SUTRON DDRGS

DIGITAL DIRECT READOUT GROUND STATION

REAR VIEW

LEFT SIDE
COVER REMOVED

FRONT VIEW

Operation and Maintenance Manual

SUTRON CORPORATION

DIGITAL DIRECT READOUT GROUND STATION (DDRGS)

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Introduction

Key Features
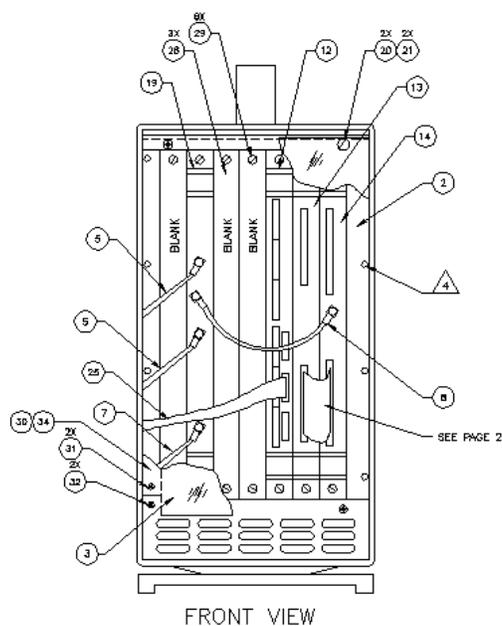
Figure 1 DDRGS overview

The SUTRON DDRGS (Digital Direct Readout Ground Station) is a state of the art digital technology based satellite earth receiving station designed for operation with the US Government's (NOAA/NESDIS) GOES (Geostationary Operational Environmental Satellite) series of spacecraft. The basic station is designed to work with Sutron's low cost LNB front end assembly along with an antenna and cable to form a complete, state of the art receiving system. The DDRGS has been designed for a minimum amount of maintenance and maximum troublefree operation. Front panel indications are provided to give the user feedback and an overall system status with a quick glance. The system has also been designed to provide quick and easy expansion of demodulators with the simple plug in of an additional card. The system software supports the additional channels without any changes other than setting the demod to the desired user channel. The system has also been designed to provide easy system updates without returning the system to Sutron. Easy product enhancements or option upgrades may be accomplished via software that is flash programmed and may be delivered to the

customer electronically. Operation is fully automatic and with power up there is an automatic Pilot Signal search and acquisition mode in which the system identifies the pilot tone. Upon phase lock of the pilot, the channels are automatically available and the output from the demodulators is sent over an RS-232C serial port. Also built into the system is a complement of signal quality measurements designed to provide indication to the health of the received signal thereby increasing overall system reliability by catching problems in the field before data is entirely lost.

Other key features include:

- Built-in nonvolatile storage for all user channel setups via flash ROM memory.

- Multitasking operating system provides continuous data reception on all channels while the completed received message data is transferred over the serial port to the attending PC.

- High accuracy on received message frequency error and received signal power strength readings. Readings are referenced to the pilot reference signal in real time as the message is received ensuring accurate signal readings.

- Ease of setup.

- Low maintenance.

- All digital receiver and channel demodulators.

- All digital receiver and support for 4 simultaneous channels (1 pilot, 3 demodulators)

- Internal expansion to add 4 to 8 additional channels by installing additional demodulator cards to the VME based system. There are 4 demodulators per card.

- Acquisition and demodulation for GOES DCS 100BPS, +/- 60deg BPSK, and

- RS232 interface for interface to a computer. The computer will be able to set up the unit, load configurations, change channel assignments, change demodulation characteristics, and dump data.

- Writable program memory to allow simple field changes to the software.

- Future Expandability / Ability to upgrade

- Setup Memory

- Ease of Operation.

- Future upgrades to the system will be possible over the serial port using Flash ROM program memory. This will allow simple system upgrades in the future using the serial port connected to a local computer. All code should be

resident in the system to allow the burning of the Flash ROM via the serial port.

Options

- "Remote Monitor" monitoring software. Powerful software for operation with base station PC computer turning the monitor into a visual center for complete system operations including a spectrum analyzer for watching the actual received channel signal. Includes VME interface board.

- Demod expansion board for 4 more user channels.

Processor

The DDRGS is controlled by a powerful Digital Signal Processor (DSP). This processor oversees all functions of the system including the actual demodulation algorithms, signal quality measurements, data transfer and pilot signal tracking. A front panel LED indicator is provided to indicate when the system has acquired phase lock on the pilot signal.

Operating System

The DDRGS utilizes a multitasking operating system to accomplish many tasks in parallel fashion. Multitasking allows for the simultaneous reception of multiple channels while transferring data over the serial port to a host computer. However, the operating system is not accessible to the user and only a simple RS232 based protocol will be required for setup and operation.

Front Panel Indicators

The front panel of the system (behind a smoked glass door) has several indicators to assist the user in obtaining an idea of the system operation. They include:

- "*LNB Fuse Trip*" red LED indication for the status of the DC power to the outdoor LNB subsystem,

- System internal power supply "*On*" status green LED,

- "*Power Fault*" red LED that will give indication that there is a basic power supply problem within the chassis.

- Pilot "*Phase Lock*" green LED to indicate that the pilot signal is locked and the system is operating nominally.

Serial Interface

Communication with the DDRGS is via the serial RS232C port. The basic defaults include 9600 baud, 8 bits, 1 Stop bit and no parity. Upon power up, the system will default to a data only mode in which no data automatically flows out the serial port. Once the system has been configured, a command is issued that will allow the transfer of data. Other data modes, such as the "Verbose" mode in which data flows continuously to the serial port, are available with the issuance of a command.

