BENCHMARK MEDIA SYSTEMS, INC.

RGC-02 Instruction Manual

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1.0 General Features

The RGC-02 allows control of levels and output mode as an integral part of an audio system module adding significant flexibility to the System 1000 module. The RGC-02 should be viewed as a remotely controllable replacement for the System 1000 module's on board signal routing switch, with the additional function of gain control. Thus the RGC-02 daughter board overrides the switch which, in turn, must be turned off. The RGC-02 is compatible with most System 1000 modules. Check the factory for specific applications.

The RGC-02 features dual gain control elements (VCAs) and soft switch, giving the operator the ability to remotely control the levels of both input channels and to remotely choose the output mode of the module. Levels are controlled by a DC voltage whose range is -10 to +2 volts. Modes are selected by using a BCD (Binary Coded Decimal) logic input. Both sets of control signals enter through the System 1000's 70 pin card edge connector at Aux Lines "a-d". See the block diagram in figure 1.0.

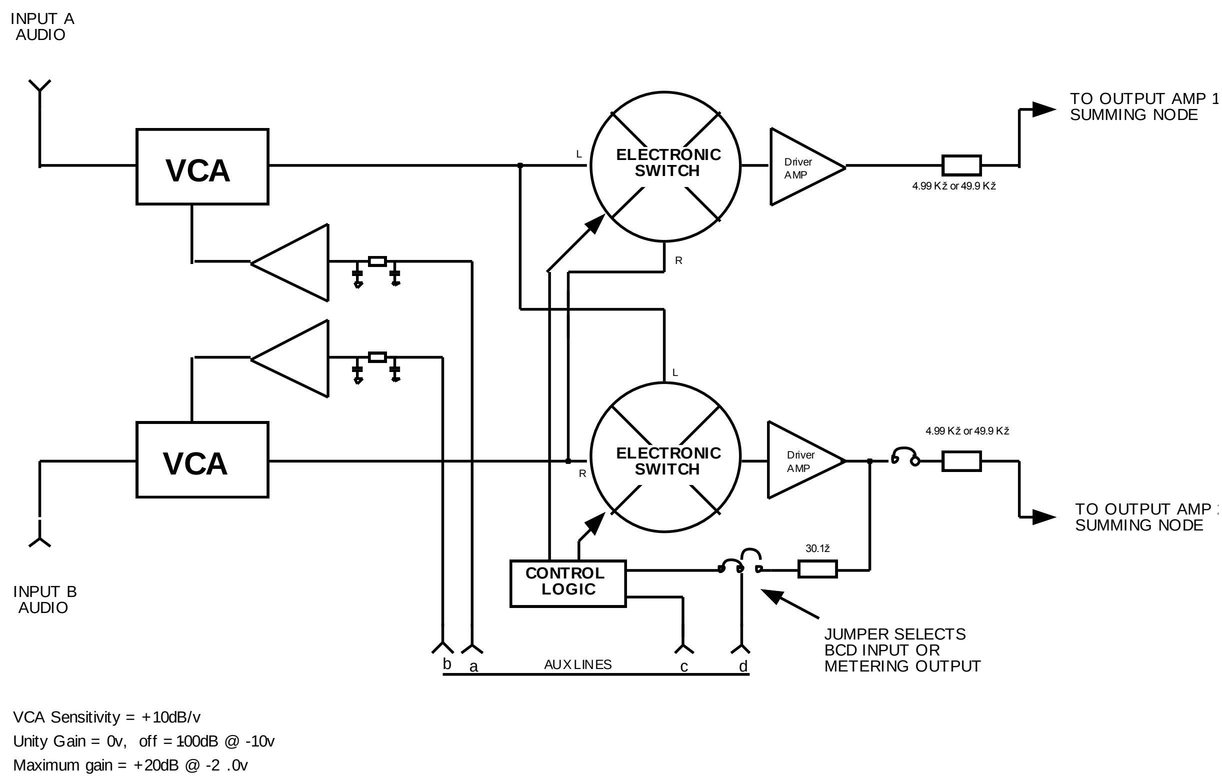

Figure 1.0 RGC-02 Block Diagram

When used with a DA-102 or MDA-102 module the output modes provided by the RGC-02 are

1) Stereo,

2) Mono,

3) Right Only,

4) Left Only.

