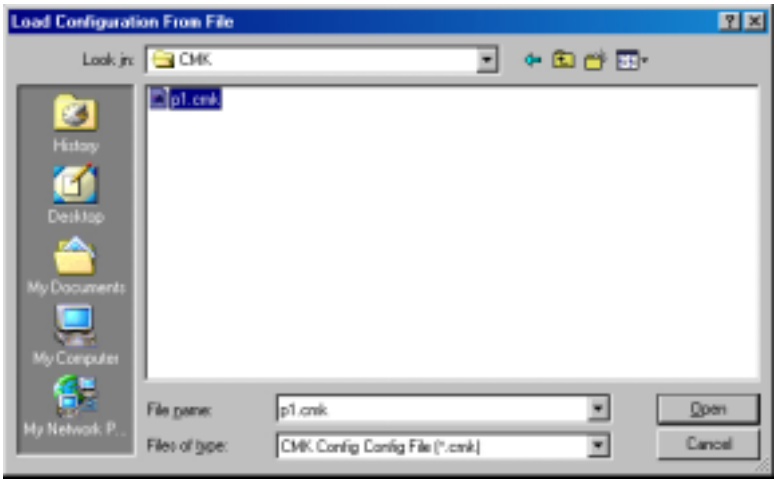

Figure 32: Loading Program Data From File Window

The user can then select the filename and click on the 'Open' button.

- **Save Program Data File** – Saves a configuration file to be stored on the PC. All configuration files have a '.cmk' extension.

Icon:  Keyboard shortcut: **Ctrl+S**

To save a configuration file to the PC, go to File → Save Program Data File, or use the Keyboard shortcut or icon shown above.

A window prompting the user for a filename should appear:

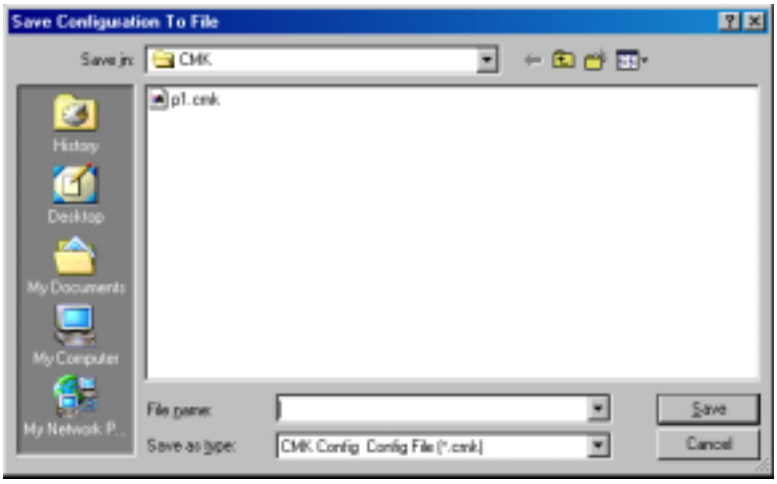

Figure 33: Save Program Data to File Window

If the configuration uses the same name as a previous configuration, a warning window will ask the user for confirmation in replacing the old file with the newly revised one.

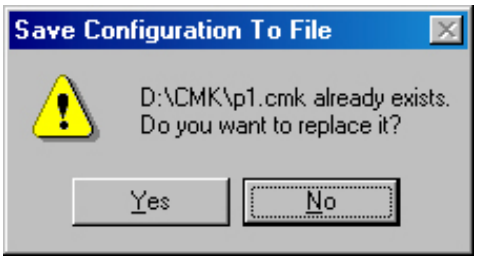

Figure 34: Confirm replacing of file window

- **Load Program Data From CMK** – Loads a configuration file from the CMK memory chip. A CMK may contain numerous configuration files which are selectable by changing the DIP-switch so, the software displays an initial configuration number as set in the DIP-switch. If a configuration number different from the DIP switch is required, it may be specified by the user.

Icon: Keyboard shortcut: **Ctrl+L**

To load a configuration from the CMK memory chip, the user must ensure that the CMK is connected to power and to a computer using a MIDI cable (please see software installation for details on connecting MIDI devices to computers). Then go to File → Load Program Data From CMK, or use the keyboard shortcut or icon as shown above. A window appears attempting to make a connection with the CMK as shown in Figure 35.

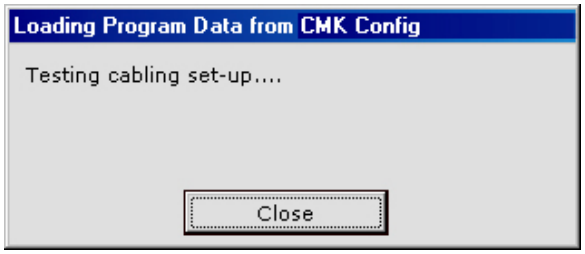

Figure 35: Software attempting to make a connection with the CMK

If a connection is not available, a window will appear as a reminder to make connections to the CMK:

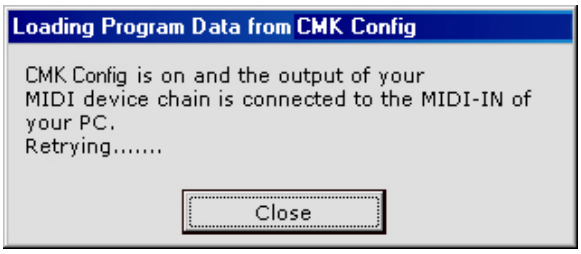

Figure 36: Software unable to make a connection with the CMK

If a connection is made, a window will appear to confirm the communication.

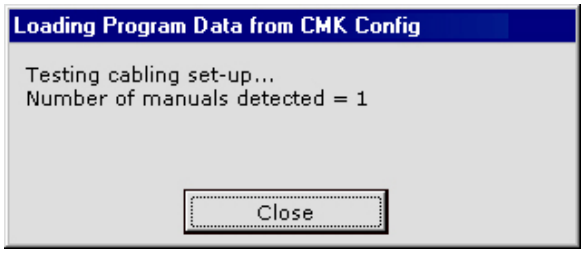

Figure 37: Software detecting number of keyboards

A window will then appear and the program will read the DIP switch to get the configuration number (see table 12 in Appendix A for DIP switch codes). The user may change the configuration number to be loaded if desired.

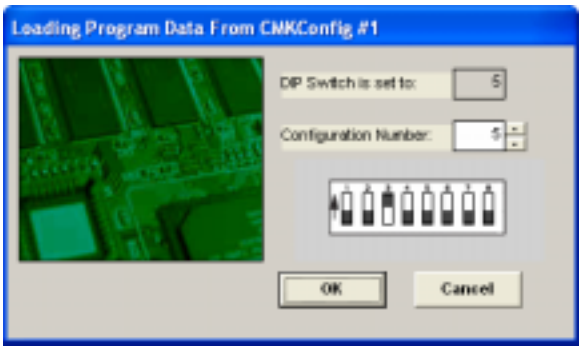

Figure 38: Successful connection between CMK and PC software

After the user has the desired configuration number, pressing 'OK' will display a window to confirm the selection:

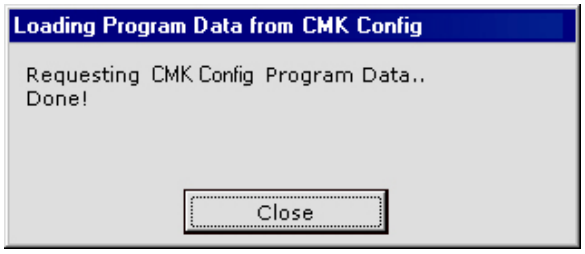

Figure 39: Confirms loading of configuration into CMKConfig software.

- **Write Program Data to CMK** – Saves a configuration file to the CMK memory chip. Typical CMK units will have numerous configuration files so the user should specify the configuration number of the current file.

Icon: 

Keyboard shortcut: **Ctrl+W**

To save a configuration to the CMK, go to File → Write Program Data to CMK or, use the keyboard shortcut or icon as shown above. The Software attempts to make a connection to the CMK.

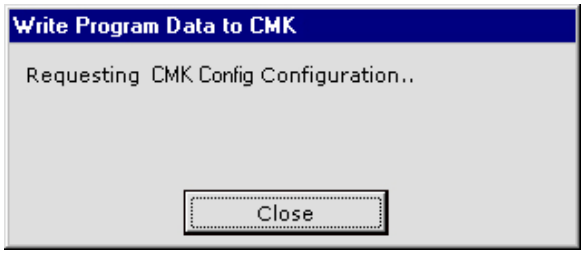

Figure 40: Software attempting to communicate with CMK

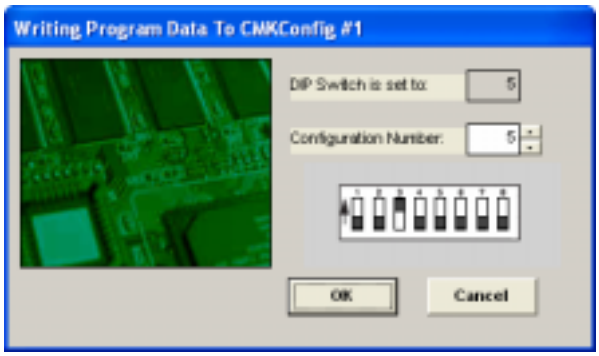

Figure 41: Successful Software connection to the CMK

NOTE: The 'DIP Switch is set to' field reflects the current DIP Switch setting. Care must be taken when choosing a new 'Configuration Number'. If a 'Configuration Number' already contains settings, writing to the same 'Configuration Number' will overwrite this information.

A window should appear to confirm that the contents were written.

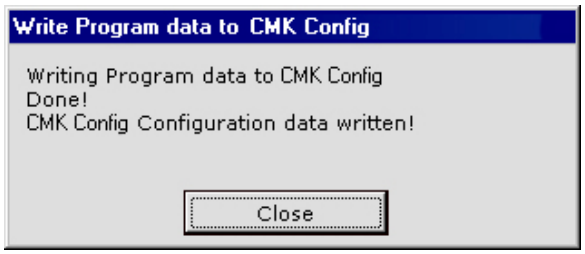

Figure 42: Confirms configuration written to CMK from CMKConfig software.

2. Options Menu

- **MIDI I/O Setup** – This function sets the MIDI input and output ports on your PC.

Icon: Keyboard shortcut: **Ctrl+M**

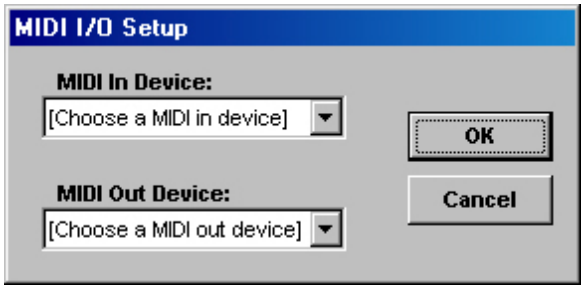

Figure 43: MIDI Input Output Setup window

2. Help Menu

- **View CMKConfig Documentation** – This function displays the CMK documentation in a web browser.

- **About CMKConfig** – This function contains the software title, company and version number.

Figure 44: Help Menu

Keyboard Functions

The keyboard is a physical representation of the items that a user needs to specify when configuring the CMK. The user must specify functions for two categories: 'MIDI channel output' and 'Piston function'.

- **MIDI Channel output** - This function controls the MIDI Channel(s) on which the keyboard can send messages. To specify the MIDI channel(s), click on the keys of the keyboard and a menu such as the one shown on the next page will appear. To select the MIDI Channel(s), use the mouse cursor to point and click on the numbered buttons inside the blue bubble. These numbers correspond to the MIDI Channels from 1-16 since the keyboard can send on multiple channels. Clicking on a selected numbered button again will deselect it.

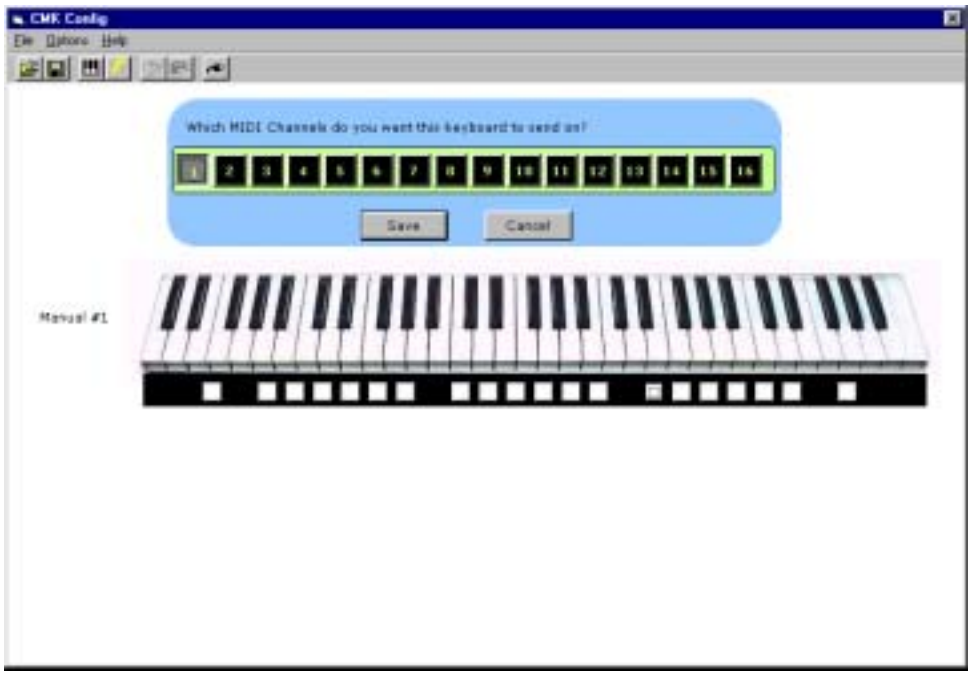

Figure 45: Clicking on the keys of the keyboard invokes a MIDI Channel select menu.

- **Piston Function** – Each piston can be configured for a particular function. To select these functions from a menu, click on any one of the twenty piston buttons and navigate through the resulting drop-down menus.

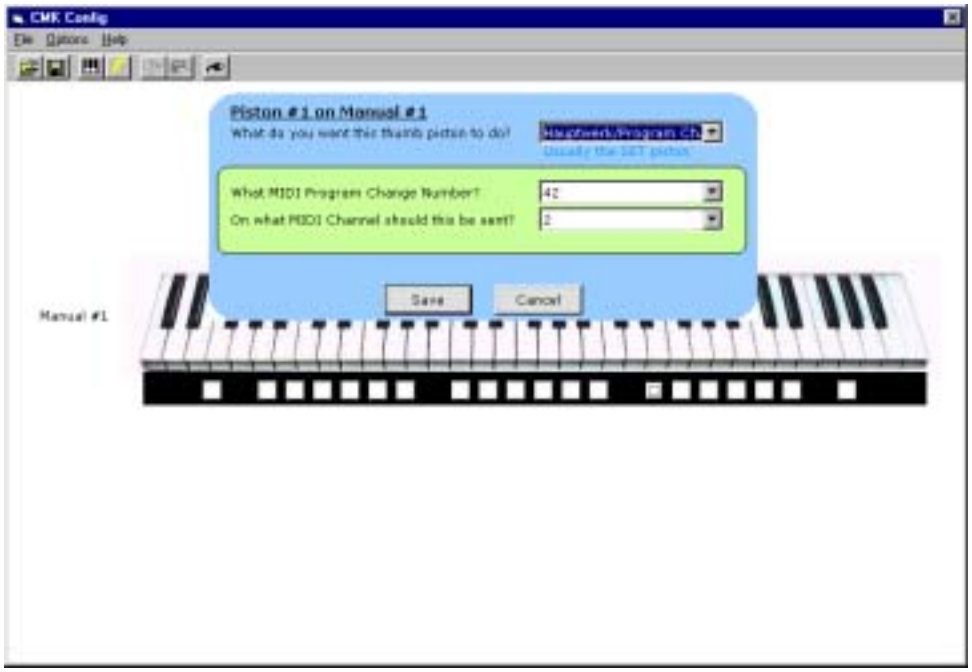

Figure 46: Clicking on an individual piston invokes the Piston function select drop-down menu.

Note that configuring these pistons in software does **not** affect the use of the two end buttons to set keyboard hardware parameters as discussed on page 29.

Three drop-down menus enable the user to select the MIDI device being controlled, specific functions of these devices, and the MIDI output channel for the command.

Table 12: Customizable Functions for each piston

Ahlborn Coupler: Allows a keyboard to play stops from another division					
A to Pedal	B to Pedal	B to A	A to B	A to Aux	B to Aux
Ahlborn Tremulant					
Swell Tremulant	Great Tremulant	Choir Tremulant			
Ahlborn Cancel					
General Cancel	Swell Divisional Cancel	Great Divisional Cancel	Choir Divisional Cancel		
Ahlborn General: associates a combination of stops to a memory level. These combinations can be from different divisions.					
Memory A General #1	Memory A General #2	Memory A General #3	Memory A General #4	Memory A General #5	Memory A General #6
Memory B General #1	Memory B General #2	Memory B General #3	Memory B General #4	Memory B General #5	Memory B General #6
Memory C General #1	Memory C General #2	Memory C General #3	Memory C General #4	Memory C General #5	Memory C General #6
Memory D General #1	Memory D General #2	Memory D General #3	Memory D General #4	Memory D General #5	Memory D General #6
Memory E General #1	Memory E General #2	Memory E General #3	Memory E General #4	Memory E General #5	Memory E General #6
Ahlborn SET: confirms assignment of stops to a piston					
Ahlborn SFZ: activates all stops of the organ					
Hauptwerk/Program Change: Allows users to control Hauptwerk functions or send program change commands using the pistons					
Any Program Change number from 1 to 128					

Table 12: Customizable Functions for each piston (cont'd)

SCPOP function: Allows user to control SCPOP functions					
Left	Up	Center	Down	Right	Clear
Great Flues	Swell Flues	Great Mixture	Great Reeds	Swell Reeds	Pedal Stops
Great to Swell	Great to Pedal	Swell to Great	Swell to Pedal	Tremolo Swell	Tremolo Great
Panic	Rec	Thru	Reset	Cancel	
Free Memory # 1	Free Memory # 2	Free Memory # 3	Free Memory # 4	Free Memory # 5	
Free Memory # 6	Free Memory # 7	Free Memory # 8	Free Memory # 9	Free Memory #10	
Fixed Memory # 1	Fixed Memory # 2	Fixed Memory # 3	Fixed Memory # 4	Fixed Memory # 5	Fixed Memory # 6
Fixed Memory # 7	Fixed Memory # 8	Fixed Memory # 9	Fixed Memory # 10	Fixed Memory # 11	Fixed Memory # 12
Go Flues Mute	Sw Flues Mute	Go Reeds Mute	Sw Reeds Mute	Unused	
Temper Type –	Temper Type +	Temper Key –	Temper Key +	Reverb	

Configuring Multiple Keyboards

The software supports the two-manual and three-manual CMK setups. For multi-manual setups, the software screen will show multiple keyboards rather than a single keyboard. In the single keyboard setup, the keyboard is labeled 'Manual #1' in the CMKconfig program window. However, for a multi-manual setup, the keyboards are numbered according to their place in the daisy-chain. Therefore, the keyboard labeled 'Manual #1' represents the keyboard connected directly to the MIDI OUT port of the personal computer. 'Manual #2' would be connected to the MIDI OUT port of 'Manual #1' and so forth. The final keyboard in the chain will have one MIDI OUT port connected to the MIDI IN port from the personal computer. The final keyboard also connects to any Ahlborn Archive and General MIDI sound modules. Using the software for setup of multiple keyboards is exactly the same as for the single-manual. For more details on correct installation, please see Figure 2 in the 'Introduction' section.

