TW INTERCOM SYSTEM OVERVIEW

RTS

Introduction

The TW Intercom System is a high performance conference-line intercommunication system that features over 25 different integral components allowing 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 that is needed to hook up a basic system. A unique circuit design, utilizing advanced solid state devices, enables the user to conveniently carry on two channels of communication through standard two-conductor shielded cable, telco JKT cable, or even ordinary lamp cord (single channel).

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. These include a station-isolate system, channel source assignment, and interfacing components. Installation is simple and straightforward using standard XLR-type plug-in connectors.

For clear undistorted sound, all user stations use dynamic microphone headsets and handsets. A wide-range frequency response and low-noise amplifiers help reduce listening fatigue even over extended periods. 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.

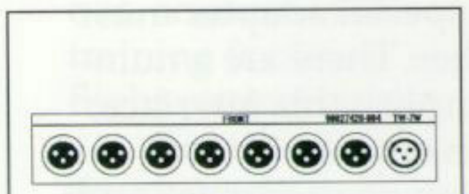
In electronic news gathering (ENG) and electronic field production (EFP), the system's portability, 12-volt battery operation and durable lightweight packaging help the crew communicate quickly and effectively.

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 distance via expendable cable can save time and money.

Non-entertainment applications include research centers, automotive testing grounds, flight and vehicle

TW INTERCOM SYSTEM

A Compilation of TW Intercom System Components

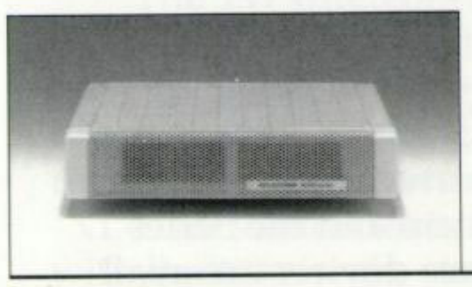


TW7W Splitter
A completely passive 1 x 7 connector splitter assembly that can be used to split a single incoming line into seven separate outgoing lines.

BP300 BELT PACK USER STATION
This lightweight user station provides two channel operation and may be used in portable, semi-portable, and fixed position applications.
– Special order only.

MRT327 USER STATION
This modular package, 2-channel station features call signaling and remote talk-off: it can be used in a portable or permanent application, as a headset or speaker station.

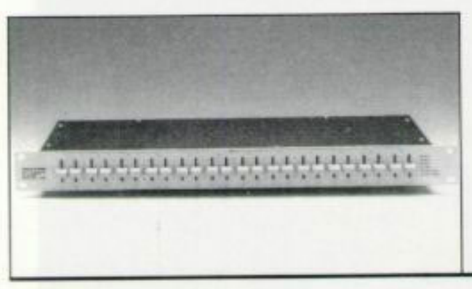
MCE325 PROGRAMMABLE USER STATION
This modular package station features user programming, 2 or 4-channel operation, headset or speaker operation, call signaling, 4-wire mode, IFB, and more.



MCS325 MODULAR SPEAKER
This unique low profile loudspeaker serves as a matching package to the MRT327 and MCE325 User Stations. It can also be used with any other user station or as a program audio monitor.

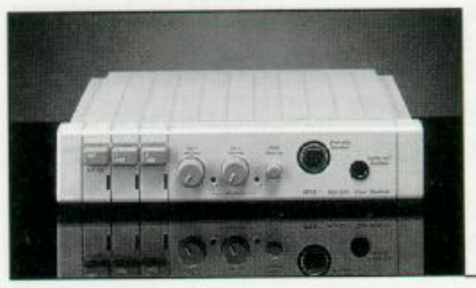
WM300 WALL MOUNT USER STATION
This 2-channel, headset user station fits into a 2-gang electrical box, or it can be installed in a desk top as a low profile console mount station.

WMS300 WALL MOUNT SPEAKER STATION
Designed to fit into a standard 4-gang electrical box, this station augments headset/handset operation with a loudspeaker for monitoring the line.

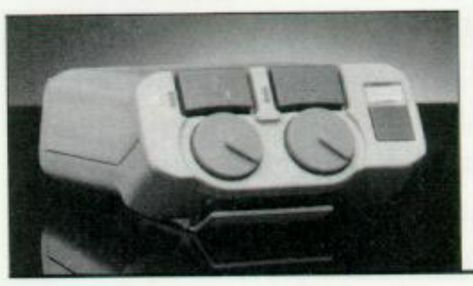


SAP612 SOURCE ASSIGN PANEL
This multiple switch assembly assigns any one of 6 intercom channels and/or 2 program audio channels to 12 separate intercom 2-channel user stations.

PS15 POWER SUPPLY
A single PS15 (two channels) can power 6 to 30 user stations, depending on model and combinations. Typically, a combination of 15 headset and speaker stations can be powered from a single PS15.

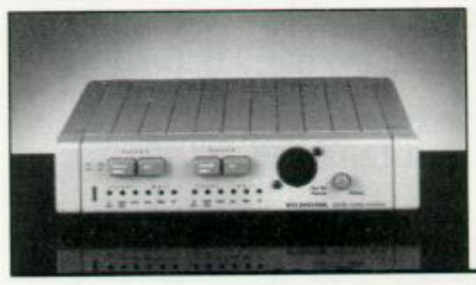


RM325
The RTS Model RM-325 is a two channel headset station for the TW Intercom system. It can be rack or console mounted, or used on a tabletop, and its many programmable features make it ideal for virtually any situation requiring one or two channels of intercom audio with or without program feed.

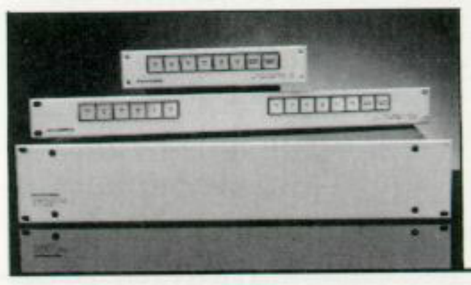


BP325 PORTABLE USER STATION
This new generation two channel unit features user programmable operational functions. It is a stereo/mono unit with program input and call light.

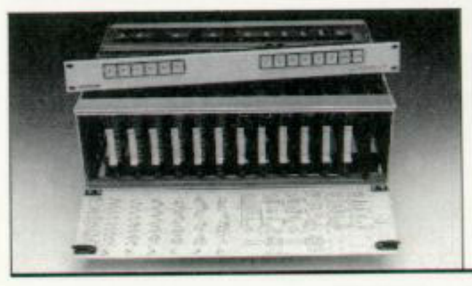
BP318/350 BELT PACK USER STATION
These lightweight user stations provide 1 & 2 channels respectively and feature call signalling and microphone kill capacities.



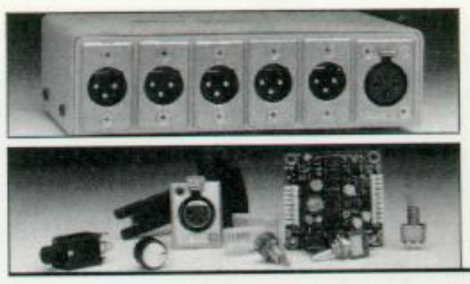
SSA324 SYSTEM INTERFACE
Features two channels of 2-wire to 4-wire conversion or one channel of 2-wire to 2-wire conversion. Optional circuitry allows for carrier signal conversion and relay contacts.



VIE306, VCP6A, VCP12A STATION ISO SYSTEM
These components provide control, switching, and interface (4-wire or 2-wire) functions for private communications between 3 control stations and 6 user stations.

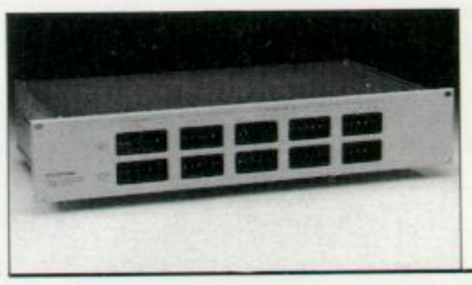


CIF612, VCP12B STATION ISO SYSTEM
These components provide control, switching, and interface (4-wire only) functions for private communications between 6 control stations and 12 user stations.

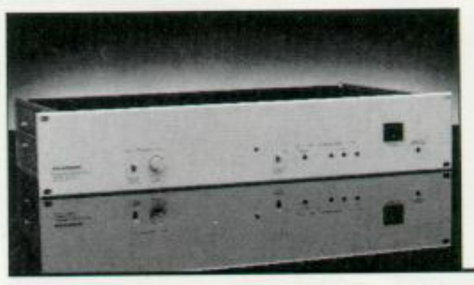


TW5W SPLITTER
A completely passive 1 x 5 connector splitter assembly.