When two RGC-02 daughter boards are used with a pair of the DA-101 mono DAs, one module designated Left and the other the Right channel, and with left and right audio signals fed in parallel to both modules, all of the functions listed above are available. A single RGC-02 and DA-101 may be used together to provide switching between two sources or mixing of the two sources and the control of the levels from the two sources, with output modes of; A input only, or B input only, or a mix of the two, ideal for the combining of channels from an ENG video cassette with remote control of the mix.

Additionally, the RGC-02 can be used to switch audio sources from two projectors on a single film island with the advantage of being able to preset the audio amplitude from the de-selected projector while the selected projector is "on the air". See Section 3.2.2 for specific applications and the necessary jumper configurations.

2.0 Unpacking and Physical Installation - General Overview

Care has been taken in packing the RGC-02 to assure it will withstand normal shipping conditions. Examine the equipment carefully as it is unpacked. If the shipping carton appears to have been damaged and if there are signs of physical damage, check the equipment and immediately notify the carrier and Benchmark.

As with any delicate electronic equipment, care must be exercised in its handling. The RGC-02 daughter board uses as a part of its switching circuitry CMOS logic devices. These devices, while internally diode protected, may be damaged by electrostatic discharge. Appropriate caution must be taken in their handling, particularly in low humidity environments. Carefully place it on the work bench for installation on its intended System 1000 module.

!!! WARNING !!!

This daughter board may not be installed on System 1000 modules operating with analog supply voltages greater than ± 18 volts. To do so may cause catastrophic failure in the VCA circuits.

2.1 Physical Installation

Remove from operation the System 1000 module intended to receive the RGC-02.

Some early System 1000 distribution amplifiers were shipped without the eighteen header pins installed. If your System 1000 has module pins installed, proceed directly to section 2.2. If your System 1000 module does not have the header pins installed two options are available to you. First, you may install the pins yourself and we will supply the pins. Secondly, you may return the module to the factory and the pins will be installed for you at no charge.

2.1.1 Installation of Header Pins

Read the instructions on de-soldering and re-soldering in your System 1000 manual.

1. Remove the shield plate from the back of the System 1000 card.

2. Insert the 10 and 8 pin strips into their mating housings on the daughter board. You will use the daughter board as a jig to facilitate pin alignment.

3. Use a static controlled work station, with a minimum of a grounded soldering iron, grounding wrist strap, and a conductive work mat. Solder the 10 and 8 pin

strips into the module. The best procedure for this is to solder only one pin in each of the two strips. Check to be sure that the strips have been properly seated directly against the P.C. board. If some readjustment is necessary, it is very easy to do with only one pin soldered. When you are satisfied that the pins are seated and in alignment, solder the remaining pins.

4. De-flux the board using a solvent appropriate to the flux being used.

5. Check the solder work to be sure that no solder bridges or cold solder joints exist.

6. Return the shield plate to the module.

2.2 Installation of the RGC-02

Before installing the RGC-02 on the intended module, make sure that the appropriate routing switches or jumpers have been either turned off or removed. With the DA-101, if the module is to be used as a distribution amplifier or as a bridged mono (40 watt) power amplifier, only position 3 of the modules signal routing switch (next to the heat sink) should be left in the "on" position. If the module is to be used as a stereo single ended headphone or 10 watt / channel monitor amplifier, then all of the signal routing switches should be in the off position. With the DA-102 all of the signal routing switches should be in the off position. With both of the MDAs the signal routing jumpers should be removed, or stored on one of the two pins.

