MDU SIGNAL LEVEL METER

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MDU SIGNAL LEVEL METER

1.0 SPECIFICATIONS:

Frequency Range	5 MHz to 860 MHz 950 MHz to 2150 MHz
Frequency Tuning Resolution	125 kHz in Tune-By-Frequency mode. Single channels in Tune-By-Channel mode
Amplitude Measurement Range	- 30 to +30 dBmV 5 MHz to 860 MHz (- 79 to -19 dBm) -25 to +30 dBmV 950 MHz to 2150 MHz (- 74 to -19 dBm)
IF Bandwidth	280 kHz at 3 dB points 600 kHz at 40 dB points
Size	6.5” x 8.5” x 3.25”
Weight	4.5 lbs.
Battery Life	4 to 8 hours depending upon downconverter / LNB current draw
Operating Temperature Range	-17°C. to 55°C.
Downconverter Power	13 VDC, current limited to 250 mA at “F” connector, or 18 VDC, current limited to 850 mA at “F” connector

MDU SIGNAL LEVEL METER

2.0 UNIT CONTROLS, INDICATORS, & CONNECTIONS

1. Meter Display - Displays amplitude (dBmV or dBm) of selected carrier and indicates the battery charge condition.

2. Channel Display - Indicates channel or transponder number selected and frequency in MHz.

3. Picture - Sound Selector - Toggles the unit between picture and sound carriers when in the 5-860 MHz range, analog channel. Evokes to Tune-By-Frequency when pressed for one greater than one second. Selects between 13V and 18V LNB power in the 950-2150 Satellite range.

4. Carrier-to-noise - Evokes carrier-to-noise measurement. The C/N answer is displayed on the LCD while the meter locks onto the carrier measurement.

5. Carrier-to-noise L.E.D. - L.E.D. lights to show the unit is displaying the carrier-to-noise measurement.

6. Dn Conv Power Switch - Controls DC voltage at RF connector to power the downconverter/LNB.

7. Dn Conv Power L.E.D. - Lights when DC voltage is present at RF connector.

8. ON/OFF Switch - Controls power to the unit.

9. Charge Indicator - Lights when battery is being charged.

10. TEST key - Performs a signal flatness test to determine the presence of multi-path interference on digital channels, resets the peak-hold feature for QPSK modulation.

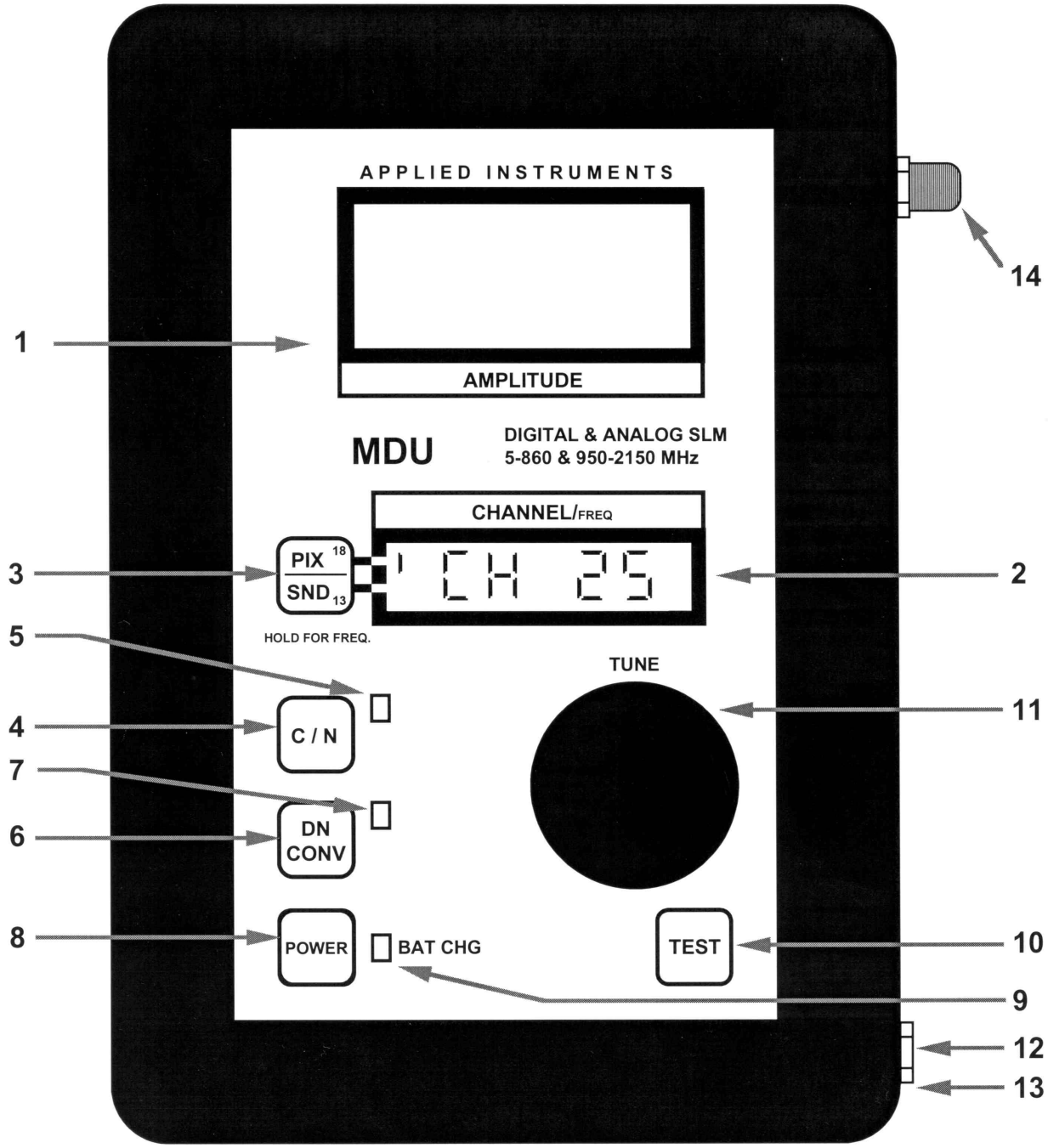
11. Tuning Knob - Tunes in channel # increments and frequency in MHz. Selects other menu position such as battery check, CAL position, channel scan, etc.

12. Charge Source Connection - Input jack to receive external AC power (via supplied wall transformer accessory) or external DC power from the vehicle charger cord.

13. Audio Jack Connection - Connect earphone for audio output.

14. RF Input Connection - Input type "F" connector for the signal to be measured.

(See next page for illustration)


APPLIED INSTRUMENTS
AMPLITUDE
MDU
DIGITAL & ANALOG SLM
5-860 & 950-2150 MHz
CHANNEL/FREQ
PIX 18
SND 13
CH 25
HOLD FOR FREQ.
TUNE
C / N
DN CONV
POWER
BAT CHG
TEST
1
2
3
4
5
6
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10
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14

MDU SIGNAL LEVEL METER

3.0 DESCRIPTION

The MDU is a microprocessor controlled signal level meter designed for use in multiple dwelling unit and wireless communications applications. It receives all Cable VHF channels, including MDS 1 and MDS 2, all UHF off-air channels, and DirectTV satellite transponder channels 1 - 32. For all installations, the MDU powers the downconverter or LNB. The amplitude readout is a high torque analog meter movement that is extremely fast responding. The MDU is compact, lightweight, and contains a husky nickel-cadmium battery pack that will power both the unit and the downconverter/LNB for hours. Both analog and digital modulation formats can be read.

3.1 FEATURES

Wide frequency range: 5 MHz to 2.150 GHz measurement capability, with three modulation measurement modes: a) analog - video or sound frequency measurement can be selected with a single keystroke. b) digital - the meter tunes to the center frequency of the channel and reads the 5.2 MHz or 24 MHz equivalent power in dBmV or dBm. The consistence of the power of the channel or transponder can be measured by switching to Tune-By-Frequency and manually tuning across the channel. Alternately, pressing the TEST key in the Tune-By-Channel mode will cause the unit to automatically scan the top of the channel or transponder response and read the peak-to-valley variation in dB on the LCD. c) QPSK digital - contains a peak hold feature for measuring and holding the amplitude of the bursty nature of QPSK digital signals.

3.2 OPERATION

Operating the MDU has been kept as simple as possible, without sacrificing functions, capabilities, or accuracy. To begin operation, press the ON/OFF switch to energize the unit. Upon turn on, the unit will display all segments on the LCD display as well as light the C/N L.E.D. for approximately three seconds. The charge L.E.D. lights only when power is applied to the external power jack, and the down converter power L.E.D. only lights when voltage is present at the F-Connector.

