

USER'S GUIDE for the
200e
ELECTRIC MUSIC BOX

by the staff of
Buchla and Associates

Introduction

20110308

Welcome to the 200e system. These notes will acquaint you with things to avoid, installation and registration instructions, and some matters of general concern, to be followed by individual descriptions of the various modules.

Registration

Please return the registration card accompanying these notes. You will be advised of new modules and software revisions as they become available. Your identity will not be revealed to third parties.

Important Safety Precautions

Do not disassemble this equipment. Refer all servicing to a qualified service engineer. But if you insist (or if you're definitely qualified), be sure to follow the next advice.

When installing, removing, or exchanging a module, please be certain to turn off the power supply. These modules are not designed to tolerate "hot patching" – power must be turned off before plugging in or unplugging modules.

Do not use the 200e system near water; do not take it into your bath, sauna or hot tub. Take care not to spill liquids on or into the 200e.

Locate the 200e away from heat sources such as radiators, fireplaces, stoves or solar cookers.

Exercise close supervision when using the instrument near children or when children are using it.

The 200e's power supply is for indoor use only. Do not use a damaged or alternate supply.

Refer all servicing to qualified personnel. There are no user serviceable parts or adjustments inside the 200e.

Installation

Retrieve the system from its case or carton, saving all packing materials, and confirming the presence of a power supply with an a.c.cord, a memory card, lots of patchcords, two thumbnuts (for locking the cabinet open) and this user's guide. If your system contains a model 225 MIDI/Preset or a model 206 Mixer/Preset module, you should also expect to find a USB firmware card. If anybody's missing, inform your source of the shortage.

Place the system on a flat surface with the handle pointing to the rear and the hinges and little blue connector toward the top. Extend the support feet and unfasten the rubber latches on either side. Now unfold the system.

If your system contains a 227e, the system outputs will be located on the back of the top row of modules. Connect standard 1/4 inch phone cords to your sound system. If a stereo system, 2 wires will be needed – use the top two connectors. If a quadraphonic system, connect the rear channels to the lower pair of jacks. If you don't have a 227e, you can use any signal output – the outputs of a 206e or the common output of a 292e would be a good choice. For this, you'll need 1/8 inch miniplugs. If you would like, you can stabilize the cabinet by using the two provided thumbnuts.

Connect the supply input to your a.c. supply (110 or 220 v.a.c.) and its output to the jack on the back of the center row. Turn on the switch (toward the power input connector). A bunch of LED's should light up, indicating success in this portion of the endeavor.

Bugs and New Features

Please send us your comments on features you'd like to see and bugs you encounter, as well as areas you'd like further explained. Be sure to send us your registration card so we may keep you updated.

Here is a current list of bugs and not-yet-implemented features:

Initial conditions will be improved in several modules.

Other modules await a feature effective only if your system has no model 225e MIDI/preset or 206e Mixer/preset. In systems without a 225e or 206e, the remote switch will be able to store the current preset, that on turnon, will be automatically called. Presently, just a few modules include this feature.

Common Stuff

Before getting in to the details of particular modules, lets pursue some items that all 200e modules share in common. First the connections.

Like its predecessors, the 200 and 100, the 200e series differentiates between control voltages, signals, and pulses. Control voltages are used to specify parameter levels, range from 0 to 10 volts, and are interconnected with banana jacks and cords. Pulses are used for timing information, and have two levels. 10 volt pulses transmit only transient information, while 5 volt pulses carry sustain information. Pulses also employ banana interconnections.

Signals are the raw material of electronic music, and ultimately become the sounds we actually hear. They are nominally 1 volt in amplitude, but can range from infinitesimally small to 20 db in excess of the nominal. Signals are

connected via 1/8 inch miniphone connectors and shielded patchcords. Note that both types of patchcords are color coded to indicate their length, a handy feature in complex patches.

Banana receptacles are color coded to indicate their function. Control voltage inputs are generally black, sometimes grey. C.V. outputs are generally blue, sometimes violet, and occasionally green. Pulse inputs are always orange – pulse outputs are invariably red.

Each 200e module contains a switch titled “remote enable”. When the LED associated with this switch is off, the module functions exactly as expected – when on, magical possibilities arise, further explained in the 225e description.

Knobs of the 200e series don’t function as regular knobs. When recalling a new preset, the value of an underlying parameter is not likely to agree with the knob setting. But fear not. Turn the knob in the normal fashion, and the value will change in the same direction, eventually catching up with the knob setting.

To allow improvements in firmware, we’ve come up with cards that can upload the various modules with the latest firmware versions. With the power off, insert the card; then while holding a module’s reset enable switch, turn on the power. 281’s are loaded twice with the same firmware card, depressing the quad enable switches instead of the remote enable switch. Similarly for the 256e, with the breakpoint switches for sections A and C serving to load this unit’s two computers. The 225e is actually two completely separate modules. The top one, the 225M, is loaded as usual, using the remote enable switch; the bottom module, the 225P has no remote switch. Use the data switch instead. Same for the 206e. The 285e has a computer for each section, with the reference select switches choosing the section. This module uses firmware cards 285F and 285B for the two sections. The 223e has two computers; 223A is loaded by holding down the green “clock” button and 223M is loaded with the “remote enable” button.

Wait up to two minutes or until the module’s lights return to their normal state.

News flash

We’ve just introduced the USB firmware card, which replaces the above described memory cards, allowing firmware to be downloaded from our website. The memory cards will continue to be used for preset storage.

And now for descriptions of individual 200e series modules.

Description - model 206e Mixer /Preset Manager

110427

A dual function module, the top section is a 6 in by 2 out mixer; the bottom section of the 206e is a replica of the 225e Preset Manager.

Mixer

The mixer portion features pan controls for each channel. Channels 1 and 6 are voltage controlled, while channels 2 – 5 are set with dedicated knobs. Note that channel 1 is, by default, directed to the left output; an increasing voltage will move its signal toward the right. Channel 6 behaves similarly, but with reversed response. Gain adjustments are provided for each input channel. Output levels for the left and right output channels are monitored with LED VU meters, with + 10 db levels occurring just prior to clipping.

A headset monitor is also provided. Its level is not stored as part of a preset.

To connect or disconnect this module from the central library function, push the remote switch. The lighted LED signifies a connection..

The 206e settings may be locally stored and subsequently recalled by the Preset Manager, described below.

Sharing the same panel, but completely independent of the mixer is a facility for Managing Presets and for Firmware Updating. First, we'll deal with

Managing Presets

Each 200e series module has a built-in processor that can read the module's knob settings and switch positions. On command from the manager these data are stored in the module's local memory as part of a global preset. A number (with optional name) is assigned to this preset, which can subsequently be recalled by transmitting its number to all the modules in a system. In this fashion, a user can store up to 30 presets - each can be retrieved by simply transmitting its number to all the modules in a system.

Now obviously, a knob (without a motor) cannot indicate the value of its associated parameter. It has a mechanically (indicated) value, but what we experience sonically is the underlying (virtual) value most recently received from the manager. The dilemma is resolved by persuading the virtual value to "catch up" with the indicated value. When you move a knob, this virtual value will change faster or slower than normal, but in the same direction as you turned the knob, eventually causing the virtual and indicated values to agree. (Some modules implement an earlier version of the knob catcher, doing nothing until the user catches the underlying value. We'll update these.

Switch settings are simpler; LED's show the true status of each switch.

You found that mouth-watering sound you want to save for posterity (or at least tomorrow's gig). Here's how to save it as a preset:

With the mode switch (under the word "DATA" - lower right corner), choose "select". The first line of the display contains the current (last recalled) preset number followed by a name (if named). The second line points to a memory location (from 1 to 30). Use the data wheel to select a memory location for your preset, and with the system remotes enabled, press the store button.

Once stored in memory, a preset may be named (or renamed). To name the preset, hit the mode switch, illuminating the "name" LED. Use the "last" and "next" switches to direct the cursor position, and the data wheel to select desired characters. When naming is complete, push the mode switch 5 times, passing through "global" and returning to "select".

Selecting a preset is equally simple. With remotes enabled, choose a desired preset with the data wheel and hit "recall". The chosen preset will appear in the first line of the display (the "current" preset), and your system will assume the appropriate state. Pulse inputs or switches (last, next) can be used to decrement or increment a memory address. Doing so recalls the preset from memory; both lines of the display are updated to the new preset.

You can use the mode switch to display global settings (apply to the system - not to individual presets). The first global display controls the setting and clearing of the remote status of all the modules in a system. The command is sent when the cursor is in the status field and the data wheel is turned. This is a convenient way to change the system status with a single knob.

```
Remote Status  
Base Channel: 16
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The next global entry is the base channel. The preset manager responds to MIDI program change messages received on the specified base channel. A blank here disables this response to program changes.

Another global entry adjusts the display contrast for both the preset manager and the MIDI decoder. Use the "next" key to cursor to the Disp field and set the contrast for best viewing.