Secondly, setup jumper configurations must be made on the RGC-02 for the module and the use to which it is intended. See Figure 3.2.2 for further information on the correct configuration of the RGC-02 with various modules.

The RGC-02 has two sets of female header strips that extend from the bottom of the board. One of these sets has ten positions and the other has eight. Install the daughter board on the System 1000 module, making sure that the corresponding number of pins is being inserted into these headers, as it <u>is</u> possible to invert the card.

!!! WARNING !!!

It is absolutely imperative that the solder joints on the bottom of the daughter board do not short against the tops of aluminum electrolytic capacitors that may be present on the module. To do so will, at a minimum, cause improper operation and at worst may cause catastrophic failure of the daughter board.

Due to the high parts density of the System 1000, the decision was made to allow, in some cases, the two boards to come into physical contact. Make sure that a polycarbonate insulating sheet is in place between the the module and the daughter board.

!!! WARNING !!!

The RGC-02 may not be plugged on to a System 1000 module while there is power on the module. To do so may cause damage to the CMOS logic on the daughter board.

While this could only be accomplished with the System 1000 module at the work bench or on an extender, it is most likely that damage will occur should the engineer forget. The combination System 1000 module and daughter board, however, may indeed be inserted into the System 1000 main frame with power on. When plugging the combination module/daughter board into the System 1000 with power present, insert the card firmly and quickly to eliminate as much as possible any time difference in contact mating.

3.0 Electrical Installation - General Overview

In this and other documents we will be using the term dBu. 0 dBu is 0.7746 volts, irrespective of source and load impedance. Implicit in the term dBu, however is the understanding that for systems to operate properly they need a low (≈60 ohm) source impedance, and hopefully, though not absolutely necessary, a bridging input. This is the same voltage that would be found on a properly sourced and terminated “600 Ω” audio transmission line operating at 0 dBm. The use of this voltage as a reference is desirable when using the readily accepted VU meter. The “VU meter” is of course a voltage measuring device, where 0.7746 volts will give a “0” indication when fed with a steady state tone. Hence it is desirable to maintain the same input voltages to the meter with a voltage sourced system as would be found in 600 Ω power matched system. See “A Clean Audio Installation Guide”, a Benchmark Media Systems application note.

While the dBu in not an officially recognized standard reference in the USA, (it is found in the Nordic N-10 standard) its common usage causes us to accept it as the most logical way to define the voltage reference that relates to the more antiquated power matched system. Occasionally, in some of our older documentation, the term dBv will be seen. This has the same meaning as dBu. Other authors will use dB/.7 or dB/0.775 to indicate this voltage reference.

3.0.1 Signals, Noise, Headroom and Distortion

The voltage controlled amplifier is one of the weaker links in an audio chain. It is typically limited to under 110 dB of dynamic range, and its distortion levels are typically limited to 0.02%. This is in contrast to our best amplifier technology with dynamic ranges near 140 dB and distortion capability lower than 0.0005%. Therefore when using VCAs, particular attention must be paid to finding their optimum operating point if maximum performance is to be achieved.

As set up in the RGC-02, the VCAs have a dynamic range of approximately 102 dB, slightly less than the vendors’ specification of 106 dB. This was done in the interest of keeping distortion performance under 0.1%, worst case. With the RGC-02 board installed on line level DAs, the maximum output capability of the combination is approximately +27 dBu; therefore the noise floor when operating at unity gain is -75 dBu. If the system reference is +4 dBu then the average signal to noise ratio is 79 dB with an overload factor (headroom) of 23 dB. This is generally quite acceptable since at best, 16 bit digital technology is limited to 96 dB, and in most cases does not exceed 92 dB. The analog tracks of one inch type C video tape are a scant 48 dB without the help of noise reduction circuitry. Current developments, however, such as PCM interleaved with video on type C machines, and MII, S-VHS and others, with their FM “Hi-Fi” audio tracks that approach the PCM capability are pressing the state of the art in storage media. Thus the engineer must be careful to optimize dynamic range at every point in the audio chain. This is done by making sure that <u>every</u> stage of <u>every</u> product reaches clip at the same point.

