

ST200 Series
(ST211, ST221M & ST251)
Satellite Communication Systems

Technical Support Manual



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1.0 Introduction

This manual provides the basic information required to successfully sell, distribute, and maintain the Mitsubishi ST200 Series satellite terminals. The ST200 Series include the following configurations:

- ST211 land mobile
- ST221M fixed site
- ST251 OmniQuest[®] transportable

This document, ST200TSM02, replaces all Technical Support Manuals previously published by Mitsubishi Electronics America, Inc. (MELA) as it combines and updates the contents of the ST200TSM01 and the ST251TSM01 into one comprehensive manual.

Distributors and other sales/service agents should use this reference document for training staff and addressing typical questions and problems from the field. Two portions of this manual warrant special attention: Sections 8.0 and 9.0. The first details MELA's product support policies and procedures. The second describes key operational considerations that can prove useful in addressing frequently asked questions. This manual is posted on MELA's web site (www.melamsat.com) in PDF format. Distributors are encouraged to download, print and distribute copies to all personnel involved in the MSAT business.

For consistency with previous manuals and concise notation this document uses the terms Mobile Terminal (MT), Mobile Earth Terminal (MET), satellite terminal, satellite communications system and satellite telephone interchangeably.

2.0 System Overview

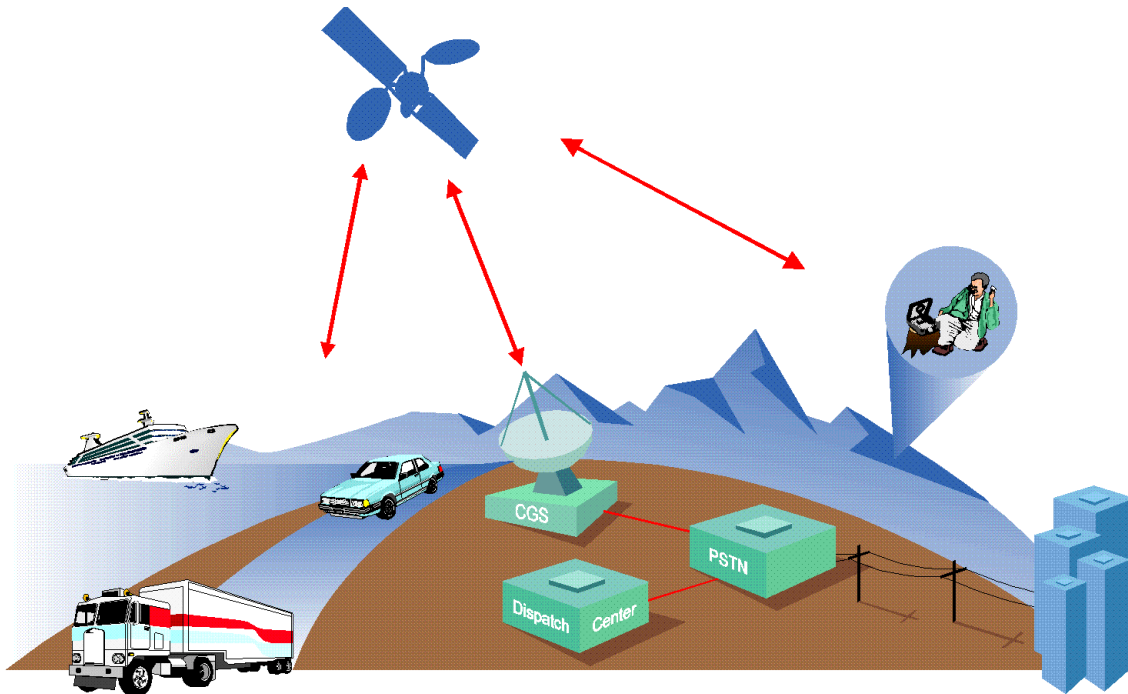
The Mitsubishi mobile satellite telephone products are designed to work on the MSAT (L-Band) satellite system anywhere in North and Central America including Alaska, Hawaii, the Caribbean, and 200 miles of coastal waters. There are currently three satellite network providers: American Mobile (AMSC) located in Reston, Virginia, TMI Communications Ltd., located in Ottawa, Canada and Telecomunicaciones De Mexico (Telecom), located in Mexico City, Mexico. The Mitsubishi MSAT products addressed in this manual are sold and distributed in North and Central America by authorized distributors and resellers.

The MSAT system comprises a satellite segment, communications ground segment (CGS) and a mobile terminal segment.

2.1 Satellite Segment

The satellite segment acts as a relay site, similar to a cellular communications base station. It passes signals to and from the CGS and MTs. AMSC launched its satellite (AMSC-1) into

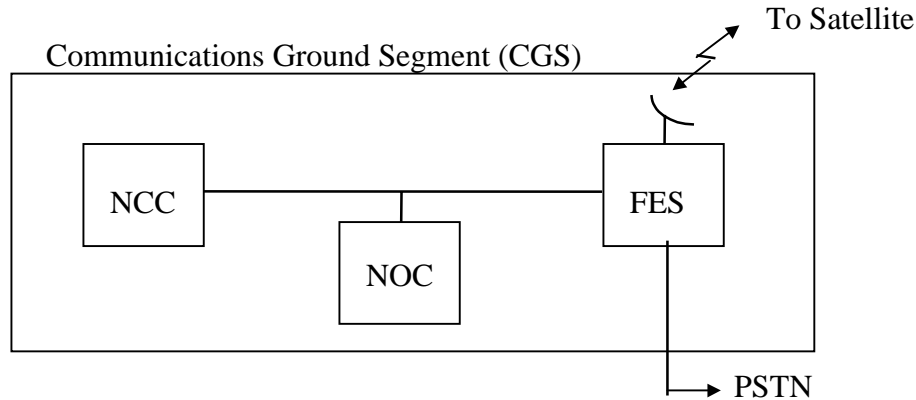
geosynchronous orbit (~ 22,300 miles / 36,000 km altitude). The MSAT satellite is one of the most powerful communications satellites on-orbit (>500,000 Watts) and is capable of seamless North American and Central American coverage. Hughes Communications designed the MSAT satellite with relatively large antennas, allowing for relatively small MT antennas.



2.2 Communications Ground Segment

The CGS routes all MT calls and provides the interface to the Public Switched Telephone Network (PSTN). The ground segment also provides feeder communications to the satellite, establishes channels for end-user calls, and managing system resources. AMSC's CGS is located at AMSC headquarters in Reston, Virginia with a backup facility located 26 miles south of this location. TMI's CGS is located in Ottawa, Ontario and Telecom's CGS is located in Mexico City.

CGS subsystems include the Feederlink Earth Station (FES), Network Communication Controller (NCC), and Network Operations Center (NOC). The FES links the signaling channels between the satellite and the NCC and communications channels between the satellite and the PSTN. The NCC uses these signaling channels to manage all communication system resources through a variable number of Control Groups (CG). Each control group uses specific signaling channels for specific MTs. The NOC oversees the entire operation, including billing and customer service.



2.3 Mobile Terminal Segment

As end-user equipment, MTs transmit and receive signals to and from the CGS via the satellite. MSAT terminals include land mobile, transportable, fixed, maritime, and aeronautical applications. Each Mitsubishi MT comprises three functional units: Antenna Unit (AU), Transceiver Unit (TU), and one or more user interfaces (like handsets or a personal computer).

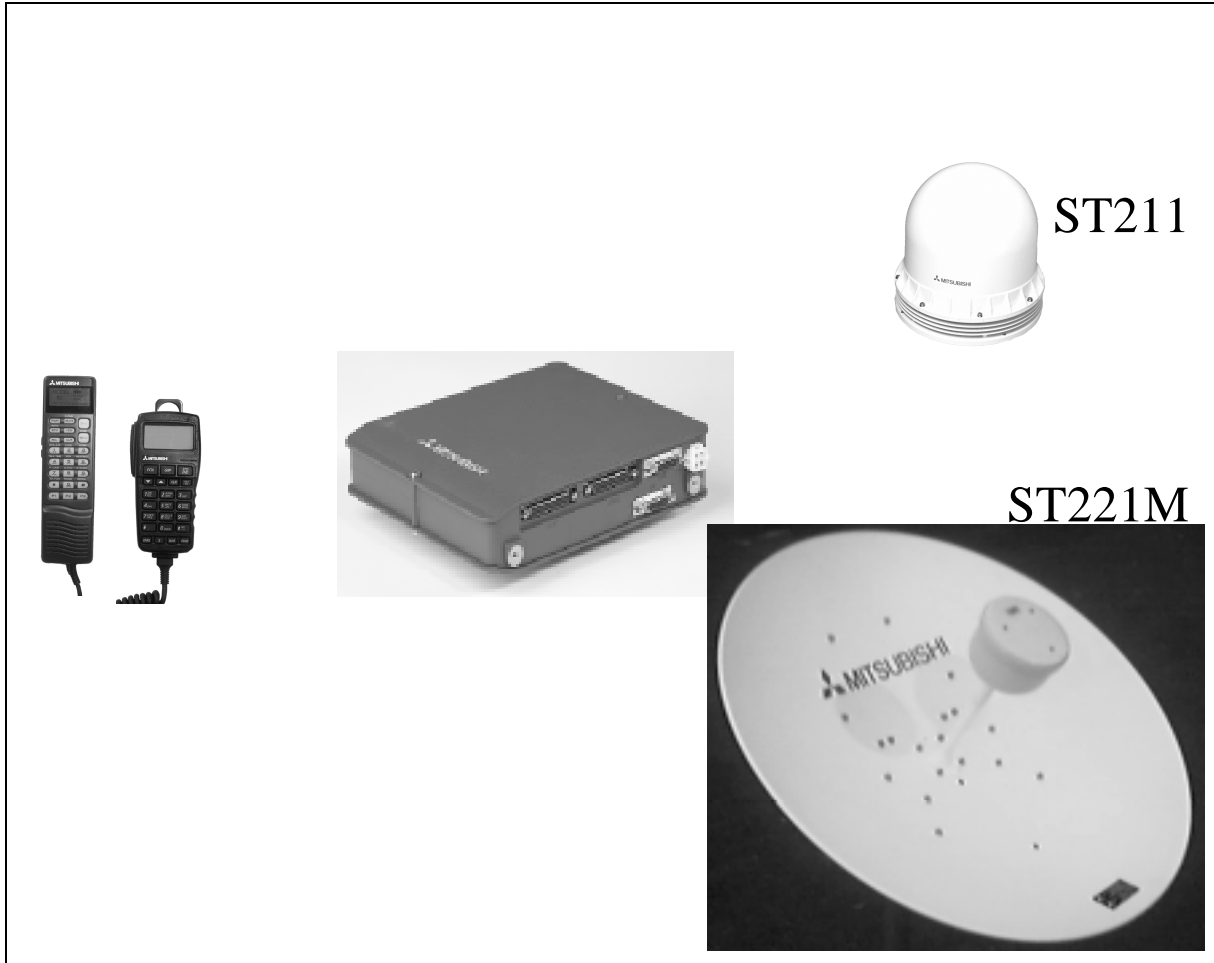
3.0 Product Overview

3.1 General Overview

The ST211 terminal includes a transceiver, beam steering unit, and handset or user terminal options. The beam steering unit is a small gyroscope that determines vehicle motion for mobile satellite tracking.

The ST221M fixed site terminal comprises the same major components as the land mobile configuration, minus the beam steering unit. The parabolic antenna in this high gain configuration replaces the dome type antenna in the land mobile unit. The ST221M also includes an AC/DC power supply.

Standard items and optional accessories provide basic digital voice, wide area dispatch and data capabilities. Mitsubishi land mobile and fixed site antennas physically incorporate the radio frequency electronics, easing installation and troubleshooting. The following figures show the primary elements of the ST211 and ST221M configurations respectively.



The ST251 OmniQuest[®] transportable terminal is one of the most versatile satellite communications systems available to date offering many unique features and capabilities. OmniQuest[®] is an integrated portable terminal containing the transceiver, antenna, battery and handset as depicted below.



3.2 Key Features

All Mitsubishi MTs are easy to operate. The basic handset, for point-to-point calling, looks and operates like a cellular phone. There are three one-touch speed dial keys and 99 alphanumeric memory locations. The handset permits any key answering, displays received signal strength, and lets users enable special features from a menu of functions. Optional accessories also allow users to operate in a hands-free mode.

All MTs accommodate service offering for wide area dispatch with an optional push-to-talk handset (shown above) and circuit switched data at 4800 bits per second.

Three new features have been added to these second-generation MTs: Horn Alert, Auto-Power-On and Echo Cancellation. Horn Alert is ideal for those with Land Mobile applications who need to be able to hear the MT ringing while away from their vehicle but while still nearby. Auto-Power-On allows the user to set the MT to automatically power on once the vehicle's engine is started (just like a car radio when left on). The software-based echo cancellation feature allows users to avoid having to install an echo canceler board in the TU.

3.3 Product Positioning

The mobile, fixed and portable terminals deliver communication where there is no existing infrastructure; or when other systems fail or become overloaded. These MTs do not compete with terrestrial offerings like cellular or PCS. However, for those companies and industries that need seamless communication, Mitsubishi MTs are a viable solution. Seamless coverage and a flat airtime rate are important for prospects who operate in multiple locations on an on-going basis.

These MTs offer top-notch brand name recognition, reliability, and quality that Mitsubishi supports with an in-warranty replacement program.

3.3.1 Target Markets

Mitsubishi mobile, fixed and portable configurations effectively address several niche markets:

- ◆ Industries that operate expansive networks like telecommunications, energy, and utilities can more efficiently manage their field units with Mitsubishi land mobile terminals.
- ◆ Remote site industries, like those involved in construction or natural resource extraction, can employ Mitsubishi fixed site MTs for communicating with isolated management or operation centers. This market also extends to the tourist industry with remote hunting and fishing lodges.
- ◆ All configurations also address large corporations or institutions—that because of geography or regulation—require back-up or contingency communications.

Companies in California and Florida in the US and other locations throughout Canada and Central America are especially receptive to this concept. Further, companies involved in transporting or working with hazardous materials like nuclear power generation and HAZMAT transportation must have an emergency mode of communications.

3.3.2 Applications

Specific MSAT applications for land mobile, fixed site and portable MTs exist throughout North and Central America today. The following examples may provide some additional insight for sales and marketing forces. The list is not exhaustive:

- ◆ **Telecommunications companies** have purchased land mobile and transportable MTs for operating and maintaining land lines, both fiber optic and wire. Mitsubishi MTs can improve the efficiency of field units responding to fiber optic cable failure, saving a lot of money. These companies typically use dispatch service.
- ◆ **Oil and gas companies** use land mobile MTs for regular pipeline maintenance operations. Maintenance trucks testing pressures and physical integrity throughout the extent of a pipeline or segment of pipeline can remain in constant communications. This concept is very similar to that employed in the telecommunication industry.
- ◆ **Mining and construction companies** can more effectively conduct day-to-day business from even the most remote locations. Their business may require continuous communications with other remote sites, fleets on the road, and headquarters through the PSTN. Day-to-day business may just entail a report at the end of each day—either voice or data.
- ◆ **Any large corporation** in regions prone to natural disasters, like the West Coast or Gulf States, can use MTs for contingency communications. This application is not the same as back-up communications for conducting business operations. Rather, contingency communications link key executives and decision-makers for implementing already existing recovery and response plans.
- ◆ **Hospitals, nuclear facilities, and HAZMAT trucks** require some form of emergency communications for public safety reasons. Dedicated channels or high availability channels can save lives during emergency situations that can disable or degrade the existing terrestrial infrastructure. As a simple example, any cellular telephone user in a major metropolitan area knows that even a minor traffic accident on a commuter route can saturate capacity as hurried drivers begin making calls. More severe emergencies exponentially degrade consumer-type systems.

4.0 Product Description

4.1 General

The land mobile MT consists of a Common Transceiver Unit (CTU), a medium gain antenna, handset, cradle and junction box (J-box), Beam Steering Unit (BSU) and all required cabling.

The fixed site configuration also includes a CTU, handset, parabolic antenna, AC/DC power converter, all required cabling, cradle, and junction box. The ST221M standard kit includes a 50 foot (15 meter) CTU to AU cable set. Other cable options might be available through certain distributors.

The OmniQuest® ST251 is a complete communications terminal containing a Transceiver Unit (TU), Antenna Unit (AU), Handset, Battery and an AC Adapter/Charger. The antenna unit is conveniently mounted in the notebook lid providing a very efficient design that allows for quick and easy setup. All standard equipment fits in the soft carrying case provided with OmniQuest®.

Optional accessories are available for all terminals for added functions and capability. Wide-area or digital dispatch requires an optional Push-To-Talk (PTT) handset. Note: availability of system features may vary based on service provider offerings. The following tables summarize standard and optional MT components, respectively.

Standard ST211 Land Mobile MT Components

Part Number	Description
TU200A	CTU, Mounting Kit
AU201A	AU, Mounting Kit, 18' (5.5m) AU-TU Cable
AU1200A(S)	BSU, Mounting Kit
SZ130A	Cradle-3, Junction Box, Mounting Kit
SZ460A	20' (6m) Power Cable
SZ100A	Basic Handset
ST200N02	Owner's Manual

Standard ST221M Fixed Site MT Components

Part Number	Description
TU200A	CTU, Mounting Kit
AU601B	AU, Mounting Kit
SZ130A	Cradle-3, Junction Box, Mounting Kit
PUP-55-13-J9	AC/DC Converter
FSC50	50' (15m) AU-TU Cable Kit
SZ100A	Basic Handset
ST200N02	Owner's Manual

Standard ST251 MT Components

Part Number	Description
NT100A	Base Unit (includes integrated antenna, antenna electronics and removable transceiver unit)
SZ100A	Handset w/ Curl Cord
OQ-CRADLE	Cradle
SZ511A	NiMH Battery Pack
SZ503A	AC Adapter/Charger
ME-SN	Carrying Case
ME-COM	Compass
OQ-REF1	Quick Reference Card
ST251NO1	Operating Instructions

Optional Components

Part Number	Description
SZ300A	PTT Handset; <i>for wide-area dispatch</i>
FZ1283A	Monitoring Speaker; <i>for hands free operation</i>
FZ806A	External Microphone; <i>for hands free operation</i>
OQFAU50	Fixed Dish Antenna w/50 ft cable <i>for OmniQuest fixed site use</i>
OQFAU100	Fixed Dish Antenna w/100 ft cable <i>for OmniQuest fixed site use</i>
SZ351A	Junction Box <i>for wide-area dispatch w/OmniQuest</i>
SZ601A	Cigarette Lighter Adapter <i>for OmniQuest</i>
SZ511A	Additional Battery <i>for OmniQuest</i>

4.2 Antenna Units

4.2.1 Dome Antenna Unit

The Dome AU (AU201A) contains a single helical antenna element mounted on a ground plane which is fixed in elevation angle and mechanically steerable in azimuth. The AU201A houses the RF Electronics Unit (RFU) underneath the antenna. The RFU includes a high power amplifier, low noise amplifier, diplexer, and control electronics. The antenna gain is approximately 9 dBi, with nominally 20 Watts of L-Band RF energy (~1.6 GHz). The Dome AU receives steering commands from the BSU, through the CTU.



WARNING: Stay 6 inches (15 cm) away from the antenna while transmitting

NOTE: The AU antenna cable connection at the CTU must be firmly secure prior to operation. Loose or improper connection may render the terminal inoperable (not able to power on) or result in error messages.

4.2.2 Fixed Site Antenna Unit

The Fixed Site AU (AU601B) is a parabolic antenna (with feed horn) which physically incorporates the RFU, including high power amplifier, low noise amplifier, and diplexer. The AU601B provides a gain of approximately 20 dBi and nominally emits 20 Watts in L-Band (~1.6 GHz).



WARNING: Stay 26 inches (60 cm) away from the antenna while transmitting

NOTE: The AU cable connections at the antenna and at the CTU must be firmly secure prior to operation. Loose or improper connections may render the terminal inoperable (not able to power on) or result in error messages.

4.3 Common Transceiver Unit

The land mobile and fixed site MTs utilize a Common Transceiver Unit (CTU), the TU200A, which provides interfaces for AUs, handsets and data devices, as well as managing signaling and communications with the CGS via the satellite. The CTU demodulates and processes received antenna signals; process, modulate, and send outgoing signals to the antenna for transmission; and manages all handsets, data devices and other accessories.

In addition to providing the major MT interfaces, the CTU is comprised of a main board, converter board and necessary power supplies. The main board multiplexes, scrambles, encodes, and interleaves signals in addition to providing frame-formatting functions. Its logic and signaling subsystem provides the central control of the MT to initialize self tests, setup/configure

the CTU, handle protocols, and manage control signals and messages with handset(s) and data devices. A logic and signaling processor in the main board includes a CODEC for analog and digital conversions of voice signals. The CTU converter board contains the necessary frequency synthesizers, up and down converters, and the QPSK modulator.

The most current CTU configuration accommodates 4800 bits per second data communications, a satellite acquisition algorithm that speeds network access, and advanced service features. The availability of advanced service features depends on the specific offerings of each service provider, but can include:

- ◆ Call Line Identification (Caller ID) and Caller ID Restriction—Handset displays the caller's phone number or protects your phone number from such devices
- ◆ Connected Line Identification and Connected Line Restriction —Handset displays the phone number of the party who you called or protects your phone number from such display
- ◆ Call Transfer—Transfers a call in progress to a third party without any previous connection
- ◆ Call Forwarding and Voice Mail—Forwards incoming calls to another number (without ringing) or to a voice mailbox when your phone is busy or unattended
- ◆ Call Waiting—Notifies the user of an incoming call during a conversation and allows switching between these calls
- ◆ Conference Calling—Allows conversations with several parties simultaneously
- ◆ Call Barring—Restricts placing one or more types of calls
- ◆ Alternate Account Charging—Allows billing to specific accounts for particular phone calls
- ◆ Enhanced Fraud Protection—Requires a four digit PIN, that the service provider assigns, to complete dialing

4.4 CTU Cradle and Junction Box

The cradle and junction box provide the appropriate interfaces for the basic handset and accessories with the CTU. The handset cradle package (SZ130A) includes a clip mount with an RJ-45 handset interface and the junction box (SZ350A) interface for accessories (PTT handset, monitoring speaker, and hands free microphone).

NOTE: All connections between the basic handset and the CTU must be firmly secure. Loose or improper connections may render the terminal inoperable (not able to power on) or result in error messages.

4.5 Beam Steering Unit

The Beam Steering Unit, or BSU (AU1200A), is a small component that attaches to the side of a CTU in the land mobile configuration. Its piezo-electric gyroscope and control system sense changes in vehicle direction. The BSU feeds these measurements directly through the CTU to the antenna for closed loop tracking. The CTU also processes this information for optimizing its system management functions. Section 5 includes additional information on antenna pointing.

The BSU must be mounted within $\pm 5^\circ$ of vertical (relative to the ground) for proper operation. For rapid satellite acquisition and lock, the vehicle should remain stationary or move along a straight path for the first ten (10) seconds of MT operation.

4.6 CTU Power Components

The power cable (SZ460A) connects from a vehicle's 12 Volt battery line directly to the CTU in a land mobile configuration. The power cable has a +12V power line, a +12V ignition sense line, and a ground line. The power and ignition sense lines each contain a 10A in-line fuse which protects the CTU and the vehicle's electrical system.

The PUP-55-13-J9 AC/DC converter provides 13.8 V at 55 Watts of continuous output power to the fixed site ST221M. This unit is enclosed in a polycarbonate case with an IEC320 inlet connector, which allows interchangeable power cords for international use. All models meet VDE class B and FCC class B emissions limits, and are approved to UL, CSA, and CTUV safety standards.

4.7 OmniQuest® Description

A brief description of each of the main components of OmniQuest® is provided below.

4.7.1 Base Unit

The OmniQuest® Base Unit (NT100A) houses all of the main electronics of the system including the Antenna, Radio Frequency Unit (RFU), removable Transceiver Unit (TU), and power electronics (including internal battery). Latches are included to secure the antenna and TU and a release lever secures the battery pack when the door is open.

NOTE: The TU and the battery are the only removable sub-assemblies in the OmniQuest®. The electronics contained in the RFU (within the NT100A unit), the antenna lid and the TU201A subassemblies are not serviceable outside MELA's service center. Distributors and their agents should not attempt to access these electronics unless authorized by MELA (does not apply to Battery Pack).

4.7.1.1 Antenna

The integrated lid Antenna receives signals transmitted from the satellite and transmits signals provided from the RFU. The OmniQuest® Antenna is comprised of a two element planar array patch antenna integrated into the lid and connected to the OmniQuest® Base Unit. The antenna provides a gain of approximately 10.8 dBic and emits 20 Watts of RF energy nominally in the L Band frequency range (~1.6 GHz).



WARNING: Stay 2 feet (24") / 61 cm away from the antenna while transmitting

The OmniQuest® antenna must be manually pointed at the satellite which is aided by using the Quick Reference Card and compass provided in the standard carrying case. Because the beamwidth of the antenna is fairly wide (~30°), approximate pointing of the antenna is easy. Once the approximate location of the satellite has been established, the pointing angle can be fine tuned by using the Received Signal Strength Indicator (RSSI) displayed on the Handset (i.e., approximate or initial pointing of the satellite needs only to be accurate enough so that a signal can be received on the RSSI). See section 5.11 for operational considerations concerning the RSSI and OmniQuest® setup.

NOTE: If an approved external antenna is used, the cable must be securely attached to the RFU prior to operation. Likewise, if switching from an external antenna back to the OmniQuest® self-contained antenna, the antenna cable must also be securely attached. Loose or improper connections may render the terminal inoperable (not able to power on or low received signal) or result in error messages.

4.7.1.2 RF Unit

The RFU is contained within the Base Unit and provides an interface between the OmniQuest® antenna and the removable TU. The RFU contains a High Power Amplifier (HPA), Low Noise Amplifier (LNA), diplexer, and control electronics that provide the proper amplification, filtering, and control of the RF signals generated from the TU and received from the satellite through the antenna.

4.7.1.3 Transceiver Unit

The removable TU201A Transceiver Unit is located inside the Base Unit, providing the necessary interfaces for user devices and the RFU, as well as managing all signaling and communications with the CGS via the satellite. It demodulates and processes the signals received by the antenna through the RFU; processes, modulates, and sends signals to the RFU for transmission, and manages all interfaces with user interface equipment, other connected accessories, and network interfaces with the CGS.

NOTE: All required interfaces for the OmniQuest® Transceiver Unit are available on the TU connector panel. Distributors should not attempt to access the electronics inside the Base Unit without prior authorization from MELA.

NOTE: The connection of the TU to either the Base Unit or the TMU must be firmly secure. To ensure proper connections after inserting the TU into the Base Unit, adjust latches (located on BOTH sides of the Base Unit) to the “L” or *locked* position.

4.7.2 Battery Pack

The SZ511A Battery Pack provides DC voltage for operating the OmniQuest® MT. The Battery Pack is comprised of NiMH Battery cells (similar to some cellular telephones) and provides for the storage of energy to provide DC power (see specifications for ratings). The Battery Pack can be charged through use of the AC Adapter/Charger from an external 115 VAC / 60 Hz power source while installed in the OmniQuest® Base Unit or when removed as discussed below.

NOTE: There are several handling, storage, and charging considerations for increasing the performance and lifetime of NiMH Battery Packs. Please refer to the ST251 Operating Instructions for details.

NOTE: The standard Battery Pack is rated to provide for ≥ 1 hour of talk time at 77°F / 25°C. Because the MT is voice activated, the typical conversation time obtained from a fully charged Battery Pack could be > 2 hours.

NOTE: There are several operational considerations concerning battery run time, which should be well understood by the users. Please refer to the ST251 Operating Instructions or section 5.11 for details.

NOTE: This Battery Pack has been designed specifically for use and operation with the OmniQuest® ST251 MT. Do not attempt to use other batteries with this unit.

4.7.3 OmniQuest® AC Adapter/Charger

The SZ503A AC Adapter/Charger provides two methods for charging the Battery Pack as well as providing DC power output for operations. The DC output cable of the AC Adapter/Charger can be used for trickle charging a battery pack installed in the OmniQuest® MT and/or for powering the MT during operation when connected to the DC Input Connector of the MT. Alternately, the Battery pack can be removed from the MT and attached directly to the unit for charging. Rapid charging of the battery takes approximately 2 hours. When the MT is powered on and in transmit mode, rapid charging changes to trickle charging and may take up to 24 hours if the MT is continuously transmitting (e.g., in data mode).

NOTE: When the battery pack is fully charged, the indicator light on the SZ503A will change from red to green (for either the “spare” battery pack or the “main” battery pack inside the base unit). Prompt removal of the battery is required to avoid overcharging, and potential damage to the SZ511A battery pack.

The DC output cable of the SZ503A is approximately 1 foot (32 cm) in length and is hard wired directly to the AC Adapter/Charger. The plug at the end of the DC output cable is a special 4-pin connector which mates to the DC Input connector of the Base Unit. The AC input cable for the AC Adapter/Charger is approximately 6 feet (1.8 m) in length. The cylindrical objects attached

to the cords are special inductive filters and are required to maintain compliance with FCC requirements for conducted emissions. No attempt should be made by distributors or users to fabricate replacement or alternate cables, to modify the length of these cables, or to remove or change the filters on the cables.

NOTE: The AC Adapter/Charger has been designed specifically for the OmniQuest® ST251. Only this unit should be used to provide power to the MT for operation or to charge the Battery Pack from an AC power source.