Upon power up, the unit will automatically tune to the channel where the unit was turned off. The downconverter/LNB power output is reset to the off condition. The spin knob is used to tune through the channel positions as well as several special menu positions. These menu positions are: calibration adjust, battery check, channel plan selection, and channel scans. The operation of these menu positions are covered in the

following sections. The PIX/SND key and the TEST key have several functions, depending on setting of the unit and modulation format chosen.

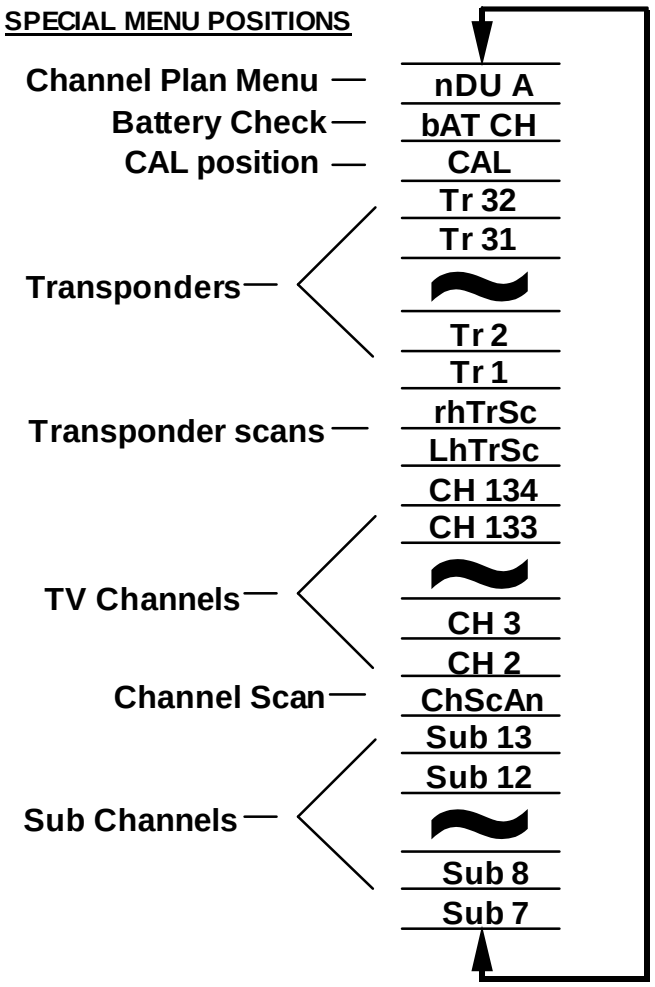


Fig 1: MDU Spin knob tuning chart

3.3 CHECKING THE BATTERY

Nickel-Cadmium battery packs will last for 300 to 1000 charge-discharge cycles if properly cared for. The most common misuse is charging the battery more frequently than it needs to be recharged. For example, you may determine that the MDU, powering the downconverter/LNB, will last for 4 hours of continuous operation. If the MDU battery gets recharged each time after only 30 minutes of usage, it will soon develop what is termed *memory* . This condition will cause the battery to only last 30 minutes. The MDU has a battery check mode that is one of the positions on the tuning

knob. In this position the bottom LCD display reads BAT CH and the meter shows the approximate charge remaining in the battery. We recommend the unit not be charged until the meter reads within 1/8 inch of the recharge line. If the user fails to check the battery for charge remaining, the unit still has a method of conveniently informing the user of a low battery condition, a LO BAT message flashes in the bottom display. The flashing LO BAT allows the channel display to be easily used while still constantly reminding the user the battery is in need of recharging.

Fig. 2 Sample display for low battery condition

The AC wall transformer will completely recharge the battery overnight (12 hours). The unit can also be recharged with the vehicle charger provided with the unit.

3.4 CALIBRATION VERIFICATION AND CORRECTION

All test equipment should, from time to time, have its calibration measured against a known accurate standard. The basis of accuracy of a signal level meter is its calibration to a reference signal of known level. The accuracy of the meter is then as accurate as the stated level of the calibration signal. The Model MDU has a calibrate tuning position (accessible in the Tune-By-Channel mode) which tunes to a calibrate frequency. In this position, the user can enter a calibration correction factor which will recalibrate the Model MDU, if necessary, to agree with the known standard. The calibration operation using the Applied Instruments Model PC-1 pocket calibrator is as follows: the PC-1 has a carrier frequency of 150 MHz and an amplitude of +0.0 dBmV. Connect the PC-1 to the RF input through whatever normal length of patch cable that you use (approximately 3 feet). Switch on the PC-1 and the Model MDU. Tune the meter to the CAL position and read the amplitude on the meter movement. The reading should be +0.0 dBmV, but, for example, assume it actually reads +0.5 dBmV. Press and hold the PIX/SND key. The CAL reading of the LCD display will be replaced by the actual CAL frequency in MHz, rather than showing CAL. This, a) informs the user of the factory set CAL frequency, and, b) indicates the unit is in the amplitude calibrate mode. (The PIX/SND key in this case is used to enter the amplitude calibrate mode and store the new calibration factor. Holding the key while changing the calibration is to prevent accidental reprogramming). Turn the tuning knob until the meter movement displays +0.0 dBmV. Release the PIX/SND key and CAL will again show on the LCD display, indicating that the correction has been stored in nonvolatile memory. The correction factor has now been made to all frequencies within the tuning range of the Model MDU.

The range of the calibration correction setting is +/- 3 dB. If the required correction is greater than 3 dB, the unit should be returned for factory recalibration.

3.5 SELECTING CHANNEL TUNING PLANS

The MDU has several tuning plans stored in memory. These include NTSC channels, off-air channels, sub channels, and DirectTV transponder frequencies. To change plans, perform the following procedure.

1) With the unit in the Tune-By-Channel mode, dial to the Channel Plan menu position. This menu position is denoted by the bottom LCD display showing a channel plan mnemonic. This label is a brief identification of the channel plan, shown in a manner that can be displayed within the limitations of displaying alpha characters on a seven-segment display. The following chart lists the tuning plans and their associated mnemonic:

Mnemonic	Channel Plan	Appendix
ndU A	MDU A, NTSC + DirectTV interleaved transponders	B
ndU b	MDU A, NTSC + DirectTV stacked transponders	C
ndU C	MDU A, NTSC (no transponders)	D
ndS A	MDS A, MMDS channels, + DirectTV interleaved transponders	E
ndS b	MDS B, MMDS channels, + DirectTV stacked transponders	F
ndS C	MDS C, MMDS channels, (no transponders)	G
SAT A	SAT A, DirectTV interleaved transponders (only)	H
SAT b	SAT b, DirectTV stacked transponders (only)	I
AIr	AIR, NTSC off air, CH 2-13, UHF 14-70	J
SUb	SUB, T channels T-7 through T-13	K

2) Once in the menu position, press and hold the PIX/SND key. This will cause the channel plan mnemonic to flash, indicating the tuning plans can now be changed. While continuing to hold down the PIX/SND key, turn the tuning knob. The channel plan mnemonics will appear with each click of the tuning knob.

3) To select the desired new plan, simply stop at the desired mnemonic and release the PIX/SND key. This will cause the channel plan mnemonic to no longer flash. The newly selected plan is immediately available for use.

3.6 TUNING CHANNEL FREQUENCIES (TUNE-BY-CHANNEL)

The unit will tune all VHF cable channels, all off-the-air UHF channels, and satellite transponders, within the frequency range of the meter. Using the tuning knob, simply tune to the desired channel to be measured. The digital display will show the channel number being received, the meter will show the carrier level in dBmV / dBm.

3.7 SETTING CHANNEL MODULATION FORMATS, DELETING CHANNELS

The model MDU can measure digital TV signals, QPSK digital signals, and analog TV signals. To enable the unit to accurately measure each of these very different signals, it must know whether the channel being measured is a digital or an analog channel. Analog channels are indicated as **CH**, digital channels are indicated as **dCH**, and QPSK digital channels are indicated as **qCH**. To set a channel to the proper modulation mode, a special programming mode must be accessed. To enter this programming mode, start with the unit in the OFF state. Press and HOLD the TEST key while energizing the unit by pressing the ON / OFF button. Continue to hold the TEST key during the power-on sequence. The unit will now power up in the programming mode; release the TEST key. Use the spin knob to tune through the channel plan to a channel to be programmed. Then, press the TEST button to cycle through the modulation modes. With every press of the TEST button, the channel mode will change from analog **CH** to digital **dCH** to QPSK digital **qCH**. A method of deleting a channel from the channel plan also is included. The forth channel "mode" indication is '-' (minus). When the display shows **-CH** within the programming mode, that channel will not appear in the tuning cycle during normal unit operation. This allows a user to delete unused channels for their customized channel setup. These **-CH** channels are not deleted from the internal channel plan memory, but rather are skipped when tuning with the spin knob during normal operation. To reinsert a skipped **-CH** channel, enter the programming mode and replace the '-' (minus) with the desired **CH** or **dCH** or **qCH** channel mode. The result of programming is stored in nonvolatile RAM, and once set, the modulation mode will remain as set until reprogrammed. To exit the programming mode, dial to the **dONE** position, and press any key other than the TEST key. The unit is now ready to operate with the newly programmed settings.

