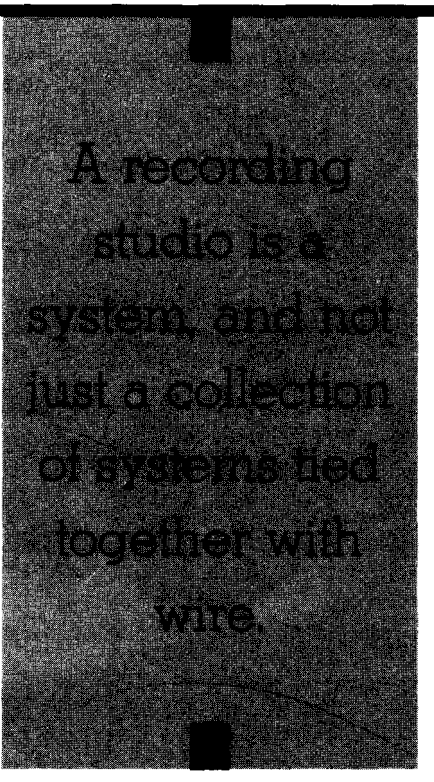
INSTALLING THE STUDIO

A Guide to Getting It All Together

by Greg Hanks

After months of intensive labor, and many thousands of dollars spent, it seems that someone is going to have to hook up all of the equipment that is sitting in the control room. Do you have the wire? Where the heck are all of those parts bags that came with this stuff? Steve?? Greg?? HELP! This not-so-pretty scenario actually happens. Nowadays, though, only the foolhardy would approach such an expensive undertaking in this manner, or so it would seem. There should be as much preparation given to the inter-connection of the facility equipment as there is to any other facet of the operation. The installation of a studio is not a little project to be taken lightly. Part and parcel to the placement and hook-up of the equipment is the care and planning thereof. We approach such an endeavor with a little different viewpoint. A recording studio is a system, and not a collection of systems tied together with wire. Therefore, the people responsible for the integration of the various components that comprise the recording studio are in effect responsible for the design of a system. This approach implies involvement with the overall planning of the room(s). The areas of interest to the designer are as follows:



Outline of Current Needs

The equipment necessary and the optimum layout thereof is mostly the result of the type of business the studio is to service. An example would be the synchronizer that ties the VTR as a slave to the multi-track recorder in a video post-environment. It would have little application in an 8-track demo studio. Therefore, put a lot of thought and care into the equipment selection and where it will live. We will explore this in more detail a little later.

Electrical Power

Once the equipment choices have been made, and the equipment locations have been established, it is necessary to determine what type of demands will be made upon the power lines. It is also necessary to know whether or not the equipment is sensitive to line fluctuations and spikes, whether this condition occurs on the power available, and if so what size and type of power conditioning is necessary. Having made these determinations, it is necessary to specify the type of electrical wiring and the location of the concurrent breaker boxes, power conditioners and all of the associated outlets. Take care, for a power line that has a high current demand generates a significant magnetic field, which translates directly to hum and electrical noise. Any large power lines should be located well away from the console summing buses and the multi-track.

Lighting

Have you ever had to walk through a room full of obstacles in the dark in order to turn on the light switch? Silly, isn't it? Well, where are you going to locate the control room lighting dimmers/switches, how much light is there going to be for maintenance, and how do you adjust the lighting for the studio area? These are some of the questions that impact the installation design, because SCR type dimmers can have a very nasty effect on the sound of the system, and all of the low level wiring should be placed as far as possible from both lighting and power wiring.

Air Conditioning: Control Room and Studio

The air conditioning sizing, duct location and specification is not really the realm of the installer, but can impact the project in that it is "really swell" to be able to get an air conditioning drop to the multi-track recorder alcove (if there is one), the amplifier and console power supply racks, and the computer closet (again, if one exists). The location of the ducting can affect where one decides to run wires or locate wall panels. These points should be addressed as the room design is being put on paper.