4.7.4 Standard Carrying Case

The Standard Carrying Case provides space to accommodate all of the standard components of the OmniQuest®, and AC Adapter/Charger. Also provided with the Standard Carrying Case is a magnetic compass and a Quick Reference Card to assist in setup. The Standard Carrying Case is constructed of 600 denier nylon with reinforced seams.

NOTE: The Standard Carrying Case only provides light protection to the OmniQuest® components from moisture and impact. The user is responsible for ensuring that the OmniQuest® components are protected to a level consistent with the users specific operating and transportation environment.

4.7.5 OmniQuest® Cigarette Lighter Adapter (CLA)

The SZ601A Cigarette Lighter Adapter (CLA) provides a method to supply 9.6V DC input to the MT from a standard 12V vehicle cigarette lighter socket. The CLA cables are similar in length to the AC Adapter/Charger cables. The CLA is functionally equivalent to the AC Adapter/Charger and can both power the OmniQuest® unit and charge a battery while installed in the OmniQuest® unit or when installed on top of the charger.

NOTE: The SZ601A CLA has been designed to meet the specific voltage requirements of the OmniQuest™ ST251. Only the SZ601A should be used to provide power to the MT for operation or to charge the SZ511A Battery Pack from a standard cigarette lighter socket. Use of other CLA adapters may void the ST251 limited warranty.

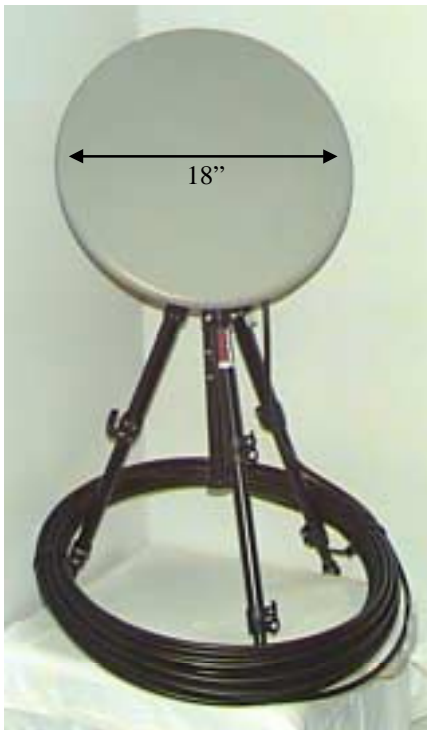
4.7.6 OmniQuest® Junction Box

Only OmniQuest® specific Junction Boxes (SZ351A, SZ352A) are designed to work with the ST251 terminal. Both Junction Boxes provide the capability of using the PTT Microphone and allow the use of hands-free accessories (i.e. external speaker, microphone). The SZ352A Junction Box includes a longer cable and is therefore more suitable for permanent vehicle installations or if the customer desires a longer cable. The Junction Box connects to the “J-Box” port of the OmniQuest® TU. For hands-free operation, the user connects the hands-free microphone and speaker to the junction box.

NOTE: Although the handset contains an external speaker which will provide hands-free/dispatch audio, the external speaker is a desirable and highly recommended option if the handset speaker is not loud enough or a remote location of the speaker is desired.

In most cases, the customer will prefer the external speaker for dispatch and hands-free operation. To activate hands-free mode, the handset must be connected to the TU and securely latched into the handset cradle. The handset cradle contains a magnet that deactivates the handset speaker and activates the external speaker when connected to the Junction Box.

4.7.7 *OmniQuest® Fixed Dish Antenna*



External antenna (OQFAU) shown with 100' cable (Type LMR400) and optional tripod. Weight of antenna and mounting hardware is less than 5 lbs. See Appendix C for detailed installation instructions.

OmniQuest® is capable of being operated with an external Fixed Dish Antenna (OQFAU50) connected to the RFU through the external antenna port (located on the back of the OmniQuest® base unit). The Fixed Dish Antenna is 18" in diameter and comes with mounting hardware and 50 feet of cable (LMR240). A 100' cable may also be used and is commercially available. The cable type needed is LMR400 and requires SMA straight connectors. The OQFAU50 is fully weatherproof and "marinized" for use in harsh or salt water environments. For temporary fixed-site applications, use of a tripod is desirable, however, the OQFAU50's mounting bracket will also accommodate a 2" diameter mounting pole.

4.8 *Basic Handset*

The standard handset (SZ100A) operates as a control panel for dialing and storing phone numbers and accessing built-in functions. The handset has a two line, seven character liquid crystal display (LCD) and a 23 button keypad (illuminated). The keypad control panel has a standard 12 button alpha-numeric telephone keypad (most with multiple functions), 3 speed

dialing keys, and eight other unique keys including a power button and two volume control buttons on the side of the handset. Users can input up to 28 characters or numbers for placing a call or memory storage in one of 99 locations (two screens required to see the entire location).



The interface between the standard handset and the cradle is a special 8-wire interface using RJ-45 connections. The interface consists of three audio lines, two serial data lines, a power-on signal line, +12V DC power, and ground. The serial data lines transmit keypad strokes and receive and display commands from the handset and CTU.

The curl cord stretches to a maximum length a 5 feet (1.5m). Do not attempt to fabricate a replacement or alternate cable, or modify the length of the curl cord provided. Although standard RJ-45 extension cables exist, Mitsubishi Electronics does not endorse these extension cables or guarantee MT product performance and reliability with these cables.

The connection of the Handset curl cord at the cradle must be firmly secure. Loose or improper connections may render the terminal inoperable (not able to power on) or result in error messages.

4.9 Push-to-Talk Handset

The Push-To-Talk handset, or PTT microphone, is an optional accessory providing access to the wide-area dispatch service known as net radio. The PTT handset lets users select up to 15 different networks, or talkgroups. The MSAT service provider configures these channels, which operate in a half-duplex manner like a standard two-way radio. The PTT handset also allows users to automatically scan through configured talk groups and select active networks. The PTT handset plugs into the junction box with the optional external speaker (needed for received audio).

The interface between the PTT handset and the junction box is a special 8-wire interface using RJ-45 connections. The interface comprises one audio line, two serial data lines, a PTT signal

line, a power-on signal line, +12V DC power, and ground. The serial data lines transmit keypad strokes and display commands to/from the transceiver.

The PTT handset must be securely connected to the junction box prior to power-on of the MT. Net radio operation also requires an external monitoring speaker.



4.10 Other Accessories

Other accessories such as Mitsubishi hands free microphones and external speakers are available through equipment distributors. Customers should contact these distributors directly concerning cost and availability.

5.0 Product Operation

Mitsubishi satellite telephones are user friendly, operating like a cellular phone (i.e., no dial tone) and requiring minimal user interaction. These MTs have many built-in features including special function keys, user programmability options, and security features. This section includes a brief design overview as useful background for understanding MT operations.

5.1 Design Overview

The Mitsubishi MTs operate under a blanket license from the FCC for MSAT Service under Part 25 (Satellite Communications) of its rules. This license, on file with the FCC (File No. 2823-DSE-P/L-93), does not require special MT identification tags for compliance. The fixed site MT, ST221M, also complies with Part 15 of the FCC Rules as a Class B unintentional source of radiation subject to the conditions thereunder. The land mobile MT has no requirement for Part 15 compliance.

The MSAT network operates in the L-Band of the frequency spectrum, roughly covering 1.5-1.6 GHz. Because L-Band signals are subject to fading, Mitsubishi MT design includes additional margin to assure performance and reliability. The terminals' digital modulation and signal

processing techniques also minimize fading effects to a level that outperforms analog cellular and standard two-way radio systems.

The mean time between failures for the land mobile and fixed site MTs is greater than 5200 hours of continuous use—actual performance may exceed this design value.



WARNING: MT operation may interfere with inadequately protected medical devices, including pacemakers. Consult a physician or the manufacturer of the medical device with any questions.

Changes or modifications to the equipment that Mitsubishi Electronics does not expressly approve can void the authority to operate equipment within commercial and residential buildings.

5.2 Signaling and Communications Channels

All Mitsubishi MTs access the MSAT network through six different special “channels”. The following table defines these channels:

Channel	From	To	Purpose
Pilot Signal	CGS	MT	Reference signal for acquisition
GC-S Channel	CGS	MT	System status, call indication, commands
MET-ST Channel	MT	CGS	Responses to CGS commands
MET-SR Channel	MT	CGS	Call setup and other requests
FES-C Channel	CGS	MT	Communications, in-band signaling
MET-C Channel	MT	CGS	Communications, in-band signaling

5.2.1 Pilot Signal

The MSAT satellite continuously transmits an L-band pilot signal in each of five regional coverage beams. The MT’s pilot signal strength (initially displayed on the handset) serves as a reference for locating the satellite before initiating the GC-S acquisition process. The pilot signal itself does not, however, carry any information.

5.2.2 GC-S Channel

The Group Controller-Signaling (GC-S) channels provide network status information, incoming call indications, and control messages from the CGS to the MT. The MSAT network can accommodate up to 16 GC-S channels per beam, per control group (see section 2.2). An MT

selects one GC-S channel, based upon the last channel used and current network conditions. Multiple terminals can share this GC-S channel using a Time Division Multiplexing (TDM) scheme. The GC-S provides information to MTs when they are idle—logged onto the network but not engaged in a call. Each MT has an encrypted Forward Terminal Identification Number (FTIN) as an address for the GC-S channel, protecting all communications. The received signal level of the GC-S channel is displayed on the handset after an idle MT completes network acquisition.

5.2.3 MET-ST Channel

MTs respond to GC-S information and commands through the MET-ST channel. Based on traffic conditions, the ground segment will assign a specific number of MET-ST channels to each GC-S channel. The TDMA channel structure is at some fixed time slot following a GS-S request/command. A unique Reverse Terminal Identification Number (RTIN) identifies MET-ST messages—the RTIN is equivalent to the Electronic Serial Number for each MT.

5.2.4 MET-SR Channel

The MET-SR channel transmits unsolicited MT requests to the ground segment such as call setup, and beam log-on. Each control group (see Section 2.2) can have up to 64 MET-SR channels. Access to the MET-SR channels is on an as-needed basis using a “Slotted ALOHA” protocol. This protocol selects an available MET-SR channel at random, transmits its message in the next available time slot, and then waits a specific amount of time to receive an acknowledgment from the ground segment (over the GC-S channel). If an acknowledgment is not received in the proper time frame the MT will wait a random amount of time and then attempt to re-transmit the message. The MT also receives information from the ground segment on the MET-SR channels that help in congestion control. The RTIN also identifies messages from the MT to the ground segment on these channels.

5.2.5 MET-C Channel

The MET-C channel transmit (1) voice and data communications from the MT to the ground segment and (2) in-band signaling. The ground segment assigns the channel to a specific MT (over the GC-S channel) in response to a call setup request (over the MET-SR channel). The MET-C channels use Single Channel Per Carrier (SCPC) / Frequency Division Multiplexing Access (FDMA). This means that each channel occupies its own dedicated 6 kHz of spectrum during a call. The MET-C channel is voice activated, only transmitting when voice or data bits are present. During an active call, the channel includes multiplexed in-band signaling messages for network management and call control functions like *on-hook* and *connect acknowledgment*.

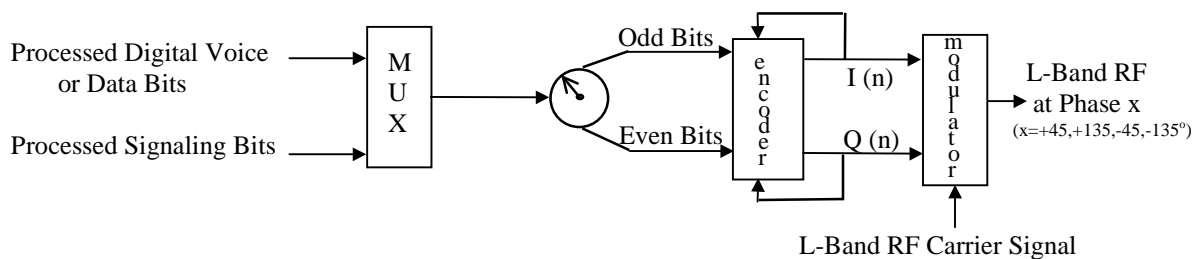
5.2.6 FES-C Channel

The FES-C channel sends (1) voice and data calls and (2) in-band signaling to the MT, from the ground segment. The ground segment assigns the FES-C channel (via GC-S channel) to an MT

in response to a call setup request (over the MET-SR channel). Like the MET-C channel, FES-C channels also use SCPC/FDMA access in a dedicated 6 kHz, voice activated slot. Likewise this channel also includes multiplexed in-band signaling messages for network management and call control functions like *ring command* and *on-hook command*.

5.3 Modulation & Encoding

The digital bit stream containing voice call, data call, and command information are Differential Quaternary Phase Shift Keying (DQPSK) modulated onto the L-Band RF carrier. Phase Shift Keying is a popular digital satellite modulation technique which assigns (and transmits) a specific phase of the carrier frequency to the value of the sample period. For QPSK there are four phase values that correspond to two bits of sampled data. In differential QPSK, the phase is also encoded with a binary algorithm or logic, like XOR or AND functions. This figure below illustrates differential encoding and modulation functions.



The MET-SR and MET-ST channels use binary Differential Phase Shift Keying (DPSK) modulation, where only two phases ($+90^\circ$, -90°) correspond to the bit values 1 and 0. The demodulators for each channel type reconstruct the bit encoded bit stream described above.

5.4 Signal Processing

Prior to modulation on the transmit side and after demodulation on the receive side, the MT digitally processes the actual voice, data, and signaling to improve performance and enhance privacy. These following sections briefly review these processing methods. For a complete discussion of privacy and security capabilities, see Section 5.5.

5.4.1 Scrambling

All digital voice and data bits, as well as signaling messages, are scrambled before being encoded and modulated for transmission to ensure privacy. The scrambler is a Pseudo-Noise (PN) scrambler with a 15-stage shift register. During each bit cycle, the output of the 15-bit shift register adds to the incoming information bit, resulting in the output bit. The output of the shift register derives from some binary combination (e.g. XOR, AND, etc.) of the resident 15 bits, with results feeding back into register during each cycle. This process continuously changes the

scrambling bit. Since the MT randomly selects the initial contents of the shift register (starting each scrambling process) the output is also random. The MT and ground segment can scramble and de-scramble the communications link because the MT transmits the initial scrambling pattern to the ground station.

5.4.2 Interleaving

Interleaving is a process by which the information bits to be communicated are “shuffled” in some organized manner. Interleaving improves performance on the digital link by mixing up the bits such that if a short fade or blockage of the signal results in the loss of some bits, they would end up being widely dispersed in the received information bits after they are deinterleaved, resulting in little or no impact. The interleaver used in the MT is a block interleaver in which data is read into the interleaver by rows and then taken out of the interleaver by columns, thus mixing up the bits in a structured way. The interleaver is only used on data bits and signaling bits (digital voice bits are not interleaved) and the block size of the interleaver (i.e. number of rows and columns) is different depending on the operating mode.

5.4.3 Forward Error Correction

Forward Error Correction (FEC) also improves communications performance for the data and signaling bit—the CODEC performs FEC for voice bits. The MT uses convolutional encoding, where two or more bits are transmitted for each original bit based upon the contents of a shift register. Specifically, the MT uses a 1/2 rate encoder of constraint length $K=7$. Therefore the MT convolutional encoder produces two output bits based on the summation of the last seven bits. The technique, called Viterbi decoding, re-assembles the information into its most likely original form.

5.5 Security Functions

5.5.1 Electronic Features

Mitsubishi MTs, including land mobile and fixed site configurations, offer five key electronic security features:

- ◆ Handset Lock Code
- ◆ Security Code
- ◆ Call Restriction Levels
- ◆ Authentication
- ◆ Communications Scrambling Vector

The basic handset has a user programmable 3-digit lock code. When locked the handset can not place or receive calls, except for 911 (or other emergency numbers in the Number Assignment Module, or NAM). Regular use of the handset lock will significantly mitigate the risk of unauthorized users.

A 4-digit security code allows users to set call restrictions, change the 3-digit handset lock code, reset an accumulated talk timer, and change the status monitor. Users can input their 4-digit security code into the MT during NAM programming. Call restriction levels include: no restriction, recall memory locations 1-99 only, and receive only.

The MT saves both the handset lock and the call restriction mode settings while off. For maximum security, users should electronically lock the handset or select *receive only* call restriction.

5.5.2 Authentication

Every MT authenticates its identity upon call setup and during commissioning and performance verification tests. The authentication process encrypts a random variable and an Access Security Key (ASK) to form an authentication code. The MT and CGS independently generate the authentication code, with the MT sending its version of the code to the CGS at the beginning of each call event. The CGS in turn verifies that the MT can continue call setup, commissioning, or performance verification tests. The authentication code is both random and encrypted for each event, with only the specific MT and CGS having all information required to produce the code.

5.5.3 Scrambling

All communications between a specific MT and the CGS are scrambled before transmission. Because the scrambling function derives from a random number that each MT selects, only that specific MT and the CGS can de-scramble intelligible communications.

5.6 Network Data Distribution & Storage

During initialization, and each time the MT is powered on, the CGS transmits network data to that MT. This data includes network status, channel parameters, and signaling channel assignments. The MT stores some of this data in Non-Volatile Random Access Memory (NVRAM), retaining the information when powered down. For example, an MT saves the *system table* in NVRAM, defining the last beam and signaling channel used. The system table helps the MT in the network acquisition process. The CGS continuously transmits detailed system status and assignment information to operating MTs through the GC-S channel (idle MT) or FES-C in-band signaling (active MT).

5.7 Shutdown Conditions

There are four conditions that may cause a MT to cease transmission or automatically shut down. All dealers should be aware of and understand these conditions for trouble resolution and user training.

- ◆ System Deactivation
- ◆ Low Power
- ◆ Temperature Alarms
- ◆ Loose or Disconnected Cables

System deactivation is when the CGS commands the MT to deactivate (handset display: *Shut Down*) due to network congestion, MT failure of a performance verification test, detection of corrupt NVRAM, or the need for excessive re-transmissions to successfully deliver messages. It is also possible that the Aeronautical Mobile Satellite Service (AMSS) may exercise its priority access rights in emergency situations. In these cases the dealer must coordinate with the MSAT service provider to request reactivation. This situation may also require re-commissioning.

An MT may automatically shut itself down if it detects low power or high temperatures. In both cases the MT notifies the user of the situation with an audible warning tone prior to automatic shutdown. In most cases the user can terminate a call in progress before automatic shutdown.

Finally, an MT may power down or not be able to power on if there are loose or disconnected cables. Proper MT operation requires secure connections between the handset, CTU, and AU. Damage to cables may also cause the power-off condition.

5.8 Operation

5.8.1 Initialization

The Mitsubishi MTs run through a hardware and software self-test procedure every time a user applies power. The MT will request programming information the first time that it powers up. After programming, described in Section 7, the unit will automatically power down. When the user powers up again, the MT will request the Pilot Frequency Code (PFC) and the Commissioning Frequency Code (CFC), which the dealer obtains from the MSAT service provider. These codes identify the pilot channel frequency (for satellite location) GC-S channel frequency (for commissioning messages). The land mobile MTs can now find the satellite and begin commissioning. Fixed site and transportable MTs require manual antenna pointing towards the satellite. This setup procedure is described in the following section (5.8.2).

The commissioning procedure automatically starts after the user responds to the *push SEND* button prompt from the MT. The initialization request from the MT goes over a special MET-SR channel to the CGS. The CGS then verifies that the MT is registered and sends a response, including initial assignment and identification information. The CGS then commands the MT to perform a Performance Verification Test (PVT) including both the signaling and the communications channels. For communications channel testing, the MT enters a *loopback* mode, sending data to the NCC for checking errors. After the MT successfully completes the PVT, the NCC sends a commissioned indication to the MT, indicating that it is ready for service.

5.8.2 OmniQuest® Setup

Upon power up, the ST251 MT runs through a self-test procedure to check the internal status of hardware and software. If no internal faults are detected, the unit will prompt the user to point the TPB antenna towards the satellite and then to press * to initiate automatic GC-S selection. During automatic GC-S selection, the MT selects a GC-S channel based upon information stored in NVRAM about the status of the MSAT system when the MT was last logged on. The MT searches GC-S channels in an organized manner starting with the GC-S channel within the beam which was last used and then moving on to others if this channel or beam is not available (based on signal strength and error rates). If the MT has been moved to another beam area since it was last operated, it must also perform a log-on procedure to notify the CGS about which CGS channel it is using (within a specific beam). Once a log-on response is received from the CGS, the MT is available for calls and the NO SVC indicator on the handset should turn off.

5.8.3 Placing a Telephone Call

To place a voice call, the user dials the telephone number on the keypad, or recalls a number from a memory location, and then presses the *send* button. Pressing speed dial keys, P1-P3, performs both telephone number input and send functions. The MT *send* button/function transmits a call request to the CGS (MET-SR channel) indicating the type of call (voice or data), the telephone number, and the RTIN. In response, the CGS sends the MT's transmit and receive frequency assignment for the call (GC-S channel). The MT then forwards the scrambling vector for the call and the MT access security check. End-to-end communications begin after the MT receives *ringing* and *off-hook* signals through in-band signaling on the FES-C channel. The MT user presses the *end* button to transmit an *on-hook* command, which the ground segment acknowledges over the FES channel.

5.8.4 Receiving a Telephone Call

While the MT is logged onto the network, but not engaged in a call, it continuously monitors the GC-S signaling channel for network status information updates, incoming call indications, and other control messages from the CGS. The MT displays incoming call type (voice or data) from the encrypted FTIN and sends an acknowledgment to the CGS over the MET-ST channel. The ground segment in turn assigns transmit and receive frequencies. The remainder of the call structure is the same as described in section 5.8.3.

5.8.5 Data Communication

Data calls are very similar to voice calls, with identical CGS signaling. Data calls identify their communications rate and format on the MT-SR channel along with the called phone number. The scrambling vector also includes the character format and speed of the data call. All Mitsubishi MTs can receive and send calls either manually with the handset or automatically with Data Terminating Equipment (DTE), such as a personal computer. Data communications

use standard AT commands, which common PC software applications normally embed within their modem script. The MT Owner's Manual and Appendix D provide information beyond the description in this section.

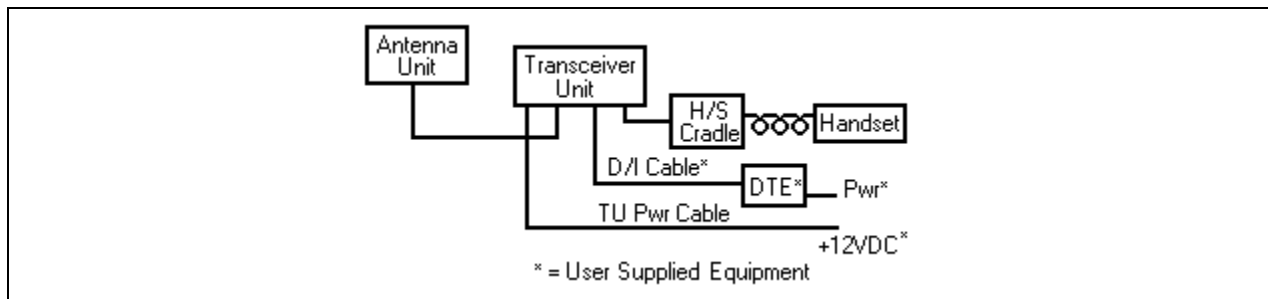
When an MT receives a data call, it produces a shorter ring with longer pauses and displays *SatData Call* on the handset. When the MT answers a data call, it routes the incoming FES-C channel to the *DATA* port on the transceiver. The MT user can send a data call directly from the handset (like a normal voice call) or automatically through the *DATA* port of the transceiver by using AT commands from a PC. Users can answer calls one of three ways: 1) pressing a key on the basic handset, 2) automatically after three rings with auto-answer function enabled, or 3) automatically after a specific number of rings (greater than 1) specified in the application software.

Users should execute three key steps prior to data call operations:

1. Obtain a data telephone number from the dealer or service provider.
2. Program and commission the MT, if this has not already been done.

Hint: Program the *DATA* telephone number into an unused memory location for future reference (e.g. memory location 99).

3. Connect the data interface (D/I) cable (provided by customer) to the DTE port (TU) and the COM port (DTE).



The following table lists key data port (TU) characteristics for reference:

Mechanical Interface	DB-25 female
Electrical Interface	RS-232
Communication mode	Full duplex
Synchronization	Start - Stop systems (Asynchronous)
Communication rate	1200bps, 2400bps, 4800 bps
Flow Control	None
Error Correction	Rate 1/2 convolutional coding
Functionality	All "AT" commands listed in the Operating Instructions

Every MT interfaces with one of the following character formats:

Start Bits	Data Bits	Parity Bits	Stop Bits
1	7	even or odd	1
1	8	none	1

Mitsubishi Electronics recommends the following DTE setup:

Communication rate	4800bps
Character format	8 bits, No parity, 1 stop bit
Flow Control	None

1. Use a serial port (COMx), on the PC to MT connection for data transmission.
Note: The COM1 port is normally utilized for this connection.
2. The MT transmits all data transparently (RTS signal line is not used / CTS line always high) so HW flow control is not necessary (i.e. ignored) but software flow control between end equipment can be used (e.g. XON/XOFF).
3. When choosing a modem driver, select a basic Hayes compatible 4800bps modem as default, or something as close to this as possible.
4. Various transfer protocols are supported; the standard configuration should be Zmodem.

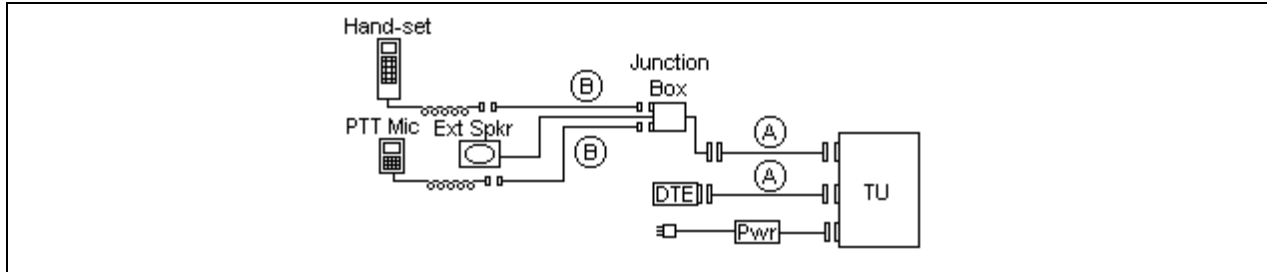
5.8.6 Net Radio/Dispatch Operation

Net Radio or Satellite Dispatch capability is a special MT function that provides a half-duplex digital network (or talk group) capability. This service requires the use of the Push-to-Talk (PTT) Microphone (SZ300A), external speaker accessory, and a separate service subscription.

A customer can configure and re-configure up to 256 talk groups, or dispatch channels, with as many as 10,000 MTs in all talk groups. Each MT can belong to 15 different talk groups. Talk group configurations and attributes download from the ground segment every time an MT powers on. The Net Radio service uses special protocols and messages on each of the previously defined channels for downloading system parameters, setting up and tearing down networks, and establishing communications between the speaker and all other members in a talk group. Dealers should be able to provide end-users with more detailed information on Net Radio service offerings.

5.9 Possible Cable Extensions

The following figure and table describe acceptable cable extensions for Mitsubishi MT configurations. MT modifications should not include full lengths for Extension A and Extension B. Note that adding any extension cable exposes the MT to various electromagnetic interference conditions, therefore Mitsubishi Electronics does not guarantee audio performance.



Extension Cable Ref: Figure 1.	Short Length \\ Minimum Cable Type	Long Length \\ Minimum Cable Type
A	50 ft \ ~15m RS-232C Standard - M\F* 26AWG - <50pF\ft Drain wire connects connector housings for a ground.	100 ft \ ~30m RS-232C Extended - M\F* 24AWG - <15pF\ft Drain wire connects connector housings for a ground.
B	50ft \ ~15m Flat Satin RJ-45 M\F - 26AWG	100ft \ ~30m Category 3 LAN RJ-45 M\F - 24AWG

M\F means the cable has one male connector and one female connector, If the cables are not available, a standard “gender bender” may be utilized.

5.10 Multiple Handsets

Mitsubishi MTs configured with both the basic handset and PTT handset can automatically switch operations between regular voice and dispatch. One of the devices will always be in a “sleep” mode, where the display does not remain in contact with the CTU. However, the transceiver will automatically “wake up” the handset and route an incoming call when the MT is idle. Users can manually wake up a sleeping handset with the press of any button (besides power), for more than half a second. The SZ300A PTT Microphone Operating Instructions manual provides a complete description of this “multi-terminal operation”.

5.11 Other Operational Considerations

- ◆ Fixed Site, ST221M, pointing requirements do not account for magnetic offset effects. This phenomenon causes a difference between magnetic north and true north, which varies more at high latitudes and over time.
- ◆ All configurations require a clear line of site to the satellite for reliable communications. The L-Band MT signals must effectively propagate 22,300 miles / 36,000 km to the satellite without significant distortion or attenuation. Mitsubishi MTs can communicate through most glass (though some tinted or reflective glass coatings will attenuate the signal), plastics, and

other non-metallic materials. Foliage can also potentially degrade signal quality. Users should strive for a completely clear line-of-site for best performance.