NOTE: The programmed channel format information* (CH, dCH, qCH, -CH) *positions are "attached" to each channel plan. If a channel plan is changed, the programmed channel format will also change to those stored for the newly selected channel plan.

NOTE: The programmable noise frequencies appear first when entering this programming mode. To program noise frequencies, refer to section 4.41 PROGRAMMING NOISE FREQUENCIES.

4.0 OPERATION

The MDU has three modulation measurement modes: a) analog - video or sound frequency measurement can be selected, b) digital - the meter tunes to the center frequency of the channel/transponder and reads the equivalent power (5.5MHz or 24 MHz) in dBmV/dBm, and c) QPSK digital - contains a peak hold feature for measuring and holding the amplitude of the bursty nature of QPSK digital signals.

4.1 ANALOG MODULATION FORMAT

Within an analog coded channel position, pressing the PIX/SND key will toggle the meter from tuning to the picture carrier and the sound carrier. The TEST key in this analog mode has no function, and the LCD display will show - - - - - - for two seconds if the TEST key is pressed while tuned to a channel set as analog.

4.11 TUNING ANY FREQUENCY (ANALOG MODULATION FORMAT)

NOTE: When entering the Tune-By-Frequency mode, the unit will function according to what modulation mode was set by the channel displayed just before entering the Tune-By-Frequency mode. The following describes the Tune-By-Frequency mode when entered from an analog channel. Do not perform measurements in the Tune-By-Frequency mode in one modulation format if the Tune-By-Frequency mode was entered from another modulation format. For example, if entering Tune-By-Frequency from analog channel CH 2 at 55.25 MHz, do not perform measurement on digital channel dCH 3 at 63.00 MHz. Instead, go back to the Tune-By-Channel mode, tune to digital dCH 3, and then re-enter the Tune-By-Frequency mode. This is because the unit operates quite differently depending on the modulation mode selected, and within the Tune-By-Frequency mode, the unit doesn't "know" what modulation mode is being used for each frequency; it is only encoded per each channel.

Pressing the PIX/SND key for more than one second causes the MDU to go into a Tune-By-Frequency mode. This mode has two useful applications. If you need to know the Video Carrier frequency of the selected channel in MHz, push and hold the PIX/SND key for one second. The channel number will be replaced by the Video Carrier frequency in MHz. No need to try to memorize the channel plan. Secondly, entering this mode now allows you to tune the unit to any desired frequency from 5 to 860 MHz and 950-2150 MHz. Simply turn the spin knob and note that the frequency changes in a 125 kHz step-per-click of the spin knob. To return to the Tune-By-Channel mode push the PIX/SND key again and the unit goes to the nearest Video Carrier frequency and displays its channel number.

NOTE: Pressing the PIX/SND key for more than one second <u>always</u> causes the MDU to go to the Video Carrier frequency when entering the Tune-By-Frequency mode from an analog channel.

To aid in antenna/dish orientation, an Expanded Peak measurement mode is available from within the Tune-By-Frequency mode only. This Expanded Peak measurement mode temporarily replaces the 60 dB of dynamic range on the meter scale with 10 dB of range. This makes the meter movement much more responsive to finding the peak signal when aiming the antenna/dish. To enter this amplitude peaking mode, press the TEST key while in the Tune-By-Frequency mode. The lower LCD will then read **PEAk**, and the meter movement needle will move to the center of the meter scale. The meter will now be much more responsive to changes in amplitude, only having 5 dB of range on either side of center.

NOTE: Do not take amplitude readings from the meter scale when in the Expanded Peak mode - the needle is now used for signal strength peaking only and does not point to the correct amplitude measurement.

To re-center the meter needle to the center of the meter scale, re-press the TEST button at any time. When the signal amplitude has been peaked to its maximum, move the spin knob one click only - this single click will exit the Expanded Peak mode, return to the Tune-By-Channel mode, and display the correct amplitude reading on the 60 dB dynamic range meter scale. The amplitude can now be read.

4.2 DIGITAL MODULATION FORMAT

Within a digital coded channel position, the modulation information is entirely digitally encoded with no separate picture or sound carriers. Therefore, pressing the PIX/SND key for less than one second has no effect on the meter, however, in the 950-2150 Satellite tuning range, it will select between 13V and 18V LNB power at the F-connector.

4.21 TUNING ANY FREQUENCY (DIGITAL MODULATION FORMAT)

NOTE: When entering the Tune-By-Frequency mode, the unit will function according to what modulation mode was set by the channel displayed just before entering the Tune-By-Frequency mode. The following describes the Tune-By-Frequency mode when entered from a <u>digital</u> channel. Do not perform measurements in the Tune-By-Frequency mode in one modulation format if the Tune-By-Frequency mode was entered from another modulation format. For example, if entering Tune-By-Frequency from digital channel dCH 3 at 63.00 MHz, do not perform measurement on analog channel CH 2 at 55.25 MHz. Instead, go back to the Tune-By-Channel mode, tune to analog CH 2, and then re-enter the Tune-By-Frequency mode. This is because the unit operates quite differently depending on the modulation mode selected, and within the Tune-By-

Frequency mode, the unit doesn't "know" what modulation mode is being used for each frequency; it is only encoded per each channel.

Pressing the PIX/SND key for more than one second causes the MDU to go into a Tune-By-Frequency mode. Entering this mode now allows you to tune the unit to any desired frequency from 5 to 860 MHz and 950 to 2150 MHz. Simply turn the spin knob and note that the frequency changes in a 125 kHz step-per-click of the spin knob. To return to the Tune-By-Channel mode push the PIX/SND key again and the unit goes to the nearest Video Carrier frequency and displays its channel number.

NOTE: Pressing the PIX/SND key for more than one second <u>always</u> causes the MDU to go to the center frequency of the channel/transponder width when entering the Tune-By-Frequency mode from a digital channel.

To aid in antenna/dish orientation, an Expanded Peak measurement mode is available from within the Tune-By-Frequency mode only. This Expanded Peak measurement mode temporarily replaces the 60 dB of dynamic range on the meter scale with 10 dB of range. This makes the meter movement much more responsive to finding the peak signal when aiming the antenna/dish. To enter this amplitude peaking mode, press the TEST key while in the Tune-By-Frequency mode. The lower LCD will then read **PEAk**, and the meter movement needle will move to the center of the meter scale. The meter will now be much more responsive to changes in amplitude, only having 5 dB of range on either side of center.

NOTE: Do not take amplitude readings from the meter scale when in the Expanded Peak mode - the needle is now used for signal strength peaking only and does not point to the correct amplitude measurement.

To re-center the meter needle to the center of the meter scale, re-press the TEST button at any time. When the signal amplitude has been peaked to its maximum, move the spin knob one click only - this single click will exit the Expanded Peak mode, return to the Tune-By-Channel mode, and display the correct amplitude reading on the 60 dB dynamic range meter scale. The amplitude can now be read.

4.22 MULTI-PATH INTERFERENCE TESTING (DIGITAL MODULATION)

Multi-path, co-channel interference, and interference from other services (PCS) are transmission impairments that will stress the adaptive equalizer in the digital set top converter and will cause freeze framing and loss of picture if severe enough. All of these impairments degrade the power consistency across the flat portion of a digital signal.

The TEST key measures the power consistency and displays the peak-to-valley variation in dB on the digital display. Present digital set top converters can tolerate about 4 to 5 dB of peak to valley variation, but the operator should experiment within the system under test to achieve a correlation between peak-to-valley variation and a no-go install.

To evoke the peak-to-valley test function, tune to a **dCH** digital channel, and press the TEST key. The LCD will display **TEST** while the test is in progress. The measured peak-to-valley number, in dB, will be displayed at the conclusion of the test. If the MDU encounters a Lo reading (less than the lowest scale reading of -30 dBmV), it calculates a peak-to-valley number by assuming a -30 dBmV reading for the minimum valley number, and uses the highest peak reading number actually read. If all readings are low, the MDU simply displays **Lo** to indicate no signals were read.

4.3 QPSK DIGITAL MODULATION FORMAT

Within a QPSK digital coded channel position, the modulation information is entirely digitally encoded with no separate picture or sound carriers. Since QPSK is used for data transmission, the carrier is only present during data communication. In order to "catch" and display these bursty carriers, the QPSK digital mode contains a Peak Hold feature. Any amplitudes read in the QPSK digital mode is held until enough signal pulses are captured to read the correct amplitude value. The measured value is held indefinitely. The TEST button is used to reset the Peak Hold function. Simply press the TEST button and the display will show **rESET**. The amplitude gathering process will start again. Keep in mind, a higher amplitude reading will be captured by the Peak Hold feature, a lower reading will be masked. Use the TEST button to initiate a reset to measure an amplitude of a lower level than what is currently displayed by the meter.

