RTS / Telex

Professional Intercom Specification & Design

By Gene E. Behrend

Rev 12-3-04

Intercom spec & design.doc

INTRODUCTION

The TW intercom System is a high performance conference-line intercommunications system that features over 25 different integral components to allow a broad variety of system configurations. The system is designed for use in teleproduction and broadcast operations as well as industrial and commercial applications. Proven performance by demanding professionals has established the TW intercom System as the standard in the field of intercommunications.

We have named this system TW ('Two-Wire"), because two-conductor cable is all you need to hook up a basic system. Unique circuit designs utilizing advanced solid-state devices enable you to conveniently carry on two-channels of two-way communications through standard two-conductor shielded microphone cable, or telco JKT cable.

A system can be custom arranged from a variety of user stations; headset and/or speaker stations-in rack mount, wall mount, portable, and console mount packages. To augment the user stations, a number of specialized formatting devices are available to expand system capabilities and flexibility. These include a station-isolate system, channel source assignment, and interfacing components. Installing is simple and straightforward using standard XLR-type plug-in connectors.

For clear, clean undistorted sound, all of our user stations use dynamic microphone headsets and handsets. A wide-range frequency response and low-noise amplifiers help to reduce listening fatigue even over extended periods of use. Powerful headphone amplifiers combat noisy ambient environments, and high line-levels maintain signal integrity over long cable runs. For versatility and top performance, the TW Intercom System is unsurpassed.

APPLICATIONS

The TW Intercom System is widely used in the entertainment field. Television studios and mobile units appreciate the system's multi-channel and multiple station capability. Camera-iso, source assign, and simultaneous two-channel operation are important capabilities in any production. The right intercommunications system can make the difference for a successful production.

In electronic news gathering (ENG) and electronic field production (EFP) portable applications, 12-volt battery power, durable lightweight packaging, and reliable circuitry help the crew to communicate effectively to get the job done.

Concert and stage productions take advantage of the system's high volume levels, and optional call-light signaling. For traveling shows, easy set-up and the ability to run signals over very long distances via expendable cable saves time and money.

Non-entertainment applications find the TW Intercom System to offer many advantages. A wide variety of optional features for special applications, the ability to interface to other systems, and choice of any headset all factor into the advantages. Industrial users include laser research centers, automotive testing grounds, flight and vehicle simulators, military training facilities, medical facilities, and even airplanes.

Commercial applications such as entertainment theme parks, schools, race tracks, and convention centers have shown the TW system to fit the bill. With central control monitoring, semi-isolated loops, long distance cable runs, and ever changing requirements, the system performs flawlessly. In any application, where quick, simple, effective intercommunications is important, the TW Intercom System provides the reliability and performance you can depend on.

SYSTEM DEFINITION

The TW Intercom System is a two-wire conference-line intercommunications system that allows a quantity of user stations to connect across a common line (also called a channel). The system operates in a full-duplex mode: simultaneous talk and listen, to and from each user station. While a minimum of two user stations and a power supply are required for communications, 50 or more user stations can be employed.

Each user station is "bridging" to the line (10,000 ohms across a 200 ohm line), and can be connected and disconnected with negligible affect on the audio quality of the line or other user stations. This design also enables user stations to be separated from the power supply by up to 3,000 feet or further with an optional user-supplied power adapter unit.

The TW Intercom System power supplies provide 32 volts DC to power the user stations; they also set a 200 ohm audio impedance on the line. Power is carried to the user stations along the same pair of conductors that carry the conversations and call-light signals.

User station features include: microphone preamp with limiter circuit, two-channel operation, electronic microphone on-off switching (in latching and momentary modes), and dynamic and/or carbon microphone headset capability.

In operation, all user stations that are connected together can talk and listen to each other on one of two selectable channels. In a small-size system, equal exchange of conversation most often takes place between operators. In medium- to large-size systems, one or two operators typically do most of the talking while the others listen –and occasionally talk

INTERCONNECTION

Interconnection to the user station's line-input connector can be accomplished using standard two-conductor shielded microphone cable. The line-input connector is wired to a loop-through extension connector for easy cab mg between user stations. Interconnection can be centrally wired ("home-run" cabling), with each cable coming from a central point or distributed ("daisy chain" cabling), where all the user stations are looped together from one to another. A recommended cabling scheme involves a combination of both configurations.

OPERATIONAL FEATURES & SPECIAL DESIGNS

A host of standard options is available on almost all user stations. The most commonly requested are; three-channel operation, call light signaling, dual-listen on two channels, program audio input for monitoring, alternate power input for local power supply, station-isolate interconnect and unswitched microphone-output to feed ancillary equipment. Also available are squawk-address send and receive for dedicated-line intercom, limited-range volume control for minimum listening volume, external mic on- off switch for footswitch operation, balanced four-wire line configuration, balanced two-wire line configuration, and a variety of other mechanical and electrical modifications. Many of these options are standard features in recently manufactured RTS products.

The user stations are designed with various input and output ports that provide for these and other options. However not all user stations can incorporate all options; for more information please consult the RTS sales or engineering departments.

Overview

The design and specification of any system must originate by accurately defining the customer's needs. This definition is a product of his operational, logistical, and budgetary perameters.

Other kinds of requirements include functional, aesthetic, physical, electrical, reliability, flexibility, and cost of ownership. Additional requirements include installation information, support over the years, training, options, special modifications, and confidence in the supplier.

There is no magic formula to designing a professional television intercommunications system. Each system must be examined on its own its own requirements which presents its own unique questions and resultant solutions. Likewise, there is no magic formula, which dictates whether a TW or matrix system is better. It is based on operational requirements and budget as well as the experience and in depth product knowledge of the person writing the specifications. This is why Telex Communications continues to maintain a staff of highly competent engineering and sales personnel to assist its customers in determining a practical affordable solution for their needs.

The following has been prepared as an overview of considerations, which must be addressed when designing or specifying a professional broadcast intercommunications system.

There are four basic core systems making up the RTS intercom product line. They are the ADAM, ADAM-CS, Zeus matrix systems and the Two-Wire (TW) Series intercom. In addition to the core systems there are several sub-systems, or peripherals, which make up the entire intercommunications system. These subsystems vary depending on whether the core is TW or matrix platform.

Two-Wire / Four-Wire Background

A two-wire (TW) intercom matrix circuit transmits and receives audio, both directions, on two wires. This format is party line (PL) by nature, with each station attached to one multiple conductor cable. Communication may be half or full duplex.

A four-wire intercom circuit transmits audio on one pair of wires and receives on a second pair. This format is point-to-point and can be pictured as a star configuration - each station connects to the center through its own multiconductor link. Instead of subsystems to achieve different functions, the central processor and software permit the system to be dynamically configured for different forms of communication.

Audio signals carried by either system platform, individually, should be of sufficient quality for on-air work if the necessity arises. Some applications do use the intercom for program audio, however, when the two platforms are brought together, problems can arise. In particular the quality of the two-wire equipment can exhibit degradation from 4 to 2-wire conversion hybrids used in the two-wire station. Also, operating levels may be different from one system to another. Some means to compensate for differing house reference levels is necessary. Despite these points, facilities with installed 2-wire beltpack circuits can enjoy the best features of 2-wire and 4-wire platforms by integrating a digitally controlled matrix four-wire system.

Multifunction TW intercom systems require distributed subsystems for each task. This means that several multiconductor cables (one for each subsystem) must be pulled throughout the facility and connected to the subsystem modules at each at each system control panel to achieve the desired communications features. TW systems are made up of various system components depending on the number of PL channels in the system and other support functions.

A TW master station may feature six PL, four IFB, six ISO and 10 point-to-point circuits, overall. 200 wires per station interconnect the four separate subsystems. The digital four-wire station with 16 PL, 24 IFB, 16 ISO and 50 point-to-point circuits uses 6-wire cable that connects from the station to the central matrix.

A digital four-wire system uses one centrally located control matrix. The matrix switches a number of audio inputs to a varying number of audio outputs and uses one 3 pair cable to tie the central matrix to each control panel. Setup and system programming for the matrix is accomplished through a terminal or PC.

The inputs are sources while the outputs are destinations. An input/output pair serving one physical location in the facility connects to a matrix port. Inside, the microprocessor digitally directs communications through the matrix according to the stored setup data. Each control panel can be assigned all or any number of functions.

The traffic management can be compared to an audio routing switcher. Although routers use only one-way paths, the intercom matrix must accommodate 2-way paths and develop the various forms of communications - PL's, IFB's, group presets, ISO's, and relays.

A feature of many digital 4-wire systems is that every control station may access any form of communication during initial setup of the system from the terminal or from a control station panel, if the panel contains a keypad. Any position has the potential to access IFB, ISO, point-to-point, PL's, group calls and relays without subsystem modules.

Even in a 4-wire matrix system, it is usually safe to assume that some complement of TW stations will be required in the operation. This can typically be in areas of floor directors, boom operators, lighting bridge, etc.

Should one first start out with a TW system as a "starter" and later decide to change over to a matrix operation, the prior purchase of TW equipment doesn't mean it is now useless. Most of the TW acquision can be adapted to work with the matrix intercom quite usefully.

One reason studio control operators prefer an extended TW intercom is a subconscious panel differentiation with a separate module used for every form of communication. A director's station, for example, may have separate panels for PL, ISO, point-to point, and IFB control. A minimal link exists between the control stations and sub-systems as an unswitched or hot microphone and a speaker that appears on one of the added panels. In the heat of a production, the director knows what panel does what and may quickly access IFB's to a specified talent.

Based on wiring complexities, a TW intercom is often preferred for less complicated applications that require quick setup and teardown. A small TW system is easy to install, because it uses a system power supply, the interconnect cable, and the user stations themselves. This configuration provides one or two PL's which is often enough in simple applications.

A TW system can be tied to a four-wire matrix through interfaces. It is best to avoid interfaces, if given the choice, but digital interfaces for 2-wire to 4-wire systems exist that yield good intersystem transparency. As a result, an initial TW purchase can interconnect to a digital 4-wire host later without significant trans-hybrid losses.

Forms of Communication

Point-to-point

A digitally operated matrix, in its simplest form, provides instant point-to-point communications between all control stations attached to the matrix. Direct access occurs when a caller depresses a talk key. At the destination panel, a tally indicator displays the origin of the call and the caller is heard in the destination speaker or headset. The destination hears the call hands free.

No one else on the matrix hears the conversation. The destination may establish a return point-to-point call in reply. Point-to-point operation usually does not involve listen keys. One common use of point-to-point communication is for roll tape commands from the technical director to the tape room.

Party line

The PL connection is the hallmark of 2-wire systems. Four-wire systems can also create multiple PL's dynamically through the central matrix. A dynamic PL uses various 4-wire ports and may be restructured rapidly. Any 4-wire port of the matrix may be part of a dynamic PL, including any control station (master station) attached to the matrix and other devices such as a telephone interface or a group of beltpacks properly interfaced.

Unlike a 2-wire master station PL (each master station accepts the same PL's on each talk and listen key), a digital matrix permits any PL to be assigned to any key on any station. A static PL uses an external 2-wire loop and may contain a number of 2-wire beltpacks or user stations. They are static because they cannot be modified by the matrix microprocessor. A static PL enters the matrix through a 4-to-2 wire converter or interface. Larger 2-wire systems have a number of 2-wire circuits, which are assigned to users from an outboard source delegation panel.

IFB

IFB's are used extensively in news, sports and interview programs. Events like the Olympic Games or general elections require numerous 'IFB's to cover the different sporting venues or many locations across the country.

The IFB circuit, used in virtually all TW facilities, is usually a 1-direction audio cue to on-air talent. The signal interrupts a predefined audio source, such as program audio, to inject a directive from the director, producer or audio to the talent. In its simplest form, IFB uses an earpiece, an external headphone box (to permit the talent to control the audio foldback level), a program source and a control station. A common IFB application is the live TV newscast where a director wishes to advise the talent that a "cut-in" is upcoming, a segment not ready, etc.

Another form of IFB uses a stereo headset (interrupt and non-interrupt foldback with on-air mic), two programs (one to each ear), an external amplifier box with two volume controls and a control station. This type of IFB is common in live sports where many on-air talent personalities may be physically located on a playing field or near a race track. In a setting such as the Olympics, as many as 80 IFB circuits may be required for the TV production.

IFB works best when it is not used. Talent can be distracted from overuse of IFB, so it is wise to confine IFB usage to necessary communications only. Consequently, a means to restrict the number of people who can simultaneously access the talent's IFB circuit is advisable. If two controllers (for example, director and audio) attempt to cue talent at the same instant, the system can be tailored to allow only the director to be heard in the talent's earpiece.

