KRELL
DIGITAL INC.

OWNERS REFERENCE

SBP-64X SOFTWARE BASED PROCESSOR

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INTRODUCTION

Welcome to the Krell Digital family of audio components. You have joined a select group of discriminating listeners who enjoy the finest in music reproduction.

Krell Digital is dedicated to the design of technologically advanced components for the reproduction of digitally recorded music. Our designs continue the Krell philosophy of uncompromising performance through leading edge technology.

Your SBP-64X is the flagship model in our digital playback component series. It will provide you with a more faithful recreation of the musical experience than any other product of its type.

The people at Krell Digital are committed to an ongoing upgrade program designed to uphold your SBP-64X's position as an industry leader. Our modular designs will enable us to offer revisions to both the software and hardware as we continue to redefine the state of the art in digital music playback.

Therefore, along with the remarkable improvement this KDI processor has rendered to your system comes the firm knowledge that you will be able to increase its capability and value as time goes by.

In the unlikely event that your SBP-64X should require service, you will be pleased to note that your component is backed by a comprehensive Customer Satisfaction Policy*, and one of the most advanced service facilities in the industry.

If, upon reading this Owner's Reference you should have any questions or suggestions, please do not hesitate to contact your authorized dealer or Krell Digital Inc.

This Owner's Reference is divided into several sections, each designed to perform a different function. The sections cover critical installation material, a "Q & A" section where we provide answers to questions which may arise, a Technical Assistance Glossary for technical explanations, and an insight into the unmatched capabilities of your SBP-64X.

While reading this guide, you may encounter some key words or phrases which are unfamiliar to you. We have tried to anticipate these potential unknowns in order to assist you in understanding the exacting technologies developed for this component by KDI. You will notice that these phrases are *italicized.* This special type face indicates that an explanation is included in the Glossary.

We may not have anticipated all the terms for which you would like further clarification. In this event, please feel free to contact your authorized dealer, or the KDI staff for further assistance.

*For detailed information on the terms and conditions of service, please consult your warranty registration card.

CRITICAL INFORMATION!

We understand that the desire to listen to your favorite music through this fine component may take precedence over reading this document. However, your SBP-64X is a very sophisticated multi-computer system as well as a state of the art audiophile component. **It should always be connected with great care.**

For this reason, we have compiled this installation guide to enable you to *"boot"* your processor quickly and correctly, without the possibility of damage through haste. It provides the procedures which will allow you to listen and enjoy your SBP-64X.

When you have completed your installation, may we suggest you return to the design features section of this manual for more information on the performance characteristics of your processor.

If you experience operational difficulties with your SBP-64X do not attempt any repairs on your own. **THERE ARE NO USER SERVICEABLE PARTS WITHIN THE SBP-64X.** Contact your authorized Krell Digital dealer for assistance.

INSTALLATION GUIDE

Fold out the Component Recognition drawings located on the last page of this booklet for a visual reference during installation.

UNPACKING

Save all packing materials. While unpacking your SBP-64X, take note of the following items:

A. 1 - SBP-64X Software Based Processor
B. 1 - Power Supply complete with 2 blue spanning cables
C. 1 - AC power cord
D. 1 - Packet with owners manual and warranty materials.

Note: If any of these items are not included, contact your authorized dealer immediately for assistance.

PRECAUTIONS

Disconnect your amplifier's AC cord from the wall receptacle. Turn off all other components.

SHIPPING

If you must ship your SBP-64X, repack the unit in its original packaging to prevent transit damage.

PREPARATION OF INSTALLATION SITES

Before you physically install your SBP-64X we recommend that you follow these guidelines in choosing the locations for the processor and power supply. This will facilitate a clean, trouble free installation.

Power Supply

1. Choose a suitable location for the power supply following three guidelines.
   A. Although well shielded, the power supply should not be placed in close proximity to hum sensitive components (i.e. PREAMPS, TURNTABLES...).
   B. You are provided two 6 foot power supply cables to span the distance between the power supply and the processor. You must therefore, plan their respective positioning within a 6 foot radius.
   C. Allow ample air space for heat dissipation on the top and sides of the power supply. Five inches on top and two inches on either side will be sufficient.