MIDI CONTROL UNIT
CMK-1

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APPENDIX A:

DIP SWITCH CONFIGURATION TABLE

Table 13: DIP Switch settings and their corresponding Configuration numbers

Configuration Number	Switch 1	Switch 2	Switch 3	Switch 4	Switch 5	Switch 6	Switch 7	Switch 8
1	0	0	0	0	0	0	0	0
2	1	0	0	0	0	0	0	0
3	0	1	0	0	0	0	0	0
4	1	1	0	0	0	0	0	0
5	0	0	1	0	0	0	0	0
6	1	0	1	0	0	0	0	0
7	0	1	1	0	0	0	0	0
8	1	1	1	0	0	0	0	0
9	0	0	0	1	0	0	0	0
10	1	0	0	1	0	0	0	0
11	0	1	0	1	0	0	0	0
12	1	1	0	1	0	0	0	0
13	0	0	1	1	0	0	0	0
14	1	0	1	1	0	0	0	0
15	0	1	1	1	0	0	0	0
16	1	1	1	1	0	0	0	0
17	0	0	0	0	1	0	0	0
18	1	0	0	0	1	0	0	0
19	0	1	0	0	1	0	0	0
20	1	1	0	0	1	0	0	0
21	0	0	1	0	1	0	0	0
22	1	0	1	0	1	0	0	0
23	0	1	1	0	1	0	0	0
24	1	1	1	0	1	0	0	0
25	0	0	0	1	1	0	0	0
26	1	0	0	1	1	0	0	0
27	0	1	0	1	1	0	0	0
28	1	1	0	1	1	0	0	0
29	0	0	1	1	1	0	0	0
30	1	0	1	1	1	0	0	0
31	0	1	1	1	1	0	0	0
32	1	1	1	1	1	0	0	0
33	0	0	0	0	0	1	0	0
34	1	0	0	0	0	1	0	0
35	0	1	0	0	0	1	0	0
36	1	1	0	0	0	1	0	0

Note: DIP-Switch settings: Off = 0, On = 1

Table 13: DIP Switch settings and their corresponding Configuration numbers (cont'd)

Configuration Number	Switch 1	Switch 2	Switch 3	Switch 4	Switch 5	Switch 6	Switch 7	Switch 8
37	0	0	1	0	0	1	0	0
38	1	0	1	0	0	1	0	0
39	0	1	1	0	0	1	0	0
40	1	1	1	0	0	1	0	0
41	0	0	0	1	0	1	0	0
42	1	0	0	1	0	1	0	0
43	0	1	0	1	0	1	0	0
44	1	1	0	1	0	1	0	0
45	0	0	1	1	0	1	0	0
46	1	0	1	1	0	1	0	0
47	0	1	1	1	0	1	0	0
48	1	1	1	1	0	1	0	0
49	0	0	0	0	1	1	0	0
50	1	0	0	0	1	1	0	0
51	0	1	0	0	1	1	0	0
52	1	1	0	0	1	1	0	0
53	0	0	1	0	1	1	0	0
54	1	0	1	0	1	1	0	0
55	0	1	1	0	1	1	0	0
56	1	1	1	0	1	1	0	0
57	0	0	0	1	1	1	0	0
58	1	0	0	1	1	1	0	0
59	0	1	0	1	1	1	0	0
60	1	1	0	1	1	1	0	0
61	0	0	1	1	1	1	0	0
62	1	0	1	1	1	1	0	0
63	0	1	1	1	1	1	0	0
64	1	1	1	1	1	1	0	0
65	0	0	0	0	0	0	1	0
66	1	0	0	0	0	0	1	0
67	0	1	0	0	0	0	1	0
68	1	1	0	0	0	0	1	0
69	0	0	1	0	0	0	1	0
70	1	0	1	0	0	0	1	0
71	0	1	1	0	0	0	1	0
72	1	1	1	0	0	0	1	0
73	0	0	0	1	0	0	1	0
74	1	0	0	1	0	0	1	0
75	0	1	0	1	0	0	1	0
76	1	1	0	1	0	0	1	0
77	0	0	1	1	0	0	1	0
78	1	0	1	1	0	0	1	0
79	0	1	1	1	0	0	1	0
80	1	1	1	1	0	0	1	0
81	0	0	0	0	1	0	1	0
82	1	0	0	0	1	0	1	0
83	0	1	0	0	1	0	1	0
84	1	1	0	0	1	0	1	0
85	0	0	1	0	1	0	1	0
86	1	0	1	0	1	0	1	0
87	0	1	1	0	1	0	1	0
88	1	1	1	0	1	0	1	0

Note: DIP-Switch settings: Off = 0, On = 1

Table 13: DIP Switch settings and their corresponding Configuration numbers (cont'd)

Configuration Number	Switch 1	Switch 2	Switch 3	Switch 4	Switch 5	Switch 6	Switch 7	Switch 8
89	0	0	0	1	1	0	1	0
90	1	0	0	1	1	0	1	0
91	0	1	0	1	1	0	1	0
92	1	1	0	1	1	0	1	0
93	0	0	1	1	1	0	1	0
94	1	0	1	1	1	0	1	0
95	0	1	1	1	1	0	1	0
96	1	1	1	1	1	0	1	0
97	0	0	0	0	0	1	1	0
98	1	0	0	0	0	1	1	0
99	0	1	0	0	0	1	1	0
100	1	1	0	0	0	1	1	0
101	0	0	1	0	0	1	1	0
102	1	0	1	0	0	1	1	0
103	0	1	1	0	0	1	1	0
104	1	1	1	0	0	1	1	0
105	0	0	0	1	0	1	1	0
106	1	0	0	1	0	1	1	0
107	0	1	0	1	0	1	1	0
108	1	1	0	1	0	1	1	0
109	0	0	1	1	0	1	1	0
110	1	0	1	1	0	1	1	0
111	0	1	1	1	0	1	1	0
112	1	1	1	1	0	1	1	0
113	0	0	0	0	1	1	1	0
114	1	0	0	0	1	1	1	0
115	0	1	0	0	1	1	1	0
116	1	1	0	0	1	1	1	0
117	0	0	1	0	1	1	1	0
118	1	0	1	0	1	1	1	0
119	0	1	1	0	1	1	1	0
120	1	1	1	0	1	1	1	0
121	0	0	0	1	1	1	1	0
122	1	0	0	1	1	1	1	0
123	0	1	0	1	1	1	1	0
124	1	1	0	1	1	1	1	0
125	0	0	1	1	1	1	1	0
126	1	0	1	1	1	1	1	0
127	0	1	1	1	1	1	1	0
128	1	1	1	1	1	1	1	0

Note: DIP-Switch settings: Off = 0, On = 1

CLASSIC MIDI KEYBOARD
CMK-1

APPENDIX B:

MIDI PROTOCOL SPECIFICATION

MIDI Protocol Specification [2]

MIDI is a convenient method of electronically recording performances and transferring them to a number of audio devices supporting MIDI software and hardware. MIDI files are smaller than their counterparts in the electronic audio music category. In the simplest form, MIDI is a sequence of messages that describe the exact steps that a soundcard plays. The two primary message types are 'Channel' and 'System'.

Channel Messages

Channel Messages apply to a specific MIDI channel and include the MIDI channel number in their status byte.

Note On, Note Off, and Velocity messages are transmitted on any of the sixteen logical MIDI channels. The message is sent as three data bytes. The first byte termed the 'status' byte indicates the Channel number. The second byte specifies the key number. The third byte specifies the velocity which is the amount of force applied to a key, or the volume of the key pressed.

Aftertouch is a message that is transmitted to describe the amount of pressure applied to keys after they are pressed to control aspects of sound production such as vibrato. The message is in the form of one data byte specifying the pressure value.

Pitch Bend modifies the sound on a given MIDI channel. The message is in the form of two data bytes which specify the position of the pitch wheel.

Program Change allows the user to control and change the type of instrument being played on a given MIDI channel. The message is in the form of one data byte.

Control Change allows the user to specify the function of the synthesizer. The message is in the form of two bytes, the first is a Status Byte indicating the controller number, and the second is a data byte indicating the control value.

Bank Select expands the number of different instrument sounds that may be selected. A Control Change message usually precedes a Program Change message allowing 16,384 banks of 128 sounds to be played. Mapping of the sounds is dependent upon the manufacturer, which have adopted their own standards.

RPN and ***NRPN*** are Registered Parameter Number and Non-Registered Parameter Number respectively. These messages allow expansion of the number of controllers available via MIDI. Registered Parameters are numbers assigned for functions like control pitch bend sensitivity and master tuning. Non-Registered Parameters are those which can be assigned by manufacturers to handle other functions.

Channel Mode messages affect the way in which a synthesizer responds to MIDI data. Controller number 121 represents a reset. Channel number 122 represents an enable/disable local control. Channel numbers 124-127 select whether a synthesizer responds to MIDI data on all channels or on one channel only (Omni Mode On or Omni Mode Off). The notes are then played polyphonically or monophonically (Poly Mode and Mono Mode) respectively.

System Messages

These are messages which are not Channel specific, and thus do not indicate the channel number in their status bytes.

System Common Messages serve to synchronize MIDI equipment (MIDI Time code), select songs (for MIDI equipment with the capability to store and recall a number of different songs), select the playback point (for MIDI equipment with MIDI system real time message recognition), tune internal oscillators, and flag the end of a System Exclusive Message.

System Real Time Messages are used to set the playback tempo (timing clock), control the playback start position (start), continue playback (continue), set the stop position (stop), eliminate 'stuck notes' (active sensing) in the event of a MIDI cable disconnection, and reset and initialize the equipment receiving a message (system reset).

System Exclusive Messages are specific to a manufacturer. Each manufacturer of MIDI equipment is granted a unique identification number by the MIDI Manufacturers association which is the first byte of the message. Afterwards, a manufacturer can send data and patch commands.

Running Status

In addition to the messages sent between MIDI devices, the MIDI language has a '*Running Status*' feature which eliminates the delayed effect caused by a large number of musical events occurring 'simultaneously'. The Running Status does this by omitting the status byte if the current status byte is the same as the previous status byte. So, one less byte is sent which will vacate that byte for other data. Often, to make use of the Running Status feature, the 'Note On' message is utilized for both 'Note on' and 'Note off' functions. Since the 'Note On' and 'Note Off' messages have differing status bytes, by making use of a 'velocity = 0' command in place of the 'Note Off' command, running status is utilized.

Table 14: MIDI 1.0 Specification Message Summary [10]

Status D7----D0	Data Byte(s) D7----D0	Description
Channel Voice Messages [nnnn = 0-15 (MIDI Channel Number 1-16)]		
1000nnnn	0kkkkkkk 0vvvvvvv	Note Off event. This message is sent when a note is released (ended). (kkkkkkk) is the key (note) number. (vvvvvvv) is the velocity.
1001nnnn	0kkkkkkk 0vvvvvvv	Note On event. This message is sent when a note is depressed (start). (kkkkkkk) is the key (note) number. (vvvvvvv) is the velocity.
1010nnnn	0kkkkkkk 0vvvvvvv	Polyphonic Key Pressure (Aftertouch). This message is most often sent by pressing down on the key after it "bottoms out". (kkkkkkk) is the key (note) number. (vvvvvvv) is the pressure value.
1011nnnn	0ccccccc 0vvvvvvv	Control Change. This message is sent when a controller value changes. Controllers include devices such as pedals and levers. Controller numbers 120-127 are reserved as "Channel Mode Messages" (on the next page). (ccccccc) is the controller number. (vvvvvvv) is the new value (0-119).
1100nnnn	0ppppppp	Program Change. This message is sent when the patch number changes. (ppppppp) is the new program number.
1101nnnn	0vvvvvvv	Channel Pressure (After-touch). This message is most often sent by pressing down on the key after it "bottoms out". This message is different from polyphonic after-touch. Use this message to send the single greatest pressure value (of all the current depressed keys). (vvvvvvv) is the pressure value.
1110nnnn	0lllllll 0mmmmmmm	Pitch Wheel Change. This message is sent to indicate a change in the pitch wheel. The pitch wheel is measured by a fourteen bit value. Center (no pitch change) is 2000H. Sensitivity is a function of the transmitter. (lllllll) are the least significant 7 bits. (mmmmmmm) are the most significant 7 bits.

Table 14: MIDI 1.0 Specification Message Summary (cont'd)

Status D7----D0	Data Byte(s) D7----D0	Description
Channel Mode Messages (See also Control Change, previous page)		
1011nnnn	0ccccccc 0vvvvvvv	Channel Mode Messages. This the same code as the Control Change, but implements Mode control and special message by using reserved controller numbers 120-127. The commands are: All Sound Off. When All Sound Off is received all oscillators will turn off, and their volume envelopes are set to zero as soon as possible. c = 120, v = 0: All Sound Off Reset All Controllers. When Reset All Controllers is received, all controller values are reset to their default values. (See specific Recommended Practices for defaults). c = 121, v = x: Value must only be zero unless otherwise allowed in a specific Recommended Practice. Local Control. When Local Control is Off, all devices on a given channel will respond only to data received over MIDI. Played data, etc. will be ignored. Local Control On restores the functions of the normal controllers. c = 122, v = 0: Local Control Off. c = 122, v = 127: Local Control On All Notes Off. When an All Notes Off is received, all oscillators will turn off. c = 123, v = 0: All Notes Off (See text for description of actual mode commands). c = 124, v = 0: Omni Mode Off. c = 125, v = 0: Omni Mode On c = 126, v = M: Mono Mode On (Poly Off) where M is the number of channels (Omni Off) or 0 (Omni On) c = 127, v = 0: Poly Mode On (Mono Off) (Note: These four messages also cause All Notes Off)

Table 14: MIDI 1.0 Specification Message Summary (cont'd)

Status D7----D0	Data Byte(s) D7----D0	Description
		System Common Messages
11110000	0iiiiiii 0ddddddd 0ddddddd 11110111	System Exclusive. This message makes up for all that MIDI doesn't support. (iiiiiii) is usually a seven-bit Manufacturer's I.D. code. If the synthesizer recognizes the I.D. code as its own, it will listen to the rest of the message (ddddddd). Otherwise, the message will be ignored. System Exclusive is used to send bulk dumps such as patch parameters and other non-spec data. (Note: Real-Time messages ONLY may be interleaved with a System Exclusive.) This message also is used for extensions called Universal Exclusive Messages.
11110001		Undefined. (Reserved)
11110010	0lllllll 0mmmmmmm	Song Position Pointer. This is an internal 14 bit register that holds the number of MIDI beats (1 beat= six MIDI clocks) since the start of the song. l is the LSB, m the MSB.
11110011	0sssssss	Song Select. The Song Select specifies which sequence or song is to be played.
11110100		Undefined. (Reserved)
11110101		Undefined. (Reserved)
11110110		Tune Request. Upon receiving a Tune Request, all analog synthesizers should tune their oscillators.
11110111		End of Exclusive. Used to terminate a System Exclusive dump (see above).
		System Real-Time Messages
11111000		Timing Clock. Sent 24 times per quarter note when synchronization is required (see text).
11111001		Undefined. (Reserved)
11111010		Start. Start the current sequence playing. (This message will be followed with Timing Clocks).
11111011		Continue. Continue at the point the sequence was Stopped.
11111100		Stop. Stop the current sequence.
11111101		Undefined. (Reserved)
11111110		Active Sensing. Use of this message is optional. When initially sent, the receiver will expect to receive another Active Sensing message each 300ms (max), or it will be assume that the connection has been terminated. At termination, the receiver will turn off all voices and return to normal (non-active sensing) operation.
11111111		Reset. Reset all receivers in the system to power-up status. This should be used sparingly, preferably under manual control. In particular, it should not be sent on power-up.

