HARRIS® assuredcommunications®

Maintenance Manual

LBI-39194

Rev. B, Nov/05

EDACS®

GPS Simulcast System Overview

INCLUDES

Publication Title	Publication Number
Simulcast System Drawings	LBI-39207

MANUAL REVISION HISTORY

REV	DATE	REASON FOR CHANGE
A	1997	Initial release.
B	Nov/05	Added new manual numbers with footnotes to the numbers they replaced. Removed reference to documents no longer in print. Incorporated updates per engineering. Changed manual format.

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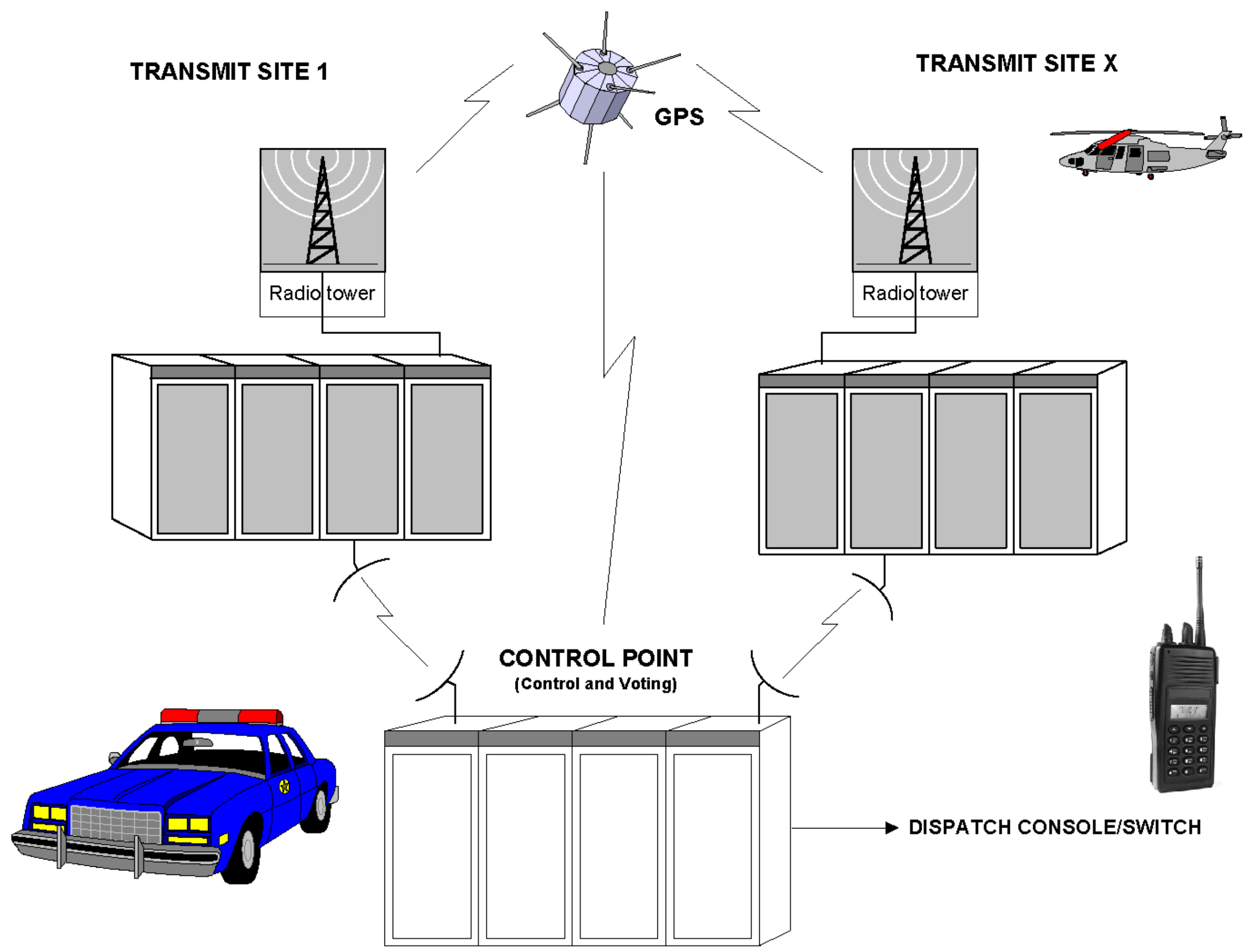
1. GENERAL SPECIFICATION

Enclosure	83" Cabinets 86" Open Racks
Power	110/220 VAC @ 50/60 Hz
Frequency	800 MHz
Bandwidth	25 kHz
Operating Temperature:	
Integrated EDACS Alarm System	0°C to +50°C (32°F to 122°F)
GPS Simulcast	-30°C to +60°C (-22°F to +140°F)
Intersite Links	1.544 Mbps (T1)
Number of System Channels per T1	24
Maximum Number of Sites	17

NUMBER OF CHANNELS	[PCM] TIMESLOTS (DSO'S)	[ADPCM] TIMESLOTS (DSO'S)
2	8	7
3 & 4	10	8
5 & 6	13	10
7 & 8	15	11
9 & 10	17	12
11 & 12	20	14
13 & 14	22	15
15 & 16	23 (15)	17
17 & 18	NA	18
19 & 20	NA	19
21 & 22	NA	21
23 & 24	NA	22



Elements:

Control Point	Global Positioning System (GPS)
Analog/Digital Voting	Digital Microwave or Leased Telephone T1 Lines
Transmit Sites	Mobile and Portable Terminals

Figure 1-1: EDACS Global Positioning System Simulcast

2. INTRODUCTION

2.1 SCOPE

This manual provides a detailed overview of the **G**lobal **P**ositioning **S**ystem (**GPS**) Simulcast trunked land mobile radio system used in conjunction with Harris' **E**nhanced **D**igital **A**ccess **S**ystem (**EDACS**®). This manual assumes some knowledge of trunking and land mobile radio systems and the technologies employed. **Note:** While Harris' trunked simulcast system allows all the functionality of other EDACS platforms, those global capabilities are not described here.

2.2 GENERAL

A simulcast communication system consists of special equipment installed at a Control Point and several Transmit Sites that simultaneously transmit the same information on the same radio frequency channel from multiple locations.

Harris' EDACS **G**lobal **P**osition **S**ystem ***(GPS***) Simulcast enhances communications in areas where the size of the coverage area is too large and/or the communication paths are blocked or hindered by irregular terrain or other obstacles to be reliably serviced by a single site EDACS communications system. When these conditions exist and the talk out coverage is inadequate, the need for a simulcast system is indicated. It is also advantageous in areas where available frequencies are limited since it uses the same set of frequencies at each site. All transmissions are system wide. This means that messages are transmitted simultaneously from all sites on the same channel and on the same RF frequency. The EDACS GPS Simulcast system combines both digital and analog systems to accommodate transmission of data, digital voice and analog information.

A typical GPS Simulcast system includes a Control Point and two or more Transmit Sites connected through a microwave system or a leased T1 telephone line. The Control Point exercises control over all Transmit Sites *(*Figure 1-1*).*

A simulcast land mobile radio system, uses a single set of frequencies *(channels)*, to provide continuous two-way radio communications over a large geographical area *(wide-area).*

Simulcast trunking utilizes a powerful combination of technologies to maximize the call capacity on the assigned communication channels. EDACS with simulcast combines the benefits of extended coverage, trunking and fault tolerance. This system provides a high performance and reliable solution when the number of frequencies is limited or a large number of users must communicate over a large area which cannot be covered from one Transmit Site.

Two major conditions must exist in a simulcast configuration. These conditions are:

1) **Outbound**: Frequency, amplitude, phase, and timing of signals from two or more Transmit Sites must be matched in the overlap zone (Figure 2-1 and Figure 2-2).
2) **Inbound:** Land mobile radios must be able to *"talk back"* to the trunking system.

Control of the timing of signals in the overlap zone is critical to effective simulcast communications. EDACS with GPS Simulcast provides an efficient and cost-effective solution for obtaining the above conditions.

The GPS consists of a "constellation" of 24 earth-orbiting satellites, control uplinks and associated land-based receivers. These satellites all transmit the same precise timing signals in the form of a pseudo-random code. GPS Receivers at all sites produce a 1 pps and a 9.6 kHz clock signal, used for system timing. At the Control Point, the timing signals are used to clock the data and are embedded on the composite reference signals which are sent to all Transmit Sites. At the Transmit Sites the timing signals from the local GPS Receivers are compared with the recovered timing signals from the Control Point. The T1 delay is adjusted to make the timing signals from the Control Point and Transmit Site match.

The GPS Receivers at the Control Point produce a 1.544 MHz clock for the Intraplex MUX reference on a T1 link. At the Transmit Site the GPS Receiver produces a 10 MHz clock for the station reference.

Since control of the timing of signals in the overlap zone is critical to effective simulcast communications, GPS provides a very precise timing signal to the Control Point and to each Transmit Site. This signal is used to generate and gate a 9600 baud clock used throughout the digital circuitry in the system as well as a 10 MHz reference used by each base station to generate carrier frequencies. The composite reference signal, sent from the Control Point, is continuously monitored and the T1 delay is adjusted to maintain the desired performance in the overlap zone.

The EDACS GPS Simulcast system is well-suited to provide coverage with portable radios. A predominance of low-powered portables in today's radio networks, makes a sufficient number of receive sites for both analog and digital calls crucial. The Audio from all receive sites is voted at the central location, (Control Point) so that the best signal can be re-transmitted and routed to the dispatcher.

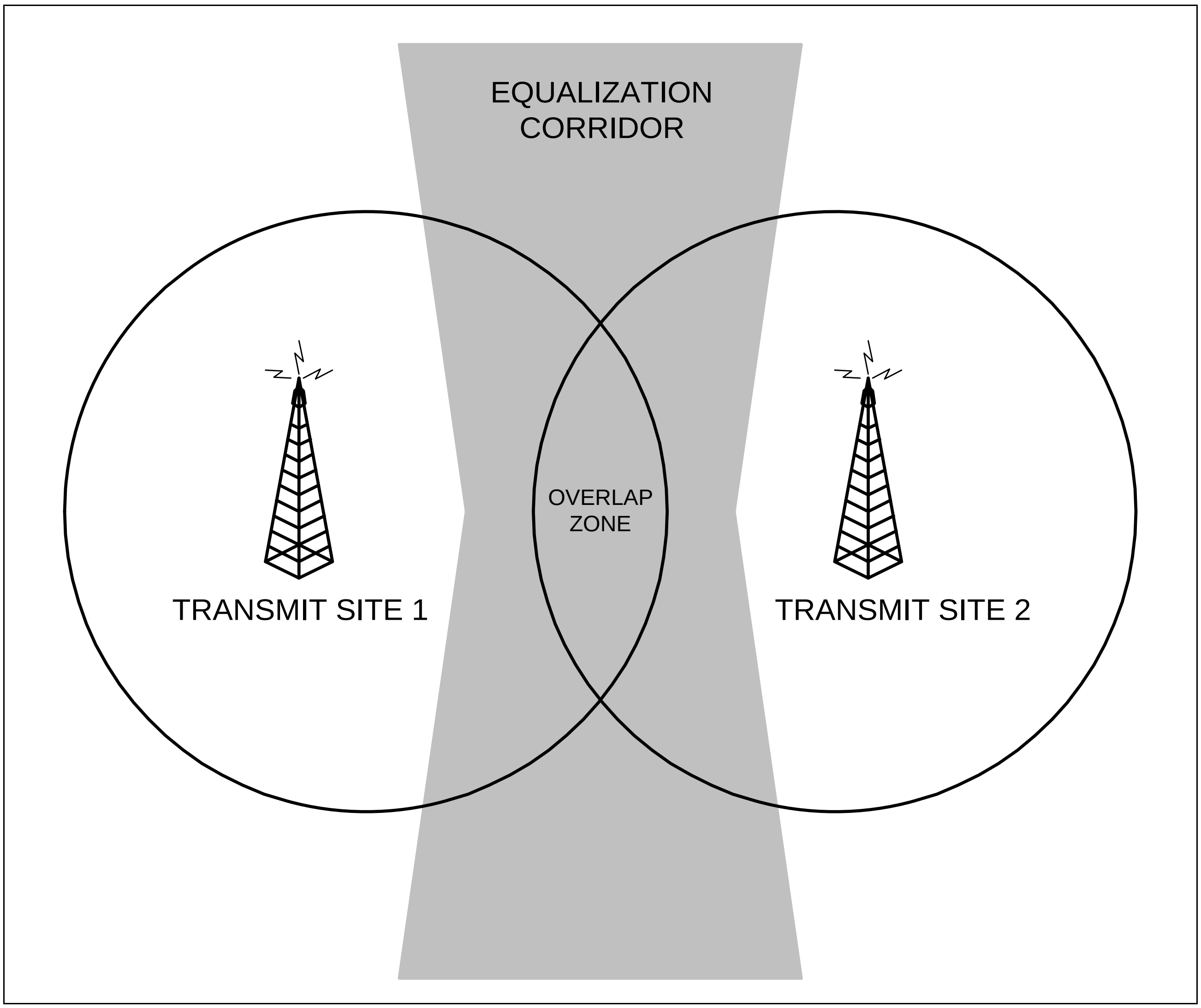


Figure 2-1: Timing Equalization Corridor

2.2.1 Functionality

EDACS GPS Simulcast performs well during normal operating conditions and also during emergency or critical communications and potential failure situations.

2.2.2 ProSync

The ProSync algorithm tells the transmit sites when to start sending data to the user radio. Data synchronization is important for high-speed control channel, secure voice, digital voice, analog communications and data communications. If the field radio cannot communicate on the control channel, it can never be directed to a working channel and will never participate in an analog or digital call. In land mobile radio systems, transient impulses, such as from extreme weather conditions, affect data synchronization.

To achieve long term stability Harris engineers developed the ProSync synchronization technology. ProSync is built into the control channel signaling and requires no special maintenance. Its purpose is to constantly resynchronize both the control channel and working channels using two different methods to safeguard system performance.