Caution: The blue Spanning Cables are proprietary in both their material design, and their "pin out" connections. Do not modify, substitute, or extend them in any way! This would incur a high risk of damage to both the power supply and processor which will void all warranty coverage.

2. Run the male end of the supplied AC cord from the power supply location to a nearby wall socket. This will be easier to accomplish now, as the component itself is not in the way. DO NOT PLUG THE AC CORD INTO THE WALL SOCKET AT THIS TIME!

   Caution: While the SBP-64X's superb regulation will not require a dedicated AC circuit, we strongly advise against any connections through extension cords or multiple AC adaptors.

   Caution: Do not remove, or bypass the grounding lug (with an adaptor) of the provided AC cord as it may induce severe RFI into your playback system.

   Note: As with any computer product, you may wish to provide surge and spike protection for your SBP-64X.

The Processor

1. The processor itself is not particularly sensitive to placement. It may be positioned anywhere in your component stack so long as it is within reach of the power supply spanning cables.

PLACEMENT

1. Place the power supply in its selected location, inserting the female end of the AC cord into the socket on the rear of its chassis. THE MALE END IS STILL NOT PLUGGED INTO THE WALL!
2. AT THIS TIME, VERIFY THAT THE "ON/OFF" SWITCH ON THE POWER SUPPLY IS IN THE "OFF" (DOWN) POSITION.
3. Run the blue spanning cables to the selected processor location.
4. Position the processor in its appointed location in such a way that the unit will not fall if not held, yet leaving access to all rear panel connections.

CONNECTIONS

Power

1. Insert the two power supply Spanning Cable connectors into their appropriate Analog and Digital sockets and firmly tighten the thumb screws.

   Caution: Do not use any tool other than your fingers for tightening the connectors. It is unnecessary, and may physically damage your component.

   Note: The spanning cables are terminated in computer industry standard, gold plated "D" connectors. Their different sizes and keyed profiles eliminate any possibility of an incorrect connection.

Digital Inputs

1. Connect the Digital Output from the Krell Digital MD-1 CD Turntable or your CD/*DAT* player to the Digital Input on the rear of your processor. Your SBP-64X will accommodate input from either the *coaxial* or optical outputs from any CD/*DAT* or Satellite broadcast source.

Note: Care should be taken in selecting the type of cable used to link the digital source to your processor. If *coaxial* cable is to be used, it should be non-capacitive and have a bandwidth in excess of 10 *MHZ* to prevent drop out errors. If available, we strongly recommend *fiber optics* for their ability to completely isolate all grounding between components, thereby preventing any player/processor ground loop interferences.

Analog Outputs

1. Using either the single ended or *balanced output* on the SBP-64X make the connections between the processor and any *high level input* on your preamplifier. Be certain to maintain L/R consistency between the cables or you will accidentally reverse your stereo image.

   Note: The SBP-64X outputs should be run directly to a high level stage of your preamp without any *input filtering.*

INITIAL POWER UP

1. Plug the power supply AC cord into the wall socket. DO NOT PLUG YOUR AMPLIFIER IN YET!
2. Turn your digital source (CD/*DAT*/Satellite) "ON".
3. Turn the power supply switch to the "ON" (UP) position, and turn "ON" your digital signal source. Whether it is CD/*DAT* or Satellite is not important. The following results should occur in this particular sequence:

   A. The three *LED's* designating Digital, Analog, and *DAC* power will illuminate simultaneously. This is your assurance that the five individual power supplies are operating and stable.

   B. After a period of 5 to 20 seconds, the *DACs* will stabilize and the *LED* corresponding to the Sampling Frequency of your digital source will illuminate.