When using the RGC-02 with DAs, if a significant amount of gain is anticipated as a <u>consistent</u> need (10 to 20 dB), it is best that the typical gain requirement be taken in the low noise variable gain (2nd) stage just prior to the RGC-02, rather than at the VCA itself. This will preserve the dynamic range of the the RGC-02 at the expense of reduced input headroom in the second stage of the DA should normal levels, i.e. +4 dBu be received by the DA. The DA, now operating with reduced input headroom, might be driven into clip. If truly high gain requirements are needed, 20 dB or more, the MDA-101 or MDA-102 should be considered. These modules have a gain range of -2 to +73 dB, with the best noise performance possible under these gain conditions.

3.1 VCA Control

Four wires are used in conjunction with the Systems 1000's analog and digital power voltages to fully control the RGC-02. We recommend that the regulated D.C. power available on the backplane of the System 1000 main frame be used for the analog and digital power source at the remote control location. This is in lieu of an auxiliary external supply as this will keep to a minimum the problem of common mode voltage differences becoming a part of the control signals.

Control of the two VCAs is accomplished by sending an appropriate DC voltage to aux lines "a" and "b" to control inputs A and B respectively. The control sensitivity of the RGC-02 is approximately +10 dB / volt. 0 volts input produces unity gain. Attenuation is achieved with a negative voltage and gain with a positive control voltage; i.e. a control voltage of -5 volts will give an attenuation of -50 dB and a control voltage of +2 volts, a gain of 20 dB. The useful limits of operation with the VCA are -10 to +2.5 volts. Practical drive circuits are given in figures 3.1, 3.2, and 3.3. The RGC-P (figure 3.1), the RGC-12 (essentially two RGC-P controllers in a small "modem" style chassis) is available as a product from Benchmark Media Systems, Inc. The output of one RGC-P may be used to drive up to ten VCA channels. Current limiting may occur with more than this number at the extreme end of the control voltage range, -10 V.

Figure 3.1

Figure 3.2

Figure 3.3

Figure 3.4

A version of the RGC-P that has opposite extremes of control voltage, that is -2.5 to +10 V, and known as the RGC-RP is also available. This is necessary for those who wish to place a mix amplifiers in the control circuitry ahead of the various VCA channels to add, say, a master gain control that would work with the individual gain controls. Muting for multiple channels of the system via a hard or soft switch may be added to the system this way. Digital control of the VCAs may be accomplished by the use of a multiplying Digital to Analog Converter and mix amplifiers to automatically override, for instance, a museum audio output system. In each instance where a mix amplifier is added to the control system, a DC signal polarity inversion takes place thus requiring the opposite extremes in control voltage input for a correct output range at the VCA.

Check with your Benchmark representative for current pricing on all control circuitry options, or call the factory direct.

3.1.1 Operational Setup of the VCA Section.

The VCA is typically used to compensate for minor amplitude variations on the various sources, to bring them to the standard house reference level.. As such, it may be desirable to limit the gain range to ± 10 or ± 6 dB, or even tighter. This is very feasible with the RGC-P and the RGC-11 controllers. The control range is continuously adjustable via on-board trim potentiometers. The trimmers set the end points of the front panel potentiometer, over the control voltage range of -10 to +2.5 volts. The RGC-P's end stops may be set anywhere in that range. Thus the limits may be set up so that the VCA appears to be an attenuator a reverse potentiometric action. If the RGC-02 is used as a mixer, the full range of the controls may be necessary.

