MP11c PCB CIRCUIT DESCRIPTION

INPUT STAGES

The MP11 has two seperate input stages one each for "INPUT 1" and "INPUT 2", these are both identical in operation with the input signal being fed from the front panel jack socket into a high impedance buffer stage configured around one half of the very low noise NE5532 dual op-amp.

The input impedance is approximately equal to R60 for "INPUT 1" i.e. around 220K, *this has been kept particularly high so as not to load the circuitry of passive bass guitars.*

The capacitor C36 is mainly to prevent radio or similar breakthro getting into the early stages of the MP11.

The second half of the NE5532 gives the signal a gain of about 5, the maximum possible using +15 and -15 volt supplies *i.e. it allows for a peak transient signal from a bass of between 5 and 6 volts.*

INPUT V.C.A. (VOLTAGE CONTROLLED AMPLIFIER)

The signals from the two input stages are mixed together with R59 and R65 and feed into the "CURRENT INPUT" of the SSM2014 V.C.A. P3 adjusts for control feed thro i.e. breakthro from the control voltage V1 into the 2014's output.

P2 adjusts for best symetry of the 2014's maximum input signal, with most of the capacitors and resistors around IC7 being for compensation or correct setting up of the 2014's internal circuitry.

The output from IC7 is dependant upon the control voltage V1, with maximum output being when V1 is at 0 volts and maximum attenuation when V1 is at 5 volts.

IC7 is configured to provide gain as well as attenuation to the incoming signal and provides a very wide range of control with very little noise being added to the signal, it is probably the best available today in terms of V.C.A. technology.

GRAPHIC STAGES

The signal from IC8 is fed directly to the graphic equalization stage via R76. *The graphic stages themselves can be considered to function exactly the same as the GP11 with the exception that the sliders are adjusted electronically instead of manually.*

Diagram 1 is a simplified circuit of the graphic stage principle used in both the MP11 and GP11. The circuit inside the box connected between the slider and ground is a "BAND PASS RESONATOR" having a fixed resonant frequency. At the resonant frequency the phase shift is zero so the box can be treated as a pure resistance at its resonant frequency.

With the slider in the "CUT" position the input signal is shorted to ground, for signal frequencies other than resonance this effect will be less and the further the frequency from resonance the less the attenuation.

With the slider in the "BOOST" position the op-amps feed back signal is attenuated causing the output level at resonance to be increased i.e. less feedback = more gain.

With the slider in the central position there will be equal attenuation to the input signal and the feedback signal giving unity gain and a flat responce.

The complete graphic equalizer section is made up of 11 of these bandpass resonators with ajacent frequency centres being divided up between two op-amps IC12 and IC13 to provide better stability to the overall circuit.

The electronic simulation of the sliders will be dealt with in the description of MP11b P.C.B.

BARGRAPH DRIVER

The input level bargraph is driven from the circuit of IC11 which monitors signals from

(1) The input to the graphic stage
(2) The output of IC13
(3) The output of IC12

IC11 is configured as a precision half wave rectifier with a 1uF capacitor (situated on MP11a) being charged via R71 and discharged via R71 and R70 in series. The gain of IC11 being set by R70/R67.

EFFECTS SEND - RETURN

The output signal from the graphic stage is attenuated by the potential divider formed by R17/R16 to "SIGNAL LEVEL" i.e. 400 to 600 mV for the effects send and is returned to "LINE LEVEL" again by the two halves of op-amp IC1, with both stages having a gain of approx 4. (combined gain of both stages is 20).

NOISE REDUCTION

A signal is taken from the output of IC8 to drive the noise reduction circuit and amplified by TR4, this is further amplified by IC6 which has a MID BOOST circuit in its feedback loop formed by R39,R40,R37 and C18, this gives it a very high gain at mid frequencies and makes it sensitive to even the smallest input signal (above the noise floor) this signal biases on TR5 quickly discharging C23 via R44. This in turn removes the positive voltage from the diode chain D1 to D6 and disables the noise reduction swiftly.

When no signal is present at TR4 base, then C23 gradually re-charges via R44 in series with R43 giving a soft return to the noise reduction.

The noise reduction works by introducing C21 between the signal from R17 and ground acting as a rather crude low pass filter i.e. it cuts off all the high frequencies and the noise with it.