```
Disp Contrst: 3  
Format Card
```

A facility exists to store presets on a card. If the card is new, it must be formatted, accomplished by inserting it in the memory socket, moving the cursor to "format card" and rotating the data switch.

The next entry allows one to move presets or groups of presets. Pick the desired range for the source presets and the desired range for the target.

<u>16-30</u> to <u>1-15</u> <u>C</u> opy <u>E</u> xchange
--

Make your choice, choose “Copy” or “Exchange” , and turn the data wheel.

Groups of 15 presets may be stored and retrieved from the card:

<u>C</u> opy Crd > 16-30 <u>C</u> opy 16-30 > Crd
--

Current settings can be altered by moving knobs or switches. Such actions will not alter the underlying stored values; a blinking LED indicates that the current preset is not stored. If the 206e's *store* switch is pressed, the current state of modules with remotes enabled will be read into the current memory location.

Next we'll deal with Firmware Updating.

A sustained press on most module's remote enable switch will display the module's current software version on the preset manager's LCD. But there are some exceptions. One is the 281e – this module has two computers, both requiring the same software. For the upper computer, push the “Quadrature A-B” switch, and for the lower use the “Quadrature C-D ”switch. A second exception is the Preset Manager. Lacking a remote switch, we use the “select” switch to accomplish the same function. A third special case is the 256e. This module also has two computers executing identical software. Access the top one by pressing the “A” breakpoint switch and the bottom one by pressing the “C” breakpoint switch. The 285e is the fourth exception – use the reference select switches to select the section you'd like to deal with

In addition to the firmware version, this action displays a module's I.D. (if applicable), which is set with DIP switches on the back of the module. These switches are normally set at the factory, but in times of desperation can be altered by the user. Contact Buchla and Associates for instructions.

To update a modules firmware, first shut down the system and insert the appropriate memory card (will have module type and software version number). The 206e takes two cards, one is labeled 206M (for mixer), and the second is the 225P (for Preset). Then, while holding the module's remote enable button (or its substitute) closed, turn on the system power. Release the button in two or three seconds. The new firmware will be transferred to the selected module. The procedure will take up to two minutes, so be patient. When finished, the module will assume its initial state.

Please note that the same card (225P) is used to load the Preset Managers on both the 206e and the 225e. That's because they're identical.

Description - model 207e Mixer / Preamplifier

207110427

A dual function module, the top section is a 6 in by 2 out mixer; the bottom section is a microphone preamplifier, to be described subsequently.

The mixer portion features pan controls for each channel. Channels 1 and 6 are voltage controlled, while channels 2 – 5 are set with dedicated knobs. Note that channel 1 is, by default, directed to the left output; an increasing voltage will move its signal toward the right. Channel 6 behaves similarly, but with reversed response. Gain adjustments are provided for each input channel. Output levels for the left and right output channels are monitored with LED VU meters, with + 10 db levels occurring just prior to clipping.

A headset monitor is also provided. Its level setting is not stored as part of a preset.

The bottom section of the 207e is a preamplifier. Gain is switch selectable, with a sustained press (1 second) toggling the phantom power for all the channels.

An envelope follower with c.v. output is also provided; LED's indicate low, normal and clipping levels.

To connect or disconnect this module from the central library function, push the remote switch. The lighted LED signifies a connection..

The 207e's settings may be locally stored and subsequently recalled by the Preset Manager, a portion of both the 206e and 225e modules.

Description - model 210e Control Voltage and Signal Router 210071215

This module directs the routing of eight control voltages and eight audio signals. The two sections function independently. Originally conceived of as an aid to store and retrieve patch routings, the 210e evolved into a module with additional capabilities.

In the control voltage section, each of five outputs can be connected to any one of eight inputs (the functional replacement for a patchcord). If more than one input is routed to an output, the result is the sum of the applied values.

Similarly, the signal routing section allows connection of each of five outputs to any one of eight inputs (patchcord emulation). Additionally, this section provides the possibility for matrix mixing, in which an output can respond to multiple inputs, with each connection independently scalable.

To route a control voltage, use the lower input/output select switches to choose the desired input and output (crosspoint); use the level knob to establish the degree of connection. A direct, full scale connection is indicated by both LED's being lit. A lesser connection has just one LED on. Note that multiple inputs can be connected to a single output; the output will be the sum of the scaled inputs. A push of the level knob will immediately connect the signal at full level or disconnect it (at no level).

To route an audio signal, use the upper select switches to choose a desired input and output; the amplitude knob selects the desired signal level. Lower than full scale settings are indicated with an orange LED; unity gain and larger with both LED's. A single red LED indicates the maximum amplitude, 10 db more than unity gain. Multiple inputs connected to a single output are mixed (summed). (To emulate a patchcord, select just one input per output and set its amplitude to unity gain.) A push of the knob will immediately connect the signal at full level or disconnect it.

Use the solo switch to audition the effect of a single input; other inputs will be disconnected in this mode. Additionally, the solo switch turns the entire display into an indicator of the coefficients associated with the 5 selected inputs for both the signal and the control voltage inputs. The thresholds for the LED's are .2, 1.6, 3.0, 4.4, 5.8, 7.2, 8.6, and 10.0. Or thereabouts. The display is a multiple bar graph, with all LED's below the set one illuminated. Reset the solo switch to escape this display

Patch routings and level settings may be locally stored and subsequently recalled by the model 225e or 206e preset manager.

To connect or disconnect this module from the central library function, push the remote switch. The lighted LED signifies a connection.

Description - model 222e Kinesthetic Input Port

222100729

The 222 Kinesthetic Input Port senses a performer's gestures and transforms them into control voltages for subsequent control of 200e systems. Two classes of gesture are sensed – one is the touch of a surface, and the other is the position of the hands in space. The two will be discussed separately, as they are somewhat independent.

Tactile sensor

The tactile surface consists of 27 individual keys, whose responses can be programmed by the user to generate pulses, programmed control voltages, pressure and impact responses. Some keys can respond to the location of a finger along the key, and two are sensitive to 2 dimensions. Two are dedicated to control of the spatial sensors; their function will be described. All keys contain LED's to indicate their status. Programming is accomplished with the aid of an LCD, whose states are changed with a "page" key.

The first page deals with singular pulses:

Puls	1:Ta	2:d
3:u	4:Tc	5:Tg

Use the cursor key to select the desired pulse, the nature of the response you'd like, and the key you'd like to serve as the source. A blank in the first position of the field causes a pulse to be delivered upon touching the key; a T causes a toggled response, with alternate touches reversing its state. The second position selects the actuating key by either turning the data wheel or by simply touching the desired key.

The next page is one of four "radio" pages (named for a scheme for selecting stations on prehistoric car radios).

Radio:6	ky:g	Loc
CV1:334	CV2:999	

Select the desired page with the data entry knob. Cursor into the "ky" field and capitalize it with the data entry knob to display the keys assigned to the current page. Enable desired keys by simply touching them. Disable them with a second touch. To escape from this mode, cursor to the "ky" field and with the data entry knob, decapitalize it.

The next field provides a choice of voltages that will be presented at the green jacks. Select between Loc, Prs, and Imp (location, pressure, Impact).

A control voltage varying between 0 and 9.99 volts will appear at the violet outputs (the decimal point is not displayed). Cursor into this field to change the programmed voltage. The next field allows a second voltage to be

programmed that appears at the blue jacks. Alternatively, the blue jacks may present location – turn the data knob to the extreme left to access location.

The bottom row of jacks provides access to Location, Pressure, or Impact from individual keys. Each output can respond to a single key with Location, Pressure, or Impact. Use the cursor key to select the data field and the data knob to select the data type (L, P, or I) and the key identifier.

The next page allows the display contrast to be adjusted for optimal viewing. Pick a number between 0 and 7.

The 222e can implement polyphony by stealing radio outputs. Page to:

Polyphony off

Use the data entry knob to select from two to four voices. The display will indicate which of the radio outputs have been “stolen” for application to polyphony. These pages will become unavailable for editing, because they will use the parameters from radio output 6. Their outputs will be used to implement polyphony.

The final page allows us to determine the effect of the two small keys located on the upper left and the upper right corners of the keyboard. The status of these keys determines whether the rings are engaged or not.

**L:Sustain rev
R:Toggle**

The keys can be switched from the toggle to the sustain mode, and thus determine the effect of the rings. If the R (of rev) is capitalized, then the effect of the keys is reversed, with the left key controlling the right ring, and the right controlling the left. All of which brings us to the:

Spatial sensor

222/2

Start by charging up the rings by plugging them into the provided USB wall chargers. The rings will glow red to show they are charging. To power them on, unplug them from the charger and use the switch on the side.

Fasten the rings to your fingers with the Velcro straps, adjusting them as needed for comfort. The red strap identifies the left ring; the green identifies the right (nautical conventions). The rings are conveniently attached to the first knuckles of the index fingers, with the little windows facing away from the body. The buttons at the center are the switches for the rings. They are easily touched with the middle fingers, but other configurations are possible.

The shape of the performance space is sort of a square cone radiating from the square window on the front of the 222 control module. The range is from about 4" to around 5', with a lateral and vertical space proportional to the distance. An orange LED is illuminated whenever a ring is in the field.

Note that the LED's on the control keys must be illuminated for pulses and control voltages to be produced. This is the default value when the 222e powers on

The left – right position of a ring in the field determines the voltage emanating from the horizontal jack on the panel. As a performer moves his hand to the right, this voltage will increase from 0 to 10 volts. Similarly, a vertical movement will increase the voltage at the vertical jack. As you move your hand toward the window, the proximity voltage (purple jacks) will increase to ten volts. Note that the voltages will not change when you exit the cone. Touching the switch will produce a pulse at the red jack, accompanied by illumination of a red LED.

The expected battery holdup time is about two hours. When the battery light stops blinking rapidly, the battery will assuredly decay in less than one hour.

When patching the 200e system, be careful not to occlude the optical path between the sensor and the hands – otherwise the signal will be interrupted unexpectedly.

All parameters (including key maps) may be locally stored and subsequently recalled by the model 225e or 206e preset manager.

To connect or disconnect this module from the central library function, push the remote switch. The lighted LED signifies a connection.

Description - model 223e Tactile Input Port

223110128 1/4

The 223 Tactile Input Port is a mutation of the 222e Kinesthetic Input Port; it drops the ring sensors in favor of a simple arpeggiation function. We'll deal first with the tactile surface and its outputs; then with the arpeggiation.

Tactile Surface

The tactile surface consists of 27 individual keys, each containing an LED for status indication. Responses can be programmed by the user to generate pulses, programmed control voltages, pressure and impact responses. Some keys can respond to the location of a finger along the key, and two are sensitive to 2 dimensions. Programming is accomplished with the aid of an LCD, whose states are changed with a "page" key.

The first page deals with singular pulses:

Puls	1:Ta	2:d
3:u	4:Tc	5:Tg

Use the cursor key to select the desired pulse, the nature of the response you'd like, and the key you'd like to serve as the source. A blank in the first position of the field causes a pulse to be delivered upon touching the key; a T causes a toggled response, with alternate touches reversing its state. The second position selects the actuating key by either turning the data wheel or by simply touching the desired key.

The next page is one of four "radio" pages (named for a scheme for selecting stations on prehistoric car radios).

Radio:6	ky:g	Loc
CV1:334	CV2:999	

Select the desired page with the data entry knob. Cursor into the "ky" field and capitalize it with the data entry knob to display the keys assigned to the current page. Enable desired keys by simply touching them. Disable them with a second touch. To escape from this mode, cursor to the "ky" field and with the data entry knob, decapitalize it.

The next field provides a choice of voltages that will be presented at the green jacks. Select between Loc, Prs, and Imp (location, pressure, Impact).

A control voltage varying between 0 and 9.99 volts will appear at the violet outputs (the decimal point is not displayed). Cursor into this field to change the programmed voltage. The next field allows a second voltage to be programmed that appears at the blue jacks. Alternatively, the blue jacks may present location – turn the data knob to the extreme left to access location.

The bottom row of jacks provides access to Location, Pressure, or Impact from individual keys. Each output can respond to a single key with Location, Pressure, or Impact. Use the cursor key to select the data field and the data knob to select the data type (L, P, or I) and the key identifier.

The next page allows the display contrast to be adjusted for optimal viewing. Pick a number between 0 and 7.

The 223e can implement polyphony by stealing radio outputs. Page to:

Polyphony off

Use the data entry knob to select from two to four voices. The display will indicate which of the radio outputs have been “stolen” for application to polyphony. These pages will become unavailable for editing, because they will use the parameters from radio output 6. Their outputs will be used to implement polyphony.

Arpeggiation

An integral part of an arpeggiator is a beat clock. The clock source is selected with the “clock” button. The 223e features three possible clock sources.

- 1) Ext – In this mode the arpeggiator will step with each pulse received in the “pulse” input.
- 2) Int – In this mode the arpeggiator will step based on eighth notes counted by the internal clock. The tempo is set with the “tempo” knob and is continuously variable from 42 to 480 BPM. An applied voltage into the “cv in” input can modulate the clock frequency.
- 3) MIDI – In this mode both clock LED’s are off. The arpeggiator uses the MIDI clock, internally transmitted from the 225e. The tempo knob selects the divide ratio applied to the MIDI clock. The available divisions are:

a) quarter note	e) sixteenth note
b) quarter note triplet	f) sixteenth note triplet
c) eighth note	g) thirty-second note
d) eighth note triplet	h) thirty-second note triplet

Each range corresponds with a light on the LED ring around the tempo knob. An applied voltage to the CV input can modulate the division.

It is essential to select the keys to be arpeggiated and to determine the control voltage associated with each key. To select the keys available for arpeggiation, first hit the “page” key ‘till the “ARPEGGIATION” LED is illuminated. The following display will appear:

Arpeggio ky: a
CV:0 Tr:1 275

Cursor to the letter a. Now play a key that you’d like arpeggiated. Its letter name will appear. Turn the data knob clockwise, thus capitalizing the name. Play each of the keys to be arpeggiated, turning the data wheel after each entry. Turn it counter-clockwise to remove the selected key from the group.

To expediently create a group of keys to be arpeggiated, cursor to the ky field and turn the data wheel clockwise, thus capitalizing KY. Now simply play each key you’d like in the group. Its LED will illuminate. Another tap on the key will remove it from the group and extinguish its LED.

The second line displays the control voltage originated by a selected key. Cursor to the CV and use the data wheel to select a control voltage from 0 to 9.99 volts. Do this for each key in the group. The second field on this line selects one of four transpositions applied to the entire keyboard called Tr:1, Tr:2, Tr:3, and Tr:4. Tuning is accomplished by turning the data wheel to select a voltage which will be added (or subtracted) to the global arpeggiator output.

A second display, accessed with another strike of the “page” button, permits selection of one of five patterns:

Rising
Fde in:10 out:10

There are 5 patterns, displayed on the first line as follows:
Rising, Falling, Triangle, Random, and Spiral.

The first three patterns order the selected notes and then play them, ascending, descending, or both, depending on the pattern. The Random pattern employs a pseudo-random number generator, and the Spiral pattern plays notes in a semi-regular pattern, usually playing each note once, before the first is repeated.

The second line of the display shows the in and out fade times. Time choices are in seconds and are .5, 1, 2, 3, 4, 6, 8, 10, 15, 20, 25, 30 for both the in and out fields. The fade voltage is a ramp from 0 to 10 volts applied to the “level” output. This may be patched to the velocity input of a 292e dynamics

manager. Fade in occurs when the run key is engaged (green); fadeout when unengaged (red). Note that the arpeggiation pattern and the pulses continue until the fade voltage reaches zero, at which time the run LED is extinguished.

To create and hold an arpeggiation pattern, press the “*add note*” button – its LED will turn green, and the run LED will turn green. Press keys to add them to the arpeggiation pattern. No need to sustain the keys – simply touch them to accumulate a pattern. To delete keys from the pattern, either press and release the delete key, then touch the single key you wish to delete, or hold the delete key, and simultaneously touch each key to be deleted. To ‘lock’ a pattern, press the “*add note*” button again; its LED will turn red. This maintains a pattern while freeing keys for other applications. Pressing the “*add note*” button again will return it to the green (unlocked) mode.

Note that the “*R*” and “*S*” keys cannot be enabled for arpeggiation, and that the small hex keys at the top left and right of the keyboard can be used to select the next and previous transpose values.

All parameters (including key maps) may be locally stored and subsequently recalled by the model 225e or 206e preset manager.

To connect or disconnect this module from the central library function, push the “*REMOTE ENABLE*” switch. A lighted LED signifies a connection.

Description - model 225e MIDI Decoder / Preset Manager 225110427

The 225e MIDI decoder translates incoming MIDI messages into analog voltages and pulses. These control signals appear on three kinds of "busses" for subsequent distribution to 200 series modules. Four busses are routed internally to 200e series modules that respond directly to MIDI messages. Four more handle only note messages, decoding them into front panel voltages that represent pitches, velocities and pulses with sustain information. An additional six busses handle controller and clock messages (two controllers each), which are translated into standard 10 volt control voltages.

Dedicated internal busses are called A, B, C, and D; note messages are applied to busses E, F, G, and H; busses J, K, L, M, N, and P handle controllers and clock. Seven module types are assigned to internal busses and will respond to note, controller, and clock messages that are appropriate to their function. These modules are the 259e, the 261e, the 281e, the 292e, the 223e, the 250e, and the 251e

Each bus responds to one selected MIDI channel; more than one bus may be assigned to the same channel, allowing multiple controllers and note messages to be derived from a single MIDI channel. Note that assignment of more than one bus to the same channel results in a polyphonic response.

To select a bus for assignment use "bus select" to illuminate the LED next to the desired bus. For busses A -H, the following display will appear:

Bus:A Ch:15 Poly
Tr:24 FT:75 V1:/

With the cursor buttons, select a data type. Use the knob to the right of the cursor buttons to enter data. The first type is the channel number; Incoming MIDI messages on this channel will be transmitted on this bus. Channel number 0 leaves the bus inactive.

The next field enables polyphony; when capitalized, the bus operates polyphonically, and note messages are distributed on all enabled busses that are addressed to the same channel number.

The third field causes incoming MIDI note-on messages to be transposed by as much as + or – 2 octaves. Units are semitones.

The fourth field is for fine tuning. A 0 translates to the standard A = 440 Hz. Larger numbers translate upwards in cents (to 99 cents).

MIDI note messages include velocity information. Normally, this information is sent unaltered to a model 292 Dynamics Manager, but if desired, non-linear transformations can be applied to velocity. Velocity curves are displayed graphically, with the normal linear response displayed as /, and other

responses displayed as slanted or bent lines. Reversed velocity responses are particularly useful for implementing voltage controlled cross-fading.

When a bus is selected from the range J - P, the following appears:

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Bus:J Channel:15
Cntrlrs:100:127
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The last two fields specify the controllers numbers assigned to the selected bus. Controller numbers may be arbitrarily chosen, but keep in mind that some fixed controllers on busses A - D are routed to certain modules internally.

If Channel is set to "Clock" (after 16 and before 0) a different interface is displayed:

```
Bus:J Chan:Clock
Div: 1/4 : 3/8
```

The Div fields allow the 225e to generate 10 volt pulses based on rhythmic divisions of an incoming MIDI clock. The numerator represents a count; valid values are 1-8. The denominator represents a note length. Valid values are:

1:	Whole note	8:	Eighth note
2:	Half note	12:	Eighth note triplet
3:	Half note triplet	16:	Sixteenth note
4:	Quarter note	24:	Sixteenth note triplet
6:	Quarter note triplet	32:	Thirty-second note

A pulse is issued after every count of note lengths. In the example above, 1/4 means "every quarter note" and 3/8 means "every third eighth note".

Up to four 259e or 261e Complex Oscillators are assigned to the four internal MIDI busses A - D, and each section of a 292e Quad Dynamics Manager and a 281e Quad Function Generator is also assigned to one of these busses.

Four types of MIDI messages are recognized and routed to appropriate modules. They are:

- 1) Note On messages, which are sent to 281e A and 292e A
- 2) Note Off messages, which are sent to 281e A and 292e A
- 3) Pitch Bend Messages, which are sent to all 259e's and 261e's on a configured internal bus channel
- 4) MIDI Clock Messages, sent to the 223e, 250e's, and 251e's

To restore all voltages and internal parameters to their nominal values, hit "MIDI reset". This also sends "all notes off" and "all controllers off" messages to all channels.

To enable storage and retrieval of your settings as part of a preset, engage "remote enable".

The MIDI interface's settings may be locally stored and subsequently recalled by the accompanying preset manager.

To connect or disconnect this module from the central library function, push the remote switch. The lighted LED signifies a connection.

Preset Manager

Sharing the same panel, but completely independent of the mixer or the MIDI Interface is a facility dedicated to Managing Presets and to Firmware Updating. First, we'll deal with Managing Presets:

Each 200e series module has a built-in processor that can read the module's knob settings and switch positions. On command from the manager these data are stored in the module's local memory as part of a global preset. A number (with optional name) is assigned to this preset, which can subsequently be recalled by transmitting its number to all the modules in a system. In this fashion, a user can store up to 30 presets - each can be retrieved by simply transmitting its number to all the modules in a system.

Now obviously, a knob (without a motor) cannot indicate the value of its associated parameter. It has a mechanically (indicated) value, but what we experience sonically is the underlying (virtual) value most recently received from the manager. The dilemma is resolved by persuading the virtual value to "catch up" with the indicated value. When you move a knob, this virtual value will change faster or slower than normal, but in the same direction as you turned the knob, eventually causing the virtual and indicated values to agree. (Some modules implement an earlier version of the knob catcher, doing nothing until the user catches the underlying value. We'll update these.

Switch settings are simpler; LED's show the true status of each switch.

You found that mouth-watering sound you want to save for posterity (or at least tomorrow's gig). Here's how to save it as a preset:

With the mode switch (under the word "DATA" - lower right corner), choose "select". The first line of the display contains the current (last recalled) preset number followed by a name (if named). The second line points to a memory

location (from 1 to 30). Use the data wheel to select a memory location for your preset, and with the system remotes enabled, press the store button.

Once stored in memory, a preset may be named (or renamed). To name the preset, hit the mode switch, illuminating the "name" LED. Use the "last" and "next" switches to direct the cursor position, and the data wheel to select desired characters. When naming is complete, push the mode switch 5 times, passing through "global" and returning to "select".

Selecting a preset is equally simple. With remotes enabled, choose a desired preset with the data wheel and hit "recall". The chosen preset will appear in the first line of the display (the "current" preset), and your system will assume the appropriate state. Pulse inputs or switches (last, next) can be used to decrement or increment a memory address. Doing so recalls the preset from memory; both lines of the display are updated to the new preset.

You can use the mode switch to display global settings (apply to the system - not to individual presets). The first global display controls the setting and clearing of the remote status of all the modules in a system. The command is sent when the cursor is in the status field and the data wheel is turned. This is a convenient way to change the system status with a single knob.

```
Remote Status
Base Channel: 16
```

The next global entry is the base channel. The preset manager responds to MIDI program change messages received on the specified base channel. A blank here disables this response to program changes.

Another global entry adjusts the display contrast for both the preset manager and the MIDI decoder. Use the "next" key to cursor to the Disp field and set the contrast for best viewing.

```
Disp Contrst: 3
Format Card
```

A facility exists to store presets on a card. If the card is new, it must be formatted, accomplished by inserting it in the memory socket, moving the cursor to "format card" and rotating the data switch.

The next entry allows one to move presets or groups of presets. Pick the desired range for the source presets and the desired range for the target.

```
16-30 to 1-15
Copy Exchange
```

Make your choice, choose "Copy" or "Exchange", and turn the data wheel.

Groups of 15 presets may be stored and retrieved from the card:

```
Copy Crd > 16-30
Copy 16-30 > Crd
```

Current settings can be altered by moving knobs or switches. Such actions will not alter the underlying stored values; an LED indicates that the current preset is not stored. If the 206e / 225e's *store* switch is pressed, the current state of modules with remotes enabled will be read into the current memory location.

Next we'll deal with Firmware Updating.

A sustained press on most module's remote enable switch will display the module's current software version on the preset manager's LCD. But there are some exceptions. One is the 281e – this module has two computers, both requiring the same software. For the upper computer, push the “Quadrature A-B” switch, and for the lower use the “Quadrature C-D ”switch. A second exception is the Preset Manager. Lacking a remote switch, we use the “select“ switch to accomplish the same function. A third special case is the 256e. This module also has two computers executing identical software. Access the top one by pressing the “A” breakpoint switch and the bottom one by pressing the “C” breakpoint switch. The 285e is the fourth exception – use the reference select switches to select the section you'd like to deal with.

In addition to the firmware version, this action displays a module's I.D. (if applicable), which is set with DIP switches on the back of the module. These switches are normally set at the factory, but in times of desperation can be altered by the user. Contact Buchla and Associates for instructions.

To update a module's firmware, first shut down the system and insert the appropriate memory card (will have module type and software version number). The 206e and the 225e take two cards, one is labeled 206M (for mixer) or 225M (for MIDI), and the second is the 225P (for Preset). Then, while holding the module's remote enable button (or its substitute) closed, turn on the system power. Release the button in two or three seconds. The new firmware will be transferred to the selected module. The procedure will take up to two minutes, so be patient. When finished, the module will assume its initial state.

Please note that the same card (225P) is used to load the Preset Managers on both the 206e and the 225e. That's because they're identical modules in the Preset Manager sections.

Model 227e System Interface

227050101

This module performs various signal manipulations, prior to sending them to an external sound system.

There are a total of 8 line level signal inputs. Four are primary inputs, and can be individually located in 2 dimensional space under voltage control. The remaining four appear as a separate four channel mixer with a single output; the inputs may optionally be routed to the four outputs. Indicators are provided to display activity and to aid in accurate bus assignment.

A microphone preamplifier with envelope detector is also provided. The microphone connector is an XLR mounted on the back of the system.

Equalization can be applied to front and rear channels; a spectral tilt function is introduced that can compensate for the high treble energy frequently characterizing electronic sounds.

Individual masters for front and rear are also provided. Monitoring facilities include VU meters on each channel, and a headphone driver for front, rear or all channels.

Main inputs

The left location pots have an effective range of from 30% to 70% of their travel. The right location pots go from 0 to 30%. Either pot switches the location to external control when turned to the clockwise extreme. Note that location is determined by either the pot settings or with externally applied voltages – the two modes do not overlap.

Swirl

Toggle the Swirl switch to enable voltage controlled swirling of an applied sound. The associated green LED will indicate the Swirl mode, in which the meanings of knob settings and applied voltages will be radically altered.

The left location pots now affects the rate of rotation of an applied signal, with center resulting in no movement, and extremes resulting in up to 10 Hz rate in a counter-clockwise (pot at min) or clockwise (pot at max) direction.

The right location pots determine the extent of the effect, with 0 resulting in a static, centered sound, and 10 resulting in a sound traveling around the periphery of the listening space. External control voltages applied when in the swirl mode will add to the pot settings.

Mike preamp

The 227e contains a preamp with envelope detector and level indication. Gain is set in 15db increments with the adjacent switch. The gain is not stored as part of a preset.

Submixer

A switch toggles the submixer in and out of the mix. An LED indicates the status. The all output is always active. Pot settings are not stored.

Headphones

A switch toggles between the front, rear, or all channels. LED's indicate current status, which is not stored.

Main outputs

LED's indicate each of the output levels. 1/4 " phone connections on the back of the system parallel the front – mounted 1/8" jacks.

Remote

To connect or disconnect this module from the central library function, push the remote switch. The lighted LED signifies a connection..

The 227e's settings may be locally stored and subsequently recalled by the model 206e or the 225e preset manager. Note that the settings of the grey knobs are not stored as part of a preset.

Model 230e Triple Envelope Tracker

230101013

This module is in two sections. The top section tracks the dynamics of applied signals, and the bottom section amplifies small signals from an external instrument or microphone. The two sections are normally connected internally, but if desired, they can be used independently.

First we'll describe the workings of the mike preamp, of which there are three. The input connectors accept either Canon XLR's or standard ¼ inch phone plugs. Three gain ranges are provided, indicated by LED's, and selected by quick presses of the "gain sets". The highest (40db) range is usually required for microphones, while instruments will usually thrive with lower gain settings.

Phantom power is available for microphones that require it – switch it on or off by pressing any gain switch for about a second. Phantom power is applied simultaneously to all the XLR inputs, but never to the phone inputs.

Individual microphone outputs are provided, as well as a mixed output. An expansion input allows one to use additional modules to expand the inputs.

Now for the envelope tracker. The three envelope trackers are normally connected to the three mike preamps. These internal connections are indicated by circled "N"'s on the panel. If desired to use an envelope tracker independently, simply patch the its input to whatever source you'd like.

With a signal applied, adjust the "sens" to turn on the orange LED's; if the gain is such that a c.v. output exceeds 10 volts, a red "overload" light will warn you.

The decay times of the envelope trackers are variable from .1 to 10 seconds.

Pulse outputs have two levels in the 200e system. The sustain level is 5 volts, and transients are short 10 volt pulses. Sustained pulses are outputted when the envelope exceeds 5 volts, causing the "action" LED to glow dimly.

The condition for a transient pulse is determined by the state of the "trans" LED. If it is off, transients are generated whenever the sustain threshold is exceeded. If switched on, transient pulses are generated only when a significant c.v. increase occurs, independently of the level. Such pulses cause the "action" LED to flash brightly. Transient signals can thus generate pulses in the presence of background sounds, a particularly useful feature when extracting rhythmic information, as from a drum.

To connect or disconnect this module from the central library function, push the remote switch. The lighted LED signifies a connection.

Model 249e Dual Arbitrary Function Generator (OBSOLETE) 249050628

The 249e consists of two multi-segment function generators drawing from separate data bases, each with its own clocking and addressing resources.

Data base editing

Organized as two 24 stage circular sequencers, each stage stores the values of two control voltages, two pulses, a time value, and some logic functions. The voltages may be interpolated or modulated with externally applied voltages. The time value can be expressed in seconds, beat fractions, or MIDI clock ticks, and can be scaled by an external voltage. Time values can be scaled separately for each output section. Logic functions include the incrementing of loop counters and conditional jumps.

Editing can be performed while sequencers are progressing. There are green and blue LED's that indicate the current stage that each output is on; when in the edit mode, an additional (green or blue) LED illuminates to indicate the stage number being edited. To enter the edit mode hit *edit*; then use the *stage select* to select a stage number. Hit *edit* again to toggle between the two displays; LED's indicate which display is being edited.

To program a voltage, hit *cv1* or *cv2*; an orange LED indicates that the LCD is displaying the voltage; use the data wheel (upper right of the *EDIT FACILITY*) to set it. Voltage range is from 0 volts to 10.00 volts in increments of .01 volts. Above 10.00 volts are codes that cause the outputs to assume the values of external inputs (ext A, ext B, ext C, ext D). If desired, hit *pitch* to see the voltage displayed as a pitch. Pitch range is 0C to 8F# (octave number + pitch). Resolution is 10 cents. Hit *interp* to interpolate voltages 1, 2, or both. (The output will arrive at the specified value in the time specified by the duration.)

Hit *duration* to set the stage time. The following display appears for either "mult" or "duration". Additional activations of the mult switch toggle between the 3 screens; when mult is active (LED on), the data entry wheel selects the ext source (one, extA, extB, extC, extD) in screen 1 and the tempo in screen 2. The duration switch selects between the two MSD's and the two LSD's in screen 1. The data wheel adjusts the values and scrolls through the note values in screens 2 and 3.

SCREEN 1

<u>M</u> <u>u</u> <u>l</u> <u>t</u> <u>i</u>	<u>T</u> <u>i</u> <u>m</u> <u>e</u>	<u>P</u> <u>u</u> <u>l</u> <u>s</u> <u>e</u>
<u>e</u> <u>x</u> <u>t</u> <u>A</u> *	<u>30</u> <u>.00</u>	<u>sec</u>

SCREEN 2

<u>M</u> <u>u</u> <u>l</u> <u>t</u> <u>i</u>	<u>T</u> <u>i</u> <u>m</u> <u>e</u>	<u>S</u> <u>U</u> <u>S</u> <u>T</u> <u>N</u>
<u>T</u> <u>e</u> <u>m</u> <u>p</u> <u>o</u>	<u>200</u> *	<u>1/16</u>

Tempo is expressed in beats per minute, where 1 beat = a quarter note.

SCREEN 3

<u>M</u> <u>u</u> <u>l</u> <u>t</u> <u>i</u>	<u>T</u> <u>i</u> <u>m</u> <u>e</u>	<u>E</u> <u>N</u> <u>A</u> <u>B</u> <u>L</u>
<u>C</u> <u>l</u> <u>o</u> <u>c</u> <u>k</u>	* <u>1/16</u>	

Permissible note values are 1/32, 1/24, 1/16, 1/12, 3/32, 1/8, 1/6, 3/16, 1/4, 1/3, 3/8, 1/2, 2/3, 3/4, whol, 3/2, 2.

MIDI clock counts at 96 per 1/4 note are: 12, 16, 24, 32, 36, 48, 64, 72, 96, 128, 144, 192, 256, 288, 384, 576, 768.

The third field, accessed with another strike of the duration key, determines how a start/advance or a strobe pulse will be handled. When a stage has a SUSTN in it, the progression to the following stage is inhibited by an active pulse. With an ENABL, the stage is enabled, and as long as the pulse is active, the sequence will progress normally. Note that either a high start/advance or a high strobe pulse (or both) cause this behavior.

The "option" key provides a short cut for duplicating time information in subsequent stages. Store the current info by holding the key until its LED is illuminated (takes 1 second). Copy it by accessing the desired stage and hitting the key. Exit with the play switch (or an edit select switch).

Hit voltage 1 to get this display:

<u>C</u> <u>V</u>	<u>1</u>	<u>i</u> <u>n</u> <u>t</u> <u>e</u> <u>r</u> <u>p</u> <u>o</u> <u>l</u> <u>a</u> <u>t</u> <u>e</u>
<u>10.00</u>	<u>x</u>	<u>e</u> <u>x</u> <u>t</u> <u>A</u>

Enter a voltage (range 0.00 - 10.00) and a multiplier. The voltage switch advances the cursor between the two LSD's (.00 - .99), the two MSD's (0 - 10) and the multiplier (1, ext A, ext B, ext C, ext D). The multiplier is normalized to one. The "interp" switch toggles the interpolate field (lower case to UPPER case). Similar for voltage 2. Hit "pitch" to toggle to a pitch representation.

Pulses are programmed by toggling the pulse keys. A stage that generates a pulse has an illuminated LED when addressed.

Stops are programmed and displayed in the same fashion. A programmed stop stops the sequence before a jump programmed in that stage is executed.

"loop" sequences the following 3 displays - the first line displays the count:

```
LoopCounter = 67
```

```
LoopCounter = 67  
Decrement L.C.
```

```
LoopCounter = 99  
Set L.C. = 99
```

"data entry" sets the loop count in the third display

"jump" sequences the following 4 displays and moves the cursor in displays 2 and 3.

```
No Jump
```

```
Jump + 23  
Certainty = 100
```

This jumps relative to the current stage #. The probability of executing a jump may be set from 1 – 100.

```
Jump to stage 24  
Certainty = 85
```

This jumps to an absolute stage #, with a certainty of 85%.