CPK62 CIRCUIT CARD KIT
A small-size user station plug-in circuit (CC62) is provided with all external controls and connectors.

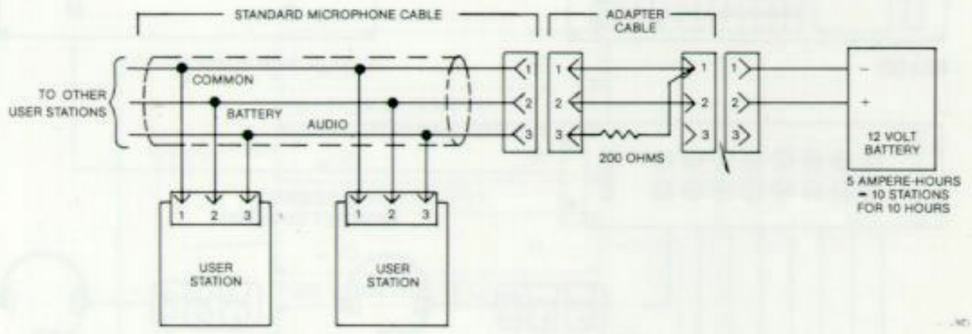


SAP 1626 SOURCE ASSIGNMENT
This multiple switch assembly assigns any one of 12 intercom channels and/or three program audio channels to twenty-six separate intercom 2-channel user stations.



PS31 POWER SUPPLY
A single PS31 can power approximately 30 user stations on any combination of 3 powered output channels. A program audio input can be added to any one of the three channels.

TW INTERCOM SYSTEM APPLICATION DIAGRAMS



12-Volt Battery Operation

In ENG and EFP applications, a 12-volt automotive battery or camera battery can power a limited system via an adapter cable. With standard microphone cable connections, a three-wire mode line provides one channel of intercom.

Information about the new series of products featuring Modular Packaging.

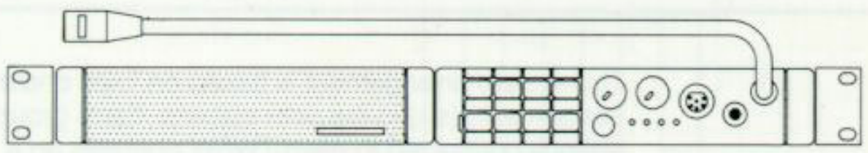
The new modular packaging scheme for intercom products allows for a variety of mounting configurations between the various user stations, power supply and loudspeaker.

Each package is a single rack unit in height and 1/2 rack width. Optional mounting hardware allows each device to be mounted in any one of the following configurations:

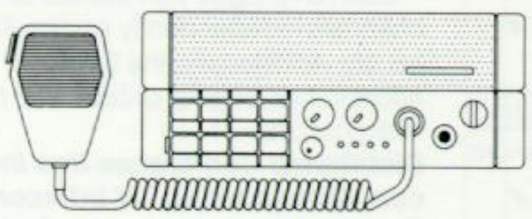
1. Two units rack mounted side-by-side
2. A single rack mounted unit
3. A single unit mounted in a console or desk top
4. Two units mounted top to bottom
5. A single unit free floating

An interesting alternate mounting scheme involves the Tektronix half-rack width housing, which will accommodate a pair of the RTS modular packages — although a very snug fit.

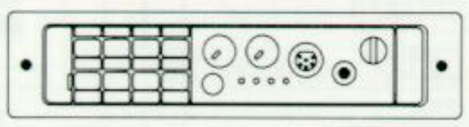
Optional accessories include a 12" and 20" plug-in gooseneck microphone and a hand-held microphone.



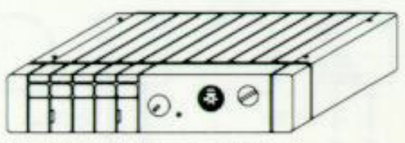
RACK MOUNT SPEAKER STATION



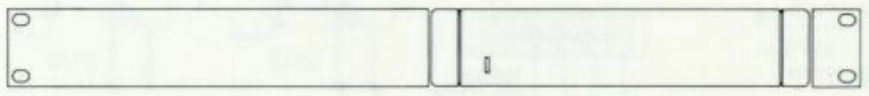
PORTABLE SPEAKER STATION



CONSOLE MOUNT HEADSET STATION



PORTABLE HEADSET STATION



SINGLE RACK MOUNT PACKAGE

The products:

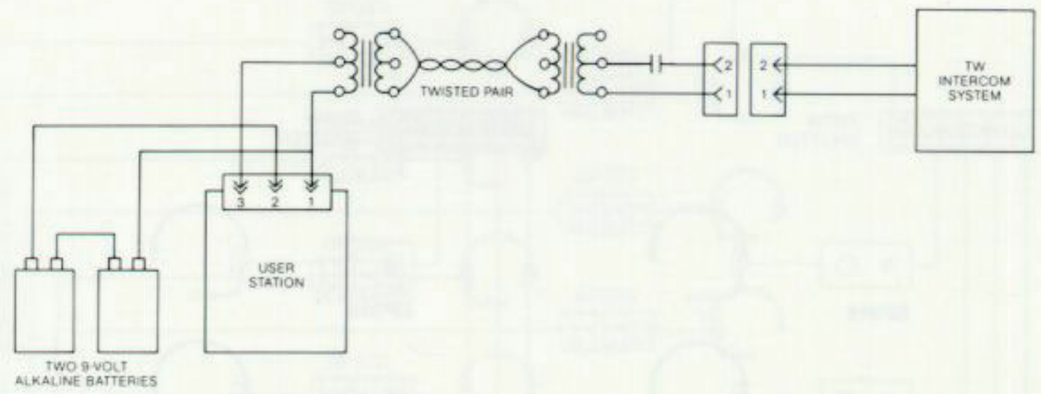
MCE325 Programmable User Station — fully optioned for maximum flexibility. Use it as a mini master station or a conventional user station.

MRT327 User Station — no options, just a basic 2-channel user station. Use as a replacement for models RM300, CM300, and with model MCS325 to replace models RMS300 and SPK300.

MCS325 Modular Speaker — a full-range voice quality, low profile loudspeaker.

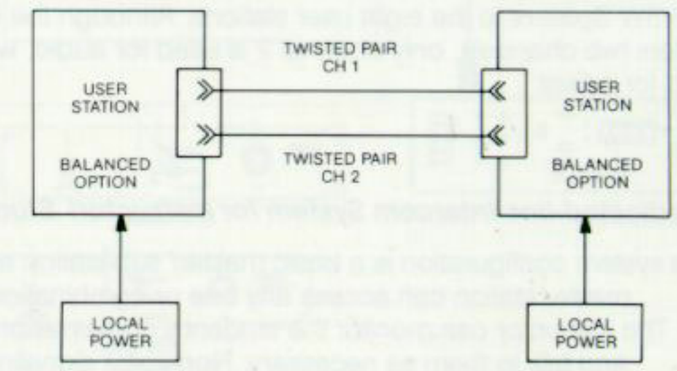
PS15 Power Supply — replaces model PS8, powers more stations, and can be doubled up with another PS15 for twice the powering capability.

SSA-324 Interface — provides 2 independent 2 wire to 4 wire converters in one package.