1. The control channel at each site is automatically resynchronized by folding a "resync" marker into the continuous control channel data stream every 60 seconds *(programmable*, sixty *(60)* seconds is the default). After the marker is transmitted, the system restarts the control channel at all transmit sites at exactly the same time. This assures automatic resynchronization in the event of a transient induced control channel shift. The EDACS field radio continues operating without interruption or impact.
2. More significantly, the working channel is resynchronized with every Push-To-Talk (PTT). As the radio is assigned to a working channel, the initial high-speed handshake is used to automatically resynchronize the high-speed data transmitted at all sites. This high-speed handshake occurs every time the user keys a radio; again, this resynchronization has no noticeable impact to the operator. In an all-digital simulcast system where only EDACS Aegis or ProVoice digital radios are used, ProSync alone is sufficient for long-term data timing stability.

2.2.3 Tri-Synchronization

The EDACS Simulcast system features ***"Tri-synchronization"*** to provide the highest level of reliable, high-quality communication.

1. The first synchronization is for high-speed (9600 baud) data. High-speed data is used for the control channel messaging, working channel handshakes, digital voice, encrypted digital voice and data. Proper synchronization of high-speed data is the most important aspect of system configuration since field units are totally dependent on control channel signaling to communicate to the system. Improper synchronization of the control channel can result in total loss of communication for field units in overlap zones. The 300 Hz and 9600 Hz clocks generated by the Control Point Timing Module and distributed from the Control Point achieves synchronization of the 9600 baud data. While ProSynch controls when the data starts, the first leg of Tri-synchronization maintains data synchronization throughout the interval.
2. The second synchronization method governs low-speed *(150-baud)* data. Low-speed is used on the working channel in clear voice to provide priority scan and updates that prevent misdirected radios. This data is automatically delayed *(as part of the T1 stream)* at the Transmit Site to compensate for the different path lengths to each Transmit Site and establish the proper timing.
3. The third leg of tri-synchronization is the equalization of the analog signals. For systems that do not use analog voice, this is not an issue. For systems that use analog voice, any difficult with tri-

synchronization is significantly minimized by using digital microwave or other digital T1 links. Stable circuitry within the EDACS equipment allows for these signals to match one another from site-to-site.

The critical parameters for analog signals are the amplitude and the phase of the modulation. Each parameter is discussed as follows:

2.2.4 Amplitude Equalization

Within the overlap zone, signals from different sites are received by user equipment at approximately the same power level. As the radio traverses this region, power levels vary and the discriminator of the user radio receiver switches between two or more signals. If the modulation amplitude is not matched, distortion occurs in analog signal recovery. To minimize this phenomenon, EDACS uses tight tolerance voice digitization circuits and state-of-the-art base station technology to provide a very consistent amplitude response from site-to-site.

EDACS GPS Simulcast is designed to be "set and forget." The precision circuits used to match the amplitudes between sites are extremely stable; typically, adjustments are required about once every two years.

2.2.5 Phase Equalization

Just as amplitude must be matched in the overlap zone, the phase of the various signals must also be equalized. Again, signals from different sites will have varying power levels as the user radio moves through the overlap zone. If one signal is not dominant, the user receiver discriminator switches between two or more signals. If the phase delays differ, system performance is degraded.

In analog, a mismatch from improper phasing creates voice distortion. To minimize this mismatch, EDACS utilizes the same high precision digital modules that provide a consistent amplitude response to allow a consistent phase response from site-to-site. As with other parts of EDACS, the alignment is maintained with distributed hardware; no single equipment failure will affect the entire system.

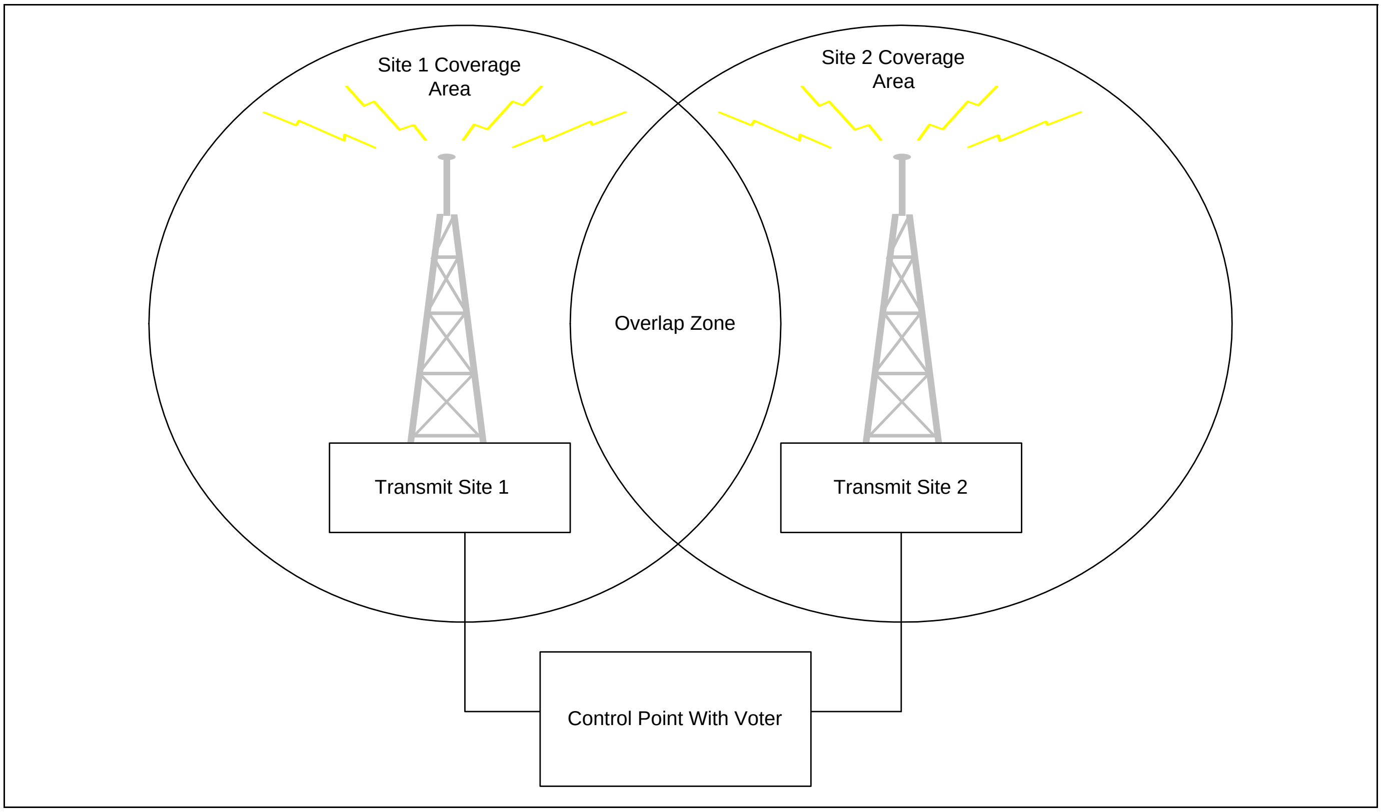


Figure 2-2: Two Site Simulcast System

2.2.6 Timing Equalization

ProSync and Tri-synchronization coordinate the transmit sites so that digital signals from different transmit sites and analog signals are matched in the overlap zone. There is one more key parameter required to complete the communication process: timing equalization. For those regions where a single transmit site is not captured the receiver discriminator circuit can alternate between the signals from multiple sites. The further a receiver is from a transmit site, the more the signal is delayed. If for a given geographic location, the data streams are offset by more than one-half of a bit, significant data errors will occur as the discriminator oscillates between multiple received signals resulting in a loss of data. EDACS GPS Simulcast corrects for this phenomenon by adding a unique delay to the data stream transmitted by each site. By adjusting the delay, the timing equalization corridor can be moved closer or further from a site. During the alignment process, Harris engineers determine the optimal delay for each transmit site so that this corridor covers the complete overlap zone. During the initial design phase, transmit sites should be selected so that the equalization corridor can encompass the entire non-capture overlap zone.

2.2.7 Transmission Path Delay

Usually, each transmit site is a different distance from the Control Point. The different distances cause signals to reach the transmit sites at different times. Therefore, it is necessary to introduce precise delay so that the separate RF signals reach the overlap zone simultaneously. This delay is added to the delay required to properly position the timing equalization corridor *(*Figure 2-1*).*

Ring microwave configuration and land-based T1 networks are often employed to provide redundancy in the transmission between the Control Point and the Transmit Sites. If a failure occurs in some portion of the microwave subsystem or leased T1 network, the signals can be redirected to another path. Transmission path delays are realigned by a process that automatically adjusts the buffer interval at the Transmit Site.

2.2.8 Managing The Overlap Zone

With ideal control, the audio quality in the overlap zone would be the same as in the capture zone. However, multipath, fading and terrain issues have a greater effect and create some background noises unique to simulcast. The GPS Simulcast system is designed to minimize these effects

Harris has two unique methods of managing the overlap zone.

1. EDACS uses a single data rate for control channel, digital or encrypted voice and data. Since the equalization corridor width is a function of the data rate, the need is to only optimize for a single corridor.
2. Harris is able to maximize performance using the EDACS GPS Simulcast Optimization technique. This process is the most sophisticated method of optimizing a simulcast system available today. Refer to paragraph 4.1.1.2.

2.2.9 Fault Tolerance

Several levels of fault tolerance have been designed into the system so that critical functionality will not be lost in the event of failures (Table 2-1). There is one site-controller computer located at the Control Point. If the site controller fails, the system converts to failsoft trunking where the CPTC takes over.

This trunking failsoft capability means that EDACS allows more transmissions than a conventional failsoft mode. Trunked failsoft allows EDACS to continue to operate in the trunked mode even if the site controller(s) fail. Even if the link between the Control Point and one of the Transmit Sites is completely destroyed, the isolated site can continue to trunk in a Bypass mode. If the control channel fails, the system automatically assigns another channel to take its place under site controller or failsoft trunking mode. Any channel can be the control channel in standard EDACS. Since every channel can handle digital voice, analog voice and data, a failed working channel can be removed from the system without significantly affecting any one mode of communications. If the frequency reference fails, the system automatically switches to the backup source for continued communications throughout the coverage area. If the Global Positioning System *(satellites)* is disabled for an extended period of time, a land line backup signal from the Control Point is used to keep the simulcast system Synchronized indefinitely. Before switching to land line backup for loss of 9.6 from the satellites, the system will stay synchronized for 2.5 hours.

Table 2-1: Levels of Fault Tolerance

Level	Failure Type	EDACS
1	Working Channel	Failed channel is removed from service *(Analog, Aegis Digital, or Data).*
2	Control Channel	Failed channel is removed from service. New channel is automatically assigned as Control Channel.
3	Site Controller	System reverts to simulcast **trunked failsoft.**
4	T1 Link	System automatically compensates for an alternative route or if the link is out reconfigures itself by isolating the remote site from the balance of the simulcast system. Isolated site continues to trunk ***(Bypass Operation).***
5	GPS Receiver/Ref. Oscillator	Second receiver oscillator becomes effective.
6	GPS Signal Affected at the Transmit Site	Landline backup from the Control Point allows simulcast operation to continue.

2.2.10 Leased T1 Links

The EDACS GPS Simulcast design allows the flexibility to use leased telephone T1 circuits as well as use of the traditional microwave link. T1 circuits are the standard in North America and parts of Asia.

A T1 circuit is a circuit capable of handling a bit stream, containing 24 time slots or DSOs. Each time slot can be used for analog voice or 64 kbps data. The bit rate of a T1 circuit is 1.544 Mbps including 8 kbps for overhead.

The quality and reliability of leased T1 circuits has increased dramatically while the cost has fallen. In some cases the cost savings provided by leasing T1 circuits relative to purchasing a dedicated microwave system can be enormous. Harris allows the option to use these circuits to connect the RF sites to the Control Point. With EDACS GPS Simulcast, 24 RF channels are supported by a single T1 link.

2.2.11 Audio Quality

This system has been designed for maximum audio quality. The result is exceptional audio quality over an extended coverage area. The full 300 to 3000 Hz clear voice band is transmitted throughout the system on every call.

Optimization is performed using measured data from throughout the coverage area and a computer simulation to determine not only the best parameters but also the ideal type and orientation of the transmit antennas. Continuous monitoring or frequent alignment is not required for EDACS Simulcast.

Adjustment is only recommended once every two years. More on Optimization is provided in paragraph 4.1.1.2.

2.2.12 EDACS Features

While all of the simulcast-specific features are essential, it is also important to remember that Harris' GPS Simulcast provides the added value of an EDACS system. User radios can *roam* from one simulcast system to any other EDACS system, simulcast or otherwise. This feature establishes overall network capabilities.

3. SIMULCAST BASICS

3.1 CONTINUOUS COVERAGE

Simulcast provides continuous coverage over a large geographic area *(wide area)* using a single set of frequencies. In a simulcast system, all sites have the same set of frequencies. The same channel is the control channel at every site *(Control Point or Transmit Site).* Voice or data messages are simultaneously transmitted from every site on the same working channel.

3.2 TALK OUT IN THE OVERLAP ZONE

The challenge of a simulcast system is to provide high quality audio and data to radios in the overlap zone. The overlap zone is the geographic region where two or more signals of equivalent power are received by a single radio *(*Figure 2-1 *&* Figure 2-2*)*. To understand the overlap zone and it's significance, the concept of capture and non-capture or overlap zones must be explained. The simulcast coverage area is divided into two types of areas: those captured by a site and those hearing two or more sites of approximately equal RF level.

3.2.1 Capture Zones

A radio *(receiver)* is ***captured*** by an RF signal when that mean signal is approximately 10 or more decibels *(dB)* above any other RF signal. When a receiver is captured by a stronger signal, other signals are suppressed.