Revision A of the RGC-02 includes a trim potentiometer that allows compensation for the gain addition that often takes place when doing a mono sum of the left and right channels. If the program that is being summed contains significant coherant material, there will be a 6 dB increase in level when the two channels are mixed. A special circuit has been added to the RGC-02 that changes the gain of the stage when switched to mono. You may adjust this gain according to the degree of addition that takes place with the source material that you are using. There are two trimmers that must be adjusted, one for each output channel of the System 1000 module. The trim resistors are R1108 and R3108. Care should be taken to make sure the output amplitude from each of the two channels are set equal. These amplitudes should be measured at the output of the System 1000 module.

3.1.2 Physical Installation of VCA Control Wiring

If possible the two VCA control lines should be shielded from external Electro Magnetic Interference (EMI), particularly if the run is long. A standard foil wrapped audio pair is ideal for this purpose, with the A channel using the black wire and the B channel using the red. The shield should be tied to the analog reference buss at the card frame.

Connect the output of the control circuit chosen at the remote control location to the input of the wire intended to feed the VCAs their control voltage. At the System 1000, attach Molex SL pins and housings to that end of the VCA control wire.

DC power should be taken from the card frame to the remote control point to power the circuits in a similar fashion.

Two pin Molex SL housings are preferred for the interconnection of the wires to the pins of the card edge connector. If two pin housings are not available, three pin housings may be used horizontally between pins on opposite sides of the 70 pin connector. That is pin positions a and c would be handled by the top housing (with the center position empty), and positions b and d would be connected with the bottom housing.

Molex™ SL series pins and housings should be used, and are available from Benchmark Media Systems, Inc.

The following are part numbers for the recommended Molex connector parts.

2 pin housing	50-57-9002
3 pin housing	50-57-9003
Individual pins	16-02-0102
Crimp tool	11-01-0118

Follow the directions that came with the crimp tool you purchased for the specifics of the operation with the connector pins used.

3.2 Soft Switch

The mode switching capability of the RGC-02 is accessed via a Binary Coded Decimal (BCD) control code. This code is made up of a number of logical "ones and zeros". By definition, a "zero" in the System 1000 is a logic voltage of zero volts (digital ground), and a "one" is a logic voltage of +12 volts (Digital +V). It can be seen, with two input wires to the logic section of the RGC-02 (aux lines c & d), that four separate combinations of zeros and ones can be placed on these two lines. This allows us to "call up" four functions with the on board BCD decoder. The four modes again are:

	Logic Code	
Mode	Aux Line "c" (LSB)	Aux Line "d" (MSB)
Stereo	0	0
Mono	1	0
Right Only (at all outputs)	0	1
Left Only (at all outputs)	1	1

Table 3.0 BCD Code for RGC-02

Aux line "c" is the least significant bit and aux line "d" is the most significant bit. On board jumpers, however, allow the pre-programing of another function for aux line "d". If it is desired to use the VCAs and switch as an alternate source select with the <u>deselected</u> audio being available for metering, then the "d" aux line would be re-configured and used for unbalanced audio to exit the daughter board and module.

3.2.1 Control Switch Wiring

A four position double pole double throw interlocking pushbutton switch, such as the Schadow F or LT series, can easily be wired to give the control logic necessary to access the functions of the RGC-02. A schematic diagram of such an assembly is shown in figure 3.4. This is available as the RGC-11 from Benchmark Media, with the additional feature of stereo synthesizer actuation when a mono selection is made from the control station. The switches chosen must be of the "break before make" variety, otherwise a short will be placed across the logic power busses during a switch change Connect the necessary logic power and return signals to and from the remote control location in a similar manner as was done with the VCA control.

3.2.2 On board Jumper Setup of RGC-02

By configuring the on board jumpers the following operational modes may be achieved.

1. Single Card Stereo Operation - This is the most common use of the RGC-02, used in conjunction with the DA-102 or MDA-102.