Table 15: Expanded Status Bytes List

(adapted from "MIDI by the Numbers" by D. Valenti, Electronic Musician 2/88) **[11]**

STATUS BYTE					DATA BYTES	
1st Byte Value			Function		2nd Byte	3rd Byte
Binary	Hex	Dec				
10000000	80	128	Chan 1	Note Off	Note Number	Note Velocity
10000001	81	129	Chan 2	"	(0-127)	(0-127)
10000010	82	130	Chan 3	"	see	"
10000011	83	131	Chan 4	"	Table	"
10000100	84	132	Chan 5	"	4	"
10000101	85	133	Chan 6	"	"	"
10000110	86	134	Chan 7	"	"	"
10000111	87	135	Chan 8	"	"	"
10001000	88	136	Chan 9	"	"	"
10001001	89	137	Chan 10	"	"	"
10001010	8A	138	Chan 11	"	"	"
10001011	8B	139	Chan 12	"	"	"
10001100	8C	140	Chan 13	"	"	"
10001101	8D	141	Chan 14	"	"	"
10001110	8E	142	Chan 15	"	"	"
10001111	8F	143	Chan 16	"	"	"
10010000	90	144	Chan 1	Note on	"	"
10010001	91	145	Chan 2	"	"	"
10010010	92	146	Chan 3	"	"	"
10010011	93	147	Chan 4	"	"	"
10010100	94	148	Chan 5	"	"	"
10010101	95	149	Chan 6	"	"	"
10010110	96	150	Chan 7	"	"	"
10010111	97	151	Chan 8	"	"	"
10011000	98	152	Chan 9	"	"	"
10011001	99	153	Chan 10	"	"	"
10011010	9A	154	Chan 11	"	"	"
10011011	9B	155	Chan 12	"	"	"
10011100	9C	156	Chan 13	"	"	"
10011101	9D	157	Chan 14	"	"	"
10011110	9E	158	Chan 15	"	"	"
10011111	9F	159	Chan 16	"	"	"
10100000	A0	160	Chan 1	Polyphonic	"	Aftertouch
10100001	A1	161	Chan 2	Aftertouch	"	Amount
10100010	A2	162	Chan 3	"	"	(0-127)
10100011	A3	163	Chan 4	"	"	"
10100100	A4	164	Chan 5	"	"	"
10100101	A5	165	Chan 6	"	"	"
10100110	A6	166	Chan 7	"	"	"
10100111	A7	167	Chan 8	"	"	"
10101000	A8	168	Chan 9	"	"	"
10101001	A9	169	Chan 10	"	"	"
10101010	AA	170	Chan 11	"	"	"
10101011	AB	171	Chan 12	"	"	"
10101100	AC	172	Chan 13	"	"	"
10101101	AD	173	Chan 14	"	"	"

Table 15: Expanded Status Bytes List (Cont'd)

STATUS BYTE					DATA BYTES	
1st Byte Value			Function		2nd Byte	3rd Byte
Binary	Hex	Dec				
10101110	AE	174	Chan 15	"	"	"
10101111	AF	175	Chan 16	"	"	"
10110000	B0	176	Chan 1	Control/	See	See
10110001	B1	177	Chan 2	Mode change	Table	Table
10110010	B2	178	Chan 3	"	3	3
10110011	B3	179	Chan 4	"	"	"
10110100	B4	180	Chan 5	"	"	"
10110101	B5	181	Chan 6	"	"	"
10110110	B6	182	Chan 7	"	"	"
10110111	B7	183	Chan 8	"	"	"
10111000	B8	184	Chan 9	"	"	"
10111001	B9	185	Chan 10	"	"	"
10111010	BA	186	Chan 11	"	"	"
10111011	BB	187	Chan 12	"	"	"
10111100	BC	188	Chan 13	"	"	"
10111101	BD	189	Chan 14	"	"	"
10111110	BE	190	Chan 15	"	"	"
10111111	BF	191	Chan 16	"	"	"
11000000	C0	192	Chan 1	Program	Program #	NONE
11000001	C1	193	Chan 2	change	(0-127)	"
11000010	C2	194	Chan 3	"	"	"
11000011	C3	195	Chan 4	"	"	"
11000100	C4	196	Chan 5	"	"	"
11000101	C5	197	Chan 6	"	"	"
11000110	C6	198	Chan 7	"	"	"
11000111	C7	199	Chan 8	"	"	"
11001000	C8	200	Chan 9	"	"	"
11001001	C9	201	Chan 10	"	"	"
11001010	CA	202	Chan 11	"	"	"
11001011	CB	203	Chan 12	"	"	"
11001100	CC	204	Chan 13	"	"	"
11001101	CD	205	Chan 14	"	"	"
11001110	CE	206	Chan 15	"	"	"
11001111	CF	207	Chan 16	"	"	"
11010000	D0	208	Chan 1	Channel	Aftertouch	"
11010001	D1	209	Chan 2	Aftertouch	amount	"
11010010	D2	210	Chan 3	"	(0-127)	"
11010011	D3	211	Chan 4	"	"	"
11010100	D4	212	Chan 5	"	"	"
11010101	D5	213	Chan 6	"	"	"
11010110	D6	214	Chan 7	"	"	"
11010111	D7	215	Chan 8	"	"	"
11011000	D8	216	Chan 9	"	"	"
11011001	D9	217	Chan 10	"	"	"
11011010	DA	218	Chan 11	"	"	"
11011011	DB	219	Chan 12	"	"	"
11011100	DC	220	Chan 13	"	"	"

Table 15: Expanded Status Bytes List (Cont'd)

STATUS BYTE					DATA BYTES	
1st Byte Value			Function		2nd Byte	3rd Byte
Binary	Hex	Dec				
11011101	DD	221	Chan 14	"	"	"
11011110	DE	222	Chan 15	"	"	"
11011111	DF	223	Chan 16	"	"	"
11100000	E0	224	Chan 1	Pitch	Pitch	Pitch
11100001	E1	225	Chan 2	Wheel	wheel	Wheel
11100010	E2	226	Chan 3	Control	LSB	MSB
11100011	E3	227	Chan 4	"	(0-127)	(0-127)
11100100	E4	228	Chan 5	"	"	"
11100101	E5	229	Chan 6	"	"	"
11100110	E6	230	Chan 7	"	"	"
11100111	E7	231	Chan 8	"	"	"
11101000	E8	232	Chan 9	"	"	"
11101001	E9	233	Chan 10	"	"	"
11101010	EA	234	Chan 11	"	"	"
11101011	EB	235	Chan 12	"	"	"
11101100	EC	236	Chan 13	"	"	"
11101101	ED	237	Chan 14	"	"	"
11101110	EE	238	Chan 15	"	"	"
11101111	EF	239	Chan 16	"	"	"
11110000	F0	240	System Exclusive		**	**
11110001	F1	241	MIDI Time Code Qtr. Frame		-see spec-	-see spec-
11110010	F2	242	Song Position Pointer		LSB	MSB
11110011	F3	243	Song Select(Song #)		(0-127)	NONE
11110100	F4	244	Undefined (Reserved)		?	?
11110101	F5	245	Undefined (Reserved)		?	?
11110110	F6	246	Tune request		NONE	NONE
11110111	F7	247	End of SysEx (EOX)		"	"
11111000	F8	248	Timing clock		"	"
11111001	F9	249	Undefined (Reserved)		"	"
11111010	FA	250	Start		"	"
11111011	FB	251	Continue		"	"
11111100	FC	252	Stop		"	"
11111101	FD	253	Undefined (Reserved)		"	"
11111110	FE	254	Active Sensing		"	"
11111111	FF	255	System Reset		"	"

** *Note: System Exclusive (data dump) 2nd byte= Vendor ID (or Universal Exclusive) followed by more data bytes and ending with EOX.*

Table 16: Control Changes and Mode Changes (Status Bytes 176-191)
Adapted from "MIDI by the Numbers" by D. Valenti-Electronic Musician 2/88, updated 1995/1999/2002 by the MIDI Manufacturers Association **[12]**

Control Number (2nd Byte Value)			Control Function	3rd Byte Value	
Decimal	Binary	Hex		Value	Used As
0	00000000	00	Bank Select	0-127	MSB
1	00000001	01	Modulation Wheel or Lever	0-127	MSB
2	00000010	02	Breath Controller	0-127	MSB
3	00000011	03	Undefined	0-127	MSB
4	00000100	04	Foot Controller	0-127	MSB
5	00000101	05	Portamento Time	0-127	MSB
6	00000110	06	Data Entry MSB	0-127	MSB
7	00000111	07	Channel Volume (formerly Main Volume)	0-127	MSB
8	00001000	08	Balance	0-127	MSB
9	00001001	09	Undefined	0-127	MSB
10	00001010	0A	Pan	0-127	MSB
11	00001011	0B	Expression Controller	0-127	MSB
12	00001100	0C	Effect Control 1	0-127	MSB
13	00001101	0D	Effect Control 2	0-127	MSB
14	00001110	0E	Undefined	0-127	MSB
15	00001111	0F	Undefined	0-127	MSB
16	00010000	10	General Purpose Controller 1	0-127	MSB
17	00010001	11	General Purpose Controller 2	0-127	MSB
18	00010010	12	General Purpose Controller 3	0-127	MSB
19	00010011	13	General Purpose Controller 4	0-127	MSB
20	00010100	14	Undefined	0-127	MSB
21	00010101	15	Undefined	0-127	MSB
22	00010110	16	Undefined	0-127	MSB
23	00010111	17	Undefined	0-127	MSB
24	00011000	18	Undefined	0-127	MSB
25	00011001	19	Undefined	0-127	MSB
26	00011010	1A	Undefined	0-127	MSB
27	00011011	1B	Undefined	0-127	MSB
28	00011100	1C	Undefined	0-127	MSB
29	00011101	1D	Undefined	0-127	MSB
30	00011110	1E	Undefined	0-127	MSB
31	00011111	1F	Undefined	0-127	MSB
32	00100000	20	LSB for Control 0 (Bank Select)	0-127	LSB
33	00100001	21	LSB for Control 1 (Modulation Wheel or Lever)	0-127	LSB
34	00100010	22	LSB for Control 2 (Breath Controller)	0-127	LSB
35	00100011	23	LSB for Control 3 (Undefined)	0-127	LSB
36	00100100	24	LSB for Control 4 (Foot Controller)	0-127	LSB
37	00100101	25	LSB for Control 5 (Portamento Time)	0-127	LSB
38	00100110	26	LSB for Control 6 (Data Entry)	0-127	LSB
39	00100111	27	LSB for Control 7 (Channel Volume, formerly Main Volume)	0-127	LSB
40	00101000	28	LSB for Control 8 (Balance)	0-127	LSB
41	00101001	29	LSB for Control 9 (Undefined)	0-127	LSB
42	00101010	2A	LSB for Control 10 (Pan)	0-127	LSB
43	00101011	2B	LSB for Control 11 (Expression Controller)	0-127	LSB
44	00101100	2C	LSB for Control 12 (Effect control 1)	0-127	LSB

Table 16: Control Changes and Mode Changes (Cont'd)

Control Number (2nd Byte Value)			Control Function	3rd Byte Value	
Decimal	Binary	Hex		Value	Used As
45	00101101	2D	LSB for Control 13 (Effect control 2)	0-127	LSB
46	00101110	2E	LSB for Control 14 (Undefined)	0-127	LSB
47	00101111	2F	LSB for Control 15 (Undefined)	0-127	LSB
48	00110000	30	LSB for Control 16 (General Purpose Controller 1)	0-127	LSB
49	00110001	31	LSB for Control 17 (General Purpose Controller 2)	0-127	LSB
50	00110010	32	LSB for Control 18 (General Purpose Controller 3)	0-127	LSB
51	00110011	33	LSB for Control 19 (General Purpose Controller 4)	0-127	LSB
52	00110100	34	LSB for Control 20 (Undefined)	0-127	LSB
53	00110101	35	LSB for Control 21 (Undefined)	0-127	LSB
54	00110110	36	LSB for Control 22 (Undefined)	0-127	LSB
55	00110111	37	LSB for Control 23 (Undefined)	0-127	LSB
56	00111000	38	LSB for Control 24 (Undefined)	0-127	LSB
57	00111001	39	LSB for Control 25 (Undefined)	0-127	LSB
58	00111010	3A	LSB for Control 26 (Undefined)	0-127	LSB
59	00111011	3B	LSB for Control 27 (Undefined)	0-127	LSB
60	00111100	3C	LSB for Control 28 (Undefined)	0-127	LSB
61	00111101	3D	LSB for Control 29 (Undefined)	0-127	LSB
62	00111110	3E	LSB for Control 30 (Undefined)	0-127	LSB
63	00111111	3F	LSB for Control 31 (Undefined)	0-127	LSB
64	01000000	40	Damper Pedal on/off (Sustain)	<63 off, >64 on	---
65	01000001	41	Portamento On/Off	<63 off, >64 on	---
66	01000010	42	Sustenuto On/Off	<63 off, >64 on	---
67	01000011	43	Soft Pedal On/Off	<63 off, >64 on	---
68	01000100	44	Legato Footswitch	<63 Normal, >64 Legato	---
69	01000101	45	Hold 2	<63 off, >64 on	---
70	01000110	46	Sound Controller 1 (default: Sound Variation)	0-127	LSB
71	01000111	47	Sound Controller 2 (default: Timbre/Harmonic Intensity)	0-127	LSB
72	01001000	48	Sound Controller 3 (default: Release Time)	0-127	LSB
73	01001001	49	Sound Controller 4 (default: Attack Time)	0-127	LSB
74	01001010	4A	Sound Controller 5 (default: Brightness)	0-127	LSB
75	01001011	4B	Sound Controller 6 (default: Decay Time - see MMA RP-021)	0-127	LSB
76	01001100	4C	Sound Controller 7 (default: Vibrato Rate - see MMA RP-021)	0-127	LSB
77	01001101	4D	Sound Controller 8 (default: Vibrato Depth - see MMA RP-021)	0-127	LSB
78	01001110	4E	Sound Controller 9 (default: Vibrato Delay - see MMA RP-021)	0-127	LSB
79	01001111	4F	Sound Controller 10 (default undefined - see MMA RP-021)	0-127	LSB
80	01010000	50	General Purpose Controller 5	0-127	LSB
81	01010001	51	General Purpose Controller 6	0-127	LSB
82	01010010	52	General Purpose Controller 7	0-127	LSB
83	01010011	53	General Purpose Controller 8	0-127	LSB
84	01010100	54	Portamento Control	0-127	LSB
85	01010101	55	Undefined	---	---
86	01010110	56	Undefined	---	---

Table 16: Control Changes and Mode Changes (Cont'd)

Control Number (2nd Byte Value)			Control Function	3rd Byte Value	
Decimal	**Binary**	**Hex**		**Value**	**Used As**
87	01010111	57	Undefined	---	---
88	01011000	58	Undefined	---	---
89	01011001	59	Undefined	---	---
90	01011010	5A	Undefined	---	---
91	01011011	5B	Effects 1 Depth (default: Reverb Send Level - see MMA RP-023) (formerly External Effects Depth)	0-127	LSB
92	01011100	5C	Effects 2 Depth (formerly Tremolo Depth)	0-127	LSB
93	01011101	5D	Effects 3 Depth (default: Chorus Send Level - see MMA RP-023) (formerly Chorus Depth)	0-127	LSB
94	01011110	5E	Effects 4 Depth (formerly Celeste [Detune] Depth)	0-127	LSB
95	01011111	5F	Effects 5 Depth (formerly Phaser Depth)	0-127	LSB
96	01100000	60	Data Increment (Data Entry +1) (see MMA RP-018)	N/A	---
97	01100001	61	Data Decrement (Data Entry -1) (see MMA RP-018)	N/A	---
98	01100010	62	Non-Registered Parameter Number (NRPN) – LSB	0-127	LSB
99	01100011	63	Non-Registered Parameter Number (NRPN) – MSB	0-127	MSB
100	01100100	64	Registered Parameter Number (RPN) – LSB*	0-127	LSB
101	01100101	65	Registered Parameter Number (RPN) - MSB*	0-127	MSB
102	01100110	66	Undefined	---	---
103	01100111	67	Undefined	---	---
104	01101000	68	Undefined	---	---
105	01101001	69	Undefined	---	---
106	01101010	6A	Undefined	---	---
107	01101011	6B	Undefined	---	---
108	01101100	6C	Undefined	---	---
109	01101101	6D	Undefined	---	---
110	01101110	6E	Undefined	---	---
111	01101111	6F	Undefined	---	---
112	01110000	70	Undefined	---	---
113	01110001	71	Undefined	---	---
114	01110010	72	Undefined	---	---
115	01110011	73	Undefined	---	---
116	01110100	74	Undefined	---	---
117	01110101	75	Undefined	---	---
118	01110110	76	Undefined	---	---
119	01110111	77	Undefined	---	---
Note:	Controller numbers 120-127 are reserved for Channel Mode Messages, which rather than controlling sound parameters, affect the channel's operating mode.				
120	01111000	78	[Channel Mode Message] All Sound Off	0	---
121	01111001	79	[Channel Mode Message] Reset All Controllers (See MMA RP-015)	0	---
122	01111010	7A	[Channel Mode Message] Local Control On/Off	0 off, 127 on	---
123	01111011	7B	[Channel Mode Message] All Notes Off	0	---
124	01111100	7C	[Channel Mode Message] Omni Mode Off (+ all notes off)	0	---
125	01111101	7D	[Channel Mode Message] Omni Mode On (+ all notes off)	0	---
126	01111110	7E	[Channel Mode Message] Poly Mode On/Off (+ all notes off)	**	---
127	01111111	7F	[Channel Mode Message] Poly Mode On (+ mono off +all notes off)	0	---

** *Note: This equals the number of channels or zero if the number of channels equals the number of voices in the receiver.*

Table 17: Registered Parameter Numbers [12]

To set or change the value of a Registered Parameter:

1. Send two Control Change messages using Control Numbers 101 (65H) and 100 (64H) to select the desired Registered Parameter Number, as per the following table.

2. To set the selected Registered Parameter to a specific value, send Control Change messages to the Data Entry MSB controller (Control Number 6). If the selected Registered Parameter requires the LSB to be set, send another Control Change message to the Data Entry LSB controller (Control Number 38).

3. To make a relative adjustment to the selected Registered Parameter's current value, use the Data Increment or Data Decrement controllers (Control Numbers 96 and 97).

Parameter Number			**Parameter Function**	**Data Entry Value**
Decimal	**Control 101 Value** (MSB)	**Control 100 Value** (LSB)		
0	00H = 0	00H = 0	Pitch Bend Sensitivity	MSB = +/- semitones LSB =+/--cents
1	00H = 0	01H = 1	Channel Fine Tuning (formerly Fine Tuning - see MMA RP-022)	Resolution 100/8192 cents 00H 00H = -100 cents 40H 00H = A440 7FH 7FH = +100 cents
2	00H = 0	02H = 2	Channel Coarse Tuning (formerly Coarse Tuning - see MMA RP-022)	Only MSB used Resolution 100 cents 00H = -6400 cents 40H = A440 7FH = +6300 cents
3	00H = 0	03H = 3	Tuning Program Change	Tuning Program Number
4	00H = 0	04H = 4	Tuning Bank Select	Tuning Bank Number
5	00H = 0	05H = 5	Modulation Depth Range (see MMA General MIDI Level 2 Specification)	For GM2, defined in GM2 Specification. For other systems, defined by manufacturer

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APPENDIX C:

SYSTEM EXCLUSIVE MESSAGE LAYOUTS

Messages common to all products [13]

General Information Identity Request

F0 7E *dd* 06 01 F7

Request the identity and special characteristics of a device. *dd* selects a particular device in the MIDI chain. *dd* = 7Fh selects any and all devices at once.