3.2.2 Non-Capture Zones

In the non-capture or overlap zones the mobile receiver accepts two or more signals. These signals mix randomly producing stronger or weaker signals. If the mean power level difference between the received carrier signals is less than 10 dB with voice modulation, audio intermodulation and distortion may occur. This distortion is evident by a crackling and popping sound heard over the speaker. Audio distortion increases to a maximum when the received carrier signals are equal. Good communication is these areas is maintained by precision system synchronization and equalization.

3.2.3 System Synchronization and Equalization

System synchronization and equalization assure that the received carrier signals do not detract from one another in the overlap zone but instead are consistent with one another. In addition, the transmitter audio from each carrier signal must be delay equalized to minimize the crackle and pop heard in the receiving radio. To accomplish these objectives the EDACS GPS Simulcast system, through system tri-synchronization, ensures that all digital signaling, digital voice and analog voice are precisely synchronized to provide the most reliable and highest quality communications possible. Tri-synchronization consist of time equalizing the high speed data *(9600 baud)*, low speed data *(150 baud)*, and the audio amplitude and phase of the transmitted analog messages.

3.2.4 Long Term System Stability

In a typical simulcast system, transients such as those caused by weather disturbances *(lightning)* can affect data synchronization. These transients may disrupt a microwave path or cause the microwave system to switch over to hot standby. Data synchronization must be maintained to achieve overall system communication integrity in the overlap zone.

Two methods are employed to assure long term synchronization and stability:

1. Frequency synchronization from Global Positioning System.
2. A unique High Speed Data Auto Re-Synchronization system.

The RF carrier frequency of each channel is maintained within 1 Hz of the frequency of all other transmitters in the simulcast system to minimize distortion due to heterodyning frequencies. To achieve this level of performance, the reference oscillator at each transmitter is locked onto a 10 MHz reference signal derived from a 1.5 gigahertz data stream from the GPS.

The accuracy of the 10 MHz oscillator, when locked to the GPS, is typically held within 0.01 Hz. During periods of short fades, the oscillator is held on the last frequency stetting with a typical aging of plus or minus 3 X 10 -10 per day.

To understand the Block Diagram *(*Figure 3-1*)* it is helpful to know:

3.2.5 Control Point

- CPTC Shelves generate PTT, A/D, TX Data, Low Speed Data *(LSD)* and Frame Sync Line *(FSL)* up to 6 channels per shelf.
- GPS Equipment generates timing signals for Sync Processing and the multiplexers.
- Sync Processing synchronizes the TX data with GPS timing, generates the composite timing signals for the Transmit Sites, selects LSD from the CPTC shelf and selects 9600 Hz from the GPS equipment for the CPTC shelves.
- The Digital Interconnects concentrate the signals to minimize inter-rack cabling.
- The MUX Interconnects allow signals to be tapped off for each multiplexer *(i.e. each site).*
- The MUX Crossconnect maps signals to the multiplexer inputs and outputs.
- The multiplexer concentrates the data/ clock/ audio signals into a T1 data stream for the Transmit Sites and receive data/clock/audio T1 data stream from the Transmit Site.
- Audio Processing performs **A**utomatic **L**evel **C**ontrol ***(ALC)***, and audio splitting on the voice channels from the voter.

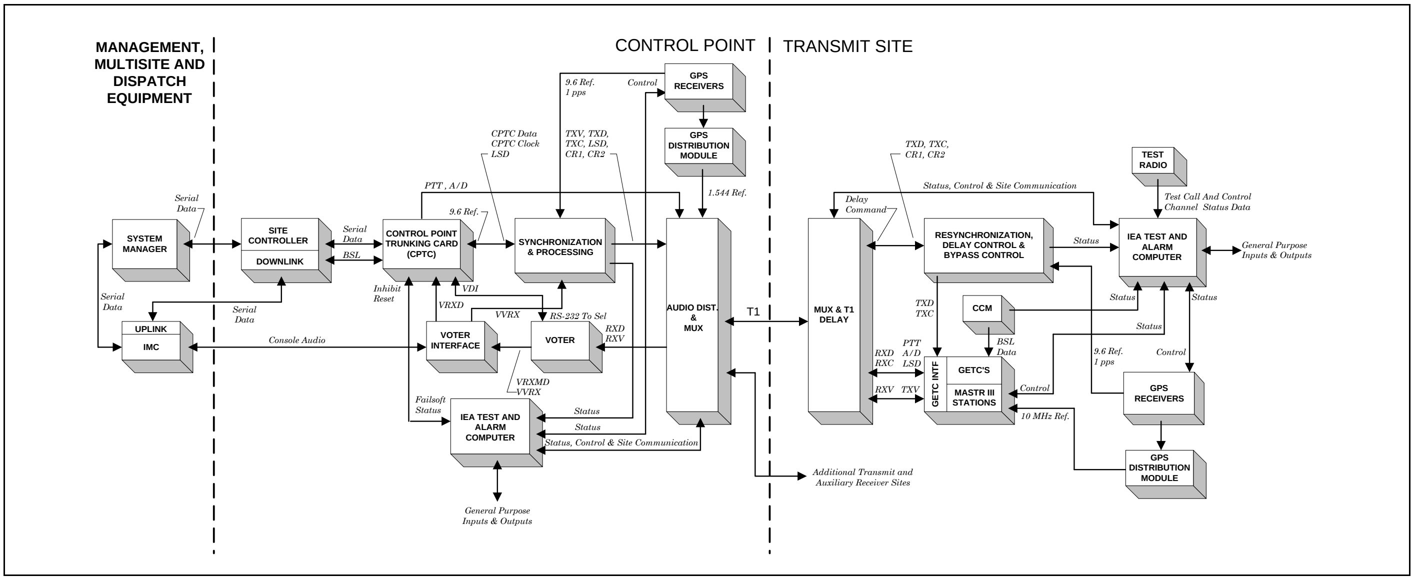


Figure 3-1: GPS Simulcast Block Diagram

3.3 TALK BACK

Precisely controlled talk out is only half of the equation for simulcast communications; land mobile radio users must also be able to talk back to a dispatcher or other mobile radios. Portable radios have significantly less power than both mobile radios and the base stations. Base stations using 100-watt transmitters propagate RF signals much further than 1 to 3-watt portables.

Advanced system design sometimes includes auxiliary receive only sites *(*Figure 3-2*)*. The signals from auxiliary receivers are carried by microwave or T1 leased telephone lines to the same Voter used to select signals from receivers at Transmit Sites. The additional receivers enhance the talk back range of low power radios by picking up the weaker signals at remote locations. This technique works for both analog and digital signals.

Another method of improving talkback is the use of tower top amplifiers in the transmit site RF equipment cabinets.

3.4 SIMULCAST DESIGN REQUIREMENTS

There are two types of land mobile radio transmission: analog and digital. Analog transmission is used for clear voice communications and is available where there is no need for digital voice, encryption, or data transmissions.

Digital transmission is used for control channel signaling, digital voice communication, encryption and data. Digital transmission provides some inherent security without the need of full encryption because FM scanners only demodulate noise when digital voice is used. Table 3-1 shows the critical simulcast design requirements for each type of transmission.

Table 3-1: Critical Simulcast Design Requirements

Transmission Type	Capabilities	Critical Simulcast Parameters
Analog	Clear Voice	Amplitude Frequency Phase
Digital	Control Channel Signaling Digital Voice Encrypted Voice Data	Timing Deviation Frequency

Each type of transmission presents unique issues for the designer. Analog requires amplitude equalization, phase equalization and frequency stability. When two signals from different sites meet in the overlap zone without equalization, the result is amplitude and phase distortion. Resolving this distortion is the most critical issue in an analog transmission. In digital transmission, timing and deviation issues are the most critical.

In digital radio systems, bit streams are transmitted instead of the continuous signals used in analog systems. As the distance between the transmitter and the receiving radio increases, the bit stream is delayed. When a signal is simulcast to a receiving radio, the bits arrive ***"offset"*** relative to one another *(*Figure 3-3*)*. Therefore, the two signals have different time delays.

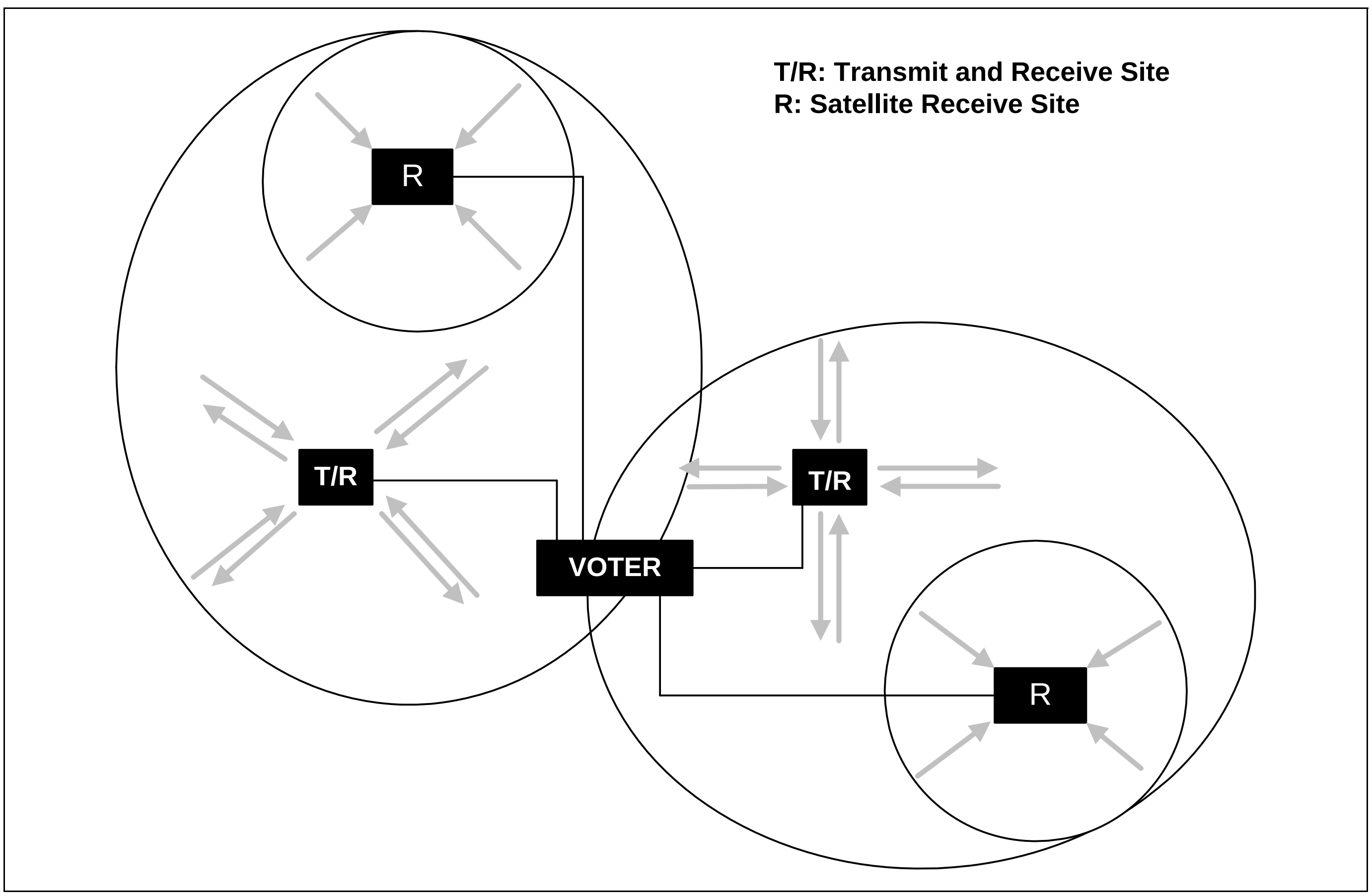


Figure 3-2: Voter and Auxiliary Receivers

If a radio samples a signal between **1T** and **2T**, it will likely detect a **0** if it listens to site A and a **1** if it listens to site B. A radio in a non-capture zone will randomly alternate between signals, introducing excessive bit errors. Of course, a high bit error rate in a digital system makes the signal unintelligible. To optimize performance in a simulcast system, the time delay differences must be kept to less than one half the bit time in areas where there is no capture. Therefore, systems that use a single data rate for digital voice, data and control channel signaling have a distinct advantage over systems using multiple data rates.

A simulcast system minimizes interference in the overlap zone by providing the equipment necessary to match the frequency and timing of transmitters at different sites. In the capture region, the mobile receiver captures the stronger signal to the complete or nearly complete exclusion of the weaker signal.

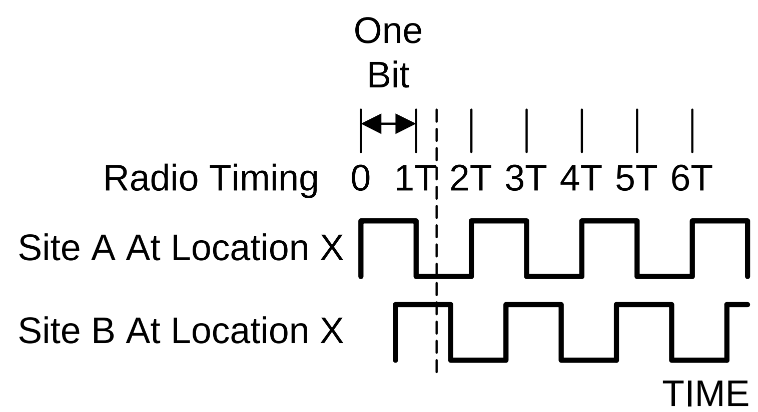


Figure 3-3: Bit Stream Delayed By More Than One-half Bit

4. GPS SIMULCAST SYSTEM

A GPS Simulcast System consists of a single Control Point, two or more Transmit Sites and optional receive-only sites. This system is equipped with an **I**ntegrated **E**DACS **A**larm ***(IEA)*** system. The IEA system is used to monitor and set simulcast system parameters and alert the user of possible fault conditions. A Transmit Site includes both a MASTR® III transmitter and receiver for each channel as well as the common equipment required for GPS Simulcast. Receive-only sites include an auxiliary receiver for each channel and are used to enhance portable talk-back coverage. The receive-only site as well as a Transmit Site may be co-located with the Control Point. The RF sites are connected to the Control Point by a microwave, a T1 or a fiber optic link. It is important that this link be stable and provide accurate digital communications between the Control Point and the Transmit sites.