   Caution: Should you have any major deviation from this sequence, do not attempt to play the unit. Disconnect it prior to powering up any other components and contact your Krell Digital dealer immediately.
4. You may now connect your amplifier to the AC mains and power up your components, remembering that the last component to be energized should be your amplifier.
5. With your volume set low, switch the source selector of your preamp to the position correlating to your chosen input connection for the SBP-64X (i.e. AUX, CD, *DAT*,...)
6. Begin playing your Compact Disk or Digital Audio Tape.

   Note: While your SBP-64X will perform beautifully from the moment you turn it on, it requires a minimum warm up period of 8 hours before it will reach its full sonic potential.

   Your installation is now complete. Should you have any further questions which are not covered in the remainder of this reference, contact your authorized KDI dealer. We wish you many hours of listening fulfillment!

SBP-64X INSTALLATION QUESTIONS AND ANSWERS

Q. My CD player has both fiber optic and *coaxial* outputs. Which one should I use?

A. Given a choice, we prefer the optical link due to its ability to completely isolate the grounds between two components. This eliminates the possibility of ground loops in the digital components.

Q. I own both a CD and *DAT* player. Do I have to change my cables every time I listen to a different digital source?

A. No. Your SBP-64X will accommodate both the *fiber optic* and *coaxial* input. Simply connect both sources using the separate inputs.

Note: When the SBP-64X senses two live inputs simultaneously, it will default to the *fiber optic* link. Therefore, when you wish to listen to the source linked with *coaxial* cable, you must turn the other (optically linked) source off.

Q. Will I damage my SBP-64X if I leave the power "ON" all the time?

A. No. These *Class "A"* analog circuits are most accurate and stable if left to idle when not in use, and the circuitry ages fastest when cycling "ON" and "OFF". The fact is, your Krell Digital processor will sound better and probably last longer if left "ON".

Note: For the protection of your processor, we recommend disconnecting the power supply from the wall outlet before any electrical storms or if you plan on being away from your home for prolonged periods of time.

Q. Do I have to switch the Sampling Frequency when I go between my CD and *DAT*?

A. No. Your SBP-64X automatically senses the input frequency and does all necessary switching.

Q. Sometimes, while listening to my *DAT*, the 44.1 *kHz LED* is illuminated. I thought *DAT* used 48 *kHz*. Is my processor malfunctioning?

A. Some Digital Audio Tape recorders can record and playback in either 44.1 *kHz* or 48 *kHz* depending on the source the tape was recorded from. The SBP-64X's *LED's* are informing you of the frequency it is receiving, and as a consequence, the sampling frequency at which the tape was recorded in.

Q. I'm not getting any sound through the processor.

A. Most likely, there has been a simple mistake in installation.

Suggestion: Check all connections IN and OUT from the processor. Check all power connections. Make certain that the power supply is switched into the ON or UP position. Have you selected the correct source on your preamp? Check the front panel *LED's* for power supply stability.

If you still have no sound, turn off the power and contact your dealer.

Q. I have some very fine audiophile interconnect cable which has superior sonic characteristics. Can I use this for my *coaxial* digital input?

A. You may experiment with any high quality cable. Do note, however, that most audio interconnect cable is not designed to carry the ultra high frequency information of a digital *bit* stream.

Note: For the SBP-64X, we recommend non-capacitive *coaxial* cable which has a bandwidth in excess of 10 *MHZ* and excellent shielding properties.

Q. While listening to my SBP-64X I experience occasional periods of silence through my speakers. Is my processor malfunctioning?

A. These *drop outs* are caused by bad data in the digital stream which is sensed by the SBP-64X. This corruption in the data may be due to a poor input connection, damaged or dirty source material, or interconnects which do not have a wide enough bandwidth.

This intermittent muting is caused by the SBP-64X. It is sensing the bad data and muting the signal to prevent possible damage to your associated components.

Suggestion: Try changing your source material, and check your connections. If these are not the causes, speak with your dealer about obtaining different cabling. If you are using *fiber optics* and source material and connections are not the problem, speak with your authorized dealer

Q. I am getting hum in my system only when I have the SBP-64X turned "ON". Is there something wrong with my processor?

A. You must have placed the power supply in close proximity to a hum sensitive component, such as your preamp or phono turntable.