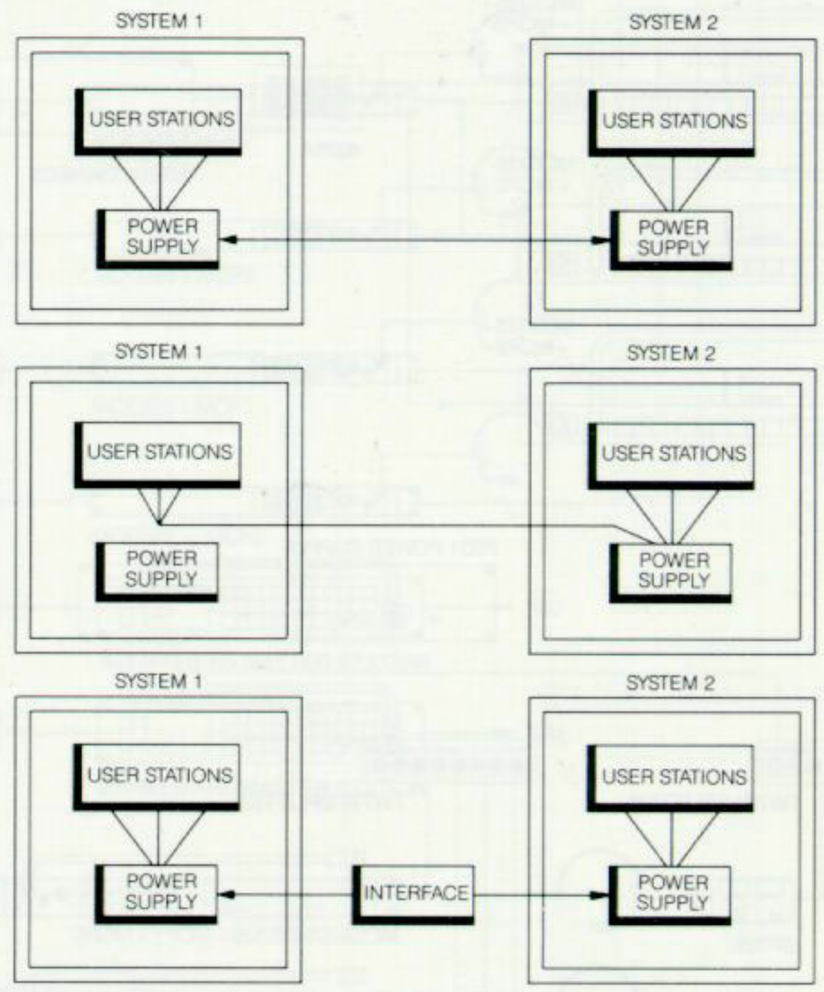
Extended Operating Range

User stations, internally powered from a low-current, 12-volt regulator, can operate at extended distances. With the standard TW Intercom power supply, a single station can operate from distances up to one mile, using microphone cable or Telco JKT cable. With an additional power source at the user station, operating distances can go up to five miles.



Dry Line Operation

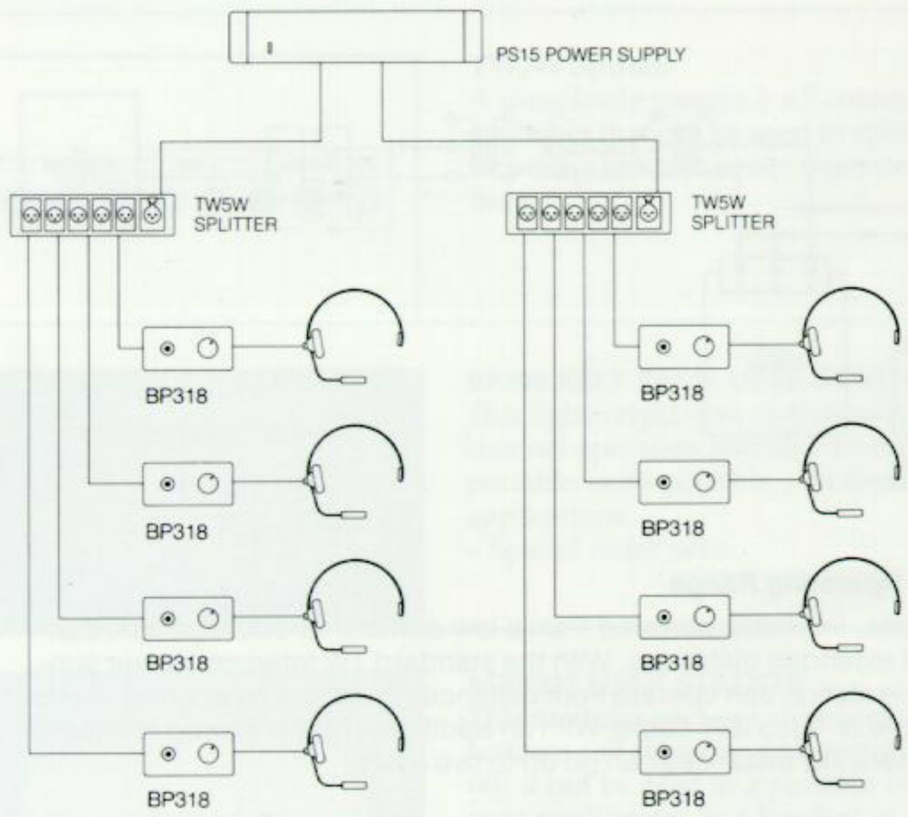
User stations can be locally powered or connected to a central power source that allows dry line operations from station to station. Extended operating range may be realized with a local power source at each user station.



System to System Interfacing

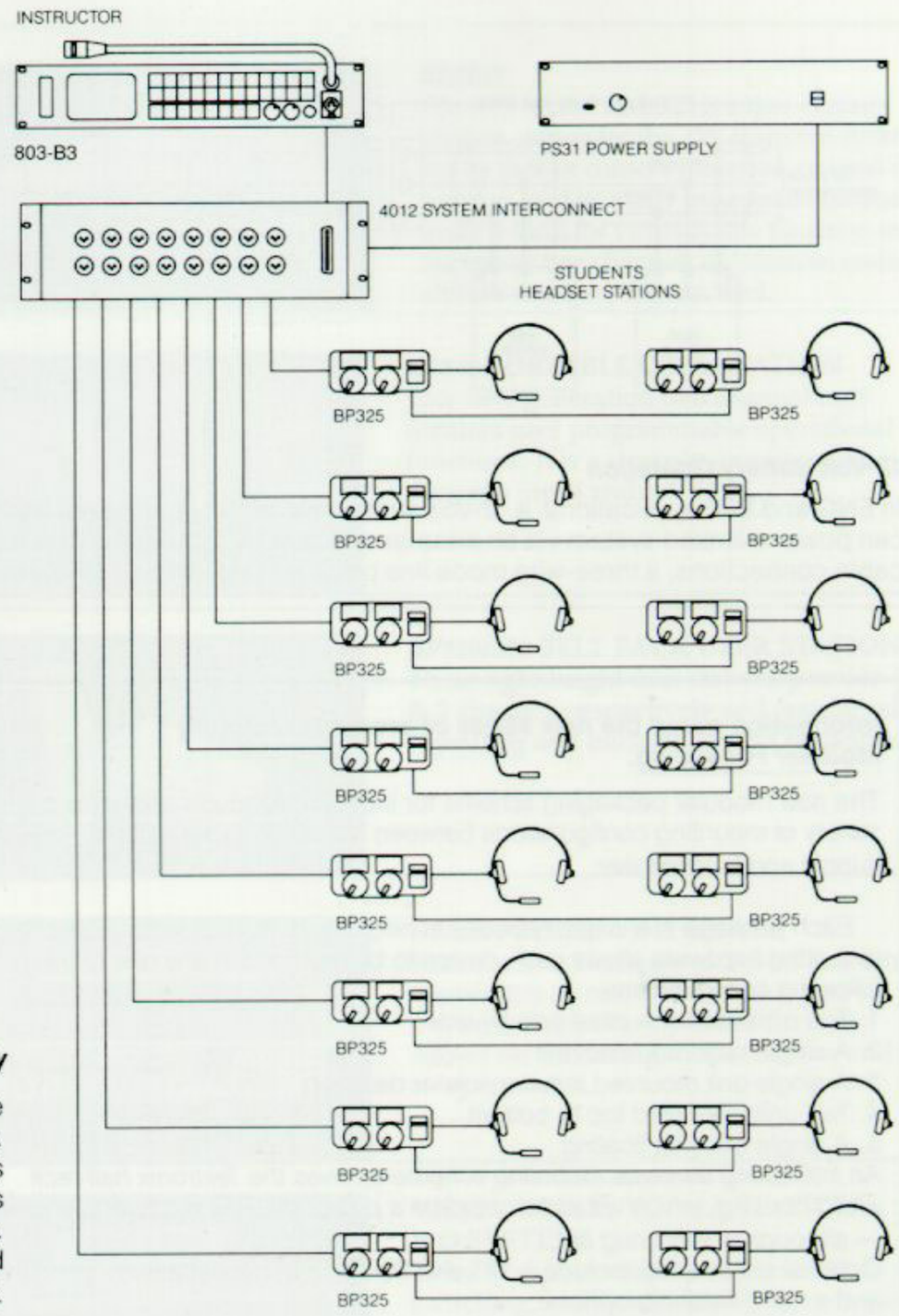
To connect two separate TW Intercom systems together, there are three recommended methods; each one has its merits. The first approach simply connects the audio signals from each power supply via the audio only connection (with line impedance selector switches in the 400 ohm/dual position). The second approach disconnects one power supply from service and uses the other to power both systems. A third approach employs a 2-wire to 2-wire interface to couple the intercom audio signals together.