C21 is tken to ground by forward biasing the diodes which provides an A.C. path to ground for the signal through C21.

MUTE

The mute facility is operated in two ways, firstly by the signal thro analogue switch IC2 and secondly by a mute facility provided within the SSM2013.

A signal from the microprocessor is received at "MUTE IN" the base of TR3 every time a mute is required, this being a 5 volt signal turns on TR3 which turns off TR2 allowing pin 10 of IC4 to go high selecting an internal mute within IC4, at the same time pin 9 of IC2 goes high which opens the analogue switch and disconnects the signal from IC4.

This operation occurs whether the mute switch is closed or open in other words muting is always applied, it is just the speed at which it operates that is changed with the mute on/off switch by introducing C11 into the circuit.

OUTPUT V.C.A.

The outpuut level is controlled by IC4 a SSM2013 V.C.A. chip.

This is a current input, current output device and R9 provides the correct current input, with IC5 converting the current output back to a voltage.

V2 is the control voltage with 5 volts being max attenuation and 0 volts being no attenuation (no gain is introduced through this stage).

P1 adjusts control voltage feed thro to the output and C84 sets the chips internal muting speed, the other resistors and capacitors around IC4 are for frequency compensation.

The 10uF capacitor C87 prevents any digital noise being fed into the chip via its control voltage input, C24 performs the same function for the input V.C.A. IC7.

OUTPUT STAGE

The signal from IC5 is buffered to drive the output by the unity gain stage around IC3 and this feeds the line output socket providing a low impedance.

Line input is fed to the virtual earth input of IC3 by R22.

D.I. OUTPUT

The pre/post EQ switch selects the signal being fed to TR1 which is an emitter follower directly driving the D.I. transformer primary of T1, this in turn provides an isolated balanced signal to the D.I. socket.

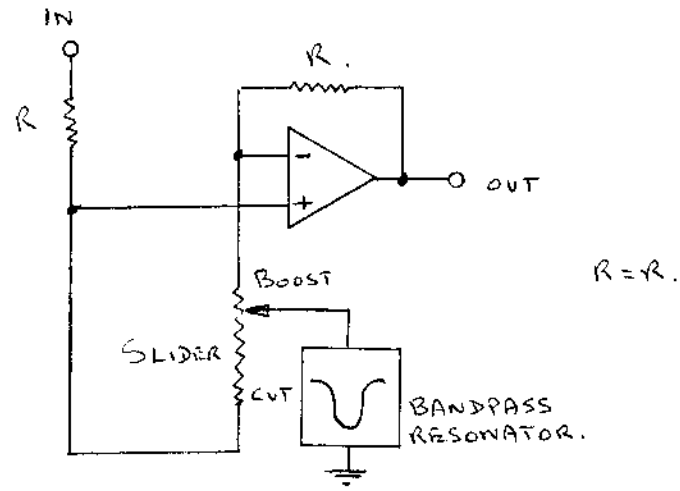

DIAGRAM (1)