REAR PANEL CONNECTORS

The following points are provided on the rear panel of the DDRGS for monitor purposes (with the exception of the input from the downconverter)

- IF input (50 Ohm) at 140.95 MHz from downconverter
- RS-232C port for multiplexed data output.
- IF monitoring port (50 Ohm) for 140.95 MHz
- IF monitoring port (50 Ohm) for 10 MHz

Power Supply

The DDRGS chassis requires AC power at 110 VAC/60 Hz or 220 VAC/50 Hz and is auto detected internally by the power supply. A forced fan cooling system is provided to ensure that the boards are cooled efficiently. The front door should always be closed to ensure proper forced air cooling of the boards.

> **ALWAYS VERIFY AC POWER REQUIREMENTS BEFORE PLUGGING THE SYSTEM IN TO THE WALL RECEPTACLE…**

Unpacking and Initial Checkout

Unpacking

Carefully remove the DDRGS from its shipping container. The shipping container may be saved and used for future shipping or relocation.

Checkout

The DDRGS is fully tested at the factory so a quick operational check for shipping damage is all that is necessary.

Inspect the case for signs of physical damage.

Open the front plexiglass door and visually look at the cards that are inserted into the VME chassis. Look to see if the cards are fully seated and that the gaps between the boards appears uniform. Verify that the coax cables are tightened down firmly on the front panels. If available, connect the LNB to the RF Input cable. Turn on the power switch located by the AC power cord on the rear of the chassis.   Verify that the green "power on" LED illuminates and that the fuse to the LNB does not trip and that the power fault does not indicate failure. Proceed with installation.

See Figure 2.
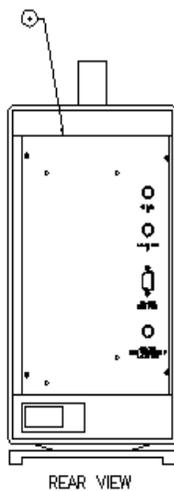
Figure 2 DDRGS rear panel

Hardware Configuration

The basic DDRGS configuration has 4 plug in boards in the VME chassis. The boards are described as follows:

1)   GOES Receiver board Sutron Model 1195.

2)   Analog to Digital Converter Model 6441.

3)   Digital Drop Receiver Board Model 4271*.

4)   Digital Signal Processor Model 4284*.

* Note that the items (circuit boards) 3 and 4 are physically connected together. NEVER attempt to remove one board without the other from the chassis.

The boards should be inserted in the following slots of the VME chassis:

BOARD	POSITION
Receiver 1195	2
A/D 6441	7
DDR 4271	6
DSP 4284	5
Blank Panel	1,3,4

Connections to Front Panels

The connections to the front panels are as follows:

Connection Name	Physical Location (From –To)	Function
RF Input from LNB	Bottom SMA connector on 1195 board to rear panel of chassis.	Supplies RF input from Antenna.
1st IF Output from Receiver	2nd SMA connector from bottom of 1195 board to rear panel of chassis.	Filtered output from Downconverter.
2nd IF Output from Receiver	3rd SMA connector from bottom of 1195 board to SMA connector on 6441 board labeled "IN 2"	10 MHz output of 1195 to Analog to Digital Board input.
2nd IF Sample	4th SMA connector from bottom of 1195 board to rear panel of chassis.	Spare 10 MHz sample to rear panel.
Serial Port	Middle connector (2x5 configuration) on front of 4284 board labeled "ser". Orient the red edge of the ribbon cable to the black arrow below the word "SER" on the front panel.	Output if DSP card to rear panel of chassis.
Digital Inputs	Bottom connector of 4271 to bottom connector of 6441.	Connects digital output of A/D to Receiver board.

Initial Power Up

When power is applied, the green "power on" indicator LED will turn on indicating that the system power is now turned on. This LED is located on the left most oriented card, or the receiver card. Immediately after turn on, look at the 'power fault' LED on the left most card within the chassis which is the receiver card. If for any reason there is a fault with the internal power supplies, this indicator should illuminate. If it does, turn the power off immediately and try another turn on sequence. If the illuminated "power fault" LED persists, contact Sutron customer service department. Normally, the "PWR OK" LED should illuminate.

The receiver card also supplies the DC power to operate the Low Noise Amplifier Block (LNB) located outdoors at the focal point of the antenna. The DC voltage (15 VDC) is passed down the RG-8 COAX cable outdoors to the LNB. If for any reason the cable is shorted or there is a complete failure of the LNB such that an excess of 1 amp is drawn, a fuse will blow and illuminate an LED on the front panel of the receiver board labeled 'LNB Fuse Blow'. This condition should be investigated and rectified immediately.

Finally, if the antenna is installed and pointed correctly and the cables are connected to the receiver, then the Pilot lock LED should turn on after several minutes of searching for the pilot signal. If after 5 or 10 minutes the lock does not occur, then the antenna pointing is not accurate.

If the initial checkout is OK, turn off the AC power.

You may now proceed to a more detailed level of operation.

Installation (System)

Antenna Installation

Consult with the manual provided with the antenna . Be certain to verify that the antenna is physically located and mechanically capable of viewing the orbital location as some types of antenna have a physical limit to the elevation angle that is to be monitored. Also, be certain that the antenna has an unobstructed view of the satellites or intended range of satellites. Be certain to investigate the wind loading forces that the antenna will impart to the structure or roof of a building if so placed. These forces may prove too extreme for most roof structures as most roofs need structural reinforcements to handle the loads.

Location and Mounting of Indoor Hardware

The installation must always be located in an indoor building in a location typically suited for computer related type of equipment. This includes an operating range typically from 10 to 35 deg C. Whenever uninterruptable power supplies are available, they are recommended as it will minimize the down time that the system will experience.

