Eμ SYSTEMS CALIBRATION INSTRUCTIONS - OCTOBER 1975

EQUIPMENT REQUIRED: It will be assumed throughout these instructions that the technician has a DC coupled oscilloscope and a high impedance digital voltmeter. The clever technician will be able to calibrate most modules in the field without the use of this equipment by means of good patches and good ears, but we will not attempt to give exact instructions for such work here.

At the factory we use a Tektronix 465 'scope and a Data Precision model 245 4 1/2 digit DVM. These have proven entirely satisfactory, and we recommend them to techs who would make good use of them. A less expensive alternative to the Tek 'scope is the Telequipment line. The Data Precision DVM seems by far the best buy around at present, but slightly less expensive 3 1/2 digit units are available.

TERMINOLOGY: We will assume that the technician understands completely the function of any module he is calibrating. We will also assume he is generally familiar with synthesizer calibration. The following terms and procedures are often used in these instructions and are worth reviewing:

OFFSET: An offset voltage is, generally speaking, a DC voltage difference between input and output. It is usually trimmed out by applying zero input and trimming the output to exactly zero volts DC. In certain cases it is necessary to trim for zero voltage difference.

GAIN: The gain of a stage is the ratio of output to input signal level; it is generally trimmed to unity at some setting of controls using standard input signals. In certain cases, the gain of an internal stage is being adjusted, and hence the output is simply adjusted to a standard amplitude.

KEYBOARD as a voltage source: Throughout these procedures, a precision voltage source is required. A keyboard is usually available, and hence will be assumed to be the voltage source. It is obviously necessary to calibrate the keyboard before any other modules using its precision; if equipment is not available to do this, the keyboard should be assumed correct and left untouched. Eμ keyboards are equipped with an "offset" control that determines the voltage output when the lowest "C" is depressed; this will be assumed to be adjusted to exactly zero volts in all cases.

1V/OCT sensitivity trims: There are two methods of calibrating frequency inputs to 1V/octave sensitivity. One method is absolute, but is substantially slower and more difficult than the alternative. This is the tracking method, which assumes one oscillator to be calibrated and allows others to have the same V/oct sensitivity, although not necessarily a precise 1V/octave. Both methods will be described below. The first oscillator must, of course, be adjusted by the absolute method, but if this is carefully done, excellent results may be obtained if the rest of the system's VCO's and filters are calibrated by the tracking method.

CENTER FREQUENCY: Each device to be calibrated for V/oct has a frequency (usually about 500 Hz) at which the V/oct trim does not affect the oscillation frequency. This is the point at which the sum of all input currents to the control node equals zero. To find the center point, use your trimming screwdriver to short the trimmer, and adjust the initial freq controls until shorting the trimmer does not affect the frequency of oscillation. This is generally done with 3V applied from the keyboard to the 1V/octave input of the oscillator; hence this 3V point should not change pitch as the oscillator is trimmed.

ABSOLUTE 1V/OCT trimming: Set up the device to be trimmed such that it is at center point with 3V applied through a 1V/oct input. Set a reference oscillator to zero-beat with the device to be trimmed at this point, using waveforms that make beat notes audible (such as sawteeth). Apply 2V instead of 3V, and trim for zero-beat at an octave ratio. Return to 3V and re-adjust reference oscillator to zero-beat. Repeat 2V trim, and then verify and optimise over entire keyboard range.

TRACKING 1V/OCT trimming: Set device to be trimmed to center frequency, and set up a reference oscillator to zero-beat, this time also patching it to keyboard, both with 3V coming from keyboard. Shift down to 2V and trim for zero-beat, then return to 3V and re-adjust reference oscillator initial freq for zero-beat. Repeat at 2V then optimise over entire keyboard range.

INITIAL MODULE SET-UP: Unless otherwise specified, modules under calibration should have no signal or control inputs applied. All controls should be set to midrange. For initial calibration of a system (done at factory) go through and set all trimmers to midrange before applying power.

CALIBRATION ORDER: If you plan to calibrate power supply levels, this should be done first. The keyboard should then be trimmed if required. It is convenient at this point to follow the order of oscillators, filters, amplifiers, other analog equipment, and finally sequencer modules.

2000 VCA

CONTROL REJ'N: Apply a 10V p/p audio sine wave to the full level control input with VCA in linear mode. Trim for minimum audio on output.

GAIN: Apply 10V p/p audio sine to full level signal input in linear mode, and set initial gain such that output level has just dropped to zero. Apply precision +5V to full level control input and trim for 10V p/p level at output.

EXP'L ZERO: Leave VGA controls and inputs exactly as above (10V p/p at signal, +5V at control. Flip switch to exp'l mode. Trim for 10V p/p output.

2010 QVCA

CONTROL REJ'N: Apply 10V p/p audio signal to uppermost control input. Trim each control rej'n trimmer for minimum audio on the associated output jack. Lag time should be set to minimum.

2100 VCLPF

OFFSET: With Q at minimum, trim for 0V output offset.

1V/OCT: Set Q such that filter barely oscillates. Patch kybd through 1V/oct or kybd switch input, adjust via tracking method. Use sine waveform from reference oscillator for best results.

2110 VCHPF

1V/OCT: This trimmer is rather difficult to adjust as the 2210 has no resonant mode. Use the tracking method to adjust, but instead of zero-beating, run the reference oscillator through the 2110 and adjust for minimal amplitude variation. For best results, use a frequency on the reference oscillator such that the filter is attenuating the signal about a factor of two. The adjustment is not terribly critical.

2120 UAF

HP OFFSET: With Q at max, trim for 0V at HP output.
BP OFFSET: With Q at max, trim for 0V at BP output.
Q REJ'N: Trim for minimal voltage change on LP output as Q is slowly varied from max to min.