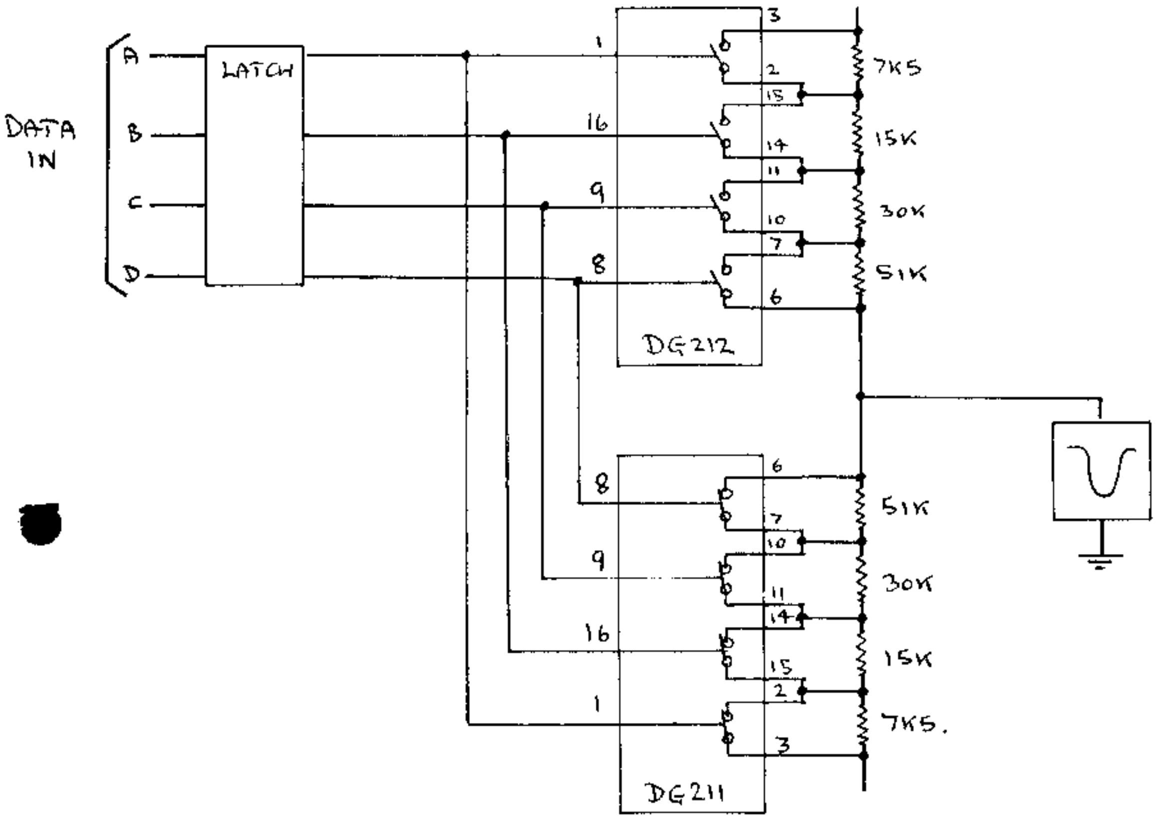

DIAGRAM (2)

MP11b P.C.B. CIRCUIT DESCRIPTION

GENERAL DESCRIPTION

IC2, the Z8681 is the heart of MP11b, it is a "MICROCOMPUTER" i.e. not just a "MICROPROCESSOR" but a whole collection of devices including a "MICROPROCESSOR" all on one chip.

The EPROM IC7 or R.O.M. (read only memory) tells IC2 what to do via the data lines D0 to D7 and address lines A0 to A13. The Z8681 chip has multiplexed address and data lines and uses IC5 to seperate out the address lines.

IC9 is the memory for the MP11 and is a 2K CMOS RAM (random access memory) chip, this is mounted in a special *non volatile RAM socket* that contains a battery to retain the memory while the MP11 is switched off and also provides protection to the memory in the event of power failure etc.

Pins 13 to 19 on the Z8681 provide additional address lines A8 to A14, the top four of these are used to select or enable other chips used on the MP11b via IC22 a 4 to 16 line decoder.

IC22 can select or enable the following chips from its outputs on pins 1 to 11, these are:-

IC22 PIN NO.	CHIP SELECTED	CHIP FUNCTION
1	IC7	4K R.O.M.
2	-	-
3	IC9	2K R.A.M.
4	IC13	D to A Converter
5	IC15	40 Hz and 60 Hz control
6	IC16	100 Hz and 180 Hz control
7	IC17	340 Hz and 660 Hz control
8	IC18	1.3 KHz and 2.6 KHz control
9	IC19	5 KHz and 10 KHz control
10	IC20	15 KHz control
11	IC4	Reading of pushbuttons and control of all front panel displays.

IC4 is a keyboard and display controller and looks after all functions that take place on the MP11a PCB.

The Z8681 microcomputer IC is run from an 8 MHz clock provided by the circuit around IC8 containing an 8MHz crystal, the output of this oscillator is divided by 16 within IC6 to provide A 500 KHz clock to IC4.

On power up capacitor C7 holds down pin 6 on IC2 until the 5 volt suply has reached its full voltage, it gradually charges up via an internal pull up resistor inside IC2, this provides a "RESET" to the Z8681 chip, and also via an inverter in IC3 "RESETS" IC4 the keyboard/display controller.