```
LoopCounter = 99  
JmpTo 24 if LC>0
```

Same as above, unless the loop counter =0, in which case it moves to the next stage. Note that loop commands are set on a per stage basis.

Output Sections

Programmed voltages appear at the green or blue banana jacks; their levels are indicated by adjacent LED's. Programmed pulses appear on pulse outputs 1 and 2; an all pulse output occurs for every stage transition.

Time scaling is voltage controllable over a 4:1 range.

Sequencers can be started or stopped with pulses or switch closures. If started already, than pulses or switch closures applied to the start/advance will advance the sequencer to the subsequent stage.

There are three ways to establish the output position of a sequencer. A switch selects one of three addressing schema.

First is x/y, which allows a two dimensional controller to address the sequencer in a continuous circular fashion (with the controls in quadrature).

Next is via a strobe pulse. Pressing the associated switch produces the following display:

Strobe A address
Stage 15

Use the data wheel to select the stage number that a pulse will force. Similarly for the right hand B display:

Strobe B address
Stage 24

The final addressing scheme uses a single voltage to select the stage number. The range and offset may be adjusted up to 24 stages, and the range sensitivity can be multiplied by 10 with the selection switch. This allows an applied voltage of from 0 - 10 volts to scan 24 stages 10 times.

“reset” normalizes the DARF to default values.

250e Arbitrary Function Generator

250110308

The 250e is a 16 stage function generator. Each stage stores two control voltages, which are set with an array of 16 potentiometers. Time values are adjusted with a parallel array of smaller potentiometers, and can serve as a third control voltage. Time can also be synchronized to MIDI clock sent via the 225e. Both control voltages and times can be interpolated, quantized, or replaced with externally applied voltages for selected stages.

Additionally, there are two programmable pulse outputs, as well as a facility for voltage control of stage position. Loop counters associated with each stage can be nested to any level.

Data base editing

Voltages and times can always be edited – just turn the knob associated with each stage to the desired value; to change ranges for either, you must enter the Edit mode, (depress the Edit switch). Turn the center knob to the desired stage, chose the desired time range (one of three) and the voltage range (one of six). Also select the voltage you'd like to operate on (one or two).

Each of the two voltages, as well as the time can be quantized – voltage in .1 volt increments, time in binary rhythmic increments of .01, .02, .04, .08, .16, .32, .64, 1.28, 2.56, 5.12. Time values may be modified through application of an external control voltage scaled from 1/2 to 2. Additional fixed scaling over a range of .25 through 4.0 may be achieved with a dedicated pot. A red quantize LED alerts you that you're very close to the edge of a quantize value. So keep it in the green.

The clock of the 250e can be synchronized to MIDI clock via a 225e. This can be selected on a stage by stage basis by setting the time range to the fourth (blank) value. All modes which require an internal clock to count down (ADV, SUST, ENA) will now wait for an appropriate number of MIDI clock ticks before proceeding. This clock division is set via the small time knob to one of seven values:

- | | |
|---------------------------|-------------------------|
| 1) thirty-second note | 5) eighth note |
| 2) sixteenth note triplet | 6) quarter note triplet |
| 3) sixteenth note | 7) quarter note |
| 4) eighth note triplet | |

If stage 1 is set to use MIDI clock then MIDI start and stop will be obeyed as well. Upon receiving a MIDI start the sequencer will immediately reset to stage 1 for playback. When using MIDI clock the time mult knob and external voltage won't affect the clock division but will affect the interpolation time.

Voltages and times may be derived from external control voltage inputs on a stage by stage basis. Controls for this trick reside in the lower left section. While in the edit mode, select the desired stage number and switch on the time and/or voltage LED's with the associated switches. Be sure to select the desired voltage (1 or 2). The stage pots now change function, choosing which of four inputs to select (follow the scheme of stage 1). A global control ("fix") disables external inputs, storing current values as if they were knob settings.

Pulse outputs are edited on the right side. All stages produce pulses at the "all" output, while pulses 1 and 2 are selected by toggling the associated switches while in the edit mode. Illuminated LED's indicate active pulses.

As an editing convenience, we offer a method of quickly programming identical switch settings in any number of adjacent stages: While in the edit mode, select the value desired for a particular switch, and while still depressing the switch, rotate the edit select through all the stages you'd like programmed to this switch value.

Stage Selection

The 250e offers several schemes for stage selection.

Pulse Mode – This is the default mode for a stage and is indicated when none of the mode LED's are on. A pulse applied to the Start / Adv input or a press of the switch will advance to the next stage.

Advance Mode – This mode is indicated when the "adv" LED is on. The stage will only advance when the time value runs out.

Sustain Mode – This mode is indicated when the "sust" LED is on. The stage will advance when the time value runs out. However, if a gate is applied to the Start / Adv input the stage will pause (sustain). When the gate goes low the stage will continue to run based on its time value.

Enable Mode – This mode is indicated when the "enbl" LED is on. This is the opposite of the Sustain mode; the stage will pause until a gate is applied to the Start / Adv input. At this point the stage will run based on its time value until the gate goes low again.

Stop Mode – This mode is indicated when the "stop" LED is on. This will cause the sequence to stop on the selected stage. A pulse to the Start / Adv input or a press of the button will continue the sequence. Pressing the "stop" button or applying a pulse to the "stop" input will also cause a stage to enter this mode.

In the upper center, we encounter a jump and loop facility, in which the subsequent stage is determined by some programmable logic. While in the edit mode, use the center knob to select a loop's last stage; then hit "set" and

use the center knob to select the loop's first stage. The "jump to" LED's in the bottom of the display will be on here. Hit "set" again to activate the loop counter and dial in the desired loop count. The loop count LED's in the bottom of the display will be on here. Hit "set" to return to the normal edit mode.

A third scheme for stage selection is presented in the lower right section. When in continuous mode, the stage number is determined by the applied control voltage. An offset control establishes the stage number for an input voltage of zero; sensitivity to an applied control voltage is .625 volts per stage. (A full scale excursion of 16 stages corresponds to 10 volts applied control voltage.) When "strobed" is active, the control is sampled, resulting in changes only when a pulse is applied.

Remote Enable

When active, this LED puts the 250e into contact with the preset manager, allowing access to stored preset values.

251e Quad Sequential Voltage Source

251110905

Four independent sequencers, each with a pulse output and control voltage output for each of 99 stages. A separate editing section provides for setting each parameter for a selected sequence; the sequence may proceed while editing a particular stage, or the edit section can track the sequencer, displaying parameters in real time, but disabling edit procedures.

Editing a sequence

To edit a particular sequence, press the sequencer's blue "display/edit" button. The associated LED will ignite, and the stage number it is currently on will appear in the "STAGE EDIT" section. Use "stage #" to select a stage for editing. A press of the *currently selected* "display/edit" switch will terminate the editing mode, the blue LED will commence blinking, and the edit section will display in real time the current parameters as the sequence progresses. *Editing is not possible when in this mode.*

The parameters in the first edit section, "SEQ. EDIT" affect the entire sequence, and not individual stages. (exceptions – "end" & "cycle" are displayed only for the last stage of a sequence, and "sync next" causes the following sequencer to reset to stage 1 whenever it is encountered).

When a number between 6 bpm and 300 bpm appears in the "tempo" field (the usual case), each sequence operates as follows:

Incoming "start" and "stop" pulses control each sequencer's progress. A "stop" pulse stops the sequence at the current stage number. A "start" pulse does one of two things; if there is a value entered for the initial delay, it resets the sequence to stage 1, and starts the sequence after the delay time has expired. If a sequencer has a blank in its initial delay field, then the start pulse merely starts the sequence at the current stage number. A toggle switch performs the same function from the front panel, alternating between green and red LED's, which display the current sequencer mode. When a stop pulse is received, the sequence is stopped.

Other modes besides the internal clock may be used to advance sequences or select their stage numbers. Push the tempo knob to advance through five alternative schemes, all of which assign new and novel functions to the "stop" and "start" pulses:

- b A - “stop” pulses decrement (back) the stage number; “start” pulses Advance it.
- J A - on receipt of a “stop” pulse, the stage number Jumps to the next stage number that contains a “loop begin”; otherwise it jumps to stage 00. “start” pulses Advance it.
- S H - “start” pulses sample the *control voltage* applied to the “stop” pulse; the sampled control voltage is applied to stage selection.
- d i r - a *control voltage* applied to the “stop” pulse is directly applied to stage selection. A ”start” pulse inhibits this activity.
- c l o - “start” and “stop” pulses are ignored. MIDI clock is enabled.

“init delay” delays the sequencer start whenever it receives a start pulse. It does not affect the timing otherwise, being ignored when cycling or looping. The delay is in hundredths of a second, yielding a range from .01 to .99 sec. (Imagine the decimal point).

If nothing is entered in the initial delay (display is dashes), then the start pulse advances the sequence without resetting it.

“reverse” plays the sequence in reverse (retrograde) order. Reverse and sync interact peculiarly. Use them simultaneously at your own risk.

“copy” copies the displayed sequence. With the copy LED on, hit the display/edit button for the sequence that you would like to copy the current sequence to. The copy LED blinks, and the edit section displays the sequence being copied to. Hit "copy" again to complete the copy process.

Similarly for “clear”. With “clear” illuminated, hit the display/edit button for the sequence to be deleted. The “clear” LED blinks; hit it again to complete the transaction. All parameters will be reset to their default values.

To end a sequence, use the yellow button to set an “end” in the stage you’d like to be the last. If desired to repeat the sequence, set “cycle”. Remember that in the cycle mode, “init delay” is ignored.

To use a sequence as a master for the following sequence, set one (or more) “sync next” pulses in the stage(s) you would like the next sequence to start on. Sequence A can thus sync sequence B, and so on, with stage D wrapping around to sync stage A. Synced sequences do honor the initial delay.

In the “STAGE EDIT” section, we set the parameters for individual stages.

First is the interval, entered as a note value from 1/64 to a whole note (1/1). If desired push the button until the 1.5 LED is lit and the displayed note will be dotted (interval multiplied by 1.5). Or push the button again to illuminate “triplt”, causing the interval to assume the time value of a triplet note (interval multiplied by 2/3). If the knob is pressed, a zero interval will be entered, indicating that the stage will be skipped; pressing it again will restore the original interval.

The next display sets the voltage value for the stage, variable from 0.0 to 10 volts, conveniently accommodating oscillators with sensitivity of 1.2 volts per octave. (Each .1 volts adds 1 semitone.)

To achieve a finer control of the 251e’s output voltages, you can set the cents offset from 00 to 99 cents for each stage. This is accomplished by pushing the voltage adjustment knob. The display will *blink*, reminding you that you are setting the number of millivolts to be added to a stage’s output. (A millivolt, if directed to an oscillator with 1.2 volts per octave pitch sensitivity will alter the oscillators pitch by one cent – 1/100 of a half tone.) Push the adjustment knob again to return to the display of volts. *The right decimal point ignites if the output contains a non-zero cents field.*

The next parameter is duration, which determines how long the output pulse lasts, as a proportion of the interval. The choices here are trans, ¼, ½, ¾, and x1, all representing fractions of the total interval. “trans” selects a pulse with no duration, triggering an attack with no sustain. Durations of ¼ and ¾ occur when two adjacent LED’s are illuminated. When all LED’s are off, no pulse appears at the output for the stage being edited.