- ◆ All terminals can preserve satellite connection despite signal (line of sight) blockages of up to 15 seconds. Therefore, Mitsubishi MTs may not have to re-acquire the satellite or re-dial the called party for temporary obstructions. For example, the ST211 land mobile configuration can retain connections while driving under an overpass.
- ◆ The ST211 land mobile terminal requires roughly 10 seconds of static operation or motion along a straight path at start-up, for rapid satellite acquisition and tracking. Turns and maneuvers prior to acquisition skew the baseline BSU conditions, degrading performance.
- ◆ The RSSI, displayed on the handset, indicates received satellite signal strength on a numeric scale of 0 through 80. The initial setup screen displays the RSSI and users can continuously view signal strength using handset *function 84*. Mitsubishi MTs also display a graphic bar representation of signal strength at all times, in the upper right hand corner of the handset LCD. The table below shows the relationship between numeric and graphic RSSI values.

Numeric RSSI	Graphic RSSI (Number of Signal Bars)
0	0
1-8	1
9-18	2
19-28	3
29-38	4
39-48	5
49-80	6

- ◆ The RSSI is a relative measure of received signal strength for a particular MT, based on automatic gain control settings. RSSI values vary among MTs, even for the same received signal strength. Dealers should not assume that a lower RSSI value for a particular MT, compared with others, definitely indicates a problem (unless other problems are also present). RSSI values in the 35-50 range are considered normal. It is unlikely that you will measure an RSSI value of above 50 on your MT.
- ◆ The RSSI displays the received signal strength of the pilot channel during acquisition, the GC-S channel after acquisition, and FES-C channel during and active call. The relative level of these three channels differs with location, time, and network status.
- ◆ All MT configurations include a beam cross-over selection mode (*function 96*). Users can select a threshold for the frequency with which their MT searches for another satellite beam when a channel drops. These thresholds are *very slow*, *slow*, *normal*, and *fast*. Therefore, users of the ST211 who typically travel across beam intersections would probably want to select *fast*. In this case satellite acquisition times would improve for crossing between satellite beams. Users who typically operate within a single satellite beam would probably want to select *very slow*, resulting in a more efficient satellite acquisition. The ST221M has the same feature within its software, but is not relevant since the unit will be installed in a fixed location.

- ◆ Background noise at either the MT end or the other user end may couple into the communications link if at a high enough volume. Background noise may sound like garble or be misconstrued as cross-talk or echo by the MT or PSTN end-users. Since the MT is voice activated, this “garble” would only come through when the MT user is speaking.

- ◆ Signal propagation to and from the satellite inserts a noticeable delay into voice communications. This delay is approximately 400 milliseconds from the time one party speaks until the other party receives audio. For short question and answer type communications the two-way delay is close to a one second, round trip from one speakers perspective, without considering the time it takes a speaker to formulate their response. Although this delay is noticeable, user expectations and discipline can easily overcome the issue. Dealers should be familiar with this delay and help set customer expectations. The propagation and processing delay should have little or no user impact on digital dispatch (since it is half-duplex), data communications, or facsimile services.

- ◆ All Mitsubishi MTs are single channel communications devices. Users cannot switch between handsets and data equipment while actively engaged in calls.

OmniQuest® Battery

- The length of standby time possible on the internal battery depends upon the specific configuration settings of the MT for Backlight Mode Selection (FCN52) and Sleep Mode (FCN 54). The general relationship of standby time to these settings is shown below (setting Auto Power Off (FCN53) to Enable will also affect overall battery time):

SLEEP MODE (FCN 54)	BACK LIGHT MODE (FCN52)	STANDBY TIME*
Enable	OFF	8 hrs.
Enable	10 sec	will vary
Enable	ON	4 hrs.
Disable	OFF	4.5 hrs.
Disable	10 sec	will vary
Disable	ON	3.5 hrs.

* Using NiMH battery @25°C and beginning of battery life

- The optimal storage temperature of 25°C results in a discharge rate of roughly 60% per month for the internal NiMH battery. Therefore, a battery which has been on the shelf for one month should provide ~ 36 minutes of transmit time which would then degrade to ~ 22 minutes after two months of storage.

6.0 Installation

The installation of a Mitsubishi MT is simple, however, performing a correct installation is extremely important.

Mitsubishi Electronics cannot offer rules or step-by-step procedures for every variation in site conditions and customer requirements. However, MT configurations allow significant

installation flexibility, allowing dealers to pay special attention to their safety and their customers' safety. Dealers should plan installations before their actual execution. Take into account cable lengths, customer preferences, antenna placement and the potential use/access to the system.

6.1 Fixed Site (ST221M)

There are no specific accessories to complete an ST221M installation. However, depending upon the installation circumstances, items such as a pedestal to mount the MT handset cradle may be required. These accessories are commonly available and manufactured by companies other than Mitsubishi Electronics America, Inc.

The location of the antenna must be considered. The system should be tested by originating and receiving actual calls after completing the installation. For the antenna, it is desirable to select a high location with a large ground plane. The roof top of the site is particularly good. The antenna may lose much of its gain if it is not mounted correctly. When installing the antenna, it is necessary to consider the mechanical structure of and the physical location of the installation. As mentioned previously, always check with the site owner to agree on placement of the system components (Common Transceiver Unit (CTU), Handset (H/S), Antenna Unit (AU), etc.). Be sure to inform the site owner if you intend to drill holes or apply permanent adhesives in or on any of the cosmetic interiors or external surfaces of the site. Remind them that the holes will be there if the system is removed from the site.

In order for the installer to avoid problems during and after installation, it is always recommended to perform two basic steps before the actual installation begins: Site Pre-Check and Installation Planning. Occupant and site safety should always be taken into consideration when planning an installation.

6.1.1 Occupant and Site Safety

Occupant and site safety must be accorded absolute priority over all other considerations when installing a Mitsubishi MT. Objects installed on a site are to be placed in such a manner that they will not cause injury to the site's occupants. These rules also require that the function of any site safety system, for example, access to fire extinguishers and their attachment hardware are not to be impaired in any manner by installing the Mitsubishi fixed site satellite telephone at that site.

Modern building sites contain a great deal of electronic equipment. Much of this electronic equipment directly affects the operation of the site itself (network management computers, heating/AC controllers). These electronic devices generate RF energy and are affected by externally generated RF energy. Care must be taken to avoid detrimental interference with the site's other electronic equipment.

Site planners take great care to design their sites to minimize both radiated RF energy and reduce the susceptibility of the site's electronics systems to external RF energy. However, if the

operational integrity of the site is to be preserved, basic guidelines must be observed when installing the MT at a site. For example, site planners often issue guidelines and precautions that are specific to a particular site, and these must be observed.

Basic Rules:

1. No portion of any antenna, Radio Frequency Unit (RFU), or Transceiver Unit (TU) should be placed within 12" of any computer or controller module, sensor or other existing electronic device in the site.
2. Wires or cabling for the MT should be routed as far from existing site cabling as possible, and in no event should they be placed next to or be routed in parallel with the cabling for any site system.
3. Whenever a cable is routed through/over a metallic object, the cable must be protected against damage with a protective sleeve.
4. Any connection to the existing site electrical system must be done in accordance with the customer, and only using site approved components.
5. All connections to the site's power distribution system must be fused.
6. After the installation has been completed, but before the site is released to the customer, the installer must verify that the functioning of the site's systems has not been affected by the MT installation.

Performing a "pre-check" of the customer's site before the installation will identify any pre-existing problems with the site. Customers are not always aware of the functional state of all parts of their site, and it is very easy for the customer to blame the installer for (as an example) a malfunctioning alarm control system, if the site has not been checked out before the installation has started.

The final installation should be presented in detail to the customer. This should help eliminate any controversy with the customer about instruments, lights and/or systems that do not operate correctly when the installation has been completed.

6.1.2 General Installation Standards

The following list of standards will help ensure that the equipment operates properly over a long period of time. The extra attention and care that is given initially may save time and effort in the future.

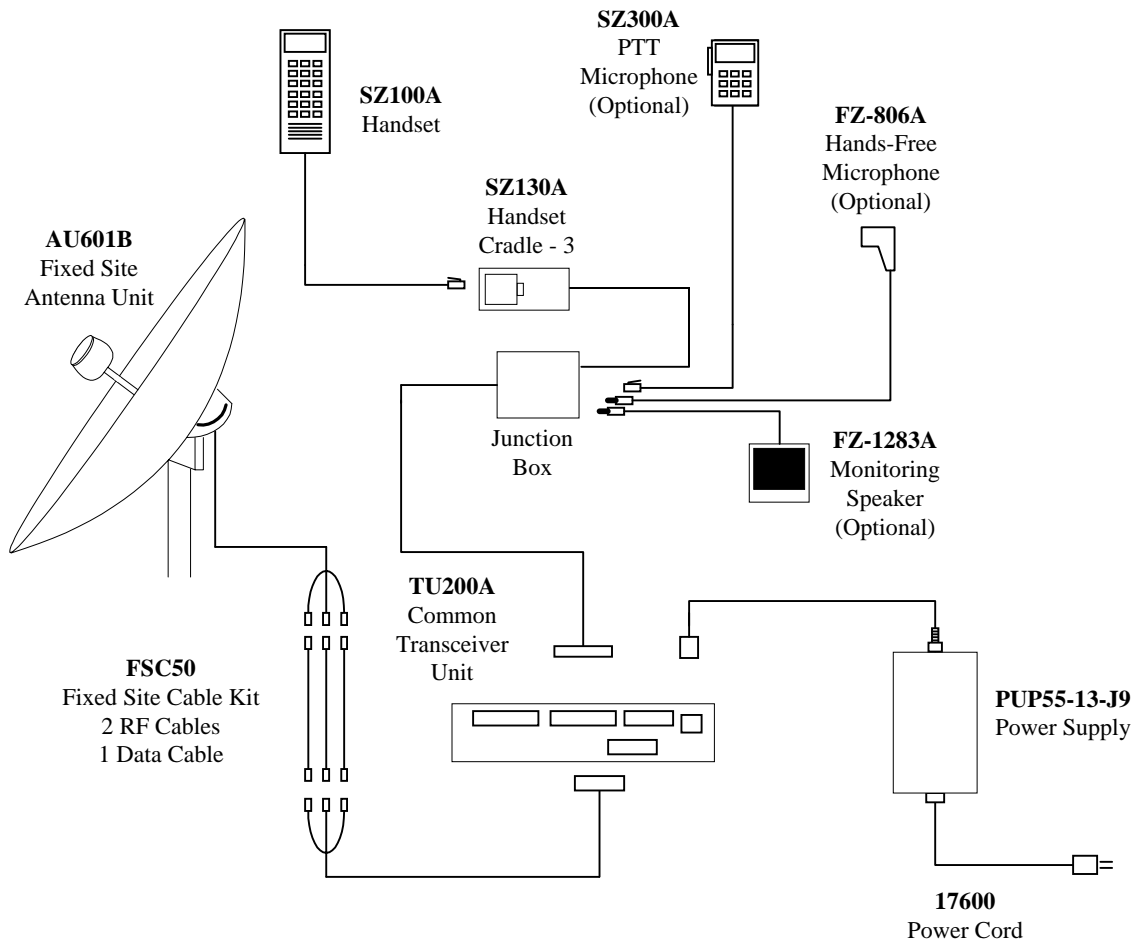
1. The National Electrical Code requires lightning protection for cabling between the fixed site antenna and supporting structure (e.g. building roof). However, specific electromagnetic pulse protection requirements vary by customer and site. The professional doing the fixed site installation should determine these requirements with the customer and install equipment based on a variety of open industry standards.
2. Wherever possible, route the terminal cables and the power cable together. This makes it easier to service the system. If one or more of the accessories are installed, route the associated cable with the other cable if possible.

3. Because of the type of cables that are used, it is recommended that the power cable should be routed from the transceiver unit installation location to the site power plant. Likewise, it is recommended that the cable which connects the user interface (handset cradle) should be routed from the site mounting location to the transceiver unit.
4. Cable lengths are fixed and must not be spliced to add or remove length.
5. Grommets should be used whenever routing cable through holes drilled in metal or through bulkheads. A ribbed flexible wiring loom may also be used to protect cables in hazardous locations where damage may occur.
6. In addition to grommets, silicone sealant (RTV) should be used to weatherproof all holes that are drilled on the outside of the site.
7. All cables should be securely fastened with cable ties to fixed objects so that they do not dislodge or flap loosely. Cables should be secured every 12-18 inches (30-45cm).
8. Ultra-violet resistant cable ties should be used when securing cables outside of the site. Other types of cable ties do not withstand the weather conditions or exposure to sunlight.
9. The main power or constant 120V AC line should be unswitched and connected directly to the site AC power supply. The built-in fuses in the power supply provide adequate current protection for the MT electrical system.
10. Placement of the CTU must be in an environmentally protected and ventilated area.
11. The electronic components are not waterproof. They are only weather resistive to dust or naturally occurring humid conditions (normal weather). Excessive high humidity conditions or extreme temperature changes are not considered “normal”. The fixed site antenna unit is considered weatherproof.
12. The wiring to the AU should never be in a downward route. A “drip loop” should always precede the connection to the AU. This retards the natural “wicking” action of moisture into the AU.

6.1.3 Installation Planning

Proper location of the various components of the MT is one of the most important parts of the installation. It has a direct effect on the customer's ease of use of the MT. The Installation engineer or technician should plan after consultation with the customer.

The following illustration is a complete overview of all the components and available (optional) accessories for the Mitsubishi Fixed Site Satellite Terminals.



As with any electronic product, it is good practice to formulate a standard pattern to perform the actual installation. Therefore, Mitsubishi Electronics America recommends installing the equipment in the following order, but the installer should use his best judgment based on the particular case:

1. Antenna Unit (AU).
2. Transceiver Unit (TU).
3. Junction-box and Cradle.
4. Plug in user interface (Handset, PTT Microphone).
5. Accessories (Hands Free Microphone, Monitoring Speaker).
6. MT Power Supply.
7. Other Cables (for external equipment or extensions etc.).

Note: Always remember personal safety practices. Use common sense. Use safety goggles and hearing protection to protect against damage to your eyes and ears.

6.1.4 Antenna Unit

To ensure the best communications channel, the antenna must have a clear line-of-sight to the network satellite.

The Mitsubishi Limited Warranty covers installations that use fixtures other than those Mitsubishi supplies, as long as their structural integrity meets or exceeds our specifications. However, if damage results from substandard installation methods or components, the Mitsubishi Limited Warranty does not apply to any necessary repairs.

Please consider the following three points during AU installation:

- ◆ Leveling

The AU must be level with respect with the horizon when installed. This ensures the best possible operation regardless of the orientation of the site.

- ◆ Torque specifications

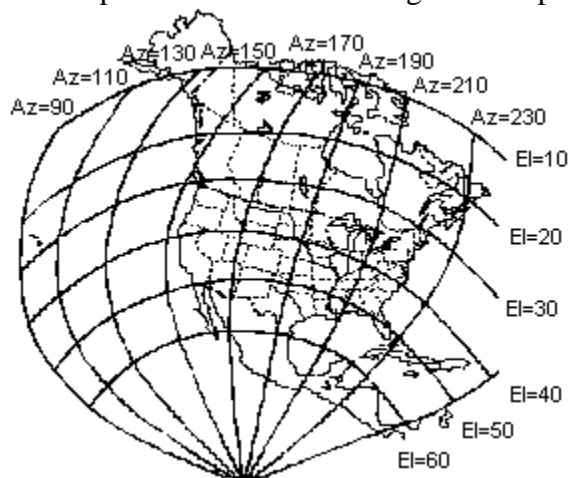
Do not over-torque the bolts used to mount the AU. Loctite should be applied to the threads of the bolts prior to installing them. The torque specifications for these bolts is 24 in./lb. Do not use air impact tools to tighten these bolts.

- ◆ Painting

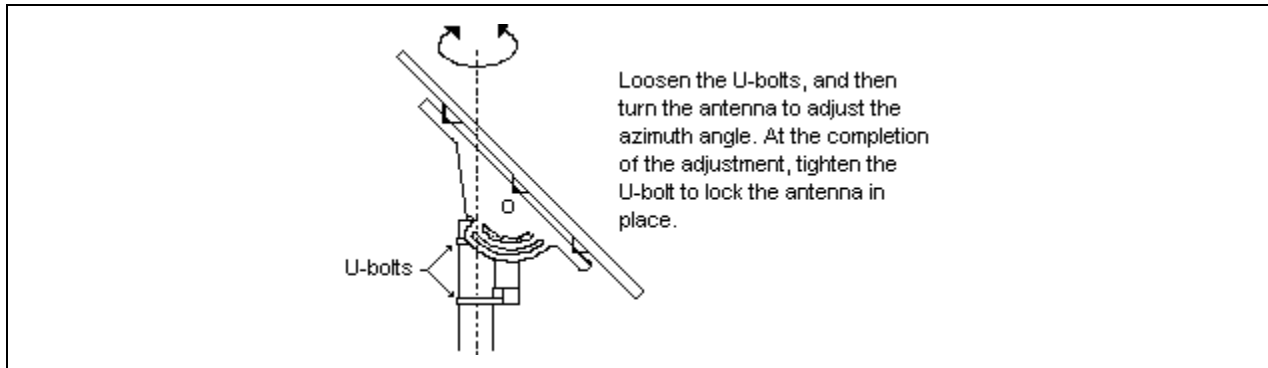
Never paint the AU. Paint will degrade the signal strength and the solvent in the paint will damage the Radome.

To determine the proper elevation (vertical) angle and azimuth (horizontal angle) to point the antenna:

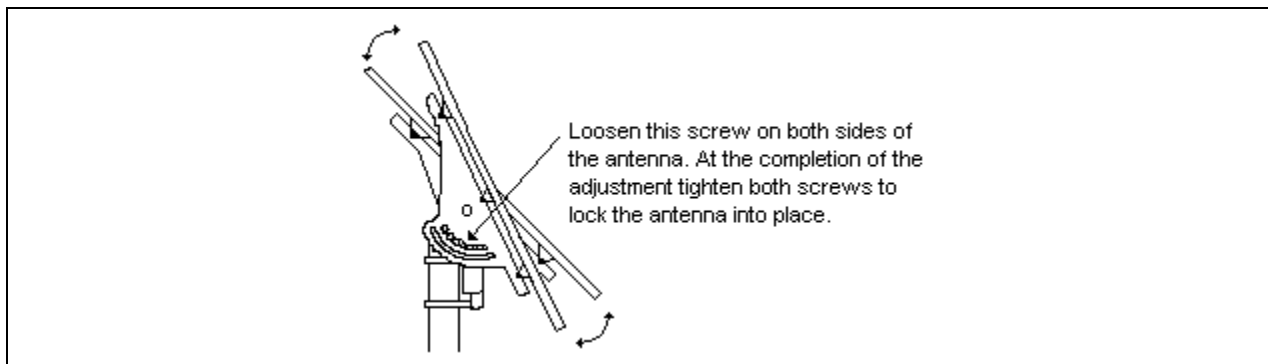
1. Locate your approximate position on the following antenna pointing map



2. From that position, determine the approximate elevation (El) angle and azimuth (Az) angle within 5 degrees.
3. Adjust the Az angle of the antenna unit to the azimuth that you determined in Step 2, using a compass if necessary.



4. Adjust the El angle of the antenna unit to the angle that you determined in Step 2, by using the scale provided on the antenna unit mounting bracket.



6.1.5 Transceiver

The CTU may be installed in several locations (i.e. under the package tray, against a wall or bulkhead, etc.) using the mounting brackets and hardware included with the CTU.

Installations may be performed with fixtures not supplied by Mitsubishi. Keep in mind that if the structural integrity of the non-supplied mounting fixtures meets or exceeds the supplied installation fixtures, these installation methods are not violations of the Mitsubishi Limited Warranty. However, if substandard installation methods are used and subsequent damage results due to the installation method, the Mitsubishi Limited Warranty does not apply to the repair of that damage.

Take care to observe the connector types and their assignments, since some cable connectors can be inserted into the wrong connector ports. Damage due to accidental connection of incorrect cables to transceiver ports is not covered by the Mitsubishi Limited Warranty.

The following items are important for a successful CTU installation.

- ◆ Leveling

The CTU must be level when installed.

- ◆ Location

No other items should be placed on top of the CTU or cables. Make sure that the CTU is not exposed to rain or other sources of moisture. The installation surface must have sufficient strength. If the location selected is not strong enough, an alternate location must be selected or an appropriate surface must be constructed. The installation area must not be easily vibrated or exposed to impact. The CTU should be installed so that it is out of the way and protected, but it should also be in a location that is accessible for servicing. Avoid installing the CTU near the area where heat is generated or where the CTU may be artificially heated to a high temperature.

There should be a minimum of two inches of air space surrounding the CTU to provide adequate convection cooling. This means that when installed, the CTU should not be in an area where items (rags, carpet, paper or accidentally placed objects) may cover the CTU, and would contain the heat generated by the CTU.

- ◆ Torque Specifications

The bolts used to mount the CTU should not be over-torqued. The torque specifications for these bolts is 24 in./lb. Do not use air impact tools for tightening these bolts.

- ◆ Cables and Connectors

The CTU should be positioned in the site so that the connectors from the AU, handsets and DTE, and power cables are protected. Make provisions to allow at least two inches of straight cable available at the connection point(s) of the CTU.

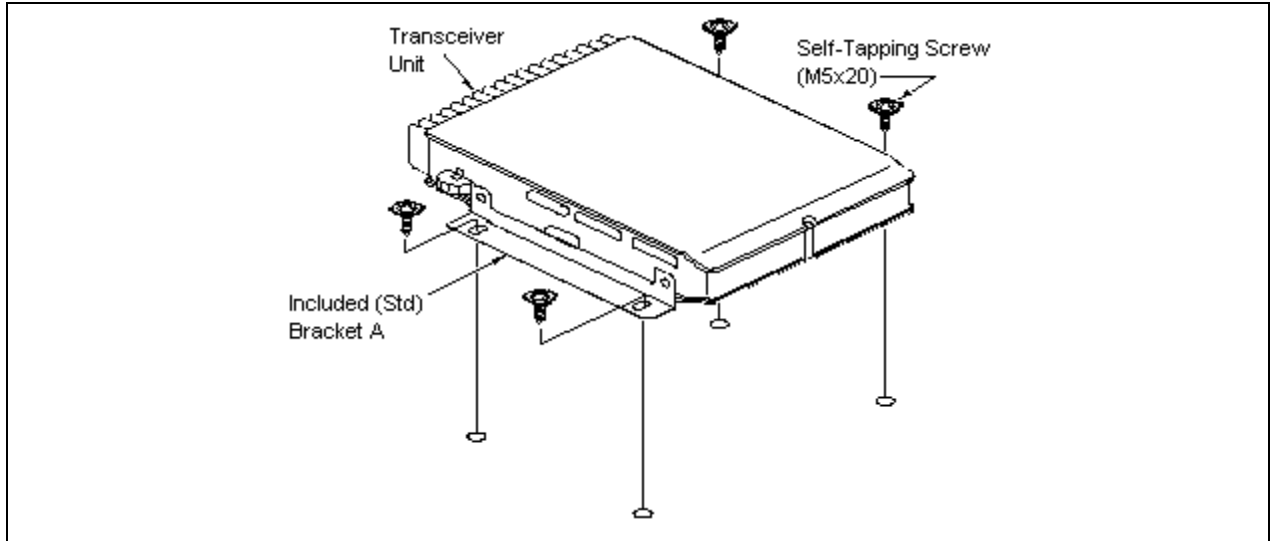
Be sure to route cables where they won't get pinched or stepped on, and where they will not make any sharp turns. If possible, the power cable should be run with the other site power connections. Any excessive cabling should be secured to a fixed object in the site with cable ties, or stowed out of sight. Use grommets for routing cable through holes drilled in metal or through bulkheads. Use silicone sealant (RTV) to weatherproof all holes that are drilled in the site.

CTU Installation Steps

Required tools: #2 Phillips screwdriver and drill (3.6mm).

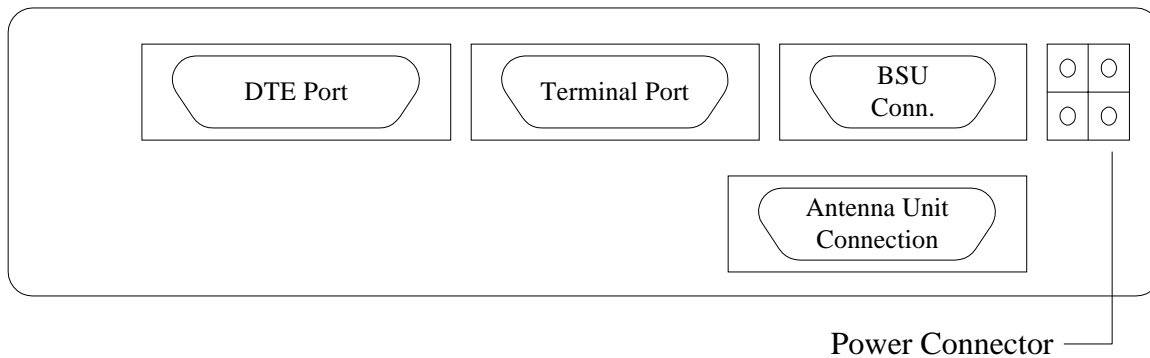
- Install “Angle Bracket-A” to both sides of the CTU. Find a level and stable area in the site. Mark the installation surface at the position of the four oval holes on the lower side of “Angle Bracket-A”. Make sure that the installed CTU does not interfere or make it difficult to perform standard operation procedures.
- Use the drill to make holes 3.6 mm in diameter at the marked positions on the floor.

- c. Connect the interface cable to the CTU, and use standard screws (M5x20 self-tapping screws) to secure the CTU. Secure the interface cables so that they can not be damaged from normal day-to-day operation (securing materials are not included).

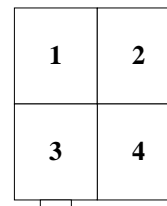


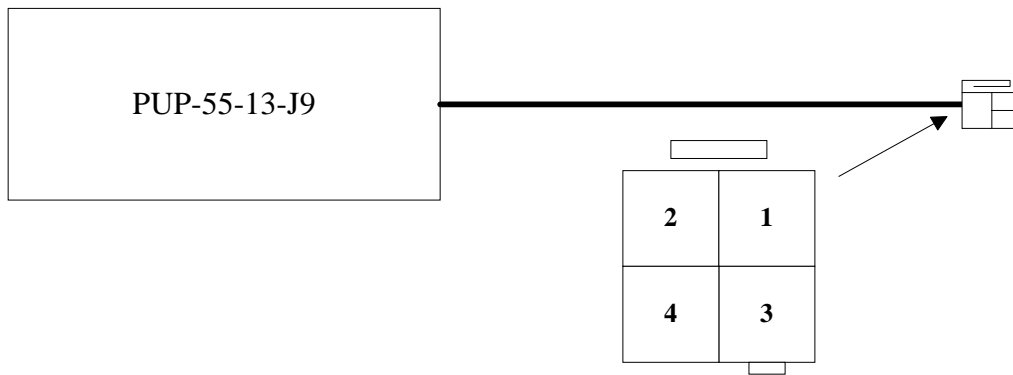
6.1.6 Power Connection

The ST221M fixed site MT includes the PUP-55-13-J9 power supply. The diagrams below explain the power connections for the CTU and the power supply.



CTU Power Connector	
Pin 1	Ground
Pin 2	+12V (Input to CTU)
Pin 3	Horn Relay (Output from CTU)
Pin 4	Ignition Sense (Input to CTU)





6.1.7 Cable Runs

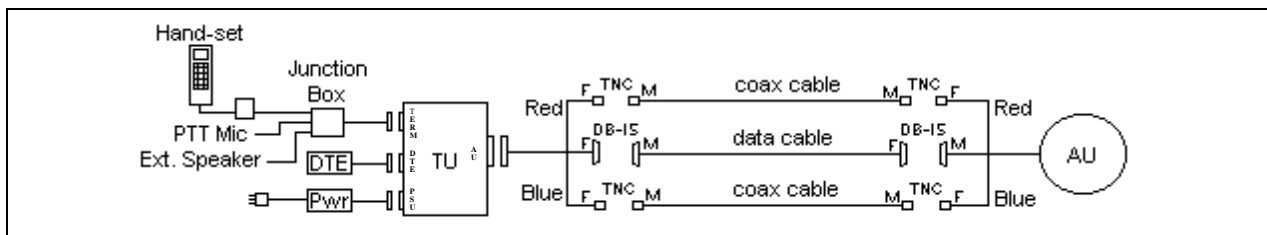
The standard antenna to transceiver cable length is 50 ft for the ST221M terminal.