MIDI IN/OUT

The MIDI out socket is driven directly from a "SERIAL PORT" inside IC2 via two inverters in IC10, these provide buffering to IC2 and give sufficient drive via R1 for the 5 ma "CURRENT LOOP" system used by MIDI.

MIDI comes into the MP11 via din socket DS3 and is isolated from the internal electronics by IC1 an opto isolator, the remote foot pedal input operates in parallel with the MIDI in socket.

The signal from the output of the optp-isolator IC1 passes thro two inverters and drives the "MIDI THRO" socket DS2, passing any information received at DS3 directly on to the MIDI thro output.

The output from the opto-coupler is also taken directly into a serial input in IC2 via pin 5.

INPUT (V1) AND OUTPUT (V2) CONTROL VOLTAGES

To produce V1 and V2 *the VCA control voltages* IC2 first "SELECTS" IC13 *the digital to analogue converter* and passes data to it via data lines D0 to D7, this data is converted to a voltage by IC13 and passed on to IC14's non inverting input.

IC14 has a gain of 2 that can be adjusted by P1, and depending on the data into IC13 will output a voltage between 0 and 5 volts.

This voltage is passed on to pin 3 of IC11 where depending on the conditions on pins 9, 10 and 11 directs the voltage to one its 8 output pins.

IC11 is an *analoge 8 channel multiplexer* and contains within it switches to direct the voltage on pin 3 to any one of its 8 outputs, it also has internal capacitors that maintain this voltage even after the input to pin 3 has ceased, it can therefore store 8 seperate D.C. voltages of different levels at its outputs, we only use the top two pins

13 and 14 to provide V1 and V2, the control voltages to the input and output V.C.A's on MP11c.

CONTROL OF THE 11 FREQUENCY BANDS.

Each of the 11 frequency bands provided on the MP11 is controlled by a 4 bit binary number, this number is latched into one half of one of the IC's numbered IC15 to IC20.

For instance if the 40 Hz band is to be changed then IC2 will select IC15 (via IC22) and pass to it via the data lines D0 to D3 a 4 bit binary code, this is latched into the top half of IC15, and once IC15 is de-selected *the data will remain on pins 2, 5, 6 and 9 of IC15 until another change is required.*

Because of the number of devices all connected simultaneously to the data lines buffering is required to prevent the data lines being overloaded, this is provided by IC21 and buffers the data to IC15 to IC20.

ELECTRONIC SIMULATION OF GRAPHIC SLIDERS

Diagram (2) shows the internal connections of the DG212 and DG211 analogue switches used in the MP11, it also shows the connection of these to the series of resistors that simulate the slider action as well as the interface to the four data lines that control the closing and opening of the switches.

The DG212 IC has four normally open analogue switches where as the DG211 has four normally closed switches, this is very convenient as it means with a single data line we can simultaneously switch out a resistor in the top half of the resistor chain and switch in a resistor in the bottom half of the chain.

This action effectively shifts the centre point of the chain up as if it were a normal slider, the centre point is taken to the *band pass resonator* and performs the same action as described for diagram (1).

The resistors in the chain are carefully chosen in value to give 15 equal 7.5K steps, with the total resistance from the top to the bottom of the chain always remaining around 100K.

This directly simulates the 100K linear slider used in the GP11 and keeps the graphic control section of the MP11 exactly the same in terms of boost, cut, Q and frequency centres as the GP11.

POWER SUPPLY

The power supply for the MP11 is shown on the MP11c drawing 2 diagram, this is fairly straight forward using a toroidal transformer with dual primaries that can be wired for 240V or 110V.

The secondary has three windings, two of these are used for the analogue circuit supply via a full wave bridge made up of D5 to D8, this feeds both positive and negative supply rails using smoothing capacitors C11 and C12, positive and negative regulators Reg2 and Reg3 and decoupling capacitors C5 and C9.

Both these supplies are further regulated down using Zener diodes to provide the positive and negative 7.5 volt supplies.

The third winding provides the 5 volt supply for the digital circuits again via a bridge, smoothing capacitor, solid state regulator and decoupling.

The unregulated supply from smoothing capacitor C20 is used to supply the bulbs and the remote foot switch circuit.