Pragmatic Overview of Available Resources

Whenever the studio design considerations are contemplated, the realistic available resources must first be determined. These resources include available real estate, floor space, time, money and manpower. These are inter-related contributions to the net available resource pool. The amount of individual contribution must be wisely allocated. Let's look at how some of the resources affect the installation:

Time

The time budget is probably the toughest to estimate with any true degree of accuracy. The reasons for this are fairly obvious, and some of the questions that must be asked are:

1. Now that we have a full materials list, how much is in stock, what has to be ordered, and how long will it take for it to come in?
2. How long does it take to cut, number and prep the wiring?
3. Who is going to do the panel design, and machining, anodizing and

engraving? By the way, how long will it take?
4. Which tasks affect others, are work schedules in a proper chronological sequence, and can concurrent tasks be handled so that they reach completion at the correct times?

Obviously, there are many factors to consider when allocating time, not the least of which is money. All too often the entire crew works a few 'all-nighters' in order to get the job done in time. Overtime is expensive, and the work performed after surviving a previous 36 hours of intense labor is less effective than it could be. The installation planning should start with the project plan, and the work should start as soon as there is definite and reliable information available about what will be needed.

Space

The proposed facility has an overall floor plan. Is there a place for the maintenance area in this plan? Where are you going to put acoustically-sensitive mechanical reverb devices? How about spare parts, client tapes or the mundane items such as stationery and office supplies? These are some of the many ways that space must be budgeted for the new operation.

Money and the Available Budget

Construction, equipment and installation have a percentile relationship to each other: the hook-up and installation are often shortchanged, and this article attempts to curtail that onerous practice. When establishing a budget for the work, a good rule of thumb figure is about ten percent of the capital equipment budget. This is not cast in concrete, and should not be used when an initial modest equipment complement is to be superseded with a more sophisticated setup. The basis of any good control room and studio wiring scheme is planning. The direct costs can be established using a relatively simple formula: $15 per signal cable, which includes termination at each end and the cost of the wire itself. In order to use this calculation method, it must be understood that a signal cable has two ends, and this expense must be doubled whenever a connector is inserted between the source and destination of the signal run. When multi-pair cable is utilized, each pair is calculated separately. Add to this amount the expenses incurred by custom interface circuitry, panel work, and miscellaneous costs such as relay racks, power supplies and the like, and you have a pretty good idea of what it will cost to implement your studio design.

Something else to keep in mind is the question of future expansion when calculating the budget. Whenever a near future increase in equipment sophistication is a possibility, it makes economic sense to allow for new requirements in the wiring.

It is far less expensive to put the cables required in place, than to rewire the facility. Let's look at this in more detail.

Projections of Future Expansion

When your business starts to grow and your clientele demands increase in terms of equipment and facility versatility, your future planning done during the installation pays off. This can be as simple as having the lines in place to upgrade from 16. to 24-track, or as complex as having the control lines and audio facility in place to accommodate a new digital 32-track with synchronization and disk-based automation. There are basically two different avenues of preparation to explore. They are as follows:

Change of Business Service Area

If the proposed new studio is a start-up business, then it is difficult to determine which of your potential client bases will prove to be the most successful or profitable. Therefore it is a good idea to be prepared for whatever your clients may throw at you. This

could mean tying together a VTR to the multi-track via a synchronizer, or installing a multitude of synthesizers in the control room and running them via a MIDI sequencer. It is obvious that you won't be purchasing everything you would need for any contingency, but will rent the items needed, and install them on a temporary basis until they have proven themselves as viable financial investments. However, if the prime business target is the advertising or video field, then it makes perfect sense to anticipate the requirements that are concurrent with that field when planning the "install." Placing a couple of runs of RG-58U for video between the front wall and the rack that the synchronizer and VTR may live, and bringing in some extra control wiring between the multi and the same rack is far less painful in the initial construction stage of the studio than it is later on. If the rock and roll market is your main target, then those lines are not absolutely necessary, but headphone feeds and direct inputs in the control room absolutely are! Similarly, if the studio is a large one, and you anticipate that you will be doing a large number of string dates, then a conductor's podium, with some control wiring for communications is essential.

The previous paragraph is intended to illustrate what may happen, and what some of the wiring requirements may be. It is an easier task as a manager to see what all of the possible options are and then eliminate those that are the least likely to occur. Future business direction or change in direction should be accounted for in your plans, both financial and technical.

Expansion of Current Service Area

It is a much simpler task to look ahead at what your current client base is, and make arrangements in the installation to accommodate the future. This is most obvious in a smaller studio where you are most likely going from 16- to 24-track, or from one 24-track to two. It is also easier to see what the requirements of the equipment you anticipate using are. Avail yourself of this insight and plan as much as possible.