- ◆ Cable routing

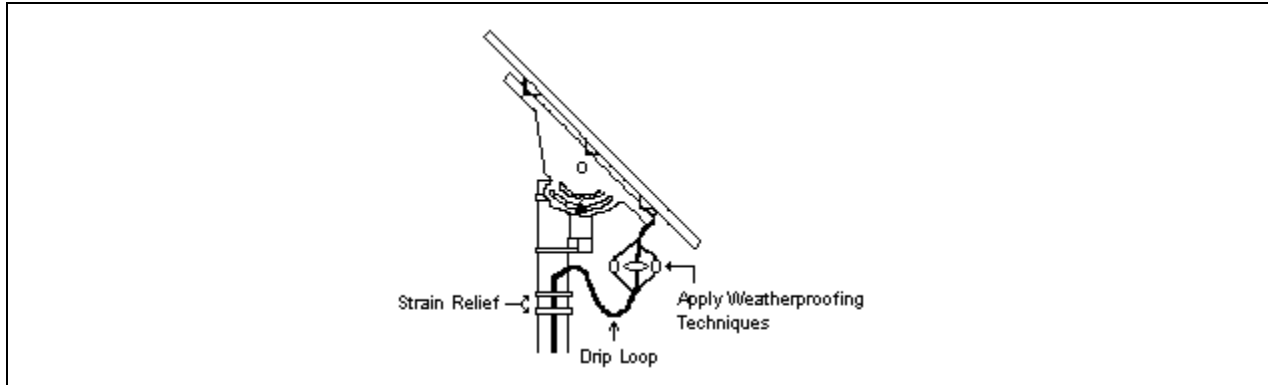
Ensure that cables are not stressed (stretched) and are not pulled or pinched. When routing the AU-cable avoid tight turns and possible rubbing of the cable. It is strongly recommended that the maximum turn radius of the AU cable be limited to 2 inches (5 cm) in the horizontal (sideways) and vertical (up and down) direction. Form a drip loop before the AU to prevent “wicking” of water into the AU housing.

- ◆ Cable connecting

Make sure the red and blue coax cables at the AU end are connected to the red and blue coax connectors the CTU end respectively. Do not cross the colors. Connect the control (data) cable to the AU and the CTU.



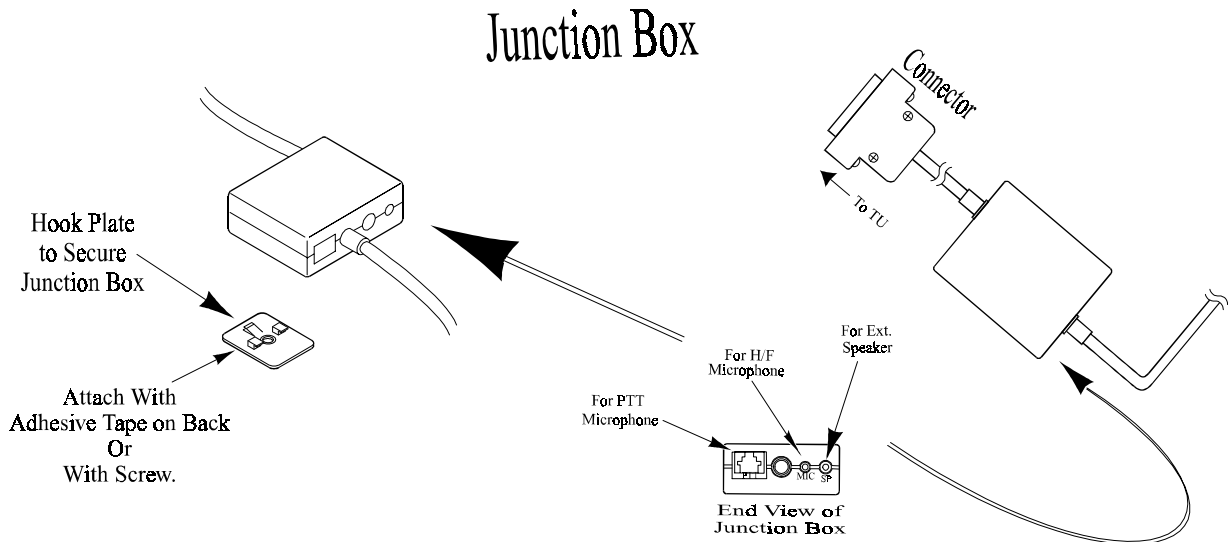
Secure the cables every 12-18 inches (30-45 cm) along the cable run. Be sure that no weight is placed on the AU cables. Form a drip loop at the AU to prevent “wicking” of water into the AU housing. Apply fusion tape or cold shrink to all exposed connections to provide weatherproofing.



6.1.8 Junction Box

The junction box is the interface for the Hands Free Microphone (FZ-806A), Monitoring Speaker (FZ-1283A) and Push to Talk (PTT) Microphone (SZ300A) accessories. Installation requires three steps:

1. Select a concealed place near the MT operator. Install the junction box in place with the included hook plate. The hook plate can be fastened to the site with either a screw or double-sided installation tape.
2. When you fasten the hook plate with adhesive tape, pre-treat the place where the adhesive tape will be applied using a cloth containing a synthetic detergent or alcohol. Remove oil, water (moisture), stains, and so on.
3. Route the remote cable through the site and secure occasionally with tie straps to prevent movement of the cable. The cable should be routed in areas where no damage will occur to the cable. Once the cable is routed, connect the other end of the remote cable to the CTU.

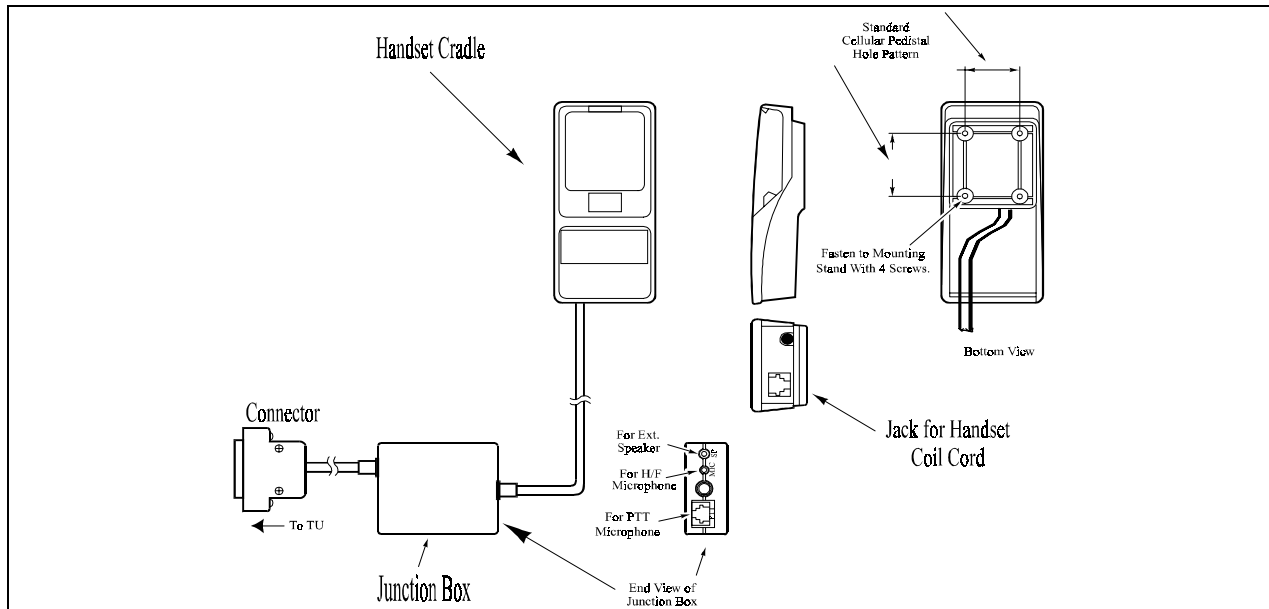


6.1.9 Handsets and Accessories

The following four steps and subsequent figure are for **handset cradle** installation:

1. Select the mounting position for the Handset cradle so that it will be within easy reach of the user and does not disturb day-to-day operations.
2. Install the Handset cradle with the attachment screws by using a mounting stand (a mounting stand is not included in the kit). This is the same type mounting stand which is commonly used for cellular phone installations.
3. Route the remote cable and secure occasionally with tie straps to prevent movement of the cable. The cable should be routed in areas where regular usage/operation will not damage the cable. Once the cable is routed, connect the other end of the remote cable to the CTU or other mounting location.

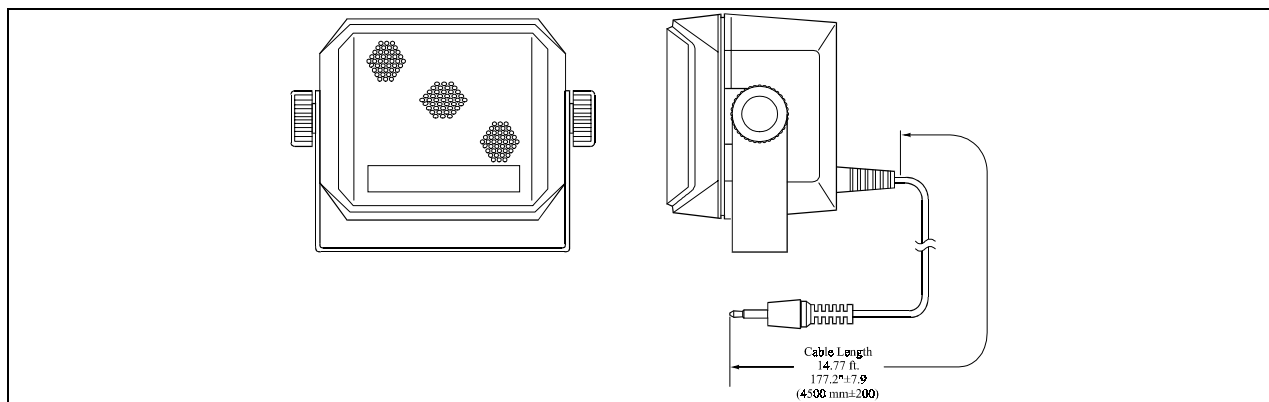
Note: The handset cradle type SZ130A includes a junction box for hands free and dispatch operation using the PTT Microphone (SZ300A).



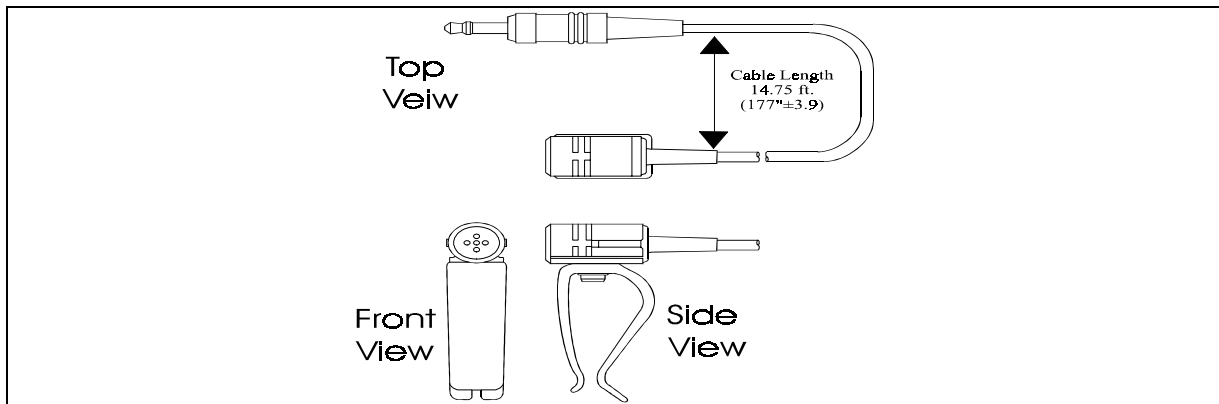
The **Push To Talk (PTT) Microphone (SZ300A)** is for dispatch/net radio use.

1. Select the mounting position for the PTT Microphone at the operating area, so that it will be within easy reach of the user.
2. Install the PTT Microphone in place with the hook attached. The hook can be fastened in the site with the included screws.
3. Plug the cable into the port indicated "PTT-MIC" in the junction box.

To install the **monitoring speaker**, select a mounting position in a convenient location inside the site so that it will not disturb day-to-day operations. Install the monitoring speaker with attached screws and speed nuts. Plug the cable into the port indicated "EXT-SP" in the junction box.



Note: Hands free operation performs best when the microphone is as close as possible to the user's voice and the monitoring speaker is reasonably far from the hands-free microphone.



Hands-free microphone installation is as simple as plugging the microphone cable into the port indicated “EXT-MIC” in the junction box.

6.2 Land Mobile (ST211)

There are no specific accessories required to complete an installation. However, depending upon the installation circumstances, items such as a pedestal to mount the MT handset cradle or hand held cellular phone cradle may be required. These accessories are commonly available and manufactured by companies other than Mitsubishi Electronics America, Inc.

The location of the antenna must be considered. The system should be tested by originating and receiving actual calls after completing the installation. For the antenna, it is desirable to select a high location with a large ground plane. The roof top of the vehicle is particularly good. When installing the antenna, it is necessary to consider the mechanical structure of and the physical location of the installation.

As mentioned previously, always check with the vehicle owner to agree on placement of the system components (Common Transceiver (CTU), Handset (H/S), Antenna (AU), etc.). Be sure to inform the vehicle owner if you intend to drill holes or apply permanent adhesives in or on any of the cosmetic interior or external surfaces of the vehicle. Remind them that the holes will be there if the system is removed from the vehicle.

In order for the installer to avoid problems during and after installation, it is always recommended to perform two basic steps before the actual installation begins: Vehicle Pre-Check and Installation Planning. Occupant and vehicle safety should always be taken into consideration when planning an installation.

6.2.1 Occupant and Vehicle Safety

Occupant and vehicle safety must be accorded absolute priority over all other considerations when installing the Mitsubishi MT. The Federal Motor Vehicle Safety Standards require that objects installed in a vehicle be placed in such a manner that they will not cause injury to the vehicle's occupants if the vehicle is involved in an accident. These rules also require that the function of any vehicle safety system, for example, the seat belts and their attachment hardware, not be impaired in any manner by any device installed in the vehicle.

Unlike older vehicles, modern vehicles contain a great deal of electronic equipment. Much of this electronic equipment directly affects the operation of the vehicle itself (engine management computers, heating/AC controllers), vehicle safety systems (air bag impact sensors and inflation controllers) or both (anti-lock brake system or traction control system computers). These electronic devices generate RF energy and are affected by externally generated RF energy.

Vehicle manufacturers take great care to design their vehicles and systems to minimize both radiated RF energy and reduce the susceptibility of the vehicle's electronics systems to external RF energy. However, if the operational integrity of the vehicle is to be preserved, the following basic guidelines must be observed when installing the MT system (or any device that generates RF energy) in a vehicle. Vehicle manufacturers have issued guidelines and precautions that are specific to their particular make and/or model of vehicle which must be observed. Information regarding vehicle-specific guidelines can be obtained from the vehicle manufacturer's Technical Assistance Department.

Basic Rules:

1. No portion of the MT should be mounted within 6 inches (15 cm) of any computer or controller module, sensor or other existing electronic device.
2. No portion of any transmitting antenna, its integrated Radio Frequency Unit (RFU) or Transceiver should be placed within 12" (30 cm) of any computer or controller module, sensor or other existing electronic device in the vehicle.
3. Wires or cabling for the subscriber unit should be routed as far from existing vehicle cabling as possible, and in no event should they be placed next to or be routed in parallel with the cabling for any vehicle system.
4. Whenever a cable is routed either through or over a metallic object, the cable must be protected against damage with an insulating medium.
5. Any connection to the existing vehicle electrical system must be done in a manner, and using components, approved by the vehicle manufacturer.
6. All connections to the vehicle's power distribution system must be fused.
7. After the installation has been completed, but before the vehicle is released to the customer, the installer must verify that the functioning of all vehicle systems has been unaffected by the subscriber unit installation.
8. If an MT is interfering with the functioning of ANY vehicle system it must be disabled until the interference problem is resolved.

Performing a "pre-check" of the customer's vehicle before the installation will identify any pre-existing problems with the vehicle. Customers are not always aware of the functional state of all parts of their vehicle, and it is very easy for the customer to blame the installer for (as an example) a malfunctioning cruise control system, if the vehicle has not been checked out before the installation has started.

Once the installation is completed, the customer should be given a detailed overview and any pre-existing conditions should be identified, as this will help eliminate future controversies regarding existing problems with the vehicle.

While making your “pre-check” inspection, make note of any special features or accessories such as anti-lock braking systems, air bags, sound systems, alarms, information computers or other electronic systems on the vehicle—these types of devices demand special installation precautions. As the final part of the vehicle pre-check, ask the customer to remove any valuables such as money, briefcases and such from the vehicle. This will help eliminate potential controversies and will make the customer confident that they are dealing with people of integrity.

6.2.2 General Installation Standards

The following list of standards that will help ensure that the equipment operates properly. The extra attention and care that is given initially may save time and energy down the road.

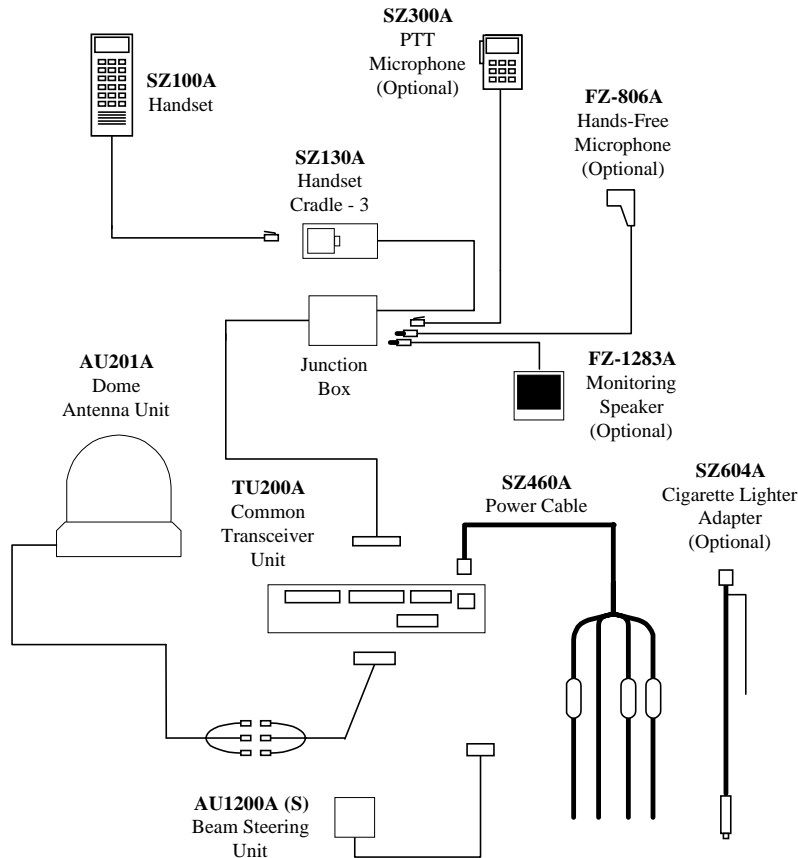
1. Wherever possible, route the terminal cables and power cable together. This makes it easier to service the system. If one or more of the accessories are installed, route the associated cable with the other cable if possible (i. e., cellular antenna).
2. Because of the type of cables that are used, it is recommended that the power cable should be routed from the transceiver unit installation location to the dashboard and engine compartment (from the back of the vehicle to the front). Likewise, it is recommended that the cable which connects the user interface (handset cradle) should be routed from the inside of the vehicle mounting location to the transceiver unit (from the front of the vehicle to the back).
3. Cable lengths are fixed and must not be cut to add length or remove excess. The only exception is the power cable. It may be shortened or lengthened. However, whenever lengthening the power cable, always use the same or better gauge of wire. Always re-attach the in-line fuse holders and install the fuses provided.
4. Whenever routing cable through holes drilled in metal or through bulkheads, use grommets. Ribbed flexible wiring loom may also be used to protect cables in hazardous locations where damage to those cables may occur. In addition to grommets, use silicone sealant (RTV) to weatherproof all holes drilled on the outside of the vehicle.
5. All cables should be securely fastened with cable ties to fixed objects so that they do not dislodge or flap loosely when the vehicle is in motion. Cables should be secured every 12-18 inches (30-45cm).
6. Ultra-violet resistant cable ties should be used when securing cables outside of the vehicle. Other types of cable ties do not withstand the weather conditions or exposure to sunlight.
7. The main power or constant +12V line (red) should be un-switched and connected directly to the vehicle battery. This line must not be connected to the switched accessory bus or any other switched line. Also, this line should never be connected to the vehicle fuse box or other fused sources. The built-in fuses in the cables provide adequate current protection for the system and for the vehicle electrical system.

8. The ground (black) line should be connected directly to the vehicles' battery ground.
9. The switched ignition line should be connected to a +12 V switched (accessory) line. Be careful not to connect this line to an accessory line that may carry a low voltage accessory trigger voltage. In many vehicles a low voltage trigger line may be used. This line carries less than the required +12 Volts. When checking for the switched +12V line, do not rely on a "test light". Confirm your circuit choice with a voltmeter.
10. Placement of the CTU must be in a protected but ventilated area. There are no specific areas to install the CTU, however it is possible to locate the CTU under the seat, on the rear cab wall of a typical truck or four wheel drive or in the trunk compartment of a typical automobile.
11. The electronic components are not waterproof. They are only weather resistant to dust or naturally occurring humid conditions (normal weather). Excessive high humidity conditions or extreme temperature changes are not considered "normal".
12. Wiring to MT components should not be run in an unbroken downward route. A "drip loop" should always precede the connection to the AU. This retards the natural "wicking" action of moisture into the AU. The Dome and Transportation Antennas are "weather-proof".

6.2.3 Installation Planning

Proper location of the various components of the MT is one of the most important parts of the installation. It has a direct effect on the customer's ease of use of the MT. Installation should be planned by the installation staff after consultation with the customer. Safety, technical feasibility and customer desires should always be taken into consideration when planning an installation.

The following figure is an overview of the components and available (optional) accessories for the Mitsubishi ST211 land mobile terminal.



Before proceeding with the installation, please make sure that all items listed on the packing slip have been received and verify that the list matches your purchase order. The following bill of materials for the ST211 should help identify if any component is missing. If any item is missing, please contact your distributor immediately.

- (1) Dome Antenna Unit (AU201A) Including:
 - (1) 18 foot (5.7 m) Cable with 3 Connectors
 - (1) 1 foot AU-TU Cable to connect the AU cable to the single CTU connector
- (1) Beam Steering Unit (AU1200A(S)) Including:
 - (1) Mounting Plate
 - (4) Screws
- (1) Common Transceiver Unit (TU200A) Including:
 - (2) Installation Brackets
 - (4) Tapping Screws
 - (4) Pan Screws
- (1) Handset (SZ100A) Including:
 - (1) Coil Cord
- (1) Handset Cradle-3 (SZ130A) Including:

- (1) CTU Cable
- (1) Junction Box
- (1) Clip w/Screw
- (4) Screws

- (1) Power Cable (SZ460A) Including:
 - (3) Fuses

- (1) ST200 Series Operating Manual (ST200N02)

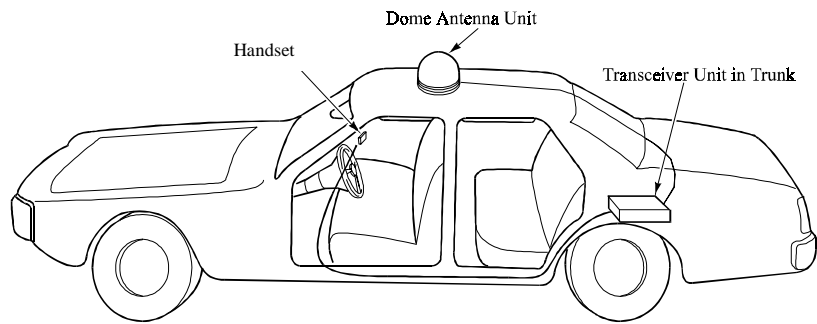
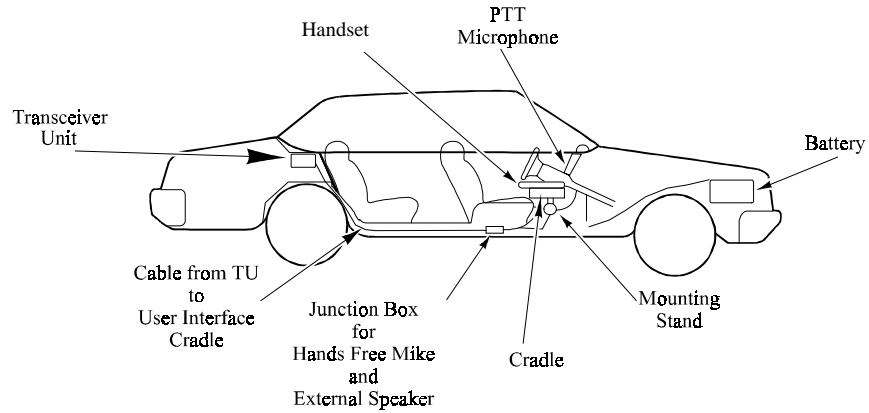
Just as with any other 12 Volt vehicle product (i.e., car stereo, cellular phone, etc.), it is a good practice to formulate a standard pattern to perform the actual installation. Mitsubishi Electronics recommends the following order:

1. Dome Antenna Unit (AU)
2. CTU Power Cable
3. User Interface Cradle and Cables
4. Plug in Handset and/or PTT Microphone
5. Common Transceiver Unit (CTU)
6. Beam Steering Unit (BSU)
7. Accessories (Hands Free Microphone, Monitoring Speaker)
8. Other Cables (for accessories, etc.)

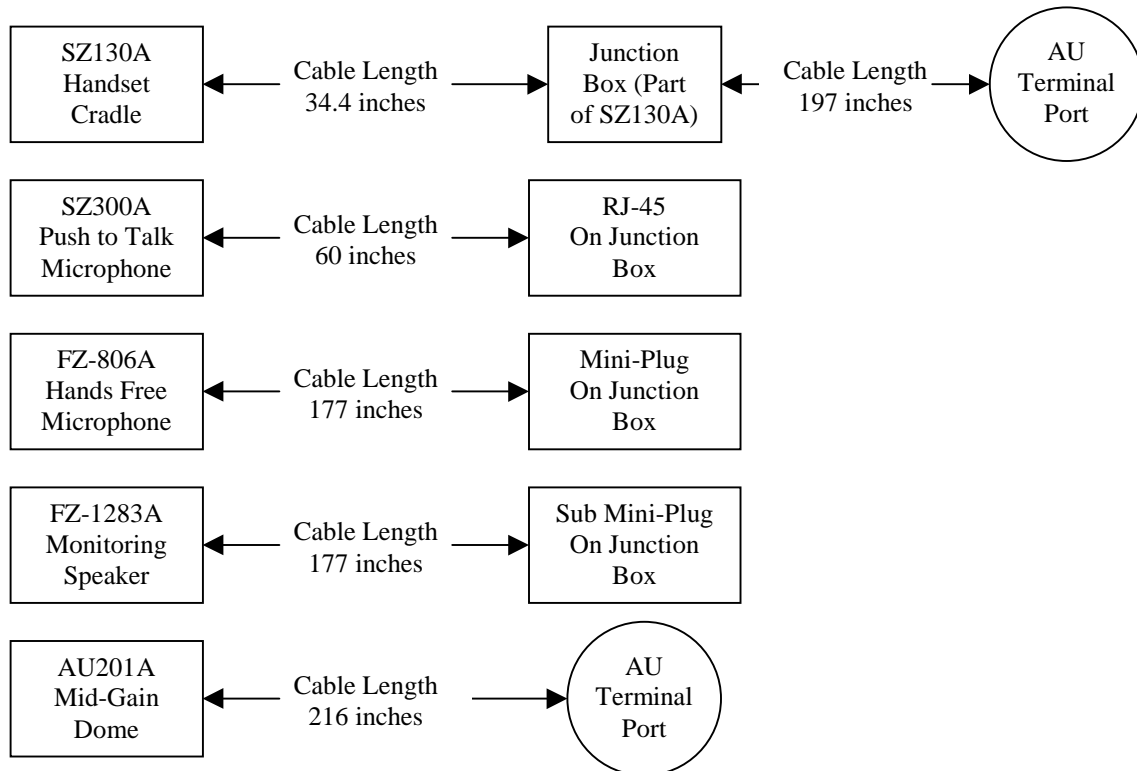
Although this is a recommended installation plan, the installer must use their best judgment in planning the installation.

Note: Always remember personal safety practices. Use common sense. Use safety goggles and hearing protection to protect against damage to your eyes and ears.

The following two figures show typical land mobile MT component locations—however, installations will vary.



The figure below identifies key fixed cable lengths. Attempts to modify these cable lengths will affect MT performance and void the limited warranty.



6.2.4 Dome Antenna Unit

The dome AU should be mounted on the roof in the center of the vehicle, as these instructions indicate. Please keep in mind the following four rules of thumb.

◆ Leveling

The AU must be level when installed. This ensures the best possible operation regardless of the orientation of the vehicle.

◆ Torque specifications

The bolts used to mount the AU should not be over-torqued. Loctite should be applied to the threads of the bolts prior to installing them. The torque specifications for these bolts is 24 in./lb. (not ft./lb.). Do not use air impact tools to tighten these bolts.

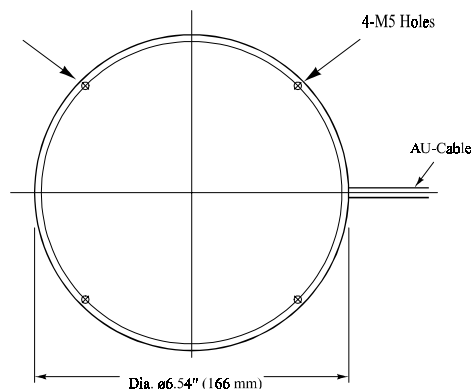
◆ Painting

Never paint the AU, since it will degrade the signal strength and the solvent in the paint will damage the Antenna Radome.