4.1 CALL PROCESSING

All outbound call assignments are made and transmissions initiated from the Control Point. All inbound calls from mobiles or portables are received, voted and processed before being sent to the Transmit Sites for retransmission.

The EDACS GPS Simulcast system functions as follows:

1. A call is assigned to a working channel at the Control Point by the Site Controller or **C**ontrol **P**oint **T**runking **C**ards **(CPTC's).**
2. Data is synchronized and processed before being passed through the MUX, microwave or T1 leased line to each Transmit Site.
3. The Transmit Site adds the appropriate delay, resynchronizes the data and passes it to the assigned station.
4. GPS Receivers provide precise timing signals at both the Control Point and each Transmit Site.
5. This same GPS timing signal is used to derive the 10 MHz frequency reference for the base stations at each transmit site.
6. For the return path, audio or data is received by the MASTR III station at a Transmit Site.
7. That information is passed to the Control Point through the MUX, microwave or T1 leased line to the input of a Voter.
8. At the Voter the signal is compared with audio or data from receivers at other RF sites.
9. The Voter then provides the best signal to the control equipment for retransmission.

EDACS GPS Simulcast supports up to 24 RF channels and 17 RF sites per system. Every channel may serve as control channel and transport analog voice, digital voice or data. Sites may be any combination of transmit/receive or receive only.

4.1.1 EDACS Simulcast Advanced Functionality

4.1.1.1 EDACS Bypass Operation

One of the primary goals for any communications system is to maintain communications under all conditions. This goal is paramount for public service communications. In a system requiring inter-site communications *(e.g., microwave or fiber optic)*, there obviously is a risk of outage.

For systems using microwave, the standard practice is adequate path margin, hot standby, reasonable lightning protection, auxiliary power sources, etc. These are all efforts to preserve the operation of a link. In a loop microwave system, if a lost link occurs, the other direction path is automatically chosen and is automatically timed. For systems using leased T1 circuitry, alternate routing is employed when available.

If the inter-site communication fails to the point where a site is ***"orphaned,"*** (in *BYPASS*) complete coverage is still desirable. As an option to the standard EDACS Simulcast system, the site can function as an autonomous system on a subset of channels with those same channels removed from the main system. The other sites continue to simulcast on the remaining channels. As another alternative, the customer can elect to turn off the isolated site and continue to simulcast on all channels with the remaining sites. This allows ***"fill-in"*** coverage from other sites in the regions previously captured by the orphaned site.

4.1.1.2 EDACS Simulcast Optimization

EDACS **S**imulcast **O**ptimization ***(ESO)*** is a Harris provided standard service that uses a specially designed measurement system and a computer simulation. The measurement system determines the actual signal strengths and time delays from all transmit sites simultaneously. A three-color map showing the communication quality is generated using the collected data. The effect of each site can be isolated and key parameters can be changed in the database to simulate changes to the simulcast system.

A Block Diagram of the measurement system is shown in Figure 4-1. At the heart of the ESO system is a vehicle-mounted GPS receiver tied to a signal measurement and recording device. Each second, the GPS receiver supplies a position update that is compared with the position of the last measurement. As the vehicle moves through the coverage area, multiple signal measurements and the exact locations are logged for later plotting.

As an additional test, ESO also keys a portable radio and records the success of its channel request. In EDACS, a radio must successfully transmit a request and receive an assignment from the site controller before a call is allowed to begin. This test verifies both inbound and outbound messages and provides secondary measurement of portable control channel coverage. It also pinpoints areas with local timing anomalies.

At each point on the EDACS Simulcast Optimization map, the potential RF capture and time differentials can be examined. Once it is known which site is creating interference, it can be determined how to minimize the interference. In minutes, the new coverage using the new parameters *(transmit power, time delay, antenna type and orientation)* can be simulated.

4.2 GLOBAL POSITIONING SYSTEM

Global **P**ositioning **S**ystem ***(GPS)*** is a ***"constellation"*** of 24 earth-orbiting satellites and associated land-based receivers. These 24 satellites consist of four (4) satellites in six (6) orbital planes approximately 10,000 miles out and orbiting the earth approximately every 12 hours. Each plane is inclined approximately 56°. If a GPS Receiver is located at 56° North Latitude the satellites will never be to the North. If installing an antenna on the side of a building anywhere in the Northern hemisphere, the antenna should be on the South side of the building and facing South.

GPS Signal (data stream) characteristics are:

- L1 - 1.5 GHz, Downlink.
- L2- 1.2 GHz, Downlink.
- Signal Levels -160 dBm to -90 dBm (Nominally -120 dBm to -130 dBm).
- RF Signals require direct line-of site to satellites.

- Each satellite has a planned life span of 7.5 years.

The US Government built the GPS network to provide tracking and guidance of airplanes, ships, missiles, etc. The satellites all transmit the same precise timing signal in the form of a pseudo-random code. Each GPS Receiver has a clock that is "set in synch" from the signals of one or more satellites. GPS provides a very precise timing signal to each GPS Simulcast Control Point and Transmit site.

This signal, received from the GPS satellites, is used by the GPS Receivers to generate and gate a 9600 baud clock used throughout the system as well as a 10 MHz reference used by each base station. Since the Transmit Sites receive the same signal as the Control Point, the system continually adjusts the signals sent from the Control Point to each Transmit Site to maintain the desired level of performance within the overlap zone.

Signals generated by GPS Receivers and what they control in the GPS Simulcast System are:

• 1.544 MHz or • 2.048 MHz	MUX
• 1 pps • 9.6 kHz	TIMING
• 10 MHz	STATIONS

A Transmit Site consists of base stations and simulcast equipment used to transmit and receive land mobile radio signals. Channels in a simulcast system are defined as control and working. The same channel at every site in the system is used as the control channel. Similarly, voice or data messages are simultaneously transmitted from every site on the same working channel.

4.3 MANAGEMENT MULTISITE AND DISPATCH EQUIPMENT

4.3.1 System Manager

The System Manager controls and monitors the EDACS GPS Simulcast System through a computer with a modem interface to the Site Controller. Through the System Manager, an operator can customize the site parameters, user data base and execute high level features.

4.3.2 Integrated Multisite And Console Controller

The Integrated Multisite and Console Controller *(IMC)* provides intelligent interconnection of the EDACS GPS Simulcast system, the Centralized Telephone Interconnect system and possibly other systems to form a fully integrated communications system supporting both voice communications and digital data.

4.4 GPS SIMULCAST CONTROL POINT EQUIPMENT

The Control Point coordinates the activities of the RF sites *(Transmit/Receive)*. All voice and data signals are routed through the Control Point where synchronization and processing are performed to enhance talk-out performance in the overlap zone. Digital messages are also routed here for processing by the Site Controller, Control Point Trunking Cards *(CPTC's)* and Integrated EDACS Alarm *(IEA)* system.

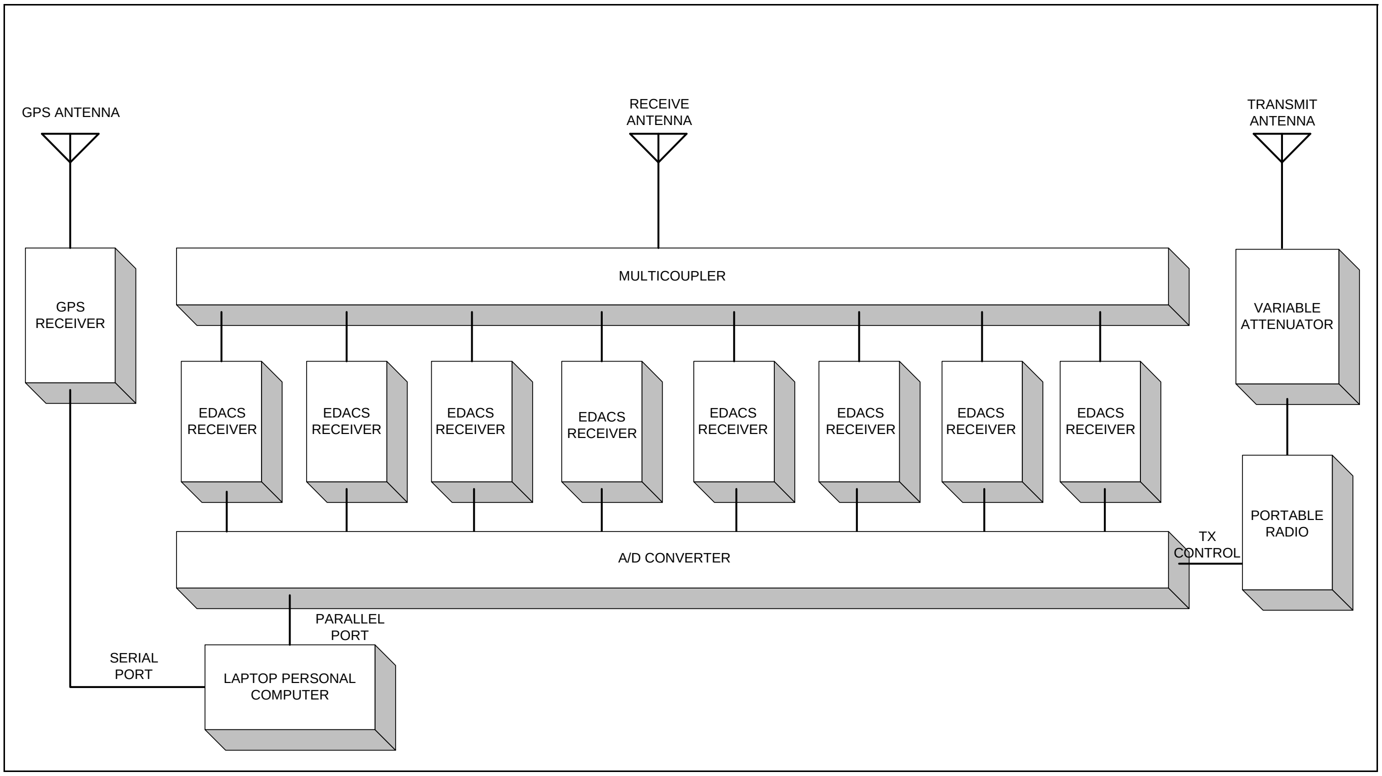


Figure 4-1: Measuring Device Block Diagram

4.4.1 Site Controller

The Site Controller directs the moment-to-moment trunking process as well as features like call validation, activity logging, patch and queue management.

The Site Controller interfaces with the System Manager and GPS Simulcast equipment to provide overall system management functions. It contains a DEC Computer, downlink GETC*(s)*, an optional 9600 baud modem and the system database.

NOTE

All programming changes to the databases are made through the System Manager.

System management functions provided through the Site Controller include:

- Call Validation - Assures that only valid users have access to EDACS.
- Activity Logging - Logs each Push-To-Talk (PTT) and release.

- Full Dispatch Support - Supports Patch/ Simulselect features.
- Eight Level Priority - Secures access for priority users when queued.
- Recent User Priority Increment - Assures completing of conversations.
- Dynamic Regrouping - Over-the -air dynamic regrouping programs temporary groups into radios for strategic purposes.
- Unit Disable - Takes a radio off the air.

The Downlink GETC(s) provide the data interface to the IMC. The 9600 baud modem provides dedicated or dial-up connection to the system manager.

4.4.2 Compact Vertical Voter

The voting system accommodates both analog voice and digital data. Analog voting is used for clear voice transmissions while digital voting is used for digitized voice and digital signaling. The voting is performed by the Compact Vertical Voter *(CV2)* which allows up to six channels of voting to be housed in a single cabinet or rack.

4.4.3 Voter Interface Rack

The Voter Interface rack contains Jackfields, a T1 MUX shelf for interface to an IMC, modem shelves, Voter Crossconnect for 6 sites or voter Crossconnect panels for more than 6 sites, Digital Dispatch modules, Connector panel, AC power strip and a power distribution panel. All of these items make up the Voter Interface which provides interfacing between the Voter and the following:

- System Manager (IMC)
- **C**ontrol **P**oint **T**runk **C**ards ***(CPTCs)*** located in the Control Point Common Equipment Rack, CPTC shelf.
- Sync Shelf located in the Control Point Common Equipment Rack.

4.4.3.1 Jackfields

The jackfields used in the Voter Interface Rack route data from the Digital Voter Crossconnect Panel to a Station Voter Interface Module.

4.4.3.2 MUX Shelf

This shelf houses all Intraplex TDM-160 Series MUX equipment. This equipment is designed to transport multiple voice, data within a standard 1.544 Mbps T1 circuit. This MUX equipment includes a:

- CM-3A Module - **C**ommon **M**odule is used to configure and communicate with the MUX shelf.
- PCM Module **- P**ulse **C**ode **M**odulation Module digitizes audio to/from the Transmit Site, providing one *(1)* voice channel per DSO time slot.
- ADPCM Module - **AD**apative **P**ulse **C**ode **M**odulation Module digitizes audio to/from Transmit Sites, providing two (2) voice channels per DSO time slot.
- Synchronous Data Module - Packs five 9600 bps data streams (10 E leads and 10 M leads) onto a single T1 time slot.

- Asynchronous Data Module - Used to send composite reference signals, Low Speed Data (LSD), and IEA communication to Transmit Sites.
- Network Data Module – Option used in place of an Asynchronous Data Module for IEA communication to Transmit Sites.