Guidelines for Successful Wiring

We have been engaging in some rather abstract intercourse about the necessity of planning, budget and time allocations. For those of you whom have braved the above, we herein offer a few morsels of hands-on info. In a sequential manner, we will attempt to outline the method we use. After all of the preliminary planning is through, you should have two very important items: (1) a floor plan, indicating the positions of all the equipment that will be used. This includes the rack layouts and locations. (2) a complete equipment list, also including the terminations of all of the equipment on the list. With these two items in hand, you are prepared to start designing. The first thing to attend to is getting a handle on how wires are going to run in the studio.

Floorplans and Run Schedules

Starting with the floorplan that has all of the equipment situated upon it, begin a list of cables that run to and from each piece. Organize this list by physical end location. This means that each "group" of wires that starts at one place and ends at another is an organizational entity. When there are cables going to many different places from the same piece of gear, then each separate run is documented individually. We organize these bundles as "schedules." A schedule is composed of whatever wires are going from point A to point B. We like to maintain two separate run schedules, one for low and line level audio, the other for high level audio (speaker level), video, control wiring and MIDI cables. Reasoning that computer information whizzing by at any reasonable baud rate sounds bad, we try to isolate audio from things that sound bad. Therefore we organize audio separately from everything thing else. Anyway, we should now be accumulating a list of schedules. These we can identify by placing circles on the floorplan at the approximate location of the wire(s) end(s). To differentiate circles, put a number in the circles that identify that group of cables (schedule). Sounds a lot more difficult than it is. Now, in the documentation on the individual schedules, we should include the following information:

Schedule #
Number of wires
Wire #'s in grouping
Type of wire
Wire color
Circuit description

We would call this documentation the "Wire Run Schedule." We also need a "Wire Run List." This is a list of all of the wire numbers used. By the way, wire numbers are a good thing, and should be used whenever there is more than one wire in an assembly of equipment!

Wire Numbers

It is good practice to identify each separate wire in any design by those in the know. Firstly, it is much easier to keep track of what is what when the harnesses are being constructed. Sec-

ondly, it is much easier to fix a system that is understandable. Many different identification methods are available, but one of the least expensive while being very expeditious is the use of wire numbers. Each wire is given a discrete number in our design scheme, but this is not necessary. What is important is that each wire is identified in some manner. Our preference is to assign a group of numbers to a function, and then to conform the sequence to the appropriate track numbers. As an example, the sends to the multitrack are numbers 200-299. It would follow that the numbers assigned to multi-track #1 line inputs 1-24 would be 201-224, with the second machine being 225-248.

Along with the wire run schedule, a wire run list must be generated. This is a sequential listing of all of the wire numbers used. Included on this document should be:

- Wire #s
- Source
- Source termination type and diagram
- Destination
- Destination termination type and diagram
- Circuit description
- Notes

When doing an installation, it behooves us all to avail ourselves of the services of the "wire-person." It is a double edged sword to enlist the aid of "outside" personnel; the advantage of being able to accomplish more is offset to some degree by the requirement of supervision. But the supervision requirement may be minimized by proper documentation, and the paperwork that results is a more thorough reference work than would otherwise be required if only the service department were doing the work. Some of the documents required when using less technical helpers include:

- Wire # summary
- Connector summary
- Wire # allocation table
- Standard connector pin-out guide
- Color code standard

Only when the job is done are these planning tasks appreciated. We have found a little respite from the tedium involved in the above through the use of the computer. Surprisingly, there are common business programs on the market that simplify this task. The everyday spreadsheet with operating macros will accomplish most of the above by entering the primary data only once. The actual programming necessary in the construction of macros, and the entering of data will take a bit longer than doing it all on paper with a pencil, but making changes and corrections is much, much faster.

Wire Run Location Considerations

As mentioned earlier, MIDI and computer information can sound bad. We should never hear the types of signals that originate in these devices. Meant to control musical devices, these signals are anything but musical! Electrostatic and electro-magnetic fields have a nasty habit of intruding themselves upon signals that should remain separate and isolated. In order to minimize these difficulties, we must keep the physical isolation between these two different signal types. This can be realized through separate conduit runs, or a shielding division within a common trough.