General Information Identity Reply

F0 7E *dd* 06 02 00 20 1C *pp pp mm mm ss ss tt tt* F7

dd: identifies the device which is responding.
pp pp = 04 03 for MKSC v3
mm mm: gives the organ model number
ss ss: identifies the major and minor software revision level, as it affects data format compatibility.
tt tt: identifies the major and minor software revision level, as it affects program capabilities.
In the case of the MKSC v3, after the *tt tt*, also pass two bytes indicated the current DIPSWITCH setting

CMK -- Special layouts [13]

Config Memory

The config memory contains a number of 256-byte blocks. Each contains CMK configuration information.
The message formats are:

F0 00 20 1C *dd* 04 01 03 aa aa aa ss ss F7

Request Config Memory data. This message should be sent by an external sequencer or by the CMK config application.

dd: identifies the device which is responding.
aa aa aa: starting offset (21-bit address) of the config block (packed 7 bits).
ss ss: number of bytes of original data to be retrieved (packed 14 bits)

F0 00 20 1C *dd* 04 01 04 *bb bb ss* <*data*, 8-for-7 format> F7

Transfer Config Memory data. This message should be sent from the CMK in response to a request message.

dd: identifies the device which is responding.
bb bb: block-count within the sequence of saved data blocks' memory data, low-order 7 bits first. The first message in a restore sequence must have a block-count of `00 00`.
ss: number of bytes of original data transferred in this block.
data: 8-for-7 coded bytes of data.

F0 00 20 1C *dd* 04 01 08 *bb bb aa aa aa ss* <*data*, 8-for-7 format> F7

Update Config Memory data. The message with subcommand 08 will be generated by the external CMK config application.

dd: identifies the device which is responding.
bb bb: block-count within the sequence of saved data blocks' memory data, low-order 7 bits first. The first message in a restore sequence must have a block-count of `00 00`.
aa aa aa: starting offset (21-bit address) of the config block (packed 7 bits).
ss: number of bytes of original data transferred in this block.
data: 8-for-7 coded bytes of data.

F0 00 20 1C *dd* 04 01 20 F7

Soft reboot CMK. The message with cause the CMK to resume operation and reload the PIC's EEPROM with the contents of the FLASH ROM indicated by the DIPSWITCH.

dd: identifies the device which is responding.

F0 00 20 1c *dd* 04 02 *ii* F7

Provides an identification number for each keyboard to identify the number of keyboards and configure each one separately. The first device is set to 0 and increments this number before passing the message to the next device.

dd: not used in this command.
ii: device identification.

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APPENDIX D:

AHLBORN MESSAGES

Table 18: Note On/Off MIDI functions to control Ahlborn Archive sound modules [14]

Slot	Pins:	Data sent: Off ----> On	Data sent: On ----> Off		Description:		Note:
					Key On/Off Data		
1	1-61	90 kk 40	90 kk 00	Sw	Ahlborn - Note On / Off		1
2	1-61	91 kk 40	91 kk 00	Gt	Ahlborn - Note On / Off		2
3	1-61	92 kk 40	92 kk 00	Ch	Ahlborn - Note On / Off		3
4	1-32	93 kk 40	93 kk 00	Pd	Ahlborn - Note On / Off		4

NOTES:

1) *"Swell Channel" defaults to 1 (0h) - usually the Ahlborn "A" division for key On/Off messages. kk = Note number 0-127 (00h to 7Fh) where 60 (3Ch) = middle "C". Normal (untransposed) output from key inputs 1-61 = 36-96 (24h - 60h). Transposer may shift this down or up in the range of -24 to +31.*
2) *"Great Channel" defaults to 2 (1h) - usually the Ahlborn "B" division for key On/Off messages.*
3) *"Choir Channel" defaults to 3 (2h) - usually the Ahlborn "AUX" division for key On/Off messages.*
4) *"Pedal Channel" defaults to 4 (3h) - usually the Ahlborn "Pedal" division for key On/Off messages. Normal (untransposed) output from key inputs 1-32 = 36-67 (24h - 43h). Transposer may shift this down or up in the range of -24 to +31.*
5) *Ahlborn modules respond only in the range - kk = 30-99 (1Eh to 63h) for A and B divisions and kk = 30-70 (1Eh to 46h) for the Pedal division.*

Table 19: Ahlborn Archive 'ROMANTIC' sound module commands for stops and couplers [14]

Group	No.	Data sent Off ----> On	Data sent On ----> Off		Description		Note
		Controller 73	**Controller 74**		**Ahlborn ROMANTIC stops**		
0	0	Bn 49 00	Bn 4A 00	Pd	Contre Gamba	16'	1
	1	Bn 49 01	Bn 4A 01		Ophicleide	16'	
	2	Bn 49 02	Bn 4A 02		Contre Violone	32'	
	3	Bn 49 03	Bn 4A 03		Contre Bassoon	32'	
	4	Bn 49 04	Bn 4A 04		A/P coupler		
	5	Bn 49 05	Bn 4A 05		B to Pd coupler		
	6	Bn 49 06	Bn 4A 06	A	Cornopean	16'	
	7	Bn 49 07	Bn 4A 07		Cornet des Bombardes	IV	
	8	Bn 49 08	Bn 4A 08		Tuba Mirabilis	8'	
	9	Bn 49 09	Bn 4A 09		Clarion	4'	
	A	Bn 49 0A	Bn 4A 0A		Orchestral Oboe	8'	
	B	Bn 49 0B	Bn 4A 0B		Clarinet	8'	
	C	Bn 49 0C	Bn 4A 0C		French Horn	8'	
	D	Bn 49 0D	Bn 4A 0D		Cor Anglais	8'	
	E	Bn 49 0E	Bn 4A 0E		Cello	8'	
	F	Bn 49 0F	Bn 4A 0F		Cello Celeste	8'	
	10	Bn 49 10	Bn 4A 10		B to A coupler		
	11	Bn 49 11	Bn 4A 11	B	Quint Flute	2 2/3'	
	12	Bn 49 12	Bn 4A 12		Piccolo	2'	
	13	Bn 49 13	Bn 4A 13		Vox Humana	8'	
	14	Bn 49 14	Bn 4A 14		Open Diapason	8'	
	15	Bn 49 15	Bn 4A 15		Flauto Mirabilis	8'	
	16	Bn 49 16	Bn 4A 16		Concert Flute	4'	
	17	Bn 49 17	Bn 4A 17		A to B coupler		
	18	Bn 49 18	Bn 4A 18		A to Aux coupler		
	19	Bn 49 19	Bn 4A 19		B to Aux coupler		

NOTES:
1) n = Channel number used by Ahlborn stop On/Off messages; defaults to 16 (Fh).
2) Controls "A" or "B" division Tremulant on corresponding channel number used by Ahlborn divisions.

Table 20: Ahlborn Archive 'CLASSIC' sound module commands for stops and couplers on [14]

Group	No.	Data sent: Off ----> On	Data sent: On ----> Off		Description		Note
		Controller 73	**Controller 74**		**Ahlborn CLASSIC stops**		
3	1A	Bn 49 1A	Bn 4A 1A	Pd	Contre Gambe	16'	1
	1B	Bn 49 1B	Bn 4A 1B		Bombarde	16'	
	1C	Bn 49 1C	Bn 4A 1C		Contre Basse	32'	
	1D	Bn 49 1D	Bn 4A 1D		Contre Bombarde	32'	
	1E	Bn 49 1E	Bn 4A 1E	A	Corno di Bassetto	8'	
	1F	Bn 49 1F	Bn 4A 1F		Plein Jeu	IV-V	
	20	Bn 49 20	Bn 4A 20		Clarion	4'	
	21	Bn 49 21	Bn 4A 21		Festival Trumpet	8'	
	22	Bn 49 22	Bn 4A 22		Gemshorn Celeste	8'	
	23	Bn 49 23	Bn 4A 23		Koppelflote	4'	
	24	Bn 49 24	Bn 4A 24		Bombarde	16'	
	25	Bn 49 25	Bn 4A 25		Harmonic Trumpet	8'	
	26	Bn 49 26	Bn 4A 26		Gemshorn	8'	
	27	Bn 49 27	Bn 4A 27		Flute a Cheminee	8'	
	28	Bn 49 28	Bn 4A 28	B	Flute Octaviante	4'	
	29	Bn 49 29	Bn 4A 29		Octave	2'	
	2A	Bn 49 2A	Bn 4A 2A		Cymbale	III	
	2B	Bn 49 2B	Bn 4A 2B		Principal	8'	
	2C	Bn 49 2C	Bn 4A 2C		Holzgedackt	8'	
	2D	Bn 49 2D	Bn 4A 2D		Flute Harmonique	8'	

NOTES:
1) n = Channel number used by Ahlborn stop On/Off messages; defaults to 16 (Fh).
2) Controls "A" or "B" division Tremulant on corresponding channel number used by Ahlborn divisions.

Table 21: Ahlborn Archive '202' sound module commands for stops and couplers [14]

Group	No.	Data sent: Off ----> On	Data sent: On ----> Off		Description		Note
		Controller 73	**Controller 74**		**Ahlborn 202 stops:**		
	2E	Bn 49 2E	Bn 4A 2E	Pd	Soubasse	32'	1
	2F	Bn 49 2F	Bn 4A 2F		Violone	16'	
	30	Bn 49 30	Bn 4A 30		Contrebombarde	32'	
	31	Bn 49 31	Bn 4A 31		Bombarde	16'	
	32	Bn 49 32	Bn 4A 32	A	Contregambe	16'	
	33	Bn 49 33	Bn 4A 33		Diapason	8'	
	34	Bn 49 34	Bn 4A 34		Quintadena	8'	
	35	Bn 49 35	Bn 4A 35		Terz	1 3/5'	
	36	Bn 49 36	Bn 4A 36		Septime	1 1/7'	
	37	Bn 49 37	Bn 4A 37		Scharff	III	
	38	Bn 49 38	Bn 4A 38		Bombarde	16'	
	39	Bn 49 39	Bn 4A 39		Trompette	8'	
	3A	Bn 49 3A	Bn 4A 3A		Tuba Mirabilis	8'	
	3B	Bn 49 3B	Bn 4A 3B		Chimes		
	3C	Bn 49 3C	Bn 4A 3C	B	Bourdon	8'	
	3D	Bn 49 3D	Bn 4A 3D		Flute Harmonique	8'	
	3E	Bn 49 3E	Bn 4A 3E		Flute Octaviante	4'	
	3F	Bn 49 3F	Bn 4A 3F		Larigot	1 1/3'	
	40	Bn 49 40	Bn 4A 40		Corno di Bassetto	8'	
	41	Bn 49 41	Bn 4A 41		Clarion	4'	

NOTES:
1) n = Channel number used by Ahlborn stop On/Off messages; defaults to 16 (Fh).
2) Controls "A" or "B" division Tremulant on corresponding channel number used by Ahlborn divisions.

Table 22: Ahlborn Archive '201' sound module commands for stops and couplers [14]

Group	No.	Data sent: Off ----> On	Data sent: On ----> Off		Description		Note
		Controller 73	**Controller 74**		**Ahlborn 201 stops:**		
	42	Bn 49 42	Bn 4A 42	Pd	Subbass	16'	1
	43	Bn 49 43	Bn 4A 43		Octave	8'	
	44	Bn 49 44	Bn 4A 44		Bourdon	8'	
	45	Bn 49 45	Bn 4A 45		Posaune	16'	
	46	Bn 49 46	Bn 4A 46	A	Bourdon	16'	
	47	Bn 49 47	Bn 4A 47		Principal	8'	
	48	Bn 49 48	Bn 4A 48		Flute a cheminee	8'	
	49	Bn 49 49	Bn 4A 49		Unda Maris	8'	
	4A	Bn 49 4A	Bn 4A 4A		Octave	4'	
	4B	Bn 49 4B	Bn 4A 4B		Spitzflote	4'	
	4C	Bn 49 4C	Bn 4A 4C		Nasard	2 2/3'	
	4D	Bn 49 4D	Bn 4A 4D		Superoctave	2'	
	4E	Bn 49 4E	Bn 4A 4E		Mixture	IV	
	4F	Bn 49 4F	Bn 4A 4F		Trompete	8'	
	50	Bn 49 50	Bn 4A 50	B	Gedackt	8'	
	51	Bn 49 51	Bn 4A 51		Gamba	8'	
	52	Bn 49 52	Bn 4A 52		Nachthorn	4'	
	53	Bn 49 53	Bn 4A 53		Cymbale/Scharff	III	
	54	Bn 49 54	Bn 4A 54		Cornet	III	
	55	Bn 49 55	Bn 4A 55		Oboe	8'	
	56	Bn 49 7F	Bn 4A 7F		All stops On / Off		
					Ahlborn Tremulants:		
	57	Bn 5C 7F	Bn 5C 00		Swell Tremulant		2
	58	Bn 5C 7F	Bn 5C 00		Great Tremulant		2
	59	Bn 5C 7F	Bn 5C 00		Choir Tremulant		2

NOTES:
1) n = Channel number used by Ahlborn stop On/Off messages; defaults to 16 (Fh).
2) Controls "A" or "B" division Tremulant on corresponding channel number used by Ahlborn divisions.

Table 23: Ahlborn Archive sound module Piston and Crescendo input functions for all four units [14]

Group	No.	Data sent: Off ----> On	Data sent: On ----> Off		Description		Note
	A0	CF 20			Ahlborn - General Cancel		1
	81	CF 01			Ahlborn - Mem. A Gen. #1		2
	82	CF 02			Ahlborn - Mem. A Gen. #2		
	83	CF 03			Ahlborn - Mem. A Gen. #3		
	84	CF 04			Ahlborn - Mem. A Gen. #4		
	85	CF 05			Ahlborn - Mem. A Gen. #5		
	86	CF 06			Ahlborn - Mem. A Gen. #6		
	87	CF 07			Ahlborn - Mem. B Gen. #1		
		…….			etc.		
	9E	CF 1E			Ahlborn - Mem. E Gen. #6		
	E4	CF 64			Cancel Crescendo		
	E5	CF 65	CF 64		Crescendo Stage #1 / Off		3
	E6	CF 66	CF 65		Crescendo Stage #2 / 1		
	E7	CF 67	CF 66		Crescendo Stage #3 / 2		
		…….			etc.		
	EF	CF 6F	CF 6E		Crescendo Stage #11/10		
	F7	CF 77	CF 6F		Crescendo Stage #12/11		
	F8	CF 78	CF 77		Crescendo Stage #13/12		
		…….			etc.		
	FF	CF 7F	CF 7E		Crescendo Stage #20/19		

NOTES:

1) *Prog#1 (00h) on the Control Channel will actually act as a "Recall Hand Registration", but will correspond to a General Cancel if hand registration is not used.*
2) *Ahlborn Archive Modules have 6 Programmable Presets on 5 Memory levels, accessed by sending Prog#1-30 (01h - 1Eh).*
3) *These functions are presumed to be connected to a "shade roller" Crescendo switch, which provides sequential switch closures and releases. These messages can also be generated by an analog input.*

Table 24: Ahlborn Archive sound module additional Piston input commands [14]

Group	No.	Data sent: Off ----> On	Data sent: On ----> Off		Description		Note
	5A	Cn 40			Ahlborn – Division Cancel		1
	5E	BF 47 46	BF 47 06		SET piston		2
	5F	BF 47 42	BF 47 02		SFZ control		3

NOTES:

1) *Prog. Change 51-85 (32h - 54h) on a Division Channel (1-4) will actually act as a Divisional Cancel.*
2) *Works with General Pistons to allow setting them via remote (MIDI) control, i.e., press & hold SET; press and release a General, then release SET; to store a new registration.*
3) *Should allow for a lamp output for this. Also, possible another input function which would act as a "reversible"; i.e., push-ON, push-OFF.:*
4) *n = Channel number used by Ahlborn stop On/Off messages; defaults to 16 (Fh).*

Table 25: Ahlborn Archive and other MIDI sound modules analog input function commands [14]

Input		Data sent	Function		Description		Note
1		CF ss	Crescendo		Crescendo		1
2		B0 07 aa		Sw	Ahlborn – Division Volume		2
3		B1 07 aa		Gt	Ahlborn – Division Volume		2
4		B2 07 aa		Ch	Ahlborn – Division Volume		2
5		B3 07 aa		Pd	Ahlborn – Division Volume		2
6		Bn 65 00 64 01 06 xx 26 yy	Tuning		Tuning and/or Temperature Sensor		3

NOTES:

1) *"ss" is the Crescendo stage, where Off=64h, Stage#1=65h, #2=66h, etc., #11=6Fh, #12=77h, #13=78h, etc., #20=7Fh.*
2) *Ahlborn modules use Controller #7 for expression. Outputs on Ahlborn channels (1-4) must be configurable, connecting to analog inputs 2-5. aa = volume value from an analog input, where 0<aa<127.*

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APPENDIX E:

SCPOP MESSAGES

Table 26: General MIDI Pipe Organ Emulation Upper Manual for SCPOP
(General MIDI patch commands converted from SYSEX messages of SCPOP) [15]

Upper Manual [using Parts 1-6]							
1	Principale 8	GM Patch	73	77	78		
		Volume	110	70	60		
		Panning	R10	L10	0		
		Reverb	100	100	80		
		Key Shift	-12	-12	-12		
2	Flauto cuspide 8	GM Patch	74	85			
		Volume	100	80			
		Panning	R15	L15			
		Reverb	100	100			
		Key Shift	-12	-12			
3	Principali 16-8	GM Patch	73	77	78	74	
		Volume	110	70	60	100	
		Panning	R10	L10	0	0	
		Reverb	100	100	80	80	
		Key Shift	-12	-12	-12	-24	
4	Fondi 16-4	GM Patch	73	77	78	74	
		Volume	105	70	60	95	
		Panning	R10	L10	0	0	
		Reverb	76	100	80	80	
		Key Shift	0	-12	-12	-24	
5	Flauti 8-4	GM Patch	74	78	74		
		Volume	90	80	105		
		Panning	R15	L15	0		
		Reverb	100	100	100		
		Key Shift	-12	0	0		
6	Fondi 16-2	GM Patch	73	77	78	74	
		Volume	110	80	80	95	
		Panning	R10	R10	L10	0	
		Reverb	115	100	80	80	
		Key Shift	12	-12	-12	-24	
7	Fondi 8-2	GM Patch	74	78	75		
		Volume	90	85	100		
		Panning	R15	L15	0		
		Reverb	100	100	105		
		Key Shift	-12	0	12		

Table 26: General MIDI Pipe Organ Emulation Upper Manual for SCPOP (cont'd)