NOTE: Clicking the spin knob one position (from one channel to the next or one frequency increment to the next) will automatically initiate the reset of the peak hold feature.

4.31 TUNING ANY FREQUENCY (QPSK DIGITAL MODULATION FORMAT)

NOTE: When entering the Tune-By-Frequency mode, the unit will function according to what modulation mode was set by the channel displayed just before entering the Tune-By-Frequency mode. The following describes the Tune-By-Frequency mode when entered from an QPSK digital channel. Do not perform measurements in the Tune-By-Frequency mode in one modulation format if the Tune-By-Frequency mode was entered from another modulation format. For example, if entering Tune-By-Frequency from QPSK digital channel qCH 3 at 63.00 MHz, do not perform measurement on analog channel CH 2 at 55.25 MHz. Instead, go back to the Tune-By-Channel mode, tune to analog CH 2, and then re-enter the Tune-By-Frequency mode. This is because the unit

operates quite differently depending on the modulation mode selected, and within the Tune-By-Frequency mode, the unit doesn't "know" what modulation mode is being used for each frequency; it is only encoded per each channel.

Pressing the PIX/SND key for more than one second causes the MDU to go into a Tune-By-Frequency mode. Entering this mode now allows you to tune the unit to any desired frequency from 5 to 860 MHz and 950 to 2150 MHz. Simply turn the spin knob and note that the frequency changes in a 125 kHz step-per-click of the spin knob. To return to the Tune-By-Channel mode push the PIX/SND key again and the unit goes to the nearest Video Carrier frequency and displays its channel number.

NOTE: Pressing the PIX/SND key for more than one second <u>always</u> causes the MDU to go to the center frequency of the channel width when entering the Tune-By-Frequency mode from an QPSK digital channel.

NOTE: Due to the bursty nature of QPSK signals, a QPSK channel does not lend itself to be useful in antenna/dish orientation. Therefore, when entering the Tune-By-Frequency mode from a QPSK channel, the expanded scale peaking aid does not function. Instead, pressing the TEST button will reset the peak hold feature and start a new measure-hold cycle.

4.4 MEASURING CARRIER-TO-NOISE

The C/N function involves first taking a channel amplitude reading and then taking a noise amplitude reading. Finally, the unit takes these readings and calculates and displays the C/N answer.

To make a C/N measurement, use the following steps:

While in the Tune-By-Channel mode, tune to the channel which a C/N measurement is to be made. Once a channel reading is being displayed by the meter, press the C/N key. The carrier reading will be "frozen" on the meter and the unit will change to a "Noise" frequency programmed into memory. The unit will then obtain a noise reading and calculate the C/N answer. The C/N answer is then displayed on the lower LCD reading, with the carrier level still being displayed by the meter. In this manner, the carrier reading and the C/N answer are both visible at the same time. The C/N L.E.D. lights to show the unit is displaying the C/N answer. To return to the carrier reading mode, press any key or move the spin knob one click.

NOTE: While in the C/N reading mode, the meter display "freezes" the last measured carrier level. Any change in the carrier level will not be shown on the meter movement. To return to real-time carrier measurement on the meter movement, exit the C/N mode.

If the MDU cannot measure a noise reading because the noise level is less than can be read by the MDU, it calculates a C/N number by assuming the lowest reading possible for the noise number, and uses the carrier number actually read. It then displays this number while flashing the LCD display, because the C/N number is greater than displayed due to the noise number being beyond the measuring capability of the MDU. The true C/N reading is equal or greater than the displayed number, however.

If there is no signal present, the LCD will display **Cn = --**, meaning there was no carrier present to perform a carrier-to-noise measurement.

Fig. 3 Sample display for carrier-to-noise measurement

4.41 PROGRAMMING NOISE FREQUENCIES

Due to the extensive range of the MDU, there are four programmable noise frequencies, each used within a specific portion of the 5 - 2150MHz range. The noise frequency ranges are: 5-50 MHz, 50-860 MHz, 950-1450 MHz, 1450-2150 MHz. To program a noise frequency, a special programming mode must be accessed. To enter this programming mode, start with the unit in the OFF state. Press and HOLD the TEST while energizing the unit by pressing the ON/OFF button. Continue to hold the TEST key during the power-on sequence. The unit will now power up in the programming mode; release the TEST key. Use the spin knob to select one of the four programmable noise frequency ranges: **n 5** indicates 5-50 MHz, **n 50** indicates 50-860 MHz, **n 950** indicates 950-1450 MHz, **n 1450** indicates 1450-2150 MHz.

In these positions, the meter is displaying an indication of relative noise amplitude, not a carrier-to-noise answer. The unit is programmed at the factory with default noise frequencies. If a different noise measuring frequency is desired, it can be re-programmed. To do so, press and HOLD the C/N button while tuned to the specific noise frequency band. The **n xxxx** display will be replaced by a flashing noise frequency. To change the noise frequency, tune the spin knob to the desired frequency. The unit will still measure and display the relative noise frequency while in this programming / measurement mode. In this manner, one can tune for the best noise frequency by watching the indicated amplitude while changing the noise frequency. When the desired results are achieved, release the C/N button and the displayed frequency will be stored as the new noise frequency. This frequency is stored in nonvolatile memory.

NOTE: The amplitude reading in the noise position is not an absolute calibrated measurement. The meter will read upscale and can be used to measure the relative strength of the noise as the meter is tuned. Do not read an amplitude number from the meter scale while in the noise frequency programming mode as the meter scale numbers will not be correct.

4.5 CHANNEL SCANS

Within a channel plan may be positions indicated as **ChScAn**, **LhTrSc**, or **rhTrSc**. These positions will perform a channel scan of certain channels depending on which channel scan is chosen. The scan differences are as follows:

ChScAn

Pressing the TEST key while in the **ChScAn** (channel scan) position will scan and measure all non-satellite channels present in the currently selected channel plan (with the exception of sub channels, **qCH** channels or skipped **-CH** channels). The maximum and minimum dBmV values are stored and used to calculate a peak-to-valley variance number. This is similar to the in-channel TEST which is used to find the peak-to-valley variance number *in-channel*, whereas the channel scan finds the peak-to-valley variance number *across all* scannable channels.

LhTrSc , rhTrSc

Pressing the TEST key while in the **LhTrSc** (left-hand transponder scan) or **rhTrSc** (right-hand transponder scan) positions will scan and measure all satellite only transponders present in the currently selected channel plan (with the exception of **qTr** transponders or skipped **-Tr** transponders). Additionally, **LhTrSc** will scan the left-hand polarized, EVEN numbered transponders only, and **rhTrSc** will scan the right-hand polarized, ODD numbered transponders only.

The maximum and minimum dBmV values are stored and used to calculate a peak-to-valley variance number for each scan. This is similar to the in-channel TEST which is used to find the peak-to-valley variance number *in-channel*, whereas the channel scan finds the peak-to-valley variance number *across all* scannable channels.

To evoke the channel scan operation, tune to the desired scanning position, either **ChScAn** or **LhTrSc** or **rhTrSc** , with the spin knob. Press the TEST button to start the scan. Each channel will be shown in the lower LCD as the channel scan progresses, with the channel amplitudes shown on the meter movement. At the end of the channel

scan, the lower LCD will show the peak-to-valley amplitude in dB. Pressing any button or turning the spin knob while within a channel scan will stop the channel scan at that point and display the peak-to-valley amplitude in dB.

NOTE: Sub channels (T-7 through T-13) are not included in a channel scan EXCEPT when the SUB channel plan is selected.

Fig. 4 Sample display for channel scan positions

4.6 DOWNCONVERTER/LNB POWER

The MDU provides DC voltage from the F-connector to power downconverters or LNBs. In the non-satellite frequency range of 5-860 MHz, 18V battery power is fed to the F-connector when the downconverter power key is pressed. The maximum current which can be provided to the F-connector in the 18V position is approximately 800 mA. In the satellite frequency range of 950-2150 MHz, a dual output voltage is provided for polarized transponders. The PIX [18] / SND [13] key has a dual function in this case. Within the 5-860 MHz range, the PIX [18] / SND [13] key toggles between the picture carrier and sound carriers when in an analog coded channel. The downconverter power is fixed at the 18V battery voltage and does not change. Within the 950-2150 MHz satellite range, the PIX [18] / SND [13] key does not toggle between the picture carrier and sound carriers since satellite carriers are digital with no associated picture/sound carriers. The downconverter power, however, is selectable between 18V and 13V. The maximum current which can be provided to the F-connector in the 18V position is approximately 800 mA; the maximum current which can be provided to the F-connector in the 13V position is approximately 250 mA.