The next parameter is a loop counter; the LED indicates the first stage in a loop; the numeric 1-9 indicates the last stage as well as the number of loops executed before proceeding to the next stage. In operation, the sequence proceeds until a number is encountered, then jumps back to the first “beg” it encounters. The loop count is decremented each repetition, and on reaching 0, the sequence proceeds and the loop counter is reset to its original value. If the loop number has been set to A, the looping will continue Always, requiring a start pulse to extract you from the infinite loop. Note that if the sequence is running in the reverse mode, the roles of the loop number and the begin stage are reversed.

An additional complexity is the looping of begin points; if a number is inserted in a stage designated as a begin point, then the begin will be honored for that number of loops. When the number is reached, the sequence will jump back to the next loop point, resetting the loop counter to its original value.

The last parameter is the stage number, which is used to select the stage for which information is displayed and edited.

The 251e has the capability of copying information from one stage to other stages. To perform this trick, hit the copy button so its LED is blinking. Now, instead of hitting the “display” button, as we did for copying sequences, hit the switches or turn the knobs associated with the parameters you’d like to copy; the LED’s (or displays) will proceed to blink. Turn the stage number pot to each of the stages you’d like to copy to, depressing it to activate the stage copy. You may hold it depressed while turning it to address contiguous stages. Complete the operation by pressing “copy” again. *Note that when copying a duration value of zero, all three LED’s will blink, and when copying a stage that is neither dotted or a triplet, both LED’s blink, reminding you that this parameter is both zero and primed for copying.*

The Master Clock

All sequencers are driven from a “MASTER CLOCK”. When the bicolor LED is off, displaying neither red nor green, the master clock multiplier is exactly 1, and the tempos for the sequencers will be precisely as indicated. Turning the knob or applying a c.v. to this section will advance or retard this clock, with the maximum advance equal to 1.5 x the indicated tempo and the maximum retardation equal to .5 x the indicated tempo.

All parameters of the 251e can be stored and retrieved as part of a preset. The remote enable light must be on to accomplish this, and either a 225e or 206e preset manager must be present in the system.

Quad Control Voltage Processor model 256e

25609030

This module offers various sorts of control voltage processing, including selection, multiplication, addition, scaling, inversion, and non-linear transformation. Its four sections are identical and independent. A description of section A follows, and is applicable to sections B, C, and D.

The leftmost knob selects between two input voltages, A1 and A2 . To enable voltage control of the selection, crank the knob to 0 and apply a selection voltage to "In Select". A voltage applied to "In Select" replaces the knob, performing the following operation:

$$V_{in} = \text{InSel} \times A2 + (1 - \text{InSel}) \times A1$$

Where V_{in} is the voltage applied to the transformation matrix. For the purposes of the present discussion, the ranges of all input voltages and knob settings are normalized to one. Note that if A1 is unconnected, the input section simply multiplies InSel and A2.

V_{in} is now applied to the transformation matrix, which works as follows:

With no breakpoint specified, 2 LED's will be illuminated, one on the left; the other on the right of the display. A press of the switch adds a single breakpoint, indicated by a third LED somewhere in the display's center.

With the breakpoint switched off, the following function is executed:

$$V_{out} = V_{in} \times V_{10volts} + (1 - V_{in}) \times V_{0volts}$$

This is a simple linear transformation of the input voltage. For zero volts input, the output is set by the knob labeled 0 volts in, and for 10 volts input, by the knob labeled 10 volts in. Other values are interpolated, and the transfer function can be represented as a straight line connecting the two endpoints. The two breakpoint knobs are not operative in this mode.

Now hit the breakpoint switch, and things get more interesting. A breakpoint LED is illuminated whose location can be set with the two knobs to the right of the switch. The resultant transfer function is the two segment line connecting the three points, mathematically represented as:

If $V_{in} < V_{inbp}$,

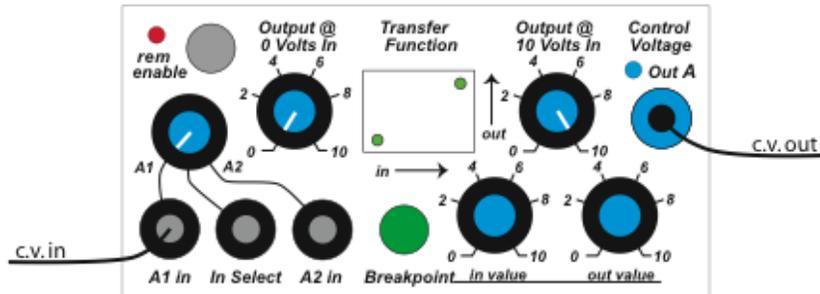
$$V_{out} = (V_{in} \times V_{outbp}) / V_{inbp} + (1 - V_{in} / V_{inbp}) V_{0volts}$$

If $V_{in} > V_{inpb}$,

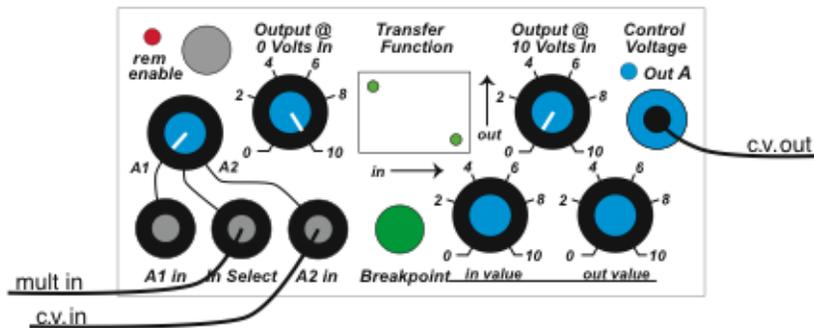
$$V_{out} = [(V_{in} - V_{inbp}) V_{10volts} + (1 - V_{in}) V_{outbp}] / (1 - V_{inbp})$$

Sorry that the algebra looks so messy for such a basically simple process. Perhaps a couple of pictorial examples will clarify things for the non-mathematically inclined.

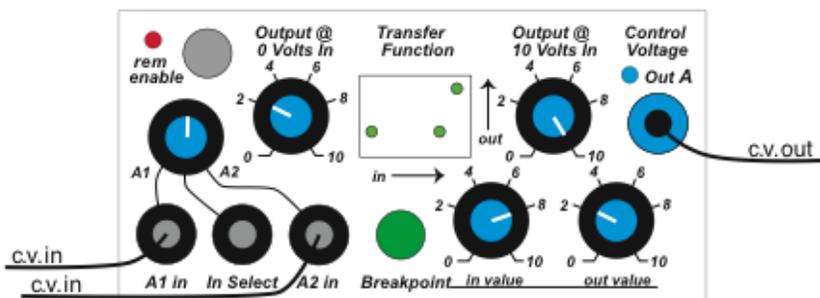
The first example is complete transparency – the 256 does nothing to the applied voltage, and the output is a replica of the input:



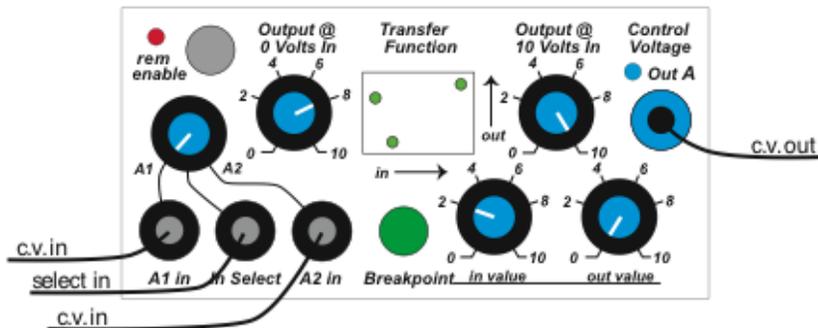
Next we take the product of two applied voltages, and invert the result:



Now add a break point, such that the output stays at a constant 2 volts until the average of two inputs exceeds 8 volts – then the output voltage rapidly goes to 10 volts:



Here we use a voltage to control the proportions of two inputs that are applied to the transform matrix. The output starts at 8 volts, for an applied input of 0 volts, has a negative peak of 0 volts when the input reaches 2 volts, and then goes to 10 volts as the input reaches 10 volts:



Note that the low resolution display provides a rough but useful indication of the transfer function. The actual voltages are calculated to a high degree of precision, and are appropriate for application to pitch and other variables.

Switch status and pot settings of the 256e can be locally stored and subsequently recalled by the model 225e preset manager.

To connect or disconnect this module from the central library function, push the remote switch. A lighted LED signifies a connection.

Note that this module has two computers; when downloading or checking firmware, use the breakpoint switches A and C instead of the remote enable switch.

Model 259e Twisted Waveform Generator

259091109

Formerly called the 259e Complex Waveform Generator, the Twisted version introduces some radically weird timbres. It is definitely not recommended for those over 25 years of age or for anyone with golden ears.

The 259e consists of two separate oscillators. One, the *modulation* oscillator, serves primarily to modulate the second, called the *principal* oscillator.

Modulation Oscillator

The modulation oscillator has two ranges, one in the audio region of 27 to 7040 Hz; the other mostly in the sub-audio, ranging from .25 Hz to 64 Hz. Three classic wave-shapes can be selected (just one at a time), and three modulation targets can be chosen, singly or in any combination.

An F.M. input provides for frequency modulation.

Pitch tracking, when enabled, forces synchronicity with the principal oscillator. With no control voltage applied to the modulation oscillator, its pitch will track that of the principal oscillator. The offset will be zero when the modulation frequency is set to 440 Hz., indicated by an extinguished bicolor LED.

A sync facility permits synchronization to MIDI note-on messages, or to subdivisions of the principal oscillator. Hard sync truncates the waveform; soft sync uses a phase locked loop to achieve synchronization.

Principal Oscillator

The principal oscillator generates a sine wave varying in frequency from 27 to 7040 Hz. The frequency can be modulated with an externally applied signal.

This sine wave is simultaneously applied to two wave-shape tables. The selected tables are indicated with green and red LED's; changes are made with a switch that advances the selection. Switch activations of more than 1 second toggle between selecting the green and red tables. Short activations advance the numbers of the selected tables.

Tables 6, 7 and 8 are actually not tables in the classical sense – they are simply portions of the operating program, full of unpredictable noise and frequent silences. When these tables are invoked, the F.M. controls are re-assigned to table scanning functions and the F.M. inputs become table modulators. This state is indicated on some units by illuminated LED's located above the F.M. controls.

A *morph* voltage pans between the two tables and a *warp* voltage varies the amplitude of the sinusoidal (driving) waveform. Both these functions can be modulated by the modulation oscillator.

MIDI messages can be received by the 259e via 1 of 4 internal busses. Bus I.D. for the module is set with two board mounted switches, and can be displayed on the 225e by holding the remote enable switch closed for about two seconds. The normal settings start at A and go for as many modules as you have (up to D, or four).

A module decodes the pitch (key #) contained in note-on messages originated by the 225e and arriving on its bus. It also responds to pitch bend messages.

As in all 200e series modules, the settings of pots and switches can be locally stored and subsequently recalled by the model 225e or 206e preset manager.

To connect or disconnect this module from the central library function, push the remote switch. A red LED signifies a connection.

(Generally unneeded is a trim procedure for the input potentiometers on the 259e. It eliminates the slight dependency of frequency versus knob setting for both the f.m. modulation knobs and the c.v. multiplier knobs. To invoke this procedure, turn all four knobs to their maximum counterclockwise positions, then press and hold the sync button for about 5 seconds.)

Model 260e Barber Pole Module

26005010

Now just what is a "barber pole" module? A barber pole, used in a bygone era to identify haircutting saloons, is a spiral (resembles a candy cane) that slowly turns around a vertical axis. The actual movement is rotational and horizontal; the perceived movement is vertical, but illusory. The term has been applied to processes in which movement is perceived to occur continuously in one direction, but ultimately there is no net movement (in that direction). The barber pole stems from another service offered by barbers – that of using leeches to suck blood from clients. The blood-soaked rags were laid out in the sun to dry, and the pole is an abstract reminder of the resultant bloody mess.

The term "barber pole" refers to an auditory illusion that can be readily produced by this module. Called the Shepard tone paradox (after its inventor, Roger Shepard), one's perception is that each note in a forever ongoing series of notes is higher in pitch than the preceding note. The illusion works in reverse also, with each note perceived to be pitched lower than its predecessor. M. C. Escher's "Ascending and Descending" is occasionally cited as a visual equivalent of the auditory paradox.

Model 260e Duophonic Pitch Class Generator

Two independent, voltage controlled pitch class generators. (A pitch class generator produces a singular pitch in every perceivable octave.) Frequency modulation inputs and a five band spectrum-shaping facility are provided.

When switched to the "barber pole" mode, an internal computer takes over pitch control of both generators, and issues pulses for triggering an external envelope generator (like a model 281e function generator), which in turn can drive a voltage controlled amplifier (like a model 292e dynamics manager). When the 260e's output signals are gated through the latter, Sheppard tones and other auditory illusions (such as the tri-tone paradox) may be produced. In this mode, only the left f.m. input is active, affecting both oscillator sections. When switched to the "continuous" mode, the right oscillator descends while the left ascends (or visa versa). The rate of change is variable to 2.5 octaves per second in either direction, and is voltage controllable. Additionally, the pitch intervals can be adjusted from quarter-tones to tri-tones.

With its multi-voicing, equalization, and frequency modulation capabilities, you will find the 260e musically more interesting than the standard Shepard tone generator used in perceptual psychology experiments.

Settings of all pots and switches can be locally stored and subsequently recalled by the model 225e or 206e preset manager.

To connect or disconnect this module from the central library function, push the remote switch. A lighted red LED signifies a connection.

Model 261e Complex Waveform Generator

261090804

The 261e consists of two separate oscillators. One, the modulation oscillator, serves primarily to modulate the second, called the principal oscillator. We'll discuss the two oscillators separately.

Modulation Oscillator

The modulation oscillator has two ranges, one in the audio range of 27 to 7040 Hz; the other mostly in the sub-audio, ranging from .25 Hz to 64 Hz. Pitches may be voltage controlled, with variable magnitude and direction. With the multiply knobs set fully clockwise, stretch tuning may be applied as desired (adjustment holes are below to the right of the main tuning knobs).

An F.M. input provides for frequency modulation.