Suggestion: Relocate the power supply in accordance with the installation guidelines.

KRELL DIGITAL SBP-64X DESIGN FEATURES

Software Based Processing requires a perfect blend of exacting, multifaceted technologies, from high tech digital innovation to an ultimate refinement of analog circuit design.

On the next two pages, we will briefly point out our methods of addressing these requirements in the Krell Digital SBP-64X.

INPUT

The SBP-64X will accommodate both *Coaxial* and Fiber Optical input to insure compatibility with any digital source with digital outputs.

PROCESSING

The "Waveform Replicator"

The KDI SBP-64X uses proprietary **"Waveform Replicator"** software which enables our four Motorola processors to perform *polynomial* computations for calculating the 63 additional data points to fill our 64 times *oversampling* requirements.

The Motorola DSP-56001

We have chosen the Motorola DSP-56001 for two reasons which make this processor clearly superior to any other for a similar application; *Dynamic Headroom,* and Precision.

Dynamic Headroom

The DSP-56001 uses a 24 *bit* data path which relates to a 48 dB increase in *dynamic headroom* over components using different processors.

Precision

Of critical importance to any processor is the size of its *accumulator,* for this limits the size of the computational *coefficients* it can utilize. If the *coefficient* is too large it will overflow the processor, forcing it to *scale* the computation. In audio processing this is especially damaging because the processors perform multiple computations based on one data sample, so each repetitive computation is based on a *scaled* figure which compounds the error on each computation. Thus, the size of the *accumulator* limits the potential precision of a processor's calculations.

The Motorola DSP-56001 gives your KDI SBP-64X substantially higher precision than other components based on different processors.

28 MHZ clock speed

The SBP-64X is run at over 28,000,000 cycles per second. This high speed, coupled with the DSP-56001's ability to perform multiple operations during a single *instruction cycle* gives the SBP-64X greater computing power than other, even higher speed processors.

DIGITAL TO ANALOG CONVERSION

THE *DACs*

The SBP-64X utilizes twin Burr Brown PCM-64 18 *bit DACs* for high speed and superb accuracy.

Parallel Data Into The *DACs*

Unlike the majority of other processors in the industry, the SBP-64X runs parallel data through the DSP's, and into the *DACs.* By using these 18 *bit DACs,* in parallel, we are able to maintain the incredible speed required for 64x *oversampling* without *multiplexing,* and then *summing* the data.

NO "BRICK WALL" FILTERING

The exacting nature of our digital information and the extraordinary technique by which our *DACs* perform their conversions enable us to avoid any type of steep slope cut off *(brick wall)* filtering in the SBP-64X. Therefore, you experience the benefit of absolute purity in the signal without any of the undesirable effects of those filters.

***DISCRETE* CURRENT TO VOLTAGE**

Current to Voltage *(I/V)* conversion, is performed in the analog domain, directly after *D/A.* In most processors this occurs either in the *DAC* itself or in an external integrated circuit *op-amp.* At Krell Digital, we feel that these methods are unacceptable. Therefore, we have engineered a 100% *discrete* Current to Voltage stage for

our processors giving a true recreation of the original music performance, without the colorations normally associated with integrated circuits.

BALANCED OUTPUT

The SBP-64X provides *balanced outputs* for those with the complimentary components which allow them to obtain still lower noise and distortion, while providing more specific imaging.

***CLASS "A"* ANALOG DESIGN**

The analog section of the SBP-64X is based on classic Krell High *bias*, Pure *Class "A"* design which has already set new standards for excellence in musical integrity.

POWER SUPPLY

The power supply for the SBP-64X, housed in a separate outboard enclosure, provides the five separate voltages required by the Digital circuitry, *DACs*, and Analog output stages. In actuality there are three completely independent power supplies and ten cascaded *discrete* regulators to supply the five voltages.

NO *OPTO-COUPLING*

The sophistication of our designs provides a degree of stability and isolation that surpasses any need for opto-coupling, and their inherent bandwidth and linearity limitations.