Another feature of a digital matrix system is the ability to inhibit any control station from acquiring IFB circuits. This function prevents the accidental engagement of IFB by a user not related to the production or authorized to use this function. Many self contained IFB systems are available today, but a digital 4-wire matrix permits flexible and interesting variations. One type involves a programmed listen key on the control panel to facilitate pre-shoot setup on remote productions.

The director may elect to hear the talent's comments just prior to the shoot on a dedicated Telco or microwave channel by using a control panel listen key. When the production begins, the director deactivates the listen key, reverting to the normal IFB talk key to cue the talent.

Cameras

Camera interconnection can be difficult or quite easy depending on the requirement and types of cameras. Many camera manufacturers have a two-wire intercom port on the CCU labeled "RTS". Unfortunately, not all CCU's are compatible with the RTS TW standard. Usually it is easier to connect to the four-wire port on the CCU directly to a 4-wire matrix port or to a TW system through a 2-4 wire interface, such as an SSA324 or SSA424.

Studio cameras also generally have program audio inputs. This is not really a part of the intercom system but may be a part of the IFB system if the program audio is to be interruptible.

Most of the more recent studio cameras have two channel intercoms; most hand-held or industrial cameras have single channel intercom capability. If the camera has two channel capabilities, we must decide how to assign the camera channels to the system channels.

ISO

The majority of large installations and virtually all mobile units use camera isolate systems. A camera isolate system allows an operator (usually the video operator or technical director) to have private communication with any of the cameras for set-up or maintenance purposes without interfering with ongoing communication between the other cameras and the director. Camera isolate systems can become quite complex and in some cases can provide interfacing to non-compatible cameras. They can also be used to provide privacy in non-camera applications.

The ISO circuit is an interrupt that reconfigures one type of 2-way communication to another. A destination station is removed from a PL to establish a point-to-point channel between two locations. ISO is common between director and/or video operator and camera operators. By depressing the select key, the video operator automatically switches a camera circuit from its assigned PL, to permit the video operator or director and camera operator to communicate privately without interference. At the end of a conversation, the camera is returned to the PL. The same function is often requested by producers who want ISO capability at their intercom station to talk privately and creatively with an ISO'd camera.

In some ISO systems, a listen inhibit mode removes the caller and the destination from the PL. Subsequent calls to either location on the ISO channel are disabled. More often, however, the calling station continues to receive and monitor audio from the entire PL at that station, thereby not completely isolating the operator from the rest of the studio.

Relays

Relays are not really a form of communication, but they have become essential in intercoms. They may key the PTT of 2-way radios, activate telephone lines, mute speakers, light indicators and activate ring-down circuits. Relays are assigned to talk and/or listen keys and may be globally set for all or some inputs, or just one (station). The number of relays in a system usually depends on the size of the system and system components.

Paging

The page feature can be a simple function that provides al-call general paging to control stations from any other control station. The digital matrix expands that premise by creating zones or group calls. Stations in each group are predefined at the terminal. Although one group call may page all stations, another one may page only those stations in the tape room. The ability to page may be assigned on a key-per-key basis. A variation on paging uses a visual tally to predefined stations, while the caller's audio defaults to an overhead speaker.

The listener, hearing the page, returns to the station, sees the identity of the caller, selects the caller's audio and continues the conversation privately. Subsequent pages continue through the overhead speaker.

Headsets

The choice of proper headsets can make a tremendous difference in the performance of an intercom system. Sound quality, operator preference, durability, and environmental factors must figure in the selection of headsets. Single ear headsets are the most popular and allow the operator to easily hear what is going on in the immediate area. Dual ear headsets are necessary in higher noise level areas. Stereo headsets allow intercom channels and program audio to be split into the left and right ears that can be very helpful in mentally separating the large number of signals that must be listened to in a complex situation. Lightweight headsets offer increased comfort at the expense of poor outside noise isolation and lower durability. In extreme noise environments such as rock concerts or car races, noise canceling headsets must be employed at the expense of drastically reduced operator comfort. Many operators, especially camera people, prefer to use their own headsets so it is important for stations to accept a wide variety of levels and impedances.

The Two-Wire (TW) System

This is a communications system in which the talk and listen signals to and from each station travel on the same path commonly referred to as party line PL) but also referred to as to as conference line or interphone.

This system is normally used where many operators will be communicating with each other in an "all conference" mode.

RTS™ Two Wire (TW) System

* Small to large scale, simple party line assignments.
* Easily set up and configured.
* Distributed hardware configuration.
* Usually no single point of failure.
* Wired via single pair or multi-conductor twisted pair cable.
* Standard capability is up to 12 party line channels.
* Up to 12 camera ISO.
* Up to 12 channels IFB.
* Interface directly to RTS wireless base station.
* May be easily interfaced to 4 wire systems.
* Interfaced to telephone circuits via third party hybrid interface.

The TW concept is the simplest form of system and is typically used for teamwork activities such as television production, aircraft testing, or scientific experiments. Live studios and mobile television units are sometimes best served by party line systems. These are generally two wire in nature; that means the talk and listen signals are carried on the same conductors. Power for the individual stations may be carried on the same conductors as the audio or may be carried on separate conductors.

In a party line system all operators share a common channel or number of channels. There is no privacy between operators except that provided by multiple channels or a camera isolation sub-system. Some signaling can be provided but usually not to the extent that every operator can selectively signal every other operator.

Two wire systems work like the telephone and early equipment was based on telephone technology and circuitry. Modern two wire systems operate on the same concept but eliminate the problems associated with telephone based technology. Modern party line systems can use one channel or multiple channels. Systems that are currently popular use from one to twelve channels. Party line operation can also be achieved using four wire techniques, but it is much simpler and less expensive to implement this style of operation in the two wire domain.

The advantages of two wire party line systems are simple wiring, easy expansion of additional stations, very little central equipment needed, a low cost per station, and simple operation for team type activities.

Two wire systems really show their value in remote production situations where the configuration of the system may change dramatically from one production to another.

The Model 802 and Model 862 System

The Model 802 can be a six or optionally twelve channel conferencing station. The talk and listen functions are individually button controlled. In the conferencing mode, an 802 system is interconnected using a 25-pair cable. All the stations are in parallel on the 25-pair cable. The first 12 pairs correspond to the first 12 buses or channels, the next 12 pairs are keying signals such that any 802 can initiate a keying function on the bus. The last pair is a program audio feed common to all the 802s. The Model 862 allows easy access to the keying signals and common program input. The keying signals are translated in the Model 862 to relay contact transfers. The Model 862 also transfers six balanced audio line for keying buses 7 through 12. If the system only contains Model 802s and a Model 862, a termination plug must be used to terminate the system.

Model 802/862 within the TW System

If the 802s and 862 are to be used in a hybrid system including TW user stations and power supplies, the TW power supplies will terminate the buses or channels than the supplies are connected to. Those buses not terminated by the TW power supplies must be terminated with an appropriate special terminating plug.

In the unbalanced TW system, one channel requires two wires and two channels requires three wires. It is possible to create either system wide channels or private channels. Private channels are created by isolating one of the conductors used for a group of user station's "channel two" (usually pin three of a three pin XLR type connector). The group can have private conversations amongst themselves or change the channel selector to the system wide channel (often channel one of the user station).

Multi-channel in the Series 800 Systems

In the balanced Series 800 system, channels are created on a pair of wires. Normally these are twisted pairs in a cable. Therefore two wires = one channel, four wires = two channels, 24 wires = 12 channels.

The 802 system uses a 25 pair cable where pairs 1 through 12 are channels 1 through 12. Keying signals use the next 12 pair and the last pair is used for program audio distribution.

The 810 system also uses a 25 pair cable but has several variations. For five channel systems, channels 1 through 5 are either on pairs 1 through 5 (newer systems) or pairs 1, 3, 5, 7, 9. For ten channel systems, pairs 1 through 10 represent channels 1 through 10. The remaining 15 pairs are reserved for use when the 810 is used in a distributed matrix configuration.

The IFB System (One Way Communications System)

IFB is a television acronym for Interrupted Feedback, Interrupted Foldback, Interrupted Return Feed (IRF). An IFB system permits a director or producer to talk to the talent, typically an "on air" announcer, newscaster, or sportscaster. Normally the talent hears the broadcast program audio including their own voice. When the director or producer activates the IFB, the program audio is replaced by the director's or producer's voice. Sometimes the program audio continues in the other ear, sometimes the program audio is reduced instead of completely removed.

How IFB Works

Those in control positions (the director, producer, or assistant director for example) control the interrupt and or announce functions via control stations. Those in receive positions (on-air talent, floor managers, studio or field crew, audience, talent and crew in remote locations) are on the receiving end of the user station feed or on the actual user stations (talent electronics or talent station) via headphones, headsets, earphones, and / or loudspeakers. In the middle, the central electronics unit provides all the necessary inputs and outputs, processing, switching, and power distribution.

Studio and Some Field Applications

The talent normally uses only the interrupt output (mono) of the Model 4020 Talent User Station. The earphone is hidden behind the talents back, a plastic tube runs from the earphone to the talents ear.

Field Application, Sports

The talent uses a noise resistant headset. The microphone on the headset is the "air" microphone; the headphone is double muff, stereo. The talent is plugged into the stereo output of the Model 4020 Talent User Station.

At the Model 400x, IFB Control Station, each talent's name is marked on a strip of tape pasted adjacent to the pushbuttons on the Model 400x. (Model 400x means 4001, 4002, or 4003).

In stadium sports, there is usually little problem in getting a microphone cable from the Model 4010 to the Model 4020 Talent User Station. In the case of golf, auto racing, and sports venues over an extended area, the distances may be too great. In this case, a telco quad can be run to the talent location and adapted to the XLR connector on the Model 4020. In some more extreme cases, a pair only is possible. In this case plug the talent's stereo headset into the stereo connection on the 4020, then connect the high side of the pair to pins 2 and 3 of the XLR3 connector and the low side to pin 1 (pseudo stereo mode). This will give a mono feed with each ear individually adjustable and both ears interrupted.

For runs of two miles of number 22 gage twisted pair, at least one talent station should be operable. For a run of one mile, two talent stations should be operable. Some users have increased the number of talent stations by using higher impedance (300 ohms) headsets.

In the case of auto racing and similar loud environment situations, low impedance noise isolating headsets will be necessary to be loud enough to overcome the environmental sound. It may be necessary to use a quad to connect up each talent station, paralleling the pairs, and running the 4020 in pseudo stereo mode, using only the interrupt ("wet") output of the Model 4010.

Field Application, ENG

In this case the earphone is again hidden as in the studio case above. If the talent has to carry on a conversation with other talent at the studio and other venues, the program feed should be a mix minus feed. The mix minus feed will allow the talent to hear the other talents loud enough without hearing one's own self too loud.

The Camera ISO systems are generally used with the TW and 800 Series system. Usually a camera is the intercom station to be isolated. Stations connected to the intercom system via the Isolate Electronics are able to communicate normally on their preassigned channel(s) until they are isolated from one of several ISO Control Stations. At that time the isolating and isolated stations leave their normal channels and can have a private conversation with each other. Tallies (indicators) show on all of the Control Panels which of the isolatable stations are currently isolated.

In the VIE306 system each of the three Control Stations has a priority. A higher priority means that particular station can override a lesser priority station. The VIE306 works well with two or four wire cameras. Some TW and 802 stations allow monitoring of the un-isolated channel during isolated operation.

The ISO systems sold by RTS Systems are the VIE306 type system and the CIF612 type system.

A six line VIE306 type ISO system consists of up to three VCP6A Control Stations, one VIE306 Isolate Electronics.

A twelve line VIE306 type system consists of up to three VCP12A Control Stations, two VIE306 Isolate Electronics.

Interfacing to other Systems

What is interfacing ? Interfacing is:

1) the interconnection of two normally separate communications systems into one system, or

2) the connection of a not directly compatible communications station, or device into a system.

To accomplish this, voice and data information is adjusted then transmitted to the other system. The adjustments include level translation, impedance compensation, mode translation, and compensation for parameters of each system. Some examples are:

1) System to system : Connecting a four-wire matrix system installed on a large mobile unit to two-wire belt packs outside of the mobile unit.

2) System to terminal: connection of a camera with built-in intercom to an intercom system, or connection of a radio transceiver into an intercom system.