TW INTERCOM SYSTEM APPLICATION DIAGRAMS



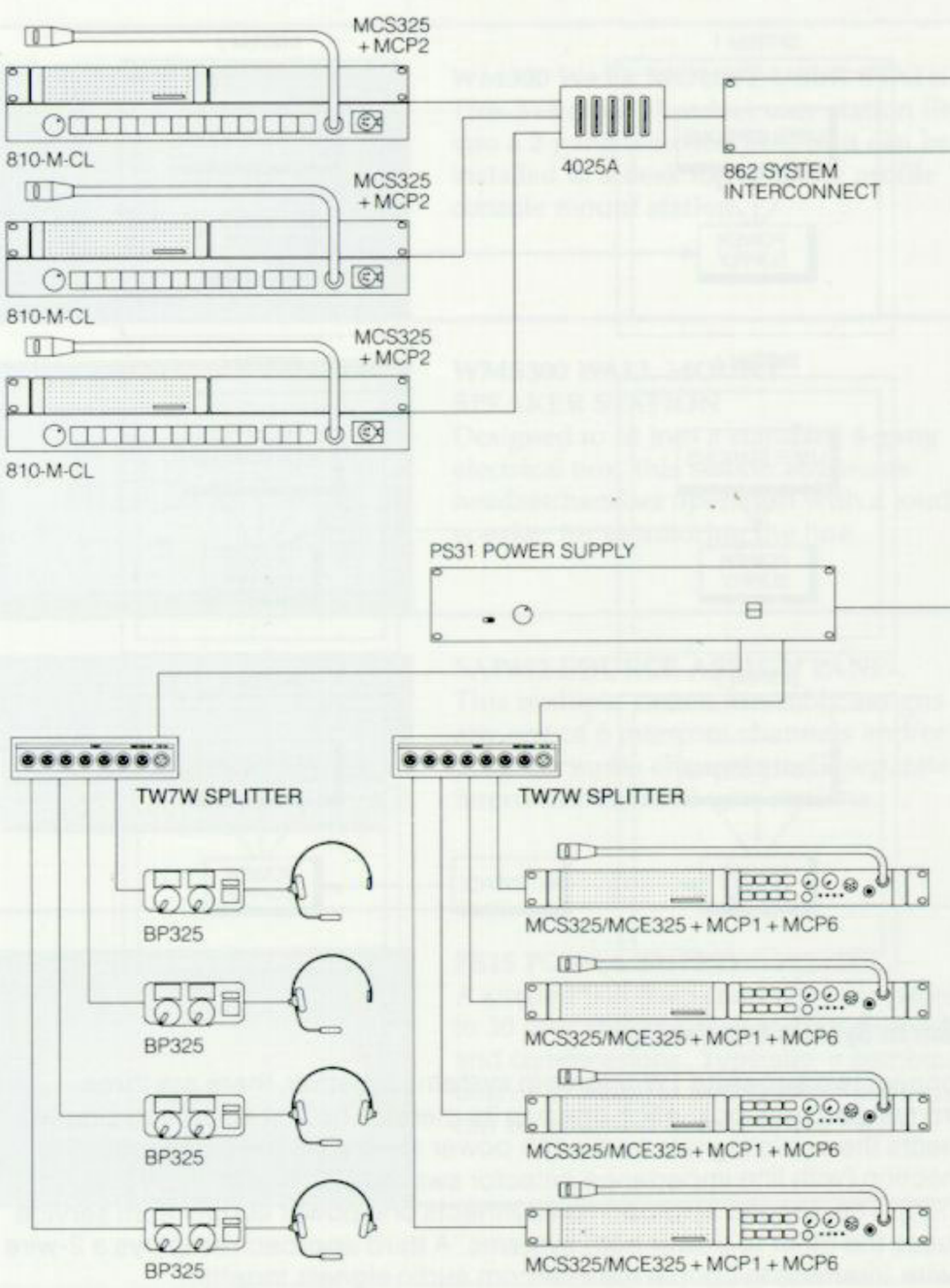
Single Channel Intercom System Using BP318 Headset Stations.

In this very simple conference-line intercom system, a single channel is distributed via TW5W Splitters to the eight user stations. Although the PS15 Power Supply offers two channels, only channel 2 is used for audio, while channel 1 is used for power.



Dedicated-line Intercom System for Instructor/ Student Training Facility

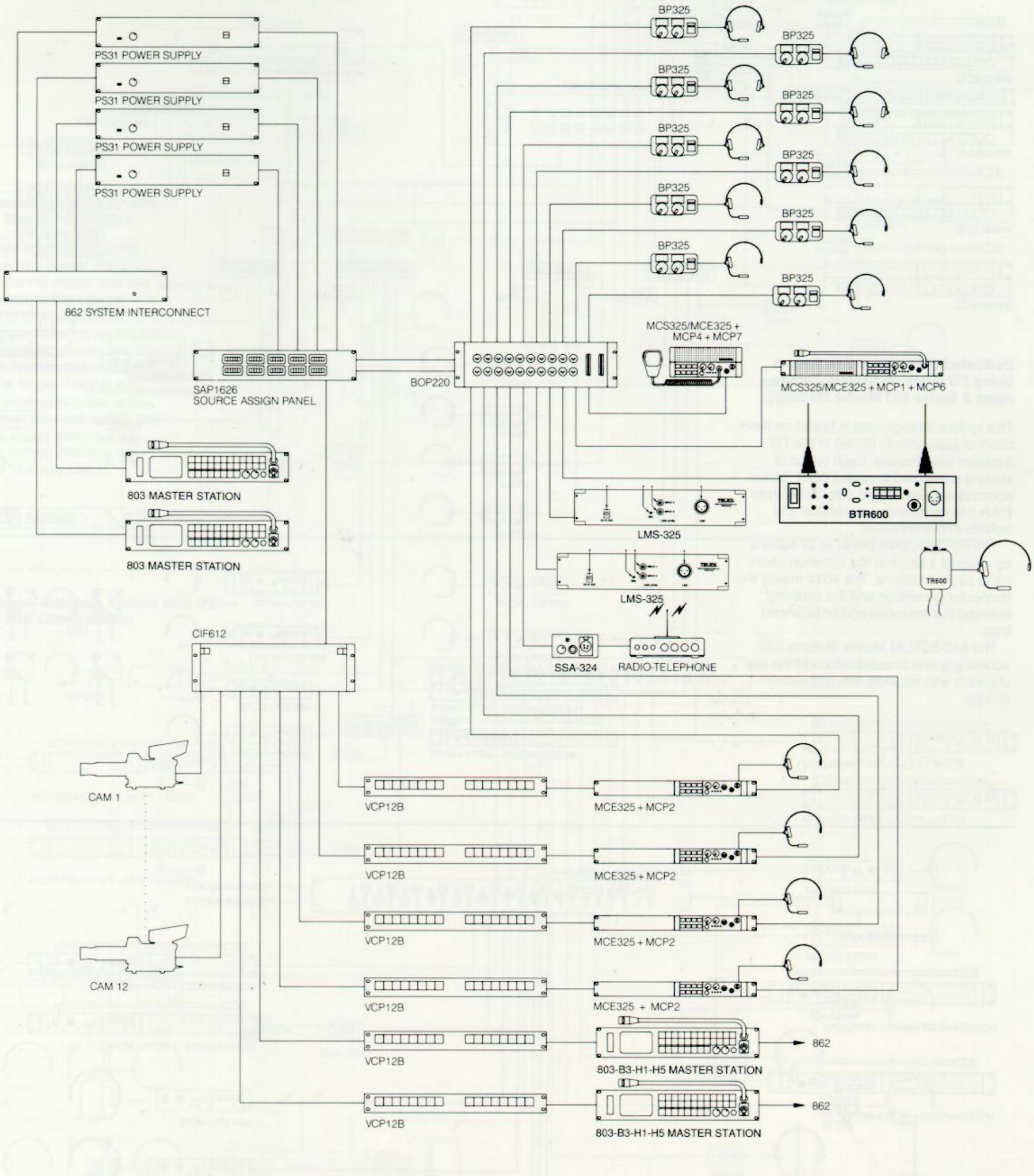
This system configuration is a basic master/ sub-station arrangement. A single master station can access any one or combination of sub-station pairs. The instructor can monitor the student's conversations with other students and talk to them as necessary. Non-voice signaling between stations is also possible with flashing lights and audible tones in both directions. This system comprises 8 student station pairs directly connected to the master station, although 12 student stations can be employed.



This system arrangement is based on fixed channel assignments (six) to the user stations. Each group of stations connected to each TW5W operates on a dedicated pair of channels.

Each 810-CL-M can access all six channels independently or simultaneously. Additionally, the 810 can address two paging circuits and two radio circuits.