Place the DDRGS to a stable surface such as a desk or table. Usually, the system is placed next to a personal computer that is or will be running Sutron PCBASE2 software.

Grounding

No additional grounding is required other that the grounding required for the power supply. Do not defeat the ground prong on the power cable. This system ground should be connected to the building/earth ground within the buildings electrical system.

Feed / LNB Assembly Installation

The feed and LNB are assembled within one single unit and is located at the focal point of the antenna. First, assemble the antenna as recommended in the manuals provided with the antenna. Included with the antenna will be 3 spars about 6 feet long. The attachment of the spars to the antenna will be as instructed in the manual while the attachment of the spars to the feed assembly can only be accomplished in one orientation. In otherwords, the three attachment points are not equilaterally spaced around the can. See figure for installation. The small white faced can end of the feed assembly should be pointed to the antenna reflector surface. The end of the feed can that has the Type-N cable attached should be facing the furthest from the antenna surface.

Figure 3   LNB Assembly
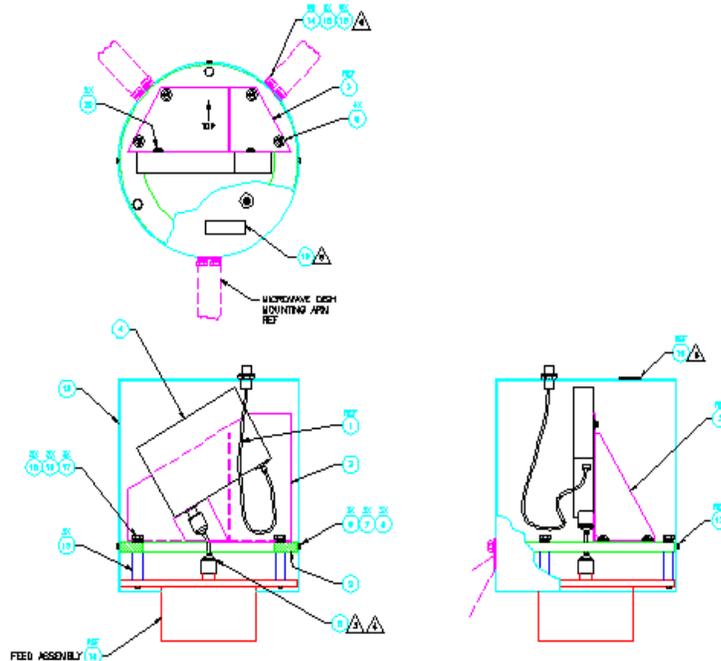
Polarization Setting

The polarization of the Feed must be set to match that of the satellite. Typically, the polarization is either in a horizontal plane with respect to the horizon or in a vertical plane with respect to the horizon although this is a more accurate

description if you are located at the same longitude as that of the satellite. The polarization of the feed may be adjusted by turning the white center portion of the feed can located at the center of the feed assembly. First, loosen the four bolts at the center of the feed and gently rotate the feed in the direction that is required. The orientation of the polarization is Vertical as shipped from the factory and is generally suitable for the GOES series spacecraft. Remember to confirm the polarization between satellites during a planned switchover and adjust the polarization if required.

Connecting the COAX Cable to the Outside LNB

It is recommended to turn off or verify that all power is off during the cable connection process.

The LNB is located at the focal point of the antenna. This is connected to the indoor DDRGS system via a coax cable, usually a RG-8 cable. This cable type is suitable for runs that are between 100 and 500 feet. Although runs of greater than 500 feet may be accommodated with RG-8 cable, it is recommended to use a low loss cable such as Heliax low loss cable (a product of Andrews Corp). It is recommended to contact Sutron for this type of application.

Connect the other end of the cable to the N-Type connector on the back of the DDRGS chassis. Ensure that the cable connector has not mis-threaded and also that there is no tension pulling the cable from the back of the chassis.

Extra caution should be exercised when installing the coax cable and applying the connector ends to the bare cable. If the cable is shorted for any reason, the fuse will blow on the front panel of the receiver when the power is applied.

The other advantage for keeping the cable short is to prevent excessive voltage drop and potentially causing the LNB to not function at its maximum.

OPERATION

After the system has passed the initial checkout in the previous section, turn the power back on. Depending on how the antenna is pointed, the system may or may not lock to the pilot signal. At this time, a spectrum analyzer may be used to fine tune the antenna using the monitor jack on the rear of the receive system. Alternately, the pilot monitor program may be used to assist in the location of the satellite in a more precise manner. (see separate manual for the software option)

It is recommended at this time to continue and set up the channels of the system regardless of whether the antenna is pointed correctly.

The DDRGS does have flash memory setup retention capability. The only item that is stored upon request is the channel selections. Since software selects the channels, a power up situation must be defined. For this reason, the factory usually sets the channels for testing purposes. Upon receipt by the customer, the new channels will be entered and a save operation will be performed. Once this save operation is performed, the system will always remember the channels even on power-up.

Quick Check

This guide will assist the user in performing a quick check-out of the system using a Personal Computer (PC) with a terminal emulator.

Connection of PC to Confirm Operation.

Using a DB-9 male to DB-9 male cable, connect the serial port on the back of the DDRGS to the Serial 'COM' port on the back of the PC, such as 'COM 1'. Using the PC, run any terminal emulator program such as Windows based 'Hyperterm' or DOS programs such as 'Procomm', or 'Kermit'.   Set the baud rate to 9600, 1 stop bit, and no parity.   With the DDRGS powered up, (follow power up instructions carefully) simply press the return key on the PC and the DDRGS should respond with '0 0' if there are no messages or 'x 0' representing x received messages.

Display Received Messages in Real Time.