4.4.3.3 Modem Shelves

Modem Shelves are used on the output of the Voter Interface Panel along with a *Digital Dispatch Option* to convert the analog output of the Voter Selector Modems and IMC **D**igital **V**oice **I**nterface **U**nit ***(DVIU)*** to a digital output. This output *(voted data)* connects to the CPTC. Each modem shelf houses up to 10 Rockwell modems with one modem dedicated to each channel. The total number of modems required at the Control Point is equal to the number of channels. Multiple modem shelves are used in system with more than 10 channels.

4.4.3.4 Voter Crossconnects

Two voter crossconnect panels are used in the Voter Interface Rack. These panels are B424 and B421/B422.

B424:

This is a single *digital/analog* crossconnect panel used when using a two channel digital voter shelf and six sites or less. This panel interfaces between Channel Voters, CPTC's and Console Switch.

B421/B422:

These are separate *digital and analog* crossconnect panels used with a single channel digital voter shelf and more than six and up to 17 sites. These panels interface between Channel Voters, CPTC's and Console Switch.

4.4.3.5 Digital Dispatch Modules

Digital Dispatch Modules mount to a frame assembly in the rear of the Voter Interface rack. They are used with the Digital Dispatch Option.

4.4.3.6 AC Power Strip

The AC power strip contains three dual AC outlets mounted in a metal housing with power cord.

4.4.3.7 Power Distribution Panel

The Power Distribution Panel provides eight *(8)* connectors to distribute +5 Vdc, +12 Vdc, -12 Vdc and ground *(GND)* throughout the Voter Interface Rack. Each connector is configured as shown (Figure 4-2).

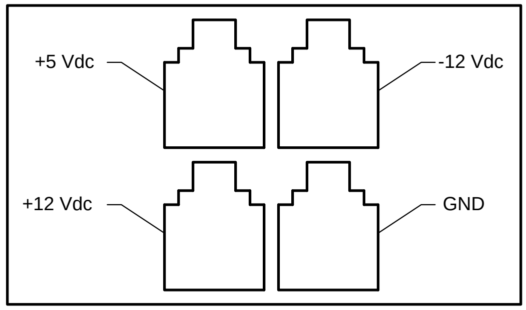


Figure 4-2: Power Distribution Panel Connectors (J1-J8)

4.4.4 Control Point Common Equipment Rack

The Control Point Common Equipment rack contains:

- 1.544 MHz Clock Selector and Distribution Amplifier
- GPS Receivers
- Control Point Trunking Shelves
  Each CPTC shelf contains:
  - Turbo Cards
  - **C**ontrol **P**oint **T**runking **C**ards ***(CPTC)***
  - Simulcast Interface Card
- Control Point Sync Shelf . This shelf contains:
  - **L**ow **S**peed **D**ata ***(LSD)*** Selector Modules
  - GPS **C**ontrol **P**oint **T**iming **M**odules ***(CPTM)***
  - Resync Modules
  - Audio ALC Modules
- IEA Test and Alarm Computer
- **U**ninterruptable **P**ower **S**upply ***(UPS)*** Shelf (Optional)[1]
- +5, ±12 Vdc Power Supply[2]
- EDACS PRISM Power Supply (EP2S) system.[3]
- Modular Power Distribution System *(MPoDS)*
- Connector Panel
- RocketPort Modules
- Alarm Crossconnect Panel

[1] Replaced by EP2S power supply system.
[2] Replaced by EP2S power supply system.
[3] Replaced by the Modular Power Distribution System (MPoDS*)*

- AC Power Strip
- Power Distribution Panel

4.4.4.1 GPS Receiver

The GPS "Receiver" receives timing signals from the GPS constellation and generates timing signals *(1pps, 9600 Hz)* and frequency standards *(10 MHz and 1.544 MHz)* for the EDACS GPS Simulcast system.

Redundant receivers are used at both the Control Point and each Transmit Site. If the Control Point and the Transmit site are co-located, the GPS Receivers for the Transmit Site are eliminated, leaving only a single set of receivers to service both the Transmit Site and the Control Point *(*Figure 4-3*).*

A GPS Receiver is a Spectracom GPS AGELESS™ OSCILLATOR, Model 8195. An antenna connects to the GPS ANTENNA port located on the rear panel of each oscillator. Outputs of each receiver connect to the inputs of Spectracom 1.544 MHz Clock Selector, Distribution Amplifier, Model 8144 *(Control Point)*, 10 MHz Distribution Amplifier, Model 8143 *(Transmit Site)* and Control Point and Transmit Site Sync Shelves.

If the Control Point and the Transmit sites are ***not*** co-located the GPS Receivers at the Control Point are connected as shown in Figure 4-4.

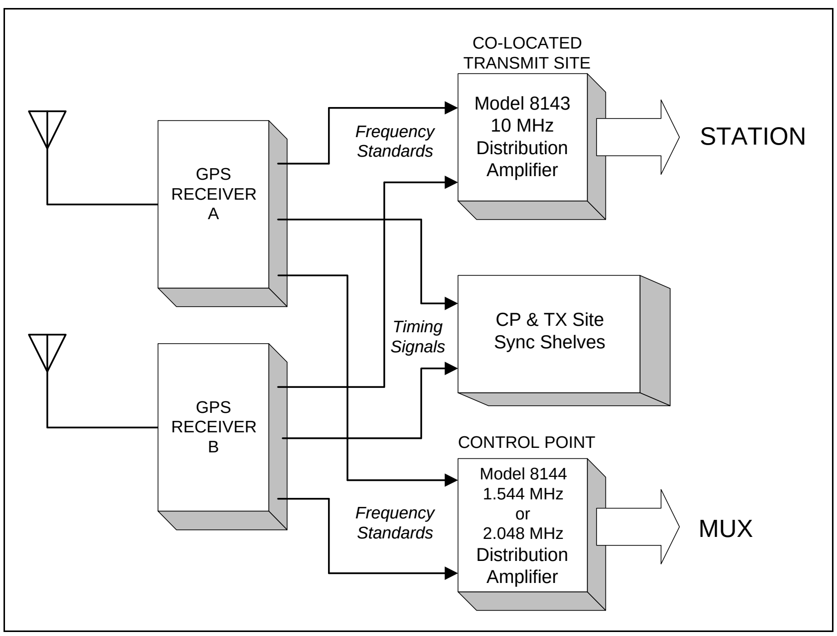


Figure 4-3: GPS Receivers
(Co-located Control Point and Transmit Site)

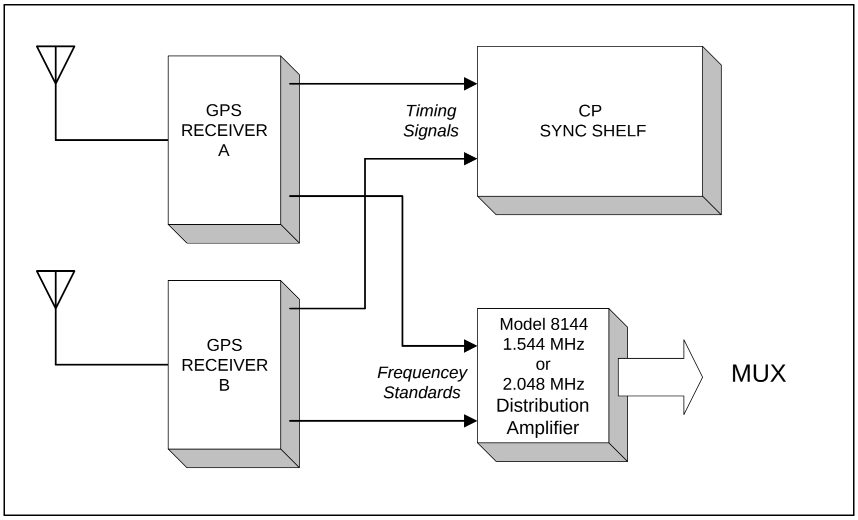


Figure 4-4: Redundant GPS Receivers
(Control Point Only)

4.4.4.2 1.544 MHz Clock Selector and Distribution Amplifier

The 1.544 MHz Clock Selector and Distribution Amplifier, Spectracom, Model 8144, produces a 1.544 MHz clock signal for the MUX at the Control Point only, Transmit Sites are ***"Loop"*** timed.

4.4.4.3 Control Point Trunking Shelf

The Control Point Trunking Shelf houses a combination of **C**ontrol **P**oint **T**runking **C**ards ***(*CPTC's),** Vertical Turbo Cards and Simulcast Interface Cards. A set of these cards is required for each channel. Each shelf provides up to twenty-one *(21)* card slots with only eighteen *(18)* slots of each shelf actually used by the Control Point. The number of shelves and card sets depends on the number of channels. Each channel connected to a shelf interfaces with a Trunking Card through an Interface Card. Each Trunking Card interfaces to an associated Vertical Turbo card.

4.4.4.3.1 CPTC

One CPTC is required per channel. These flexible microprocessor packages manage digital signaling, transmitter control and control of the base stations.

As part of EDACS's full and failsoft trunking, the CPTC's provide the interface both to the site controller and to each other. If the Site Controller, for some reason, is taken off line, i.e. to upgrade the software, the CPTC's can continue the trunking process and the simulcast function can continue.

4.4.4.3.2 Simulcast Interface Card

The Simulcast Interface Card used in the EDACS GPS Simulcast System provides signal level conversion and clock synchronization of those signals the source of or destination to is the CPTC.

4.4.4.3.3 Vertical Turbo Card

The Vertical Turbo Card provides additional processing power and memory for the CPTC.

4.4.4.4 Sync Shelf

The Control Point Sync Shelf and associated modules is referred to as SYNCHRONIZATION & PROCESSING in the Block Diagram (Figure 3-1). This shelf contains the:

- **C**ontrol **P**oint **T**iming **M**odule ***(CPTM)***
- LSD Selector Module
- ReSync Module
- Audio ALC Module

4.4.4.4.1 Control Point Timing Module

The CPTM has three functions. At the Control Point, these functions:

1. Generate 300 Hz FSL *(Frame Sync Line)*
2. Generate Composite References
3. Select 9600 Hz Clocks

The CPTM selects a 9600 clock and 1 pps signal from the redundant GPS clock sources. A Clock Generator generates a 19,200 Hz clock for use internal to the module. The 300 Hz generator generates the 300 Hz required by the ReSync Module. It also ensures that the phase of the 300 Hz is proper relative to the **F**rame **S**ync **L**ine ***(FSL)*** input. The Composite Reference Generator takes the selected 9600 Hz clock and inserts tags at the proper time to create reference signals that contain:

- Composite Reference 1 *(CR1)* - contains 9600 Hz clock plus tags for 300 Hz and pseudo FSL.
- Composite Reference 2 *(CR2)* - contains 9600 Hz clock plus tags for 1 pps.

The Control Point Sync Shelf contains a redundant pair of CPTM's

4.4.4.4.2 Low Speed Data Selector Module

The **L**ow **S**peed **D**ata ***(LSD)*** Selector Module automatically selects a 150 Baud Data stream *(Low speed data)* from one of up to twenty-four Control Point GETC's. All Control Point GETC's generate identical low speed data except for the active control GETC. The channel number of the selected source is displayed on the front of the LSD Selector Module, two digit LED display.

The function of this module is to select a 150 Baud data source for the simulcast system. This selected source is distributed to the Control Point MUX shelves for all sites. The Control Point Sync Shelf contains redundant LSD Selectors.

4.4.4.4.3 Resync Module

The ReSync Module performs the function of simulcast re-synchronization for 9600 bps data in the EDACS GPS Simulcast System. Each module is capable of performing this function on six data paths *(channels)* independently. Data and clock input for each channel *(at RS-232 levels)* flow through the module at logic levels and are output as RS-422. Also, input to this module is a 300 gating clock and a 9600 bit clock, both at logic levels *(TTL)*.

4.4.4.4.4 Audio ALC Module

The Audio **A**utomatic **L**evel **C**ontrol ***(ALC)*** modules provide clear voice audio processing for six independent audio channels in GPS Simulcast Systems. This Module is designed for "transparent" (0 dB gain, 0 dB loss) operation at the normal system level of -10 dBm, and to maintain this -10 dBm output level with input fluctuations of æ10 dB or more (gain is limited to 12.5 dB).

4.4.4.5 Integrated EDACS Alarm System Test and Alarm Computer

The **I**ntegrated **E**DACS **A**larm ***(IEA)*** Test and Alarm computer interfaces with the GPS Simulcast system to monitor system parameters and alert the system operator of any fault conditions. The IEA also provides remote control for GPS Receivers, MUX and Base Stations.

4.4.4.6 Uninterruptable Power Supply Shelf[4]

An optional **U**ninterruptable **P**ower **S**upply ***(UPS)*** Shelf *(188D5464P1)* houses a 349A9866P1 UPS. This supply is capable of 1000 VA, 560 watts for approximately 8 minutes battery time and supplies 120 VAC.

4.4.4.7 +5, ±12 Vdc Power Supplies

An EDACS **R**edundant **P**ower **S**upply ***(RPS)*** system is used with the GPS Simulcast Common Equipment Rack to increase the reliability of the simulcast system. The power supply modules used in this system operate on 120 VAC or 240 VAC and provide the system voltages *(+5 Vdc and* ±12 Vdc) and current required for operation.

4.4.4.7.1 EDACS Prism Power Supply System (EP2S).[5]

The EP2S Power Supply System replaces the UPS shelf and the +5, ±12 Vdc Redundant Power Supply (RPS) system. This EP2S Power Supply System provides a modular redundant power system capable of producing the various operating voltages required for EDACS or Prism™ applications.

This power supply system *(EP2S)* consists of a power supply chassis (AC or DC), a fan module and up to six (6) BMR 910 series redundant power system modules. The EP2S power supply chassis houses the power modules and provides up to four (4) different DC voltage outputs; such as +5V, +12V, -12V, and +24V or +5V, -15V and +24V.