MP11 FOOTSWITCH

USE OF MIDI

The MP11 foot switch uses MIDI program change data to convey its commands to the MP11 itself.

The following program change numbers are used for the various memories:-

USER MEMORY	MIDI PROG NO:-	PRESET MEMORY	MIDI PROG NO:-
0	0	0	16
1	1	1	17
2	2	2	18
3	3	3	19
4	4	4	20
5	5	5	21
6	6	6	22
7	7	7	23
8	8	8	24
9	9	9	25

It also uses MIDI program change data to alter the "OUTPUT LEVEL" on the MP11 with the following program change numbers producing increases or decreases as described below:-

MIDI PROG NO:-	EFFECT ON OUTPUT LEVEL
11	Increase by 1 step.
12	Decrease by 1 step
13	Increase by 10 steps
14	Decrease by 10 steps

MIDI TRANSMIT FORMAT

As described in the "MIDI GENERAL INFORMATION" MIDI is sent in "BYTES" or blocks of 8 "BITS" with the "LSB" sent first and the "MSB" last.

Added to this is a "START BIT" ("0") before the "LSB" and a "STOP BIT" ("1") after the "MSB" on each "BYTE" sent.

Taking our example of the "STATUS BYTE" for a program change on MIDI channel 1 and adding the "START" and "STOP" bits we get:-

< *data sent start bit first*

```
              1  11000000  0
        STOP BIT           START BIT
```

This is the first complete "BYTE" to be transmitted for our program change followed by the program number itself, for program number zero this would be:-

```
              1  00000000  0
        STOP BIT           START BIT
```

So we now have two groups of 10 "BITS" to transmitt to the MP11 to select user memory "0" lets look at how the footswitch circuit does this.

FOOTSWITCH CIRCUIT

Each "BIT" sent has to be precisely 31.25 micro-seconds in length and the timing for this is produced by the 1MHz clock circuit around IC2 pins 12 and 13.

The 1MHz is divided by 32 within IC3 and is allowed out of pin 5 only when pin 12 is low, to provide the necessary 31.25 KHz bit rate required.

IC's 5,6 and 7 are all "SHIFT REGISTERS" with parallel "IN" and serial "OUT". The output from all three eventually arrives at pin 3 of IC7 where it feeds into one input of IC4 this in turn directly drives the MIDI output via a transistor and current limiting resistor.

Taking "SHIFT REGISTER" IC7 as an example, its output comes from pin 3 (the serial output) and its parallel input consists of the pins shown along the bottom of the IC with pin 1 being the first and pin 7 the last. Any data set up on these pins is latched into the IC when pin 9 (the parallel/serial select line) goes from high to low, and when the clock on pin 10 starts it moves this data out of pin 3 one "BIT" at a time.

At the same time it moves data in to IC7 from the serial output of IC6 and also moves data from IC5 into IC6, so as long as the clock is running a stream of data is fed to the MIDI output. This stream of data contains all information set up on the parallel inputs to the three 4014 chips and conveys the necessary "PROGRAM CHANGE" required to the MP11.

CLOSING A FOOTSWITCH CONTACT

Closing a footswitch contact causes a number of events to occur, say we close footswitch "4" then the diode from micro switch "4" pulls data line D2 high setting the appropriate input to IC6 for memory number 4.

Data line D2 pulls the input to pin 11 of IC2 and pin 1 of IC4 high via another diode, this causes a "RESET" to IC3 starting the clock and gives a 20 micro second long pulse from pin 4 of IC4, these are anded together in IC1 to produce a positive parallel/serial pulse at pin 4 of IC2.

This latches the data into IC5, 6 and 7 with the next positive clock pulse data is clocked out of IC5, 6 and 7 to the MIDI.

PRESET/USER SELECTION.

Closing the "PRESET" switch pulls the base of the transistor high turning it on, this takes pin 6 of IC1 low causing pin 4 to go high, this takes pin 1 high and as pin 2 is already high causes pin 3 to go low keeping IC1 pin 4 latched high, this turns on the transistor lighting the preset LED. The opposite occurs for the user switch.

Pin 4 of IC1 is connected to pin 7 of IC6 and this selects the data for a preset memory "PROGRAM CHANGE". The capacitor on pin 2 of IC1 ensures the "USER" memory is always selected on power up.