◆ Cable routing

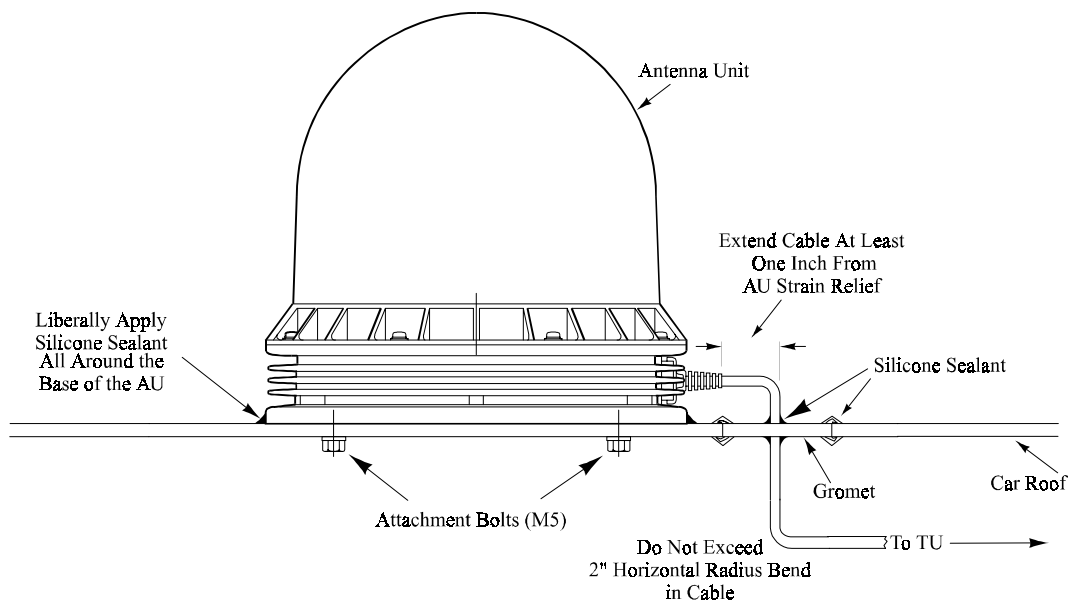
Ensure that cables are not stressed (stretched) and will not pull or pinch when the trunk lid is opened and closed. When routing the AU-cable avoid tight turns and possible rubbing of the cable. It is strongly recommended that the maximum turn radius of the AU cable be limited to 2 inches (~5cm) in a horizontal (sideways) and one (1) inch (~3cm) bend in the vertical (up and down) direction. The recommended way to route the AU-cable is up the inside bulkhead of the trunk (where the CTU is installed) and to the outside of the vehicle, over the center of the rear window (from the trunk) to the roof. Install the AU-cable by using the cable guide.

The figure below illustrates the direct mount approach, with four M5 screws attaching the AU directly to vehicle roof.



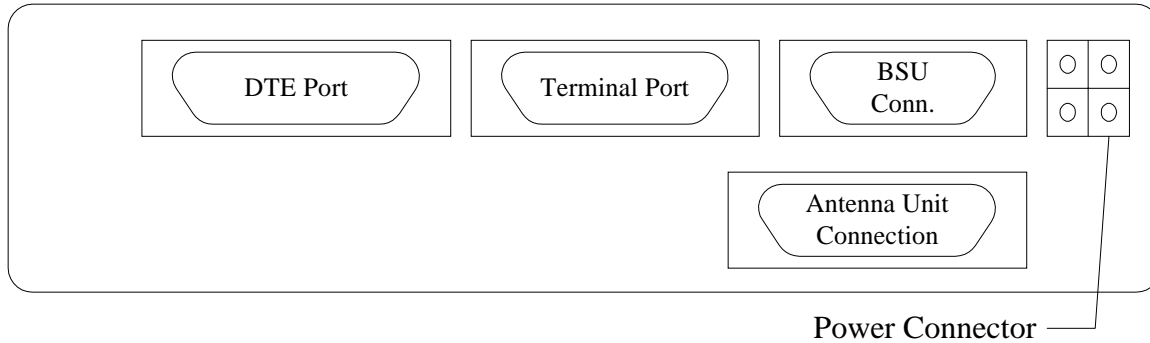
A typical direct roof installation, below, requires a hole large enough (approximately 3/4"[2cm]) to pass the AU connector into the vehicle. A perforated (solid with a slit) grommet and silicon (RTV) sealant should be used where the cable penetrates the vehicle. Silicon (RTV) sealant should also be used around the bottom of the AU and injected into each screw hole to weatherproof the vehicle.

Mitsubishi Electronics strongly recommends a maximum AU cable turn radius of two (2) inches (5 cm) in a horizontal (sideways) and one inch bend in the vertical (up and down) direction. The typical AU-cable routing is down by the inside bulkhead of the trunk, where the CTU is installed.

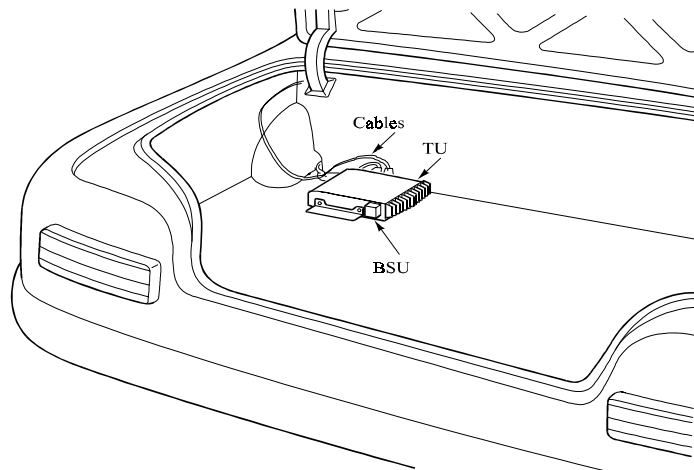


6.2.5 Transceiver

Take time to observe the connector types and their assignments (see section 6.2.6). Some cable connectors may be capable of being inserted into the wrong connector port. Damage due to accidental connection of incorrect cables to transceiver ports is not covered by the Mitsubishi Limited Warranty.



The following figure shows a typical placement of the CTU, but other locations like under the package tray and against the rear seat bulkhead are acceptable. The CTU placement must be out of the way and protected from loose items that may fall on top of the unit or bump the connections.



Installations may be performed with fixtures not supplied by Mitsubishi. Keep in mind that if the structural integrity of the non-supplied mounting fixtures meet or exceed the supplied installation fixtures, these installation methods are not violations of the Mitsubishi Limited Warranty. However, if substandard installation methods are used and subsequent damage results due to the substandard installation method, the Mitsubishi Limited Warranty does not apply to the repair of that damage.

The following items are important CTU installation considerations:

◆ **Leveling**

The CTU must be level when installed, especially when the BSU is connected. You cannot level the BSU alone with the standard BSU mount. The "↑" on the BSU must point upward.

◆ **Protected Area**

The CTU should be installed so that the spare tire, tire jack, tools, tire chains or other items are not thrown on top of the CTU or cables. Make sure that the CTU cannot be exposed to rain or other sources of moisture. Do not put anything on top of the CTU (e.g., luggage, etc.). The installation surface must have sufficient strength. If the location selected is not strong, an alternate location must be selected or an appropriate surface must be constructed. The installation area must not be easily vibrated or exposed to impact while the car is in motion.

◆ **Accessibility**

The CTU should be installed so that it is out of the way and protected, but it should also be in a location that is accessible for servicing.

◆ **Heat**

Avoid installing the CTU near the area where heat is generated or where the CTU may be artificially heated to a high temperature.

◆ **Sufficient Air Space**

There should be a minimum of two inches of air space surrounding the CTU to provide adequate convection cooling. This means that when installed, the CTU should not be in an area where items (rags, carpet, paper or accidentally placed objects) would contain the naturally generated heat of the CTU.

◆ **Torque specifications**

The bolts used to mount the CTU should not be over-torqued. The torque specifications for these bolts is 24 in./lb. (not ft./lb.). Do not use air impact tools for tightening these bolts.

◆ **Protect cable and connectors.**

The CTU should be positioned in the vehicle so that the connectors from the AU, BSU, user interface, and power are protected. Make provisions to allow at least two (2) inches (5 cm) of straight cable available at the connection point(s) of the CTU.

◆ **Cable Routing**

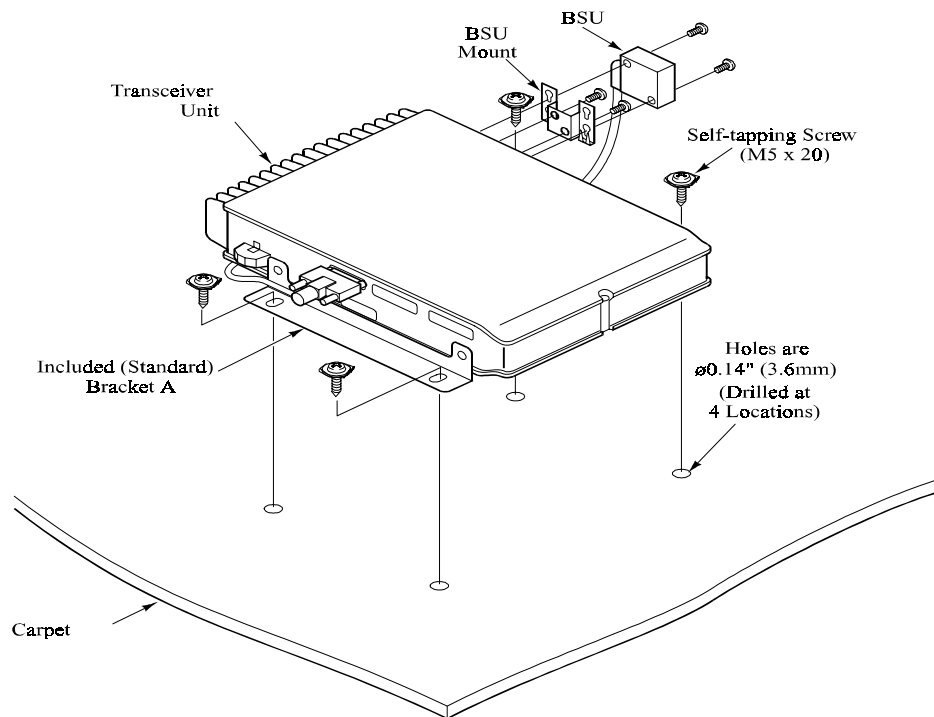
Be sure to route cables where they won't get pinched or stepped on. Do not make any sharp turns or route the cable near the brake, clutch, and accelerator. If possible, the power cable should be run under the carpeting. Any excessive cabling should be secured to a fixed object in the trunk with cable ties, or stowed out of sight behind panels. Grommets should be used whenever routing cable through holes drilled in metal or through bulkheads and silicone sealant (RTV) should be used to weatherproof all holes that are drilled in the vehicle.

Standard Horizontal CTU Installation Steps

Required tools: Phillips (No. 2) screwdriver and drill (3.6mm).

Use standard or specified hardware and install securely. Do not damage the fuel tank or vehicle cables when drilling the holes through the trunk floor.

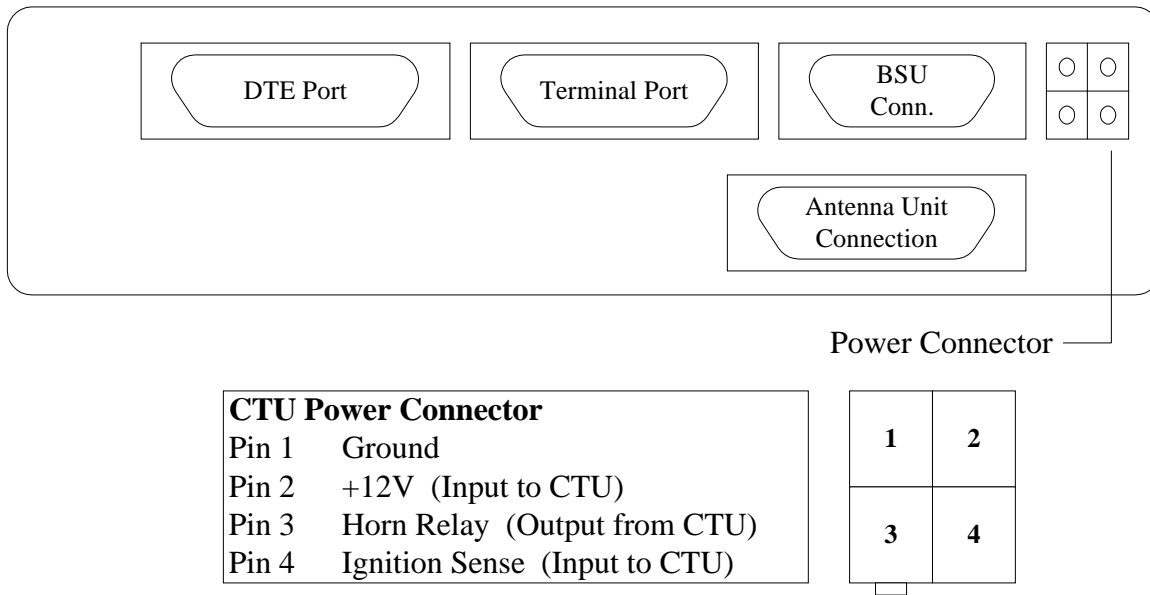
- a) Install “Angle Bracket-A” to both sides of the CTU. Find a level and stable area in the trunk. Mark the trunk floor at the position of the four oval holes on the lower side of “Angle Bracket-A”. Make sure that the installed CTU does not interfere or make it difficult to take out or put back the spare tire or tools.
- b) Use the drill to make holes 3.6mm in diameter at the marked positions on the floor. Carefully check the vehicle to make sure that you do not damage systems or items under the floor (e.g., gas tank, exhaust pipe, catalytic converter, vehicle wiring, etc.)
- c) Secure the BSU. Connect the interface cable to the CTU, and use standard screws (M5x20 self-tapping screws) to secure the CTU. Secure the interface cable so that it can not be damaged when loading/unloading the trunk (securing materials are not included).



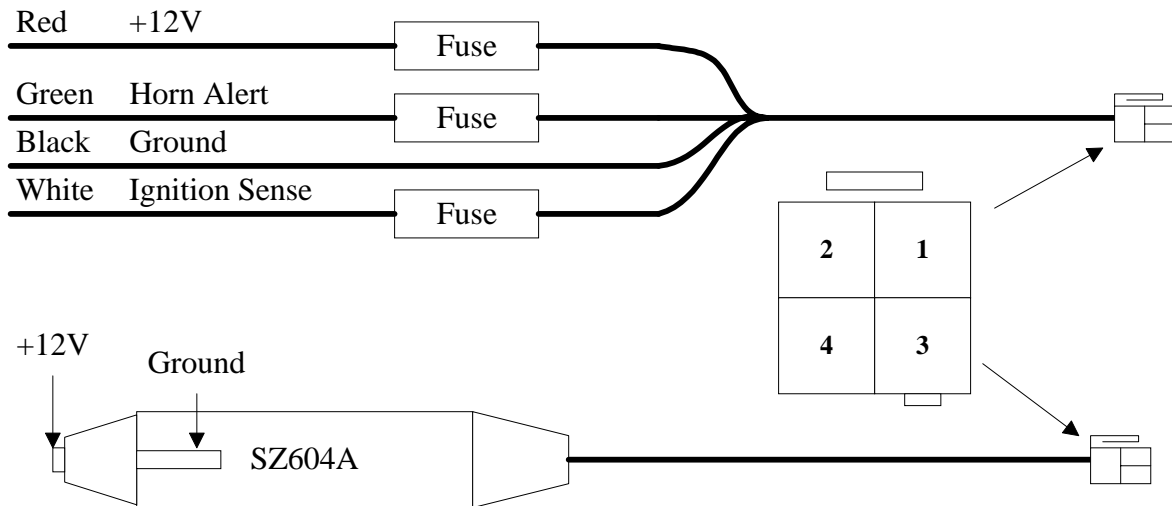
6.2.6 Power Connection

There are two methods for powering the CTU in a land mobile MT: the power cable that is included with the MT or the optional cigarette lighter adapter (CLA). The diagrams below show the CTU power connection and the SZ406A power cable and the SZ604A CLA.

TU200A Common Transceiver Unit Power Connector



SZ406A Power Cable and SZ604A Cigarette Lighter Adapter



Always disconnect the negative (-) side of the battery prior to any electrical work on a vehicle. Even if the installer has disconnected the battery, the vehicle is not totally immune to slips. Some vehicle systems retain power for some time after the battery has been disconnected. Shorting or grounding the wrong wire or connector could activate the air bag, for example, necessitating a costly and needless repair.

6.2.7 Junction Box

The junction box is the connection interface for the Hands Free Microphone (FZ-806A), Monitoring Speaker (FZ-1283A) and Push to Talk (PTT) Handset (SZ300A) accessories. Refer to figure in Section 6.1.8.

1. Select a concealed place under the front seat or under the dashboard. Install the junction box in place with the included hook plate. The hook plate can be fastened to the vehicle with either a screw or double-sided installation tape.
2. When you fasten the hook plate with adhesive tape, pre-treat the place where the adhesive tape will be applied using a cloth containing a synthetic detergent or alcohol. Remove oil, water (moisture), stains, and so on.
3. Route the remote cable under the vehicle carpet and secure occasionally with duct tape to prevent movement of the cable. The cable should not be routed in areas where the action of seat adjustment could damage the cable. Once the cable is routed, connect the other end of the remote cable to the CTU in the trunk

6.2.8 Handsets and Accessories

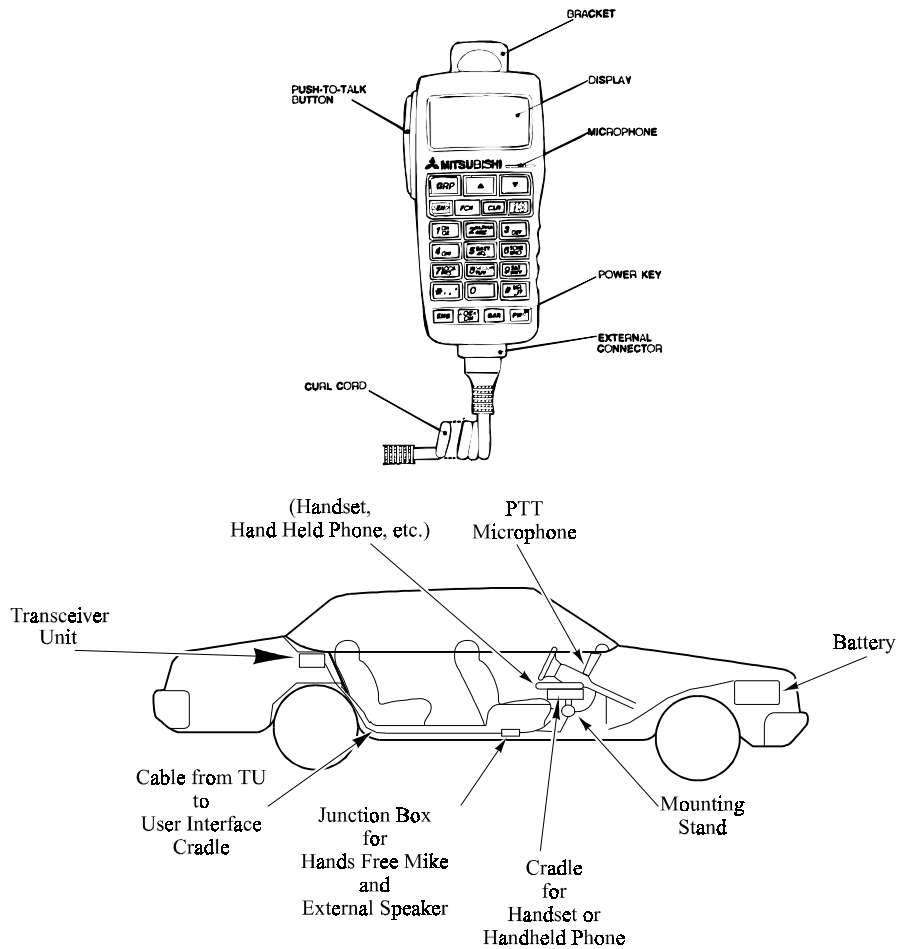
Handset Cradle (refer to figures in section 6.1.9)

1. Select the mounting position for the Handset cradle so that it will be within easy reach of the user and not disturb driving.
2. Install the Handset cradle with the attachment screws by using a mounting stand (a mounting stand is not included in the kit). This is the same type mounting stand commonly used for cellular phone installation.
3. Route the remote cable under the vehicle carpet and secure occasionally with tape to prevent movement of the cable. The cable should not be routed in areas where the action of seat adjustment could damage the cable. Once the cable is routed, connect the other end of the remote cable to the CTU.

The Push To Talk (PTT) Microphone (SZ300A) is for dispatch radio use

1. Select the mounting position for the PTT Microphone on the dash board or the front console, so that it will be within easy reach of the user and not disturb driving.

2. Install the PTT Microphone in place with the hook attached. The hook can be fastened to the vehicle with the attached screws.
3. Plug the cable into the port labeled "PTT-MIC" in the junction box.




In the illustration above, the user interface terminal cable does not exit the trunk. NEVER route cables outside the vehicle passenger compartment.

Hands Free performs best when the H/F microphone is as close as possible to the user's voice and the monitoring speaker is reasonably far from the H/F microphone. Section 6.1.8 clearly illustrates how the hands-free microphone and external speaker plug into the junction box.

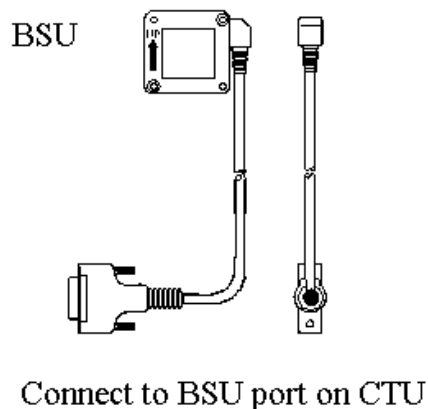
6.2.9 Beam Steering Unit

The Beam Steering Unit (BSU) provides important information to land mobile CTUs concerning antenna alignment. Improper BSU installation will adversely affect satellite acquisition and tracking. There are several important items to keep in mind about the placement of the BSU.

- ◆ The Arrow on the BSU must point UP. 
- ◆ The BSU must be level. Never exceed an inclination of five (5) degrees
- ◆ The BSU should be kept away from magnetic influences.

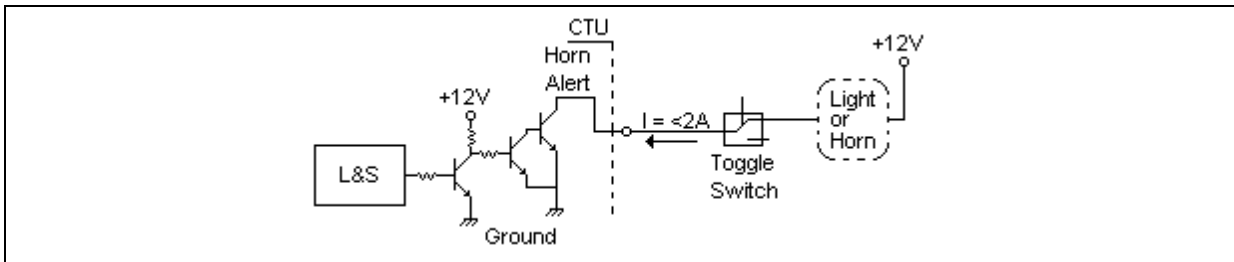
The BSU mounting kit includes the BSU mount and four screws to attach the BSU to the CTU. If BSU installation on the CTU is not possible, attach it to a vertical surface close to the CTU.

- a) After installing the CTU in the trunk, attach the BSU mount to the CTU with two of the included screws.
- b) Install the BSU on the BSU mount with two of the other included screws. When you install the BSU on the mount, you should make sure that the direction of the arrow indicated on the surface of the BSU is perpendicular to the horizon.
- c) If the inclination of the BSU is more than about five degrees, adjust the level of the CTU by setting a spacer (not included) between the CTU and the vehicle.
- d) Route the cable of the BSU under or around the CTU and connect to the CTU.
- e) **Do Not** install the BSU near (3 inches or 8 cm or less) stereo speakers. The allowable maximum flux density must be less than or equal to 5 gauss.
- f) Two-way radio systems installed in the same vehicle as a land-mobile MSAT telephone may interfere with the BSU. Ask your dealer about the shielded BSU. Also, wrapping a BSU in aluminum tape will help eliminate potential interference problems.



6.2.10 Horn Alert

The Horn Alert interface is a 24AWG wire that is connected to Pin 4 of the Power Supply connector. This lead is capable of sinking 2A of 12VDC current. The operational state of this lead is either open or ground.



A toggle switch is shown for easy deactivation before driving instead of a more complicated function call via the handset. Mitsubishi recommends using a Bosh Relay part number 0-332-019-150 (Tessco part number 79246) Single Pole, single throw horn relay (12V, 30A inductive load) and the Celldyne Relay Socket part number RH2 (Tessco part number 44084) Pre-Wired Socket (includes 3 14 AWG and 2 18 AWG 24" (61cm) leads or equivalents. Tessco's phone number is 1-800-472-7373 (USA, Canada, Mexico) or 1-410-229-1200. Note that Mitsubishi does not warrant horn alert or any accessories not provided by Mitsubishi.

There is a two-ring delay before the horn alert lead is active.

7.0 Programming & Commissioning

7.1 General Process and Procedures

Before operating a MT, the user must register it with the MSAT system and manually initialize it. This process requires coordination with the MSAT service provider to receive the required programming information, based on customer account activation or reactivation.

The manual initialization procedure only needs to be conducted once for a new MT account (not every time the customer uses the MT). The MT may also have to be re-initialized due to certain changes in their service account or due to deactivation from the MSAT CGS.

For a complete checklist of steps required for initialization and quick reference procedures, see Appendix B.

7.2 Initialization

The manual initialization process consists of the following basic steps:

- ◆ Number Assignment Module (NAM) Programming
- ◆ Manual System Acquisition
- ◆ Commissioning (with PVT)

The term “Programming” is sometimes used to generically refer to the entire initialization process. “Programming” is in no way associated with MT software or programming of user interface equipment software.

Number Assignment Module (NAM) Programming and Manual System Acquisition require the input of specific data parameters provided by the MSAT service provider and chosen by the dealer or user. The Commissioning process is automatically performed between the MT and the CGS and includes the Performance Verification Test (PVT). The PVT is used to test specific functions and performance characteristics of the MT before final commissioning approval.

Programming and Commissioning steps are shown on the left side of the table in Appendix B, page 96, while the normal startup process is shown on the right side of the figure. Many of the steps required for the normal process are similar but require less user action (i.e., are more automated).

There are several steps that should be taken prior to beginning the actual programming and commissioning procedure:

- ◆ Ensure that you provide the correct MT and customer account information to your MSAT service provider for assignment of parameters as follows:
 - MT Electronic Serial Number (ESN)
 - MT type (medium gain dome; transportable; super-high gain fixed site)
 - Services requested (data, dispatch with talk group definitions, etc.)
- ◆ Ensure that all required information has been received from the MSAT service provider before starting the programming procedure:
 - Phone number(s) (referred to as MIN for Mobile Identification Number)
 - Seed Access Security Key (SASK)
 - Pilot Frequency Code (PFC) and Commissioning Frequency Code (CFC) for the appropriate satellite beam.
- ◆ Ensure that the data provided by your MSAT service provider is correctly assigned to the Electronic Security Number (ESN) (commonly called RTIN for Return Terminal Identification Number) of the MT which you are initializing. The ESN of the MT is provided on the Common Transceiver Unit (CTU).

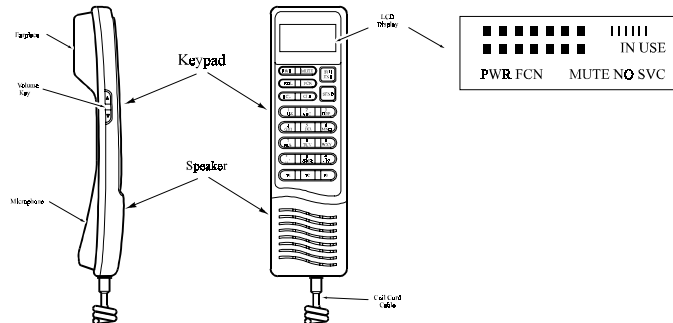
- ◆ Ensure that the MT has been correctly configured (i.e., proper setup as detailed in operating instructions manual).
- ◆ Ensure that a suitable power source is properly connected to the MT.

After successful commissioning:

- ◆ Perform tests to confirm proper operation of the MT
 - Outbound and Inbound Telephone Call
 - Outbound and Inbound Data call (if service subscription applies)
 - Net Radio (Dispatch) transmit and receive (if applicable)
- ◆ Ensure proper information provided to the MT end-user (if applicable)
 - Phone numbers (Telephone and Data number as applicable)
 - 4-Digit Security Code
- ◆ Ensure user has owners manual and understands operation of equipment

7.3 Number Assignment Module (NAM) Programming

NAM (number assignment module) is a general name for the data storage area within the MT where information required for system operation is stored. Detailed NAM Programming procedures follow.