Troughs and Conduit

Throughout this discourse, I have been referring to cables going from one place to another, without mention of the manner in which this is accomplished. We wish to route cables in a manner that will allow future wires to be installed or current wires to be removed. This cable routing should be accessible with a minimum of fuss and bother. We also wish to penetrate all sound barriers a minimum number of times and in as few places as possible.

Wiring within the control room itself is much easier to accommodate, and this is what we will address, as your studio designer knows best how to get from the control room to the outside world. Within the control room there should be cable troughs accessing each and every equipment location. These troughs should remain accessible through either floor panels that can be raised, or wall panels that may be unscrewed. Your particular location and application will determine the dimensions and physical structure of the troughs, but keep in mind that it is good to pick up a little extra shielding in the troughs to reduce both EM1 and RFI. The construction should be of metal, however wood troughs lined with a thin lead sheeting work very well. When lining a trough in lead, or constructing it out of steel, remember that in order for this shielding to be effective, it must be brought to ground. The trough locations for the control wiring have a little different route requirement than the audio lines. Some problems come with the fact that there are also audio lines associated with VTRs and MIDI devices, and it is much easier (though more costly) in sonic purity to place these lines in the same location. At any rate, the control and MIDI lines should somehow be physically isolated from the audio lines. There is another group of cables that should also be isolated from the low level wiring, and those are the speaker and cue lines, (at speaker level). It is not uncommon for the headphone wiring to be run in the same trough as the studio mic lines. It is also not unusual to find unnecessarily high levels of high frequency cross-talk and cue power amplifier instability in these installations! If it is really necessary to run these lines together, then shield the high level lines, and face the instability problems with build out resistors or other applicable means.

Floorplan Ergonomics

We went over it before, but really, we should talk a wee bit more about the location of the multi-track. . . If the multi-track(s) is going to be put in a soffit (which is a good idea because of the improvement available in acoustic noise from the fans as well as the air conditioning drop availability), then can the inputs and outputs be accessed without having to remove the machines from the soffits? Can the noise reduction system by installed/bypassed easily and are the record firing lines accessible to find any errant signals?

Outboard Rack(s)

There are basically four different types of outboard racks in common use, and these are:

1. Roll-around racks-

A roll-around rack is usually between three and five feet in height and houses most of the equipment that the mixer will be requiring at his fingertips most of the time. This design offers a great deal of operation flexibility: when the units are not in use, they may be easily moved out of the way to afford greater use of the floor space. There are also some difficulties associated with interconnecting these devils with the rest of the system so they can withstand abuse. The methods readily available are hard-wired umbilical cables and floor mounted multi-pin connectors, or some mix of the two. Consider this when laying out the outboard racks.

2. Built-ins in the producer's desk-

This is a method that provides a space for a few pieces of equipment the engineers believe will always be needed within "arms reach." The hook-up advantages are obvious, but take care with the grounding and the possibility of the hum fields that can develop from the location of the various power supply transformers in relation to the console summing buses and preamplifiers. Remember, a transform er is nothing but a misclassified hum pick-up or generator!

3. Half height racks placed behind the mixing position-

When you pick up one of those glossy, thick industry magazines and see the multi mega-buck control rooms with consoles that seem to go on to eternity, you'll usually spy a "behind the mix position" complement of outboard equipment. One of the reasons for the apparent proliferation of this design is most of these click new installs are designed for audio-for-video post-production work! In this type of work, a producer, director, sound editor and a couple of other people are in the control room, all offering direction, doing paperwork, and sitting above and behind the mixer. This people placement is functional in that environment and the "behind the mix position" layout of outboard equipment offers a large desk space, while at the same time provides needed isolation between the aforementioned personnel and the mixer. Not heeding the requirement of listening while an adjustment is being performed, a stiff neck is not uncommon among the engineering staff. The choice of equipment allocated to these racks is a very sensitive issue.

4. Stationary racks, (wall-mounted, monitor and console power supply, six-foot relay rack stuck in the corner, etc.)-

While economy favors this layout, as well as being blessed with a simpler wiring task, this choice of outboard equipment mounting for anything other than room equalizers, noise reduction, and the like is a very tasteless choice. This becomes an ungainly and unmoving rock of electronics you have to retreat to in order to modify the sounds. After working a room that employs this form of ergonomic consideration for a few short hours, most people are looking for a new environment in which to create. Ease of use is of paramount importance in all designs.