The DDRGS will print out received messages in real time for monitoring and debug purposes. In order to enter the mode in which all data are continuously printed out, type the following sequence:

O100 "CR" (the first character is alphabetic and the next three are numbers)

This will enable the data to flow, along with debug information, directly to the terminal.   If multiple channels are enabled, the printout will interleave signal quality readings and received data as the real time output is sent to the terminal.

The system must operate in a non-verbose mode when the PCBASE2 software is operating with the DDRGS. Therefore, it is very important to turn off the 'verbose' mode where all information is printed to the screen when the monitoring period is over. This may be accomplished by issuing a 'O000' "CR" command. Alternately, the front panel reset button may be depressed thus automatically returning the system to the "non-verbose" mode. Remember, this must be done before running the PCBASE2 application.

Pilot Phase Lock Operation

A pilot signal (a continuous <u>unmodulated</u> carrier) is provided on Channel 100 of the 199 GOES Domestic channels. It is located exactly 500 Hz high from the center of the channel 100.   While the pilot is uplinked to the satellite at a very high frequency accuracy, the downlink from the satellite is relatively inaccurate with offsets in frequency of +/- 15KHz . This offset is generally stable and slow moving and usually varies by the greatest amount when the system is switched to another satellite. For this reason, the receiver must search for the pilot signal over a 30 KHz range. (+/- 15.0 KHz.) The receiver must continue sweeping if a modulated signal is received indicating that a regular DCP channel has been swept across. (adjacent channels) The full sweep time generally should not exceed 5 minutes. Once lock has been acquired for some period of time, the frequency settings are saved in memory and the next sweep will cover a smaller frequency range permitting a faster lock to occur.

Once the pilot is found, the frequency sweeping is stopped and the channel locations may now be correctly located. The front panel green LED will illuminate.

Antenna Pointing Diagnostic Aide

Once the satellite is located, a fine tuning signal strength is calculated and displayed based on the pilot tone signal strength. After the phase lock of the pilot signal has occurred, the signal strength of the pilot is measured and displayed through the terminal interface. By providing some form of indication on screen, the antenna may then be finely pointed to the satellite in order to maximize the signal strength. If the optional "Satellite Monitor" interface is chosen, then a continuous real time screen display of the pilot signal strength will be displayed .

Below is an example of the printout during the use of this feature.

```
DDRGS - HyperTerminal                                           _ □ ×
File  Edit  View  Call  Transfer  Help

PL: PPower: 53.7 PQual 23.7 AvgPower 50.6 AvgQual 15.5
PL: PPower: 54.0 PQual 22.3 AvgPower 50.6 AvgQual 15.5
PL: PPower: 53.9 PQual 24.0 AvgPower 50.6 AvgQual 15.5
PL: PPower: 53.9 PQual 25.2 AvgPower 50.6 AvgQual 15.5
PL: PPower: 53.9 PQual 24.0 AvgPower 50.6 AvgQual 15.5
PL: PPower: 53.8 PQual 24.3 AvgPower 50.6 AvgQual 15.5
PL: PPower: 54.0 PQual 22.6 AvgPower 50.6 AvgQual 15.5
PL: PPower: 53.8 PQual 22.0 AvgPower 50.6 AvgQual 15.5
PL: PPower: 53.6 PQual 23.0 AvgPower 50.6 AvgQual 15.5
PL: PPower: 53.8 PQual 22.7 AvgPower 50.6 AvgQual 15.5
PL: PPower: 53.9 PQual 23.7 AvgPower 50.6 AvgQual 15.5
PL: PPower: 53.9 PQual 22.5 AvgPower 50.6 AvgQual 15.5
PL: PPower: 54.1 PQual 22.6 AvgPower 50.6 AvgQual 15.5
PL: PPower: 53.9 PQual 24.2 AvgPower 50.6 AvgQual 15.5
PL: PPower: 54.0 PQual 24.9 AvgPower 50.6 AvgQual 15.5
PL: PPower: 54.0 PQual 22.6 AvgPower 50.6 AvgQual 15.5
PL: PPower: 53.9 PQual 23.7 AvgPower 50.6 AvgQual 15.5
PL: PPower: 53.6 PQual 22.2 AvgPower 50.6 AvgQual 15.5
PL: PPower: 53.5 PQual 22.6 AvgPower 50.6 AvgQual 15.5
PL: PPower: 53.7 PQual 24.4 AvgPower 50.6 AvgQual 15.5
PL: PPower: 53.6 PQual 20.9 AvgPower 50.6 AvgQual 15.5
PL: PPower: 53.7 PQual 22.6 AvgPower 50.6 AvgQual 15.5
PL: PPower: 53.5 PQual 20.4 AvgPower 50.6 AvgQual 15.5
PL: PPow_

Connected 0:30:50    Auto detect   9600 8-N-1    SCROLL  CAPS  NUM  Capture  Print echo
```

Invoke the command as follows:

- Using the serial port, create a direct connection to the DDRGS. Press enter or help to confirm connection.

- The first task is to enter the Verbose mode of operation. This is done by entering "O100" where the first character is alphabetic and the next three are numbers.

- The second task is to disable all active channels. Although this is not a requirement, it is useful for the best readout. Disable the channels by issuing a

"C0" command. Follow with another "kill channel" command ("C1", C2", etc.) until all channels are disabled. Verify all disabled channels with the "help" command.

- Enter the "M" command. The printout seen above indicates the output provided. Enter another "M" command in order to disable the pilot monitoring feature.