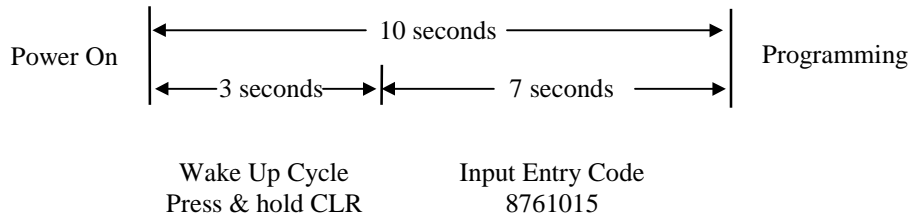


If the NAM of your MT has not previously been programmed, or a NAM check error is detected during the self test when turning the MT on, the following display indicates that NAM programming must be completed.

**Program
SAT NAM**

1. Press the | PWR | key on the Handset for at least ½ second. The display will briefly check all fields in the display which will be followed by an audible tone.
2. Press and hold the CLR key after the initial power on and within 3 seconds.

3. Allow the “wake up” cycle (3 seconds) to finish and then enter the entry code (while holding down the CLR key). You must complete the entry code input process within 10 seconds of turning on the CTU. The following is a graphical representation of the time limit to complete programming entry. The entry code is 8761015. A user can re-program the MT 20 times.



If 20 programming attempts are exceeded or the entry code will not allow programming entry, it is possible that the software in the MT has been compromised. In this situation, the MT must be returned for service. This is a safeguard to prevent illegal tampering or cloning.

You must press SEND to commit data entered to the program and cycle to the next step. If an incorrect number of digits are entered, the display will not change to the next step after pressing SEND.

4. Enter 10 digits for MIN (Mobile Identification Number, i.e., Handset telephone number), then press SEND.

**MIN=XXX
XXXXXXX**

The displays depicted are what is shown prior to pressing SEND.

The MIN is the 10 digit telephone number which is assigned and supplied by the MSAT service provider. Entering all 0 (zero) as the MIN will reset all FCN settings (e.g., Lock Code) and erase all of the user’s stored programs (e.g., name & phone number).

5. Enter 4 digits for Security Code, then press SEND.

**SecCode
= XXXX**

Be sure to inform the customer of the four digits which have been selected as the Security Code. It will be needed to change the unlock code (if desired), or to inquire what the lock code is (if the customer forgets).

6. Enter 3 or 4 digits for the Emergency Number, then press SEND.

**EMG. No.
= XXXX**

Calls using the “Emergency Number” can be made at all times and 911 is always valid (in addition to what is programmed in this location). Please check with your MSAT service provider to determine the appropriate “Emergency Number”, its operation and its administration.

7. Enter “01” as the AU Type for ST211, then press SEND
Enter “05” as the AU Type for ST251, then press SEND
Enter “07” as the AU Type for ST221M, then press SEND
8. Enter 20 digits for (S)ASK (Seed Access Security Key), then press SEND.

ASK=XXX XXXXXXX

The (S)ASK is assigned and supplied by the MSAT service provider.

Due to security reasons, you will not be able to see the (S)ASK once you press SEND. Be sure to check each 5-digit block on the display before entering the next 5 digits.

The last several digits of the (S)ASK provide a checksum for the initial digits. This checksum is verified by the MT when SEND is pressed. If the MT will not accept the ASK after pressing SEND or Check 11 or Check 30 appears, the (S)ASK was either entered incorrectly or provided incorrectly from the MSAT service provider.

9. Press STO/END to complete programming.

In order to change a code already entered, press the SEND key to return to the beginning of programming. In order to exit from the programming mode, press the STO/END key at any time. Not pressing STO/END key will result in errors and incorrect programming.

10. The MT will power off after pressing the STO/END key. This is normal and indicates that programming is complete.

7.4 Manual Pilot/GC-S Selection

After programming is successfully completed, an MT must acquire the satellite system for the first time using data parameters input by the user. This process is called Manual Pilot/GC-S (Group Controller-Signaling) acquisition because the user must manually input the pilot channel frequency and the GC-S channel frequency used for commissioning. The MT uses the pilot signal to acquire the satellite and receives system information and commissioning commands on the commissioning GC-S channel. The PFC (Pilot Frequency Code) and CFC (Commissioning Frequency Code) are assigned by the MSAT service provider and must be input during initialization.

The following procedures must be performed to successfully perform manual acquisition:

1. In the event that the MT has not completed the initialization procedure before, the user is prompted to perform manual pilot/GC-S selection with the following message.

**Enter
PFC/CFC**

The Manual Pilot/GC-S selection procedure can be executed without the above MT request, which is only displayed if the MT has not been commissioned before.

It is recommended that the Status Monitor be turned on prior to beginning the manual acquisition process by pressing FCN 84, the 4-digit security code, the '*' key and then the STO/END key. This may aid in troubleshooting any problems which may occur (see Appendix A for details). The Status Monitor should be set to OFF before turning over equipment to the user.

To perform Manual Pilot/GC-S selection and commissioning when the MT is in a shutdown state:

2. Press FCN 93 to activate the Manual Pilot/GC-S Selection mode.
3. Press 1 to execute Manual Pilot/GC-S Selection

**PFC/CFC
Press 1**

4. Enter the 10-digit PFC, then press STO/END.

**PFC=XXX
XXXXXX**

5. Enter the 10-digit CFC, then press STO/END.

**CFC=XXX
XXXXXX**

During Steps 4 and 5, if there is a code already used and stored in the memory, it will appear at this time. If this code is correct, press STO/END to proceed to the next step without re-entry of the code.

If you enter the wrong digits and then press STO/END, the MT may not proceed to the next step. If this happens, re-enter the code. To return to the previous step, press the CLR key.

6. Press SEND for at least ½ second to start the Pilot/GC-S acquisition process.

**To Srch
PushSND**

- 6a. The MT will then prompt you to conduct the manual pointing setup procedure with the following message.

**BnnSmm
OK*/NG**

After confirming the Beam ID and maximizing the Received Signal Strength indication, press the | * | key to start the GC-S selection. To return to step 4, press the | # | key twice.

7. During acquisition, the following message is shown if the Status Monitor is OFF (for a list of messages with Status Monitor ON see Appendix A).

**SAT
Search**

If you want to suspend manual selection while SAT Search is displayed, press STO/END for at least ½ second to make the MT reset.

8. The result of Manual Pilot/GC-S Selection is indicated on the display as follows:

Successful Manual GC-S selection:

**SAT
-ON-**

- The MT proceeds to the next step (Commissioning or Log-on) automatically.

Failed Pilot selection :

**PFC=XXX
XXXXXX**

- Re-enter the PFC, then press STO/END (this is the same as step 4).

Failed GC-S selection :

**CFC=XXX
XXXXXX**

- Re-enter the CFC, then press STO/END (this is the same stage as step 5).

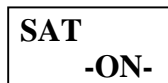
It may be helpful to turn the status monitor (FCN/84) ON prior to starting the manual Pilot/ GC-S selection or commissioning procedures. This may aid in troubleshooting any problems as the status monitor will provide additional information. Turn the status monitor OFF prior to MT delivery to the customer. See Appendix A or the operating instructions manual for more information on the status monitor.

7.5 Commissioning

All MTs are required to successfully complete a Commissioning procedure before being allowed to operate within the MSAT system. Commissioning verifies that the MT is capable of operationally providing the compatibility, functionality and performance required by the MSAT system.

The normal commissioning procedure is automatically executed after the Manual Pilot/GC-S Selection depending upon the internal status of the MT. This automatic process may take 2 to 10 minutes. If the “Setup” prompt appears during this time frame (OK*/NG#), press * to resume the process.

1. Status Monitor OFF - For normal commissioning with the Status Monitor OFF, the basic screen is displayed as below. During the commissioning procedure, the NO SVC indicator is lit. When commissioning has been successfully completed, the NO SVC indicator will turn off indicating that the MT is ready for use.



The NO SVC indicator will turn off to inform the user that the MT is available after successful commissioning.

2. Status Monitor ON - During manual acquisition and commissioning with the Status Monitor ON, the display will change as different steps in the commissioning process are executed. The displays typically seen are shown as follows. For a listing of all Status Monitor displays, see Appendix A.

B0XSXX
M:PILOT

B0XSXX
M:GC-S

B0XSXX
COM

B0XSXX
PVT:COM

B0XSXX
COM

B0XSXX
IDLE

B0XSXX
-ON-

7.6 Commissioning Problems

If a problem is encountered during the commissioning process between the MT and the MSAT system, the process may be halted or the MT may be deactivated by the MSAT system. If one of these conditions results, the following displays will be shown and the appropriate action taken as discussed below.

1. MGSP (internal protocol) error .

COM NG
PushSND

- **ACTION:** Press the SND key to resume the commissioning procedure.

2. Commissioning failure (various reasons).

COM NG
PushPWR

- **ACTION:** Press the PWR key to reset the MT and re-start the whole initialization procedure (from step 2 in Manual Pilot/GC-S selection, FCN 93,1).

3. Commissioning failure, MT deactivation.

**ShutDwn
PushPWR**

- **ACTION:** This shows that the MT is deactivated on the MSAT system. Press the PWR key and re-try the entire initialization procedure (from FCN 93,1). If the MT is still deactivated, turn the power off and then on again. Set the MT to “AutoCOM ON” (using FCN 94), then execute the Manual Pilot/GC-S Selection again. If the MT will still not commission, see “Reactivation” procedures.

7.7 Other Procedures

Additional or modified procedures must be followed in order to reactivate a deactivated MT or to re-commission an MT which has been previously commissioned. These additional procedures are detailed below.

7.7.1 Reactivation

If the MT is deactivated (i.e., in a shutdown state), a reactivation procedure is necessary for further operation within the MSAT system. When the MT is deactivated, it will not successfully complete the initialization procedure until the reactivation process has been performed. The required steps for reactivation are as follows.

1. Confirm whether the MT is really deactivated or not.

If the MT is actually deactivated, one of the following messages will be displayed after power on and will remain displayed after trying to execute any function.

**ShutDwn
PushPWR**

**SAT
ShutDwn**

2. Contact the MSAT service provider to find out the reason for deactivation and make a request for reactivation. If your Status Monitor was ON, you should be able to indicate where the problem occurred during the commissioning process. The MSAT service provider should be contacted only after the MT has been checked for any other operational problem (e.g., physical damage, loose connections, unclear line of sight).
3. Press FCN 94 and then * to set the commissioning mode to "AutoCOM ON". Each time you turn the MT on, AutoCOM is automatically set to “OFF”.
4. Ensure that the Status Monitor is set ON (FCN 84, 4-digit code, * if necessary).
5. Press FCN-9-3 to activate the Manual Pilot/GC-S Selection mode.
6. Press 1 to execute Manual Pilot/GC-S Selection

PFC/CFC
Press 1

7. The 10-digit PFC previously used should be displayed, verify this number, then press STO/END.

PFC= 155
XXXXXX

8. The 10-digit CFC previously used should be displayed, verify this number, then press STO/END.

CFC= 155
XXXXXX

If you enter the wrong digits and then press STO/END, the MT may not proceed to the next step. If this happens, re-enter the code. To return to the previous step, press the CLR key.

9. Press SEND for at least 1/2 second to start the Pilot/GC-S acquisition process.

To Srch
PushSND

NOTE: For additional details of the manual acquisition and commissioning process, refer to the applicable section in this document.

7.7.2 Re-commissioning

At times, an MT which has previously been commissioned may need to be re-commissioned in order to make major changes in a service account (e.g., changing account to new customer and phone number) or during troubleshooting if swapping CTUs. The differences between initial commissioning and re-commissioning are discussed below. Refer to Appendix B for a complete listing of re-commissioning procedures.

- ◆ When re-commissioning an MT, the complete Initialization process must be performed again including programming. During reprogramming, some input parameters may change depending upon the need for re-commissioning (e.g., MIN, AU type, etc.), but in all cases the SASK will be different and must be provided from your MSAT service provider.
- ◆ The main difference between the first initialization procedure and reprogramming is that some data will already be stored in the MT. During reprogramming, press SEND to keep the same data desired and scroll to the next parameter. Refer to Appendix B for step by step details. During Manual Pilot/GC-S, press STO/END to keep the same PFC and CFC.

8.0 Product Support

Mitsubishi Electronics' position as an industry leader cannot be maintained by only developing new products. Mitsubishi also constantly strives to enhance product support and customer satisfaction. Since the introduction of MSAT service several years ago, we have been working closely with our customers to develop new procedures and improve existing ones to make sure that our overall customer support matches the high quality product that we offer.

8.1 Product Distribution

Since Mitsubishi Electronics distributes MTs through authorized distributors, all terminals and accessories should be ordered through these distributors or their designated channels. Mobile terminal and accessory pricing, availability, and packaging may vary and will depend on the service provider.

8.2 Marketing & Sales Support

In order to successfully market Mitsubishi MTs, we will provide, in coordination with the service provider, a variety of training programs including: product positioning, set up and operations, programming and commissioning, product support and maintenance.

Marketing collateral material is also available. Mitsubishi Electronics' collateral material includes brochures, posters and presentation slides. Distributors interested in developing their own collateral can obtain product pictures and graphics from Mitsubishi Electronics, free of charge.

Mitsubishi Electronics' sales support team located in Reston, Virginia is always available to answer product questions, provide marketing assistance, and participate in joint customer visits and demonstrations with distributors targeting key customers accounts in their respective areas. Our web site "www.melamsat.com" can be accessed for online product information.

8.3 Technical Support

For technical support contact:

Mitsubishi Electronics MSAT Service Center
12PM-8PM EST (Monday Through Friday)
Phone: (800) 966-MSAT (USA and Canada)
Phone: (310) 632-9098 (Elsewhere)
Fax: (310) 632-9099

Periodic product bulletins will also be distributed on an as needed basis to announce critical product information such as new accessories, features, upgrades, etc. Product bulletins are also posted on our web site (www.melamsat.com).

8.4 Limited Warranty

The Mitsubishi MT product line includes a one-year limited warranty as described in the “The Mitsubishi Limited Warranty Statement” in section 8.4.2. The statement is also printed in the Operating Instructions Manual. This statement details the manufacturer's limited warranty coverage.

The MT main components (i.e. CTUs, AUs, and handsets) are covered for one year from the date of purchase. Other accessories are covered for six months from the date of purchase. Some services are not covered under warranty—the end-user or dealer is responsible for such charges. Please refer to the limited warranty statement for specific limited warranty information. Mitsubishi MTs do not have a “mail in” warranty card. The customer must present a proof of purchase (bill of sale) to establish proof of warranty.

8.4.1 Limited Warranty Terms

The following items are covered by a one (1) year Limited Warranty:

- ◆ TU
- ◆ AU
- ◆ Basic Handset
- ◆ Push to Talk Microphone

The following items are covered by a SIX (6) MONTH Limited Warranty:

- ◆ Handset Cradle
- ◆ Hands Free Microphone
- ◆ External Monitoring Speaker
- ◆ AC Adapter/Charger
- ◆ All Cables, Connectors & Mounting Hardware
- ◆ Brackets
- ◆ All Miscellaneous Hardware

The following items are **not covered** under Warranty:

- ◆ Product set-up, installation or the manner of installation, including adjustments of user controls or options or any other adjustment necessary to prepare the unit for display or retail purchase
- ◆ Any problem caused by the satellite or ground system
- ◆ Service that results in no trouble found (NTF)
- ◆ Freight damaged product

- ◆ Moisture intrusion of any type
- ◆ Hidden damage due to moisture intrusion
- ◆ Customer education service requests
- ◆ Damaged units due to misuse or neglect
- ◆ Labor for replacement of remote transmitters or A/C adapters
- ◆ Defects caused by unauthorized modification or alteration
- ◆ Power surge damage caused by electrical system or lightning
- ◆ Any problem or damage caused by use of product contrary to product design
- ◆ Any problem or damage caused by use of product contrary to the Operating Instructions Manual instructions
- ◆ On-site service mileage charges
- ◆ Product programming / commissioning.
- ◆ Product unlocking
- ◆ Unintentional damage of any type
- ◆ Intentional damage

8.4.2 Mitsubishi Limited Warranty Statement

This Limited Warranty applies to Mobile Satellite Terminal (MSAT) products and accessories purchased in North America from Mitsubishi Electronics America, Inc. Telecommunications and Network Systems Division (MELA-TNSD). This Limited Warranty is valid only within the country where the product was purchased.

WHAT WE WILL DO

If your MITSUBISHI MSAT Product fails while in normal use and service to maintain factory standards of operation, due to a manufacturing defect in materials and/or workmanship, within ONE YEAR from date of shipment (SIX MONTHS for accessories), MELA will (at MELA's option), either repair or replace the Product. In the event MELA repairs or replaces the Product, the repair or replacement Product will be warranted under the terms of this limited warranty for the remainder of the ONE YEAR period mentioned above (remainder of the SIX MONTH period for accessories) or ninety (90) days, whichever is longer. You should understand that repairs might include the replacement of Product, parts or components with functionally equivalent reconditioned Product, parts or components.

HOW TO OBTAIN SERVICE

In order to obtain warranty service you must bring or return the Product along with a copy of your bill of sale, to an Authorized MITSUBISHI Service Agent or service provider. To obtain the name or address of an authorized service agent, call the number printed below. Please do not send Product to the address listed at the end of this section. The Product in all cases must be accompanied by the following information: Your Name, Address, Telephone Number and MSAT Telephone Number(s), the name of your MSAT System Provider, your bill of sale bearing the mechanical serial number of the Product indicating the date of purchase, installation (if applicable) and a description of the problem you are having with the Product.

Repair evaluated as "in warranty" by an authorized MITSUBISHI MSAT service agent, must have a valid and verifiable copy of your bill of sale or other suitable document which indicates the date of original sale. The proof of purchase must be presented at the time service is requested. Otherwise, the service agent may charge for service rendered.

WHAT IS NOT COVERED

This warranty does not cover Product programming, commissioning, reconfiguration of lock codes, security codes, call restrictions, removal, failure of any equipment not supplied by MITSUBISHI, or failure of the Product due to misuse, as determined by MELA (including use in other than the normal or customary manner), neglect, accident, accidental damage, dropping, bending, twisting, stressing, crushing, any type of liquid intrusion caused by any circumstance, improper installation, improper repair, alteration, modification or adjustment. Since the MSAT system on which the Product operates is provided by an organization (MSAT Service Provider) independent from MELA, we are not responsible for the operation, availability, loss of airtime, coverage or the range and clarity of the system.

Warranty period on "previously owned" Product begins on the date of purchase by the original owner.

THERE ARE NO OTHER EXPRESS WARRANTIES, WHETHER WRITTEN OR ORAL, OTHER THAN THIS PRINTED LIMITED WARRANTY. ALL IMPLIED WARRANTIES, INCLUDING WITHOUT LIMITATION, THE IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR PARTICULAR PURPOSE, ARE LIMITED TO THE DURATION OF THIS LIMITED WARRANTY. IN NO EVENT SHALL MITSUBISHI BE LIABLE FOR INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES OF ANY NATURE WHATSOEVER, INCLUDING BUT NOT LIMITED TO LOST PROFIT OR COMMERCIAL LOSS, TO THE FULL EXTENT THOSE DAMAGES CAN BE DISCLAIMED BY LAW.

Some states, provinces or countries do not allow the exclusion or limitation of incidental or consequential damages, or limitations of the duration of implied warranties, so the preceding limitations may not apply to you. This warranty gives you specific legal rights, and you may have other rights that vary from state to state, province to province or country to country.

For Products purchased from MELA-TNSD for use in North America contact:

**MITSUBISHI ELECTRONICS AMERICA, INC. (MELA)
TELECOMMUNICATIONS & NETWORK SYSTEMS DIVISION (TNSD)
ATTN: MSAT TECHNICAL SUPPORT MANAGER
3040 E. VICTORIA STREET
RANCHO DOMINGUEZ, CA 90221 USA
1-800-966-MSAT or 1-310-632-9098
Fax: 1-310-632-9099**

8.4.3 Limited Warranty Administration

Because MSAT technology involves complicated circuitry, the Mitsubishi service philosophy requires dealers to replace failed MT components (AU, TU, Handset, etc.) and contact the MSAT Service Center for any repairs to MT components

Mitsubishi Electronics America may provide an in-warranty replacement of a failed MSAT component, at no charge to distributors in good standing. Not all circumstances qualify for this replacement service. Mitsubishi Electronics reserves the right to determine which case qualifies for this program. No in-warranty labor, travel or expense reimbursement is provided by Mitsubishi Electronics, therefore, dealers should make every effort to have defective or malfunctioning units delivered to their location. Dealers can also offer their customers on-site maintenance agreements for additional charges.

8.5 Out-Of-Warranty Repairs

An end-user who experiences a problem with their Mitsubishi MSAT equipment should work with their dealer to resolve the problem or perform troubleshooting to locate the component responsible for the problem. If the dealer cannot resolve the problem and concludes that an MT component is defective, the dealer should contact MSAT Technical Support at (800) 966-6728 or (310) 632-9098 to arrange repair of the equipment. The customer will need to provide the following information:

- ◆ Customer name
- ◆ Customer address
- ◆ Equipment model number
- ◆ Mechanical serial number (begins with M)
- ◆ Electronic serial number (begins with C6 and only for Transceiver Units)
- ◆ Problem with the equipment
- ◆ Specific service request
- ◆ Method of payment
- ◆ Preferred method of return shipment

After providing this information, the customer will receive a Return Material Authorization number. This number must be written clearly on the outside of the packing material so that the warehouse where the Service Center is located can properly identify it. The equipment should be shipped, with a note explaining the problem, to:

MSAT Service Center
Mitsubishi Electronics America
Attn.: (RMA Number)
3040 E. Victoria Street
Rancho Dominguez, CA 90221

The MSAT Service Center will test the equipment and determine what, if anything, needs to be done to repair the equipment. There is a fee for this analysis.

For equipment that is found to have a problem, the Service Center will contact the customer with an estimated repair cost. This will be based on the test and analysis fee, the hourly labor rate plus the cost of parts and handling. If the customer does not accept the repair charges and wants the equipment shipped back to them, only the analysis fee will be charged.

If the customer decides that the repair cost is excessive when compared with the cost of replacement, he should contact an authorized dealer to purchase a replacement. The customer may purchase a complete component (i.e., CTU or AU) or purchase a part from the list of parts available to dealers.

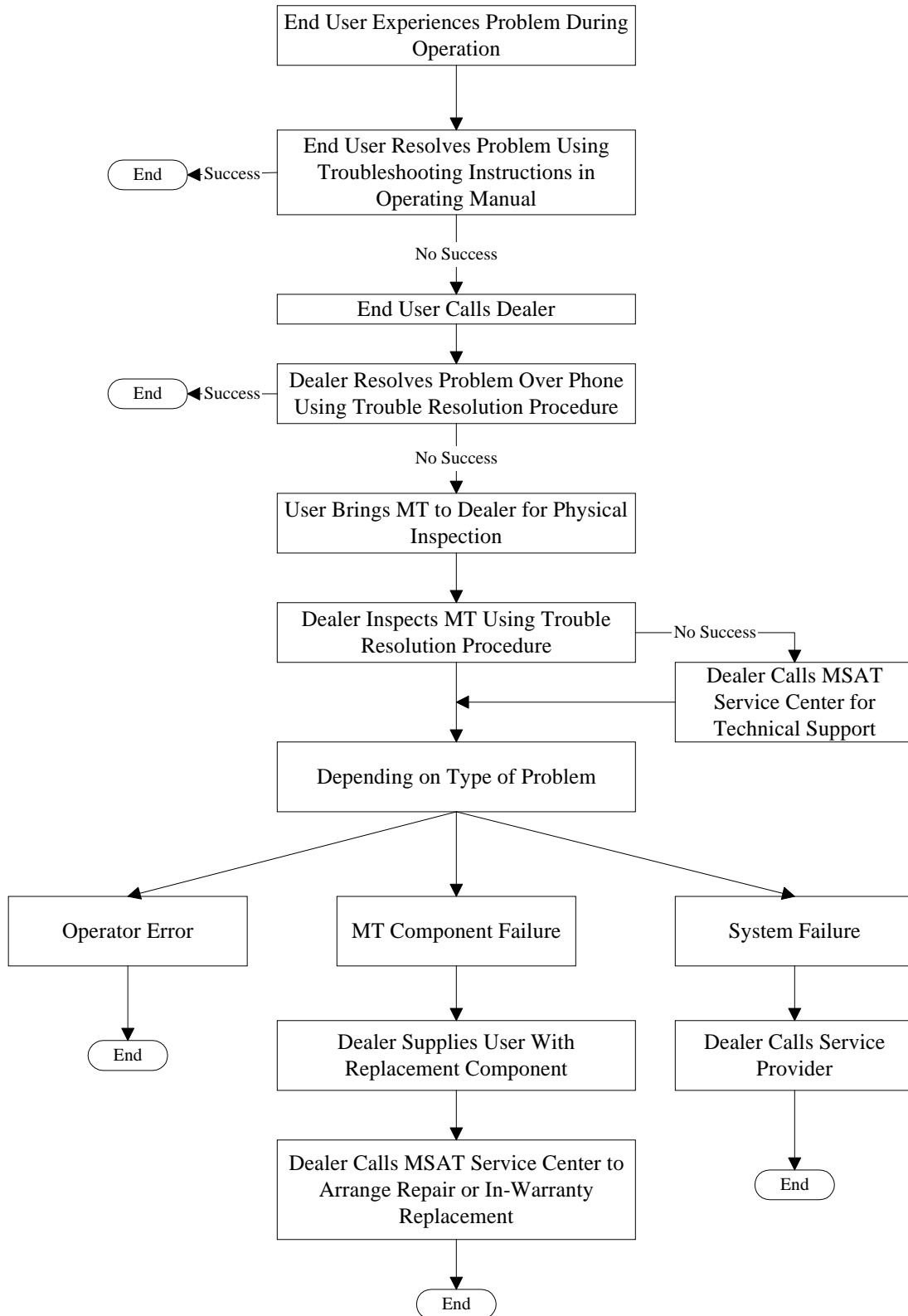
After receiving approval to complete any required repair work, the Service Center will repair the equipment using new or reconditioned parts. They will then test the equipment and return it to the customer.

For any questions about the status of equipment sent in for repair, the customer should call MSAT Technical Support at (800) 966-6728 or (310) 632-9098. To escalate any problem with this process, the customer should ask to speak with the MSAT Technical Support Manager.

9.0 Problem Resolution

In addition to the basic troubleshooting procedures in the operating instructions manual, this section provides general problem resolution procedures for the dealer, first line problem analysis guidelines to aid the dealer in identifying possible causes of the problem, and problem solving checklists to isolate a problem to operator error, an MSAT service problem, or to a specific component part of the MT.

The general problem resolution process is depicted on the diagram below.



End-users encountering problems should consult the troubleshooting instructions found in the operating instructions manual. If the problem cannot be identified, the user should call the dealer.

1. The dealer may be able to successfully resolve the problem over the phone, especially in the case of operator error. If not, the dealer should inspect the unit.
2. Depending on the type of problem, the dealer will inspect all or part of the equipment using the trouble resolution procedures in the following sections and determine the type of problem. If the dealer cannot successfully identify the problem, the Mitsubishi MSAT Service Center can provide Technical Support. Together, they should be able to identify the problem.
3. The action taken by the dealer will depend on the type of problem identified:

A. Operator Error: this type of error, usually the result of poor user training, is often easy to solve but difficult to identify. Commissioning and the use of the net radio function are two common areas where inexperienced users frequently have problems. Special attention should be given to ruling out operator error and proper instructions should be given to the end user to correct the problem and prevent future problems, if required.

It is the dealer's responsibility to ensure that the user is operating the MT in the proper manner before equipment is sent to the Service Center for repair or exchange. If necessary, the dealer should provide the necessary training to the end user.

B. System failure: When a system failure is suspected, the dealer should call the MSAT service provider's customer service to confirm a system problem and receive further instructions.

It is the dealer's responsibility to rule out system related problems by coordinating with the MSAT service provider before equipment is sent to the Service Center for repair or exchange.

C. MT component failure: If a faulty MT component is identified, the following process should be followed:

1. Use the first line problem analysis and checklists in the following sections to characterize, verify, and isolate the equipment problem to a specific component.
2. In the next troubleshooting step, the dealer will exchange one of the major components of the MT system. The level of exchange for the MTs is based on the following modules:

MT Component	Part Numbers
Handset	SZ100A
Cradle	SZ130A
Common Transceiver Unit	TU200A
Antenna Units	AU201A, AU601B

3. Coordinate with the MSAT Service Center for exchange of the faulty equipment considering the following guidelines:
 - ◆ Do not advise the user to send the MT directly to Mitsubishi Electronics. You should communicate directly with the MSAT Service Center.
 - ◆ MSAT components which are exchanged, per the Limited Warranty, may be new or remanufactured to new product standards.
 - ◆ When the Common Transceiver Unit (CTU) is exchanged, the new CTU must be programmed and the new ESN must be provided to the MSAT service provider so that it can be changed in their system. Also, inform the MSAT service provider that the old ESN should be removed from their system.
 - ◆ When you exchange the CTU, inform the customer that all phone numbers and names programmed in memory locations will be lost. Dealers may reload the information in the new CTU at no charge or for a fee. The amount you charge for this service is in no way endorsed or determined by Mitsubishi Electronics.

The exchange process outlined in this section will be more effective if the dealer has a complete MT available at the location where the troubleshooting is taking place. It is recommended that all dealers purchase one MT to use for troubleshooting and exchange purposes. Otherwise, it will be necessary for dealers to inform customers to wait until a replacement module is received from the Service Center.