Waveshape is voltage controllable, ranging from sine through square and pulse; a multiplying input varies the degree and direction. Three modulation targets can be chosen, singly or in any combination. Note that *pitch modulation responds only to sinewaves*.

Pitch tracking, when enabled, forces synchronicity with the principal oscillator. With no control voltage applied to the modulation oscillator, its pitch will precisely track that of the principal oscillator. The offset will be zero when the modulation frequency is set to 440 Hz. (indicated by extinguishing the bicolor LED).

A sync facility permits synchronization to MIDI note-on messages, or to subdivisions of the principal oscillator. Hard sync truncates the waveform; soft sync uses a phase locked loop to achieve synchronization.

Principal Oscillator

The principal oscillator generates a sine wave varying in frequency from 27 to 7040 Hz, which is then applied to three voltage-controlled timbre-shaping elements. The *degree* of timbre is variable in offset, magnitude and direction. *Symmetry* and *order* have variable offset and are voltage controllable.

MIDI messages can be received by the 259e via 1 of 4 internal busses. Bus I.D. for the module is set with two board mounted switches, and can be displayed on the 225e by holding the remote enable switch closed for about two seconds. The normal settings start at A and go for as many modules as you have (up to D, or four).

A module decodes the pitch (key #) contained in note-on messages originated by the 225e and arriving on its bus. It also responds to pitch bend messages and to may respond to fine tuning messages as follows:

To respond to MIDI fine tuning messages, the “Ft” field in the 225e’s display must contain something other than a default value of “An” for the bus of interest (buses A – D). This fine tune data is in cents (a cent is 1% of a semitone), and can range from –49 cents to +49 cents. It can be set for each bus, and therefore for each of four oscillators.

Note that if fine tuning is enabled for a particular oscillator, that oscillator’s pitch knob will be incapacitated, as will its F.M. input and control voltage input. Pitch will be completely determined by MIDI signals.

So when you wonder why your oscillators tuning controls seem dead, check the 225e’s fine tuning field for the bus that’s driving your oscillator. You need an “An” in that field to enable analog control.

As in all 200e series modules, the settings of pots and switches can be locally stored and subsequently recalled by the model 225e or 206e preset manager.

To connect or disconnect this module from the central library function, push the remote switch. A lighted red LED signifies a connection.

(Generally unneeded is a trim procedure for the input potentiometers on the 261e. It eliminates the slight dependency of frequency versus knob setting for both the f.m. modulation knobs and the c.v. multiplier knobs. To invoke this procedure, turn all four knobs to their maximum counterclockwise positions, then press and hold the sync button for about 5 seconds.)

Fluctuating Random Voltages

Two independent sections, A and B, generate continuously changing random voltages with voltage controlled “probable rate of change”.

Quantized random voltages

This has two sections, called C and D, that share the shape and number of states. Distribution and time correlation are switch selected, with the following sequence of combinations possible:

<u>Number</u>	<u>Distribution</u>	<u>Time correlation</u>
1	flat	none
2	medium	none
3	medium	medium
4	bell	none
5	bell	high

The number of states is voltage controllable.

Stored random voltages

2 identical units here, called E and F, share three control voltage inputs, called skew, degree, and chaos.

When centered, the skew does nothing to the random voltage, but when turned left or right, the average voltage will move accordingly, with the probability distribution reshaped (skewed in one direction).

Degree establishes the degree of randomness in the output signal.

Chaos describes the shape of the probability distribution. Low chaos would suggest mostly small variations, with occasional large deviations from the norm. High chaos results in all levels of deviation having equal probabilities.

An interesting application for the 266e is the randomization of control voltages. For this, apply the control voltage to the skew input and adjust the degree and chaos for the desired uncertainty.

Settings of all pots and switches can be locally stored and subsequently recalled by the model 225e or the 206e preset manager.

To connect or disconnect this module from the central library function, push the remote switch. A lighted red LED signifies a connection.

Model 267e Source of Uncertainty with Filters

267190412

The Model 267e combines a noise source, two random voltage sources, and two voltage controlled filters.

Noise is dispensed in three flavors. Integrated white noise has a "low" spectral bias (-3 db/octave). Musically "flat" noise has a flat spectrum (constant energy per octave) and is a particularly useful source for subsequent processing. White noise is electrically flat, but musically balanced toward the "high" end of the spectrum (+3 db/octave).

Fluctuating Random Voltages are continuously variable, with voltage control of bandwidth over the range of .05 to 50 Hz, making possible changes that vary from barely perceptible movement to rapid fluctuation. Applied pulses sample these voltages, providing stored random voltages with arbitrarily wide, voltage controlled time correlations. Externally applied control voltages may be passed through unmodified, or may be randomized to any desired extent.

With nothing connected to the inputs, the both filter inputs are normalized to the flat white noise described above. Connect a signal to the input and you're filtering the signal.

The bandwidth adjustment determines the filter's passband, which can vary (inversely) from a few octaves to as little as one semitone. An external voltage can be applied to voltage control the bandwidth.

The frequency control establishes the filter's center frequency, which ranges from 31 Hz to 4 kHz, and can also be voltage controlled.

Both the center frequency and the bandwidth, as well as the amplitude, can be modulated. Apply a signal to the "mod in", and use the switch to select any combination of amplitude, frequency, or bandwidth modulation. The modulation knob and an applied control voltage determine the depth of modulation.

The 267e's settings can be stored and retrieved with a 225e or a 206e preset manager.

To connect or disconnect the module from the central library function, press the remote enable switch. A lighted LED denotes a connection.

Model 272e Quad Polyphonic Tuner

272110904

Four tuners, all sharing a common data base, which consists of 20 "slots", with each slot assigned to an F.M. station. Slots (and therefore stations) can be selected with control voltages, either sampled or continuous.

Antenna setup

Locate the two connectors on the back of the instrument (the same boat the 272e is installed in). One is a standard Motorola antenna socket, the other a blue banana jack. Connect the supplied antenna to these. Power on the system; a red LED should be illuminated on the antenna, indicating that power is applied. Locate the antenna above the system and away from large metal objects.

Station assignment

Press the "auto assign" button to initiate a procedure that automatically assigns the stations with the best signals to the twenty slots. The display will read "scan" until the assignment is complete.

Stations may be assigned manually. Select a desired "slot #" on tuner A and dial in the frequency of the station you'd like occupying that slot. Stations may be deleted; just press "delete" while displaying the station on tuner A. Stations occupying slots above the deleted one will drop down one slot, thus leaving no unfilled slots.

Tuner A serves as a master - it is the only tuner capable of assigning new stations to slots.

Station selection

Stations may be selected with continuous control voltages ("S&H" and "advance" LED's off). With the "slot" LED lit, a tuner's slot# will be displayed and selected with a sensitivity of .5 volts per slot, and the knob can be used to alter the slot number. When "frequency" is displayed, the entire F.M. band is spread over the 10 volt control voltage range, and the accompanying knob may be used to alter the (frequency of slot 0 only).

With "S&H" illuminated, the control voltage will be sampled by an incoming pulse, and with "advance" lit, an applied pulse will simply advance a tuner's slot number.

Polyphony

The 272e incorporates a polyphonic resource, with the four tuners sequentially providing "notes" with variable attack and decay times. The sustain switch offers the possibility of sustaining the "notes" as long as the incoming pulse is above the 5 volt threshold. Red LED's show the status of each tuner.

Settings of pots and switches, as well as station assignments, can be locally stored and subsequently recalled by the model 225e or 206e preset manager.

To connect or disconnect this module from the central library function, push the remote switch. A lighted red LED signifies a connection.

Model 281e Quad Function Generator

281090825

The 281 has four function generators organized in 2 pairs. The following describes the top pair (A&B), but applies to the bottom pair as well (C&D).

The two topmost generators, A and B, normally function independently, but can be paired to operate in a quadrature mode.

Independent operation

A momentary switch selects one of four modes: transient, sustained, cyclic or none. On receipt of a pulse, output voltage A ramps up to 10 volts at a rate determined by the sum of an applied control voltage and the setting of the attack time knob. If in the sustained mode, the voltage will stay high as long as the input pulse is maintained. If not in the sustained mode, or when the input pulse terminates, the output ramps down to zero at a rate determined by the sum of the decay voltage and the setting of the decay knob. If no mode is selected, incoming pulses will have no effect – envelopes will be initiated by internal MIDI signals.

At the end of the decay, a pulse is generated and applied to pulse out A. If in the cyclic mode, the cycle now repeats.

Same for section B.

The time range for both attack and decay is from .001 to 10 seconds. The scale is linear from .001 to .03 seconds (input value from 0 to 3/8), and exponential from .03 to 10 seconds (input value of 3/8 to 1).

Outputs may be OR'd together, with one scaled and one at full value. The OR outputs may be used to establish an initial attack transient followed by a sustain at some lower value. Other applications will occur to you, but keep in mind that the OR levels are not stored as part of a preset.

The quadrature mode

Generators A and B operate in tandem to provide more complex envelopes. The quadrature mode is toggled by a push switch and indicated by LED's near the outputs.

As before, a pulse applied to the A input triggers the attack phase of A. When A's attack is completed, B begins its attack while A stays high. When B's attack is complete, A begins its decay while B stays high. And finally, when A's decay is completed, B begins its decay.

The trigger logic for the quadrature mode is derived from section A. If set to the sustain mode, A will stay high until the end of the initiating pulse. If A is in the cycle mode, the cycle repeats when B's decay ends.

The 281e's settings may be stored and retrieved with the model 225 or the 206e preset manager.

In conjunction with the 225e, the 281e can also monitor an internal MIDI bus, responding to note on and note off messages as well as controller 64 (sustain). To perform this function, the device select switches (on back of unit) must be set to device A. To read the device select code, depress either of the quadrature switches for a couple of seconds. The 225p or the 206p will display "module 281 A1" or "module 281 A2" if the switches are set for A. Additionally, the code version number will be displayed.

Note that to load or display firmware for this module, you must use the quadrature switches instead of the remote enable switch. There are two computers; load each separately, using first one, then the other quadrature switch.

To connect or disconnect this module from the central library function, push the remote switch. A lighted red LED signifies a connection.

For further explanation of the above features, please consult the description of the 225e MIDI/USB Decoder.

Model 285e Frequency Shifter / Balanced Modulator

285090430

The 285e consists of two independent sound processors: a frequency shifter, and a balanced modulator.

Frequency shifter

Shifts the frequencies of applied signals both up and down using either an internal or external reference source. The voltage controllable internal reference frequency can range between 1 and 1 kHz and can be modulated with an applied signal. The external reference can be anything from a simple sine wave to a very complex signal.

This module can generate an interesting illusion of depth, when the outputs are sent to a stereo pair and the shift frequency is set to just a few Hz.

Balanced Modulator

Performs the functions of classic ring modulation, plus adds some new tricks. As in the frequency shifter, the internal reference frequency is voltage controllable, can vary from 1 to 1kHz, and can be modulated with an applied signal. The external reference can be whatever you like, with the complexity of the signal determining the complexity of the outcome.