2. Stereo Operation with two Mono DA cards. This requires two DA-101s and two RGC-02s. One of the module / daughter board assemblies is designated LEFT and is jumpered accordingly, while the other is designated RIGHT and is jumpered for that operation. The two assemblies most probably will have their VCAs tied together in parallel rather than operating independently. However, the logic control must be operated in parallel. That is, the same logic signals must come to both sets of aux lines "c" and "d" (wired in parallel).

3. Since the MDA-101 is strictly a single channel module, use of the RGC-02 with it is not recommended. Use the RGC-01 with the MDA-101 since it is also a single channel device.

4. Telecine Operation from a DA-101. In this mode the optical multiplexer selects between two inputs for an “on the air” feed. The deselected projectors audio is fed to reassigned aux line “d” for special metering and level adjustments. This is desirable for the smaller market station that has only one island.

The following dual chart gives the jumper assignments necessary for the setup of the various modules, and then the results when the various modes are chosen.

Module	Use	Module Signal Routing	RGC-02 Jumpers	Output Mode	BCD Code “c d”	Result
DA-102	Normal single module stereo.	1 - Off 2 - Off 3 - Off 4 - Off	A-B, D-E, G-H, I-J.	Stereo Mono Right Left	0 0 1 0 0 1 1 1	In A to Out 1, B to 2 A+B to 1&2 B to 1&2 A to 1&2
MDA-102 Dual Mic-Pre / DA.	Normal single module stereo.	Remove jumpers	A-B, D-E, G-H, I-J.	Stereo Mono Right Left	0 0 1 0 0 1 1 1	In A to Out 1, B to 2 A+B to 1&2 B to 1&2 A to 1&2
Dual DA-101s and RGC-02s	Normal two module stereo.	1 - Off 2 - Off 3 - On 4 - Off	D-E, I-J Lf, G-H Rt, G-F	Stereo Mono Right Left	0 0 1 0 0 1 1 1	Stereo A+B out Both modules B out Both modules A out Both modules
DA-101	Dual input mono DA or PA	1 - Off 2 - Off 3 - On 4 - Off	D-E, I-J,	Stereo Mono Right Left	x x 1 0 0 1 1 1	Stereo mode not used. A+B Mix. Input B Only Input A Only
DA-101	Stereo monitor / hdphone amp.	1 - Off 2 - Off 3 - Off 4 - Off	A-B, D-E, G-H, I-J.	Stereo Mono Right Left	0 0 1 0 0 1 1 1	Stereo-Single ended Mono -Single ended Right -Single ended Left -Single ended
DA-101	Mono telecine switching DA.	1 - Off 2 - Off 3 - On 4 - Off	C-D, G-H,	Pro 1. Pro 2.	0 X 1 X	A to 1, B to Aux d B to 1, A to Aux d

Table 3.2

See the component assembly diagram for physical location of jumper points A through J

4.0 Theory of Operation - General

The RGC-02 utilizes the SSM-2013 VCA chip from Solid State Micro Technology for Music, Inc. a division of Precision Monolithics, Inc. This particular unit allows excellent performance with a relatively small amount of support circuitry. Particular attention has been paid to R.F. immunity in the control circuitry.

The switching circuitry utilizes the 74C42 CMOS BCD decoder chip, available from many vendors. All audio switching is handled by the 4066 CMOS analog gate chip. Pseudo current mode switching is used in this design. All current to voltage translation is accomplished with NE5532 or NE5534 operational amplifiers.

4.1 Voltage Controlled Amplifiers

The SSM 2013 is a current in, current out device. See schematic figure 4.1. It has, from our vantage point, a peak “clip” point of +/- 800 µA. In this definition, clip is a sharp rise in distortion, rather than an abrupt signal swing limitation. While the vendor claims a 106 dB dynamic range for this part, in the interest of low distortion, its dynamic range has been limited to approximately 102 dB. Since the peak output voltage of most operational amplifiers operating at +/- 15 volts is 12 volts peak (+21 dBu), the correct input resistor for +/- 800 microamp operation would be 15.4 k Ω . The VCA current to voltage converters found in U4 and U6 have the same value of feedback resistor to allow the entire section to operate at unity gain with 0 volts at the input of the control port. 0 volts at the input of the control port of the 2013 causes it to be a unity current gain amplifier. A current to voltage converter is placed at the output of the VCA chip to drive multiple outputs from the VCAs.