Incorporating the EP2S Power Supply System also involved a new power distribution panel. Power Distribution Panel 19C852636P1 was replaced with Power Distribution Panel SXA 120 4334/1. This panel provides DC power interconnections between the EP2S or the MPoDS and the individual units within the equipment rack.

4.4.4.7.2 Modular Power Distribution System (MPoDS)

The MPoDS replaces the EP2S power supply system. This system consists of power supply chassis SXK 104 3962/1 and power supply modules BMR 910 359/2. The power supply chassis houses the power modules, which provide +5/±12Vdc throughout the EDACS GPS Simulcast Common Equipment Rack. Power distribution is provided by connection to the power supply back panel. The power supply chassis is a self-contained power distribution panel and accommodates standard jacks that connect to cabinet harnesses. The power modules are fitted within the power supply chassis in order to provide the proper mix of voltages necessary for operation of the equipment rack.

4.4.4.8 Mounting Frame

This mounting frame *(P01)* mounts in the back of the Common Equipment rack. Connector panels M1, M2 & M3 on the ends of cables coming from the various rack components are mounted in this frame assembly. Panel M1 is a Digital Distribution Module used with the Digital Dispatch Option. Panel M2 is used as a T1 interconnect module. Panel M3 is a single connector panel.

[4] Replaced by EP2S power supply system.
[5] Replaced by the Modular Power Distribution System (MPoDS).

4.4.4.9 RocketPort Modules

RocketPort Modules M4 and M5 are 16 port serial termination modules and mount on a shelf just behind the mounting frame above. These modules are part of the IEA and connect between the IEA and the MUX. Module M4 also connects to GPS Receivers D801 & D802.

4.4.4.10 Alarm Crossconnect Panel

The Alarm Crossconnect panel is used in conjunction with the Integrated EDACS Alarm *(IEA)* system to provide interface connections between the IEA and CPTC shelves. The Alarm Crossconnect also provides interface connections between the IEA and the Sync Shelf.

4.4.4.11 AC Power Strip

The AC power strip contains three dual AC outlets mounted in a metal housing with power cord.

4.4.4.12 Power Distribution Panel

The Power Distribution Panel provides eight *(8)* connectors to distribute +5 Vdc, +12 Vdc, -12 Vdc and ground *(GND)* throughout the Control Point Common Equipment Rack. Each connector is configured as shown (Figure 4-5).

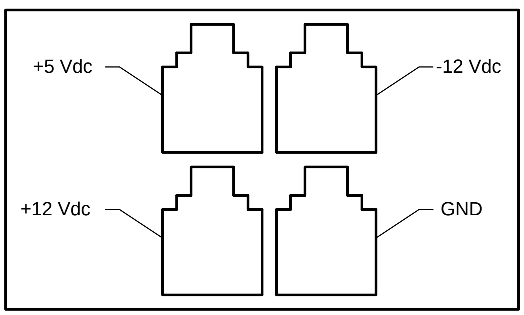


Figure 4-5: Power Distribution Panel Connections (J1-J8)

4.4.5 <u>Transmit Control/Test Rack</u>

- The Transmit Control/Test Rack contains:
- Control Panels A300-A308
- Transmission Test Set
- Digital Oscilloscope
- Test Cables
- Test Cable Drawer
- Crossconnect Panels B410- B414
- Alignment Receiver/Radio

- AC Power Outlet Strip
- +13.8 Vdc Power Supply

4.4.5.1 Control Panels

Control Panels used with GPS Simulcast consist of 24 switches. These switches provide switching for an analog/digital function or a **P**ush-**T**o-**T**alk ***(PTT)*** function as follows:

A300 is an Analog/Digital *(A/D)* Control Panel *(S01-S24)*

A301 is a PTT Control Panel *(S01-S03)*

A302 is a PTT Control Panel *(S04-S06)*

A303 is a PTT Control Panel *(S07-S09)*

A304 is a PTT Control Panel *(S10-S12)*

A305 is a PTT Control Panel *(S13-S15)*

A306 is a PTT Control Panel *(S16-S18)*

A307 is a PTT Control Panel *(S19-S21)*

A308 is a PTT Control Panel *(S22-S24)*

4.4.5.2 Transmission Test set

The Transmission Test Unit used in the GPS Simulcast Transmit Control/Test Rack is CONVEX catalog number 806-RA-03-03 or equivalent.

806 = Transmission Test Unit

RA = 1 Rack Unit High, 19 inches wide *(with mounting holes per EIA)*

03 = 115/230 VAC *(45-65 Hz)*

03 = Dual LED display

For more information concerning this Test Unit, refer to the manufacturer's maintenance manual supplied with the unit.

4.4.5.3 Digital Oscilloscope

The oscilloscope is a Tektronix Model TDS-430A *(Replaced Model 2232)*. This oscilloscope is a two *(2)* channel digital oscilloscope *(400 MHz, 100 MS/s)* and includes a rack mount kit. For more information concerning this oscilloscope, refer to the maintenance manual supplied by the manufacturer.

4.4.5.4 Test Cables

A set of test cables used with the test equipment are provided with the Transmit Control/Test Rack.

4.4.5.5 Test Cable Drawer

A drawer is provided in the Transmit Control/Test Rack to store test cables.

4.4.5.6 Control Crossconnect Panels

Crossconnect Panels B410 through B414 work in conjunction with Control Panels A300 through A308 to map **A**nalog *(voice)*/**D**ata ***(A/D)*** transmission and PTT leads to GPS Simulcast Sites 1-24. Crossconnect Panel B410 is used with Control Panel A300 to map Analog/Data functions for simulcast Sites 1 -24).

Crossconnect Panel B411 is used with Control Panels A301 and A302 to map PTT functions to sites 1-6.

Crossconnect Panel B412 is used with Control Panels A303 and A304 to map PTT functions to sites 7-12.

Crossconnect panel B413 is used with Control Panels A305 and A305 to map PTT functions to sites 13-18.

Crossconnect panel B414 is used with Control Panels A307 and A308 to map PTT function to sites 19-24.

4.4.5.7 Alignment Receiver

The Alignment Receiver/Radio is used for service and alignment. This receiver/radio consists of a shelf mounted ORION radio. An RF Attenuator *(0 to 101 dB)* connects between the antenna input to the radio and the actual antenna connector (J8) of the shelf. The Attenuator is switched in and out if the circuit by **SERVICE** and **ALIGN** switch S1 and two internal relays. Levels of attenuation are selected a by a series of nine toggle switches, located on the front panel of the Alignment Receiver.

4.4.5.8 AC Power Strip

The AC power outlet strip contains three dual AC outlets mounted in a metal housing with power cord.

4.4.5.9 +13.8 Vdc Power Supply

This is a +13.8 Vdc base station power supply capable of providing up to 435 watts.

4.4.6 Audio Distribution And MUX Rack

Equipment used in the Control Point Audio Distribution and MUX Rack includes:

- MUX Shelves TRI1-TRI6
- Jackfields A601-A603 & D601-D606
- Audio Distribution Shelf*(s)*
- Audio Distribution Modules
- MUX Distribution Panel B401
- Distribution Panel B402
- Distribution Modules M1-M4
- Mounting Frame
- AC Power Strip

4.4.6.1 MUX Shelves

The Audio Distribution and MUX rack and houses six *(6)* MUX Shelves TRI1-TRI6. These shelves contain all Intraplex TDM-160 Series MUX equipment. This equipment consists of the following:

- CM-3A Module **-** CM-3A T1 Common Module is used to configure and communicate with the MUX shelf.
- PCM or ADPCM Modules **- P**ulse **C**ode **M**odulation or **A**daptive **D**ifferential **P**ulse **C**ode **M**odulation ***(ADPCM)*** modules are used to digitize voice audio. A PCM card is used for one *(1)* voice channel per DSO time slot. An ADPCM card is used for two *(2)* voice channels per DSO time slot.
- Synchronous data modules **-** Packs five 9600 bps data streams (10 E leads and 10 M leads) onto a single T1 time slot.
- Asynchronous Data Card **-** Used for **L**ow **S**peed **D**ata (LSD), composite reference signals and Integrated EDACS Alarm (IEA) system communications.
- Network Data Card - especially used in place of an Asynchronous Data Module for IE communications to Transmit Sites.

4.4.6.2 Jackfields

These Jackfields *(A601-A603 & D601-D606)* are used to route the various signals, *(analog/digital, data and clock)* to MUX shelves TRI1-TRI6.

4.4.6.3 Audio Distribution Shelf

An Audio Distribution Shelf mounts in the front of the Audio Distribution and MUX rack and houses up to twelve Audio Distribution Modules.

4.4.6.4 Audio Distribution Module

An Audio Distribution Module is used to buffer two independent audio channels and provide six separate 600 ohm balanced outputs for each channel. The input to the Audio Distribution Module comes from an ALC module located in the Sync Shelf. Six *(6)* outputs from the Audio Distribution Module feed up to a maximum of six *(6)* multiplexer shelves located in the same cabinet.

4.4.6.5 MUX Distribution Panel B401

The MUX Distribution Panel Interfaces between the Common Equipment Cabinet and MUX Shelves TRI1-TRI6. This panel collects LSD, CR1 and CR2 signals and distributes these signals to MUX shelves TRI1-TRI6.

4.4.6.6 Distribution Panel B402

Distribution Panel B402 mounts on the rear of the Audio Distribution and MUX rack. This panel consist of four *(4)* Distribution Modules M1-M4. Shelf.

4.4.6.6.1 Distribution Module M1

Distribution Module M1 collects A/D IN *(Analog/Digital)* and distributes this signal to MUX shelves TRI1-TRI6.

4.4.6.6.2 Distribution Module M2

Distribution Module M2 collects TXD IN *(data)* and distributes this signal through jackfields D601-D606 to MUX shelves TRI1-TRI6 respectively.

4.4.6.6.3 Distribution Module M3

Distribution Module M3 collects TXC IN *(clock)* and distributes this signal through jackfields D601-D606 to MUX shelves TRI1-TRI6 respectively.

4.4.6.6.4 Distribution Module M4

Distribution Module M4 collects TXV IN *(audio)* and distributes this signal to the Audio Distribution Shelf.

4.4.6.7 Mounting Frame

A mounting frame mounts in the back of the Audio Distribution and MUX rack. Connectors on the ends of cables coming from the various rack components are mounted in this frame.

4.4.6.8 AC Power Strip

The AC power strip contains three dual AC outlets mounted in a metal housing with power cord.

4.5 TRANSMIT SITE

4.5.1 Common Equipment Rack

The Common Equipment Rack contains:

- Station Crossconnect Panel
- Interface Panel
  - Programming/Diagnostic Module
  - Bypass Mapping Module
- Sync Shelf
  - Resync Module
  - GPS Timing Module
  - Bypass Module
- Power Supplies
  - Uninterruptable Power Supply (Optional)[6]
  - +5, ±12 Vdc Power Supply [7]
  - EP2S Power Supply System[8]
  - MPoDS

[6] Replaced by EP2S power supply system.
[7] Replaced by EP2S power supply system.
[8] Replaced by the MPoDS.

  - o +13.8 Vdc Power Supply

- Jackfields
- GPS Receiver
- 10 MHz Distribution Amplifier
- MUX Shelf
- Remote Test Unit (RTU)/Control Channel Monitor *(CCM)*
- Orion Radio
- Buffer Board
- Power Distribution Panel

4.5.1.1 Station Crossconnect Panel

The Station Cross Connect Panel is used to provide a connectorized interface to the MASTR III stations in the **GPS** Simulcast system. This panel essentially re-maps (routes) the station logic *(multiple functions per channel)* to the simulcast control & MUX logic *(multiple channels per function)*. The one exception to this is transmit low speed data (*150D)*, which is bussed to all stations in parallel.

This panel mounts to a frame assembly which is then mounted on the rear of the transmit site equipment cabinet.

4.5.1.2 Interface Panel

This interface panel mounts in the middle position on the back side of the simulcast equipment rack. The Interface Panel provides the ability to couple audio and control functions of multiple stations on single 25 pair cables, and all intra-cabinet wiring to common connector panels.

This Interface panel consists of a frame assembly and three *(3)* modules:

- Programming/Diagnostic Modules, M1 & M2
- Bypass Mapping Module M3

Two RocketPort 16 MultiPort Serial Controllers M4 & M5 mount on a separate mounting frame. This mounting frame mounts direct behind the interface panel.

4.5.1.2.1 Programming/Diagnostic Module

Interface Modules M1 & M2 are used in the GPS Simulcast Transmit Rack Interface panel as Programming/Diagnostic modules. These modules are used to input data from the MASTR III station to the Test and Alarm Computer through RocketPort Modules M4 & M5. The IEA Test and Alarm Computer can, in reverse, set station perimeters in the MASTR III station.

4.5.1.2.2 Bypass Mapping Module

Bypass Mapping Module M3 is used in the GPS Simulcast Communication System to establish a bypass buss and provides a simplified method of establishing and testing split system operation

4.5.1.3 Sync Shelf

At the Transmit Site, the Sync Shelf mounts in the Transmit Site Common Equipment Cabinet.

The Sync Shelf and associated modules referred to as Resyschronization, Delay Control & Bypass Control in the Block Diagram (Figure 3-1) contains the:

- GPS Timing Module
- ReSync Module
- Bypass Module

At the Transmit Site, these functions:

- Select 9600 Hz Clocks
- Recover references from composites
- Control T1 Delay

4.5.1.3.1 Resync Module

The ReSync Module performs the function of simulcast re-synchronization for 9600 bps data. Each module is capable of performing this function on six data paths *(channels)* independently. Data and clock input for each channel *(at RS-232 levels)* flow through the module *(at logic levels)* and are output at RS-422. Also, input to this module is the 300 gating clock and the 9600 bit clock, both at logic levels.