Upper Manual [Using parts 1-6]								
8	Fondi 8-2-1	GM Patch	74	78	75	73		
		Volume	90	100	95	90		
		Panning	R10	L10	L20	R20		
		Reverb	100	100	110	100		
		Key Shift	-12	0	12	24		
9	Mutazioni 2	GM Patch	74	78	76	75		
		Volume	95	100	95	100		
		Panning	0	0	R24	L24		
		Reverb	100	100	100	110		
		Key Shift	-12	-12	7	12		
10	Mutazioni 1	GM Patch	74	78	75	76	73	
		Volume	90	106	90	90	80	
		Panning	0	L15	R12	L25	R25	
		Reverb	90	100	100	110	110	
		Key Shift	-12	0	0	19	24	
11	Mutazioni in Terza	GM Patch	76	74	78	75	73	
		Volume	80	100	105	85	85	
		Panning	0	R10	L10	L63	R63	
		Reverb	110	90	90	100	100	
		Key Shift	16	-12	-12	12	12	
12	Pienino	GM Patch	78	79	20	73	76	
		Volume	100	70	85	80	82	
		Panning	0	0	0	R20	L20	
		Reverb	100	90	100	110	100	
		Chorus	0	3	0	0	0	
		Key Shift	-12	-12	-12	12	19	
13	Ripieno Leggero	GM Patch	74	79	20	73	76	
		Volume	105	110	110	110	115	
		Panning	L15	R12	R30	0	L30	
		Reverb	90	90	110	100	110	
		Chorus	0	3	0	0	0	
		Key Shift	-12	-12	12	0	19	
14	Ripieno forte	GM Patch	74	20	74	20	21	76
		Volume	120	124	112	107	109	100
		Panning	0	0	0	L30	R10	R30
		Reverb	90	80	90	110	110	0
		Chorus	3	0	0	0	0	0
		Key Shift	0	-12	-24	19	7	24
15	Grand Jeux	GM Patch	58	20	74	73	59	73
		Volume	125	125	110	110	120	110
		Panning	0	L24	0	L44	R24	R44
		Reverb	85	100	80	100	85	100
		Chorus	3	0	0	0	0	0
		Key Shift	-12	0	-12	24	0	19

Table 26: General MIDI Pipe Organ Emulation Upper Manual for SCPOP (cont'd)

Upper Manual [Using parts 1-6]								
16	Petit Jeux	GM Patch	58	20	73	73	70	73
		Volume	115	100	95	95	115	90
		Panning	R12	0	R24	L24	L12	0
		Reverb	105	100	103	103	105	100
		Reverb	3	0	0	0	0	0
		Key Shift	-12	-12	0	7	-12	19
17	Recit des Ances	GM Patch	58	70	67			
		Volume	105	90	120			
		Panning	2	L20	R20			
		Reverb	100	100	100			
		Key Shift	-12	-12	-12			
18	Salicionale 8	GM Patch	75	75	76			
		Volume	85	85	45			
		Panning	R63	L63	0			
		Reverb	115	115	100			
		Key Shift	0	0	0			
19	Principale 8 in Tremolo	GM Patch	73	77	76			
		Volume	110	70	60			
		Panning	R10	L10	0			
		Reverb	100	100	80			
		Key Shift	-12	-12	-12			

Table 27: General MIDI Pipe Organ Emulation Lower Manual SCPOP
(General MIDI patch commands converted from SYSEX messages of SCPOP) [15]

Lower Manual [using Parts 7-11]							
1	Flauto Camino 8	GM Patch	74	74	76		
		Volume	85	85	80		
		Panning	R63	L63	0		
		Reverb	103	103	95		
		Key Shift	-12	-12	0		
2	Quintadena 8	GM Patch	73	76	77	73	
		Volume	75	80	51	75	
		Panning	R63	0	0	L63	
		Reverb	90	90	90	90	
		Key Shift	-12	-12	0	-12	
3	Flauti 8-4	GM Patch	74	76	74	74	
		Volume	85	75	85	85	
		Panning	L63	R12	R63	L12	
		Reverb	100	90	100	90	
		Key Shift	0	0	0	-12	

Table 27: General MIDI Pipe Organ Emulation Lower Manual SCPOP (cont'd)

Lower Manual [using Parts 7-11]							
4	Flauti 16-4	GM Patch	74	74	76		
		Volume	95	85	75		
		Panning	R20	L20	0		
		Reverb	90	103	80		
		Key Shift	-24	0	0		
5	Fondi 8-2	GM Patch	76	73	74	74	
		Volume	75	82	82	82	
		Panning	L15	R63	L63	R15	
		Reverb	90	100	100	90	
		Key Shift	0	12	12	-12	
6	Fondi 4-2	GM Patch	73	74	77	73	76
		Volume	80	100	90	100	60
		Panning	L63	R63	0	0	0
		Reverb	103	103	103	110	103
		Key Shift	12	12	12	0	12
7	Septade	GM Patch	76	74	73	74	
		Volume	80	80	45	100	
		Panning	L15	0	0	R15	
		Reverb	103	103	80	103	
		Key Shift	0	24	14	-12	
8	Nazardo	GM Patch	76	74	80	79	80
		Volume	90	100	90	100	80
		Panning	0	L20	0	R20	0
		Reverb	90	100	115	90	100
		Key Shift	0	0	7	-12	19
9	Fondi 8-4-1	GM Patch	74	76	73		
		Volume	100	100	100		
		Panning	R15	L15	0		
		Reverb	100	100	105		
		Key Shift	-12	12	24		
10	Sesquialtera	GM Patch	76	73	73	74	73
		Volume	105	100	53	100	105
		Panning	L15	L24	R24	0	R15
		Reverb	100	100	90	90	100
		Key Shift	0	7	23	-12	0
11	Pienino Flauti	GM Patch	76	73	73	74	74
		Volume	95	70	70	100	85
		Panning	L15	L63	R63	R10	0
		Reverb	90	100	100	90	100
		Key Shift	0	24	24	-12	0
12	Ripieno I	GM Patch	73	76	73	73	20
		Volume	90	100	90	85	80
		Panning	0	0	0	L35	R30
		Reverb	100	100	100	100	100
		Key Shift	-12	0	0	19	12

Table 27: General MIDI Pipe Organ Emulation Lower Manual SCPOP (cont'd)

Lower Manual [using Parts 7-11]							
13	Ripieno II	GM Patch	74	76	73	73	20
		Volume	105	120	115	110	105
		Panning	0	0	0	L35	R35
		Reverb	100	90	110	110	110
		Key Shift	-12	0	7	24	0
14	Cromorno	GM Patch	60	70			
		Volume	110	100			
		Panning	0	0			
		Reverb	115	115			
		Key Shift	-12	-12			
15	Jeux	GM Patch	70	74	73	60	73
		Volume	120	110	120	127	105
		Panning	R20	0	0	L20	0
		Reverb	103	95	103	103	115
		Key Shift	-12	-12	0	-12	19
16	Jeux Doux	GM Patch	70	76	73	60	
		Volume	110	110	125	115	
		Panning	L12	0	0	R12	
		Reverb	103	100	90	103	
		Key Shift	-12	-12	-12	-12	
17	Vox Umana 8	GM Patch	73	74	76		
		Volume	75	75	55		
		Panning	R12	L12	0		
		Reverb	95	95	95		
		Chorus	3	0	0		
		Key Shift	-12	-12	-12		
18	Flauto 4 in Tremolo	GM Patch	73	73	76		
		Volume	85	85	70		
		Panning	R63	L63	0		
		Reverb	127	127	70		
		Key Shift	0	0	0		

Table 28: General MIDI Pipe Organ Emulation Pedals SCPOP
(General MIDI patch commands converted from SYSEX messages of SCPOP) [15]

Pedals [using parts 12-16]							
1	Principale 16	GM Patch	74	74	73		
		Volume	95	85	80		
		Panning	0	R12	L12		
		Reverb	91	91	91		
		Key Shift	-24	-12	-12		
2	Subbasso 16	GM Patch	73	79	74		
		Volume	110	110	105		
		Panning	0	0	0		
		Reverb	65	80	80		
		Key Shift	-24	-12	-24		
3	Fondi 16-8	GM Patch	74	74	73	73	76
		Volume	90	75	80	100	60
		Panning	0	L63	0	R63	0
		Reverb	91	91	91	90	90
		Key Shift	-24	-12	-12	-12	0
4	Quintadena	GM Patch	73	79	74	73	
		Volume	110	110	105	100	
		Panning	0	0	0	0	
		Reverb	65	80	80	80	
		Key Shift	-24	-12	-24	0	
5	Fondi 16-4	GM Patch	74	74	73	73	74
		Volume	95	90	68	100	95
		Panning	0	L36	0	R36	0
		Reverb	90	90	90	90	90
		Key Shift	-12	0	-12	0	0
6	Ancia da 8	GM Patch	74	74	73	59	65
		Volume	90	75	70	80	100
		Panning	0	0	0	R12	L12
		Reverb	91	91	91	90	90
		Key Shift	-24	-12	-12	0	0
7	Ripieno I	GM Patch	74	74	73	20	73
		Volume	90	125	80	112	110
		Panning	0	0	0	L20	R20
		Reverb	105	110	90	110	100
		Key Shift	7	-12	-12	-12	12
8	Ripieno II	GM Patch	58	73	74	20	20
		Volume	125	90	120	120	120
		Panning	0	0	0	L63	R63
		Reverb	120	110	115	125	125
		Key Shift	-12	-12	0	0	0
9	Tutte le Ancie	GM Patch	20	73	73	70	59
		Volume	120	90	70	86	115
		Panning	0	0	0	L48	R48
		Reverb	125	110	100	125	127
		Key Shift	-12	-12	-12	0	0

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APPENDIX F:

CIRCUIT BOARD SCHEMATICS

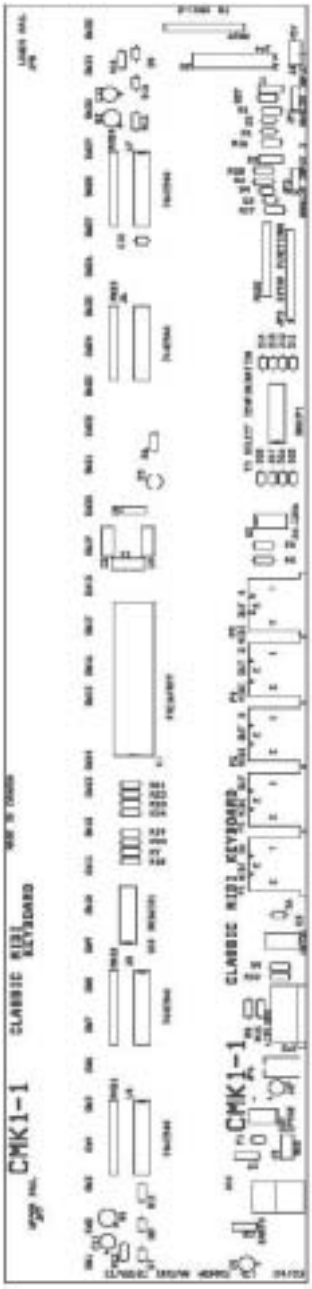

Figure 47: CMK1-1 Classic MIDI Keyboard Circuit board 1 Silk Screen

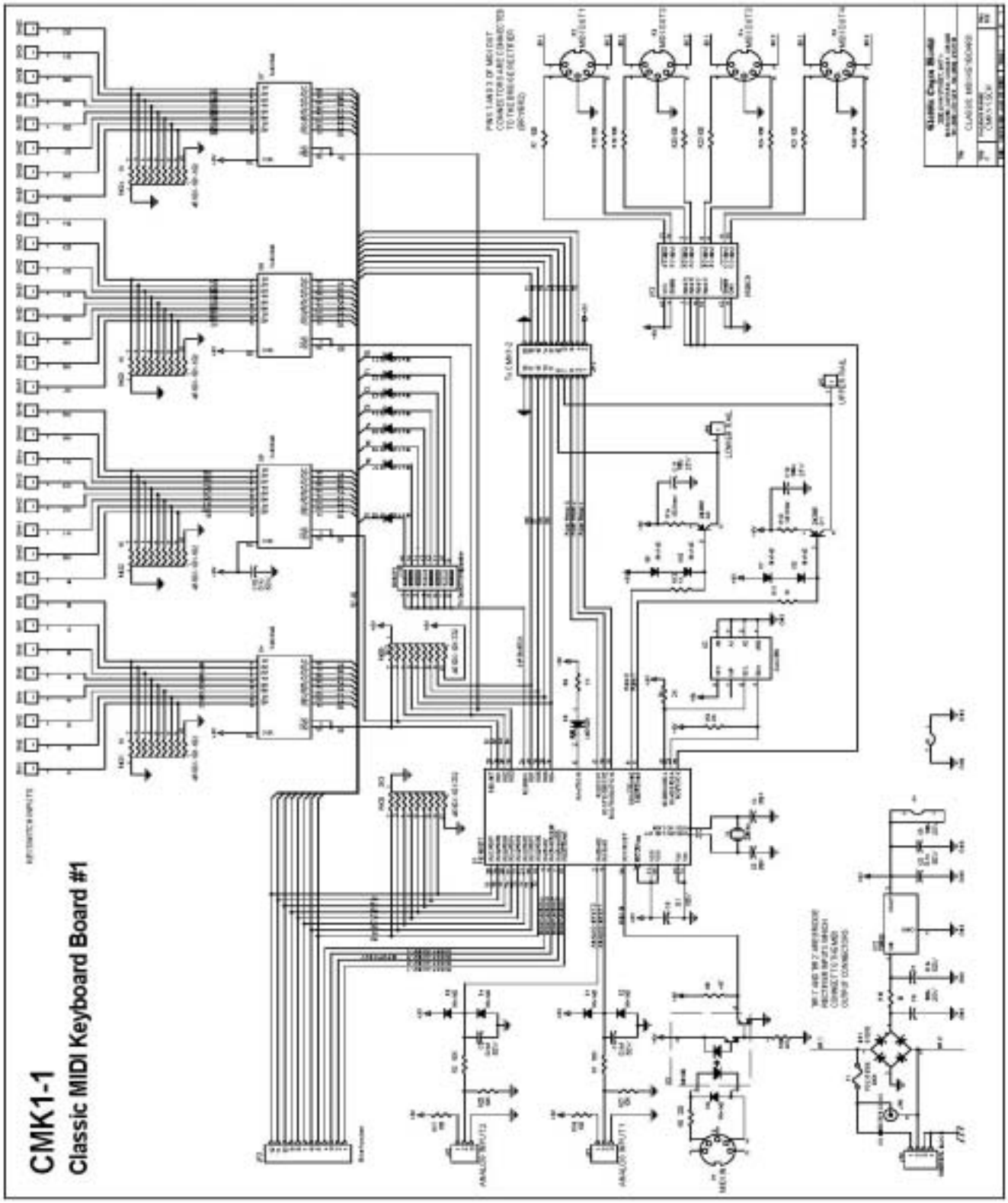

Figure 48: CMK1-1 Classic MIDI Keyboard Circuit board 1 schematic

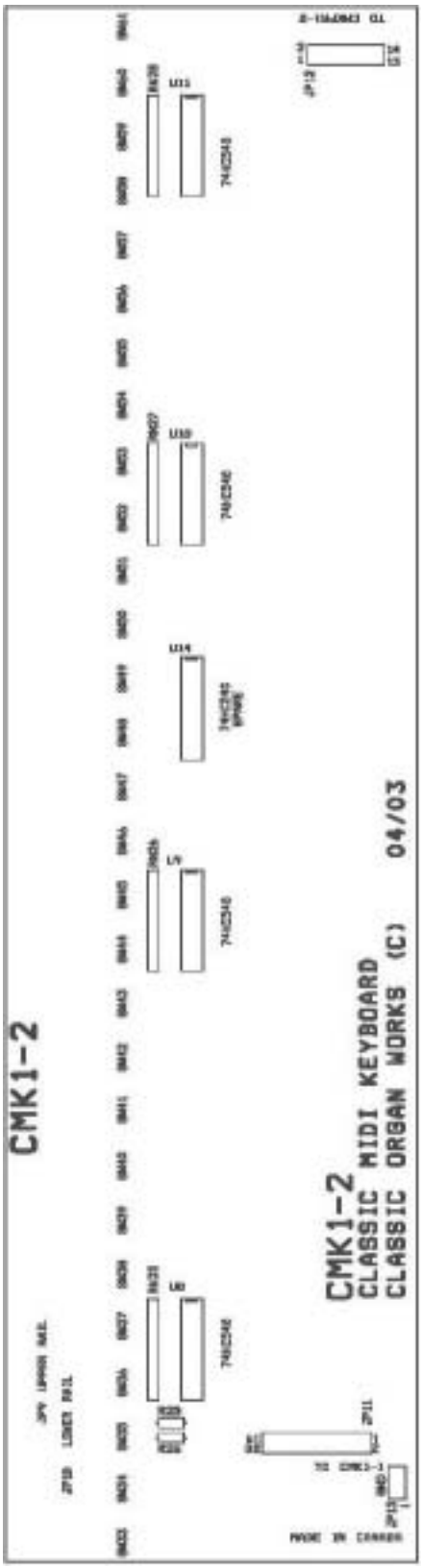

Figure 49: CMK1-2 Classic MIDI Keyboard Circuit board 2 Silk Screen

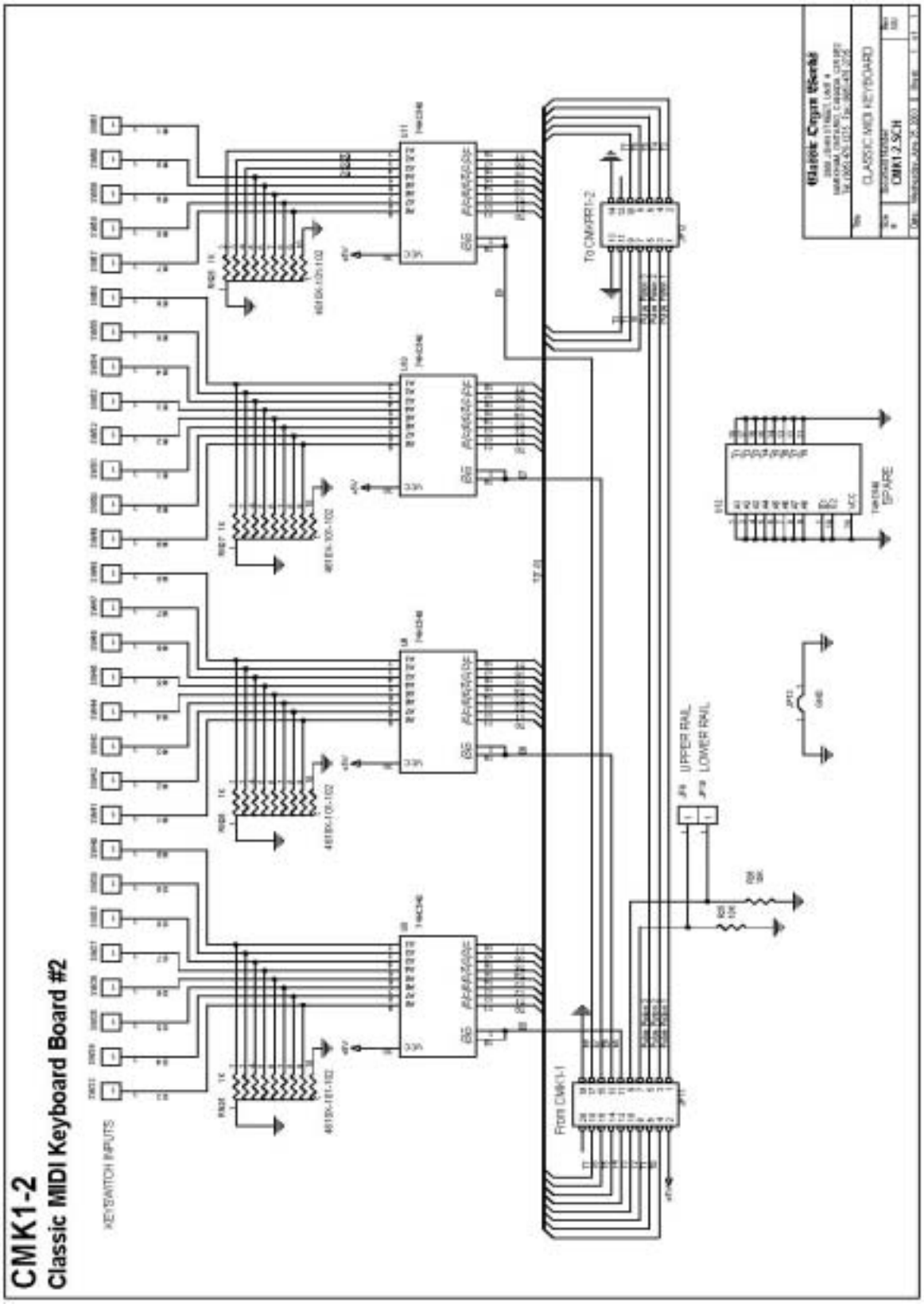

Figure 50: CMK1-2 Classic MIDI Keyboard Circuit board 2 schematic

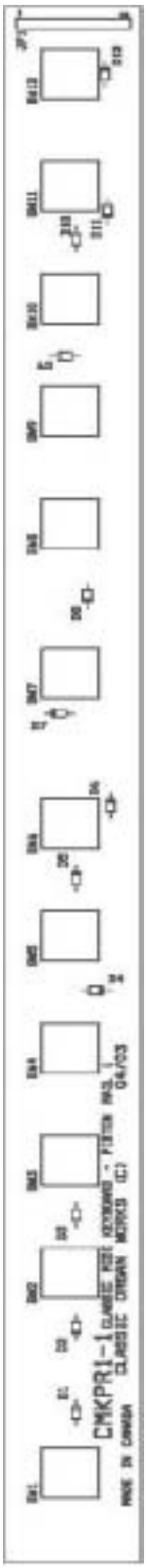

Figure 51: CMKPR1-1 Classic MIDI Keyboard Piston Rail board 1 Silk Screen

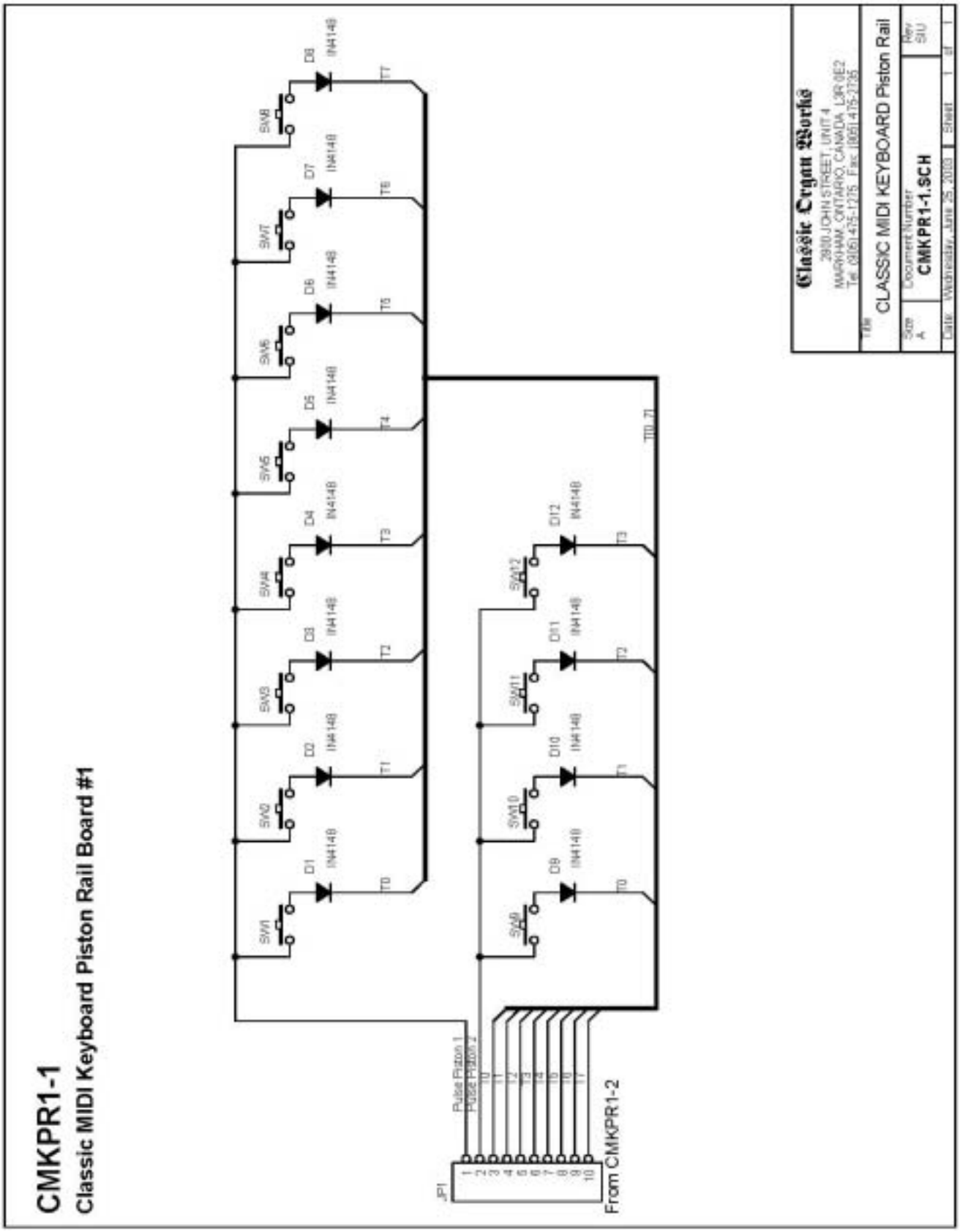

Figure 52: CMKPR1-1 Classic MIDI Keyboard Piston Rail board 1 schematic

Figure 53: CMKPR1-2 Classic MIDI Keyboard Piston Rail board 2 Silk Screen

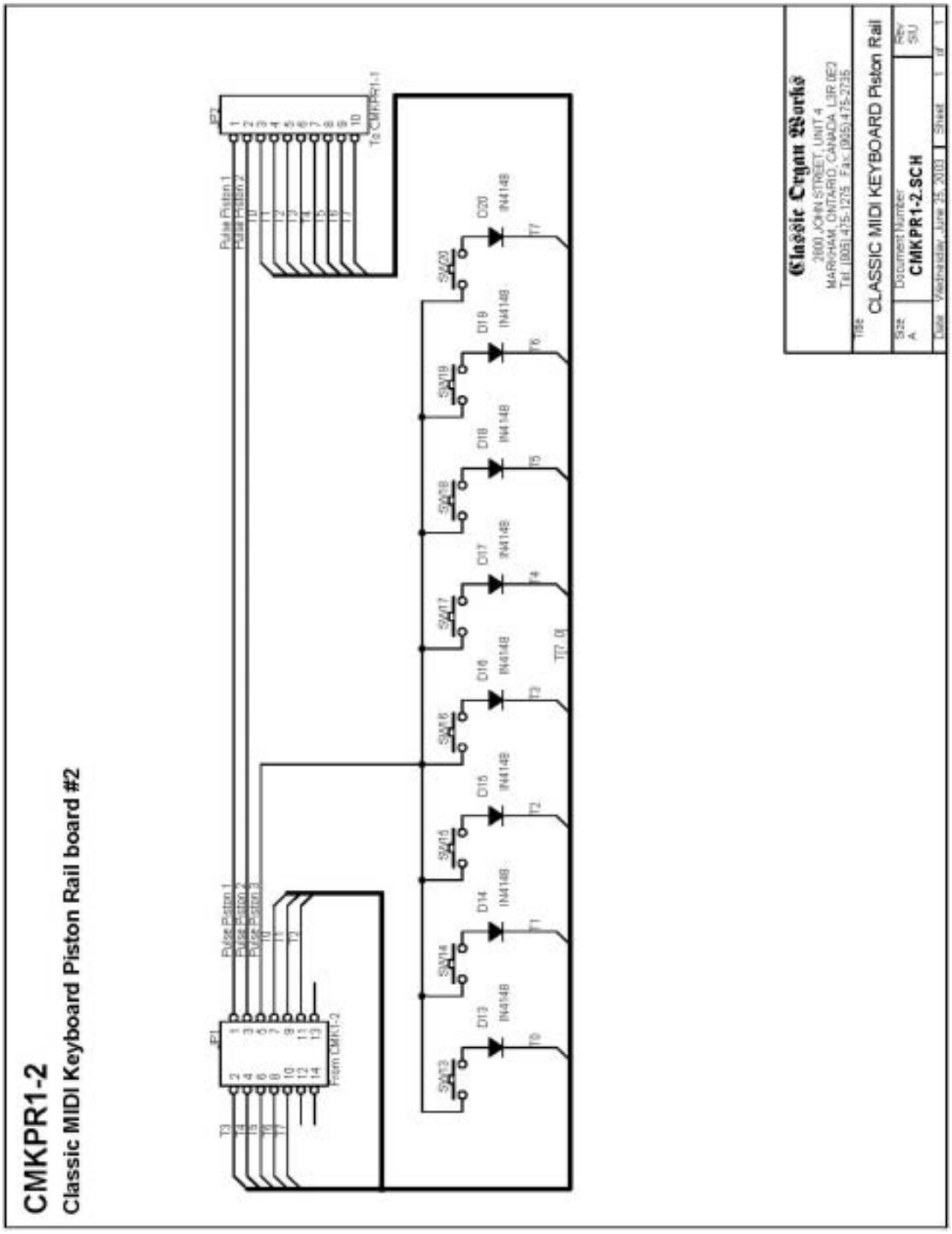

Figure 54: CMKPR1-2 Classic MIDI Keyboard Piston Rail board 2 schematic

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CMK-1

APPENDIX G:

MECHANICAL DRAWINGS

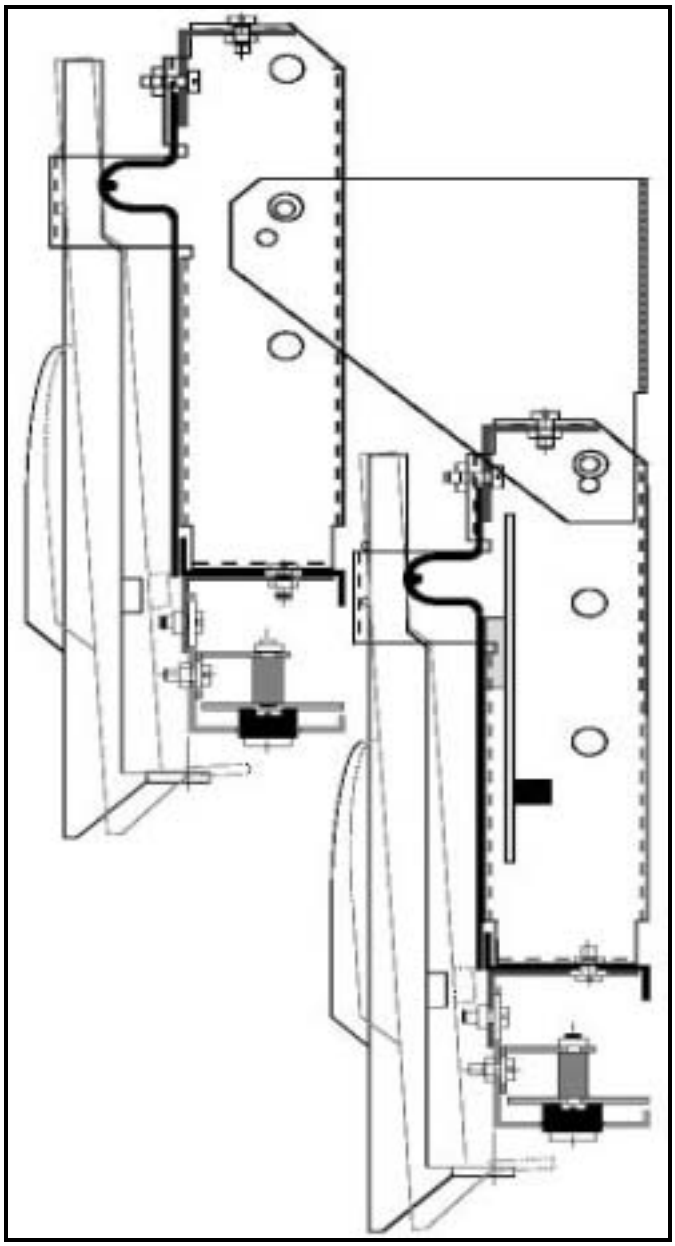

Figure 55: Two-manual CMK mounted level

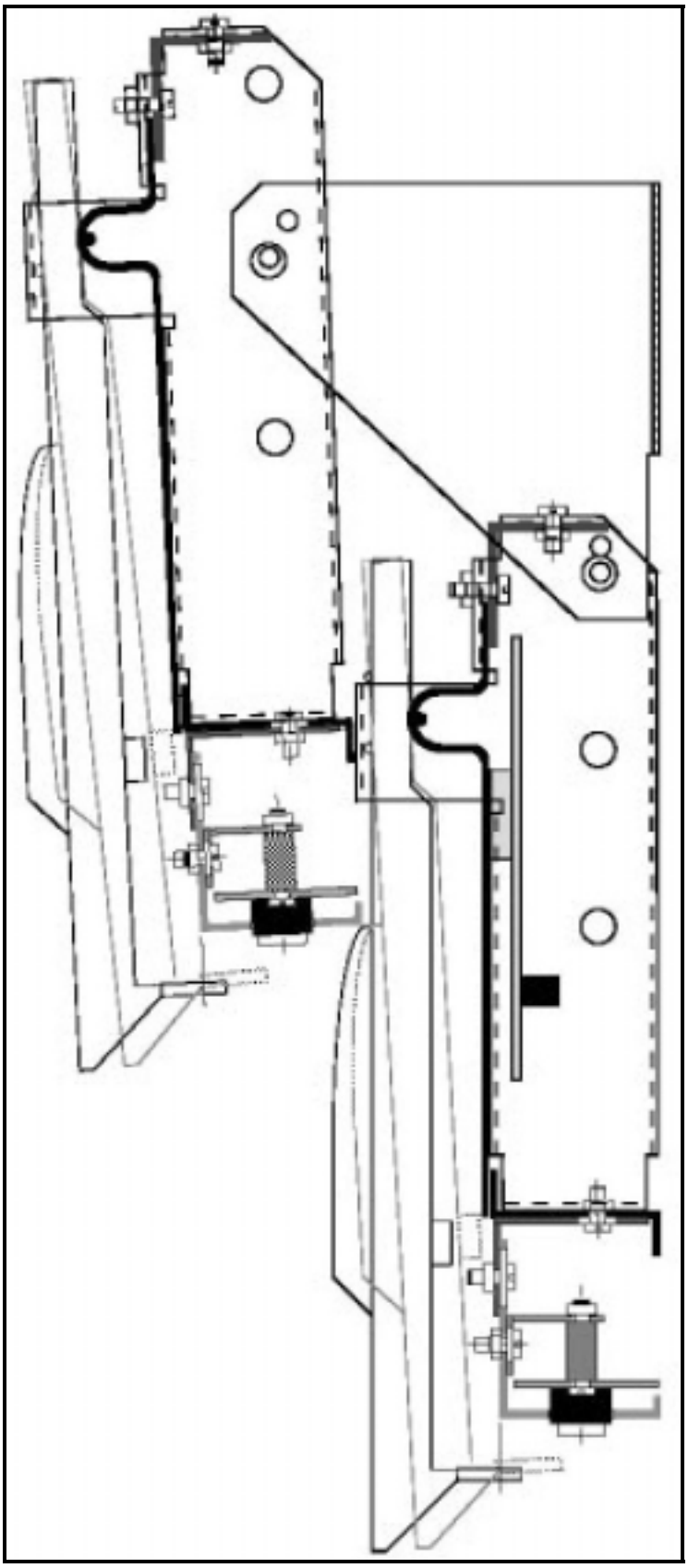

Figure 56: Two-manual CMK mounted tilted-up

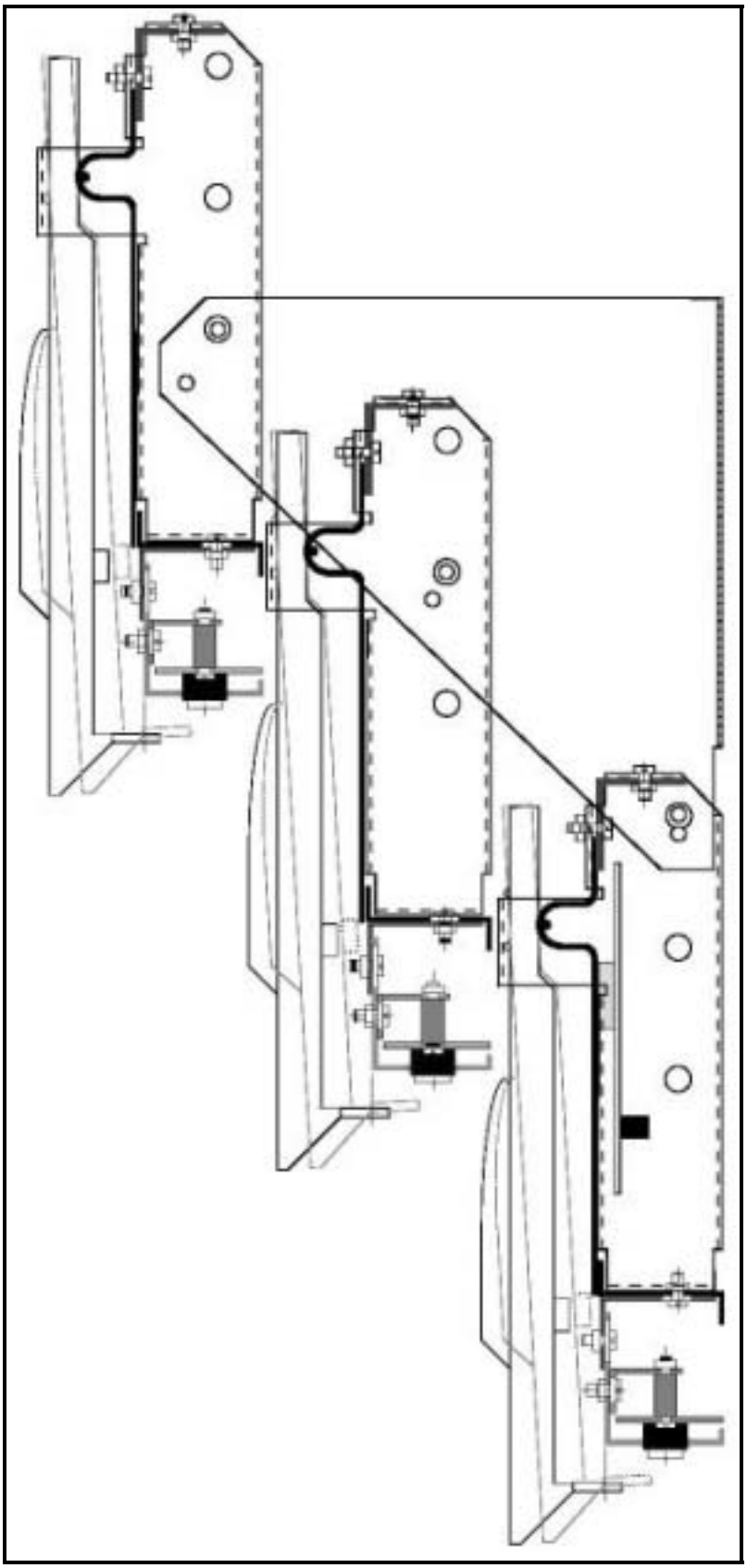

Figure 57: Three-manual CMK mounted level

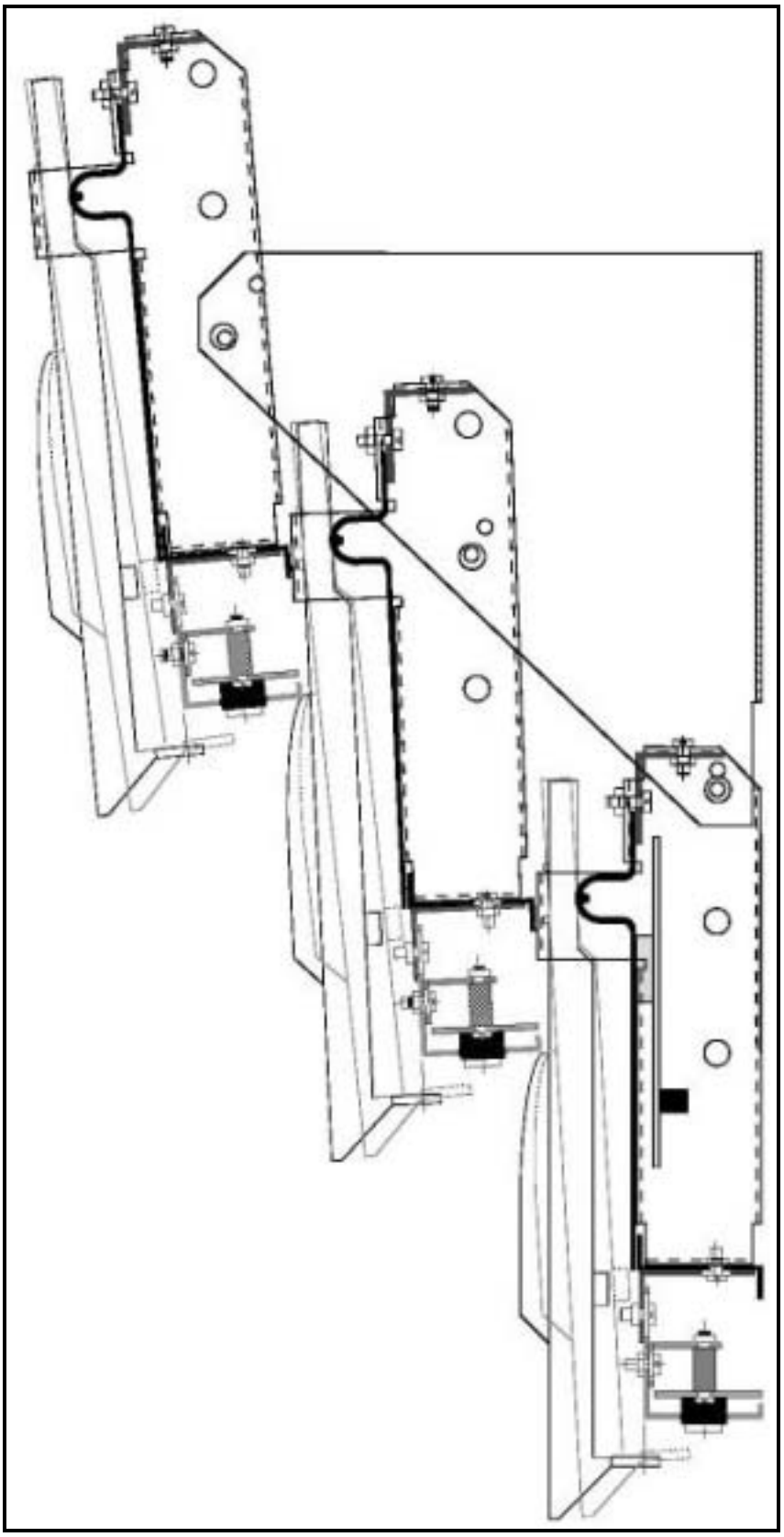

Figure 58: Three-manual CMK mounted ‘tilt-up’