- Observe the instantaneous pilot readout to the left with a signal quality (somewhat based on the signal strength) in an adjacent column to the right. After approximately one minute, an average power column will present a value based on the average of the instantaneous power. This is done because the pilot signal power is not received at a constant level. The total downlink power is shared with all responding channels at the same time. This causes the overall power to drop when periods of heavy transmissions occur. Conversely, during periods that no DCPs are transmitting, the Pilot signal power will be at its maximum. The average value is intended to assist during the antenna pointing to know whether the last change made to the antenna was a good choice or a bad choice.

- When complete, issue another "M" command and reset the channels. This may alternately be accomplished by pressing the reset button on the front panel of the DDRGS or removing the AC power.

Setting Demodulator Channels

With the DDRGS directly connected to a terminal or PC running a terminal emulator, enter into the verbose mode. This is done by:

(in the below examples, do not type the quote marks "")

"O100" CR   (first character is alphabetic, others are numbers)

After entering this command, the channels may be individually set up to the number of channels that the system supports. The standard DDRGS configuration has 3 demods not including the demod that is dedicated to the pilot signal. These are labeled 0, 1, 2 or 3.

This is accomplished with:

"PxCyyy1"CR

In the above example, x is the demodulator number beginning with 0. Therefore, choices include 0,1,2, for the basic system and continuing with 3,4,5,6 for the 4-channel demod expansion board.

The "yyy" is the GOES satellite channel. Always include 3 digits and include preceeding 0's for channels less than 100. For example, 009, 046, 121, 199, etc.

Channel 100 is not a valid selection.

Enter all planned channels of operation into the system.

EXAMPLE: Set demodulator 0 to channel 35.

Issue a "P0C0351"CR.

The response will be:

"100 BPS demod start on channel 35 unit 0"

Saving Demodulator Channels in Permanent Memory

Press "S".

The system will respond with "are you sure (y/n) ?"

Enter the appropriate response, "y".

At this time, either the reset button may be pressed , or resetting the AC power to the system will prepare for operation with PCBASE2.

Once the above command has been executed, then resetting the system or removing the AC power will not destroy the channel setup.

Clearing Demodulator Channels

The channels previously set may now be cleared from memory by issuing the clear command. Press "Cx" CR (where x is the demod number 0 through 3) and the DDRGS will respond with "channel x closed down". If there is activity on the demod channel, then the channel will be closed after the completion of the current message.

Changing Channels assigned to Demodulators

In order to change a channel, first the clear channel command must be issued. Next the set channel command must be used. A previously set channel may not be changed without first clearing the channel. Remember to save the channels after they are set.

Normal Operation Mode (Quiet Mode)

Normal operation mode will never transmit information over the serial port until directed to do so. The Host PC is expected to issue a "CR" in which the response will be:

"X Y <CR>"

Where X is the number of stored messages and Y is always "0"/

Each issuance of a "D" command will print out the next line of the oldest received message. Each line that is printed out is preceded with a "+" sign indicating that there are more lines to follow. When the last line is sent, the line is preceded with a "-" sign. The value of the X will drop by one after the pulling out of each message.

NOTE: A power up of the system will always place the system in the "QUITE" mode where no characters are sent to the serial port. This allows for proper operation with PCBASE software.

Debug Mode (Verbose Mode)

The debug mode may be entered by issuing a "O100"CR command to the serial port. This will allow the print out of messages along with power and frequency information interlaced with synchronization information. The data will continuously be sent to the serial port as shown by the following example:

```
H0xxx0351!I0000802829xxxxxxxpxkCE558744
+-ª21.49 15.75 232 -ª21.50 15.75 242 -ª21.50 15.75 255 -ª21.50 15.75 246 -ª21.5
-2 15.75 238 -ª21.54 15.75 235 -ª21.52 15.75 231 -ª21.54 15.75 225 ¤WtNQ
carrier freq = -62.500000, power = 49.521564
d:-1GOT MLS
d:-1d:1d:-1d:1d:-1d:1d:-1d:1d:-1d:1d:-1d:1d:-1d:1d:-1d:1d:-1d:1d:-1found
EOT
H0xxx0351!I0000802906xxxxxxxpxkCE558996
+-ª10.71 46.68 3.725 0.882 0.882 1.863 3.725 240 -ª10.74 46.68 3.725 0.863 0.88
+2 1.863 3.725 239 -ª10.76 46.68 3.725 0.882 0.882 1.863 3.725 239 -ª10.76 46.6
+8 3.725 0.882 0.882 1.863 3.725 239 -ª10.85 46.68 3.725 0.882 0.882 1.863 3.72
+5 239 -ª11.06 46.68 3.725 0.863 0.882 1.863 3.725 239 -ª11.15 46.68 3.725 0.88
-2 0.882 1.863 3.725 241 -ª11.26 46.68 3.725 0.863 0.882 1.863 3.725 238 ¤\nNO
carrier freq = 6.250000, power = 48.301453
GOT MLS
found EOT
H0xxx0351!I0000803113xxxxxxxpxkCE4C78D0
+-ª10.35 10.34 -ª77.56 77.56 -ª12.7 12.9 -ª026 052 -ª171 172 -ª153 155 -ª038 03
-9 -ª157 182 ¤`jNO
```