Monitor Rack

There are a few different pieces of equipment that fit well together in the same rack area. Console power supplies, monitor power amplifiers, alternate speaker selector system, alternate function power supplies, room equalizers and sometimes the noise reduction rack all fit well within the same enclosure. While not necessarily functionally linked, these items all share the attribute that they do not need frequent attention. When you do not need to get to something, there is no need to keep it within that valuable floor space within easy reach. Care must be taken when installing items of this type in the rack in terms of grounding. Power amplifiers mounted in a rack require care that the signal output minus of the power amplifier is not tied (through the rack chassis mounting) to other devices. When contemplating a location for the monitor rack, keep in mind the desirability of putting the rack in a closet, close to the control room speaker location. There are usually a few fans associated with the console power supply or the monitor power amplifiers, and the acoustic isolation that a closet provides is nice. It is also easier to put an air conditioning drop in a closet than putting this same drop within the control room proper. Two items we are delighted to find associated with a monitor rack are lighting behind the rack and enough room to move around behind the system.

Rack Wiring Considerations

With the assembly of all of the above, a number of factors must be kept in mind. The proper assembly of a rack can make this humble carrier of equipment a thing of beauty. The common shortcomings of rack wiring are the lack of harness strain relief and the lack of available 110 VAC. It is our contention that all rack equipment should be interfaced with a "standard" connector. Any local equipment requirement deviations from this stand-

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ard can easily be accommodated with "pig tails." This enables equipment to be moved in patch position and changed as requirements demand with a minimum of fuss and bother. Most of the better relay rack manufacturers provide the ability to dress the audio up one side of the rack with strain relief, and the power on the other.

Synthesizer Location

With the proliferation of synthesizers, MIDI devices, drum machines and such, control room floor space (already at a premium) is reduced even further. Some of the functional considerations are:

1. Monitor-

It is always nice, when performing a complex musical part, to be able to hear what you are doing. If it is not convenient to be located within the mixer's monitor field, then contemplate a set of small speakers for the synthesist. Headphone feeds to the synthesizer location are a functional alternative.

2. Direct Ins-

The number of mic inputs in the control room often exceeds the studio mic input count. Synthesizers often have an output level of -10 to -20. The output impedance is low and unbalanced. Direct inputs are traditionally comprised of a transformer input of 47-100 k ohm with a 150 ohm output impedance. This provides for an output level of -35 to -45. With older, conventional transformer-coupled mic pre-amplifiers, this is a satisfactory arrangement. With newer transformerless instrumentation type preamps, this arrangement provides less than available performance. The reason for this disparity has a lot to do with the available headroom of older pre-amp design, and the sound of the pads used on the front end. A traditional "direct" transformer is designed for electric guitar use. For most synthesizer applications, the use of a cable that ties signal "+" to the tip of a 1/4-inch phone and the signal "-" to the sleeve, in conjunction with a separate ground run between console chassis and synthesizer chassis will provide superior performance. The difficulties encountered with this approach involve the buzzes and hums that arise from complex MIDI setups with multiple instruments. MIDI carries its own shields through, and set up ground loops!

MIDI Connections

There is an increased need for MIDI tie lines between the synthesizer location and the console. This is especially true when the install&ion is for the musician's home studio, and both the performing and engineering tasks are the responsibility of the same individual. MIDI control of outboard is also proliferating and a MIDI patch bay is becoming a necessity. Remember to keep these lines physically isolated from the audio lines! Also, keep the chassis grounding integrity of the synth system consistent with the rest of the audio system.

Power Connections

It seems foolish, but the one thing that most every instrument area lacks is a sufficient number of electrical outlets. The computer system alone will require d full outlet strip on its own. Don't shortchange this important consideration.

Grounding

The proper "earthing" of any complex electronic system is not the arcane black art that many people believe it to be. The confusion that surrounds grounding stems in part from the concept that "ground is ground is ground." This is true in all aspects except real life This issue is one thdt deserves a far more thorough treatment than is possible in this article. We will delve into this science in the November (AES) issue of Mix! ■