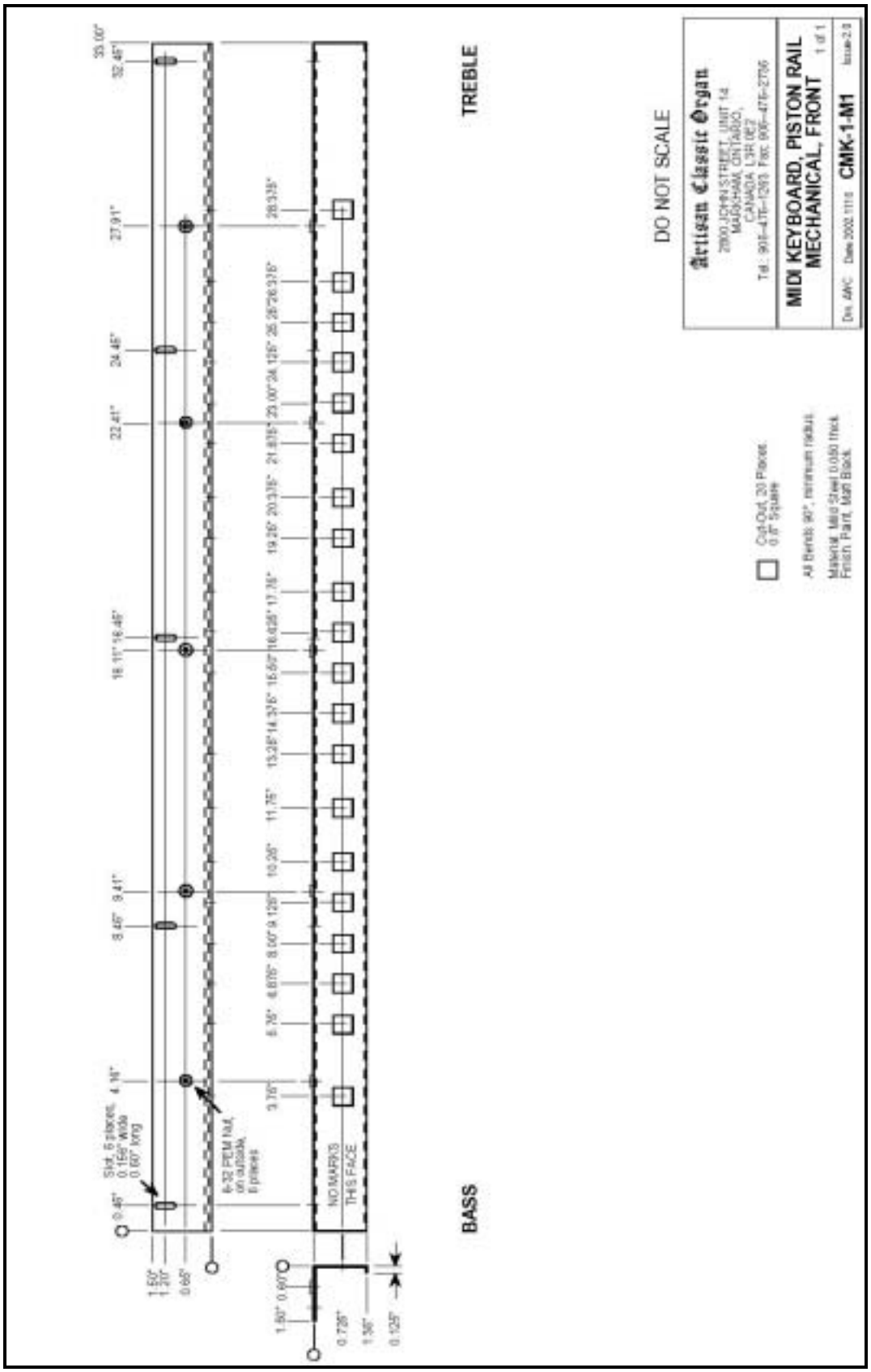

Figure 59: CMK Piston Rail front panel mechanical drawing

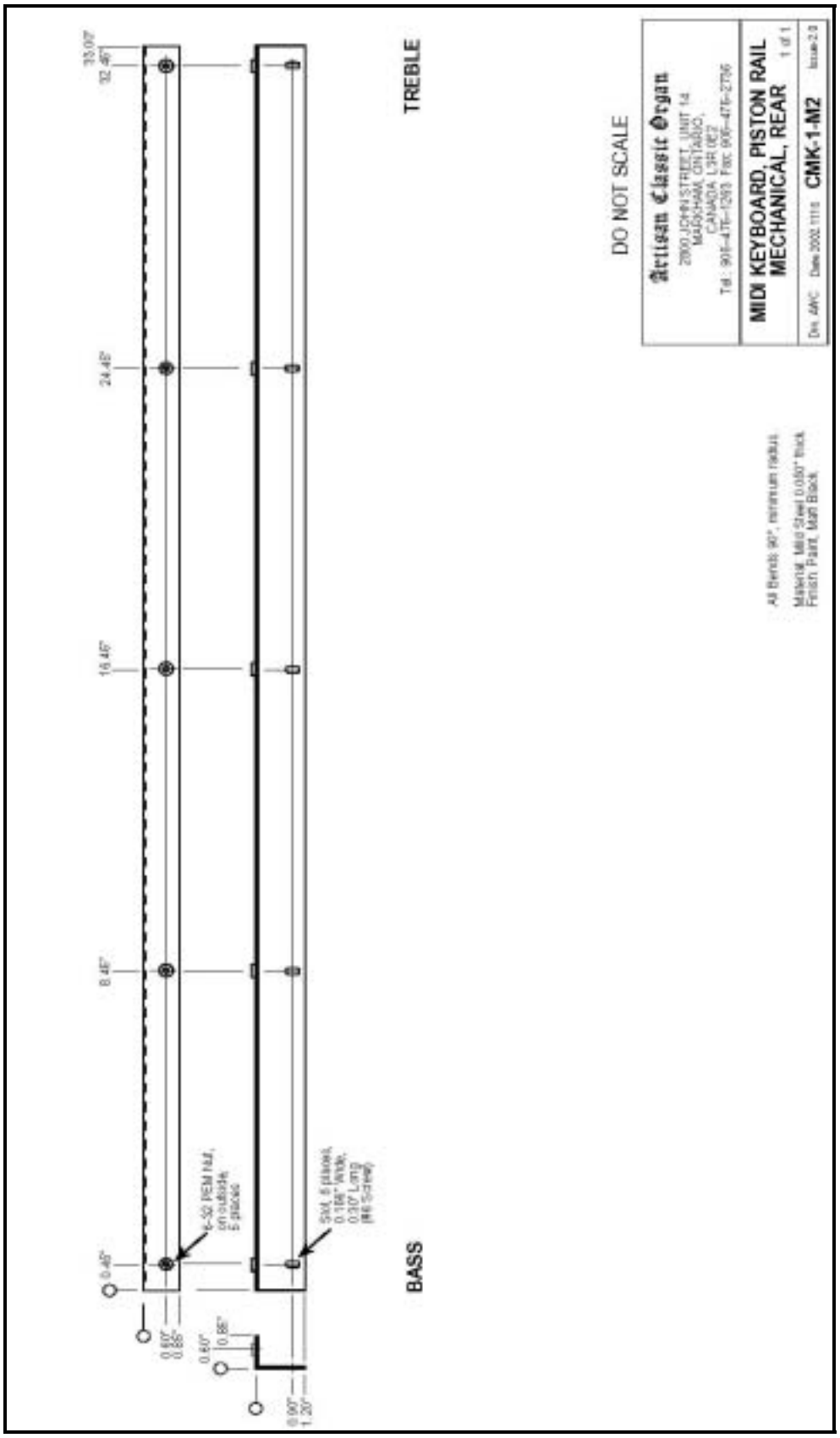

Figure 60: CMK Piston Rail Mounting rail mechanical drawing

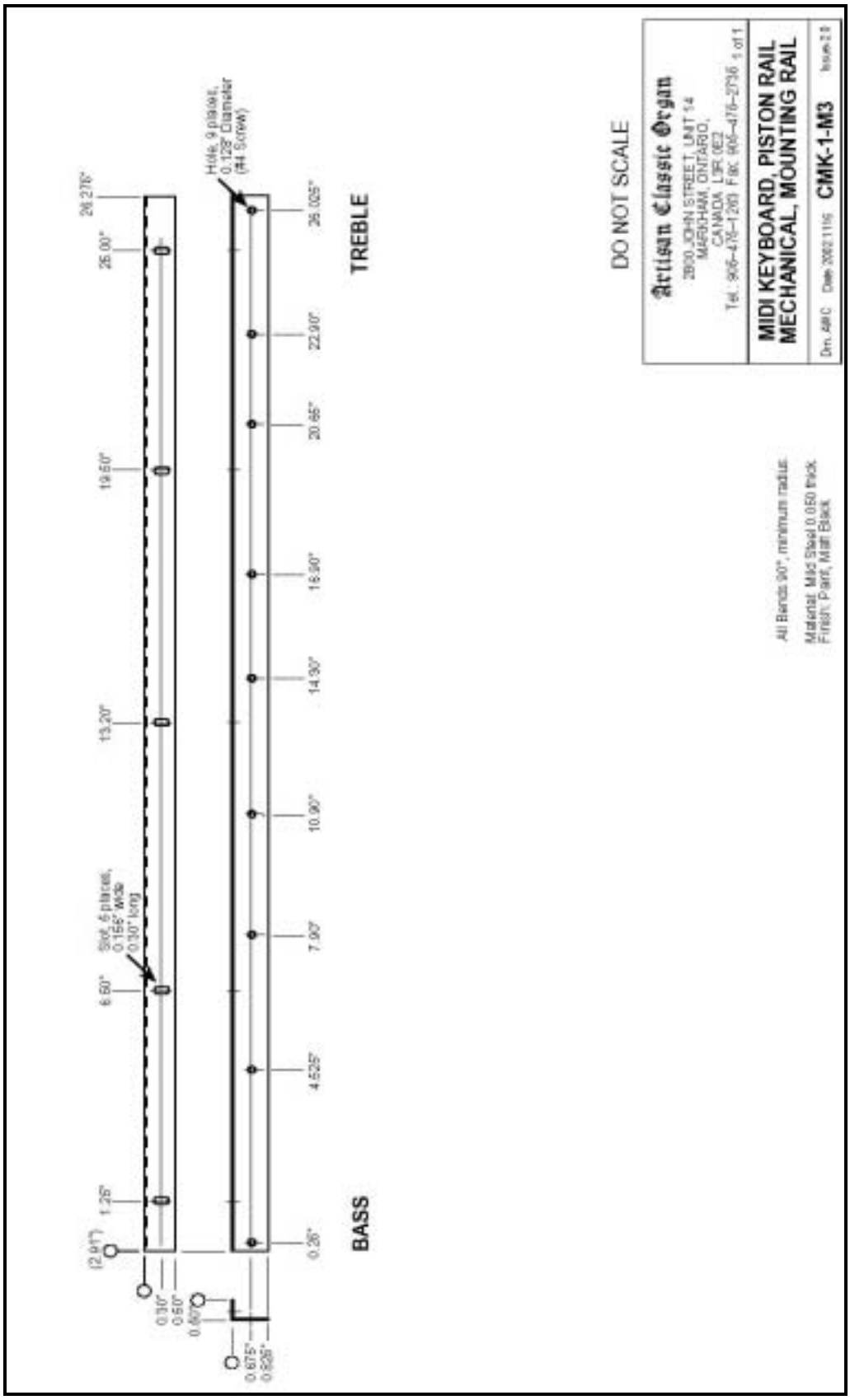

Figure 61: CMK Piston Rail circuit board mounting rail mechanical drawing

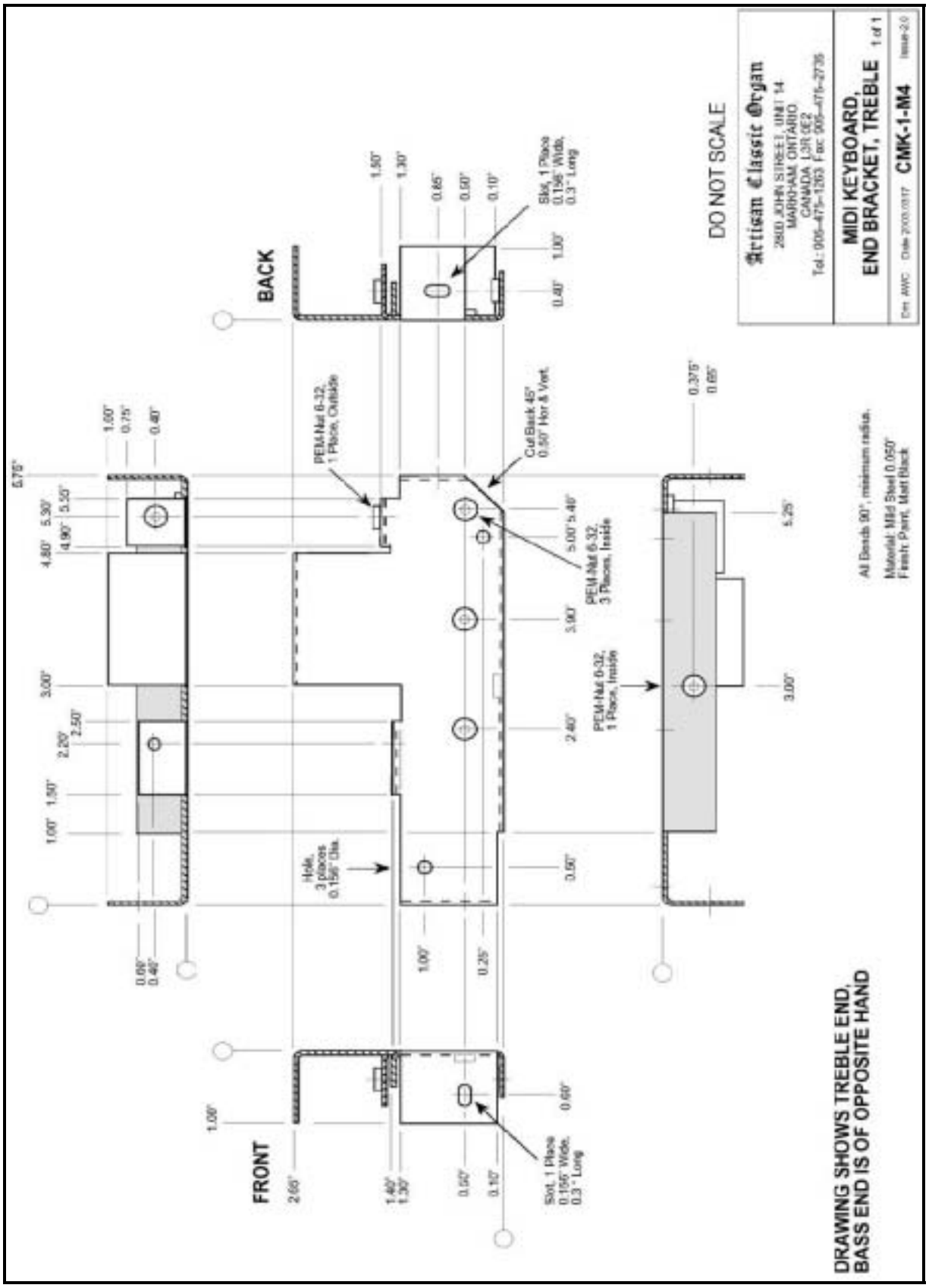

Figure 62: CMK Side mounting bracket mechanical drawing (treble end)

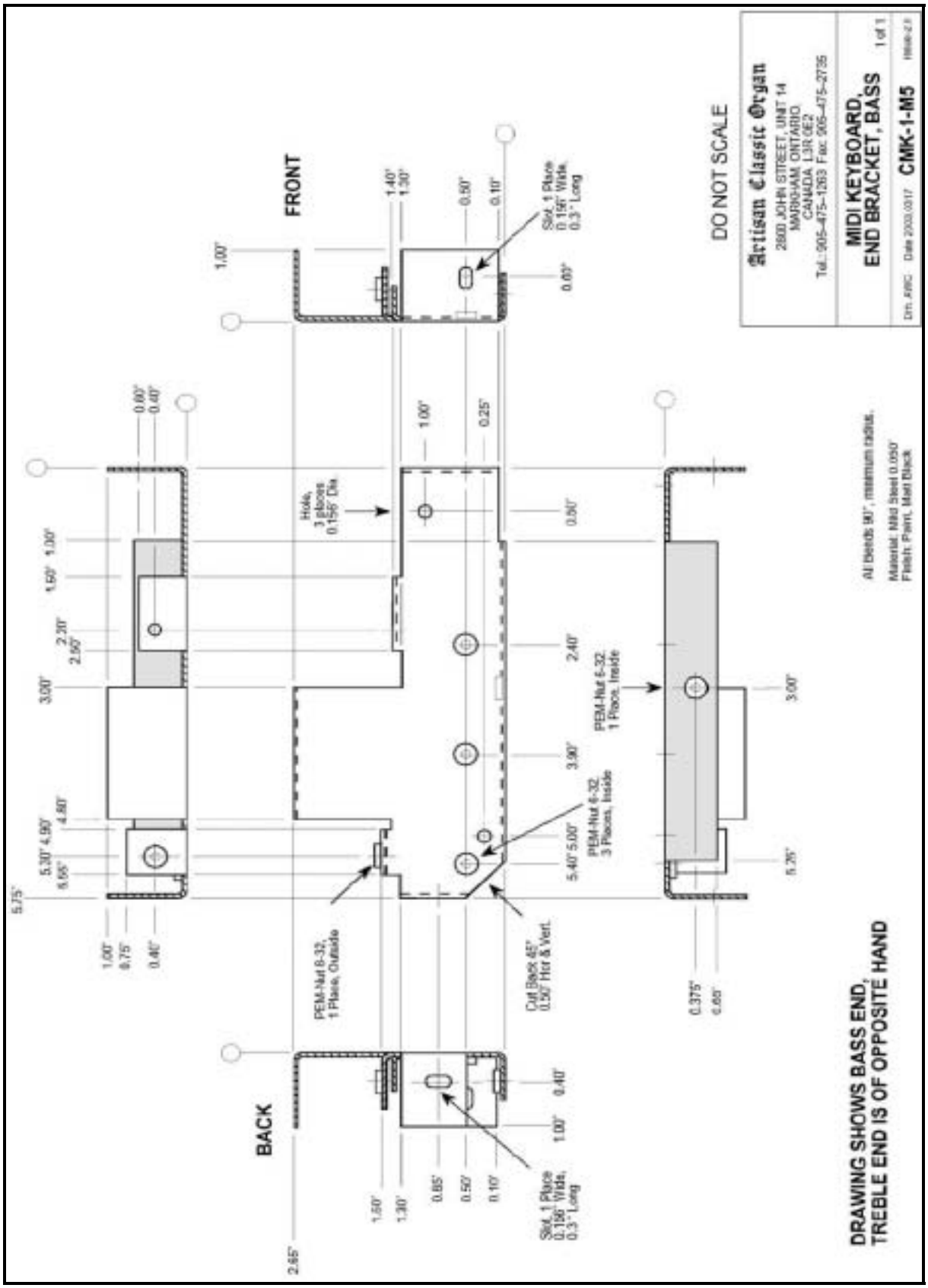

Figure 63: CMK Side mounting bracket mechanical drawing (bass end)

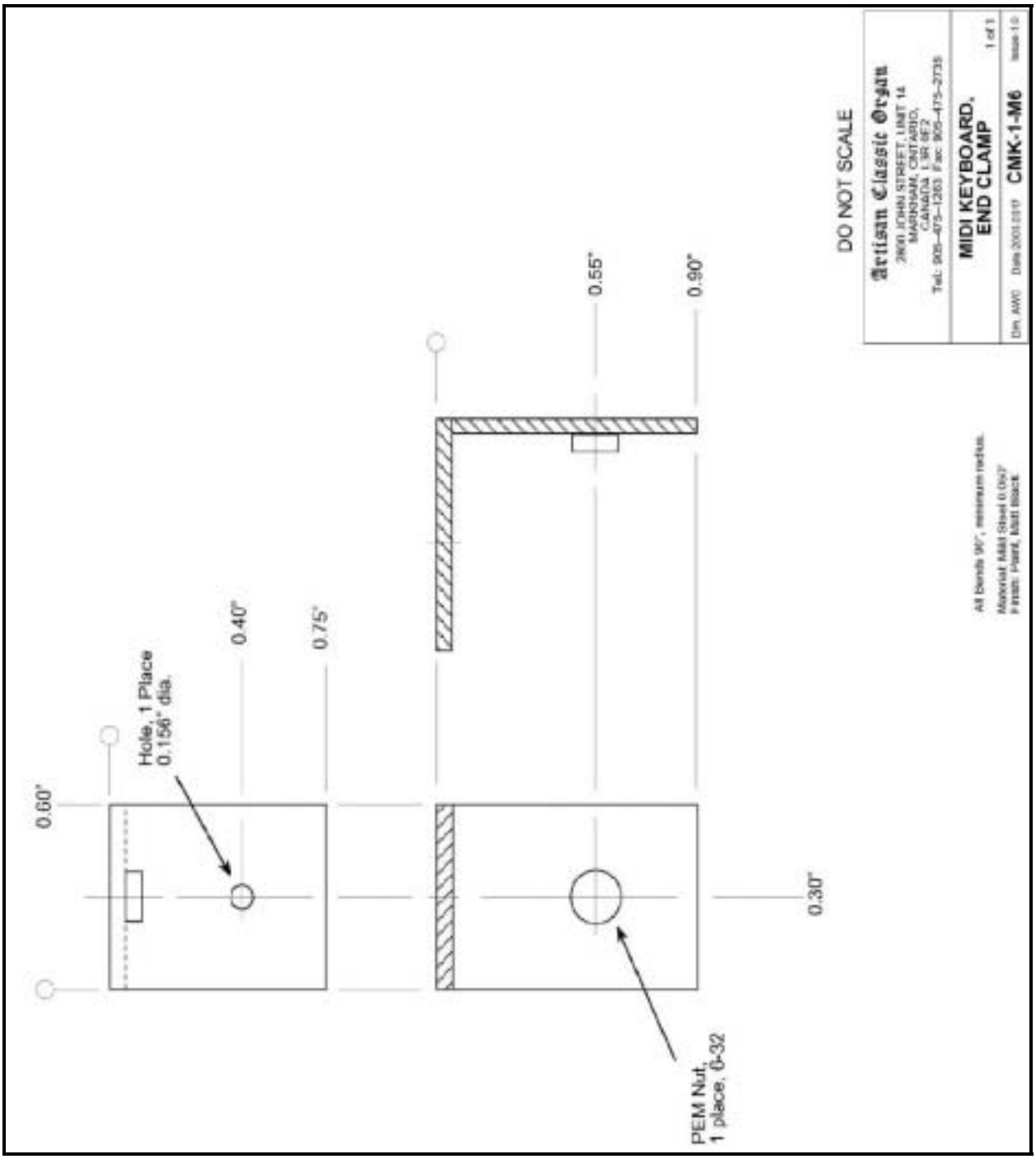

Figure 64: CMK End clamp mechanical drawing

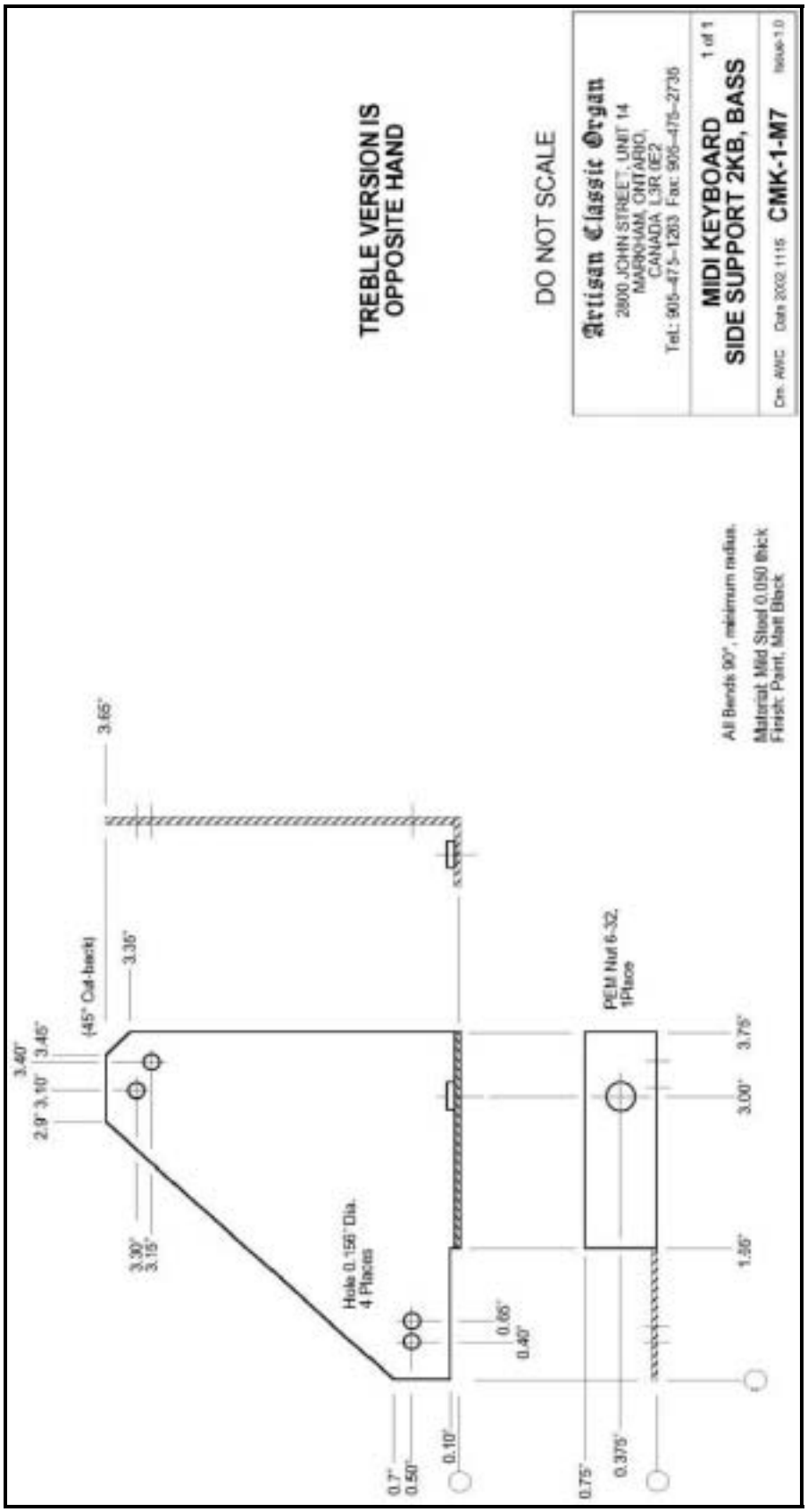

Figure 65: CMK two-manual mounting bracket mechanical drawing

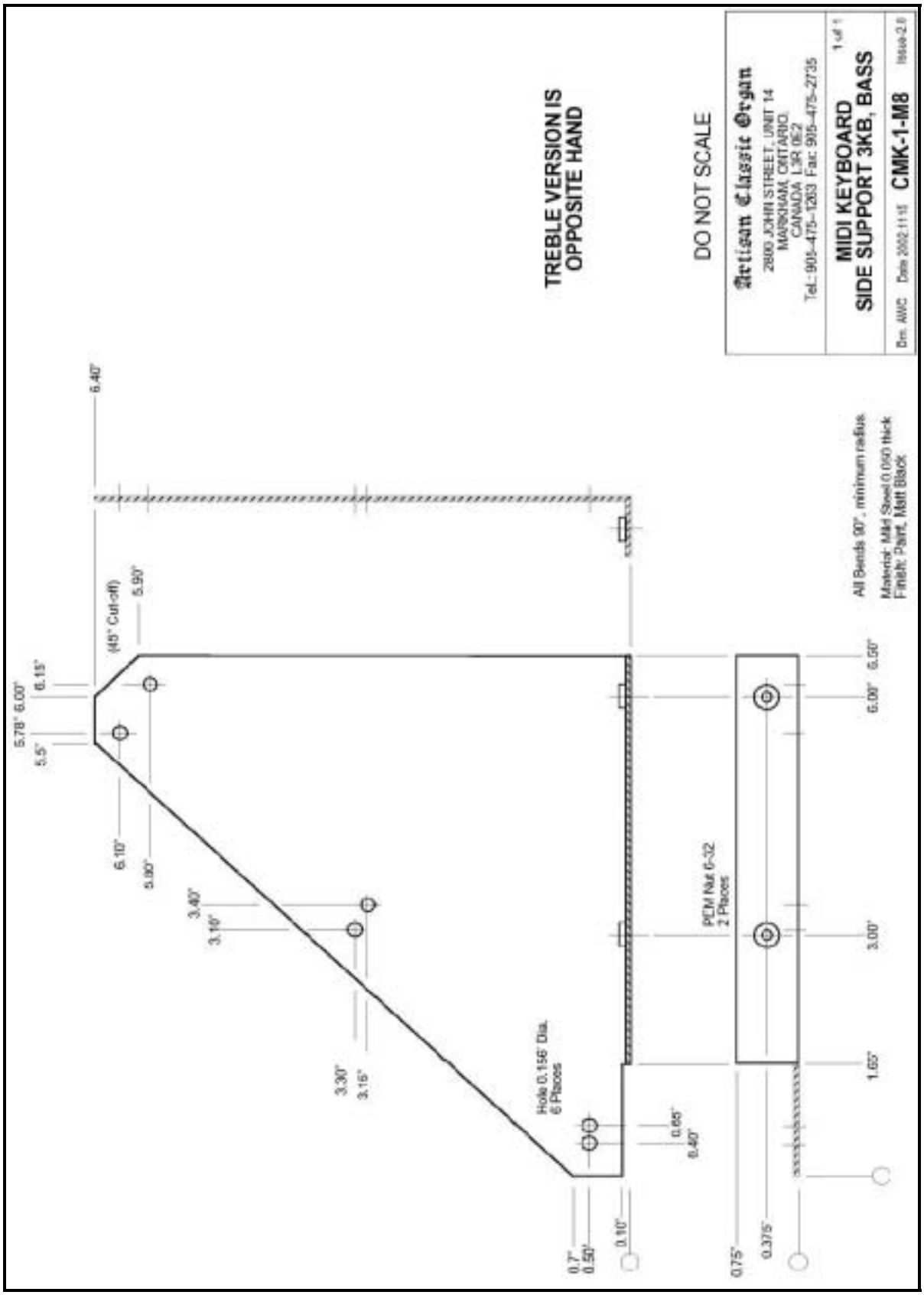

Figure 66: CMK three-manual mounting bracket mechanical drawing

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