Why is there interfacing, operationally ? From an operations point of view:

1) an operation requires a larger collection of personnel and equipment than normal,

2) a mobile unit is used with a permanent installation to conduct an operation,

3) coordination is required with personnel / equipment at a remote location,

4) a special part of the operation requires communication with an odd system or terminal, or

5) a redundant "backup" path is required.

Why is there interfacing, technically ? There are system to system (or terminal or device) differences. Some of these are:

1) **Mode differences**. There are several not directly compatible modes of operation : two wire mode, four wire mode, full duplex mode, half duplex mode, simplex mode. Examples: the TW System is two-wire full duplex, the ADAM matrix is four-wire full duplex, the telephone is two wire full duplex except some long distance calls are half duplex (both people can not talk at once), a walkie talkie is simplex, Audiocom is two-wire full duplex, ClearCom is two-wire full duplex, office intercoms are often simplex operation.

2) **Level and Impedance differences**.

System voltage levels range from - 40 dBu to + 21 dBu with peaks to +28 dBu (where 0 dBu = 0.7746 volts). Some typical level ranges are listed below.

Intercom or Audio System	***Nominal Impedances, Ohms***	***Nominal Level, dBu***	***Level Range dBu***
Telephone	600 to 900	-15	-40 to +0
Old ClearCom	200, 10000	-30	-45 to -15
New ClearCom	200, 10000	-22	-30 to -14
Audiocom	200, 10000	0	-8 to +1
RTS Systems The TW System	200, 10000	-10	-18 to -1
McCurdy Radio 9500 Intercom	600, 10000	+8	+0 to +28
Recording Studio Equipment	600, 10000	+4	-6 to +24

Why are there different modes of intercom operation? Some intercom operating modes offer advantages over others. For example, two-wire is quick and easy to hook up, while four-wire is easier to interface to other systems.

What is there to interface? The following often need interfacing:

Television camera intercoms to intercom systems,

Example 1: triax adapter four-wire CCUs to the TW intercom system,

A television camera uses a triax cable to connect the camera to the rest of the electronic system because the triax cable allows operation over longer distances with consistent quality. The triax cable uses radio frequencies to transmit information both ways on the cable. This is, in effect, four-wire (two path) communication.

Two-wire systems to four-wire systems,
TW intercom system to an ADAM matrix system or CS9500,

Full duplex systems to simplex systems,
TW intercom system to a radio transceiver,

When medias change,
TW intercom system to an optical system (e.g., the TW System to a fiber optic system,
TW System full duplex wired to full duplex wireless.

Interfacing Theory
There are three tasks to interfacing:

1) Mode Conversion,
2) Level Changing and
3) Signal / Data Conversion.

Modes
The following modes exist in RTS Systems and other intercom systems:

M2) Two-Wire,
M4) Four-Wire.

The following sub-modes are considered for two-wire and four-wire:

M2F) Two-Wire, Full Duplex,
M2H) Two-Wire, Simplex
M4F) Four-Wire, Full Duplex,
M4H) Four-Wire, Simplex

Level Problems
One problem in interfacing from two-wire to two-wire is caused by the 2 wire systems' use of 2 to 4 wire hybrids. Interfacing requires conversion from two wire to four wire twice to allow level adjustments to and from systems. The quality of the two-wire to four-wire hybrid limits the amount of make-up gain available to match levels in one system or the other.

Another problem is that level adjustment is difficult when interfacing from a limiter controlled system such as the TW Intercom System to a non-limiter controlled system such as some two or four wire systems. The reason for the difficulty is that the perceived loudness is greater on the TW System and much less on the non-limiter controlled system. This difference can be improved or eliminated depending on two limiting factors: 1) the headroom of the electronics involved, and 2) the quality of any two-wire to four-wire hybrids in the path.

Interfacing from two wire to two wire systems is the most difficult. Interfacing from two-wire to four-wire is easier, and interfacing from four-wire to four-wire is the easiest.

The problem in two-wire / two-wire interfacing is getting the levels right and preventing oscillations.

The level of the TW and 800 Series conference intercom systems ranges from -10 dBu to 0 dBu, with an average value of - 6 dBu, and is limiter controlled.

Some other systems are listed in Table 3-1, below. The objective is to convert the modes and to adjust the levels.

Signal / Data Conversion

Call Light
Some intercom systems use a "Call Light" signal to illuminate lights in individual stations. This signal may be a 20 kHz tone, a DC level, or a digital logic level. An interfacing device may handle the method conversion to carry the call light signal.

Data
Other systems have data flow via various methods including: contact closure, logic level, RS485 bus, RS422 bus, RS 232 bus. The handling of the RSxxx signals are done best on a case by case basis. RTS Systems' use of RS422, and RS485 signals are limited to system wide use. At this point, system to system communications is done via RS232 communications by wire, fiber optic, or via modem and telephone line. Some system to system communication is accomplished via user specified hardware imbedded in RTS Systems special products.

The Model 802/803 have an RS232/485 connection that allows control of the Model 802/803 via a terminal or another computer.

Interfacing Practice
Interfacing Television Camera Intercom Systems to the TW Intercom System

General Camera Configuration Information for Television Cameras (except ENG units)

Television cameras used in broadcast and industry usually have two parts: a camera head and a camera control unit (CCU). The camera head assembly usually contains the camera, lens assembly, camera electronics, and triax adapter (if used). The CCU contains additional electronics for processing video, the other end of the triax adapter, an interface for microphone audio, and the intercom interface. The intercom interface usually incorporates some switches and electronics so that the intercom can be two-wire or four-wire.

The Problems in Interfacing to Cameras
There are two problem areas in television camera intercoms: 1) The electronics in the camera head and 2) the intercom interfacing electronics at the CCU.

Some possible problems with the camera head intercom electronics are as follows:

Inadequate headphone drive (Not loud enough for athletic contests and studio shows)

No limiter in the microphone preamplifier (level variations are too much)

The headphone and the microphone share a common circuit return conductor (headphones oscillate when volume is turned up)

The Triax Adapter / electronics does not give the camera intercom enough headroom, so there is a trade-off between signal clipping and signal to noise ratio.

The microphone on/off switch does not disconnect the microphone preamplifier thus adding noise to the system.

Some possible problems with the CCU intercom interface electronics are:

An earth ground is applied to the wiring usually in two-wire mode (causes hum loops in the system)

The four-wire input to the camera is not bridging impedance

The two wire "RTS Systems compatible" interface loads the line

No safety capacitors are installed in the CCU, thus causing burnt transformers if connected to the TW line

Alternatives for Interfacing to Television Cameras

1. Bypass the camera, tape a microphone cable to the camera cable, plug a TW belt pack in at the end.

2. Use the existing camera intercom, interface it to the TW system with a Model SSA324 or SSA424 interface (if camera intercom is 4-wire).

3. In multicore connected cameras, use the camera wiring to allow a TW belt pack to plugged into the camera head. This allows the camera operator to use a portable User Station mounted on his belt or attached to the camera body. (this requires significant modification to the camera head and CCU)

Table 3-1

Intercom Comparisons

	Intercom Types				
Parameter	TW	TELCO	2-Wire	4-Wire	Carb-mic
Impedance / Nominal/Ohms	200	600	150 to 200	600	150*
Impedance / range/ohms	50 to 400	600 to 900	100 to 1000	600 to 10,000	4 to 150
Balanced / Unbalanced	Un	Bal	Un	Bal	Un
Mode 2 / 4-Wire	2	2	2	4	2
Send/Peak Power / milliwatts (est.)	5	1	0.7	7	2
Send / Receive Levels / (dBu)	0 to -10	0 to -10	-10 to -20	+8	0 to -30

TELCO = Telephone-lines in 2-wire mode

2-Wire = Clear-Com, ROH, HME, R-Columbia, Protech, Theatre Techniques, Telex**, David Clark, R. Columbia, some television cameras

4-Wire = RTS ADAM, Philip Drake, Link, McCurdy, Ward Beck, ADM, Farrtronics, PESA, Audix, Datatronics, all triax television cameras, some multi-core television cameras, Radio-telephones, Telephone-Line circuits, Wireless Intercom systems

Carbon Mic Interphone = RCA, Daven, Video Aids, General Electric, Colorado Video, many low-cost television camera intercoms

* Per Station

** Telex Phase 2 = 300 ohm, 5 mW balanced line.

Headset Cable Lengths

The dynamic (low level) headset cable carries signal levels that differ by as much as 34 dB + 52 dB = 86 dB. Ordinarily, there are three types of unwanted coupling possible; resistive (through a common ground), capacitive and inductive. Since separate grounds are carried back to the microphone preamplifier and headphone amplifier, the common ground resistive coupling is, in this design, negligible. The capacitive coupling can be made non-significant by a 100% shield in the cable.

The inductive coupling mode dominates in this design, and can be offset in several ways: 1) The distance between the microphone and headphone pairs can be increased (and the mutual inductive coupling decreased) by the use of "ribbed" cable that is two cables molded together side-by-side; 2) Both the microphone pair and the headphone pair can each be tightly twisted; 3) Two separate cables can be run; and/or 4) A balancing transformer on the microphone circuit may be used.

Estimated, Safe Operating Distances are as follows:

Single cable, two shielded twisted pair: 10 feet.
Dual ribbed cable, two shielded twisted pair: 30 feet.
Separate cables, shielded twisted pair in each: 50 feet and more.
Balanced microphone input: up to 100 feet depending on cable used.

Headphone Impedances

Low impedance headphones are louder, causing the user station to draw more current from its power source. High impedance headphones are not as loud, drawing less current. Many of the RTS user stations have a headphone impedance range from 25 – 600 ohms. Headphones up to 2,000 ohms will function but greatly reduced levels. In a double muff headset such as a Beyer DT-109, there are two 50 ohm headphones connected in parallel resulting in an impedance of 25 ohms.

Wiring Practices/Workmanship Standards

The two most significant wiring practice/workmanship problems are as follows:

1. Line noise due to an intermittent connection:
    Poor solder joint.
    Corroded connector.
    Loose screw terminal.
    An uninsulated cable shield touching the metal
    shell of the connector.

2. Unintentional grounding, phase reversals (channel reversing) and power reversal. Cable shields must not touch connector shells or be tied to the connector shell lug. Cables (especially the vinyl insulated type) must not be pulled tight around sharp edges.

Portable user stations should not arbitrarily be taped or fastened to metal structures. Grounding the case of the user station to an arbitrary structure may introduce large noise voltages due to local ground currents or due to the completion of a "ground loop antenna".

Phase reversals are most common with portable microphone cable that has not been checked with a standard cable tester after fabrication or repair.

DC power reversals are usually not harmful to user stations since standardly there is a protective diode in the circuit. The station simply doesn't work. Remember: negative is ground in this system.

Always clear all earth grounds from the RTS TW System circuit return ground. The only ground should be the 22,000 ohm resistor in the power supply.

Unbalanced vs Balanced

The TW System, in the standard, unbalanced configuration has been operated at distances of up to two miles with acceptable system noise levels.

Routing the TW System cables along the same ductways and pathways as the main power cabling can increase the noise and hum levels in the system.

If TW System cables have to be routed in this manner at distances over 300 meters (1,000 ft), a balanced conversion should be made.

Alternatively, the entire system can be operated in an optional balanced mode and be powered at each station with the "local power" option. This is sometimes called "dry line, balanced" operation.

Extended Range On Part Or All Of The System

If a station is locally powered, operational range can be extended up to five miles, using two transformers to step up the line impedance to 800 ohms (for lower losses).

When the users station has the four wire / 800 ohm option installed, operation is possible up to 20 miles along Telco dry pairs.

Operation over longer distances (3000 miles) is possible using dial up or minimum loss dry lines and the TW series of interfaces.

TW Cable Considerations

Crosstalk

Use shielded cable to interconnect user stations in areas of possible electrical interference, (areas such as those near: digital equipment, high current primary power conductors “mains”, transformers, transmitters, and lighting dimmers. Do not run TW Intercom System cables along the same ductways and pathways as these cables.

Standard wire size for the TW Intercom System interconnection is #22 gauge shielded cable, such as Belden 8761, 8723, 9406.

In permanent installations, to reduce both capacitive and resistive crosstalk and to afford a degree of RF and electrostatic shielding use a cable, which has a shielded twisted pair for each channel, such as Belden 8723. Each pair consists of a conductor for the channel, a conductor for circuit ground return and shield around the two conductors. The shield is accessed via a drain conductor. This drain conductor and the shield can augment the circuit grounds and thus lower the ground resistance. **Do Not tie the shield to chassis, earth, or connector shell ground**.