The above mode may be useful to monitor in debugging situations.
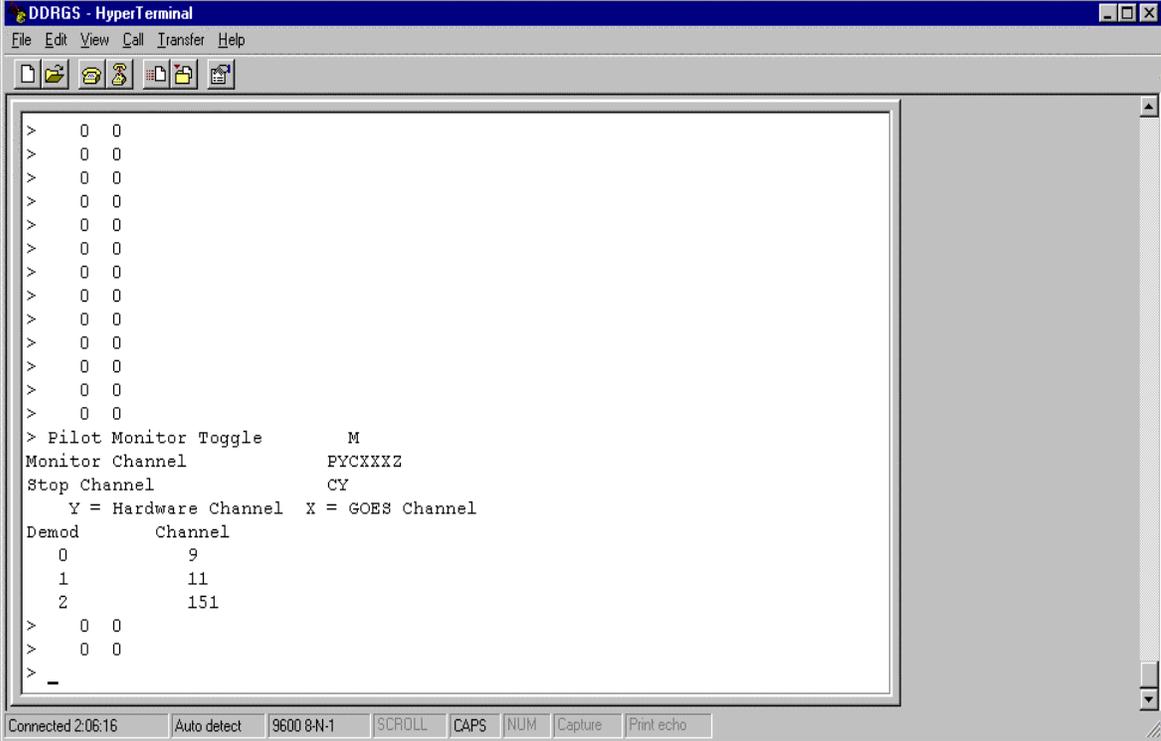
Time Stamp Capability

The system has an on board clock to keep time for time stamping of the received messages. A command is provided to set the time from an external source such as a PC. This may be updated at any time during operation. See the command under PC interface command.

Help Command

The help command gives a quick list of the commands that are available to the typical user. This gives a quick list of the commands along with the current channel assignments for the demodulators.

Example of help command.

```
> DDRGS - HyperTerminal                                                    _ □ ×
File  Edit  View  Call  Transfer  Help

  □  ☞   ☎ ☝   ▭ ☝   ☜

>     0  0
>     0  0
>     0  0
>     0  0
>     0  0
>     0  0
>     0  0
>     0  0
>     0  0
>     0  0
>     0  0
>     0  0
>     0  0
> Pilot Monitor Toggle          M
Monitor Channel                PYCXXXZ
Stop Channel                   CY
    Y = Hardware Channel  X = GOES Channel
Demod        Channel
   0            9
   1            11
   2            151
>     0  0
>     0  0
>  _

Connected 2:06:16     Auto detect    9600 8-N-1     SCROLL   CAPS  NUM  Capture   Print echo
```

Command Summary

The following list will describe the commands. It is by these commands that the system will be set-up, monitored, and controlled.

Function	*Command Sequence*	*Result*
Help	'H'<CR>	Prints simplified list of System Commands
Set Channels	'PxCyyy1' <CR> Where x= demod number 0,1,2,3, etc. Y = channel always with leading zeros, ex, 009, 046, 121, etc.	Enters the channel into the system memory. Unless a system 'Save' is performed, the channels will be lost on the next power up sequence.
Save Channels	'S'<CR> System follows with 'are you sure y/n?' Respond accordingly with a 'y' or 'n'.	Performs a FLASH ROM write cycle to permanently save the channels in memory. Any following power up sequences or reboots will default to these saved channels.
Delete Channels	'Cx' <CR> 'x' is the channel that you want disabled. x=0,1,2,3…etc. Ex. "C1<CR>"	This will delete the particular channel from the system memory including a system power up or reset.
Operation Mode	'Ox00'<CR> x=0 for quiet mode (NORMAL OPERATION) x=1 for VERBOSE mode.	Normal operation indicates that no data is sent over the serial port unless the attending computer has requested for it. No debug information is present. The verbose mode will allow the system to dump constantly information to the attending computer as received. Included in this is special debug

		information.
Monitor Mode	'M'<CR>	This mode may only be executed after the "O100" <CR>command has been issued to place the system in a verbose mode. Once issued, the M command will print out received signal strength numbers about the pilot tone. After one minute, an average strength will be printed in addition to the instantaneous power. Issue another "M" to terminate the readings.
Time	"T"<CR> "Tmmddhhmmss"<CR> EX: "T0714102213"	Send "T"<CR> and the system will return the current time of the system clock. The "T" followed by the string will set the time as follows: Mm=month, dd=day, Hour, min,sec. Example: July 14th, 10:22:13 am
Dump Data	"D"<CR>	Request for Data. Send "D" <CR> to cause the system to send the next line of data to the serial port. Only one line is printed per "D" command. See details below.

Details on "D<CR>" command

The mux responds with a header line followed by one or more data lines as follows:

012345678901234567890123456789

Hnxxxcccc!Immddhhmmssxxxxxxxxxxkiiiiiiii<crlf>

+dddddddddddddddd…dddddddddddddddddddddddd<crlf>

78 characters data and there is still more data in the buffer for this message.