Distributed Conference-line Intercom System using TW Intercom System Components with Series 800 Master Stations



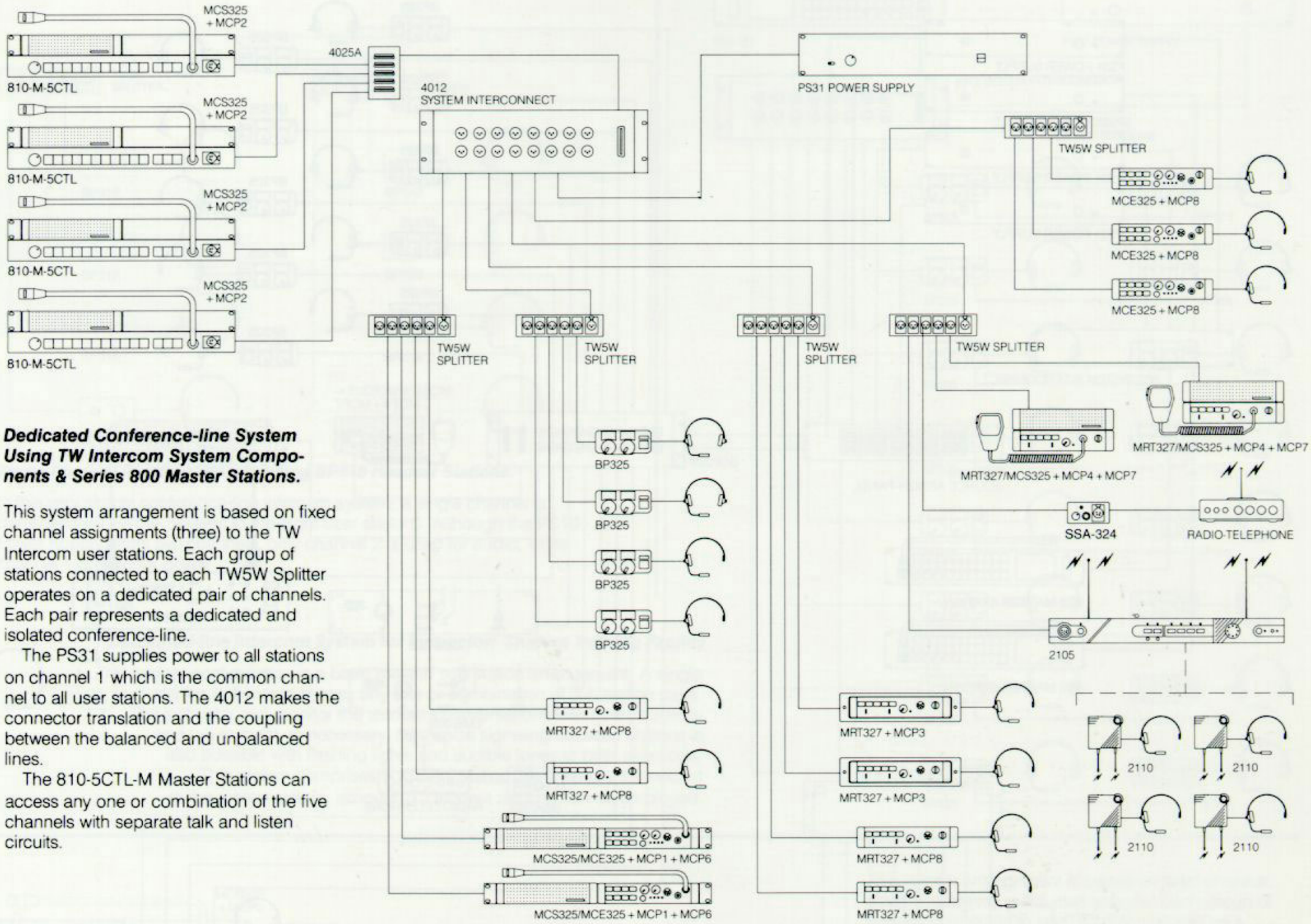
Large Scale Twelve Channel Intercom System with Integral Station Isolate System.

In this system arrangement, 12 intercom channels are distributed to the two-channel stations via the SAP1626 Source Assignment Panel. Additionally, the SAP1626 assigns the camera station channels via the CIF612 Station Isolate System.

The 802 Master Stations can access any one or combination of the 12 channels while the TW Intercom stations can access two channels as assigned.

The iso system allows 802 and TW stations to individually isolate channels to the camera stations.

TW INTERCOM SYSTEM APPLICATION DIAGRAMS

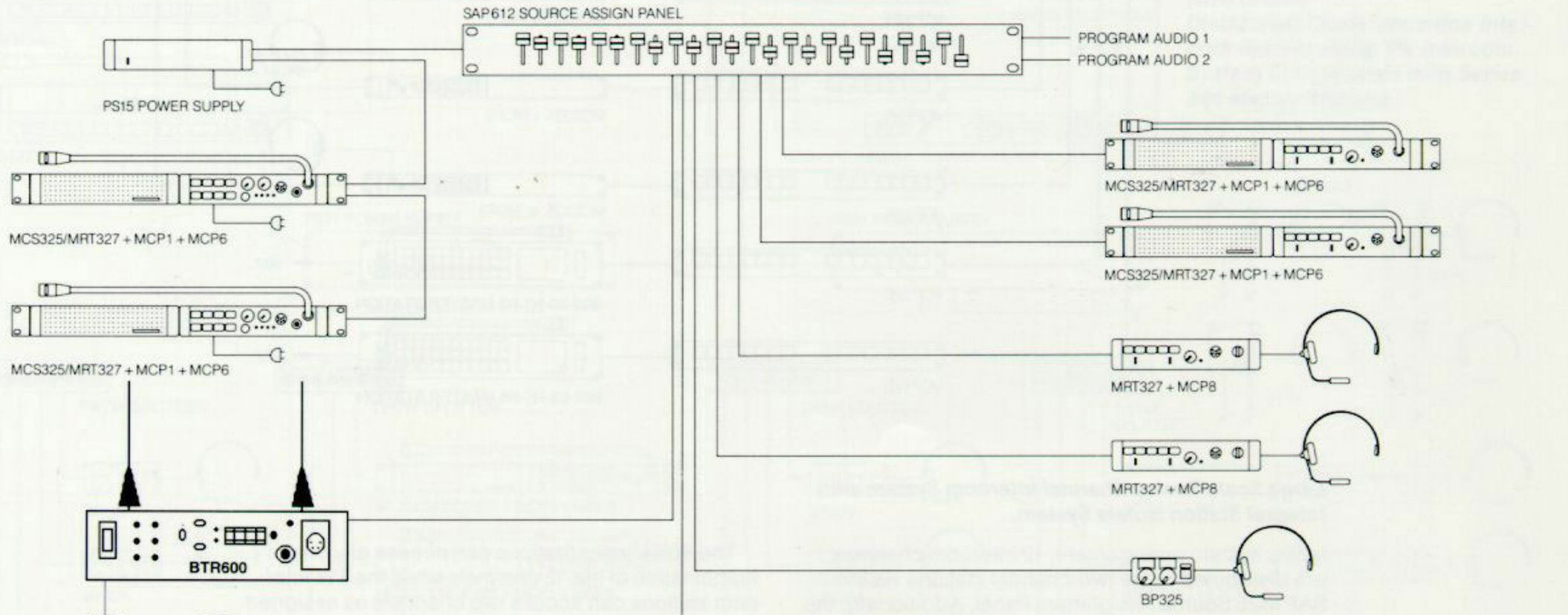


Dedicated Conference-line System Using TW Intercom System Components & Series 800 Master Stations.

This system arrangement is based on fixed channel assignments (three) to the TW Intercom user stations. Each group of stations connected to each TW5W Splitter operates on a dedicated pair of channels. Each pair represents a dedicated and isolated conference-line.

The PS31 supplies power to all stations on channel 1 which is the common channel to all user stations. The 4012 makes the connector translation and the coupling between the balanced and unbalanced lines.

The 810-5CTL-M Master Stations can access any one or combination of the five channels with separate talk and listen circuits.