Crosstalk Through A Common Circuit Ground

Since, in the unbalanced version of the TW Intercom System, all channels share a common circuit ground return, crosstalk due to common ground resistance can occur. This crosstalk is proportional to the ratio of the common ground resistance to the system terminating impedance, 200 ohms. This occurs when a talker on one channel is heard by a listener on another channel due to the common ground resistance (see Figure 8-4). Reduction of this crosstalk can be accomplished by reduction of the circuit ground resistance. Reduction of the ground resistance can occur as a side benefit of using shielded cable, since the shield drains can be tied together and electrically parallel the circuit ground.

Another way of lowering this kind of crosstalk is to "homerun" all interconnecting cables to a central or "home" location. This causes the common circuit ground path to be very short, and other things being equal, makes a low common ground resistance.

Crosstalk Through A Mutual Capacitance Of Two Conductors

Two conductors such as a twisted pair can accumulate a large mutual capacitance over long distances. Using a figure of 100 picofarads per meter and a distance of 1 kilometer, results in a total capacitance of 100 nanofarads or 0.1 microfarad. The reactance of 0.1 microfarad at 800 hertz is 2000 ohms. Referred to the system impedance of 200 ohms, the apparent crosstalk is about 20 log (200/2000) or about -20 dB. Separating the two channel conductors by a shield greatly reduces the capacitive crosstalk, so that the resistive crosstalk discussed above dominates.

A Low Crosstalk Approach To Interconnection

To reduce capacitive and resistive crosstalk and to afford a degree of "RF" and electrostatic shielding, a shielded, twisted pair per channel type cable can be used. Each pair consists of a conductor for the channel, a conductor for circuit ground return and, of course, the shield as a conductor and the shield drain conductors. These drain conductors and the shield can augment the circuit grounds and, thus, lower the ground resistance.

Distances/Conductor Sizes/Distributed vs Central Connection

Systems that stretch over distances of kilometers are more subject to power losses and crosstalk. These problems can be minimized through the use of large enough wire, shielded cables and central connections.

System Current/System Capacitances/Loading

The system currents are determined by several parameters:

1. The current required to supply standby current for each user station.

2. The current required to supply the dynamic current to generate line signal, headphone signals, speaker signals and call lamp signals.

3. The current required to start up a system by charging up to (50) 4000 microfarad capacitors or 0.2 farad.

4. The current limit imposed by the power supply to protect itself.

5. The secondary current limit imposed by the power supply when a fault is close to the power supply (little or no circuit resistance). This limit, called the foldback current, further protects the power handling electronic devices in the supply and determines the system start-up time.

Currents 1 and 2 can be calculated by multiplying the number of user stations times the user station current data in the Complete User Station Specifications.

Current 3 is usually limited by current 5.

Currents 4 and 5 are listed in the Power Supply Specifications.

Current 5 can be used to calculate the system start-up time:

The system start-up time = [approx] (NC/i) dV

where N is the number of stations.
C is the capacitance per station = 4 millifarads
i is the power supply foldback current
dV is a change in voltage across the capacitors, say 10 volts.

For a 20 station system, a 1 ampere foldback current, and a 10 volt change on the capacitors:

The time = (20 X .004 X 10)/1 = 0.8 seconds

The actual system start-up time will be longer since voltages in each user station have to stabilize before audio can be transmitted. This time is on the order of several seconds.

Headset Cable Lengths

The dynamic (low level) headset cable carries signal levels that differ by as much as 34 dB + 52 dB = 86 dB. Ordinarily, there are three types of unwanted coupling possible; resistive (through a common ground), capacitive and inductive. Since separate grounds are carried back to the microphone preamplifier and headphone amplifier, the common ground resistive coupling is, in this design, negligible. The capacitive coupling can be made non-significant by a 100% shield in the cable.

The inductive coupling mode dominates in this design, and can be offset in several ways: 1) The distance between the microphone and headphone pairs can be increased (and the mutual inductive coupling decreased) by the use of "ribbed" cable that is two cables molded together side-by-side; 2) Both the microphone pair and the headphone pair can each be tightly twisted; 3) Two separate cables can be run; and/or 4) A balancing transformer on the microphone circuit may be used.

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Separate cables, shielded twisted pair in each: 50 feet and more.
Balanced microphone input: up to 100 feet depending on cable used.

Wiring Practices/Workmanship Standards & Grounding

The two most significant wiring practice/workmanship areas are:

1. Line noise due to an intermittent connection:
    Poor solder joint.
    Corroded connector.
    Loose screw terminal.
    An uninsulated cable shield touching the metal
    shell of the connector.

2. Unintentional grounding, phase reversals (channel reversing) and power reversal.
Cable shields must not touch connector shells or be tied to the connector shell lug.
Cables (especially the vinyl insulated type) must not be pulled tight around sharp edges.

Portable user stations should not arbitrarily be taped or fastened to metal structures. Grounding the case of the user station to an arbitrary structure may introduce large noise voltages due to local ground currents or due to the completion of a "ground loop antenna".

Phase reversals are most common with portable microphone cable that has not been checked with a standard cable tester after fabrication or repair.

DC power reversals are usually not harmful to user stations since standardly there is a protective diode in the circuit. The station simply doesn't work. Remember: negative is ground in this system.

Always clear all earth grounds from the RTS TW System circuit return ground. The only ground should be the 22,000 ohm resistor in the power supply.

Unbalanced versus Balanced

The TW System, in the standard, unbalanced configuration has been operated at distances of up to two miles with acceptable system noise levels.

Routing the TW System cables along the same ductways and pathways as the main power cabling can increase the noise and hum levels in the system.

If TW System cables have to be routed in this manner at distances over 300 meters, a balanced conversion should be made. Contact RTS Systems for information on the various various methods of balancing a TW line.

Alternatively, the entire system can be operated in an optional, balanced mode, and be powered at each station with the "local power" option. This is sometimes called "dry line, balanced" operation.

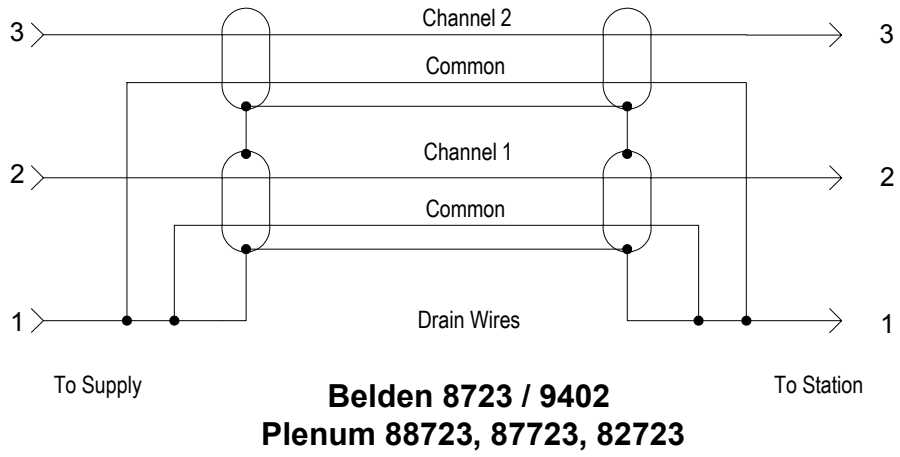
System circuit ground (commons) must not he directly connected to "earth" or "chassis" ground (where directly means a connection an ohmmeter would show low resistance). Each user station is bypassed to its own chassis via a 0.1 microfarad capacitor, establishing a radio frequency RF ground to reduce radio frequency interference from radio transmitters.

The drain wire(s) in a TW circuit is a current carrying conductor and must remain floating with respect to any racks or equipment ground.

In order to prevent a buildup of voltage across the system capacitance, the power supply has a resistor to chassis ground (22 kilohms). If the system has no RTS power supply, a bleeder resistor should be supplied at a central point in the system for each channel.

The basic benefit of not "earth grounding" the RTS System circuit return is that it permits continued operation during an electrical system ground fault. This accidental grounding can happen as the result of a pinched wire or a scraped cable that has been pulled across a sharp edge. A single accidental ground can be tolerated by the system until the fault can be cleared and (with luck) before a second ground fault can cause noise or overload or bring the system down.

Another benefit of not "earth" grounding the return is that it prevents the introduction of noise through "earth" currents from other equipment. If the RTS circuit ground conducts these currents, it is likely that they will be heard as interfering noise on the communication line.



Belden 8723 / 9402
Plenum 88723, 87723, 82723

Crosstalk reduction over long distances using 2 pair individual shielded pairs

Belden 8723, 9402 or plenum rated Belden 88723, 87723, 82723.

Temperature Range Consideration

All of the elements of the TW Intercom System have been designed to operate over the temperature range of 0 degrees Celsius (32 degrees Fahrenheit) to 50 degrees Celsius (122 degrees Fahrenheit).

The high temperature range is extended another 15 degrees Celsius if the units are not operating at full capacity or some other worst-case condition.

The low temperature range is extended another estimated 20 degrees Celsius if the full system gain range is not required.

The major operating problem at lower temperatures will be the dew point and the resultant condensation. If this is the typical operating environment, then it is recommended that the equipment be opened, cleaned, dried and sprayed with several light coats of plastic spray. This will lessen the noises generated by leakage currents that occur when the moisture and any dirt or film combine. Cleaning can be accomplished with a rinse of 1,1,1, trichlorethane, a very mild detergent (saponifier type) wash and 2 or 3 thorough rinses with distilled water. This routine is to first wash off the nonpolar soluble substances, then the polar soluble substances.

NOTE: IT IS NECESSARY TO PROVIDE SUITABLE SKIN AND LUNG PROTECTION DURING THE USE OF THE TRICHLORETHANE SOLVENT.

Cooling Requirements

In general, only the power supplies require cooling consideration. Normally, leaving 2 inches clearance above and below the rack-mounted supplies is adequate. Portable supplies should not be left in the sun and these supplies should have clearance of 6 inches from five of the six surfaces.

All other elements of the TW Intercom System require no special consideration. It is important to note that belt packs and other equipment left in the sun can cause burns to human flesh, due to the large amount of heat transfer possible. The user stations will normally continue to operate if one can only figure out a way to flip the switches and touch only the knobs.

Moisture / Contamination Protection

If, in the field, a soft drink or something like it is spilled into the equipment, the equipment can be dismantled and cleaned gently with clean water. After the equipment is dry it can be returned to service. If this happens fairly often, residues in the water can be deposited on the equipment. It should be noted that a build-up of contaminates and humidity can cause audible noise on the RTS TW System line. If it is likely that the equipment is continually to be exposed to contaminating liquid, suitable plastic covers should be employed. It may also be necessary to add a plastic coating as described above.

When using equipment in the rain always protect the equipment with plastic covers - also, make sure all cable connectors are lifted out of the mud or snow and protected with plastic bags. Rain, mud and snow in connectors can cause considerable audible noise in any communications system.

Magnetic Fields: Hum and Relay Problems

When the balanced type of TW Intercom System equipment is used, it is possible to induce hum into the system by placing or locating user stations or system interconnects near a hum source, such as, power transformers or electrical switch panels or lamp dimmers. When the microphone switch is turned on and a dynamic microphone headset is used, the dynamic microphone is a sensitive antenna for magnetic fields. Often, operating personnel will go on a break, leave the microphone on and lay the headset on equipment with power transformers or near TV cameras or monitors with vertical deflection yokes.

The speaker user stations used in the TW System have strong magnetic fields near the speakers. These fields can cause reed relays to malfunction. Some of the TW Intercom System and Series 4000 IFB equipment has reed relays installed. Keep these facts in mind when mounting equipment very close to one another.

TW Questions and Answers

Q 1. How does my camera interface with the RTS Systems intercom ?

A. With RTS SSA324 or SSA424 two to four wire converters and cameras set up in a four-wire mode.

Q 2. How do I hook the up RTS TW intercom system with a telephone?

A. There is several ways: the best interface is the "Link" produced by Telos. This interface has a Digital Signal Processor that optimizes the matching of both telephone and RTS Systems TW line.

Another way is to use a Triad S84X transformer and a toggle switch. This works well with an 802 master station and a phone line. Use a one to two step-up to the phone line (the RTS Systems line is 200 ohms and the phone is about 800 ohms). The transformer can withstand the DC from the phone line and can be used to hold the phone line. The transformer cannot withstand the DC from the TW line and must be capacitor coupled to a TW line. Use 22 microfarad, 50-volt capacitors. Connect the negative side of each capacitor to one of the sides of the primary; hook the positive to the common and one channel of the TW system.

Q 3. Does RTS Systems make wireless intercoms?