-dddddddddddd…ddddddfpsm<crlf>

up to 78 characters data and there is no more data in the buffer for this message.

- A data value of $ indicates the character had parity error.
- A data value > A0hex indicates the character was a control character, subtract A0 to computer the proper character.
- The last 4 characters of the message are used to encode some quality measurements:

    f-frequency (use equation to convert to an ASCII character)

    p-power (use equation to convert to an ASCII character)

    s-signal to noise (use equation to convert to an ASCII character)

    m-modulation (use equation to convert to an ASCII character)

Special Commands

> *<u>Warning</u>: The following commands should be used with extreme care and attention to detail. Only attempt to use these commands to upgrade the DDRGS operating system from special upgrade files supplied by Sutron. Extreme caution must be used as any mistake in the use of these commands will result in having to return the system (DSP cards) to Sutron for system re-initialization.*

Note: Before any upload is to be performed, the system should be entered into the Verbose mode by entering "O100" as found above in the command set. Secondly, all channels should be disabled. Do this by issuing a 'kill' command for each channel while in the debug mode. (Ex, 'C'0 CR, 'C'1 CR…)   It is generally preferable to have the system connected to the antenna and phase locked to the pilot channel.

Special Function	*Command Sequence*	*Result*
Upload FLASH ROM	'U' CR	Enter the 'U' command. The system will wait for file upload to begin. Using most any ASCII upload method such as Hyperterm, Procomm, or Kermit, upload the file into the memory. (Note that uploads are done at 9600 Baud with no x/y/z batch enabled) For example, Hyperterm should use the "send text file" menu option. At the end of the upload, press 'q' to terminate the upload. The system will respond with the number of blocks uploaded. Note that some systems do not provide an indication of when the files are comleted downloading. If so, wait about 4 to minutes and then issue the "q" terminating command. Do NOT send any commands to the system during the upload. Proceed with Verify command.
Verify FLASH Upload	'V' CR	The verify command must be used <u>only</u> after the 'U' command. Repeat the exact sequence above in the 'U' command. The response of the system should be "files verified'. ***Any other response requires repeating the 'U' and 'V' commands. Proceed immediately with the burn sequence.***
Burn FLASH ROM	'B' CR	Following a successful verify, proceed immediately with a burn. Issue the "B" and wait. Allow several minutes for the flash ROM to be burned followed by the return of the prompt indicating "Flash programmed sucessfully". Once the burn is complete, press the system reset button on the front panel in order for the new code to be executed.

DIAGNOSTIC MEASUREMENTS

All received messages will have the following signal quality measurements measured and passed to the host computer as an appendage to the message.

Received Signal Strength:

Measurements relative to the "Pilot signal" on Channel 100. This means that the received messages have the received power level at the instant of reception compared to the pilot signal strength. Since the pilot tone is maintained to +47 dBm EIRP unmodulated. Resolution of the measurement is .5 dB with accuracy of +/- 2 dB over the C/No range of at least 38 to 56 dB-Hz.**

**Note: Besides variations in the DCPRS's EIRP, (which is the desired measurement) the overall link gain can vary as a function of UHF transponder loading, satellite used, satellite configuration operating mode, antenna in use, antenna pointing losses, DCP battery power, S_Band and DCS unique equipment in use. The AGC circuitry within this system will keep the average power in the total DCS band-pass (~ 400 KHz) roughly constant.

Frequency:

Measured frequency has a resolution of 6.25 Hz with an accuracy of greater than 25 Hz. Range includes full channel bandwidth of +/- 500 Hz.

Modulation Index:

Measured modulation index measurement has a range of 40 to 80 degrees with 60 degrees being nominal for the 100 BPS signals. Resolution of the measurement shall be 5 deg or better with accuracy of the measurement within +/- 5 degrees.

Maintenance and Service

Periodic Maintenance

Required Materials, Tools and Test equipment

- Approved anti-static grounding device

- Volt/Ohm meter,

    - max-input voltage >25 VDC (110 VAC)

    - accuracy when reading 3v - ±0.05v

    - input impedance > 1 MegOhm (most digital voltmeters meet these requirements, some needle and scale meters may not)

    - (Optional) Spectrum Analyzer capable of 140.95 MHz. Resolution BW of 1KHz or less is necessary.

    - Oscilloscope, 100 MHz.

Cleaning

Interval: as needed.

Case

Clean with a soft cloth and mild detergent solution. Dry with clean soft cloth.

Blow out any dust accumulation that may occur around the fan assembly and on the printed circuit boards.

Servicing

Disconnect main power before servicing.

LNB Fuse Replacement

Ground yourself to the chassis case before touching any of the circuit boards. Open the front door to the chassis. Remove the fuse from the holder and test it with an ohm meter. If it is an open circuit, replace it with a new fuse of the exact same rating. The replacement fuse should not exceed 1 Amp and is preferable if it is a "slow blow" type.

Cable Connections

Ground yourself to the chassis case before touching any of the circuit boards. Open the front door to the chassis. The unit's internal cabling will now be visible. Check that each end of all cables is tightly attached. Also verify that all

boards are inserted into the chassis firmly and that the end screws are completely screwed down.

Updating Internal ROM Firmware (See commands)

SUTRON may offer improvements and enhancements to the DDRGS's internal operating program periodically. This upgrade can be loaded from a specially prepared firmware ROM file that may be transmitted to the customer via electronic means and uploaded into the system.

!! IMPORTANT !!

Do not attempt to interrupt the upgrade once the process has begun. Doing so will leave the DDRGS ROM in an unprogrammed state and the DDRGS will not operate and will have to be returned to Sutron Customer Service for repair.