4.5.1.3.2 Transmit Timing Module

The **T**ransmit **T**iming **M**odule **(TXTM)** contains an internal clock generator that generates a 19,200 Hz clock for internal use. The timing module selects the 1 pps and 9600 Hz clock from the redundant GPS locked clock sources. In addition, it also provides for selection of the landline 9600 Hz in the event that redundant GPS sources have failed. The Signal Recovery is the corresponding function of the Composite Reference Generator at the Control Point. It extracts the 9600, 300, 1 pps and pseudo FSL from the reference signals. The 9600 Hz landline is sourced from a Xilinx IC to be filtered by a PLL circuit and returned for use by the T1 delay module. The T1 delay module examines the selected GPS signals (1 pps and 9600) and compares the phase to the corresponding landline signals. If certain "hysterisis hurdles" are exceeded, the number of T1 cycles of delay desired are serially sent to the Intraplex MUX where the actual delay is accomplished. The TX Sync Shelf contains a redundant pair of TXTMs.

4.5.1.3.3 Bypass Module

The Bypass Module is used in the GPS Simulcast Synchronizer shelf located in the equipment rack at the Transmit Site.

The Bypass module forces the transmit site into bypass and lights the appropriate front panel LED's for any of the following conditions:

- A Transmit Timing Module *(TXTM)* major alarm *(logic high)* is received from the TXTM module in the Synchronizer Shelf.
- A 10 MHz distribution amplifier major alarm *(open or high logic level)* is present.
- A sync major alarm *(logic high)* is received from the Resync Modules.
- A system bypass input *(logic high)* from the IEA system is present.
- The front panel Local Bypass switch is switched to "ON."

The module is used to enable split system operation by a front panel switch. When enabled, a front panel LED is lit and a signal indicator *(Monitor Split System)* is fed to the IEA. Once the system goes into the Bypass mode, the Bypass module generates a logic low Split System enable output signal. This signal is used by the Bypass Mapping Module to control GETC inhibit lines *(i.e., select which stations will be operating while in the bypass mode and which stations will be held in Reset).*

4.5.1.4 Uninterruptable Power Supply Shelf[9]

An optional Uninterruptable Power Supply (UPS) Shelf (188D5464P1) houses a 349A9866P1 UPS. This supply is capable of 1000 VA, 560 watts for approximately 8 minutes battery time and supplies 120 VAC.

4.5.1.5 +5, ±12 Vdc Power Supplies[10]

An EDACS **R**edundant **P**ower **S**upply ***(RPS)*** system is used with the GPS Simulcast Common Equipment Rack to increase the reliability of the simulcast system. The power supply modules used in this system operate on 120 VAC or 240 VAC and provide the system voltages *(+5 Vdc and* ±12 Vdc) and current required for operation.

4.5.1.5.1 EDACS Prism Power Supply System (EP2S).[11]

The EP2S Power Supply System replaces the UPS shelf and the +5, ±12 Vdc Redundant Power Supply (RPS) system. This EP2S Power Supply System provides a modular redundant power system capable of producing the various operating voltages required for EDACS or PRISM applications.

This power supply system *(EP2S)* consists of a power supply chassis (AC or DC), a fan module and up to six (6) BMR 910 series redundant power system modules. The EP2S power supply chassis houses the power modules and provides up to four (4) different DC voltage outputs; such as +5V, +12V, -12V, and +24V or +5V, -15V and +24V.

Incorporating the EP2S Power Supply System also involved a new power distribution panel. Power Distribution Panel 19C852636P1 was replaced with Power Distribution Panel SXA 120 4334/1. This panel provides DC power interconnections between the EP2S or the MPoDS and the individual units within the equipment rack.

4.5.1.5.2 Modular Power Distribution System (MPoDS)

The MPoDS replaces the EP2S power supply system. This system consists of power supply chassis SXK 104 3962/1 and power supply modules BMR 910 359/2. The power supply chassis houses the power modules, which provide +5/±12Vdc throughout the EDACS GPS Simulcast Common Equipment Rack. Power distribution is provided by connection to the power supply back panel. The power supply chassis is a self-contained power distribution panel and accommodates standard jacks that connect to cabinet harnesses. The power modules are fitted within the power supply chassis in order to provide the proper mix of voltages necessary for operation of the equipment rack.

4.5.1.6 +13.8 Vdc Power Supply

This is a +13.8 Vdc base station power supply capable of providing up to 435 watts.

4.5.1.7 Jackfields

The Common Equipment has three jackfields; T601-T603. T601 & T602 connect the Station Crossconnect panel to the MUX Crossconnect panel. T603 connects the Sync Shelf to the MUX Crossconnect panel.

[9] Replaced by EP2S power supply system.
[10] Replaced by EP2S power supply system.
[11] Replaced by the Modular Power Distribution System (MPoDS)

4.5.1.8 Integrated EDACS Alarm Test And Alarm Computer

The **I**ntegrated **E**DACS **A**larm ***(IEA)*** Test and Alarm computer interfaces with the GPS Simulcast system to monitor system parameters and alert the system operator of any fault conditions. The IEA also provides remote control for GPS Receivers, MUX and Base Stations.

4.5.1.9 GPS Receivers

Redundant GPS Receivers located at the Transmit Sites receive timing signals *(1 pps, 300 Hz, 9600 Hz)* from the GPS constellation and generate frequency standards *(10 MHz and 1.544 MHz)* for the EDACS GPS Simulcast system. A GPS Receiver consists of Spectracom GPS AGELESS™ OSCILLATOR, Model 8195. An antenna connects to the GPS ANTENNA port located on the rear panel of each oscillator. Outputs of the receivers connect to the inputs of 10 MHz Distribution Amplifier, Model 8143 *(*Figure 4-6*)*.

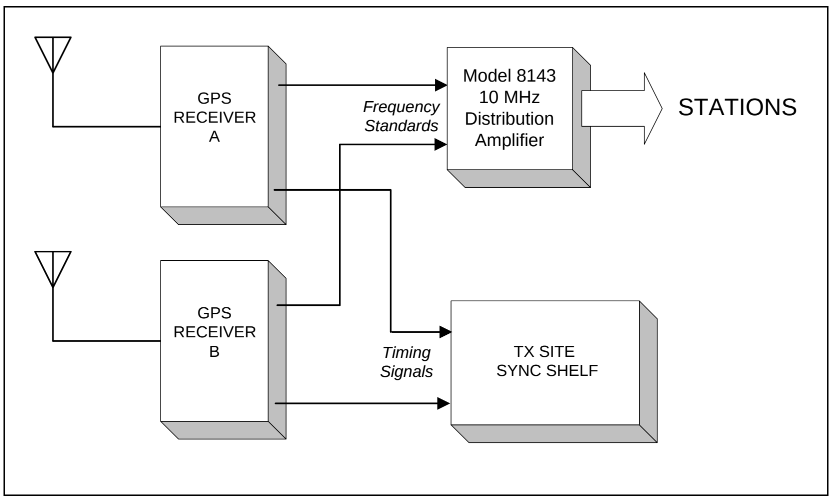


Figure 4-6: Redundant GPS Receivers

4.5.1.10 10 MHz Distribution Amplifier

The 10 MHz Distribution Amplifier, Spectracom Model 8143 produces a 10 MHz clock for Transmit Sites.

4.5.1.11 MUX Shelf

The GPS Simulcast Equipment Rack houses a single MUX Shelf. This shelf contain Intraplex TDM-160 Series MUX equipment. This equipment consists of five (5) modules as follows:

- CM-3A Module **-** T1 Common Module is used to configure and communicate with the MUX shelf.
- PCM or ADPCM Modules **- P**ulse **D**ifferential **M**odulation ***(PCM)*** or **A**daptive **D**ifferential **P**ulse **C**ode **M**odulation ***(ADPCM)*** Modules are used to digitize voice audio. The PCM card is for 1 voice channel per DSO time slot. The ADPCM card is for 2 voice channels per DSO time slot.
- Synchronous data Modules - pack five 9600 bps data streams *(10 E leads and 10 M leads)* onto a single T1 time slot.

- <u>Asynchronous Data Module</u> – Used for **L**ow **S**peed **D**ata ***(LSD)***, composite reference signals and **I**ntegrated **E**DACS **A**larm ***(IEA)*** system communications.
- <u>T1 Delay Module</u> – In each TX site multiplexer is used to compensate for T1 delays from the Control Point. **Note:** All data is in digital format on the T1, so the T1 delay compensation is applicable to all voice, data and LSD data streams.
- <u>Network Data Module</u> – Option to provide IP communication for IEA. Replaces one Asynchronous Data Module.

4.5.1.12 Remote Test Unit/Control Channel Monitor

The **R**emote **T**est **U**nit ***(RTU)*/C**ontrol **C**hannel **M**onitor ***(CCM)*** is used in the Transmit Site Common Equipment Rack to check the operation of the Control Channel by monitoring the channel for correct sync and message integrity. The RTU is also used to check the operation of the working channels by initiating a call request on the system. The RTU checks high and low speed data from the assigned working channel and the working channel GETC checks the high and low speed data from the RTU.

The CCM is used to obtain channel assignment and channel drop information from the control channel and provide it to the working channel GETCs. This information allows each working channel GETC to determine when it has been assigned a call and when the call is dropped.

4.5.1.13 Orion Radio

The Orion™ radio is the mobile radio used in the Remote Test Unit/Control Channel Monitor as described in the preceding paragraphs. The Orion radio has an FM dual-conversion, super-heterodyne receive circuit designed for operation in the 806-825 MHz and 851-870 MHz frequency ranges. The transmit circuit is designed to operated in the 806-870 MHz frequency range and is available in two power ranges, 12 watts or 35/30 watts.

4.5.1.14 Buffer Board

The buffer board provides level conversion, buffering and fault detection for the RTU and CCM. This is so that the output of the CCM ORION radio can be sent to the working channel GETC's on the Backup Serial Link *(BSL)*.

4.5.1.15 Power Distribution Panel

The Power Distribution Panel provides eight *(8)* connectors to distribute +5 Vdc, +12 Vdc, -12 Vdc and ground *(GND)* throughout the Control Point Common Equipment Rack. Each connector is configured as shown (Figure 4-7).

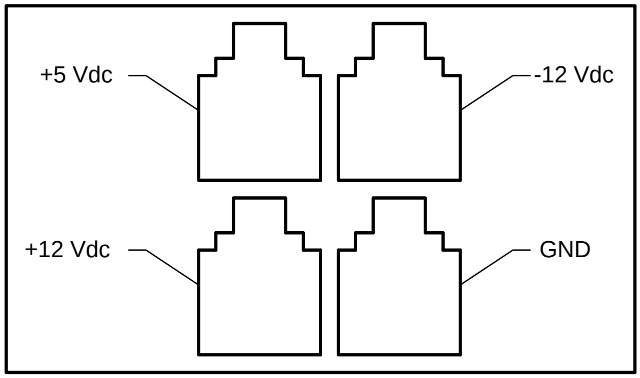


Figure 4-7: Power Distribution Panel Connectors (J1-J8)

4.5.2 Station Equipment Rack

The Transmit Site Station Equipment Rack completes the communications path and processes all control and interface functions between the mobiles in the coverage area and at the Control Point. It processes and resynchronizes information received from the Control Point and transmits analog and digital voice information and data.

The Station Equipment rack contains:

- MASTR III Base Station(s) up to four (4)
- EDACS GPS Interface Panel
- GPS Simulcast Station GETC
- AC Power Strip
- Station Power Supply
- Fan Assembly
- DC Power Panel

4.5.2.1 MASTR III Base Station

The MASTR III base station receives inbound voice and data form mobiles and portable radios. It then demodulates this information and passes it on to the GETC for I/O processing. The processed data is then sent to the GETC for I/O processing. The processed data is then sent to the MUX for transmission to the Control Point. Outbound data received from the Control Point MUX is routed through the Transmit Site GETC before being re-transmitted to the mobiles and portables. The MASTR III base station consists of:

- T/R Shelf
- Transmit Power Amplifier
- Station Power Supply
- Station GETC
- EDACS Interface Panel

4.5.2.1.1 T/R Shelf

The MASTR III **T**ransmit/**R**eceive ***(T/R)*** Shelf contains the station control electronics. The station control electronics consist of a backplane board, power module, system module and an interface board. The backplane also connect the RF section which consists of the receive circuit synthesizer module, first IF module, second IF module and the transmit synthesizer module.

4.5.2.1.2 Transmitter Power Amplifier

The transmitter power amplifier amplifies the input signals received from the T/R shelf for transmission.

4.5.2.2 EDACS GPS Interface Panel

The EDACS GPS Simulcast interface panel allows quick and easy interconnections of all audio and control functions in an EDACS GPS Simulcast Communication System. The interface panel provides the ability to couple control functions of multiple stations on a single 25 pair cables. The Interface Panel can connect up to three *(3)* such cables plus one serial cable. This panel also provides all intra-cabinet wiring to common connector panels.

4.5.2.3 GPS Simulcast Station GETC

The GPS Simulcast Station GETC is used to provide control interfacing to the MASTR III base station, site controller, dispatch console and other trunked stations at the same transmit site. The GETC shelf assembly consists of a GETC Logic board, +5 Vdc Regulator Assembly, Turbo Board, GETC Interface Module and a GETC Surge Protector.

4.5.2.4 AC Power Strip

The AC power strip contains three dual AC outlets mounted in a metal housing with power cord.

4.5.2.5 Station Power Supply

In AC systems the station power supply provides all necessary power to operate a single base station, including dc power for the power amplifier and the ac power for the fan assembly. It supplies 26 Vdc at 15 amperes and 13 Vdc at 3 amperes to the base station from either a 120 Volt or 230 Volt ac source.

4.5.2.6 Fan Assembly

This is a 120 VAC Fan providing cabinet cooling.

4.5.2.7 DC Power Panel

The DC Power Panel is used in 12/24 Vdc applications. This panel provides a bus distribution of a 12 Vdc or a 12/24 Vdc power source.