A. Yes, the BTR300 and the BTR500. Also, HME, Cetec Vega and Swintek all make wireless intercoms that interface directly with RTS Systems equipment.

Q 4. How do I hook the up RTS TW intercom system with a two-way radio?

A. For a full duplex radio, an SSA324 or SSA424 may be used.

For a simplex radio where a transmitter key is required, an SSA324 or SSA424 (both with call signaling option) can be used. Any call light on the channel can key the SSA. If a separate pair is used to key the radio, an ordinary SSA324 or SSA424 can be used.

Q 5. What are the impedance parameters of your earpieces and headsets, in case I want to supply my own?

A. Headset: Headphone: 25-1000 ohms. Mic: 150-500 ohms. Earpieces: 150 to 1000 ohms.

Q 6. How do I tie two RTS Systems TW Intercom Systems together?

A. Newer Equipment: Using (2) PS31 units, interconnect the audio output (it is recommended that one uses audio isolation transformers and safety capacitors, then set impedance switches on each PS31 to 400 ohms.

Older Equipment: Connect as above. If one system has an impedance switch, use it. System level will drop 3 dB. If neither system has an impedance switch, the line level will drop 6 dB. Some older supplies can be modified to have impedance switches.

Q 7. How many 4001/VCP6 panels can I put into one system?

A. 4001: Four.
VCP6A: Three.

Q 8. Why do I need so many power supplies in my system when there are only a few user stations?

A. To provide maximum assignability through the use of a SAP1626 and BOP220, power to each channel is necessary. However, with the introduction of the Model 4012 system interconnect, as long as channel 1 of the user stations is a common conference line and only channel 2 is assignable, a PS8 can power several user stations.

Q 9. Why do I have to use the RTS Systems TW power supply?

A. The TW power Supply allows both signals and power to be on the same wire. Two wires can carry one channel of voice signals, power, and the call light signal. Three wires as in a standard microphone cable allow two channels of voice signals, two channels of call light signals and power.

Q 10. How far can I run my lines ?

A. See Tables 12-1 and 12-2. Distance is based upon using 22 gage wire, and current at end of run. Note doubling the number of units at end of run will halve operating distance.

Table 10-1
Maximum Operating Distances (Using PS10, PS30, PS31, PS50, or PS60 Power Supplies)
Versus User Station Model #s

Model #	**Quantity**	**I-tot** (milliamperes)	**Distance** (feet)	**Distance** (meters)
BP300	1	37	8708	2679
BP300L	1	60	5370	1652
BP317	1	37	8708	2679
BP320	1	45	7160	2203
BP320L	1	67	4809	1480
BP325(St)	1	80	4027	1239
BP325(St)*	1	60	5370	1652
SPK300**	1	100	3222	991
SPK300L***	1	125	2577	793

Table 10-2
Maximum Operating Distances (Using PS8 Or PS15 Power Supplies)
Versus User Station Model #s

Model #	**Quantity**	**I-tot** (milliamperes)	**Distance** (feet)	**Distance** (meters)
BP300	1	37	5024	1531
BP300L	1	60	3098	944
BP317	1	37	5024	1531
BP320	1	45	4131	1259
BP320L	1	67	2774	846
BP325(St)	1	80	2323	708
BP325(St)*	1	60	3098	944
SPK300**	1	100	1859	567
SPK300L***	1	125	1487	453

*Surface mount version. **Also valid for RMS300. ***Also valid for RMS300L. See Appendix F for the basis of Tables 12-1 and 12-2. WM300, CM300 similar to BP300. WMS300 similar to SPK300. MRT327 similar to BP300 (headset operation), SPK300L (Speaker operation).

Q 11. How many units can I use with the PS31 power supply?

A. See table below.

Station Type	Model	Quantity
Belt Pack, Headset	BP300	41
Belt Pack, Headset, Call Light	BP300L	25
Belt Pack, Headset, Single Channel	BP317	41
Belt Pack, Headset, Stereo	BP320	33
Belt Pack, Headset, Stereo, Call Light	BP320L	22
Belt Pack, Headset, Stereo, Call Light, Microprocessor	BP325(St)	19
Belt Pack, Headset, Stereo, Call Light, Microprocessor*	BP325(St)	25
Speaker, Portable**	SPK300	15
Speaker, Portable, Call Light***	SPK300L	12

Note: Capacity can be increased by using two PS31 power supplies, splitting the load between the two supplies, interconnecting the supplies audio only, and by switching the power supply impedance switches from Normal to DUAL.

Q 12. How many units can I use with the PS8 or PS15 power supplies?

A.See table below.

Station Type	Model	PS8	PS15
Belt Pack, Headset	BP300	11	27
Belt Pack, Headset, Call Light	BP300L	7	16
Belt Pack, Headset, Single Channel	BP317	11	27
Belt Pack, Headset, Stereo	BP320	9	22
Belt Pack, Headset, Stereo, Call Light	BP320L	6	15
Belt Pack, Headset, Stereo, Call Light, Microprocessor	BP325(St)	5	11
Belt Pack, Headset, Stereo, Call Light, Microprocessor*	BP325(St)	7	16
Speaker, Portable**	SPK300	4	10
Speaker, Portable, Call Light***	SPK300L	3	8

Note: Capacity can be increased by using two PS8/PS15 power supplies, splitting the load between the two supplies, interconnecting the supplies audio only, and by switching the power supply impedance switches from Normal to DUAL. *Surface mount version. **Also valid for RMS300. ***Also valid for RMS300L. WM300, CM300 similar to BP300. WMS300 similar to SPK300. MRT327 similar to BP300 (headset operation), SPK300L (Speaker operation).

Q 13. What kind of cables should I use to hook up a TW System?

A. Portable, use standard 3 Pin XLR microphone cable - but make sure that pin 1 is not connected to the connector shell!!!

Fixed, use Belden two twisted pair cable. There are two kinds: type 8723 and 9406. Type 9406 has a drain wire inside each shield, type 8723 has a single drain wire between the shields and the jacket. Another trade-off is the 9406 can have lower resistive crosstalk, but the 8723 has half the capacitance, which means given the same system frequency response, 8571 feet of 8723 can be used versus only 3175 feet of 9406.

Parameter	**8723**	**9406**
Jacket Shape	Round	Oval
Jacket Size	0.165 in.	0.175 X 0.280 in.
Conductor Size, AWG	22	22
Shield Coverage	100%	100%
DCR, Conductors	15 ohm / 1000 ft.	15 ohm / 1000 ft.
DCR, Shield	16.6 ohm / 1000 ft.	13 ohm / 1000 ft.
DCR, Two Shields, parallel	NA	6.5 ohm / 1000 ft.
NEC Type	CM	CM
CSA Certification	PCC FT 1	PCC FT 4
Drain Wires	one	two
Drain Location*	Outside shields	Inside each shield
Capacitance, between conductors	35 pF / ft.	50 pF / ft.
Capacitance, conductor to shield	62 pF / ft.	95 pF / ft.
Length of cable to make maximum system capacitance of 300 nanofarads:	8571 feet	3175

* Notes: Paralleling drain wires in type 9406 cable will reduce resistive crosstalk.

Q 14. How do I interface to an RTS Systems TW Intercom to Clear-Com ?

A. Use a ClearCom TW12. Call lights will also be translated.

Q 15. How do you adjust the cue/interrupt volume on an IFB System?

A. Put a 220 ohm resistor across TB-1 (in the Models 4001,4002, or 4003) pins 1 & 2. This will reduce the gain by 6 dB.

Q 16. What's the difference between a PS30 & PS31?

A. The PS30 has 3 wet and 3 dry audio channels. The wet channels were numbered 1,3,5; the dry, 2,4,6.

The PS31 has 3 wet channels, plus the dual impedance switch. Upgraded circuitry design and reduction in channels reduces confusion on the part of the user.

Q 17. Why does RTS Systems equipment cost so much?

A. RTS Systems equipment is very high quality, high technology utilizing quality parts, attention to detail, passion for accuracy, and special packaging for aesthetics. The equipment is backed with good documentation and factory support.

Q 18. How many IFB talent stations can I put on one line?

A. A maximum of (3) three Model 4020s using a TW5W splitter.

Q 19. How does the dual listen function operate?

A. Dual Listen (DL) option uses concentric volume control knobs.
RMS300/SPK300: Large knob is always Channel 1, small knob is always Channel 2.
For all other user stations: Large knob is always the volume control for the channel you are talking on and the small knob is always the other channel.

Q 20. I currently have an RMS300 and I want to add a 4001 beneath it. How do I connect the two so I can use one gooseneck mic for both?

A. Use an RMS300 with the USMB option installed (see SD2712 in the RMS300 Technical Data Package, TDP3504). Modify the 4001 as detailed in the 4001 Service Manual in the sections entitled "Connection to existing microphones, "TW" type user stations and other sources" and in the figure entitled "Line Level Input".

Use the USM OPTION on both the RMS300 and 4001. See the Series 4000 Technical Manual.

Q 21. Why does the gooseneck not work when I turn off the speaker on the RMS300?

A. The speaker ON/OFF switch shuts off both the speaker and panel microphone, the headsets are selected at this time. When the speaker ON/OFF switch is switched on, the speaker & gooseneck are selected, & the headsets are off.

Q 22. When I turn up the volume on my RMS300 I get feedback on the speaker.
How can I increase the gain without feedback?

A.
1. Adjust the Sidetone / Balance Control for each channel.
2. Move the microphone away from the speaker.
3. Don't cover the holes in the microphone head with your hand.
4. Operate in the push-to-talk mic mode.
5. Increase the Speaker Dim by changing R31 to be a 2.2k 1/4-watt resistor. This reduces gain by 10dB.

Q 23. Is it okay to hook up a tape recorder to the line? If so, how do I do it?

A. Yes, but not too many at one time. Select which channels you want to record and then use both an isolating audio transformer and blocking capacitors to couple the tape recorder into the circuit. Make certain the tape inputs are high impedance (10 kilohms or higher). Pins 1 & 2 = CH.1 and pins 1 & 3 = CH.2.

Connect X to either CH1 or CH2 via capacitors, C, shown. Capacitors C are 1 microfarad, 50 volts electrolytic capacitors. The transformer is a 10,000 ohm to 10,000 ohm 100 mW minimum audio transformer.

Q 24. What is the relationship between the channels on the master station, on the SAP1626, on the BOP220 and the channels on TW stations?

A. Channels 1 to 12 on the 802 correspond to thumbwheel positions 1 to 12 on the SAP1626. Switch positions CH1 and CH2 on a user station correspond to the upper and lower rows of thumbwheels on the SAP1626. The 1-20 connectors on the BOP220 correspond to the vertical columns 1-20 of the EXTERNAL thumbwheels on the SAP1626.

Q 25. How many master stations (Models , 802, 803, 8105CTL, 810CL) can I put into a system?

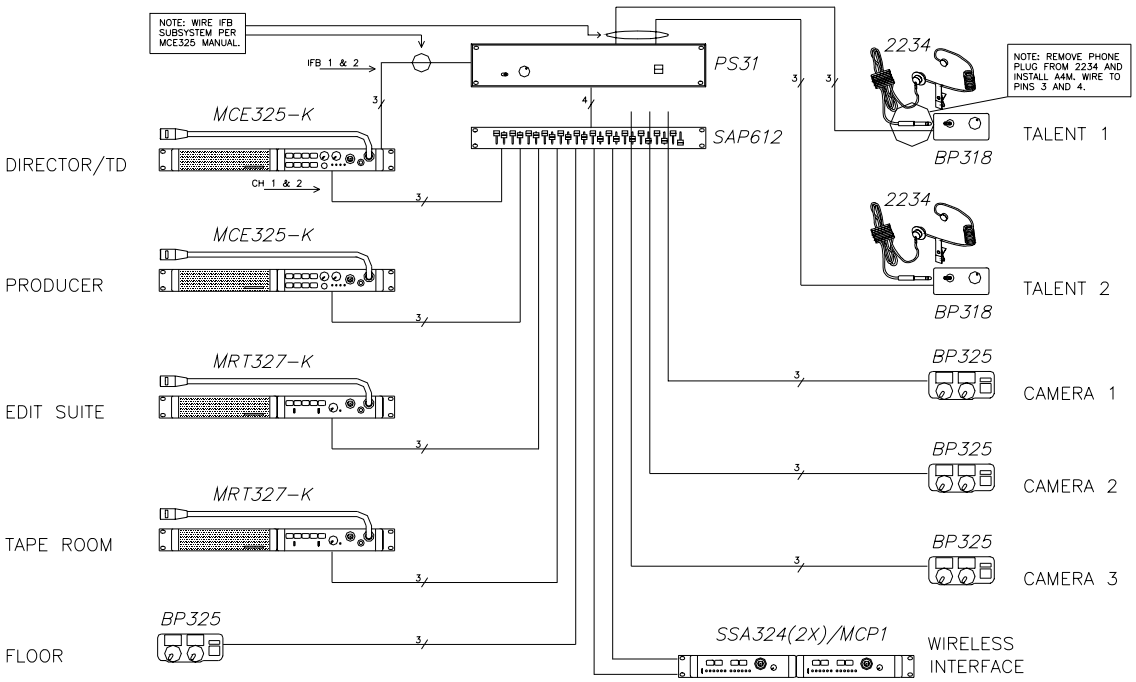
A. Up to 25 with 6 dB roll off at 200 hertz, up to 50 with 6 dB roll off at 400 hertz. This limitation does not apply to the unbalanced TW system, nor to advanced product planned for the future. In general, a greater number of transformers in a system will cause low frequency loading. The present versions of the master stations all have transformer balancing.