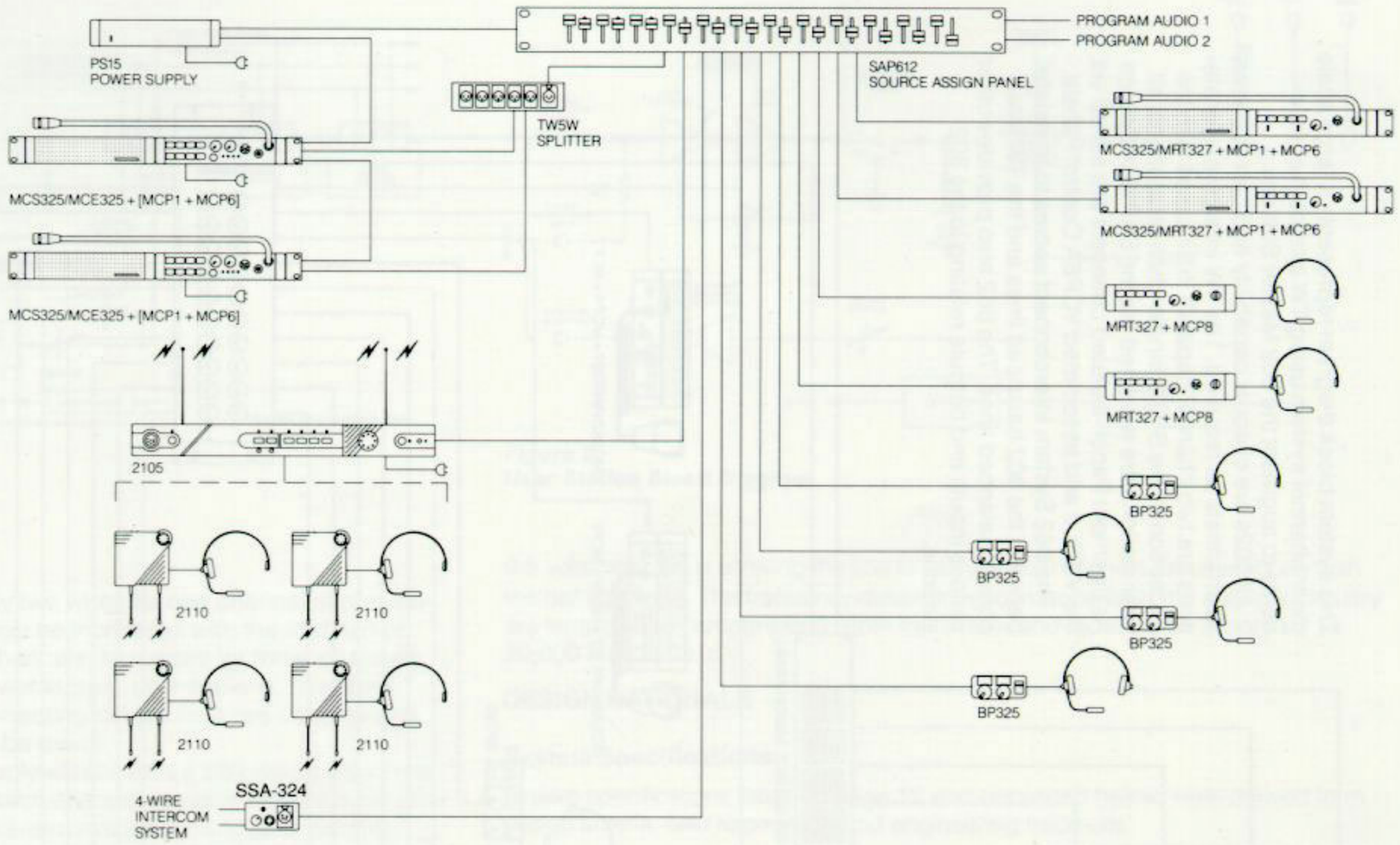


In this multi-channel system, each of the two channel stations may be assigned to any combination of the four intercom channels and/or two program audio channels. The 2100 Wireless sub-system is assigned a single channel and provides wireless headset operation between the base station and up to four roving stations. The system to system interface connects to a four wire circuit.

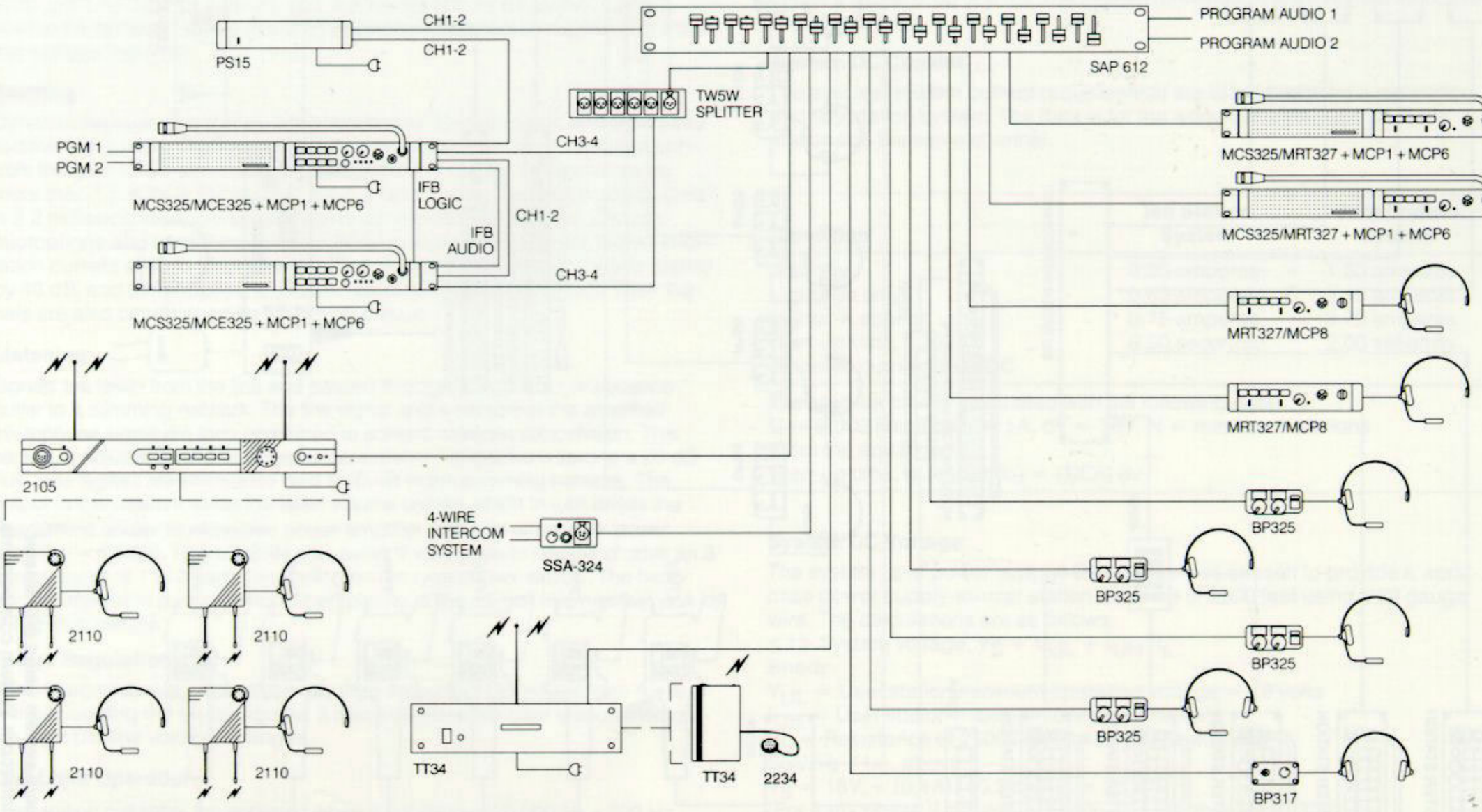
Multi-Channel Intercom System — Small to Medium Size Configuration