When the upgrade is complete the message "ROM upgrade successful" will be displayed. Reset the system now using the button on the front panel or using the AC power on the rear of the chassis. The DDRGS will be ready for operation with its new firmware.

Programming the ROM

The steps are as follows: (Consult the detailed commands listed earlier)

1)   Press the "U" and begin the upload process. At the end of the upload, press "q". This terminates the first step.

2)   Press the "V" and begin the upload process again using the exact same download file as in the previous step. At the end of the upload, press "q". Look for a response of "files verified". Any other response indicates a problem and the process should stop.

3)   If the above steps are successful, press "B" and answer the y/n. Provide the system several minutes to program the flash and do not disturb the system during the programming under any circumstances.

4)   Reset the system from the front panel or via the AC power.

Troubleshooting

Problem	Check	Fail Action
LNB Fuse Blows on GOES Receiver	Short in LNB cable or Problem in LNB.	Check and verify cable. Use Ohm meter and verify cable. Replace Fuse.
Pwr Fault LED Illuminated on GOES Receiver	Power supply in system chassis.	Remove all boards from the VME chassis. Insert only the GOES receiver board.
System Never Phaselocks. (No Green LED)	Pointing of Antenna. Use Pointing diagnostic aide.	Disconnect all coax cables and inspect. Verify that antenna has not moved location. Verify from NOAA/NESDIS that the satellite is operational and in position. (See WEB site)
No Communication via serial port.	Connection of all cables within system.	Reboot PC and restart Hyperterm. Verify baud rate = 9600. Reboot power to DDRGS.
Missing or Poor Data Reception	Antenna Pointing.	Move antenna using the Pointing aide. Use spectrum analyzer to confirm quality of signals.

APPENDIX A

Satellite Channelization

The following satellite bands will be able to be selected and transmissions over these channels are to be received:

GOES DOMESTIC:

Number of Channels	199
Channel Spacing	1.5 KHz.
Nominal Channel BW	1.0 KHz
Data Rate	100 BPS
Pilot Tone	(500 Hz above center of Channel) Channel 100.*

Channel Definition Examples:

Channel 1	9.851000	MHz
Channel 100	9.999500	MHz
Pilot Signal	10.000000	MHz
Channel 151	10.076000	MHz
Channel 199	10.148000	MHz

INTERNATIONAL Satellite Channels (GOES, GMS, METEOSAT) (100 BPS Only):

Number of Channels	33 (Channel 1 is above Channel 199 GOES Domestic)
Channel Spacing	3.0 KHz
Nominal Channel BW	1.0 KHz
Data Rate	100 BPS

Channel Definition Examples:

Channel 1	10.152500	MHz
Channel 15	10.194500	MHz
Channel 33	10.248500	MHz

Channel 1	10.151750	MHz
Channel 15	10.193750	MHz
Channel 33	10.247750	MHz

APPENDIX B

GOES 100 BPS Message Format

Compatibility with the existing NESDIS 100 BPS transmitters (1.5 KHz Channel BW):

+/- 60 BPSK, 1.5 KHz channel spacing, message structure:

 0.5 sec to 5.0 sec. unmodulated carrier,

 0.5 sec to 2.5 sec. 1/0 pattern

Data

All transmitted bits are Manchester encoded.

CARRIER SYNCHRONIZATION

Acquisition Time

Acquires 100 BPS messages in less than or equal to 0.5 sec with >90% probability for C/No = 30 dB-Hz and within +/- 500 Hz of center of channel. (The transmission may have a minimum of .5 seconds to a maximum of 5.0 seconds of unmodulated carrier.

Synchronization During Modulation

The demodulator shall maintain carrier synchronization after acquisition when the carrier is modulated as described in the Message Compatibility section.

SYMBOL SYNCHRONIZATION

Acquisition Time

After successful carrier acquisition, the demodulator shall acquire symbol synchronization with an alternating 1-0 pattern within .3 seconds of the start of the Manchester encoded pattern. A received transmission may have a minimum of .48 seconds to 2.5 seconds of alternating ones and zeros.

MAXIMAL LENGTH SEQUENCE (MLS)

Exactly 0.15 seconds (15 bits) of the Maximal Length Sequence (MLS) sync word follows the 1/0 pattern and is transmitted with the MSB transmitted first for all message types. The MLS has a value of:

Coded Address Word	Code Format
(MSB) 100010011010111	Binary
42327	Octal
44D7	Hexadecimal - implied "0" as MSB

BCH ENCODED ADDRESS WORD

Exactly 0.31 seconds (31 bits) Bose-Chaudhuri-Hocquenghem (BCH) coded address word with the MSB transmitted first. The BCH coded address word has the value: (Example:)

Coded Address Word	Code Format
(MSB) 0011010010000101011101100011111	Binary
03220535437	Octal - implied "00" as MSBs
1A42BB1F	Hexadecimal - implied "0" as MSB

DATA ENCODING

All received data shall be Non Return to Zero (NRZ) Manchester encoded (split phase).

DATA MAPPING

All received Manchester encoded data is defined in the following manner:

A.   The carrier shall be the reference as zero phase.

B.   A data "0" shall consist of a +60 ±5 carrier phase shift for 5 milliseconds, followed by a -60 ±5 carrier phase shift for 5 milliseconds.

C.   A data "1" shall consist of a -60 ±5 carrier phase shift for 5 milliseconds, followed by a +60 ±5 carrier phase shift for 5 milliseconds.

Received Symbol Rate

The data rate shall be 200.00 symbols/second ±0.03 symbols/second. This corresponds to Manchester encoded 100 BPS data.

Data Asymmetry

The demodulators will process encoded data that has data asymmetry that does not exceed ±1% of the bit period.

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