Q 26. What is the difference between the 4000 Series IFB System and the IFB system on the 862?

A. The 4000 Series is a complete system. The 862 IFB is part of a system. To complete the system, one must connect high impedance earphones, or for more level an amplifier and lower impedance phones. Another configuration using special wiring could integrate TW beltpacks or the Model 4020 belt packs into the system. The master station channels 7-12 can be used for the IFB. It is best not to try to have IFB and intercom on the same channel, so channels should be allocated (from channels 7-12) for IFB-only use.

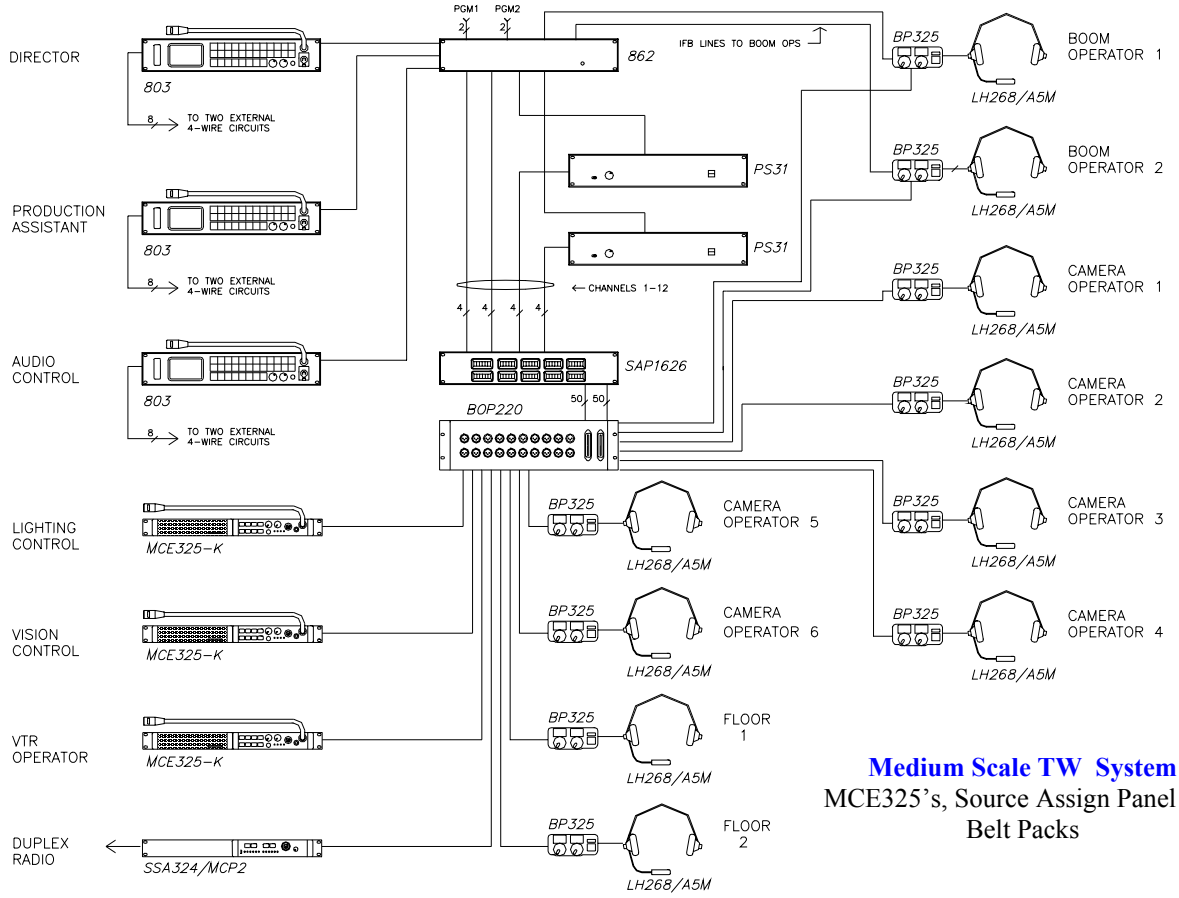
Q 27. Can I use Phase I TW Intercom w/current TW?

A. Not with a PS8 or PS15, but with other RTS Systems TW power supplies.



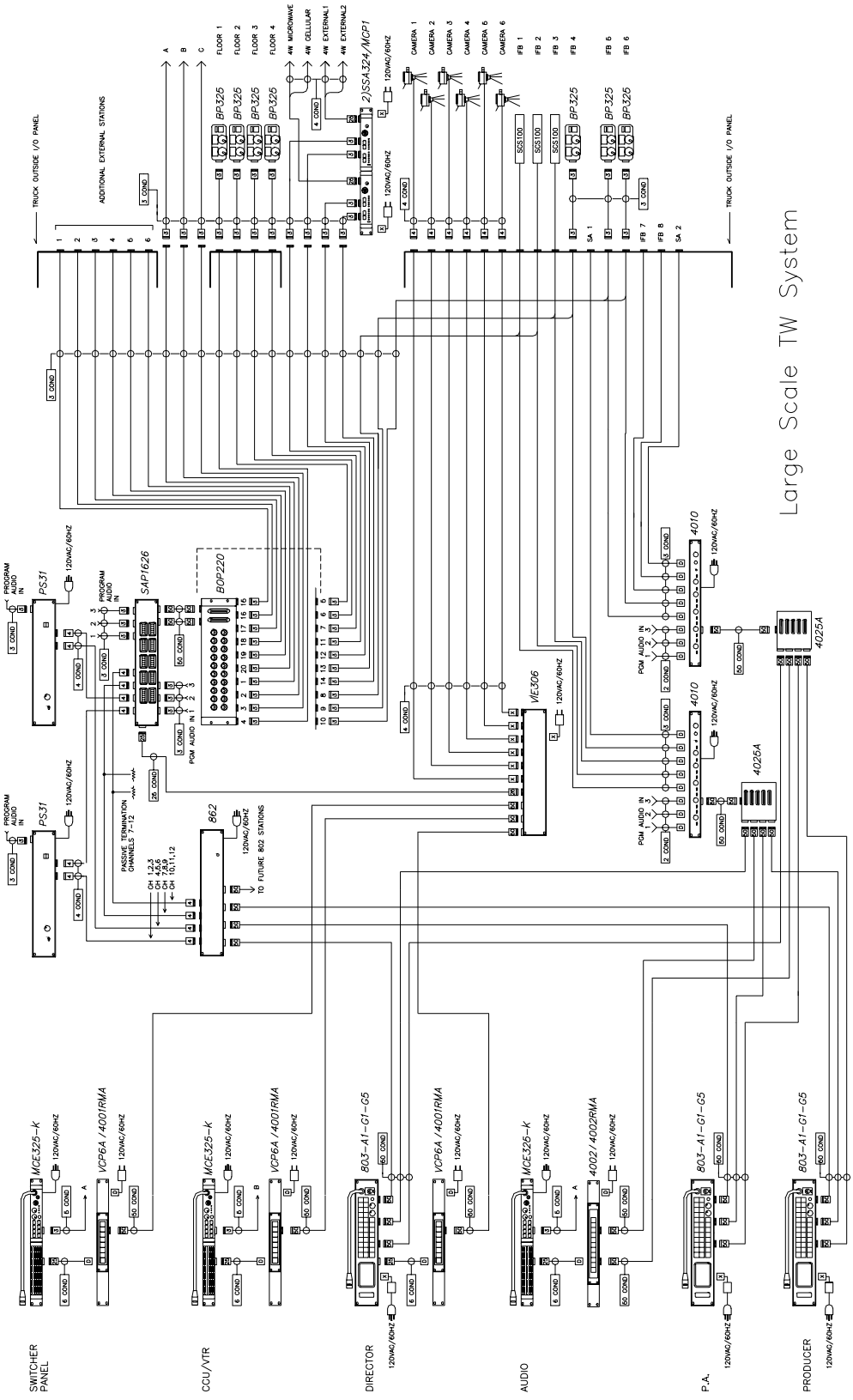
Small Scale TW System

MCE325's, Simple IFB, Source Assign Panel and Belt Packs



Medium Scale TW System

MCE325's, Source Assign Panel and Belt Packs


Large Scale TW System
TRUCK OUTSIDE I/O PANEL
ADDITIONAL EXTERNAL STATIONS
BP325
SCS100
BOP220
SAP1626
PS31
862
VIE306
4010
4025A
MCE325-K
VCP6A/4001RMA
803-A1-G1-G5
4002/4002RMA
SWITCHER PANEL
CCU/VTR
DIRECTOR
AUDIO
P.A.
PRODUCER

General Criteria for Specifying the Core Intercom System

The following are some basic questions for determining intercommunications needs. Once you know how many users are involved and how the customer intends to use the system, from the answers to these questions, you can make a general decision of whether a matrix or a TW system is most suitable for the application. With this information, you can also determine how many PL's or matrix ports are required which will help you determine what accessories or sub-systems are required for the system.

CONSIDERATIONS

- ☐ Is this a completely new system ?_____
- ☐ Is this a new system using hardware from existing older system ?_____
- ☐ Is this an existing system being added to or upgraded ?_____
- ☐ What is the budget ?_____
- ☐ If budget constraints, choose core system which will satisfy immediate needs and easily allow for future expansion later._____
- ☐ List positions requiring control or user stations (determine who needs to talk and/or listen to whom).

[Examples]

STUDIO CONTROL	STUDIO FLOOR	SUPPORT AREAS	MISC.
Director	Camera Operators	Video Tape	Radios
Associate Director	Floor Managers	Edit Suites	Telephones
Producer	Booms	Post Production	External Feeds
Associate Producer	Lighting Bridge	Graphics	Future Expansion
Production Assistant	Talent (IFB)	News Room	
Video Operator	Studio Announce	Transmission	
Audio Engineer	Dressing Rooms	Master Control	
Lighting Director		Maintenance	
Effects			

- ☐ Is it necessary to have users talk to several others on an individual basis or is the majority of communicating done using party lines, or a mixture of both ?_____
- ☐ How many simultaneous separate conversations or channels are envisioned ? _____
- ☐ How many party lines are required ?_____
- ☐ How are users grouped operationally ?_____
- ☐ Will the operating configuration change frequently for different applications, i.e. do the users speak to a different group of people at different times of the day ?_____
- ☐ How many studios are involved and what interaction do they have with each other, i.e.: do they need to speak to each other ?_____
- ☐ Is one large matrix best or several smaller ones systems connected together or is a channel on a multi-channel TW party line sufficient ?_____
- ☐ Headsets vs. speaker type stations required ?_____
- ☐ Headset requirements ? (mono, stereo, dual or single muff, lightweight, noise canceling)
- ☐ Headset connector requirements ? (4 pin, 5 pin depending on station capability or in house preference)
- ☐ Any high ambient noise location's ?_____
- ☐ Panel space limitations ?_____

IFB

- ☐ How many IFB circuits are required ?_____
- ☐ Do any of the outputs drive radio or satellite links ?_____
- ☐ Do any of the outputs drive telephone or other types of outgoing lines ?_____
- ☐ Are wireless cues required for IFB's ?_____
- ☐ How many program inputs ? _____
- ☐ Do the IFB's frequently receiving different program sources ?_____
- ☐ Does each IFB receive its own channel or does it need to share a common channel ?_____
- ☐ What type of earpiece or headphone is required for talent ?_____

CAMERAS

- ☐ How many cameras in the system?_____
- ☐ Is it necessary to be able to isolate one or should all cameras be a part of the same group and hear the same conversations at all times ?_____
- ☐ Should the cameras be able to talk to each other ?_____
- ☐ Will they be fixed to one PL or join other PL's frequently ?_____
- ☐ Should they have one or two channels (Production and Engineering) ?_____
- ☐ Do the cameras have a 4 wire, 2-wire or both intercom ports on the CCU ?_____
- ☐ Triax or Multi-core ?_____
- ☐ 1 Channel or 2 ?_____
- ☐ Program Input ?_____

MISC.