Four Channel Intercom System — Medium Size Configuration

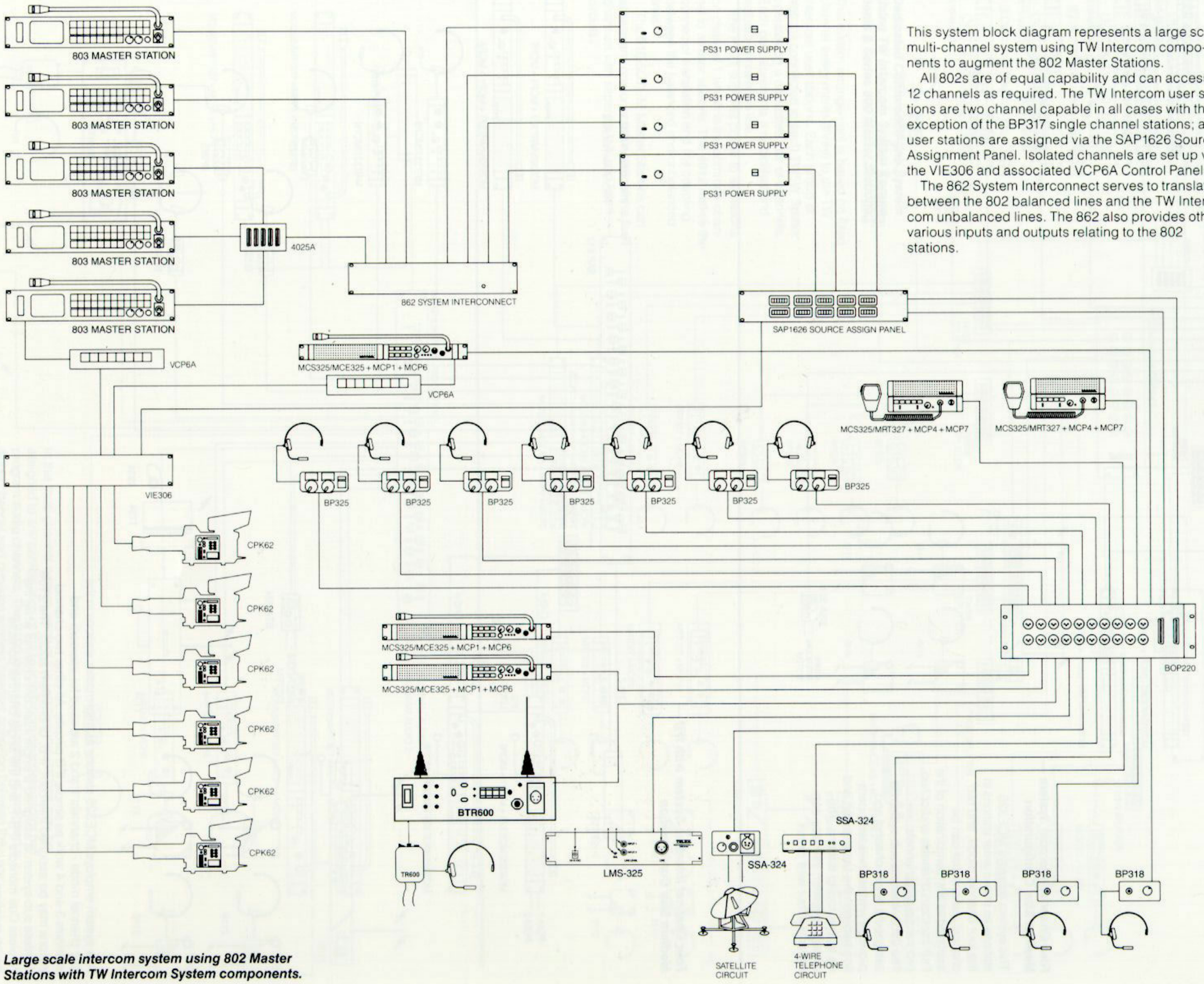
This system employs MCE325 stations as mini-master stations in the four channel mode, and two channel stations that can be assigned to any combination of the four intercom channels and/or two program audio channels.
The 2100 Wireless sub-system is assigned a single channel and provides wireless headset operation between the base station and up to four roving stations. The system to system interface connects to a four-wire circuit.



Four Channel Intercom System with IFB — Medium Size Configuration



This system employs MCE325 stations as mini-master stations in the four channel mode - channels 1 and 2 are used for intercom and channels 3 and 4 work as simple IFB circuits. All other two channel stations may be assigned intercom, IFB, or program audio. The 2100 Wireless sub-system is assigned a single intercom channel while the Wireless Cue monitors IFB 1, and the single channel portable station monitors IFB 2.



Large scale intercom system using 802 Master Stations with TW Intercom System components.

This system block diagram represents a large scale multi-channel system using TW Intercom components to augment the 802 Master Stations.

All 802s are of equal capability and can access all 12 channels as required. The TW Intercom user stations are two channel capable in all cases with the exception of the BP317 single channel stations; all user stations are assigned via the SAP1626 Source Assignment Panel. Isolated channels are set up via the VIE306 and associated VCP6A Control Panels.

The 862 System Interconnect serves to translate between the 802 balanced lines and the TW Intercom unbalanced lines. The 862 also provides other various inputs and outputs relating to the 802 stations.

TW INTERCOM SYSTEM TECHNICAL DISCUSSION

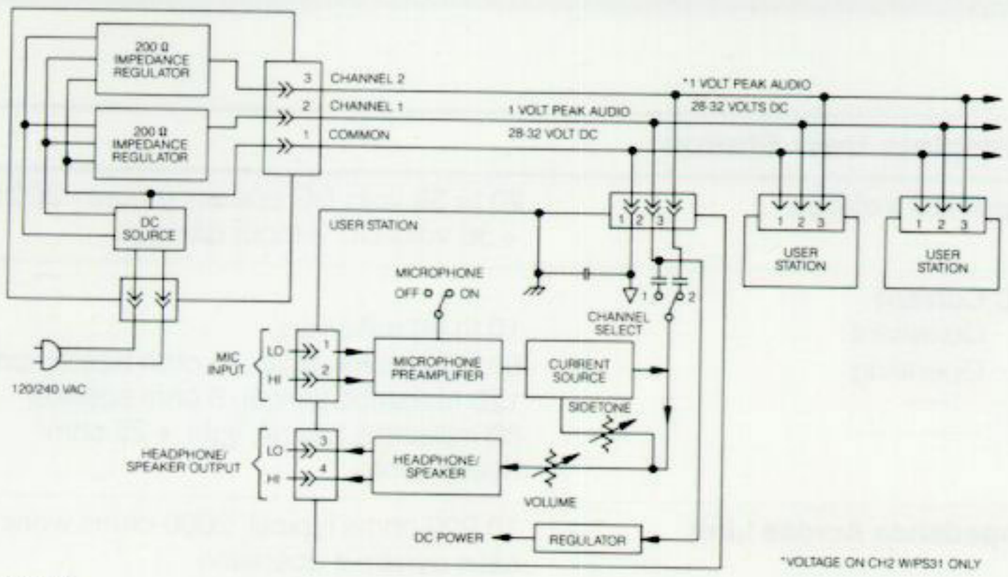


Figure 1:
System Concept Block Diagram

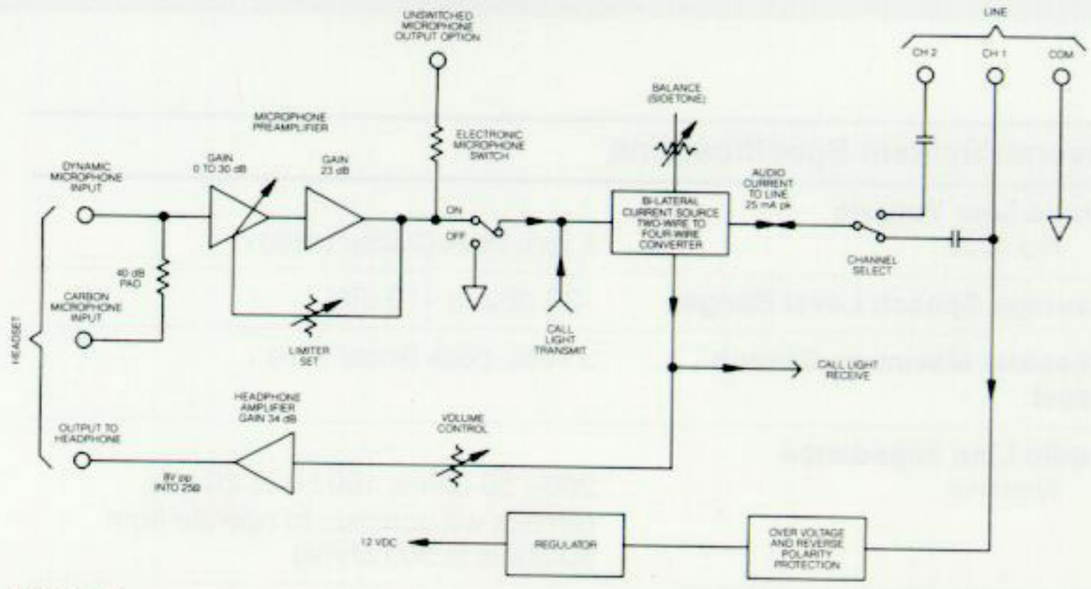


Figure 2:
User Station Block Diagram

SYSTEM OPERATION (see fig. 1)

The TW Intercom System requires only two wires fôr one channel of communications—the number of channels may be increased with the addition of extra wires, e.g., three wires for two channels, four wires for three channels, etc. A typical system consists of a power supply, user stations, headsets, handsets, microphones, and interconnecting cables (in a two channel system, standard microphone cable can be used).