KRELL DIGITAL TECHNICAL ASSISTANCE GLOSSARY

The following glossary represents simplified explanations for key words or phrases encountered in the course of this manual.

32kHz

The sampling frequency of Satellite broadcast.

44.1kHz

The sampling frequency of Compact Discs.

48kHz

The sampling frequency of Digital Audio Tape.

ACCUMULATOR

A work and storage area where data is held and computed in a Digital Signal Processor.

The accumulator must be large enough not only for the target data, but also for the end product of the computation. As the precision of computations increases, the larger the resulting end data will be. Therefore, the size of the accumulator places a limit on the potential precision of a processor.

BALANCED OUTPUT

A method of isolating the outputs from ground which offers increased gain, superior imaging, and isolation from external interference. Balanced output operation on the SBP-64X requires a preamp with corresponding balanced inputs.

BIAS

A current or voltage applied to a transistor to control the linearity of its operation. Generally speaking, so long as the transistor is kept within its tolerance range, higher bias will improve transistor operation.

BIT

The fundamental building block of digital information. The term, expressing the smallest part of a digital *word* is derived from the words BInary DigiT.

BOOT

Booting is a term loosely referring to initializing the startup sequence in a computer.

BYTE

A group of 8 *bits*. The primary component in a digital *word.*

CLASS "A"

In audio components, Class "A" represents an operating state for power supplies and circuitry which is widely acknowledged as having superior sonic characteristics to other forms of operation.

CLOCK SPEED

The speed at which a processor operates, usually expressed in *MHZ.*

COAXIAL

A type of cable design where a center conductor is surrounded by an insulator which is then wrapped with a metallic shield.

COEFFICIENTS

Numbers used in high order mathematical computations. In general terms, the length of a coefficient is directly related to the accuracy of the computation.

D/A

Digital to Analog conversion.

DAC

Digital to Analog Converter. The circuit which converts the digital information (in this case, from the DSP-56000) into an analog signal for playback in your audio system.

DAT

Digital Audio Tape.

DDD

The symbol (SPARS code), which appears on most CD's, representing Pure Digital Recording. Digital Recording, Digital Mixing, and Digital Mastering.

DISCRETE

In this text, Discrete circuit design utilizes individual components (i.e. FETs, Transistors ...) not Integrated Circuits. It is generally accepted that correctly executed discrete circuits are superior in performance than the less expensive IC's.

DITHERING

Dithering is a process by which random noise is mixed in with low amplitude signals created as a by product of *quantization* errors. This *dither* masks the unwanted signals partially through random cancellation and partially by raising the noise floor to envelop these signals. Dithering is commonly performed in digital recording to counter the *quantization* errors which commonly occur during Analog to Digital processing.

DROP OUT

In this usage, drop out is a term referring to periods of silence during digital audio playback.

DYNAMIC HEADROOM

The ability of a component to correctly duplicate high speed, high level *transient* signals in excess of those normally encountered in audio playback. If a component does not have sufficient Dynamic Headroom, it will either fall short of the actual intensity and accuracy of the *transient,* or it may distort it.

FIBER OPTICS

An interconnecting link through which digital data is transmitted via a beam of light.

HIGH LEVEL INPUT

An input which does not require extraordinary amplification in the preamp as do the Phono MC/MM inputs. High level inputs include Tape, Tuner, Auxiliary, CD, DAT...

INPUT FILTERING

A filter used in the input to correct an unwanted signal characteristic from an anticipated source.

INSTRUCTION CYCLE

A period of time in which a processor completes a single or series of operations.

SBP-64X SOFTWARE BASED PROCESSOR DATA

HARDWARE DIGITAL

DESIGN:	Krell Digital - Proprietary.
INPUTS:	Digital inputs for both *coaxial* and optical.
DIGITAL SIGNAL PROCESSORS:	Four Motorola DSP-56001 24 *bit* processors with 56 *bit accumulator,* operating two per channel in parallel.
DACs:	Two Burr Brown 18 *bit* PCM-64's running one per channel with parallel input.