The control ports for the VCAs, aux line “a” and aux line “b”, have a DC input resistance of 10.2 k Ω . This is the input resistors of the inverting / scaling control amplifier. A large amount of AC filtering has also been placed on the input lines. Additionally, 4.7 µF capacitors, C11 and C21, have been placed in the feedback loops of the control amplifiers. This is all in the interest of 1. Low RFI, 2. Immunity from AC power line interference, and 3. Elimination of noise from a “dirty” control pot.

At times the noticeable response time of the control amplifier may be annoyingly slow and a smaller feedback capacitor may be substituted. I.e. a 2.2 µF capacitor, provided there are no power line signal problems.

4.1.1 THD Trim

Only one trimming potentiometer is necessary for the VCA section. This is used to trim the device for lowest distortion at high gains. This trim is factory set and should never need to be adjusted, unless the SSM-2013 is replaced. The procedure for adjusting this trim is as follows;

1. Select input A only or input B only operation from the daughter board via the mode selection switch, depending on which VCA chip was replaced.

2. Set the gain of the VCA to approximately 20 dB. This is done by feeding a 2 kHz input signal into the System 1000 with an amplitude of 0 dBu. The gain of the VCA is then adjusted for an output amplitude of +20 dBu. This assumes that the System 1000 module is operating at unity gain. If it is not, then reset the module to operate at unity gain.

3. With the 2 kHz tone going into the system, adjust the trim for minimum total harmonic distortion. THD levels of 0.01% to 0.02% should be able to be achieved when the daughter board is returned to unity gain, at +20 dBu out.

4.2 Mode Switching Circuits

Each VCA output has feeds to two 4066 CMOS analog switches. Therefore both A (Left) and B (Right) audio signals are available at these points of feed to the remainder of the modules circuitry.

Audio is switched using current mode switches. This is done by inserting the switch at the summing node of the operational amplifier. The audio input voltage is converted to a current by the input resistor. It is then either passed to the summing node of the op-amp via the series FET or sent to ground via the shunt FET. This circuit topology offers an number of advantages over the more conventional voltage mode switching. First, low voltage silicon technology may be used. Secondly, when in the off state a very low voltage is at the input of the series FET and hence there is very low high frequency coupling through the intrinsic drain to source capacitance of the FET. Thirdly, you will note that because the FETs are operating at or very near to ground (signal reference) potential, the FET package may be operated between ground and the + analog supply. This eliminates the need for special power configurations.

4.2.1 Logic Circuits

The mode selection is made via a two wire BCD input. Normally a jumper exists between jumper points D and E, tying aux line d to the input of the 74C42. The Binary code for the mode selection is given in section 3.2 and 3.2.2. The 74C42 decoder circuit operates with negative logic at its output. That is when a normal positive logic input is fed to the device, the selected output goes low (0 volts), and all the remaining outputs stay high (+12 volts). This is used in the diode logic that follows to actuate the correct FET switches for the desired function. The FET switches operate in pairs with one of the FET inputs being fed directly from the logic circuitry and the other from an inverted signal. The inverter is a simple single transistor device, consisting of an MPSA06 and associated resistors and diodes. Resistors R38 through R40 are the pull down resistors for the four FET series/shunt pairs.

It can be seen that each of the four outputs of the decoder actuate a number of the FET pairs depending upon the function required. For instance, R41 is associated with the FET pair that switches the audio from input A to summing node 1. R38 is associated with FET pair that switches the audio from input B to summing node 2. Therefore to achieve stereo output from the card, both lines connecting to resistors R38 and R41 need to go low. This is accomplished by output 1 through diodes CR12 and CR13 when a jumper is connected between jumper points G and H. The rest of the functions operate in like manor.