The current is limited and short-circuit protected. Upon exceeding the allowable current, either by an overload condition or a direct short-circuit, the downconverter power circuitry will quickly shut off for approximately two seconds. Then, power will be reapplied. If the overload condition or direct short-circuit condition still exists, the downconverter power circuitry will again quickly shut off for approximately two seconds. This self-protecting cycle will continue until the overload condition or direct short-circuit condition is removed, or the downconverter power is shut off by the operator. If an overload condition exists (a faulty downconverter attempting to draw excessive current), the downconverter L.E.D. will light each time power is provided to the F-connector, then extinguish during the automatic power shut off period. A

steadily glowing downconverter power L.E.D. indicates that power draw is within limits. By contrast, a dead short-circuit of the F-connector will cause the L.E.D. to be totally extinguished. The downconverter power circuitry will retry to power the F-connector every two seconds, but no L.E.D. indication will be shown. If the downconverter L.E.D. does not light upon application of downconverter power due to an overload or direct short-circuit condition, the unit will be protected, but the condition should be removed as soon as possible.

NOTE: In the 18V position, battery voltage is fed to the F-connector and will range approximately 17-22V.

5.0 ACCESSORIES / MAINTENANCE

5.1 CANVAS PROTECTIVE BAG

The padded canvas bag provides additional protection to the MDU while being transported and the cover flap can be quickly unzipped and folded open for access to the front panel operating controls and indicators. The inside of the cover flap contains a small pocket suitable for storing a three or four foot patch cable.

5.2 A.C. WALL TRANSFORMER

The wall transformer is rated at 117 VAC, 50-60 Hz primary and 12VAC at 2 Ampere secondary. Using a transformer with a lesser or greater rating may damage the transformer and the MDU.

CAUTION: The external power jack can receive power from the provided AC wall transformer. Any attempts to charge the battery of the MDU on an external power source other than the provided AC wall transformer may result in poor operation or damage to the unit.

5.3 VEHICLE CHARGER CORD

The vehicle charger allows the MDU to be charged from the cigarette lighter socket of a 12 Volt vehicle. This feature is for charging purposes only, the unit should not be operated while charging.

5.4 RF INPUT CONNECTOR REPLACEMENT

Since the RF input connector receives many insertions per day of the drop wire, the life of the connector is fairly short. The connector is a common type "F" double female which can be replaced with only a 7/16 inch wrench. No case disassembly is required; however, it is easier to access if the MDU is removed from the padded carrying case.

5.5 BATTERY PACK REPLACEMENT

After the normal lifetime of service the battery pack will need to be replaced. This requires some disassembly of the unit. To replace the battery pack, perform the following steps:

1. Remove the unit from its canvas bag.

2. Remove the latch bracket on the right side of the unit. Release the latches on the right side of the unit.

3. Open the panel cover and carefully unplug the ribbon cable connector from the lower printed circuit board.

4. Use a pin punch or similar tool to partially slide the hinge pins out of the hinges. Use pliers to completely remove the hinge pins. Lay the panel assembly aside.

5. Remove the two Phillips head screws on each side of the lower case.

6. Remove the RF input connector.

7. Carefully unplug the two wire plug at the upper left edge of the printed circuit board.

8. Turn the unit upside down while keeping your fingers over the case opening so as not to drop the assembly as it slides out of the case. (While holding the unit inverted slightly flex the plastic case and let gravity slide the assembly out of the case). Unplug the connector on the wire from the battery pack at the printed circuit board. The old battery pack will now slide out of the chassis.

9. Insert the new battery pack into the battery holder portion of the chassis, making sure the wires leaving the protective insulator paper box are towards the **bottom** of the chassis. See Fig. 5 below.

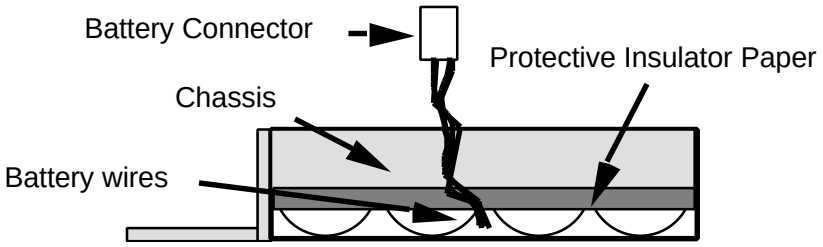


Fig. 5 Battery wire installation.

WARNING: THE PROTECTIVE INSULATOR PAPER IS TO INSULATE THE BATTERY FROM THE METAL CHASSIS. THE INSULATOR MUST BE IN PLACE AS SHOWN IN FIG. 5, WITH THE INSULATOR EXTENDING <u>BELOW</u> THE CHASSIS EDGE. THE BATTERY WIRES MUST EXIT THE BATTERY COMPARTMENT FROM <u>BELOW</u> THE INSULATOR.

10. To reinstall the chassis into the case, turn the chassis on its side (hinges up, latches down) and slide the chassis assembly into the case. (Make sure the threaded type "F" connector hole aligns with the case hole).

11. To finish reassembly, reinstall the type "F" connector and the chassis screws. Attach the removed front panel assembly and reconnect all previously disconnected ribbon and wire connectors. Replace the latch bracket.

Upon completion of reassembly, turn the unit on and switch to the battery check position. If the meter reading is at or below the recommended charge line indicating that the battery is nearly discharged, plug the unit into the AC wall transformer and allow the battery to charge overnight.

6.0 WARRANTY

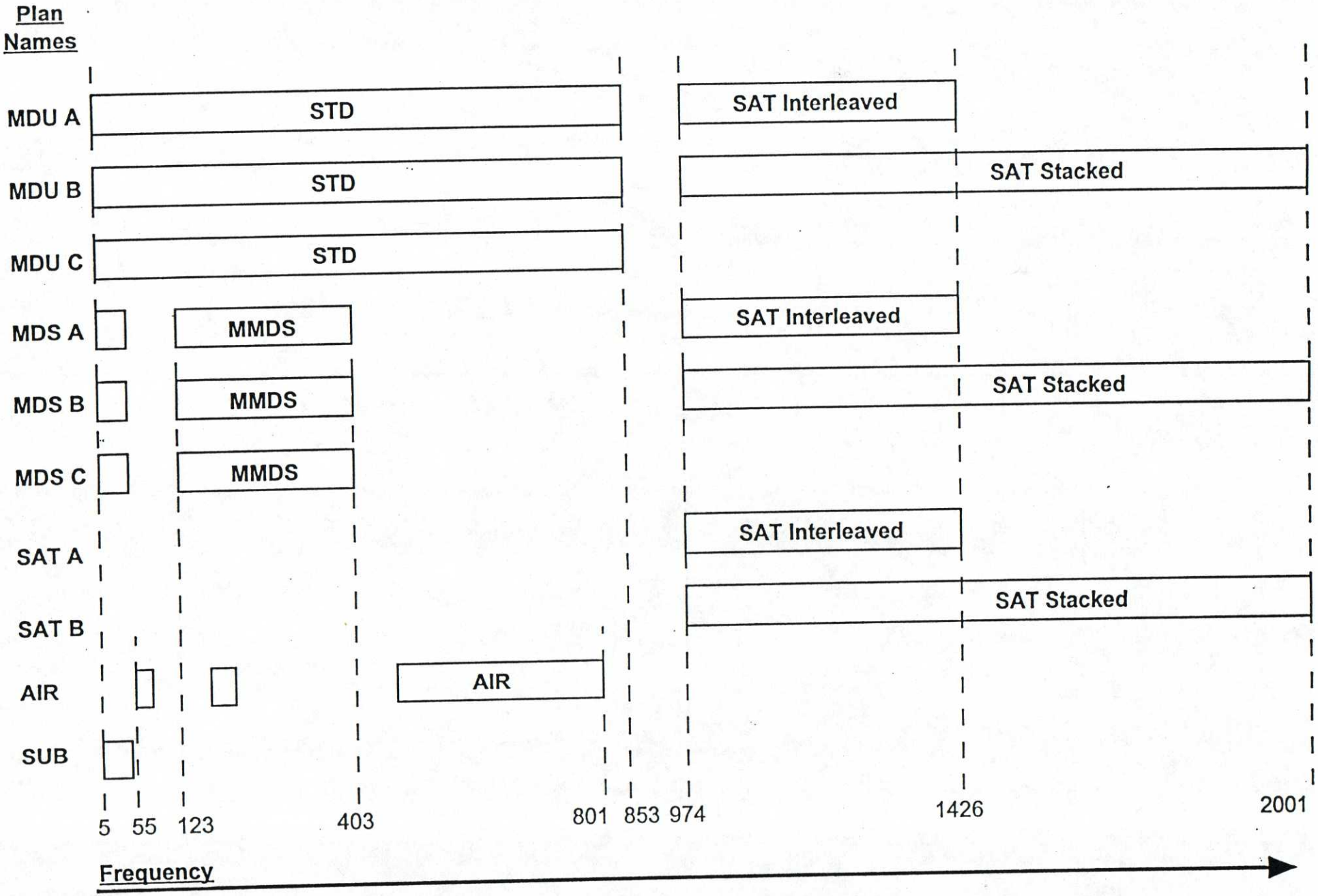
The Applied Instruments MDU is warranted against defects in material and workmanship for a period of twelve months. Applied Instruments agrees to repair or replace any assembly or component found to be defective under normal use during this period. Our obligation under this warranty is limited solely to repairing the instrument which proves to be defective within the scope of the warranty when returned to the factory. Transportation to the factory is to be prepaid by the customer. Authorization by Applied Instruments is required prior to shipment.