HARDWARE ANALOG

DESIGN:	Proprietary 100% *discrete,* High *bias Class "A"* Krell design.
CURRENT TO VOLTAGE:	Proprietary, 100% *discrete.*
OUTPUTS:	Proprietary, 100% *discrete,* Balanced and Single Ended.
POWER SUPPLY:	Proprietary, High *bias, Class "A"* Krell design. Completely independent power supplies for Analog, Digital, and *DAC* power, in separate housing. Ten, 100% *discrete,* cascaded stages of regulation to provide the five necessary voltages.

SOFTWARE DATA

Krell Digital Inc. proprietary **"Waveform Replicator"** software which include high order algorithms.

PROCESSING DATA

OVERSAMPLING: 64 times.

SAMPLING RATE:	**SBP-64X**	**vs.**	**INDUSTRY STANDARD**
Compact Disc	2.8224 *MHZ* – 2,822,400/sec.		*44.1kHz* – 44,100/sec.
DAT	3.072 *MHZ* – 3,072,000/sec.		*48kHz* – 48,000/sec.
Satellite	2.048 *MHZ* – 2,048,000/sec.		*32kHz* – 32,000/sec.

kHz

The letters used to represent Kilo Hertz, a measure of frequency referenced in thousands per second. (ex. 1kHz = 1000 times/sec.)

LED

Light Emitting Diodes.

MHz

The letters used to represent Mega Hertz, a measure of frequency referenced in millions per second. (ex. 1MHz = 1,000,000 times/sec.)

MULTIPLEX

In digital audio processors, *multiplexing* divides source signals between multiple processing circuits (i.e. *DACs,* Processors...). It allows processing at higher speed than the individual circuits can do alone. The trade off to *multiplexing* in the analog domain is the requirement to reconstruct the complete signal through *summing.*

OP-AMP

Integrated circuits used as OPerational AMPlifiers. Despite their significant sonic colorations, *OP-AMPs* are often used in audio components due to their cost effectiveness.

OPTO-COUPLING

Optically transferring information from one circuit to another in CD's, DAT's, and Digital to Analog processors. *Opto-coupling* does add colorations to music, but it is much less expensive than designing more advanced, quiet circuits. Opto-coupling is often used to isolate digital noise from analog circuits.

OVERSAMPLING

A method by which additional *samples* are plotted in between the original recorded *samples* in order to increase the *time domain* resolution of the playback waveform.

POLYNOMIAL

Polynomials, simply stated, are long, high order equations which can be used to specify exacting oversampled points which accurately follow the natural profile of a musical waveform.

QUANTIZATION

The process by which analog music is converted into digital data.

SAMPLES

A digital sample is a quantized coordinate representing a specific amplitude at a specific time. Thousands of samples per second are quantized during recording to digitally represent the original music.

SAMPLING RATE

The frequency at which analog data is *sampled* in the recording process (ex. a Sampling Rate of *44.1kHz* which is used in recording CD's represents 44,100 quantized *samples* per second).

SCALING

In this application scaling is a term referring to the rounding off of computed numbers due to the overflowing of a processor's *accumulator.* This results in a loss of accuracy in oversampled data points.

SUMMING

Summing, in the analog domain, is a process by which sections of information are reconstructed (summed) after *multiplexing* and processing.

TIME DOMAIN

In this application, another way of stating the Digital Domain.

TRANSIENT

A signal which travels from a low amplitude to high amplitude in an extremely short time.

WORD

Used in the digital context, a word is a group of *bits* and or *bytes* which combine to determine the size of a data path.