A second output on the ring modulator can pan between the unmodified input signal and the ring modulated version. This panning may be voltage controlled.

All the settings of this module can be stored and retrieved with the 225e or 206e preset manager.

Note that when displaying the firmware versions or loading new firmware, you must use the reference switches to select the module's section. The module requires two firmware cards, labeled 285F (freq) and 285B (balanced).

To connect or disconnect this module from the central library function, push the remote switch. A lighted red LED signifies a connection.

Model 291e Triple Morphing Filter

291090919

The 291e consists of three voltage controlled filters which can be operated independently or in parallel.

The amplitude, center frequency, and bandwidth of each filter may be independently voltage controlled. Each may be modulated with externally applied signals.

The morphing capability might be described as moving through a series of snapshots of the filter, with each snapshot consisting of a complete description of the filter parameters, and each parameter continuously varying between snapshots. Morphing is accomplished with an applied voltage, or alternatively can be initiated with a pulse, with each stage time independently set. From one to eight stages may be employed.

To edit a stage, select a desired stage with the red edit select switch. A red LED indicates the selected stage, and the green LED in the ninth position signals the play mode. The green switch toggles the play mode. Note that editing can be performed while in the play mode, allowing you to perceive the dynamic effect of changing parameters.

The central switch selects one of the three individual filters (nodes) for editing. Use the rotary encoders to adjust the values for amplitude, bandwidth, and frequency for each node. Note that amplitude affects only the summed output.

These three parameters may be modulated by signals applied to the modulation inputs. Use the switch to select amongst 7 combinations of modulation types, and the rotary encoder to adjust the modulation intensity.

The LCD will display the exact levels as well as the modulation amount:

A: 99 B: 56 F: 3.5k
M: 98 Sust T: 4.0

Morphing

A variety of means for progressing through the filter stages is provided. The control voltage input can serve two functions:

- 1) A voltage applied to the morph input will select a filter stage, with the selected number of stages spread over the 10 volt control range. This mode is enabled with the entry of "control voltage" in the bottom line of the display. In this mode, pulses are disabled, and "control voltage" is displayed for all stages.
- 2) If "control voltage" is not selected, then the applied voltage multiplies the stage time from 1 to 10. The voltage will affect all the stage times.

To automatically progress through the defined filter stages, use the edit select switch to select a stage; then enter a time value for that stage; successive stages will be advanced according to the times associated with each stage, which can range from .01 to 10 seconds.

This assumes that "Free" is entered in the center field in the bottom line. "Cycl" is similar, but loops the filter to the first stage. "Enbl" will permit the stage to be advanced only if an applied pulse is high, extending the time until the pulse goes high. "Sust" is the opposite, permitting advancement only with a low pulse, and inhibiting it when high. A "Puls" or a "Stop" inserted here will unconditionally stop the morphing at the specified stage, waiting for a pulse to advance immediately to the next stage ("Puls") or to the first stage ("Stop").

If the field identifier (a, b, f, or m) is capitalized, the filter will smoothly morph to the new value of the field. If the identifier is lower case, the filter will jump to the new value. Note that the fields are separate; a signal may jump in frequency while its level is slowly changing. The time field determines the stage time in either case.

To move the cursor between the identifiers, and the time field, press the data wheel. A sustained press allows the LCD contrast to be adjusted. Press it again to store the displayed value.

A solo switch, selecting one of the three nodes, proves convenient for editing, and is available when monitoring the all output. An expand input allows ready expansion of the filter; just plug in another 291e for an additional three nodes.

The 291e's settings can be stored and retrieved with the model 225e or 206e preset manager.

292e Dynamics Manager

292050101

Functionally identical to the original 292, with the exception of two new features - the 292e has velocity inputs, allowing controllers to control note volumes with performance gestures. And its settings can be stored as a part of a 200e series preset.

The 292e sports four independent voltage controlled amplifiers. Each has a signal input and output, a control voltage input that varies the unit's gain from -120 to +3db, an offset adjustment, and a velocity input. The latter adds further control to the gain when employed (usually from a controller equipped with velocity output), and has no effect when unconnected.

A three state switch selects one of three operating modes: straight gate (VCA), lowpass filter (VCF), or a combination of the two, in which the spectral response varies as the gain is changed.

Frequency domain gating can impart a dynamic tonal variation to sounds that gives the listener a sense of absolute loudness. This quality is characteristic of all acoustic instruments (the harder you strike, pluck, or blow, the richer the overtone structure).

A mix of the four output signals is also provided.

Gain adjustments and switch positions may be stored for later recall by the Preset Manager, part of the MIDI/USB Decoder model 225e or the Mixer model 206e. A push button switch enables (or disables) this remote connection; an LED indicates the current status.

In conjunction with the 225e, the 292e can also monitor an internal MIDI bus, responding to the velocity byte of MIDI note on messages.

For further explanation of the above features, please consult the description of the 225e MIDI/USB Decoder.

To connect or disconnect this module from the central library function, push the remote switch. A lighted red LED signifies a connection.

296e Spectral Processor

296110930

This is a multifunction 16 channel bandpass filter with separate voltage controlled amplifiers (VCA's) and envelope followers associated with each channel filter. We'll discuss several applications forthwith – you'll undoubtedly come up with more of your own.

Programmable filter

Plug in a signal to either of the cross-connected inputs. It will be connected to all 16 of the filter sections. Press the DISP switch 'till "A levels" is illuminated, and turn the morph control counterclockwise, thus illuminating the orange LED. The three "SPEC-TRUM XFER" LED's should be off. The "all" output is now the sum of all 16 filters, each of whose amplitude response is governed by one of the 16 touch-controlled potentiometers. The unit now functions as a simple 16 channel bandpass filter, with the spectral shape indicated by the illuminated potentiometers. Touch a potentiometer to alter the corresponding filter's response.

Morphing filter

Similarly, select the "B levels", crank the morph control clockwise to illuminate the yellow LED, and adjust the potentiometers to the desired B response. We now have a second response curve stored for the 296e, and we can use the morph control to pan between the two curves. The actual net filter response can be observed by selecting "progrm", while the two curves can be edited by selecting "A levels" or "B levels".

By using a control voltage to rapidly alter the degree of morphing, we can generate interesting new timbres. A knob associated with the morph input ("A/B") determines the control voltage's effect, and a "sig in" allows for audio modulation of the morph level.

Split filter

By monitoring only the odd or even outputs, we've effectively split the filter into two parts, with the odd filters summed to the "odd" outputs and the even numbered filters directed to the "even" outputs. To complete this separation, connect separate signals to the odd and even inputs.

*(The little symbol between the connectors indicates this sort of connection: when only one patch cord is connected, the empty side will **also** receive the applied signal. When both sides are connected, the left side will drive only the odd numbered filters, while the right will drive only the even.)*

Comb Filter

An interesting effect, particularly in stereo, can be created by separating the odd signals from the even. The result is presented at the “*COMB OUTPUTS*”. The level controls have no effect on these outputs.

Spectral display

With the “*DISP*” section on “*envlps*”, the potentiometer LED’s will display the real time spectrum of the applied signal(s). The individual outputs of this display are brought out to banana jacks immediately above the potentiometers. These envelope followers can be routed anywhere a control voltage that responds to a specific range of frequencies is desired. The envelopes contain no frequency components; their “*decay times*” are adjustable, and can be extended for a long time.

With the “*DISP*” section on “*decay*”, a spectrum of decay times is presented; each may be altered with the associated potentiometer.

Voltage controlled filters

The 296e incorporates voltage controlled amplifiers (VCA’s) on each of the 16 bandpass filters. By applying varying control voltages to the VCA inputs (located directly beneath the potentiometers), rather complex dynamic spectra can be realized. The control voltage inputs are displayed in “*progrm*”.

Spectral transfers

By analyzing the spectrum of a sound applied to the “*odd*” input, and applying the spectrum to the signal from the “*even*” input, we can perform a sort of vocoding. To conserve several patchcords, choose “*odd > even*” in the “*SPEC-TRUM XSFER*” section. The necessary connections will be accomplished internally, the appropriate green LED will light, and the signal emerging from the even output will have (approximately) the spectrum of the odd signal input imposed on it. Note that the intermediate operation of simultaneously illuminating both the “*odd > even*” and the “*even > odd*” LED’s exchanges the spectra of the two inputs, potentially resulting in some ridiculous sounds.

You’ll have to use some patchcords to map further correlations. Use the envelope outputs to drive VCA inputs in whatever pattern you conceive.

If you're fortunate enough to possess two 296e's, you can perform a more accurate spectral transfer, eliminating the inaccuracy introduced by the odd/even business. The second 296e will analyze the sound applied to its input, and apply the spectrum to an internal bus. To complete the operation illuminate the "ext > all" LED in the first unit. The spectrum will now be transferred to the signal applied to the input, resulting in a vocoded signal at the "all" output. For some even more non-predictable sounds try simultaneously engaging the "ext > all" mode on both 296e's.

"PRE-EMPHASIS" controls are provided that allow one to accentuate the treble frequencies that may suffer in the spectral transfers. The math is tricky, but the controls work.

Sampling envelopes

Pressing the "freeze" switch or applying a pulse will freeze the output envelopes, but in different manners, depending on the setting of the "DISP" LED's. If either the "A levels" or "B levels" LED is illuminated, the envelopes will be displayed for the duration of the freeze signal, and will become the new A or B spectral response on its release. In other modes, the envelopes will simply be frozen for the duration of the applied pulse or switch closure, but they will not be stored.

All of the 296e's data with the exception of the "PRE-EMPHASIS" control settings may be stored as part of a preset. A preset manager (206e or 225e) is required for this trick.

User interface

When using the interface to draw in levels with your finger a slower swipe will generate the most accurate result.

Note: *Future versions of the 296e firmware must be loaded with the USB firmware card. The old memory cards will not work in this application.*

297 Infinite Phase Shifter

297091218

The Infinite Phase Shifter displaces the phase of an applied signal by up to 1800 degrees, depending on frequency and number of stages selected. The phase shifted signal may be combined with the original to create a moderately warped comb filter with complimentary outputs. Notch density and depth can be varied through feedback (resonance) and stage selection. A wide range sweep oscillator enables the familiar cyclical phase shift effect.

All parameters (phase shift, notch depth, sweep rate, sweep depth, resonance) are voltage controlled, with processing control inputs where appropriate. A built-in envelope follower facilitates the creation of amplitude-dependant effects.

The 297 is capable of “barber pole” phasing, with the phase shift (and the consequent filter peaks and notches) continuously moving in one direction. Unique circuitry provides (or consumes) the extra time involved in this process. The rate of changes can be varied up to 2.5 octaves per second in either direction and is voltage controllable.

Patch Chart

The following pages constitute a diagram of currently available 200e modules. Make Xerox copies, cut out the modules, and paste them together to create your own personalized patch chart. If you print it in a lighter color, lines representing patch cords can be drawn and will be prominent.