VOLUME UP/DOWN

When the volume up or down switches are closed the appropriate "PROGRAM NUMBER" is set up on D0 and D3 via the diodes from the switch, another diode pulls the input to pin 9 of IC2 high making sure the "USER" memory is selected, as it must be to give the correct program number for this function.

Pin 8 of IC1 is also pulled high enabling the oscillator combination of IC1 and IC2, this feeds negative spikes from pin 10 of IC4 into pins 5 and 6 of IC4, every time this occurs a parallel/serial pulse is sent to IC5, 6 and 7 causing them to latch in their parallel data and repeat the program change output at regular intervals depending on the speed of the oscillator, thus ramping the MP11 output level up or down.

The speed of the oscillator can be set by varying the value of the 470K resistor, bigger resistor = slower speed.

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LIGHTING THE 0 TO 9 LED's

Each time a 0 to 9 contact is closed this latches on the appropriate pair of "OR" gates driving a transistor and lighting the LED in its collector. At the same time it pulls the base of the transistor next to the "VOL DOWN" switch high which turns the transistor on producing a negative pulse in to the "OR" gate in its collector, this is acting as an inverter and provides a positive pulse to all pairs of "OR" gates to reset them, leaving only the one being selected still lighting its LED.

SUPPLY

The circuit is driven from the 12 volt supply from the MP11, this drives all LED's directly and drives the electronics via a 5 volt zener diode regulator.

Very little current is drawn by the 5 volt supply as the entire circuit is built around CM05 IC's.

"MIDI" GENERAL INFORMATION.

The word MIDI stands for musical instrument digital interface and is a system that allows the interconnection of many types of musical equipment through a standard interface.

Each MIDI equipped instrument usually contains a receiver and a transmiter. The receiver receives MIDI messages via a "MIDI IN" socket and executes MIDI commands. The transmitter originates messages and transmits them via the "MIDI OUT" socket.

A "MIDI THRO" socket is also sometimes used and this simply re-transmits any MIDI data received at the "MIDI IN" socket for connection to further instruments.

MIDI IN	-	Receives MIDI commands
MIDI THRO	-	Re-transmits "Midi In" data
MIDI OUT	-	Transmits MIDI commands

THE SYSTEM

The MIDI system is a serial interface system, in other words it transmits its information one bit at a time rather like sending a sentence of "Words" by morse code, where each word is sent one letter at a time and no sense can be made of the word by another person until all its letters have been received, also no sense can be made of a sentence until all its words have been received.

The analogy between MIDI and morse code can be carried further in that morse code consists of dots and dashes where as MIDI consists of "1's" and "Ø's" with a "Ø" being a low voltage i.e. zero volts, and a "1" being a high voltage i.e. 5 volts.

The main differences are that morse code sends "WORDS" of different lengths where as MIDI "words" are always the same length, this being eight "BITS" with a "BIT" being either a "1" or a "Ø", i.e. eight "1's", eight "Ø,s" or any combination of the two.

MIDI COMMANDS

MIDI commands always consist of either two or three "WORDS" with the "WORDS" being known as "BYTES".

The first "WORD" or "BYTE" is known as the "STATUS BYTE" and indicates the type of MIDI command, this command information is conveyed in the first four "BITS" being sent with the first BIT always being set to a "1".

There are only eight "STATUS BYTES" in MIDI and these are as follows:-

	1ØØØ	-	NOTE OFF
	1ØØ1	-	NOTE ON
	1Ø1Ø	-	AFTER TOUCH (POLYPHONIC)
	1Ø11	-	CONTROL CHANGE
*	11ØØ	-	PROGRAM CHANGE
	11Ø1	-	AFTER TOUCH (MONOPHONIC)
	111Ø	-	PITCH WHEEL CHANGE
	1111	-	SYSTEM COMMAND

matrix by driving one of the transistors on and at the same time pulling an IC2 output low, this will light the LED corresponding to the intersection of the two.

The 7 segment display is driven by lines A0 to A3 via IC3 the BCD to 7 segment decoder.

INPUT LEVEL BARGRAPH.

The input level bargraph is an IC specifically designed for the purpose, the D.C. signal level input comes in via pin 5 of IC1 from MP11c, with reference levels set up on the IC by resistors R3 and R4.