- ☐ How many two-way radio circuits ?_____
- ☐ How many telephone lines ?_____
- ☐ How many two wire (TW) production drops ?_____
- ☐ How many stage announce feeds ?_____
- ☐ How many “actor’s call” feeds ?_____
- ☐ How many general paging circuits ?_____
- ☐ Any external controls required ?_____
- ☐ Any relays required and how many ?_____
- ☐ Select panel types based on the defined operations relating to the above._____
- ☐ Beltpacks, 1 channel or 2 ?
- ☐ Form factor of user stations ? (rack mount for headset, rack mount with speaker, beltpack, portable with speaker, console mount, wall mount with headset, wall mount with speaker)
- ☐ Wireless (single channel with no call signal) or wired belt packs (1 or 2 channel with call signal) ?
- ☐ Is a Source Assignment Panel required to make changes to a TW configuration ?_____

EXPANDABILITY & FUTURE REQUIREMENTS

Having understood the requirements and prepared a configuration, one additional factor to consider is what the system requirements may be in the future. This may impact the size of the matrix frame or TW system being specified as well as the entire system design.

Will the System size be expanded in the future ? Will it remain within the current boundaries of or will it exceed the current system's maximum size and capabilities ?

For 2-wire systems, will the Power Supply be large enough to handle the additional user stations ?

Will the addition of more user stations also require an assignment panel to improve communication paths and configuration for different applications ?

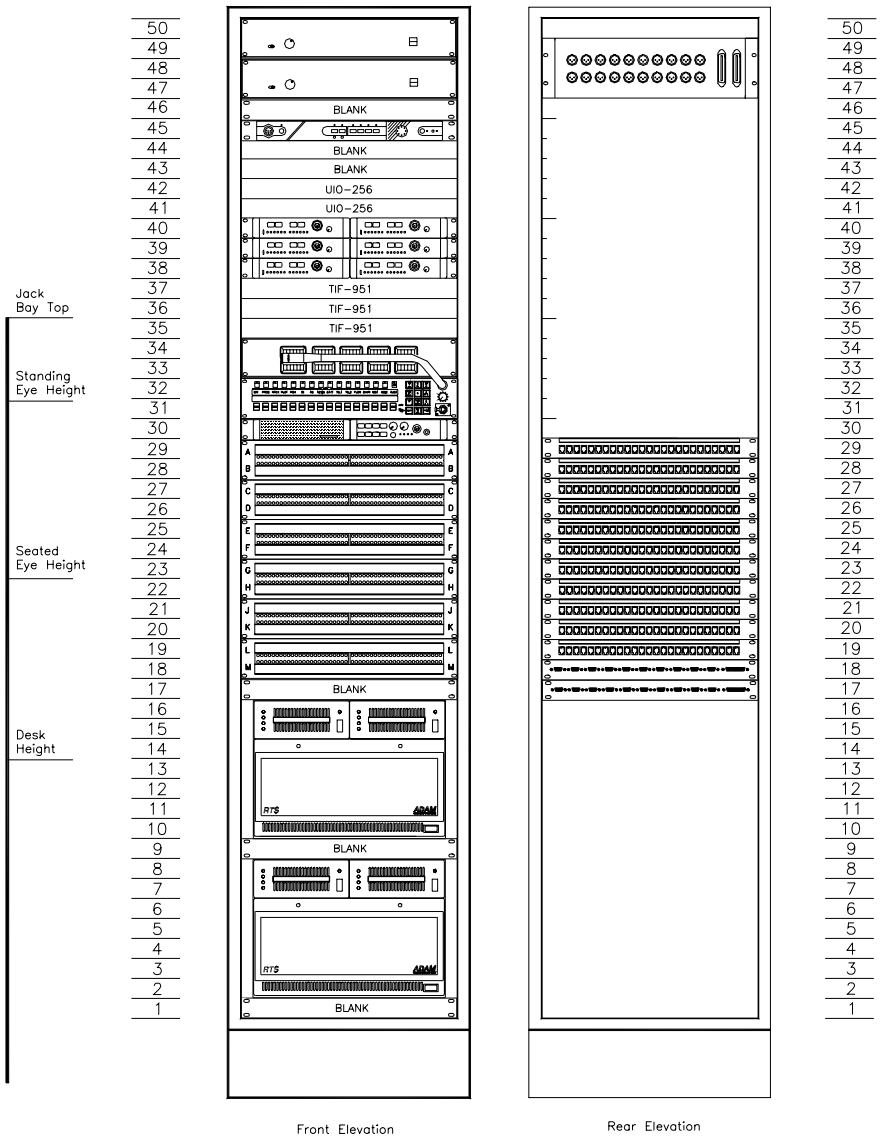
FINAL ANALYSIS

Will the system design meet the budget ? If not, how can the system be scaled to retain the immediate critical and necessary features ?

What options can be considered for the system to retain maximum flexibility with fewer and less expensive components ?

With the intercom and IFB requirements defined, we now have the information required to proceed with the design and costing process. An equipment list that includes intercom and IFB can be made that will allow us to look at budgetary parameters. If the design meets budget requirements, we have succeeded. If not, we need to go back to the drawing board or obtain additional capital funding.

Equipment Placement Considerations



The drawing to the left shows a typical layout of equipment in the central equipment room.

This rack will house all core system components of the intercom system.

Note also that TW subsystem components are located in this rack along with the matrix and TW maintenance intercom panels.

Components illustrated support a two frame ADAM matrix 256x256, 12 channels of two-wire intercom, 6 powered TW channels, 4 channel wireless intercom, 6 telephone lines, 32 relay controls, and an audio test jackfield.

Break-out panels are located behind jackfield panels where maintenance access will be less likely required. The rear of the matrix and other subsystem components are open at rear for easy access.

Typical rack depth should be at minimum 30” with a 4” base.

Consideration of the placement of front access equipment in the core rack must be carefully made. Mounting height relative to function, visibility and operational aspects are important to proper placement of equipment. Positional consideration relating to rear access is also important. Attention must be given to avoid blocking access to devices which require frequent maintenance or periodic changes.

Careful placement of devices relative to clearance between rear connector panels of front mounted equipment and rear mounted I/O panels which, due to lack of adequate clearance between the two, may cause sharp radii bends of cables which could cause damage to the cable or connector integrity.

Never block or impede the air flow of any ventilation fans. Investigate heat dissipation of all equipment in rack and provide adequate spacing between those devises known to run at suspected high temperatures.

System Installation Guidelines

CABLE INTEGRITY
All wire and cable shall be continuous and splice-free for the entire length of run between designated connections or terminations. Under no conditions should cable be spliced.

CABLE SUPPORT
Secure all wire and cable run vertically in conduit for distances of greater than thirty (30) feet at the vertical run terminations, or outside conduit at distances of no more than ten (10) feet. Under no conditions shall any cable in the system be supported by a connection point. All cables should be secured prior to any connections. Do not use adhesive plates for securing cable ties, and under no conditions should cable ties be secured to removable equipment.

CABLE IDENTIFICATION
Identify all wire and cable clearly with permanent labels printed and replicated about the full circumference of the cable, so that cable identification can be read without the need to turn or rotate the cable.

LABEL LOCATION
Provide identification within one (3) inches of each connection, and, where wire and cable enter or exit from conduit or boxes, within twelve (12) inches of the point of entry or exit.

LABEL MATERIAL
Label materials shall be durable, with non-erasable identification clearly visible below any protective covering. Lettering shall be of sufficient density to afford reading in reduced rack lighting. Minimum character size shall be 1/8", utilizing either 24 pin dot-matrix printers in high density mode, or laser printers. Labels shall be self-laminating type, printed with cable identity codes only, repeated continuously and completely about the circumference of the cable, and shall be of sufficient size to show printable area completely around the cable. Avoid using descriptive labels. They are often vague and confusing.. Acceptable labels are manufactured by Brady, Panduit or Thomas and Betts..

ROUTING
All internal cabling shall remain within the respective rack frame. Inter-rack wiring within the same contiguous group of racks shall be routed via the rack bases; inter-rack wiring between rack groups and to other areas of the project shall be routed via the overhead cable tray, conduit, or computer floor. Never run any cable laterally between adjacent racks through side openings within the rack bay.

SERVICE LOOPS
Provide service loops where harnesses or different classes cross, where equipment is mounted on rack slides, where equipment not on rack slides must be removed from the front, or where hinged panels are to be interconnected. Service loops shall permit full extension of rack slides, or removal plus one foot of front access equipment not on rack slides, without visible stress on service loop.

FANOUT
Provide proper fanout of cables, using adequate cable ties, for successive connections from one side of the equipment connected. Fanout shall be accomplished in a logical manner, with a minimum of cable crossover and stress on cables. Fanout points shall permit easy access to cable identification labels.

CABLE SHIELDING
All shielded cable shall be insulated. Do not permit shields to contact conduit, raceway, boxes, panels or equipment enclosures. Tin terminated shield drain wires and insulate with heat shrinkable tubing.

Determine the space available at each position, e.g. 2 rack units high, console, under console, wall mounted, overhead, etc.

Determine if this is a headset station, speaker and panel microphone station, or both headset and speaker plus panel microphone.

Select equipment for each operating position for an entire system.

Verify physical sizes for fit in the space you have allocated. Also verify that the equipment capability meets your anticipated needs.

Add the appropriate equipment to the operating position list for each position, system by system if you haven't already done so.

You are now ready to develop the cabling requirements by drawing a "block" or single line diagram.

LAYING OUT THE SYSTEM

Laying Out A System Diagram
Accurate documentation is crucial in any complex system design. Single Line and Block Diagram methods are commonly used in system documentation. This form of documentation is vital during construction as well as for on-going maintenance or upgrades.

Block Diagrams are basic fundamental drawings which contain a minimum degree of detail simply showing equipment or devices as simple blocks or symbols interconnected by single lines and may show simple signal path direction. The symbols representing equipment or devices have only simple reference designations used for low level identification.

Single Line (S/L) Diagrams are drawings containing far greater detail than block diagrams and show, by means of graphic symbols and interconnecting lines, the course of a system and the component devices used therein. They also depict device location designations, cable reference numbers, model numbers, device reference designations, device connector reference designations and, if required, jackfield references and signal reference levels. These drawings are usually produced and provided for the system integrator.

Now determine system to system interconnection, for example, pickup feeds for panel microphones and speakers or speaker amplifiers.

Draft an equipment list from the "Block" diagram and your notes.

Cables that tie to another system (Add a note clearly identifying the equipment by manufacturer, model number, and if more than one in the system, identify which one by number, code, or distinctive name cable ends that are for future use should be so identified: “Future”

Make sure all central equipment required for a subsystem is included, identified, and properly terminated.

CABLE SCHEDULE

The Cable Schedule is a book form listing consisting of tabular “from-to” data establishing wiring connections within or between devices or equipment within a system or facility. The cable schedule is prepared on 8-1/2" x 11" vellum or bond media. The principal sections of a cable schedule are as follows:

Cable number with system ID prefix
Source connection identification
Destination connection identification
Cable type (manufacturer's number)
Cable length
Functional description of cable in system
Connector wiring diagram reference codes

EQUIPMENT RACK ELEVATION DRAWINGS

Equipment Rack Elevation drawings show the physical layout of equipment or panels in a rack and is usually viewed from the front. They also show incremental delineation of panel locations, 1 rack unit each (1-3/4"), and numbered from 1 - "x", 1 being the lower most rack unit. These drawings will also depict the over-all height of the racks, including any base.

CONSOLE ELEVATION DRAWINGS

Console Elevation drawings show the physical layout of equipment or panels in a console and is usually viewed from the front. It also shows incremental delineation of panel locations, 1 rack unit each (1-3/4"), and numbered from 1 - "x", 1 being the lower most rack unit. This drawing will also depict the over-all height of the vertical panel opening (V.P.O.) in each section of the console.

PULL SHEETS

A Pull Sheet is a tabular listing consisting of data depicting cable run paths of cables listed in the Cable Schedule. It will identify conduit or wireways used in the distribution of specific groups of cables from their source to destination. Typically, the Pull Sheets are prepared on 8-1/2" x 11" vellum or bond media.