The unique TW Intercom power supply establishes a 200 ohm system line impedance at audio frequencies for each channel, while simultaneously providing 24 to 32 volts DC power for the entire system. This feature permits audio signals and DC power to share the same pair of wires.

The microphone preamplifier in each user station feeds a signal of ±5 milliamps peak-to-peak onto the 200 ohm line via a high output impedance current source. The resulting line voltage of ±1 volt peak-to-peak drives the headphone amplifier of each station.

Each user station draws DC power from the line as needed, but does not significantly load the 200 ohm line.

USER STATION OPERATION (see fig. 2)

Each user station contains: a microphone preamplifier with limiter circuit (max. gain 54 dB, min. gain 22 dB), electronic mic on-off switch, current source transmitter, input line buffer, headphone/speaker amplifier and a special voltage regulator.

Sending

Dynamic microphone signals are amplified to 1.5 volts peak, and then used to drive the current source transmitter to 5 milliamps peak. The limiter controls the gain of the microphone preamplifier so that audio peaks are no more than 1.5 volts at the input of the current source. The limiter attack-time is 2.2 milliseconds and the decay time-constant is 0.5 second. Carbon microphone and amplified-dynamic/electret-type headsets are fed an excitation current of 10 to 15 milliamps. Their microphone signals are attenuated by 46 dB, and then applied to the microphone preamplifier input. Their signals are also conditioned by the limiter circuit.

Listening

Signals are taken from the line and passed through a high input impedance buffer to a summing network. The line signal and a sample of the amplified microphone signal are then combined to achieve sidetone cancellation. This sample is adjustable so that sidetone cancellation ranges from zero to a 20 dB hull. Line signals are attenuated by 6 to10 dB in the summing network. The output to this network feeds the listen volume control which in turn drives the headphone and/or loudspeaker power amplifier (net gain of network power amplifier = 24 dB). This amplifier can swing 9 volts peak-to peak and drive an 8 ohm speaker at 1 to 2 watts depending on the type of user station. The headphone amplifier is protected from short circuits at the carbon-mic headset jack by a 100 ohm resistor.

Power Regulation

The voltage regulator draws the required amount ot DC power from the line without loading the audio signals; it also stabilizes the user station electronics from DC line voltage changes.

Call Light Operation

User station call lights are activated when a continuous 20,000 Hz ± 200 Hz tone is present on any given channel. This tone is injected on the line via the current source of any user station equipped with call light circuitry. Call light circuitry stations have a 20,000 Hz tone receiver which decodes the call signal, and activates a built-in flasher circuit (a pulsing lamp provides greater brightness and visibility). Each user station flasher has a slightly different frequency (approx. 5 Hz) so that current surges from the lamps are randomly spaced out and do not overload the line. The 20 kHz tone has nominal value of 0.5 volts peak, thus allowing the line to carry speech signals simultaneously with the call light tone. The frequency-determining components in the call light circuitry are temperature compensated. Both transmitter and receiver are factory set to 20,000 Hz ± 200 Hz.

DESIGN RATIONALE

System Specifications

System specifications listed on page 12 and discussed below, were derived form design criteria, field experience and engineering trade-offs.

Audio Line Voltage

The audio line voltage of 1 volt peak was chosen to maintain a high signal-to-noise ratio. Although this is considered a line-level signal there is little danger of crosstalk coupling only microphone lines sharing the same cable runs.

Audio Line Impedance

The audio line impedance is 200 ohms. This is low enough for good noise immunity from external interference and large enough to permit reasonable system power requirements. The combination of line impedance to 100 ohms, a signal drop of 6 dB. The system has enough reserve gain for operation at this level.

System DC Current

The average system current requirements are listed below for a ten station and fifty station system. The data is for the worst-case situation of all the stations on the same channel.

Condition	Ten Station System	Fifty Station System
Standby	0.30 amperes	1.50 amperes
Lights on only	0.63 amperes	3.15 amperes
Lights + speech	0.75 amperes	3.75 amperes
Start-up time, 1.25 amperes current @0 VDC	0.50 seconds	2.00 seconds

The start-up time is calculated with the following data:
C = 0.002 F/station, i = 1A, dV = 18V, N = number of stations
From the equation:
Start-up time, dt (seconds) = (NC/i) dv

System DC Voltage

The system (and power supply) DC voltage was chosen to provide a worst-case power supply-to-user station distance of 2500 feet using #22 gauge wire. The calculations are as follows:
<1> System voltage, $V_S + V_{UL} + I_{UH} R_L$
where:
V_{UL} = User station minimum operating voltage = 18 volts
I_{UH} = User station maximum operating current
R_L = Resistance of 2500 feet of #22 gauge wire pair
Solving <1>, above:
V_S = 18V; + (0.1A) (80.7 ohms) = 26.07V
(For early phase II stations, when V_{UL} = 24, then V_S = 32V)

System Cable Capacitance Loading

The system cable capacitance is calculated assuming a cable capacitance of 30 picofarads/foot and 10,000 feet cumulative cable = 0.3 microfarads. Under these conditions, speech bandwidth is 100 Hz to 2.5 kHz ± 3 dB, and the call light signal is attenuated by 20 dB. The call light receiver circuit has ample reserve gain to operate at these low levels.

TW INTERCOM SYSTEM SPECIFICATIONS

Overall System Specifications

Audio Line Voltage	
Nominal	1 volt, peak (0 dBμ peak)
Average Speech Level Range	–20 dBμ to –10 dBμ
Absolute Maximum Speech Level	3 volts, peak (linear limit)
Audio Line Impedance	
Nominal	200 ± 50 ohms, 100 Hz to 20 kHz (system will continue to operate from 50 ohms to 300 ohms)
User Station Bridging Impedance	
Nominal	10,000 ohms, 100 Hz to 20 kHz
Minimum	2000 ohms (worst case dynamic condition)
System DC Line Voltage	
Nominal	32 Volts DC
Operational Range	18 to 35 volts DC
Steady state without damage	–1.5 volts to 36 volts DC
Transient	±200 volts, 8 milliseconds or less (after this time, power supply and user station fuses open)
System DC Current	
Quiescent (per station)	10 to 50 milliamps
Dynamic (per station)	60 milliamps (25 ohm headphones) 80 milliamps (lights and 25 ohms headphones) 120 milliamps (8 ohm speaker)
Start-up Current	1.25 amperes, 50 units, all kinds
Fault Current	4.0 amperes, power supply at voltage greater than 12 volts 1.0 amperes, power supply at voltage less than 12 volts
Operating Distances	
Maximum DC limit	5000 ft., distance along cable, power supply to single station, #22 gauge wire – DC voltage drop limitation
Maximum AC limit	10,000 ft. dry pair, power supply at each end, #22 gauge wire
System Capacitance	
Maximum	0.3 microfarads (cumulative effect of 10,000 ft. of cable at 30 picofarads/foot)

Complete User Station

Input DC Voltage	20 to 35 volts DC operating from –200 to +36 volts DC without damage
DC Current	
Quiescent	10 to 50 milliamps
Operating	60 milliamps typical, 25 ohm headphones 120 milliamps typical, 8 ohm speaker 80 milliamps typical, light +25 ohm headphones
Impedance Across Line	10,000 ohms typical, 2000 ohms worst case dynamic operation
Ambient Temperature Range	
Operating	0°C to 60°C
Storage	–55°C to 125°C
Noise Contribution to 200 Ohm Line	
One Unit	–75 dBμ
Ten Units	–67 dBμ
Microphone Preamplifier	
Input Impedance*	470 ohms
Source Impedance*	200 ohms, nominal
Maximum Input Level	150 Millivolts
Voltage Gain	54 dB
Frequency Response	100 Hz to 10,000 Hz, ±3 dB
Limiter Range	30 dB
Carbon Mic Excitation Current	10 milliamps, nominal
*Dynamic Microphone Input	
Current Source Transfer Ratio Output	5 milliamps/1.5 volts ±5 milliamps into 200 ohms = ±1 volt peak-to-peak, nominal
Headphone Amplifier	
Overall Voltage Gain	24 dB
Output Power	
Headset Station	1/3 watt, into 25 ohms
Speaker Station	1-5 watts, into 8 ohms (model dependent)
Frequency Response	150 Hz to 8000 Hz, ±3 dB
Headphone Impedance Range	25 to 600 ohms
Call-Light	
Signaling Frequency	20,000 Hz ±200 Hz
Flashing Rate	5 Hz ±2 Hz
Talk-Off Frequency	24,000 Hz ±200 Hz

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