9.1 First Line Problem Analysis

There are several features of the Mitsubishi MTs which will aid the user or dealer in verifying, troubleshooting, and resolving potential problems. Information is provided in the Operating Instructions Manual, which allows users to troubleshoot problems or aid the dealer in troubleshooting problems by following the Basic Troubleshooting Procedures. These procedures use system status reporting features such as audible indicators & warnings, error codes, and other status characteristics to identify the potential cause of the problem at a high level. This may aid the user in resolving the problem by themselves (e.g., tightening loose handset connection) or in providing better information to the dealer to resolve it remotely (over the phone, if possible).

This section contains a First Line Problem Analysis checklist that can be used remotely to resolve problems prior to the user bringing the equipment to the dealer location (in case of operator error, system problem, or obvious and correctable MT problem).

First Line Problem Analysis Checklist

Procedure	Action
A. Characterize the Problem	Rule out items B through E below; refer to checklists.
<i>Attributes</i>	
Power On/Off OK?	
Check codes displayed?	
Call initiation OK?	
Call receiving OK?	
Call quality OK? Receive? Transmit?	
<i>Conditions</i>	
Location, line of sight, blockage, foliage?	
Weather conditions?	
Are problems encountered under different conditions?	
What is the specific MT configuration?	
<i>Timeframe</i>	
When was the problem encountered?	
How long did the problem persist?	
Is the problem constant or intermittent?	
B. Rule out operator error	Educate the user.
User's experience level?	
Has user read and understood the manual?	
Trace steps leading to problem.	
Has the user made other errors?	
C. Rule out System-Related Problems	Call the Service Provider to confirm the existence of a system-related problem.
Is the "No SVC" indication displayed all or much of the time?	
Fast busy signal?	
Can't make or receive calls?	
Are calls being dropped?	
Have there been similar complaints from others during this time period?	
D. Check for obvious hardware problems	Inspect MT components.
Are any cables pinched, pulled or cut?	
Are all connectors tight?	
Are there signs of any physical damage?	
E. Has the MT been exposed to moisture?	Inspect MT components.
Was the MT exposed to rain or snow?	
Did the user spill a beverage on the handset?	

9.2 Trouble Checklists

This section has been developed to solve a variety of product and system problems. These checklists can be used with land mobile, transportable and fixed site MT configurations to resolve most common problems. If you need further assistance please contact the MSAT Service Center at (800) 966-6728.

Problem: The MT will not power on or off

The most common cause of MT power on failures is a defective power supply in the transceiver unit (CTU), which can only be repaired at the Mitsubishi MSAT Service Center. Other possible causes may be ruled out by following the checklist below.

What to Check	What to do
1. Does the MT turn off while starting the engine?	This is a standard feature of the MT.
2. Are shaded blocks displayed on the handset?	Shaded blocks may indicate a transceiver unit failure or a bad connection.
3. Is the power in the power supply or battery sufficient?	Change power supplies or charge the battery.
4. Are the connections good?	Make sure the connections between the CTU and BSU, AU, handset and vehicle battery are tight and not damaged or corroded. Make sure the handset is not attached to the PTT port.
5. Are cables defective?	Check for breaks in the cable.
6. Fuse in power cable.	Replace defective power cable fuses.
7. Fuse in the vehicle or power supply.	Replace defective fuses.
8. Does the MT respond to the handset keypad?	Lack of response to the keypad may indicate software corruption.
9. Is the ST251 MT lid open?	Lid must be open for the ST251 to power up.

Problem: MT fails commissioning

Dealers and MT users who do not commission MTs regularly sometimes find the process difficult. As long as the commissioning instructions are followed carefully and the process is not rushed, it is simple and easy.

There are several common reasons for failure of the commissioning process. The most common reason is that the MT has not been programmed with the correct SASK or the service provider has not properly activated the account. Also, because the buttons on the Mitsubishi handset keypad are small and recessed, holding down the CLR button while entering the program mode entry code in order to get into program mode is difficult for some people and requires several attempts. Other possible problems can be ruled out by following the checklist below.

What to Check	What to do
1. Is the signal strength high enough?	Make sure the antenna is not blocked or reflected and review the signal strength requirement in the operating instructions.
2. Were the correct MIN and SASK entered?	Reprogram the MT if necessary.
3. Were the right PFC and CFC frequencies correctly entered?	Use FCN 93 to enter the correct PFC and CFC.
4. Does the ESN on the TU match that in the account?	Check with the service provider to verify the ESN.
5. What is the MT account status?	Check with the service provider to make sure the account is in “ready for commissioning” status.
6. Does “COM NG Push SND” message show on LCD?	This indicates an error during commissioning. Push the Send button or conduct manual Pilot/GC-S selection.
7. Does the display show “COM NG Push PWR”, “Wait COM” or “Push PWR”?	These messages all indicate that commissioning failed. Turn the MT off and try again.
8. Does the display show “COM” or “PVT: COM”?	These are normally displayed during the commissioning process. Wait for successful completion.

Problem: MT does not complete initialization

After an MT has been commissioned, it should be able to establish contact with the satellite network and be ready to make calls within 60 seconds of being powered on. This initialization process sometimes takes longer, but should definitely be completed in less than two minutes.

What to Check	What to Do
1. Does “SAT Search” message show on LCD?	Wait for MT to complete manual Pilot/GC-S selection. This process should take less than 10 minutes, unless there is an equipment failure.
2. Is an “E” displayed in the upper right hand corner on the LCD?	This indicates that the MT is downloading bulletin board information from the satellite network. Wait for it to clear.
3. NO SVC	This message may be displayed when the MT is in a poor location or when there is an account problem.

Problem: Signal strength is low

MT signal strength, as indicated by the Receive Signal Strength Indicator (RSSI), must be high enough for the MT to maintain contact with the satellite network, to commission the MT and to

complete calls. The signal strength may be too low because of signal blockage, improper installation of the antenna or beam steering unit (BSU) or corroded connections. Defective antenna units can also result in low signal strength.

For the ST211, when the Auto-On feature is selected, the vehicle must be at a stand still or driven in a straight line for the first 10 seconds after start up. This procedure will allow the BSU time to calibrate.

What to Check	What to do
1. Did the signal strength gradually decline over several days?	This symptom is usually related to an antenna failure. Replace the antenna to see if that resolves the problem.
2. Are the connections between the AU and TU secure and corrosion-free?	Look at the connections and make sure the pins are straight and rust-free. Keep insulating or water sealing materials outside of the connection.
3. Are the right cables being used?	Follow the installation instructions, since excess cable length or incorrect type can reduce signal strength.
4. Is the BSU installed correctly?	Review installation instructions and make sure the BSU is mounted upright, in the direction of the arrow.
5. For the ST251 only-Is the transceiver fully inserted and seated properly inside the base unit?	Improper installation of the TU can cause degradation in signal strength.

Problem: Error message or check code is displayed.

When a MT is turned on, it performs a self-diagnostic check and displays an error code if it encounters a problem. Some error codes indicate problems that can be fixed by reprogramming the MT or ensuring that the connections to the TU are good. Some check codes indicate a hardware failure that may require component replacement.

Check Code or Error Message	What to do
1. Shutdown/Push Power or Sat Shutdown	Indicates receipt of a “cease transmit” message from the satellite network. This message is usually seen during failed commissioning attempts. Coordinate with the service provider and try again.
2. High TMP	Turn the MT off and let it cool for 30 minutes. If the message persists, the AU may be defective.
3. Check 11	This indicates a TU failure.
4. Check 13	This indicates a TU failure.
5. Check 14	This indicates an unusual RF power status and may mean that there is a problem with the AU.
6. Check 20	This indicates an unusual transmission burst that may be the result of an AU failure.
7. Check 21	This indicates a TU failure.
8. Check 23	This indicates a TU failure.
9. Check 24	This indicates a TU failure.
10. Check 30	Verify that the SASK is correct.
11. Check 40	The BSU may be defective.
12. Check 42	The BSU may be defective.
13. Check 43	Check the connection to or replace the BSU.
14. Check 44	The BSU may be defective.

Problem: Audio quality is poor or volume is low.

Most user complaints about audio volume can be resolved by reviewing operating instructions and performing a physical inspection of the system.

What to Check	What to Do
1. Is the volume set too high or low?	Adjust the volume level.
2. Is the received audio intermittent?	Make sure the MT has a clear transmission path.
3. Is the handset cradle or junction box damaged?	Replace damaged part or component.

Problem: Calls cannot be initiated.

This type of complaint is usually the result of a de-activated account or an equipment failure. Other possible causes can be found below.

What to Check	What to do
1. Is the antenna blocked?	Move the MT so that the antenna has a clear view of the satellite.
2. Is the Received Signal Strength Indication (RSSI) low?	Move the antenna to increase the RSSI.
3. Do you hear a fast busy (or “reorder”) tone?	Make sure that the MT is not set to data mode. Verify account status with service provider. The reorder tone often indicates a problem with the account that the service provider must resolve. The system may be busy, so you should try the call later.
4. Was the correct number dialed?	Try dialing the number again.
5. Are the connections between the AU, TU and BSU secure?	Make sure the connections are secure.
6. Has the BSU been calibrated?	To calibrate the BSU, turn the MT off and remain stopped or drive straight for 10 seconds after turning it on again.
7. Is the BSU installed properly and horizontally?	Install the BSU according to the instructions.

Problem: MT does not complete data calls

Successful data calls require 1) correct account set up, 2) a properly configured TU and 3) the right DTE settings. The explanations for data call setup included in Appendix D of this manual are usually sufficient. However, some users find that they must spend time working with their data communications provider to properly set the DTE.

What to Check	What to do
1. Are the data parameters set correctly?	Use FCN 92 to check parameters.
2. Is service type set to data?	Use FCN 91 to change if necessary.
3. Are modem settings correct?	Work with your data service provider to make sure the settings are correct.

10.0 Key Contact Directory

The following directory is a list of MELA's authorized MSAT distributors in North America. Please check our web site at www.melamsat.com for updates and changes to this list.

<p>El Dorado International Holdings Limited Zona Franca, Puntarenas Costa Rica Phone: (506) 663-7707 Fax: (506) 663-2798 http://www.eldosat.com Email: eldorado@imailbox.com</p>	<p>Glentel, Inc. 8501 Commerce Court Burnaby, BC V5A 4N3 Phone: (800) 784-1721 Fax: (800) 636-6381 http://www.glentel.com Email: satinfo@glentel.com</p>
<p>INFOSAT Telecommunications 18 Fawcett Road Coquitlam, BC V3K 6X9 Phone: (888) 524-3038 Fax: (604) 524-6067 http://www.infosat.com Email: info@infosat.com</p>	<p>MOBEX Communications, Inc. 3512 Cavalier Drive Fort Wayne, IN 46808 Phone: (800) 336-6825 Fax: (219) 471-5294 Email: dcayton@mobex.com ahenderson@mobex.com</p>
<p>NSat Corporation Urb. Caribe, Suite 201 1569 Alda Street San Juan, Puerto Rico 00926 Phone: (787) 763-3131 Fax: (787) 763-3920 Email: nperez@spiderlink.net</p>	<p>SatCom Systems, Incorporated P.O. Box 7460 Burbank, CA 91510-7460 Phone: (818) 526-1700 Fax: (818) 526-1715 http://www.satsrv.com Email: info@satsrv.com</p>
<p>Seven Seas Communications 1700 E. Las Olas Blvd Suite 202 Ft. Lauderdale, FL 33301 Phone: (800) 566-9600 Fax: (954) 761-7668 http://www.sevensesascom.com Email: sails@sevensesascom.com</p>	<p>SOURCEtech Inc. 5955 Jimmy Carter Blvd. Suite 201 Norcross, GA 30071 Phone: (678) 966-0023 Fax: (678) 966-0054 http://www.sourcetechinc.com Email: orespinoza@sourcetechinc.com</p>
<p>Stratos 3300 Corporate Avenue Suite 108 Weston, FL 33331 Phone: (888) 766-1313 Fax: (709) 748-4305 http://www.stratos.ca Email: info@stratos.ca</p>	<p>Tecnologia Sistemas y Aplicaciones Calle Cuautemoc No. 75, El Carmen Coyoacan 04100 Mexico DF Phone: (525) 327-0505 Fax: (525) 554-5576 or (525) 327-0581 Email: tsacom01@mail.internet.com.mx</p>

If you need to contact us, you can reach us at the following locations:

Mitsubishi Electronics America, Inc.	Telephone	Fax
Telecommunications/Network Systems Division 12007 Sunrise Valley Drive Suite 220 Reston, VA 20191 Product Questions	(703) 758-7811	(703) 758-7137
Mitsubishi Electronics MSAT Service Center 3040 East Victoria Street Rancho Dominguez, CA 90221 Technical Support/Out-of-warranty Repairs/Spare Parts	(800) 966-MSAT (310) 632-9098	(310) 632-9099

11.0 System Specifications

Communication Modes

Voice	Full Duplex Digital Voice at 6400 bps
Net Radio (option)	Half Duplex Digital Voice at 6400 bps
Data	1200 bps/2400 bps/4800 bps / (AT Command Set)

System Specifications

General:

Transmit Frequencies	1626.5 - 1660.5 MHz
Receive Frequencies	1525.0 - 1559.0 MHz
Polarization	Right - Hand Circular (RHC)
Channel Spacing	6 kHz

Communications (MET-C and FES-C) and GC-S Outbound Signaling Channel:

Channel Rate	6.75 kbps
Modulation	DQPSK
Access Method	SCPC/FDMA for Communications Channels TDM for GC-S Channel
Voice CODEC	Improved Multi-Beam Excitation (IMBE) @ 6.4 kbps
Scrambler	Random Pseudo Noise (PN) generator with 15 stages
FEC Encoder	Convolutional, Rate 1/2, k=7
FEC Decoder	Viterbi
Interleaving	Block - data communications and all signaling

MT-ST and MT-SR Inbound Signaling Channel:

Channel Rate	3.375 kbps
Modulation	Differential Phase Shift Keying (DPSK)
Access Method	TDMA - MET-ST Slotted Aloha - MET-SR
Scrambler	Random Pseudo Noise (PN) generator with 15 stages
FEC Encoder	Convolutional, Rate 1/2 and 3/4
FEC Decoder	Viterbi
Interleaving	Block

ST211 (Land Mobile) Performance Specifications

G/T	-16 dB/K (15° to 60° elevation)
EIRP	12.5 - 16.5 dBW
Turning Rate	60°/sec max.
Turning Acceleration	20°/sec max.

ST221M (Fixed Site) Performance Specifications

G/T	-5 dB/K (5° to 50° elevation) -4 dB/K (50° to 90° elevation)
EIRP	12.5 - 16.5 dBW

ST211 (Land Mobile) Power Specifications

Power Consumption

Primary DC Voltage	12V DC nominal (11.5 to 15.6V range)
Transmit	4.5 A
Receive	1.8 A

ST221M (Fixed Site) Power Specifications

Power Consumption

Primary AC Voltage	120VAC nominal (85 to 265 VAC range)
Primary DC Voltage	12V DC nominal (11.5 to 15.6V range)
Transmit	2.4 A
Receive	0.8 A

Physical Specifications

Transceiver Unit	
WxHxD	8.1" x 2" x 12.1"
Weight	6 lb.
Handset	
WxHxD	8" x 2.2" x 1.3"
Weight	0.6 lb.
AU601B Antenna Unit	
Dia. x Height	33.5"(Ø) x 17"(H)
Weight	16.1 lb.
AU201A Antenna Unit	
Dia. x Height	6.8"(Ø) x 6.6"(H)
Weight	3 lb.
Beam Steering Unit	
WxHxD	0.8" x 2" x 2"
Weight	0.4 lb.

ST211/ ST221M Environmental Specifications

Temperature			
State	Antenna Unit		Transceiver Unit
Operating	-30°C to 43°C	(-22°F to 109°F)	-30°C to 55°C (-22°F to 131°F)
Power-On	-45°C to 49°C	(-49°F to 120°F)	-40°C to 85°C (-40°F to 185°F)
Storage	-55°C to 85°C	(-67°F to 185°F)	-55°C to 85°C (-67°F to 185°F)
Relative Humidity	98% at 38°C		98% at 38°C
Rain	2"/hr (50mm/hr)		NA
Solar Radiation	1120 W/m ²		NA
Shock (survival)	½ sin, 20g, 11ms		½ sin, 20g, 11ms
Vibration	(Note: 5-20Hz: 0.05g ² /Hz, 20-150 Hz: -3dB/octave)		
Operating	1.05g rms		1.05g rms
Storage	1.7g rms		1.7g rms

ST211 Wind Specification

State	Antenna Unit	Transceiver Unit
Operating	120 mph (200 km/hr)	NA
Storage	163 mph(272 km/hr)	NA

ST221M Wind Specification

State	Antenna Unit	Transceiver Unit
Operating	67 mph (30 m/s) <i>100mph w/positive lock</i>	NA
Storage	134 mph(60 m/s)	NA

OmniQuest® ST251 General Specifications

Primary Voltage	9.6V DC nominal (11.5 to 15.6V range)
Power Consumption	
Transmit	2.4 A (1 hour continuous talk time)
Receive	1.7 A (2.5 hour receive time)
Standby	0.8 A (8 hours stand-by time)
Sleep Mode	0.6 A
Power Off	0.1 mA
G/T	-14.6 dB/K (25° to 60° elevation)
EIRP	12.5 - 16.5 dBW (25° to 60° elevation)

OmniQuest® ST251 Physical Specifications

Base Unit	Total (Excluding Handset Cradle)
WxHxD	11.3" x 2.0" x 8.3" (287 mm x 51 mm x 210 mm)
Weight	5.3 lbs (2.4 kg)
Handset	
WxHxD	8" x 2.2" x 1.3" (203 mm x 56 mm x 33 mm)
Weight	0.7 lbs (0.3 kg)
AC Adapter / Charger	
WxHxD	4.0" x 2.5" x 7.5" (102 mm x 64 mm x 190 mm)
Weight	1.7 lbs (1.0 kg)
Soft Carrying Case	
WxHxD	16.3" x 12.5" x 3.3" (412 mm x 318 mm x 83 mm)
Weight	2.2 lbs (1.0 kg)

OmniQuest® ST251 Environmental Specifications

Parameter

Operating Temperature	
w / AC Charger	-25°C to +50°C (-13°F to +122°F)
w / Standard Battery	0°C to +40°C (32°F to +104°F)
Storage Temperature	-35°C to +85°C (-31°F to +185°F)
Relative Humidity (non-condensing)	98% at 38°C (100°F)
Wind	
Operating	22 mph (36 km/h)
Rain	5 mm/hr (Base Unit when closed - do not use in rain)
Solar Radiation	1120 W/m ²
Shock (Survival)	1/2 sin, 20g, 11 ms
Vibration	(note: 5 - 20 Hz: 0.50 g ² /Hz, 20 - 150 Hz: -3 dB/octave)
Operating	1.05g rms
Storage	1.7g rms

GLOSSARY

AC	Alternating Current
AMSC	American Mobile Satellite Corporation
AMSC1	AMSC's Satellite @ 101°W
AMSS	Aeronautical MobileSatellite Service
ASA	Authorized Sales/Service Agent
ASD	Authorized Service Depot
CFC	Commissioning Frequency Code
CGS	Communications Ground Segment
CLA	Cigarette Lighter Adapter
CNV	Converter
CODEC	Coder/Decoder
DC	Direct Current
DPSK	Differential Phase Shift Keying
DQPSK	Differential Quaternary Phase Shift Keying
DTE	Data Terminating Equipment
EIRP	Effective Isotropic Radiated Power
ESN	Electronic Serial Number
FCN	Function
FDMA	Frequency Division Multiplexing
FEC	Forward Error Correction
FES	Feeder Earth Station
FIU	Facsimile Interface Unit
FTIN	Forward Terminal Identification Number
GC	Group Controller
GC-S	Group Control Signaling
GHz	Gigahertz
HPA	High Power Amplifier
IMBE	Improved Multi-Band Excitation
KHz	Kilohertz
LNA	Low Noise Amplifier
MET-SR	Mobile Earth Terminal-Signaling Random
MET-ST	Mobile Earth Terminal-Signaling TDMA
MSAT	Mobile Satellite
MSAT1	TMI's MSAT Satellite @ 101°W
MTBF	Mean Time Between Failure
MT	Mobile Terminal
NAM	Number Assignment Module
NCC	Network Communications Controller
NG	No Good
NOC	Network Operations Center
NVRAM	Non-Volatile Random Access Memory
PFC	Pilot Frequency Code
PN	Pseudo-random Number
PNC	Private Network Capacity (Provider)

PSTN	Public Switched Telephone Network
PVT	Performance Verification Test
QPSK	Quaternary Phase Shift Keying
RF	Radio Frequency
RFU	RF Unit
RHC	Right Hand Circular
RSSI	Receive Signal Strength Indicator
RTIN	Reverse Terminal Identification Number
SCPC	Single Channel Per Carrier
SVC	Service
TDMA	Time Division Multiple Access
TMI	TMI Communications
TPB	Transportable
TU	Transceiver Unit
VASP	Value Added Service Provider

APPENDIX A - STATUS MONITOR REFERENCE

The MT Status Monitor is accessed through FCN 84 and is displayed on the active user interface (standard Handset, or PTT microphone). The Status Monitor displays MT status information regarding communications conditions and current operational mode and can be useful during the initialization process for troubleshooting if problems happen to occur.

When the Status Monitor is ON, the MT displays the MSAT system status information, instead of the SAT-ON- message.

BnnSmmE XXXXXX

- ◆ The top line of the LCD shows the Beam ID (: nn) and the Received Signal Strength Indication (RSSI: mm) through 80 levels from 00 through 80.
- ◆ When the MT is receiving updated system table (bulletin board) from the MSAT SYSTEM or when it receives an unusual table, E is displayed.
- ◆ The lower line of the LCD shows the current status of the MT and any internal process which may be occurring as follows:

A:PILOT	:Undergoing Automatic Pilot Selection
A:GC-S	:Undergoing Automatic GC-S Selection
PushF93	:Waiting for execution of Manual Pilot/GC-S Selection
M:PILOT	:Undergoing Manual Pilot Selection
M:GC-S	:Undergoing Manual GC-S Selection
COM	:Undergoing Commissioning
WaitCOM	:Waiting for Commissioning
PushPWR	:Commissioning failure
ShutDwn	:Shut Down
PVT	:On PVT (Performance Verification Test)
PVT:COM	:Undergoing PVT during Commissioning
LOGON	:Undergoing Logon
Idle	:In Idle status
BEAM-X	:Searching Beams for possible Beam Crossover
-ON-	:Completion of initialization (enable for call setup)
MM:SS	:During conversation (talk time indication in minutes and seconds)

APPENDIX B - INITIALIZATION AND COMMISSIONING PROCEDURES

INITIALIZATION CHECKLIST

Pre-Programming

To Service Provider

- MT ESN
- MT Antenna Type
- Services:
 - Data
 - Dispatch (w/definitions)
 - Advanced Features

From Service Provider

- Phone Number(s)
 - SASK
 - PFC
 - CFC
-

Programming & Commissioning

- Setup Complete
 - Power Source Supplied (battery charged if internal)
 - MT connections firmly secure
 - Program MT
 - Manual System Acquisition
 - Commissioning
-

Post Commissioning

Verification Testing

- Outbound/Inbound Telephone Call
- Outbound/Inbound Data Call (if applicable)
- Transmit/Receive Dispatch Call (if applicable)
- Turn Off Status Monitor

Provide to End User

- Phone Number(s)
- 4-Digit Security Code
- MT Operating Instructions Manual
- Basic MT Training

**Quick Reference Procedures
Handset Programming and MT Commissioning**

USER STEP/ACTION	RESULTING DISPLAY	NOTES
1. Press PWR for > 1/2 sec	→ Program SAT NAM	
2. Press and Hold CLR	← Program SAT NAM	
3. Wait 3 seconds; enter Access Code (8761015)	MIN= ●	Complete input within 7 seconds (within 10 seconds after power on)
4. Release CLR	MIN= ●	
5. Enter 10 digit Telephone # Press SEND	SecCode =	
6. Enter 4 digit Security Code Press SEND	EMG.No = 911	
7. Enter 3 or 4 digit Emergency # Press SEND	AU Type = 03	Received from MSAT Service Provider Pick random or user defined code; inform user of code 911 is default and always valid; enter another # if available
8. Enter 2 digit Antenna Type Press SEND	ASK=XXX XXXXXXX	01 = ST211 05 = ST251 07 = ST221M
9. Enter 20 digit SASK (no* req'd) Press SEND, then STO/END	Tone will sound and MT will power off automatically	Received from Service Provider; input and check 5 digits at a time Prompt only; must use FCN 93 to input actual codes (see below)
10. Press PWR for >1/2 sec	Enter PFC/CFC	To turn status monitor on before acquisition and commissioning
11. Press FCN 84	Enter Code	Must match security code input during programming
12. Enter 4 digit security code	Status OFF	
13. Press # Press STO/END	Enter PFC/CFC	
14. Press FCN 931	PFC= CFC=	Provided by Service Provider
15. Enter 10 digit PFC Press STO/END	To Srch PushSND	Provided by Service Provider
16. Enter 10 digit CFC Press STO/END	→ BOXSXX M:PILOT	See Section 7.5 for all displays
17. Press SEND; then wait (~ 2-10 minutes)	BOXSXX -ON-	
18. Turn Status Monitor Off	SAT -ON-	Same as turning ON

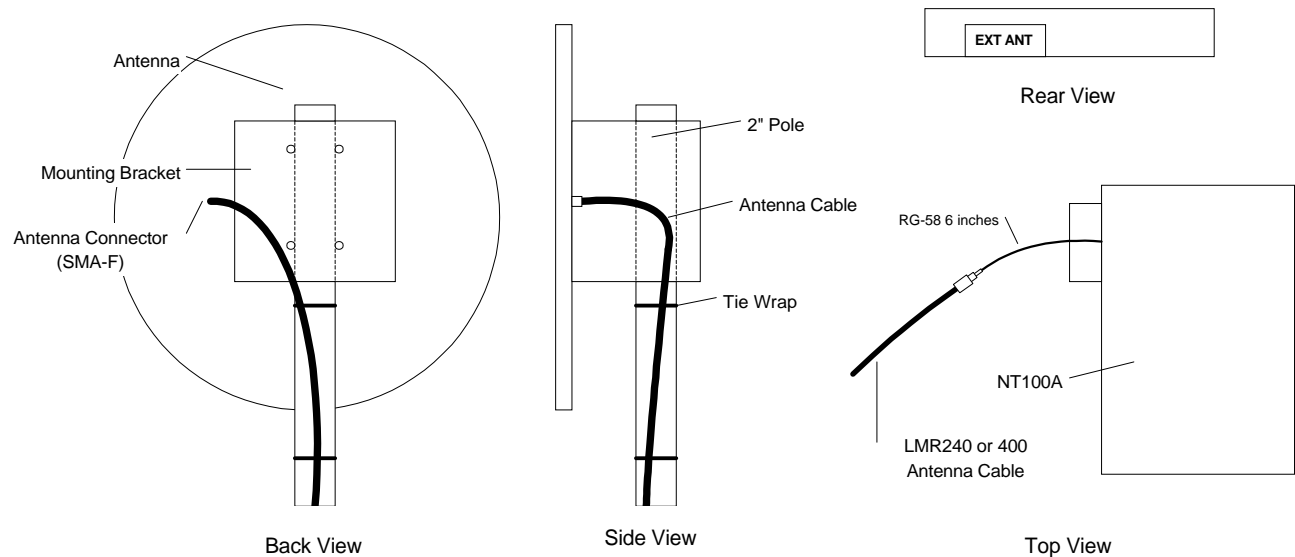
**Quick Reference Procedures
Handset* Re-activation or Recommissioning**

USER STEP/ACTION	RESULTING DISPLAY	NOTES
1. Press PWR for > 1/2 sec (see notes with a - c) a. TPB MT: this display shown →	See Below Dependent on Situation (a - c) <div style="border: 1px solid black; padding: 2px; display: inline-block;">B0XSXX OK*/NG#</div>	Recommissioning - go to step 2 Reactivation - Press *; go to step 11
b. Reactivation: commissioning failure or CGS deactivation c. Recommissioning (excl.TPB)	<div style="display: flex; justify-content: space-around;"><div style="border: 1px solid black; padding: 2px; text-align: center;">COM NG PushPWR</div><div style="border: 1px solid black; padding: 2px; text-align: center;">ShutDwn PushPWR</div></div> <div style="border: 1px solid black; padding: 2px; display: inline-block; margin-top: 5px;">SAT -ON- ..</div>	Go to step 11 Go to step 2 (B0XSXX displayed if Status Monitor ON)
2. Press and Hold CLR	Same display as above	
3. Wait 3 seconds; enter Access Code (8761015)	→ <div style="border: 1px solid black; padding: 2px; display: inline-block;">MIN=800 1234567</div>	Complete input within 7 seconds (within 10 seconds after power on)
4. Release CLR	← <div style="border: 1px solid black; padding: 2px; display: inline-block;">MIN=800 1234567</div>	
5. Enter 10 digit Telephone # Press SEND	→ <div style="border: 1px solid black; padding: 2px; display: inline-block;">SecCode =1234</div>	Change # if applicable, received from MSAT Service Provider Pick random or user defined code; inform user of code 911 is default and always valid; enter another # if available 01= ST211 05 = ST251 07 = ST221M
6. Enter 4 digit Security Code Press SEND	→ <div style="border: 1px solid black; padding: 2px; display: inline-block;">EMG.No = 911</div>	
7. Enter 3 or 4 digit Emergency # Press SEND	→ <div style="border: 1px solid black; padding: 2px; display: inline-block;">AU Type = 03</div>	
8. Enter 2 digit Antenna Type Press SEND	→ <div style="border: 1px solid black; padding: 2px; display: inline-block;">ASK=XXX XXXXXXXX</div>	
9. Enter new 20 digit SASK (no*) Press SEND;then STO/ END	Tone will sound and MT will power off automatically	Received from Service Provider; input and check 5 digits at a time
10. Press PWR for >1/2 sec	Same as display from step 1	
11. Ensure Status Monitor is ON (FCN 84,sec code,#,STO/END)	Same as display from step 1	Turn Status Monitor ON before acquisition and commissioning
12. Press FCN 94	<div style="border: 1px solid black; padding: 2px; display: inline-block;">AutoCOM OFF</div>	
13. Press # Press STO/END	Same as display from step 1	Turn AutoCOM ON for reactivation or recommissioning
14. Press FCN 931	<div style="border: 1px solid black; padding: 2px; display: inline-block;">PFC= 155 XXXXXXXX</div>	Stored PFC should be valid unless MT has changed beam location Stored CFC should be valid unless MT has changed beam location See Section 7.5 for all displays
15. Enter 10 digit PFC Press STO/END	<div style="border: 1px solid black; padding: 2px; display: inline-block;">CFC=155 XXXXXXXX</div>	
16. Enter 10 digit CFC Press STO/END	<div style="border: 1px solid black; padding: 2px; display: inline-block;">To Srch PushSND</div>	
17. Press SEND; then wait (~ 2-10 minutes)	<div style="border: 1px solid black; padding: 2px; display: inline-block;">B0XSXX M:PILOT</div> → <div style="border: 1px solid black; padding: 2px; display: inline-block;">B0XSXX -ON-</div>	
18. Turn Status Monitor Off	<div style="border: 1px solid black; padding: 2px; display: inline-block;">SAT -ON-</div>	Same as turning ON

APPENDIX C

OMNIQUEST® EXTERNAL ANTENNA INSTALLATION INSTRUCTIONS

1. Select approximate equipment locations based on the lengths of the cables provided with the equipment and optimal antenna placement. The antenna must have a clear line-of-sight (LOS) with the network satellite.
 2. Mount the bracket on the antenna using the provided hardware.
 3. Mount the antenna on a pre-installed pole (diameter should be less than 2 inches) using the U-bolts provided or mount to a tripod using the ¼ inch threaded hole on the elevation bracket.
 4. Determine the correct azimuth and elevation angles for the antenna at your location by using the map found on Page 24 of the ST251 Operating Instructions Manual.
 5. Adjust the mounting bracket to the proper azimuth and elevation and tighten the elevation screws and U-bolts or the tripod head.
 6. Attach the antenna cable to the antenna connector. Be careful to not exceed the torque limit for this connector. Apply weatherproofing material and use tie wraps to secure the cable to the mounting pole or tripod.
 7. Rout the antenna cable from the antenna to the OmniQuest, ensuring that the cable is not stretched, pulled or pinched. Avoid tight turns (cable bends should be greater than 1.75 inches) and protect the cable from possible friction. Coil and secure any excess cable near the OmniQuest. The cable must not be cut.
 8. If this is a permanent installation, secure the cables every 12 to 18 inches along the cable run. Be sure no weight is placed on the antenna connector. Tighten the U-bolts and apply Loctite to the threads of the elevation angle bracket and antenna. Apply fusion tape or cold shrink wrap to all external connections to provide weatherproofing.
 9. Connect the 6 inch flexible RG-58 jumper cable at the OmniQuest end of the antenna cable.
 10. Open the door at back of the OmniQuest marked “EXT ANT” and disconnect the lid antenna by sliding off the connector. Attach the external cable to the OmniQuest antenna port.
 11. For further instructions, see your OmniQuest Operating Instructions.
- ★ Equipment problems related to improper installation are not covered by the Mitsubishi Limited Warranty.