Applied Instruments assumes no liability for secondary charges or consequential damages and, in any event, Applied Instruments' liability for breach of warranty under any contract shall not exceed the purchase price of the MDU shipped and against which a claim is made.

Any application recommendation made by Applied Instruments for the use of its products are based upon tests believed to be reliable, but Applied Instruments makes no warranty of the results to be obtained. This warranty is in lieu of all other warranties, expressed or implied, and no representative or person is authorized to represent or assume for Applied Instruments any liability in connection with the sale of our products other than set forth herein.

Warning: The MDU Signal Level Meter is a sophisticated electronic RF signal measurement device which is not designed to withstand mistreatment or accidental abuse. This is due to the complex and precision nature of the componentry involved. It cannot withstand treatment one can give a much simpler device such as a voltmeter. Mistreatment or accidental abuse may lead to failures which cannot be covered under warranty.

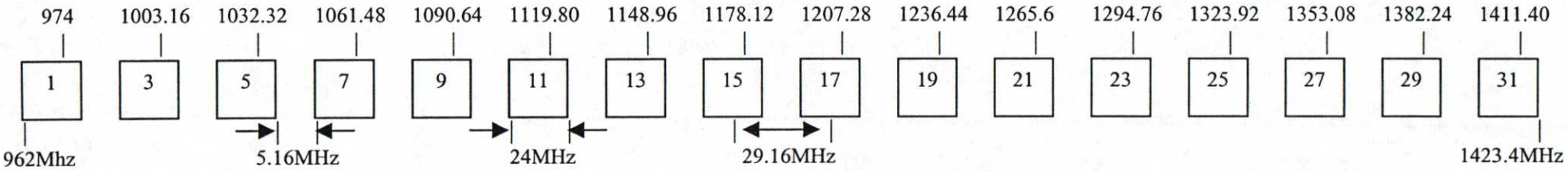
Channel / Transponder Plans

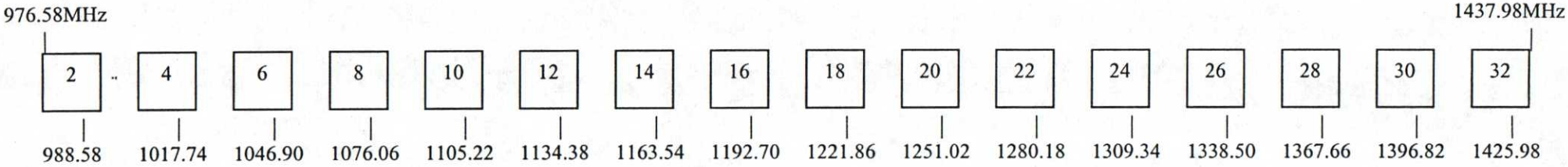


"L" BAND FREQUENCY PLAN

Note: Add 575MHz to the LHCP frequencies when using the upconverted technique (single cable method). This transponder/channel plan is stored in the MDU Meter as 'SAT A'.

RHCP
(13VDC)





LHCP
(18VDC)

Appendix A - MMDS Downconverters Using 2278 MHz Local Oscillator

Microwave Input		Downconverted Output		Channel Designator	
Channel	MHz	Video(MHz)	Sound(MHz)	Number	Letter
MMDS-1	2150-2156	123.25	127.75	MMDS-1	-
MMDS-2	2156-2162	117.25	121.75	MMDS-2	-
A-1	2500-2506	223.25	227.75	24	K
B-1	2506-2512	229.25	233.75	25	L
A-2	2512-2518	235.25	239.75	26	M
B-2	2518-2524	241.25	245.75	27	N
A-3	2524-2530	247.25	251.75	28	O
B-3	2530-2536	253.25	257.75	29	P
A-4	2536-2542	259.25	263.75	30	Q
B-4	2542-2548	265.25	269.75	31	R
C-1	2548-2554	271.25	275.75	32	S
D-1	2554-2560	277.25	281.75	33	T
C-2	2560-2566	283.25	287.75	34	U
D-2	2566-2572	289.25	293.75	35	V
C-3	2572-2578	295.25	299.75	36	W
D-3	2578-2584	301.25	305.75	37	AA
C-4	2584-2590	307.25	311.75	38	BB
D-4	2590-2596	313.25	317.75	39	CC
E-1	2596-2602	319.25	323.75	40	DD
F-1	2602-2608	325.25	329.75	41	EE
E-2	2608-2614	331.25	335.75	42	FF
F-2	2614-2620	337.25	341.75	43	GG
E-3	2620-2626	343.25	347.75	44	HH
F-3	2626-2632	349.25	353.75	45	II
E-4	2632-2638	355.25	359.75	46	JJ
F-4	2638-2644	361.25	365.75	47	KK
G-1	2644-2650	367.25	371.75	48	LL
H-1	2650-2656	373.25	377.75	49	MM
G-2	2656-2662	379.25	383.75	50	NN
H-2	2662-2668	385.25	389.75	51	OO
G-3	2668-2674	391.25	395.75	52	PP
H-3	2674-2680	397.25	401.75	53	QQ
G-4	2680-2686	403.25	407.75	54	RR

Appendix B: MDU A Channel Plan

Interleaved Transponders

Channel	VIDEO	AUDIO	Channel	VIDEO	AUDIO
SUB 7	7.000	11.500	MDS 2	117.250	121.750
SUB 8	13.000	17.500	CH 24	223.250	227.750
SUB 9	19.000	23.500	CH 25	229.250	233.750
SUB 10	25.000	29.500	CH 26	235.250	239.750
SUB 11	31.000	35.500	CH 27	241.250	245.750
SUB 12	37.000	41.500	CH 28	247.250	251.750
SUB 13	43.000	47.500	CH 29	253.250	257.750
CH 2	55.250	59.750	CH 30	259.250	263.750
CH 3	61.250	65.750	CH 31	265.250	269.750
CH 4	67.250	71.750	CH 32	271.250	275.750
CH 5	77.250	81.750	CH 33	277.250	281.750
CH 6	83.250	87.750	CH 34	283.250	287.750
CH 7	175.250	179.750	CH 35	289.250	293.750
CH 8	181.250	185.750	CH 36	295.250	299.750
CH 9	187.250	191.750	CH 37	301.250	305.750
CH 10	193.250	197.750	CH 38	307.250	311.750
CH 11	199.250	203.750	CH 39	313.250	317.750
CH 12	205.250	209.750	CH 40	319.250	323.750
CH 13	211.250	215.750	CH 41	325.250	329.750
CH 14	121.250	125.750	CH 42	331.250	335.750
CH 15	127.250	131.750	CH 43	337.250	341.750
CH 16	133.250	137.750	CH 44	343.250	347.750
CH 17	139.250	143.750	CH 45	349.250	353.750
CH 18	145.250	149.750	CH 46	355.250	359.750
CH 19	151.250	155.750	CH 47	361.250	365.750
CH 20	157.250	161.750	CH 48	367.250	371.750
CH 21	163.250	167.750	CH 49	373.250	377.750
CH 22	169.250	173.750	CH 50	379.250	383.750
CH 23	217.250	221.750	CH 51	385.250	389.750
MDS 1	123.250	127.750	CH 52	391.250	395.750

For satellite channels, frequency in VIDEO column corresponds to CENTER transponder frequency.