PROCESSING UNIT

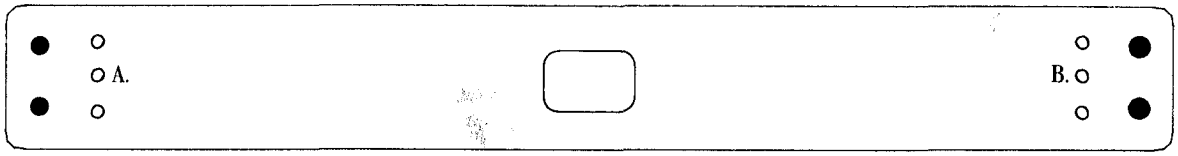


FIGURE 1.1 PROCESSING UNIT (FRONT)

A. SAMPLING FREQUENCY INDICATORS
The SBP-64X will process digital information in three frequencies in order to decode Satellite Transmission *(32kHz)*, Compact Disc *(44.1kHz)*, and Digital Audio Tape *(48kHz)*. The processor will switch to the correct frequency according to the input signal.

B. POWER READINESS INDICATORS
The five double-regulated power supplies in the SBP-64X are isolated into three groups; DIGITAL POWER, ANALOG POWER, *DAC* POWER. The indicators represent stable power conditions in their respective groups.

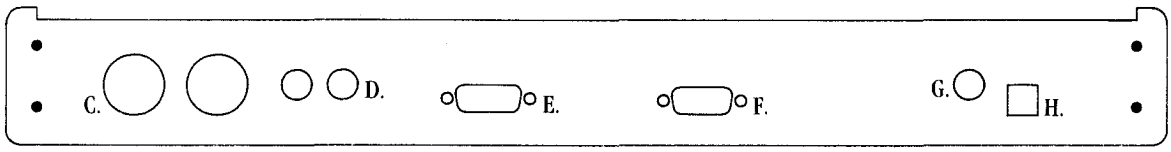


FIGURE 1.2 PROCESSOR UNIT (REAR)

C. *Balanced Outputs* L/R
D. Single Ended Outputs L/R
E. Analog/ *DAC* Power Input
F. Digital Power Input
G. Digital Signal Input - *Coaxial*
H. Digital Signal Input - Fiber Optic

POWER SUPPLY

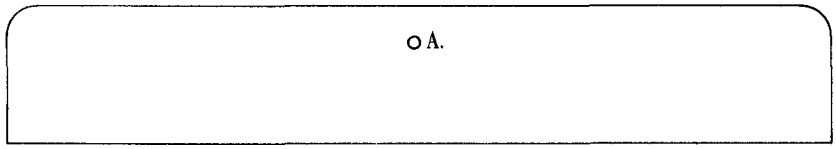


FIGURE 2.1 POWER SUPPLY (FRONT)

A. Power "ON/OFF" Indicator

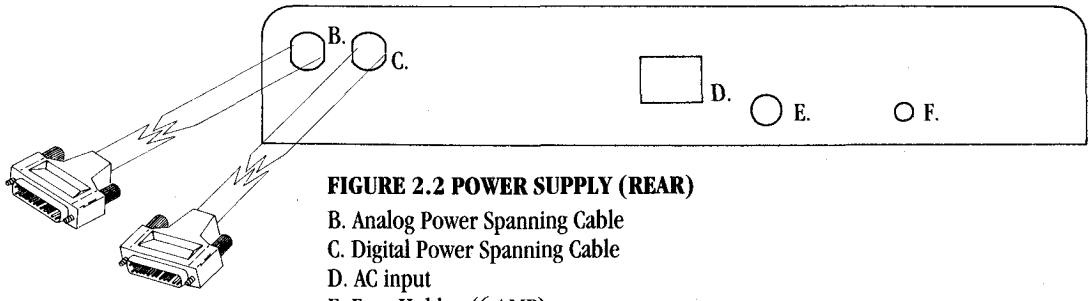
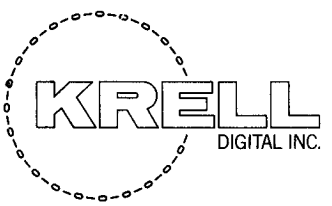


FIGURE 2.2 POWER SUPPLY (REAR)

B. Analog Power Spanning Cable
C. Digital Power Spanning Cable
D. AC input
E. Fuse Holder (6 AMP)
F. Power "ON/OFF" switch



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