AC POWER

Determine AC power requirements by estimating loads from manufacturer’s specs and apply an appropriate derating as a sefety margin according to local building codes. Install mains circuit breakers as required.

Dual AC receptacle strips are recommended in racks, one on each inside panel or rail. Separate circuit protection must be provided for each strip.

Cable schedule for the system. (example #1)

INTERCOMMUNICATIONS SYSTEM CABLE SCHEDULE

Project: **System:**

Sorted By: PFX/NUM **Revision:** **Date:**

Dip Switch w=◆ r=❐ x=☒ o=□

Cable		-------- Matrix Frame --------				------------- Source ---------------					---- Cable ----			----------- Destination -----------					ID	Device Addressing							
Pfx	#	#	Card	Port	Circuit	Rm	Locn	Device	Refdes	Conn	Type	Clr	Ln	Rm	Locn	Device	Refdes	Conn	1-8	1	2	3	4	5	6	7	8
AA	10001																			◆	◆	☒	□	❐	❐	❐	◆
AA	10002																										
AA	10003																										
AA	10004																										
AA	10005																										
AA	10006																										
AA	10007																										
AA	10008																										
AA	10009																										
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AA	10024																										
AA	10025																										
AA	10026																										
AA	10027																										
AA	10028																										
AA	10029																										

Cable schedule for the system. (example #2)

SYSTEM CABLE SCHEDULE

Client: | Rev:

CABLE PFX NUMBER	TYPE	SEX	SOURCE	DESTINATION	SEX	LENGTH	TERM	FUNCTION
IC 1001	8771	XLM	ER-5 SAP1626, J-111	ER-5 PS31, J-107	XLF	8'	TV12-14	POWER INTERCONNECTION
IC 1002	8451	XLM	ER-5 SAP1626, J-105	ER-5 AUDIO JACKFIELD, 5-B12	?	4'	TV12-10	DRY AUDIO SAP IN 13
IC 1003	8451	XLM	ER-5 SAP1626, J-106	ER-5 AUDIO JACKFIELD, 5-B13	?	4'	TV12-10	DRY AUDIO SAP IN 14
IC 1004	8451	XLM	ER-5 SAP1626, J-107	ER-5 AUDIO JACKFIELD, 5-B14	?	4'	TV12-10	DRY AUDIO SAP IN 15
IC 1005	9585	MRM	ER-5 SAP1626, J-111	ER-5 BOP22O, J-122	MRF	8'	TV12-16	SAP/BOP INTERCONNECT
IC 1006	9585	MRM	ER-5 SAP1626, J-103	ER-5 BOP220, J-121	MRF	8'	TV12-16	SAP/BOP INTERCONNECT
IC 1007	8723	XLF	ER-5 BOP220, J-111	GREEN ROOM, WMS300	XLM	95'	TV12-5	GREEN ROOM LINE
IC 1008	8451	XLF	ER-5 BOP220, J-109	ER-5 JACKFIELD, 5-A5	?	8'	TV12-15	FLOOR DIRECTOR LINE (RF)
IC 1009	8723	XLF	ER-5 BOP220, J-114	ANNC. BOOTH, BP300	XLM	110'	TV12-5	ANNOUNCER LINE
IC 1010	8723	XLF	ER-5 BOP220, J-108	EDIT 2 848A, J-602	XLM	40'	TV12-5	EDIT 2 848A TW LINE
IC 1011								
IC 1012	8723	XLF	ER-5 BOP220, J-104	STUDIO AUDIO 848A, J-602	XLM	120'	TV12-5	STUDIO AUDIO 848A TW LINE
IC 1013	8723	XLF	ER-5 BOP220, J-103	STUDIO CONTROL 848A, J-602	XLM	120'	TV12-5	STUDIO CONTROL 848A TW LINE
IC 1014	8723	XLF	ER-5 BOP220, J-105	EDIT 1 848A, J-602	XLM	70'	TV12-5	EDIT 1 848A TW LINE
IC 1015	8723	XLF	ER-5 BOP220, J-107	SWEETENING 848A, J-602	XLM	85'	TV12-5	SWEETENING 848A TW LINE
IC 1016	8723	XLF	ER-5 BOP220, J-102	TMN-2 ER-20 848A, J-602	XLM	10'	TV12-5	TMN-2 ER-20 848A TW LINE
IC 1017								
IC 1018	8723	DBF	EDIT 2 848A, J-1001	ER-5 DATA SPLITTER	DBM	150"	TV12-6	EDIT 2 848A DATA
IC 1019	8451	XLM	ER-5 PS31, J-110	ER-5 JACKFIELD, 5-B10	?	6'	TV12-10	PROGRAM INPUT
IC 1020	9585	MRF	EDIT 2 848A, J-401	ER-5 AUDIO SPLITTER	MRM	150"	TV12-16	EDIT 2 848A MTX LINE
IC 1021	8723	XLF	ER-5 I/F-1, TWI224 - 4 W PORT	ER-17 CAM-1 CCU	?	45'		SEND TO CAM-1
IC 1022	8723	XLF	ER-5 I/F-2, TWI224 - 4 W PORT	ER-17 CAM-2 CCU	?	45'		SEND TO CAM-2
IC 1023	8723	XLF	ER-5 I/F-3, TWI224 - 4 W PORT	ER-17 CAM-3 CCU	?	45'		SEND TO CAM-3
IC 1024	8723	XLF	ER-5 I/F-1, TWI224 - 4 W PORT	ER-17 CAM-1 CCU	?	45'		RCVE FROM CAM-1
IC 1025	8723	XLF	ER-5 I/F-2, TWI224 - 4 W PORT	ER-17 CAM-2 CCU	?	45'		RCVE FROM CAM-2
IC 1026	8723	XLF	ER-5 I/F-3, TWI224 - 4 W PORT	ER-17 CAM-3 CCU	?	45'		RCVE FROM CAM-3
IC 1027	8451	DBM	ER-5 SAP1626, J-108	ER-5 I/F-1 TW PORT	XLM	6'		CAM-1 ICOM
IC 1028	8451	DBM	ER-5 SAP1626, J-108	ER-5 I/F-2 TW PORT	XLM	6'		CAM-2 ICOM
IC 1029	8451	DBM	ER-5 SAP1626, J-108	ER-5 I/F-3 TW PORT	XLM	6'		CAM-3 ICOM
IC 1030	8451	MOF	DIRECTOR 848A, J-104	DIRECTOR 4001, TB-1	TER	2'	TV12-9-A	DIRECTOR MIC, IFB
IC 1031	8451	MOF	ON LINE EDIT 848A, J-104	ON LINE EDIT 4001, TB-1	TER	2'	TV12-9-A	ON LINE EDIT MIC, IFB
IC 1032	8451	MOF	SWEETENING 848A, J-104	SWEETENING 4001, TB-1	TER	2'	TV12-9-A	SWEETENING MIC, IFB
IC 1033	9585	MRF	DIRECTOR 4001, J-16	ER-5 SPLITTER #1	MRM	125'	TV12-16	DIRECTOR IFB CONTROL
IC 1034	9585	MRF	ON LINE EDIT 4001, J-16	ER-5 SPLITTER #1	MRM	75'	TV12-16	ON LINE EDIT IFB CONTROL
IC 1035	9585	MRF	SWEETENING 4001, J-16	ER-5 SPLITTER #1	MRM	90'	TV12-16	SWEETENING IFB CONTROL

Two Wire (TW) Products

803 MASTER STATION:

803	803 Master Station
803-C	803 w/4-wire Listen Option
803-C-G1	803 w/4-wire Listen Option & IFB-4001 Emulate (4-IFB,1SA)
803-C-G1G5	803 w/4-wire Listen Option & IFB-4002 Emulate (8-IFB,2SA)
803-G1	803 w/IFB-4001 Emulate (4-IFB,1SA)
803-G1G5	803 w/ IFB-4002 Emulate (8-IFB,2SA)
862	System interconnect for 802/803

Matrix/Conference Line Intercom:

810-CL	Master station, 10 channel Conference line
810-5CTL	Master station, 5 channel talk/listen conference line

Modular Series Main Components:

RM-325*	Modular user station, 2 channel stereo w/call light & headset connector
MRT-327*	Modular user station, 2 channel w/call light & headset connector
MCE-325*	Modular user station, 2 or 4 channel w/call light & headset connector

Portable Speaker Stations:

SPK300L	Speaker/Headset station w/call light and hand mic

Wall mount Stations:

WM300L	Wall Mount Headset station w/ call light, 1/4" phone jack & headset connector
WMS300L	Wall Mount Speaker/Headset station w/call light, & headset/mic connector

Console Mount Stations:

CM300L	Console Mount Headset station w/ call light, 1/4" phone jack & headset connector

Belt Packs:

BP-318	Headset station, 1 channel w/call light, & headset connector
BP-350	Headset station, 2 channel w/call light, & headset connector
BP-325	Headset station, 2 channel binaural w/call light, & headset connectors

Power Supplies:

PS-15*	Power supply for 15 stations, 1 powered chan. (modular)
PS-31	Power supply for 30 stations, 3 powered chan.
	*(requires mounting hardware - MCP1 or MCP2 or MCP8)

Modular Series Speakers:

LMS-325*	Modular Amplified Loudspeaker
MCS-325*	Modular Loudspeaker

Modular Series System Interface Devices:

SSA-424*	Digital System to system interface 2 ch 2-wire to 4-wire conversion
SSA-324*	Analog System to system interface 2 ch 2-wire to 4-wire conversion

Modular Rack Mounts:

MCP1	Rack mount kit (for two main components)
MCP2	Rack mount kit (for single main component)
MCP3	Console mount kit
MCP4	Tandem mount kit (top/bottom configuration)
MCP8	Plain portable side channels (pair)

Two Wire (TW) Products
Cont'd.

Call Light Indicator:

CIA-1000	Call light indicator with top mounted (standard) red flashing light (front mount light optional). Audiocom/RTS/compatible channel select control, line and loop connectors. Spring clamp terminals for relay output. 1/2 rack wide by 1 high. Available in RTS gray or Audiocom black.

Microphones for Station Equipment:

MCP5	Panel mount electret gooseneck microphone 12" (plug in)
MCP6	Panel mount electret gooseneck microphone 20" (plug in)
MCP7	Hand-held microphone w/6pin connector (coiled cord)
LR412	Gooseneck electret panel microphone 12" (hard mount)
LR420	Gooseneck electret panel microphone 20" (hard mount)
FPA375	Front Panel Adapter for MCP5/MCP6 (plug in adapter bushing & connector)

Intercom Distribution:

SAP-612	Source assign panel for channel assignment - 6ch to 12 TW busses
SAP1626	Source assign panel for channel assignment -12 TW circuits and 3 program inputs to 20 two-wire positions and 6 cameras
BOP 220	I/O Break-out panel for use with the SAP 1626 and 802/803 master stations
SV-3	Interconnect cable assy, SAP to BOP, 25-pin translation from 50-pin, 5ft

Interconnects and Splitters:

TW5W	1 X 5 two channel 3pin XLR type passive splitter (stand-alone)
TW7W	1 X 7 two channel 3pin XLR type passive splitter (panel mount)
BOP1000	Blank mounting panel for TW7W
WP1	Black 3 pin XLR wall plate (passive junction plate)
4012	System interconnect, 50pin to 3pin connector translation assy. Used w/ 810/803's
4022	1 X 2 25 pair, 50pin Passive Splitter
4025A	1 X 4 50 pin Passive Splitter
4024	50 pin Punch Down Connecting Block

IFB:

4010	Central Electronics 4-IFB, 1SA
4001	Control Station for 4-IFB, 1SA
4002	Control Station for 8-IFB, 2SA
4003	Control Station for 12-IFB, 3SA
IFB325	Portable Single Channel IFB Earset User Station
4030	Portable Two Channel IFB Earset User Station

Camera ISO

VIE306	Camera isolate central electronics
VCP6A	Control station for 6 cameras (console mount or requires 4001RMA for rack mount)
VCP12A	Control station for 12 cameras (rack mount)

VHF Wireless Intercom:

BTR-500	2 Channel UHF Beltpack User Base Station
TR-500	2 Channel UHF Portable Beltpack Transceiver
2105	VHF 4-Beltpack User Base Station
2110	VHF Portable Beltpack Transceiver

WIRELESS IFB:

TT-44	IFB 16 Channel Talent transmitter
TR-34	IFB 16 Channel Talent receiver