Appendix B: MDU A Channel Plan
Interleaved Transponders

Channel	VIDEO	AUDIO	Channel	VIDEO	AUDIO
CH 53	397.250	401.750	CH 83	577.250	581.750
CH 54	403.250	407.750	CH 84	583.250	587.750
CH 55	409.250	413.750	CH 85	589.250	593.750
CH 56	415.250	419.750	CH 86	595.250	599.750
CH 57	421.250	425.750	CH 87	601.250	605.750
CH 58	427.250	431.750	CH 88	607.250	611.750
CH 59	433.250	437.750	CH 89	613.250	617.750
CH 60	439.250	443.750	CH 90	619.250	623.750
CH 61	445.250	449.750	CH 91	625.250	629.750
CH 62	451.250	455.750	CH 92	631.250	635.750
CH 63	457.250	461.750	CH 93	637.250	641.750
CH 64	463.250	467.750	CH 94	643.250	647.750
CH 65	469.250	473.750	CH 95	91.250	95.750
CH 66	475.250	479.750	CH 96	97.250	101.750
CH 67	481.250	485.750	CH 97	103.250	107.750
CH 68	487.250	491.750	CH 98	109.250	113.750
CH 69	493.250	497.750	CH 99	115.250	119.750
CH 70	499.250	503.750	CH 100	649.250	653.750
CH 71	505.250	509.750	CH 101	655.250	659.750
CH 72	511.250	515.750	CH 102	661.250	665.750
CH 73	517.250	521.750	CH 103	667.250	671.750
CH 74	523.250	527.750	CH 104	673.250	677.750
CH 75	529.250	533.750	CH 105	679.250	683.750
CH 76	535.250	539.750	CH 106	685.250	689.750
CH 77	541.250	545.750	CH 107	691.250	695.750
CH 78	547.250	551.750	CH 108	697.250	701.750
CH 79	553.250	557.750	CH 109	703.250	707.750
CH 80	559.250	563.750	CH 110	709.250	713.750
CH 81	565.250	569.750	CH 111	715.250	719.750
CH 82	571.250	575.750	CH 112	721.250	725.750

For satellite channels, frequency in VIDEO column corresponds to CENTER transponder frequency.

Appendix C: MDU B Channel Plan

Stacked Transponders

Channel	VIDEO	AUDIO	Channel	VIDEO	AUDIO
SUB 7	7.000	11.500	MDS 2	117.250	121.750
SUB 8	13.000	17.500	CH 24	223.250	227.750
SUB 9	19.000	23.500	CH 25	229.250	233.750
SUB 10	25.000	29.500	CH 26	235.250	239.750
SUB 11	31.000	35.500	CH 27	241.250	245.750
SUB 12	37.000	41.500	CH 28	247.250	251.750
SUB 13	43.000	47.500	CH 29	253.250	257.750
CH 2	55.250	59.750	CH 30	259.250	263.750
CH 3	61.250	65.750	CH 31	265.250	269.750
CH 4	67.250	71.750	CH 32	271.250	275.750
CH 5	77.250	81.750	CH 33	277.250	281.750
CH 6	83.250	87.750	CH 34	283.250	287.750
CH 7	175.250	179.750	CH 35	289.250	293.750
CH 8	181.250	185.750	CH 36	295.250	299.750
CH 9	187.250	191.750	CH 37	301.250	305.750
CH 10	193.250	197.750	CH 38	307.250	311.750
CH 11	199.250	203.750	CH 39	313.250	317.750
CH 12	205.250	209.750	CH 40	319.250	323.750
CH 13	211.250	215.750	CH 41	325.250	329.750
CH 14	121.250	125.750	CH 42	331.250	335.750
CH 15	127.250	131.750	CH 43	337.250	341.750
CH 16	133.250	137.750	CH 44	343.250	347.750
CH 17	139.250	143.750	CH 45	349.250	353.750
CH 18	145.250	149.750	CH 46	355.250	359.750
CH 19	151.250	155.750	CH 47	361.250	365.750
CH 20	157.250	161.750	CH 48	367.250	371.750
CH 21	163.250	167.750	CH 49	373.250	377.750
CH 22	169.250	173.750	CH 50	379.250	383.750
CH 23	217.250	221.750	CH 51	385.250	389.750
MDS 1	123.250	127.750	CH 52	391.250	395.750

For satellite channels, frequency in VIDEO column corresponds to CENTER transponder frequency.

Appendix C: MDU B Channel Plan
Stacked Transponders

Channel	VIDEO	AUDIO	Channel	VIDEO	AUDIO
CH 53	397.250	401.750	CH 83	577.250	581.750
CH 54	403.250	407.750	CH 84	583.250	587.750
CH 55	409.250	413.750	CH 85	589.250	593.750
CH 56	415.250	419.750	CH 86	595.250	599.750
CH 57	421.250	425.750	CH 87	601.250	605.750
CH 58	427.250	431.750	CH 88	607.250	611.750
CH 59	433.250	437.750	CH 89	613.250	617.750
CH 60	439.250	443.750	CH 90	619.250	623.750
CH 61	445.250	449.750	CH 91	625.250	629.750
CH 62	451.250	455.750	CH 92	631.250	635.750
CH 63	457.250	461.750	CH 93	637.250	641.750
CH 64	463.250	467.750	CH 94	643.250	647.750
CH 65	469.250	473.750	CH 95	91.250	95.750
CH 66	475.250	479.750	CH 96	97.250	101.750
CH 67	481.250	485.750	CH 97	103.250	107.750
CH 68	487.250	491.750	CH 98	109.250	113.750
CH 69	493.250	497.750	CH 99	115.250	119.750
CH 70	499.250	503.750	CH 100	649.250	653.750
CH 71	505.250	509.750	CH 101	655.250	659.750
CH 72	511.250	515.750	CH 102	661.250	665.750
CH 73	517.250	521.750	CH 103	667.250	671.750
CH 74	523.250	527.750	CH 104	673.250	677.750
CH 75	529.250	533.750	CH 105	679.250	683.750
CH 76	535.250	539.750	CH 106	685.250	689.750
CH 77	541.250	545.750	CH 107	691.250	695.750
CH 78	547.250	551.750	CH 108	697.250	701.750
CH 79	553.250	557.750	CH 109	703.250	707.750
CH 80	559.250	563.750	CH 110	709.250	713.750
CH 81	565.250	569.750	CH 111	715.250	719.750
CH 82	571.250	575.750	CH 112	721.250	725.750

For satellite channels, frequency in VIDEO column corresponds to CENTER transponder frequency.

Appendix C: MDU B Channel Plan
Stacked Transponders

Channel	VIDEO	AUDIO
CH 113	727.250	731.750
CH 114	733.250	737.750
CH 115	739.250	743.750
CH 116	745.250	749.750
CH 117	751.250	755.750
CH 118	757.250	761.750
CH 119	763.250	767.750
CH 120	769.250	773.750
CH 121	775.250	779.750
CH 122	781.250	785.750
CH 123	787.250	791.750
CH 124	793.250	797.750
CH 125	799.250	803.750
CH 126	805.250	809.750
CH 127	811.250	815.750
CH 128	817.250	821.750
CH 129	823.250	827.750
CH 130	829.250	833.750
CH 131	835.250	839.750
CH 132	841.250	845.750
CH 133	847.250	851.750
CH 134	853.250	857.750
TR 1	974.000	
TR 3	1003.125	
TR 5	1032.375	
TR 7	1061.500	
TR 9	1090.625	

Channel	VIDEO	AUDIO
TR 11	1119.750	
TR 13	1149.000	
TR 15	1178.125	
TR 17	1207.250	
TR 19	1236.500	
TR 21	1265.625	
TR 23	1294.750	
TR 25	1323.875	
TR 27	1353.125	
TR 29	1382.250	
TR 31	1411.375	
TR 2	1563.625	
TR 4	1592.750	
TR 6	1621.875	
TR 8	1651.000	
TR 10	1680.250	
TR 12	1709.375	
TR 14	1738.500	
TR 16	1767.750	
TR 18	1796.875	
TR 20	1826.000	
TR 22	1855.125	
TR 24	1884.375	
TR 26	1913.500	
TR 28	1942.625	
TR 30	1971.875	
TR 32	2001.000	

For satellite channels, frequency in VIDEO column corresponds to CENTER transponder frequency.

Appendix D: MDU C Channel Plan

Channel	VIDEO	AUDIO	Channel	VIDEO	AUDIO
SUB 7	7.000	11.500	MDS 2	117.250	121.750
SUB 8	13.000	17.500	CH 24	223.250	227.750
SUB 9	19.000	23.500	CH 25	229.250	233.750
SUB 10	25.000	29.500	CH 26	235.250	239.750
SUB 11	31.000	35.500	CH 27	241.250	245.750
SUB 12	37.000	41.500	CH 28	247.250	251.750
SUB 13	43.000	47.500	CH 29	253.250	257.750
CH 2	55.250	59.750	CH 30	259.250	263.750
CH 3	61.250	65.750	CH 31	265.250	269.750
CH 4	67.250	71.750	CH 32	271.250	275.750
CH 5	77.250	81.750	CH 33	277.250	281.750
CH 6	83.250	87.750	CH 34	283.250	287.750
CH 7	175.250	179.750	CH 35	289.250	293.750
CH 8	181.250	185.750	CH 36	295.250	299.750
CH 9	187.250	191.750	CH 37	301.250	305.750
CH 10	193.250	197.750	CH 38	307.250	311.750
CH 11	199.250	203.750	CH 39	313.250	317.750
CH 12	205.250	209.750	CH 40	319.250	323.750
CH 13	211.250	215.750	CH 41	325.250	329.750
CH 14	121.250	125.750	CH 42	331.250	335.750
CH 15	127.250	131.750	CH 43	337.250	341.750
CH 16	133.250	137.750	CH 44	343.250	347.750
CH 17	139.250	143.750	CH 45	349.250	353.750
CH 18	145.250	149.750	CH 46	355.250	359.750
CH 19	151.250	155.750	CH 47	361.250	365.750
CH 20	157.250	161.750	CH 48	367.250	371.750
CH 21	163.250	167.750	CH 49	373.250	377.750
CH 22	169.250	173.750	CH 50	379.250	383.750
CH 23	217.250	221.750	CH 51	385.250	389.750
MDS 1	123.250	127.750	CH 52	391.250	395.750