4.5.3 RF Equipment Rack

The RF Equipment Cabinet/Rack contains 800 MHz specific combining/multicoupling equipment:

- Filtronic-Comtek FR190-CA101-F1V1-B FINITY Tower Top Amplifier
- Decibel Products DB8062F Transmit Combiners
- Filtronic-Comtek FR190-CA167-F1V1-B FINITY Receiver Multicouplers (8 Channels)

4.5.3.1 Transmit Combiners

Transmit combiner*(s)* are used to connect multiple RF channels from the outputs of multiple transmit power amplifiers to a single antenna system. This series of transmit conbiners are used in either a trunked or conventional communication system. A single combiner allows two transmit channels to be phased together in to a single output. Using multiple combiners, up to a maximum of 20 channels can be combined in to a single output.

A combination of Decibel isolators, DB4345-A, DB4345M-A or DB4345-2C, are provided for each RF channel to protect against the possibility of transmitter intermodulation. For the ease of required frequency adjustment, a BNC tuning port is provided on the face of each combiner. RF channels can be added one at a time or in groups up to 10 channels utilizing standard phasing harness. Adding more than 10 RF channels may require high-power tee connectors at the phasing cables and one at the input to the antenna cable *(Refer to the vendor installation and operations manual).*

4.5.3.2 Receiver Multicouplers

Receiver Multicouplers permit connection of multiple receive circuits to a single antenna system and generally provide improvement in overall system receive sensitivity. Each Receiver Multicoupler consists of a chassis, preselector, amplifier, power supply and power divider *(splitter)* arrangement. All unused outputs should be terminated with dummy loads.

Electrically the receiver Multicoupler distributes the output of a single antenna system to a number of receive circuits and maintains or improves overall system sensitivity. The Multicoupler should provide good impedance matching. splitter losses are overcome by the amplifier gain and inputs are limited to only desired signals by the preselector filters. A lightning surge protector protects AC power inputs.

The Inifinty™ system includes a Receiver Multicoupler and a matched Tower Top Amplifier. This subsystem is essential to achieving the desired performance in the 800 MHz band and is standard equipment in GPS Simulcast system. This subsystem provides balanced coverage for three-watt hand-held portables. Such a portable will have the same "Talk-Back" capability as the base stations *(Refer to Infinity System Maintenance Manual AE/LZB 119 3103/1).*

5. GLOSSARY

Alignment

Adjustment of amplitude and phase characteristics of analog signals. The signals from the base stations at each Transmit Site are aligned to match in the overlap zone.

Bypass

Removal a site(s) from simulcast and have that site function as an autonomous system on a subset of its channels with these same channels removed from the main system.

Capture

A radio receiver is *captured* by a signal when that signal mean power lever is approximately 10 or more decibels *(dB)* above any other RF signal.

Control Point

The geographic location containing the simulcast control equipment, site controller and voters. Typically, the Control Point is co-located with the dispatch center.

Constellation

This is in reference to 24 earth-orbiting GPS satellites that provide precise timing signals world-wide.

DVIU

Digital Voice Interface Unit

EDACS

Enhanced Digital Access Communications System, Harris' advanced trunked radio system.

GPS

Global Positioning System. A collection of 24 celestial satellites and Earth-based receivers used to generate precise timing and frequency information.

IEA

Integrated EDACS Alarm system used to monitor system parameters and alert the operator of a fault condition.

Non-Stop Trunking

The EDACS design utilizes distributed processing to control the trunking function and to permit the system to keep trunking in the event of a site controller failure.

Offset

As the distance between the transmitter and receiving radio increases, the bit stream is delayed or offset to one another.

Optimization

Adjustment of timing parameters and signal level to minimize data errors in the overlap zone.

Overlap Zone

Geographic region between Transmit Sites where average signals levels are approximately equal.

Pro-Sync

An algorithm which tells the transmit site when to start sending data to the user radios by placing a marker in the data stream every 60 seconds.

Receive-Only Site

Geographic location containing auxiliary receivers with no transmitters. Receive-only sites may be used to enhance portable talk-back coverage.

Roam

The ability of a mobile two-way radio to move from one simulcast system to any other EDACS system, simulcast or otherwise.

RX

Receive

Simulcast

The simultaneous broadcast of the same signals from multiple locations using the same RF frequency channels.

Talk Back

The ability of a land mobile user to actually *"talk back"* to a dispatcher or other mobile radio.

T1

North American standard bit stream (1.544 Mbps) used to connect the Control Point to the Transmit Sites. Supports 24 *(DSO)* channels.

Transmit Site

Geographic location containing base stations and simulcast equipment used to transmit and receive land mobile radio signals.

Transmission Resource Interface (TRI)

EDACS equipment that combines analog and digital signals into a T1 data stream, controls the timing of that stream, and monitors the T1 link.

TX

Transmit

Voter

Electronic subsystem that selects the best analog and digital signals from multiple remote sites.

Voter Digital Interconnect *(VDI)*

This line is used with Digital Jessica which requires a dedicated path from the Voter Digital Selector to the CPTC. This paths allows a terminal to drop the working channel when Digital Jessica is operation. The normal path from Voters to CPTC is interrupted by the Digital Interconnect from the switch (IMC).

Wide-Area

Two-way radio communications over a large geographical area.

APPENDIX
(MAINTENANCE MANUALS)

INSTALLATION AND MAINTENANCE MANUALS

The following table provides a listing of all manuals required for the GPS Simulcast System. This table is divided into three categories:

- OVERVIEW & INSTALLATION
- CONTROL POINT
- TRANSMIT SITE

Title	Publication Number
OVERVIEW & INSTALLATION	**MM21659-0001**[12] ***(Volume 1)***
OVERVIEW	LBI-39194
GPS Simulcast System Drawings	LBI-39207
INSTALLATION	LBI-39206
Ductwork	LBI- 38875
Electrostatic Discharge Protection	LBI-38737
Standard For Site Grounding and Protection	AE/LZT 123 4618/1
Jumper And Switch Settings	AE/LZB 119 2907/1
Alignment Procedure	LBI-39210
Troubleshooting Guide	AE/LZB 119 2904
IEA Test And Alarm Computer (Introduction, Operation, Configuration)	LBI-39209
CONTROL POINT	
COMMON EQUIPMENT RACK	**MM21659-0002**[13] ***(Volume 2)***
GPS 1.544 MHz Distribution Amplifier (Spectracom, Model 8144)	
GPS Receiver (Spectracom, Model 8195)	
Control Point Trunking Shelf	AE/LZB 119 1916/1
Control **P**oint **T**runking **C**ard (**CPTC**)	AE/LZB 119 1886
Turbo Board ROA 117 2239	AE/LZB 119 1887
Simulcast Interface Card	AE/LZB 119 1888
Jackfield (S01-S20) (ADCP-80-320)	
Synchronizer Shelf	AE/LZB 119 1903
GPS Timing Module	AE/LZB 119 1875
Low Speed Data Selector Module	AE/LZB 119 1880
ReSync Module	AE/LZB 119 1876
Audio ALC Module	AE/LZB 119 1878

[12] Replaced AE/LZB 123 3252/1.
[13] Replaced LBI-39211/1.

Continued

Continued

Title	Publication Number
IEA Test And Alarm Computer Maintenance Manual	AE/LZB 119 2898/1
Alarm Crossconnect Panel	AE/LZB 119 2896/1
Rack Mount Chassis (Model C19-C01)	
CPU Card (Model P575/90/120)	
CPU Quick Reference Card (Pub. # 21093D)	
Video Board (Diamond Stealth 64 PCI/DRAM)	
Video Extender (Cybex Inc. PEUE_TRANS)	
216 Point Digital I/O Board (Model PCDIO *(Pub. # 00431-050-23A)*	
48 Point Analog Board (CIO-DAS48-PGA)	
48 Point Digital I/O Board (IOD-48S)	
Hard Disk Drive (HAWK 2XL *(Pub. # 77767490)*	
3-1/2" Disk Drive (TEAC FAX LINE)	
Monitor User's Guide (17GS)	
5/+12/-12 Power Supplies (UPS)	LBI-39038
Power Distribution Panel (UPS)	LBI-39158
EDACS PRISM Power Supply (EP2S)	AE/LZB 119 3077/1
Power Distribution Panel (EP2S & MPoDS)	AE/LZB 119 3078/1
Modular Power Distribution System (MPoDS)	EN/LZB 119 3912/1
TRANSMIT CONTROL TEST RACK	**MM21659-0003**[14] ***(Volume 3)***
Control Panel	LBI-38482A
Control Panel Crossconnect	AE/LZB 119 2908/1
Transmission Test Set	*(Vendor)*
Oscilloscope	*(Vendor)*
Alignment Receiver	LBI-39213
+13.8 Volt Power Supply	LBI-38550
AUDIO DISTRIBUTION AND MUX RACKS	**MM21659-0004**[15] **(V*olume 4)***
MUX Shelf (Intraplex, TDM-160 Series)	
Jackfields (ADCP-80-320)	
Audio Distribution Shelf	AE/LZB 119 1919/1
Audio Distribution Module	AE/LZB 119 1879
MUX Distribution Panel B401	AE/LZB 119 3112/1
Distribution Panel B402	AE/LZB 119 2895/1

Continued

[14] Replaced LBI-39211/2.
[15] Replaced LBI-39211/3.

Continued

Title	Publication Number
VOTER INTERFACE RACK	**MM21659-0005**[16] ***(Volume 5)***
Modem Shelf	LBI-38478
MUX Shelf (Intraplex, TDM-160 Series)	
Voter Crossconnect Panel *(6 Sites)*	AE/LZB 119 3121/1
Voter Crossconnect Panel *(7 - 17 Sites)*	AE/LZB 119 3122/1
Digital Dispatch Module	LBI-3921
Power Distribution Panel (UPS)	LBI-39158
Power Distribution Panel (EP2S & MPoDS)	AE/LZB 119 3078/1
AC Power Strip	LBI-4841
TRANSMIT SITE	
SIMULCAST EQUIPMENT RACK	**MM21659-0006**[17] ***(Volume 6)***
Standard For Site Grounding and Protection	AE/LZT 123 4618/1
Electrostatic Discharge	LBI-38737
GPS Simulcast System Drawings	LBI-39208
GPS Simulcast TX Site Cable Drawings	LBI-39216
Simulcast Cable Drawings	LBI-38878
Simulcast Equipment Rack	LBI-39217
Station Cross Connect Panel	AE/LZB 119 1873
Signal Selector/10 MHz Distribution Amplifier (Spectracom., Model 8143)	
GPS Receiver (A/B) (Spectracom, Model 8195)	
MUX Shelf (Intraplex, TDM -160)	
Jackfields (ADCP-80-320)	
Synchronizer Shelf	AE/LZB 119 1903
Bypass Module ROA 117 2278	AE/LZB 119 1881
ReSync Module ROA 117 2263	AE/LZB 119 1876
GPS Module ROA 117 2260	AE/LZB 119 1875
Transmit Site Interface Panel	LBI-39205
Bypass Mapping Module	AE/LZB 119 1883
Diagnostic/Programming Module	LBI-38813
Rocket Port Module (RocketPort 16)	
Test Radio/ Control Channel Monitor	AE/LZB 119 1885
Orion Control Channel Monitor Buffer Board	AE/LZB 119 1877
+13.8 V Power Supply	LBI-38550

Continued

[16] Replaced LBI-39211/4.
[17] Replaced LBI-39199/1.

Continued

Title	Publication Number
+5/+12/-12 V Power Supply (UPS)	LBI-39038
Power Distribution Panel (UPS)	LBI-39158
EDACS Prism Power Supply (EP2S) System	AE/LZB 119 3077/1
Modular Power Distribution System (MPoDS)	EN/LZB 119 3912/1
Power Distribution Panel (EP2S & MPoDS)	AE/LZB 119 3078/1
GPS Receiver (Model 8195)	
Signal Selector (Model 8143)	
STATION EQUIPMENT RACK	**MM21659-0007**[18] ***(Volume 7)***
Station GETC Shelf	LBI-39200
Station GETC	LBI-38894
Turbo Board	LBI-38822
GETC Configuration	LBI-38988
GETC Interface Module ROA 117 2269	AE/LZB 119 1659
GETC Protector Module ROA 117 2275	AE/LZB 119 1660
MASTR III Station	
EDACS GPS Simulcast MASTR III Station	LBI-39197
MASTR III Transmitter Combination Manual	LBI-38775
EDACS GPS Simulcast Interface Panel	LBI-39198
Programming/Diagnostic Module 19C852204	LBI-38813
BSL/FSL Module 19C852226	LBI-38818
Mapping Module ROA 117 2259	AE/LZB 119 1871
800 MHz RF Package	LBI-39025
AC Power Strip	LBI-4841
Fan, 120 VAC	LBI-4842
Power Supply	LBI-38551
Fuse Panel	LBI-39146
RF EQUIPMENT RACK & TEST AND ALARM COMPUTER	**MM21659-0008**[19] ***(Volume 8)***
Transmitter Combiner (DB8062F *(095366-000-A))*	
Receive Subsystem for 800 MHz Private Radio Systems	AE/LZB 119 3103/1
IEA Test And Alarm Computer (Introduction, Operation, Configuration)	LBI-39209
IEA Test And Alarm Computer Maintenance Manual	AE/LZB 119 2898/1
Alarm Crossconnect Panel	AE/LZB 119 2896/1
Rack Mount Chassis Model C19-C01	
CPU Card Model P575/90/120	
CPU Quick Reference Card Pub. # 21093D	

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[18] Replaced LBI-39199/2.
[19] Replaced LBI-39199/3.

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Title	**Publication Number**
Video Board Diamond Stealth 64 PCI/DRAM	
Video Extender Cybex Inc. PEUE_TRANS	
216 Point Digital I/O Board (Model PCDIO *(Pub. # 00431-050-23A)*	
48 Point Analog Board (CIO-DAS48-PGA)	
48 Point Digital I/O Board (IOD-48S)	
Hard Disk Drive (HAWK 2XL *(Pub. # 77767490)*	
3-1/2" Disk Drive (TEAC FAX LINE)	
Monitor User's Guide (15GS or 17GS)	