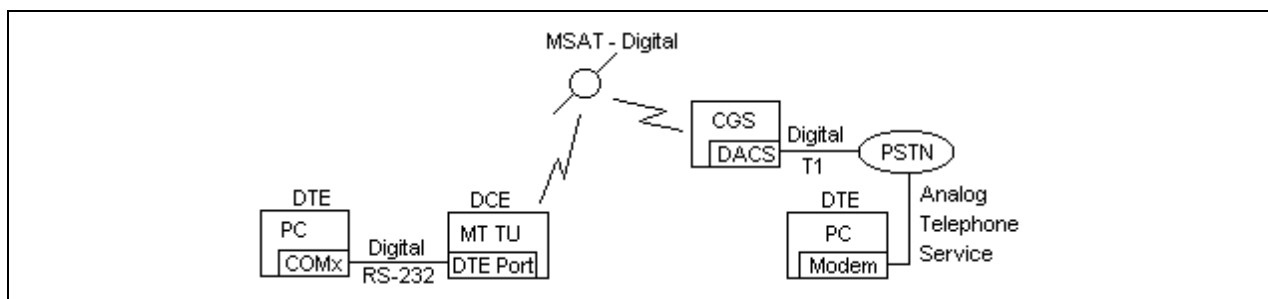


APPENDIX D - DATA OPERATION

The purpose of this technical supplement is to provide additional information to the Mitsubishi MT user for circuit switched data operation. The level of detail addresses typical questions or problems. This technical information, together with the owner's manual, is useful for installing and using the Mobile Terminal (MT) data capability.

The Mitsubishi MT is essentially a digital satellite modem that communicates over a digital RF path to the Communication Ground Segment (CGS). At the CGS, the digital signal is re-modulated into a T1 format for interfacing with the Public Switched Telephone Network (PSTN). Therefore, the MT will connect directly into one of the COM (serial) ports of the Data Terminal Equipment (DTE).

These components and interfaces are shown below:



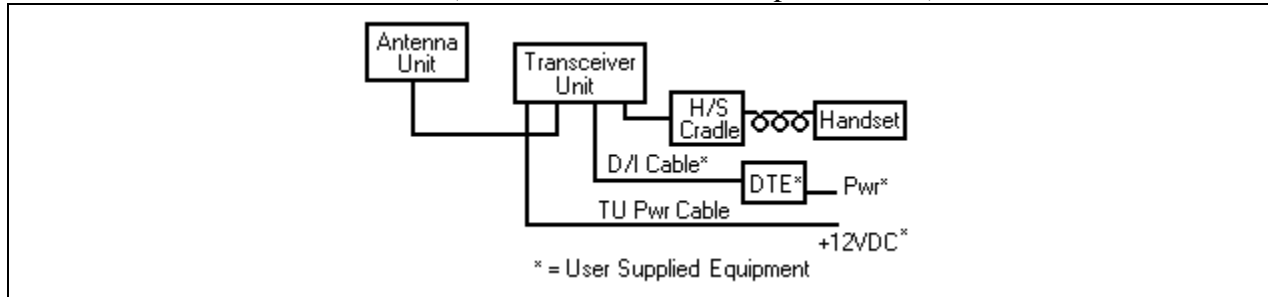
Your Mitsubishi MT may be used to place or receive data calls. When receiving a data call, the MT will produce a data ring (a shorter ring and longer pauses) and indicate “SatData Call” on the MT handset display. When the user answers the call (either by pressing a key on the handset or using the AutoAnswer functions), the incoming call will be routed to the DTE port on the MT Common Transceiver Unit (CTU). Once the call has been connected through the DTE port, the DTE devices at either end of the link can communicate.

For proper operation, be familiar with all instructions in the MT owners manual, the AT commands supplement, and this supplement. You must also be familiar with your DTE's owner's manual and all specific communications software manual.

Set-Up

1. Apply to your MSAT service provider for a data telephone number(s) to receive data calls. A special data number is not needed to place data calls from your MT, only to receive them. In addition to your voice telephone number, up to 2 (two) different data telephone numbers per MT could be issued (depending on maximum intended communication rate). One number is assigned for receiving 4800bps and 2400bps, another number is assigned for receiving 2400bps and 1200bps. For more information please consult with your MSAT service provider.
2. Program and Commission the MT(if not previously done).
Note: No additional programming is required to utilize the data option.
3. Connect the Data Interface (D/I) Cable into the DTE port on the CTU and to the COMx port on your DTE.

Note: D/I Cable is RS-232 serial data cable with DB-25 (M) connector on one end (to interface with CTU's DB-25 (F) serial port connector) and with DB-25 (M) or DB-9 (F) connector on the other end (to connect serial COMx port to DTE).



Common Transceiver Interface and Settings

The following three tables list the CTU interface characteristics, possible character formats, and recommended settings.

TABLE 1: DATA PORT CHARACTERISTICS

Mechanical Interface	DB-25 female
Electrical Interface	RS-232
Communication mode	Full duplex
Synchronization	Start - Stop systems (Asynchronous)
Communication rate	1200bps, 2400bps, 4800bps
Flow Control	None
Error Correction	Rate 1/2 convolutional coding
Functionality	All "AT" commands listed in the Operating Instructions

TABLE 2: DATA CHARACTER FORMAT

Start Bits	Data Bits	Parity Bits	Stop Bits
1	7	even or odd	1
1	8	None	1

TABLE 3: RECOMMENDED DTE SETUP AND MT DATA SERVICE PARAMETERS SELECTION

Communication rate	4800bps
Character format	8 bits, No parity, 1 stop bit
Flow Control	None

Common Transceiver Data Interface Configuration

Before starting the first data communication session, manually enter the desired parameters of the MT port using the Handset.

1. Enter FCN 92 on the Handset to activate "data service parameters selection" mode. Note: Table 3 shows recommended settings for both MT and DTE. Please refer to "Data Service Parameters Selection [FCN92]" of "ST200 Owner's Manual" for more information

2. By pressing [*] or [#] buttons select desired parameters. Recommended setting is 48 8N1 (Table 3).

Note: These parameters should always match those of the Host computer even if it could run at different speed.

PC Port and Modem Configuration

Port Setup

1. Use a serial port (COMx), on the PC to MT connection for data transmission.
Note: The **COM1** port is normally used for this connection.
2. Select the port's data communication rate to match that of CTU. Recommended rate is **4800bps**.
3. Switch **ON** Software flow control **XON/XOFF** option in the advanced port setup configuration.

Note: The MT transmits all data transparently (RTS signal line is not used; the CTS line is always high) so H/W flow control is not necessary (i.e., ignored) but S/W flow control between end equipment can be used (e.g. XON/XOFF).

Modem Setup

1. When choosing a modem driver, select a basic **Hayes Compatible** modem as the default or something as close to this as possible (e.g. Standard Modem, Generic Hayes, Personal Hayes etc.). Select the communication rate of the modem to match the MT transceiver interface setup. Recommended rate is **4800bps**.
2. Under specific modem commands, change **ATH^M** to **AT^M** for disconnect/hang-up, and select **DTR** to go **low** on hang-ups from the local DTE
3. Select **Zmodem** as standard transfer protocol.

Note: The MT supports a variety of protocols, but standard configuration should be Zmodem.

Operation

1. To ensure reliable data communication, be sure the receive signal strength indicator on the handset shows sufficient level (RSSI should be greater than 45) prior to making a call using high communication rate 4800bps. If the signal level is not strong enough (RSSI equals 40 or less) lowering the speed rate to 2400bps will increase reliability of data transfers.
2. Most operations will be performed between the end equipment (DTE) and are transparent to the user.

Placing A Data Call

1. There is **no need to change** the setting **FCN 91** to place a data call from a regular computer which is using a Hayes compatible modem configuration (with "AT Command"). Upon receiving "AT Command" through the serial data port the MT will switch to data mode automatically to conduct the data communication session. After an automatic data call is completed, the MT will automatically return to default (Manual Voice) mode.
2. To place data call with DTE which doesn't support "AT Command" or directly using optional PTT microphone (SZ300A) as DTE, use **FCN 91** (refer to "Service type selection [FCN91]" in the "ST200 Owner's Manual"). By pressing the [*] or [#] keys switch to "**Manual Data**" mode. Once selected, this mode will remain active until "Manual Voice" mode is selected.

Receiving A Data Calls

1. To receive a data call, service type selection (FCN/91) is not necessary since the MT automatically detects the call mode from the received call.

Communication Software Application Information

Using a Windows 95 Computer

This procedure is for configuring a Windows 95 computer to use MSAT Switched Data service, when using a Mitsubishi MT. This procedure assumes that you are using a standard communications utility such as Hyperterminal or ProComm that is compatible with Windows 95.

1. Connect the computer to the CTU

1. POWER OFF the computer AND the satellite phone.
2. Connect an RS-232 serial cable (25 pin male) to the data port on the CTU. Connect the other end to a COM port on the computer.

NOTE: The CTU acts as the modem. It is not necessary to have a modem installed on the computer.

3. Power on the computer and the satellite phone.

2. Install a new modem in Windows 95

1. NOTE: The “new modem” that you will be installing in Windows 95 is simply a set of configuration parameters that will apply to the transceiver. Again, you will NOT be using a physical modem on the computer.
2. Open “Control Panel”, double-click “Modems”.
3. “Install New Modem” dialog: Select other, click “Next”.
4. Check the box “Don’t detect my modem” and click “Next”.
5. Select Standard Modem Types, Standard 9600 bps modem. Click “Next”.
6. Select the COMx port that the RS-232 serial cable is connected to (COM1 or COM2). Click “Next”.

NOTE: The CTU must have exclusive use of the COMx port. If you have a modem in your computer, ensure that it is not using this COMx port.

7. Setup confirmation will be displayed, click “Finish”.
8. Modem Properties dialog appears.

3. Configure the new modem

1. In the Modem Properties dialog: with the Standard 9600 bps Modem selected, click “Properties”.
2. General tab: COM port should match the port being used for the serial cable that connects the computer to the Mitsubishi satellite phone transceiver.
3. General tab: Set Maximum Speed to **4800**.
4. Connection tab: Data bits = **8**, Parity = **None**, Stop bits = **1**. Click “Advanced”...
5. Advanced Connection box: Check the box “Use flow control” and set to Software (XON/XOFF).
6. Click “OK” to close Advanced Connection box. Click “Port Settings”...
7. Advanced Port Settings box: check “Use FIFO buffers.”
8. Set both Transmit and Receive buffer sliders to second notch from left. Click “OK”.

9. Click “OK” again to return to Modems Properties. Click “Close” and then close Control Panel.

4. Configure the CTU for data service

Enter FCN 92 to configure port settings on the phone. Set to: Data bits = **8**, Parity = **N**, Stop bits = **1**, and speed = **4800** bps. When properly configured, the handset will display: **48 8N1**.

5. Start the data communications session

1. Start the communications software package.
2. Within the communications software package, select the Standard 9600 bps Modem as the modem to be used for data communications.
3. Check that the computer and transceiver are communicating properly by typing “AT” and <Enter>. You should receive “OK” back from the transceiver.
4. Establish a data call by sending an AT command to the transceiver: “ATDxxxxxxx<CR>”. The xxxxxxxx is the phone number of the device you wish to connect to. The handset should display “SAT DATA CONNECT.”

For further information on using MSAT Circuit Switched Data service, please see your satellite phone user’s guide or supplemental literature.

Using ProComm (version 3.0)

1. Connect computer to the CTU

- 1.1 POWER OFF the computer AND the satellite phone.
- 1.2 Connect an RS-232 serial cable (DB-25 pin male) to the data port on the CTU. Connect the other end to a COMx (COM1 or COM2) port on the computer.
NOTE: The CTU acts as the modem. It is not necessary to have a modem installed on the computer.
- 1.3 Power on the computer and the satellite phone

2. Configure ProComm Plus

- 2.1 Select: “Setup” on pull down menu Setup
Observe 4 Horizontal Tabs: System\Data\Fax\Internet
- 2.2 Select Horizontal Tab: “System” and select vertical Tabs:
 - 2.2.1 “System Options” (Default)
 - 2.2.2 “System Connection”
Click on “Install New Modem or Connection”.
Under “Modems” choose: **Generic Hayes 2400 Compatible. (no fax)**
Under “Port Selection”: choose “COMx local connection”.
NOTE: COMx is COM1 or COM2 port through which computer is connected to CTU
Click “OK”
 - 2.2.3 “Dialing Options” (Default)
 - 2.2.4 “Answer Options”
In the “System Connection” choose **Generic Hayes 2400 Compatible. (no fax) COMx**
In the “Auto Answer mode”: choose **Data**
In the “Rings to answer” choose **2**
- 2.3 Select Horizontal Tab: “Data” and select vertical Tabs:
 - 2.3.1 “Data Options” (Default)
 - 2.3.2 “Data Connection”:
In the “Current Data Connection” choose **Generic Hayes 2400 Compatible. (no fax)”- COMx**
Confirm Primary data initialization string: ATE1Q0V1X4&C1&D2^M
Set “Modem default baud rate”: **4800** --> *NOTE: This should match the Host/Guest computer even if it can run at a different speed.*
 - 2.3.3 “Transfer Protocol”
Set “Current Transfer Protocol”: **Zmodem**
Set “Other Options”:
“Transmit Method”: **Streaming**
“Error detection”: **32 bit CRC**
 - 2.3.4 “Terminal Options”
Set “Current Terminal” as **ANSI BBS**
Check the box to switch **ON** “Incoming CR to CR/LF”
- 2.4 Port Settings:
Select the Baud rate as **4800**
Select Parity: **None**

Select Data bits: **8**
Select Stop bits: **1**
Select Duplex: **Full**
Select Break length (10th sec): **5**
Check box to switch **ON** "Software flow control [Xon/Xoff]"
Click "OK"

Make sure that the bottom tool bar shows: ANSI BBS, Zmodem, Hayes 2400 Compat. - COMx, 4800, N-8-1, CTS. Port opened – COMx (COM1 or COM2 computer port you intend to use)

3. Configure CTU for data service

- 3.1 Enter Fcn 92 to configure port settings on the phone. Set to: Data bits = 8, Parity = None, Stop bits = 1, and speed = 4800 bps. When properly configured, the handset will display:
48 8N1.

4. Placing a data call

- 4.1 Pull down the "File" menu and select "Connection Directory"
- 4.2 Using "Manual Connection" from the pull down "Connect" menu or "New Entry" from the pull down "Edit" menu enter the telephone number of the receiving computer (e.g. 1 800 123 4567). Make sure that call type is a "Long Distance"- type, which include both country code and area code.
- 4.3 Click "Dial". While making data connections the CTU handset makes a distinguishing sound: three short beeps with a long pause. In the meantime, the handset display first should show the telephone number of the computer you are calling (e.g. 800 123 4567) and then "SAT DATA CONNECT".

5. Receiving the data calls

- 5.1 Close down all applications
- 5.2 From the pull down "Setup" menu, go to "Auto Answer" and check "Data" to turn ON auto answer on data calls.
- 5.3 While receiving a data call the CTU will produce a data ring (a shorter ring with the longer pauses). At first the handset will display the blinking message "DATA CALL", and after acknowledging connection with distinguished high-low-pitch sound, it will display "SAT DATA CONNECT".

LapLink (version 7.0)

1. Connect computer to the CTU

Connect your computer to the CTU and configure the CTU as described in this appendix.

2. Configure LapLink;

- 2.1 In the LapLink window, pull down menu: “Options” and select “Port Setup”
- 2.2 Port Setup
 - 2.2.1 Disable all the COMx ports that you don’t intend to use with the CTU. **NOTE:** To disable a port you need to highlight it in the port setting window and un-check “Enable Port” box. For more information please follow instructions on the screen of the Help window or read LapLink Owner’s Manual.
 - 2.2.2. Select (by highlighting) the COMx (COM1 or COM2) - port your Modem is on. (Ref. 1.2 on page D6) or choose Win95 Modems.
 - 2.2.3 Check **ON** box “Enable Port”
- 2.3 Modem Setup
 - 2.3.1 Windows 95 users can select Win95 modems
 - 2.3.2 Click on “Configure” to open Modem Configuration window
 - 2.3.3 Highlight “Standard 9600 bps Modem (COMx)Click on “
 - 2.3.4 Check **ON**: “Auto Answer” Enabled
 - 2.3.5 “Answer Rings” type **2**
 - 2.3.6 In the “Modem Timeouts” window type in:
“Callback Timeout” type **200**
“Callback Delay” type **10**
“Redial Delay” type **30**
 - 2.3.7 Click on “Properties”
Click on “General” set “Maximum speed” at **4800**
NOTE: *This must match at the other computer even if the other computer can run at a different speed.*
Click on “Connection” to set Connection Preferences
Choose “Data bits” **8**
Choose “Parity” **None**
Choose “Stop bits” **1**
 - 2.3.8 Click “OK”
 - 2.3.9 Click “Close”
- 2.4 Click “Close”

3. Placing a data call

- 3.1 Pull down menu “Connect”.
- 3.2 Select: “Connect over Modem...”
- 3.3 In the “Dialing” window input the phone number to call and select services.
- 3.4 Click “Dial”

pcANYWHERE (version 2.0)

1. Connect computer to the CTU

Connect your computer to the CTU and configure the CTU as described in this appendix.

2. Configure pcANYWHERE to call a Host PC

- 2.1 At the pcAnywhere window choose “Call a Host PC”
- 2.2 In the window “Host PC Directory” highlight selection “pcANYWHERE Host via modem”
- 2.3 Click on: “Edit...” to enter “Edit Host PC Entry” window
 - 2.3.1 Enter information into “Host PC Information”
 - 2.3.2 Enter phone number into “Phone Number”, click “OK”
 - 2.3.3 “Hardware Selection” window
“Your Hardware Configuration Name” select **Modem**
Choose: “Edit...” to “Edit Hardware Configuration”
In “Hardware Information” in the window “Description of Hardware Entry” choose **Modem**; in “Modem”:
Check **ON** -- Use Modem.
Pull Down -- **Hayes Compatible**
Data Rate: **4800**
Flow Control: **NONE**
Parity: **None**
Click on “Advanced...”
In the “Advanced Hardware Options” turn **ON** – “Adjust Port Speed to Modem”
Click “OK”
 - 2.3.4 Click “OK”

3. Configure pcANYWHERE to be a Host PC

- 3.1 In the pcANYWHERE window choose “Be A Host PC”
- 3.2 In the “Allow Control Options” window enter your “Caller Information” options, than click “OK”
- 3.3 “Your Hardware Configuration Name” select **Modem** and click “Edit” to “Edit Hardware Configuration”
- 3.4 In the “Hardware Information” in the window “Description of Hardware Entry” choose **Modem**
- 3.5 In the window “Device” select port COMx (Ref. 1.2 on the page D6). In the “Modem” window:
Check **ON** -- Use Modem.
Pull Down -- **Hayes Compatible**
Data Rate: **4800**
Flow Control: **NONE**
Parity: **None**
Click on “Advanced...”
In the “Advanced Hardware Options” window check box to Turn **ON** – “Adjust Port Speed to Modem”, Click “OK”
- 3.6 Click “OK”
- 3.7 Click on: “Wait for Call”

CrossTalk (version 2.3)

1. Connect computer to the CTU

Connect your computer to the CTU and configure the CTU as described in this appendix.

2. Configure CrossTalk

- 2.1 Pull down menu from “File”.
- 2.2 Select 1 NORMAL.XWP
- 2.3 Select “Continue” in dialog box “Phone Number”: **NORMAL .XWP**
- 2.4 Pull down menu from “Settings”.
- 2.5 Select: “Connection...”
Connection Settings
 - 2.5.1 Connection: **Local Modem**
 - 2.5.2 Under “Settings”, select “Dialing” and input the phone number to call and any dialing modifiers.
 - 2.5.3 Under “Settings”, select “Connection” and input:
Speed **4800**
Flow Control: **NONE**
Data Bits: **8**
Parity: **NONE**
Stop Bits: **1**
 - 2.5.4 Under “Settings”, select “Modem” :and select
“Current Modem Assignments”: **COMx Custom Hayes Smartmodem**
4800/4800B
“Modem Profiles”: **Custom Hayes Smartmodem 4800/4800B**
- 2.6 Click “OK”
- 2.7 Pull down menu from “Settings” and select: “File Transfer...”
Select “File Transfer”: Zmodem
- 2.8 Click “OK”
- 2.9 Save these terminal settings, under a different name, for future use of the MSAT, also save these settings for the Host mode.

3. Placing a data call to a Host PC:

- 3.1 Pull down menu from “Action” and select: “Connection\Connect”
- 3.2 Under “Phone Number: [File Name] input the Host PC phone number you wish to call.
- 3.3 Select “Continue”

4. Configure for receiving a data call in the Host PC Mode

- 4.1 Pull down menu: “File” and choose: “New”
- 4.2 In the “new” session window open the “Dialer”, and select “ANSWER” and choose “Dial”.
- 4.3 In the “Answer a call” dialog box:
Choose “OK”, unless your require a password for the login sequence.
Choose “OK”, unless you wish to use an alternate download directory.
Choose “OK”, unless you wish to limit dial-in callers to the download directory only.
Choose your modem COMx Port and Speed. **4800**.
- 4.4 Click “OK”

- 4.5 In the “Answer” dialog box choose “Yes”, to answer incoming calls now.
- 4.6 Message: ANSWER.XWP; Waiting for Call... should appear.
- 4.7 Ensure that the connection settings are the same as above. Please save this configuration under a different name for future use of the Host with a MT.
PC is now in Host mode...

On-line Services: AOL (v.2.5)

1. Connect computer to the CTU

Connect your computer to the CTU and configure the CTU as described in this appendix.

2. America OnLine (version 2.5)

- 2.1 To set-up AOL for the first time on the very first screen select: "Cancel"
- 2.2 At the "Welcome" window enter the screen name "New User" and select "Setup"
- 2.3 Choose: Edit Location
Network Setup
Select your two local phone numbers...((703) 707-1000) & ((703) 264-3280)
Modem Speed: **4800 BPS**
Network: **AOLnet**
Click on "SAVE"
- 2.4 Choose: "Set Up Modem"
In the "Modem Selection and Customization" window
Select: **Hayes Compatible (error correcting) (v2.5)**
Modem Port: **COMx**
Click "OK"
- 2.5 Select: "Sign On" and follow instructions....

On-line Services: CompuServe (version 2.0.1)

1. Connect computer to the CTU

Connect your computer to the CTU and configure the CTU as described in this appendix.

2. Configuring CompuServe

- 2.1 In the “CompuServe Dialer” and in “CompuServe Information Manager”: Select “_Settings\Sessions...”
- 2.2 Setup Session Settings:
Current: **CIS Connection**
Connector: **COMx**
Baud Rate: **4800**
Network: CompuServe
- 2.3 Select: Use “Winsock & configure”
WinSock Settings
Host Name: **gateway.compuserve.com**
Change “Connect Time-out” to: **100**
Click “OK”
- 2.4 Select: “More...”
More Session Settings
Change “HMI time-out” to: **100**
Click “OK”
- 2.5 Select: “Modem”
In the “Modem Control Strings” window
Modem: Current settings (**Hayes**)
Initialize: **ATS0=0 Q0 V1 &C1&D2^M**
Clear the field for Hang Up
Click “OK”
- 2.6 Click “OK”

LAN and E-Mail Applications

cc:Mail (Mobile version 6)

1. Connect computer to the CTU

Connect your computer to the CTU and configure the CTU as described in this appendix.

2. Configure cc:Mail (v.6)

- 2.1 At the Lotus cc:Mail Mobile window Pull down menu “Mobile” and Select “Locations...”
- 2.2 At the “Locations” window:
 - Choose “Communications”
 - Choose “Edit...”
 - At the “Edit Communications Method” window
 - “Method Name”: Default Communication Method
 - “Method Type”: **Modem**
 - “Modem Type”: Pull down menu and Select **Hayes Smartmodem 4800**
 - “Serial Port” **COMx**
 - “Speed” **4800**
 - Click “OK”
- 2.3 Click “OK”

msMail (for Windows version 3.2)

1. Connect computer to the CTU

Connect your computer to the CTU and configure the CTU as described in this appendix.

2. Configure msMail

- 2.1 After loading msMail into your PC, obtain the script compiler (SCRCOMP.EXE) and modem script (HAYES48.MDM) from your msMail system provider.
- 2.2 Copy both files and change directory into a temporary directory.
At the DOS prompt:
Type: "C:> Edit Hayes48.mdm"
- 2.3 Upon entering the DOS editor, the text file (Hayes48.mdm) is displayed.
Page down until the **reset_okay:** procedure.
Inside the if statement change:
sendln "ATS0=0S7=45S9=6S10=50S12=50&W" to sendln "ATS0=0&W"
- 2.4 Pull down the File menu and select: "Save"
- 2.5 Pull down the File menu and select: "Exit"
- 2.6 At the DOS prompt:
Type: "scrcomp hayes48.mdm"
The compiler should respond with "No errors".
The compiler creates **ushays48.scr**
Change directory to c:\windows\msmail\msrmt\glb
- 2.7 Rename: **ushays48.scr** to something you will remember as the original (i.e. ushays24.old).
- 2.8 Copy **ushays48.scr** (the file the compiler created) from the temporary directory into c:\windows\msmail\msrmt\glb.
- 2.9 Return to Windows and start Microsoft Mail.
- 2.10 At the msMail window
- 2.11 Pull down the "Mail" menu and select: "Communications"
At the "Communications" window:
Change the "script name": to **Hayes Smartmodem 4800**
Under "Communication": "Baud Rate" of **4800** and select your appropriate **COMx** port.
- 2.12 Click "OK"