The supply to IC1 is kept to + 25 volts by zener diode ZD1, the LED chain is driven between the +15 and -15 volt supplies to prevent earth track current being drawn that would cause break thro on the MP11c analogue PCB every time the bargraph LED's lit up.

The 10 output pins of IC1 are arranged to drive all 15 LED's with some in groups of 2 and those in the sensitive area of the display being single LED's.

The ground connection and supplies for this IC come from the analogue circuitry where as the supply and ground connection for the displays and push buttons come from the digital side.

On all P.C.B's it is very important that analogue ground and digital ground are kept seperate and only meet back at the smoothing capacitors. This reduces digital break thro into the sensitive analogue circuit.

MP11a P.C.B. CIRCUIT DESCRIPTION.

GENERAL INFORMATION.

The MP11a PCB is the entire front panel of the unit and contains all displays and push buttons associated with all the functions available on the MP11 itself.

CONTROL OF DISPLAYS AND PUSHBUTTONS.

The 8279P-5 I.C. situated on MP11b handles the control of all the push buttons and all displays except the "INPUT LEVEL" bargraph. This I.C. is a *keyboard and display interface controller* and communicates directly with the "MICRO-COMPUTER" chip on MP11b via the eight data lines D0 to D7.

THE PUSHBUTTONS.

IC5 is a 3 to 8 line decoder and selects each one of the eight rows of push buttons in turn, its input comes from pins 32, 33 and 34 of the 8279 and these are called "SELECT LINES" SL0 SL1 and SL2. These select lines pass a 3 bit binary number to pins 1, 2 and 3 of IC5 and this selects one of its eight outputs marked 0 to 7.

If a push button is depressed this is detected on one of the five "RETURN LINES" RL0 to RL4 feeding back into the 8279, and it will know which push button it is depending on which "ROW" is selected at the time.

THE L.E.D. MATRIX.

The L.E.D. MATRIX includes all the frequency band displays as well as the indication of "INPUT GAIN", "OUTPUT GAIN" and the "USER"/"PRESET" L.E.D's.

Select lines SL0 to SL3 drive the input on pins 20, 21, 22 and 23 of IC4, a 4 to 16 line decoder.

The 4 bit binary number passed to IC4 selects each of its 16 outputs in turn causing them to pull the bases of transistors TR1 to TR14 low, this turns each transistor on and connects the 5 volt supply to the rows of L.E.D's in the matrix.

As well as sequentially selecting the rows of L.E.D's, line 13 (pin 15) of IC4 enables the 7 segment display at the appropriate time to coincide with IC3 passing to it data to light the segments indicating the chosen memory number.

IC2 is another 4 to 16 line decoder that pulls low one of its 16 output pins depending on the data passed to it from the 8279 lines B0 to B3.

Between them IC4 and IC2 can light any LED in the

The only one of these used with the MP11 is "PROGRAM CHANGE".

The second half of the "STATUS BYTE" conveys "MIDI CHANNEL" information, with 16 channels being available to use, these are as follows:-

CHANNEL		
1	-	0000
2	-	0001
3	-	0010
4	-	0011
5	-	0100
6	-	0101
7	-	0110
8	-	0111
9	-	1000
10	-	1001
11	-	1010
12	-	1011
13	-	1100
14	-	1101
15	-	1110
16	-	1111

Thus a "STATUS BYTE" for "PROGRAM CHANGE" on MIDI channel 1 would be:-

11000000
MSB LSB

This "STATUS BYTE" would be sent via MIDI one bit at a time with the "LSB"(Least Significant Bit) sent first and the "MSB"(Most Significant Bit) sent last, the receiving instrument would then know that a "PROGRAM CHANGE" is being selected on channel one but it still needs to know which program number is to be selected and this is where the second BYTE or the "DATA BYTE" is used.

"DATA BYTES" always start with the first (MSB) bit being a "0" and with the remaining seven bits it is possible to have 128 combinations of "1's" and "0's", thus it is possible to select any one of 128 program numbers these being numbered 0 to 127

Program zero would be:- 00000000
Program 127 would be:- 01111111

Therefore to select say program 127 via MIDI the following two "BYTES" of information would have to be sent:-

11000000 then 01111111