Appendix D: MDU C Channel Plan

Channel	VIDEO	AUDIO	Channel	VIDEO	AUDIO
CH 53	397.250	401.750	CH 83	577.250	581.750
CH 54	403.250	407.750	CH 84	583.250	587.750
CH 55	409.250	413.750	CH 85	589.250	593.750
CH 56	415.250	419.750	CH 86	595.250	599.750
CH 57	421.250	425.750	CH 87	601.250	605.750
CH 58	427.250	431.750	CH 88	607.250	611.750
CH 59	433.250	437.750	CH 89	613.250	617.750
CH 60	439.250	443.750	CH 90	619.250	623.750
CH 61	445.250	449.750	CH 91	625.250	629.750
CH 62	451.250	455.750	CH 92	631.250	635.750
CH 63	457.250	461.750	CH 93	637.250	641.750
CH 64	463.250	467.750	CH 94	643.250	647.750
CH 65	469.250	473.750	CH 95	91.250	95.750
CH 66	475.250	479.750	CH 96	97.250	101.750
CH 67	481.250	485.750	CH 97	103.250	107.750
CH 68	487.250	491.750	CH 98	109.250	113.750
CH 69	493.250	497.750	CH 99	115.250	119.750
CH 70	499.250	503.750	CH 100	649.250	653.750
CH 71	505.250	509.750	CH 101	655.250	659.750
CH 72	511.250	515.750	CH 102	661.250	665.750
CH 73	517.250	521.750	CH 103	667.250	671.750
CH 74	523.250	527.750	CH 104	673.250	677.750
CH 75	529.250	533.750	CH 105	679.250	683.750
CH 76	535.250	539.750	CH 106	685.250	689.750
CH 77	541.250	545.750	CH 107	691.250	695.750
CH 78	547.250	551.750	CH 108	697.250	701.750
CH 79	553.250	557.750	CH 109	703.250	707.750
CH 80	559.250	563.750	CH 110	709.250	713.750
CH 81	565.250	569.750	CH 111	715.250	719.750
CH 82	571.250	575.750	CH 112	721.250	725.750

Appendix D: MDU C Channel Plan

Channel	VIDEO	AUDIO	Channel	VIDEO	AUDIO
CH 113	727.250	731.750	CH 124	793.250	797.750
CH 114	733.250	737.750	CH 125	799.250	803.750
CH 115	739.250	743.750	CH 126	805.250	809.750
CH 116	745.250	749.750	CH 127	811.250	815.750
CH 117	751.250	755.750	CH 128	817.250	821.750
CH 118	757.250	761.750	CH 129	823.250	827.750
CH 119	763.250	767.750	CH 130	829.250	833.750
CH 120	769.250	773.750	CH 131	835.250	839.750
CH 121	775.250	779.750	CH 132	841.250	845.750
CH 122	781.250	785.750	CH 133	847.250	851.750
CH 123	787.250	791.750	CH 134	853.250	857.750

Appendix E: DISH PRO Channel Plan

Stacked Transponders

Transponder	CENTER
TR 1	974.000
TR 3	1003.125
TR 5	1032.375
TR 7	1061.500
TR 9	1090.625
TR11	1119.750
TR13	1149.000
TR15	1178.125
TR17	1207.250
TR19	1236.500
TR21	1265.625
TR23	1294.750
TR25	1323.875
TR27	1353.125
TR29	1382.250
TR31	1411.375
TR 2	2111.375
TR 4	2082.250
TR 6	2053.125
TR 8	2024.000
TR10	1994.750
TR12	1965.625
TR14	1936.500
TR16	1907.250
TR18	1878.125
TR20	1849.000
TR22	1819.875
TR24	1790.625
TR26	1761.500
TR28	1732.375
TR30	1703.125
TR32	1674.000

Appendix H: SAT A Channel Plan

Interleaved Transponders

Transponder	CENTER
TR 1	974.000
TR 2	988.625
TR 3	1003.125
TR 4	1017.750
TR 5	1032.375
TR 6	1046.875
TR 7	1061.500
TR 8	1076.000
TR 9	1090.625
TR 10	1105.250
TR 11	1119.750
TR 12	1134.375
TR 13	1149.000
TR 14	1163.500
TR 15	1178.125
TR 16	1192.750
TR 17	1207.250
TR 18	1221.875
TR 19	1236.500
TR 20	1251.000
TR 21	1265.625
TR 22	1280.125
TR 23	1294.750
TR 24	1309.375
TR 25	1323.875
TR 26	1338.500
TR 27	1353.125
TR 28	1367.625
TR 29	1382.250
TR 30	1396.875
TR 31	1411.375
TR 32	1426.000

Appendix I: SAT B Channel Plan

Stacked Transponders

Transponder	CENTER
TR 1	974.000
TR 3	1003.125
TR 5	1032.375
TR 7	1061.500
TR 9	1090.625
TR 11	1119.750
TR 13	1149.000
TR 15	1178.125
TR 17	1207.250
TR 19	1236.500
TR 21	1265.625
TR 23	1294.750
TR 25	1323.875
TR 27	1353.125
TR 29	1382.250
TR 31	1411.375
TR 2	1563.625
TR 4	1592.750
TR 6	1621.875
TR 8	1651.000
TR 10	1680.250
TR 12	1709.375
TR 14	1738.500
TR 16	1767.750
TR 18	1796.875
TR 20	1826.000
TR 22	1855.125
TR 24	1884.375
TR 26	1913.500
TR 28	1942.625
TR 30	1971.875
TR 32	2001.000

Appendix J: AIR Channel Plan

Channel	VIDEO	AUDIO
CH 2	55.250	59.750
CH 3	61.250	65.750
CH 4	67.250	71.750
CH 5	77.250	81.750
CH 6	83.250	87.750
CH 7	175.250	179.750
CH 8	181.250	185.750
CH 9	187.250	191.750
CH 10	193.250	197.750
CH 11	199.250	203.750
CH 12	205.250	209.750
CH 13	211.250	215.750
UHF14	471.250	475.750
UHF15	477.250	481.750
UHF16	483.250	487.750
UHF17	489.250	493.750
UHF18	495.250	499.750
UHF19	501.250	505.750
UHF20	507.250	511.750
UHF21	513.250	517.750
UHF22	519.250	523.750
UHF23	525.250	529.750
UHF24	531.250	535.750
UHF25	537.250	541.750
UHF26	543.250	547.750
UHF27	549.250	553.750
UHF28	555.250	559.750
UHF29	561.250	565.750
UHF30	567.250	571.750
UHF31	573.250	577.750
UHF32	579.250	583.750
UHF33	585.250	589.750
UHF34	591.250	595.750
UHF35	597.250	601.750

Channel	VIDEO	AUDIO
UHF36	603.250	607.750
UHF37	609.250	613.750
UHF38	615.250	619.750
UHF39	621.250	625.750
UHF40	627.250	631.750
UHF41	633.250	637.750
UHF42	639.250	643.750
UHF43	645.250	649.750
UHF44	651.250	655.750
UHF45	657.250	661.750
UHF46	663.250	667.750
UHF47	669.250	673.750
UHF48	675.250	679.750
UHF49	681.250	685.750
UHF50	687.250	691.750
UHF51	693.250	697.750
UHF52	699.250	703.750
UHF53	705.250	709.750
UHF54	711.250	715.750
UHF55	717.250	721.750
UHF56	723.250	727.750
UHF57	729.250	733.750
UHF58	735.250	739.750
UHF59	741.250	745.750
UHF60	747.250	751.750
UHF61	753.250	757.750
UHF62	759.250	763.750
UHF63	765.250	769.750
UHF64	771.250	775.750
UHF65	777.250	781.750
UHF66	783.250	787.750
UHF67	789.250	793.750
UHF68	795.250	799.750
UHF69	801.250	805.750

Appendix K: SUB A Channel Plan

Channel	VIDEO	AUDIO
SUB 7	7.000	11.500
SUB 8	13.000	17.500
SUB 9	19.000	23.500
SUB 10	25.000	29.500
SUB 11	31.000	35.500
SUB 12	37.000	41.500
SUB 13	43.000	47.500