5.0 Troubleshooting Techniques

Armed with the knowledge of the circuit descriptions given above, standard trouble shooting techniques should be used to determine first the general area of malfunction, and then more specifically the actual offending components. A review of the most basic of these techniques follows.

1. It is best to trouble shoot a module at a work bench using current limited lab power supplies. Set the current limiting of the power supplies to 150 mA for the analog supplies and 100 mA for the logic supply. This will protect the module and still allow the location of failures to be made.

2. Since most failures are catastrophic in nature rather than a gradual degradation of performance, make a close visual inspection of the module for any discoloration of components and possible shorts on the PC board itself. Discoloration would indicate excessive heat, most likely from a component failure. Remove any component that has obviously failed, i.e. carbonized resistors or I.C. packages that are cracked.

3. If fuses are blown, replace them and power up the module. If there are short circuits on the module the current limiting of the power supplies will prevent any further failures, and the presence of a short will be shown by the current limiting of the power supplies. Allow the module to operate in this condition.

4. Look for any components that are operating to hot to the physical touch. This will show where the shorts are when there is no physical symptoms. Typically one can just keep their hand on a surface at 130° F. With one exception, that of the PS-101, all of the components of the System 1000 are meant to operate at temperatures lower than this.

3. Remove any components, i.e. transistors or integrated circuits that are experiencing overheating. Most often at this point the power supplies will come out of current limiting, and the module and daughter board will function, at least in part. If further problems exist after the power supplies come out of current limiting, they can most often be found by preforming voltage checks through the circuitry.

5.1 Circuit Board De-Soldering

Printed circuit boards are <u>very</u> easy to damage by excessive heat. Unless you have developed the specialized skills necessary to remove and replace components, we suggest that you leave the task to someone skilled in these techniques.

When servicing printed circuit boards we strongly recommend the use of a vacuum de-soldering station, such as the Pace MBT-100.

The proper technique with these stations is to apply the tip to the area to be de-soldered and wait for the solder to thoroughly melt. You can be sure of a thorough melt by observing the top side of the board. <u>When</u> the solder there has become liquid, apply the vacuum while moving the hollow tip with the component lead in a circular motion. By rotating the lead, with the tip against the board, but <u>without</u> applying pressure to the pad, you are able to most thoroughly remove solder in the plated-through hole. In turn the component will often drop out of the board when you are finished.

If the solder is not thoroughly removed from the plated-through hole, attempting to remove the component will bring with it plating from inside the hole. This may destroy the usefulness of the board. If you find that your attempt to completely remove the solder from the hole and pads has failed, do not attempt to re-heat the area with the de-soldering tool, as this will <u>overheat</u> the pad, and not the area that is in need. As a result the board is usually damaged. Rather, re-solder the joint, and then go back and apply the proper technique, by allowing the solder in the joint to thoroughly melt <u>before</u> applying vacuum. This technique uses new solder as an efficient heat conductor to the total area, eliminating hot spots.

5.2 Circuit Board Re-Soldering

NASA has developed an effective technique that ensures highly reliable solder joints. It involves first heating the component lead, since it usually has the higher mass, by applying a small amount of solder to the tip of the soldering iron at almost the same time as you apply the iron to the component lead. This will allow some flux to make it to the component lead. The iron should be approximately 1/8" above the board. When the lead has come up to temperature so that it melts the solder when placed against it and has good wetting, slide the soldering iron down the lead and heat the printed circuit board pad while applying a controlled amount of solder to the joint. All of this should take no more than a couple of seconds. If the component that is to be installed has leads that are oxidized, it will be necessary to clean them. This may be done with either a Scotch Bright® abrasive pad or fine bristle fiberglass brush, among other methods.

This completes the RGC-02 instruction manual. Ed Oct 28, 1988

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